Useful Microbiological Testing for Meat and Poultry Products

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USA Foodborne Illness by Product Type: Batz *et al.*

TABLE ES-3: DISEASE BURDEN BY FOOD CATEGORY, SUMMED ACROSS PATHOGENS, BY COMBINED RANK

	Food Category	QALY Loss	Cost of Illness ($ mil.)	Illnesses	Hospital-izations	Deaths
1	Poultry	14,744	2,462	1,538,468	11,952	180
2	Complex foods	7,518	2,078	3,001,858	11,674	189
3	Pork	7,830	1,894	449,322	4,334	201
4	Produce	6,171	1,404	1,193,970	7,125	134
5	Beef	5,766	1,338	760,799	4,818	131
6	Deli/Other Meats	5,065	1,338	204,293	1,889	129
7	Dairy products	5,410	1,232	297,410	2,933	114
8	Seafood	2,762	921	642,860	2,937	97
9	Game	2,551	651	46,636	1,106	69
10	Eggs	2,252	428	170,123	2,472	45
11	Baked goods	988	273	462,399	1,833	25
12	Beverages	403	94	146,577	606	8
	Total	61,461	14,114	8,914,713	53,678	1,322

http://www.epi.ufl.edu/sites/www.epi.ufl.edu/files/RankingTheRisksREPORT.pdf

Basis of the Presentation
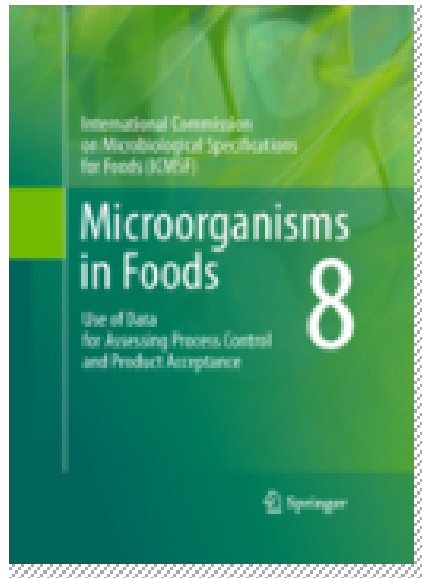
Microorganisms in Foods 8

Use of Data for Assessing Process Control and Product Acceptance
International Commission on Microbiological Specifications for Foods (ICMSF)

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Part II: Application of Principles to Product Categories

Chapter 8: Meat Products pg 75 - 94
Chapter 9: Poultry Products pg 95 -106

'meat'

- sheep, lamb
- beef, veal
- pork,
- snails, frogs legs
- others

Sub-commodities of 'meat'

- raw whole meats
- raw comminuted ('ground') meats
- dried and fermented (raw cured shelf stable)
- dried meats
- cooked
- fully retorted, shelf stable, uncured
- shelf stable, cured
- (snails, frogs legs)

Chapter 8: Meat Products Contents

- Raw meat products (excluding comminuted meats)
- Raw comminuted meats
- Raw cured shelf stable meats
- Dried meat products
- Cooked meat products
- Fully retorted shelf-stable uncured meats
- Shelf-stable cooked cured meats
- Snails and Frog Legs

Raw Comminuted Meats

- Examples
  - Sausages
    - Irish breakfast sausage
    - Xiang Chang (China)
    - Isaan sausage (Thailand)
    - Longganisa (Philippians)
  - Burgers
  - Meat puddings

- Main Pathogens
  - *Salmonella* (all)
  - *Campylobacter* (pork and poultry)
  - STEC (Beef or lamb products)
  - *L. monocytogenes* (all)
- Hazards in some regions
  - *Yersinia* (pork)
  - *Trichinella* (pork)

Comminuted Meat Product Testing : Part 1

Relative importance		Useful testing
Critical ingredients	Low to high	Pre-testing beef trimmings for *E. coli* O157:H7 may be useful when confidence in supplier control is low. e.g. n=30 c=0 m=0 ISO:16654 (see table 8.1pg 78)
In-process	Low	Routine in-process samples are not normally collected. *Samples of meat at various stages of processing can be used to establish a baseline and understand changes in the microbial population during processing.*
Processing environment	Low	Sample equipment surfaces before start-up to verify efficacy of cleaning and disinfection. Typical levels encountered <500 cfu/cm^2 but may vary by surface type.
Shelf life	Low	Routine shelf life testing of refrigerated raw meat is not recommended. *Shelf life testing may be useful to validate code dates of new retail products or when new packaging systems are installed.*

Comminuted Meat Product Testing : Part 2

Relative importance		Useful testing
End product	Medium	Test freshly packaged product for indicators for on-going process control and trend analysis using internally developed guidelines. *Levels for processing do not apply during distribution or at retail.*

Sampling plan & limits/g

Product	Microorganism	Analytical method	Case	n	c	m	M
Raw, comminuted meat	*E. coli*	ISO 16649-2	4	5	3	10	100

Medium — Routine testing is not recommended for salmonellae. In regions where ground beef is a continuing source of *E. coli* O157:H7 illness, the following criteria are recommended.

Sampling plan & limits/25g

| Product	Microorganism	Analytical method	Case	n	c	m	M
Ground beef	*E. coli* O157:H7	ISO 16654	14	30	0	0	-

Plan Performance:
Raw Comminuted Meat

- Geometric mean concentration (***cfu/g***) at 95% probability of rejection (table A2 pg 361)

  - PLAN: *E. coli* n=5 c=3 m=10 M=100

    - S.d.(0.25) = 23;   S.d. (0.5) = 39;

    - S.d.(0.8) = 51;   S.d. (1.2) = 57

- Geometric mean concentration (***g for 1 cfu***) at 95% probability of rejection (table A3 pg 362)

  - PLAN: *E. coli* O157:H7 n=30 c=0 m=0 (25g)

    - S.d.(0.25) = 1 cell in 290g;   S.d. (0.5) = 1 cell in 430g;

    - S.d.(0.8) = 1 cell in 850g;   S.d. (1.2) = 1 cell in 2400g

Cooked Meat Products: perishable cured and uncured

- Examples
  - Ham
  - Turkey roll
  - Pate
  - Mea
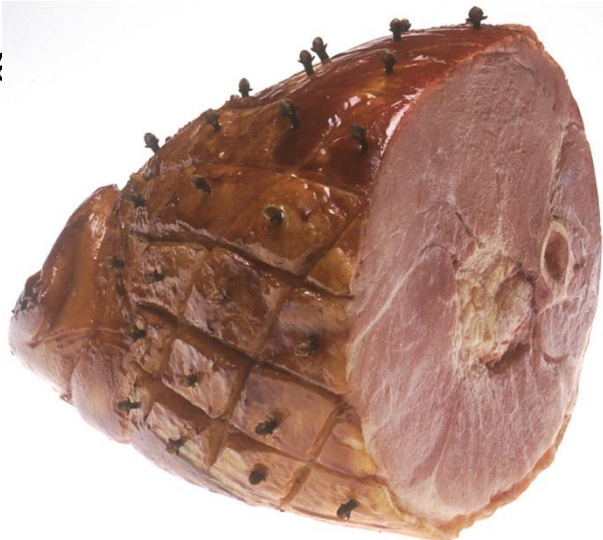
- Main Pathogens
  - *Salmonella* (all)
  - *Campylobacter* (pork and poultry)
  - STEC (Beef or lamb products)
  - *L. monocytogenes* (all)
  - *C. perfringens* (all)
  - *S. aureus* (all)

- Hazards in some regions
  - *Yersinia* (pork)
  - *Trichinella* (pork)

Cooked Meat Product Testing : Part 1

Relative importance		Useful testing
Critical ingredients	Low	These products do not contain non-meat ingredients of significance for microbiological safety or quality
In-process	High	Monitoring the cooking parameters is essential (TIME AND TEMPERATURE)
	Medium	For products that support *L. monocytogenes* growth, post-cook samples can assess control of *Listeria* spp. Typical levels encountered post-cook: Absence of *Listeria* spp.
Processing environment	High	For products that support *L. monocytogenes* growth, during production sample product contact surfaces before packaging. Environmental sampling programme ongoing (floors, drains and non-product contact surfaces) for absence of *Listeria* spp.
	Medium	Sample equipment surfaces before startup to verify cleaning and disinfection. e.g. ACC typical levels encountered <500 cfu/cm^2 may vary by surface type.
Shelf life	Medium	Shelf life testing may be useful for refrigerated products with extended dates. Shelf life testing of frozen products is not necessary

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Cooked Meat Product Testing : Part 2

Relative importance		Useful testing						
End product	Medium	Test for indicators of ongoing process control and trend analysis						

			Sampling plan & limits/g				
Product	**Microorganism**	**Analytical method**	**Case**	**n**	**c**	**m**	**M**
Cooked Meat	*Aerobic colony count*	ISO 4833	2	5	2	10^4	10^5
	E. coli	ISO 16649-2	5	5	2	10	10^2
	S. aureus	ISO 6888-1	8	5	1	10^2	10^3
Cooked uncured meat (e.g. roast beef)	*C. perfringens*	ISO 7937	8	5	1	10^2	10^3

Cooked Meat Product Testing : Part 3

Relative importance		Useful testing						
End product	Medium	Routine sampling for pathogens is not recommended unless the application of GHP or HACCP is in question. The following testing is then recommended:						

				Sampling plan & limits/25g				
	Product	**Microorganism**	**Analytical method**	**Case**	**n**	**c**	**m**	**M**
	Cooked Meat	*Salmonella*	ISO 6579	11	10	0	0	-
	Cooked Meat (no growth)	*L. monocytogenes*	ISO 11290-2	N/A	5	0	10^2	-
	Cooked Meat (supports growth)	*L. monocytogenes*	ISO 11290-1	10	5	0	0	-

Plan Performance Examples: cooked meat

- Geometric mean concentration (cfu/g) at 95% probability of rejection (table A2 pg 361)

    - PLAN: *E. coli* n=5 c=2 m=10 M=100

        - S.d.(0.25) = 17;   S.d. (0.5) = 25;
        - S.d.(0.8) = 33;   S.d. (1.2) = 39

- Geometric mean concentration (g/cfu) at 95% probability of rejection (table A3 pg 362)

    - PLAN: *L. monocytogenes* n=5 c=0 m=0 (25g)

        - S.d.(0.25) = 1 cell in 44g;   S.d. (0.5) = 1 cell in 49g;
        - S.d.(0.8) = 1 cell in 55g;   S.d. (1.2) = 1 cell in 62g

Chapter 9: Poultry Products
Contents

- Raw poultry products

- Cooked poultry products

- Fully retorted shelf-stable poultry products

- Dried Poultry Products

Raw Poultry Products

- Examples

  - Whole Chicken, Turkey

  - Chicken portions

  - Duck portions

- Main Pathogens

  - *Salmonella*

  - *Campylobacter*

Raw Poultry Products: primary production

- Small farms, Extensive production
  - Parent flocks free from *Salmonella*
  - Control programmes on farm difficult

- Large farms, intensive indoor production
  - Parent flocks free from *Salmonella*
  - Control programmes for *Salmonella* and *Campylobacter* can be realised

FAO CORPORATE DOCUMENT REPOSITORY

Title: Swedish experience relating to the control of Salmonella in the national herd, …

Produced by: Agricultu

Food and Agriculture Organization of the United Nations

World Health Organization

Agenda Item 4.2 a)

GF/CRD Sweden-1

FAO/WHO Global Forum of Food Safety Regulators
Marrakech, Morocco, 28 - 30 January 2002

Country report on the Swedish experience relating to the control of Salmonella in the national herd, with specific focus on the salmonella policy related to poultry production, and the results regarding Salmonella prevalence and human salmonellosis incidence

by the Ministry of Agriculture, Food and Fisheries (Sweden)

Country Report proposed by Sweden

- Summary
- The Swedish Salmonella control programme
Salmonella in poultry
relation of salmonella control in live animals and human salmonellosis incidence

Raw Poultry Product Testing : Part 1

| Relative importance		Useful testing
Critical ingredients	Low	Time and temperature should be controlled for raw poultry ingredients. Routine testing of non-meat ingredients, if any, is not recommended
In-process	Medium	Test whole carcass rinse or tissue samples (e.g. neck flap) to establish a baseline at various stages of processing and to evaluate where changes in the microbial populations occur during processing. Typical levels for psychrotrophs, *E. coli* and *Salmonella* depend on sampling site , sampling method and processing conditions within each factory.
Processing environment	Medium	Sample equipment surfaces before start-up to verify efficacy of cleaning and disinfecting. Typical levels encountered <500 cfu/cm^2 but may vary by surface type.
Shelf life	Low	Routine shelf life testing of refrigerated product is not recommended. Testing of frozen product is also not recommended.
		Shelf life testing may be useful to validate code dates of new retail products or when new packaging systems are installed.

Raw Poultry Product Testing : Part 2

Relative importance		Useful testing
End product	Medium	Test for indicator organisms for on-going process control and trend analysis of fresh pack product using internally developed guidelines. Typical levels encountered: •Aerobic colony count $<10^5$ CFU/g •*E. coli* $<10^2$ CFU/g *Not usually applicable to retail product or product in the distribution chain.* Routine lot acceptance sampling is not recommended for salmonellae or *Campylobacter* on raw poultry. Outbreak investigations or new supplier certification may benefit from determining the prevalence of salmonellae or *Campylobacter* in some situations •In countries or regions that have established performance criteria , the required sampling plan and tests should be applied

International Document on Control of Salmonella and Campylobacter in Poultry

GUIDELINES FOR THE CONTROL OF *CAMPYLOBACTER* AND *SALMONELLA* IN CHICKEN MEAT

CAC/GL 78-2011

9.5

Step 16: Inside/outside wash
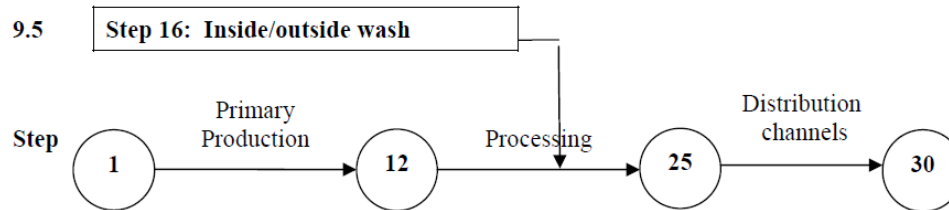
9.5.1 GHP-based control measures

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) or TSP may further reduce *Campylobacter* levels by an average of 1.3 $\log_{10}$ CFU/ml or 1.0 $\log_{10}$ CFU/ml 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%.

Dried Poultry Products:

- Examples

  - Dried cooked chicken

  - Bouillon powder/paste

  - Dried salted chicken strips

- Main Pathogens

  - *Salmonella*

Dried Poultry Product Testing : Part 1

Relative importance		Useful testing
Critical ingredients	Low	These products do not contain non-meat ingredients of significance for microbiological safety or quality
In-process	High	Monitoring the cooking and formulation parameters like pH and preservatives. The manufacturing process should be validated for control of salmonellae that are present in poultry meat
	Low	Routine microbiological testing of in-process samples is not recommended
Processing environment	Medium	Sample equipment surfaces before startup to verify cleaning and disinfection. E.g. ACC typical levels encountered <500 cfu/cm^2 but may vary by surface type.
Shelf life	Low	These products are inherently shelf-stable when properly dried and protected from high humidity. The higher the a_w of snack products may require verification of stability e.g. mould

Dried Poultry Product Testing : Part 2

Relative importance		Useful testing
End product	Medium	Routine sampling is not necessary. If application of GHP and HACCP is in question, sampling for Salmonellae may be considered.

			Sampling plan & limits/25 g				
Product	**Microorganism**	**Analytical method**	**Case**	**n**	**c**	**m**	**M**
Dried Poultry	*Salmonella*	ISO 6579	11	10	0	0	-

Plan Performance : Dried Poultry Products

- Geometric mean concentration (g per cfu) at 95% probability of rejection (table A3 pg 362)

    - PLAN: *Salmonella* n=10 c=0 m=0 (25g)

        - S.d.(0.25) = 1 cell in 93g;   S.d. (0.5) = 1 cell in 120g;

        - S.d.(0.8) = 1 cell in 180g;   S.d. (1.2) = 1 cell in 310g

Examples of Regulatory Standards: E.U. Food Safety Standards

COMMISSION REGULATION (EC) No 1441/2007

of 5 December 2007

amending Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs

1.4	Minced meat and meat preparations intended to be eaten raw	*Salmonella*	5	0	Absence in 25 g	EN/ISO 6579
1.5	Minced meat and meat preparations made from poultry meat intended to be eaten cooked	*Salmonella*	5	0	From 1.1.2006 Absence in 10 g From 1.1.2010 Absence in 25 g	EN/ISO 6579
1.6	Minced meat and meat preparations made from other species than poultry intended to be eaten cooked	*Salmonella*	5	0	Absence in 10 g	EN/ISO 6579
1.7	Mechanically separated meat (MSM) (^{9})	*Salmonella*	5	0	Absence in 10 g	EN/ISO 6579

Examples of Regulatory Standards:
E.U. Process Hygiene Standards

Food category	Micro-organisms	Sampling plan (¹)		Limits (²)		Analytical reference method (³)
		n	c	m	M	
2.1.6 Minced meat	Aerobic colony count (⁷)	5	2	5×10^5 cfu/g	5×10^6 cfu/g	ISO 4833
	E. coli (⁸)	5	2	50 cfu/g	500 cfu/g	ISO 16649-1 or 2
2.1.7 Mechanically separated meat (MSM) (⁹)	Aerobic colony count	5	2	5×10^5 cfu/g	5×10^6 cfu/g	ISO 4833
	E. coli (⁸)	5	2	50 cfu/g	500 cfu/g	ISO 16649-1 or 2

Concluding Remarks

- The ICMSF recommendations should be used as a guideline

- Legislative microbiological standards in national and international trade may need to be applied and complied with

- The ICMSF sampling plan performance calculator can be used to evaluate alternative plans. (http://www.icmsf.org/main/software_downloads.html)

Thank you for your attention …