BREADING CONTRIBUTES TO THE MICROBIAL POPULATIONS OF FROZEN BREADED FISHERY PRODUCTS

By Melvin A. Benarde*

ABSTRACT

IN ORDER TO TEST THE SUGGESTION THAT BREADINGS ARE A MAJOR SOURCE OF BACTERIAL CONTAMINATION IN FROZEN PRECOOKED FISHERY PRODUCTS, BREADINGS WERE OBTAINED FROM THREE SOURCES: THE MANUFACTURER DIRECTLY; RETAIL OUTLETS; AND OFF THE PRODUCTION LINE FROM PROCESSORS OF BREADED FROZEN FOODS.

IT WAS FOUND THAT THE BREADINGS OBTAINED DIRECTLY FROM THE MANUFACTURERS WERE UNIFORMLY LOW IN BACTERIAL NUMBERS. THOSE OBTAINED FROM THE SHELVES OF RETAIL STORES HAD SIMILARLY LOW COUNTS. THE IN-USE SAMPLES, HOWEVER, HAD SIGNIFICANTLY HIGHER TOTAL PLATE AND COLIFORM COUNTS.

APPARENTLY IT IS DURING THE HAND-PROCESSING OPERATIONS IN THE PLANT THAT BREADINGS BECOME CONTAMINATED. THE SUGGESTION THAT BREADING, PER SE, IS A MAJOR SOURCE OF BACTERIAL CONTAMINATION SEEMS UNTENABLE.

BACKGROUND

Frozen precooked fishery products and specialties have found a ready market in the United States. Apparently, these "convenience foods" fit our changing patterns of living since these new foods are replacing, in large part, similar items normally prepared and cooked at home.

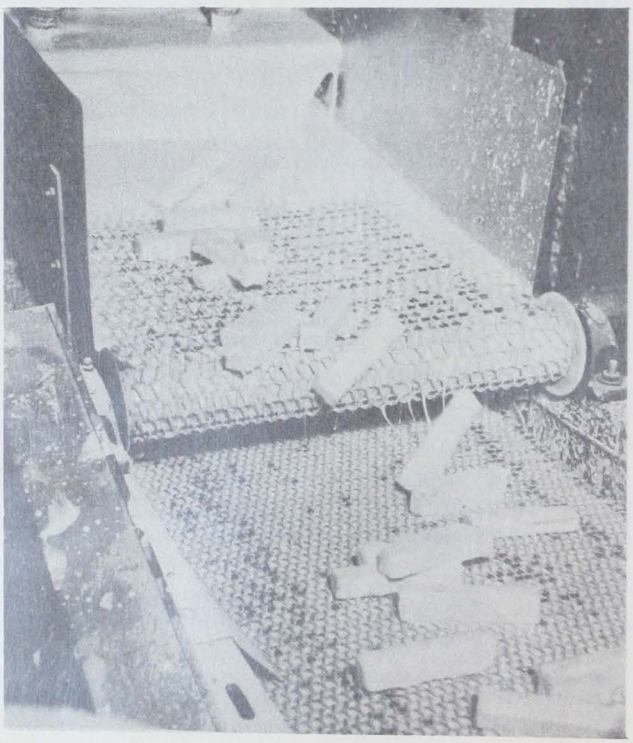


FIG. 1 - IN A PLANT THAT IS MECHANIZED, FISH STICKS ON CONVEYOR BELT GO THROUGH A BATTER PRIOR TO BREADING.

From a bacteriological viewpoint, it is highly possible that commercially-prepared fishery products may suffer from excessive handling, improper storage, and generally unsanitary conditions. Straka and Stokes (1956) have pointed out that "the dangers of excessive microbial contamination in pre-cooked frozen foods are real." Thus, a potential health hazard may be a distinct possibility.

Many of these new products can be called "made-up" dishes; that is, they consist of many ingredients added to the "name" item to enhance its over-all appeal. For example, one such ingredient used extensively in precooked products is breading material. 1/

In order to achieve a crisp toast-like character as well as coating for improved color, breadings of various types are added to fishery products during processing.

It has been suggested (Larkin, Litsky, and Fuller 1956) that these breadings may be a major contributor of bacterial

* SEAFOOD PROCESSING LABORATORY, DEPARTMENT OF ZOOLOGY, UNIVERSITY OF MARYLAND, CRISFIELD, MD.

1/ THE TERM "BREADING" COMMONLY INCLUDES A VARIETY OF PREPARATIONS: BREAD OR CRACKER CRUMBS ALONE; THOSE CONTAINING A HOST OF INGREDIENTS, INCLUDING NONFAT DRY MILK SOLIDS, TOASTED CEREALS, EGGS, AND LEAVENING; AND THOSE CONTAINING SHORTENING, DEXTROSE, MONOSODIUM GLUTAMATE AND MALT EXTRACT, IN ADDITION TO THE OTHERS. DRY BATTER MIXES ALSO HAVE BEEN CALLED BREADING AS THEY CONTAIN MUCH THE SAME FORMULATION AND THEY ARE USED IN MUCH THE SAME WAY AND IN MANY INSTANCES ARE USED IN CONJUNCTION WITH BREAD OR CRACKER CRUMBS.

contamination in precooked frozen fishery products. In order to test this suggestion, breadings were obtained from three sources: directly from the manufacturer; at retail outlets; and from processors of fish and shellfish products as they were being breaded. These samples were subjected to a series of microbial examinations to discover the number and types of contaminating microflora.

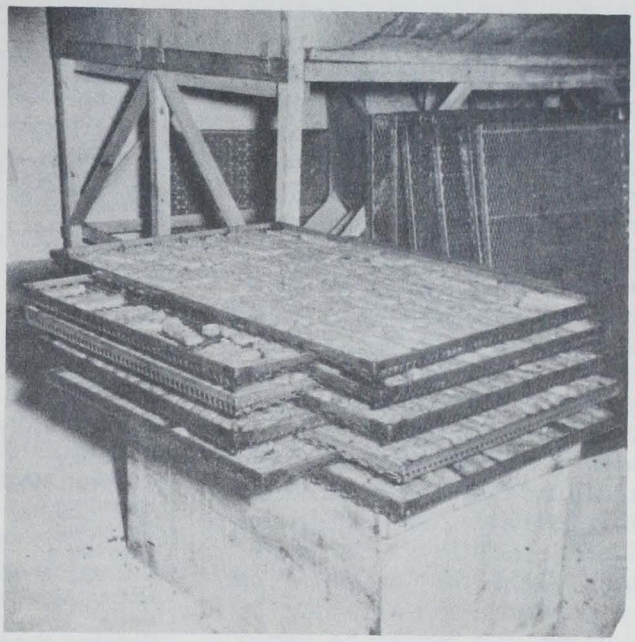


FIG. 2 - COOKED BREADED FISH STICKS READY FOR THE PACKING TABLE IN A PLANT WHERE PROCESSING IS NOT MECHANIZED.

METHOD

Fifty-gram (1.8-oz.) samples of breading were placed in a food blendor containing 450 milliliters of sterile chilled distilled water. After a 3-minute blending period, additional tenfold serial dilutions were made. Triplicate 1 and 0.1 milliliter quantities of the appropriate dilution were placed in or onto suitable media. Nutrient agar 2/ (pH 6.8) was used to determine estimated total bacterial numbers. Levine's EMB 2/, tergitol-7 2/, violet red bile 2/, and desoxycholate agars 2/, incubated at 37° C. for 24 hours were used as streak plates for coliform counts. In addition, 10, 1, and 0.1 milliliter aliquots of the original homogenate were placed in lauryl sulphate broth 2/ to determine the most probable numbers (MPN) of coliforms. Sets of 3 replicate broth tubes were employed. The tubes were allowed to incubate for 48 hours in a water bath maintained at 37° C.

Potato dextrose agar 2/ (pH 3.5) was used for determination of yeast and mold counts. These plates were read after 5 days incubation at 24° C.

Table 1 - Comparison of Total Plate Counts for the Three Groups of Breading Samples

Sample Type	Counts Per Gram		
	Manufacturers'	Retail	Commercial Processors'
Breading	2,900		
Batter Mix	4,000		
Breading	4,500		
Batter Mix	1,250		
Breading	700		
Crumbs	360		
Breading	800		
Batter Mix	1,400		
Batter Mix	1,250		
Breading	1,200		
Crumbs		300	
Breading		600	
Cracker Meal		100	
Breading		1,500	
Cracker Meal		200	
Breading		350	
Breading		300	
Crumbs			6,000
Cracker Meal			7,500
Batter Mix			10,000
Batter Mix			10,000
Cracker Meal			18,000
Batter Mix			19,000
Breading			14,000

Finally, moisture and pH determinations were performed. The air-oven method as described in Official Methods of Analysis (AOAC 8th Ed.) was used. Electrometric determinations of pH were made on slurries of the breading in distilled water.

RESULTS AND DISCUSSION

The counts obtained from 10 manufacturer's samples (representing the 4 largest producers in the country), 7 retail samples, and 7 in-use samples are listed in table 1.

The manufacturer's samples ranged from 360 bacteria per gram for a bread crumb item, to 4,500 per gram for a breading. The retail samples were likewise uniformly low; the highest was one breading containing 1,500 bacteria per gram.

2/ ALL DIFCO PRODUCTS.

The in-use samples, on the other hand, contained many more bacteria than those of either the manufacturer's or retail samples.

It may be noted that the crumb items in each of the three sets had the lowest counts. This may be due to the difference in total nutrients between the plain crumbs, and breadings and batters. Since bread crumbs are made from crumbled bread which is toasted, they contain all nutrients normally found in bread; but toasting may seal off these nutrients and make them unavailable to bacteria. On the other hand, breadings and batters consist of such ingredients as egg and milk solids, malt extract, leavening, and maybe other ingredients in such a form that they are readily available to bacteria. In addition, the moisture content of the crumb, approximately 4 percent, was significantly lower than the 9-11 percent 3/ found for batter and breading. Finally, pH 4/ values of 5.3-5.6 for crumbs, as against 6.1-6.5 for batters were obtained. All three factors, ingredients in a form readily available to bacteria, higher moisture content, and hydrogen-ion activity may actually serve to increase bacterial proliferation. The in-use samples were obtained from open cans, sacks, and pots as they were being applied to the fish and shellfish products in the plants. Samples 3-7 of this group were obtained from a plant where processing operations were entirely manual and in which the women continually handled the product.

Table 2 - Comparison of Mold and Yeast Counts from Breaded Material

Sample Type	Manufacturers'		Retail		Commercial Processors'	
	Mold	Yeast	Mold	Yeast	Mold	Yeast
	(Colonies Per Plate)					
Breading	1	0				
Batter Mix	2	0				
Breading	2	0				
Batter Mix	2	0				
Breading	1	0				
Crumbs	2	0				
Breading	3	0				
Batter Mix	2	0				
Batter Mix	2	0				
Breading	2	0				
Crumbs			1	0		
Breading			2	1		
Cracker Meal			1	0		
Breading			3	0		
Cracker Meal			1	0		
Breading			2	1		
Breading			1	1		
Crumbs					10	4
Cracker Meal					7	6
Batter Mix					4	3
Batter Mix					13	6
Cracker Meal					7	3
Batter Mix					6	3
Breading					9	5

Table 3 - Comparison of MPN Values and Plate Counts for Coliform Bacteria from Breading Material

Sample Type	MPN/100 gm. LTB	TERG-7	VRBA	EMB	DA
	(Colonies Per Plate)				
	Manufacturers'				
Breading	230	15	0	3	
Batter	0	0	0	1	
Breading	0	0	0	1	
Batter	920	4	0	0	
Breading	0	0	0	0	
Crumbs	0	0	0	0	
Breading	0	0	0	0	
Batter	43	13	0	3	
Batter	0	0	0	0	
Breading	0	0	0	0	
	Retail				
Crumbs	30	3	0	0	0
Breading	91	3	0	0	0
Cracker Meal	0	0	0	0	0
Breading	0	0	0	0	0
Cracker Meal	0	0	0	0	0
Breading	0	0	0	0	0
Breading	0	0	0	0	0
	In-Use				
Crumbs	30	3	0	0	0
Cracker Meal	200	12	6	2	3
Batter	2,500	20	1	6	0
Batter	150	2	0	0	0
Cracker Meal	90	1	0	0	0
Batter	90	8	0	0	0
Breading	250	10	2	6	3

In addition to higher total plate counts, the in-use samples had higher mold and yeast counts as noted in table 2.

The asporogenic pink and orange pigmented yeasts found were probably the ubiquitous Rhodotorula. The molds were predominantly Aspergillus and Penicillium. These yeasts and molds may have sanitary but little public health significance. The greater number of molds found in the in-use samples points up the normally moist condition present in the processing plant--which is favorable to growth mold.

The coliform count, on the other hand, has a greater bearing on the general sanitary as well as health aspects of food processing.

3/DETERMINED BY AIR-OVEN METHOD AS DESCRIBED IN 8TH ED. OF OFFICIAL METHODS OF THE A.O.A.C.
4/BREADING IN WATER SLURRIES DETERMINED BY ELECTROMETRIC METHOD.

Normally, coliform bacteria could have been satisfactorily determined by the most probable number (MPN) procedure alone. However, as we have been interested in obtaining a relatively rapid and economical plate test for coliform density determinations in fishery products, four selective media were employed in addition to replicate lauryl sulphate broth tubes. These four media represent an attempt to obtain a complete picture of the organisms of intestinal origin should they be present in breadings. The data obtained with all coliform media are listed in table 3.

Three manufacturers' samples had gas-positive tubes. Further testing, however, indicated their nonfecal nature. They proved to be type II intermediates. This was also the case with the two retail samples.

Sample 1 of the in-use group, contained a nonfecal contaminant but samples 2-7 proved to be fecal types.

These findings coupled with visual inspection may allow the presumption that such contamination occurs from within the plant.

It may be seen that tergitol-7 agar gave consistently better results than the others. Colonies were present on this agar consistent with the presumptive-positive lauryl sulphate tubes. However, addition of triphenyltetrazolium chloride is necessary in order to distinguish colonies from breading particles. Tergitol-7 contains the indicator brom thymol blue which is yellow below pH 6 and blue above. Both breading and colonies assume these colors according to their particular characteristics. When the tetrazole is added, the coliform colonies are an easily distinguishable dark red.

Because of the dry nature of the breading samples from the three sources they were examined for spore-forming organisms.

Five-milliliter amounts of the original 1:10 dilutions were heated for 20 minutes at 80° C. At that time pour-and-streak plates were made using nutrient agar, blood agar, and Brewers anaerobic agar. The nutrient agar plates were incubated aerobically at 36° C. for 72 hours. Blood agar plates were incubated aerobically and anaerobically (spray method) at 36° C. for 72 hours and the Brewer anaerobic agar by similar procedure.

The aerobic plates showed a range of colonies, 100-1,400 per gram, somewhat similar to the total plate counts of the manufacturer and retail samples.

Anaerobic incubation produced approximately 40 colonies per gram from batter mix. Crumbs and breading were negative. Staining revealed Gram positive rods characteristic of the genus Bacillus. Similarly with aerobic incubation, staining revealed Gram positive rods of the Bacillus type.

When one considers breading manufacture, it is not surprising that the product is low in microbial numbers. After the dough passes from an automatic mixer to stainless steel belts moving through gas-fired ovens maintained at approximately 475° F., it emerges at about 212° F., to be run through a mechanical breaker. It is then fed into bins, that are cooled by filtered air pulverized to size, and automatically bagged and sealed. This is a generalized version of the individual modifications normally practiced. The intense heat destroys the bacteria and the highly sanitary processing operations minimize reinoculation.

SUMMARY AND CONCLUSIONS

1. Samples of breadings from three sources were tested for bacterial density: from the manufacturer directly; from retail stores; and in-use samples from processing plants.

2. Breadings as received from the manufacturer do not appear to harbor large bacterial propulations.

3. Indications are that breadings contribute bacterial contamination to precooked frozen fishery products after the breadings have been contaminated by the handlers during processing.

4. The precooking process destroys, to a great extent, the bacteria which contaminate the breading during processing. The tests on the microbial populations of the retail samples show these populations to be uniformly very low.

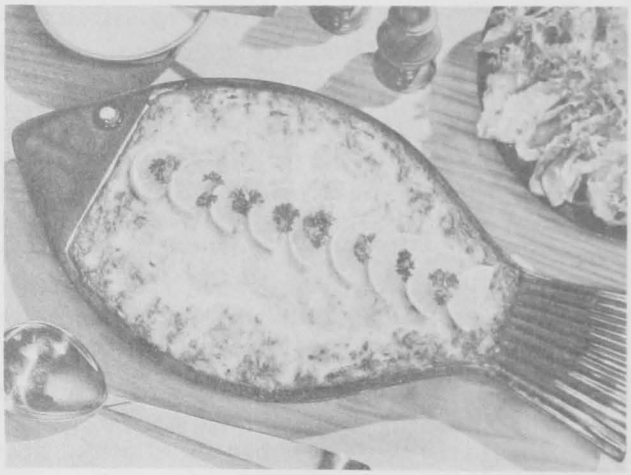
BIBLIOGRAPHY

STRAKA, R. P. AND STOKES, J. L.
1956. MICROBIOLOGICAL HAZARDS OF PRECOOKED FROZEN FOODS. QUICK FROZEN FOODS, VOL. 18, PP. 182-185.

LARKIN, E. P.; LITSKY, W.; AND FULLER, J. F.
1956. INCIDENCE OF FECAL STREPTOCOCCI AND COLIFORM BACTERIA IN FROZEN FISH PRODUCTS. AMERICAN JOURNAL OF PUBLIC HEALTH, VOL. 46, PP. 464-468.

A QUICK CASSEROLE

The busy homemaker will welcome some time-saving meals that will appeal to all members of the family. A good cold-weather meal is a casserole which contains canned Maine sardines, cheese, and cooked potatoes. It is nourishing, palatable, attractive, as well as time-saving.



The Maine sardine is a small silvery fish called the sea herring. It is found in the cool waters off the Northeastern coast of the United States, the bulk of the catch being off the coast of Maine.

Maine sardines are usually packed in vegetable oil. They are also packed in olive oil, mustard sauce, tomato sauce, and several specialty packs. They are excellent sources of proteins and some of the essential vitamins and minerals.

The home economists of the U. S. Bureau of Commercial Fisheries suggest that you serve "Maine Sardines and Potatoes au Gratin," a quick casserole for busy days.

MAINE SARDINES AND POTATOES AU GRATIN

- 2 CANS ($3\frac{1}{4}$ OUNCES EACH) MAINE SARDINES
- 2 TABLESPOONS CHOPPED ONION
- 2 TABLESPOONS BUTTER OR OTHER FAT, MELTED
- 2 TABLESPOONS FLOUR
- $1\frac{1}{2}$ TEASPOONS SALT
- $\frac{1}{4}$ DASH PEPPER
- 2 CUPS MILK
- 1 CUP GRATED CHEESE
- 2 TEASPOONS WORCESTERSHIRE SAUCE
- $1\frac{1}{4}$ QUARTS SLICED COOKED POTATOES

Drain sardines. Reserve 6 sardines for top. Cook onion in butter until tender. Blend in flour and seasonings. Add milk gradually and cook until thick, stirring constantly. Add cheese and Worcestershire sauce. Arrange half of the potatoes, the sardines, and the remaining potatoes, in layers in a well-greased 2-quart casserole. Cover with the cheese sauce. Bake in a moderate oven, 350° F., for 15 minutes. Garnish with the 6 sardines and continue baking for 15 minutes. Serves 6.