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FISH FERMENTATION WITH THE USE OF PAPAIN*

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ABSTRACT

This study is designed to show the effect of papain, the dried latex of *Carica Papaya*, Linne, as a proteolytic agent in the fermentation of "bagoong" (fish paste) and patis (fish sauce). It has been found that as a proteolytic agent, 0.3 percent to 0.5 percent of purified papain is the most effective concentration in accelerating the fermentation process. The usual fermenting period which takes around six (6) months or more has been reduced to 4 to 7 days without destroying the characteristic flavor inherent to the final product. Likewise, the use of crude papaya latex gave similar results.

INTRODUCTION

"Bagoong" is a fish paste obtained by fermentation of properly prepared whole or ground fish. It has a flavor similar to anchovy paste prepared in Europe. A very common fish preparation, "bagoong" is used as a condiment or flavoring agent for vegetables and meat. Along with "bagoong" a liquid fish sauce known as "patis" is often made by separating the solid from the liquid portion of the autolysate. The liquid fish sauce is straw yellow to amber in color resulting from the digestion of salted fish or shrimp and has cheesy flavor and fishy odor. In Burma, fish sauce is called *ngapi*, in the Indo-Chinese group of countries, it is called *nuoc-man*; while in Thailand, it is called *nampla*.[4]

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[4] Indo-Pacific Fisheries Council, *Fisheries Products Manual*, pp. 97-133.

The proper aging of "bagoong" and "patis" may require six to twelve months. For this reason, a producer and manufacturer of this product is forced to tie up considerable investment in raw materials, containers and warehouse space. The purpose of this study is to reduce the cost of production by accelerating the aging period with the use of the proteolytic agent papain. It may pave the way for a more extensive development of bagoong and patis as flourishing local industries and expand the domestic and world market for both fishery products.

Uyenco, et al, (1942) in their studies, found that "bagoong" processing is actually digestion of protein by enzymes present mainly in the viscera of the raw material. The bacteria appear to play a minor role in the process due to the presence of high concentration of salt.

In recent years, attention has been focused on the use of hastening agents to accelerate the fermentation period without destroying the characteristic flavor of the final product.

Studies have been made in other countries like Japan on the use of artificial enzyme, like pronase and biophrase. The technique was found useful but not applicable in the Philippines because the artificial proteolytic enzymes are not available locally.

Papain is the purified dried latex of the fruit of *Carica papaya,* Linne (Fam. Caricaceae). It possesses a digestive activity not less than that of the reference papain.[5]

According to Hwang,[6] the digestant action of the juice from papaya, a fruit of the melon tree, *Carica papaya,* Linne, has been known for centuries. The results of the experimental investigation of its action appeared in 1874. In 1878, Wittmack in Germany also reported the digestive properties of the milky juice of the papaya.

This study indicates that the use of locally produced papain could accelerate the aging period of bagoong and patis.

MATERIALS AND METHODS

Materials: For this experiment anchovy (dilis) *Stolephorus sp.* was used.

[5] Lager, R.K. *A New Method for the Assay of Papain.* Annals of the New York Academy of Science, Vol. 54, p. 236.

[6] Kao, Hwang & A.C. IV. *A Review of Literature on the Potential Therapeutic Significance of Papain.* Annals of the New York Academy of Science, Vol. 54, pp. 161-166.

Both the crude papaya latex and purified papain were used as the proteolytic agent. Crude papaya latex was gathered from papaya trees grown in Muntinglupa, Rizal, and Sta. Maria, Bulacan.

The latex was obtained from the green papaya fruit by making several longitudinal scratches or cuts in its skin with a sharp stainless knife. The free flowing latex was caught in a beaker. The curdled latex along the incisions were scraped from the fruit and combined with the rest of the latex.

The latex was purified by mixing it with three (3) volumes of 95 percent ethyl alcohol. The precipitate is again washed with two (2) volumes of 95 percent of ethyl alcohol. The procedure is repeated using two (2) volumes of diethyl ether. The final residue is then dried and ground finely in a mortar and pestle.

Ordinary solar salt from Parañaque, Rizal, was used for salting.

Method: The fish was washed with 3 percent brine. All foreign matters like small stones and weeds and other grit were removed. After draining, the fish was mixed with salt. The ratio of salt used was 1:3. Several proportions of papain and salted fish were tried to determine the minimum amount of papain to be added to the mixture to get the best result. The following proportions were tried:

1. For every kilo of fish, 1 gram of papain
2. For every kilo of fish, 2 grams of papain
3. For every kilo of fish, 3 grams of papain
4. For every kilo of fish, 5 grams of papain
5. For every kilo of fish, 1 teaspoon of fresh papaya latex was added.
6. One batch served as control.

All samples were stored in covered glass containers. During the experimental period, the pH and chemical analyses were determined for crude protein on the autolysate. Periodic bacterial count were determined on the samples during the process of fermentation together with organoleptic examination.

RESULTS AND DISCUSSION

The results of the studies are summarized in Table 1. The table shows the results of the protein analyses made on the liquid portion of the anchovy "bagoong" with and without papain. A significant difference is noted in the rate of digestion between samples with different amounts of papain and samples which serves as the control. This is shown graphically in figure 1. The difference is to be expected because the presence of papain, due to its digestive and proteolytic property disintegrated the fish flesh faster, losing its shape, making considerable fish protein dissolve in the liquid. The protein content of this liquid is a fair measure of the progress of digestion.

TABLE I. *Crude Protein Content of Liquid Portion of Anchovy Bagoong with and without Papain.*

Day	Control	0.1%	0.2%	0.%	0.5%	Fresh Latex 1 tsp.
1	4.20	4.37	6.42	10.96	11.55	9.47
7	7.83	11.11	11.23	12.80	14.45	11.73
14	8.21	12.49	13.79	12.73	—	13.08
21	10.13	14.79	14.56	13.40	13.76	13.28
28	12.60	12.84	—	13.84	13.70	13.63
35	12 25	12 78	14.17	—	—	—

It can be seen from the figure that an increase in the amount of papain present in the sample results in more rapid digestion as determined by protein analysis. The sample treated with 0.5 percent papain gave the fastest rate of digestion within a week, followed by samples with 0.3 percent papain. The least was the sample treated with 0.1 percent papain.

During the experiment, it was noted that the pH range of the hydrolysate was from 5 to 6, which is slightly acidic.

The results of the bacterial analysis for anchovy fish paste are shown in Table 2. In comparative analysis, anchovy fish paste with

TABLE II. *Total Bacterial Content of Anchovy Bagoong with and without Papain.*

D A Y	CONTROL	Anchovy with Papain
1	9,730	21,105
7	2,000	none
14	none	none
21	277	none
28	306	none
35	none	none

papain contains more than twice the amount of bacteria present in the control sample.

As the rate of digestion proceeds, the total bacterial content of samples with papain decreased and reached the sterility point and remained constant. This result is illustrated in Figure 2.

As to physical characteristic, samples treated with papain changed their original appearance more rapidly than the untreated. The rapid change depended on the amount of papain in the samples. This observation was very much evident on samples treated with 0.5 percent papain. The fish lost its shape. Fish flesh were completely disintegrated and the samples were liquid and pasty in appearance within seven days of storage. Samples treated with 0.3 percent papain showed complete fish flesh disintegration on the 10th day while the fish in samples treated with 0.2 percent papain completely lost its original appearance on the 14th day of storage. On the 7th day, the sample with one (1) teaspoon of fresh latex showed signs of losing its original shape and appearance. The loss in shape was completely evident on the 16th day of storage.

As to the odor and flavor, anchovy "bagoong" treated with papain after a few days of storage had a characteristic odor. As the fermentation went on, the smell of papaya disappeared. The flavor of bagoong with papain was accepted like that of the untreated sample; for taste test (Hedonic Scale) nobody could detect which of the samples were treated with papain.

CONCLUSION

This study showed that papain hastens the fermentation of bagoong (fish paste) and patis (fish sauce), which shows that it could be used to shorten the aging period.

Papain added to the salted fish significantly increased the rate of digestion of fish protein.

The most effective concentration of purified papain in accelerating the fermentation process was between 0.3 percent and 0.5 percent.

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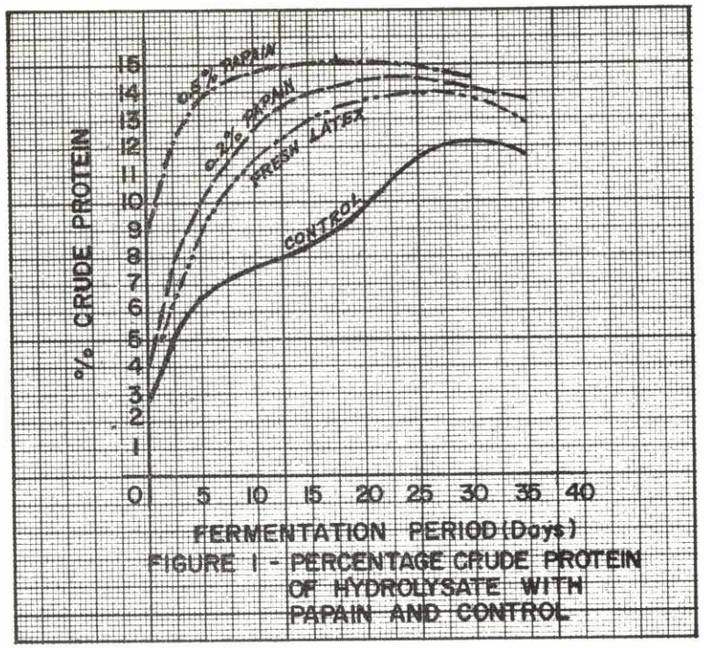
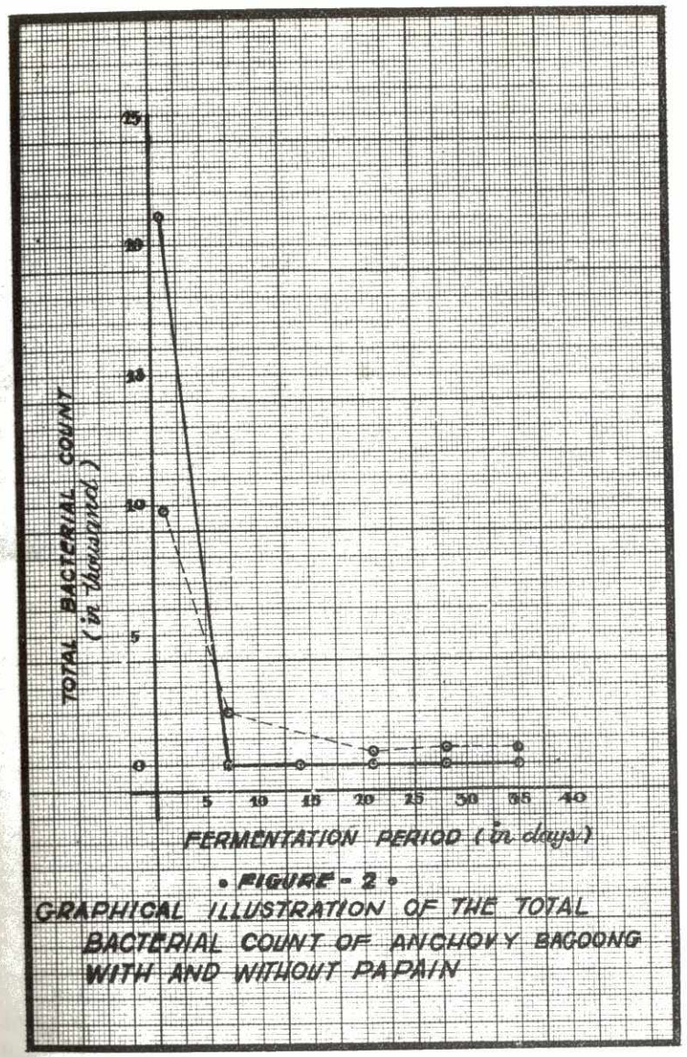
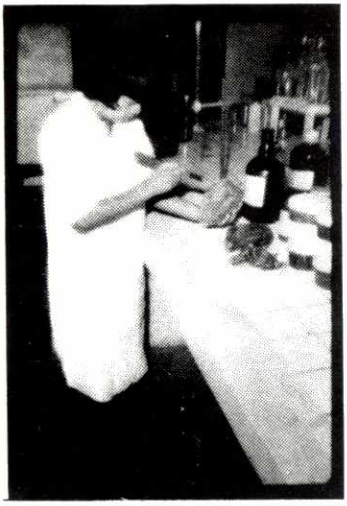


FIGURE 1 - PERCENTAGE CRUDE PROTEIN OF HYDROLYSATE WITH PAPAIN AND CONTROL



• FIGURE - 2 •

GRAPHICAL ILLUSTRATION OF THE TOTAL BACTERIAL COUNT OF ANCHOVY BAGOONG WITH AND WITHOUT PAPAIN



Collection of papaya latex.

Raw materials for bagoong-making using papaya latex to shorten fermentation period.