CODEX ALIMENTARIUS COMMISSION

Food and Agriculture Organization of the United Nations

World Health Organization

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Agenda Item 4 **CX/FH 10/42/4**

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD HYGIENE

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Kampala, Uganda, 29 November – 3 December 2010

PROPOSED DRAFT GUIDELINES FOR CONTROL OF *CAMPYLOBACTER* AND *SALMONELLA* SPP. IN CHICKEN MEAT

(At Step 3)

Prepared by Argentina, Australia, Belgium, Brazil, Canada, Croatia, Denmark, European Union, Fiji, France, Germany, Iceland, Ireland, Japan, New Zealand, Norway, Spain, South Africa, Sweden, The Netherlands, Uganda, United Kingdom, United States of America, Vietnam, FAO, WHO, ALA, ICGMA, OIE

Governments and interested international organizations are invited to submit comments on the attached Proposed Draft Guidelines at Step 3 (see Appendix 1) and should do so in writing in conformity with the Uniform Procedure for the Elaboration of Codex Standards and Related Texts (see *Procedural Manual of the Codex Alimentarius Commission*) to: Ms Barbara McNiff, U.S. Department of Agriculture, Food Safety and Inspection Service, 1400 Independence Avenue, SW, Washington, D.C. 20250, FAX +1-202-720 3157, or email: Barbara.McNiff@fsis.usda.gov with a copy to: Secretariat, Codex Alimentarius Commission, Joint WHO/FAO Food Standards Programme, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy, by email codex@fao.org or fax: +39-06-5705-4593 **by 20 October 2010.**

BACKGROUND

The 40th Session of the Committee on Food Hygiene (November 2009) agreed to return the proposed draft Guidelines to Step 2 for further development by an electronic working group led by New Zealand and Sweden with active participation and support from Brazil.

It was agreed that the electronic working group would revise the proposed draft Guidelines based on the written comments submitted to the 40th CCFH and submissions received during the Working Group while ensuring that the revised document be maintained as close as possible to the current structure and content.

The Proposed Draft Guidelines, as prepared by the electronic working group, are hereby circulated for comments at Step 3 (see Appendix I). The list of participants of the electronic working group is attached as Appendix II.

APPENDIX I

PROPOSED DRAFT GUIDELINES FOR CONTROL OF *CAMPYLOBACTER* AND *SALMONELLA* IN CHICKEN MEAT

Table of contents

1. Introduction

1. Campylobacteriosis and salmonellosis are the two most frequently reported food borne diseases worldwide and chicken meat is considered to be one of the most important food vehicles. The burden of the diseases and the cost of control measures are highly significant in many countries and contamination with zoonotic *Campylobacter* and *Salmonella*[1] has the potential to severely disrupt trade between countries.

2. The Guidelines apply a risk management framework (RMF) approach as advocated in the Codex Committee on Food Hygiene (CCFH) guidelines for microbiological risk management[2]. "Preliminary Risk Management Activities" and "Identification and Selection of Risk Management Options" are represented by the guidance developed for control measures at each step in the food chain. Following sections on "Implementation" and "Monitoring" complete application of all the components of the RMF.

3. The Guidelines build on general food hygiene provisions already established in the Codex system and develop potential control measures specific for *Campylobacter* and *Salmonella* of public health relevance in chicken meat. In this context, the Guidelines give effect to the Codex Alimentarius Commission (CAC) commitment to developing standards that are based on sound science and risk assessment[3]. Potential control measures for application at single or multiple steps are presented in the following categories:

- Good hygienic practice (GHP) - based. They are generally qualitative in nature and are based on empirical scientific knowledge and experience. They are usually prescriptive and may differ considerably between countries.
- Hazard - based. They are developed from scientific knowledge of the likely level of control of a hazard at a step (or series of steps) in a food chain, have a quantitative base in the prevalence and/or concentration of *Campylobacter* or *Salmonella,* and can be validated as to their efficacy in hazard control at the step. There is an obvious expectation of consumer protection but the actual degree of protection will be unknown.

4. Examples of control measures that are based on quantitative levels of hazard control have been subjected to a rigorous scientific evaluation in development of the Guidelines. Such examples are illustrative only and their use and approval may vary amongst member countries. Their inclusion in the Guidelines illustrates the value of a quantitative approach to hazard reduction throughout the food chain and, where the web-based decision tool is applied, the likely level of public health protection that may result from particular food-chain scenarios and choices of control measures at the national level.

5. The Guidelines are presented in a flow diagram format so as to enhance practical application of a primary production-to-consumption approach to food safety. This format:

- Demonstrates differences and commonalities in approach for control measures for *Campylobacter* and *Salmonella*
- Illustrates relationships between control measures applied at different steps in the food chain
- Highlights data gaps in terms of scientific justification / validation for GHP-based control measures
- Facilitates development of HACCP plans at individual premises and national levels
- Assists in judging the equivalence[4] of control measures for chicken meat applied in different countries.

6. In doing so, the guidelines provide flexibility for use at the national (and individual primary production and processing) level.

2. Objectives

7. The primary objective of these Guidelines is to provide information to governments and industry on the control of *Campylobacter* and *Salmonella* in chicken meat that will lead to significant reductions in food

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[1] Human pathogens of public health relevance only. For the purposes of this document, all references to *Salmonella* and *Campylobacter* relate only to human pathogens.

[2] Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM) CAC/GL 63-2007

[3] Objective 2 of the Codex Strategic Objectives is "Promoting widest application of scientific principles and risk analysis" and the CAC Procedural Manual states that "Health and safety aspects of Codex decisions and recommendations should be based on a risk assessment, as appropriate to the circumstances" - 19th Edition, page 182

[4] Codex Guidelines on the Judgement of Equivalence of Sanitary Measures Associated with Food Inspection and Certification Systems (CAC/GL 53-2003).

borne disease. Their application should also facilitate international trade. The Guidelines provide a scientifically sound international tool for robust application of GHP- and hazard-based approaches to control of *Campylobacter* and *Salmonella* in chicken meat according to national risk management decisions.

8. It is not the intention of the Guidelines to set quantitative limits for *Campylobacter* and *Salmonella* in chicken meat in international trade. Rather, the Guidelines follow the example of the overarching Codex *Code of Hygienic Practice for Meat* (CAC/RCP 58-2005) and provide an "enabling" framework which countries can utilise to establish control measures appropriate to their national situation.

3. Scope and use of the Guidelines

3.1. Scope

9. These Guidelines apply to control of all *Campylobacter* and *Salmonella* that may contaminate chicken meat (*Gallus gallus*) and cause food borne disease. The primary focus is on chicken meat in the form of broiler carcasses and portions, with the exclusion of offals. These guidelines can be applied to other classes of chickens, e.g. end-of-lays, as appropriate.

10. The Guidelines apply to all steps in a "primary production-to-consumption" food pathway for chicken meat produced in typical "industrial' systems. While the Biosecurity provisions in this document have been developed primarily for controlled-environment housing systems they also have applicability to other housing systems.

3.2. Use

11. The Guidelines develop specific guidance for control of *Campylobacter* and *Salmonella* in chicken meat according to a "primary production-to-consumption" food pathway approach, with potential control measures being considered at each step, or group of steps, in the process flow. The Guidelines are supplementary to and should be used in conjunction with the *Recommended International Code of Practice – General Principles of Food Hygiene* (CAC/RCP 1 – 1969), the *Code of Hygienic Practice for Meat (*CAC/RCP 58-2005) and the *International Code of Practice for the Processing and Handling of Quick Frozen Foods* (CAC/RCP 8-1976).

These general and overarching provisions are referenced as appropriate in the Guidelines and their content is not duplicated in these Guidelines.

12. The primary production section of these Guidelines is supplementary to and should be used in conjunction with the *OIE Terrestrial Animal Health Code*[5] *(chapter 6.4 Hygiene and Disease Security Procedures in Poultry Breeding Flocks and Hatcheries*[6] *and chapter 6.5 Prevention, Detection and Control of Salmonella in Poultry) 2009 Edition.*

13. The Guidelines systematically present GHP-based control measures and examples of hazard-based control measures. GHP is a pre-requisite to making choices on hazard-based control measures. Examples of hazard-based control measures are limited to those that have been scientifically evaluated as being effective under conditions of commercial use. A list of scientific references supporting hazard-based control measures can be found in Section 14 of these Guidelines. Countries should note that these hazard-based control measures are indicative only and the references provided should be reviewed to assist application. The quantifiable outcomes reported for control measures are specific to the conditions of particular studies and would need to be validated under local commercial conditions to provide a meaningful estimate of hazard reduction[7]. Government and industry can use choices on hazard-based control measures to inform decisions on critical control points (CCPs) when applying HACCP principles to a particular food process.

14. Several hazard-based control measures as presented in these Guidelines are based on the use of chemical decontaminants to reduce the prevalence and/or concentration of *Campylobacter* and/or *Salmonella* positive broiler carcasses. The use of these substances is subject to approval by the competent authority. Also these Guidelines do not preclude any other choice of a hazard-based control measure that is not included in the examples, and that may have been scientifically validated as being effective in a commercial setting.

15. Provision of flexibility in application of the Guidelines is an important attribute. They are primarily intended for use by government risk managers and industry in the design and implementation of food control systems.

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[5] Refer to web site: www.oie.int.
[6] Currently under revision as at May 2010.
[7] FAO/WHO, 2009b

16. The Guidelines should be useful when judging the equivalence of different food safety measures for chicken meat in different countries

4. Definitions

Batch	A subset of a flock. A group of chickens sent together to a slaughterhouse at the same time.
Broiler	Birds of the species *Gallus gallus* selectively bred and reared for their meat rather than eggs
Chicken	Birds of the species *Gallus gallus*
Competitive exclusion[8]	The administration of defined[9] or undefined bacterial flora to poultry to prevent gut colonisation by enteropathogens, including *Salmonella*.
Crate	Container used to transport live chickens to the slaughterhouse.
Epidemiological unit[10]	A group of animals with a defined epidemiological relationship that share approximately the same likelihood of exposure to a pathogen. This may be because they share a common environment (e.g. animals in a pen), or because of common management practices. Usually, this is a herd or a flock. However, an epidemiological unit may also refer to groups such as animals belonging to residents of a village, or animals sharing a communal animal handling facility. The epidemiological relationship may differ from disease to disease, or even strain to strain of the pathogen.
Establishment[11]	The premises in which animals are kept
Flock[12]	A number of animals of one kind kept together under human control or a congregation of gregarious wild animals. For the purposes of the Terrestrial Code, a flock is usually regarded as an epidemiological unit.
Module	A structure containing crates / cages that facilitates loading and unloading
On-line Reprocessing	Additional washing step that may be used (instead of trimming or washing off-line) as a control measure for faecal or ingesta contamination
Partial depopulation	Incomplete harvest of chickens from a growing flock
Total depopulation	Full harvest of chickens from a growing flock

[8] This definition is taken directly from the OIE Terrestrial Animal Health Code. www.oie.int
[9] Probiotics are defined competitive exclusion products
[10] This definition is taken directly from the OIE Terrestrial Animal Health Code. www.oie.int
[11] This definition is taken directly from the OIE Terrestrial Animal Health Code. www.oie.int
[12] This definition is taken directly from the OIE Terrestrial Animal Health Code. www.oie.int

5. Principles applying to control of *Campylobacter* and *Salmonella* in chicken meat

17. Overarching principles for good hygienic practice for meat are presented in the *Code of Hygienic Practice for Meat* (CAC/RCP 58-2005) section 4: *General Principles of Meat Hygiene*. Two principles that have particularly been taken into account in these Guidelines are:

i. The principles of food safety risk analysis should be incorporated wherever possible and appropriate in the control of *Campylobacter* and *Salmonella* in chicken meat from primary production to consumption

ii. Wherever possible and practical, Competent Authorities should formulate risk management metrics[13] so as to objectively express the level of control of *Campylobacter* and *Salmonella* in chicken meat that is required to meet public health goals.

6. Risk profiles

18. Risk profiles are an important part of "Preliminary Risk Management Activities" when applying a RMF to a food safety issue. They provide scientific information to risk managers and industry in the design of food control systems that are tailor-made to individual food production and processing systems.

19. The contents of these Guidelines are predicated on two extensive risk profiles on *Salmonella* and *Campylobacter* in broiler chicken. These risk profiles are currently available from the following websites:

ftp://ftp.fao.org/codex/ccfh40/fh40rpsl

ftp://ftp.fao.org/codex/ccfh40/fh40rpcb.

7. Primary production-to-consumption approach to control measures

20. These Guidelines incorporate a "primary production-to-consumption" flow diagram approach so as to identify all steps in the food chain where control measures can potentially be applied. As well as facilitating a systematic approach to the identification and evaluation of all potential control measures, consideration of all steps in the food chain allows different combinations of control measures to be developed. This is particularly important where differences occur in primary production and processing systems between countries and risk managers need the flexibility to choose risk management options that are appropriate in the national context.

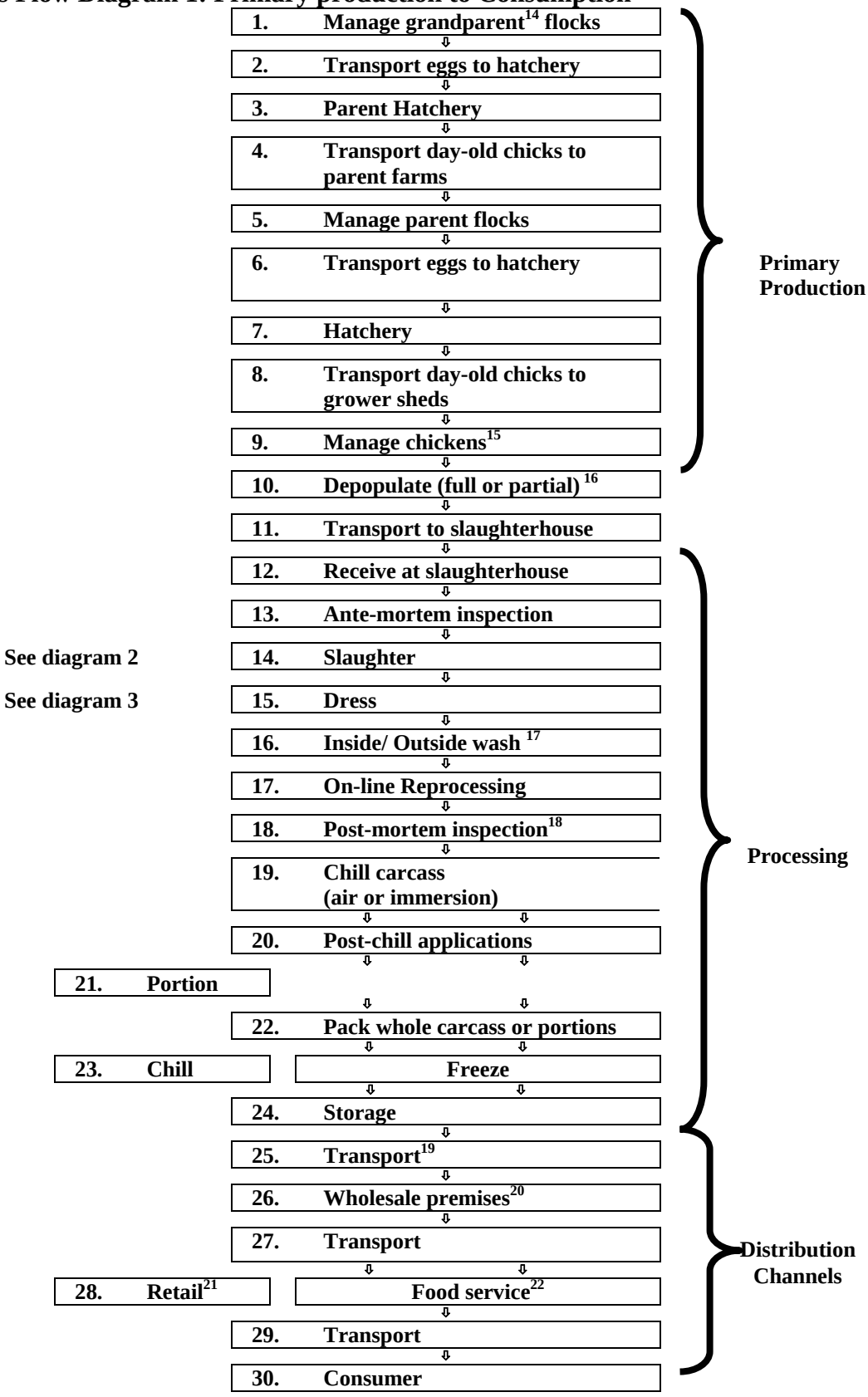
7.1. Generic flow diagram for application of control measures

21. A generic flow diagram is presented in sequence on the following pages.

22. Individual premises will have variations in process flow and should adapt design of HACCP plans accordingly.

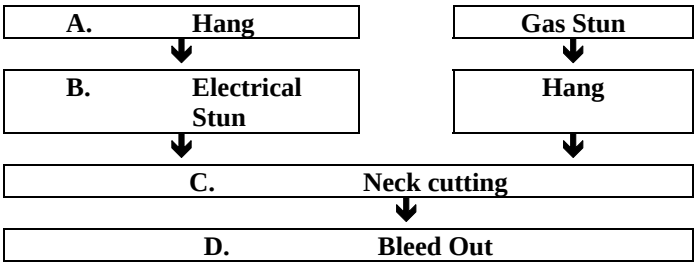
[13] Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM) CAC/GL 63-2007.

Process Flow Diagram 1: Primary production to Consumption

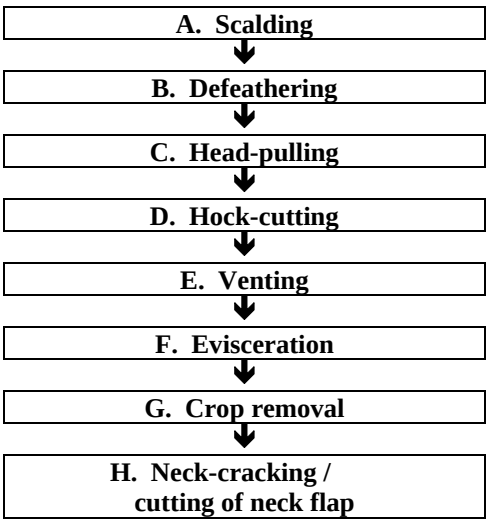


[14] Steps 1 – 4 also apply to great grandparents and elite breeding flocks
[15] May include ante-mortem inspection
[16] May include ante-mortem inspection
[17] May occur throughout the process
[18] May occur before the inside / outside wash
[19] May go direct to retail / food service
[20] Including storage
[21] Including storage
[22] Including storage

Process Flow Diagram 2: Step 14 - Slaughter



Process Flow Diagram 3: Step 15 - Dress[23],[24]



7.2. Availability of control measures at specific process flow steps addressed in these Guidelines

23. The intent of the following table is to illustrate where specific control measures for *Campylobacter* and/or *Salmonella* have been identified in relation to each of the process flow steps at different sections of the food chain. Control measures are indicated by a tick and their details are provided in these Guidelines or the OIE Terrestrial Animal Health Code[25] in the case of GHP. A blank cell means that a specific control measure for *Campylobacter* and/or *Salmonella* has not been identified for the process flow step.

[23] These process steps are generic and the order may be varied as appropriate
[24] Washing/rinsing may take place at a number of steps during dressing
[25] Refer to web site: www.oie.int.

Availability of Control Measures at Specific Steps in the Process Flow

Process Step	GHP-based control measures		Hazard-based Control Measures	
	Campylobacter	***Salmonella***	***Campylobacter***	***Salmonella***
1. Grand Parent Flocks ↓		OIE +✓		
2. Transport to Hatchery ↓		OIE +✓		
3. Parent Hatchery ↓		OIE +✓		
4. Transport to Parent Farms ↓		OIE		
5. Manage Parents ↓		OIE		
6. Transport to Hatchery ↓		OIE +✓		
7. Hatchery ↓		OIE +✓		
8. DOC to Grower Sheds ↓		OIE		
9. Manage Chickens ↓		OIE +✓		
10. Depopulate ↓		OIE		
11. Transport to Slaughterhouse ↓	✓	OIE		
12. Receive at Slaughterhouse ↓		✓		
13. A-M Inspection ↓				
14. Slaughter ↓				
15. Dress ↓				✓
16. Inside / Outside Wash ↓			✓	✓
17. On-line Reprocessing ↓			✓	✓
18. P-M Inspection ↓				
19. Chill Carcass ↓	✓	✓	✓	✓
20. Post-Chill Applications ↓			✓	✓
21. Portion ↓		✓		
22. Pack ↓		✓	✓	✓
23. Chill or Freeze ↓			✓	
24. Storage ↓		✓		
25. Transport ↓				
26. Wholesale ↓		✓		
27. Transport ↓				
28. Retail or Food Service ↓		✓	✓	✓
29. Transport ↓				
30. Consumer		✓	✓	✓

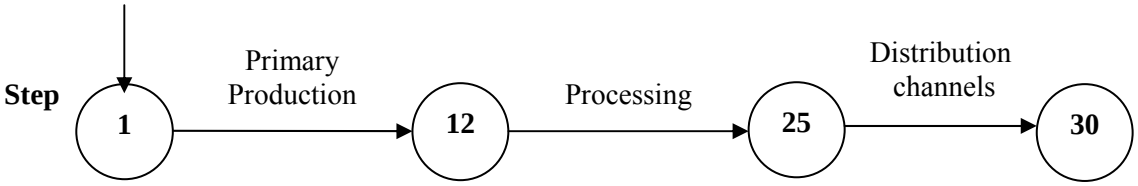
8. Control measures for Steps 1 to 11 (Primary Production)

24. These Guidelines on primary production are supplementary to, and should be used in conjunction with, the:

- OIE Terrestrial Animal Health Code[26]:
  - Chapter 6.4 "Hygiene and Disease Security Procedures in Poultry Breeding Flocks and Hatcheries"[27], and
  - Chapter 6.5 "Prevention, Detection and Control of Salmonella in Poultry".
- *Code of Practice on Good Animal Feeding* CAC/RCP 54-2004.

Note: specific provisions from the OIE Terrestrial Animal Health Code and Animal Feed documents are not provided in these Guidelines.

8.1 Step 1: Manage grandparent flocks



8.1.1 GHP-based control measures

25. Control of *Campylobacter* and *Salmonella* in grandparent flocks is strengthened by the application of a combination of biosecurity and personnel hygiene measures. The particular combination of control measures adopted at a national level should be determined by the competent authority, in consultation with relevant stakeholders.

For *Salmonella*

26. The breeder flock should be kept free from *Salmonella* to prevent transmission of infection.

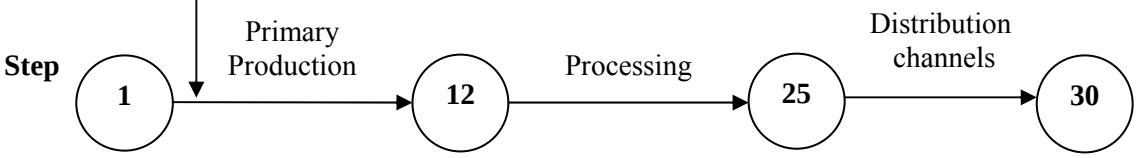
27. Where a flock is found to be *Salmonella*-positive a range of responses are detailed in the OIE Terrestrial Animal Health Code[28], Chapter 6.5 "Prevention, Detection and Control of Salmonella in Poultry".

28. Feed should be treated, stored and delivered in a manner that minimises the presence of *Salmonella*. Breeder feed should preferably be delivered in dedicated vehicles used only for feed transports.

29. The use of control measures such as live and inactivated vaccines, competitive exclusion and some water and feed additives e.g. organic acids or formaldehyde may require approval by the competent authority, to permit their use.

[26] Chapters 6.4 and 6.5 in the 2009 Edition (www.oie.int)
[27] Currently under revision as at May 2010.
[28] Refer to web site: www.oie.int.

8.2 Step 2: Transport eggs to hatchery

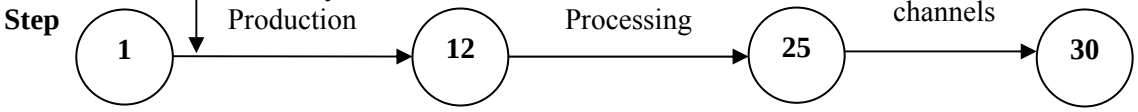


8.2.1 GHP-based control measures

For *Salmonella*

30. Only eggs from *Salmonella*-negative flocks should be sent for hatching. When this is not practical, the eggs from *Salmonella*-positive flocks should be transported separately from other eggs.

8.3 Step 3: Parent hatchery



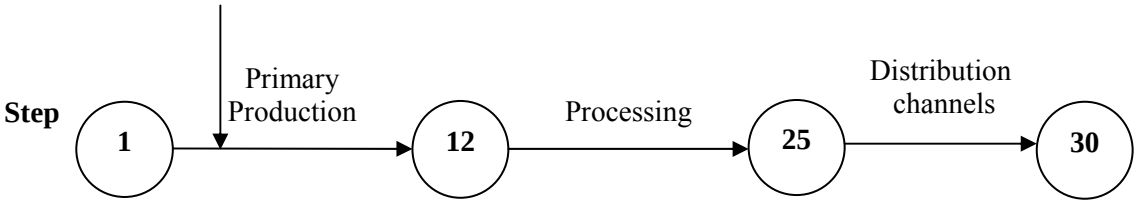
8.3.1 GHP-based control measures

For *Salmonella*

31. If possible, only eggs from *Salmonella*-negative flocks should be hatched.

32. Where the use of eggs from flocks that are known to be contaminated is unavoidable, they should be kept separate and hatched separately from eggs from other flocks. Trace back of infection to the contaminated breeding flocks should be performed and control measures should be reviewed.

8.4 Step 4: Transport Day-old Chicks to Parent Farm



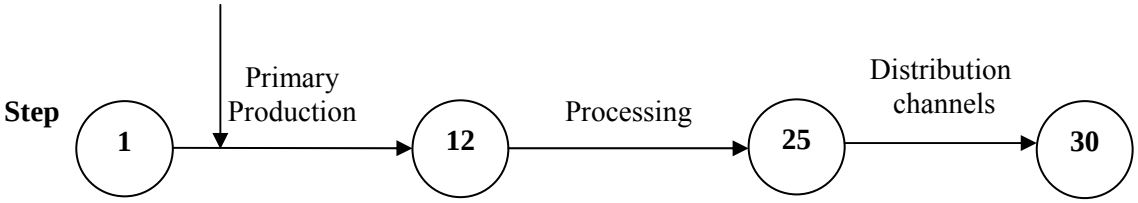
8.4.1 GHP-based control measures

33. Personnel involved in the transportation of day-old chicks to parent flocks should not enter any livestock buildings and should prevent cross contamination of day old chicks during loading and unloading.

8.5 Step 5: Manage parent flocks

34. The control measures described at Step 1 apply at this Step.

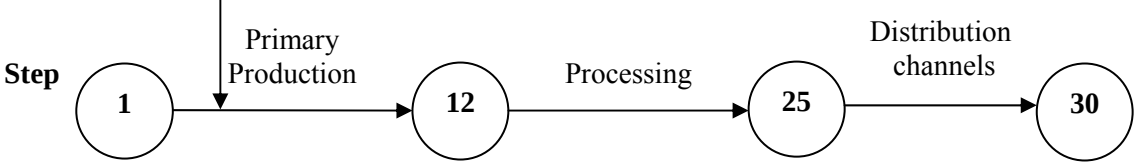
8.6 Step 6: Transport eggs to hatchery



For *Salmonella*

35. Only eggs from *Salmonella*-negative flocks should be sent for hatching. When this is not practical, the eggs from *Salmonella*-positive flocks should be transported separately from other eggs.

8.7 Step 7: Hatchery

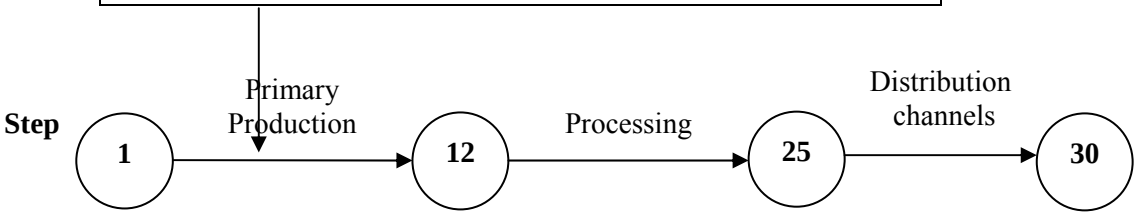


8.7.1 GHP-based control measures

For *Salmonella*

36. Where the use of eggs from flocks that are known to be contaminated is unavoidable, they should be kept separate and hatched separately from eggs from other flocks and the chicks should be kept isolated from other flocks. Trace back of infection to the contaminated breeding flocks should be performed and control measures should be reviewed.

8.8 Step 8: Transport day-old chicks to grower sheds

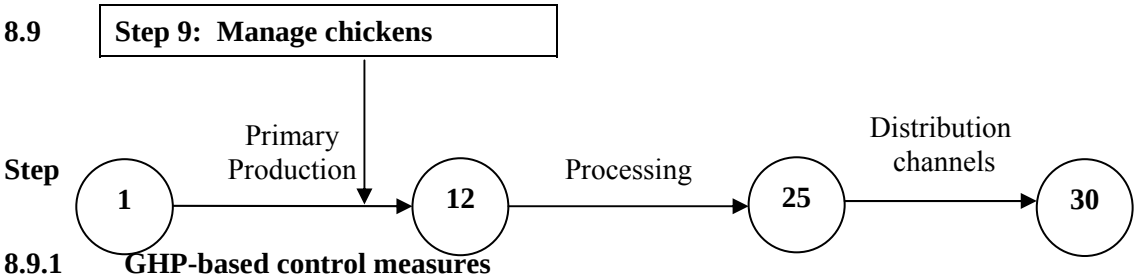


8.8.1 GHP-based control measures

37. Personnel involved in the transportation of day-old chicks should not enter any livestock buildings.

38. Personnel should follow appropriate biosecurity procedures to avoid cross contamination of day old chicks during loading and unloading. All live bird transport crates and modules should be cleaned, sanitized and dried to the greatest extent practicable before re-use.

8.9 Step 9: Manage chickens



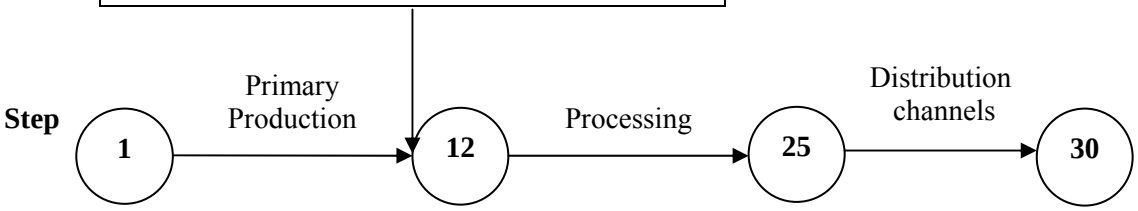
8.9.1 GHP-based control measures

39. A pest control programme should be designed according to local conditions.

For *Salmonella*

40. The use of specific control measures such as competitive exclusion bacteria, organic acids in pre-slaughter drinking water and organic acids or formaldehyde in feed, may require approval by a competent authority to permit their use.

8.10 Step 10: Depopulate (full or partial)



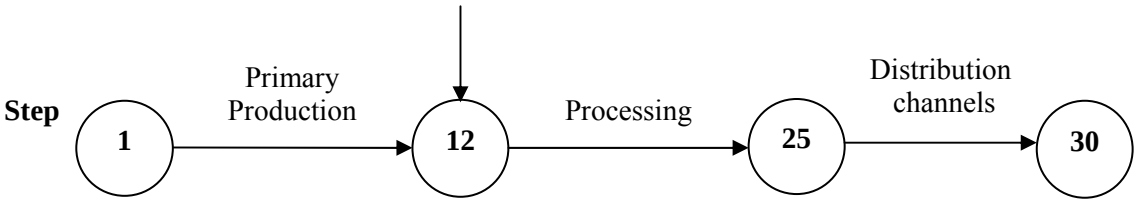
8.10.1 GHP-based control measures

41. Full depopulation of the flock should be carried out where possible. Where this is not practicable and partial depopulation is practised, particular attention should be paid to strict biosecurity and hygiene of catchers and the equipment they use.

42. It is preferable that sheds being partially depopulated are scheduled for catching prior to those being fully depopulated on the same day.

43. When feed withdrawal is practised, water additives such as lactic acid that may lower post-harvest crop contamination may be used.

8.11 Step 11: Transport to slaughterhouse



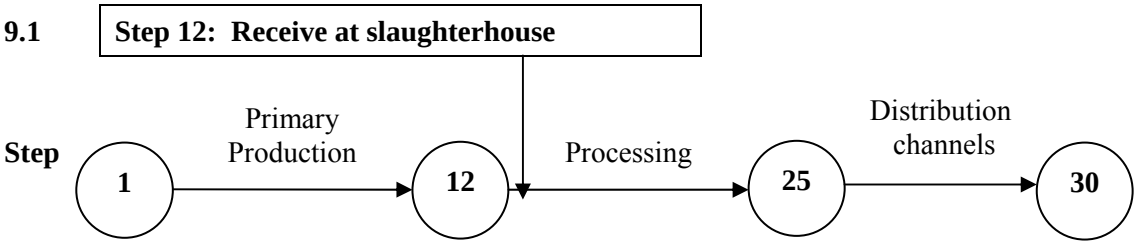
8.11.1 GHP-based control measures

For *Campylobacter* and *Salmonella*

44. All live bird transport crates and modules should be cleaned, sanitized and dried to the greatest extent practicable, before reuse.

9. Control measures for Steps 12 to 24 (Processing)

9.1 Step 12: Receive at slaughterhouse



9.1.1 GHP-based control measures

45. Information about *Salmonella* and/or *Campylobacter* flock status should be provided in a timely manner to enable logistic slaughter and/or channelling of products to treatment, where appropriate to the national situation.

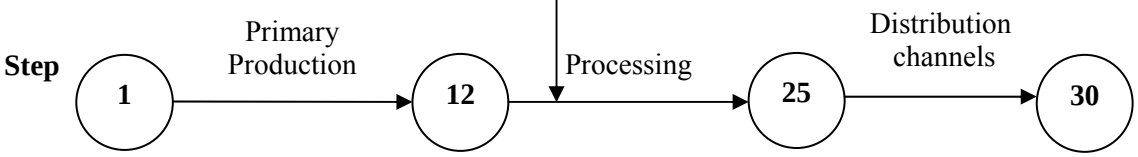
46. Flocks, where practical, should be slaughtered after 8-12 hours feed withdrawal in order to reduce the likelihood of contamination of carcasses by faecal material and ingesta.

47. Stress to chickens should be minimised, e.g. dim lighting, minimal handling and avoiding delays in processing.

For *Salmonella*

48. If flocks that are positive for *Salmonella* are presented for slaughter this should be done in a manner that minimises cross contamination to other flocks, e.g. by slaughtering them at the end of the day, or all on one day and preferably the last day(s) of the working week.

9.2 Step 13: Ante-mortem inspection

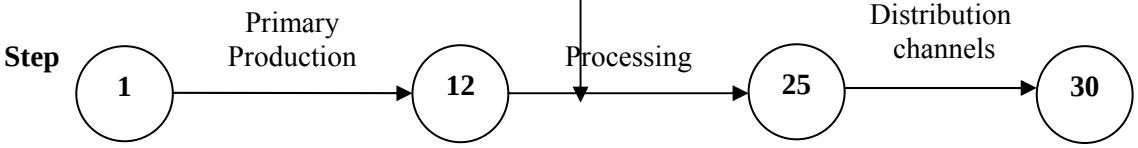


9.2.1 GHP-based control measures

49. Moribund, unhealthy or otherwise unsuitable chickens should not be processed.

50. Where numbers of chickens that are dead on arrival, moribund, unhealthy or otherwise unsuitable for processing exceed expected levels, the processor should notify the relevant responsible person, e.g. the competent authority, the farmer, veterinarian, catcher or transportation company, so that appropriate preventative and/or corrective action can be taken.

9.3 Step 14: Slaughter



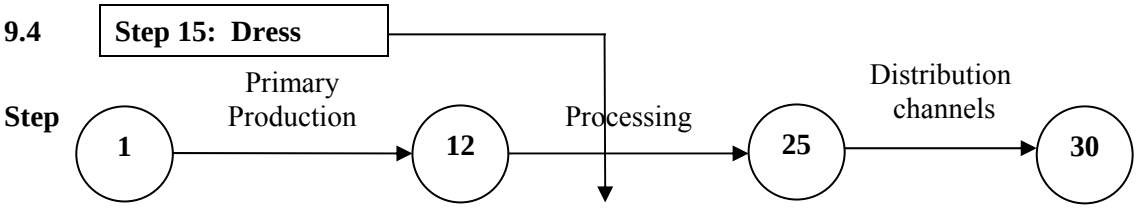
9.3.1 GHP-based control measures

51. Positive flocks may be diverted for specific processing and/or treatment according to national food safety policies.

52. Measures should be taken to minimise bird stress at live hanging, e.g. use of blue light, breast comforter, suitable line speed.

53. Bleeding should be substantially completed before scalding in order to prevent inhalation of scald water and to reduce the amount of blood entering the scalder.

9.4 Step 15: Dress



9.4.1 GHP-based control measures

54. So as to minimise contamination[29] of carcasses, control measures may include:

- Washing with abundant potable water
- Trimming
- Use of chemical decontaminants approved by the competent authority
- Use of other physical methods approved by the competent authority.

55. These methods can be applied alone or in combination at key process steps and should be initiated by inspection, be it visual or automated inspection. Multiple control measures may not always be additive.

[29] Decontamination of carcasses will likely reduce, but not eliminate *Salmonella* and *Campylobacter* bacteria on broiler carcasses and broiler meat

56. Where re-hang of carcasses is necessary, it is preferable that this is done mechanically so as to reduce cross-contamination.

57. All chickens which drop on the floor should be condemned, or reprocessed under specific conditions as determined by the competent authority. Any dropped product should trigger corrective actions as appropriate, such as trimming and re-washing.

9.4.1.1 Scalding

58. Contamination during scalding can be minimised by:

- The use of counter-current flow
- High flow rates of water with adequate agitation
- Having an optimum scalding temperature[30] to minimise levels of *Campylobacter* and *Salmonella*
- Use of approved[31] chemicals e.g. pH regulators.

59. Other factors that should be taken into account when designing process control systems that minimise contamination during scalding include:

- Degree of agitation
- Use of multi-staged tanks
- Pre-scald wash systems
- Raising the temperature at processing breaks high enough for a long enough time to kill *Campylobacter* and *Salmonella* in the scalders
- Tanks being emptied and cleaned at end of a processing period
- Tanks being cleaned and disinfected at least daily
- Hygiene measures applied to reused/recycled water.

9.4.1.2 Defeathering

60. Cross contamination at defeathering can be minimised by:

- Ensuring appropriate fasting of chickens prior to slaughter
- Prevention of feather build-up on equipment
- Continuous rinsing of equipment and carcasses
- Regular adjustment and maintenance of equipment
- Particular attention to cleaning moving parts
- Regular inspection and replacement of plucker fingers.

9.4.1.3 Head pulling

61. Head pulling should be carried out in such a manner that leakage from the crop is prevented. Heads should be pulled downwards to reduce contamination due to crop rupture.

9.4.1.4 Evisceration

62. Rupture of the viscera and spread of faeces can be minimised by:

- Limiting size variation in batches so that birds of similar sizes are processed together
- Careful adjustment and regular maintenance of machinery.

9.4.1.5 Crop removal

63. Where possible, crops should be extracted in a manner that is likely to limit carcass contamination.

[30] Taking into consideration, suitability requirements (i.e. not affecting the skin)
[31] The competent authority may require processing aids to be approved.

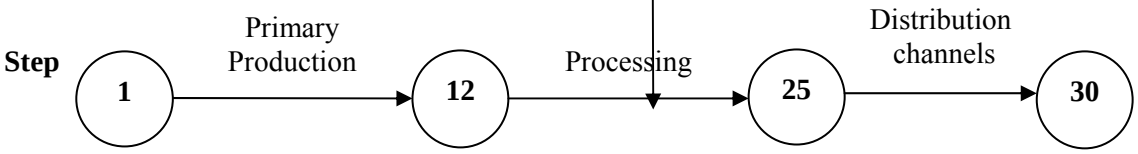
9.4.2 Hazard-based control measures

For *Salmonella*

64. Spray applications of 20-50 ppm chlorinated water following defeathering and carcass evisceration have been shown to reduce the prevalence of *Salmonella*-positive broiler carcasses from 34% to 26% and from 45% to 36%respectively[32].

65. Immersion in Tri Sodium Phosphate (TSP) has been shown to reduce prevalence of *Salmonella*-positive carcasses from 72% to 4%[33]

9.5 **Step 16: Inside/outside wash**



9.5.1 GHP-based control measures

66. The inside and outside of all carcasses should be thoroughly washed, using pressure sufficient to remove visible contamination. Appropriate equipment should be used to ensure direct water contact with the carcass. The removal of contaminants may be aided by the use of brushing apparatus installed in line with the inside/outside wash.

9.5.2 Hazard-based control measures

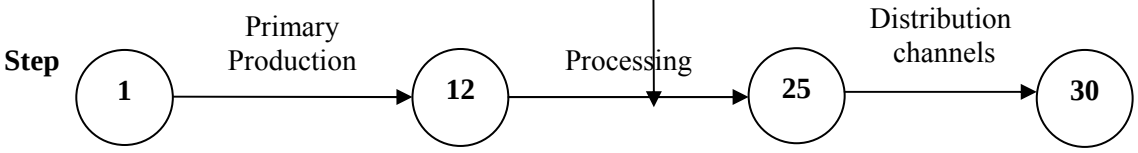
For *Campylobacter*

67. Carcass washing systems with 1-3 washers using water with 25-35ppm total chlorine, have been shown to reduce levels of *Campylobacter* by about 0.5 $\log_{10}$ CFU/ml of whole carcass rinse sample. Post-wash sprays using Acidified Sodium Chlorite (ASC)[34] or TSP may further reduce *Campylobacter* levels by an average of 1.3 $\log_{10}$ CFU/ml[35] or 1.0 $\log_{10}$ CFU/ml[36] of whole carcass rinse sample respectively.

For *Salmonella*

68. Inside/outside washing using a spray application of 20-50 ppm chlorinated water has been shown to reduce the prevalence of *Salmonella*-positive broiler carcasses from 25% to 20%. A second inside/outside washing following upon the first resulted in a reduction of *Salmonella*-positive broiler carcasses from 16% to 12%[37].

9.6 **Step 17: Online reprocessing[38]**



9.6.1 Hazard-based control measures

For *Campylobacter* and *Salmonella*

[32] Stopforth et al, 2007.
[33] Salvat et al 1997
[34] JECFA 2007. ASC was evaluated by JECFA at its 68th meeting and the Committee recommended that it be approved for use on poultry and other products
[35] Bashor et al, 2004, Oyarzabal et al, 2004
[36] Bashor et al, 2004
[37] Stopforth et al, 2007
[38] Where approved by the Competent Authority.

69. An on-line reprocessing spray system incorporating ASC has been shown to reduce *Campylobacter* in the whole carcass rinse sample by about 2.1 $\log_{10}$ CFU/ml and to reduce the prevalence of *Salmonella*-positive carcasses from 37% to 10%.[39]

70. Dipping carcasses in 10% TSP reduced *Campylobacter* by 1.7 $\log_{10}$ CFU/g neck skin and the MPN of *Salmonella* was reduced from 1.92 $\log_{10}$ CFU/g neck skin to not detected.[40]

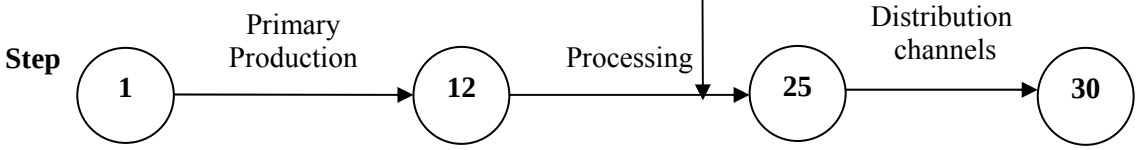
For *Salmonella*

71. The use of ASC (750ppm, pH 2.5, spray application) has in one industrial setting been shown to reduce *Salmonella* prevalence on carcasses from about 50% to levels below detection. In another industrial setting *Salmonella* prevalence was reduced by 18% (700-900ppm, pH 2.5, spray application).[41]

72. A pre-chill ASC spray reduced the *Salmonella* prevalence on carcasses from 17% to 9%. Dipping carcass parts in ASC reduced the *Salmonella* prevalence from 29% to 1%. [42]

73. Spray application of 8-12% TSP immediately before carcass chilling was shown to reduce *Salmonella* prevalence from 10% to 3%[43]

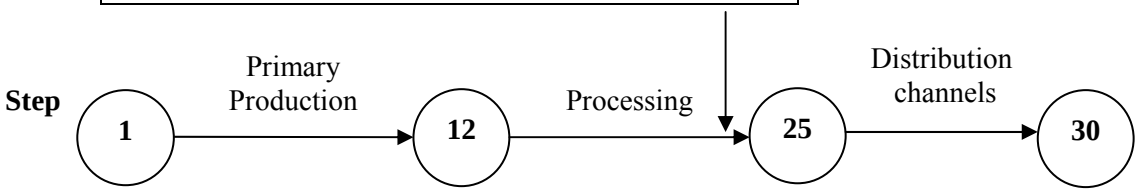
9.7 Step 18: Post mortem inspection



9.7.1 GHP-based control measures

74. Line speeds and the amount of light should be appropriate for effective post-mortem inspection of carcasses for visible contamination, organoleptic defects and relevant gross pathology.

9.8 Step 19: Chill carcass (air or immersion)



9.8.1 GHP-based control measures

75. Chicken meat should be chilled, using air or immersion chilling, as quickly as possible to limit the growth of micro-organisms on the carcass. Design and operation of chilling systems should ensure that the target temperature of chilled carcasses is achieved by the time carcasses exit the chiller.

9.8.1.1 Air chilling

76. If water sprays are used during air chilling to prevent desiccation of carcasses, they should be arranged to minimise cross contamination.

9.8.1.2 Immersion Chilling

77. Where considered necessary for control of *Campylobacter* and *Salmonella,* processing aids may be added to the chiller water[44]. These should be approved by the competent authority and may include, among others:

[39] Kere-Kemp et al, 2001. Kere-Kemp et al, 2002.
[40] Whyte et al, 2001
[41] FAO/WHO, 2009b
[42] Stopforth et al, 2007
[43] Stopforth et al, 2007
[44] A variety of processing aids are reviewed in: FAO/WHO: Benefits and Risks of the Use of Chlorine-containing Disinfectants in Food Production and Food Processing. FAO/WHO 2009a..

- Free chlorine (as produced by chlorine gas, sodium-hypochlorite, calcium hypochlorite tablets or electrolytically generated hypochlorous acid)
- Organic acids (e.g. citric, lactic or peracetic acid)
- Other oxidants (e.g. hydrogen peroxide, peroxy acids, chlorine dioxide, acidified sodium chlorite)

78. The use of chlorine in the chill tank may not act as a decontaminating agent by acting directly on the contaminated carcass. However, there would be a washing off effect by the water itself, and the addition of chlorine at a level sufficient to maintain a free residual in the water would then inactivate *Campylobacter* and *Salmonella* washed off, preventing re-attachment and cross-contamination.

79. Water (including recirculated water) should be potable and the chilling system may comprise of one or more tanks. Chilled water can be used or ice may be added to it. Water flow should be counter-current and may be agitated to assist cooling.

80. Following chilling, any excess water should be allowed to drain away from the carcasses to minimise cross-contamination of carcasses at subsequent steps in the processing chain.

9.8.2 Hazard-based control measures

For *Campylobacter*

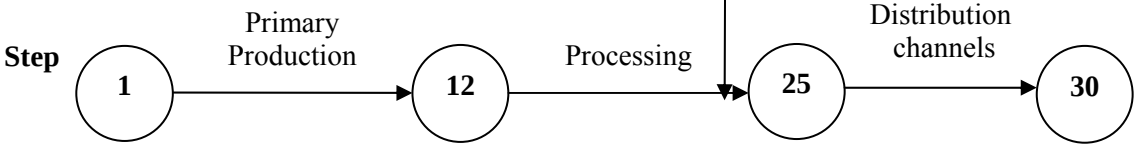
81. Forced air chilling (blast chilling) may reduce the concentration of *Campylobacter* on chicken carcasses by 0.4 $\log_{10}$ CFU/carcass[45].

82. Immersion chilling has been shown to reduce concentrations of *Campylobacter* by 1.1-1.3 $\log_{10}$ CFU/ml of carcass rinse[46].

For *Salmonella*

83. Immersion chilling in water treated with 20ppm or 34 ppm chlorine or 3ppm or 5 ppm chlorine dioxide reduced *Salmonella* prevalence from 14% in controls to 2% (20ppm Cl_2), 5% (34ppm Cl_2), 2% (3ppm ClO_2) and 1% (5 ppm ClO_2) respectively.[47]

9.9 Step 20: Post-chill applications



9.9.1 Hazard-based control measures

For *Campylobacter*

84. Immersing whole carcasses in 600-800ppm ASC at pH 2.5 to 2.7 for 15 seconds immediately post-chill, has been shown to reduce *Campylobacter* by 0.9-1.2 $\log_{10}$ CFU/ml of whole carcass rinse sample[48].

For *Salmonella*

85. The use of ASC (750 ppm, pH ≈ 2.5, immersion dip) post-chill has been shown to reduce prevalence of *Salmonella* positive carcasses from 16% to a level below detection.[49]

86. Spray applications of 20-50 ppm chlorinated water have been shown to reduce the prevalence of *Salmonella*-positive carcasses from 10% to 4%.[50]

87. A chlorine dioxide generating system applied as a dip at 5ppm post-chill resulted in 15-25% reduction in *Salmonella* prevalence.[51]

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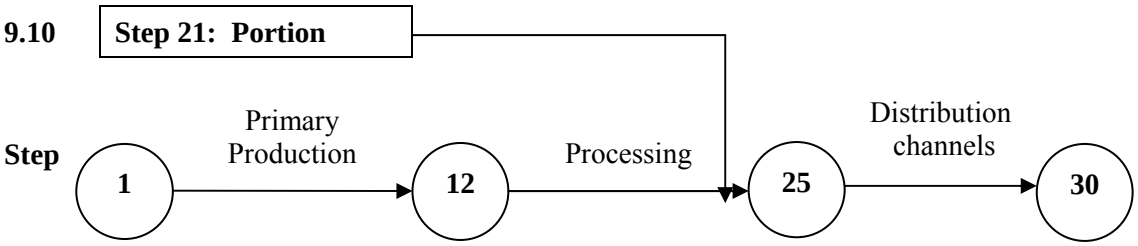
[45] Boysen and Rosenquist, 2009
[46] Oyarzabal et al, 2004
[47] Lillard, 1980
[48] Oyarzabal et al, 2004
[49] FAO/WHO, 2009b
[50] Stopforth et al, 2007

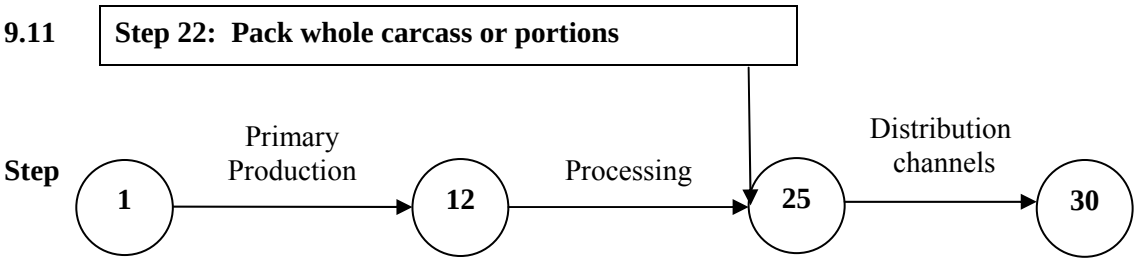
88. Spraying carcasses immediately after spin chilling with 10% TSP resulted in a reduction of *Salmonella* prevalence from 50% to 6%.[52]



9.10.1 GHP-based control measures

For *Salmonella*

89. Chilled carcasses should be held in temperature controlled environments and processed as soon as possible, or with the addition of ice to minimise the growth of *Salmonella*.



9.11.1 GHP-based control measures

90. Care should be taken when packaging to minimise external contamination of the pack, e.g. by use of leakproof packaging or absorbent pads.
91. Pre-packed chicken products intended to be cooked by the consumer should be labeled[53] with safe handling and cooking instructions as appropriate to the National situation.

For *Salmonella*

92. Chilled carcasses should be held in temperature controlled environments and processed as soon as possible or with the addition of ice to minimise the growth of *Salmonella*.

9.11.2 Hazard-based control measures

For *Campylobacter*

93. Modified atmosphere packaging containing a high oxygen (70%O_2) concentration, has been shown to reduce *Campylobacter* by 2.0-2.6 $\log_{10}$ CFU/g over 8 days chilled storage[54].

For *Campylobacter* and *Salmonella*

94. Various doses of Gamma rays or electron beams[55] applied to warm, chilled, or frozen carcasses have been shown to be effective at eliminating *Campylobacter* and *Salmonella*. Where irradiation is permitted, levels should be validated and approved by the competent authority.

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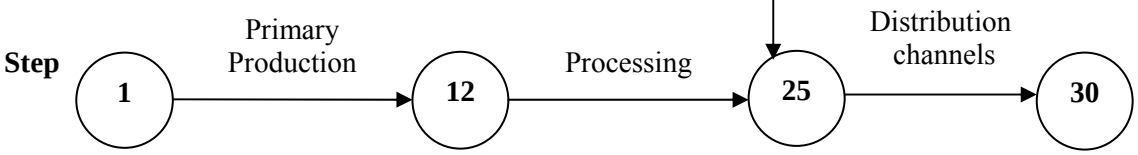
[51] FAO/WHO, 2009b
[52] Salvat et al, 1997
[53] Refer to General Standard for the Labeling of Pre-packaged Foods (Codex STAN1-1985) and WHO's "Prevention of food-borne disease: Five keys to safer food"
[54] Boysen et al, 2007
[55] Refer to General Standard for Irradiated Foods (Codex STAN106-1983)

9.12 **Step 23: Chill / Freeze**



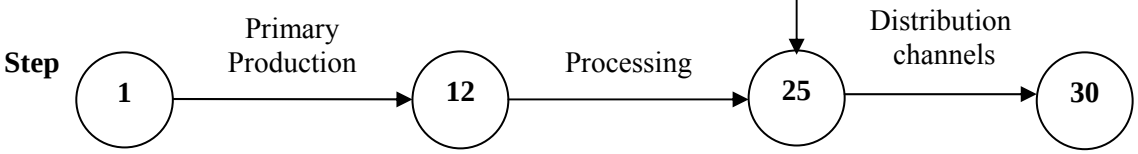
9.12.1 Hazard-based control measures

For *Campylobacter*

95. Freezing of naturally contaminated carcasses followed by 31 days of storage at -20 degrees C has been shown to reduce *Campylobacter* by 0.7 to 2.9 $\log_{10}$ CFU/g.[56]

96. Crust freezing using continuous carbon dioxide belt freezing of skinless breast fillets has been shown to give a reduction of *Campylobacter* of 0.4 $\log_{10}$ CFU/fillet.[57]

9.13 **Step 24: Storage**



9.13.1 GHP-based control measures

For *Salmonella*

97. Products should be stored at temperatures preventing growth of *Salmonella*.[58]

10. Control measures for Steps 25 to 30 (Distribution channels)

98. For GHP-based control measures for all aspects of transport, refer to the Recommended International Code of Practice – General Principles of Food Hygiene and the Code of Hygienic Practice for Meat.

10.1 **Step 25: Transport**

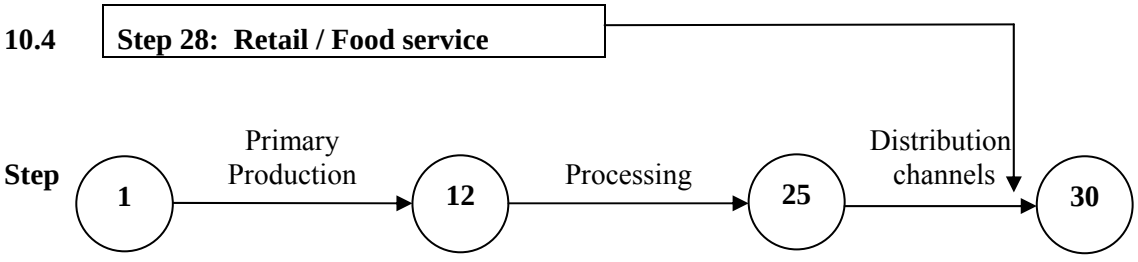
10.2 **Step 26: Wholesale Premises**

For *Salmonella*

99. Products should be stored at temperatures preventing growth of *Salmonella*.

10.3 **Step 27: Transport**

10.4 **Step 28: Retail / Food service**



10.4.1 GHP-based control measures

10.4.1.1 Retail

100. Retailers should ensure that hygiene measures are in place to prevent cross-contamination between raw chicken meat and other food.

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[56] Boysen and Rosenquist 2009. Georgsson et al, 2006
[57] Boysen and Rosenquist 2009.
[58] Packaging in modified atmosphere does not prevent growth of *Salmonella* if temperature abuse occurs.

101. Retailers should separate raw and cooked products.

102. Hands should be washed and sanitized after handling raw chicken meat. Retailers may also provide customers with the means to sanitise hands after handling raw chicken meat packs.

103. Where product is packed at retail for individual selection by customers, packs should be leak-proof where possible. Extra packaging supplied at the display counter allows customers to separate chicken from other purchases.

10.4.1.2 Food service

104. For GHP-based control measures, also refer to the Code of Hygienic Practice for Precooked and Cooked Foods in Mass Catering (CAC/RCP 39-1993).

105. Thawing of frozen chicken should be carried out in a manner that minimises the potential for growth and cross contamination.[59] Washing of raw chicken carcasses should not be carried out as it is likely to spread contamination.

106. Food service operators should be fully trained in and aware of the differences between raw and cooked chicken products in relation to food safety and ensure separation at all times.

107. Food service operators should have hygiene measures in place that minimise cross-contamination between raw chicken and hands, contact surfaces and utensils, and should prevent contamination of other foods.

For *Salmonella*

108. Products should be stored at temperatures preventing growth of *Salmonella*.

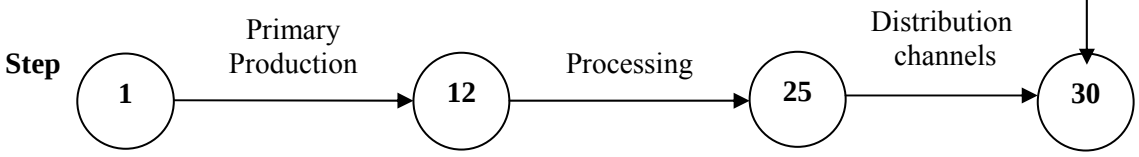
10.4.2 Hazard-based control measures

For *Campylobacter* and *Salmonella*

109. Chicken meat should be cooked according to a process that is capable of achieving at least a 7 log reduction in both *Campylobacter* and *Salmonella*.[60]

10.5 **Step 29: Transport**

10.6 **Step 30: Consumer**



10.6.1 GHP-based control measures

110. Consumer education should focus on handling, hand washing, cooking, storage, thawing, prevention of cross contamination, and prevention of temperature abuse. The WHO Five keys to safer food[61] assists in this process.

111. Special attention should be paid to the education of all persons preparing food, and particularly to persons preparing food for the young, old, pregnant and immuno-compromised.

112. The above information to consumers should be provided through multiple channels such as national media, health care professionals, food hygiene trainers, product labels, pamphlets, school curriculae and cooking demonstrations.

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[59] Refer to the International Code of Practice for the Processing and Handling of Quick Frozen Foods (CAC/RCP 8-1976)

[60] Cooking chicken meat thoroughly will eliminate *Campylobacter* and *Salmonella.* It has been shown that cooking chicken meat to 165°F (74°C) minimum internal temperature, with no hold time, will give at least a 7 $\log_{10}$ reduction in both *Campylobacter* and *Salmonella.* USDA, 2005

[61] http://www.who.int/foodsafety/consumer/5keys/en/

113. Washing of raw chicken carcasses and/or chicken meat, where deemed necessary, should be carried out in a manner which minimises the possibility of contamination of other foods and other food-contact and human-contact surfaces.

114. Consumers should wash and sanitise food contact surfaces after raw chicken preparation to significantly reduce the potential for cross-contamination in the kitchen.

For *Salmonella*

115. Products should be stored at temperatures preventing growth of *Salmonella*.

10.6.2 Hazard-based control measures

For *Salmonella* and *Campylobacter*

116. Chicken meat should be cooked according to a process that is capable of achieving at least a 7 log reduction in both *Campylobacter* and *Salmonella*.[62]

11. RISK-BASED CONTROL MEASURES

117. GHP provides the foundation for most food control systems. Where possible and practicable, food control systems should incorporate hazard-based control measures and risk assessment. Identification and implementation of risk-based control measures can be elaborated by application of a risk management framework (RMF) process as advocated in the *Principles and Guidelines for the Conduct of Microbiological Risk Management* (MRM) (CAC/GL 63-2007).

118. While these guidelines provide generic guidance on development of GHP-based and hazard-based control measures for *Campylobacter* and *Salmonella*, development of risk-based control measures for application at single or multiple steps in the food chain are primarily the domain of competent authorities at the national level. Industry may derive risk-based measures to facilitate application of process control systems.

11.1. Development of risk-based control measures

119. Competent authorities operating at the national level should develop risk-based control measures for *Campylobacter* and *Salmonella* where possible and practical.

120. Risk modelling tools used to explore risk management options and contribute to risk management decisions should be fit for purpose.

121. The risk manager needs to understand the capability and limitations of risk modeling tools they have selected[63].

122. When developing risk-based control measures, competent authorities may use the quantitative examples of the likely level of control of a hazard at certain steps in the generic food chain in this document, as a peer-reviewed scientific resource[64].

123. Competent authorities formulating risk management metrics[65] as regulatory control measures should apply a methodology that is scientifically robust and transparent.

11.2. Availability of a web-based decision tool

124. FAO/WHO through JEMRA has initiated the development of a web-based decision support tool[66] for exploring the potential for development of risk-based control measures for *Campylobacter* and *Salmonella* in the raw meat chicken food chain at the national level. This will be found on the website, once available[67].

125. This web-based tool can be used to estimate relative risk reduction and/or ranking consequential to:

- implementation of a specific control measure at a particular step in the food chain (from primary production through to consumption)

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62. USDA, 2005

63 Basic Food Hygiene texts Guidelines for Microbiological Risk Assessment 1996

64 FAO/WHO 2009b. FAO/WHO Technical Meeting on *Salmonella* and *Campylobacter* in chicken meat. Rome 4-8 May 2009.

65 Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM) CAC/GL 63-2007.

66 Initiated after FAO/WHO Technical Meeting on *Salmonella* and *Campylobacter* in chicken meat. Rome 4-8 May 2009. Trialled November 2009. Reviewed April 2010. The tool will be subject to future peer review.

67 www.mramodels.org

- implementation of a particular combination of control measures at different steps in the food chain
- modelling of different food chain scenarios to that presented in this document

126. Industry may also make use of the decision support tool when designing premises-specific food safety programmes that may differ in availability of specific control measures.

127. The user of the decision support tool at the national level should:

- Take responsibility for the appropriateness of the scientific data that is introduced
- Be aware of the uncertainty that inevitably accompanies risk modelling and in conjunction with the risk manager, use the web-based tool to *explore* risk management options and *inform* risk management decisions, rather than provide a prescriptive base
- Not use the tool to impose specific scientific assumptions

12. IMPLEMENTATION OF CONTROL MEASURES

128. Implementation[68] involves giving effect to the selected control measure(s), development of implementation plan, communication on the decision on control measure(s), ensuring regulatory framework and infrastructure for implementation, and evaluation process to assess whether the control measure(s) have been properly implemented.

12.1 Validation of control measures

129. Refer to the *Guidelines for the Validation of Food Safety Control Measures* (CAC/GL 69 -2008).

Note: GHP-based control measures are not subject to validation.

12.2 Prior to Validation

130. Prior to validation of the hazard-based control measures for *Campylobacter* and/or *Salmonella*, the following tasks should be completed:

- Identification of the specific measure or measures to be validated. This would include consideration of any measures approved by the competent authority and whether any measure has already been validated in a way that is applicable and appropriate to specific commercial use, such that further validation is not necessary.
- Identification of any existing food safety outcome or target, established by the competent authority or industry. Industry may set stricter targets than those set by the competent authority.

12.3 Validation

131. Validation of measures may be carried out by industry and/or the competent authority.

132. Where validation is undertaken for a measure based on hazard control for *Campylobacter* and/or *Salmonella,* evidence will need to be obtained to show that the measure is capable of controlling *Campylobacter* and/or *Salmonella* to a specified target or outcome. This may be achieved by use of a single measure or a combination of measures. The *Guidelines for the Validation of Food Safety Control Measures* (CAC/GL 69 -2008) provides detailed advice on the validation process (section VI).

12.4 Implementation

133. Refer to the *Code of Hygienic Practice for Meat* (CAC/RCP 58-2005), section 9.2.

12.4.1 Industry

134. Industry has the primary responsibility for implementing, documenting, applying and supervising process control systems to ensure the safety and suitability of chicken meat, and these should incorporate GHP and validated measures for control of *Campylobacter* and/or *Salmonella* (HACCP) as appropriate to national government requirements and industry's specific circumstances.

135. The documented process control systems should describe the activities applied including any sampling procedures, specified targets e.g. performance objectives or performance criteria, set for *Campylobacter* and/or *Salmonella*, industry verification activities, and corrective and preventive actions.

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[68] See Section 7 of the Codex Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)(CAC/GL 63-2007) .

136. The competent authority should provide guidelines and other implementation tools to industry as appropriate, for the development of the process control systems.

12.4.2 Regulatory systems

137. The competent authority may choose to approve the documented process control systems for GHP and HACCP and stipulate verification frequencies. Microbiological testing requirements should be provided for verification of HACCP systems where specific targets for control of *Campylobacter* and/or *Salmonella* have been stipulated.

138. The competent authority may choose to use a competent body to undertake specific verification activities in relation to the industry's process control systems. Where this occurs, the competent authority should stipulate specific functions to be carried out.

12.5 Verification of control measures

139. Refer to the *Code of Hygienic Practice for Meat* (CAC/RCP 58-2005), section 9.2 and the *Guidelines for the Validation of Food Safety Control Measures* (CAC/GL 69 -2008). Section IV.

12.5.1 Industry

140. Industry verification should demonstrate that all control measures for *Campylobacter* and/or *Salmonella* have been implemented as intended. Verification should include observation of processing activities, documentary checks, and sampling for *Campylobacter* and/or *Salmonella* testing as appropriate.

141. Verification frequency should vary according to the operational aspects of process control, the historical performance of the establishment and the results of verification itself.

12.5.2 Regulatory systems

142. The competent authority and/or competent body should verify that all regulatory control measures implemented by industry comply with regulatory requirements as appropriate for control of *Campylobacter* and/or *Salmonella*.

13. Monitoring and review

143. Monitoring and review of food control systems is an essential component of application of a risk management framework (RMF)[69]. It contributes to verification of process control and demonstrating progress towards achievement of public health goals.

144. Information on the level of control of *Campylobacter* and *Salmonella* at appropriate points in the food chain can be used to for several purposes e.g. to validate and/or verify outcomes of food control measures, to monitor compliance with hazard-based and risk-based regulatory goals, and to help prioritise regulatory efforts to reduce foodborne illness. Systematic review of monitoring information allows the competent authority and relevant stakeholders to make decisions in terms of the overall effectiveness of the food control systems and make improvements where necessary.

13.1 Monitoring

145. Monitoring should be carried out at appropriate steps[70] in the food chain using randomized or targeted sampling as appropriate. Examples of the utility of monitoring systems for *Campylobacter* and/or *Salmonella* in broiler chickens may include:

- sampling (e.g. environmental, blood, faecal) of breeders and hatcheries for determination of general *Salmonella* status
- faecal sampling of chickens prior to delivery to slaughter to determine flock status and permit logistic scheduling and/or channeling of positive chickens for specific processing steps e.g. to heat treatment or freezing
- caecal or cloacal sampling for *Campylobacter* at delivery to determine slaughter flock status for epidemiological investigations

[69] See section 8 Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM) CAC/GL 63-2007

[70] Recommendations on surveillance in poultry flocks for *Salmonella* are provided in the OIE Terrestrial Animal Health Code, Chapter 6.5 "Prevention, Detection and Control of *Salmonella* in Poultry (2009 Edition)

- whole bird rinse, neck skin or other sampling at the end of primary processing (normally after immersion or air chilling) to verify compliance with hazard-based regulatory or company performance goals
- sampling of retail product to determine contamination trends post-processing
- national or regional surveys for establishing baseline levels of contamination and assisting in formulation of regulatory performance goals within the food chain

146. Regulatory monitoring programmes should be designed in consultation with relevant stakeholders, with the most cost-efficient resourcing option being chosen for collection and testing of samples. Given the importance of monitoring data in risk management, sampling and testing components should be standardized on a national basis and be subject to quality assurance.

147. The type of data collected in monitoring systems should be appropriate for the outcomes sought[71].

148. Monitoring information should be made available to relevant stakeholders in a timely manner e.g. to producers, processing industry, consumers.

149. Wherever possible, monitoring information from the food chain should be combined with human health surveillance data and food source attribution data to validate risk-based control measures and verify progress towards risk-reduction goals. Activities supporting an integrated response include:

- surveillance of clinical salmonellosis and campylobacteriosis in humans
- epidemiological investigations including outbreaks and sporadic cases

13.2 Review

150. Monitoring data on *Campylobacter* and *Salmonella* and associated risks should be reviewed on a periodic basis to provide information on the effectiveness of risk management decisions and actions.
151. Periodic review of monitoring data at relevant process steps should be used to inform future decisions on selection of specific control measures, and provide a basis for their validation.
152. Information gained from monitoring in the food chain should be integrated with public health surveillance, food source attribution data, and withdrawal and recall data, where available to evaluate and review the effectiveness of control measures.
153. Where monitoring of hazards or risks indicates that regulatory performance goals are not being achieved, risk management strategies and/or control measures should be reviewed.

13.2.1 Public health goals

154. Countries should consider the results of monitoring and review when setting public health goals[72] for food-borne campylobacteriosis and salmonellosis and when evaluating progress. Monitoring of the food chain in combination with source attribution and human health surveillance data are important components.

[71] Enumeration and sub-typing of microorganisms generally provides more information for risk management purposes than presence or absence testing.

[72] International organisations such as WHO provide guidance for establishing and implementing public health monitoring programmes. WHO Global Foodborne Infections Network (GFN) http://www.who.int/salmsurv/en/

14. Scientific References

Bashor, M.P., Curtis, P.A., Keener, K.M., Sheldon, B.W., Kathariou, S. and Osborne, J.A., 2004. Effects of carcass washers on *Campylobacter* contamination in large broiler processing plants. *Poultry Science,* **83**(7), 1232-1239.

Boysen L., Knøchel S.and Rosenquist H. 2007. Survival of *Campylobacter jejuni* in different gas mixtures. FEMS Microbiology Letters, **266**, 152-157.

Boysen L, Rosenquist H. 2009. Reduction of thermotolerant *Campylobacter* species on broiler carcasses following physical decontamination at slaughter. *Journal of Food Protection*. **72**(3), 497-502.

FAO/WHO, 2009a. Benefits and Risks of the Use of Chlorine-containing Disinfectants in Food Production and Food Processing. Report of a Joint FAO/WHO Expert Meeting, Ann Arbor, MI, USA. 27-30 May 2008.

FAO/WHO, 2009b. Technical Meeting on *Salmonella* and *Campylobacter* in chicken meat. 4-8 May 2009, Rome, Italy. Report.

Georgsson, F., Orkelsson, A.E., Geirsdottir, M., Reiersen, J. and Stern, N.J., 2006. The influence of freezing and duration of storage on Campylobacter and indicator bacteria in broiler carcasses. *Food Microbiology,* **23**(7), 677-683.

JECFA, 2007. Evaluation of Certain Food Additives and Contaminants: Acidified Sodium Chlorite (ASC). WHO TRS No:947. Report of the 68th JECFA meeting

Kere-Kemp, G, Aldrich, M.L., Guerra, M.L. and Schneider, K.R., 2001. Continuous online processing of fecal- and ingesta-contaminated poultry carcasses using an acidified sodium chlorite antimicrobial intervention. *Journal of Food Protection,* **64**(6), 807-812.

Kere-Kemp, G. and Schneider, K.R., 2002. Reduction of *Campylobacter* contamination on broiler carcasses using acidified sodium chlorite. *Dairy, Food and Environmental Sanitation,* **22**(8), pp. 599-606.

Lillard, H.S., 1980. Effect on broiler carcasses and water of treating chiller water with chlorine or chlorine dioxide. *Poultry Science*, **59**, 1761-1766

Oyarzabal, O.A., Hawk, C., Bilgili, S.F., Warf, C.C. and Kemp, G.K., 2004. Effects of postchill application of acidified sodium chlorite to control *Campylobacter* spp. and Escherichia coli on commercial broiler carcasses. *Journal of Food Protection,* **67**(10), 2288-2291.

Salvat, G., Coppen, P., Allo, J.C., Fenner, S., Laisney, M.J., Toquin, M.T., Humbert, F. and Colin, P., 1997. Effects of AvGard™ treatment on the microbiological flora of poultry carcasses. *British Poultry Science*, **38**, 489-498

Stopforth, J. D., O'Connor, R., Lopes, M., Kottapalli, B., Hill, W. E. and Samadpour, M., 2007. Validation of individual and multiple-sequential interventions for reduction of microbial populations during processing of poultry carcasses and parts. *Journal of Food Protection*, **70**, 1393-1401.

U.S. Department of Agriculture, Food Safety and Inspection Service. 2005. Time-Temperature Tables for Cooking Ready-To-Eat Poultry Products.

Whyte, P., Collins, J.D., McGill, K., Monahan, C. and O´Mahony, H., 2001. Quantitative investigation of the effects of chemical decontamination procedures on the microbiological status of broiler carcasses during processing. *Journal of Food Protection,* **64**(2), 179-183.

APPENDIX II

Electronic Working Group on the draft guidelines for control of *Campylobacter* and *Salmonella* in chicken meat,
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