Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

# Canadian Microbiological Baseline Survey

**of**

# Chicken Broiler

**and**

# Young Turkey Carcasses

**June 1997 - May 1998**

Canada

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## INTERNET ACCESS

This report and other related information are available from the Internet such as:

- fact sheets on the causes and prevention of foodborne diseases associated with microbial pathogens
- GENERIC MODELS for poultry slaughtering operations, intended for use as a guide by plants developing their HACCP (Hazard Analysis Critical Control Program) system
- the meat hygiene Manual of Procedures (MOP),
- the Meat Inspection Act & Regulations, by contacting the

CFIA website: "www.cfia-acia.agr.ca"

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Sample collection and/or oversight was provided by on-site CFIA staff at the participating federally registered slaughtering establishments.

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# Canadian Microbiological Baseline Survey of Chicken Broiler and Young Turkey Carcasses
# June 1997 - May 1998

## SUMMARY

A national survey was conducted to evaluate the prevalence and levels of *Salmonella spp*., *Escherichia coli* (Biotype 1) and Aerobic Plate Counts (APC) on chicken broiler and young turkey carcasses under current processing practices. Carcasses from federally registered establishments across Canada were evaluated using the rinse sampling procedure developed by the United States Department of Agriculture (USDA). Results were expressed as (colony forming units) CFU/ml of rinse fluid which were then calculated as approximate CFU/$cm^2$ of carcass surface area. The average percentage of carcasses testing positive for Salmonella (USDA qualitative test) was 21.1% for chicken broilers and 19.6 % for young turkeys. The estimated number of Salmonella rinsed from sampled carcasses (using the USDA qualitative MPN method) was less than 100 from 97 % of chicken broiler and 98 % of young turkey carcasses collected after chilling but prior to cut-up and/or packaging. The 80th percentile (used as "m" in a 3 class sampling plan by the USDA) for results expressed as CFU/ml was 21 *E. coli* for chicken broiler carcasses and 23 for young turkeys. Similarily, the 98th percentile (or "M") for *E. coli* bacteria per ml of rinse fluid was 950 CFU/ml for broiler chicken carcasses and 350 CFU/ml for young turkeys. The geometric mean for APC was 971 and 1,306 CFU/ml of rinse fluid for chicken broiler and young turkey carcasses respectively.

## INTRODUCTION

Consumer groups concerned with food safety, poultry growers and processors desiring to adapt to rapidly evolving new technologies and processes, and regulatory agencies worldwide supplementing organoleptic - based inspection methods with requirements to control foodborne pathogenic bacteria all recognize the need to better integrate science into existing inspection programs. The development of HACCP (Hazard Analysis and Critical Control Points) systems for poultry slaughtering operations has provided just such an opportunity. However, the implementation of HACCP has highlighted the need for microbial guidelines or standards to objectively quantify the critical limits or pass/fail criteria for use in HACCP plans as part of the verification activities at applicable CCP's (Critical Control Point) to demonstrate ongoing process control over e.g. evisceration and chilling operations. For example, the USDA conducted a "Nationwide Broiler Chicken Microbiological Baseline Data Collection Program" during 1994/5 and a similar program for young turkeys in 1997/8 to assist them in developing performance based microbiological guidelines or standards for the implementation of HACCP. CFIA and national poultry industry associations made a joint decision in 1996 to conduct a similar national baseline survey of poultry carcasses from federally inspected slaughtering establishments.

## OBJECTIVES

1. To provide current data on the prevalence and levels of *Salmonella spp.*, *Escherichia coli* (Biotype 1) and Aerobic Plate Counts (APC) on chicken broiler and young turkey carcasses under commercial processing practices.

2. To use the information to calculate science based *Escherichia coli* (*E. coli*) guidelines and *Salmonella spp*. standards for incorporation into the MPIP policy and for use by plants developing HACCP systems to
   - enhance the safety of poultry meat products and
   - facilitate continued trade in poultry products with e.g. the United States (US).

**Program Design Relative to Objectives :**

The survey was modelled after the Nationwide Broiler Chicken Microbial Baseline Data Collection Program, Working Draft, July 16, 1994, United States Department of Agriculture (USDA). Sample collection and laboratory testing procedures were based on the aforementioned document and the "Pathogen Reduction; Hazard Analysis and Critical Control Point (HACCP) Systems" regulatory amendments as published in the Federal Register (61 FR 38806) on July 25, 1996 (internet address "http://www.fsis.usda.gov/OA/haccp/ imphaccp.htm").

## SURVEY DESIGN

**Sampling plan :**

It was determined that a sample size of 750 chicken broiler and 542 young turkey carcasses would sample the Canadian poultry production at roughly 10 times the ratio as used in the US baseline survey (USDA, 1996). An additional 20% was added to compensate for any samples which could not be submitted (e.g. plant closed) and for carcasses which might arrive at the lab either too warm (>10$^{o}$C) or too late (more than 24 h after collected).

Within a province, sampling units (carcasses) were allocated proportional to slaughter volume in each establishment. Plants assigned less than one sample were excluded. Within an establishment, a day was randomly selected for collection of each carcass. Based on 1995 slaughter volumes, the survey design ensured that 99.9% of the chicken broilers, and 99.6% of young turkeys slaughtered under federal inspection were eligible to be sampled.

Schedules for a 52 week period were distributed to the Veterinarian-in-Charge (VIC) at each poultry establishment included within the survey.

**Sample Collection and Handling :**

A carcass with no parts trimmed or missing was randomly selected under the supervision of government inspection staff. Sterile technique was carefully observed during sample collection and packaging. Each carcass was selected after chilling, at the end of the drip line or at the last readily accessible point prior to cut-up or packaging. Samples were double-bagged and shipped in precooled insulated containers with frozen jell pack(s) sufficient to maintain carcass temperature above freezing but below 10°C during transit. Samples were to be processed at the laboratory by the day after collection.

**Laboratory procedures :**

After determining the temperature and weight, each carcass was shaken for one minute within a sterile bag containing 400 ml of Butter field's diluent for chicken broiler and 600 ml for young turkey carcasses.

The rinse fluid was then sampled according to following bacteriological tests:

- APC incubated for 48 ± 3 h @ 35 ± 1EC using 3M Petrifilm™ (JAOAC, 1990),
- *E. coli* count incubated for 48 ± 4 h @ 35 ± 1EC using 3M Petrifilm™ (JAOAC, 1991),
- Salmonella *qualitative* test- official Food Safety and Inspection Service (FSIS),USDA method, and Salmonella *quantitative* test- official FSIS/USDA Most Probable Number (MPN) method, but only on samples positive to the salmonella qualitative test.

Silliker Laboratories of Canada, Ltd. has been accredited by Agriculture and Agri-Food Canada (AAFC) for various microbial tests. To assure conformance to the above listed procedures, one (1) announced and one (1) unannounced audit were performed by representatives of CFIA, Health Canada and CPEPC at the beginning, and during the course of the survey, respectively.

**Statistical analysis :**

A specific numerical value was required to permit statistical analysis. Therefore samples which had some of the target bacteria present, but in very low quantities ( reported as <1), were assigned a numerical value between zero (0) and 1.0 ie 0.1, 0.2, 0.3,....prior to further analysis.

Counts expressed in CFU/ml were used to calculate percentiles required for 3 class sampling plans ie the 80th (equivalent to "m") and the 98th percentile (equivalent to "M"). However APC or E. coli, expressed as CFU/ml,
were transformed into $\log_{10}$ prior to calculating other summary statistics such as the median, geometric mean, the standard error & confidence intervals, etc.
Data from carcass rinse fluids, expressed as colony forming units (CFU)/ml, was also converted to counts per $cm^2$ by using the formula published in the FSIS/USDA microbial baseline survey (USDA, 1996) as follows:

Total colony forming units (CFU) of bacteria / Total Surface Area ($cm^2$)
= (# CFU/ml recovered x ml used to rinse the carcass) / ((0.87 x w) + 635)

The denominator is a formula reported by N. L. Thomas (1978) ;

*Total Carcass Surface Area ($cm^2$) = 0.87w + 635*

where "w" is the weight of the carcass in grams.

The geometric mean of the *Salmonella spp., E coli* or APC counts was determined by calculating the antilog of the mean bacteria count log $_{10}$.

The Upper and Lower 95% Confidence Limits of the average or mean bacteria count (each count expressed as or transformed into log $_{10}$) was calculated using the following formula:

*mean of the counts transformed into log $_{10}$ ±*
*1.96 x (standard deviation of the counts transformed into log $_{10}$*
*÷ square root of the number of values).*

The 95% Confidence Interval (C.I.) of the geometric mean was then obtained by calculating the antilog of the confidence limits as obtained from the preceding formula. The standard error (S.E.) was also contained within the preceding formula since the S.E. is defined as the:

*(standard deviation of the counts transformed into log $_{10}$*
*÷ square root of the number of values).*

All aforementioned summary statistics were obtained by the use of Excel™ version 7 including the largest and smallest values which were readily obtained by ordering the data set in ascending or descending order. Then the number of
values within each consecutive range, as contained in the tables and figures, were manually calculated by using the associated row numbers in the large Excel ™ spreadsheet which contained all the test results which had been entered directly by the laboratory.

## RESULTS

### Sampling Profile :

Prior slaughter volume and the corresponding number of carcasses requested for both chicken broilers and young turkeys are presented in Tables 1 and 2 .

Carcasses were tested from a total of 36 chicken and 14 turkey slaughtering plants. The remaining seven (7) chicken and eight (8) turkey establishments, which were unable to participate in the survey, accounted for only 3.3 % of the chicken and 4.3 % of the requested turkey samples. Among participating plants, the number of low volume plants scheduled for 1-3 samples was 10 for chickens and 6 for turkeys.

From 901 chicken carcasses scheduled for selection as samples, 774 (or 86%) were suitable for testing by the laboratory (Table 1). Similarly, of 651 turkey carcasses included in the national sampling plan, 506 (or 78% of requested samples) qualified for testing (Table 2). The remaining carcasses were in transit too long, or arrived too warm or were not received for testing (Table 3).

Of the tested chicken carcasses, 90% were supplied by 25 chicken slaughtering establishments. Similarly, 90% of the tested turkey carcasses came from 7 turkey slaughtering establishments.

The average weight of the carcasses tested at the laboratory was 1.4 kg for broiler chickens and 5.3 kg for young turkeys.

***Salmonella spp* :**

The average percentage of carcasses testing positive for Salmonella (qualitative test) was 21.1 % for sampled chicken broiler carcasses and 19.6 % for young turkeys (Table 4).

The geometric mean salmonella count from the MPN method was 0.08 CFU/ml of rinse fluid for chicken broiler carcasses and 0.08 CFU/ml for young turkey carcasses (Table 5).

Tables 6-7a and Figure 1, modelled after the USDA-FSIS baseline surveys, present the prevalence or frequency of occurrence of *Salmonella spp*. in the rinse fluids from chicken broiler and young turkey carcasses. Data is presented such that each level or interval in the Tables and Figures encompasses one log cycle.

The estimated number of salmonella bacteria (MPN method) on sampled Canadian poultry carcasses was very low. Less than 0.30 Salmonella cells per ml of rinse fluid were enumerated from 98% of chicken and turkey carcasses (Tables 6 & 7, Figure 1). Similarly, 98% of chicken and turkey carcasses had below 0.30 Salmonella cells per $cm^2$ of surface area as sampled by the rinse method (Tables 6a & 7a). Moreover, 61% of chicken carcasses (Tables 6 & 6a, Figure 1) and 68% of turkey carcasses (Tables 7 & 7a, Figure 1) found to be positive by the qualitative method (reported as Salmonella positive) had levels of salmonella below the level of detection as tested by the quantitative MPN method.

Under 100 salmonella CFU per carcass were isolated from 96.9% of chicken and 96.0% of turkey carcasses (Figure 2).

The seasonal incidence of salmonella positive carcasses was relatively constant throughout summer, fall and winter (20-22%), but dropped to 15% in the spring (Figure 3) for young turkey carcasses. A seasonal peak in the summer was observed for chicken broiler carcasses (Figure 3).

**Escherichia coli (*E. coli*) Biotype I :**

Tables 8 -9a and Figure 4 present the prevalence, or frequency of occurrence, of *Escherichia coli*

(Biotype 1) in chicken broiler and young turkey carcass rinse fluids such that each level or interval encompasses one log cycle.

The 80th and 98th percentile for E. coli bacteria, (used as a general indicator of hygiene during evisceration operations), was 21 and 950 CFU/ml respectively for chicken broilers. Corresponding counts were 23 and 350 CFU/ml respectively for young turkeys (Table 5).

**Aerobic Plate Count (APC) :**

Tables 10 - 11a and Figure 5 present the prevalence, or frequency of occurrence, of APC in chicken broiler and young turkey carcass rinse fluids such that each level or interval encompasses one log cycle.

The geometric mean per ml of carcass rinse fluid for APC was 971 CFU/ml (or $\log_{10}$ 2.99) for chicken broilers and 1,306 CFU/ml (or $\log_{10}$ 3.12) for young turkeys (Table 5).

## CONCLUSIONS

Canadian results for salmonella incidence and for *E. coli* & APC counts were similar to those reported in the US poultry baseline surveys.

Summary statistics from the national baseline surveys should be considered by Canadian poultry establishments developing or reviewing their plant specific HACCP system.

The national percentage of carcasses positive for *Salmonella spp*.(% +ve), such as provided by this survey, may be used as a reference to measure the effectiveness of any future pathogen reduction initiatives.

# TABLES

**Table 1. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998:**
***Chicken broilers, sampling plan and number of carcasses received and suitable for testing***

| Region | 1995 Slaughter Volume | Proportion of National Slaughter | Number of Samples Requested | Number Suitable for Testing | Proportion of National Samples |
|---|---|---|---|---|---|
| Atlantic | 39,892,896 | 8.9 % | 80 | 70 | 9.0 % |
| Québec | 133,512,917 | 29.8 % | 269 | 233 | 30.1 % |
| Ontario | 133,386,898 | 29.8 % | 266 | 232 | 30.0 % |
| Mid-West | 27,849,760 | 6.2 % | 56 | 47 | 6.1 % |
| Alberta | 43,038,015 | 9.6 % | 86 | 63 | 8.1 % |
| British Columbia | 70,444,222 | 15.7 % | 144 | 129 | 16.7 % |
| Total | 448,124,708 | 100.0 % | 901 | 774 | 100.0 % |

**Table 2. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998:**
***Young turkeys, sampling plan and number of carcasses received and suitable for testing***.

| Region | 1995 Slaughter Volume | Proportion of National Slaughter | Number of Samples Requested | Number Suitable for Testing | Proportion of National Samples |
|---|---|---|---|---|---|
| Atlantic | 1,039,113 | 5.0 % | 33 | 15 | 2.9 % |
| Québec | 5,359,393 | 25.9 % | 168 | 138 | 27.3 % |
| Ontario | 8,089,200 | 39.1 % | 255 | 188 | 37.1 % |
| Mid-West | 2,060,367 | 10.0 %. | 65 | 51 | 10.1 % |
| Alberta | 1,802,840 | 8.7 % | 57 | 50 | 9.9 % |
| British Columbia | 2,347,487 | 11. 3% | 73 | 64 | 12.7 % |
| Total | 20,698,400 | 100.0 % | 651 | 506 | 100.0 % |

**Table 3. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998:**
***Chicken broilers and young turkeys, number of sample carcasses requested, not received, not suitable for testing and suitable for laboratory testing.***

| Number | Chicken Broilers | Young Turkeys |
|---|---|---|
| **Requested** | **901** | **651** |
| **Not Received** | **32** | **67** |
| **Temperature >10ºC** | **86** | **68** |
| **Transit Time >24 hr** | **9** | **10** |
| **Suitable for Testing** | **774** | **506** |

**Table 4. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998:**
***Proportion of sampled chicken broiler and young turkey carcasses shown to be positive for Salmonella bacteria upon laboratory testing.***

| | Chicken Broilers | Young Turkeys |
|---|---|---|
| **% *Salmonella* +ve ± S.E.** | **21.1 ± 1.5** | **19.6 ± 1.8** |
| **C. I., % *Salmonella* +ve** | **18 -24** | **16 -23** |

%+ve -percentage of sampled carcasses testing positive for *Salmonella spp*.
S.E. -Standard Error using the binomial distribution
C. I. -95% Confidence Interval

(There is a 95% probability that the true (or exact) percentage of chicken broiler carcasses testing positive for Salmonella bacteria from the entire population of Canadian chicken broilers slaughtered in federally registered plants during 1997-98 was somewhere within the range of 18 -24 %)

**Table 5. Canadian National Microbiological Poultry Baseline Survey, June 1997 -May 1998:**
***Summary statistics for specified bacteria counts from samples of chicken broiler and young turkey carcasses***

| | | CFU/ml of carcass rinse fluid | | CFU/cm$^2$ of carcass surface area | |
|---|---|---|---|---|---|
| **Bacteria** | **Summary Statistics** | **Chicken Broilers** | **Young Turkeys** | **Chicken Broilers** | **Young Turkeys** |
| **MPN *Salmonella spp.*** (quantified positive samples only) | **Geometric Mean** | **0.08** | **0.08** | **0.008** | **0.006** |
| | **C.I. Geometric Mean** | **0.06 -0.12** | **0.06 -0.10** | **0.004 -0.013** | **0.005 -0.008** |
| | **$Log_{10}$ Mean ± S.E.** | **-1.07 ± 0.07** | **-1.11 ± 0.05** | **-2.12 ± 0.12** | **-2.21 ± 0.06** |
| | **Median Value** | **0.04** | **0.09** | **0.009** | **0.007** |
| | **Maximum Value** | **>110** | **0.40** | **>0.30** | **0.032** |
| ***Escherichia. coli* Biotype I** (E. coli) | **Geometric Mean** | **16.22** | **9.33** | **3.54** | **1.12** |
| | **C.I. Geometric Mean** | **14.48 -18.73** | **8.16 -10.63** | **3.12 -4.03** | **0.98 -1.28** |
| | **$Log_{10}$ Mean ± S.E.** | **1.22 ± 0.03** | **0.97 ± 0.03** | **0.55 ± 0.03** | **0.05 ± 0.03** |
| | **Median Value** | **13** | **9** | **3** | **1** |
| | **Maximum Value** | **8,000** | **3,000** | **1,658** | **433** |
| | **m (80th percentile)** | **73** | **23** | **16** | **3** |
| | **M (98th percentile)** | **927** | **350** | **208** | **51** |
| | **% of counts # 1,000** | **98.4** | **98.8** | **99.9** | **100.0** |
| **Aerobic Plate Count** (APC) **@ 35ºC** | **Geometric Mean** | **971** | **1,306** | **210** | **158** |
| | **C.I. Geometric Mean** | **844 -1,066** | **1,123 -1,519** | **192 -231** | **135 -185** |
| | **$Log_{10}$ Mean ± S.E.** | **2.99 ± 0.02** | **3.12 ± 0.03** | **2.32 ± 0.02** | **2.20 ± 0.03** |
| | **Median Value** | **870** | **1,100** | **182** | **130** |
| | **Maximum Value** | **290,000** | **520,000** | **57,732** | **34,599** |

CFU/ml or cm$^2$-colony forming units (estimated number of bacteria) per millilitre of rinse fluid or per square centimetre of surface
MPN-most probable number (closely approximates the number of bacteria), quantitative method applied to positive samples only
Geometric Mean-antilog of the average of the bacteria counts which had been transformed into $log_{10}$ ; C.I.-95% confidence interval
Median Value -50th percentile; 80th percentile-maximum value for 80 percent of the eg *E. coli* counts

**Table 6. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998*:***
***Distribution of Salmonella (per ml) enumerated in rinse fluids from chicken broiler carcasses testing positive for the presence of Salmonella bacteria.***

| Range MPN CFU/ml | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <0.03[1] | 99 | 60.7 | 9.9159161e+13 | 60.7 |
| 0.030 -0.30 | 60 | 36.8 | | 97.5 |
| 0.301 -3.0 | 2 | 1.3 | | 98.8 |
| 3.01 -30.0 | 1 | 0.6 | | 99.4 |
| >30.0[2] | 1 | 0.6 | | 100.0 |
| Total | 163 | 100.0 | | |

MPN-Most Probable Number (closely approximates the number of bacteria)
CFU/ml -colony forming units (estimated number of bacteria) per millilitre of carcass rinse fluid
[1] Negative by quantitative MPN method
[2] Actual maximum level reported was A>110" MPN/ml which was evaluated as 110 CFU/ml

**Table 6a. Canadian Poultry Microbiological Baseline Survey, June 1997-May 1998:**
***Distribution of Salmonella (per $cm^2$ of surface area) as calculated from rinse fluids from chicken broiler carcasses testing positive for the presence of Salmonella bacteria.***

| Range MPN CFU/$cm^2$ | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <0.01[1] | 99 | 60.7 | | 60.7 |
| 0.01 -0.30 | 50 | 30.7 | 9.9149160e+13 | 91.4 |
| 0.0301 -0.30 | 11 | 6.7 | | 98.1 |
| 0.3001 -3.0 | 2 | 1.3 | | 99.4 |
| 3.001 -30.0[2] | 1 | 0.6 | | 100.0 |
| Total | 163 | 100 | | |

MPN-Most Probable Number (closely approximates the number of bacteria)
CFU/$cm^2$ -colony forming units (estimated number of bacteria) per square centimetre of carcass surface area
[1] Negative by quantitative MPN method
[2] Actual maximum level reported was A>110" MPN/ml which was evaluated as 110 CFU/ml

**Table 7. Canadian Poultry Microbiological Baseline Survey, June 1997-May 1998*:*** ***Salmonella spp. distribution (per ml) enumerated in rinse fluids from young turkey carcasses which tested positive for the presence of Salmonella bacteria.***

| Range MPN CFU/ml | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <0.03[1] | 67 | 67.7 | 679799 | 67.7 |
| 0.030 -0.30 | 30 | 30.3 | | 98.0 |
| 0.301 -3.0 | 2 | 2.0 | | 100.0 |
| 3.01 -30.0 | 0 | 0.0 | | |
| >30.0[2] | 0 | 0.0 | | |
| Total | 99 | 100 | | |

MPN-Most Probable Number (closely approximates the number of bacteria)
CFU/ml -colony forming units (estimated number of bacteria) per millilitre of carcass rinse fluid
[1] Negative by quantitative MPN method
[2] Actual maximum level reported was A>110" MPN/ml

**Table 7a. Canadian Poultry Microbiological Baseline Survey, June 1997-May 1998:** ***Salmonella spp. distribution (per*** **cm$^2$)** ***as calculated from rinse fluids from young turkey carcasses which tested positive for the presence of Salmonella bacteria.***

| Range MPN CFU/cm$^2$ | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <0.01[1] | 67 | 67.7 | 67 | 67.7 |
| 0.01 -0.03 | 31 | 30.3 | 97 | 98.0 |
| 0.0301 -0.30 | 1 | 2.0 | 99 | 100.0 |
| 0.3001 -3.0 | 0 | 0.0 | | |
| 3.001 -30.0 | 0 | 0.0 | | |
| >30.0 | 0 | 0.0 | | |
| Total | 99 | 100.0 | | |

MPN-Most Probable Number (closely approximates the number of bacteria)
CFU/ml -colony forming units (estimated number of bacteria) per square centimetre of carcass surface area
[1] Negative by quantitative MPN method

**Table 8. Canadian Poultry Microbiological Baseline Survey, June 1997-May 1998:** ***Escherichia coli (Biotype I) distribution (per ml) enumerated in rinse fluids from chicken broiler carcasses.***

| Range CFU/ml | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <1[1] | 31 | 4.1 | 31 | 4.1 |
| 1 -10 | 306 | 39.5 | 337 | 43.6 |
| 11 -100 | 316 | 40.8 | 653 | 84.4 |
| 101 -1,000 | 110 | 14.2 | 763 | 98.6 |
| 1,001 -10,000 | 11 | 1.4 | 774 | 100.0 |
| 10,001 -100,000 | 0 | 0.0 | | |
| 100,001 -1,000,000 | 0 | 0.0 | | |
| Total | 774 | 100.0 | | |

CFU/ml -colony forming units (estimated number of bacteria) per millilitre of carcass rinse fluid

[1] Negative by test method

**Table 8a. Canadian Poultry Microbiological Baseline Survey, June 1997-May 1998:** ***Escherichia coli (Biotype I) distribution (per $cm^2$ ) as calculated from rinse fluids from chicken broiler carcasses.***

| Range CFU/$cm^2$ | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <0.01[1] | 31 | 4.0 | | 4.0 |
| 0.01-1 | 137 | 17.7 | 3.1168579e+16 | 21.7 |
| 1.01 -10 | 410 | 53.0 | | 74.7 |
| 10.01 -100 | 153 | 19.8 | | 94.5 |
| 100.01 -1,000 | 42 | 5.4 | | 99.9 |
| 1,000.01 -10,000 | 1 | 0.1 | | 100.0 |
| 10,000.01 -100,000 | 0 | 0.0 | | |
| Total | 774 | 100 | | |

$CFU/cm^2$ - colony forming units (estimated number of bacteria) per square centimetre of carcass surface area

[1] Negative by test method

**Table 9. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998:** ***Escherichia coli (Biotype I) distribution (per ml ) enumerated in rinse fluids from young turkey carcasses***

| Range CFU/ml | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <1[1] | 26 | 5.1 | 26 | 5.1 |
| 1 -10 | 271 | 53.6 | 297 | 58.7 |
| 11 -100 | 175 | 34.6 | 472 | 93.3 |
| 101 -1,000 | 28 | 5.5 | 500 | 98.8 |
| 1,001 -10,000 | 6 | 1.2 | 506 | 100.0 |
| 10,001 -100,000 | 0 | 0.0 | | |
| 100,001 -1,000,000 | 0 | 0.0 | | |
| Total | 506 | 100.0 | | |

CFU/ml -colony forming units (estimated number of bacteria) per millilitre of carcass rinse fluid

[1] Negative by test method

**Table 9a. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998:** ***Escherichia coli (Biotype I) distribution (per $cm^2$ ) as calculated from rinse fluids from young turkey carcasses***

| Range CFU/$cm^2$ | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <0.01[1] | 0 | 0.0 | 0 | 0.0 |
| 0.01 -1 | 255 | 50.4 | 255 | 50.4 |
| 1.01 -10 | 205 | 40.5 | 460 | 90.0 |
| 10.01 -100 | 41 | 8.1 | 501 | 99.0 |
| 100.01 -1,000 | 5 | 1.0 | 506 | 100.0 |
| 1,000.01 -10,000 | 0 | 0.0 | | |
| 10,000.01 -100,000 | 0 | 0.0 | | |
| Total | 506 | 100 | | |

CFU/$cm^2$ -colony forming units (estimated number of bacteria ) per square centimetre of carcass surface area

[1] Negative by test method

**Table 10. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998**: ***Distribution of Aerobic Plate Count (APC) @35ºC (CFU/ ml) enumerated in rinse fluids from chicken broiler carcasses.***

| Range CFU/ml | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <1[1] | 0 | 0.0 | 0 | 0.0 |
| 1 -10 | 0 | 0.0 | 0 | 0.0 |
| 11 -100 | 21 | 2.7 | 21 | 2.7 |
| 101 -1,000 | 413 | 53.4 | 434 | 56.1 |
| 1,001 -10,000 | 307 | 39.7 | 741 | 95.8 |
| 10,001 -100,000 | 29 | 3.7 | 770 | 99.5 |
| 100,001 -1,000,000 | 4 | 0.5 | 774 | 100.0 |
| Total | 774 | 100 | | |

CFU/ml -colony forming units (estimated number of bacteria) per millilitre of carcass rinse fluid

[1] Negative by test method

**Table 10a. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998: Distribution of Aerobic Plate Counts (APC) @35ºC (CFU/ $cm^2$) as calculated from rinse fluids from chicken broiler carcasses.**

| Range CFU/$cm^2$ | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <1[1] | 0 | 0.0 | 0 | 0.0 |
| 1 -10 | 0 | 0.0 | 0 | 0.0 |
| 10.01 -100 | 225 | 29.1 | 225 | 29.1 |
| 100.01 -1,000 | 460 | 59.4 | 685 | 88.5 |
| 1,000.01 -10,000 | 84 | 10.9 | 769 | 99.4 |
| 10,000.01 -100,000 | 5 | 0.6 | 774 | 100.0 |
| 100,000.01 -1,000,000 | 0 | 0.0 | | |
| Total | 774 | 100 | | |

CFU/$cm^2$ -colony forming units (estimated number of bacteria) per square centimetre of carcass surface area

[1] Negative by test method

**Table 11. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998:** ***Distribution of Aerobic Plate Counts @35ºC (CFU/ml) enumerated in rinse fluids from young turkey carcasses***

| Range CFU/ml | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <1[1] | 0 | 0.0 | 0 | 0.0 |
| 1 -10 | 0 | 0.0 | 0 | 0.0 |
| 11 -100 | 25 | 4.9 | 25 | 4.9 |
| 101 -1,000 | 214 | 42.3 | 239 | 47.2 |
| 1,001 -10,000 | 168 | 33.2 | 407 | 80.4 |
| 10,001 -100,000 | 90 | 17.8 | 497 | 98.2 |
| 100,001 -1,000,000 | 9 | 1.8 | 506 | 100.0 |
| Total | 506 | 100.0 | | |

CFU/ml -colony forming units (estimated number of bacteria) per millilitre of carcass rinse fluid

[1] Negative by test method

**Table 11a. Canadian Poultry Microbiological Baseline Survey, June 1997 -May 1998:** ***Distribution of Aerobic Plate Counts @35ºC (CFU/cm$^2$) as calculated from rinse fluids from young turkey carcasses***

| Range CFU/cm$^2$ | Number of Samples | Percent of Total | Cumulative Number | Cumulative Percent |
|---|---|---|---|---|
| <1[1] | 1 | 0.2 | 1 | 0.2 |
| 1 -10 | 17 | 3.3 | 18 | 3.5 |
| 10.01 -100 | 206 | 40.7 | 224 | 44.2 |
| 100.01 -1,000 | 205 | 40.5 | 429 | 84.7 |
| 1,000.01 -10,000 | 57 | 11.3 | 486 | 96.0 |
| 10,000.01 -100,000 | 20 | 4.0 | 506 | 100.0 |
| 100,000.01 -1,000,000 | 0 | 0.0 | | |
| Total | 506 | 100.0 | | |

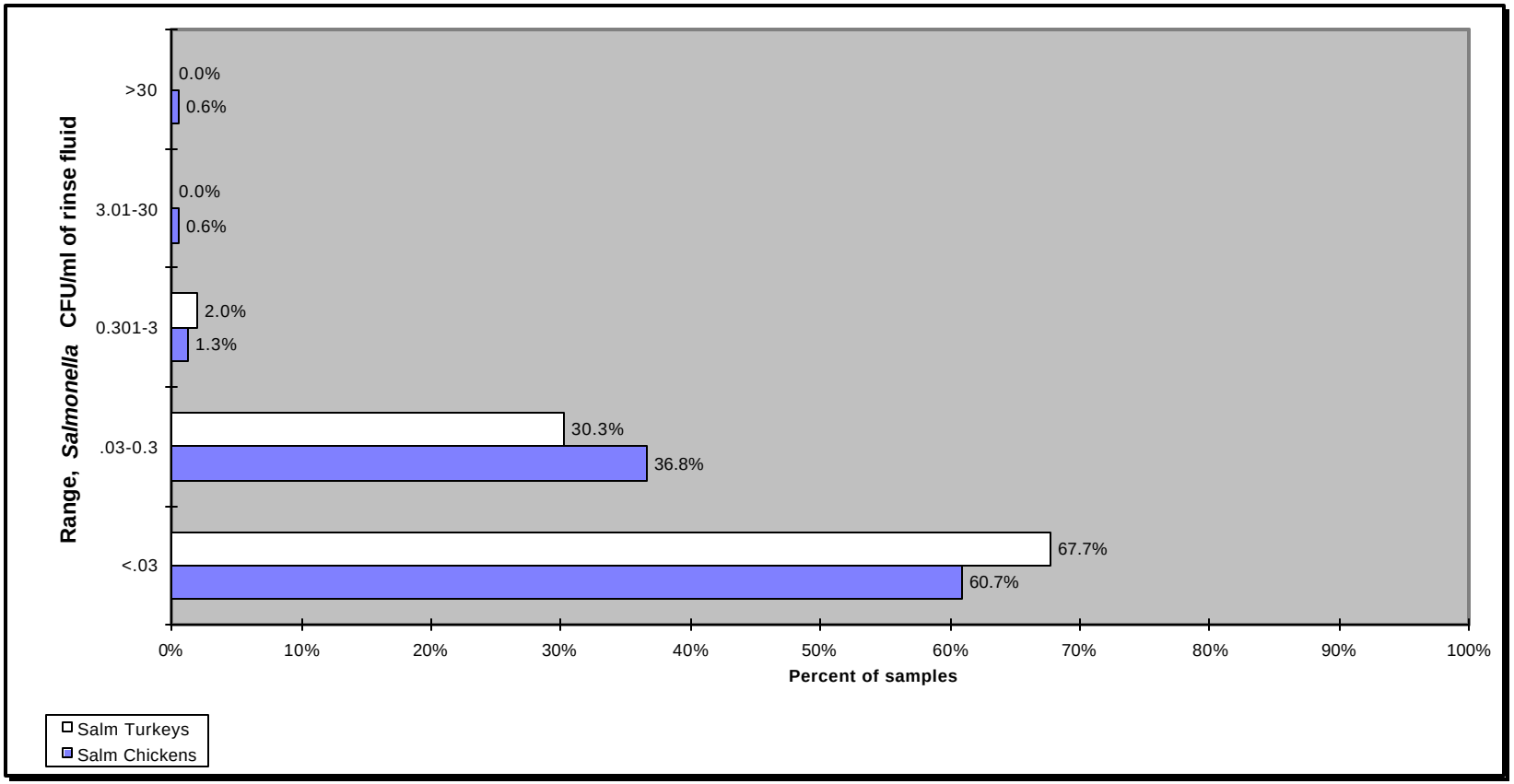
CFU/cm$^2$ -colony forming units (estimated number of bacteria) per square centimetre of carcass surface area

[1] Negative by test method

# FIGURES

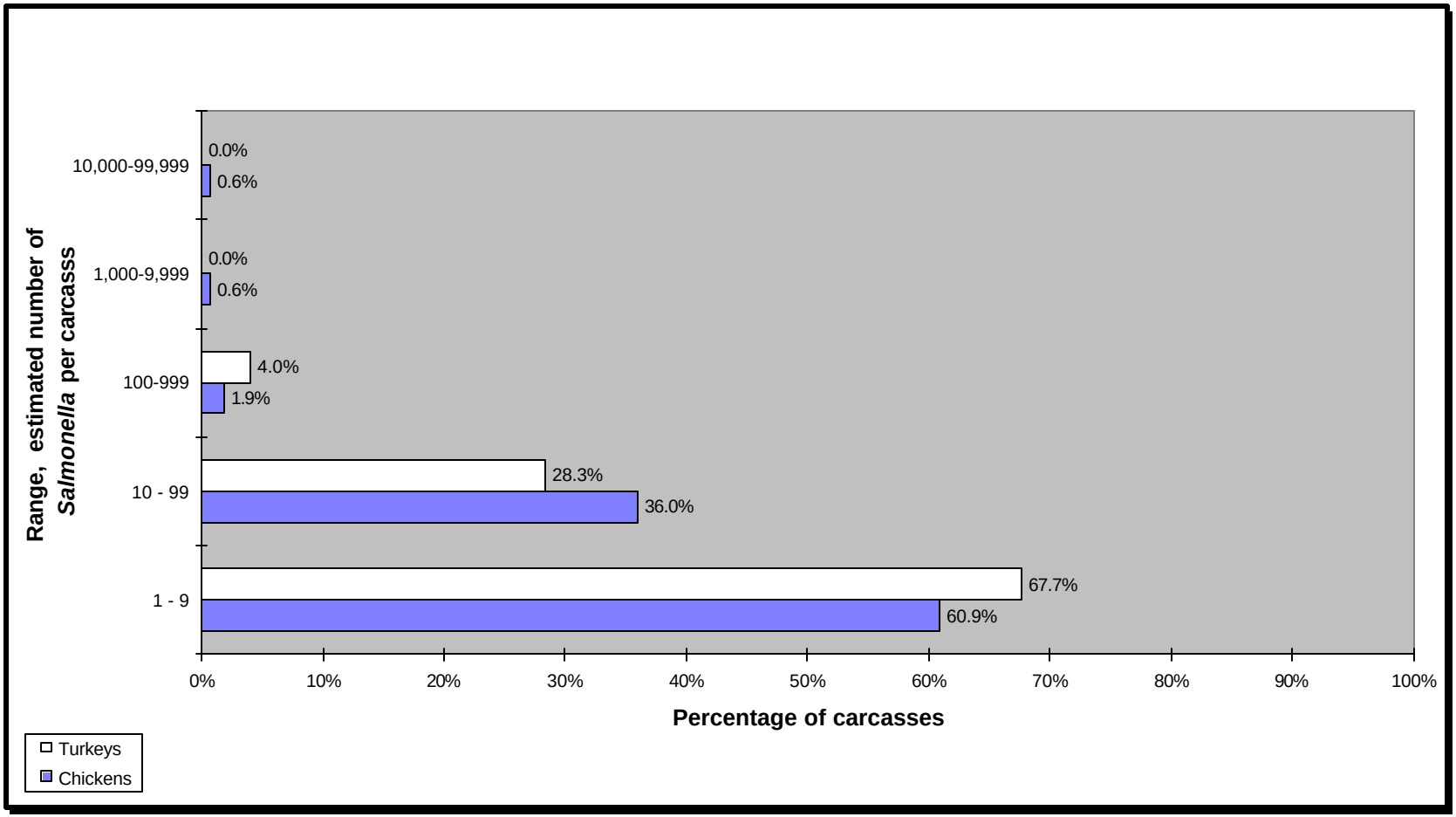
# Figure 1. Distribution of *Salmonella* bacteria

## Enumerated in Chicken & Turkey Carcass Rinse Fluids



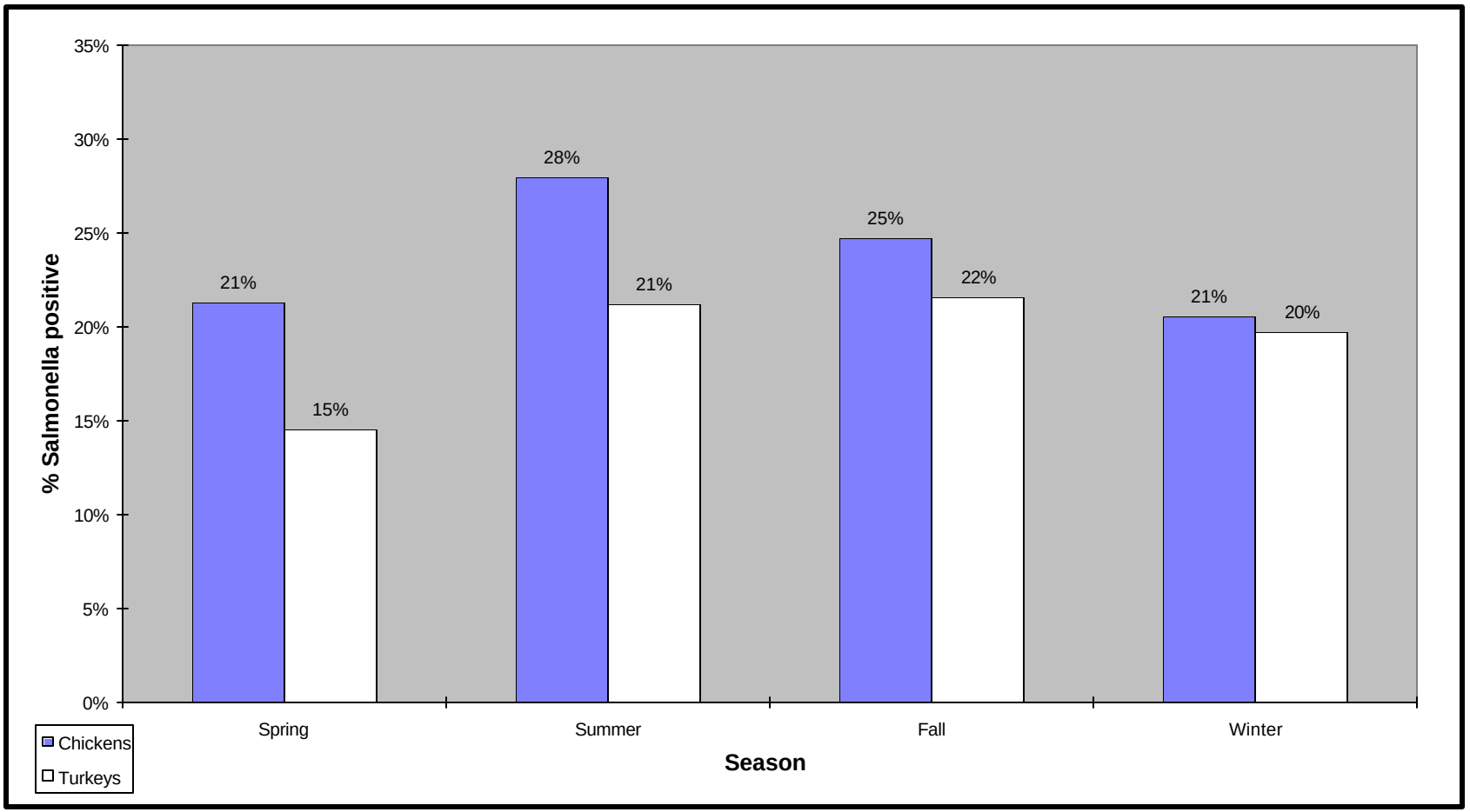
# Figure 2. Distribution of *Salmonella* bacteria;

## Number estimated on chicken & turkey carcasses



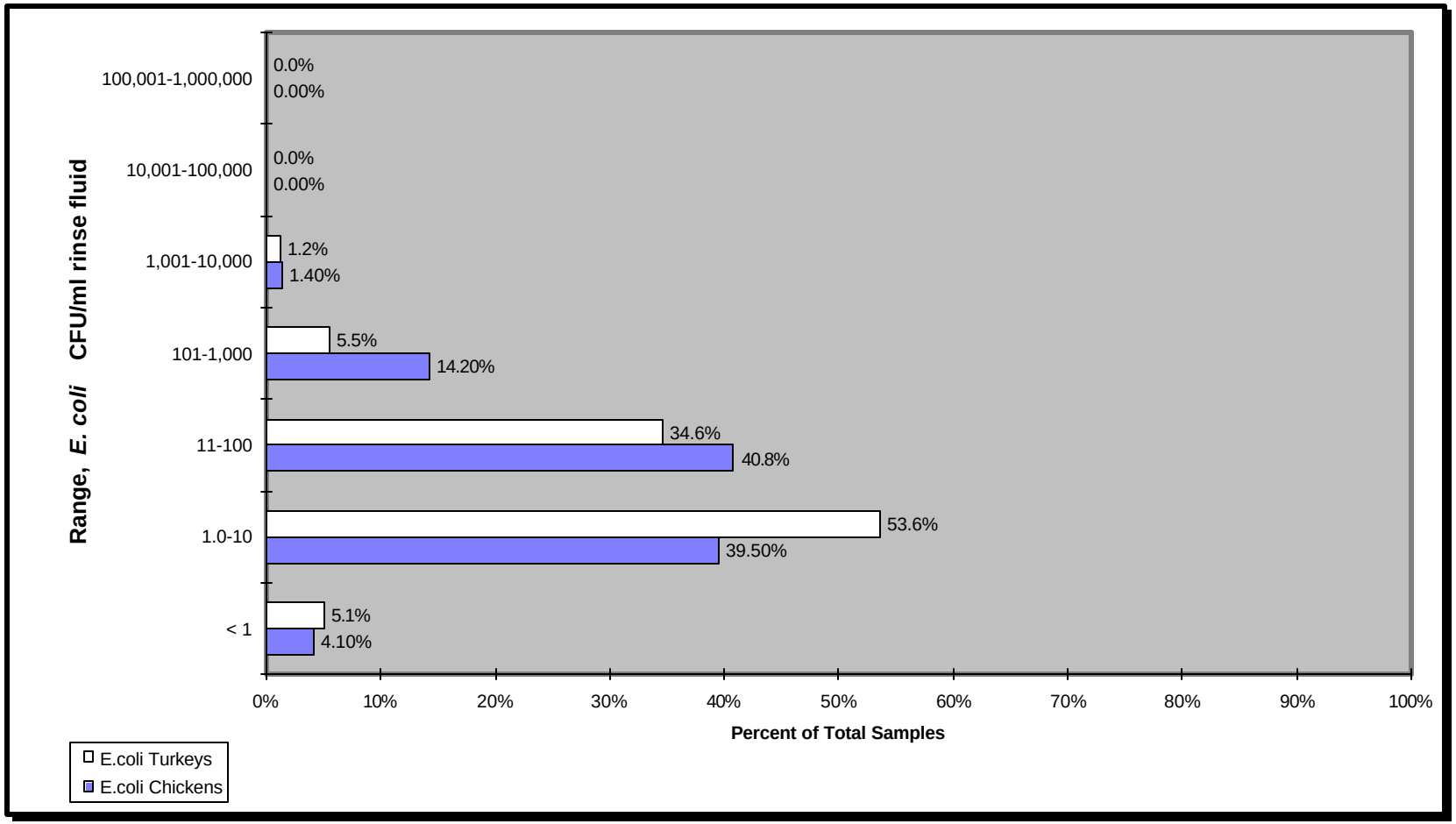
# Figure 3. Seasonal Incidence of *Salmonella* sp.

## on Canadian Chicken Broiler and Young Turkey Carcasses

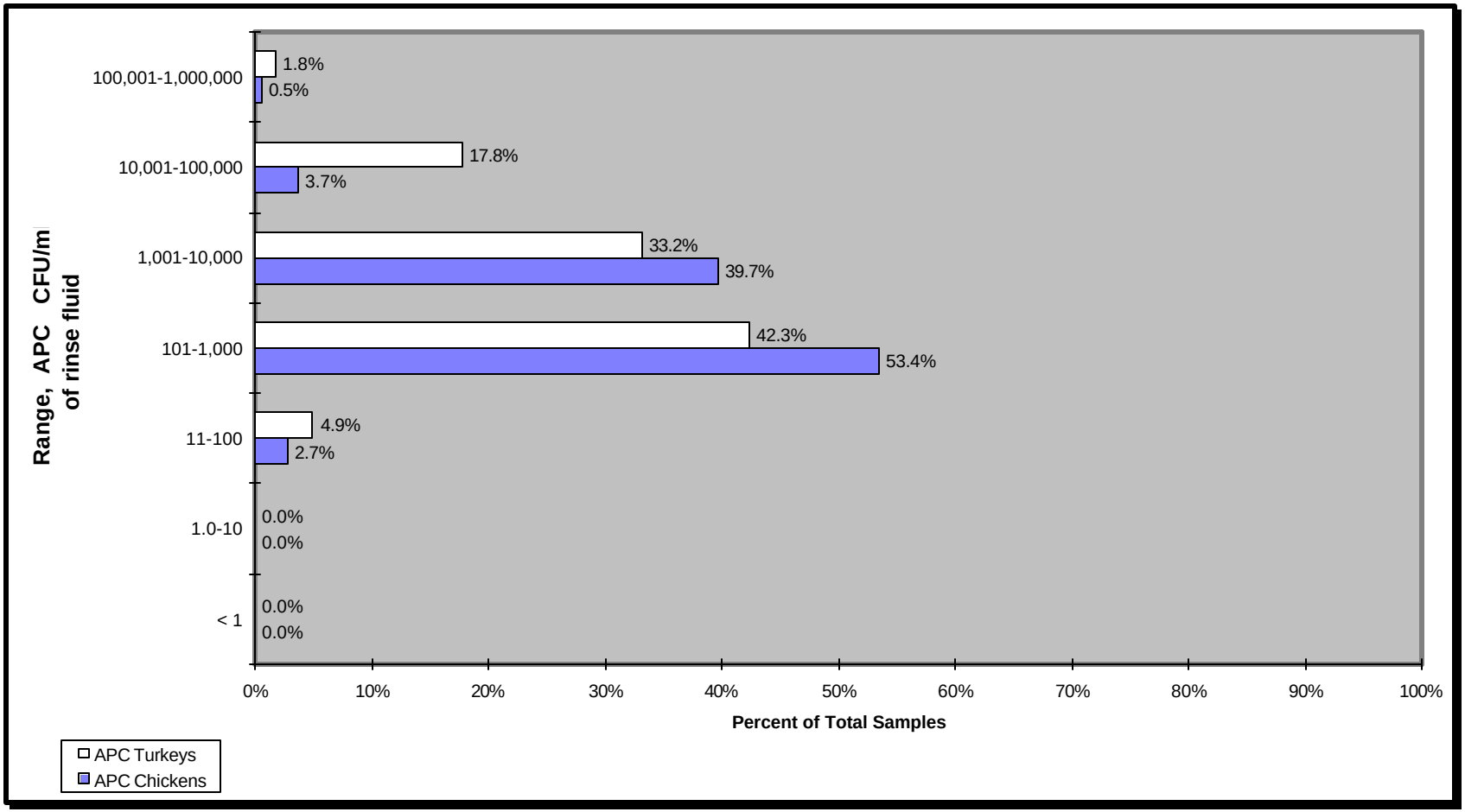


# Figure 4. *Escherichia coli* (Biotype I)

## Distribution in Chicken and Turkey Carcass Rinse Fluids



# Figure 5. Aerobic Plate Count grown at 35° Centigrade
## Distribution in Chicken and Turkey Carcass Rinse Fluids



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