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Agenda Item 3

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## JOINT FAO/WHO FOOD STANDARDS PROGRAMME CODEX COMMITTEE ON CONTAMINANTS IN FOODS

### Third Session

Rotterdam, The Netherlands, 23 - 27 March 2009

### MATTERS OF INTEREST ARISING FROM OTHER INTERNATIONAL INTERGOVERNMENTAL ORGANISATIONS (Submitted by the International Atomic Energy Agency)<sup>1</sup>

### COORDINATED RESEARCH PROJECT ON APPLICATIONS OF RADIOTRACER AND RADIO-ASSAY TECHNOLOGIES TO SEAFOOD SAFETY RISK ANALYSIS

#### **Background**

1. The International Atomic Energy Agency (IAEA) encourages and assists the development and practical application of research on peaceful uses of atomic energy throughout the world so as to foster the exchange of scientific and technical information. IAEA coordinated research activities are designed to stimulate and coordinate the undertaking of research by scientists in IAEA Member States in selected nuclear fields. These coordinated research activities are normally implemented through Coordinated Research Projects (CRP) that join together research institutes in both developing and developed Member States to collaborate on the research topic of interest. The research that is supported encourages the acquisition and dissemination of new knowledge and technology generated through the use of nuclear technologies and isotopic techniques in the various fields of work covered by the IAEA mandate.
2. The research results, which are generated in projects lasting three to five years, are freely available to Member States and the international scientific community through their dissemination in IAEA scientific and technical publications and in other relevant international or national journals. Where it is practical and relevant, the knowledge gained through a CRP is used to enhance the quality of projects delivered to Member States through the IAEA Technical Cooperation Programme.
3. The IAEA strives to stimulate through its research activities the growth of nuclear sciences and technologies in developing countries. The projects bring together developing and developed countries to concentrate on the same research topic at the same time, and help the countries in sharing and using the knowledge and experience gained. Nuclear and isotopic techniques can often provide unique and cost effective solutions to problems, and the research can make crucial differences to peoples in their ordinary lives, helping in areas of greatest human need and promoting the goals of sustainable development.

#### **Introduction to the Coordinated Research Project**

4. Radiotracer and radio-assay nuclear techniques are particularly useful for generating information on the bio-kinetics and food-chain transfer of metals and toxins in marine organisms, including those that are consumed as seafood. Such information could be better linked to analyses that support risk-based management decisions with respect to the safety assessment of commercially important seafood intended for human consumption.

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<sup>1</sup> Document prepared by and under the responsibility of the IAEA.

5. In support of these objectives, the IAEA has initiated a *Coordinated Research Project on Applications of Radiotracer and Radio-assay Technologies to Seafood Safety Risk Analysis*. It is envisioned that this research will lead to the potential establishment of maximum levels in seafood for those contaminants already evaluated (cadmium) as well as contaminants not evaluated to date (harmful algal blooms, persistent organic pollutants and other toxins) through the Joint FAO/WHO Expert Committee on Food Additives (JECFA) and the Joint FAO/WHO Codex Alimentarius Commission.

6. The CRP has brought together research laboratories with the required capabilities that, as members of wider groups, have a focus, or intention, to apply radio-assay and radiotracer techniques to evaluate and generate information on the bio-kinetics and food-chain transfer of metals and toxins in marine organisms, especially those that are valued as seafood. Immediate benefits to individual groups include assistance from IAEA/FAO to improve laboratory competence for the specific requirements of the project and the opportunity to interact with groups working on comparable problems in different environments.

### **Objectives of the Coordinated Research Project**

7. The broad objective of the CRP is to generate data on priority contaminants in seafood organisms with regard to human consumption, sale and export, and to assess the application and relevance of these experimentally-derived and field-based data to the management of these contaminants in seafood. The specific CRP objectives include the:

- Integration of current studies on applications of nuclear techniques to the study of the bioaccumulation and food-chain transfer of contaminants in seafood with risk management decisions in relation to the assessment of their suitability for human consumption and trade
- clear identification of the needs for scientific data on the bioaccumulation of priority contaminants in seafood through linkages with international standardisation bodies
- generation of data that are relevant to the management of contaminants in seafood through the application of radiotracer, radio-assay and related nuclear technologies

### **Activities of the Coordinated Research Project**

8. Subsequent to the Consultants Meeting and the First Research Coordination Meeting held under the CRP,<sup>2</sup> the *Second Research Coordination Meeting (RCM) for the Coordinated Research Project on Applications of Radiotracer and Radio-assay Technologies to Seafood Safety Risk Analysis* met at the International Centre for Theoretical Physics in Trieste, Italy, from 8-12 December 2008.<sup>3</sup>

9. The second meeting noted that the general objectives of the RCM were to:

- Discuss and review the project reports presented by the individual participants, including in the context of the overall CRP objectives and the conclusions and recommendations of the 1<sup>st</sup> RCM
- Examine additional means of strengthening interaction between the participants
- Prepare revised conclusions and recommendations to facilitate the project tasks

10. In reviewing the objectives of the CRP and discussions at the 1<sup>st</sup> RCM, the participants confirmed that the CRP would optimally generate scientifically sound outputs and outcomes related to international standardization activities, including the:

- generation of quality-assured field data on contaminant levels in target biota, using reference materials
- interpretation of data underpinned by mechanistic understandings, based on radio-assay/tracer experimental studies

<sup>2</sup> See CX/CF 08/2/3 - Add. 1 of February 2008 for details.

<sup>3</sup> The full report of the *Second Research Coordination Meeting (RCM) for the Coordinated Research Project on Applications of Radiotracer and Radio-assay Technologies to Seafood Safety Risk Analysis* is available on request.

- potential consideration of data by JECFA to facilitate decision making on acceptable background levels in seafood and/or advice from JECFA on what additional data would be needed
- JECFA and/or related expert committee assessments of seafood contaminants based on the CRP data provided, leading to the potential establishment of Codex maximum levels in seafood

11. Among the topics of discussion, presentations were made to provide information on the further consideration of the CRP results within the international community. These presentations included:

- Recent Standardization Activities of the Joint FAO/WHO Codex Alimentarius Commission Related to Seafood and Seafood Safety
- Proposal Concerning the Establishment of the Marine Radioecology International Network (MARLIN)
- Status of Ongoing and Future IAEA Technical Cooperation Projects on the Use of Receptor Binding Assay for the Quantification of PSP and CFP Bio-toxins in Seafood
- Country Presentations, Conclusions and Recommendations

### **Country Presentations**

12. **Chile** made the following observations:

- Production statistics show that mussels, and in particular *Mytilus chilensis*, accounts for 2-3% of total exports. Historically, several mollusk (bivalve) exports have been rejected (high levels of cadmium), with strong losses for the economy (USD \$50,000/container).
- Four species of mollusks of commercial value have been selected for uptake, depuration and bio-accessibility studies related to cadmium.
- The most consumed and commercialized bivalve, *Mytilus chilensis*, was studied for uptake, depuration and bio-accessibility for the first time.
- Bio-accessibility to humans (*Mytilus chilensis*) differed if the contaminated mussel was digested cooked or raw. Raw mussels resulted in higher intakes of cadmium than cooked mussels.
- Most mussels are consumed raw in Chile. More importantly, Chile consumes 36.2 kg/per capita/year of seafood (FAO, 1998), of which 9.2% is shellfish (3.3 kg per capita per year). This value is the highest among the countries of the Humboldt Current Large Marine Ecosystem.
- A regional radio-toxicological assessment network for shellfish and fish is needed. The network would help standardize methodologies and define natural local/regional levels of contaminants, such as cadmium, which occurs naturally in Chilean waters, thereby providing Codex with realistic data on cadmium concentrations to facilitate trade from undeveloped producing countries.

13. **China** made the following observations:

- Cadmium pollution in shellfish is a critical seafood safety concern due to high consumption, including the commonly known oysters and scallops, but also marine gastropods. China also exports a significant amount of shellfish overseas (both dried and fresh products).
- Data shows that many of these shellfish contain high cadmium concentrations in their tissues, even when harvested from a clean marine environment. In addition to the commonly known bio-magnification of mercury in the marine food chain, recent studies showed that cadmium can also be bio-magnified (i.e., concentration increases with increasing trophic levels) in marine gastropods.
- In Hong Kong, the average shellfish consumption is 50 grams/per capita/day, in addition to fish consumption of 142 grams/per capita/day. There have been reported cases in which Hong Kong rejected the imports of oysters from the USA and Canada due to violations of cadmium safety

standards. It is thus important to understand the factors affecting the accumulation of cadmium in these marine shellfish and the potential risk of cadmium to human health as a result of seafood consumption.

14. **France** made the following observations:

- In Europe, traditional fisheries mainly harvest the king scallop *Pecten maximus*, with the UK and France being the top producers (over 35,000 tons in 1999). Even though it is a seasonal activity, these fisheries represent a very high commercial value (>€ 70 million/yr). In addition to *P. maximus*, the variegated scallop *Chlamys varia* represents an important species for local fishermen on the European Atlantic coast of France.
- Various research studies have already identified high cadmium levels in tissues of these scallop species, independently of the contamination status of the fishing area. These levels are often above the current international guidelines in whole soft parts or in specific tissues. Therefore, this might be of concern for human health when the entire edible tissue (i.e., *C. varia*) or gonads (i.e., *P. maximus*) are consumed.
- This could also be critical for local populations consuming large amounts of seafood. For example, the consumption of only 300-400 g of *C. varia* (whole individuals) or 1.9 kg of mussel *Mytilus edulis* from the Marennes-Oléron Bay (western France) is necessary to reach the PTWI. More study is therefore required on:
  - the dietary habits of local populations that consume high amounts of seafood
  - Cadmium levels in seafood products

15. **French Polynesia** made the following observations:

- Ciguatera Fish Poisoning (CFP) is caused by the ingestion of tropical reef fishes which have bio-accumulated and bio-transformed the ciguatoxins (CTXs) produced by the benthic dinoflagellate *Gambierdiscus* (Lewis and Holmes, 1993). CFP is the cause of major health and economic problems in communities such as the Pacific Island nations, where nutrition depends heavily on seafood consumption.
- There is a mean annual incidence of 2-4 cases/thousand inhabitants in French Polynesia. Moreover, French Polynesia is listed among the 23 countries where people consume more than 50 kg of fish/year. The production and consumption of reef fish is as follows:

**Population, Production and Consumption of Reef Fishes in 2007<sup>4</sup>**

Archipelagos/Societies	Population (%)	Production (tons)	Export (tons)	Consumption (tons)
Tahiti & Moorea	194,623 (75 %)	1,050	0	1,700
Leeward Islands	33,184 (12.8 %)	450	50	400
<i>Tuamotu - Gambier</i>	16,847 (6.5 %)	1,300	500	800
<i>Marquesas</i>	8,632 (3.3 %)	250	30	220
<i>Australes</i>	6,310 (2.4 %)	350	70	280
<b>Total</b>	<b>259,596</b>	<b>3,400</b>	<b>650</b>	<b>3,400</b>

<sup>4</sup> Data obtained from A. Stein, Fisheries Department of French Polynesia.

- The French Polynesian regulation (No. 1183 CM 20/12/05) covering sanitary procedures for seafood exported to the European Community under EC regulation CE No. 853/2004 state that seafood likely to contain bio-toxins, such as CFP toxins, cannot be marketed.
- Managing CFP risk appears to be a very complex and challenging issue due to the absence of an international reference assay and a clear clinically effective dose harmful to humans. For these reasons, French Polynesian exports are limited to pelagic fish species.
- Based on our results to date, we can recommend the following:
  - The receptor binding assay (RBA) is an efficient analytical method for both research and monitoring issues regarding CFP, as it is ten-fold more sensitive than the mouse bioassay and is specific to the ciguatoxins, the toxins regarded as the principal cause of human illness.
  - However, the clinically effective harmful dose for humans still needs to be established. This could be the RBA value designating non-toxic fish, taking into account that a specific dose should be set for each region of the world, as ciguatoxins differ among regions. In addition, the RBA technique needs to be improved with regard to its lower limits of detection, including analytical methodologies, in order to minimize the exposure risk to local populations.
- In regard to cadmium, the French Polynesian regulation (No. 1183 CM 20/12/05) is as follows:
  - 0.1 mg/kg wet weight of flesh for *Anguilla anguilla*, *Katsuwonus pelamis*, *Thunnus* species and *Euthynnus* species, *Mugil labrosus labrosus*
  - 0.3 mg/kg wet weight of flesh for *Xiphias gladius*
  - 0.05 mg/kg wet weight of flesh for other fish species
  - 0.5 mg/kg wet weight of flesh for crustaceans
  - 1 mg/kg wet weight of flesh for bivalve molluscs and cephalopods
- In 2006, a total of 4,115 tons of tuna were harvested. A total of 176.4 tons were marketed locally in Papeete (Tahiti Island) and 311.5 tons were exported.

16. **Ghana** made the following observations:

- Generally, the consumption of shellfish by the domestic population is insignificant; however, coastal populations consume significant amounts. The consumption of marine fish is very high.
- The majority of coastally harvested shellfish is not marketed locally, however, data for shellfish exports in particular are lacking.
- Heavy metals and algal toxins do not appear to be an issue at present in either domestic or international markets. However, there are periodic spikes in cadmium and iron levels in the western corridor of Ghanaian waters where marine fisheries activities are highest in the country. There are also regular appearances of green algal blooms in the same area towards the last quarter of each year, although toxins have not been implicated in these blooms.
- Concerns have been raised by various stakeholders that these heavy metals could bioaccumulate in seafood tissues that are ingested by consumers. Stakeholders also maintain that regular screening of algal blooms should be conducted to serve as an early warning signal for the appearance of toxins in Ghanaian waters.
- Ghana is currently analysing levels of cadmium, copper, iron and zinc in seafood, as well as characterizing the levels of metals in sediments and seawater, in the Western region of Ghana. We are also currently counting and identifying zoo flora in the study area.

17. **Japan** made the following observations:

- Japan imported 46,438 tons of marine bivalves and 81,464 tons of other marine invertebrate, including cephalopods, in 2007. Among these imports, 206 tons of bivalves were rejected in violation of Japanese regulations.

- In regard to processed seafood, Japan imported 46,295 tons of bivalves, of which 254 tons were in violation (China, 81 tons out of 5,402 tons; Korea, 6 tons out of 3,594 tons as shucked shellfish) and 399,460 tons of other invertebrates, of which 1,210 tons were in violation (China, 8 tons out of 54,234 tons; China, 51 tons out of 51,340 tons as frozen food; Thailand, 82 tons out of 40,340 tons; Vietnam, 606 tons out of 38,754 tons as fillet and 153 tons out of 23,418 tons as frozen food). Most of these products were rejected because of pathogenic microorganisms, paralytic shellfish poisons, ciguatoxin, veterinary drugs and feedstuff additives.
- Although heavy metal contamination does not currently appear to be a problem, increasing seafood imports from developing countries has resulted in an increase in public pressure to monitor cadmium, lead and mercury. However, as the cadmium PTWI for Japanese consumers was assessed based on an average Japanese weight of 53.3 kg at 22.3  $\mu\text{g}/\text{person}/\text{day}$  (seafood contribution 12.5% in 2005), it is lower than the JECFA value ( $1\ \mu\text{g}/\text{man}\text{-kg}/\text{day} \times 53.3 = 53.3\ \mu\text{g}/\text{person}/\text{day}$ ) and therefore, the government has indicated that there is no reason for additional monitoring and/or new regulations for imported seafood.
- Cadmium levels in soft tissues of Japanese oysters and clams are analyzed by ICP-MS. Scientific survey results (2008) indicate that levels in Japanese oysters and clams (0.82 - 1.1 ppm/wet weight) were comparable with previous reported levels of Japanese seafood (oyster, 0.10 - 0.68 ppm/wet weight) and below the Codex recommendation of 2 ppm/wet weight. Simultaneously, cadmium levels in clam and oyster collected at the Vietnamese Red River coast indicated that cadmium levels in some oysters (0.7 -2.1 ppm/wet weight) were over the 2 ppm/wet weight level, but those in clam soft tissue (0.08 - 0.21 ppm/wet weight) were below this value.
- The cadmium source estimation using sediment content in clam soft tissue only partly correlated with element concentration, suggesting that most of cadmium arises from naturally occurring marine phytoplankton, with some contamination originating from terrigenous particle anthropogenic sources. The cadmium tracer study used to quantify the cadmium source contribution in clam was conducted by rearing clam with radioactive cadmium labelled phytoplankton, suspended sediment, and in seawater. The result indicated that most of the cadmium source uptake is from phytoplankton and sediment, while cadmium from all sources persists in soft tissues at slow rates of excretion.
- Based on our studies to date, and in view of increasing international seafood trade between developing and developed countries (Japan imported 14,892 tons of oysters in 2001 and 17,500 tons of clams in 2005), the evaluation of cadmium in commercially important seafood such as oysters and clams will be necessary, especially due to high cadmium concentrations reported (oyster <0.02 - 4.7 ppm/wet weight, clam <0.02 - 2.2 ppm/wet weight). In order to promote international trade by lowering the risk of rejection and in complying with domestic seafood safety regulations, scientific approaches to decrease the contamination of commercially important seafood produced in developing countries is critical. Radio-tracer technologies are invaluable in evaluating and controlling the source of contamination and in managing coastal environments.

18. The **Philippines** made the following observations:

- Bio-toxins are toxins produced by organisms that can cause human harm and although there are many different types of bio-toxins, they differ from toxic metals in that their effects are immediate rather than chronic. Toxic dino-flagellates that produce neurotoxic saxitoxins, such as *Pyrodinium bahamense* var. *compressum* (PbC), are ingested and accumulated by filter-feeding bivalves such as the green bay mussel, *Pernia viridis*, which can act as a direct vector to human intoxication. Recently, 13 deaths from paralytic shellfish poisoning (PSP) were reported in the Philippines and 120 patients were hospitalized due to the consumption of illegally transported contaminated mussels. A good PSP management system entails good communication as well as the involvement of researchers, the monitoring body and fisheries managers.

- In 2006, the Philippines produced 36,600 metric tons of mussel and oysters (amounting to 246.2 M PhP) from the total of 2.1M metric tons of aquaculture products (equivalent to 55.67 B PhP) harvested. In the same year, a total of 144.9 M Kg of fish, crustaceans, molluscs, and preparations thereof were exported with FOB value of 386.3 M USD. Since 1991, mussels and oysters are being exported to neighbouring Asian countries (Hong Kong, Taiwan, Kuwait, Singapore and Saudi Arabia), some European countries (Germany, Switzerland, etc), Canada and South Africa.
- Socio-economic instability, as well as deteriorating public health, dramatically increases when mussels and oysters test positive for PSP toxin. During the 1992 outbreak in Manila Bay, around 38,500 fisher- folk were displaced from work due to the red tide scare, with an estimated economic loss of 3.4 B PhP. Likewise, the shellfish ban in Sorsogon Bay in Bicol, Philippines has resulted in losses of PhP 70,000/day from trade in mussels and other shellfish since 2005.
- It is therefore imperative that a risk analysis for PSP should be conducted. The worldwide accepted regulatory limit of 80 µg/100g of meat requires a further examination, particularly since the Philippines regulations were decreased to 40 µg/100g of meat due to reported incidents of PSP at levels lower than 80 µg. It is also recommended that body weight in relation to toxicity should also be considered since the population of most developing countries have a relatively lower body mass and are the immediate victims of PSP. Population and economic variations should also be taken into account.
- It is further recommended that a more sensitive activity assay, such as the Receptor Binding Assay (RBA), should be used as a preliminary screening method and as an early warning tool for the regulatory body. The accepted AOAC Mouse Bioassay has a lower LOD of ~40 µg/100g of meat, which in the case of the Philippines and other countries with a regulatory limit of 40 µg/100g of meat it is not sufficient as the AOAC method does not detect levels lower than 40 µg and the probability of giving a false negative result is high.

19. **Thailand** made the following observations:

- Paralytic shellfish poisoning: The Thai coast is a highly productive area for mussels, oyster, shrimp and fish (aquaculture). Thailand is the number one exporter of seafood in the world. Seafood is also the main supply of protein for local Thais, especially those living along the coast. Although Thailand does not have any serious problems with harmful algae blooms, we need to be prepared to control and protect our consumers if a problem occurs. It is therefore necessary that criteria or regulations are established in order to prevent contamination, especially with the current increase of environmental problems causing potential hazards to human health.
- Testing has confirmed that receptor binding assay is the best and most suitable method for measuring toxins and for the enforcement of potential criteria or regulations to be established. This method was applied to determine PSP toxicity levels in more than 140 shellfish samples collected along the coastline of the Gulf of Thailand and the Andaman Sea. The primary objective of the study was to introduce the Thai regulatory authorities to the receptor binding assay as the preferred nuclear based method for determining PSP contamination. In addition, the study was meant to establish the distribution pattern of PSP along the Thai coastline so as to identify the most sensitive area and species for additional monitoring. This method can therefore be used as an early warning system to protect humans from PSP. The result of our analysis are summarized as follows:

Species	PSP toxicity as µg STX equivalent/100g shellfish*	
	Max (+ SD)	Min (+ SD)
Blood cockle	13.103(+ 2.212)	0.985(+ 0.003)
Green mussel	7.222(+ 1.549)	0.367(+ 0.025)
Pacific oyster	1.514(+ 0.011)	0.162(+ 0.034)
Hard clam	0.558(+ 0.029)	ND
Razor clam	0.543(+ 0.043)	ND

\*The WHO recommendation is 80µg STX equiv/100g shellfish

- The concentration variation by geographical area and season was demonstrated. It was also demonstrated that the receptor binding assay is a highly sensitive, high throughput and cost effective method with the lowest limit of detection of the methods studied, i.e. at around 5 ng/ml of shellfish extract. The RSD from our analysis of all samples demonstrated an error rate of less than 30% and an error deviation from our QC check standard of less than 20%, i.e. 2.5, 2.5 and 2.7 with the stated QC value of 3.0nM.
- The establishment of criteria or regulations requires further study, especially a risk assessment for each species, as consumption may not represent a significant portion of the diet and is dependent on the community.

**Thailand export of seafood (mussels)\***

Species	2007	2008
<i>Paphia undulata</i>	573.13	569.93
<i>Perna viridis</i>	946.44	395.58
<i>Amusium pleuronectus</i>	1113	2.73

\*Metric tons

- In regard to cadmium, the Fish Inspection and Quality Control Division (FID) of the Thailand Department of Fisheries are responsible for safety and quality control of exported seafood. In 2008, the FID examined about 3000 samples for cadmium contamination. All sample values varied from <0.01 - 0.4 mg/kg, i.e. the levels complied with EU regulations.
- A combination of HPLC, LC/MS/MS and MBA (Mouse Bio-assay) are used for the detection of biotoxins, as follows:

Biotoxin	Detection method	Species analyzed	Amount found
PSP	HPLC, MBA	<i>Paphia undulate, Perna viridis, Saccostrea commercialis, Gafraium tumidum, gafraium divaricatum</i>	In 2008, about 1560 samples were analyzed. Toxins were not detected.
ASP	HPLC		
DSP and Lipophilic toxin ( PTX, YTX, AZA)	LC/MS/MS, MBA		

- Seafood exports are still negatively affected by additional regulations and requirements established by the EU countries, including the introduction of new analytical techniques that require the development of additional national expertise and capabilities for the determination of contamination. Thailand also faces problems related to the contamination of cultured shrimp and fish with antibiotics and drug residues.

20. **Vietnam** made the following observations:

- Heavy metals are currently not a serious problem in domestically consumed or exported seafood. However, rapid industrial growth has lead to increasing public concerns related to cadmium and other toxic metal contaminants.
- Vietnam is presently the eighth largest seafood exporter worldwide. In 2007, the turnover value of exported seafood was USD \$4 billion, with Japan the largest seafood importer at 40% of the total and with an estimated shipment of over 15,000 tons of fish, shrimp and bivalve molluscs. The second biggest importer of Vietnamese seafood is the EU.
- According to data issued by the Vietnam Association of Seafood Export and Products (VASEP), the estimated value of seafood exported from Vietnam could reach USD \$4.3 billion in 2008. However, it was estimated that the Japanese proportion of the market would decrease



to 29%, primarily due to concerns raised over contaminated aquaculture production areas (shrimp and fresh catfish).

- In this regard, Japanese authorities reported and rejected Vietnamese seafood due to higher than allowable levels of antibiotic residues, such as chloramphenicol, nitrofurans and semicarbazide (SEM). It was further concluded that although the total estimated 2008 seafood exports will increase, the decrease in exports to the Japanese market was primarily due to non-compliance with aquaculture guidelines issued by the Ministry of Agriculture and Rural Development.

## SURVEY OF FUMONISIN B1 CONTAMINATION OF FOOD-GRADE COMMERCIAL MAIZE KERNEL LOTS FROM FIVE SAMPLING AREAS IN NIGERIA IN 2002<sup>5</sup>

### **Background**

21. The 2nd Session of the Codex Committee on Contaminants in Foods (CCCF) established an electronic working group (led by Brazil) to develop a discussion paper on fumonisins (ALINORM 08/31/41, para. 177) "which should include an overview of available data and scope of the problem of fumonisin contamination" and "should take into account the previous discussion paper presented at the 32nd Session (March 2000) of the Codex Committee on Food Additives and Contaminants" (CX/FAC 00/22).

22. The IAEA is pleased to contribute the following survey<sup>6</sup> on fumonisin B1 in shelled maize kernels marketed in Nigeria for consideration at the current 3<sup>rd</sup> Session of the CCCF under agenda item 9(a), document CX/CF 09/3/9.

### **Introduction to the Project**

23. Fumonisins, along with aflatoxins, are the major mycotoxins of health concern. They are unique amongst the mycotoxins in being almost exclusively contaminants of maize, the human dietary staple, particularly when grown in warmer regions. Maize has been in the diet of Nigerians for centuries. It started as a subsistence crop and has gradually become one of the more important crops and the most frequently consumed in Nigeria. Fumonisins are commonly detected in symptomless maize kernels, and surveys of good quality maize and maize based products have revealed the natural presence of fumonisins at levels generally of the order of 1 µg/g.

24. Because of concerns about mycotoxin contamination in the food and feed supply in developing countries, the International Atomic Energy Agency (IAEA), Technical Cooperation (TC) Department, Division for Africa, developed a number of international capacity building projects aiming at the establishment of analytical infrastructures to monitor import/export agricultural products for consumer health protection and to support food trade between member states. Within the framework of the IAEA TC project NIR/5/030 entitled *Regulatory Control and Monitoring of Contaminants and Residues in Fresh Produce*, staff members from the National Agency for Food and Drug Administration and Control (NAFDAC, Nigeria) were trained on mycotoxin methodologies and regulatory limits.

### **Project Summary**

25. Under the TC Project NIR/5/030, a study was designed to assess the incidence and contamination levels of fumonisin B1 in maize samples marketed in five geographical locations in Nigeria. Maize kernel samples were purchased from markets, retail outlets, and cereal stores in Lagos, Ibadan, Maiduguri, Kaduna, and Enugu. The samples were identified by location and lot number and sent to the FAO/IAEA Training and Reference Centre for Food and Pesticide Control (TRC), Agrochemicals Unit, FAO/IAEA Agriculture and Biotechnology Laboratory at Seibersdorf, Austria. Each lot was tested for fumonisin B1 (FB1) by HPLC-fluorescence detection technique, using a pre-column derivatization method. The limit of quantitation (lowest calibrated level) of the analytical method was 0.01µg/g for FB1. The FB1 concentration among the eighty-seven lots marketed in Nigeria varied from a low of 0.01µg/g to a high of 2.98µg/g and averaged

<sup>5</sup> Produced by the Agrochemicals Unit, FAO/IAEA Agriculture and Biotechnology Laboratory, IAEA Laboratories, in Seibersdorf, Austria, in collaboration with the Mycotoxin Unit, Oshodi Central Laboratories, NAFDAC, in Lagos, Nigeria.

<sup>6</sup> The full report of the *Survey of Fumonisin B1 Contamination of Food-Grade Commercial Maize Kernel Lots from Five Sampling Areas in Nigeria in 2002* is available on request.

0.91µg/g. While all eighty-seven lots were contaminated with FB1, the overall results indicated that relatively low levels were encountered in the lots tested in Nigeria. Twenty-eight percent of the eighty-seven lots tested less than 0.50µg/g and 67.8% contained concentrations of FB1 less than 1.0µg/g.

### **Project Results and Conclusions**

26. The study indicated that fumonisin B1 is a widespread contaminant of maize kernels in Nigeria. Various contamination levels were encountered across the five different areas and the overall results revealed relatively low levels of contamination. These findings were consistent with results reported worldwide confirming the widespread presence of the fumonisins in maize, and demonstrate the potential risk of chronic exposure of the consumer to fumonisin, especially through the ingestion of poor food quality grade grain.

27. Since maize has become Africa's most important staple food crop, being consumed up to three times a day and used as weaning food for babies, the enforcement of good agricultural practices, including the disposal of visibly damaged kernels, screenings and fines through cleaning procedures, and wet food processing, is strongly recommended to reduce the fumonisin B1 content, thus preventing exposure of consumers to harmful toxins in food.