POST-HARVEST OPERATIONS AND PRODUCT UTILIZATION STUDIES ON BANGOS

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The most perishable of all protein foodstuffs, fish deteriorates in quality soon after harvest. The operations that follow harvesting must then be carefully considered, knowing that the market price of fish is partly determined by its state of quality when it reaches the consumer. To assure its availability and ease of transport, a portion of the harvested fish should be converted to products that keep better.

Bangos utilization studies have been the subject of interest of various food researchers, largely due to its special flavor and popularity as a food item in the Filipino diet. Local investigations on the handling, processing and quality control of bangos maybe classified into the following areas:

1. Handling, chilling and freezing
2. Preliminary operations, smoking, salting and drying
3. Canning of bangos formulations
4. By-product utilization

Handling and Icing

The use of low temperature as in chilling or icing is the simplest and cheapest method by which the onset of spoilage is retarded. Studies on icing bangos for transport by boat, by air, or by land were conducted recently by the Food Terminal Inc. (Dolmendo, et al, 1975).

Four types of containers with the same dimensions were studied for use in boat transport at a travel time of 24 hours. Fish were pre-chilled prior to packing in containers. Results showed that the insulated 1 cu m containers provided with drainage outlets at the bottom, with bañeras separated from each other by wooden dividers, gave the best quality of fish and negligible loss in weight.

For air transport, at a travel time of 1 hour, if fish were pre-chilled prior to packing and with the center temperature of fish at 0°C, good quality could be obtained at a low ice to fish ratio of 1:20 or without ice at all. Styrofoam boxes with a net capacity of 60 kg were preferred for air transport.

For land transport, bañeras provided with holes for drainage of fish fluids and melted ice were found to preserve the quality of the fish and are much cheaper and more durable than styrofoam boxes. However, styrofoam boxes are preferred over bañeras when fish which are not pre-chilled are transported by land.

Modified containers for handling and transport of bangos were also compared with the typical bañera. Quality assessment was made by objective tests correlated with sensory evaluation. Results are shown in Table 1 (Buenafe, et al., 1974).

Table 1. Quality assessment of chilled bangos (Chanos chanos Forskal) stored in three types of containers.

A. Using container insulated with styrofoam and provided with drainage outlet.

Time (Hr.)	Temperature of Fish, °F	VRS	Organoleptic Evaluation
0	71.3	6.82	fresh, odor characteristic of bangos
1	45.8	nd	nd
5	36.5	nd	nd
10	32.7	7.02	fresh, no off-odor whatsoever
20	32.5	7.89	fresh, texture firm as before
30	33.4	8.52	fresh, pale color with slime
40	37.0	9.73	still fresh, with somewhat fishy odor
50	45.2	17.50	acceptable, slimy and fishy
60	79.1	29.34	definitely unacceptable

B. Using modified bañera provided with drainage holes and a platform to prevent melted ice and leached fish fluids from soaking fish.

Time (Hr.)	Temperature of Fish, °F	VRS	Organoleptic Evaluation
0	71.2	7.01	fresh, odor typical of fresh bangus
1	37.3	nd	nd
2	32.2	nd	nd
10	46.8	16.93	acceptable, little fishy odor, firm
15	78.9	23.62	spoiled, not acceptable

C. Using typical bañera

Time (Hr.)	Temperature of Fish, °F	VRS	Organoleptic Evaluation
0	71.3	7.01	fresh, odor typical of fresh bangos
1	37.5	nd	nd
5	32.7	nd	nd
10	56.9	19.6	acceptable, with little off odor, softened
15	78.5	27.3	spoiled, not acceptable

The market quality of chilled bangos was assessed by objective tests and found to fluctuate within the same batch of samples (Table 2). This indicates the heterogenous quality of fish sold in the market which reflects the varying quality of handling operations used by the industry.

Table 2. Market quality of randomly sampled bangos (Chanos chanos Forskal) as assessed by VRS (Volatile reducing substance).

Days of storage	Temperature (°F)	VRS*
3	8°	I. 23.09
		II. 23.46
5	20°	I. 37.46
		II. 40.92
10	20°	I. 35.34
		II. 32.46
		III. 33.69
3	8°	I. 41.21
		II. 40.93
5	20°	I. 27.51
		II. 26.63
		III. 27.23
10	20°	I. 38.46
		II. 40.11
		III. 39.11

*VRS - microequivalents/5 ml press juice. It is an objective index of quality which increases with increasing degree of spoilage.

Freezing and cold storage

The loss in weight of bangos during frozen storage may be minimized by the use of polyphosphates to decrease the amount of "thaw drip" from frozen bangos. Preliminary studies on the effect of various combinations of sodium chloride and polyphosphates on the quality of frozen bangos have been made.

Data on bangos commercial freezing, including time required for sensible heat removal, thermal arrest time, freezing time and weight before and after freezing were also studied (Dolendo, et al, 1978).

Peroxide values and indices of rancidity of fat extracted from bangos after varying periods of frozen storage have been studied and correlated with the amount of NaCl and traces of cupric salts in the aqueous solutions where the fish samples are soaked for several hours (Bigueras, 1971).

In a recent study, the deterioration on the quality of bangos at frozen storage was assessed using the VRS test. The VRS (volatile reducing substances) content of the fish increases with increasing spoilage in a direct relationship which makes this chemical test an objective index of quality (Table 3).

Table 3. Data showing the relationship between the VRS (Volatile reducing substances) and the log bacterial numbers of frozen bangos with storage time

Samples	Days of Storage	Temperature (°F)	VRS	Log Bacterial Number
I	0	--	A. 17.67 B. 16.26 C. 17.44	6.6727
II	26	14°	A. 19.28 B. 21.91	7.1468
III	29	16°	A. 21.20 B. 21.44	7.1789
IV	35	12°	A. 34.87 B. 43.59	8.1633
V	39	19°	A. 48.06 B. 43.35	6.3880
VI	41	12°	A. 53.48 B. 33.25	6.8037

Source of fish: Pond No. 2, U.P. College of Fisheries, Diliman, Quezon City

Using the VRS test to assess the effect of antibiotics and antioxidants, preliminary studies show the improvement of the shelf-life of frozen fish by the use of some additives.

Preliminary operations, (Deboning), salting, smoking, drying and other products

The weight of bangos ranging from 32 g to 1,345 g and length from 6.1 cm to 53 cm were studied in relation to meat yield against round weight. Meat yield of bangos increased with round weight up to 600 grams, beyond which the curve levelled off (Arroyo, 1975). The percentage yield of edible portion of bangos as compared to some species of fish has also been determined.

The preparation of boneless bangos has received popular attention due to the convenience and better edibility resulting from the complete deboning operation. In the process, when the backbone is separated from the flesh, the neural, haemal and some pleural spines attached to it are removed. Skill is required however, to remove the several spines embedded in the muscles -- 38 branching spines at the dorsal portion, 14 spines from the nape along the lateral line, and 16 fine branching spines along the ventral muscels (Arroyo, 1974; BFAR leaflet).

Fish curing such as salting, smoking, drying and marinating maybe employed to improve the keeping quality of bangos. A review of the research on fish processing in the Indo-Pacific area was made recently (IPFC studies, 1967) (Orejana, 1973).

Studies have been made on the development of smoked soft-boned bangos and its storage qualities as related to the physico-chemical characteristics of the product while stored at various temperatures. Preparation of smoked soft-boned bangos involve the following operations: cleaning and eviscerating, soaking at desired salt concentration, pressure cooking, drying, and smoking at optimum temperature. Brining at 95°S, pressure cooking at 10-20°C yielded a product of good quality as indicated by objective and subjective tests (Baclig, 1970).

Preliminary studies on the effect of salt impurities, duration and temperature of smoking, brine concentration and type of fuel on the quality of smoked and salted bangos have been completed.

Unlike soft-boned bangos which is pressure cooked without deboning, smoked boneless bangos has been prepared and its quality correlated with storage temperature, method of packing and brine concentration. Microbiological and chemical tests were correlated with sensory evaluation to assess the quality of the product (Guevara, et al, 1978).

Fish protein concentrate (FPC) has also been prepared from bangos. This protein-rich powder maybe used as a flavoring agent or food supplement and can be stored indefinitely due to its low moisture and fat content. FPC prepared from bangos has an advantage over those prepared from other species due to its light color and good flavor. No organic solvent is necessary if mechanical pressing operations are done efficiently. This drastically reduces the cost of FPC preparation. The amino acid content of the unprocessed bangos has also been compared with the FPC prepared from it and both have been found to be rich in essential amino acids (Orejana, 1974).

Canning of bangos

The canning of bangos has been the subject of investigations by several research agencies. Product formulations have been made for canned bangos sardine style; bangos in oil, with tausi, with pork, escabeche-style; salmon-style; and many others. Recently, the development of canned fish sausage with skinned bangos, as well as the paksiw na bangos packed in glass jars has been done (Arroyo, et al, 1975). French sardine style formulations have been prepared (Gonzales, et al, 1970) and Marfori, et al, in 1974 conducted a storage life study of canned bangos.

As early as 1957, Sulit et al published procedures on the canning of bangos and the preparation of some bangos by-products.

The steps involved in canning essentially include dressing of bangos, cutting into can-length size, brining, pre-cooking, filling into cans, exhausting, sealing, processing at required temperature and time, cooling, and labeling. The ingredients added during the filling operations depend on the formulations desired.

By-product utilization

The conversion of waste materials of bangos processing to stable by-products may spell the difference between profit or loss in the bangos processing industry. Fish meal and fish silage, hydrolysate (bagoong and patis) and oils, and guanine extracts are a few of the more important by-products prepared from bangos offals.

In a recent study, fish meal and silage were prepared from bangos offals. Fish meal was prepared by steaming followed by drying and grinding while fish silage was prepared by using varying concentrations of sulfuric acid to hydrolyse the tissues and dissolve the bones. The two types of products which can both be used as feed ingredients were compared, based on proximate analyses and pepsin digestibility test.

Proximate analyses -- protein, moisture and ash content, and NPU values of fish meal and fish silage are shown in Table 4 and 5. Statistical analyses showed that the difference in the digestibility values expressed as percentage nitrogen was significant at 10 percent level (Flores, et al).

Table 4. Proximate analyses of fish silage and fish meal from Chanos chanos Forskal

Samples	% Moisture		% Protein		% Fat		% Ash	
	A	B	A	B	A	B	A	B
Fish Silage	56.50	130.33	18.83	43.32	11.85	27.33	4.14	9.53
Fish Meal	10.53	11.80	45.13	50.83	15.20	16.20	11.77	13.11

A - Wet weight basis
B - Dry weight basis

Table 5. % NPU of fish silage and fish meal from Chanos chanos Forskal

Samples	Pepsin digestibility % protein	Solubility % protein	% NPU of total protein
Fish silage	1.1156	18.3145	36.91
Fish Meal	1.3499	15.8625	33.34

Various methods of preparing by-products from bangos offals have also been studied (Orejana, et al). Fish meal samples prepared by sun-drying and artificial drying have been compared as to percent moisture, protein and ash content. Peroxide and iodine values were used to assess rancidity. The use of the wet reduction and dry reduction processes was also studied.

The amino-nitrogen, Total Volatile Base (TVB) and pH of fish silage prepared from bangos offals have been determined in a recent study.

The pH, solid to liquid ratio, percent NaCl and amino-N of hydrolysate (bagoong) from bangos offals were measured, using salt to fish ratios (1:3, 1:3.5, 1:4).

The internal organs (viscera) of bangos can be formulated into an easy-to-prepare snack item by the use of flour and eggs, and can also be incorporated in kropeck.

Fish oils have found industrial uses in other countries. In a recent study, oils from bangos offals were prepared by different methods of extraction. The percentage yield, specific gravity, free fatty acid value and peroxide and iodine number of the oil samples extracted were compared.

This paper reviewed the recent investigations made locally on the utilization aspects of bangos. Cost-analyses and feasibility studies on the manufacture of various products require more intensive study.

Finally, the development of the bangos processing industry will depend initially on the quantity of raw material made available to the fish processor.

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