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A Research Note

Prevalence of *Campylobacter jejuni* on Turkey Wings at the Supermarket Level

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ABSTRACT

Campylobacter jejuni was found on 64.1% of 184 packaged fresh and on 55.6% of 81 frozen turkey wings purchased from local supermarkets over a 2-month period. The prevalence of the agent on the wings varied with sampling day. For fresh wings (12 samplings), it varied from 33.3% to 100% and for frozen wings (9 samplings), it varied from 17% to 100%. At a detection limit of 300 cells/wing, the mean number of *C. jejuni* on the positive fresh wings was 740 cells/wing (range 616 to 832) and on the frozen wings 890 cells/wing (range 661 to 1096). All fresh wings were purchased at the time of arrival at the supermarkets. Thirty packages of wings collected from the refrigerated shelves (2 to 4-d old) had no detectable *C. jejuni*.

Campylobacter species are widely spread in the animal kingdom, both as pathogens and commensals (*22*). *Campylobacter jejuni* has been established as a major cause of infectious enteritis in man with a frequency rivaling that of *Salmonella* (*2,4,7,15,24*). Foodborne transmission has been implicated as one route of infection (*1,3,7*). Outbreaks associated with consumption of undercooked chicken and turkeys have been reported (*1,21*). Recent studies have revealed isolation rates of *C. jejuni* from processed chickens that range from 1.7 to 98% (*1,5,10,14,18,19,24*). Limited studies for turkey meat indicate a prevalence of 33 to 100% (*1,12,18*). Prevalence of the organism in the feces of various birds ranges from 30 to 100% (*1,13,18*). The objective of this study was to estimate the prevalence and number of *C. jejuni* in turkey wings sold in retail stores of Davis, California.

MATERIALS AND METHODS

Sampling

Packages of fresh and frozen turkey wings were obtained from three supermarkets. The fresh wings were classified according to the supermarket source, i.e., brand A-fresh and brand B-fresh. The frozen turkey wings were classified as brand B-frozen and brand C-frozen. The fresh turkey wing samples were obtained usually on the day of arrival at the supermarket. Older fresh samples were obtained as cold samples which could have been on the supermarket shelf of the refrigerated display case for 2 to 4 d. The frozen samples (especially brand C-frozen) were obtained from the supermarkets after they had been defrosted, cut, packaged and put in the refrigerated display case. The minimum sample size of turkey wing packages which would be required to estimate the prevalence of *C. jejuni* at a level of significance of 5% was 265 wings (*11*). This figure was also based on a mean reported prevalence of 73% (*12,18*). Although there were between 2 to 4 turkey wings per package, one wing (average weight of 400 g) was thought to be representative of a package based upon the assumption of equal chance of contamination within a package.

Enumeration procedure

One wing from each package was placed in a heavy-duty Zip-Loc polyethylene bag containing 30 ml of nutrient broth (BBL polypeptone, 20 g; yeast extract, 2 g; NaCl, 5 g; distilled water, 1 L) with the antibiotics: polymyxin B at 5,000 IU/L, trimethoprim lactate at 5 mg/L and vancomycin at 10 mg/L (added as presterilized solutions to the broth after autoclaving and cooling). Each bag was massaged for 2 to 4 min.

Ten ml of the washing were centrifuged (5 min, $3000 \times g$) and 0.1 ml of the supernatant fluid was plated on a selective medium composed of 52 g of brain heart infusion agar (Difco), 0.5 g of yeast extract, 50 ml of lysed bovine red blood cells and 1 L of distilled water. The pH was adjusted to 7.4. After autoclaving and cooling to 47 to 50°C, the blood and the three antibiotics were added at the concentrations previously described. Inoculated plates were incubated at 42°C in an atmosphere of 5% O_2:10% CO_2:85% N_2. Suspect colonies were checked microscopically for typical morphology and motility, counted and subcultured in differential media for further classification as described by Ullman (*25*). Due to dilution factors, the detection limit was 300 cells/wing.

Statistical procedures

Estimated group prevalences of *C. jejuni* were compared statistically using the normal approximation to the binomial distribution (*16*). The BMDP statistical software (*6*) was used for the desired computations.

RESULTS AND DISCUSSION

During a 2-month period, 265 packages of fresh and frozen turkey wings were bought from three local supermarkets and analyzed (seventeen sampling dates) for the presence of *C. jejuni*. Table 1 summarizes the findings with respect to the source, type of product (fresh or frozen), and the existence of any statistically significant difference in the proportion of samples positive for *C. jejuni* among the sampling groups.

Of the 265 wings, 163 (61.5%) harbored the agent. Pre-

TABLE 1. *Summary of the prevalence of* C. jejuni, *by type of product and brand, in samples of packaged turkey wings purchased from three Davis, CA supermarkets during the period of November 20, 1981 through January 25, 1982.*

Supermarket-type of product	Total number of samples tested	Number of positive samples	Positive samples (%)
A-fresh	121	75[a]	62
B-fresh	63	43	68.3[b]
B-frozen	35	26	74.3[b]
C-frozen	46	19	41.3[c]
Total fresh	184	118	64.1
Total frozen	81	45	55.6[b]
Grand total	265	163	61.5

[a]Based on a minimum detection level of 300 cells/wing.
[b]Not statistically significant at P = 0.05.
[c]Statistically significant, P = <0.05.

ous studies have shown a recovery rate of 100% from turkey cecal specimens, and recovery rates of 94% from freshly dressed turkey carcasses before chilling and 34% after overnight chilling (*12*). Another study (*18*) revealed that *C. jejuni* was present in 83% of air-chilled turkeys after processing and 100% of water-chilled turkeys. Of the 184 fresh and 81 frozen wings, 118 (64.1%) and 45 (55.6%), respectively, harbored the agent. This difference was not significant (P>0.05).

As Table 1 shows, there was no significant (P>0.05) difference in the prevalence of *C. jejuni* between brand A and B fresh samples and brand B fresh and frozen samples. A significantly (P<0.05) higher prevalence for *C. jejuni* was observed in brand B than in brand C frozen samples. This might have been due to the origin of turkey meat, to differences in transportation times from the slaughterhouse to the supermarkets, age of parts and possible differences in handling. Brand B turkey meat originated in California only, whereas brand C originated from both inside and outside California. Thus, the time between slaughtering and selling may have been longer for brand C than for brand B. Cutting and packaging of brand B turkey wings was done in the slaughterhouse or the warehouse. This may have lead to more cross-contamination with the fresh products. In contrast, brand C was defrosted, cut, packaged and labeled at the supermarket.

Table 2 demonstrates the observed variations in prevalence with sampling day over the 2-month sampling period. The high degree of variability in the prevalence from sampling day to sampling day is obvious. Lack of sufficient data did not permit determination of the trend in prevalence over time. Variability in prevalence for products of the same brand may be due to differences in the levels of the agent in the intestines and on feathers of the birds, in the origin of the birds from different ranches, slaughterhouses and whether the birds came from lots processed early in the morning or later in the day. Some of these contributing factors have been demonstrated recently (H. Yusufu, MPVM report, University of California, Davis, 1982).

In addition to the fresh wing packages obtained at the time of their arrival in the supermarket, 30 more packages 2-to 4-d old were obtained from the refrigerated shelves. No *C. jejuni* was isolated from any of these packages. Kinde et al. (*10*) has recently reported a decreasing prevalence of *C. jejuni* during cold storage of chicken wings, possibly due to the detrimental effect of increasing num-

TABLE 2. *Prevalence by sampling day of* C. jejuni *on fresh and frozen turkey wings purchased from three Davis, CA, supermarkets during the period of November 20, 1981 through January 25, 1982.*

	Fresh[a]				Frozen			
	Brand A		Brand B		Brand B		Brand C	
Date	No. samples	% positive	No. samples	% positive	No. samples	% positive	No. samples	% positive
Nov. 20							6	33
Nov. 23	14	71.4						
Nov. 30							4	100
Dec. 2	7	86			8	100		
Dec. 7	8	100					4	75
Dec. 9			24	75				
Dec. 10	9	89					4	25
Dec. 11	10	50						
Dec. 14	12	33.3					4	25
Dec. 16			25	56				
Dec. 18	24	71						
Dec. 23	8	63			13	61.5	2	50
Jan. 8	29	41.4						
Jan. 11							6	17
Jan. 15					14	64	5	40
Jan. 25			14	79			11	36.4
Total	121	62[b]	63	68.3	35	74.3	46	41.3

[a]Samples collected at the time of arrival at the supermarkets.
[b]Based on a minimum detection level of 300 cells/wing.

bers of psychrotrophic spoilage bacteria on the meat or sublethal damage by cold.

The mean number of *C. jejuni* for the 118 positive fresh samples was 740 cells/wing (range of 616 to 832 cells/wing) and for the 45 positive frozen samples was 890 cells/wing (range of 661 to 1096 cells/wing). A human volunteer became ill after ingesting a suspension of 10^6 cells of *C. jejuni* in a glass of milk (*23*), while another volunteer became ill 4 d after ingesting only 500 cells (*17*). Pasteurization of milk and water, and cooking and baking of meat will readily kill *C. jejuni* (*8,9*), but there is evidence that short cooking methods, such as barbecue, may not be always effective (*1*).

Overall this study agrees with previous findings (*12,18*) on the high prevalence of *C. jejuni* on turkey meat. With respect to food safety, the significance of the presence and numbers of *C. jejuni* on turkey meat cannot be critically assessed since, at the present time, we do not know what a pathogenic *Campylobacter* is (*1,3,4,7*). Available reports (*1*) indicate that poultry meat has been implicated epidemiologically only in a very few outbreaks of campylobacteriosis. Heterogeneity with the *Campylobacter* group has been demonstrated (*2*). In practical terms, this may mean that not all *C. jejuni* strains found in poultry are pathogenic.

REFERENCES

1. Blaser, M. J. 1982. *Campylobacter jejuni* and food. Food Technol. 36:89-92.
2. Blaser, M. J., and L. B. Reller. 1981. Campylobacter enteritis. N. Eng. J. Med. 305:1444-1452.
3. Bokkenheuser, V. D., and A. C. Mosenthal. 1981. Campylobacteriosis-a foodborne disease. J. Food Safety 3:127-143.
4. Butzler, J. P., and M. B. Skirrow. 1979. Campylobacter enteritis. Clin. Gastroenterol. 8:737-765.
5. Christopher, F. M., G. C. Smith, and C. Vanderzant. 1982. Examination of poultry giblets, raw milk, and meat for *Campylobacter fetus* subsp. *jejuni*. J. Food Prot. 45:260-262.
6. Dixon, W. J. (ed.). 1981. BMDP statistical software. University of California Press, Berkeley, CA.
7. Doyle, M. P. 1981. *Campylobacter fetus* subsp. *jejuni:* an old pathogen of new concern. J. Food Prot. 44:480-488.
8. Doyle, M. P. and D. J. Roman. 1981. Growth and survival of *Campylobacter fetus* subsp. *jejuni* as a function of temperature and pH. J. Food Prot. 44:596-601.
9. Gill, C. O., and L. M. Harris. 1982. Survival of *Campylobacter fetus* subsp. *jejuni* on meat and cooked foods. Appl. Environ. Microbiol. 44:259-263.
10. Kinde, H., C. A. Genigeorgis, and M. Pappaioanou. 1983. Prevalence of *Campylobacter jejuni* on chicken wings. Appl. Environ. Microbiol. (in press).
11. Levy, P. S., and S. Lemeshow. 1980. Sampling for health professionals. Lifetime Learning Publications, Belmont, CA.
12. Luechtefeld, N. W., and W-L.L. Wang. 1981. *Campylobacter fetus* subsp. *jejuni* in a turkey processing plant. J. Clin. Microbiol. 13:266-268.
13. Luechtefeld, N. W., M. J. Blaser, L. B. Reller, and W-L.L. Wang. 1980. Isolation of *Campylobacter fetus* subsp. *jejuni* from migratory waterfowl. J. Clin. Microbiol. 12:406-408.
14. Park, C. E., Z. K. Stankiewicz, J. Lovett, and J. Hunt. 1981. Incidence of *Campylobacter jejuni* in fresh eviscerated whole market chickens. Can. J. Microbiol. 27:841-842.
15. Public Health Laboratory Service, UK. 1982. *Campylobacter* infections 1977-80. Br. Med. J. 282:1484.
16. Remington, R. D., and M. A. Shork. 1970. Statistics with applications to the biological and health sciences. Prentice-Hall, Inc., Englewood Cliffs, NJ.
17. Robinson, D. A. 1981. Infective dose of *Campylobacter jejuni* in milk. Br. Med. J. 282:1584.
18. Simmons, N. A., and J. Gibbs. 1979. *Campylobacter* spp. in oven-ready poultry. J. Infect. 1:159-162.
19. Sivaraj, S., J. A. Rosenfield, G. R. Davey, and T. C. Sorrell. 1982. *Campylobacter jejuni:* incidence in processed broilers and biotype distribution in human and broiler isolates. Appl. Environ. Microbiol. 43:1219-1220.
20. Skirrow, M. B., and J. Benjamin. 1980. "1001" campylobacters: cultural characteristics of intestinal campylobacters from man and animals. J. Hyg. 85:427-442.
21. Skirrow, M. B., R. G. Fidoe, and D. M. Jones. 1981. An outbreak of presumptive food-borne *Campylobacter* enteritis. J. Infect. 3:234-236.
22. Smibert, R. M. 1978. The genus *Campylobacter*. Ann. Rev. Microbiol. 32:678-709.
23. Steele, T. W., and S. McDermott. 1978. Campylobacter enteritis in South Australia. Med. J. Aust. 2:404-406.
24. Svedhem, A., B. Kaijer, and E. Sjögren. 1981. The occurrence of *Campylobacter jejuni* in fresh food and survival under different conditions. J. Hyg. 87:421-425.
25. Ullman, U. 1979. Methods in *Campylobacter*. pp. 435-452. *In* T. Bergan and J. R. Morris (eds.) Methods in microbiology XIII Academic Press, New York.

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J. Food Sci. 41:738-742.

37. Sneath, P. H. A., and D. Jones. 1976. *Brochothrix*, a new genus tentatively placed in the family *Lactobacillaceae*. Int. J. Syst. Bacteriol. 26:102-104.
38. Snedecor, G. W., and W. G. Cochran. 1971. Statistical methods, 6th ed. Iowa State University Press, Ames, IA.
39. Snyder, H. E. 1964. Measurement of discoloration in fresh beef. J. Food Sci. 29:535-539.
40. Steel, K. J. 1961. The oxidase reaction as a taxonomic tool. J. Gen. Microbiol. 25:297-306.
41. Sutherland, J. P., J. T. Patterson, and J. G. Murray. 1975. Changes in the microbiology of vacuum-packaged beef. J. Appl. Bacteriol. 39:227-237.
42. Sutherland, J. P., J. T. Patterson, P. A. Gibbs, and J. G. Murray. 1975. Some metabolic and biochemical characteristics of representative microbial isolates from vacuum-packaged beef. J. Appl. Bacteriol. 39:239-249.