Nationwide Raw Ground Turkey Microbiological Survey

NATIONWIDE RAW GROUND TURKEY

MICROBIOLOGICAL SURVEY

EXECUTIVE SUMMARY

During January through March 1995 and September through November 1995, raw ground turkey samples were collected from plants operating under Federal inspection. From the 40 plants producing the product during the survey two hundred ninety-six samples were analyzed to estimate the national prevalence and levels of bacteria of public health concern in raw ground turkey as currently produced. The samples were analyzed for the presence of those bacteria most often associated with human illness as determined by foodborne illness reports; other pathogens of interest, because of the severity of human illness they produce; and certain bacteria, or groups of bacteria, thought to be of value as indicators of general hygiene or process control.

The national product prevalence of the Aerobic Plate Count was estimated to be 100%; total coliforms, 95.5%; *E. coli* (Biotype I), 84.4%; *Clostridium perfringens*, 28.1%; *Staphylococcus aureus*, 57.3%; *Listeria monocytogenes*, 30.5%; *Campylobacter jejuni/coli*, 25.4%; and *Salmonella*, 49.9%. *Escherichia coli* O157:H7 was not recovered from any of the 296 samples analyzed. These prevalences provide an estimate of the percentage of 25 gram samples of ground turkey that would be positive if the total volume of all the federally inspected ground turkey produced was analyzed.

INTRODUCTION

For ground turkey, the initial microflora reflects that of the chilled carcasses and thus is comprised chiefly of gram-negative aerobic psychrotrophic bacteria which are primarily considered spoilage bacteria, and to a lesser extent, pathogenic bacteria. The grinding process increases the surface area and distributes the microorganisms, originally present only on the surface, throughout the product where the environment is favorable for their growth.[1][2] Producers of any ground product must exercise considerable control over the microbiological condition of raw materials, equipment sanitation and temperature control to minimize the microbial content.

Raw ground turkey, as such, has not constituted a serious foodborne illness problem. This may be due to proper cooking since consumers typically cook ground turkey products well done. However, those who consume the product without adequate cooking have an increased risk of contracting salmonellosis or campylobacterosis, since *Salmonella* and *Campylobacter* can be associated with raw poultry.[3] In addition, special care must be

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taken to avoid cross-contamination of ready-to-eat foods with raw ground turkey and in the cleaning and sanitizing of food preparation work surfaces after handling raw ground turkey, or any raw meat or poultry product.

OBJECTIVE

The objective of the Nationwide Raw Ground Turkey Microbiological Survey was to provide estimates of the national prevalence and levels of selected bacteria of public health concern in raw ground turkey produced in plants operating under Federal inspection. The survey was limited to approximately 300 samples, collected over two 7 week sampling intervals.

SURVEY DESIGN

Plants Included in the Sampling Frame:

The target population for the raw ground turkey survey was federally-inspected plants producing product labeled "ground turkey." A list of establishments to be sampled in the survey included those establishments which produce raw product labeled "ground turkey" as identified by various FSIS databases. Once a preliminary sampling frame was obtained, a list of establishments was then sent to the appropriate regions to determine if the designated establishments in their region produced ground turkey. The FSIS regional office was also asked to add other establishments that produced the product. Based on all information, a final sampling frame of 75 establishments that potentially produced ground turkey was compiled for the ground turkey survey.

Sample Design, Collection and Description:

For the two intervals of this study, samples were requested weekly from each establishment in the sampling frame. Random samples were collected by FSIS Inspectors-in-Charge following the procedures in FSIS Directive 10230.2 (8/6/92), instructions provided on computer generated sample collection request forms, and specific instructions applicable to this program. Samples consisted of one pound of raw ground turkey (finished product) collected from the processing line just prior to final packaging. The samples were bagged, placed in an insulated shipper with gel packs capable of maintaining refrigeration temperatures, and shipped to the laboratory via an overnight delivery service. Only those samples received at the laboratory within an established 38 hour window between sample collection and sample receipt, and with a sample receipt temperature of 0°C to 10°C, inclusive, were analyzed. Those samples received outside of those constraints were discarded.

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Selection of Organisms:

For the purposes of this survey, the organisms selected were those most often associated with human illness as determined by foodborne illness reports[4][5] or certain pathogens of concern because of the severity of the illness they produce in humans:

- *Salmonella*
- *Staphylococcus aureus* (coagulase positive staphylococci)
- *Clostridium perfringens*
- *Escherichia coli* O157:H7
- *Campylobacter jejuni/coli*
- *Listeria monocytogenes*

Data on certain bacteria, or groups of bacteria, thought to be of value as indicators of general hygiene or process control were also collected[6]:

- Total coliforms
- *Escherichia coli* (Biotype I)
- Aerobic Plate Count (APC) at 35°C (total viable aerobic microorganisms)

Laboratory Methods:

The laboratory methods used were identical to those used in the Nationwide Federal Plant Raw Ground Beef Microbiological Survey[7].

The Aerobic Plate Count (APC) at 35°C, total coliforms, *E. coli* (Biotype I), *C. perfringens* and *S. aureus* are reported as colony forming units (cfu) per gram. *L. monocytogenes*, *C. jejuni/coli*, *E. coli* O157:H7 and *Salmonella*, because they require enrichment, are reported as the Most Probable Number estimate of bacterial population density (MPN) per gram. For these pathogenic bacteria, 25 gram samples were first analyzed by a qualitative enrichment method with a minimum detection level of 0.04 organisms per gram (i.e. at least 1 organism in 25 grams). If positive, the analysis was repeated on a separate 25 gram portion of the original sample using the MPN method for enumeration which has a minimum detection level of 0.03 MPN per gram. In some cases, insufficient sample reserve was available to perform all required enumeration analyses. Differences in the number of samples enumerated are noted in the tables.

Statistical Methods:

National prevalences provide an estimate of the percentage of 25 gram portions of raw ground turkey that would be positive for a particular microorganism if the total volume of all the federally inspected raw ground turkey produced was analyzed.

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Plants with higher production volumes will have a greater impact on the overall bacterial profile of federally inspected ground turkey.

- For example, if plant #1 has a prevalence of 10% positive for *Salmonella* and produced 100 pounds and plant #2 has a 20% positive rate for the same organism but produces 200 pounds, the overall product prevalence for the 300 lbs of product would be about 17%.

- On the other hand, if plant #1 had a 20% positive rate for *Salmonella* and produced 100 pounds and plant #2 had 10% positive for *Salmonella* and produced 200 pounds, the overall product prevalence for the 300 lbs of product would be about 13%.

Prevalence data are based on the microbiological analyses performed on a 25 gram sample of raw ground turkey. Prevalences and average levels were statistically estimated by weighting each result according to the volume of ground turkey produced for that week by the plant. Standard errors of estimates were derived and calculated using statistical methods.

Data Limitations:

The survey was designed to provide estimates of national prevalences and levels of selected microorganisms in raw ground turkey. The data obtained provides a first-hand indication of which microorganisms might be present in federally inspected raw ground turkey. These results are useful for comparison purposes, for example, for comparing these results with future survey results obtained using the same methodology. The information also could be useful for determining relationships between different organisms.

The survey was not designed to provide microbiological information for individual plants. In order to obtain such information, one would need to collect a large number of samples from each plant over a period of time.

Sampling of establishments occurred over a relatively short period of time (January - March and September - November 1995) and not continuously over a complete year. As a result, the estimates as presented may not reflect possible seasonal differences.

RESULTS

Based on available resources, it was estimated that 300 samples could be collected for this program. To obtain approximately 300 samples, the survey was conducted in two intervals, from January 1995 through March 1995 and September 1995 through November 1995, since the first sampling interval only yielded half of the samples. At the time of the

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survey, 47 out of the 75 plants in the original frame reported operating and producing raw ground turkey. Four establishments were excluded from the survey since these plants produced product late in the day and samples could not be shipped the same day. One plant stopped producing during the survey and was excluded. From the remaining plants, 40 plants provided samples and 296 sets of analytical results were obtained and used for the final statistical summaries. From this data, it is estimated that at the time of the survey, these plants produced an average of approximately 6.25 million pounds of raw ground turkey per week during the survey period.

The prevalences shown in Table 1 represent the percent of 25 gram samples estimated to be positive for that analysis if the total volume of all federally inspected ground turkey produced was analyzed. Aerobic Plate Counts (APC @ 35°C) were found in 100% of samples analyzed. Coliforms were found to have a national prevalence of 95.5% and *E. coli* Biotype I, 84.4%. Of the pathogens, *C. perfringens* was found to have a national prevalence of 28.1%; *S. aureus*, 57.3%; *L. monocytogenes*, 30.5%; *C. jejuni/coli*, 25.4%; and *Salmonella*, 49.9%. *E. coli* O157:H7 was not recovered from any of the 296 samples analyzed.

National product levels of bacteria per gram of product are presented in Table 2. The mean levels are expressed as both the log mean and the geometric mean; the geometric mean is the antilog of the log mean. For example, in Table 2, the geometric mean level for estimated product prevalence of viable aerobic bacteria recovered in the Aerobic Plate Count @ 35°C was 14,305 cfu per gram (cfu/gram); the corresponding log mean was 4.16. The geometric means of total coliforms and *E. coli* (Biotype I), when detected, were 156 cfu/gram and 93 cfu/gram, respectively. When positive for a specific pathogen, the geometric mean of *S. aureus* was 121 cfu/gram; *C. perfringens*, 39 cfu/gram; *C. jejuni/coli*, 2.80 MPN/gram; *Salmonella*, 2.63 MPN/gram; and *L. monocytogenes*, 0.75 MPN/gram.

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Table 1.   Estimated National Prevalences of Selected Bacteria in Raw Ground Turkey
Produced under Federal Inspection

Microorganism	Samples Analyzed	Prevalence [a]	SE [b]
Direct Enumeration			
Aerobic Plate Count @ 35°C	296	100.0	NA[c]
Total Coliforms	296	95.5	1.4
Escherichia coli (Biotype I)	296	84.4	1.7
Clostridium perfringens	296	28.1	3.3
Staphylococcus aureus	296	57.3	3.8
MPN Enumeration			
Listeria monocytogenes	296	30.5	3.8
Campylobacter jejuni/coli	295 [d]	25.4	3.5
Escherichia coli O157:H7	296	0	NA[c]
Salmonella spp.	296	49.9	3.8

[a]   Estimates are weighted by weekly production estimates with an adjustment for non-response and non-producers.

[b]   Standard Error of prevalence.

[c]   NA = not applicable.

[d]   Insufficient tissue available to perform all analyses on one sample.

Source: Nationwide Raw Ground Turkey Microbiological Survey (January - March, September - November 1995)

Table 2.   Estimated National Mean Levels of Selected Bacteria in Raw Ground Turkey Produced under Federal Inspection.

| Microorganism | Number of Samples Quantified | Number of Quantified Samples Positive [a] | Level of Positives [b] | | | |
			Log$_{10}$ Mean [c]	SE [d]	Geometric Mean [c]	95% CI [e]
Direct Enumeration (cfu/g)						
Aerobic Plate Count @ 35°C	296	296	4.16	0.10	14,305	(9,200; 22,200)
Total Coliforms	296	280	2.19	0.04	156	(128, 190)
Escherichia coli (Biotype I)	296	228	1.97	0.04	93	(76, 113)
Clostridium perfringens	296	78	1.60	0.11	39	(23, 66)
Staphylococcus aureus	296	145	2.08	0.07	121	(89, 163)
MPN Enumeration (MPN/g)						
Listeria monocytogenes	54 [f]	11	-0.12	0.13	0.75	(0.41, 1.35)
Campylobacter jejuni/coli	77 [f]	25	0.45	0.42	2.80	(0.42, 18.52)
Escherichia coli O157:H7	0	NA [g]	NA [g]	NA [g]	NA [g]	NA [g]
Salmonella spp.	95 [f]	32	0.42	0.11	2.63	(1.61, 4.31)

[a]   Positive by quantitative method.
[b]   Levels only of those samples found positive by quantitative method.
[c]   Estimates are weighted by weekly production estimates with an adjustment for non-responders and non-producers.
[d]   Standard Error of the log$_{10}$ mean of positives. The Standard Error can be used to construct confidence intervals for the log$_{10}$ mean of positives.
[e]   Confidence Interval for the geometric mean of positives.
[f]   Only those samples found positive by qualitative method were quantified.
[g]   NA = not applicable.

Source: Nationwide Raw Ground Turkey Microbiological Survey (January - March, September - November 1995)