



# Prototyping of a Mechanized *Bagoong* Squeezer

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## Abstract

*The high demand for bagoong keeps the processing as one of the established industries of Region I. Its presence in every home justifies its indispensability to the Ilocano cuisine.*

*This prototyping project surfaced from an expressed need of one bagoong processor from Santa Lucia Sur. The designed machine has a capacity of 24 liters. It has several parts: a) a perforated cylindrical bucket with paddle which carries the fish substrate, b) a one-directional motor, 1 hp capacity, c) the casing which houses the bucket and the motor, and d) its accessories: the electrical controls and faucets. The cylindrical bucket spins at an approximate speed of 1700 rpm.*

*Three (3) models were constructed. To document the comparative performance per model, the ANOVA was done. All three models manifested significant results. From the usual squeezing time ranging from 30 to 45 minutes, then followed by another 15 minutes for bottling with the manual method, the first model did both squeezing and bottling in 5 min, 24 seconds, while the 3<sup>rd</sup> model further improved to 3 minutes, 6 seconds.*

*In conclusion, the designed machine satisfied the requirements of the cooperators, but did not satisfy the requirements of the Pangasinan bagoong processors. It is then recommended that a higher capacity of motor and more complicated design to take care of other concerns be adopted to meet Pangasinan's export requirement.*

## Introduction

### Background of the Study

One of the established industries of Region I is *Bagoong* processing. *Bagoong*, or *bugguong* in Iloco, is a common ingredient used in the Philippines and particularly in Northern Ilocano Cuisine. It is made by fermenting salted fish, which may be of different

species. However, most Ilocanos choose *monamon*, or *bangus*. Regardless of the species of fish used, the result will still be similar in flavor. It is used as a flavor enhancing agent in the place of salt, soy sauce, or monosodium glutamate. It is used to make the fish stock, the base to many Ilocano dishes, such as *pinakbet*, *dinengdeng*, *inabraw*; or as a dressing for cold steamed greens in the dish *ensalada*, like ferns, bitter melon leaves, or sweet potato leaves. *bagoong* is also used as a condiment, in many cases, a dipping sauce for *chicharon*, whole fried fish, green and ripe mangoes, or hard boiled eggs. This variety of uses of *bagoong* establishes the need of this product in every home.

**The Cooperator**

This prototyping project is being supported by a cooperator who expressed his need for the machine, Mr. & Mrs. Ronnie Bello of Kaikai Food Products at Mabilbila, Santa, Ilocos Sur.

*Fig. 1. The Prototype. Products, owned and managed by Mr. & Mrs. Ronnie Bello.*

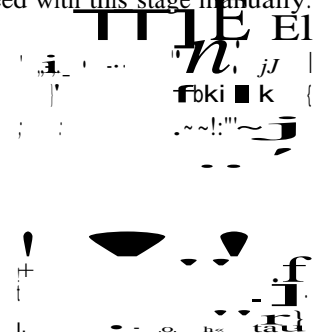
**Objectives**

*Bagoong* processors in Region I have expressed their immediate need of a mechanical fish squeezing machine to hasten the decay of the fermented fish. This machine is not yet existing in Region I. The *bagoong* processors proceed with this stage manually. Despite the wearing of gloves, contamination is high when done With hands. The proposed squeezer intends to ehmmate the manual operations involved in the process, especially in the handling of the fish while squeezing and bottling. (Per FNRI standard operating procedures).

**Review of Related Literature**

As a backgrounder to the prototyping activity, the following readings were referred:

In the late 1920's, *bagoong* was synonymous with the Family name: Lorenzana, from Don Felipe Lorenzana who started large-scale manufacturing of *Bagoong* in the Philippines. According to family oral history, Don Felipe and a cousin, Delfin, has already



**Fig. 2. The Prototype**

experimented with the product since the early 1900 but were stumped on the hows. The Bagoong Lorenzana brand was the only large-scale producer for a long time. Tin cans were used to pack the fermented fish. But because the tin cans rusted quickly, Don Felipe thought of using earthen jars or *burnays* (in Iloco) to contain the bagoong, an idea he copied from the grandfather of Sostenes Lorenzana, who was then in the basi business. This gave birth to the Lorenzana bagoong and patis.



*Fig. 3. Bagoong fermenting in burnay jars. Photo taken in Ilocos Norte, Philippines*

*(Autobiography of Dr. Crispina L. Macagba, Co-Founder of LORMA Hospital and Colleges and Oral Family History Letters from Sostenes L. Lorenzana to David Lorenzana by David J. Lorenzana, May 17, 2006.)*

Filipino food without bagoong would simply be like... life without color! (Salcedo, Philippine Daily Inquirer).

Fish processing may be subdivided into two major categories: fish handling which is initial processing of raw fish and fish products manufacturing. The activities within the realm of fish handling are: sorting, dressing, cutting, eviscerating, skinning, pre-cooking, breadng, blanching, filleting, salting and packing (<http://en.wikipedia.org>).

Bagoong is also termed as fish sauce. It is an essential ingredient in many curries and sauces. Fish sauce is a staple ingredient, not only for Filipino cuisine, but also for the Vietnamese, Thai, Lao, and Cambodian cuisines. In addition to being added to dishes during the cooking process, fish sauce can also be used in mixed form as a dipping condiment, and it is done in many different ways by each country mentioned for fish, shrimp, pork, and chicken. In southern China, it is used as an ingredient for soups and casseroles.

The National Economic Development Authority (NEDA) and Department of Science and Technology (DOST) Offices in Region I were in constant partnership to inject innovations to Micro Small and Medium Enterprises (MSMEs). Having felt the high preference for ground bagoong, bagoong processors started packing their fish sauce and patis in bottles. Selling the product in bottles was made more convenient unlike the old

product where the fishes need to be pressed to get all the sauce before mixing with other foods, just like in cooking *dinengdeng*. In order to compete in the market, the producer needs to keep up with new technologies in the industry. The project was started in 1997. (NEDA-1 Knowledge Emporium).

DOST provides technical assistance to the producers in the form of available equipment, training, and microbial analysis for quality testing of bagoong. At first, the only available equipment was the shiever and heavy duty grinder. The bagoong sold wholesale were placed in big plastic drums to retailers and the bagoong sold by retail were scooped into plastic bags especially during the town's market day. All products sold were without label and open to adulteration by wholesale buyers. To ensure that the high quality of the product reaches the consumers, the packaging need to be improved (<http://www.neda.gov.ph/Knowledge-Emporium>).

There are almost as many traditional methods of packaging fermented fish as there are ways of making it - such as earthenware pots, oil cans, drums and glass bottles. In the past, the latter have been used because of their low cost, but nowadays, cheaper plastic containers tend to replace the traditional types. The most important function of packaging for fermented fish products is that the containers should be air-tight, helping to develop and maintain the airless conditions required for good fermentation and storage. As the major advantage of these products is their low cost, the type of packaging is necessarily restricted. Glass bottles are often used for the better-quality products, but earthenware pots and even plastic bags are used.

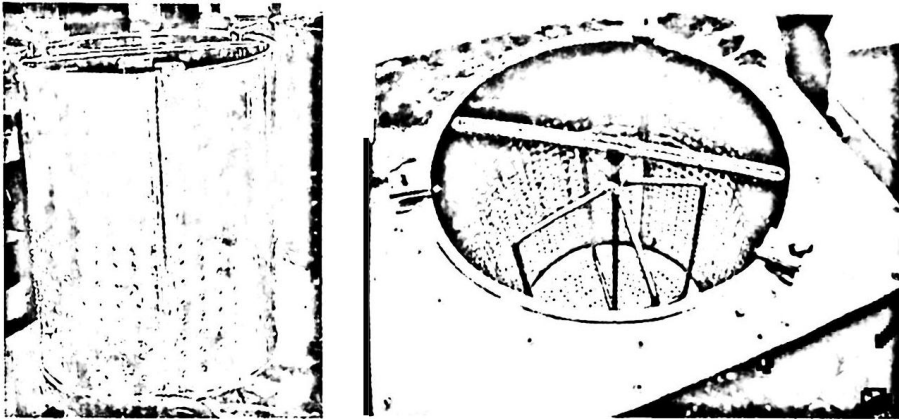
Although traditional processing represents a low-cost option for many small-scale producers, there may be large losses in terms of wasted fish. Improved technologies are usually techniques that require little in the way of expensive equipment, but at the same time increase the quality and the efficiency of the process. Often all that is needed to improve the process and the quality of the final product is the provision of clean water, education and training facilities, simple equipment, or basic materials.

The economics of manufacturing, marketing and export may seem complicated, but the end results are clear and simple; product quality improves and producers prosper. There is much pride in being able to carry into an international airport, bottled "patis" or canned "taba ng talangka" without embarrassment or worse, the threat of quarantine. Being global forces producers and manufacturers to upgrade quality, innovate on flavors, packaging and marketing. No more horror stories about bugs going into a jug of fermenting "bagoong". Now, specific products are facilitatively requested through the use of technology. (<http://travel.pangasinan.gov.ph/industry/pasalubong.htm>)

## Results and Discussion

### The Designed Squeezer

The designed machine (please see Figure 2) has a capacity of 24 liters, accommodating 1 can of fermented *bagoong*. When the fish is loaded to the bucket, the bucket spins at an approximate speed of 1700 rpm.



**Fig. 4 and 5.** *The cylinder with perforations and the paddle stimulating the squeezing process*

The casing (Fig. 2) carries the cylinder (Fig. 5) with perforations and the paddle (Fig. 6) which stimulates the squeezing activity. The cylinder will contain the fermented fish to be squeezed. The ¼ hp capacity of the motor was based from the Santa cooperator with very fluid fish sauce formulation. The cooperator is only using anchovies (*monamon*) as the basic fish substrate.



**Fig. 6.** *The cylindrical bucket, with a paddle, squeezing 20 liters of fermented bagoong.*

### On the Choice of Motor Type

The first step in constructing the prototype squeezer is the choice of an appropriate motor to run the machine.

Table 1 shows the comparative performance between two types of motor which the researchers used to decide the type to be adopted for the prototype, namely; the reversible and the one-directional.

Table 1. The Squeezing Results of the Machine vis--vis the Type of Motor Used with the 1" Design

Type of Motor	Duration of Squeezing			Effect
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	
a. Reversible	15 min	15.3 min	14.8 min	The faucets are clogged with fish bones
b. One-Directional	2.5 min	3.1 min	4.95 min	Bottling is continuous

Because of the clogging that occurred with the use of a reversible motor, the one-directional motor was chosen, so that squeezing and bottling could be done faster.

### On the Machine Layout

There were three models constructed. They are presented subsequently.

The first design was presented to the cooperator and was already satisfactory. However, the cooperator suggested an improvement (2" design)- to provide a screen at the lower base to prevent the passage of salt and other fine fish bones.

#### 1<sup>st</sup> Trial

Size of Housing Frame	0.65m x 0.65 x 1.2 meter high, stainless steel.
Size of perforated cylinder	0.4m diameter
Size of perforation	(only lower half has holes) 7/16" to 1/8"
Capacity of motor	1/4hp
Capacity of squeezer	24 liters of bagoong
Squeezing time	3 to 5 min
Size of Paddle	3/8" diameter, 10" high
Attached accessories	two faucets and drain, electric timer

2" Trial has the same technical description with the 1" design; but it has a detachable stainless screen at the lower half portion to separate the salt from the fish sauce. This was suggested by the cooperator. However, the effect was clogging of the faucets.

### 3<sup>rd</sup> Trial

Size of Housing Frame	0.65m x 0.65 x 1.2 meter high, stainless steel.
Size of perforated cylinder	0.4m diameter
Size of perforations	(3/4 of the cylinder has holes) 7/16 to 1"
Capacity of motor	1/4hp
Capacity of squeezer	- 24 liters of bagoong
Squeezing time	3 to 5 min
Size of Paddle	3/8" diameter, 10" high
Attached accessories	6 faucets and drain, electric timer for 3 men to bottle



*Fig. 7. A third design to improve the bottling process was the provision of bigger perforations to 3/4 of the cylinder; as well as the installation of 6 faucets, tripling the speed of the former design to bottle the fish sauce.*

### The Financial Requirements

The prototyping was the joint efforts of three entities: the technology taker or cooperator, ICIERD and UNP. The financial counterparts per collaborating entity are shown in Table 2 as follows:

Table 2. Breakdown of Financial Counterparts by Cooperating Agency

Agency	ICIERD	UNP	KAIKAI	TOTAL
Amount of Share in Ph P	12,100.00	5,000.00	36,526.10	53,626.10
Nature of Expense	Honoraria & Communication	Gas & Oil (with vehicle & driver)	Materials + Labor	
Percent Share	22.56%	9.32%	68.11%	100.00%

### The Assessed Test of Significance

The original method of squeezing the fermented fish was by press the fermented fish until everything is ground. The bones would then be left inside using a plastic sieve, with holes 1 mm in diameter. The laborers would pour several buckets on the plastic sieve with a container where the screened fish sauce would accumulate, then manually the plastic sieve. This process is repeated until all the 24 liters are done, which on the average would



consume 30 to 45 minutes. Bottling, which will consume another 15 minutes would follow after the squeezing process.

With the 1<sup>st</sup> trial design of the mechanized squeezer, squeezing and bottling are done in an average time limit of 5minutes, 24 seconds. While in the third design, squeezing and bottling are again improved to just 3 minutes, 6 seconds on the average due to the added six (6) faucets. Table 3 provides the data on the time consumed per design.

Table 3. The Time Consumed per Trial Per 24 Liters

Mode of Squeezing	Time Consumed, in minutes				t-value	Interpretation
	per Trial					
	2	3	Ave			
Manual	30	35	45	36.67	0.002	Significant
<sup>st</sup> 1 Machine Design	5.2	6.0	5.0	5.4		
<sup>iii</sup> 3 Machine Design	3.0	3.5	<b>2.8</b>	3.1	0.003	Significant

e=0.05

·RSAC, UNP

Using the one-way analysis of variance (ANOVA), the manual mode and use of the **I** machine design is significant at 0.05 level, so with the manual mode and use of the 3" machine design. This suggests that there is a significant effect on the mechanized squeezing using the 1<sup>st</sup> design and so with the third design. Likewise, using the T-test, between the manual and the **I** design, there is significant effect in the squeezing between the two modes, and so with the effect between the manual and the third machine. Between the **I** and the 3" designs, the squeezing time is still significant. This statistical treatment would prove the significant improvement in the manual squeezing mode through the prototype.

### Promotional Attempts

The prototype squeezer was taken to Maniboc and Pangapisan, two barangays of Lingayen, Pangasinan, where the best and big time bagoong processors are located. The researchers conducted demonstration on the machine's operation at E-mars *Bagoong* at Maniboc, and at ELF *Bagoong* at Pangapisan.

It was known from the trip that the Pangasinan *bagoong* producers use several fish species for the substrate; like *galonggong* (*tuna sp.*), *tamban*, etc. They are not using *monamon* (anchovies) because they claim that this species is quite expensive in their

locality. After the fermentation process, the fish is crushed by a hammer mill, then kept in bins for the squeezing and bottling processes. The sauce formulation is very thick, unlike that of the Santa cooperator.

## Conclusion

1. The ¼ hp motor is no longer sufficient to squeeze the fish because the sizes are bigger than the *monamon* of Kaikai, aggravated further by the very thick formulation of the sauce. In other words, the machine did not meet the *bagoong* requirements of the Pangasinan producers for export as to capacity. However, the machine meets the *bagoong* requirements of the Santa cooperator.

2. Using the 1" design, the squeezing efficiency of Kaikai improved a lot from its traditional time of 30 minutes for every 24 liters, as shown by the t-value of 0.002.

3. Likewise, the 3" design is still significant with the t-value of 0.003. This test of significance shows that the introduced mechanization will improve the squeezing and bottling efficiency of the cooperator. The third design squeezed out all *bagoong* paste from the spines in 3 min, 6 seconds, almost 12 times faster than the manual process thereby facilitating also the bottling process, and at the same time, lessening the manual handling to ensure more sanitary bottled *bagoong* products.

## Recommendations

After the construction of the prototype, the following recommendations could be cited:

1. A bigger motor capacity should be adopted to suit the Pangasinan *bagoong* producers' target volume.
2. There are a lot of manual handling being done after the fermentation process. The squeezing, screening and bottling processes are all done manually. One single machine to process the fermented fish from squeezing up to the bottling could be introduced as another innovation to cater to the concerns of the Pangasinan *bagoong* producers, to eliminate the manual operations during these three processes.

## References

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