EVALUATION OF A SYSTEMS-BASED APPROACH TO CONTROLLING BLOWFLY INFESTATION OF TRADITIONALLY PROCESSED FISH AT SMALL-SCALE PROCESSING SITES

by

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Abstract

Blowfly infestation is a complex process. Levels of infestation can be influenced by a number of factors including processing techniques, fish species being processed, season, location and standards of hygiene. The situation is further complicated by fish processing sites being highly variable, both in terms of types of fish and methods of processing. No two processing sites are the same, which means that a blowfly control measure that is effective at one site may be inappropriate at another. Successful blowfly control therefore depends upon the use of control measures that are appropriate to the particular circumstances at each processing site.

Recent research suggests that if control measures are to succeed they must be based on a detailed understanding of infestation modes, external factors, variations in processing techniques and the socio-economic context within which the processing takes place. The most effective and sustainable way to control blowfly infestation of traditionally cured fish is through applying a systematic approach based on Hazard Analysis Critical Control Point (HACCP) principles. This is because the timing, mode and causes of the infestation vary considerably between processing sites and can even alter at a particular site if the processing practices or the external conditions change. The best way to control the infestation will also vary, according to the particular circumstances of the infestation. Approaching the problem of blowfly control systematically allows a control measure to be chosen that is appropriate to the infestation problem at any given site.

The systems-based approach to blowfly control has recently been evaluated during community-based field trials conducted at small-scale fish processing sites located along the eastern coast of India. This research has clearly demonstrated that the systems-based strategy offers a safe, efficient and cost-effective remedy to the problem of blowfly infestation at small-scale traditional fish processing sites. The outputs of this research and potential for transferring the systems-based approach to controlling blowfly infestation at small-scale fish processing sites in Africa are discussed in this paper.

Résumé

L'infestation par les mouches constitue un processus complexe. Les niveaux d'infestation peuvent être provoqués par des facteurs différents tels que les techniques de transformation, les espèces de poisson transformé, la saison, la localité et les conditions d'hygiène. La situation se complique davantage à cause de la haute variabilité des sites de transformation du poisson, soit en termes de types de poisson que de méthodes de transformation. Il n'existe pas deux sites de transformation qui soient similaires, cela signifiant que les mesures de maîtrise de la mouche qui soient efficaces dans un site, se révèlent inappropriées dans un autre. Une maîtrise réussie donc de la mouche dépend de l'emploi de mesures de contrôle appropriées aux conditions particulières de chaque site de transformation.

La recherche récente nous révèle que si les mesures de maîtrise réussissent, elles sont basées sur une compréhension des modalités d'infestation, des facteurs externes, des variations des techniques de transformation, comme du contexte dans lequel la transformation a eu lieu. La façon plus efficace et soutenable pour maîtriser l'infestation des mouches du poisson traité traditionnellement se montre l'application d'une approche systémique basée sur les principes de système d'analyse des risques-maîtrise des points critiques (HACCP). Cela à cause des variations considérables de la durée, des modalités, des raisons de l'infestation, qui sont très aléatoires entre les différents sites de transformation, et peuvent changer dans le même site avec les changements des pratiques de transformation et des conditions extérieures. La meilleure façon de maîtriser l'infestation, présente aussi des différences, selon les circonstances particulières de l'infestation. Une approche systématique du problème de maîtrise de la mouche nous permet d'appliquer des mesures de maîtrise qui soient appropriées au problème particulier d'infestation dans un site donné.

L'approche basée sur le système pour la maîtrise de la mouche a récemment été évaluée pendant des essais de terrain au niveau des communautés, effectués dans des sites de transformation à petite échelle situés le long des côtes orientales de l'Inde. Cette recherche a clairement montré comme la stratégie basée sur les systèmes se révèle un remède sûr, efficace et convenable, pour résoudre le problème dû à l'infestation des mouches dans les sites de transformation traditionnelle du poisson à petite échelle. Le résultat de cette recherche et le potentiel pour transférer l'approche de système basé sur le contrôle de l'infestation des mouches dans les sites de transformation de poisson à petite échelle en Afrique sont discutés dans ce rapport.

1. INTRODUCTION

Traditionally processed fish is a nutritionally and economically important commodity in many tropical, developing countries. Throughout processing and early storage, fish are exposed to infestation by blowflies (Diptera: Calliphoridae). This is a significant cause of post-harvest losses in the traditional fish processing industry, exacerbated by the basic, unhygienic conditions under which much of the fish is processed, particularly at the small-scale level.

While few detailed quantitative studies of insect related losses of cured fish have been carried out, losses of 25 percent are thought to be common and, in the authors' experience, losses in excess of 90 percent can occur in situations where no preventative measures are used. Such frequent and extensive losses cannot be sustained and therefore some processors have responded to the problem by applying unsuitable, toxic household and agricultural insecticides directly to their fish, jeopardizing not only their own health, but also the health of fish consumers.

A range of methods of infestation control have been developed and promoted for use at fish processing sites over the past 15–20 years. These include, among others, the use of solar driers, mesh screens erected over drying racks to prevent gravid females from gaining access to the fish, improved salting methods to render the fish unacceptable to ovipositing blowflies and feeding larvae, and the application of approved insecticides.

Despite extensive research and promotion of remedial techniques, uptake of recommended control measures by fish processors has been poor and therefore insect infestation of traditionally processed fish remains a major cause of losses. The apparent failure to successfully promote recommended control measures is generally attributed to two factors. The first is socio-economic, whereby implementation of the suggested measures may be too costly or culturally unacceptable. The second is poor extension of research findings to the fish processors. While the first is difficult to overcome, the second can be improved with good training of extension workers and better incentives.

The success of the control measures must, however, also depend upon a detailed understanding of the various modes of infestation, and the influence of external factors – such as climatic variations, fish species processed, processing practices followed and insect species present – on infestation patterns and levels. It has become apparent that a reduction in insect infestation of traditionally processed fish may only be achieved by developing a systematic and holistic control strategy that is adaptable to the many different fish processing systems and takes into account limiting socio-economic factors.

The systems-based control strategy outlined in this paper was a principal output of the Department for International Development (DFID) funded project "Adaptation of a Systems-based Approach to Insect Control, R7971". The design of the strategy was fully informed by the findings of a comprehensive review of insect infestation (Johnson and Esser, 2000), which was also an output of the project. The review indicated that effective and sustainable control of infestation is only likely to be achieved if a more systematic approach, which fully takes into account infestation modes, external factors and variations in processing parameters, is used.

The idea of a systematic approach is to study when, how and why the fish have become infested and then to select an appropriate method of controlling the infestation based upon these findings. The strategy is applied by conducting an on-site infestation audit that follows the five simple steps shown in Figure 1.

1.1 Determine the method of processing, the processing steps followed and their sequence

A systematic approach involves studying exactly when the fish are becoming infested and what processing risk factors may be influencing the infestation. It is therefore necessary to determine exactly how the fish are processed, including what order the processing steps are carried out in. The simplest way to identify and describe how the fish are processed is to draw a flow diagram of the process.

1.2 Determine when in the process the fish are being infested and by what mode

It is important to find out when the fish is becoming infested. It is possible that the infestation is occurring at more than one point in the process, or even before the fish arrives at the processing site. Using the process flow diagram as a guide, samples of the processor's fish should be examined at each processing stage for signs of blowfly eggs and larvae. The earliest stage in the process where blowfly eggs or larvae are found on the fish is the point at which the infestation has first occurred. If there are fresh egg batches or egg cases present on the fish at a later stage, or if larvae of different ages or sizes are infesting the fish, it is possible that the fish is being infested at more than one point in the process. It is also important to find out what mode of infestation is occurring. It is possible that both direct and indirect infestation may occur at the same processing point, or at different points.

1.3 Consider which processing risk factors may be influencing the infestation

Because many processing practices can influence infestation, it is important to consider whether any of the practices being followed may be risk factors. Each of the processing practices up to and including the point in the process where the infestation last occurred should be considered to see if the practices may be influencing the infestation.

1.4 Consider which non-processing risk factors may be influencing the infestation

Because some external factors can influence infestation, it is important to consider whether any of these factors are occurring at the site.

1.5 Select the necessary, appropriate control measures

Having determined when, how and why the infestation is occurring, it is possible to select control measures that are appropriate to combat the type of infestation occurring.

In general, the number of control measures needed to control the infestation will depend upon:

- the number of processing points where the infestation occurs;
- whether the infestation occurs through both modes;
- how many processing risk factors are involved;
- how many external risk factors are involved.

The systems-based control strategy offers fish processors a flexible and sustainable way of controlling blowfly infestation of their products. By providing processors with the means to select control measures appropriate to their particular circumstances, a high level of control may be achieved. The combination of important benefits afforded by the strategy should aid its extension and widespread adoption by cured fish processors in different countries.

1.
Determine the method of processing, the processing steps followed and their sequence – construct a flow diagram

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2.
Determine the timing and mode of infestation

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3.
Identify the processing risk factors

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4.
Identify the external risk factors

↓

5.
Select the necessary appropriate control measures for each risk factor

Figure 1: Summary of infestation audit

2. FIELD EVALUATION METHODS

The research commenced with a scoping survey of 22 fish processing villages located in the Indian coastal states of Andhra Pradesh and Orissa. Semi-structured interviews were held with fish processors, and background information was collected on processing techniques, losses caused by blowfly infestation, remedial measures in use, socio-economic context within which processors operate and fish processing costings.

The survey revealed that most traditional fish processing is a capitalistic enterprise, entirely driven by market forces and mostly conducted by resource poor, mostly female, small-scale/artisanal fish processors. Blowfly infestation and associated losses were frequently identified with major problems during the monsoon season. Most processors appeared resigned to seasonal losses and took little action to prevent them

Selection of processing sites for the evaluation trials was determined by a number of factors, such as village size, representative nature of fish processing operations in each area, number of people dependent on fish processing, the importance of fish processing to the community during monsoon periods (when blowfly infestation is at its highest), supply of fish throughout the year (particularly during monsoons), access to the processors to consistent alternate sources of fish (such as trawlers) in order that lack of fish landings in the village did not disrupt field research work, knowledge that exists on the villages as a result of previous work done by other development projects, the rapport between the researchers and the processor groups in the village, and potential for market growth (based on improved quality of products). Three villages were selected for the field trials – Uppada and Timmapuram in Andhra Pradesh, and Shandkud, which is located in Orissa. Six processing sites, three control (those not using blowfly control interventions) and three experimental (those using blowfly control interventions) were selected in each village.

Processors were profiled according to age, sex, educational background, size of operation, number of employees, processing technique, understanding of infestation issues, etc. Wherever possible, control and experimental processors were paired according to similarity. During the course of the fieldwork, five sets of trials (two in Uppada, two in Timmapuram and one in Shandkud were carried out. In Uppada and Timmapuram, trials were conducted during both monsoon and dry seasons. Because of operational difficulties the trials in Shandkud were restricted to the monsoon season.

Before selection of processors and commencement of field trials, sensitization meetings were held with the fish processors and wider community to explain the purpose of the research and obtain initial feedback on processing activities and problems caused by blowfly infestation. Following profiling and selection of processors to participate in the trials, infestation audits were conducted at each processing site. The infestation audits were informed by a combination of direct observations and on-site interviews with the fish processors. Further meetings were held to discuss the nature of the problem and possible interventions.

The experimental processors were then asked to select from a menu of interventions, which included speeding up initial processing, washing fish twice, plastic sheeting, sharper knives, improved on-site hygiene, more frequent brine changing, salting tank lids and frames, drying racks and drying trays. Although the project provided the physical interventions, the processors themselves were fully involved in their design. The field researchers remained on-site throughout the field trials, monitoring activities, obtaining feedback, and collecting financial and technical data. Technical data included fish species, weights, temperature, relative humidity, wind speed, fish drying rates, brine strength, blowfly activity, infestation levels and downgrades. Financial data included costs and revenues associated with fish processing, and other business expenses and revenues.

3. RESULTS AND DISCUSSION

Of the field trials performed during the project, it was only those carried out in Uppada during the monsoon season of 2002 that were significantly affected by rain. During the other trials, environmental conditions were insufficiently challenging to provide a rigorous test of the effectiveness of the systems-based strategy in reducing infestation. For this reason, and to avoid unnecessary repetition, discussion will focus on the results obtained during this series of trials, with the results of other trials being referred to where appropriate to provide illustration and comparison.

3.1 Environmental data

Environmental data were collected during the course of 6 of the 11 trials conducted at Uppada between 9 July and 4 September 2002. The remaining five trials were disrupted by rain, when the processors applied the coping strategy of producing lower value wet salted fish, as opposed to salted-dried product.

During the first two trials, conducted early July, air temperatures were mostly in the mid- to high-thirties, and relative humidities were low – generally less than 50 percent. Cloud cover was zero and wind speeds variable, ranging from about 0.5 to 3.5 m/s. In effect, dry season conditions (a consequence of the delayed monsoon) prevailed. The monsoon proper, usually characterized by periods of heavy rains interspersed with drier spells, commenced during the first week of August. Of the nine trials conducted during this period, five were disrupted by rain. During periods when fish drying took place, air temperatures were in the low to mid thirties and relative humidities ranged from approximately 50 to 80 percent. Cloud cover was zero or light and wind speeds seldom exceeded 1.5 m/s.

3.2 Fish drying rates

Drying rates were monitored at both control (C) sites, where fish were dried on the ground, and experimental (E) sites, where they were dried on raised drying racks. Drying curves for one of the trials (Trial 5), expressed as percentage weight loss against time, are given in Figure 2. Drying periods ranged from 6 to 16 hours. In 16 out of 18 cases, the drying rates of fish dried on drying racks were higher than those dried on the ground. Application of the Wilcoxon Rank Sum Test, a non-parametric significance test, based on the rankings of items from both samples combined, demonstrated differences in drying rates between experimental and control fish to be significant at the 5 percent level throughout the drying periods of all trials (Table 1). The processors were of the opinion that the rack-dried fish were organoleptically superior to those dried on the ground.

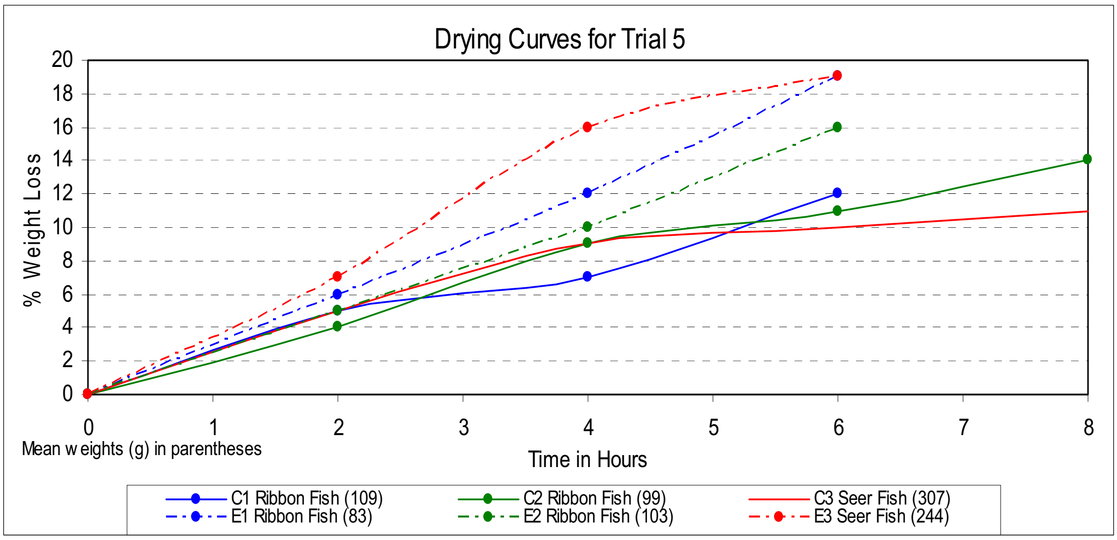

Figure 2: Drying curves for Trial 5

Table 1: Points during drying at which differences in drying rates of control and experimental fish were statistically different

Trial	Times at which weight losses were recorded during drying (hrs)			
	2	4	6	8
1	*	*	*	
2	*	*		
3	*	*	*	*
4	*	*	*	
5	*	*	*	
6	*	*	*	

*Significant at 5 percent level

3.3 Blowfly activity

The blowfly population at Uppada was dominated by the Oriental Latrine Fly, *Chrysomya megacephala* (Fabricius). Adult females were significantly more numerous than males. *Chrysomya albiceps* (Weidmann), *Lucilia cuprina* (Weidmann) and *Sarcophaga* spp. were also present.

During the salted-dried fish processing trials, when drying conditions were good, no statistical differences were demonstrated between blowfly counts at the experimental and control sites. However, counts at the experimental sites were generally lower than those at the control sites. Although improved hygiene would be expected to make the experimental sites less attractive to visiting blowflies, any difference would be mitigated by the close proximity of the sites to each other.

Blowfly counts recorded during the wet salted fish trials (Figure 3), when heavy rain prevented drying, indicate higher levels of blowfly activity than was the case during the salted-dried fish trials. Counts recorded at the experimental sites were highly significantly lower than at the control sites (t=3.96, P<0.001). It is during the salting stage that fermentation processes in the fish produce the volatiles that attract gravid female blowflies. The entrances to the salting tanks at the experimental sites were sealed with closely fitted lids, which would have been more effective in controlling the release of attractant volatiles than the loose palmyrus leaves used to cover the tanks at the control sites. This may have contributed to the lower levels of blowfly activity observed at the experimental sites.

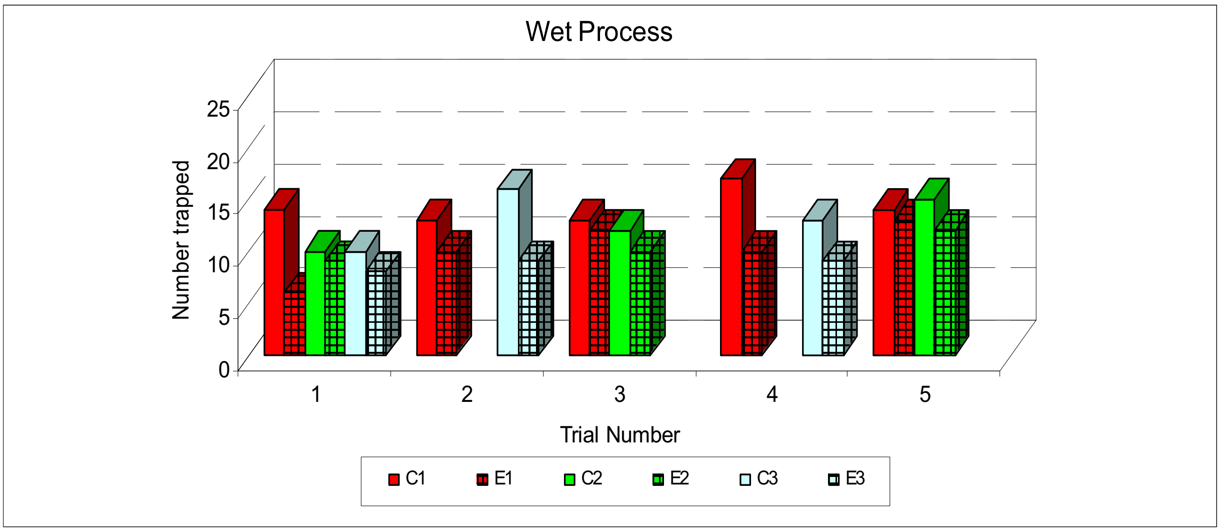

Figure 3: Blowfly counts during wet-salted fish processing trials

3.4 Blowfly infestation

Fish are susceptible to blowfly infestation during both the salting and drying stages of the process. In the wet salting trials, the fish salted in the control vats became heavily infested with blowfly larvae on every occasion (Table 2).

In all cases, when the experimental processors correctly fitted the salting tank lid, infestation was prevented.

Table 2: Infestation during the salting stage of the wet process

Trial	Control processors			Experimental processors		
	C1	C2	C3	E1	E2	E3
	Larvae	Larvae	Larvae	Larvae	Larvae	Larvae
1	Infested	Infested	Infested	Not infested	Not infested	Not infested
2	Infested	ND	Infested	Not infested	ND	Not infested
3	Infested	Infested	ND	Infested*	Infested*	ND
4	Infested	ND	Infested	Not infested	ND	Not infested
5	Infested	Infested	ND	Not infested	Infested*	ND

ND – No data (processor unavailable for trial) *Salting tank incorrectly fitted by processor.

In the salted-dried processing trials, infestation levels were significantly lower (t=7.12, $P<0.001$) in the fish produced by the experimental processors. In all trials, infestation was either absent or reduced in the experimental group (Figure 4).

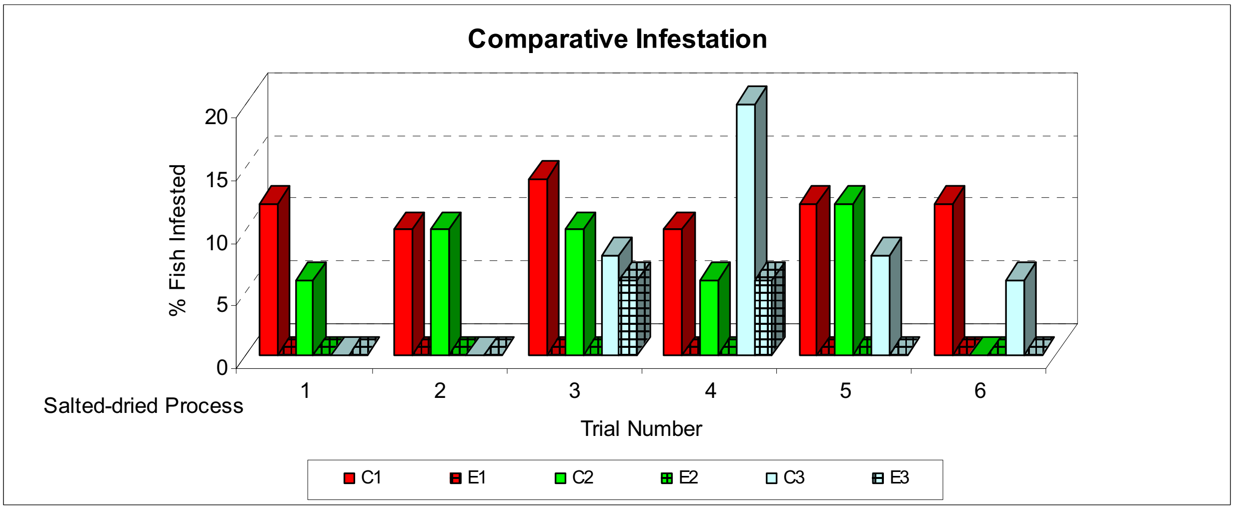

Figure 4: Infestation levels in fish processed by salting and drying

The field trials provided a convincing demonstration of the effectiveness of the systems-based strategy in controlling blowfly infestation during processing.

3.5 Damage and spoilage

Various factors, including infestation damage, low quality raw material, poor handling, microbiological spoilage and biochemical reactions, can combine to affect the final quality of the processed fish. At the end of processing, processors generally grade their fish according to quality and sell low quality product at a reduced price, either as animal feed or fertilizer.

In the wet salting trials, all of the fish produced by the control processors and those experimental processors who failed to correctly fit the salting tank lids, were downgraded and sold for 4–5 Rupees per kilogram. None of the fish produced by the remaining experimental processors were downgraded. These fish sold for 7.5 Rupees per kilogram.

Results obtained from the salted-dried fish processing trials (Figure 5) consistently demonstrated the effectiveness of the systems-based strategy in reducing losses resulting from spoilage and damage.

The principal factors that contributed to the poor quality of the downgraded fish were infestation and inadequate salting. Brine concentrations in the control tanks were significantly lower than in the experimental tanks (t=2.7, $P<0.01$). Saturation values of brine in the experimental tanks were generally between 85 and 95 percent, whereas brine in the control tanks tended to be in the region of 70 to 85 percent. Rainwater ingress would undoubtedly have led to dilution of the brine in the control tanks. This in turn would have facilitated both microbiological and chemical spoilage in the control fish as well as rendering them more susceptible to blowfly infestation.

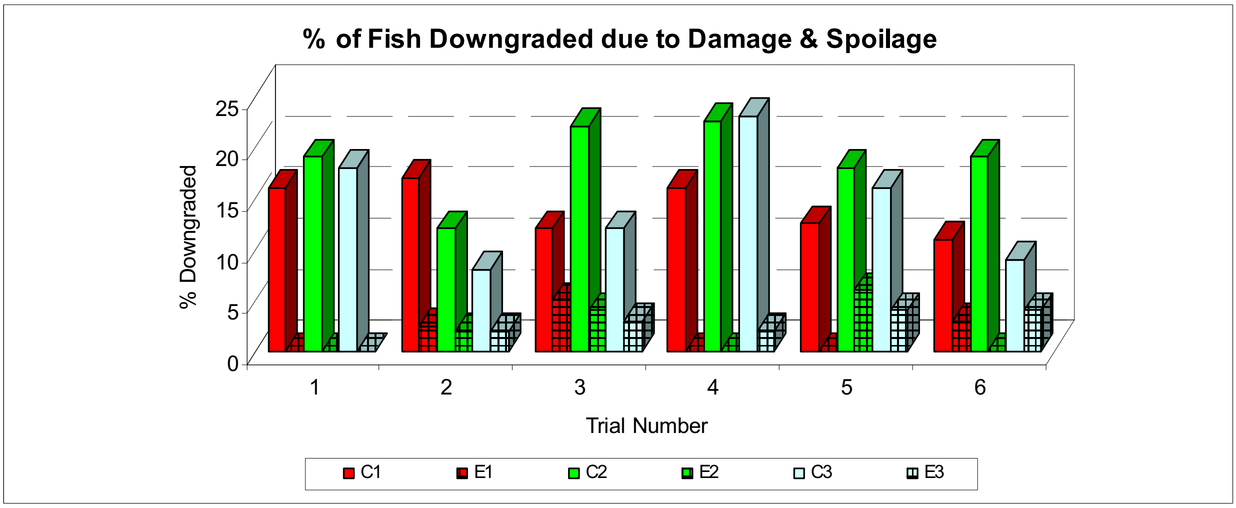

Figure 5: Percentage of fish downgraded during salted-dried fish processing trial

3.6 Ranking of interventions according to processors preferences

At the end of the trials, the fish processors were asked to rank the interventions used in order of preference (Table 3).

Of the interventions selected by the processors, the drying racks, salting tank lids and submerging frames were consistently ranked in the top three. These interventions were perceived to confer immediate benefits and required little extra effort by the processors. However, the initial capital required to purchase the drying racks and lids were identified as possible constraints to their adoption. Interventions that involved collecting water, e.g. vat cleaning, extra fish washing and brine changes were less well received by the processors, mainly because of the extra labour involved in fetching water and the cost of salt.

Table 3: Interventions ranking table

Intervention	Overall ranking		
	Uppada	Shandkud	Timmapuram
Plastic groundsheet for initial processing	6	1	4
Better quality knives	4	4	8
Regular cleaning of vats	8	6	6
Additional fish washing	7	7	7
Disposal bins for processing waste	5	5	5
Regular brine changes	9	8	4
Salting vat lids	2	2	1
Drying racks and trays	1	3	2
Submerging frame	3	–	3

3.7 Uptake of the interventions

Approximately 8 months after completion of the trials, the field researchers revisited Uppada to monitor uptake of the interventions and obtain current data on processor perceptions.

They found the processors were continuing to use the interventions introduced by the project and in some cases have adapted them to suit their individual circumstances. In the case of the drying racks, the processors have clearly identified benefits in respect of improved quality and reduced losses. Initial capital cost, however, is a barrier to their adoption that will have to be taken into account during any subsequent extension. The ranking of interventions in order of preference was similar to that recorded earlier, i.e. wooden lids, drying racks and submerging frames found most favour with the processors.

3.8 Processors' income and expenditure

The main source of revenue is, of course, the sale of dried fish for human consumption. The sale of dried fish for animal consumption is a source of income when the product is of poor quality. Some wet salt fish is also sold.

Costs and revenues were recorded in interviews with the processors. Current costs were recorded for fish, porterage of fish from beach to processing area, fee for use of processing area, labour during processing, salt, insecticide, transport of dried fish to market, market fees, and subsistence and travel costs. Capital expenditure was for vats for salting, knives for cleaning fish, plastic buckets and other containers, brooms, bamboo baskets for transporting the dried fish, palmyrus leaves for the fish to rest on during drying and plastic sheet to store the dried fish under. The expected life of these capital goods is from as little as one month for the bamboo baskets to as much as 5 to 10 years for the concrete vats.

3.9 The analysis of costs and benefits

From the limited data collected during the trials (only a minority of the processors were debtors) it was difficult to establish the effective interest rate. The most authoritative reports were 2.5 percent per week, i.e. 261 percent *per annum*. In practice, lenders may postpone or waive payment of interest at times when the processor is experiencing difficulties. This, effectively, lowers the real interest rate.

Some processors may have access to financial capital at a lower rate of interest institutions, such as DWACRA (Development of Women and Children in Rural Areas). It was reported that interest rates of 24 percent per annum were charged to members of a DWACRA group, and this is also used in the calculations below.

The analysis differentiates between the items of capital expenditure undertaken as part of the project that was designed specifically to improve the quality of the dried fish during the monsoon season and the usual capital expenditure. The project related expenditure is expected to have a significant effect in rainy conditions, but no impact at all (or a limited impact) on the quality of the product in the dry seasons. These costs were therefore set only against the batches processed during the rainy weeks; we have assumed 10 weeks out of 52.

In practice the traditional capital costs were negligible. On the other hand, the total costs of all the interventions implemented at the request of the processors appeared so high that extremely high losses would be made if the investments were self-financed. However, these figures are unreasonably high for two reasons. First, because some of the items in the processors wish-list of capital items were items they would have already, most obviously knives. And second, because the list was uncritically drawn up because the processors did not have to meet the cost of the purchases. In this analysis we will focus on the preferred interventions rather than all of them.

It can be seen in Table 4 that at the local interest rate processors would record a loss, a substantial loss, on the batches of fish processed in the monsoon. Column a) shows that control processors typically lose 55 Rupees per batch when affected by rain. In column b) the capital costs of the preferred interventions have been included with the result that the processors make a loss of 103 Rupees for each batch processed. Finally column c) shows the situation when a concessionary rate of interest of 24 percent is available. Then a batch generates a profit of 33 Rupees.

Table 4: Costs and benefits of the interventions (Rs)

	a) Control processors (2.5 % per week interest)	b)Experimental processors (2.5 % per week interest)	c)Experimental processors (24 % *per annum* interest)
(1) Revenue	775	933	933
(2) Current costs	831	820	820
(3) Profit [(1) – (2)]	–32	113	113
(4) Traditional capital costs	23	23	14
(5) Profit [(3) – (4)]	–55	90	99
(6) Preferred intervention costs		193	66
(7) Profit [(5) – (6)]		–103	33

However, all these estimates are deliberately very conservative and it should be noted:

1. Because of better handling, the interventions will almost certainly give rise to some gains in the quality of the dried fish outside the rainy season. This will have a beneficial effect on incomes throughout the year.

2. We may expect the processors themselves to identify cheaper ways of effecting the improvements, from the use of alternative materials, cheaper sources of materials and local craftsmen. If the capital costs of the improvements were reduced by slightly more than half, from 193 to 90 Rupees, which is almost certainly achievable, the experimental processors would break-even.

4. CONCLUSIONS

The technical data provided clear evidence that interventions introduced using the systems-based approach are effective in reducing blowfly infestation and losses of traditionally processed fish, particularly at the salting and drying stages of processing. The processors remarked on the improved quality of the fish processed when the interventions were used. Financially the interventions appear costly, but realistically local initiative can manage expenses to make the improvements affordable even at local interest rates. The technical and financial findings, together with the socio-economic data collected during the trials, indicate that the systems-based approach has the potential to offer economic benefits to poor processors in a sustainable way. For these benefits to be realized, however, it is important that the approach is introduced as part of an extension campaign that takes into account socio-economic constraints, particularly access to affordable credit to invest in infrastructure.

5. GENERAL DISCUSSION

The systems-based approach has similarities with the food safety control system Hazard Analysis Critical Control Point (HACCP), in that a process is illustrated as a flow diagram describing each step of the process. Hazards and risks are evaluated and appropriate, informed control measures introduced at specific points in the process chain. Unlike HACCP, however, the systems-based approach does not require detailed, documented monitoring of critical control points, and is therefore more applicable to small-scale artisanal situations. It should be noted that the systems-based approach to identifying and controlling risk factors can be applied to a wide range of problems and products, e.g. microbiological spoilage, contamination with toxic chemicals and pathogens, histamine build-up, and is not restricted to controlling blowfly infestation alone. The approach can be applied to any sequence of activities that can be described by a flow diagram. It is an approach that allows characterization of hazards, identification of appropriate interventions and their introduction to those points in the flow diagram where they will be most effective. The success of the approach very much depends on gaining a detailed understanding of the hazards and risks encountered through a combination of on-site observations and in-depth discussions with the primary stakeholders, e.g. food processors, farmers. Involvement of the primary stakeholder at every stage is critical to the success of the systems-based approach. In essence, the systems-based approach allows the development worker to identify relevant hazards and, in consultation with the primary stakeholder, agree appropriate interventions. It is not the interventions that drive the process; rather the interventions are derived from the application of the systems-based approach itself.

The traditional fish processing sector in African countries has many similarities with processing in South Asia and also experiences problems of insect infestation and insecticide misuse by some fish processors. The evaluation trials conducted in India demonstrated that the systems-based approach has the potential to be transferable and support the view that the approach should be applied to controlling blowfly infestation at traditional fish processing sites in Africa. Extension materials to promote the systems-based approach were developed in India and could easily be adapted to the African context through inclusion of local case studies. It is strongly recommended that fisheries extension services in African countries adopt the systems-based approach to assist fish processors in controlling the continuing problems of blowfly infestation, post-harvest losses and insecticide misuse.

6. REFERENCES

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SENSORY PANELS OF SMALL PELAGIC SPECIES IN THE SADC REGION

by

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Abstract

The objective of this paper is to present a study about some small pelagic fish species in the Southern African Development Community (SADC) region, focusing mainly on horse mackerel, which led to the creation of quality assessment sensory panels (visual guidelines). In addition, some examples will be given of traditional processing methods of horse mackerel, showing how to add value to the final product and its quality.

Small pelagics (horse mackerel, anchovy and pilchard) play an important role in the SADC region, providing animal protein sources in food security programs. In 1999 world fish production was estimated to be 125 million tonnes, which means that the average availability of fish for human consumption was approximately 14 kg per capita worldwide. If we consider the production of fish in the SADC in the same year (i.e. 2 million tonnes) compared to its population (about 154 million), and the fact that one-third of the production is used as animal feed, actual availability of regional fish for human consumption is only a scant 9 kg per capita. Small pelagic fish constitute a large part of this (about 40 percent).

There is a relative lack of quality assessment sensory panels for some tropical fish species in many countries (e.g. Mozambique), which has often led to difficulties for the technicians involved in the task of fish quality assessment. Under these circumstances, the need has been identified to not only establish a sensory profile for the main fish species but also to identify their shelf-life. For this reason the INFOSA project decided to support the creation of quality assessment sensory panels for some SADC fish species, as well as the study of their shelf-life, starting with frozen horse mackerel.

The samples (frozen and whole horse mackerel) obtained from distributors were analysed for quality and quality changes by performing characteristic sensory, chemical and microbiological analyses. Photographs of the observed changes were then used to create the sensory panels.

The results of this study will be valuable for seafood consumers, local and regional markets, the processing industry and official regulators, among others. They will give the professional more possibilities to promote the exchange of information between regional and specialized international laboratories.

The sensory panels and the data about the shelf-life will be used in campaigns to promote the consumption of fish of good quality in the local and regional markets, and in the development of training materials about handling and processing of small pelagic fish, especially for the small-scale/artisanal sector.

1. INTRODUCTION

Food security planners and even nutritionists all over the world continue focussing their attention on fishery products as a potential source of nutrients for human consumption.

Between 1950 and 1993 fishery production increased from 20 million tonnes to about 100 million. In a first phase this fast expansion involved almost exclusively the most developed countries of the time, which can be explained by the social and economic conditions prevailing after the Second World War. At the time, there was a range of factors that favoured fishery catches and the industrial production of their by-products. Particular reference can be made to the simultaneous existence of unexploited fishery resources, entrepreneurial capacity able to revert to civil use of the technological developments attained during the hostilities and others (Tenreiro de Almeida, 2000).

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The second half of the twentieth century confirmed, much faster than it could be imagined, that the action of man (multiplied by a powerful technology) ends up frequently as a threat to his own future, on account of the thorough damage that such action has gradually caused to various ecosystems. That fact and the conditioning of the fishing activity by the market frequently lead to high levels of losses or waste as a result of rejection of a relevant part of the catches (notably the disastrous effects of trawling), as may be seen from Table 1 (Vasconcelos, 2004).

Table 1: Examples of fisheries that generate major wastes (rejections)

FISHERY	FISHING REGION	Ratio: QUANTITY (weight) REJECTED AT SEA/ QUANTITY LANDED
Trawl – crustaceans (shrimp)	Central-Western Atlantic	12.13
Traps "*covos*" (crab)	Bering Strait	9.71
Gillnets "*alabote*"	California	4.83
Trawl "*badejo*"	North-Eastern Atlantic	2.83
Trawl (fish)	Persian Gulf	1.75
Trawl " *lagostim*"	North-Eastern Atlantic	1.70
Traps (lobster)	Central-Eastern Pacific	1.68
Longline "*espadarte*"	Central-Eastern Pacific	1.58
Trawl (kingklip) "*pescada*"	North-Eastern Atlantic	1.18
Tackle (tuna)	Eastern Indian Ocean	1.13
Trawl (codfish)	North-Eastern Atlantic	0.51

Source: OCEANA, June 2004

Studies published in the second half of the 1990s about the coasts of Angola, Namibia and South Africa clearly show the relevance of rejections in trawl operations for small pelagic and in particular kingklip "*pescada*". (In relation to the quantity landed, rejections at sea reached approximately 20 percent kingklip; 20 percent frogfish "*tambo*ril"; 70 percent "*maruca-da-África-do-Sul ou badejo-do-Cabo*"; and almost 100 percent spadefish "*peixe-galo*", among other species.)

With crustaceans the situation is even more remarkable; it is estimated that about 20 million tonnes are rejected per year, chiefly in tropical shrimp fisheries. A shrimp fishing vessel has about 10 to 20 percent total effective catch, the remainder is thrown into the sea, or in isolated cases is delivered to small vessels that come from the coast for that purpose.

In many of the Southern African Development Community (SADC) regions, small pelagic fish is a popular low-cost food. Local production in several SADC countries cannot meet the demand, and considerable quantities of frozen small pelagic are imported, mainly from Namibia and Angola. They are eaten in many different ways, such as fried, salted, marinated, fermented, smoked, canned and dried.

Thus, considering the importance of preserving quality and reducing post-catch losses of small pelagic marketed in the region, one of the fundamental aspects is the implementation of rational fishing operations and of Inspection and Quality Assurance systems, so as to conform to the new sanitary requirements of the international market and of the consumers in general.

On the other hand, the deficiency of description of the sensory changes occurring during the deterioration processes of tropical fishery species leads to the shortage of technical instruments, such as sensory panels for the experts' analytical work. In view of the importance of small pelagic in the region as a cheaper source of protein, mackerel (*Trachurus*) was chosen for a first study.

Another problem with horse mackerel has been said to be its limited shelf-life because of high oil content of the fish, which makes it highly susceptible to rancidity (Blatt, 1998).

This paper presents the results of the study on sensory alterations in horse mackerel, which will be used for the sensory analyses at laboratory level, as well as for consumer awareness, so that consumers begin to materialize their right to have quality fish, and develop the ability to identify the degree of freshness of the mackerel being sold in the local markets.

2. FISHERIES IN THE SADC REGION

The fishery sector in the SADC region – integrating fishery catches, processing and marketing – constitutes in many areas an essential activity, the relevance of which goes beyond the merely economic aspects because it represents an undeniable social contribution (namely in the direct and indirect employment of coastal populations), besides being a means of subsistence and food security.

Its contribution for the GDP is small, but it is estimated that millions of people depend on fisheries for survival.

In the various SADC countries, animal protein from fisheries varies from 10 to 43 percent, and the average consumption varies from 6.7 to 14 kg/year. For example, in Tanzania (a country with a coastline) 75 percent of the households consume fisheries 6 out of 7 days of the week (Gameira and Wilson, 2003).

Consumption varies considerably from region to region because of cultural aspects, proximity of coastal areas and resource abundance. Table 2 shows the per capita utilization in the SADC region (Hara, 2001).

According to FAO (1990) estimates (Table 3), Angola, Mozambique and Namibia possess the greatest potential for increased sustainable production at 400 000 tonnes or more each, followed by South Africa with an unrealized potential of around 225 000 tonnes[2] , while Tanzania has the least potential at 54 000 tonnes.

The industrial production of mackerel is the most important resource. Namibia is the major producer, with a biomass estimated at 2 000 000 tonnes (1992/1993), which was reduced in recent years because of very adverse environmental conditions, changing the biomass to 1 000 000 tonnes[3] (Hara, 2001).

Europe can only meet 62.5 percent of its requirements in fishery products, and the fisheries exported from Africa contribute with more than 11.5 percent of those needs, while the other four continents contribute with a total of 26 percent (IPIMAR); this means that European countries still need the raw materials from Africa, but under certain conditions, namely sanitary quality.

[2] Barange (1999) stipulates that the biomass for horse mackerel in South Africa is estimated at between 300 000 and 500 000 tonnes and can be sustainably exploited annually at a minimum of 100 000 tonnes/year.
[3] Namibia is blessed with a rich fish resource because of the Benguele upwelling system, which results in exceptional biological productivity of its waters. Adverse environmental conditions, persistent low levels of oxygen over a wide area of the continental shelf resulted in severe anoxic conditions in most of the central and northern waters of Namibia's EEZ.

Table 2: Per capita fish supply and the contribution of fish to animal protein for the world, Africa and the individual states of Southern Africa

	Per capita supply (kg/yr)	Fish protein (g/person/day)	Animal protein (g/person/day)	Fish/animal protein ((%)
World	13.3	4.0	24.9	16.1
Africa	8.1	2.4	11.5	21.0
Eastern Africa	5.8	1.7	10.7	16.2
Southern Africa	4.3	1.1	17.2	6.6
SADC countries				
Angola	19.7	.0	16.4	42.9
Botswana	3.0	1.0	19.7	4.9
Democratic Republic of Congo	8.1	2.3	22.3	10.4
Lesotho	1.5	0.5	10.5	5.1
Malawi	9.2	2.7	5.7	47.1
Mauritius	21.2	6.9	28.9	24.0
Mozambique	2.5	0.8	3.6	21.2
Namibia	10.0	2.3	22.7	10.2
Seychelles	66.3	19.4	37.5	51.7
South Africa	9.3	2.9	27.2	10.7
Swaziland	0.1	0.0	16.0	0.3
Tanzania	13.8	4.0	10.6	37.6
Zambia	7.7	2.2	8.9	25.2
Zimbabwe	2.7	0.8	8.5	9.7

Source: Food Policy 26 (2001) 11–34

Table 3: Actual/estimated average production, estimated potential sustainable production, realized potential production and some other coastal features of SADC maritime states

Feature	Angola	Mozambique	Namibia	S. Africa	Tanzania	Total
Coastline length (km)	1 650	2 500	1 500	2 880	750	9 280
EEZ area (km^2)	605 700	562 000	504 000	1 050 000	223 000	2 944 700
Year declared EEZ	1975	1978	1991	1977	1989	
Average production (tonne)	84 369	25 703	593 742	574 774	45 887	1 324 475
1990s	1990–93	1990–94	1990–94	1990–94	1990–94	
Total potential production (tonne)	643 000	425 000	1 000 000	800 000	100 000	2 968 000
Unrealized potential (tonne)	558 631	399 297	406 258	225 226	54 113	1 643 525

Source: Food Policy 26 (2001) 11–34

3. HORSE MACKEREL – A POSSIBLE SOLUTION?

3.1 Horse mackerel – the fish!

Horse mackerel is a fish of the *scombridae* family, with a black iridescent silvery-bluish green colour (Photo 1); the sides are silvery, and the body is streamlined with tapered head; no black pigment on front of dorsal fin; lateral line starts high and drops sharply below the second dorsal fin; young fish often have yellow spots and are found near shore and offshore, occasionally taken from piers running into deep water.

Photo 1: Colours of the fresh mackerel skin surface

Mackerel and nutritional value
Horse mackerel is a rich oil fish, an abundant source of vitamin B12 and an excellent source of omega-3 fatty acids. It is an outstanding source of selenium, an important antioxidant that is present in every cell of the body (Ruiter, 1995). Because of its high oil content, fresh horse mackerel is very perishable. The nutritional aspects of mackerel are shown on Table 4.

Table 4: Nutritional value of horse mackerel

Nutritional value (100 g fillet of mackerel)

Nutrients	Nutritional value	Nutrients	Nutritional value
Calories (g)	134	Carbohydrate (g)	0
Total fat (g)	5.4	Cholesterol (g)	62
Saturated fat (g)	1.5	Sodium (mg)	56
Monounsaturated fat (g)	1.8	Iron (mg)	0.4
Polyunsaturated fat (g)	1.5	Zink (mg)	6
Dietary fibre (g)	0	Selenium (mg)	231
Protein (g)	20	Vitamin B12 (mg)	35

Source: USDA National Nutrition Database (2001)

Some tropical fish also show a marked seasonal variation in chemical composition and the oil content of these species varies with size; largest fish containing about 1 percent more oil than smaller ones (Huss, 1995).

The lipids present in teleostei fish species may be divided into two major groups: the phospholipids and the triglycerides [4].

Fat depots are also typically found spread throughout the muscle structure. The concentration of fat cells appears to be the highest, close to the myocommata and in the region between the light and dark muscle (Kissling *et al*., 1991). The dark muscle contains some triglycerides inside the muscle cells even in lean fish because this muscle is able to metabolize lipids directly as energy. The

[4] The phospholipids make up the integral structure of the unit membranes in the cells; thus, they are often called structural lipids. The triglycerides are lipids used for storage of energy in the fat depots, usually within special fat cells surrounded by a phospholipids membrane and the rather weak collagen network (Huss, 1995).

corresponding light muscle cells are dependent on glycogen as source of energy for the anaerobic metabolism (Huss, 1995).

The percentage of polyunsaturated fatty acids with four, five or six double bonds is slightly lower in the polyunsaturated fatty acids of lipids from freshwater fish (approximately 70 percent) than in the corresponding lipids from marine fish (88 percent) (Stansby and Hall, 1967).

Horse mackerel and health benefits
Preliminary evidence of eating horse mackerel benefits (as oil fish) shows that omega-3 fatty acids from fish oil may help to regulate the rhythm of the heart. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have been reported to help prevent cardiac arrhythmia and also modulate immune function. Research also suggests that DHA is essential for vision in infants (Ruiter, 1995). Health benefits include:

- lipid content: potential role in the prevention of heart disease;
- high content in polyunsaturated fat acids (PUFAs (n-3), not synthesized by humans;
- liposoluble vitamins A, D and E;
- high content of protein, vitamin B and mineral (Na, K, Ca).

3.2 Horse mackerel – the solution?
In the past, horse mackerel was considered a lower quality product as compared to hake and pilchard, and it was sent to South Africa for the production of flour.

Nowadays horse mackerel is sold in the region in 10 kg frozen blocks, involved in plastic sheeting and packed in carton boxes in a total of 30 kg. In Mozambique it is estimated that the importation of horse mackerel reaches about 25 percent of the total fish consumption at national level, in view of its low cost and the fact that it only requires refrigeration, maintaining quality for several days (Gameira and Wilson, 2003). Congo imports about 88 000 tonnes.

In general, people prefer to consume the small-sized mackerel (less than 20 cm), which makes it easier to share the meal among the family.

Many countries, such as Zimbabwe, which prefer beef, chicken or pork as a source of protein – with the decline of purchasing power and other socio-economic problems – started to consume mackerel, chiefly fresh. As may be seen from Table 5 (Hara, 2001), prices are very competitive.

Table 5: Average retail prices for selected items of main sources of protein from selected retail food shops in Lilongwe (Malawi), Lusaka (Zambia) and Harare (Zimbabwe), both in local currency and their equivalent in US$ (February 1999)[5]

Item	Kandolo	Malawi	Shoprite	Zambia	TM	Zimbabwe
	MWK/kg	US$/kg	ZMK/kg	US$/kg	ZWN/kg	US$/kg
Beef	122.5	2.72	7 150	3.04	114.50	2.94
Chicken (whole)	75.0	1.67	5 550	2.36	48.95	1.26
Bream (kariba)			3 550	1.51	67.00	1.72
Kapenta (fresh)			2 350	1.00	50.25	1.29
Chambo	81.25	1.81				
Usipa, utaka	56.50	1.26				
Horse mackerel	42.50	0.94	2 500	1.06	24.79	0.64

Source: Food Policy 26 (2001)11–34

[5] US$ exchange rates (1998) used: US$1=MK45; US$1=ZK2350; US$1=Z$39

4. MATERIAL AND METHODS

This work at laboratory level was undertaken by the Fisheries Inspection Laboratory (LIP) of the Maputo Provincial Fisheries Directorate in Mozambique. A technical officer was in charge, with the support of the Director and the supervision and technical support of INFOSA[6].

4.1. Sampling and sample preparation

The result of any characteristic sensory, chemical and microbiological analyses involves the manner in which the sample was brought into the laboratory, was obtained and handled, and the manner in which the sample was prepared for analysis once it reached the laboratory, as well as what specific analyses were performed from beginning to end.

The requirements for good handling and processing of the samples have been taken into account. The samples of horse mackerel frozen whole have been obtained from the main distributors. Then the samples were taken into the laboratory where some were stored at room temperature, while others in ice. The room temperature was about 25 ^{o}C by means of air conditioning and about 20 ^{o}C at night. The registration of quality and quality changes was done by performing sensory, chemical and microbiological analyses. Only for comparison reasons, some samples were stored at room temperature until they were no longer fit for human consumption.

The sampling was undertaken according to the norms of the International Commission on Microbiological Specifications for Food (ICMSF, 1988).

4.2. Monitoring the changes of mackerel kept at room temperature and in ice

Evaluation of quality loss and shelf-life of horse mackerel have been conducted using different analytical methods. Thus, the changes in the levels of sensory, chemical (pH, TVBN and TMA), as well as microbiological requirements during fish decomposition process, were investigated.

Sensory assessment

Sensory quality changes, such as appearance, colour, smell, texture, have been determined using the EU panel (Table Freshness), introduced in the council decision No.103/76 of January 1976 as the most commonly used method for quality assessment in the inspection service and in the fishing industry.

The sensory analysis was conducted by a taste panel consisting of three experienced judges, according to traditional guidelines concerning chilled fish.

Four categories were ranked, namely: *highest quality* “Excellent (3)”; *good quality* “Good (2)”; *fair* “Fair (1)”; and *unacceptable quality* “Bad (0)”.

Table Freshness ratings were applied: Council Regulation (EEC) No.103/76 OJNo.L20 (28 January 1976) (EEC, 1976) (Huss, 1995).

Sensory assessment included the following: appearance of whole fish, gills, fillet, eyes, blood, external and flesh odour.

Chemical assessment

The freshness assessment was determined using the most widely used measurements in assessing seafood products. Thus, the following chemical methods were performed: Total Volatile Bases Nitrogen (TVB-N) and Trimethylamine (TMA) assay by team distillation method and pH determination by method of potentiometer. Because of the high costs and the available funds, histamine determination was not performed (Photo 2).

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Photo 2: Chemical analysis sector at the Fisheries Inspection Laboratory of the Provincial Directorate of Fisheries, Maputo, Mozambique

Microbiological assessment
Microbiological examination was also performed using NMKL methods. Total aerobic count, total coliforms, thermal tolerance, *E. Coli* and *Salmonella* have been determined.

The aim of microbiological examinations of the samples was to evaluate the possible presence of bacteria in order to monitor the hygiene and quality of the fish during handling, storage and processing.

5. RESULTS

The results of this study will be valuable for seafood consumers, local and regional markets, the processing industry and official regulators, among others. They will give professionals more possibilities to promote the exchange of information between regional and specialized international laboratories.

5.1 Sensory quality changes
For a total of 20 days some samples were kept in an isolate box in ice, while others were kept at the LIP's room temperature, as above mentioned.

Tables 6 and 7 show the degree of classification of the sensory changes that occurred in terms of general appearance, muscle firmness, skin colour and integrity, eye colour and shape, gill colour and smell, and general smell of the sample.

Table 6: Sensory quality assessment of frozen mackerel stored in ice

Day	Sample	Quality changes of mackerel samples stored in ice						
		Appearance	Firmness	Skin	Eyes	Gills	Smell	Average
0	MSI	3	3	3	3	3	3	3
2		3	3	3	2	3	3	3
4		3	3	3	2	3-2	3	2.8
6		3	3	3	2	3-2	3	2.7
8		2	3	3	1	3-2	3	2.3
10		1	3	3	1	2	2	2
12		1	2	2	1	2	2	1.7
14		1	2	2	1	2	2	1.7
16		1	2	2	1	1	2	1.5
18		0	1	1	1	1	1	1
20		0	0	1	0	1	0	0

Evaluation score:	3 = Excellent	2 = Good	1 = Fair	0 = Bad

MSI = mackerel stored in ICE

Table 7: Sensory quality assessment of frozen mackerel stored at room temperature (LIP)

Day	Sample	Quality changes of mackerel samples stored at room temperature						
		Appearance	Firmness	Skin	Eyes	Gills	Smell	Average
0	MSRT	3	3	3	3	3	3	3
2		3	2	2	1	2	2	2.0
4		2	2	1	1	2	1	1.5
6		1	1	0	0	1	0	0.5

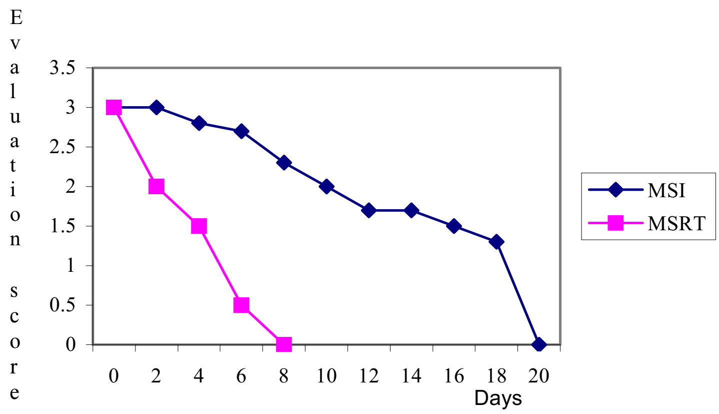
Evaluation score:	3 = Excellent	2 = Good	1 = Fair	0 = Bad

MSRT = horse mackerel stored at room temperature

Figure 1 shows the comparison of the sensory results between horse mackerel stored in ice (MSI) and the one stored at room temperature (MSRT) at the LIP.

5.2 Chemical quality changes

For 20 days (4 days for MSRT) samples also underwent chemical analyses, regarding pH, TVB and TMA, the results of which may be seen in Table 8. Figure 2 shows the comparison of the results for pH; Figure 3 for TVB; and Figure 4 for TMA between horse mackerel stored in ice (MSI) or stored at room temperature (MSRT).



Evaluation score: Excellent (3); Good (2); Fair (1); Bad (0).

Figure 1: Sensory quality changes of frozen mackerel stored in ice (MSI) and at room temperature (MSRT) for 20 days

Table 8: Chemical assessment of frozen mackerel kept in ice for 20 days and at room temperature for 4 days

Day	MSI			MSRT		
	pH	TVB *	TMA *	pH	TVB *	TMA *
0	5.97	10.92	5.46	5.97	10.92	5.46
2	6.35	16.8	5.92	6.97	19.99	9.66
4	6.19	17.64	5.71	7.72	38.05	24.86
6	6.42	19.86	6.60			
8	7.01	21.2	7.14			
10	7. 28	23.34	7.88			
12	7.34	25.91	8.97			
14	7.48	29.49	12.72			
16	7.77	32.24	18.46			
18	7.55	36.85	20.07			
20	7.91	41.17	21.18			

* mg-N/100 g

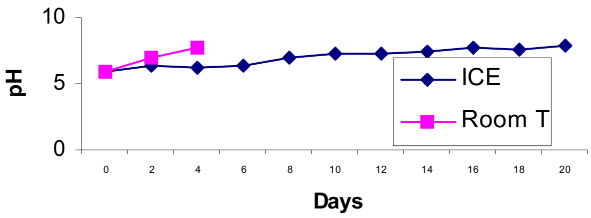


Figure 2: pH changes of mackerel stored in ice and at room temperature

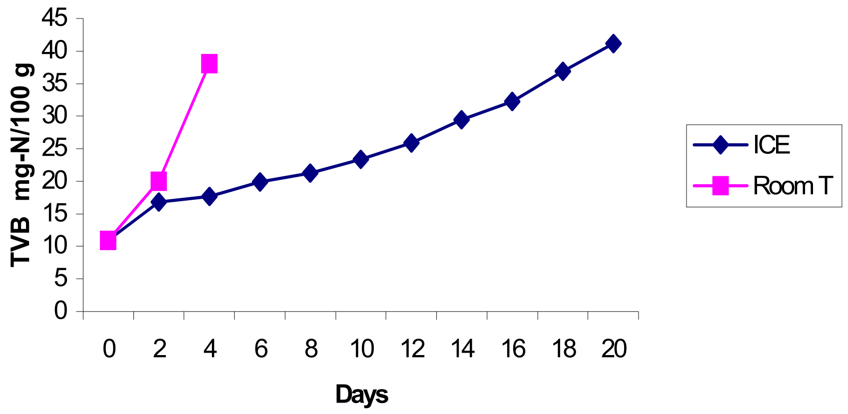


Figure 3: TVB changes of mackerel stored in ice and at room temperature

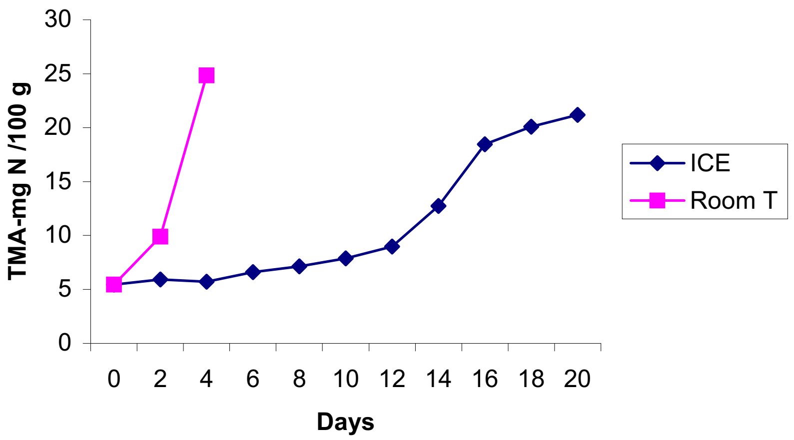


Figure 4: TMA changes of mackerel stored in ice and at room temperature

5.3 Microbiological assessment

Table 9 below shows the results of the microbiological analyses of the above mentioned horse mackerel samples stored in ice for 20 days, undertaken on day 0, 7, 14 and 20.

Table 9: Microbiological assessment, after thawing, of frozen mackerel stored in ice for 20 days

Parameters	Time frame (days)			
	0	7	14	20
Total aerobic bacteria count	3.2 log ufc/g	4.9 log ufc/g	6.8 log ufc/g	3.3 log ufc/g
Total coliforms	43/g	<3/g	<3/g	7.8 log ufc/g
Thermal tolerance bacteria	4/g	<3/g	<3/g	150/g
E. coli	<3/g	<3/g	<3/g	<3/g
Salmonella	Absent	Absent	Absent	Absent

5.4 Quality Assessment Sensory Panels with sensory changes of horse mackerel
Sensory (quality) changes were observed (in the frozen horse mackerel samples, stored in ice) in whole fish and particularly the eyes, the fillet and the gills of the fish in question.

The observed changes were then used to create sensory panels.

The panels also indicate data regarding the day when those observations were made (Day 0, 2, 4, 6, 8, 10, 12 and 14), microbiological results and the classification given according to the freshness ratings of the Council Regulation (EEC) No 103/76 OJNo.L20 (28 January 1976) (EEC, 1976) (Huss, 1995).

This process is considered as the first and main step for the establishment of the Quality Assessment Panel (Table Freshness).

6. INTERPRETATION

6.1 Comparison of frozen horse mackerel kept in ice and at room temperature
Comparison of the sensory analyses (Figure 1) as well as the pH (Figure 2), TVB-N (Figure 3) and TMA (Figure 4) levels between the samples kept in ice with those kept at room temperature confirmed the known fact that ice storage increases the shelf-life of the product.

6.2 Correlation between sensory and chemical analyses
Good correlation between the sensory and chemical analyses was observed. The sensory quality assessment score (Tables 6 and 7), clearly shows that the spoilage of the mackerel stored at room temperature is faster than that kept in ice. Such outcome is also found in the chemical analyses (Table 8) where the results show clearly the difference between both storage conditions.

6.3 Comparison of TVB and TMA levels and microbiological results
The Total Volatile Bases Nitrogen TVB-N is one of the most widely used methods nowadays to estimate the degree of decomposition of the fish. The Trimethylamine (TMA) provides an accurate indication of bacterial spoilage in some species. Both the TVB-N and the TMA were determined in both samples kept at room temperature and in ice. The comparison of these two parameters showed that TVB-N levels are higher than TMA levels at the same stage of decomposition. This confirms the known fact that the TVB-N is the general term which includes the measurement of TMA (produced by spoilage bacteria), DMA (produced by autolytic enzymes during frozen storage), AMMONIA (produced by desamination of amino acids and nucleotides and other compounds associated with seafood spoilage), while the presence of TMA in spoiling fish is the result of the bacterial reduction of TMA-Oxide.

The TMA results have correlation with microbiological results (Table 9), where some changes could be observed during the monitoring process.

7. CONCLUSION AND RECOMMENDATIONS

Most of the conclusions of this study were in line with expectations, because they are the same found for other species already described in literature[7].

[7] Mackerel may harbour a number of biological, chemical and physical hazards, the most prevalent of which is pathogenic bacteria. Therefore, it should be cooked thoroughly before eating to destroy all harmful organisms and routine analyses should be performed in order to ensure public health protection. Mackerel is a perishable product, thus good manufacture practices (GMP) from distributors and market sellers can maintain the high quality and increase the shelf-life. The application of traditional ice slows down the microbiological and biochemical mechanisms involved in the loss of quality of horse mackerel, thus implying a significant extension of its shelf-life from 6 to 20 days if compared with storage in room temperature. The storage does not improve the quality of the product, but it will also not decrease significantly during storage as long as the mackerel is stored properly and used within the recommended time frame. It is also recommended by this study.

The importance of this study lies with the utilization of this technical material for future actions:

- Considering that there is a relative lack of quality assessment sensory panels for some tropical fish species in many countries (e.g. Mozambique), which has often led to difficulties for the technicians involved in the task of fish quality assessment, it will be necessary to describe these changes in greater detail, illustrate them with better quality photographs and establish their use by laboratory technicians.
- Apply the same method for some other SADC fish species.
- At the level of markets, apply the results of this study for:

  a) defining the shelf-life of horse mackerel, considering transport and distribution conditions in the region's markets, and spreading this technical information by means of guidelines;
  b) preparing campaigns to promote the consumption of fish of good quality in the local and regional markets, developing training materials about handling and processing of small pelagic fish, especially for the small-scale sector;
  c) analysing existing handling and processing methods and promoting their divulgation and improvement.

It is also recommended that fish inspection should be improved by implementing and coordinating uniform inspection programs or improving the quality and quantity of information among the Ministry of Fisheries, Ministry of Health, Town Council and fish industry.

Work is also being done concerning information on horse mackerel processing within the SADC.

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INCIDENCE DE *Listeria* spp. EN MILIEU MARIN AU MAROC

par

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Abstract

In Morocco, 986 samples of marine origin have been studied to assess the level of contamination of the coast by *Listeria* spp. The results show differences in the tested samples and are of 6, 4.6 and 3.4 percent respectively, for sea water, sediments and shellfish. *Listeria monocytogenes* and *Listeria innocua* are the only species identified. The colimetria in shellfish production sites does not allow to draw a relation to the degree of contamination for *Listeria* spp., and this is questioning the efficacy of monitoring the sanitary state of the coast. The highest contamination is observed during winter; the sites close to a mouth are the most threatened by contamination.

Résumé

986 échantillons d'origine marine sont étudiés en vue d'évaluer l'incidence de la contamination du littoral par *Listeria* spp. au Maroc. Les résultats obtenus montrent une variation selon le compartiment analysé et sont de 6, 4,6 et 3,4 pour cent respectivement pour l'eau de mer, le sédiment et le coquillage. *Listeria monocytogenes* et *Listeria innocua* sont les seules espèces identifiées. La colimétrie des sites conchylicoles ne permet pas d'établir une relation avec l'incidence de la contamination pour *Listeria spp*. et repose la question de son efficacité pour apprécier la salubrité du littoral. La contamination est plus élevée en hiver et les sites proches des embouchures sont les plus menacés par la contamination.

1. INTRODUCTION

Bien qu'isolée et reconnue pathogène depuis 1929, *Listeria monocytogenes* n'a été confirmée en tant qu'agent d'infection humaine d'origine alimentaire qu'à partir de 1981 suite à l'éclosion de foyers épidémiques ayant impliqué la salade de choux (Schelech *et al.* 1983), les produits laitiers: lait pasteurisé (Fleming *et al.* 1985), fromage type mexicain (Linnan *et al.*1988), Vacherin Mont d'or (Bille, 1989), fromage à pâte molle (Goulet *et al.*1995), lait chocolaté (Dalton *et al.* 1997), les produits carnés: pâté (Mc Lauchlin *et al.* 1991), langue de porc en gelée (Goulet *et al.* 1993), rillettes (Goulet *et al.* 1998) et enfin les produits de la pêche (Rocourt *et al.,* 2000; Elliot et Kvenberg, 2000). Tous ces produits présentent la caractéristique commune d'être des aliments prêt-à-manger donc n'ayant pas subi un traitement listéricide avant consommation, généralement stockés aux températures de réfrigération pendant de longue période ce qui permet à *Listeria monocytogenes* de croître et d'atteindre la dose infectieuse. Il est très important de souligner que ces épidémies surviennent principalement dans les pays industrialisés et sont rarement rapportées en Afrique, en Asie et en Amérique du sud (Rocourt *et al.,* 2000).

En raison de l'intérêt de *Listeria monocytogenes* en tant que pathogène émergent et afin d'évaluer son rôle éventuel en tant qu'agent de listériose d'origine alimentaire au Maroc, des études ont été réalisées sur la prévalence de cette bactérie dans les produits laitiers (El Marrakchi *et al.* 1992) et dans les produits carnés (Kriem *et al.* 1998). Suivant le même objectif, la présente étude se propose d'estimer l'incidence de *Listeria monocytogenes* en milieu marin. Elle est réalisée sur des sites échantillonnés dans le cadre de la surveillance de la salubrité du littoral situé entre Essaouira et Tan Tan (Région d'Agadir).

2. MATÉRIEL ET MÉTHODES

a) Echantillonnage

18 sites conchylicoles situés au niveau du littoral atlantique de la région d'Agadir (centre ouest du Maroc) ont été échantillonnés à fréquence mensuelle durant une période de deux ans. Un total de 986 échantillons dont 326 de coquillages représentés par les moules (Mytilus galloprovincialis et Perna perna), 331 échantillons d'eau de mer et 329 échantillons de sédiment sont analysés au cours de cette

étude. Les prélèvements des différents compartiments s'effectuent à marée basse. L'eau de mer est prélevée à 20 cm sous la surface à l'aide de flacons stériles, le sédiment est prélevé uniquement de la partie superficielle et mis dans des flacons stériles et les coquillages sont recueillis dans des sacs en plastique à usage unique. Les échantillons prélevés sont placés dans des glacières. Ils sont traités immédiatement après réception au laboratoire ou stockés dans un réfrigérateur. Dans ce dernier cas, les échantillons sont analysés dans un délai maximum de 16 heures.

b) Analyses bactériologiques

Dénombrement des coliformes fécaux

Pour le coquillage et sédiment, la méthode utilisée pour le dénombrement des coliformes fécaux est celle décrite dans la norme AFNOR NF V 45-110. Pour l’eau de mer la méthode utilisée est la méthode OMS/PNUE, N°22 (Anonyme, 1985).

Recherche et identification des Listeria

L'analyse est réalisée selon la norme AFNOR NF V 08 055 pour la recherche de *Listeria monocytogenes* dans les aliments.

Sérotypie de *L. monocytogenes*

La détermination des sérovars de *L. monocytogenes* est conduite à l'aide d'antisérums monofactoriels de lapin dirigés contre les antigènes somatiques et flagellaires de ce germe en utilisant la méthode décrite par Seeliger et Höhne, 1979.

3. RÉSULTATS

Sur 986 échantillons analysés dont 331 d'eau de mer, 326 de coquillages et 329 de sédiments prélevés à partir de sites échantillonnés dans le cadre de la surveillance de la salubrité de la partie littorale comprise entre Essaouira et Tan Tan, 46 sont positifs pour *Listeria* spp soit 4,7 pour cent. *Listeria monocytogenes* et *Listeria innocua* sont les deux espèces identifiées dans les proportions relatives de 2,5 et 2,7 pour cent. L'association des deux espèces a été observée sur 6 échantillons et la présence de *Listeria monocytogenes* seule est notée dans 19 échantillons. En se référant au compartiment analysé, il apparaît que l'eau est la plus contaminée par *Listeria* spp. (six pour cent), viennent ensuite le sédiment (4,6 pour cent) puis le coquillage (3,4 pour cent). Le même ordre de répartition est noté pour les deux espèces identifiées. Ainsi, leur isolement est plus fréquent dans l'eau de mer que dans les sédiments tandis que dans les coquillages l'incidence de la contamination par les deux espèces est moins élevée. Les sites échantillonnés dans cette étude font l'objet d'une surveillance régulière en vue de déterminer leur degré de salubrité notamment en fonction de la colimétrie des coquillages qui permet d'établir 4 classes: A (colimétrie < 300), B (300–6000), C (6000–60 000) et D (>60 000) selon la circulaire interministérielle n° 1246 (Anonyme, 2001) qui s'inspire de la Directive européenne 91/492/CEE fixant les règles sanitaires régissant la production et la mise sur le marché de mollusques bivalves vivants (Anonyme, 1991). Les coquillages provenant des sites A peuvent être exploités directement pour leur commercialisation sans aucun traitement préalable. L'analyse des résultats relatifs aux 18 sites échantillonnés (tableau 2) révèle que 10 sites sur 14 classés A sont exempts de *Listeria* spp. Les 4 autres sites en l'occurrence Tamri, Tifnit, Sidi R'bat et Aglou sont contaminés. Il est très important de noter que pour les deux premiers sites contaminés l'incidence est élevée, elle est respectivement de 17,5 pour cent et 13,7 pour cent pour *Listeria* spp. et 10,5 pour cent et 7,8 pour cent pour *Listeria monocytogenes.* L'incidence de contamination des deux derniers sites est importante, avec des proportions respectives de 3,9 et 4,3 pour cent pour la seule espèce identifiée *Listeria innocua.* Dans une tentative de déceler une éventuelle corrélation entre la colimétrie et l'incidence de la contamination par *Listeria* spp., nous avons choisis deux groupes de sites. Le premier groupe est composé de Anza ville, Anza port et Oued Souss qui sont classés D (interdiction d'exploitation des coquillages provenant de ces zones), et le second est formé de Tamri, Tifnit, Sidi R'bat et Aglou qui sont classés en A mais ayant manifesté une contamination par *Listeria* spp. L'analyse des eaux de mer des sites composant ce dernier groupe permet aussi de les considérer comme zones approuvées pour l'exploitation conchylicole selon les recommandations de l'OMS/PNUE (100 pour cent des échantillons <100 coliformes fécaux/100 ml) (Martinez-Hanzanares *et al.* 1992). L'examen des résultats relatifs à la colimétrie et à la contamination par *Listeria* (tableau 2) montre clairement l'absence de corrélation entre les deux groupes bactériens. Cette observation est confirmée lorsqu'on se réfère aux résultats de l'autre groupe formé de sites classés en D comme Sidi Ifni ville et Oued Souss où la colimétrie dépasse le seuil de 60 000 coliformes fécaux par 100 g et où la contamination par *Listeria* spp. est totalement absente. Des nombres comparables d'échantillons (243–250) ont été étudiés pendant chacune des quatre saisons au cours de deux années (2000–2001) sauf pour l'hiver qui a été analysé pendant trois saisons. L'incidence de la contamination par *Listeria* spp. de la zone littorale étudiée semble être fonction de la saison du moment que le taux le plus élevé est enregistré en hiver où 7,8 pour cent des échantillons contiennent des *Listeria* comparativement au printemps, à l'été et à l'automne où des taux respectifs de 3,2 pour cent, 3,3 pour cent et 4,4 pour cent sont notés. Il est curieux de constater que quel que soit le compartiment analysé, au printemps, la contamination est exclusivement due à *Listeria monocytogenes,* ailleurs elle est mixte avec une prédominance de *Listeria innocua* en hiver et en été et de *Listeria monocytogenes* en Automne (tableau 3). La sérotypie des isolats de *Listeria monocytogenes* montre que le sérovar 1/2 b est prédominant et représente 91 pour cent des souches isolées. Le deuxième sérovar identifié est le 1/2 a; il représente 9 pour cent des isolats.

4. CONCLUSION

La contamination des sites, échantillonnés dans le cadre de la surveillance de la salubrité du littoral, par *Listeria* spp. révèle une incidence de 6, 4,6 et 3.4 pour cent, respectivement pour l'eau de mer, le sédiment et le coquillage. Les résultats comme ceux relatifs aux produits laitiers et carnés montrent que le Maroc qui a basé son économie sur la promotion du secteur halieutique par l'exportation des produits de la pêche, est concerné par les problèmes posés par *Listeria monocytogenes*.

RISK ASSESSMENT AND SEAFOOD PRODUCTS IN DEVELOPING COUNTRIES

by

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Abstract

Developed countries have experienced in the last decade a constant progress towards fish industrialization with the application of new techniques for improving the quality and safety of fish products. The lact of resources in the same field is affecting developing countries, with the creation of obstacles and imposition of trade barriers for the access to the international market. Fish and fish products, being the most internationally traded foodstuffs in the world (50 percent originating from developing countries), accounting for the 38 percent of world fish production, have been implicated in a number of reported cases of food-borne illnesses. The safety of fish products is a public health objective of the whole international community and all efforts much be taken to prevent and manage the occurrence of food-borne outbreaks caused by pathogens (bacteria, virus, parasites, toxins). Unfortunately the existence of different national or international standards and the lack of harmonization led to arbitrary or unjustified measures, particularly for those less developed countries. The World Trade Organization (WTO), with the greements of 1995 on SPS (Sanitary and Phytosanitary measures) and TBT (Technical Barriers to Trade) developed principles for achieving the harmonization of standards. In response, WHO in collaboration with the Food and Agriculture Organization (FAO), promoted new risk management strategies.

1. INTRODUCTION

The rapid advances in fish industrialization, fish technologies and the changing landscape of international policy associated with fish safety are unprecedented in developed countries. Less developed countries, on the other hand, do not have all resources to invest in these areas, but by necessity are focused on improving the exploitation of their national fish resources to increase food security and gain access to the international market with the export of their food products. Unfortunately the occurrence of food pathogens in fish products originating from developing countries and the increased risk of cross-border transmission of infectious agents has raised food safety concerns. The subsequent trade restrictions imposed by the international community have affected their potential in the international market and caused economic losses. But are these bans scientifically justifiable? In recent years, risk assessment studies conducted on different pathogen-commodity combinations proved to be a valuable tool for the international scientific community and risk managers to review these restrictions. The World Health Organization (WHO), in collaboration with the Food and Agriculture Organization (FAO), has developed practical guidance documents for the preparation of risk management strategies using microbiological risk assessment (MRA) and associated scientific information. With the help of MRA, it will be possible to set scientifically justifiable international standards, review the trade bans and pave the way for transferring risk assessment technology and data between countries, including developing countries.

2. INTERNATIONAL TRADE OF FISH AND FISH PRODUCTS

Fish and fish products represent the most internationally traded foodstuffs in the world, accounting for the 38 percent of world fish production (aquaculture and catches), which has increased steadily (8.5 percent since 2003) to approximately 120 million tonnes in recent years. The international trade in fishery commodities reached an export value of US$58.2 billion in 2002. The World Trade Organization (WTO) rules regulate 99 percent of this trade. More than 50 percent of this trade originates in the developing countries. Thailand is the number one exporting country with US$4 300 million in exports annually. China with a recently sharp increase in its export performance is now number two among all fish exporting countries with US$3 700 million annually.

The United States, Europe and Japan currently dominate the world markets both in terms of prices and market access requirements, and with 17.3 percent, 39 percent and 18.4 percent of world imports respectively, accounted for more than 80 percent of total import value. The United States, besides being the world's fourth major exporting country, is the second biggest importer.

3. FOOD-BORNE PATHOGENS AND FISH PRODUCTS

The last two decades have seen a large increase in international trade, fish consumption and the new trend in food technology and global food production, processing, distribution and preparation. We have also seen an increase in the number of reported cases of food-borne illness associated with fishery products, both with the emergence of new food-borne pathogens as well as the re-emergence of well known pathogens.

Most of the available data on food-borne illness is from industrialized nations, but the situation in poorer nations is probably worse. Developing countries may not have the resources needed to identify and document food-borne illness outbreaks, or outbreaks may go unreported in an effort to prevent negative publicity, which could affect a nation's tourism and trade industries.

In industrialized countries, where the reporting systems have documented significant increases in the number of cases, the percentage of people suffering from food-borne illness each year has been reported to be as high as 30 percent. In the United States, it is estimated there are 76 million cases of food-borne diseases, 325 000 hospitalizations and 5 000 deaths each year; and 2 366 000 cases, 21 138 hospitalizations, 718 deaths in England and Wales (Adak *et al*., 2002; Mead *et al*., 1999). It should be said that it is highly likely that many seafood-borne illnesses are not reported by the patient (under-reporting) nor recognized as a food-borne illness (underdiagnosis). The result is that the number of investigated cases of seafood-borne disease (as all food-borne illnesses) reported by each reporting country is a small fraction of the actual number of food outbreaks. In the developing countries food-borne and water-borne illness with 2.2 million cases among children, represent an important public health problem that significantly affect people’s health life with serious socio-economic implications. There are many factors that explain the increase: change in animal husbandry; changes in increase in susceptible populations; increase in travel; change in lifestyle and consumer demands.

Food-borne disease comprises a broad group of illnesses. Among them, gastroenteritis is the most frequent clinical syndrome, which can be attributed to a wide range of micro-organisms, including bacteria, viruses and parasites. The gravity or severity of food-borne diseases depends on the type of strain of virus or bacteria and on host factors, including pre-existing immunity, the ability to elicit an immune response, nutrition, age and non-specific host factors. The lethality of food-borne diarrhoea is much higher in some particularly vulnerable segments of the population, including children under five years of age, pregnant women, immunocompromised people (patients undergoing organ transplantation or cancer chemotherapy, AIDS) and the elderly (Gerba *et al*., 1996).

Fish and fish products were identified as an important vehicle of infection or intoxication during food-borne disease outbreaks in Europe and the United States. In Europe (42 countries) during the period 1993–98, from the WHO (2001) epidemiology data, the fish, shellfish and fish products category encompassed 1 201 outbreaks, corresponding to 5.3 percent of the total investigated outbreaks. The type of micro-organism associated with seafood may vary depending upon whether it is fresh or processed. Most of the outbreaks of illnesses occur in countries where seafood is eaten raw or is inadequately cooked. For example, in Japan where seafood is eaten raw, 70 percent of food-borne human illness is seafood associated.

In the United States, seafood ranked third on the list of products that caused food-borne disease between 1983 and 1992 (Lipp and Rose, 1997). Ten to nineteen percent of food-borne illness reported in the United States involved seafood as a vehicle; and between 1993 and 1997, 6.8 percent of the food-borne illnesses involved consumption of fish and shellfish (FAO, 2004).

The most important bacteria associated with consumption of fish products are *Vibrio* spp. (*V. parahemolyticus, V cholerae V vulnificus*), *Listeria monocytogenes*, *Clostridium botulinum. Aeromonas hydrophila, Plesiomonas shigelloides, and Salmonella*. Viruses are also present. A recent compilation of data from ten surveillance systems in Europe found Norovirus (Norwalk and Norwalk-like viruses) to be responsible for more than 85 percent of all non-bacterial outbreaks of gastroenteritis reported from 1995 to 2000 (Lopman *et al*., 2003). Hepatitis A is also involved in many food-borne cases.

V. parahaemolyticus is commonly isolated from seafood products, especially in bivalve molluscs. Bacterial load fluctuate with temperature, especially in the temperate zones, with the higher numbers being isolated in the warmer months. *V. parahaemolyticus* is the primary cause of food-borne illness in Japan and Taiwan. It seldom causes death, but it does lead to closures of shellfish-harvesting areas and the interruption in shellfish trade. *V. vulnificus* infection is not common in Europe but has for some years been a safety issue in the Gulf Coast area of the United States. The infections, which can cause severe septicaemia in immunocompromised people, are almost exclusively caused by consumption of raw bivalve molluscs such as oysters. Today, *V. vulnificus* is the most significant pathogen associated with oyster consumption. There are about 50 reported cases in the United States annually with a mortality rate nearly 60 percent higher in Asia.

V. cholerae may be sub-typed into more than 200 serotypes. Of these, only serotype O1 and O139 are associated with epidemic and pandemic cholera. Non-O1, non-O139 serotypes are rarely associated with sporadic cases of gastroenteritis. Choleragenic *Vibrio cholerae* are characterized by their ability to produce cholera toxin encoded by ctx gene, which can be detected by molecular technique such as PCR. The PCR characterization is necessary because (a) environmental isolates of O1 serotype can be non-toxigenic (Sakazaki and Donovan, 1984); (b) some environmental non-O1 isolates may agglutinate with polyvalent O1 antiserum (Shimada *et al*., 1987); *V. cholerae* O155 agglutinates with commercial O139 antiserum leading to misidentification (Dalsgaard *et al*., 2002).

The majority of cases in which cholera has been linked to seafoods have involved raw products, often molluscs. *V. cholera* is not common on fresh fish. In this regard none of 748 samples of warm water shrimp imported into Denmark were positive (Dalsgaard *et al*., 1996), nor were 131 fresh and brackish water prawn samples from Bangladesh (Balakrish Nair *et al*., 1991).

Shigella is not associated with particular food raw materials but its presence is exclusively a question of poor hygienic handling, and humans are its natural reservoir. *Shigella* is not naturally present in water but may survive for up to 6 months in water (Wachsmuth and Morris, 1989) and may survive for a long time in clams and oysters (Feldhusen, 2000). Outbreaks have been caused by a multitude of food products, including shrimp and clams (Lampel *et al*., 2000). Cross-contamination of raw or previously cooked foods during preparation with an infected asymptomatic carrier and poor personal hygiene are typical factors contributing to infection.

*L. monocytogenes (*with a reported annual incidence between 0.01 and 0.5 cases per 100 000 population) is an organism indigenous to the general environment where it is typical of decaying plant material. It is not typical of aquatic and marine environments and can easily be isolated from processed fish products. The organism can grow at refrigeration temperature and can survive in the food processing environments. *L. monocytogenes* has been isolated from a variety of seafood both fresh and processed, such as frozen seafood, smoked fish, surumi. Presence of *L. monocytogenes* in tropical seafood is rare compared to seafood from temperate environments (Embarek, 1994). The infection resulting from *L. monocytogenes* occurs in aged people, pregnant women and infants. The bacterium causes infection of the central nervous system and a severe septicemia, which can be fatal in susceptible population, in particular in older people and infants. In pregnant women it causes abortion, stillbirth and fatal meningitis of the newborn.

Campylobacter (with a reported annual incidence up to 95 cases per 100 000 population), which die quickly in open marine waters, may accumulate in shellfish where they appear to be protected. One study has reported that up to 42 percent of Irish shellfish were positive for mesophilic *Campylobacter* (cf Feldhusen, 2000). *Salmonella* is one of the most important food-borne pathogens, being responsible for about half the reported cases and outbreaks of food-borne diseases in the United States (Butt *et al*., 2004a). It is the only food-borne disease reported in all countries, with an annual reported incidence rate ranging from 6.2 to 137 cases per 100 000 population. It is generally believed that like E. coli, *Salmonella* is not present in the natural aquatic environment but is derived as a result of sewage contamination. *Salmonella* has been detected in 16 percent of tropical prawns and in 22.1 percent of water and mud samples (Reilly and Twiddy, 1992). Using PCR, higher occurrence could be documented in tropical seafood (Kumar *et al*., 2003). There are several instances of rejection of shrimp from South East Asia because of contamination with *Salmonella.*

A. hydrophila has received particular attention because of its association with human diseases. It has been isolated from both polluted and unpolluted bodies of water throughout the world (Schubert, 1975). In a study conducted by Fricker and Tompsett (1989), toxigenic strains of *Aeromonas* spp. were isolated from seafood, and suggested that seafood was a potential source of virulent aeromonads. Hudson *et al*. (1992) examined the presence of *A. hydrophila* from ready-to-eat seafood, and in about 40 percent shellfish were contaminated by *A. hydrophila,* whereas in finfish it was found to be 28 percent. Therefore, in cases of food-borne bacterial illnesses in which oysters are implicated, *Aeromonas* sp. should be included in the general screening for causative micro-organisms (Abeyta *et al.,* 1986). This bacterium can cause varies diseases: septicemia, wound infections, ocular infections.

S. aureus has been isolated at levels of 2–10 percent in fish and bivalves. The main route of contamination is the transfer from food handlers with hand infections or with a cold or a sore throat to cooked fish products or handled crustaceans. The enterotoxigenic strains are responsible for the intoxication.

Viruses are responsible for the largest number of cases of seafood-borne diseases and are in particular associated with raw (under-cooked) molluscan shellfish. They have their niche in the human gastro-intestinal tract, and their presence in water and seafood is a consequence of poor hygiene: either water being contaminated with sewage or products being contaminated by food handlers.

Hepatitis A is frequently involved in food-borne outbreaks by the consumption of mollusc shellfish. The annual incidence rates vary from 1.2 to 22.3 cases per 100 000 of the population. Notably Hepatitis A virus was responsible for the largest outbreak of viral food-borne disease ever to be recorded in Shanghai, China, in 1988 where more than 290 000 people were infected by eating clams harvested in sewage polluted areas (Lees, 2000; Halliday *et al*., 1991).

Recently Norovirus (ex-Norwalk virus) was highly involved in food-borne outbreaks. The food vehicle was molluscs, which are able to filter and accumulate in their body viral particles from the surrounding (contaminated) water. Norovirus was the etiologic agent of 284 outbreaks in the United States between 1997 and 2000; and in 455 outbreaks in Sweden between 1994 and 1998 (Fankhauser *et al*., 2002; Heldlund *et al*., 2000).

4. WTO-SPS AGREEMENT AND HARMONIZATION OF STANDARDS

The globalization of food trade, along with technological advances in many phases of the food chain (production, handling, processing and distribution), the increasing awareness and demand of consumers that ask for safe and high quality food and the food safety scares in the 1990s (BSE, dioxins, and genetically modified organisms) have put food safety and quality assurance among the priorities for many governments. Consequently, many countries have tightened food safety controls, imposing on imports additional costs and requirements that are not always technically or scientifically supportable. This is particularly true for those less developed countries. The results is that we had different standards and regimes being imposed by importing countries on producing countries, to ensure that products meet the requirements of the target market.

To overcome the lack of harmonization and to minimize arbitrary or unjustified measures on food marketing with negative effects on trade, the WTO developed principles of achieving harmonization of standards and equivalency in food control systems and the use of scientifically based standards. These principles are embodied in two binding agreements of 1995, the SPS (Sanitary and Phytosanitary measures) and TBT (Technical Barriers to Trade). The SPS agreement acknowledges the right of WTO member countries to take sanitary and phytosanitary measures (based on international standards, guidelines and other recommendations adopted by the Codex, where they exist) necessary to protect human, animal and plant life and health in the agricultural sector, including fisheries. In case of differences, each member must accept the measures of other countries as equivalent to their own provided with the same level of protection. Even though these two agreements helped member countries in the process of harmonization, they were unable to totally eliminate differences on national standards and inspection systems with the resulting non-tariff trade barriers.

The objective of the TBT Agreement is to prevent the use of national or regional technical requirements, or standards in general, as unjustified technical barriers to trade. The agreement covers standards relating to all types of products, including industrial products, and quality requirements for foods (quality provisions, nutritional requirements, labelling, packaging and product content regulations, and methods of analysis).

5. SPS AND RISK ASSESSMENT

Major efforts are to be taken by countries to harmonize procedure and promote equivalence schemes between importing regions. The SPS agreement requires that national measures should be based on scientific principle and on an assessment of the risks to humans, animal and plant life using internationally accepted risk assessment techniques developed by Codex or other relevant international organizations. The Codex, which is responsible for the implementation of FAO/WHO food standards programme and which is recognized as international standards setting body for food safety and quality under the SPS agreement, has developed principles and guidelines for the conduct of risk assessment to promote international harmonization.

In 2002, a Joint Consultation FAO/WHO explored the principles and established guidelines for incorporating the Microbiological Risk Assessment (MRA) in the development of food safety standards guidelines and related texts. In 2003, the Codex adopted guidelines for the judgement of Equivalence of Sanitary Measures associated with the Food Inspection and Certification System (CAC, 2003). In these consultations, concepts such as ALOP (acceptable level of protection) and FSO (food safety objective) were deeply discussed. Recently the International Life Sciences Institute (ILSI) and International Commission for Microbiological Specification for Food (ICMSF) published a volume where is described the concept of FSO in food safety management as a means to translate “risk” into definable goals for operational food safety management systems. The ALOP defines the public health objective in terms of number of cases of a disease per given number of population over a specified time period (e.g. 1/100 000 *per annum*). It can be considered the goal of each country and can be articulated by the FSO, which is defined by ICMSF as the maximum frequency or concentration of a microbiological hazard in food at time of consumption, to provide the appropriate level of health protection.

6. DEVELOPING COUNTRIES AND HARMONIZATION

Developing countries are facing problems in the field of food safety and food security. In addition to being responsible for human health problems within the countries, the presence of infectious agents in seafood imported from developing countries resulted in rejection of seafood consignments leading to major economic losses to exporting countries in general, and to seafood processing industries in particular.

Currently the WTO and Global Agreement in Tariffs and Trade (GATT) are dedicating the majority of their attention to trade and trade conflict between large trading blocks and market (United States, EU, Japan) and little to the interests of small developing countries. To date, globalization of food markets has not succeeded in bringing about rural development and reduction of poverty in the participating developing countries. In order to adopt rules created for these big countries, little time was given to adjust them to institutions to assure that export products are in compliance with, to them exotic, food safety rules. In the developing countries the main issues are food security and maintaining prices at affordable levels. The affordability of food extends into the affordability of food safety. How much food safety can be bought by a consumer that has less than US$1/day to spend for food? In this context food safety and risk analysis are in the hand of consumers that manage risk by careful buying and proper food preparation. We have also to consider some specific facts associated with developing countries such as: the acquired resistance to pathogens (e.g. exposure to pathogens is fairly common but epidemics are rare); food-borne disease is not perceived as a priority in public health (different perception of risk); investment in food safety infrastructure is low; strong interest in niche production; the cost burden for food safety compliance, food safety (e.g. HACCP) tailored to local customs.

In applying the food safety concepts in this social contest we must avoid blindly transferring the western model. Instead, considerable work must be done to develop capacity building and to assist national stakeholders in the development and implementation of trade-related policies and global trading rules with a special focus on a comprehensive approach from farm to table. For the Hazard Analysis Critical Control Point (HACCP) implementation and use of results of risk assessment, developing countries need to develop certain minimal skills, understand concepts of risk assessment and have availability of infrastructure and equipment that are seriously lacking. In this regard some important issues that need to be addressed are: technical assistance on infrastructure, institutional and capacity building, and investments in SPS/Trade.

7. FISH SAFETY STRATEGY AND RISK ANALYSIS

The fish strategy in support of a food chain approach and food safety must incorporate the components of risk analysis. With the assessment, management and communication of risk, the overall risk analysis process is widely recognized today as the fundamental methodology underlying the development of a food safety standard that provides adequate health protection and facilitates trade in food (FAO/WHO, 1995). Risk assessment is a scientific evaluation of known or potential adverse health effects resulting from human exposure to food-borne hazards. Risk management is a process of weighing policy alternatives to accept, minimize or reduce assessed risks and to select and implement appropriate options. Risk communication is an interactive process of exchange of information and opinion on risk among risk assessors, risk managers and other interested parties.

Risk management deals with reviewing food safety policies, regulation and control of risk, and is currently embodied in two binding agreements of WTO, the SPS and TBT Agreements that, as said above, introduced the need to perform a risk assessment in the event of trade dispute. This was a huge stimulus to develop risk assessment technique in order to justify scientifically the measures taken by member countries to protect the human, animal and plant health.

The risk assessment approach has been used for some time for setting the maximum residue limits of pesticides, chemical contaminants and additives. It is relatively new for biological hazards, which represent a major concern in fish trade. International guidelines are being developed and only a few countries (Canada, United States, Japan) with significant scientific and financial resources have been able to initiate fully food microbiological risk assessments. Developing countries are lacking the necessary human and financial resources and are not able to contribute adequately despite their important role in international fish trade.

Risk assessment is a scientific process aiming at estimating the risk, using four steps: hazard identification, exposure assessment, hazard characterization (a dose-response in a quantitative approach) and risk characterization (probability of disease occurrence). These are the Codex definitions: Hazard identification – identification of biological, chemical, physical agents capable of causing adverse health effect and which may be present in a particular food or group of food; Exposure assessment – the qualitative and quantitative evaluation of the likely intake of biological chemical and physical agents via food as well as exposure from other sources if relevant; Hazard characterization – the qualitative/quantitative evaluation of the nature of adverse health effect associated with the hazard; Risk characterization – the process of determining the qualitative and/or quantitative estimation, including the attendant uncertainty of the probability of occurrence and severity of known or potential adverse health affect in a given population based on hazard characterization, identification and exposure assessment.

Governments, international organizations, academics, research organizations and companies have published numbers of examples of MRA, which from a scientific point of view had become an indispensable tool to oversee the dynamics of pathogens in complex food chains and to analyse the effects of possible interventions in a systematic manner. In 1999 the Codex adopted the "Principles and Guidelines for the Conduct of Microbiological Risk Assessment; the 2002 FAO/WHO consultation in Kiel led to the report entitled "Principles and Guidelines for Incorporating Microbiological Risk Assessment in the Development of Food Safety Standards"; results of a ILSI Europe workshop held in 2003 were finalized in the report "FSO Role in microbiological Food Safety Management" published in 2004. All of these experiences focused on ad hoc MRA being utilized in food safety management to understand the magnitude of prevailing risk regarding a pathogen/product combination and design risk intervention scenarios, while appropriate.

The 32nd session of the CCFH (Codex Committee in Food Hygiene) identified in 1999 a list of pathogen/product combinations that required expert risk assessment advice. In response, FAO and WHO jointly launched a programme of work aimed to facilitate risk management strategies to better address microbiological food safety. As expert input to Codex, the ad hoc Joint Expert Meetings on Microbiological Risk Assessment (JEMRA) have the objective of providing expert advice on risk assessment of microbiological hazards in foods to their member countries and to Codex. This involved the implementation of a number of activities, including the establishment of expert drafting groups to examine 4 of the 21 pathogen commodity combinations identified in 1999 as priority issues, in particular: *Listeria monocytogenes* in ready-to-eat foods, *Salmonella* spp. in broilers and eggs, *Campylobacter* in poultry and *Vibrio* spp. in seafood. The *Salmonella*, *Campylobacte*r and *Vibrio* risk assessments have been recently finalized. Among the other 17 pathogen-commodity combinations identified as priority issues, only Salmonella in fish is relevant to fish trade.

The FAO and WHO risk assessment work on *Vibrio* spp. in seafood initiated in 2001 at national and international level. An ad hoc expert drafting group was established to examine the available relevant information and undertake the risk assessment. Five risk assessments have been undertaken as follows with different focus: *V. parahaemolyticus* in oysters (global assessment); *V. parahaemolyticus* in clams (Thailand focus); *V. parahaemolyticus* in finfish consumed raw (Japan focus), *V. vulnificus* in oysters (United States focus), *V. cholerae* in warm water shrimp in international trade. Other similar mechanisms therefore need to be initiated to assess the risk of other hazards, such as histamine, heavy metals, viruses and parasites relevant to fish trade and consumption. But important resources need to be mobilized for this to take place.

8. WHY THE FAO/WHO RISK ASSESSMENTS OF *V. CHOLERAE* IN WARM-WATER SHRIMP IN INTERNATIONAL TRADE?

FAO and WHO recently initiated a joint risk assessment study of choleragenic *Vibrio cholerae* O1, and O139 in warm water shrimp for the export market. This specific pathogen–commodity combination was chosen because shrimp represent an important commodity in international trade and most shrimp producing countries are in the developing world. In fact in 2003, of the 4.3 million tonnes of shrimp traded, 70 percent was warm-water shrimp, with three-quarters originating in developing countries.

Shrimp is widely consumed both in developing countries and developed countries. In most Asian shrimp producing countries, large-sized high quality shrimp goes to the export market and only small-sized varieties are consumed locally. Shrimp was also implicated in several outbreaks of V. cholera infection, which is endemic in major exporting countries and is a significant cause of illness, because of a lack of potable water and ice, handling by asymptomatic carriers, and contamination in kitchens and street vendors. In 1991 in South America, a cholera outbreak in which seafood was implicated as a vehicle, caused more than 400 000 cases and 4 000 deaths.

Some notable facts associated with shrimp rejection on trade include: 1978-United States block list of Asian shrimp because of *Salmonella* in raw product; 1997-EU ban shrimp from Bangladesh because of cholera; the 1997 cholera epidemic in East Africa that resulted in European Commission banning imports of fish products from Kenya, Mozambique, the United Republic of Tanzania and Uganda until June 1998; 1998-EU ban of fish from Uganda because of possibility of cholera. From these episodes it is clear that cholera outbreaks certainly affect exports in third countries causing severe economic consequences on the shrimp processing industry. But in many cases no science based risk estimate has been used to justify the trade ban. Following the 1997-EU ban in East Africa, the WHO/FAO stated that the ban was not scientifically justifiable and the restrictions were lifted in June 1998.

After the establishment in Europe of the EU Rapid Alert System (RASFF) there were many bans on internationally traded shrimp. In Europe mainly two members (Italy and Norway) were responsible for 75 percent of the *Vibrio* notifications from 1999 to 2002, with 75 percent of cases resulting from frozen shrimp. In 2005 most alert notifications of *Vibrio cholerae* found on traded shrimps originated from third countries. In particular, following the Sweden analysis on shrimp from Sweden via Vietnam and from Bangladesh via Denmark notified in 2005 by Norway, the *V. cholerae* isolated strain were not O1 and not O139 serotype and no toxinogenetic activity was demonstrated with PCR. Considering that only O1 and O139 serotypes are associated with epidemics and pandemic cholera, because of the *ctx* gene (Non-O1, Non-O139 have been occasionally reported to cause sporadic cases and are not associated with epidemics) (Desmarchelier, 1997), these RASFF notifications were not scientifically justified because they were dealing with no pathogens.

Additionally, a study of Dalsgaard *et al.* (1995) reported that 2 percent of samples from tropical shrimp culture environments were positive for O1 *V. cholerae* but subsequent molecular studies indicated that these isolates were non-toxigenic.

The purpose of the risk assessment of *V. cholerae* in warm-water shrimp in international trade was to estimate the likelihood of consumers in selected importing countries contracting cholera following consumption of warm-water shrimp. At the beginning of the study, exposure assessment for both markets (domestic and international) were considered important because of differences in handling. Subsequently only the export market was considered because shrimp for domestic use does not appear to be an important vehicle for transmission of cholera, and current data such as uncertainties on handling, storage, practices, route of cross-contamination and consumption practices of domestic shrimp limited the risk assessment.

Shrimp destined to the export market are generally processed under HACCP at processing premises: immediately iced after harvest, subjected to a strict hygienic control and washed with potable waters. Moreover shrimp are exported frozen and thawed and cooked in the receiving countries leading to a negligible exposure to the pathogen. To corroborate this fact, a series of studies conducted in several countries in Asia during the late 1980s reported an absence of choleragenic *V. cholerae*. A recent study in India indicated the absence of choleragenic *Vibrio cholerae* in shrimp processed in India for export under the HACCP condition (Karunasagar, 2005), with the occasionally domestically marketed shrimp (low value) being contaminated with toxigenic *Vibrio cholerae*. In Peru, during the 1991 epidemic, all five samples of domestically marketed fish were contaminated with *V. cholerae* but only one of 1 011 samples of shrimp for export were positive for this pathogen (DePaola *et al*., 1993). The re-emergence of cholera in Peru in 1991 resulted in the loss of US$700 million in fish and fishery-product exports.

The risk assessment conceptual model used in this study was based on shrimp harvesting, post-harvest handling, processing, cooking (in units approved for export on the basis of good hygiene practices [GHP] and good manufacturing practices [GMP] requirements), distribution and retail (frozen shrimp in international transport, wholesale storage, supermarket and restaurants) and consumption. As mentioned earlier, shrimp intended for export are generally iced immediately after harvest and transported in ice to certified processing units that meet the above requirements. So the model took into account the pronounced reduction in the levels of the pathogens that occur during cooking of shrimp either before export or before consumption. It also assessed the risk if shrimp were consumed raw or inadequately cooked in the importing country (worst case scenario).

Because of data limitations and very little quantitative data, the quantitative risk assessment was not able to consider the whole harvest-to-consumption phase. In this study three approaches were used: qualitative, semi-quantitative (harvest to consumption pathways) and quantitative (distribution to consumption). For the exposure assessment the frequent testing done on warm-water shrimp at the port of entry in importing countries during 1995–2000 was considered. Of the over 21 857 warm-water shrimp samples tested in Japan, United States and Denmark only 2 were positive (0.01 percent). The pathogen was not detected in smaller sample sets from the United States and Denmark. Risk assessments assumed that 90 percent of warm-water shrimp were eaten cooked and 10 percent were eaten raw (sashimi, etc).

Assumptions were made on distribution of time and temperature, data on the effect of cooking, washing and freezing, and on duration of frozen storage before consumption. For the risk characterization the d-r curve was combined with the estimated exposure to choleragenic *V. cholerae* in shrimp.

Regarding the qualitative approach, the risk was assessed for raw shrimp, shrimp cooked at farm and eaten without further heat treatment and shrimp cooked immediately before consumption. Factors identified for *V.cholerae* were: severity, occurrence risk, growth in product required to cause disease, effect of production, processing and handling, consumer terminal step, epidemiological link. The final risk estimate was very low for the three types of products.

For the semi-quantitative risk assessment, a risk ranger was used (Sumner and Ross, 2002) based on answering 11 questions (risk criteria) on dose and severity (hazard severity and susceptibility) probability of exposure (frequency of consumption, proportion consumed, size of population) probability of contamination (probability of raw product contaminated, effect of processing, possibility of recontamination, post-process control), increase to infective dose, cooking before eating. The predicted illness per century in selected population was: 1 case in Japan, 0.4 cases in the United States and 0.1 cases in the United Kingdom, France, Italy and Germany.

This semi-quantitative risk assessment has concluded that even if all imported shrimp is consumed without any further cooking, the risk of cholera is about 2–4 cases in 100 years. This is an over-estimate because (a) imported volume has been taken as edible volume and (b) it is common that shrimp are generally consumed after cooking – this would reduce the bacterial numbers by greater than six logs. Thus the risk would be very low or near to zero. This inference is supported by epidemiological data that have been used to validate the model. Cholera is a reportable disease and most developed countries importing warm-water shrimp have in place a good surveillance system. The data captured in these countries show that there are no cases of cholera reported as a result of imported shrimp.

The quantitative risk assessment based on modelling and uncertainties, estimated likelihood of cholera illnesses in 7 countries in each of 6 years (1995–2000) with a predicted illness ranges from 3 to 30 cases/century.

The results of the three risk assessment, considering the differences in the way they were set up with different approaches (qualitative, semi-quantitative and quantitative) and models, pointed to a very low risk of contracting cholera from consumption of warm-water shrimp in the raw state. Moreover they highlighted the need for countries to specifically test for choleragenic or toxigenic *V. cholerae* O1 and O139 and recognized the difference on domestic situation in developing countries that have to be addressed separately. The hope is that in the future risk assessment will provide a scientific input to the regulatory authorities to review the measures adopted for protecting human health and to link food trade bans to the real risk existing for the population.

9. DEVELOPING COUNTRIES AND MICROBIOLOGICAL RISK ASSESSMENT (MRA)

While developing countries are in the process or elaborating food safety control programmes (HACCP, GHP, GMP), the lack of their technical infrastructure, scientific and financial resources constitutes a barrier for the direct application of MRA concepts in their national or regional context.

But it is essential that developing countries start to understand and contribute to the MRA developed by the FAO/WHO for implementation of effective risk management strategies at different steps along the food chain. To have international value, the risk assessments will need, where appropriate, to incorporate data from different countries (including developing countries) (e.g. data on pathogen prevalence and on levels-quantitative data – from farm to fork), where the fish species concerned are produced, traded and/or consumed. With this aim it must be a prerogative of international organizations (e.g. FAO, WHO, OIE, World Bank, NGOs) and the scientific community to invest in MRA in developing countries by improving their public health surveillance and monitoring system on micro-organisms in food. The whole international community will benefit from sharing prevalence data collected from the surveillance systems of third countries when the global risk assessment is concerned.

FAO and WHO can support this assistance by providing training (study visit, cascade training, seminars for risk managers), scientific expertise (on FSO, ALOP, d-r curve concepts), technical resources and funding for data collection and laboratory capabilities. This exercise will lead to the establishment of professional networks between countries with similar input to MRA (including developing countries) and facilitate the work of national and international risk managers with strong links between them and risk assessors at the national and international levels.

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EFFET DU DEGRÉ DE SÉCHAGE DU POISSON FERMENTÉ-SALÉ-SÉCHÉ SUR SON ÉTAT D'INFESTATION PAR *Dermestes* spp.

by

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Abstract

Three batches of fermented salted dried catfish with roughly the same salt content, but three different moisture contents, respectively 22, 19.8 and 14.6 percent, are infested with first instar larvae of *Dermestes* spp., both *maculatus* (Degeer) and *frischii (Kugelann)*:

- Per groups of 40 beetles in plastic boxes containing 1 kg of cured fish each;
- and separately in small jars with a piece of dried fish.

These experiments ran eight full weeks.

Observations on the evolution of the mean corporal weight of the larvae, the weight loss of the cured fish and the life cycle of the beetles bred on the different batches, showed that the less dried one (22 percent m.c.) recorded the highest weight loss (9.75 percent), the lowest mortality in the three first larval instars (4 percent) and, concomitantly, the shortest life cycle for the beetles (49 days).

Key Words: *Arius gambiensis*, *Dermestes* spp., fermented salted-dried catfish, beetle infestation, moisture content, Sénégal

Résumé

Trois lots de machoîrons fermentés-salés et séchés, contenant la même quantité de sel environ, mais ayant des teneurs en eau différentes respectivement 22, 19,8 et 14,6 pour cent, sont infestés avec des larves de premier stade de *Dermestes maculatus* (Degeer) et *Dermestes frischii* (Kugelann) mélangées, durant 8 semaines:

- par groupe de 40 larves dans de grandes boites plastiques contenant 1 kg de poisson sec chacune;
- et individuellement dans de petits récipients plastiques avec un morceau de poisson sec.

Le suivi de l'évolution pondérale des larves élevées en groupe, de la durée de développement et du pourcentage de mortalité en élevage individuel ainsi que le calcul de la perte de poids subie par le poisson sec dans les différents lots sont effectués. Les résultats obtenus montrent que c'est dans le lot le plus humide (22 pour cent de teneur en eau), qu'on enregistre la plus grosse perte en poids (9,75 pour cent), le plus faible pourcentage de mortalité pour les 3 premiers stades larvaires (4 pour cent), et aussi, la durée de développement la plus courte (49 jours).

Mots clés : *Arius gambiensis, Dermestes* spp., poisson fermenté-salé-séché, infestation, teneur en eau, Sénégal.

1. INTRODUCTION

Le poisson transformé par les méthodes traditionnelles en Afrique subsaharienne subit un certain nombre de déprédations causées essentiellement par les insectes coléoptères du genre *Dermestes* (Watanabé, 1974 ; Osuji, 1975a ; FAO, 1981 ; Diouf, 1987 ; Guèye-NDiaye, 1990).

Il existe des pratiques traditionnelles de protection contre ces insectes. Parmi celles-ci on relève la forte diminution de la teneur en eau des produits par un séchage adéquat.

Peu d'études ont porté sur l'évaluation de l'efficacité de cette méthode. On peut citer une publication relativement ancienne de Scoggins et Tauber (1951) et quelques autres plus récentes de Poulter (1970 *in* FAO, 1981) de Bostock *et al.* (1987) et Zakhia (1992).

Les résultats des observations exprimés par Scoggins et Tauber (1951) et par Bostock et al. (1987) apparaissent pour le moins contradictoires.

Dans ce contexte, il nous a paru intéressant de présenter nos propres observations, effectuées au Sénégal sur le poisson fermenté-séché ou "Guedj" une des trois principales spécialités locales (Guèye-NDiaye, 1995). Dans le travail qui va suivre nous étudions chez une espèce de poisson transformé, l'effet de la teneur en eau du produit fini sur son degré d'infestation par *Dermestes* spp. pendant un stockage de huit semaines, après infestation expérimentale.

2. MATÉRIEL ET MÉTHODES

<u>Traitement du poisson</u>

L'espèce utilisée est un poisson téléostéen siluriforme, *Arius gambiensis,* ou mâchoiron, localement appellé "kong". Elle est rarement consommée à l'état frais au Sénégal.

Les machoirons sont divisés en trois lots de 20 kg chacun. Ils sont ensuite éviscérés, ouverts en portefeuille, puis trempés pendant 24 heures dans une saumure constituée de 1450 g de sel fin dissout dans dix litres d'eau de mer. Ce trempage est suivi d'un rinçage rapide toujours dans de l'eau de mer puis de l'étalement sur les claies de séchage.

Les différents lots sont alors séchés pendant respectivement quatre, six et huit jours sur les claies de séchage, en les retournant régulièrement et en les recouvrant la nuit afin d'éviter leur réhumidification.

Dosage des teneurs en eau et en sel

A la fin du séchage, chacun des lots est placé pendant 72 heures dans un congélateur à –25 °C pour enrayer toute infestation initiale, puis ramené à température ambiante dans un endroit aéré, à l'abri des insectes jusqu'à ce que le poids se stabilise.

a) Dosage de la teneur en eau

Cinq échantillons sont alors prélevés à partir de chaque lot, pour doser le taux moyen d'humidité par la méthode standard: l'échantillon broyé au mixer et pesé (poids frais ou p.f) est séché à l'étuve dans un creuset métallique sec préalablement taré, à 110 °C pendant 3 heures. Il est ensuite mis à refroidir dans un dessicateur avant d'être repesé (poids sec ou p.s); sa teneur en eau (t.e.) est alors donnée par la formule suivante

$$t.e = \frac{\text{Poids frais} - \text{Poids sec}}{\text{Poids frais}} \times 100$$

Trois répétitions sont faites pour chaque échantillon, et la teneur en eau du lot est la moyenne de toutes ces valeurs.

b) Dosage de la teneur en sel

Elle est effectuée avec la méthode de "titrage coulométrique à intensité constante" (Edeline 1965; Rodier 1984): l'échantillon à doser est préalablement broyé au mixer; 2,5 g de ce broyat sont mélangés à 250 ml d'eau distillée; après agitation et homogénéisation, on laisse décanter. 0,5 ml de la solution à titrer sont alors prélevés du surnageant, et le pourcentage de NaCl est mesuré à l'aide d'un chloruromètre préalablement étalonné. Sur chaque lot, trois poissons sont prélevés au hasard, à partir desquels trois échantillons sont pris et dosés séparément; sur chaque échantillon, le titrage est répété trois fois, et la teneur en sel finale est la moyenne de toutes ces valeurs.

Evaluation de l'effet de la teneur en eau sur le développement de *Dermestes* et sur le niveau des pertes

Toutes les expériences ont été menées à la température ambiante et dans les conditions naturelles d'éclairement, à l'intérieur d'une enceinte couverte et aérée comparable aux magasins de stockage trouvés sur les lieux de production.

Pendant toute la durée de l'expérimentation (8 semaines), la température et l'humidité de l'enceinte sont enrégistrées quotidiennement à l'aide d'un thermohygrographe. Leurs valeurs ont varié respectivement de 27 à 31°C et de 70 à 100 pour cent

Des adultes de *Dermestes maculatus* (Degeer) et *Dermestes frischii* (Kugelann) ont été capturés dans les lieux de transformation du poisson où ils vivent ensemble et mis à pondre au laboratoire sur des sardinelles braisées-séchées dans des boîtes en plastique.

Les femelles déposent leurs oeufs dans les fentes et crevasses d'où ils sont prélevés délicatement et mis à incuber sur du papier filtre ou du coton humidifié dans des boîtes de Petri.

Les larves obtenues sont utilisées un à deux jours après leur éclosion pour infester les différents lots de poisson séché.

L'évaluation de l'effet de l'humidité sur le développement des larves de *Dermestes*, et sur le niveau des pertes enregistrées dans chacun des lots de poisson séché, s'est faite à partir des deux expériences décrites ci-dessous.

1/ <u>Elevages en groupe</u>:

Trois échantillons de poisson pesant 1 kg, sont placés chacun dans une boîte plastique (28,5 x 27,5 x 8 cm) fermée par un couvercle à fenêtre grillagée doublée de fine mousseline pour l'aération ; Chaque boite reçoit quarante larves de premier stade. Tous les cinq jours, dix larves de chacune des boites sont pesées puis remises en place pour suivre l'évolution pondérale.

Au bout de 8 semaines, les échantillons de poisson sont repesés après avoir été débarrassés des insectes et des déchets et leur teneur en eau est à nouveau dosée suivant la méthode décrite plus haut, ce qui permet de calculer la perte en poids. Les larves, nymphes et adultes de *Dermestes* morts ou vivants sont dénombrés et le pourcentage total de mortalité déterminé pour chaque lot.

2/ <u>Elevages individuels</u>:

Vingt cinq petits échantillons d'A. *gambiensis* d'environ 5g, sont placés chacun dans une petite boîte cylindrique en matière plastique numérotée (5 cm de diamètre et 7,5 cm de hauteur) dans laquelle est ajoutée une larve de premier stade.

Les boîtes sont fermées à l'aide d'un carré de mousseline retenu par une bague élastique. Les observations sont menées tous les 5 jours pendant la durée de l'expérimentation, pour évaluer le taux de mortalité à différents stades et calculer la durée du développement ainsi que le nombre moyen de mues.

3. RÉSULTATS

Après traitement, les trois lots de machoiron ont des teneurs en eau respectives de : 22 pour cent (lot 1, séché pendant quatre jours), 19,8 pour cent (lot 2, séché pendant six jours) et 14,6 pour cent (lot 3, séché pendant huit jours).

1/ Elevage en groupe:

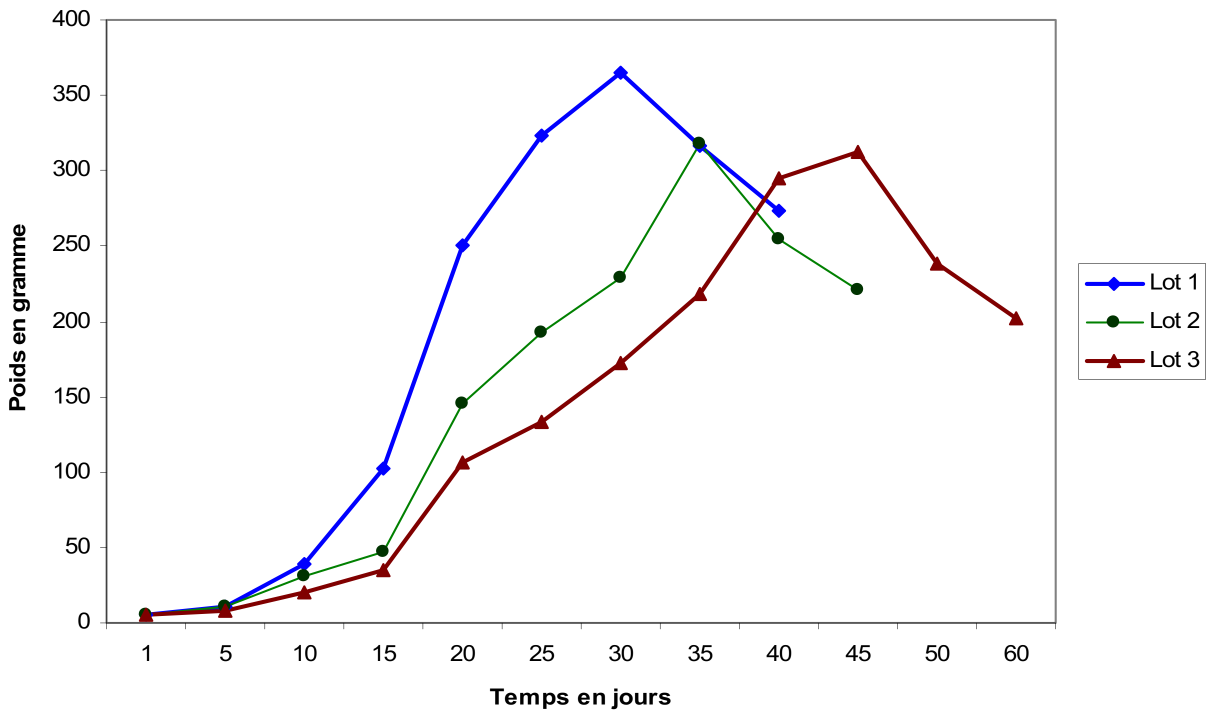
La perte de poids sec du poisson (Tableau 1) est plus faible quand le taux d'humidité en début d'expérience est bas: elle est de 2,4 pour cent pour 14,6 pour cent de teneur en eau, contre 9,7 à 22 pour cent

Tableau 1 : Perte de poids du poisson en fonction de la teneur initiale en eau

	Lot 1	Lot 2	Lot 3
Teneur en eau initiale (en %)	22,0 [a]	19,8 [ab]	14,6 [b]
Teneur en eau finale (en %)	22,5 [a]	23,6 [a]	23,1 [a]
Poids final (en gramme)	908,3 [a] ± 0,01	993,3 [b] ± 0,72	1083,3 [c] ± 0,92
% de perte en poids	9,17 [a]	5,4 [b]	2,4 [c]

Les courbes d'évolution du poids corporel des larves de *Dermeste*s (figure 1) sont semblables pour les différents lots: le poids augmente jusqu'au dernier stade larvaire, puis diminue à l'apparition de la nymphe. Les adultes n'ont pas été pesés. On remarque à partir du 5ème jour après l'éclosion, une nette différence de poids entre les larves élevées sur les différents lots de poissons: plus la teneur en eau est élevée, plus les larves sont lourdes.

Figure 1. Evolution du poids corporel des larves de Dermestes spp



Le pourcentage de mortalité est plus élevé dans le lot le plus sec (lot 3), tandis que dans le lot 1 où la teneur en eau est la plus élevée, la mortalité est faible (Tableau 2).

Tableau 2 : Pourcentage total de mortalité de *Dermestes sp.* élevés par groupes de 40

	Larves		Adultes		% total de mortalité
	Vivantes	Mortes	Vivantes	Mortes	
Lot 1	3	23	11	3	65 [a]
Lot 2	0	29	9	2	77,5 [b]
Lot 3	0	34	3	2	92,5 [c]

2/ Elevages individuels:

Dans les lots 2 et 3, c'est au début du développement, respectivement au stade 2 et au stade 1, qu'on enregistre les plus fortes mortalités. Le pourcentage de mortalité larvaire total est élevé dans les deux cas.

Tableau 3 : Mortalité larvaire totale et à différents stades de *Dermestes sp.* en élevage individuel

	% de larves mortes sans muer	% de mortalité des larves de 2ème stade	% de mortalité des larves de 3ème stade	% de mortalité larvaire totale
Lot 1 22% HR	0 [a]	0 [a]	4 [a]	32 [a]
Lot 2 19% HR	4 [a]	28 [b]	12 [b]	60 [b]
Lot 3 14% HR	40 [b]	8 [c]	12 [b]	88 [c]

En revanche, pour le lot 1, c'est à partir du 4ème stade, ou au delà des vingt premiers jours de vie larvaire, et plus précisément des trente cinq premiers jours que l'on constate les plus fortes mortalités; le pourcentage total reste cependant faible (32 pour cent), (Tableau 3 et Figure 2).
La durée de développement et le nombre moyen de mues montrent que ce sont les larves, élevées sur les poissons séchés du lot 1 à teneur en eau initiale la plus élevée, qui présentent le temps de développement le plus court et le nombre de mues le plus petit (Tableau 4).

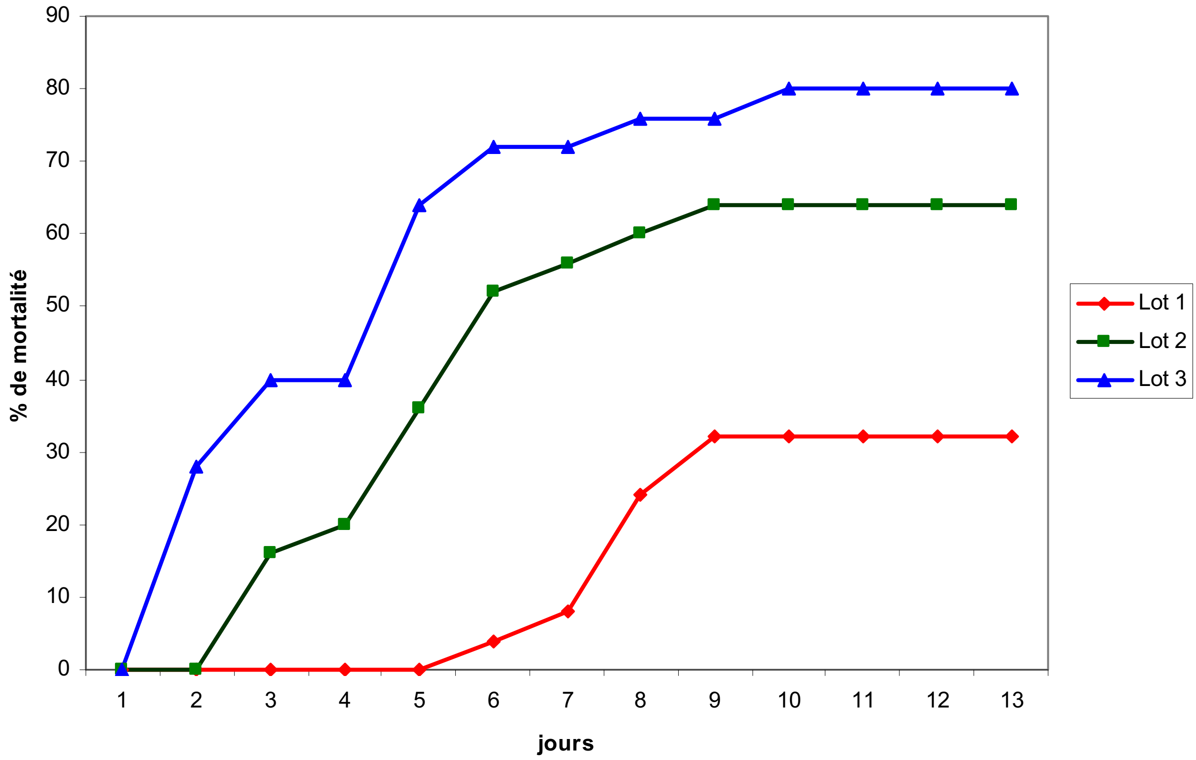
Tableau 4 : Durée de développement et Nombre moyen de mues de *Dermestes sp.* en élevage individuel

	Nombre moyen de mues	Durée de développement larvaire (jours)	Durée totale de développement (jours)
Lot 1	9,2 [a] ± 0,017	30 [a] ± 1	49 [a] ± 2,00
Lot 2	10,1 [a] ± 0,026	45 [b] ± 0	64 [b] ± 2,00
Lot 3	11,3 [b] ± 1,05	55 [c] ± 1	70 [c] ± 1,73

4. DISCUSSION

Le salage des trois lots de poisson a été fait exactement dans les mêmes conditions et la teneur en sel est de 11,9 pour cent dans le lot 1, 12,9 pour cent pour le lot 2 et 13,9 pour cent pour le lot 3: Les légères différences notées entre ces valeurs s'expliquent aisément, car elles sont exprimées par rapport au poids sec du poisson transformé, ainsi, le lot le plus sec (lot 3) présente la teneur en sel la plus importante.

Figure 2. Evolution du taux de mortalité larvaire



Au bout des huit semaines d'expérience, la teneur en eau a augmenté dans tous les lots et plus particulièrement dans le lot 3 qui, par sa plus forte teneur en sel est le plus hygroscopique. Cela est dû au fait que la fin de l'expérience a coincidé avec le milieu de la saison des pluies, quand l'humidité de l'air est à son maximum (90 à 100 pour cent). Les plus fortes mortalités (65 à 92,5 pour cent) enregistrées dans les élevages de groupe sont probablement dues à ce phénomène. Les conditions optimales de développement de ces insectes étant de 32 à 35 °C pour la température et environ 75 pour cent pour l'humidité relative (Howe, 1965; Amos, 1968; Azab et *al*.., 1972a; Osuji, 1975 b).

Le suivi de la mortalité des larves élevées individuellement permet de voir que dans le lot 3 où le poisson est le plus sec en début d'expérience, 40 pour cent des larves sont mortes dès le stade 1 (Tableau 3). Les courbes de mortalité larvaire cumulée (Fig. 2) permettent de préciser que dès le cinquième jour déjà, le nombre de morts était de 30 pour cent. Ce taux de mortalité important peut s'expliquer par le fait que ces jeunes larves aux pièces buccales non encore bien sclérifiées, n'ont probablement pas pu se nourrir de poisson, plus sec donc plus dur et plus résistant, suite à sa faible teneur en eau. Cette hypothèse est confirmée par leur poids corporel qui est resté bas.

Les courbes d'enregistrement de l'hygrométrie montrent que jusqu'à la fin de la quatrième semaine (28ème jour), l'humidité ambiante était de 75 pour cent le jour et 90 pour cent la nuit. A partir de la cinquième semaine, ces valeurs sont passées à 80 et 100 pour cent.

Or la figure 2, montre une brusque augmentation de la mortalité larvaire vers cette période (25 ème jour)

Toye (1970) *in* F.A.O. (1981) signale que les adultes de *Dermestes* préfèrent des humidités relatives plus élevées (80 pour cent) que les larves. On peut donc penser que l'augmentation de l'humidité ambiante explique en grande partie, la forte mortalité enregistrée dans les élevages de groupe.

Le cycle biologique de *Dermestes* sp. est de 5 à 7 mues (Howe, 1953 *in* Haines et Rees, 1989; Azab et *al*. 1972b). Seuls les insectes du lot 1 approchent de ces valeurs (Tableau 4) avec 49 jours de durée totale de développement, mais après 9 mues en moyenne. Dans les 2 autres lots, la durée du développement est allongée.

La perte en poids sec du poisson dans les élevages de groupe à la fin de l'expérience qui est de 9,7 pour cent dans le lot 1 est tout à fait comparable à celle de 8,1 pour cent enregistrée dans une étude antérieure (Gueye-Ndiaye 1990), et concernant le même type de produit.

Les lots 2 et 3 avec leur teneur en eau plus faible au départ, ont accusé des taux de pertes plus bas, respectivement de 5, 4 et 2, 4 pour cent

Notre étude montre qu'avec une teneur en eau de l'ordre de 15 pour cent on obtient une bonne protection du poisson fermenté-salé-séché contre l'infestation par *Dermestes* pendant au moins 8 semaines. Ces résultats vont dans le sens de ceux de Poulter (1980) *in* F.AO. (1981) et de Bostock *et al* (1987). Le premier auteur montre que le poisson séché jusqu'à 15 pour cent d'humidité avec une teneur en sel de 5 à 20 pour cent en poids frais, peut être conservé pendant plus d'un an si les conditions de stockage sont correctes.

Bostock et *al* (1987) signalent dans un travail de synthèse que c'est à des teneurs en eau comprises entre 15 et 30 pour cent, ou plus, que les coléoptères, en particulier le genre *Dermestes*, infestent le poisson séché. Toutefois, ils ne précisent pas si les produits contenaient du sel.

En revanche, Scoggins et Tauber (1951), donnent des résultats différents. Ces auteurs mettent en évidence que des teneurs en eau de 10,5 à 15,9 pour cent sont favorables au développement de *Dermestes maculatus* nourris sur farine de sardines séchées non salées; les mortalités enregistrées sont faibles, de l'ordre de 4 pour cent.

Ces résultats contradictoires pourraient s'expliquer par la présence du sel dans nos échantillons et ceux de Poulter et par le mélange des 2 espèces, *Dermestes frischii* et *D. maculatus* ; en effet, le sel n'est pas propice au développement de *Dermestes*, en particulier de *D. maculatus* (FAO, 1981). De plus, ils ont utilisé de la farine de poisson et non du poisson entier comme c'est le cas dans la présente expérience.

Selon Marc (1989) et Moustaid (1989) cités par Zakhia, (1992), une teneur en eau de 14 à 15 pour cent inhiberait le développement micriobien dans le poisson fermenté séché non salé. Un séchage adéquat jusqu'à 15 pour cent du poisson fermenté-salé-séché présente donc le double avantage de le préserver contre l'infestation par les insectes, mais aussi la prolifération bactérienne pour une meilleure conservation.

Malheureusement, le séchage traditionnel à l'air libre est très tributaire des conditions climatiques en particulier de l'augmentation de l'hygrométrie ambiante; des produits bien séchés peuvent alors se ré humidifier surtout quand ils sont salés, comme cela a été le cas dans la présente étude au bout de la 4ème semaine.

Le taux d'humidité usuel du poisson fermenté-salé-séché au Sénégal est généralement supérieure à 20 pour cent (Gueye- Ndiaye, 1995 ; Golob et *al*., 1995) et peut même atteindre 35 à 37 pour cent (Diouf, 1987) .

5. CONCLUSION ET RECOMMANDATIONS

Les résultats obtenus dans cette étude montrent qu'un séchage plus poussé du poisson jusqu'à une teneur en eau de 14 à 15 pour cent avant stockage permettrait de diminuer fortement les pertes dues aux coléoptèress dermestidae, en gênant considérablement, la prise de nourriture des jeunes larves.

L'adjonction d'une certaine quantité de sel semble aussi être un facteur déterminant ; aussi, la combinaison de ces deux techniques simples, et naturelles ne pourra être pleinement efficiente que si le séchage se fait dans de bonnes conditions en particulier pendant la saison des pluies, et si l'emballage et le stockage du produit sont adéquats pour empêcher sa ré -humidification.
Les autorités compétentes doivent veiller à ce que les sites de production soient dotés des infrastructures nécessaires pour que ces conditions soient remplies, et que les producteurs soient formés et sensibilisés aux bonnes pratiques, et à la compréhension du processus d'infestation et de réinfestation des produits au niveau des sites.

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UTILISATION DU SEL MARIN CONTRE *Dermestes maculatus* ET *D. frischii* (Coleoptera Dermestidae) DÉPRÉDATEURS DES POISSONS SÉCHÉS AU SÉNÉGAL

par

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Abstract

Three batches of 20 kg of catfish (*Arius gambiensis*) are traditionally cured in fermented dried fish or "guedj", with different salt contents, respectively: 7.5 (Batch A), 13.0 (Batch B) and 19.3 percent (Batch C).

After drying, cured fish is experimentally infested by first instar larvae of *Dermestes maculatus* and *D. frischii*, separately: In each case, 25 larvae are bred individually and 40 together in three replicates, during 8 weeks.

The follow-up of these experiments shows that the higher salt content in Batch C is noxious to the larvae of both species: 65 to 100 percent mortality is recorded whereas these values drop to 0 to 4 percent for Batch A; they seem not to be able to feed correctly on the product, and grow very slowly; therefore fish is not damaged, and less than 1 per cent of weight loss is recorded in Batch C after 8 weeks, while 15 percent in Batch A.

D. frischii appears more tolerant to high salt contents than *D. maculatus*, but the latter has grown here on dried fish with 13 per cent salt content, unlike some other studies on the subject.

Key words: Fermented dried fish, salt content, *D. maculatus*, *D. frischii*, Seénégal.

Résumé

Trois lots de machoiron frais (*Arius gambiensis*) de 20 kg chacun sont transformés en poissons fermentés salés séchés ou « guedj » avec des teneurs en sel différentes : 7,5 pour cent (lot A), 13 pour cent (lot B) et 19,3 pour cent (lot C). Les produits obtenus après séchage, sont infestés expérimentalement avec des larves de premier stade de *D. maculatus* et de *D. frischii*, séparément, de manière individuelle et par groupe de quarante larves.

Le suivi de ces expériences a montré que les teneurs en sel élevées (19 pour cent et plus) ne sont pas propices au développement de ces insectes; les pourcentages de mortalité sont de 65 à 100 pour cent dans le lot C contre 0 à 4 pour cent dans le lot A. Par ailleurs, le poids des larves augmente peu et leur durée de développement est plus longue.

Les lots de poisson ainsi salés sont très peu attaqués par les insectes et présentent un pourcentage de perte en poids négligeable (moins de 1 pour cent quelque soit l'espèce de *Dermestes*) au bout des 8 semaines. *D. frischii* s'est montré plus tolérant au sel que *D. maculatus*, qui néanmoins peut se développer à une teneur de 13 pour cent.

Mots-clés : poisson fermenté-séché, teneur en sel, *Dermestes maculatus*, *D. frischii*, Sénégal.

1. INTRODUCTION

Les pertes enregistrées dans le secteur de la transformation artisanale du poisson au niveau des pays en développement étaient estimées en 1977, à 3 millions de tonnes (poids frais), soit le quart d'une production annuelle mondiale évaluée à 12 millions de tonnes (U.S. National Academy of Sciences, 1978 *in* FAO 1984). Les causes de ces pertes sont diverses et variées: émiettement, modifications chimiques, agents microbiens et surtout infestation par les insectes (FAO, 1984).

Les espèces responsables sont essentiellement les mouches sur poisson humide, et les Coléoptères Dermestidae en fin de séchage et pendant le stockage (Mallamaire, 1957; Aref *et al.*, 1965 in FAO, 1984; Osuji 1973; Esser *et al*., 1990). Ces pertes sont plus élevées sur poisson d'eau douce (jusqu'à 50 pour cent que sur poisson marin (10 à 30 pour cent), *in* FAO, 1984.

Le salage, en tant que technique de conservation, est très utilisé dans le traitement artisanal du poisson dans les pays côtiers de l'Afrique de l'Ouest. Au Sénégal, les producteurs augmentent les quantités de sel utilisés pendant l'hivernage pour réduire l'infestation due aux mouches (Diouf, 1987 ; Guèye-Niaye & Gningue, 1995).

Cet effet protecteur du sel contre les insectes est bien connu, (Cole, 1963 in FAO, 1984; Green, 1967; Osuji, 1975; Walker & Wood, 1986 a et b), cependant la relation entre le taux de perte, et la teneur en sel n'est pas clairement établie.

D'après Amos (1968), *D. frischii* serait plus tolérant au sel que *D. maculatus*. Néanmoins, parmi les lots d'insectes régulièrement recueillis sur les sites de transformation de poisson à Dakar, les deux espèces sont abondantes et souvent, *D. maculatus* se révèle plus nombreux.

Dans cette étude, nous essayons d'établir une relation entre la teneur en sel et le taux de perte du produit d'une part, le comportement des deux espèces par rapport au sel, d'autre part.

2. MATÉRIEL ET MÉTHODES

Traitement du poisson

Une seule espèce de poisson est utilisée: le machoiron, *Arius gambiensis*, localement appelé «Kong», ainsi qu'une seule technique de transformation : le «Guedj» ou fermenté séché décrite précédemment (Guèye-N'Diaye & Gningue, 1995). Le sel utilisé est du sel marin acheté au marché par sac de 25 kg.

Soixante kg de poissons frais de taille homogène, sont divisés en trois lots de 20 kg chacun, puis transformés en «Guedj» par trempage pendant 24 h dans dix litres d'eau de mer:

Lot A : sans adjonction de sel
Lot B : + 1450 g de sel dissout
Lot C : + 2100 g de sel dissout

Après un rinçage rapide dans l'eau de mer, les poissons sont étalés sur les claies et séchés pendant sept jours; des observations sont effectuées après 24 et 48 h de séchage pour avoir une idée sur l'infestation par les mouches.

Les différents lots sont ensuite placés au congélateur à (–25°) pendant 72 h pour enrayer toute infestation initiale, avant d'être ramenés à la température ambiante dans un meuble fermé et grillagé, jusqu'à stabilisation du poids.

Dosage de la teneur en eau et en sel

Ces dosages sont effectués au laboratoire d'Analyses et Essais de l'Ecole Supérieure Polytechnique de Dakar.

Teneur en eau

La méthode standard, avec dessiccation à l'étuve est utilisée: 5 prises d'essai sont réalisées sur 5 poissons de chaque lot, et broyés au mixer. On prélève sur chacune d'elles, un échantillon qu'on place dans un creuset métallique ; celui-ci est préalablement taré après avoir séjourné pendant 15 minutes à l'étuve à 110 °C puis refroidi dans un dessiccateur; le creuset contenant l'échantillon est alors placé à l'étuve pendant 3 heures à 110 °C puis refroidi dans les mêmes conditions: le tout est ensuite repesé, et la teneur en eau (t.e.) est donnée par la formule suivante:

$$t.e = \frac{\text{Poids frais - Poids sec}}{\text{Poids frais}} \times 100$$

La teneur en eau du lot est la moyenne de ces 5 valeurs.

Teneur en sel

Elle est dosée suivant la méthode de « titrage coulométrique à intensité constante » (Edeline, 1965; Rodier 1984). A partir des prises d'essais précédemment broyés au mixer, 2,5 g sont prélevés et mis dans 250 ml d'eau distillée. Après agitation et homogénéisation, on laisse décanter. 0,5 ml du surnageant sont prélevés pour doser le pourcentage de chlorure de sodium à l'aide d'un chloruromètre préalablement étalonné; sur chaque échantillon, trois mesures sont faites. La teneur en sel est la moyenne de toutes ces valeurs.

<u>Evaluation de l'effet de la teneur en sel du poisson séché sur le développement de Dermestes spp. et le niveau des pertes</u>

Des adultes de *D. maculatus* et *D. frischii* sont capturés sur le site de transformation puis triés pour séparer les deux espèces. Femelles et mâles de même espèce sont placés ensemble sur des sardinelles braisées séchées non infestées, dans des boîtes en plastique à couvercle grillagée en présence d'un coton imbibé d'eau.

Les oeufs déposés par les femelles dans les fentes et crevasses des sardinelles sont alors prélevés délicatement avec un pinceau, et mis à incuber dans des boîtes de pétri sur papier filtre humidifié. Les larves obtenues, sont utilisées 1 à 2 jours après leur éclosion pour infester les poissons.

A partir de chaque lot, 2 types d'expériences ont été menés, pendant 8 semaines.

Elevage en groupe

A partir de chaque lot A, B et C définis plus haut et pour chacune des 2 espèces; *D. maculatus* et *D. frischii* 3 échantillons de 500 g chacun sont placés dans 3 boîtes en plastique (28,5 x 27,5 x 8 cm) fermées avec un couvercle grillagé et quarante larves de premier stade sont ajoutées dans chaque boîte.

Tous les cinq jours, dix larves de chaque boîte sont prélevées et pesées ensemble avant d'y être remises pour suivre l'évolution pondérale.

En début d'expérience, le poids frais du poisson séché utilisé est mesuré de même qu'à la fin, après avoir enlevé les insectes, leurs exuvies et déjections; les larves, nymphes et adultes vivants ou morts sont dénombrés et le pourcentage total de mortalité déterminé. Le dosage des teneurs en eau initiales et finales dans les différents lots, a permis de calculer les pertes en poids sec dans chaque cas.

Elevage individuel

Pour chaque lot, et chaque espèce, vingt cinq petits échantillons de poissons de 5 g sont placés chacun dans une boîte en plastique de 5 cm de diamètre et 7,5 cm de hauteur. Dans chacune d'elles est ajoutée une larve de premier stade, avant fermeture par un carré de mousseline retenu par une bague élastique.

L'observation régulière de ces élevages individuels a permis d'évaluer le taux de mortalité à différents stades de développement, et de calculer les valeurs moyennes de la durée du développement et du nombre de mues.

Dans les deux types d'expériences, les résultats obtenus sont comparés par des tests statistiques avec le logiciel STAT-ITCF 5^{e} version. Deux tests ont été utilisés au seuil de probabilité de 5 pour cent selon les cas:

- le test T ou test de Student Fischer pour la comparaison entre lots,
- le test U ou test de Mann et Whitney pour comparer les deux espèces d'insecte dans un même lot.

3. RÉSULTATS

La teneur en sel est de 7,5 pour cent dans le lot A, 13 pour cent dans le lot B et 19,3 pour cent dans le lot C. En revanche, les teneurs en eau sont comprises entre 19 et 20 pour cent (Tableau 1) et ne sont pas significativement différentes entre les lots.

Elevage en groupe

Le tableau 1 montre que le pourcentage total de mortalité est nul aussi bien chez *D. maculatus* que chez *D. frischii* dans le lot A. Ces pourcentages augmentent considérablement et de manière significative pour les lots B et C. Pour chacun de ces trois lots A, B et C, on ne note pas de différences significatives au niveau des résultats entre les deux espèces.

Le pourcentage de perte en poids sec du poisson est relativement élevé dans les lots B et C. Pour l'ensemble de ces lots pris deux à deux, ces pourcentages sont significativement différents. Toutefois pour chaque espèce et quel que soit le lot, on n'observe pas de différence significative.

L'évolution du poids corporel moyen des larves en fonction de leur âge a été étudiée d'abord par espèce au niveau de chaque lot (Fig. 1), ensuite par lot sur chaque espèce (Fig. 2). On remarque que, dans le lots A et B, la prise de poids des larves est plus rapide (0 à 450 mg ou plus pour 10 larves), avec un pic au dernier stade, avant de chuter à l'apparition de la nymphe. Tandis que dans le lot C, le poids n'arrive pas à dépasser 200 mg et les larves meurent presque toutes au bout des 8 semaines sans atteindre le stade nymphal (pas de pic sur la courbe). Cependant, dans B, seuls deux adultes de *D. frischii* ont été obtenus en fin d'expérience.

Le poids corporel moyen des larves a été étudié à 40 jours. Les différences observées entre les lots sont toutes hautement significatives chez *D. maculatus* comme chez *D. frischi;* Pour chacune des deux espèces, la différence entre poids corporel moyen des larves dans chaque lot n'est pas du tout significative dans le lot A (7,5 pour cent de sel). En revanche, elle l'est dans les lots B (13 pour cent de sel) et C (19,3 pour cent de sel).

Elevage individuel

Les résultats sont consignés dans le tableau 2. Jusqu'au troisième stade larvaire (L3), on ne note aucune mortalité dans le lot A, pour *D. maculatus* comme *D. frischii* et le pourcentage total de mortalité reste faible quoi que légèrement plus élevée qu'en élevage de groupe (4 pour cent contre 0 pour cent) chez *D. maculatus*.

Le nombre moyen de mues, la durée du développement larvaire et du développement total, augmentent chez les insectes élevés sur le lot B par rapport au lot A, avec toujours un léger avantage pour *D. frischii*. Avec le lot C, la comparaison n'est pas possible du fait que toutes les larves sont mortes avant la fin de l'expérience sans avoir donné d'imago ni de nymphe. Donc seuls les lots A et B ont été pris en compte; il faut noter cependant que dans B, la mortalité juvénile est très forte, (52 pour cent au stade L3).

Le nombre moyen de mues larvaires n'est pas significativement différent entre A et B pour une même espèce, de même qu'entre les deux espèces sur le même lot.

La durée du développement larvaire est différente significativement sur les lots A et B chez *D. maculatus* (P=2,97 pour cent), contrairement à *D. frischii* où P=15,73 pour cent. Cependant, la différence entre les deux espèces n'est significative sur aucun des lots considérés.

Concernant la durée totale du développement, les tests ne sont significatifs dans aucun des cas de comparaison effectuée : ni entre les lots A et B pour une même espèce, ni entre les espèces *D. maculatus* et *D. frischii* pour un même lot.

4. DISCUSSION

Le suivi des élevages de larves de *D. frischii* et *D. maculatus* sur les 3 lots de poisson montre qu'avec des teneurs en sel de 13 pour cent (lot B) à 19,3 pour cent (lot C), le pourcentage de mortalité est élevé et la durée du développement allongée; la prise de poids des larves est faible, comparativement au lot A à 7,5 pour cent de teneur en sel.

Les observations faites dans l'expérience d'élevage individuel confirment celles des élevages en groupe en ce qui concerne les taux de mortalité qui d'ailleurs sont beaucoup plus élevés ici: en effet, il ne reste pas de survivants dans le lot C au bout des 8 semaines.

On remarque cependant que les résultats obtenus dans les expériences où les larves vivent en groupe sont plus significatifs que dans les élevages individuels; les mortalités dans ces derniers sont très fortes dans le lots B et C dès les 3 premiers stades. Ainsi, les paramètres calculés (durée de développement et nombre moyen de mues) l'ont été sur un effectif réduit. Les tests de comparaison effectués sont d'ailleurs pour la plupart non significatifs.

On peut penser qu'un effet de groupe ait pu se manifester dans ces 2 types d'expérience, entraînant les disparités que l'on constate entre les valeurs observées.

En effet dans le genre *Dermestes* existe un phénomène d'agrégation dans les déjections qui accélérerait le développement (Rakowski & Cymborowski, 1982), ce qui pourrait en partie expliquer ce phénomène.

L'augmentation de la teneur en sel a un effet certain sur *Dermestes* spp. Tel que signalé par Osuji (1975),Wood *et al.* (1987). En effet, les différences de pourcentages de perte en poids sec, et de poids corporel moyen des larves de 40 jours, sont toutes significatives entre lots.

Toutefois, pour une même teneur en sel, il n'y a pratiquement pas de différence entre les espèces dans le lot A, le test n'étant pas significatif. Dans B et C, on observe le contraire. On remarque donc une meilleure tolérance de *D. frischii* vis-à-vis du sel par rapport à *D. maculatus*, tel que signalé auparavant (Amos, 1968). Mais ce phénomène ne semble perceptible ici, qu'au delà d'un certain seuil qui est de 7,5 pour cent de concentration.

Certains auteurs tels que Mushi et Chiang (1974), Osuji (1975), Walker et Wood (1986b), Wood *et al.* (1987), indiquent qu'une teneur en sel de 10 pour cent inhibait totalement le développement de *D. maculatus*; or dans notre étude, à 13 pour cent de teneur en sel, la moitié des larves de *D. maculatus* arrivent à vivre dans les élevages de groupe au delà de 8 semaines et même quelques individus élevés individuellement ont pu donner des imagos au bout de 61 jours.

Ces auteurs cités ont surtout travaillé sur du poisson d'eau douce, avec des populations de *Dermestes* spp. qui n'avaient jamais été en contact avec le sel auparavant ; ce qui pourrait expliquer cette différence.

Ce phénomène est comparable à celui observé chez certaines mouches telles que *Chrysomya megacephala* (Diptera Calliphoridae), qui selon Esser (1990) présente une grande tolérance au sel (40 pour cent en poids sec) dans le sud est asiatique, alors que d'autres espèces de la même famille sont contrôlées par des teneurs de 8 pour cent (en poids sec) au Malawi (Walker et Wood, 1986a).

5. CONCLUSION ET RECOMMANDATIONS

Malgré la variabilité des valeurs indiquées, le sel peut être considéré comme un moyen naturel de protection du poisson séché contre les coléoptères dermestidae, en plus de son effet sur la flore bactérienne dont il ralentit l'activité autolytique.

Il devrait cependant être utilisé le plus pur possible (> 90 pour cent de Nacl), ce qui n'est pas toujours le cas du sel marin utilisé dans la transformation artisanale du poisson en Afrique, où il est même souvent réutilisé contre toute règle d'hygiène ; la présence des impuretés entraîne le développement de bactéries halophiles de couleur rouge, qui accélèrent le rancissement des produits.

Dans cette étude, bien que cela n'était pas son objectif, les observations préliminaires faites sur les poissons après 24 et 48 h de séchage montrent l'efficacité du sel contre les pontes de mouches dont la plupart sèchent sur place sans donner de larves.

Les producteurs, devraient être formés et sensibilisés à de meilleures pratiques, en les incitant à mieux sécher et saler les poissons transformés pour diminuer les pertes et pour une meilleure conservation. Les mesures d'accompagnement suivantes devront aussi etre prises pour plus d'efficacité :

- diminuer la promiscuité sur les sites de production en réglementant l'accès à la profession et en exploitant plus judicieusement l'espace disponible
- approvisionner les sites en sel marin de qualité et à bas prix et trouver une utilisation au sel déjà utilisé
- doter ces sites d'infrastructures adéquates (claies de séchages, fours solaires, magasins de stockage) et en quantité suffisante
- enlever régulièrement les déchets de la transformation et nettoyer les sites

6. REMERCIEMENTS

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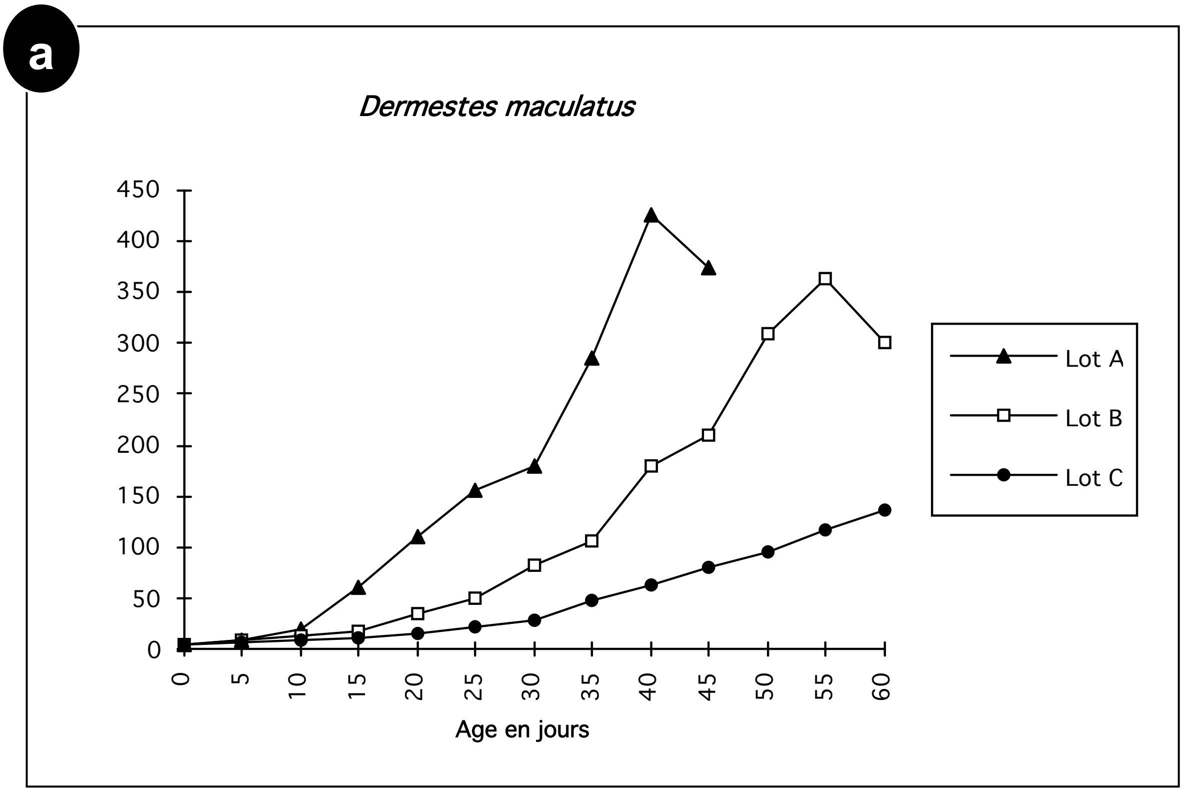
Tableau 1. Pourcentages de mortalité totale de *Dermestes* spp. élevés en groupes de 40 sur les 3 lots, et pourcentages de perte en poids sec enregistrés sur ces lots.

	Teneur en sel initiale (en %)	Teneur en eau initiale (en %)	Teneur en eau finale (en %)	% total de mortalité		% de perte en poids sec	
				D. maculatus	*D. frischii*	*D. maculatus*	*D. frischii*
Lot A	7,55±0,39	19,28±0,24	19,76±0,52	1,36	0	15,15±0,62	15,79±0,67
Lot B	12,98±0,16	19,66±0,28	20,38±0,71	50	45	3,55±0,10	3,69±0,09
Lot C	19,34±0,16	19,91±0,43	19,98±0,66	75	65	0,36±0,03	0,74±0,04

Tableau 2. Mortalité et caractéristiques du développement de *Dermestes* spp. en élevage individuel sur les 3 lots.

	Lot A		Lot B		Lot C	
	D. maculatus	*D. frischii*	*D. maculatus*	*D. frischii*	*D. maculatus*	*D. frischii*
% de mortalité des larves L1	0	0	8	8	68	48
% de mortalité des larves L2	0	0	20	16	12	16
% de mortalité des larves L3	0	0	24	28	8	24
% de mortalité totale	4	0	76	64	100	100
Nombre moyen de mues	8,1±0,22	8,0±0,3	9,3±0,28	8,7±0,32	-	-
Durée de développement larvaire	45,2	45,3	58	55	-	-
Durée totale de développement (en jours)	51,3	50,6	61	58	-	-



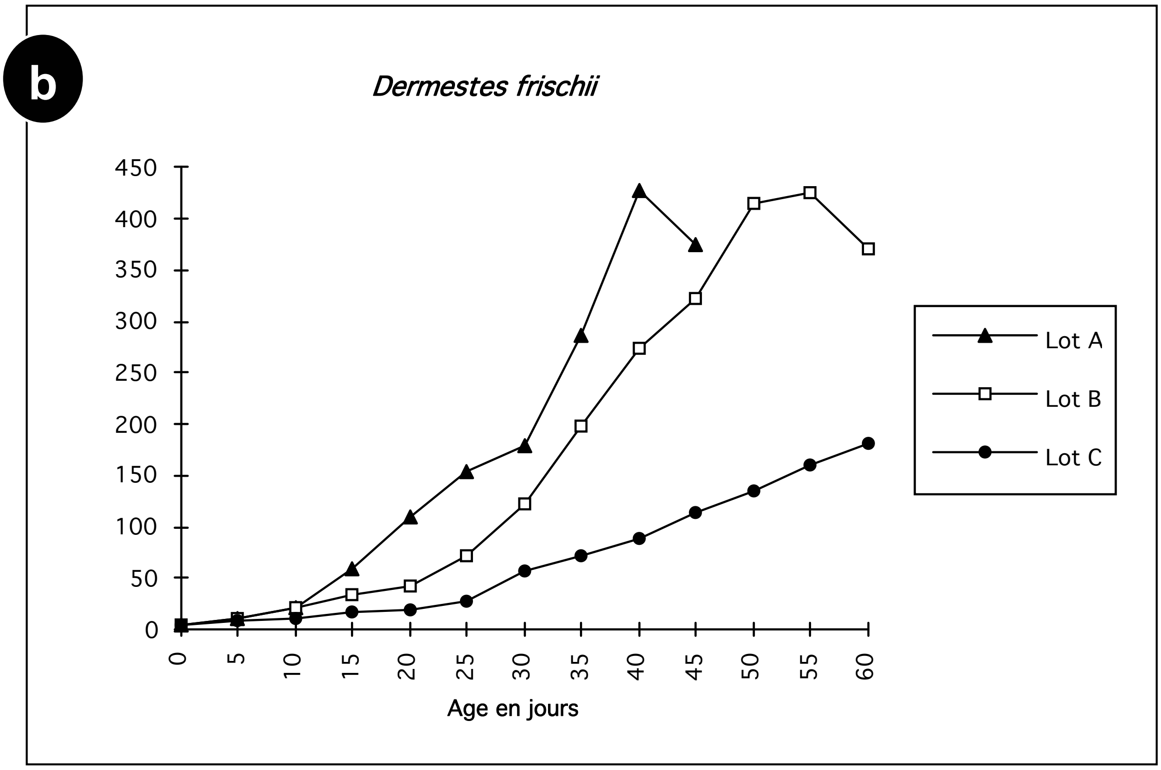


Figure. 1 : Evolution du poids corporel moyen de 10 larves élevées par groupe de 40 sur chacun des 3 lots de poissons séchés.

a Dermestes maculatus
b Dermestes frischii

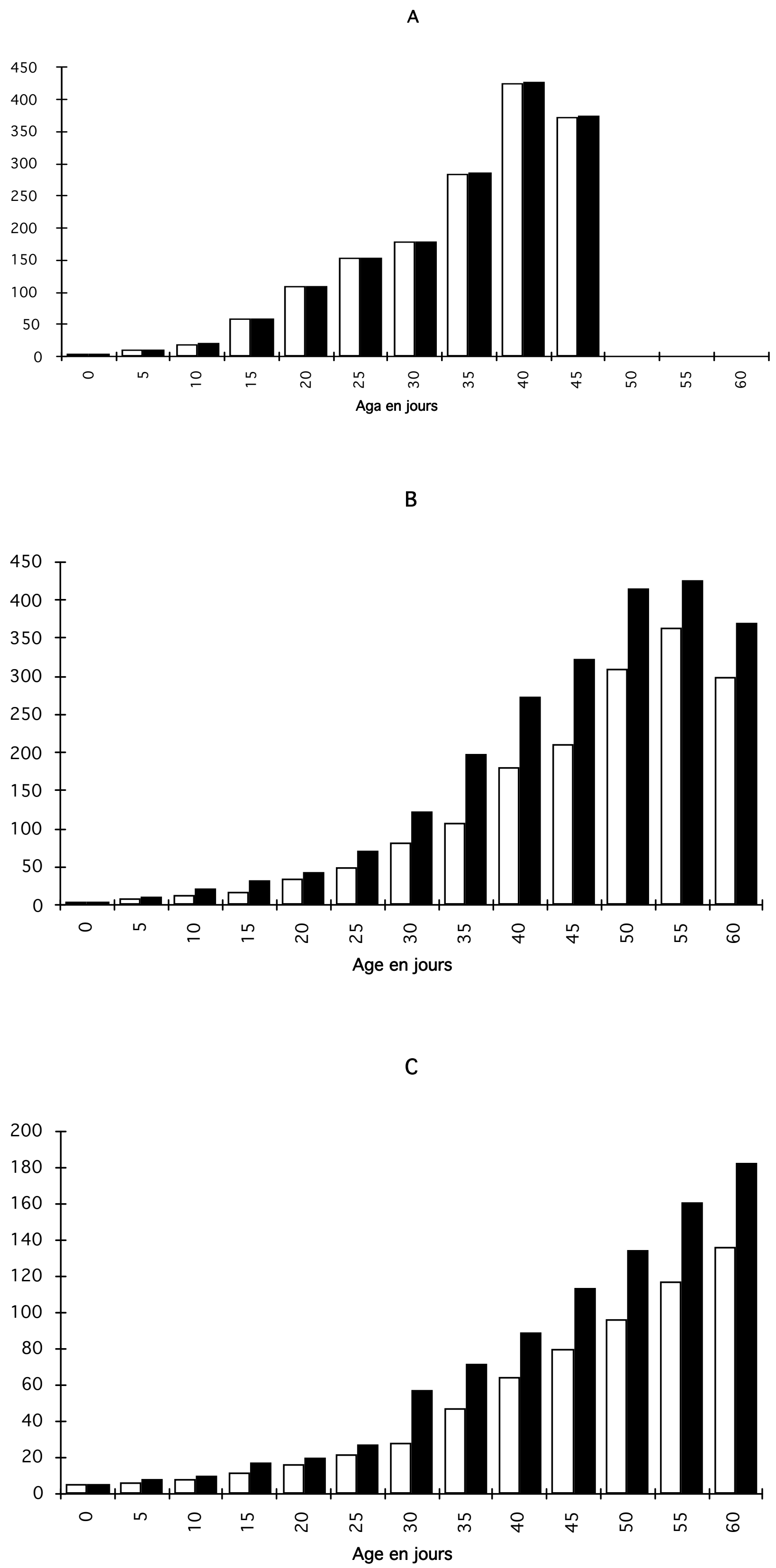


Fig.2 : Comparaison de l'évolution du poids corporel moyen de 10 larves de élevées en groupe de 40 sur chacun des 3 lots.

□ *D. maculatus*

■ D. *frischii*

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THE REGIONAL ROLE OF LVFO IN PROMOTING SUSTAINABLE FISHERIES UTILIZATION

by

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Abstract

Fish is very important to the economies of the three East African Community (EAC) Partner States. Most of the fish comes from Lake Victoria. Fish production potential from the lake is estimated at over 500 000 tonnes valued at US$600 million at the beach level and US$300 million in export. Most of this fish is exported to the European Union (EU). There are, however, stringent export requirements to the EU market, which have necessitated development of high fish handling and processing standards. These requirements were partly responsible for the bans on fresh fish export from East Africa to EU between 1996 and 2000. The EAC Partner States have an intergovernmental organization, the Lake Victoria Fisheries Organization (LVFO), which is mandated with harmonizing, developing and adopting measures for sustainable utilization of the living resources of Lake Victoria. The LVFO has spearheaded the processes to meet the export fish quality requirements. The Organization initially coordinated the efforts that included establishing a regional taskforce (RTF) of experts and later a regional working group (RWG) to provide guidelines for meeting fish quality requirements. The RTF and RWG have so far come up with a Code of Practice (COP) for Fishing and Fish handling in Lake Victoria, the Manual of Standard Operating Procedures (MSOPs) and the Fish Inspectors Guide. The documents are to be adopted and utilized by the Partner States to meet the fish quality assurance and safety requirements. The paper outlines the initiatives undertaken to improve the quality and safety of fish and fishery products from Lake Victoria to meet especially the export market requirements, the challenges in the fishery sector, future plans for research and development in the post-harvest sector, and regional efforts to promote communication on fish quality assurance aspects and network of experts in the region.

Résumé

Le poisson est très important pour les économies des trois pays partenaires de la communauté est africaine (CEA). La plupart du poisson provient du Lac Victoria. La production potentielle de poisson du lac est estimée à plus de 500.000 tonnes évaluées à 600 millions de dollars EU au niveau plage et 300 millions de dollars EU à l'export. La majorité de ce poisson est exportée vers l'Union Européenne. Il y a toutefois des exigences très rigoureuses à l'export vers le marché de l'UE, qui ont nécessité le développement des normes élevées de manutention et de transformation du poisson. Ces exigences étaient en partie à la base des interdictions d'exportation du poisson frais de l'Afrique de l'est vers l'UE entre 1996 et 2000. Les pays partenaires de la CEA ont une organisation intergouvernementale, l'Organisation des Pêches du Lac Victoria (LVFO), qui est mandatée dans l'harmonisation, le développement et l'adoption de mesures pour une utilisation durable des ressources vivantes du Lac Victoria. La LVFO a été le fer de lance dans la conformité aux exigences de qualité du poisson d'exportation. L'organisation a initialement coordonné les efforts incluant l'établissement d'une Task Force régionale (RTF) d'experts et plutard un groupe régional de travail (RWG) pour donner les lignes directrices pour se conformer aux exigences. La RTF et le RWG sont à ce jour parvenus à produire un Code d'Usage (COP) pour la pêche et la manutention du poisson dans le Lac Victoria, le manuel des procédures de normes d'opération (MSOPs) et un guide des inspecteurs du poisson. Les documents doivent être adoptés et utilisés par les Etats partenaires pour se conformer aux exigences de l'assurance qualité et de sécurité sanitaire. Le document donne les grandes lignes des initiatives prises pour améliorer la qualité et la sécurité sanitaire du poisson et produits de la pêche du Lac Victoria pour se conformer surtout aux exigences du marché d'exportation, les défis du secteur halieutique, les plans futurs pour la recherche et le développement dans le secteur post-capture et les efforts régionaux pour promouvoir la communication dans les aspects liés à l'assurance qualité du poisson et le réseau des experts dans la région.

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1. INTRODUCTION

1.1 Importance of Lake Victoria and its fisheries

Fish has become an important economic export commodity for the three East African countries. Fish exports to international markets are basically from Lake Victoria. The lake is the largest freshwater fisheries in Africa and second to Lake Superior in the world. Lake Victoria, which is shared by the three EA countries, namely, Kenya (6 percent), Tanzania (51 percent) and Uganda (43 percent), lies astride the equator and has a shoreline of 3 450 km, a catchment area of 194 200 km^2. The lake basin has the fastest growing population in EA of over 30 million, which is a third of the combined population of the EA States and with a rate of growth of 3 percent *per annum*. Much of this population derives its livelihood either directly or indirectly from the lake resources. The three EA Partner States designated Lake Victoria and its basin as an economic growth zone because of its great economic potential, which includes a rich fishery, freshwater for domestic, industrial and agricultural use, hydropower generation, aesthetical, recreational and tourist attraction, transport avenue, unique fauna and flora species along the shorelines and in the islands.

2. FISH PRODUCTION FROM LAKE VICTORIA

Lake Victoria had over 500 endemic fish species, some of which have disappeared as a result of several adverse factors impacting on the lake, most of them arising from human transactions within the lake and its basin. Currently, commercial fisheries is dominated by three species, the Nile perch (*Lates niloticus);* Nile tilapia *(Oreochromis niloticus)* and the sardine-like (*Rastrineobola argentea)* locally known as "Dagaa/Omena/Mukene". Fishery production from Lake Victoria is estimated at 500 000 tonnes annually with a value of US$600 million at the beach level. Exports from the lake to international markets are estimated at 127 000 tonnes valued over US$300 million. Much of fish processed using traditional methods is also exported to Central and Southern Africa countries.

3. GENERAL CHALLENGES OF THE FISHERIES OF LAKE VICTORIA

The major challenges in the fishery sector of Lake Victoria include:

- decline in fish catches and fish diversity;
- capture of immature fish;
- increasing fishing pressure;
- increasing demand for fish and increasing capacity in industrial fish processing;
- use of destructive fishing gears and methods;
- high fish quality requirements especially by the export market;
- low adherence to fish quality standards;
- environmental degradation;
- decline in fish species diversity.

4. REGIONAL INSTITUTIONAL FRAMEWORK FOR DEVELOPMENT AND MANAGEMENT OF FISHERIES RESOURCES

The East African Community (EAC) Partner States formed a Lake Victoria Fisheries Organization (LVFO) through a Convention signed in 1994 by the EAC Partner States. The organization was charged with the overall responsibility of harmonizing national measures, developing and adopting conservation and management measures for the sustainable utilization of the living resources of Lake Victoria. It was specifically expected to:

- promote proper management and optimum utilization of fisheries and other resources of the lake;
- enhance the capacity of existing fisheries institutions;

- provide a forum for discussion of the impacts of initiatives on the lake;
- provide for the conduct of research on the living resources and the environment;
- coordinate training and extension in all aspects of fisheries;
- advise on the impact of introduction of non-indigenous organisms;
- serve as a clearing house and a data bank for information on the fisheries resources of the lake;
- promote the dissemination of information.

The Organization has a well defined institutional structure comprising of:

- a Council of Ministers responsible for fisheries that make decisions and adopt measures for management of the fisheries resources of the lake;
- a Policy Steering Committee (PSC) of Permanent Secretaries responsible for fisheries that review and submit management recommendations to the Council of Ministers;
- an Executive Committee of Heads of Fisheries Management and Heads of Fisheries Research Institutes, which reviews management and scientific activities, agrees on management measures to be implemented and submit them to the PSC;
- a Fisheries Management Committee made up of Heads of Fisheries Management Institutions, which develops management policies and recommends management and conservation measures;
- a Scientific Committee of Directors of Fisheries Research Institutes, which identifies research requirements, reviews research methodologies and ensures dissemination of research results;
- the activities of the LVFO are coordinated by a Secretariat located at Jinja in Uganda.

5. FISH EXPORTS FROM LAKE VICTORIA

5.1 Fish export to international markets

Over 30 fish processing plants are established around Lake Victoria, basically producing fish fillets from Nile perch for the export market. The exports of Nile perch fillets from Lake Victoria to Europe began in 1983 with the establishment of fish processing plants in Kenya in 1981. Similar development followed in Uganda and Tanzania and by 1996 all the three EA Partner States were exporting Nile perch fillets and other fishery products to Europe, Southeast Asia and the Near East. This was a divergence from the known primary exports of coffee, tea and cotton. The Nile perch fishery products entered the European market under a "third good" category, that is, as a miscellaneous item. Table 1 shows the exports of Nile perch fillets, gutted and beheaded products to international markets.

By-products of Nile perch, such as fish maws, skins and oils are also exported but their data are not included in the table. The graph below shows the trend in Nile perch fish exports to international markets

Some artisanally processed fishery products also enter the international markets but in small quantities targeting specialized markets. Although the EU is still considered the biggest and most lucrative market for fish exports from Lake Victoria, fish and fishery products are also exported to Asia, Near East, North and Latin America, Australia and Eastern Europe.

Table 1: Exports of chilled and frozen fillets, gutted and beheaded, of Nile perch fishery products from Lake Victoria 1991–2004

Year	Kenya		Tanzania		Uganda		Total	
	Tonnes	Value US$(,000	Tonnes	Value US$(,000	Tonnes	Value US$(,000	Tonnes	Value US$(,000)
1991	10 198	11 395			4 751	5 309	14 949	16 704
1992	10 971	14 649	4 248	5 672	4 831	6 451	20 050	26 772
1993	14 531	21 198	6 097	6 449	6 037	8 807	26 665	36 454
1994	11 967	26 930	8 454	8 942	6 563	14 769	26 984	50 641
1995	10 983	21 933	12 405	13 122	12 971	25 903	36 359	60 958
1996	16 477	39 976	20 296	52 278	16 396	39 781	53 169	132 035
1997	14 719	43 084	23 076	54 821	9 839	28 800	47 634	126 705
1998	11 698	29 974	36 386	65 728	11 604	29 733	59 688	125 435
1999	12 482	34 249	23 757	51 993	13 342	36 608	49 581	122 850
2000	15 826	34 254	32 601	49 796	15 876	34 363	64 303	118 413
2001	17 947	50 385	32 423	79 536	28 153	79 039	78 523	208 960
2002	16 456	52 248	24 732	82 516	25 169	87 574	66 357	222 338
2003	16 546	50 908	32 436	104 458	25 111	86 343	74 093	241 709
2004	15 728	52 084	34 707	87 503	30 057	102 917	80 492	242 504

5.2 Fish exports to regional markets

Nile perch dominates fish exports to international markets, whereas tilapia is more important in regional markets, such as DR Congo, Central African Republic and Rwanda. Dagaa is gaining recognition in the domestic and regional trade. As value addition is being pursued for the Nile perch fishery products, improvement in the catching and processing of dagaa is high on the LVFO agenda. The aim is to make dagaa more available for human consumption rather than for animal feeds, which now takes more than 50 percent of the catch.

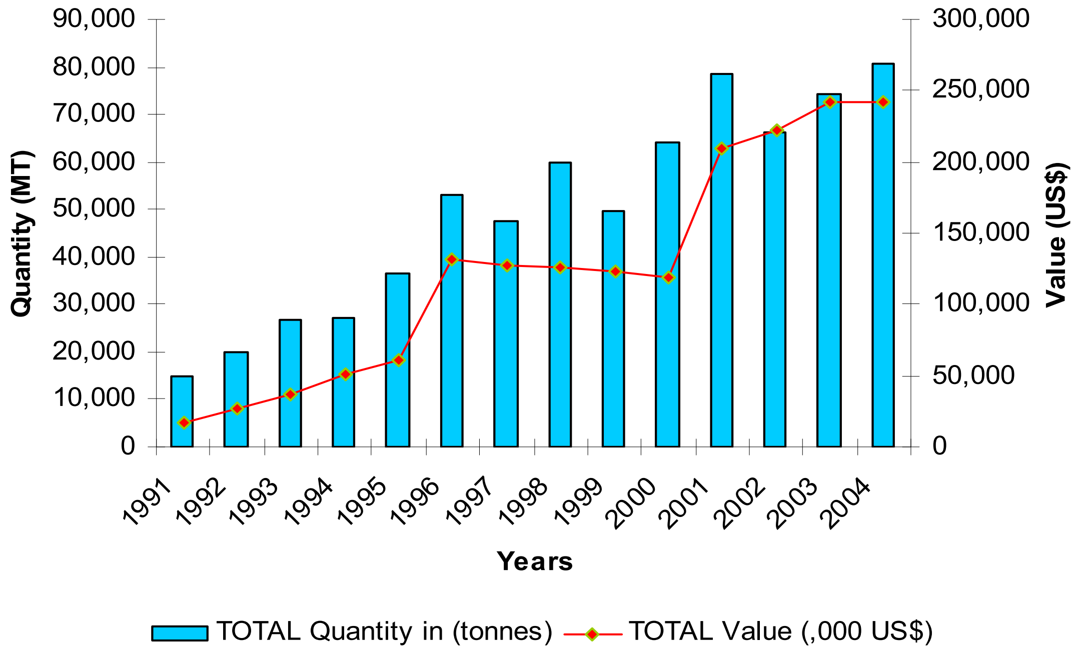

Figure 1: Total Nile perch fish exports (chilled and frozen fillets, gutted and beheaded) from Lake Victoria 1991–2004

6. CHALLENGES OF FISH QUALITY ASSURANCE

The challenges of fish quality assurance arise from the inappropriate methods used in the post-harvest sector resulting in contamination of the fish. The major challenges are:

- inadequate fish handling facilities at landing sites;
- lack of appropriate infrastructure, such as roads and electricity;
- lack of ice at landing sites;
- lack of ice holding facilities on fishing crafts;
- inadequate basic social infrastructure, such as toilets and potable water;
- lack of sun-drying facilities for dagaa;
- lack of storage facilities for dried and smoked fishery products.

7. BAN OF FISH EXPORT FROM EAST AFRICA TO THE EU (1998–2002)

Concern for food safety by European consumers was raised as incidences of salmonella were alluded to in some EU markets resulting in the imposition of intermittent fish bans from 1998 to 2000. The EU set stringent fish quality and safety requirements that exporters had to comply with. A longer ban was imposed from 2001 to 2002 on allegation that fish was caught using destructive and hazardous methods.

Tanzania was able to respond faster to international concerns on fish quality and safety than Kenya and Uganda because its fisheries division, as the competent authority, had direct control over established fisheries structures so as to implement measures and monitor the process right from the grassroots to the centre. The competent authorities in Kenya and Uganda, which were the Ministry of Health and the Uganda National Bureau of Standards, respectively, lacked such structures for direct control and therefore had to work through the Fisheries Departments.

8. INTERNATIONAL FISH EXPORT QUALITY REQUIREMENTS ESPECIALLY TO THE EUROPEAN UNION

The fish export countries to international markets are required to comply with the stringent fish quality and safety requirements provided in the EU Directive 91/493/EEC for fish and fishery products. The Directive stipulates that imports to the EU have to comply with sanitary conditions at least equivalent to those of production and placing on the market of EU products. The standards apply to harvesting, handling, treatment/processing, packaging, transport and storage of fish and fishery products meant for human consumption. Basically, the Directive 91/493/EEC requires that:

- Hygiene and safety standards of fisheries products imported from third countries (outside member states) shall be the same as those produced within the member states.
- A responsible inspection body (Competent Authority) in the third country shall be charged with health and hygiene inspection of fish establishments.
- A list of approved establishments authorized to handle and process fish products after inspection checks shall be prepared by the Competent Authority and forwarded to the EU.

The EU Commission visits all countries intending to export fish and fishery products to the EU market to ascertain the status of hygiene. If a country is found to be in conformity with the EU requirements, it is put on List I, where countries outside the EU have the specific conditions for importing fish and fishery products. The list is published in the Official Journal of the European Commission. The EU Commission visited the three East African countries a number of times. When the countries eventually conformed to the EU requirements, they were put on List 1 as follows: Kenya on 29 April 2005; Tanzania on 8 September 2004 and Uganda on 27 December 2004.

9. THE REGIONAL STRATEGY ON FISH QUALITY ASSURANCE

The intermittent fish export bans demonstrated further the need for joint actions, and in 1999 the LVFO Council of Ministers adopted a regional collective strategy to improve quality and safety of fish and fishery products from Lake Victoria. As a result, the following accomplishments were made:

- The national fisheries departments were legitimately acknowledged as the "single competent authority" on fish and fishery products in the three EAC Partner States.
- Regular sampling of fish, water and sediments was done using accredited laboratories within and outside East Africa.
- A Regional Task Force formed by the Partner States embarked on the process of harmonizing fish quality assurance measures and standards.
- Basic facilities for fish handling, sanitation and hygiene were established at the beaches, and some beaches designated and developed to handle fish destined for export markets.
- Fish processing factories were upgraded and Hazard Analysis Critical Control Point (HACCP) was adopted.
- Fisheries inspectors and factory workers were trained in HACCP and fishers sensitized on proper fish handling and hygiene.
- A Regional Coordinating Committee of the National Fish Processors and Exporters Associations was formed to collaborate and share fish quality assurance, safety and market information.
- The LVFO secured a patent to protect the international market for Nile perch fish and fishery products, and fish exporters are encouraged to use it.
- Diversification into production of value-added fishery products began.

Implementing the strategy enabled the Partner States to conform to the EU requirements and by October 2002 the fish bans were lifted and fish exports to EU markets resumed. The fish bans had adverse socio-economic impacts on the well-being of the fisher communities and the Partner States' economies arising from the loss of benefits in terms of incomes, employment, foreign exchange earnings and investment.

The lessons learned from the bans on fish exports are the catalyst in the relentless efforts of the Partner States to harmonize fish quality assurance measures and standards for both the international and regional markets. The fish bans demonstrated the global view that the source of fish exports is Lake Victoria and not the individual Partner States. The bans also revealed how sensitive the EU market was and the need to diversify to other markets.

10. THE INSTITUTIONAL STRUCTURE FOR HANDLING FISH QUALITY ASSURANCE UNDER LVFO

10.1 Harmonization of the Competent Authority

The Partner States harmonized on the competent authority by formally acknowledging and designating the National Fisheries Departments. The Fisheries Departments have structures to monitor the implementation of fisheries activities from the grassroots to the centre. The Departments have well trained and qualified fisheries inspection services to inspect fish, fishery products, fishing crafts, fish handling facilities, processing establishments, transportation and marketing facilities, and exit points to international markets. The Fisheries Departments are united under the LVFO, with a special forum, the Fisheries Management Committee (FMC), where the fisheries managers specifically handle issues related to their mandate. The FMC is a joint planning, monitoring and review tool with provision to harmonize fish quality assurance and safety measures and to evaluate national implementation of agreed regional measures. The FMC recommendations are considered, adopted and approved by the LVFO Executive Committee, the Policy Steering Committees and the Council of Ministers respectively. The measures approved are eventually endorsed by superior departments of the EAC for regional implementation by the Partner States. The responsibility of the competent authorities regarding fish quality assurance aspects include:

- to control aquaculture, and capture fisheries activities, fish landing, handling, transportation, processing and marketing;
- to approve and license aquaculture and fish processing establishments and their operations, including factory sea vessels;
- to carry out inspections and audits of aquaculture systems, fish processing plants, sea factory vessels, fish markets and gazetted fish landing sites to ascertain compliance with national standards for fish and fishery products;
- to certify post-harvested fish and fishery products, including live fish for local and export markets;
- to lay down, review and enforce all procedures, code of practice and legal provisions for compliance;
- to specify conditions for placement on the market of fish and fishery products including those imported;
- to designate fish inspectors and determine their in-service training needs for capacity building;
- to identify appropriate testing laboratories and approve them in collaboration with the responsible national standards body for physiochemical and microbiological analyses;
- to monitor aquaculture establishments, fishing grounds and other critical areas for pollution contaminants, e.g. heavy metals, trace elements, pesticide residues, microbes;
- censure of any research activities pertaining to the safety and quality of fish and fishery products and inquire into any activities directly or indirectly affecting them;
- overall responsible body for all fisheries matters;
- to perform such other functions as may be necessary or expedient for quality assurance of fish and fishery products in accordance with the national regulations.

10.2 Regional task force with LVEMP support

Despite the efforts of the individual country to address the fish bans and that of the factory owners to improve the processing conditions, the problem was too complex to be handled singly. Fishing was not restricted to one country's jurisdiction, and better price offers in one country could tilt the supply of fish as raw materials, making it difficult to enforce national regulations. In 1999 the LVFO organized a regional workshop on fish quality in Mwanza, Tanzania, which was attended by the fish quality experts and personnel from the fish processing plants. The workshop recommended the harmonization of fish quality assurance measures among the three Partner States. In 1999, the LVFO Council of Ministers adopted a Collective Regional Strategy and Plan of Action that included establishment of a regional committee on fish quality assurance. Subsequently, the Partner States formed a Regional Task Force (RTF) with the Lake Victoria Environment Management Project (LVEMP) support to harmonize the fish quality assurance measures and certification by undertaking the following:

- Identify critical factors affecting fish quality and safety and make recommendations on: type of data to be collected; methodology for data collection; criteria for selecting parameters and sampling sites for chemical and microbiological analysis; and cross-border information sharing and dissemination.
- Review relevant literature on fish quality assurance and certification including attendant national laws.
- Harmonize the functions of the Competent Authority.
- Develop and harmonize Codes of Practice and accompanying Inspectors Guide for fishing, fish handling and processing in the Lake Victoria region.
- Identify training needs and recommend general training guidelines tailored to the needs of the Fish Quality Assurance, Safety and Product Development (FIQA) personnel.
- Make terms of reference for the establishment of a trio FIQA audit body and identify the resources and method of reporting.
- Propose how accreditation, compliance and sustenance of FIQA laboratories will be achieved.
- Assess the needs and develop criteria for the establishment of a regional referral laboratory.

- Develop a harmonized Manual of Standard Operating Procedures (MSOPs) for approval of establishments, facilities, environment monitoring and certification of fish for local and export markets.
- Prepare and present a draft report to managers and stakeholders and incorporate their comments in the final report.
- Launch the final report on regional harmonization of Fish Quality Assurance and Certification standards.

10.3 Working groups of the LVFO

The LVFO reorganized its activities into five programmes each with a number of working groups (WGs). There is a working group on FIQA. The role of FIQA is to prepare an implementation plan for fish quality assurance, safety and product development; develop criteria for establishing of national monitoring laboratories and a regional referral laboratory; develop criteria for establishing model fish landing beaches and markets; promote development of value-added products; review laws and regulations pertaining to FIQA and recommend areas for improvement, package information on FIQA for dissemination and creation of awareness among stakeholders; and develop fish quality assurance certification for Lake Victoria and a Code of Practice for fishing, fish handling and processing on Lake Victoria (LVFO, 2005). The FIQA WG is composed of the fish inspectors, researchers involved in fish quality standards and product development, and representatives of fish processors.

11. DEVELOPMENT OF OPERATIONAL GUIDELINES FOR FISH QUALITY ASSURANCE

The FIQA RWG and RTF jointly came up with four major outputs towards the development of operational guidelines to be used for fish quality assurance in the marine and freshwater fisheries sectors of the three EAC Partner States and these are:

- HACCP procedures;
- The Code of Practice (COP) for Fish and Fishery Products;
- Inspectors Guide for assessment of compliance with the COP;
- Manual of Standard Operating Procedures (MSOPs) for inspection and quality assurance in capture fisheries and aquaculture.

11.1 The Hazard Analysis Critical Control Point (HACCP)

An HACCP system was adopted by the EAC Partner States and training in HACCP conducted for the fish inspectors and factory employees. HACCP is a system that is used to control or eliminate potential dangers associated with food production processes. A checklist of the HACCP is provided in the MSOPs for inspection and quality assurance in capture fisheries and aquaculture.

Each fish processing establishment is required to draw and submit to the Competent Authority a Quality Management Programme (QMP) based on Good Manufacturing Practice (GMP) and develop a quality assurance system based on the HACCP approach. The Competent Authority does a desk review of the HACCP manual using the checklist on HACCP-based quality management programme. The Authority checks whether the steps are followed as advised and whether management commitment is provided for in terms of a team and budget to implement the HACCP Programme. The desk review is followed by a visit to the factory to ascertain what is on the ground, and if everything is all right the HACCP manual is approved. The Fish Inspectorate monitors the implementation of HACCP programmes by the factories. The factory is supposed to review and adjust the HACCP manual every 6 months to accommodate any new changes in the production process and then submit it to the Competent Authority for verification and auditing

11.2 The COP for fish and fishery products
The COP stipulates codes of practice for handling fish from fishing ground through the domestic and export market distribution chains to the consumer. It includes capture as well as aquaculture for all water bodies in East Africa, including the Indian Ocean. Moreover, it addresses mariculture, including seaweeds. The document is essentially completed except for the input of stakeholders that will usher it into a ready document for legislation as a standard by EAC.

11.3 Manual of Standard Operating Procedures (MSOPs) for inspection and quality assurance in capture fisheries and aquaculture
The MSOPs for inspection and quality assurance in capture fisheries and aquaculture stipulates the procedures to be followed in implementing the COP. The MSOPs provide guidelines for sampling of fish and fishery products for analysing and evaluation of fish technology, chemical, microbiological and environmental microcontaminants.

11.4 Inspectors guide (IG) for assessment of compliance with the COP
The IG provides the critical elements to be monitored, where and how to do it. The IG operationalizes the COP and provides a harmonious procedure to be followed during official audits or self-check inspection exercises for maximum cost-effective compliance regarding requirements for fishing, fish handling, fish infrastructure, transportation, preservation, processing distribution and marketing. The IG is to be used in conjunction with the COP and the MSOPs as well as other relevant documents.

12. IMPLEMENTATION OF PROJECTS ON FIQA

Sustainable utilization of the fisheries of Lake Victoria is also being fulfilled through implementation of specific projects. The projects currently implemented by the LVFO include:

- the Production and Marketing of Value-added Fishery Products in Eastern and Southern Africa funded by the Common Fund for Commodities (CFC) through FAO and the Common Market for Eastern and Southern Africa (COMESA);
- the EU-funded Implementation of the Fisheries Management Plan (IFMP) Project.

12.1. The production and marketing of value-added fishery products in Eastern and Southern Africa funded by the CFC through FAO and COMESA
This project focuses on assisting industrial fish processors to develop value-added Nile perch products. The project also assists in design and implementation of fish quality control system, assists artisanal processors and traders of dagaa through a microfinancing programme to produce quality products for human consumption and disseminate information on Nile perch and dagaa value-added production to stakeholders. Various studies have been undertaken to establish the status of the Nile perch fishery, the international markets for Nile perch and the socio-economic aspects of the dagaa.

12.2. The EU-funded Implementation of the Fisheries Management Plan (IFMP) Project
The EU-funded IFMP has components specifically aimed at improving fish quality standards on the lake.

These include:

- construction of model fish landings that meet export requirements including those to the EU;
- training of fishers in improved fish handling methods;
- provision of social infrastructure, such as water and sanitation facilities.

13. FUTURE PLANS FOR RESEARCH AND DEVELOPMENT IN POST-HARVEST SECTOR

Regional plans for research and development in the post-harvest sector include:

- development of value-added fishery products;

- research in the utilization of Nile perch by-products;
- experiments in various and improved methods of processing dagaa for small-scale fish processors aiming at increasing amount for human consumption;
- development of training modules in post-harvest fish handling and processing for community training;
- training in approved fish handling methods and improved processing methods for fishers, artisanal fish processors and fish traders.
- promote the adoption of improved low-cost fish processing technologies for small-scale operations.

14. REGIONAL EFFORTS TO PROMOTE COMMUNICATION ON FISH QUALITY ASSURANCE ASPECTS

The LVFO efforts to promote communication on fish quality assurance aspects include the following:

- A Regional Information, Communication and Outreach (ICO) strategy, which has been developed and adopted to ensure that information generated by the various working groups is properly packaged, accessible and disseminated to stakeholders and other interested parties.
- The FIQA working group is a forum that fosters communication, exchange and sharing of information.
- Regional forums, such as meetings, workshop and conferences, facilitate communication with various stakeholders and technical experts.
- The regional fisheries database is being strengthened to accommodate data and information on various aspects of fisheries, including post-harvest fisheries, and to be accessed through a network.
- The LVFO website is being organized to ensure delivery of up-to-date information on various aspects.
- Articles in the *African Journal of Hydrobiology and Fisheries*, the *Mputa* newsletters, brochures, feature articles in newspapers and other publications are the medium of communication.
- Production of documentary films is to provide a more comprehensive picture on what is happening in the fisheries sector, including in the post-harvest sector.
- Radio and television programmes are being used to target fishers to sensitize them on how to improve the quality and safety of fish through proper handling and hygiene.
- A monitoring and outreach program enables the heads of fisheries departments and research institutes to reach out, consult and interact with the fisher communities, fish processing establishments, local authorities and other relevant stakeholders.

15. REGIONAL EFFORTS TO PROMOTE NETWORK OF EXPERTS IN THE REGION

The formation of WGs for the major thematic areas is a determined attempt to promote a network of experts in the region. This provides an opportunity for the FIQA members to network among themselves and also to network with experts of other specialized areas. Forums to bring together experts within the region are held for the purpose of making plans, harmonize activities, evaluate progress and share experiences. The members of the WGs are encouraged to produce papers jointly for presentation to conferences and to publications as technical papers in journals and other publications. The FIQA WG provides an opportunity for members to join relevant regional and international networks.

THE IMPACT OF GLOBALIZATION ON THE POST-HARVEST FISHERIES SECTOR AROUND LAKE VICTORIA IN UGANDA

by

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Abstract

A preliminary study was conducted in early 2002 using two sets of structured questionnaires that were constructed to gather information from major stakeholders around the Ugandan portion of Lake Victoria. Respondents included managers of fish processing plants and fisheries administrators.

The results of the survey indicated that the infrastructure of the gazetted landing sites, including the sanitation and hygiene, had improved significantly. As such, the fish percentage rejects had decreased from 20 to 30 percent in 1980 to less than 5 percent in 2001, which translated into increased incomes for fishers. However, this seemed to have stimulated increased fishing effort from the passive to active fishing gear and increased the number of nets. The processing plants increased their processing capacities and initiated plans for installation of process lines for value-added products. To meet international quality and market demands required substantial investment in quality and safety management systems, training of personnel and/or recruitment of highly qualified personnel. Because of the preference for lean fish among consumers in the importing countries, the size of Nile perch caught decreased from 5 to 7 kg in 1980 to 1 to 2 kg in 2001, which was essentially immature according to Department of Fisheries Resources (DFR) regulations. The fisheries managers on the other hand increased the capacity of personnel involved in quality assurance through training. They also established and/or strengthened linkages between various players in the marketing chain.

The direct impact of globalization was to stimulate fishing effort, which while it led to improved infrastructure for fishers and processors, the increased demand could impact negatively through the collapse of the Nile perch fishery as a result of increased use of destructive fishing methods. Several recommendations were made, including implementation of a surveillance system to curb processing of immature fish.

Résumé

Une étude préliminaire a été conduite au début de 2002 en utilisant deux jets de questionnaires semi-structurés qui ont été confectionnés pour collecter les informations des principaux acteurs autour de la portion ougandaise du lac Victoria. Les destinataires incluaient les gestionnaires d'usines de transformation du poisson et les administrateurs des Pêches.

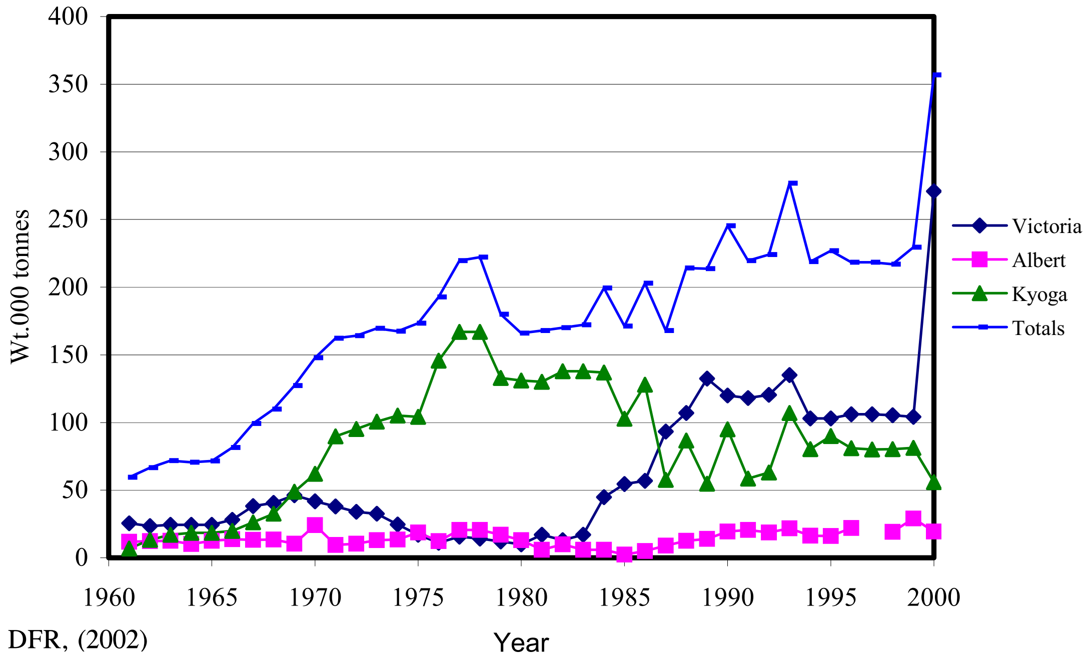
Les résultats de l'enquête indiquent que les infrastructures des sites de débarquement y compris les installations sanitaires et l'hygiène ont significativement été améliorées. Ainsi le pourcentage de rejets de poisson a régressé de 20-30 pour cent, en 1980 à moins de 5 pour cent en 2001, qui traduit un accroissement des revenus pour les pêcheurs. Toutefois ceci semble avoir stimulé l'augmentation de l'effort de pêche des engins passifs vers les engins actifs et une augmentation des filets. Les usines de transformation ont accru leurs capacités de transformation et initié des plans pour l'installation de lignes de production pour les produits à valeur ajoutée. Pour satisfaire les exigences internationales de qualité et de demandes du marché, un investissement substantiel en systèmes de gestion de qualité et sécurité sanitaire, la formation du personnel et/ou le recrutement de personnel hautement qualifié ont été réalisés. Du fait de la préférence du poisson maigre par les consommateurs des pays importateurs, la taille de Perche du Nil capturée a régressé de 5–7 kg en 1980 à 1–2 kg en 2001, qui est essentiellement immature selon la règlementation de DFR. Les gestionnaires des pêches ont d'un autre côté augmenté la capacité de leur personnel impliqué dans l'assurance qualité à travers la formation. Ils ont aussi établi et/ou renforcé les liens entre les différents acteurs dans la chaîne de commercialisation.

L'impact direct de la globalisation a été de stimuler l'effort de pêche est à la base de l'amélioration des infrastructures pour les pêcheurs et transformateurs mais l'augmentation de la demande par ailleurs peut avoir un impact négatif à travers l'effondrement de la pêcherie de la perche du Nil comme résultat de l'emploi accru de méthodes de pêche destructrices. Différentes recommandations ont été faites incluant la mise en oeuvre d'un système de surveillance pour freiner la transformation de poisson immature.

1. INTRODUCTION

Uganda's fishery is mainly based on artisanal capture fisheries from lakes, rivers and swamps, which constitute 18 percent of the total surface area. The production trend increased gradually up to 1980 (Figure 1), especially in the two major lakes, Victoria and Kyoga. The increase was largely attributed to the introduction of Nile perch *Lates niloticus* in both lakes during the 1950s and early 1960s. At that time, the exploited fishery resource was for the domestic market and occasionally for the regional market. The nature of the fishery remained unchanged until the late 1980s when Uganda entered the international fish trade after economic liberalization. Several medium-sized fish processing plants were established to process chilled and/or frozen Nile perch (*Lates niloticus*) fillets for the export market that included the European Union. (EU), Near East, the Far East and Australia. The lucrative EU market currently absorbs 80 percent of Uganda's fish exports, which became the second foreign exchange earner after coffee in 2001 at US$79 million and contributed 2 percent of the national GDP (DFR, 2002). Although most of the plants had installed capacities varying between 30 and 50 tonnes, they were only processing 5–20 tonnes of raw material with a turnover of 1.5–6 tonnes of finished product per day. The raw materials consisted mostly of large-sized perches with a minimum weight of 4 kg that gave 1 kg fillet depending on type of cut. The artisanal fishers using 3–5 m wooden boats with 25 nets on average, landed 100–1000 kg of catch depending on size of boat (Reynolds and Kirema-Mukasa, 1991).

Although the contribution from developing countries to the international fish trade increased from 60 to 66 percent, the worldwide catches have shown a marked decline since the 1989 peak (FAO, 1994). However, in 2000 there was another peak of 96.7 million tonnes attributed to Asian aquaculture. In contrast and because of its dietary and economic benefits, the demand for fish increased substantially and inadvertently created a supply gap that translated directly into increased fishing effort.



Source: DFR, (2002)

Figure 1: Total catches landed by major lakes

Participation in the international fish trade required that exporting countries complied with international safety and quality market standards. Non-compliance usually attracted bans as demonstrated in 1997 and 1999 when EU banned fish exports from Uganda and other riparian states of East Africa. On both occasions, the industry lost revenue, market contacts and had to invest massively in remedial measures prior to re-entry into the market. By 2001, the industry seemed to have recovered from the effects of the bans and had stabilized, which time coincided with insatiable demand for freshwater fish in the international market. The increased demand created a supply gap, which was directly translated into an increased fishing effort. These changes impacted on almost every aspect of the fisheries sub-sector. In the case of Uganda, the infrastructure, including handling and processing facilities along the entire chain from the fishing ground to the exit port, had to be refurbished to meet the EU market requirements as stipulated in the Council Directive 91/ 493 EEC of 22 July 1991 *laying down the health conditions for the placing on the market of fish and fishery products*. In this regard, compliance to this Directive undoubtedly called for heavy investment on the part of industrial processors and close collaboration among other stakeholders, including policy makers. It is against this background that this study was conducted to assess the impact of globalization on the post-harvest sector in Uganda.

2. OBJECTIVES

2.1 Principal objective

- to gather information on the perceived impact of globalization on the post-harvest sector in Ugandan portion of Lake Victoria.

2.2 Specific objectives

- to identify areas in the post-harvest sector affected by fish exports;
- to establish the magnitude of the impact.

3. MATERIALS AND METHODS

A simple structured questionnaire was used to gather information from 30 fishers from six gazetted landing sites (Kasenyi, Katosi, Dimo, Kansesero, Kigungu and Kiyindi), responsible managers at fish processing plants in operation and administrators at Department of Fisheries Resources (DFR). In addition, secondary data from each of the above sources were documented and analysed. The questionnaire was filled in by the author to ensure consistency and avoid unnecessary delays. Only eight plants out of ten in operation participated in the study. Additional information was gathered from other relevant authorities and persons. The data gathered were manually analysed because the sample size was relatively small. The identities of the plants have been concealed to protect their confidentiality; however each alphabetical letter (A-H) in this paper represents a particular plant in operation. The study was conducted from March to April 2002.

4. RESULTS AND DISCUSSION

The results of this preliminary study indicated that there were positive as well as negative socio-economic impacts that had direct or indirect effects on the post-harvest fisheries sector at individual and/or institutional level. Positive impacts included infrastructural development of the entire marketing chain, massive investment in the fish sector for implementation of revised marketing strategies and quality monitoring systems. Negative impacts included decreased fish size, increased fishing effort, change of eating habits, increased processing capacities and change of capture methods. Most of these impacts were interrelated.

5. POSITIVE IMPACTS

5.1 Development of infrastructure along fish marketing chain

Prior to globalization the marketing chain was fairly basic. The majority of landing sites were inaccessible and inadequately equipped to handle fish intended for the export market. However, after the inception of fish processing plants in the mid-1980s some landing sites were gazetted by DFR for improvement to meet the EU recommended standards. They included Kasenyi, Katosi, Dimo, Kansesero, Ggolo, Kigungu, Ssenyi, Kiyindi. In addition, most plants developed their own landing sites either at/ near/far from their premises. The improvement was undeniably reflected in the sanitation and hygiene of the respective landing sites, which in turn had a bearing on fish spoilage rates as evidenced by the percentage of fish rejected because of quality at plant reception points (Figure 2).

The results indicated that although the 4 percent rejects in 2001 was still high, it was comparatively lower and more stable than in 1996 when the intervention measures were scarcely in place as indicated by the haphazard trend in Figure 2. The intervention measures consisted of developmental structures, such as jetties, sanitary as well as handling, and sheds. As a concerted effort from DFR, a cold chain was developed from fishing ground to exit port and temperatures maintained within the acceptable limits ($0^{o}C^{+/-1}$). Additionally, quality inspectors were recruited and stationed at landing beaches and processing plants. As a result, the rate of spoilage was drastically reduced from above 9 percent in 1996 to an average of 4 percent in 2001 (Figure 2). In this regard, globalization had a positive contribution in the reduction of post-harvest losses.

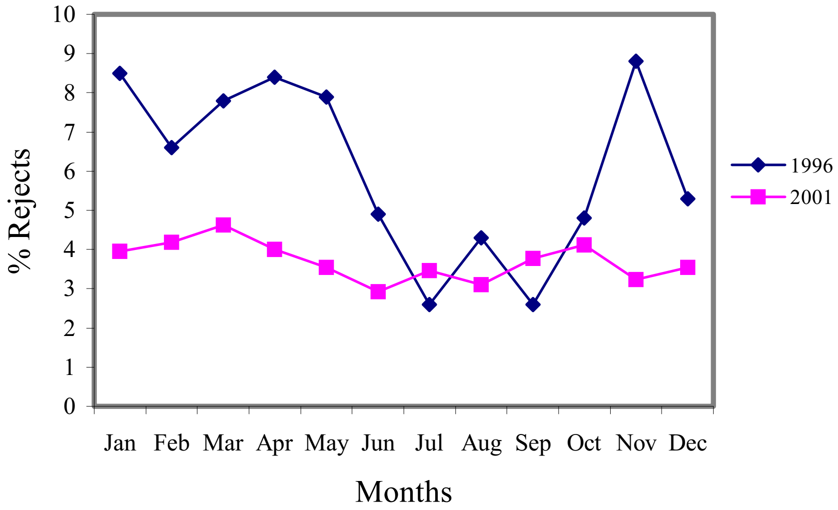


Figure 2: The impact of intervention measures on level of fish spoilage

5.2 Quality and safety monitoring systems

At the inception of industrial fish processing in the mid-1980s, markets hardly raised quality and safety issues. However, with time as they became global concerns, markets started to impose conditions on imports. The EU was the first to demand compliance to Council Directive 91/ 493 EEC of 22 July 1991 *laying down the health conditions for the placing on the market of fish and fishery products,* as referred to above. The Directive was immediately followed by a series of other related directives and non-compliance usually attracted bans, as demonstrated in 1997 and 1999 around the Lake Victoria basin. To avoid future bans, respective stakeholders monitored fish quality from capture to exist route. On average each plant incurred US$20 000 for only microbiological analysis of fillet samples (Figure 3), which was almost 25 percent of total export value for small plants. In totality, analyses for chemical and microbiological parameters was over US$400 000 in 2001 (DFR, 2002).

Analyses of pesticide residues in fish, sand sediments and lake water were conducted in specialized laboratories in the Netherlands at cost of 191 339 Dutch guilders, which the Competent Authority had to pay. Although results indicated that all samples were below international acceptable limits for all chemical residues analysed, they were conducted for a period of 1 year on a monthly basis in 1999 and twice in 2001.

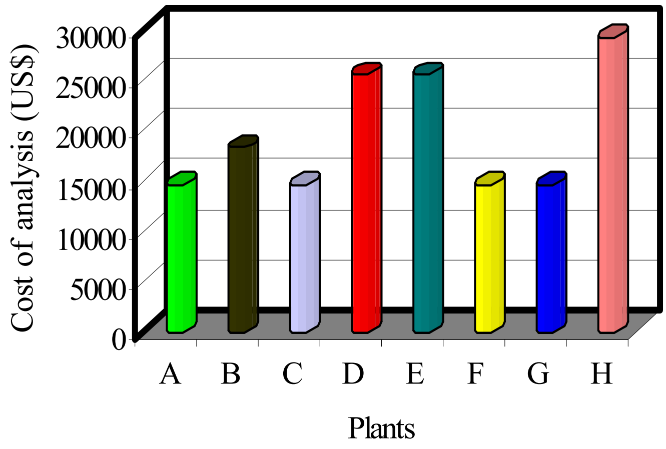


Figure 3: The cost of microbiological sample analysis in 2001

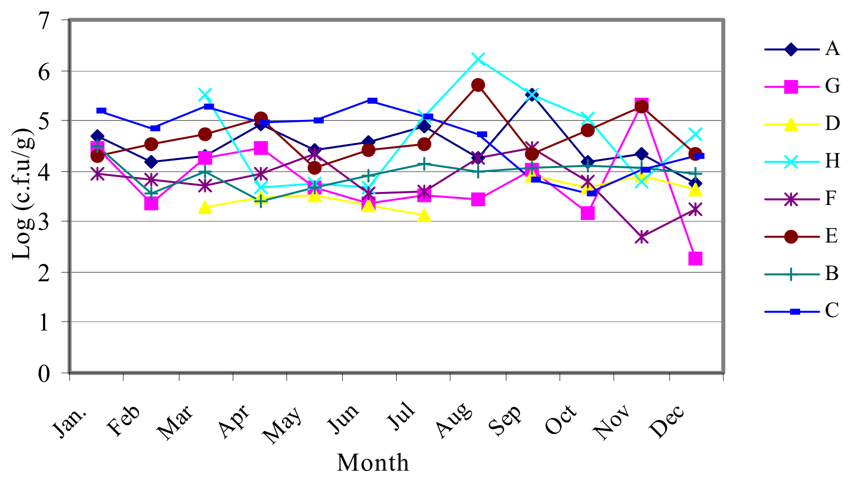


Figure 4(a): Average microbial load (TPC) in fillets during 2001

On the other hand, results from local laboratories indicated that apart from total plate counts (TPC) in Figure 4(a); *Staphylococcus aureus* (SA) Figure 4(b); and total coliforms (TC) Figure 4(c), all the other microbiological contaminants checked were either absent or far below allowable limits. For example, *Salmonella* and *Listeria* were absent in 25 g of sample.

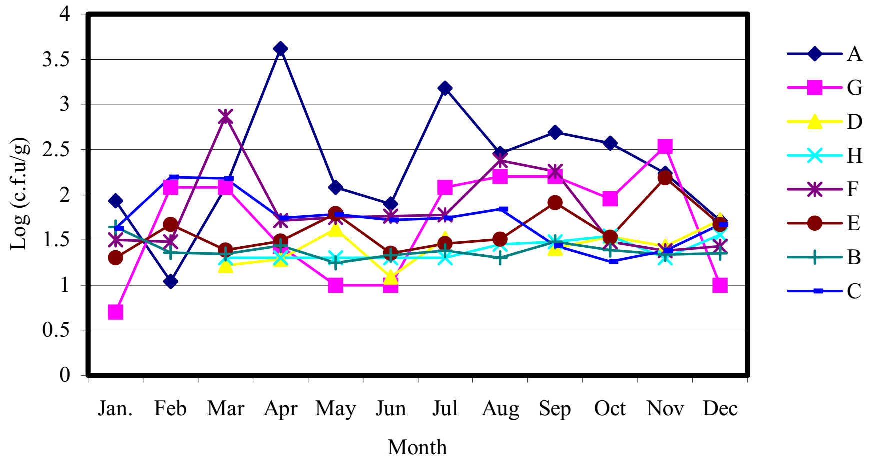


Figure 4(b): Prevalence of *Staphylococcus aureus* in fillets during 2001

Although TPC, SA and TC (Figures 4a, 4b, 4c respectively) varied wildly over time and space, most of them, and for the majority of plants, were within allowable limits 10^5, 10^2, and 10^3 respectively (ICMSF, 1986). The allowable limits for SA according to DFR safety standards is 10^2 per 100 g of sample. In which case, apart from plants A and G (Figure 4b), which were persistently above the limits, most of the plants were operating sufficiently below the required limits.

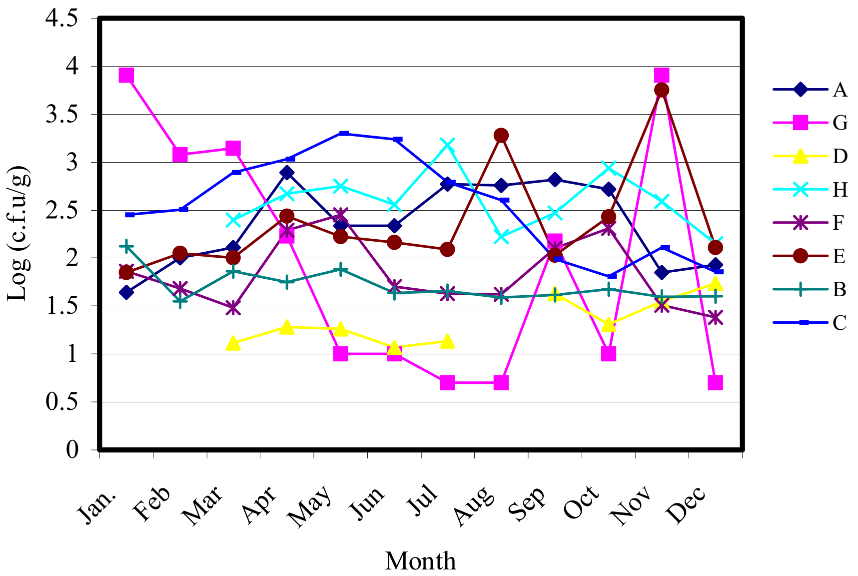


Figure 4c: Prevalence of total coliform fillets during 2001

5.3 Foreign exchange earnings

It was noted that foreign exchange earnings (Figure 5) increased from US$ <30 million in 1997 to US$87.4 million in 2001. Presently, fish exports account for 2.2 percent of the GDP and the second foreign exchange earner after the traditional coffee. Processing plants have also provided employment to 2 000 Ugandans albeit at a minimum wage of US$1 to US$5 per working day depending on plant and type of task.

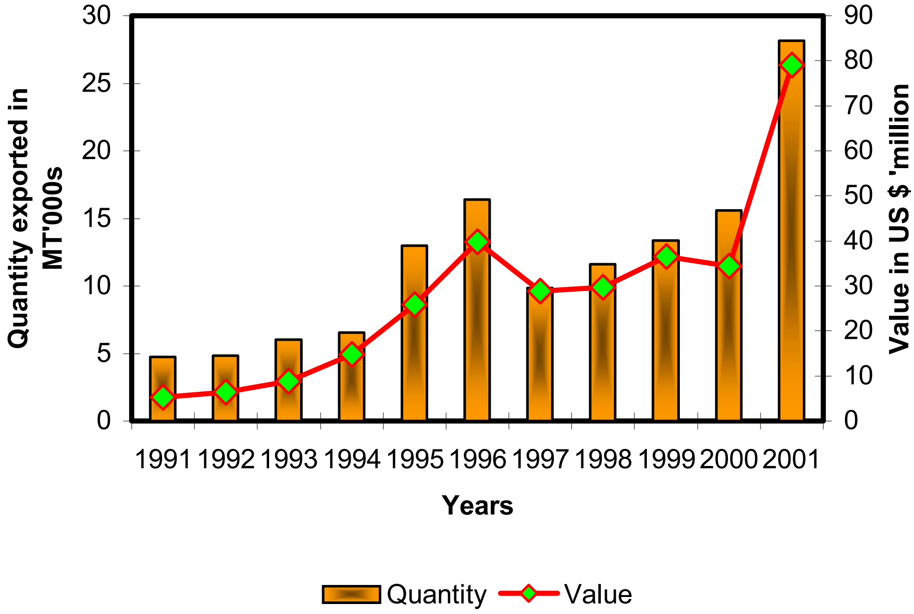


Figure 5: Increased foreign exchange earnings through fish exports

5.4 Marketing strategies

At the time of inception, most plants were engaged in primary processing of chilled and/or frozen fish fillets for a few export market outlets. With globalization, there was a tendency for horizontal and vertical diversification in that more products were processed and more market outlets sought. This was evidently demonstrated in 2001, when some plants started to install lines for value-added products intended for fast food market outlets. Exports of value-added fish products, such as fish fingers, balls, burgers, dumplings, would inevitably fetch higher prices than primary products on the international fish market.

6. NEGATIVE IMPACTS

6.1 Capture method

When the Nile perch fishery peaked in 1989, the most common method employed to capture large-sized perches was gillnetting using 8–12 inch mesh size with a depth of 26 meshes. However, with the onset of globalization, the author observed the mesh size reduced to 4–5 inches, which were manipulated to reduce the mounting ratio, such that the mesh size was further reduced upon setting. Moreover, the nets were set in doubles or three layers to depth of 52–78 meshes to increase the chance of fish capture. According to Othieno (pers. Comm.), more active and destructive gears, such as beach seines, cast nets, baskets and traps, were common and quite often used in shallow waters with detrimental consequences to the recruitment process (Kamanyi *et al.*, 1998). As such, globalization has undoubtedly changed the manner in which fish is captured in Ugandan waters. However, the author has observed an increase in the use of hand lines around Lake Victoria during the last 4–5 years. According to FAO (1995) fish caught by an active method has a better quality index and a longer shelf-life than fish captured by passive methods, such as gillnetting.

6.2 Fishing effort

In the early 1980s, there were about 3 000) fishing boats, less than 300 outboard engines and on average 20 gillnets per boat operating on Lake Victoria (Odongkara and Okaranon, 1997). Nonetheless, there was surplus fish on the market, hence the establishment of fish processing plants in

Uganda in mid-1980s. Each plant contracted less than 10 suppliers to deliver 4 tonnes on average of raw materials per person per day. A fishing round trip was only 12–18 hours and the average turn over was 500 kg. The nets were cast in the evening and hauled early morning without fear of theft. However, the 2000 Lake Victoria frame survey established that there were 15 544 boats, 2 031 outboard engines and an average of 100 nets per boat and 254 453 long line hooks (UNECIA, 2002). In spite of the seemingly high number of nets, most fishing boats returned with an average catch of 30 kg per trip. As such, the number of suppliers per plant was increased from less than 10 to more than 30 with a turnover of almost a tenth of the 1980 figure. Because of this low turnover, most plant suppliers decided to construct insulated boats with capacities varying 5–7 MT, which stayed out on the lake for 3–5 days to guarantee substantial deliveries to the respective plants. Unfortunately, prolonged stay on the lake necessitated availability of large quantities of ice to maintain the acceptable icing ratio of 1:1 and a cold chain (Clucas and Ward, 1996). Consequently, plants had to supply extra ice, which meant added expense because it was freely offered to the agent as an incentive. In other words, while the fishing effort increased, the catch per unit effort decreased. The cost of inputs designed to maximize supply increased appreciably.

6.3 Fish size

When the Nile perch peaked in 1989, the average size for processing was 5 kg and above. In conformity with the 1964 Fish and Crocodile Act and the then prevailing customer preference, plants used to process fish weighing more than 2 kg for chilled fillets and 4–7 kg for frozen fillets as shown in Table 1(a). Fish weighing more than 7 kg were filleted, frozen then apportioned in 100–250 g portions for specific foreign markets. Alternatively, these large fish were apportioned into steaks by local traders and sold to low-income local consumers at affordable prices. The landing beach prices varied from UGX 300-500/= per kg^{-1} which was equivalent to US 20–30 cents. At that time, fish weighing less than 2 kg was not recommended for processing. It was therefore sold together with very large fish and/or rejects to artisanal fish smokers. The minimum recommended harvestable fish size for Nile perch is about 50 cm and weighing more than 2 kg (Fish Act, 2002). However, with globalization and increased fish exports (Figure 5), the average fish size decreased appreciably (Table 1a and b) from 2–3 kg in 1989 to 500 g in extreme cases.

Table 1: Customer preferences in years 1991 and 2001

a) 1991

	Fish for chilling		Fish for freezing	
Name of plant	Fish size (g)	Wt. of fillet (g)*	Fish size (g)	≃ Wt of fillet (g)*
A	≤ 2000	≤600	≥ 4000	≥1300
B	≤ 2000	≤600	≥ 4000	≥1300
C	≤ 3000	≤1000	≥ 5000	≥1600
E	≤ 4000	≤1300	NA	NA

b) 2001

A	≤ 1500	100-500	≤ 4000	300-1000
B	≤ 1500	200-500	≤ 4000	300-1000
C	≤ 1500	200-500	≤ 7000	300-2000
D	≤ 2000	100-500	≤ 4000	300-1300
E	≤ 2000	200-800	≤ 5000	500-1000
F	≤ 1000	100-500	≤ 4000	300-1000
G	≤ 1000	200-500	≤ 4000	300-1300
H	≤ 1000	100-500	≤ 4000	300-1300

*Estimated weights of popular fillet sizes calculated from Y value in Table 3.

6.4 Eating habits

Several reasons have been advanced to account for the decrease in fish size targeted for processing between 1991 and 2001 (Table 1(a) and (b)). The change in the eating habits of consumers in the lucrative EU market has been cited as one of the principal reasons. Populations in affluent countries have been advised to decrease the fat content of their diets as a means of reducing the risk of various diseases, notably heart disease (MAFF, 1995). Admittedly, large Nile perch (15 kg) and small perch (< 2 kg) contains about 20 percent and < 5 percent respectively of lipid (Ssali, 1988). However, Nile perch fat has been known to have large amounts of *Omega 3* fatty acids namely; eicosapentanoic (EPA) and docosahexanoic (DHA), which is good for health (Kizza, 1989) because it restores the endothelial function of cardiovascular red membranes in individuals with heart problems (Goodfellows, 2000). Regardless of the available nutritional information, most orders from the EU still specified that fillets weighing less than 500 g should constitute over 80 percent of the total consignment. As a result, plant managers were quite prepared to pay over UGX 2 500/= (Equivalent to US$1.30) for a fish weighing less than 1 kg to supply EU market than risk their market by processing large-sized perch. Ironically, large-sized perches were costing almost a third of the prime small-sized fish i.e. UGX 800/= (Equivalent to US 40 cents). On the global market a chilled fillet weighing between 100 and 500 g was priced at US 20–50 cents more than a corresponding fillet weighing more than 800–1 200 g (Kasozi, pers. Comm.). As a consequence, the fishing effort has increased by 6-fold (Lugolobi, pers. Comm.) in the Ugandan portion of Lake Victoria. The second reason cited, which was a consequence of high demand, was that since the small-sized fish are predominantly found in shallow waters along the shoreline, fishermen found it economically rewarding to concentrate their efforts in shallow waters. According to a *Newsweek* article of March 2002, *the fish on the plate is becoming smaller and smaller, although some stakeholders, especially politicians would rather interpret it as the plate becoming larger and larger with the ever increasing demand for fish*. The other contributory reason was the stiff competition between Nile perch and the cheaply farmed catfish from Vietnam and China, into Europe and tilapias into American markets (Okongo, per.comm.). However, Nile perch export quantities from Uganda do not have a significant role in the United States market.

6.5 Processing capacities

With globalization of the markets, the processing capacities of plants increased tremendously as shown in Table 2, which inadvertently exerted more pressure on fish stocks because of high demand for raw processing materials. The expansion required substantial investments. Generally, the increase in processing capacities had positive as well as negative impacts on the Uganda fish export sector. The positive aspects have been highlighted in Figure 5.

Table 2: Processing and installed capacities

Name of plant	Mid-1980s processing capacity (Tonnes $/d^{-1}$)*	2001 processing capacity (Tonns $/d^{-1}$	Installed processing capacity (Tonnes $/d^{-1}$)
A	10	32	50
B	20	30	50
C	20	25	60
D	10	40	80
E	20	45	50
F	5	20	30
G	10	30	50
H	20	50	80

*Initial allotted quotas in late 1980s or early 1990s, i.e. inception of industrial fish processing

The negative impacts include elimination of socially disadvantaged groups of people from the fish market chain especially the women who were previously involved in artisanal processing of fish for the local as well as regional market. At the time of the study, most women were involved in support services that were characterized by low-profit margins and usually unrelated to fisheries. Smoking as a preservation method was on the decline because processing plants were offering over US$1 per kg, which was beyond the reach of most artisanal processors. The majority of people residing in the hinterland and who were relying on artisanal route for supply of the “cheap” source of animal protein have had to look for alternative plant proteins with low biological value (MAFF, 1995; Potter and Hotchkiss, 1995). Besides, those that had access could not afford it. Whole fish had become too expensive for the ordinary person. As such, most people had resorted to consumption of by-products waste, i.e. trimmings and carcasses that were used as condiments in their diets. In the 1980s, the per capita fish consumption was 13 kg and fish was the cheapest source of animal protein. In 2001, the per capita consumption had reduced to 9.7 kg, which was attributed to population increases (UBOS, 2002). However, with globalization and assuming that the 2001 export figure of 28 153 tonnes were processed from 3-fold the quantity of raw material, then the available fish for domestic consumption was less by a quarter of total catches of 220 300 MT. In real terms therefore the per capita consumption was further reduced to 6.64 kg.

The specifications of the EU and United States markets required the removal of the red meat and belly flaps, which substantially reduced the recovery or yield (Y) but contributed to increased quantities of by-products available for local consumption. However, most plants maximized Y depending on market and size of fish (Table 3).

Table 3: Average yield from average-sized Nile perch (3 kg) for export.

Name of plant	%Yield (Y)
A	38–42
B	36–40; 42
C	35–38
D	41–46
E	39
F	38
G	43
H	37

On the other hand, the Near East, Asia and Australia markets required only slightly trimmed products but their consignments were large. In both scenarios, the quantities of fish required to meet the market demand were so high that fishers had to increase the fishing effort.

7. CONCLUSION

Globalization had both positive and negative impacts on the post-harvest sector in Uganda. There were overwhelming positive impacts that included employment creation, establishment of the cold chain, refurbishment of gazetted landing sites, improvement of quality status for fish exports, widened utilization base through value addition, opportunities created for capacity building and improving the economic status of fish in the national economy. However, the negative impacts, although few, had far- reaching consequences on the sector. It has interfered with the recruitment process in the Nile perch fishery, deprived the vulnerable members of the fishing communities (especially the womenfolk) of their livelihood, made fish unaffordable to the majority of the populace, which inadvertently lowered the per capita consumption of fish.

8. RECOMMENDATIONS

- The consumers in importing countries should be sensitized about the nutritional facts of Nile perch.
- Government through Fisheries Resource Department should take drastic measures to curb the processing of immature fish; otherwise the Nile perch fishery may collapse sooner than later.

- There should be closed seasons on Lake Victoria to allow sufficient recovery of fish stocks.
- A surveillance system should be put in place to monitor compliance to agreed slot size.
- Processing quotas should be imposed on the processing plants.
- Alternative source of income should be made available to the vulnerable members of the fishing communities and especially the womenfolk.
- A comprehensive study should be conducted to establish the current impact of globalization on the whole fisheries sector in Uganda.

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ASSESSMENT OF FISHERIES PRODUCTS VALUES ALONG KENYA'S EXPORT MARKETING CHAIN

by

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Abstract

Kenya's fisheries sector plays very important roles as source of food (fish), employment and income, raw material for fishmeal and foreign exchange. The sector has undergone rapid changes in the last decade in line with the changing economic environment. Lake Victoria is Kenya's dominant source of fish for domestic and export market. This study assessed the structure and trends of the fish production and marketing systems of Lake Victoria in Kenya, focusing on valuation of fisheries products along the export marketing chain. Results of this study will guide decision-making on the types, how much and where resources need to be allocated to ensure continued output from this sector.

The study used a value chain analysis methodology. Data and information were collected from both primary and secondary sources at all stages of the fish export marketing chain. Primary data came from interviews of key players in the industry, including fishers, fisheries officers, fish marketing middlemen, artisanal fish processors and traders, managers of industrial fish processing factories and fisheries researchers. Secondary data came from published and unpublished manuscripts, existing databases and the internet.

This study reveals that Lake Victoria fisheries products have an annual market value of about Ksh 6.2 billion at landing. Of this, Nile perch constitutes Ksh 4.1 billion, of which about Ksh 2.1 billion worth of fish enters the export chain. Middlemen (agents) add Ksh 0.2 billion, making a pre-factory gate value of Ksh 2.3 billion while the gross value of output by fish processing and exporting factories is Ksh 4.1 billion. The fishmeal industry also adds value of about Ksh 418 million. Following the export bans to the EU in 1997–2002, the industry has followed a market diversification strategy to minimize similar risks. This report shows that the fisheries sector contributes significantly to the local and national economy, hence, adequate resources should be allocated that are commensurate with its importance and to ensure sustained output.

1 US$ = Ksh 75]

1. INTRODUCTION

Kenya's fisheries sector is very important as source of food (fish), employment, income, raw material for fishmeal and foreign exchange. Fisheries production and marketing activities have rapidly changed in the last decade in line with changing economic environment. This study assessed the structure and trends of fish production and marketing systems of Lake Victoria in Kenya, focusing on valuation of fisheries products along the export marketing chain. Results of this study will guide decision-making on the types, how much and where resources need to be allocated to ensure continued output from this sector.

1.1 Specific objectives of study

The study's specific objectives were:

- to describe the structure of Kenya's fisheries production and marketing systems;
- to analyse the trends of production and export of Kenya's fisheries products;
- to determine the values of fisheries products along Kenya's export marketing chain.

1.2 Methods of data collection

Data and information for this report were collected from both primary and secondary sources. Most of the data came from interviews of key players in the industry, including: fishers, fisheries officers, fish marketing middlemen, managers of fish processing factories and fisheries researchers. The study also made use of existing secondary data in published and unpublished manuscripts as well as from databases.

2. THE STRUCTURE OF KENYA'S FISH INDUSTRY

Kenya's fisheries sub-sector is based on three main fish sources, namely, inland freshwater, coastal marine and aquaculture. Of these, inland freshwater fisheries are the most important, with Lake Victoria dominating fish production. Lake Victoria alone has contributed 92 percent (equivalent to 142 000 tonnes) of annual mean of 154 000 tonnes of total fish landed in Kenya between 1998 and 2003. Besides Lake Victoria, the other freshwater fish sources are lakes Turkana, Baringo, Naivasha, and Jipe and several dams and rivers spread across the country, which collectively produce only 3 percent of total fish. Marine and aquaculture fisheries constitute only about 4 percent and 1 percent respectively of fish landed in the country.

Lake Victoria accounts for about 97 percent of all exported fisheries products from Kenya. The lake, which is the second largest freshwater lake in the world, is known to have high fish diversity, with some reports putting the number of different fish species at 170. However, only three species – Nile perch (*Lates niloticus*), "dagaa" or "omena" (*Rastrineobola argentea*) and tilapia (*Oreochromis* spp.) – are of commercial importance. In recent years, these three have constituted about 52 percent, 33 percent and 10 percent respectively of the total fish caught in Kenya's Lake Victoria; all the other species constituted just about 5 percent. The quantity of Nile perch landed in Kenya is less than half of that in either Uganda or Tanzania, but is above the catches in all other African countries combined (Table 1).

2.l Lake Victoria fish marketing channel

Numerous small-scale artisanal fishers dominate fish production in Lake Victoria. They supply fish to several middlemen and traders located at different stages along the supply chain. These middlemen in turn supply fish to the industrial fish processing establishments, artisanal fish processing units and the domestic consumer markets.

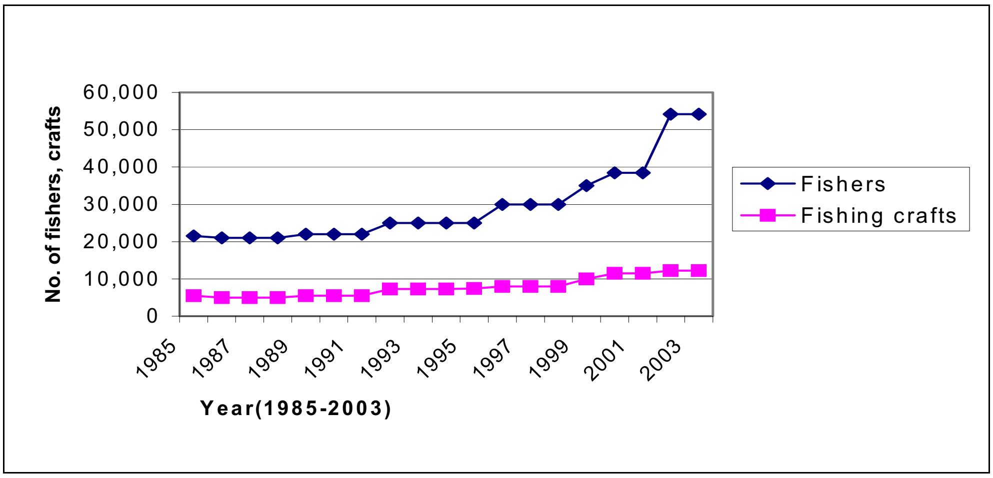
Lake Victoria's fish distribution channel may be viewed as comprising mainly of two separate, but interlinked, sub-channels. First is the industrial/ export market sub-channel, which supplies fish to the fish processing factories and ultimately to export markets. The major players in this channel are fishers, fish buying agents, fish processing factories and fish exporters. In this channel, fish is bought by factory-contracted or independent collector agents located at various landing beaches. The agents mainly use factory-owned insulated trucks to transport fish to the factories. At the factories the fish is filleted and the main products exported, while by-products are supplied to the domestic market. This channel handles dominantly Nile perch.

Second is the artisanal/domestic sub-channel, which supplies fish to numerous domestic consumer markets in the country. This sub-channel's actors include fishers, artisanal fish processors and traders. The logistical arrangement in this sub-sector is quite simple, with fishers supplying fish to women or male traders at the lakeside, who then sell the fish in the nearby market or to second level middlemen and who then transfer it to other distant markets. The mode of transport is also simple, depending on the distance to market. In this case, traders transport fish using either public passenger vehicles, bicycles or just walk. Some fish in this channel undergoes simple traditional preservation by sun-drying, smoking or deep-frying. The main fish products distributed in this channel are dagaa, tilapia, other fish species and Nile perch by-products.

2.2 The fish supply situation in Kenya

The number of fishers in Kenya has consistently increased over the years (Figure 1). The high rate of entry into the fishery is largely because of low prospects of employment in the other sectors of the economy. Recent statistics indicate that there are now about 54 000 fishers in Kenya, about 90 percent of them in Lake Victoria. About 50–60 percent of fishers target Nile perch for the export industry, while the rest target mainly tilapia and dagaa.

Available statistics indicate that fish landings in Lake Victoria increased from 18 680 tonnes in 1982 to a peak of about 220 000 tonnes in 1992; thereafter followed a general declining trend (Figure 2 and Table 1). Detailed analysis of available data reveals five marked Nile perch catch regimes since 1976. The first period extended from 1976 up to 1985, when less than 50 000 tonnes were landed each year. From 1986 to 1988 the annual catches ranged between 50 000 tonnes and 90 000 tonnes. The period 1989 to 1993 had record catches, largely attributed to the Nile perch boom. During this period annual catches ranged between 90 000 tonnes and 120 000 tonnes. There was a decline in catches from 1994 to 1999, the period of the Nile perch bans. The catches dropped from 110 000 tonnes to 60 000 tonnes per year within this time. The period after 2000 has experienced very low catches, which are comparable to catches in 1986 to 1988 period. The most recent records show that just about 60 000 tonnes of fish were landed in 2003.



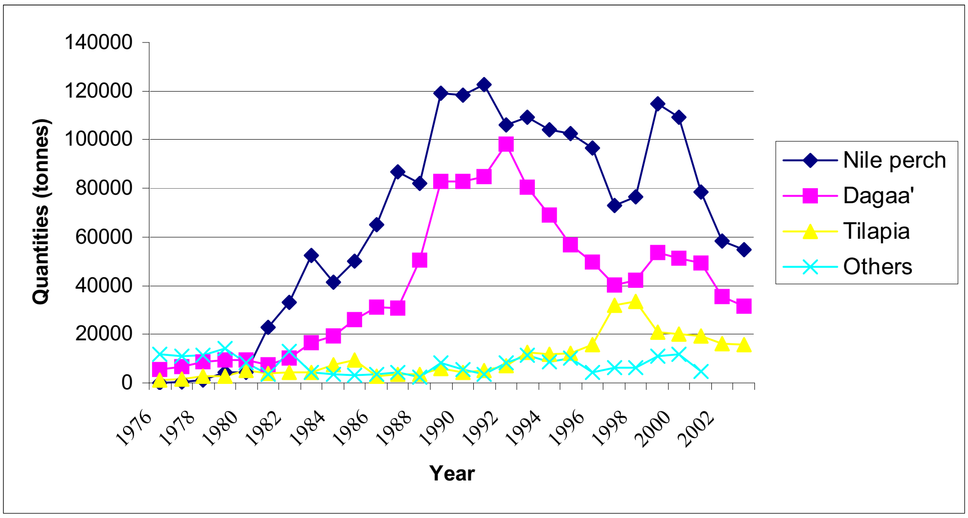
Source: Department of Fisheries/KMFRI frame survey data

Figure 1: Fishers and crafts on Lake Victoria (1985–2003)

Table 1: Comparative Nile perch landings by African countries (in tonnes) (1950–2002)

Country	1950	1960	1970	1980	1990	2000	2001	2002
Tanzania	.	.	1 000	.	179 262	90 000	96 000	92 000
Uganda	5 300	21 900	41 400	72 450	120 334	87 257	88 881	90 698
Kenya	.	.	.	4 310	71 930	109 815	78 534	58 432
Mali	3 600	4 800	6 600	5 294	4 232	6 592	6 000	6 000
Egypt	.	.	.	.	.	3 278	5 328	5 775
Nigeria	4 300	6 000	18 300	24 770	2 066	5 814	7 819	5 322
Senegal	.	.	.	.	.	1 451	1 300	1 300
Sudan	.	.	.	.	-	-	-	200
Ethiopia	.	.	.	.	.	65	63	37
TOTAL	13 200	32 700	67 300	106 824	377 824	304 272	283 925	259 764

Source: FAO



Sources: Fisheries Department statistics and KMFRI

Figure 2: Lake Victoria fish landing (1976–2003)

Catch decline is one indicator of over-exploitation, and has been a cause of concern especially for Nile perch, whose catch has gradually decreased since 1991 (only rising sharply in 1999 following the lifting of the ban on fish exports to the EU, then falling off again). The declining catches are largely attributed to the use of small mesh nets, indiscriminate gears and mass-target fishing methods, which have been prevalent in Lake Victoria. In particular, there has been a gradual reduction in mean mesh sizes of gillnets used in the lake in the last decade. The other two commonly applied stock assessment indicators – mean catch sizes and catch per unit effort – have also generally declined in the past decade. It is, therefore, imperative that efforts geared towards developing the fish exporting industry must address the causes and consequences of over-exploitation in Lake Victoria.

2.3 Kenya's Nile perch exports

Nile perch is the dominant fish species in the export trade, accounting for about 95 percent in volume and value of Kenya's total fish exports. The main raw material in Nile perch processing industry is whole Nile perch supplied from the various landing beaches of Lake Victoria. The raw fish is supplied to the factory usually chilled for processing. The main products include: fillets (skin on and skinless), whole body (gutted, headless), fish maws and swim bladders. The by-products are fish frames, scales, skin, offals (fat deposits).

The frozen products are packed in polythene bags and finally in cartons, the chilled products being packed in styrofoam boxes. In the cold stores, the finished products are stored at –5 ºC for chilled products and at –18 ºC for frozen products. The frozen fish products are then exported via Mombasa Port, while chilled products leave through Nairobi Airport. Most of Nile perch exports are now dominantly in frozen form. Chilled fish products fetch higher prices but require very stringent requirements in quality assurance, in particular, an efficient airfreight and logistical support system. Following the Nile perch export bans, Kenya's fish exporters largely left the lucrative chilled fish market for the less demanding and less paying frozen fish export trade.

2.4 The export markets

The number of export markets has expanded over the years. In 2002–2003, Kenya exported about 17 000 tonnes of Nile perch to at least 26 countries in nearly all continents. Available records for the years preceding 2002 did not categorize fish exports by destination. However, from 2002, the market areas have been assessed within three main blocks. (See Table 2 and Figure 3 showing the distribution of exports by quantity and Table 3 and Figure 4 for export values.)

- The EU countries. The main markets in order of importance are: The Netherlands, Italy, Germany, Belgium, Portugal, Spain, Cyprus, Malta, France and Poland. The EU countries imported 34 percent and 37 percent of Kenya's fish exports in 2002 and 2003 respectively. The EU accounted for an average of 36 percent of the value of exported fish in the two years.

- The Far East and Australia. The main markets in order of importance are: Australia, Japan, Hong Kong, Singapore, Malaysia and China. This block imported 27 percent and 24 percent of Kenya's fish exports in 2002 and 2003 respectively. The fish imported by these countries represented, on average, 26 percent of the value of fish exports.
- The Near East and U.A.E. This is dominated by Israel as the single most important importer of Kenyan Nile perch. A small amount of fish is also exported to the United Arab Emirates (UAE). This block imported 33 percent of Kenya's fish in 2002 and 34 percent in 2003. Of these, Israel alone imported 28 percent and 32 percent in the two respective years, making it the most important single destination for Kenyan Nile perch. The fish imported by Israel accounted for 29 percent of value of total fish exports.
- The rest of the world. These include the United States, Venezuela, Colombo and Cuba. Available data indicate that some little fish have recently been exported to African countries, although the nature of fish export could not be verified. These countries accounted for 5–6 percent of fish exports both in terms of quantity and value.

2.5 Trends of Kenya's fish exports

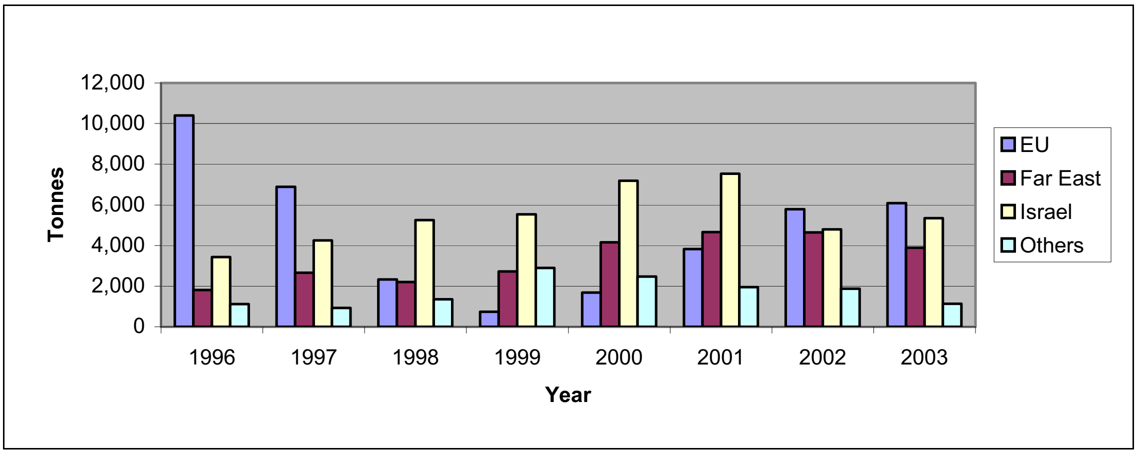
Starting from early 1980s, Nile perch exports increased steadily till the mid-1990s. The 1997, 1998 and 1999 successive export bans of fish and fishery products from Lake Victoria to the EU, which was then importing about 87 percent of all fish exports from Kenya, interrupted this trend. The lowest proportional intake by the EU was in 1999 when it imported only 6 percent of Kenya's fish. New markets emerged during the ban to replace the void created. Israel became the most prominent single importer of Kenya's fish (Table 2). However, it should be noted that the EU has consistently offered the highest prices for Kenya's fish, hence, despite the emergence of new markets the overall value of exports went down during the bans.

EU has gradually regained its position as the leading fish importing block. As Kenya improves its fish quality assurance status, the EU will likely become even a stronger fish importer. The post-2000 export trends (quantity and values) show the emergence of three strong importer blocks, almost sharing fish exports equitably (Table 2, Table 3; Figure 3 and Figure 4). Future projections are that the three main export market blocks (the EU, the Far East and Israel) will compete for Nile perch. Because of its strategic location, better fish prices and emerging trade partnership with Kenya, the EU has definite advantages to become the leading importer of Kenya's fish.

Table 2: Nile perch exports grouped by market regions (tonnes)

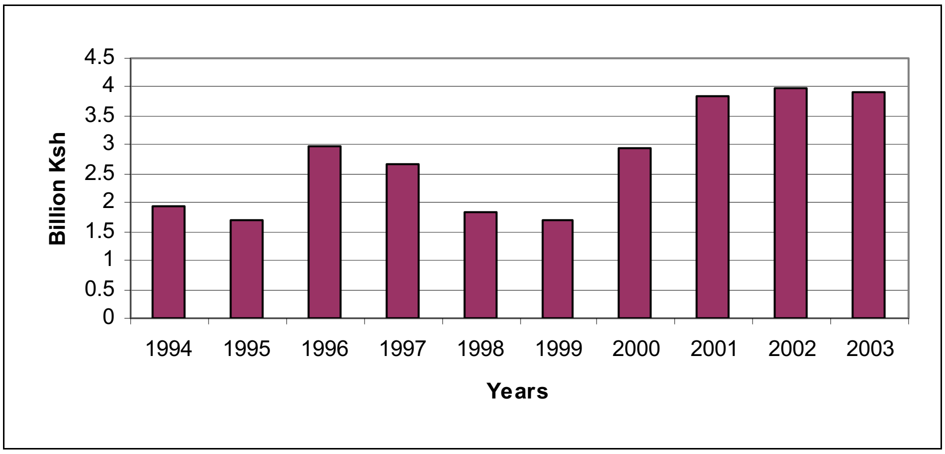
Year	Market destination				
	EU	Far East and Australia	Israel	Others	Total
1996	10 388	1 801	3 431	1 120	16 740
1997	6 882	2 664	4 244	929	14 719
1998	2 320	2 201	5 252	1 349	11 122
1999	742	2 722	5 529	2 894	11 887
2000	1 680	4 146	7 185	2 468	15 479
2001	3 818	4 650	7 530	1 947	17 945
2002	5 783	4 647	4 799	1 878	17 107
2003	6 081	3 888	5 341	1 135	16 445

Source: Kenya Fish Processors and Exporters Association; Fisheries Department



Source: Kenya Fisheries Department/AFIPEK/KMFRI

Figure 3: Trends of Nile perch exports by market regions (1996–2003)



Source: Kenya Fisheries Department/AFIPEK/KMFRI

Figure 4: Value of Nile perch exports (1994–2003)

3. VALUE OF FISHERIES PRODUCTS ALONG EXPORT MARKETING CHAIN

3.1 Value of fish at fish landing

The fish landing value, which represents the gross amount received by fishers, is determined by the quantity of landed fish and the prevailing price at landing. Using mean quantities and prices for the period 1998–2003, the value of fish landed in the Kenyan part of Lake Victoria has been estimated at an average of about Ksh 6.2 billion per year (Table 4). Of this, Nile perch accounted for 66 percent of the landed fish value, equivalent to Ksh 4.1 billion.

Table 3: Value of Kenya's fish exports (Ksh)

Destination	Value of exports (Ksh) per year				
	1999	2000	2001	2002	2003
EU					
Belgium				157 787 154	105 708 887
France				-	7 103 050
Germany				175 228 893	90 378 604
Greece				119 652 390	93 707 084
Netherlands				634 188 519	819 266 033
Norway				-	377 434
Italy				194 923 422	219 976 805
Malta				7 988 903	15 133 200
Poland				-	3 124 390
Portugal				127 744 423	75 443 357
Cyprus				6 474 483	19 659 000
Spain				18 851 070	53 631 417
EU total				1 442 839 257	1 413 130 657
The Far East & Australia					
Hong Kong				148 694 700	96 435 153
China				5 076 500	2 937 067
Malaysia				56 381 066	60 311 276
Singapore				50 945 818	57 899 432
Australia				304 653 095	510 960 621
Japan				494 012 823	242 677 227
The Far East & Australia total				1 059 764 002	971 220 776
The Near East & UAE					
Israel				1 066 071 545	1 254 866 306
UAE				175 674 468	57 748 192
The Near East & UAE total				1 241 746 013	1 312 614 498
Americas					
USA				221 283 868	157 427 015
Venezuela				217 104	50 135 284
Colombo				10 375 200	-
Cuba				-	10 558 800
Americas total				231 876 172	218 121 099
Africa and others					
Re-Union				5 332 500	5 197 500
D.R.Congo				94 632	-
Egypt				-	1 329 758
Other				-	740 691
Africa total				5 427 132	7 267 949
Total value	1 669 417 000	2 721 560 000	3 784 335 000	3 981 652 576	3 922 354 979

3.2 Value addition on Nile perch by middlemen

Of the three commercial species, only Nile perch enters the export market chain while tilapia and dagaa are for domestic consumption. Nearly all fish factories of Lake Victoria get Nile perch supplies through an intermediary. The typical fish supply arrangement involves hundreds of middlemen or "fish agents", who operate between the factories and fish landing beaches and transport fish using insulated trucks. A typical agent handles 3–5 tonnes of fish daily, earning an average gross margin or commission of about 10 percent. Agents purchase about 37 000 tonnes of Nile perch annually, with a landing value of nearly Ksh 2.1 billion. This is the quantity of Nile perch entering the export chain (the remaining quantity of landed Nile perch remaining in the local markets, usually rejected fish because of undersize or those not meeting export quality standards). The value addition by agents on Nile perch is therefore about Ksh 0.2 billion, giving a total value of Nile perch delivered at the factories by agents to be about Ksh 2.3 billion per year.

Table 4: Value of fish at fish landing

	Mean annual quantities landed, 1998–2003 (tonnes)	Mean annual landing price, 1998–2003 (Ksh/ Kg)	Mean annual value of landed fish, 1998–2003 (Ksh)
Nile perch	73 674	55.4	4 081 540 000
Dagaa (wet weight)	46 754	23.8	1 112 755 000
Tilapia	14 168	48.7	689 982 000
Other	7 084	42.6	301 778 000
Aggregate	141 680		6 186 055 000

Source: Compiled from Fisheries Department records

3.3 Value addition by fish processing factories

There are presently seven fish factories in Kenya specializing in the processing and exporting of Nile perch products. The expansion in capacities of the factories has been so rapid that from mid- 1990s there has been excess capacity in the processing industry. It is estimated that most factories are now operating at just about half of their established capacities, the main reason for under-capacity utilization being fish supply problems.

One of the strategies taken by the factories in Kenya to overcome fish supply problems has been to seek some of their fish from Tanzanian and Ugandan parts of Lake Victoria. This trade takes place in two main forms. First, fishermen land on Kenyan beaches fish that has been caught outside the Kenyan boundary in Lake Victoria. This fish would be reflected in the catch statistics and estimated value of fish landed in Kenya. Second, Kenya's fish factories directly import fish, either in fully or semi-processed state (e.g. headless and gutted), from partner factories located in the other two countries. The trade was very important mainly in the 1980s and 1990s, but gradually declined as Uganda and Tanzania developed their fish processing and exporting infrastructure.

Data obtained from Tanzania Fisheries Department (2001–2004) indicate that an average of about 3 300 tonnes of Nile perch is exported annually to factories in Kenya (Table 5), although the trend has been declining. There are no comparative records for Uganda-to-Kenya direct Nile perch trade, but indications are that the volume of trade is much smaller because Uganda has better infrastructure for fish processing and export than Tanzania. A conservative estimate of about 30 percent of the Tanzania-to-Kenya export trade may be realistic for Uganda-to-Kenya fish exports, representing about 1 000 tonnes annually. This means that about 4 300 tonnes of Kenya's fish exports (about 25 percent) are imported and re-exported from its neighbouring countries.

The imports (which are in semi-processed form) have to be further filleted, frozen, packaged and transported to the exit port. Assuming that in this way the factories add value of about 50 percent on directly imported fish, the contribution of fish imports on the overall value of exported fish will be about 12.5 percent (equivalent to about Ksh 0.5 billion).

Table 5: Kenya's Nile perch imports from Tanzania

Year	Quantity (tonnes)
2001	3 926 724
2002	3 209 949
2003	3 080 234
2004	2 950 518
Mean (01-04)	3 291 856

Source: Data from Tanzania Fisheries Department

Table 6: Value changes along the Nile perch export chain

	Billion Ksh (Based on 37 000 Kg of Nile perch entering the export chain at landing)	Details
Purchased by agents	2.1	Agents purchase 37 000 kg of Nile perch and transport to factories (represents about 50 percent of landed fish)
Value added by agents	0.2	About 10 percent mark up to cater for transport and profits
Value at pre-factory gate	2.3	
Value added by factory on fish from local chain	1.3	(Through filleting, storage, packaging, transport etc.)
Value contributed from imported fish	0.5	(About 4 300 tonnes of semi-processed fish products imported and re-exported)
Ex-factory value	4.1	Of fillet going for export (98 percent of value) and by-products going for local market (2 percent of value)

Kenya's fish factories exported fish products with an ex-factory (f.o.b) value of 3.98 billion in 2002 and 3.92 billion in 2003 (Table 3), giving an annual average of Ksh 3.95 billion for the two years. During the same period, the factories sold 20 504 tonnes of by-products at Ksh 5 per kg, earning an additional Ksh 102.5 million. The gross value of Nile perch from fish factories was, therefore, Ksh 4.05 billion. The factories, therefore add about 1.3 billion to the fish along the export chain, representing about 57 percent of the value at pre-factory gate.

3.4 Value of fish for fishmeal

The fishmeal industry in Kenya has continued to expand, stimulated by the need to export to the neighbouring countries. It is currently primarily based on Lake Victoria fisheries, with dagaa and Nile perch by-products as the main inputs. This industry has continued to expand, with construction of additional capacity. One of the most notable effects of the expanded fishmeal industry in the country has been import substitution. Kenya was importing high quantities of fishmeal in the 1980s, but the quantity has gradually declined as local fishmeal production picks up. In 1976–1980, Kenya imported fishmeal worth about US$1.5 million annually, but this figure had reduced by nearly 50 percent in 2000, at nominal prices. Local fishmeal production has, therefore, saved the country some amount of foreign exchange, although it has raised some concern with regard to food security for poor households. Pressure on Kenya's fisheries is expected to increase towards meeting the fishmeal demand. The local demand for fishmeal in Kenya is not yet satisfied, leave alone the potential of expanded regional market.

There are no recent accurate estimates of the amount of dagaa and Nile perch by-products that go for fishmeal production. However, a survey conducted from 1997 to 1999 indicated that about 40–60 percent of dagaa was being processed to fishmeal. Using the lower end figures (to take care of a rapidly rising population and fish demand), the fishmeal industry uses a minimum of 12 600 tonnes of dry dagaa (converted from 18 000 tonnes of wet "dagaa") and 8 000 tonnes of Nile perch by-products a year. The retail prices for dry dagaa and Nile perch by-products are Ksh 30 per kg and Ksh 5 per kg respectively. These give a retail value of Ksh 378 million of dagaa and Ksh 40 million of Nile perch by-products being used in the fishmeal industry per year, giving a total value of Ksh 418 million.

3.5 Artisanal fish processors and traders

The artisanal processing sub-sector may be divided into three broad categories, namely, the processing system for Nile perch frames, the traditional processing systems for whole fish and the fresh fish trade. The traditional processing system for whole fish handles tilapia, dagaa and Nile perch rejected by fish processing factories. Over time, the traditional fish processing has declined along the lake as indicated by the disappearance or abandonment of the traditional fish smoking kilns. These used to be a common feature in most fishing villages; however, they have slowly disappeared over the last 10 years.

A typical artisanal fish processor-trader in Kenya is likely to be female, with nearly half of them engaged in subsidiary activities to supplement the income from fish trade. Most of the traders normally sell their fish within a distance of 20 km from the source. The processor-traders most often will transport fish to a market 2–3 days in a week while the other days are spent seeking supplies and processing the fish. Very few traders, if any, have received a formal training relevant to their trade. Artisanal processors and traders' incomes vary very widely between individuals, market sites, the type of activity, level of investment, seasons etc., hence, it is difficult to have an accurate representative income or cost structure for the artisanal fish trade.

Previous attempts, for example by Gibbon (1997) estimated that a small-scale lake-based artisanal fish processor handling about 10 fish pieces a day, each piece giving a margin of US$0.36, would result in about US$109 in a month. After deducting costs, the processor would remain with a net income of about US$42 per month. On the other hand, an artisanal fish processor at a larger scale handling about 1 000 pieces in a month would make a net income of about US$327 a month. Another study by Abila (1996) determined that a Nile perch frames processor in Kenya received a profit margin of 8–10 percent of the sale price, equivalent to about US$0.03 per kg of processed fish frame. If 30 000 tonnes of frames were processed in a year by 2000 processors, then each artisanal processor would have an average profit of about US$450 in a year.

3.6 Constraints in the fisheries production and marketing chain

Among the important problems faced by fishers are: irregular, fluctuating and, often low, incomes, lack of access to credit, poor infrastructure (e.g. roads, electricity), lack of cold storage facilities for their fish (e.g. ice and cold rooms), inability to organize themselves and improve their bargaining power, lack of information on savings options, inadequate savings facilities, lack of skills for alternative livelihood, inadequate post-harvest handling facilities, inadequate training and skills for post-harvest fish handling, and lack of business management skills. Fish traders and processors are constrained by: low and unreliable fish supplies, fluctuating fish prices, lack of credit, high transport costs because of poor infrastructure, high taxes, decreasing sources of wood fuel for fish processing, lack of quality standards for domestic market etc.

4. CONCLUSION AND RECOMMENDATION

This study reveals that Lake Victoria fisheries products have an annual market value of about Ksh 6.2 billion at landing. Of this, Nile perch constitutes Ksh 4.1 billion, of which about Ksh 2.1 billion worth of fish enters the export chain. Middlemen (agents) further add Ksh 0.2 billion, making a pre-factory gate price of Ksh 2.3 billion, while the gross value of output by fish processing and exporting factories is Ksh 4.1 billion. The fishmeal industry also adds value of about Ksh 418 million. Following the export bans to the EU in 1997–2002, the industry has followed a market diversification strategy to minimize similar risks. This report shows that the fisheries sector contributes significantly to the local and national economy, hence, adequate resources should be allocated that are commensurate with its importance and to ensure sustained output.

However, there are critical constraints that still face the fish production and marketing sub-sectors. It is, therefore, imperative that efforts geared towards developing the fish exporting industry must address the causes and consequences of these constraints in Lake Victoria.

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IMPACT OF THE NEW EU REGULATORY FRAMEWORK ON THE EXPORT OF FISHERY PRODUCTS

by

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Abstract

The food security policy of the EU aims at three main objectives, which are (i) ensuring a high level of protection of human and animal health, (ii) putting the quality at the centre of the preoccupations, and (iii) re-establishing confidence in consumers. In this regard an upgrade of the regulatory framework has been made which institutes a new regime in connection with hygiene of foodstuffs (Hygiene packet). The latter contributes to the strengthening of measures of food security assurance and recognizes for the first time in food legislation the application of the precautionary principle.

Résumé

La politique de sécurité alimentaire de l'UE vise trois principaux objectifs à savoir (i) l'assurance d'un niveau élevé de protection de la santé humaine et animale, (ii) placer la qualité au centre des préoccupations et (iii) rétablir la confiance des consommateurs. A cet effet une refonte du cadre réglementaire a été effectuée qui institue désormais un nouveau régime relatif à l'hygiène des denrées alimentaires (*paquet hygiène*). Ce dernier participe du renforcement des mesures d'assurance de la sécurité alimentaire et reconnaît pour la première fois dans la législation alimentaire l'application du principe de précaution.

1. INTRODUCTION

Objectifs et principes généraux
Les objectifs généraux de la politique de sécurité alimentaire de l'UE sont:

Assurer un niveau élevé de protection de la santé humaine et animale à travers un accroissement des contrôles tout au long de la chaîne alimentaire.

Placer la qualité au centre des préoccupations
Indissociable de la sécurité alimentaire, la notion de qualité distingue deux niveaux : 1) la qualité non négociable concerne la sécurité de notre alimentation et des exigences minimales en matière de protection de l'environnement et des espèces animales et végétales ; 2) la qualité relative ou subjective rend une denrée alimentaire vraiment unique à travers le goût, l'apparence, l'odeur, les méthodes de production et la facilité d'utilisation.

Rétablir la confiance des consommateurs
Afin de restaurer cette confiance, la sécurité des denrées alimentaires est renforcée à travers des procédures plus strictes de surveillance et de contrôle. Les consommateurs doivent pouvoir disposer donc d'une information claire et précise sur tous les enjeux relevant de la sécurité alimentaire. Le marquage CE de conformité , les mentions spécifiques comme le label écologique ou les indications géographiques et appellations d'origine protégées sont autant d'initiatives qui placent la qualité, la protection des consommateurs et la défense des productions traditionnelles au centre des préoccupations.

2. PRINCIPES GÉNÉRAUX

Le règlement (CE) n°178/2002 établit 5 principes généraux qui prévalent désormais sur toutes les dispositions des autres textes dans ce domaine :

Le caractère intégré de la chaîne alimentaire est réaffirmé
Il est impératif d'assurer un niveau élevé de sécurité alimentaire à toutes les étapes de la chaîne alimentaire, du producteur primaire jusqu'au consommateur, pour en garantir l'efficacité globale.

L'analyse du risque est un fondement essentiel de la politique de sécurité alimentaire
Trois interventions distinctes sont nécessaires : l'évaluation des risques au moyen d'avis scientifiques, la gestion des risques par l'intervention des pouvoirs publics et la communication sur de tels risques en direction du grand public. Si les données scientifiques disponibles ne permettent pas une évaluation complète du risque, l'application du principe de précaution, reconnue pour la première fois dans la législation alimentaire, est souhaitable dans le but d'assurer un niveau élevé de protection.

La responsabilité de tous les exploitants du secteur alimentaire est désormais engagé.
Chaque intervenant du secteur est responsable de la sécurité des produits qu'il importe, élabore, transforme, met sur le marché ou distribue. En cas d'émergence d'un risque, il prend sans délai les dispositions restrictives nécessaires et en avertir les autorités.

La traçabilité des produits est établie à toutes les étapes de la chaîne alimentaire
Au moyen de systèmes adéquats de collecte d'information, les exploitants doivent être en mesure d'identifier toute entreprise qui leur a fourni une denrée alimentaire ou à qui ils fournissent leurs produits.

Les citoyens ont droit à une information claire et précise des pouvoirs publics
Ils sont consultés de manière ouverte et transparente tout au long du processus de décision politique. Ces efforts d'information et de transparence correspondent aux principes de la politique communautaire en faveur des consommateurs.

L'Union européenne a élaboré un important corpus de textes législatifs relatifs aux mesures de police sanitaire, de contrôles vétérinaires et d'hygiène des denrées alimentaires.

Contraignants dans tous les États membres et s'appliquant aux pays candidats et tiers qui exportent vers l'Union, ces textes ont tout d'abord pour but de réglementer les importations, la mise sur le marché et les échanges intracommunautaires d'animaux et de produits animaux. Ils définissent des normes d'hygiène et de sécurité et établissent des contrôles à l'échelle européenne. Les États membres sont responsables de la mise en œuvre de cette législation et déterminent les sanctions applicables en cas d'infraction. En complément, l'OAV effectue des audits et des inspections officielles dans les États membres et les pays exportateurs, puis communique ses conclusions et ses recommandations aux autorités nationales et communautaires ainsi qu'au grand public.

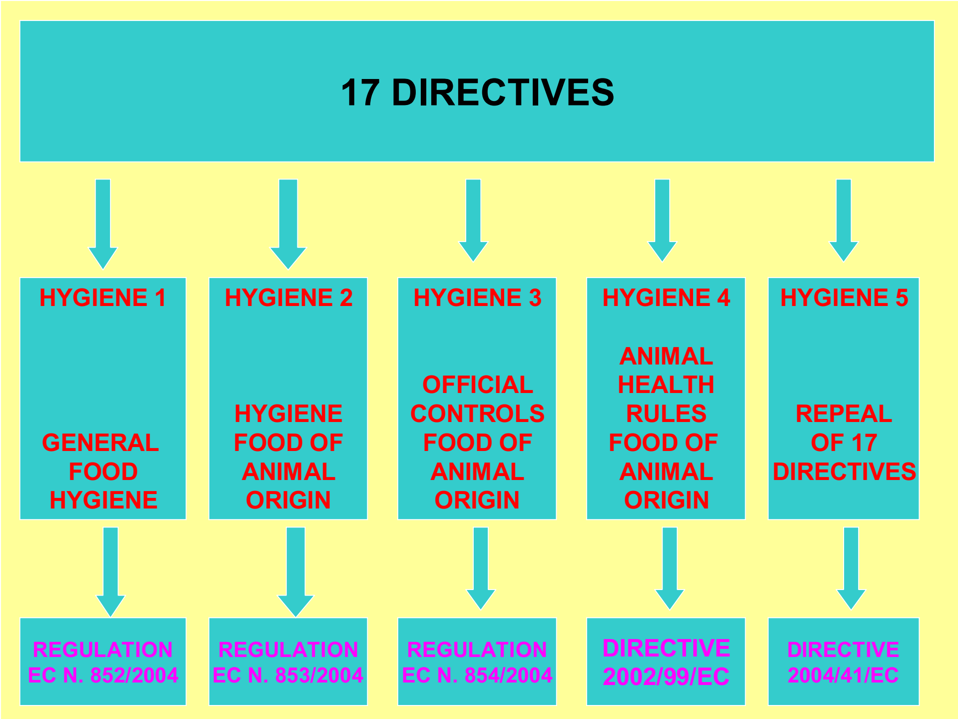

Figure 1 : Nouveau régime relatif à l'hygiène des denrées alimentaires (p*aquet hygiène)*

Règlement (CE) n° 852/2004 **du Parlement européen et du Conseil, du 29 avril 2004, relatif à l'hygiène des denrées alimentaires**.

Dans le cadre de la révision de la législation sur l'hygiène des denrées alimentaires, ce règlement met l'accent sur la définition des objectifs à atteindre en matière de sûreté alimentaire, laissant aux exploitants du secteur alimentaire la responsabilité d'adopter les mesures de sécurité à mettre en œuvre afin de garantir l'innocuité des aliments.

Synthèse

Cette révision de la législation communautaire concerne les règles d'hygiène alimentaire figurant dans la directive 93/43/CEE du Conseil afin de mettre en place une politique globale et intégrée s'appliquant à toutes les denrées alimentaires de la ferme jusqu'au point de vente au consommateur.

Champ d'application

Le présent règlement vise à assurer l'hygiène des denrées alimentaires à toutes les étapes du processus de production, depuis la production primaire jusqu'à la vente au consommateur final. Il ne couvre pas les questions relatives à la nutrition, ni celles concernant la composition et la qualité des denrées alimentaires.

Ce règlement s'applique aux entreprises du secteur alimentaire et non à la production primaire et à la préparation domestique de denrées alimentaires aux fins de l'utilisation privée.

Dispositions générales et dispositions spécifiques

Tous les exploitants du secteur alimentaire veillent à ce que toutes les étapes dont ils sont responsables, depuis la production primaire jusqu'à la vente ou la mise à disposition des denrées alimentaires au consommateur final, soient effectuées de manière hygiénique, conformément aux dispositions du présent règlement.

Les exploitants du secteur alimentaire exerçant des activités de production primaire et certaines activités connexes doivent se conformer aux dispositions générales d'hygiène de la partie A de l'annexe I. Des dérogations peuvent être accordées en ce qui concerne les petites exploitations, tant que cela ne compromet pas les objectifs du règlement.

Les activités connexes concernées sont :

- le transport, la manipulation et l'entreposage de produits primaires sur le lieu de production lorsque leur nature n'a pas été sensiblement modifiée ;
- le transport d'animaux vivants si nécessaire ;
- le transport, depuis le lieu de production vers un établissement, de produits d'origine végétale, de produits de la pêche et de gibier sauvage, lorsque leur nature n'a pas été sensiblement modifiée.

Par ailleurs, les exploitants du secteur alimentaire qui exercent des activités autres que celles de production primaire doivent se conformer aux dispositions générales d'hygiène de l'annexe II. Cette annexe détaille les dispositions concernant :

- les locaux, y compris les sites extérieurs;
- les conditions de transport;
- les équipements;
- les déchets alimentaires;
- l'alimentation en eau;
- l'hygiène personnelle des personnes en contact avec les denrées alimentaires;
- les denrées alimentaires elles-mêmes;
- le conditionnement et l'emballage;
- le traitement thermique, qui permet de transformer certaines denrées alimentaires;
- la formation des professionnels du secteur.

Traçabilité et retrait des denrées alimentaires

Conformément au règlement (CE) n° 178/2002 , les exploitants du secteur alimentaire mettent en place des systèmes et des procédures permettant la traçabilité des ingrédients et denrées alimentaires et, le cas échéant, des animaux utilisés pour la production de denrées alimentaires.

De même, lorsqu'un exploitant du secteur alimentaire constate qu'une denrée alimentaire présente un risque grave pour la santé, il la retire immédiatement du marché et en informe l'autorité compétente ainsi que les utilisateurs.

Règlement (CE) n° 853/2004 du Parlement européen et du Conseil, du 29.04.2004, fixant les règles spécifiques d'hygiène applicables aux denrées alimentaires d'origine animale.

Dans le cadre de la révision de la législation relative à l'hygiène des denrées alimentaires, ce règlement fixe des règles spécifiques d'hygiène pour les denrées alimentaires d'origine animale, afin de garantir un niveau élevé de sécurité alimentaire et de santé publique.

Synthèse

Les denrées alimentaires d'origine animale figurant à l' annexe I du traité instituant la Communauté européenne peuvent présenter des dangers microbiologiques et chimiques. De tels risques nécessitent l'adoption de règles spécifiques d'hygiène qui permettent de contribuer à la réalisation du marché intérieur et d'assurer un niveau élevé de protection de la santé publique. Ces règles viennent en complément de celles fixées par le règlement (CE) n° 852/2004 sur l'hygiène des denrées alimentaires, qui concerne, notamment, l'agrément des exploitants.

Obligations générales

Les dispositions du présent règlement s'appliquent aux produits d'origine animale, transformés et non transformés, mais ne concernent pas les denrées composées en partie de produits d'origine végétale. Sauf indication contraire, ces dispositions ne s'appliquent pas non plus au commerce de détail, ni à la production primaire destinée à la consommation privée, pour lesquels les dispositions du règlement précité sur l'hygiène des denrées alimentaires sont suffisantes.

Agrément

Les établissements manipulant des produits d'origine animale doivent être agréés par l'autorité compétente de leur État membre. Cette obligation d'agrément ne s'applique pas aux établissements qui exercent uniquement des activités de production primaire, des opérations de transport, le stockage de produits qui ne nécessitent pas une régulation de température, ou des activités de vente au détail non soumises au présent règlement.

Les États membres tiennent à jour des listes d'établissements agréés. Ces derniers reçoivent un numéro d'agrément auquel s'ajoutent des codes indiquant le type de produits d'origine animale fabriqués.

Importations en provenance de pays tiers

La Commission dresse des listes des pays tiers en provenance desquels les importations de produits d'origine animale sont autorisées, conformément au règlement précité sur les contrôles officiels. Lors de l'établissement de ces listes, elle tient notamment compte :

- de la législation du pays tiers en vigueur ainsi que de l'organisation et du pouvoir de l'autorité compétente et des services d'inspection ;
- de la situation sanitaire générale dans ce pays ainsi que des conditions sanitaires de production, de fabrication, de manipulation, d'entreposage et d'expédition appliquées aux produits d'origine animale;
- de l'expérience acquise en matière de commercialisation avec le pays tiers et de sa collaboration dans l'échange d'information notamment sur les risques sanitaires ;
- des résultats des inspections/audits communautaires effectués dans ce pays ;
- de l'existence dans le pays tiers d'une législation sur l'alimentation animale ainsi que de programmes de surveillance des zoonoses et des résidus.

Produits de la pêche

Capturés dans leur milieu naturel, les produits de la pêche sont éventuellement manipulés pour la saignée, l'étêtage, l'éviscération et l'enlèvement des nageoires. Ils sont ensuite réfrigérés, congelés ou transformés et/ou conditionnés/emballés à bord de navires conformément aux règles fixées dans la présente section.

Des dispositions spécifiques d'hygiène sont introduites pour les éléments suivants :

- la nature des équipements sur les bateaux de pêche, les navires usines et les bateaux congélateurs : caractéristiques des aires de réception, de travail et d'entreposage et des installations de réfrigération/congélation, l'évacuation des déchets et la désinfection ;

- l'hygiène des bateaux de pêche, des navires usines et des bateaux congélateurs : la propreté, la lutte contre toute contamination et le traitement par l'eau et le froid ;
- l'hygiène à respecter pendant et après le débarquement des produits de la pêche : la lutte contre toute contamination, le matériel utilisé, les halles de criée et les marchés de gros ;
- les produits frais et congelés, la pulpe de poisson séparée mécaniquement, les endoparasites dangereux pour la santé humaine (contrôle visuel) ainsi que les mollusques et crustacés cuits ;
- les produits de la pêche transformés ;
- les normes sanitaires applicables aux produits de la pêche : évaluation de la présence de substances et de toxines dangereuses pour la santé humaine ;
- le conditionnement, l'emballage, l'entreposage et le transport des produits de la pêche.

Règlement (CE) n° 854/2004 du Parlement européen et du Conseil, du 29.04.2004, fixant les règles spécifiques d'hygiène d'organisation des contrôles officiels concernant les produits d'origine animale destinés à la consommation.

Dans le cadre de la révision de la législation sur l'hygiène des denrées alimentaires, ce règlement met l'accent sur la définition des objectifs à atteindre en matière de sûreté alimentaire, laissant aux exploitants du secteur alimentaire la responsabilité d'adopter les mesures de sécurité à mettre en œuvre afin de garantir l'innocuité des aliments humaine.

Synthèse

Ce règlement vient en complément des règlements sur l'hygiène des denrées alimentaires, sur les exigences spécifiques relatives aux denrées alimentaires d'origine animales et sur les contrôles officiels des denrées alimentaires et des aliments pour animaux. Des règles spécifiques pour les contrôles officiels concernant les produits d'origine animale sont nécessaires pour prendre en compte des aspects spécifiques associés à ces produits.

Dispositions générales

Le règlement pose des exigences en matière d'agrément des établissements par l'autorité compétente. Lorsque, au cours d'un contrôle, l'autorité compétente décèle des irrégularités graves par les exploitants du secteur alimentaire, elle peut leur retirer cet agrément.

Les exploitants du secteur alimentaire doivent fournir à l'autorité compétente toute l'assistance requise dans l'exécution du contrôle, notamment en ce qui concerne l'accès aux locaux et la présentation de documents ou de registres.

Les contrôles officiels comprennent des audits des bonnes pratiques d'hygiène et les principes HACCP (analyse des dangers et maîtrise des points critiques), ainsi que des contrôles spécifiques dont les exigences sont définies par secteur (viandes fraîches, mollusques bivalves, produits de la pêche, lait et produits laitiers).

Produits de la pêche

En plus des contrôles généraux, les produits de la pêche font l'objet de contrôles officiels au moment du débarquement ou, avant la première vente, dans une halle de criée ou un marché de gros. Ces contrôles comprennent notamment :

- des tests de surveillance organoleptique ;
- des tests de l'azote basique volatil total ;
- des tests de contrôle de l'histamine ;
- des tests de surveillance de la teneur en contaminants ;
- des tests microbiologiques ;

- des tests de dépistage des parasites ;
- des contrôles sur la présence de poissons toxiques ou contenant des biotoxines.

Sont déclarés impropres à la consommation humaine les produits de la pêche dont les contrôles organoleptiques, chimiques ou microbiologiques révèlent la présence en quantité excessive de substances dangereuses pour la santé humaine.

L'UE est constamment dépendante des importations du poisson et des produits de la pêche pour couvrir ses besoins. En 2003 l'UE des 15 a importé pour presque 13 milliards d'euros en valeur de poisson et des produits de la pêche avec des exportations atteignant environ 2,5 milliards d'euros. Cinquante pour cent des importations viennent de 10 pays avec la Norvège qui détient la plus grosse part (15%). Le produits importés les plus significatifs en termes de valeur sont les filets de poissons (€2,5 milliards), les crustacés (€2.4 milliards) et le poisson préparé/préservé (€1,6 billion). Les denrées les plus exportées sont le poisson congelé et le poisson frais (respectivement €870 et €300 millions). Le Japon etait le plus important marché d'exportation avec une valeur de €300 millions.

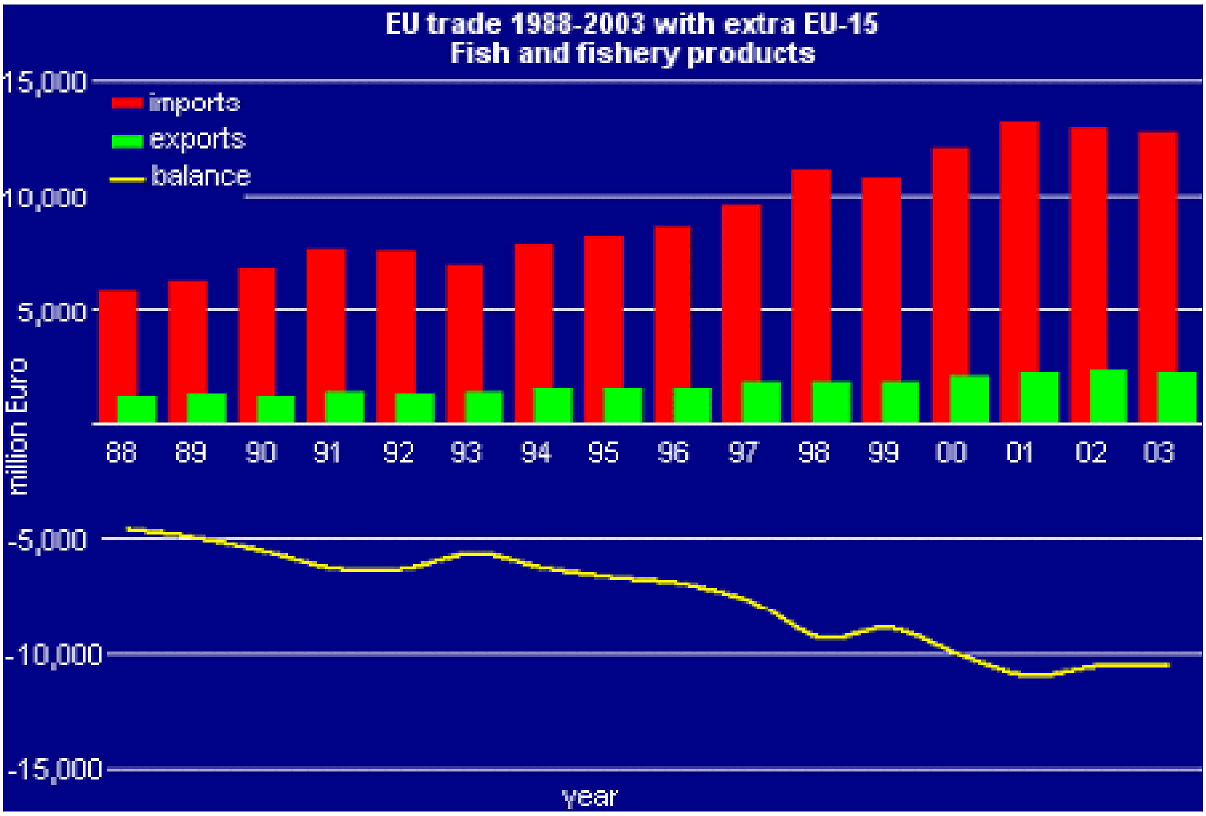

Figure 2 : textes complémentaires aux normes horizontales (paquet hygiène)

1) Reg. (CE) 2065/2001 «application du Reg. (CE) 104/2000 sur l'information du consommateur dans les secteur de produit de la pêche et de l'aquaculture »
2) Dir. 92/5 « concernant les aditifs autres que les colorants et les édulcorants »
3) Dir. 98/83 « relative à la qualité des eaux destinées à la consommation humaine »
4) Dir. 2001/22 « portant fixation des modes de prélèvement d'échantillons et de méthodes d'analyse pour le contrôle officiel des teneurs en plomb, cadmium, mercure et MCPD dans les denrées alimentaire
5) Reg. (CE) 466/2001 «fixation des teneurs maximales dans les denrées alimentaires »
6) Dec. 95/149 « fixant les valeurs limites en ABVT pour certaines catégories des produits de la pêche et les méthodes d'analyse à utiliser »
7) Dec. 2001/67 « modifiant la Dec. 95/328 établissant la certification sanitaire des produits de la pêche en provenance des P.T. pas encore couverts par une décision spécifique »

8) Directive 2000/13/CE «relative au rapprochement des législations des États membres concernant l'étiquetage et la présentation des denrées alimentaires ainsi que la publicité faite à leur égard ».

EXPORT POTENTIALS IN THE ARTISANAL FISHERIES SECTOR OF NIGERIA: OPPORTUNITIES AND CONSTRAINTS

by

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Abstract

Background information is presented on the fish resources and production of the artisanal and industrial fisheries sectors in Nigeria and the importance of the sector in terms of employment, income generation, foreign exchange earnings and food security. Fish and fishery products export potentials to Europe and the United States include shrimps, crabs claws, frozen fish, cephalopods, ornamental fish, smoked fish and dried white shrimps. Globalization has brought a number of changes in fish trade as well as increase in market opportunities. Nigeria artisanal fisheries could benefit considerably from increased trade to the ethnic markets in Europe and United States through export of smoked fish and small dried shrimp. However, the trade in traditional fish products, such as smoked fish, is coming under increasing scrutiny from authorities both in the exporting and importing countries. The importance of Quality Assurance and Quality Management based on the principles of Hazard Analysis Critical Control Points (HACCP) in the certification of the quality of fish and fishery products for local and export markets along the line of small-scale export in terms of sustainability of livelihoods are discussed. Constraints to trade and suggested improvement are highlighted. Recommendations are given for possible action by both the importing and exporting countries to meet the challenges and realize the opportunities in the global marketplace.

Résumé

Des informations de base sont présentées sur les ressources et la production des secteurs de la pêche artisanale et industrielle au Nigeria et l'importance du secteur en termes d'emplois, génération de revenus, devises étrangères et de sécurité alimentaire. Les potentiels d'exportation dans l'Union européenne (UE) et aux Etats Unis d'Amérique (USA) du poisson et des produits de pêche comprennent les crevettes, pinces de crabes, poisson congelé, céphalopodes, poisson ornemental, poisson fumé et crevettes blanches séchées. La globalisation a engendré un nombre de changements dans le commerce du poisson de même qu'une augmentation des opportunités de marché. Le secteur de la pêche artisanale du Nigeria pourrait bénéficier considérablement du commerce accru sur les marchés ethniques en Europe et USA à travers l'exportation de poisson fumé et de petites crevettes blanches séchées. Toutefois le commerce des produits de pêche traditionnels comme le poisson fumé, est sous examen minutieux par les autorités tant des pays importateurs qu'exportateurs. L'importance de la gestion de l'Assurance Qualité basée sur les principes de l'Analyse des Dangers Maîtrise des Points Critiques (HACCP) dans la certification de la qualité du poisson et produits de la pêche pour les marchés local et d'exportation le long de la chaîne d'exportation à petite échelle en terme de durabilité des moyens d'existence est discutée. Les contraintes au commerce et amélioration suggérée sont mises en relief. Les recommandations sont faites pour une possible action par les pays importateurs et exportateurs pour relever les défis et exploiter les opportunités du marché global.

1. INTRODUCTION

Nigeria has an estimated human population of 125 000 000, land area of 923 768 km^2 and a coastline of 853 km bordering the Gulf of Guinea. The territorial sea and Exclusive Economic Zone (EEZ) cover an area of approximately 256 000 km^2. The inland water mass constitutes about 15 million ha and includes natural and man-made lakes.

Fisheries have substantial social, economic, nutritional and food security importance. The contributions of fisheries to the nation's socio-economic wealth are enormous when considered against the background of employment creation, income generation, provision of valuable animal protein, rural development and foreign exchange inflow through export of shrimp and smoked fish.

In addition to those people involved in direct primary production of fish, there are those involved in ancillary industries, such as boat building, gear making, ice production, packaging, marketing and distribution.

The Nigerian fishing industry consists of three major sectors, namely, the artisanal, industrial and aquaculture. The artisanal fishery sub-sector contributes 87–90 percent of total domestic fish consumption in the country while that of the industrial fishery sector is very minimal and ranges between 5 and 7 percent. The aquaculture sector is now developing very fast although its contribution to domestic consumption of fish, which is still being quoted at 30 000 tonnes *per annum* (FDF), is an underestimation. The potential of fish farming in Nigeria is estimated at 1.31 million tonnes if 25 percent of 1.75 million ha of suitable land for farming is used (Tobor, 1991).

The industrial fishery sector in Nigeria is export oriented. Between 1993 and 2002 a total of 52 564 tonnes of fishery products valued at $276 million was exported. Products exported to European markets include shrimps, sole and cuttlefish, medium-sized barracuda and crab claws. On the other hand, the export activity of small-scale fishery is presently limited to sub-regional trade, which in most cases is not documented as to quantities and the returns in terms of foreign exchange earnings. This sub-regional trade is essentially a cross border transaction. However, some fishery products of small-scale fishery operators, mainly smoked fish and dried/smoked white shrimp, do find their way to Europe and United States, either through middlemen as accompanied baggage export or by air freight. Nigerians export about 60 tonnes (product weight) yearly to United Kingdom markets alone (Ward, 2000).

This paper discusses the various value-added products that can be derived from artisanal fish catches, globalization and the export markets for small-scale fish processors. Opportunities and constraints faced by exporters are highlighted and solutions proffered.

2. FISHERIES RESOURCES

In the marine fisheries the commercially important demersal resources include the Croakers (*Pseudotolithus typus* and *P elongatus*); Grunter (*Pomadasys* sp); Catfish (*Arius* sp); Spadefish (*Drepane africana*).

The most important pelagic resources in the in-shore areas are West African sardines (*Sardinella maderensis*) and bonga (*Ethmalosa fimbriata*), while tuna and tuna-like species are found offshore.

Among the shellfish, the pink shrimp *Penaeus notialis* and the tiger shrimp *Penaeus monodon* are the most common species.

In the inland fisheries the most common and important species and groups in this category include: *Lates niloticus*, *Clarias gariepinus*, *Heterotis niloticus*, *Tilapia* spp, *Synodontis* spp and *Gymnarchus niloticus*.

In the fish farming the most common and important species are the African catfish (*Clarias gaariepinus)* and Tilapia.

3. FISH PRODUCTION, DEMAND AND SUPPLY TRENDS

The estimated fish demand in Nigeria is 1.875 million tonnes based on a population figure of 125 million people and a per capita consumption of 15 kg, which is the global average. Average total fish supply including those from distant water trawlers is however on the average about 1.192 million tonnes *per annum* making per capita consumption 9.54 kg/head/year.

The Nigerian fishing industry consists of three major sectors, namely the artisanal, industrial and aquaculture. The artisanal fishery sub-sector contributes 87–90 percent of total domestic fish consumption in the country (Table 1). The contribution of industrial fishery sector to fish production is very minimal and ranges between 5 and 7 percent (Table 2). The aquaculture sector is now developing very fast although its contribution to domestic consumption of fish is still being quoted at 30 000 tonnes *per annum* (FDF), which is an underestimation. The potential of fish farming in Nigeria is estimated at 1.31 tonnes if 25 percent of 1.75 million ha of suitable land for farming is used (Tobor, 1991).

Table 1: Artisanal fish production in Nigeria (1997–2002), tonnes

Year	1997	1998	1999	2000	2001	2002
Coastal/ brackish	175 126	219 073	239 228	236 801	239 311	253 063
Inland rivers and lakes	185 094	213 996	187 558	181 268	194 226	197 902
TOTAL	360 220	433 070	426 786	418 069	433 537	450 965
Percent contribution	87.2	89.6	89.0	89.5	89.14	88.13

Table 2: Industrial fish production in Nigeria (1997–2002), tonnes

Year	1997	1998	1999	2000	2001	2002
Fish	15 326	17 947.3	14 181	13 977.3	15 792	16 064
Shrimp	10 807	10 716.3	15 249	8 056	12 380	12 797
EEZ	1 570	1 291	1 709	1 375	206	1 230
TOTAL	27 703	29 954.6	31 139	23 308.3	28 378	30 091
Percent contribution	6.7	6.2	6.5	5.0	5.84	5.88

Total fish supply in year 2002, including those from distant water trawlers, is however about 1.192 million tonnes *per annum* making per capita consumption 9.0 kg/head/year. Supplementation of domestic production with imports leads to a substantial outflow of scarce foreign exchange. Nigeria for example is the biggest importer of frozen fish in the world (Table 3).

Table 3: Nigeria fish import and value (1993–2002)

Year	Quantity (tonnes)	Value (US$)
1993	356 217	267 156 521
1994	229 224	150 947 991
1995	266 448	140 308 752
1996	403 273	290 351 310
1997	382 442	158 632 744
1998	373 043	190 098 052
1999	466 840	209 958 638
2000	557 884	241 066 537
2001	648 196	368 188 841
2002	681 151	375 027 917
TOTAL	4 364 718	2 391 737 303

4. FISH AND FISHERY PRODUCTS IN NIGERIA FOR EXPORT MARKETS

A wide range of fish and fishery products is produced in Nigeria for the international markets, while some others are imported for consumption. Among the fish and fishery products imported are canned fish, stockfish, frozen fish, fish fingers and smoked fish.

Products exported to Europe include fresh fish, frozen fish, smoked and dried fish, frozen shrimps and prawns, frozen crab claws, frozen cuttlefish and fish fillet. Shrimp accounts for about 86 percent of fish and fishery products exported to Europe, followed by crabs (6 percent), fish (4 percent) and cephalopods (4 percent). Table 4 shows the volume and values of shrimp export between 1993 and 2002.

Table 4: Nigeria shrimp export and value (1993–2002)

Year	Quantity (tonnes)	Value (US$)
1993	2 322.59	8 539 423.48
1994	3 368.39	11 163 114.00
1995	4 265.28	13 393 769.00
1996	3 845.50	14 345 623.85
1997	2 946.15	8 386 458.40
1998	8 028.16	31 163 784.00
1999	7 418.74	46 485 491.05
2000	6 303.25	39 495 886.22
2001	6 694.21	48 820 497.00
2002	7 372.54	54 053 123.00
TOTAL	52 564 81	275 847 169.00

As for the traditional smoke-dried products, the target products for export are smoked whole catfish, chunked smoked *Heterotis*, chunked smoked mixed species of freshwater species, such as *Gymnarchus* spp., Nile perch and catfish. Others are smoked bonga, *Sardinella*, sole and a few small white shrimp either in smoked or dried forms. Smoked catfish accounts for 70 percent of all exports to the ethnic markets in Europe and America. The traditional fish and fishery products are destined for the so-called ethnic markets in Europe, United States and other countries of the world.

5. LAWS AND REGULATIONS GOVERNING FISHERY PRODUCTS

There are various laws and regulations put in place nationally and internationally to assure safety and quality of fish and fishery products. In Nigeria, Federal Department of Fisheries of Federal Ministry of Agriculture and Rural Development is the competent authority that regulates fisheries activities and certifies fishery products for export. The relevant regulations in Nigeria governing fishery products are:

- Sea Fisheries (Fish Inspection and Quality Assurance) Regulations 1995
- Inland Fisheries (Fish Quality Assurance) Regulations 1995

These Regulations are HACCP based. It is a self-regulatory mechanism for all producers and processors. Its implementation is mandatory. The provisions of these regulations are akin to those of the United States Regulations and the EU directive 91/493/EEC laying down the health conditions for the production and placing on the market of fishery products.

The three organizations saddled with the development and enforcement of such regulations – FDF, NAFDAC and SON – play complementary roles and act in consonance with the provisions of the Codex Alimentarius Commission. The other laws that regulate fish production activities are:

i. Sea Fisheries Decree No. 71 of 1992
ii. Inland Fisheries Decree No. 108 of 1992
iii. Sea Fisheries (Licensing) Regulations
iv. Sea Fisheries (Fishing) Regulations

While processors are expected to comply with (a) and (b) above, producers are to comply with (i) to (iv) above. The quality assurance regulations have been made in line with internationally recommended codes of practice and standards by Codex Alimentarius. These are meant to satisfy the Sanitary and Phytosanitary (SPS) requirements of WTO and the importing countries. They promote good hygiene practices (GHP) and good manufacturing practice (GMP).

6. OPPORTUNITIES AND CHALLENGES IN ARTISANAL EXPORT TRADE

6.1 Ethnic market

Immigrants in Europe, United States, Canada, Japan, Saudi Arabia and elsewhere like to eat their own traditional products, at least every now and then. This has created an interesting ethnic market for such products in the global marketplace. For instance in Europe, the market for smoked fish from West Africa may be over 3 000 tonnes per year with a producer value of US$10 million and a retail value of US$50 to 60 million. Imports of smoked fish from West Africa into the United Kingdom during the 12 months from May 1999 were estimated to be in the order of 500 tonnes (product weight), with a retail of US$5.8 and US$9.35 million (Ward, 2000). Nigeria accounted for 50 percent of the trade. The main beneficiaries of the trade, which relies on artisanal processors, appear to be entrepreneurs who facilitate export and import. While they play an important role and one that would be difficult to replace, there is clearly a need to develop the trade and organize it so that rejection is minimized, the vulnerability of those involved is reduced and the returns more equitably shared.

Globalization is the increased interconnectivity of countries and people in the world where we share our products, our cultures and ourselves (Teutscher, 2000). Globalization has brought with it a number of changes in the way in which trade is undertaken as well as an increase in market opportunities. On the one hand, equivalence of production and quality assurance systems has led to the introduction of associated standards by key markets, such as the European Union and North America. These new and relatively stringent standards have to be met by producers and exporters in any country, who wish to supply these markets.

6.2 Prerequisites

What are the prerequisites to play or start to play in the global marketplace?

- First of all, there must be goods or services available for trade.
- Second, there must be exchange of information between buyers and sellers.
- Third, products must be competitive in the market.
- Fourth, countries and communities cannot formally participate if there is no proper governance, i.e. if there is no legal framework and no functioning and stable institutions.

A numbers of actions must be taken to meet the challenge and realize the opportunities.

7. COMPLIANCE WITH IMPORT REGULATIONS

The challenges are high and so are the rewards if the challenges are met. The losses of failing to meet them are equally high. A particularly difficult challenge for developing countries is formed by the quality regulations in the global marketplace. Much effort has been made by many countries to strengthen their fish inspection services and upgrade their production systems in order to comply with the quality requirements. Anyway, the rewards were sweet: many developing countries saw a sharp increase in fish export over the last years. But reaching compliance is one thing, maintaining compliance is another, and several countries are now in difficulty and risk losing market access. Incidentally, importing partners do not offer sufficient help to exporting countries to maintain compliance levels except maybe in a few cases.

7.1 Constraints to trade

The trade in traditional fish products, such as smoked fish from West Africa to Europe, is coming under increasing scrutiny from authorities both in the exporting and importing countries. International trade legislation designed for relatively sophisticated industrial level processing is being applied to what is essentially a traditional process. As a result, processors and exporters are unable to meet the required standards set by authorities in the country of export. Likewise, importing country authorities apply inspection procedures, which 1 in 4 consignments fail (Ward, 2000). Of these, 70 percent are destroyed. This is approximately 17.5 percent of airfreight consignments and equivalent to 20 tonnes of product, with a retail value of £240 000 to £390 000 at current prices. Formal trade is therefore being constrained in what is, at retail level in importing countries, a high-value product. And parallel to formal trade there is an informal export and import trade, which relies on air passengers who carry small amounts of product in their luggage

As a result of enforcement of relatively recent EU legislation governing fish and fish products and import/export, consignments of smoked fish are regularly detained and often destroyed by Port Health Authorities at Gatwick and Heathrow Airports. The main reasons why smoked fish consignments are detained are:

- Smoked fish is smuggled in among other goods such as vegetables and is therefore undeclared and therefore has no health certificate. Likewise undeclared dried meat is concealed in consignments of smoked fish.
- Packaging is inadequate – re-used (computer or TV boxes), in poor condition; newspaper or baskets are used for packing the fish.
- Insect infestation.
- Establishment numbers are stapled on the box rather than written on (labelling).
- Health certificates are not filled in correctly. For example, the establishment number is used as the reference number. The word “various” is used as the scientific name of species rather than the scientific name.

7.2 Suggested improvement

In order to minimize the risk of consignments being detained by Port Health Authorities on arrival in an EU country, it is recommended that existing and potential exporters and importers' attention be drawn to the control of insect infestation and mould growth, the use of correct packaging, and how to prepare and process the necessary paperwork for export/import. Best practice guidelines for exporters and importers to minimize detention of smoked fish at port of entry is presented in Appendix 1.

8. IMPORTANCE OF EXPORTS TO LIVELIHOODS IN SMALL-SCALE FISHERY

The importance of exports to small-scale fishery operators for sustainable livelihoods is first and foremost to earn foreign exchange. When value is added to fish and fishery products, there are benefits in a number of ways. In many instances, adding value will be equated with exporting the resultant products and earning foreign exchange, which may be important for economic security. The employment of more labour for the tasks of value addition may distribute wealth more equitably and add to the food and economic security of individuals.

Foreign exchange earnings by small-scale fishery will not only allow the operators to bring in some of the inputs that have to be imported, e.g. nets, outboard engines (OBE) and spare parts, but also guarantee a more decent and better standard of living (Akande, 2000). This will also alleviate their poverty level in terms of:

- being able to send their children to good schools (i.e. better education);
- being able to afford medical expenses to stay alive;
- being able to eat good food;
- being able to employ others to work for them outside the family ties;
- being able to afford the luxuries of life, e.g. decent houses and cars.

9. CONCLUSION

The importance of export includes its potential to generate the much-needed foreign exchange from value added and other products exported to international markets. The benefits that will accrue include better standard of living and economic security. Against the backdrop of equitable distribution of wealth and economic security of individuals, the consequences of international trade on the supply of low-value fish for poorer people must also be at the front burner when exporting high-value fish and fishery products to developed countries. At the same time there is a need to better understand the implications of the trade on food security at home. Food security is a key issue in Nigeria. Initiatives to support the export of traditional products must consider the implications this will have on food security. An analysis of current policy on food security, poverty alleviation and export trade would provide a baseline understanding of how Nigeria is currently addressing the food security and export trade without one jeopardizing the other.

10. RECOMMENDATIONS

The following recommendations emanate from this paper:

- Importing partner countries in line with the directives and guidelines of WTO, should assist developing countries in attaining and maintaining compliance with the rules and regulations of the global marketplace, in particular in the areas of quality assurance and technology.

- Special standards should be developed for export of traditional products, and information about the "ethnic" market should be promoted to stimulate the trade.

- Partnerships should be between exporters or associations of exporters of fish and fishery products in developing countries with distribution centres in importing countries.

- Governments must assist small-scale fishery operators to break into international markets through provision of infrastructures, exemption or low export tariff, credit facilities and sponsor research.

APPENDIX 1

Best Practice Guidelines for exporters and importers to minimize detention of smoked fish at port of entry (Ward, 2000).

Documents
Consignment must have a fully completed and original health certificate issued by the EU competent authority in the country of export. The health certificate must be completed using the language of the country of entry into the EU, e.g. English for the United Kingdom, French for France.

The health certificate must:
- be on a single sheet of paper;
- show no correction or tipex;
- give the common name and scientific name of the fish species;
- give the correct weight of the consignment as per the air waybill;
- show the official stamp of the EU authorized authority in the country of export;
- include the name, capacity and signature of the authorized EU authority representative;
- have an official stamp of the authorized authority in a different colour to other stamps on the certificate.

Air waybill or bill of lading
This must show the consignee's full name and address and telephone number.

Packing list and/or invoices
This must always be attached to the air waybill. All items in the consignment must be declared. The word <u>assorted</u> is not allowed.

Certificate of Veterinary Checks available from the EU Port Health Authority
Importers wishing to clear their own consignments should go to the airport cargo shed reception. The reception staff will give you a copy of the Certificate of Veterinary Checks (CVC) form and the other documents (health certificate, invoice, air waybill, packing list) accompanying the consignment. You must complete the left-hand side of the (CVC) form. The other document will contain information you require to do this. When you have completed the CVC you should take it along with the Health Certificate, air waybill and/or invoices and packing list to the Port Health Authority. An officer will inspect the consignment and issue a Port Health clearance note. You can obtain customs clearance.

Packaging
Smoked fish must be packed in new cardboard or polystyrene boxes. It must not be packed in re-used boxes, baskets or be packed using newspaper, otherwise it will be detained.

Clearly written or stamped on each box should be:
- name of the country of origin of the product;
- number of the EU approved establishment from which product originated.

Product
The two main reasons why Port Health will detain and destroy smoked fish consignments are because it is infested with insects or there is mould growth on the product.

Insect infestation
The most common insect infesting smoked fish is the adult *Dermestes* beetle and its larvae (small hairy reddish brown maggot). Exporters should ensure that after smoking the product does not come into contact with adult beetles or larvae. Smoked fish should be stored in an insect free environment. It should not be stored or mixed with product from unknown sources where insect infestation exists before it is packed and taken to the airport. Only insect free consignments should be exported.

Mould growth
Mould spores are found in the air and soil and can contaminate fish during processing. Exporters should ensure that smoked fish are checked for mould growth before a consignment is packed and transported. They should also make sure that smoked fish has been well dried and stored and packed in a dry environment using dry packaging materials. Packing smoked fish close to high moisture food stuffs, such as vegetables, may lead to high humid conditions during transport and will increase the likelihood of mould growth.

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THE CHALLENGES IN PROMOTING EXPORT OF FISH FROM ARTISANAL MARINE FISHERY IN TANZANIA

by

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Abstract

The advent of trade liberalization coupled with higher fish prices in the global fish market is tempting Tanzania to expand the exportation of fish. The idea at the moment is to include in the export list certain finfish species being caught by artisanal fishers on the inshore marine waters. The initiative is quite in line with the current fisheries policy, which emphasises on increasing food fish availability, increasing fishers' income, employment in fisheries and increasing foreign exchange from fish export. Indeed, the country has experience in exportation of fish and fish products, especially from Lake Victoria fishery. However, this new venture will most likely pose some unique challenges. Whereas in the case of Lake Victoria the export trade has predominantly been that of an exotic species, the *Lates niloticus*, in the marine it is intended to include more than 12 species with diverse harvesting and spoilage characteristics. The potential problems of quality and quantity would probably emerge as a function of resource, technological and institutional limitations. This paper presents a systematic assessment of the situation, looking at various potential challenges. It also provides measures that can be adopted in mitigating the resource, socio-economic and technological issues to meet the food security at home and food safety requirements of the importing countries.

1. INTRODUCTION

The total fish landings from both inland and marine capture fisheries in Tanzania are estimated to range between 300 000 and 400 000 tonnes *per annum*. The former fishery produces more than 80 percent of the total, which excludes the amount that is caught by foreign vessels in the Exclusive Economic Zone (EEZ). Fishing is predominantly artisanal, a sub-sector that generates more than 95 percent of fish from the traditional sources.

The country has a coastal line stretching for about 1 400 km long; however, its continental shelf is very narrow and it lacks favourable oceanographic conditions, such as the upwelling. As in the case of other water bodies in the country, fishing in the inshore marine waters is basically artisanal. In addition, there is limited shallow water shrimp trawling by an average fleet of 20 licensed vessels *per annum*.

The development of artisanal marine fishery has been sluggish, retarded by various problems to include: lack of capital associated with lack of credit facilities, low level of technology, unavailability of fishing gear and poor extension services. Consequently, fish landing from the inshore marine waters is relatively low, standing at about 50 000 tonnes *per annum*, despite the estimated potential yield of over 100 000 tonnes.

The artisanal marine fishery sub-sector employs more than 20 000 full-time fishers, using about 5 000 small fishing canoes. A common canoe has the capacity of taking a crew of four fishers on board, for a day trip. Passive gears, particularly gill nets of different size, hand lines, long lines and traps do most of the fishing. The motorization level is still low with about 500 out-board and less than 100 in-board engines. The engines are more often used by fish collection boats, which are relatively larger than a common canoe.

The fishery produces mainly sardine and anchovy, which together forms 30–50 percent of the total fish landing. Other fish being landed include: scavenger (*changu*), parrotfish (*pono*), Carangidae

(*Kolekole*), rabbitfish (*Tasi*), mackerel (*Vibua*), sharks (*Papa*), rays (*Taa*), lobster (*Kamba kochi*), shrimp (*Kamba*) and octopus (*Pweza*).

Crustaceans, molluscs and echinoderms, such as shrimp, lobster, crabs and sea cucumber, have for quite a long time been traditional export products from the marine waters. The increased financial and socio-economic benefits being accrued from fish export trade is tempting the country to promote even further the fish export drive. This is in line with the current poverty alleviation policy. However, there are important issues that have to be addressed before such a goal can be realized.

2. OBJECTIVE

The objective of this work is to assess the main challenges that face the export promotion drive and present possible mitigation measures. It focuses on three main challenges:

- How to balance potential trade-offs.
- What can be done to develop compliance to fish quality, safety and value addition.
- How to develop human and institutional capacity to meet the other challenges.

3. METHODS

This study is a multidisciplinary assessment of the situation based on historical data, literature review, field visits, unstructured interview and experience from different places. The analysis starts with an overview on fish export trend before tackling the challenges.

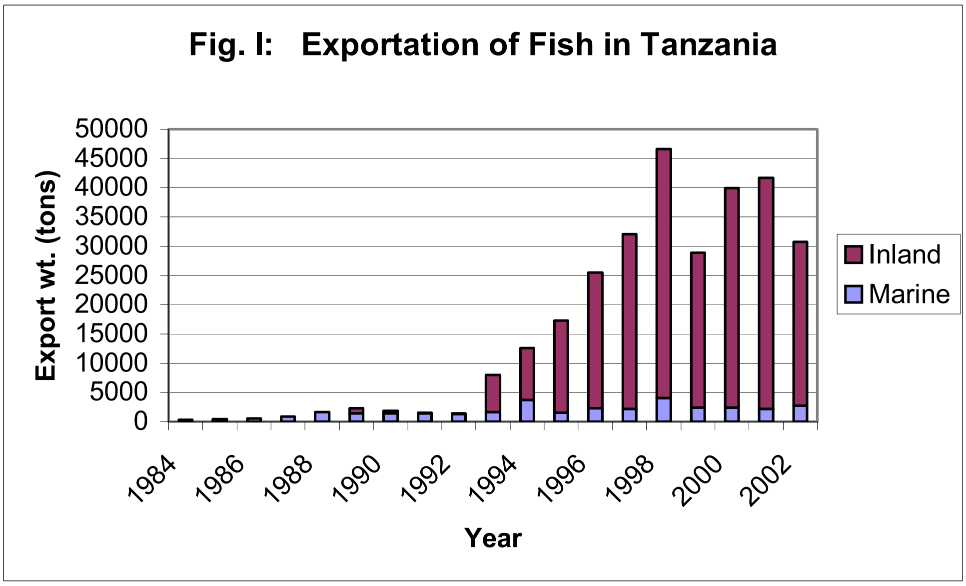
4. THE FISH EXPORT TREND

The exportation of fish and marine product from Tanzania has a long-standing history; it dates back to the thirteenth century. During the period, traders from Persia, Arabia and India, travelling by sea, used to take out dried salted fish – particularly the king fish, sea shells, shark fins and later on the sea cucumber. Export trade of fish from the inland waters was mainly confined to riparian countries, say Lake sardine from Lake Tanganyika (Tanzanian sector) being sold or bartered in Congo D.R or Burundi.

The trade continued even after independence from Britain in 1961. East and Central African countries remained the main export market for cured fish from Tanzania. Nonetheless, the trade was restricted by government policy aimed at promoting food security at home. However, marine products, such as prawns, sea cucumber, lobster, crab and seaweed, were exempted from this policy intervention. The above products were not in high demand locally because of prohibitive price, local customs and taboo.

The restrictive policies were reversed in the advent of trade liberalization policy, under the Structural Adjustment Programme (SAP), back in 1980s. The move coincided with Nile perch (*Lates niloticus*) boom in Lake Victoria and expansion of coastal state jurisdiction over the EEZ. The favourable conditions, however, could not bring immediate expansion of the export trade. Marketing of fresh/frozen fish beyond the boarders was severely limited by lack of adequate human and physical capacity.

The period between late 1980s and early 1990s experienced tremendous growth in exportation of cured fish. Smoked and salted dried Nile perch as well as sun-dried Lake sardines became popular products in the regional market. The volume was significant in that some of the importing countries went to the extent of re-exporting the products to other distant landlocked countries (Dampha, 1993).



The exportation of frozen fish from Tanzania increased exponentially in 1993, when about 8 000 tons export weight or 21 000 tons (l.w.e) were exported compared to 2 000 tons (l.w.e) in 1992 (Figure 1). This was achieved following the building of export-oriented fish processing plants, particularly in Lake Victoria zone and the expansion of the EU market.

At the moment, Tanzania has about 19 fish processing plants, with different capacities, that are approved to export fish and fish products to the EU markets (Table 1).

Table 1: Distribution of approved fish processing plants

	LOCATION	FISHERY	NO. OF FISH PLANTS
1.	Dar-Es-Salaam	Marine	6
2.	Tanga	Marine	1
3.	Mafia	Marine	1
3.	Mwanza	Lake Victoria	8
4.	Musoma	Lake Victoria	3
TOTAL			19

Source: URT – Fisheries Division

Important traditional fish and fishery products exported from the inshore marine fishery in Tanzania are presented in Table 2.

Based on available data, there is no doubt that export of fish and fish products have assumed an increasingly higher proportion in the economy of the country. Today fish and fishery products are ranked among the top five export products in Tanzania in terms of value. The export volume is valued at about US$60–70 million *per annum*.

It ought to be said, however, trend in Tanzania seems to follow what is going on in the whole of the developing world, where fish export is now forming the bulk of export earning. FAO (2004) estimated that in 2002 the developing countries' share in total fishery exports was 49 percent by value and 55 percent by quantity. At the same time, developed countries accounted for about 82 percent of total fishery product imports.

Table 2: Export of fish from the inshore marine water (kg)

Fish products	2000	2001	2002
shrimp	1 218 180.50	1 175 095.00	1 248 008.20
Lobster	63 093.40	98 793.00	119 261.00
Live lobster	14 798.50		63 589.00
Crab	29 880.00	51 719.00	487 950.00
Live crab	67 261.00		128 242.00
Octopus	492 763.20	275 285.70	355 310.00
Squids	26 749.50	55 164.00	59 359.00
Sea shells	345 163.50	433 643.00	253 189.00
Beche de mer	124 478.00	49 947.00	6 800.00
Shark fins	3 337.00	2 849.00	-
TOTAL	**2 385 704.60**	**2 142 495.70**	**2 721 708.20**

Source: URT Statistics

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4. THE CHALLENGES

Although there are many formidable challenges facing the exportation of marine finfish, the issues of potential trade-offs, quality and institutional capacity building seem to be the most prominent ones.

5. POTENTIAL TRADE-OFFS

The global fish market is expanding rapidly as a function of stagnation in fish production from the traditional capture fishery, at the time the population grows exponentially. Actually, the prevailing situation increases the aggregate demand for fish, thus raising fish prices.

In turn, the high fish prices stimulate the export drive, particularly from poor countries to high-income countries. It creates a favourable condition for countries such as Tanzania to realize fisheries development objectives. In most cases this includes: increasing food fish availability to people, income to fishers, employment opportunity and, of course, increasing foreign exchange for the country.

An attempt to realize the multiple objectives simultaneously, however, could easily lead to serious trade-offs. Potential ones may include:

- Trade-offs between export revenue and food security.
- Trade-offs between increased income and employment opportunity.
- Trade-offs between export revenue and resources sustainability.

Trade-offs between export and food security
Based on experience from different countries, export of fish often has direct impact on domestic consumption. Once started, increased volumes of fish would tend to flow to the lucrative markets, reducing per capita fish supply at home. The mechanism behind it is simple to understand, "*You can't eat your cake and have it*", so goes an adage.

The fish prices being offered in the domestic market are low compared to the ones prevailing in the global fish market. For instance, an average price of fish in distant fishing grounds in Tanzania ranges between TZS 150/=[1] to 300/= per kilogram of popular brands such as scavenger, rabbit fish and Carangidae. It is much lower for sardine, which can fetch as low as TZS 50/= per kilogram. The price is relatively about six times higher in Dar-Es-Salaam and ten times more in the export market. This price differential justifies and can easily trigger increased effort to sell fish in the latter market.

Regarding the contribution of fish towards food fish security, Friedrichs (1998) reported that in Tanzania fish was contributing about 37 percent of total animal protein. This was definitely a significant raise, from about 10 percent at independence in 1961. The positive trend could be attributed to deliberate promotional initiatives taken by the government to increase fish production and ensure adequate supply to the domestic market.

The 1989 fisheries policy white paper had a target set to raise annual average per capita consumption of fish from 12 kg to 20 kg by the year 2000. Unfortunately, however, this could not be realized because of stagnant production from capture fishery, sluggish aquaculture development and population growth. Mgawe (2000) found the per capita fish supply in Tanzania was 6.5 kg/person/year at independence in 1961, peaked up at 16 kg/person/year in 1988 before declining, back to 6.5 kg/person/year in 1998. Gradually, increased fish export is generating a negative impact on fish supply per capita at home.

This is happening when prices of substitute protein products such as poultry and beef products are increasing. Possible solution under this circumstance may include improved utilization of unpopular small-sized tropical species to include Lake sardines and by-catch products. Production of value-added products is one way of improving the utilization.

Trade-offs between income and employment
Improvement of fishing technology is the most common method used when trying to increase fisher's income. Under artisanal setting this may include increasing the number of engines to enable fishers to reach distant rich fishing grounds and bring back the catch before spoilage. However, technological initiative can lead to a shift from labour-intensive artisanal fishery to capital-intensive semi-industrial fishery, consequently reducing employment opportunity in the fisheries.

To safeguard employment opportunity in the inshore fishery, the government needs to adopt the same policy intervention that it employed in the case of Nile perch fishery in Lake Victoria – where semi-industrial fishing was prohibited, allowing fishing to continue being the domain of artisanal fishers only.

Trade-offs between export and resource sustainability
There is no doubt that expanded export trade has socio-economic benefits, including revitalization of the local economy, employment opportunity, increased income, foreign exchange and entrepreneurial opportunities in the fisheries sector. This goes well with government policies on fisheries development and poverty alleviation. On the other hand, however, this could be a looming threat for marine resource conservation and its sustainability.

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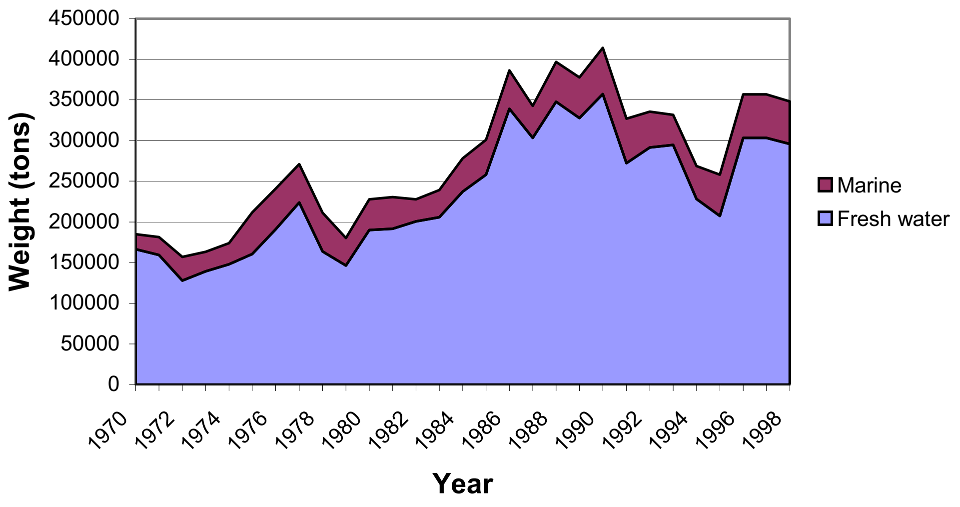
[1] 1 US$ = TZS 1 120

The historical data available suggests that the inshore marine resources in Tanzania and the level of harvesting placed upon it by the local fishing communities have reached a constant stage. Neither the landings nor the fishing effort shows noticeable increment over time (Figure 2 and Table 3). This could suggest that either this fishery is still in its development stage with potential room for expansion or is operating at an Open Access reference point.

Based on the precautionary principle it is imperative to lean on the side of resource. The fact that the yield and fishing effort have remained at the same level for a number of years, casts some doubt over the authenticity of working assumptions on fish stocks. Under such uncertainties the move to promote fishing effort has to be taken very carefully to avoid the collapse of the respective fishery.

Fig. 2: TOTAL FISH LANDING - TANZANIA



The high fish price offered by the export fish market coupled with poverty and profit motive will be an incentive for illegal, unreported and unregulated (IUU) fishing. The intensification of the fishing effort under the Open Access scenario will most likely result in over-fishing and habitat destruction, a development that can be terminal to the resource base.

Furthermore, the condition in place allows only a few species of fish to be processed for export (Table 4). It also imposes size restriction; fish weighing less than 2.5 kg per piece is prohibited from being used as raw material for the export market. The measures are meant to safeguard the fishery resource from growth over-fishing and, more important, to safeguard food security at home.

On the other hand, however, the fish species and size that have been authorized form less than 10 percent of fish landings from the inshore marine fishery (Table 5). As if that were not enough, about 30 percent of the eligible species being landed is made of small-sized fish below the legitimate size of 2.5 kg per fish.

Table 3: Fishing effort profile

ITEM	1998	2001	CHANGE
Number of landing sites	210	206	-4
Number of fishers	20 625	19 293	-1 332
Number of fishing vessels	5 157	4 927	-230
No. of outboard engines	463	336	-127
Number of inboard engines	55	51	-4
Gill nets	9 125	5 136	-3 989
Shark nets	3 463	2 852	-611
Traps	5 299	5 557	+258
Hand lines	9 383	13 382	+3 999
Long lines	11 734	5,272	-6 462
Beach seines	319	485	+166
Trawl	7	4	-3
Cast nets	0	173	+173
Ring nets	128	224	+96
Scoop nets	256	252	-4
Purse seine	15	68	+53
Fixed fences	254	72	-182
Spears	0	496	+496
Trawlers	17	20	+3

Source: URT Frame survey

Table 4: Provisional list of finfish allowed for export

	Common name	Local name	Species
1.	Tuna	Jodari	*Thunnus, Euthynnus* spp.
	Kingfish	Nguru	*Scomberomorus* spp.
2	Carangids	Kolekole	*Caranx* spp.
3	Parrot fish / blue fish	Pono	*Scarus, Calotomus* spp.
4	Red snapper	Fuatundu	*Lutjanus* spp.
5	Grouper/ Rock cod	Chewa	*Cephalopholis, Epinephelus* spp.
6	Shark	Papa	*Triaenodon, Carcharhinus* spp.
7	Skate	Taa	
8	Soles	Gayogayo	*Bothus*
9	Marlins	Nduwaro	
10	Catfish	Hongwe	*Ariidae*

Source: URT

Table 5: Composition of fish sold at ferry market in Dar July 2002-July2003

No	Common name	Local name	Weight (kg)	Percent (%)
1	Sardine	Dagaa	2 326 929	57
2	Mackerel	Vibua	362 828	9
3	By-catch	Samaki wa meli	353 085	9
4	Scavenger	Changu	237 888	6
5	Carangoides	Kolekole	75 279	1.8
6	Rabbit fish	Tasi	67 601	1.6
7	King fish	Nguru	50 920	1.1
8	Parrot fish	Pono	39 787	1
9	Tuna	Jodari	22 890	0.5
10	Others	Wengineo	532 404	13
	TOTAL		**4 069 611**	**100**

Source: Ferry Fish Market Statistics

This leaves a very small quantity of raw material qualifying as raw material for export under standing regulations. The struggle to increase the landings can fuel the multiplication of fishing effort, with fishers fishing harder to meet both the export demand and the equally competitive expanding domestic fish market (Table 6).

Table 6: Average fish prices at ferry fish market July 2002-2003

No.	Common Name	Local Name	Price (Tsh)/kg
1	Lobster	Kambakoche	4 746
2	Tuna	Jodari	1 344
3	Kingfish	Nguru	1 206
4	Grouper/Rock Cod	Chewa	1 131
5	Emperor red snapper	Fuatundu	1 048
6	Octopus	Pweza	879
7	Scavenger	Changu	826
8	Shark	Papa	815
9	Carangoides	Kolekole	811
10	Redfish	Numba	787
11	Baraccuda	Mizia	771
12	Rabbit fish	Tasi	704
13	Silver-biddy	Chaa	664
14	Ray	Taa	646
15	Catfish	Hongwe	605
16	Mackerel	Vibua	565
18	Parrotfish	Pono	551
19	By-catch/frozen	Samaki wa meli	379
20	Sardine	Dagaa	212

Source: Ferry Fish Market Statistics

The challenge in this regard is how to trade profitably without further depleting fish stocks**.** One possible solution to this situation would be to promote production of raw material for the developing industry of value-added products that can utilize small-sized tropical species.

In addition, many actions are needed to prepare for the ability to monitor, regulate and control the impacts of the export drive. The intervention should include building the institutional capacity in terms of training, control and enforcement mechanism.

6. QUALITY ISSUES

The complexities of harvesting, processing, transporting and distributing finfish from remote points along the 1 400 km of coastline create formidable challenges. One obvious challenge is the production of high- quality products to meet stringent quality standards of potential importers.

Tanzania has good experience on how problems associated with quality can interrupt the export trade and cause devastating socio-economic problems to the fishing community. In two different occasions, January 1997 to August 1998 and March to December 1999, the EU imposed a ban on importation of fish from East Africa over quality assurance issues.

Given that the EU is the main trade partner, importing over 60 percent of the fish, the measure had a devastating economic effect on the country. And more important it affected the livelihood and socio-economic pattern in fishing communities. Export quantity dropped by 55 percent and domestic price fell by 70 percent from TZS 850 down to 250 per kg. Similarly, the number of fishers decreased by 20 percent (URT 1999).

Based on such experience it is important to consider risk areas in the inshore marine fishery production chain and take precautionary control measures.

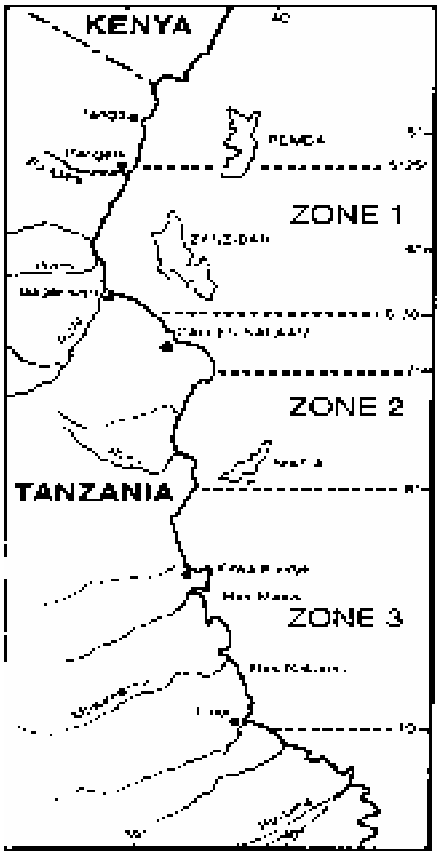


Figure 3: Fishing zones in Tanzania

The potential quality factors that could affect promotion of fish export from the inshore marine fishery in Tanzania include:

- distance between fishing grounds and fish plants;
- the supply of quality ice;
- personal hygiene and handling practice;
- undeveloped fish landing sites;
- limitation in existing regulations.

6.1 Distance between fishing grounds and fish plants

Most of the rich fishing grounds are situated in areas far from where fish processing plants are located (Figure 3). The whole of the coastal line has eight fish processing plants; six are located in Dar-Es-Salaam, one in Mafia and the remaining one in Tanga

For a number of years fishers and fish collectors have been trying to fish, store and transport their fresh fish catches to the much paying urban fish markets. However, the practitioners have been recording huge physical and financial losses as a result of poor fish handling practices, time involved and high tropical temperatures.

On average, a fishing/collection trip can take about 7–12 days. During this period, fish is iced and kept inside locally made insulated containers. Unfortunately, the containers are poorly designed and constructed resulting in high-melting rate, thus increased cost of ice. Fish handlers use insufficient amount of ice in order to reduce the cost; in the process they tend to lower the quality of fish.

The challenge in this context is how to disseminate the construction technology and the use of improved locally made, insulated fish containers, and promote proper application of ice.

6.2 The supply of ice

Most of the ice being used by fishers on the inshore marine fishery is supplied by ice plants situated in Dar-Es-Salaam. The ice is transported in rectangular insulated containers placed on board transport boats. An average container has a holding capacity of about 3–3.5 tons.

Generally, the cost of ice tends to be high because of high-melting rate as a result of tropical temperature, prolonged fishing trip of up to 12 days, and poor construction of the containers.

Small rectangular boxes are also used in transportation of fish on trucks. These are made of soft wood insulated by expanded polystyrene; unfortunately the construction is poor, resulting in insufficient use of ice and supply of low-quality fish.

Part of the solution to the present problems may include encouraging private investors to establish fish processing plants in rich fishing areas. Actually, the one in Mafia is a very good example of the proposition. The initiative has reduced the time taken to deliver the fish to a processing plant and ensure that quality ice is available in sufficient quantities.

Likewise, it is important to make sure that adequate training in fish handling and use of ice is provided to fishers and fish handlers. Carpenters have to be trained in design and construction of proper insulated fish containers.

6.3 Personal hygiene and handling practice

Contamination by fish handlers is the main source of great quality problems in fish handling and processing industry. The new export trade will require changes in attitude among practitioners. Hence, it is important to develop a training programme on personal hygiene and sanitation for the practitioners.

6.4 Undeveloped fish landing sites

The coast of Tanzania has about 206 multi-user landing sites (Table 7). Generally, the sites are sandy beach lacking important facilities for proper fresh fish handling, such as potable water, ice, containers and storage equipment. As a matter of fact, the sites can hardly offer expected support for upstream handling of fish, particularly for the quality demanding export market.

In view of the prevailing situation, there should be a plan to upgrade the existing low-cost sites to meet the standards required by importers. The provision of ice in a selected site should be a priority. This can be facilitated through the use of ice silos, insulated containers and even small solar-generated ice plants.

Lack of landing platform is another problem that reduces unloading and handling efficiency. The use of barge and floating fish processing plants is certainly another alternative to resolving this problem and enhancing the quality of export products.

Table 7: Total landing sites along the coast

	Region	District	Permanent landing Site	Temporary landing Site	Total
1.	TANGA	Muheza	18		18
		Pangani	12		12
		Tanga	25		25
2.	COAST	Bagamoyo	13		13
		Mafia	32	2	34
		Mkuranga	10		10
		Rufiji	12	3	15
3.	DAR-ES-SALAAM	Ilala	1		1
		Kinondoni	5		5
		Temeke	8		8
4.	LINDI	Kilwa	17	1	18
		Lindi	18		18
5.	MTWARA	Mtwara	29		29
TOTAL			**200**	**6**	**206**

Source: URT Frame survey 2001

6.5 Limitation in existing regulations

There are several legal instruments that provide for fish quality control and assurance in Tanzania. These include: The Fisheries Act (2000), Fish Quality Control and Standard Regulations (2000) and Food (Control of Quality) Act No. 10 of 1978. However, enforcement of these regulations has been passive with little incentive to act. The advent of increased export trade will dictate improved monitoring and control systems supported by a functional fish inspection regime.

Again, the country is yet to establish a risk-based control system for the species allowed for export. Hence, a well-designed survey of the fish supply chain is required in order to identify control points and prepare a code of practice.

In this regard, fish inspectors will need reorientation and sufficient knowledge to enable them cope with monitoring of the control system in place and that required by the international market.

7. INSTITUTIONAL CAPACITY BUILDING

The quality issue is crucial in winning an export market, which is rather complex, characterized by dynamic demands. At the moment, it entails mandating the use of Hazard Analysis Critical Control Point (HACCP) system and adoption of risk analysis. It also compels increased testing of important quality parameters in order to maintain and improve fish safety standards. Unfortunately, many of the players in the Tanzanian artisanal marine fishery are not aware of the standards required by their high paying fish importers!

The provision of adequate training to key practitioners in this regard is the major requirement for successful improvement of fish safety and standards to attract the export market. The training programme should be designed to involve all stakeholders including: fishers on board, fish collectors, landing site managers, processors in plants and fish inspectors, as well as laboratory personnel from the Competent Authority.

It is also imperative that the communication network be established to connect important landing sites and players. This will enhance flow of market information and provision of other important technical and administrative services.

8. RECOMMENDATIONS AND CONCLUSION

It is generally agreed that fish export should be promoted and sustained because of its positive effects on the sustainability and improvement of livelihoods of the fishing communities, including the poor. However, the following considerations are very important in ensuring success of the export drive for the in-shore marine finfish in Tanzania.

- Societies no longer exist that are not aware of the high paying fish markets. In this case, it is futile and, indeed, unjustifiable to deny the export drive that does not touch the sardines, important in ensuring food security at home.

- The quantity of legalized fish, which can be made available as raw material for filleting, is too small to support a reasonable-sized export trade. In this regard it might be useful to look into the possibility of utilizing small-sized species in the production of raw material for the growing added-value industry.

- Many actions are needed to prepare for the ability to monitor, regulate and control the export drive. The challenge in this connection is how to trade profitably without further depleting fish stocks. As such, there is a need for clear policy guidelines to strike trade-offs balance and ensure sustainable livelihood through food security, employment and income.

- A quality system should be prepared and put into practical effect. This should include the upstream monitoring system. As such, it calls for institutional capacity building, particularly provision of training to key stakeholders all along the production chain.

- Training of fishers and handlers is very important for delivery of quality raw material. Area of interest should include proper use of ice, construction of insulated containers and boxes, and hygienic management of landing sites.

- The establishment or upgrading of minimum cost landing sites, which meet the required standard, is very important in ensuring proper upstream handling of fish. The infrastructure improvement should also include provision of ice-producing machines or storage facilities.

In summary, the fish export trade is offering many socio-economic benefits and opportunities to developing countries such as Tanzania, but also presents trade-offs and quality challenges. These have to be sorted out in order to maximize the benefits and safe guard the sustainability of the resource. The intervention should include building of the institutional capacity through training and strengthening of control and enforcement regime.

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AFRICAN FISH SAFETY NETWORK

by

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Abstract

The modalities to form an African Regional Network for Fish Safety were set at the 2000 meeting organized by INFOPECHE and sponsored by UNIDO. The following fora on fish safety and utililization emphasized the necessity to have such a regional grouping. In order to actually set up the basis for this organization FAO has accepted that a meeting be held back-to-back with the Workshop on Fish Technology, Utilization and Quality Assurance. The present paper presents the aspects of the modus operandi and the coordination issues to be discussed.

Résumé

Les modalités de la formation d'un réseau régional africain de sécurité sanitaire du poisson ont été établies lors d'une réunion organisée par INFOPECHE en 2000 et sponsorisée par l'ONUDI. Les forums suivants sur la sécurité sanitaire et l'utilisation du poisson ont mis en exergue la nécessité d'avoir un tel regroupement régional. En vue d'établir réellement les bases de cette organisation la FAO a accepté qu'une réunion aie lieu concommittamment à l'atelier sur la technologie, l'utilisation et l'assurance qualité du poisson. La présente contribution donne les aspects de modus operandi et de coordination qui seront discutés.

1. INTRODUCTION

The idea to form an African Regional Network for Fish Safety was conceived by INFOPECHE, which furthermore organized a workshop sponsored by the United Nations Industrial Development Organization (UNIDO) in the year 2000. At this meeting modalities were set but lack of commitment by member countries has delayed the complete takeoff of the network.

Looking at the current trends and developments in the international scene, Africa should not delay to come to an agreement to form a network to exchange ideas, harmonize activities, transfer information, share problems and facilities, increase trade and technology, and have a common mouthpiece to keep in step with the world.

At the 5th Congress of the International Association of Fish Inspectors (IAFI) in The Hague in 2003, it became necessary that stakeholders in the fishery industry on the continent form a fish safety network with INFOPECHE as the secretariat. The appeal was emphasized early this year during the 28th session of the CODEX meeting on fish and fishery products in Cape Town, South Africa. A preliminary meeting for the Network was to be held during the latter part of 2004 in South Africa, but because the country was to host the 28th session of the CODEX meeting in early 2005, arrangements could not be completed. A request was therefore made to FAO, by way of assistance, for a strong African representation at the IAFI congress in Sydney, Australia, in September 2005 to kick-off the network alongside the congress.

2. OBJECTIVES

The objectives of the fish safety network are to:

- enhance communication between member/interested countries;
- create a forum through which different experiences and expertise can be shared;
- gather and disseminate relevant information to member/interested countries;
- promote food safety principles and practices in fish handling and processing;

- conduct awareness and training programmes for fish handlers and processors to work in collaboration;
- harmonize activities as well as train regulatory bodies in member countries.

The main goal of the network is to lead to equivalence/harmonization in various countries and regions or sub-regions by:

- transferring knowledge;
- developing common policies;
- developing common approaches;
- sharing training facilities;
- bringing Africa together to have a common mouthpiece;
- increasing trade among member countries.

3. ORGANIZATION

The organization should undertake to:

- create a secretariat to coordinate activities of the network;
- establish terms of reference for the drafting of a constitution;
- draft a constitution;
- organize a preliminary meeting to adopt a constitution;
- elect executives to handle activities of the network;
- create a fish safety panel within the network;
- create steering committees within the fish safety panel.

4. FISH SAFETY PANEL

- The members of the fish safety panel within the network should be comprised of members working for governments, representatives of the fish industry sector and other relevant institutions.

- Members should have the following background:

  a) fish technology;
  b) food microbiology;
  c) food service/food technology;
  d) work in the fish industry with background experience in fish handling, processing, quality assurance systems and marketing.

- Fish safety panel members must be adequately trained in the codex general principles of food hygiene, Hazard Analysis Critical Control Point (HACCP) and its associated concepts, such as Sanitation Standard Operating Procedures (SSOPs) and Good Hygiene Practices (GHP).

- Panel must have knowledge in fisheries legislation, such as Codex Alimentarius, World Trade Organization (WTO) requirements (e.g. SPS, TBT), EU Council Directives, and Food and Drug Administration (FDA), Federal Rule 21.

5. STEERING COMMITTEE

The steering committee should be responsible for the drafting of the constitution for the regional safety panel in collaboration with relevant international organizations, such as FAO, UNIDO, INFOPECHE, the ministerial conference on fishery cooperation among states bordering the Atlantic Ocean.

6. ROLE OF THE PANEL

The regional fish safety panel will be responsible for:

- conducting local and international training workshop/seminars in the member countries and arouse their awareness regarding fish safety issues;
- information collection and data dissemination relating to standards, safety and quality requirements;
- exchanging of experience;
- assisting and facilitating the conditions of artisanal fish stakeholders to ensure production and high quality, and safe fish products for both domestic and export markets;
- preparing a regional fish inspectors and quality assurance manual;
- working directly within the secretariat.

7. LINE OF ACTION FOR THE NETWORK

The African fish safety network will seek to address the following problems:

- trade
- information flow
- data collection and exchange
- industry
- training (laboratories)
- projects/funds

To begin this, questionnaires have been prepared to gather information on the continent in order to form the database.

8. FUTURE PLANS

These will include the following:

- a preliminary meeting to adopt the constitution and elect executives to be hosted by the secretariat (INFOPECHE);
- annual/biennial meeting of the network to be hosted by the executives in collaboration with the secretariat;
- review problems, assess progress and areas of need on the continent;
- identify projects, training and sourcing for funds;
- promote intra-regional trade;
- follow trends in the international scene so as to move with other continents by way of information flow;
- risk assessment.

9. IMPORTANCE/ADVANTAGES

The African fish safety network is very important because it will:

- strengthen the regional bodies – INFOPECHE, INFOSAMAK, and INFOSA;
- help access resources and funds;
- help create a common platform for fish safety issues;
- help disseminate information;
- help collect adequate information (database) on the continent.

Note: The African Regional Fish Safety Network is not to replace INFOPECHE, INFOSAMAK or INFOSA but is to provide a complementary role to these bodies.

10. OUTLOOK

Fish safety and quality (from HACCP to risk assessment: Challenges and Way Forward for African technologists and regional governments).

Fish inspection

Inspections are carried out to evaluate processes, facilities and controls used in the manufacture, storage and distribution of fish (foods) and to assess product safety and acceptability in light of inspection results.

Inspection plays an important role in preventing commercial fraud (and adulteration of fish [food]), thus protecting consumers from economic loss. It plays a vital role in economic stability (food security, etc.) by helping to reduce economic losses. It can also help improve a county's image in international trade by assuring import countries that products are manufactured, processed, packaged and stored under good manufacturing practices (GMPs) and good hygiene practices (GHPs).

Inspection is the primary tool a regulatory agency has for detecting procedures and practices that may be hazardous and taking action to correct deficiencies. Important areas of product (fish) inspection comprise the checking of processing and storage establishments (suitability of premises and equipment) and supervision of sale and distribution points.

To support the inspection activities, laws and regulations that provide the inspector with scientifically based rules for product safety must be provided. There are various types of inspection: pre-operational, routine, follow-up and compliant inspections; and currently HACCP and Quality Management Systems, which are referred to as audits.

Risk assessment

Risk assessment, a preventive control system to assure safety of fishery products, is being hampered because of challenges such as:

- lack of data for risk analysis and management;
- inadequate accredited and reference laboratories in the various regions of Africa;
- lack of networking coordination (regional/international) to share and disseminate information;
- inadequate technical capacity to handle fish and fishery products as well as risk assessment.

The way forward for players in the fishery industry, as well as the regional governments are:

- harmonization of inspection services, certification and other aspects;
- networking and information dissemination (among all concerned with fish/fishery products);
- infrastructure development, including laboratory accreditation and reference laboratories;
- commitment on the part of governments to ensure fish and fishery product safety.

African fish safety network
Looking at the current trends and developments in the international scene, Africa should not delay_to come to an agreement to form a network to exchange ideas, harmonize activities, transfer information, share problems and facilities in order to increase trade and technology; thereby to keep in step with the world.

Efforts were made earlier by INFOPECHE but not without difficulties. At the 5th Congress of the International Association of Fish Inspectors (IAFI) in The Hague in 2003, it became necessary that stakeholders in the fishery industry on the continent agree to form a fish safety network with INFOPECHE as secretariat. This call was re-enforced early this year during the twenty-eighth session of the CODEX meeting on fish and fishery products in Cape Town, South Africa.

The objectives of the fish safety network are:

- enhance communication between member/interested countries;
- create a forum through which different experiences and expertise can be shared;
- gather and disseminate relevant information to member/interested countries;
- promote food safety principles and practices in fish handling and processing;
- conduct awareness and training programmes for fish handlers and processors in a collaborative manner.

The main goal of the network is to lead to equivalence/harmonization in the various countries and regions or sub-regions by:

- transferring knowledge;
- developing common policies;
- developing common approaches;
- sharing training/facilities, etc.

11. PROGRESS

Efforts were made to hold a conference before the 6th IAFI conference in Australia this year but preparation could not be concluded. This was mainly because of financial problems and also because the CODEX meeting that was to be held in South Africa coincided with the preliminary conference of the network, which was to have been held there.

Efforts are however being made to gather information on activities in the fishery sector on the continent through questionnaires, and a paper should be presented of these findings at the 6th IAFI Congress in Australia in September 2005.

Information gathered will also be used as a guide for the safety network in planning activities regarding the continent. Although various activities are already taking place on the continent, they are scattered and uncoordinated, and it is believed that the formation of the network will bring all projects to the doorstep of member countries for all to assess, learn and benefit from them.

EVOLUTION OF NILE PERCH INTO A SIGNIFICANT TRADE COMMODITY IN THE GLOBAL MARKET

by

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Abstract

The entry of the Lake Victoria exotic fish known as Nile perch into world trade in the 1980s brought many changes and challenges to the lake region. Although Nile perch was introduced into Lake Victoria mainly from Lake Albert in the 1960s, the fish did not establish itself until the early 1980s when the fish started appearing in fishers' catches. Fishers who preferred to land the popular indigenous tilapia species, *Oreochromis esculanta,* scorned the new fish in their catches because financially they earned less from it, because it had no market then. The local people also had no interest in this plentiful and easily available fatty fish.

It was in the 1980s that a small fish processing factory in Kenya decided to utilize the cheap and easily available fish to produce fillets for fast food outlets in Nairobi. The same establishment also marketed the processed fillets to Israel and later to the EU and United States. This trade continued in Kenya, until the early 1990s when the other two East African countries, Tanzania and Uganda, also built a Nile perch-based industry, which collectively and at individual country level is now much larger than Kenya's industry.

The Nile perch industry has flourished but not without problems and challenges. Some of these include: sanitary and phytosanitary requirements, international standards' market demands, fish bans, effects of commercialized fishing and trade, and cross-border conflicts. The Nile perch has weathered all these challenges and has remained a highly preferred freshwater fish in the European market and other destinations. A total of over 80 000 tonnes of processed fish are exported by the three East African States, earning them more than US$250 000 per year.

How long this achievement will be sustained, especially considering the rapidly evolving market demands, remains to be seen. The traceability and eco-labelling phenomenon currently gaining global acceptance are yet other challenges that the Nile perch industry must face and overcome. The lessons learned over the years that helped keep the Nile perch trade alive will somehow help surmount the anticipated challenges.

1. INTRODUCTION

The East African Community (EAC) consists of three countries, namely, Kenya, Uganda and Tanzania, which are linked together by Lake Victoria. Tanzania has the largest share of the lake, 51 percent; Uganda 43 percent; and Kenya 6 percent. Kenya and Tanzania have a coastline and therefore are endowed with rich marine fisheries resources at their disposal. Although Uganda is landlocked, it is endowed with many inland lakes and rivers, besides Lake Victoria, which are also rich fisheries resources (Figure 1).

Fisheries resources in East Africa

Lake Victoria is the major economic fisheries resource of the three countries, from which the world-traded fish commodity, the Nile perch (Figure 2), is harvested. Other commercially important fish from Lake Victoria include the Nile tilapia (*Oreochromis niloticus*) and the freshwater sardines, *Rastrineobola argentea,* which enjoy both the regional and international markets.

The marine fisheries are underexploited by both Tanzania and Kenya. The marine fish trade commodity in these two countries includes prawns, lobsters, octopus and assorted finfish. Kenya processes and exports tuna loins. There is however no established land-based industry for tuna, despite its abundance in both Kenyan and Tanzanian Exclusive Economic Zones (EEZs). Most of these resources are exploited and processed by distant waters fishing nations.

Figure 1: Map of East Africa

The Nile perch industry

Figure 2: Nile perch (*Lates niloticus*) (Mbuta) – one of the most important commercial fish species in the Lake Victoria basin

The Nile perch is an exotic fish introduced into the Lake Victoria in the 1960s and again early 1970s. The Nile perch fishery started to gain its economic importance in the 1980s, when Kenya ventured and introduced frozen fillets as an export commodity in international markets. The Nile perch fishery has since gained so much economic importance in the past 10 years that it is now the most valued fish export commodity in the East African region.

Nile perch accounts for about 53 percent of the total fish production in Kenya and over 80 percent of Kenyan fish exports. It provides direct employment to over 200 000 Kenyans.

2. THE FISH INDUSTRY IN EAST AFRICA

The Fish industry in the three East African States plays a very important role in the economies of these countries through employment creation, income generation, foreign exchange earnings and contribution to food security and poverty reduction strategies. Fish production, fish trade, industrial processing and export, and related enterprises – such as packaging, boat building and net making – support about 4 million East Africans directly. The fisheries sub-sector contributes about 3 percent to the GDPs of Uganda and Tanzania and about 0.4 percent to Kenya's GDP. Fish is also an important source of government revenue, and as an export commodity it earns the three countries substantial foreign exchange: US$50 million for Kenya; US$82 million for Uganda; and over US$100 million for Tanzania.

Most of the fish landed in Uganda, Kenya and Tanzania comes from Lake Victoria. Thus the lake contributes approximately 49 percent, 92 percent and 61 percent of the total fish landed in Uganda, Kenya and Tanzania, respectively.

3. FISH EXPORTS

The Nile perch constitutes over 80 percent of fish exports from the East African region. Over 70 percent of this fish was exported to the EU member states prior to the series of EU bans on East African fish in 1997, 1998 and 1999. The market is now stable and much more diversified since the fish ban experience, although the EU still remains the most important export market of the Nile perch for the three East African States.

The EU market was the driving force behind the three States' effort to ensure the achievement of the high safety and quality standards of their fish and fish products in order to gain and sustain the world market share.

4. THE EU MARKET REQUIREMENTS

The Competent Authority (CA) for fish and fish products
One of the requirements of the EU market is the establishment of a Competent Authority (CA) by a third country wishing to export fish to the EU. The CA would ascertain that the handling of targeted fish for the EU market by third countries complies with the EU standards and the fish processing establishments adhere to their Hazard Analysis Critical Control Point (HACCP) plans.

To ensure sustainability of fish safety, quality and trade, the three States have well organized and efficient CAs. In Uganda, the Fisheries Resources Department of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) is the agency responsible for statutory inspection, certification and control of fish and fishery products. In Kenya, the Ministry responsible for the Fisheries Department is the CA for fish and fish products' safety and quality; while in Tanzania the Department of Fisheries in the Ministry of Natural Resources and Tourism is the CA.

All the three CAs have well trained and experienced inspectors, who are also adequately trained in HACCP-based inspections. These inspectors are charged with inspection and monitoring of the fish production areas (the fishing environment), fish processing establishments and markets, and certification of the products.

The EU Directive 91/493/EEC
With respect to requirements of EU Directive 91/493/EEC and also desiring to streamline their operations to achieve efficiency, the East African governments have done the following:

- appointed and established CAs in each country, to create a one stop for licensing, management, quality control and development aspects of fisheries;
- enacted fisheries legislation in all three countries on health and safety issues, that are harmonized with EU and other international fish safety legislation;
- provided technical assistance to export processing establishments to meet required international processing standards, and develop and adhere strictly to HACCP plans, instituted in all their operations;
- facilitated formation of fisheries sector associations for fish traders, especially fish processors and exporters associations with enforceable code of practice as a means of self-regulation.

The EU bans on fish exports from East Africa

The EU fish bans on fish exports from East Africa into its markets, between 1998 and 2000, although unfortunate because of the enormous economic losses incurred by fishers, traders and governments in the region, helped the industry focus more on safety issues of the fish and fishery products. The governments before the bans lacked comprehensive legislation to enforce necessary safety and quality issues. Certification systems were also not well defined, causing processors and traders to deal with a number of government agencies with respect to fish certification.

The poor definition of CAs and their roles was partly responsible for the three EU bans on Lake Victoria fish exports. The three bans experienced by the East African countries were as follows:

- 1997: on claim of *Salmonella* contamination. This was limited to only Spain and Italy;
- 1998: following cholera outbreak in East Africa and Mozambique;
- 1999: on suspicion of presence of pesticides residues in Lake Victoria. This third and last ban was lifted in April 2000 for Tanzania; August 2000 for Uganda; and November 2000 for Kenya.

Harmonization with European Union (EU) Regulations

The Council Directive 91/493/EEC of 22 July 1991 lays down the health conditions for marketing of fish and fishery products in the EU. Third countries fulfilling the conditions of this Directive are listed in the Commission Decision 97/296/EEC of 22 April 1997, which is regularly revised and updated, and in the last few years many third countries have been included. The EU classifies third countries into two categories (lists) for import of fishery products for human consumption.

The first category (List I)

This list includes countries whose processing systems and health standards are at least equivalent to those of the EU and whose CAs have been audited by the EU inspection team**.**

The second category (List II)

The countries in List II are those that have not been audited by the EU inspectors, but have supplied the Commission with written guarantees that fulfils import conditions. Fish products from List II may enter the EU market under bi-lateral agreements with individual EU Member States and may be subjected to additional national legislation of the importing State.

The road to compliance with the Council Directive 91/493/EEC by the East African Community States

The EU DG SANCO teams at various times have inspected the CAs, fish processing establishments and fish landing sites of the three East African States, which are now harmonized with EU standards after they were found to have complied with requirements, and all have been placed on List.

Tanzania was the first to be upgraded to List I in 1997. The country enjoyed this status until March 1999, when EU imposed a ban on fish products from Lake Victoria. The ban on the exports was later lifted in April 2000, after which the EU inspectors visited the country twice to ascertain that safety measures were in place, before reinstating the country back to List I. Uganda was placed on List I, in 2003 and Kenya in 2004.

The role of the CA

The major impediments for Kenya and Uganda to achieve List I status were the lack of clarity on the definition and the roles of their CAs. The EU inspection teams were concerned that inspection and certification roles were not clearly defined because they were being handled by various government agents and, therefore, no single agency appeared in full control of the certification process. All the three CAs have now been streamlined and have developed adequate capacity to inspect and certify fish and fish products for export.

Fish quality and safety assurance legislative framework

All the three countries have developed fish quality and safety legislation that ensure fish and fishery products placed on any market are safe for human consumption. The legislations allow for sanctions for non-compliant establishment.

Sampling and analysis of samples for monitoring purposes

Sampling for pesticide residue analysis has been an ongoing programme since the last ban on fish exports from Lake Victoria by the EU on alleged use of chemicals for fishing. The CAs in the region have been collecting and analyzing water, fish and sediment samples for pesticide residues from identified landing sites in Lake Victoria on a regular basis. This exercise is carried out to fulfil the written guarantees given to EU by CAs to monitor pesticide residues in water, fish and sediments. It is also envisaged that the programme will assist the CAs to build a database on the status of the fish and the fishing environment, which would in turn be an assurance to consumers on the safety and quality of fish in Lake Victoria. The results of the analysis have been satisfactory, as so far have shown no detection of pesticides at the level of detection (LOD).

The microbiological analysis of fish samples and swabs collected from fish contact surfaces is regularly conducted by CAs in fish processing establishments.

Importance of Nile perch to the community

Nile perch has brought both pain and joy to the riparian community, although the benefits outweigh the challenges.

Challenges

The importance of Nile perch as a value trade commodity changed the fishing patterns from the hitherto subsistence fishing and a way of life to an aggressive economic fishing activity, which attracted others from distant areas to migrate to the lake to cash in on the lucrative business. The change in fishing patterns brought the following challenges:

- mushrooming of unplanned fishing villages;
- increase in HIV/AIDS;
- increase in piracy and thefts;
- over-fishing because of demand;
- resource user conflicts;
- cross-border conflicts;
- use of destructive gears and methods;
- environmental degradation;
- interruption of known way of life.

Benefits

The community, despite the numerous challenges, has benefited from the Nile perch evolution to a world trade commodity. Some of these benefits include:

- increased economic activities, as more money is available in fishing villages;
- employment creation;

- better prices for their fish;
- greater interest in participation in fisheries management.

Public participation in fisheries management and fish safety and quality
The EAC realized that though the Nile perch industry had evolved into a lucrative business and created rapid development, including industrialization, there was imminent danger that the fishery can easily collapse if serious measures are not taken to regulate fishing. In this regard, the EAC decided to work with community to ensure sustainable fisheries management.

The three East African countries have, therefore, developed and now adopted Beach Management Units, popularly known as BMUs, to be primary grassroot institutions that would ensure compliance with fisheries management measures by all players. The beach leadership has been in existence in both Kenya and Tanzania for a very long time but did not have any legal backup and was not recognized by the governments.

The roles of the BMUs include the following:
- ensuring that fishers carry out fishing and fish handling responsibly and hygienically;
- disseminating information on responsible fishing and fish handling methods to the community and stakeholders;
- ensuring that hygiene standards at the landing site are maintained;
- management of environmental issues;
- surveillance and participation in law enforcement.

5. UPSTREAM CONTROL OF FISH SAFETY AND QUALITY

To address some of the severe constraints on the fisheries post-harvest issues, the three East African states have endeavoured to improve fish handling facilities at fish landing sites. Funding for improvement of these facilities is usually sourced through an integrated approach, where the Government, the fish processors, the local communities and donors participate.

To ensure traceability of harvested fish from fishing grounds to the consumer, the three East African states have introduced local health certificates at landing sites. The local health certificate accompanies fish from the landing sites to the fish processing establishments to ensure that fish for export is collected at designated areas that have been certified by CAs.

6. PRIVATE SECTOR ASSOCIATIONS FOR FISH PROCESSING AND EXPORT

One of the most useful outcomes of the EU harmonization process was the implied requirement of an organized private sector capable of self-regulation. The Fish Processors and Exporters of the three countries organized themselves into strong member-driven associations, namely: Association of Fish Processors and Exporters of Kenya (AFIPEK), Uganda Fish Processors and Exporters Association (UFPEA) and Lake Victoria Fish Processors and Exporters Association of Tanzania (LVFPAT). These associations are also members of the East African Fish Processors Association and have been instrumental towards ensuring that required standards are maintained by establishments through development of the Code of Conduct for their members. These associations have also acted as useful interfaces with governments in the fisheries co-management and trade issues.

The fish processing associations are basically focused on exports, a sector that takes less than 50 percent of total fish landings. The need for the business linkages between large- and small-scale players in fisheries cannot, therefore, be overstated. The associations are expected to play a key role towards achieving this linkage as a means of expediting development in the small-scale fish trade and industry.

7. RECENT FISH TRADE DEVELOPMENTS AND CHALLENGES

Trademark
A natural resource cannot be patented but can be registered for an exclusive use of trademark. The Nile perch is now registered as "Lake Victoria Perch" through Lake Victoria Fisheries Organization (LVFO), and this is expected to give the popular product a niche market in the world trade as a prime and choice product.

Value addition
The three states ought to look into value addition to maximize revenues derived from the Nile perch products and also to enhance sustainable management of the natural resource, as less would be harvested for the equivalent earnings.

Value-chain reduction
Fish reaching the EU market from the East African region often goes through four or more steps before it is retailed to the consumer. This usually results in a substantial difference between retail and export price. The Nile perch fillet Freight On Board value to the East African exporters is US$3–4, but the same fillets retail at between US$15 and 17 in the EU supermarkets. This opportunity window, if properly explored and developed, would enhance revenues from Nile perch products for the three EAC states.

Slot-size
Limitations on exports of whole Nile perch and fillets below certain sizes and weights, if implemented, would discourage fishing of juveniles and encourage stock recruitment and hence contribute to increased sustainability of fishing in Lake Victoria. The three countries are, however, implementing the harvesting of Nile perch within the agreed slot-size with very encouraging success.

Sanitary and Phytosanitary (SPS) issues
Procedures and duration required to implement SPS issues in fish and transparent verification mechanisms sometimes present problems in the fish industry. Unilateral demands, such as sudden introduction of new standards, will only continue to hurt the region's fishery economy. The current practice where an exporter whose consignment has suffered a rapid alert is not given an opportunity to access to the sample in question for independent verification can be construed as unfair technical barrier to trade. Even if the exporter accesses the sample, the ensuing results may not be considered when the verifying laboratory is not EU based. Rapid alert is a situation that arises when a consignment is marked as having a pathogen or unauthorized substance and is posted in the internet. Unfortunately it takes much longer time to remove the rapid alert from internet, even after mandatory compliance of ten subsequent samples, than it takes to place it there.

Effort by the EAC states to harmonize fish inspection and quality assurance standards and procedures
The process was initiated by a regional task force (RTF) composed of six members, two from each of the East African states, which was established to undertake the activity in 2000. The RTF has so far developed three draft documents, namely:

- Code of Practice (COP) for fishing, fish handling and processing in Lake Victoria;
- An Inspectors Guide;
- A Manual of Standard Operating Procedures for fish inspection and quality assurance.

A joint regional harmonization team consisting of the members of the RTF and the Regional Working Group on Fish Quality and Assurance members, was formed in 2003 to establish sanitary standards, measures and procedures for fish and fishery products. The joint team through consultative meetings has thus developed the following final draft documents:

- A COP for Fish and Fishery products: Part I (Capture Fisheries) and Part II (Aquaculture);

- Inspectors' Guide, Part 1 and II;
- The Manual of Standard Operating Procedures (MSOP), Part I to IV (in the final stages of development).

All these drafts will be presented to stakeholders for adoption.

8. CONCLUSION

The Nile perch industry has weathered many challenges, including rejection by community and flourished to attain a world class trade commodity status. The Nile perch continues to be a highly preferred freshwater fish in the European market and many other international and regional markets. This million dollar trade has attracted the attention of the three states' economists and is receiving mention in the states' economic surveys and projections. This importance is easily demonstrable in Uganda, for example, where fish exports are the major foreign exchange earners. It is expected that this achievement will be sustained despite the new and emerging challenges facing the industry, such as traceability, risk management and eco-labelling phenomenon currently gaining global acceptance. The lessons learned over the years that helped keep the Nile perch trade alive will somehow help the commodity surmount the anticipated challenges.

The Workshop on Fish Technology, Utilization and Quality Assurance was held by the Fish Utilization and Marketing Service of FAO's Fishery Industries Division in collaboration with the FAO Regional Office for Africa. The Workshop was held to review progress and problems in post-harvest fish utilization in Africa and formulate recommendations to FAO, its member countries and all institutes, institutions and persons interested in fish utilization in Africa. The experts reviewed in particular fresh fish utilization, fish processing, quality assurance, and marketing and socio-economic issues. The review was done through presentation by the secretariat of a report on progress and events since the Consultation in Fish Technology held in 2001, presentation of 26 papers, abstracts of two additional papers, and a field trip to the Mbegani Fisheries Development Centre, a fish market and a processing unit in Dar es Salaam. The report includes the recommendations as well as the papers that were available to the experts.

L'Atelier sur la technologie, l'utilisation et l'assurance de qualité du poisson a été organisé par le Service de la commercialisation et de l'utilisation du poisson de la Division des industries de la pêche de la FAO, en collaboration avec le Bureau régional de la FAO pour l'Afrique. L'atelier a été organisé pour passer en revue les progrès et problèmes dans l'utilisation du poisson après capture en Afrique, et formuler des recommandations à la FAO, à ses pays membres et à tous les instituts, institutions et personnes intéressés par l'utilisation du poisson en Afrique. Les experts ont examiné notamment l'utilisation du poisson frais, la transformation du poisson, l'assurance de qualité, la commercialisation et les questions socioéconomiques. Cet examen s'est effectué à travers la présentation, par le secrétariat, du rapport sur les progrès et événements depuis la Consultation d'experts FAO sur la technologie du poisson en Afrique qui s'est tenue en 2001, des présentations de 26 communications, des résumés de deux contributions supplémentaires, et une visite de terrain au Mbegani Fisheries Development Centre, au marché au poisson et dans une unité de transformation de poisson à Dar es Salaam. Le rapport inclut les recommandations de même que les communications qui étaient à la disposition des experts.

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