STUDIES ON THE PREPARATION OF SALTED FISH PASTE (BAGOONG) FROM DRIED DILIS (STOLEPHORUS INDICUS)[1]

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INTRODUCTION

Of the principal commercial species in the Philippines the anchovies are the most widely exploited. This is due to their wide range of distribution in the territorial waters of the archipelago at different seasons of the year. Consequently, it is a common all-year-round food fish which is consumed fresh as well as dried and salted.

Eight species of anchovies are reported found in the Philippines (Roxas, 1934). Of these only two are important, the long-jawed anchovy, *Stolephorus commersonii*, and the Indian anchovy, *S. indicus* (Manacop, 1952). The principal fishing areas extend from the northern to the southern part of the Philippines. These are the waters of Cagayan Province, Manila Bay, Balayan Bay, Batangas Bay, Sorsogon Bay, Samar Sea, Maqueda Bay, those around Coron and Busuanga Islands, Melgar Bay, and those off northern Surigao Province, Margosatubig and southern Zamboanga. The fishing seasons vary according to areas and the life stages of the fish, but fishing is done throughout the year.

The annual catch of anchovies reported by commercial fishing vessels in 1951 is 9,101,358 kilos, or more than 9,000 tons. In fishing centers where they are landed in commercial quantities they are either dried or salted into fish paste (*bagoong*).

Fresh *dilis* are generally sun-dried for three days (Avery, 1950) without the addition of salt. Because of the high protein

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and mineral contents of this fish, the people, especially the common masses, are using it extensively as a main dish, alone or mixed with vegetables. The light weight of dried dilis makes it easy to transport from remote fishing villages to cities and towns where further processing can be conveniently carried out.

The purpose of this study was to explore the possibilities of using dried dilis as raw material for the preparation of secondary fishery products such as salted fish paste and fish sauce.

MATERIALS AND METHODS

Materials.—(*a*) Dried dilis of the species *Stolephorus indicus.* (*b*) The coarse Manila solar salt. The percentage of impurities, particularly of calcium and magnesium salts, is rather high in this salt.

Freshening.—Several proportions were tried to determine the optimum amount of water needed to work up the dried dilis to the fresh state. The following proportions were tried:

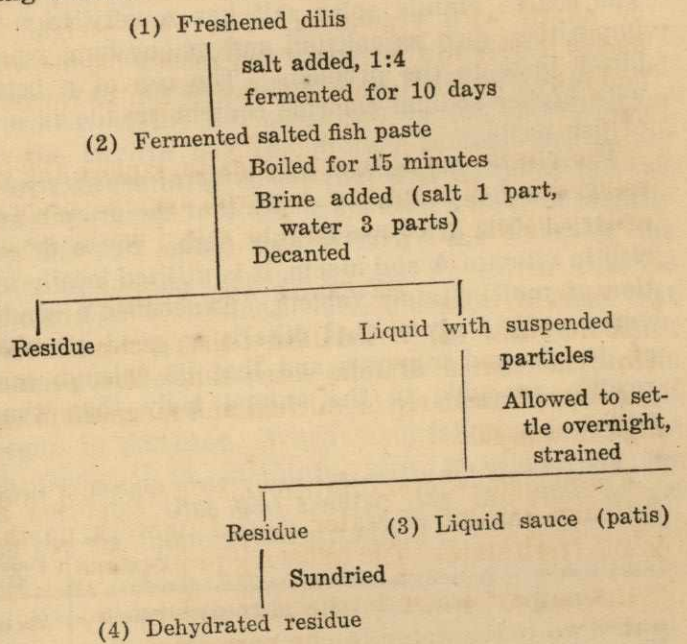
1. One part water to one part dried dilis.
2. Two parts water to one part dried dilis.
3. Three parts water to one part dried dilis.
4. Four parts water to one part dried dilis.

The above mixtures were set aside. After 24 hours the corresponding amounts of salt were added to give a final proportion of one part salt to four parts freshened fish. The mixtures were then allowed to ferment at temperatures ranging from 37° to 45° C.

Chemical analysis.—The proximate chemical composition and sodium chloride content of the dried dilis and of the following experimental batches were determined:

1. Freshened dilis.
2. Salted fish paste (bagoong).
3. Residue after removal of the surface liquid (fish sauce or *patis*).
4. Residue after addition of concentrated brine solution to replace the surface liquid (fish sauce) that was removed.
5. Fish sauce during the period of fermentation.

6. Analysis of the different intermediate products as shown in the following schematic diagram:



Bacterial plate count determinations.—Periodic bacterial counts were determined of the bagoong samples during the process of fermentation. After allowing the preparations to ferment for twelve days the bagoong was removed from the incubator and stored at room temperature. Periodic bacterial counts per gram of the samples were also determined during storage.

RESULTS AND DISCUSSION

The manufacture of salted fish paste (bagoong) is a fermentation process wherein the proteolytic enzymes convert the fish protein into soluble amino-acids. In the process the sodium salt of glutamic acid (sodium glutamate) is produced (Harrow, 1947). This compound and the other salts of amino-acids produced in the fermentation may be responsible for the characteristic odor and flavor of the finished products. Hamm and Clague (1950) and Sulit (1949) recommend the utilization of a high-grade salt to improve the bagoong. At the same time, Hamm claims that the enzymes inherently present in the fish may be responsible for the proteolytic conversion of fish proteins

to amino-acids. But other enzymes elaborated by the bacteria may aid also in the splitting of the proteins to amino-acids. The coarse Manila solar salt has a very high percentage of impurities, such as calcium and magnesium, which impart the bitter taste to the products. The use of a better grade salt with higher sodium chloride content results in a better quality of fish paste.

Proximate composition and mineral constituents of dried and freshened dilis.—Table 1 shows that the protein and ash content of dried dilis are considerably high. Since dried dilis is also rich in vitamin A and niacin, it is utilized locally in the preparation of multi-vitamin tablets. Experiments conducted by Navarro (1950) reveal that dilis is as good as milk as a source of protein and minerals and that its calcium content is more readily available to the animal body than that present in milk.

TABLE 1.—*The moisture, ash and protein content of dried, freshened and fresh dilis.*

	Dried dilis	Freshened dilis	Fresh dilis
	Per cent	*Per cent*	*Per cent*
Moisture	19.55	69.79	73.71
Ash	10.79	3.86	3.60
Protein (N x 6.25)	64.08	26.40	19.49

TABLE 2.—*Showing the correct amounts of water added to freshen the dried dilis.*

Water	Dried dilis	Salt	Remarks
gm.	*gm.*	*gm.*	
500	500	250	Too dry, water not enough.
1,000	500	375	Slightly dry.
1,500	500	500	Fish approaches almost its fresh state.
2,000	500	625	Water is too much.

Before the dried dilis could be used for bagoong making, it was necessary to freshen it to approach its fresh state. In this respect, as Table 2 shows, the best proportion of dried dilis to water was found to be 1:3. After soaking for 24 hours the appearance of the freshened dilis was almost the same as that of the fresh form. Table 1 further shows that freshened dried dilis approaches the proximate chemical composition of fresh dilis (Sulit et al., 1952). A good dried dilis when freshened with water does not have the strong fishy odor characteristic of the fresh dilis. In this respect its utilization for bagoong

making may be considered an advantage over that of fresh dilis. On the other hand, the finished product acquires characteristic cheeselike odor and flavor.

Periodic protein determination of the fish sauce in the fermenting of bagoong.—Table 3 shows that there was a gradual increase of protein in the fish sauce during the fermentation process. On the twelfth day the protein content was at its maximum. At this state the consistency and flavor of the fish paste were most desirable. At the same time a layer of slightly turbid liquid, the fish sauce, formed above the solids of the mixture. This liquid was siphoned off and its sodium chloride and protein contents determined. The analysis revealed that the protein content was 11.53 per cent which was still much higher than the government specification of 6 per cent protein for fish sauce. After the twelfth day, the protein content of the patis began to decrease. When artificial heat is used in making fish paste, it is, therefore, wise to siphon off the clear liquid not later than the twelfth day in order to get patis having the maximum protein content.

TABLE 3.—*Periodic determination of protein content of the fish sauce (patis) taken from fermenting salted fish paste (bagoong).*

Number of days	Moisture	Protein (N x 6.25)
	Per cent	*Per cent*
3	92.26	2.52
6	77.50	6.65
9	74.41	7.74
12	71.11	8.98
15	64.76	11.53
18	64.66	11.33
21	64.23	10.95
	63.72	10.27

Table 4 shows that the amount of protein in the residue after removing a portion of the patis was 20.68 per cent. Concentrated brine to equal approximately the amount of the patis removed was added to the residue. The protein content of the final mixture was found to be 15.07 per cent, which was still higher than the government specification of 12.5 per cent protein for salted fish paste. The same table further shows the protein and sodium chloride contents of the dehydrated bagoong residue which were 35.85 per cent and 47.33 per cent, respectively. A little amount of water added to the dehydrated bagoong residue restored it to the consistency of salted fish paste. The powder

itself serves as condiment or flavoring material for vegetable preparations.

TABLE 4.—*Showing the percentages of salt and protein, and alkalinity of the various portions of salted fish paste (bagoong).*

Various portions of bagoong	Protein (N x 6.25)	Sodium chloride	Alkalinity
	Per cent	*Per cent*	ml. acid
Salted fish paste (bagoong)	17.34	23.61	0.050
Residue, less fish sauce	20.68	26.29	0.075
Residue, dried	35.85	47.33	0.038
Residue, plus concentrated brine	15.07	23.53	0.038
Fish sauce (patis)	8.69	21.68	0.042

Bacterial plate counts of bagoong.—During fermentation and storage of the bagoong the bacterial count was found to be very high during the first 24 hours. The counts decreased slowly during the succeeding days. The high bacterial count may be due to favorable conditions of increased moisture and temperature. The decrease in bacterial count did not, however, affect the production of the characteristic flavor and odor of a good fish paste. This might have been due to the continued proteolytic actions of the enzymes originally present in the material and those elaborated by the bacteria. Table 5 clearly indicates that the minimum bacterial count was obtained during storage. At this stage, the characteristic flavor was still detectable. The result would seem to indicate that the enzymes continued their proteolytic action by splitting the proteins to soluble amino-acids.

TABLE 5.—*Bacterial plate count of bagoong during fermentation and storage.*[a]

Number of hours	Total bacteria per gram of sample
During fermentation—	
24	12,040,000
72	1,220,000
120	180,000
192	75,000
288	3,600
During storage—	
384	6,900
456	6,980
720	3,300
840	3,040
1,248	1,550
1,584	1,150

[a] Determined by the Microbiology Section, Division of Fisheries Technology, Bureau of Fisheries, Manila.

SUMMARY

1. Dried dilis (*Stolephorus indicus*) was freshened and used as the material for the preparation of salted fish paste.

2. Different amounts of water were added to several batches of dried dilis to obtain the right amount for freshening.

3. Salt was added to each batch of dilis freshened for 24 hours in the proportion of 1 part salt to 4 parts fish. This mixture was then allowed to ferment at temperatures ranging from 37° to 45° C.

4. Analyses of the original dried dilis, freshened dilis and the mixture during the different stages of the fermentation were made for protein, moisture and sodium chloride content.

5. Bacterial counts were also taken to determine the numerical trend of the bacteria during the fermentation process.

REFERENCES

AVERY, A. C. (1950). Fish processing handbook for the Philippines. Research Report 26. Fish and Wildlife Service, U.S. Dept. of the Interior.

HAMM, W. S., and J. A. CLAGUE. (1950). Temperature and salt purity effects on the manufacture of fish paste and sauce. Research Report 24, Fish and Wildlife Service, U.S. Dept. of the Interior.

HARROW, B., and P. M. APFELBAUM. (1947). An Introduction to Organic Chemistry. Sixth Edition, 454 pp., Illus. John Wiley and Sons, Inc., New York.

MANACOP, P. R. (1952). The principal marine fisheries. Fisheries Bulletin (in press). Dept. of Agric. & Nat. Res.

NAVARRO, O. B. (1950). The availability of calcium in bagoong and dilis (thesis). Univ. Mass., Amherst, Mass.

ROXAS, H. A. (1934). A review of Philippine isospondylous fishes. Phil. Jour. Sci. 55: 231–295.

SULIT, J. I., and S. S. SANTIAGO. (1950). A preliminary report on studies of salted fish paste. Dept. of Agric. & Nat. Res. Popular Bulletin 29.

SULIT, J. I., O. B. NAVARRO, R. C. SAN JUAN, and E. A. CALDITO. (1952). Proximate chemical composition of various species of Philippine market fishes. Fisheries Bulletin (in press). Dept. Agric. & Nat. Res.