Fishery Wastes and By-Products Utilization: Turning the Nuisance into Valuable Resources

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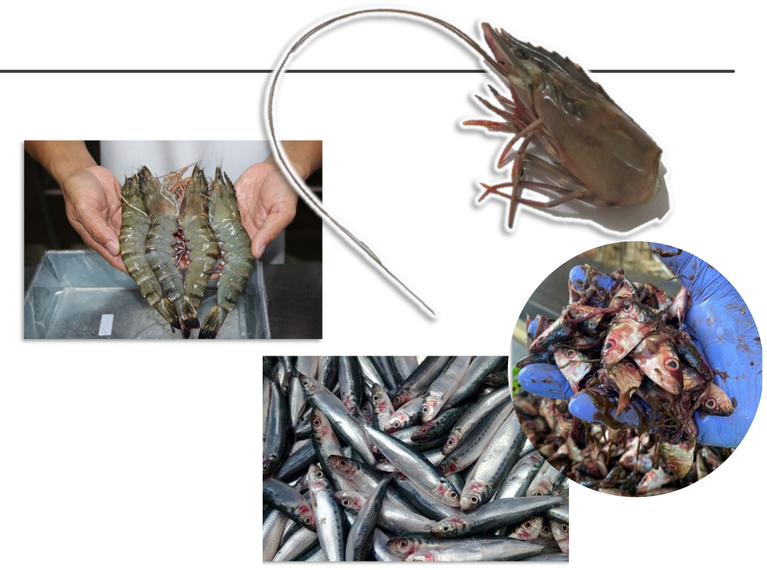
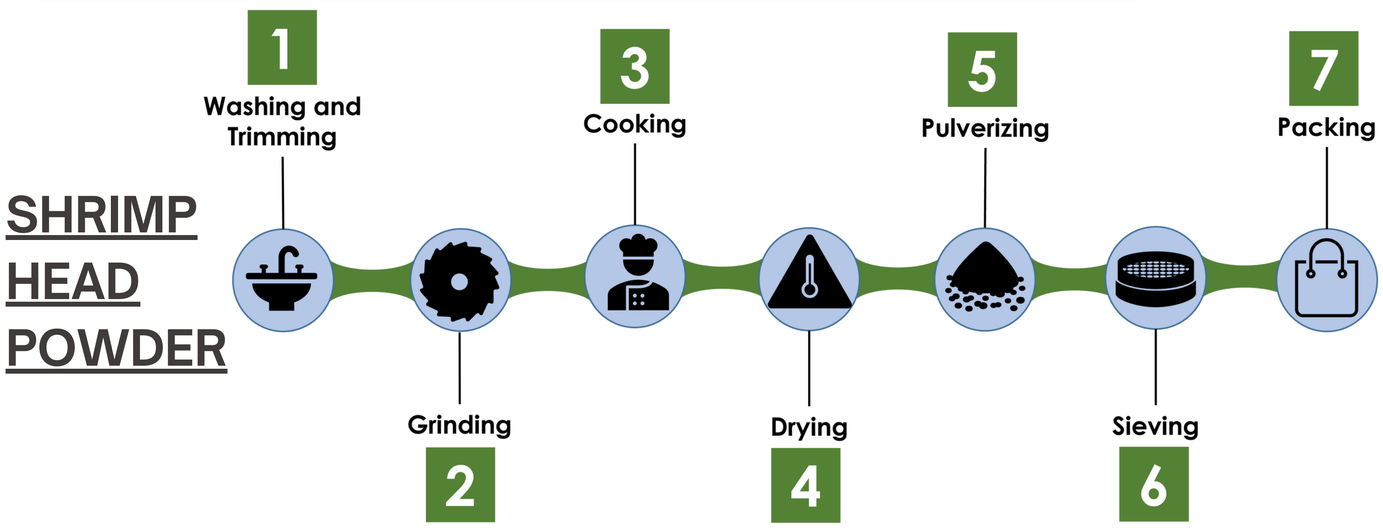
1 Introduction

Over the past years, the increasing volume of fish waste has been considered a global concern due to its damaging environmental impact and significant contribution to economic loss. In the Philippines, bottled sardines and shrimp processing industries produce large amounts of waste in the form of heads and viscera, which comprise around 35-50% of the raw materials. These are often treated and disposed in designated landfills or dumped directly into the sea due to a lack of technological means to utilize the discarded portions from postharvest processing operations. Pursuant to the overarching goal of the circular economy, various studies have been conducted to maximize the utilization of fishery wastes and by-products. This study aims to utilize shrimp head wastes into powder form using a cabinet-type drier and establish the processing yield, product quality, and shelf stability. Moreover, the ongoing project on the utilization of sardine heads and viscera aims to develop a low-cost technology for silage production.

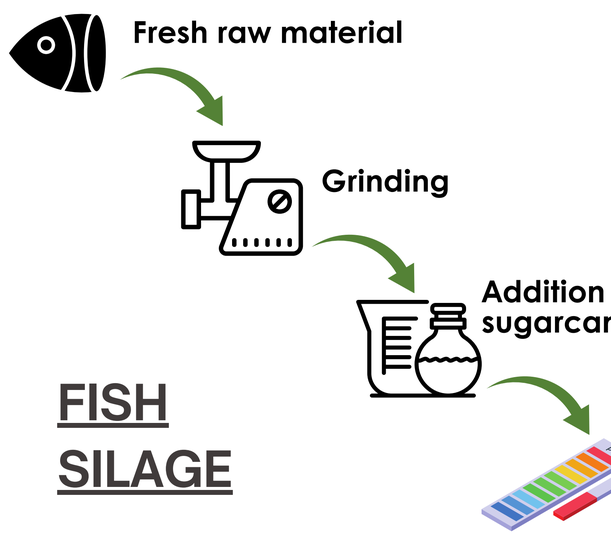


2 Methodology

SHRIMP HEAD POWDER



FISH SILAGE



3 Results

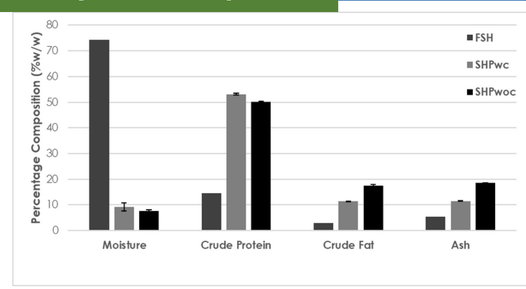
SHRIMP HEAD POWDER

Processing yield

Stage	Percentage Yield (%w/w)	
	SHPwc	SHPwoc
Raw	--	--
Cleaned/washed	81.82	60.02
Cooked	72.73	53.48
Dried	34.22	22.46
Powdered	26.72	20.42

Physico-chemical and Physical Properties

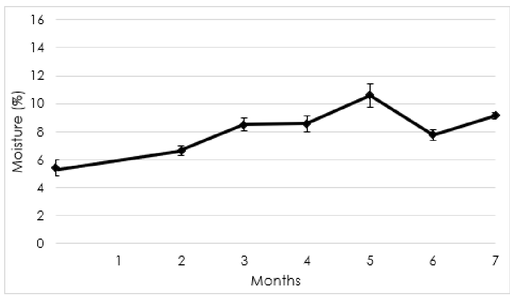
Property/Parameter	Treatment	
	SHPwc	SHPwoc
Water Activity	0.12 ± 0.001	0.09 ± 0.005
Solubility (%)	20.67 ± 4.16	29.33 ± 1.15
Bulk Density (g/ml)	0.58 ±0.01	0.55 ± 0.12
Peroxide value (meq/kg)	2.95 ± 0.04	2.89 ± 0.84

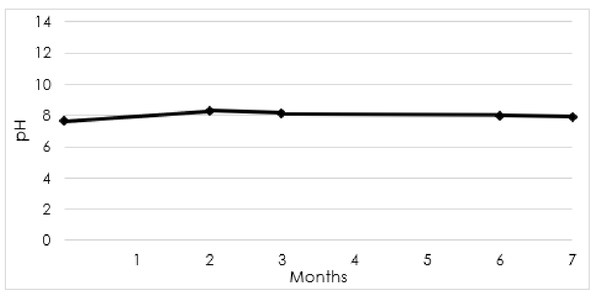


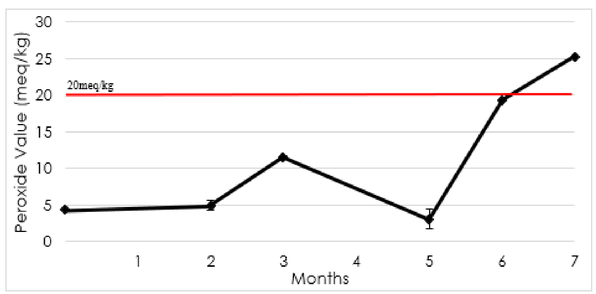
Shelf-life Evaluation

Reference Microorganism	Standard Guideline (DOH-FDA Circular No. 2013-010)*	Period of Storage (months)							
		0	1	2	3	4	5	6	7
APC *(CFU/g)*	5x10^5	<25	-	<25	100	220	-	325	200
Yeast and Molds *(CFU/g)*	-	<10	-	13	10	20	-	<10	<10
S. aureus (CFU/g)	10^2	<10	-	<10	<10	<10	-	<10	<10
E. coli (MPN/g)	11	<3	-	<3	<3	<3	-	<3	<3
Salmonella (per 25g)	Absent	A	-	A	A	A	-	A	A

(-) no data; (A) absent
*for Frozen Cooked Crustaceans; acceptable level of microorganism achievable under GMP







- The microbiological quality of dried products is significantly affected by the lowering of water activity to less than 0.60, where no microbial proliferation is expected; thus, the water activity values obtained imply that both shrimp head powders are microbiologically safe.
- The product's microflora, after seven months of storage, shows that the product is still safe, based on the Philippine Food and Drug Administration's (FDA) microbiological criteria for Frozen Cooked Crustaceans (FDA 2013).
- The product moisture has an increasing trend over time; however, it is still within the 25% moisture content for dried foods. With the increasing trend, the water activity is also expected to increase over time. With the pH values relatively close to the optimum range for most bacteria of pH 6.5-7.5, this observation may soon encourage more microbial proliferation.
- The longest storage with Peroxide Value without theoretically affecting the sensory properties is after six months, eventually exceeding the limit after seven months.

FISH SILAGE

	Acid Ensilage	Fermented Silage
pH	4.13	4.83
Crude Protein %	15.25	14.09
Total Plate Count (CFU/g)	1,150	1,150
Yeast and Mold Count (CFU/g)	<10	<10

Initial findings suggest that acid and organic-method-produced silage from sardines' heads and viscera yield an average crude protein of 15.25% and 14.09%, respectively; hence, the addition of agricultural by-products will be explored to increase its nutritional value and improve its palatability.

4 Conclusion

Powders developed from shrimp heads are of high nutritional value with acceptable physico-chemical, microbiological, and sensory properties; thus, showing promising qualities for further development. Fish silage also presents a practical alternative for the conversion of wastes from bottled sardine production into feed for aquaculture and animal husbandry, or fertilizer for crops. These technological innovations are promising initiatives to deliver progress on the shared goals of food loss and waste reduction which is a great leap towards improving food security and maximizing the economic potential of the fisheries industry.

References
Dilbaghi N, Sharma S. 2007. Food spoilage, food infections and intoxications caused by microorganisms and methods for their detection. Pp 5-8.
[FDA] Food and Drug Administration. 2013. Revised Guidelines for the assessment of microbiological quality of processed foods, FDA Circular No. 2013-10.