

THE MICROBIOLOGY OF SOME SELF-SERVICE, PACKAGED, LUNCHEON MEATS¹

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(Received for publication August 20, 1961)

Microbiological examinations were made on 181 packages of sliced luncheon meats which were collected over a period of 21 months. Packages were obtained from 3 stores. Samples from 26 packages developed defects (sour, yeasty or musty, and sliminess) after storage for 3 to 7 days at 3° to 7.5° C; most of these originated from only one of the three stores.

Microbial counts on several spoiled samples, especially pickle loaf and macaroni-cheese loaf exceeded 2 billion/sq. inch.

There are a variety of sliced, packaged, self-service luncheon meats available in retail markets where they are stored at temperatures above 0° C. If such meats carry certain psychophilic microorganisms, abnormal odors and/or flavors may develop under certain conditions, especially after the consumer purchases and stores such products at varying refrigerator temperatures and for varying time intervals.

Adame, Post, and Bliss (1) studied the bacteriology of commercially prepared, wrapped "wet" and "dry" type sandwiches. The staphylococcus count (using selective media) on some of the "dry" type sandwiches (including ham and salami) was greater than the standard plate count. No coagulase positive strains were recovered. However, they indicated that food poisoning types might be able to multiply under the same conditions, i.e., at ambient air temperatures (23° - 30°C) for 17-20 hours prior to sale.

Allen and Foster (2) studied the deterioration of vacuum-packed sliced processed meats during refrigerated storage. They suggested that meat packers cannot control types of organisms in their products, but that numbers can be controlled by good plant sanitation. If the microbial count is excessive, then storage life may be shortened.

Alford and Elliot (3) postulated that bacteria growing on food products stored at low temperatures may not cause fat deterioration so long as the food is held near 0°C; however, short periods at higher temperatures could cause fat lipolysis by the enzyme formed at the lower temperature.

Alm, Ericksen, and Molin (4) reported that some sliced processed meat products retained a higher quality in cold storage when vacuum-packed than when sealed at atmospheric pressure. They con-

cluded that shelf-life in vacuum packages is prolonged when the initial bacterial count is low.

American Meat Institute Foundation (5) reported that adequately processed cured meats are subject to recontamination on the surface during handling, slicing, and packaging. Micrococci, yeasts, lactobacilli, microbacteria, and other lactic acid bacteria may be present.

Brown, Vinton, and Gross (6) reported that heat resistant cocci in processed canned ham multiplied slowly at refrigerator temperatures. They reported that multiplication of cocci in meat may act as a safety measure against growth of undesirable organisms.

Deibel, Niven, and Wilson (7) studied microbiological and related aspects of some fermented sausages and reported bacterial counts ranging from 4 million to 48 million per g in salami samples from various establishments. Lactobacilli comprised the predominant flora.

Miller (8) investigated the microbial flora of self-service, package, square slices of cooked ham and found a range of fewer than 1,000 to 52 million microorganisms per sq inch of surface area (initial count). Samples from 28 of 113 packages stored for 4 to 7 days at 4° to 11°C were sour. The dominating organism from the sour samples belonged to genus *Microbacterium*.

EXPERIMENTAL PROCEDURE

Four types of self-service, packaged luncheon meats (balogna, pickle loaf, cooked salami, and macaroni-cheese) were purchased at approximately weekly intervals over a period of 21 months from 3 of several stores doing a large volume of business in Riley County, Kansas. Within 15 minutes after purchase the packages were placed at 3° to 4°C and initial microbiological analyses were made on an outside slice from each package within 4 hours.

Five portions from at least 3 slices of each package were re-wrapped in "saran wrap". One of the 5 portions was placed at 3° to 4° C; one at 7° to 7.5°C; and one at 10° to 11°C. After 3 to 4 days one sample from each of the 3 temperature ranges was removed and analyzed. The remaining samples

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TABLE 1—MICROBIAL POPULATIONS OF PACKAGED SLICED LUNCHEON MEATS SOON AFTER PURCHASE, AND AFTER STORING AT 3° TO 11°C FOR 3 TO 7 DAYS (STORE I)

Type of product	Number of packages	Initial counts	Approximate numbers of microorganisms per sq inch of surface area					Total packages having an obvious abnormal odor, or showing sliminess
			Time and temperature of storage (portions of opened packages)					
			3 to 4 days at:			7 days at:		
		3° to 4°C	7° to 7.5°C	10° to 11°C	3° to 4°C	7° to 7.5°C		
Bologna	22	<1T to 9M Md = 3½T	<1T to 5M Md. = 20T	<1T to 5.5M Md. = 310T	<1T to 12M Md. = 1.7M	<1T to 4M Md. = 84T	<1T to 120M Md. = 5.5M	0
Pickle Loaf	16	<1T to 14M Md = 12T	<1T to 14M Md. = 45T	<1T to 20M Md. = 111T	<1T to 200M Md. = 1M	<1T to 600M Md. = 575T	3T to 700M Md. = 46M	3
Cooked Salami	16	<1T to 1.6M Md = 3T	<1T to 8M Md. = 18T	3T to 85M Md. = 126T	<1T to 200M Md. = 1.1M	<1T to 150M Md. = 40T	6T to 300M Md. = 2.8M	1

T = thousand, M = million, B = billion, Md. = median

stored at 3° to 4°C and 7° to 7.5°C were held 7 days before analysis.

Procedures were essentially the same as those previously employed by Miller (7), except that eugonagar was used as a medium instead of tryptone-glucose-yeast extract agar. Plates were incubated at approximately 23°C.

RESULTS AND DISCUSSION

Microbial counts on packages of meat at time of purchase.

Initial counts made within 4 hours after purchase on bologna, pickle loaf, and cooked salami (Table 1) from Store I, revealed medians of 3,500, 12,000, and 3,000 microorganisms per sq inch, respectively.

In 3 similar products (Table 2) from Store II, listed in the same order, the median counts were 56,000, <1,000, and 1.1 million; 2 additional products (Store II), i. e., macaroni-cheese, and vacuum sealed macaroni-cheese showed medians of 32,000 and <1,000, respectively.

Median counts on 4 products (Table 3) from Store III were <1,000, 61,500, 240,000, and 176,000 on bologna, pickle loaf, cooked salami, and macaroni-cheese, respectively.

Maximum initial counts were 14 million on pickle loaf from Store I, 19 million on nonvacuum sealed macaroni-cheese from Store II, and 65 million on pickle loaf from Store III. Microbial counts and

condition of samples stored 3 to 4 days and 7 days at various temperatures follow:

Store I: Three of 16 samples of pickle loaf exhibited abnormal odors and sliminess in 7 days at 7° to 7.5°C. The maximum count at this time was 700 million per square inch and the median 46 million. Samples from one of 16 packages of salami were slimy and sour in 7 days at 3° to 4°C and at 7° to 7.5°C; the counts were approximately 200 million on the slimy samples. Nothing abnormal in odor or appearance was detected among 22 samples of bologna. The maximum count was 120 million, and the highest median 5.5 million (Table 1).

Store II: Of a total of 21 packages of macaroni-cheese loaf, samples from 3 packages were found to have a definite musty odor in 7 days at 7° to 7.5°C. Counts on these samples were approximately 200 million per square inch.

The maximum counts for bologna, pickle loaf (vacuum-sealed), and salami (vacuum-sealed) were 70 million, 21 million, and 60 million, respectively. There was no obvious spoilage or sliminess in samples from 40 packages of these products (Table 2).

Store III: Samples from 4 of 20 packages of bologna were sour and slimy in 7 days at 7° to 7.5°C. Microbial counts on these 4 samples were 275 million to 400 million; the median of the 20 samples for the same time and temperature was 4.7 million.

Of 14 packages of pickle loaf, samples from 6

packages had a sour (and/or yeasty) odor, and were slimy in 7 days at 7° to 7.5°C; additional samples from 3 of the same 6 packages were sour and slimy in 7 days at 3° to 4°C. Other samples from 1 of the 6 packages were slimy and had an "off" odor in 4 days at 3° to 4°C, and in 4 days at 7° to 7.5°C. Microbial counts on 3 of the 6 samples were more than 2 billion per sq inch in 7 days at 3° to 4°C.

Samples from 3 of 12 packages of salami exhibited obvious "off" odors and, in addition, 1 of the 3 samples was slimy; counts on the abnormal samples were 100 million, 200 million, and 260 million in 7 days at 7° to 7.5°C.

Of a total of 20 packages of macaroni-cheese loaf, samples from 6 packages were sour or otherwise obviously abnormal in odor and appearance in 7 days at 7° to 7.5°C; other samples from 4 of the same 6 packages were spoiled in 7 days at 3° to 4°C. (Table 3). Counts on the 6 samples were 600 mil-

lion to more than 2.5 billion per sq inch at 7° to 7.5°C. The median of 20 samples held 7 days at 7° to 7.5°C was 450 million.

NATURE OF THE MICROBIAL FLORA

Several genera of microorganisms were cultured from the luncheon meats. Among the organisms found were catalase negative streptococci, and lactobacilli. Yeasts, micrococci, and microbacteria were commonly present. Pinpoint colonies were frequently observed in considerable numbers on plates. Pseudomonads were observed infrequently.

Straka and Stokes (9) isolated 17 representative psychrophilic bacterial cultures and 1 yeast from materials collected at antarctica. The optimum growth temperatures for 16 of these psychrophiles were 20°C or above, and the maximum growth temperatures of 15 cultures were between 28° and 35°C.

TABLE 2—MICROBIAL POPULATIONS OF PACKAGED SLICED LUNCHEON MEATS SOON AFTER PURCHASE, AND AFTER STORING AT 3° TO 11°C FOR 3 TO 7 DAYS (STORE II)

Type of product	Number of packages	Initial counts	Approximate numbers of microorganisms per sq inch of surface area					Total packages having an obvious abnormal odor and/or showing sliminess
			Time and temperature of storage (portions of opened packages)					
			3 to 4 days at:			7 days at:		
		3° to 4°C	7° to 7.5°C	10° to 11°C	3° to 4°C	7° to 7.5°C		
Bologna	18	<1T to 9M Md. = 56T	<1T to 10M Md. = 300T	<1T to 13M Md. = 360T	<1T to 18M Md. = 5.5M	<1T to 11M Md. = 1M	22T to 70M Md. = 11M	0
Macaroni & Cheese	10	<1T to 19M Md. = 32T	26T to 70M Md. = 770T	2T to 60M Md. = 1.8M	—	22T to 144M Md. = 1.3M	30T to 220M Md. = 2.4M	2
Macaroni & Cheese ^a	11	<1T to 300T Md. = <1T	<1T to 1M Md. = 3T	<1T to 55M Md. = 15T	3T to 90M Md. = 20T	6T to 70M Md. = 10T	5T to 200M Md. = 90T	1
Pickle Loaf ^a	12	<1T to 180T Md. = <1T	<1T to 4M Md. = <1T	<1T to 4.5M Md. = <1T	<1T to 5M Md. = <1T	<1T to 7.5M Md. = <1T	<1T to 21M Md. = 400T	0
Cooked Salami ^a	10	9T to 6.5M Md. = 1.1M	<1T to 16M Md. = 2.3M	21T to 14M Md. = 2.2M	38T to 25M Md. = 3.7M	5T to 33M Md. = 3.0M	60T to 60M Md. = 3.8M	0

^avacuum sealed

TABLE 3—MICROBIAL POPULATIONS OF PACKAGED SLICED LUNCHEON MEATS SOON AFTER PURCHASE, AND AFTER STORING AT 3° TO 11°C FOR 3 TO 7 DAYS (STORE III)

Type of product	Number of packages	Initial counts	Approximate numbers of microorganisms per sq inch of surface area					Total packages having an obvious abnormal odor, and/or showing sliminess
			Time and temperature of storage (portions of opened packages)					
			3 to 4 days at:			7 days at:		
		3° to 4°C	7° to 7.5°C	10° to 11°C	3° to 4°C	7° to 7.5°C		
Bologna	20	<1T to 350T Md. = <1T	<1T to 1M Md. = 4.5T	<1T to 40M Md. = 14.5T	<1T to 80M Md. = 120T	<1T to 60M Md. = 91.5T	<1T to 400M Md. = 4.7M	4
Pickle Loaf	14	<1T to 65M Md. = 61.5T	<1T to 700M Md. = 1.7M	100T to <2B Md. = 5.5M	650T to >2B Md. = 27.5M	12T to >2B Md. = 11M	1.1M to >2B Md. = 240M	6
Cooked Salami	12	<1T to 9M Md. = 240T	<1T to 16M Md. = 1M	7T to 17M Md. = 1.1M	8 to 30M Md. = 9M	<1T to 80M Md. = 6M	1T to 260M Md. = 16.5M	3
Macaroni & Cheese	20	<1T to 19M Md. = 176T	<1T to 350M Md. = 6.8M	2T to 300M Md. = 25M	12T to 1B Md. = 132M	<1T to 2B Md. = 55M	2T to >2B Md. = 450M	6

These findings strengthen our convictions for choosing an incubation temperature of 23°C for plates, so as to culture most psychrophilic organisms and many mesophiles.

ACKNOWLEDGMENT

The author acknowledges the technical assistance of William A. Welty, a student in veterinary medicine, and the advice of Professor D. L. Mackintosh, Department of Animal Husbandry.

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