ACCURACY OF THE OFFICIAL METHOD FOR DETERMINING BREADING PERCENTAGES OF FROZEN RAW BREADED SHRIMP

By Mary E. Ambrose* and Charles F. Lee**

ABSTRACT

The accuracy of the method provided in the U. S. Standards for Grades of Frozen Raw Breaded Shrimp for determining breading percentage was tested by preparing, freezing, and debreading samples of known breading content. The varying conditions normal to commercial practice were simulated by preparing samples, using combinations of 3 types of batters and breaders, 3 species of shrimp, 2 methods of holding prior to breading, and holding some samples in frozen storage. Storage samples were debreaded after 2, 4, and 6 months. The effects of operator differences and levels of breading were also studied.

The data on apparent change in breading content from 355 samples were statistically analyzed. It was found that iced or frozen storage of the shrimp prior to breading did not affect debreading behavior significantly. There were small but significant differences in apparent change of breading content, owing to species and batter variations. The average apparent change in breading content for this series of samples was -0.57 percent, and the statistical limit for inclusion of 95 percent of the samples was 1.74 percent. The corresponding values for another series of samples prepared to test another commercial line of breaders and batters were considerably lower than these.

On the basis of these data, it is recommended that the correction factor used in the calculation of shrimp material be changed to 2 percent. There were small variations in apparent change in breading content due to frozen storage, different operators, or levels of breading, but they were not sufficient to affect the recommended correction factor.

INTRODUCTION

The voluntary Standards for Grades of Frozen Raw Breaded Shrimp (U. S. Department of the Interior, 1958) provides that the product contain not less than 50 percent by weight of shrimp material. To permit objective determination of compliance with the Standards, the staff of the Technological Laboratory at College Park, Md., developed a method of analysis for percent of shrimp in the product.

Inasmuch as all analytical methods have some degree of variability, a tentative correction factor of 5 percent has been used in the calculation of the percent of shrimp in determining compliance with the Standards. Owing to a lack of data on all the many variables involved, this correction factor was made somewhat large in order not to penalize the producer for uncertainties in the method of analysis. It is desirable, however, to make the correction factor as small as the accuracy of the method will permit, to ensure uniformity of product.

The purpose, therefore, of the work reported here was to determine the accuracy of the method under the many variable conditions encountered in the production of fro-

Fig. 1 - This is the debreading machine that is in most general use by shrimp-breading plants. The geared shafts on each side of the center shaft permit the use of double brushes but these are less effective for removal of breading than the paddle.

*Chemist
**Chemical Engineer } Technological Laboratory, U. S. Bureau of Commercial Fisheries, College Park, Md.

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zen raw breaded shrimp in order to make a recommendation as to the magnitude of a revised correction factor.

EXPERIMENTAL

This study consisted of preparing frozen raw breaded shrimp of known breading content and then analyzing the product by the official method for determining breading content. The difference between the known content of breading and the analytically determined content gave a measure of the accuracy of the analytical method.

PREPARATION OF SAMPLES: In the preparation of a sample of known breading content, 20 peeled, deveined, and split shrimp, with tailfins attached, were weighed, the shrimp were battered and breaded by hand, the breaded sample was weighed, and the percent of breading actually applied was calculated. The samples were packed in waxed cartons, overwrapped with moisture-vapor-proof cellophane, and frozen by being placed in single layers on a shelf of a still-air freezer at 0° F. for at least 24 hours.

Breading percentages ranged from 23 to 54, most samples being in the range of 35 to 45 percent.

ANALYSIS FOR BREADING PERCENTAGE: The breaded samples were reweighed when removed from the freezer to make certain that the loss of moisture during freezing was negligible. The shrimp were then debreaded by the official method in the Standards for Grade of Frozen Raw Breaded Shrimp (U. S. Department of the Interior, 1958). Samples were analyzed within 2 weeks after being prepared, except those for frozen storage.

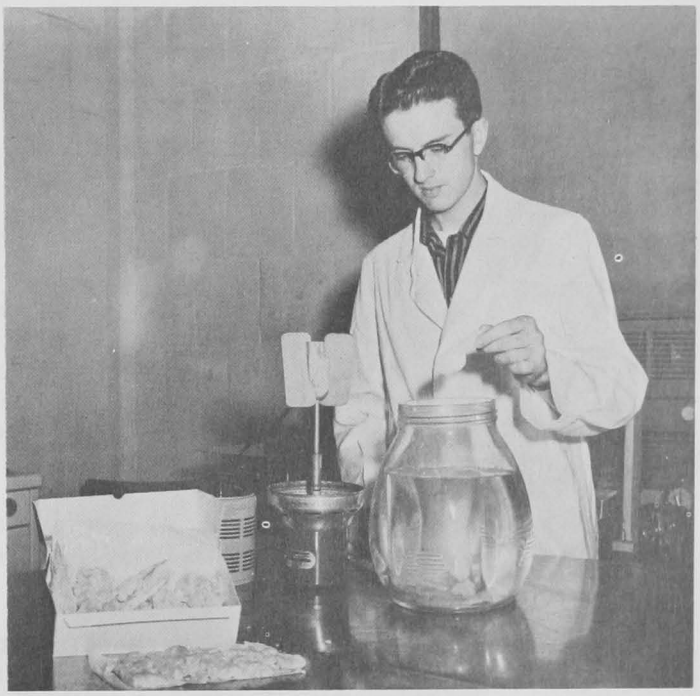

Fig. 2 - The operator is adding a weighed sample of breaded shrimp to an experimental debreader. The principal of paddle agitation was found to give the most efficient removal of all types of breading.

COMMERCIAL VARIABLES TESTED: Samples of known breading content were prepared and analyzed to test the effect of the variable conditions occurring normally in the commercial manufacturing process. The commercial variables tested were types of batters and breaders, species of shrimp methods of handling shrimp in the shell--whether iced or frozen, and time the breaded product was held in frozen storage. A flow diagram of the study is given in figure 3.

Types of Batters and Breaders[1/]: The wide variety of batters and breaders used in the industry could not be duplicated in the laboratory. Any effect of batters and breaders on the accuracy of the debreading method, however, would be largely due to the difference in time required to remove the breading. Therefore, the laboratory samples were prepared from a commercial breader that is used in a number of shrimp-breading plants, designated in the tables as breader C, and two batters that were formulated from varying proportions of eggs, milk or water, and breader C to give the extremes of debreading behavior. The batter A combination was removed with difficulty and sometimes imcompletely, but the batter B combination was removed easily. These two batters were used throughout the experiment to test the effects of the other commercial variables.

1/ "Batter" signifies dry batter mix, eggs and water or milk.
"Breader" signifies dry commercial mix for breading.
"Breading" or "breading content" signifies the entire coating, both batter and breader.

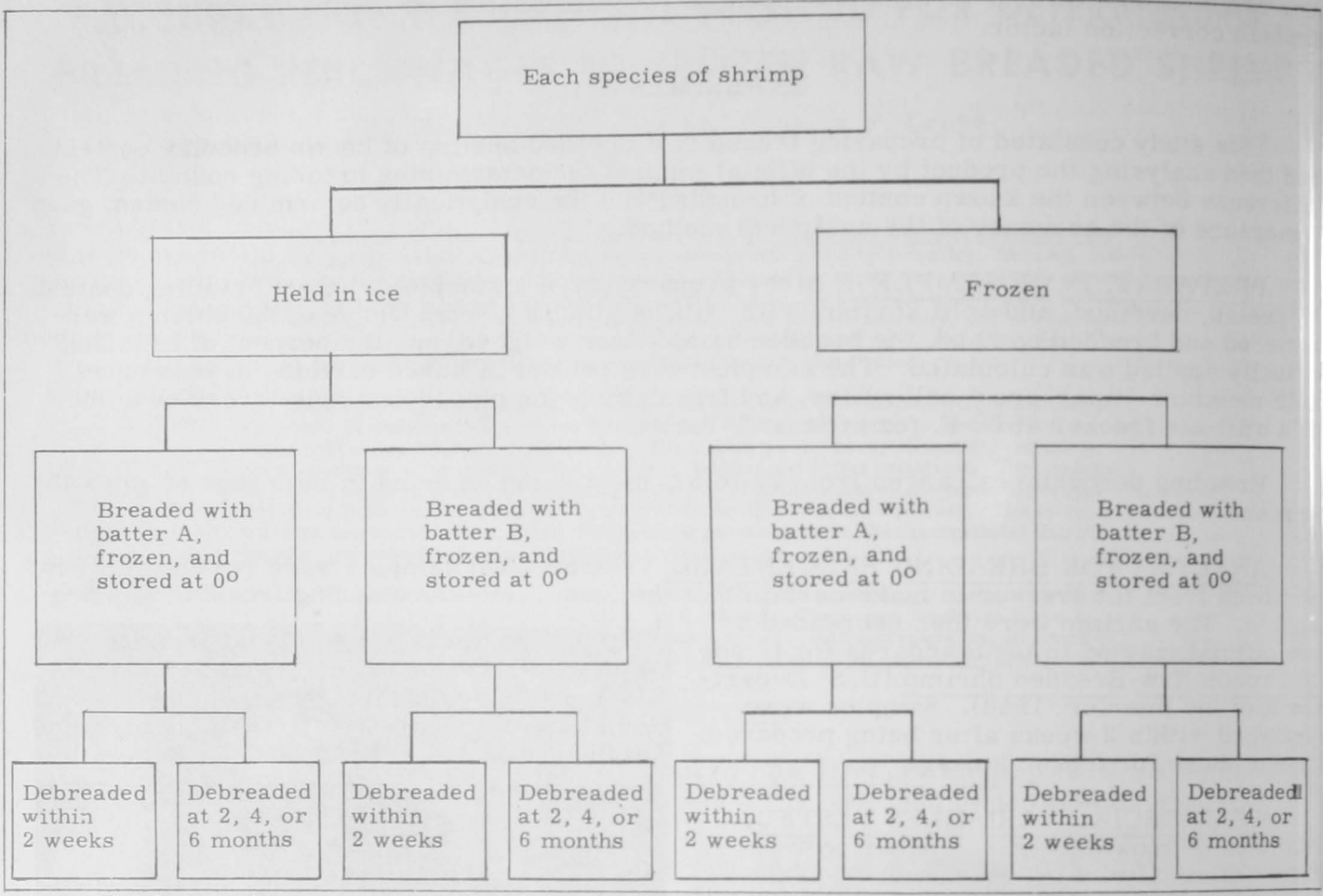

Fig. 3 - Flow diagram of treatment of samples breaded with breader C for study of commercial processing variables.

Another series of samples was prepared to test a variety of batters and breaders obtained from another large commercial producer. These batters and breaders have been given the designation D. Some of the dry mixes were intended for use as both batter and breader and therefore are designated by the same number.

Species of Shrimp: Producers of breaded shrimp use any of the commercial varieties of shrimp that are of a proper size for breading. Samples utilized in this study were prepared from the following species of shrimp:

1. Brown shrimp (Penaeus aztecus) from the Gulf of Mexico (various ports).
2. Pink shrimp (Penaeus duorarum) from the Gulf of Campeche (Tampa) and Tortugas grounds (Key West).
3. White shrimp (Penaeus setiferus) from South Atlantic (Georgia).
4. "White" shrimp from Pamlico Sound (North Carolina). These shrimp were the color of the usual white shrimp, P. setiferus, and were purchased for white shrimp but were grooved, which is characteristic of brown and pink shrimp.

All brown iced shrimp were obtained from Brownsville and Tampa, and some of these were frozen in the shell. Some frozen brown shrimp were obtained locally, with no knowledge of the location of the packer except that they were produced in the United States. The data from samples prepared from these various lots of frozen brown shrimp were found to show no significant differences when analyzed statistically, so these data were combined.

The two lots of pink shrimp were handled separately, owing to the known wide separation in fishing grounds and the unusual data obtained from the samples prepared from pink shrimp from the Dry Tortugas grounds.

The Pamlico Sound shrimp were all obtained from one producer over a 3-month period during one season. Variations in debreading behavior were small from lot to lot, so these data were combined.

Brown iced shrimp from Brownsville, Texas, were used to prepare the samples to test D batters and breaders. Control samples were prepared from batter A and breader C, as previously used.

Previous Handling of Shrimp: Almost all producers of breaded shrimp are located near shrimp-producing waters and use locally-caught shrimp when available. In off-seasons, they must rely on shrimp frozen in the shell either from their own storage or from other sources, including an increasing quantity of imports from other countries. The experimental lots of shrimp of each species were divided into two parts. One-half was shipped and held in crushed ice until breaded. The other half was frozen in the shell either before shipping or after arrival at the laboratory. After at least 5 days in frozen storage, these shrimp were thawed and breaded. Thus 2 series of samples were obtained from each species to correspond to the 2 holding conditions encountered in industry for the raw material.

Storage Studies: In addition to the debreading of samples immediately after they were frozen, samples were stored at 0° F. to determine the effect of frozen storage on the accuracy of the debreading process. Samples were debreaded after intervals from 2 to 6 months in 0° F. storage.

OPERATOR VARIANCE: The actual debreading process is mechanical and permits little variation between operators. After agitation, however, the shrimp are individually rinsed under a spray of water to remove loose particles of breading. A flick of the thumbnail is sometimes necessary to aid the spray of water to dislodge large areas of remaining breading. Although care is taken not to exert pressure of the fingers on the shrimp flesh, it is possible that different operators would obtain different results. The data were regrouped by debreading operators to determine if operator variance was significant. The debreading data from five operators were studied. Two of the operators were inexperienced.

VARIANCE DUE TO BREADING LEVEL: The debreading data were regrouped by breading levels, in ranges of 5 percent breading applied, from 30.1-35.0 percent to 45.1-50.0 percent. The purpose was to determine if the level of breading applied to the shrimp affected the accuracy of the debreading method.

Fig. 4 - The debreaded shrimp are drained on an inclined screen. The operator is picking particles of shrimp meat from the removed material, this operation is not normally required as the amounts of separated flesh rarely is enough to weigh on a gram scale.

RESULTS AND DISCUSSION

COMMERCIAL VARIABLES TESTED: Species, Batter, and Handling Condition: A total of 355 samples were prepared from batters A and B and breader C and were analyzed within 2 weeks. The effect of frozen storage will be considered separately. The number of samples for each combination of species, batter, and handling condition varied from 8 to 49. These data were subjected to statistical analysis. Significant differences were found for variations in species and batter but not for the previous handling of the shrimp. The data therefore were combined for the samples prepared from iced and frozen shrimp of each species and batter. The data for the testing of commercial variables except storage are presented in table 1.

Table 1 - Apparent Change in Breading Content with Variations of Species of Shrimp and Batters

Shrimp Used			Batter[2]	Number of Samples	Apparent Change in Breading Content[1]			
Species	Location of Catch	Number of Lots			Range	Mean	Standard Deviation[3]	Statistical Limit for Inclusion of 95 Percent of Samples
					(Percent)			
Brown	Gulf of Mexico	5	A	50	-3.6 to 2.8	-0.40	1.49	2.0
			B	32	-3.0 to 3.2	-0.15	1.33	2.0
Pink	Campeche	2	A	58	-4.4 to 1.4	-0.96	1.43	1.4
			B	59	-4.3 to 2.0	-0.96	1.41	1.4
Pink	Dry Tortugas	1	A	20	-3.3 to 4.5	-0.38	2.18	3.2
			B	21	-3.7 to 0.7	-2.10	0.81	-0.8
White	Georgia Coast	1	A	16	-0.6 to 3.0	1.06	1.23	3.1
			B	16	-3.6 to 1.1	-0.98	1.49	1.5
"White" grooved	Pamlico Sound	5	A	52	-4.6 to 3.3	-0.43	1.55	2.0
			B	31	-1.5 to 2.6	0.26	0.95	1.8
Total		14		355	-4.6 to 4.5	-0.57	1.41	1.74

1/Percent breading by analysis minus percent breading applied.
2/Batter A prepared from eggs, milk, and commercial breader C.
Batter B prepared from eggs, water, and commercial breader C.
3/Deviation from the arithmetic mean of the apparent changes.

The values obtained for individual samples for apparent changes in breading content we both positive and negative for most groups of samples. All but two of the mean values wer negative. The range or variation, however, was greater for some groups of samples than f others, as is shown by the values for the standard deviations.

Several groups of samples exhibited unusual apparent changes in breading content. Th mean values for Dry Tortugas pink shrimp batter B samples and the Georgia Coast white shrimp batter A samples showed unusually large deviations from the mean value for all sa ples. Also the Dry Tortugas pink shrimp batter A samples gave a very wide range for ap- parent changes in breading content, resulting in a high standard deviation. These samples were prepared from only one lot of shrimp of each species and were therefore the smalles groups of samples analyzed. It is quite possible that further sampling of these species wo u result in values for the means and standard deviations more nearly approaching those for t whole series of samples.

These data indicate that the tentative correction factor of 5 percent is too large. A co rection factor large enough to include 95 percent of the samples analyzed would properly protect the producer and ensure to the consumer a better and more uniform product at any stated level of breading. The apparent change in breading content which includes 95 perce of each group of samples is given in the last column of table 1. For the total number of sa ples the value is 1.74 percent, and of the groups of samples, only 2 small groups exceed 2 percent. It is therefore recommended that the correction factor be changed from 5 percen to 2 percent.

Table 2 - Apparent Change in Breading Content with Various Combinations of D[1] Batters and Breaders Applied to Iced Brown Shrim

Batter[2]	Breader[3]	Apparent Change in Breading Content[4]			
		Range	Mean[5]	Standard Deviation[6]	Statistical Limit for Inclusion of 95 Percent of Samples
		Percent	Percent	Percent	Percent
1	7	-5.4 to 0.9	-2.15	1.64	0.53
2	8	-3.7 to 0.4	-1.45	1.40	0.84
3	8	-3.0 to 1.6	-1.04	1.42	1.28
4	8	-4.3 to -1.2	-2.43	0.96	-0.86
5	5	-6.5 to -2.1	-3.56	1.40	-1.27
6	6	-5.2 to -0.5	-3.11	1.47	-0.70
A[7]	C[8]	-2.5 to 2.8	0.45	1.28	1.64

1/Commercial line of batters and breaders.
2/Dry commercial mixes with water.
3/Dry commercial mixes, some also used for batter preparation.
4/Percent by breading analysis minus percent breading applied.
5/Average of 10 samples.
6/Deviation from arithmetic mean of the apparent changes.
7/Control--eggs, milk, and breader C.
8/Control--commercial breader C.

Table 2 gives the data for the 60 samples prepared from D batters and breaders. Without exception the mean values were negative, and the statistical values for apparent change in breading content that include 95 percent of the samples were all well below the suggested 2 percent.

Storage Studies: A total of 183 samples were stored for periods up to 6 months. For each group of a certain species and batter, the apparent change in breading content varied somewhat from that of the respective samples not subjected to frozen storage. There was no trend in the changes with increasing storage time, and the magnitude of the changes did not affect the recommended 2 percent correction factor.

OPERATOR VARIANCE: There were very slight variations due to operators, but the effect of even the inexperienced operators was not sufficient to affect the recommended correction factor.

VARIANCE DUE TO BREADING LEVEL: When the data were regrouped by breading levels, the apparent changes of breading content were of the same general magnitude and showed no significant differences.

SUMMARY AND CONCLUSIONS

The apparent change in breading content was studied on 355 samples of breaded shrimp prepared from a commercial breader, designated as C, and from different species of shrimp and batters, and with different holding conditions (iced or frozen) of shrimp in the shell. The difference between the actual breading applied and the breading content by analysis was taken as a measure of the accuracy of the method. No significant differences were found for the different holding conditions of the shrimp in the shell. There were differences due to variations in batter and species of shrimp. However, the statistical limit for inclusion of 95 percent of the samples for all combinations of species and batters supports the recommendation for a 2 percent correction factor for breading percentage.

Another series of samples was prepared and analyzed for breading content, using commercial batters and breaders from another manufacturer, designated as D. The apparent changes in breading content for these samples varied significantly from control samples but in such a direction that they are all well below the suggested 2 percent correction factor.

A total of 165 samples were stored at 0° F. for periods up to 6 months duration. Differences were found for storage samples of some species and batters compared to the respective samples debreaded soon after being frozen, but there was no trend in the differences with increased storage time. No differences due to storage were sufficiently large to preclude the use of the suggested 2-percent correction factor.

The data from the major series of 355 samples were regrouped by debreading operators and then again by breading levels. Only minor differences were apparent for either of these two factors.