BACTERIA AND YEAST COUNTS OF PREPACKAGED, SLICED, CURED BACON, AND SLICED, FRESH SIDE PORK[1]

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SUMMARY

Initial counts of 161 packages (21 brands) of sliced, cured bacon (yeasts and bacteria combined) ranged from <1,000 to 30 million per cm². After 3 to 14 days at 3 to 6 C counts ranged from <1,000 to 650 million per cm². Brand F showed the highest counts, and numerous small yeast colonies were seen on the lean. Abnormal odors and sliminess were observed in some samples. Initial bacterial counts on sliced, fresh side pork (53 packages, 2 brands, 2 stores) varied from <1,000 to 25 million per cm². Species of *Pseudomonas* and *Achromobacter* dominated and counts were higher in packages from Store A, rising to 1 billion per cm² in 6 to 7 days at 6 C.

There is considerable interest at present in the microbial flora of prepackaged meats at the time of purchase, and how this relates to subsequent keeping quality in the home.

Cavett *(1)* reported that bacon with a normal salt content of 5 to 7% in the aqueous phase spoiled in about 15 days when stored at 20 C. The sour odor which had developed was probably due to combined activities of micrococci and lactic acid bacteria.

Ingram *(2)* stated that cured sliced Wiltshire bacon normally carries 100,000 to 1 million salt-tolerant bacteria per gram predominantly species of *Micrococcus* and *Lactobacillus.* When stored at 15 C for 4 days numbers rose as high as 100 million. There was a slow decline in organoleptic quality in 14 days.

Jensen *(3)* found that the flora of bacon going into cure varied from season to season and year to year, but the numbers depended on sanitary practices. In the smoking process virtually all microorganisms were destroyed.

Tonge, Baird-Parker and Cavett *(4)* studied the micro-ecology of cured, sliced, vacuum-packed bacon during storage at 20 and 30 C and found that catalase positive cocci dominated the flora the first 9 days. Streptococci and lactic acid bacteria became dominant later under low salt conditions.

EXPERIMENTAL PROCEDURE

Twenty-one brands (161 packages) of sliced, cured bacon were purchased during 20 months from 5 large volume stores. Two brands of sliced, fresh side pork were purchased from 2 large volume stores during 9 months. Within 15 minutes after purchase, the packages were placed at 3 C and initial microbial counts were made within 4 hours.

A 10-cm² portion (5 cm on each side) including approximately equal areas of lean and fat was excised and placed in 99 ml of 0.15% peptone water in a 6-oz screw-cap bottle. Plate counts, using eugonagar, were based on the numbers of microorganisms removed from 1-cm² area of meat by vigorous shaking for 5 min on a Kahn shaker, followed by appropriate dilutions in 0.15% peptone water (shaken 25 times by hand). Plates were incubated 4 days at 23 C.

RESULTS AND DISCUSSION

As shown in Table 1, initial bacterial counts on 89 packages of cured bacon comprising 14 brands (from Sept. 1964 to July 1965) ranged from <1,000 to 30 million per cm² while medians were <1,000 to 65,000. The high counts were limited to approximately 15 packages, and 7 of these yielded counts of 1 million to 30 million at purchase.

After 3 to 7 days at 3 to 6 C, samples from some of the packages yielded 100 million to 640 million microorganisms per cm². Yeasts usually dominated the flora in most samples and small colonies could be seen on the slices from some packages. Lactic acid bacteria dominated in a few packages, especially in the vacuum-packed brands. Micrococci were also found, but seldom dominated. Brand F showed the largest number of packages having high counts. Brands B, D, E, G, H, and I (42 packages) did not show a single sample above 180,000 organisms per cm². Abnormal odors and sliminess were noted in stored samples from some high count packages when yeasts were present in large numbers.

During the period from Sept. 1965 to July 1966 bacterial counts per cm² on 72 packages (17 brands) of cured bacon varied from <1,000 to 5 million at purchase time (Table 2). After 7 to 14 days at 3 to 6 C, counts per cm² ranged from <1,000 to 180 million. The higher counts were on samples from 7 brands of sliced "ends and pieces." This type of product appeared on the retail market in larger quantities when the price of bacon increased.

Because Brand F showed the highest counts during 1964-1965, additional packages were purchased and analyzed in 1965-1966. Samples from 13 packages

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TABLE 1. COMBINED YEAST AND BACTERIAL COUNTS ON SLICED, CURED BACON (SEPT. 1964-JULY 1965) SOON AFTER PURCHASE AND AFTER STORING AT 3 TO 6 C FOR 3 TO 7 DAYS

Brands of bacon	No. of pkgs.	Initial counts	Counts per cm² at time indicated[a] Time and temperature of storage (portions of opened packages) 3 to 4 days at: 3 C	3 to 4 days at: 6 C	7 days at: 3 C	7 days at: 6 C
A	8	1T to 13M Md. = <1T	1T to 24M Md. = 110T	<1T to 50M Md. = 125T	<1T to 65M Md. = 190T	<1T to 46M Md. = 300T
C	8	<1T to 25M Md. = <1T	<1T to 65M Md. = <1T	<1T to 100M Md. = <1T	<1T to 70M Md. = <1T	<1T to 100M Md. = <1T
B, D, E, G, H, I	42	<1T to 21T Md. = <1T	<1T to 25T Md. = <1T	<1T to 80T Md. = <1T	<1T to 180T Md. = <1T	<1T to 100T Md. = <1T
F	10	<1T to 30M Md. = 65T	<1T to 100M Md. = 4.5M	<1T to 200M Md. = 5M	<1T to 140M Md. = 8M	<1T to 650M Md. = 10M
J	4	<1T to 1M Md. = 10T	—— ——	<1T to 5M Md. = 1M	—— ——	<1T to 17M Md. = 5M
K Vacuum packed	9	<1T to 10M Md. = 10T	<1T to 25M Md. = <1T	<1T to 75M Md. = <1T	<1T to 60M Md. = <1T	<1T to 100M Md. = <1T
L, M, N Vacuum packed	8	<1T to 25M Md. = <1T	<1T to 2M Md. = 3T	<1T to 20M Md. = 10T	<1T to 13M Md. = 20T	<1T to 25M Md. = 40T

[a]T = Thousand; M = Million; B = Billion; Md. = Median.

TABLE 2. COMBINED YEAST AND BACTERIAL COUNTS ON SLICED, CURED BACON (SEPT. 1965-JULY 1966) SOON AFTER PURCHASE AND AFTER STORING AT 3 TO 6 C FOR 7 TO 14 DAYS. BRANDS OF SLICED ENDS AND PIECES INCLUDED

Brands of bacon	No. of pkgs.	Initial counts	Counts per cm² at time indicated[a] Time and temperature of storage (portions of opened packages) 7 days at: 3 C	7 days at: 6 C	14 days at: 3 C	14 days at: 6 C
F	13	<1T to 650T Md. = <1T	<1T to 1M Md. = <1T	<1T to 8M Md. = <1T	<1T to 6M Md. = 5T	<1T to 12M Md. = 30T
9 Miscellaneous brands	28	<1T to 140T Md. = <1T	<1T to 600T Md. = <1T	<1T to 3 1/2M Md. = <1T	<1T to 3M Md. = <1T	<1T to 5M Md. = <1T
7 Miscellaneous brands (ends & pieces)	31	<1T to 5M Md. = <1T	<1T to 210M Md. = 3T	<1T to 110M Md. = 30T	<1T to 160M Md. = 200T	<1T to 180M Md. = 1M

[a]T = Thousand; M = Million; B = Billion; Md. = Median.

TABLE 3. BACTERIAL COUNTS ON SLICED, FRESH SIDE PORK (OCT. 1965-JUNE 1966) SOON AFTER PURCHASE AND AFTER STORING AT 3 TO 6 C FOR 3 TO 7 DAYS

Brands of fresh side pork	No. of pkgs.	Initial counts	Counts per cm² at time indicated[a]			
			Time and temperature of storage (portions of opened packages)			
			3 to 5 days at:		6 to 7 days at:	
			3 C	6 C	3 C	6 C
Store A	27 (unless otherwise indicated)	<3T to 25M Md. = 160T	65M to 350M (5 packages only)	150M to 500M (5 packages only)	100T to 560M Md. = 100M	10M to 1B Md. = 200M
Store B	26 (unless otherwise indicated)	<1T to 13T Md. = 3T	30T to 65M Md. = 1M (14 packages)	10T to 100M Md. = 2.5M (14 packages)	250T to 75M Md. = 4M (7 packages)	1M to 150M Md. = 12M (7 packages)

[a]T = Thousand; M = Million; B = Billion; Md. = Median.

(Table 2) stored up to 14 days at 3 to 6 C showed considerably lower counts during 1965-1966. The microbial flora of the brands in Table 2 was essentially the same as those in Table 1.

Bacterial counts were made on samples from 53 packages of sliced, fresh side pork purchased from 2 stores (Table 3). Counts were much higher in packages from Store A, and there was obvious spoilage in some samples held for 3 days at 3 to 6 C. Species of *Pseudomonas* and *Achromobacter* dominated, and counts were as high as 500 million per cm² after 3 to 5 days at 6 C.

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