



A Study on Added Value Analysis of Skipjack Fish using Hayami Method Approach for Rolade and Fishball Product

Sri Dharma Cyntya Atmaka*, Ria Iswandari, Noer Aza Fauziana, Novika Mila Prametha, Meta Aquarista Galia

Agro-Industrial Product Development Study Program, Cilacap State Polytechnic, Cilacap, Central Java, Indonesia

*Corresponding author (cyntyaatmaka@pnc.ac.id)

Abstract

Skipjack fish (*Katsuwonus pelamis*) is a high value fishery commodity in Indonesia that requires processing to enhance its added value, extend its shelf life, and improve its marketability. This study aimed to analyze the added value of processing skipjack fish into fish rolade and fish balls using the Hayami method. The research was conducted in January 2026 in Gumilir Village, North Cilacap, with primary data collected through observations and interviews. The results showed that skipjack fish rolade generated an added value of IDR 67,450/kg with an added value ratio of 48.18%, while skipjack fish balls generated an added value of IDR 60,140/kg with an added value ratio of 50.12%. Furthermore, skipjack fish rolade generated higher profits than skipjack fish balls, whereas skipjack fish balls offered a more affordable product option that may support market penetration strategies. These findings provide useful insights for product diversification and decision-making in the development of a more profitable and sustainable skipjack fish processing industry.

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Introduction

Fish consumption has continued to increase due to growing public awareness of the nutritional benefits of marine derived animal protein. In Indonesia, per capita fish consumption is projected to reach 26.08 kg in 2025. Among the country's fishery commodities, skipjack fish (*Katsuwonus pelamis*) is one of the most economically valuable species and constitutes a major catch, particularly in Eastern Indonesia. The production of skipjack fish recorded at the Fish Landing Center (TPI) in Cilacap Regency reached 429.094 kg in 2025 (Badan Pusat Statistik Kabupaten Cilacap, 2026). Despite its abundant production, the economic potential of skipjack fish has not been fully realized because processing and marketing systems remain suboptimal. As a highly perishable commodity, fresh skipjack fish is susceptible to rapid quality deterioration, resulting in a relatively low market value.

Processing skipjack fish into processed products is an effort to provide added value by increasing the economic value and shelf life of the product. Added value can be interpreted as the increase in the value of commodities caused by processing, transportation, and storage activities in the production stages (Haidi et al., 2020). Through the processing process, skipjack fish that have a low selling price can be transformed into

products with higher economic value and longer durability. The diversification of processed skipjack products can also create wider market opportunities and strengthen the competitiveness of Indonesian fishery products.

Skipjack rolade and skipjack fish ball are two forms of diversification of processed fish products that have quite good market potential. Rolade is a roll-shaped processed product made from meat mixed with spices and other additives, then wrapped and steamed (Sanditya et al., 2023). Meanwhile, fish balls are a round-shaped processed product made from ground meat that is seasoned, rounded, then boiled (Jemri and Jannah, 2022; Yusuf et al., 2023). These two products have different characteristics in terms of production process, processing costs, selling prices, and consumer preferences.

Value-added analysis can provide a comprehensive overview of the contribution of each factor of production in producing the final product. Through this analysis, it can be known the amount of value added to raw materials, the distribution of income for labor, the contribution of other inputs, and the profits obtained by entrepreneurs (Sathre and Gustavsson, 2009). The added value ratio was classified into three categories as low (<15%), moderate (15%–40%), and

high (>40%) (Santos et al., 2024).

Previous studies have investigated the added value of processing various fishery commodities, including squid into squid crackers, skipjack fish into skipjack tuna floss, and milkfish into amplang. The result indicated that the added value of squid cracker processing increased from IDR -1.697/kg with an added value ratio of -3.20% before investment to IDR 36,925/kg with an added value ratio of 34.87% after investment (Intyas and Firdaus, 2020). The processing of skipjack tuna floss by Wadimah MSMEs generated a high added value ratio of 58.1% (suanto et al., 2025). The added value analysis showed that processing milkfish into amplang at the "Sinar Laut" business generated an added value of IDR 101,226/kg and an added value ratio of 72.30%, indicating a high level of added value (Yarna Hasiani et al., 2024). These studies primarily focused on evaluating the added value of a single processed product. However, comparative analyses of different processed products derived from the same raw material, particularly skipjack fish, remain limited. Consequently, there is insufficient information regarding how differences in processing characteristics influence the added value, income distribution, and profitability of alternative skipjack-based products. This represents an important research gap for supporting product diversification and decision-making in the fish processing industry.

To address this gap, the present study compares the added value of two skipjack fish products, namely fish rolade and fish balls, using the Hayami Method. The scientific novelty of this study lies in its comparative evaluation of two alternative processing products derived from the same raw material, providing a comprehensive assessment of added value, labor income, contribution of other inputs, and business profitability within a single analytical framework. Therefore, this study aims to analyze and compare the added value obtained from processing skipjack fish into fish rolade and fish balls. The findings are expected to provide practical insights for selecting economically viable product diversification strategies and to support the development of a more profitable and sustainable skipjack fish processing industry.

Materials and Methods

This study was conducted from December 2025 to

January 2026 in Gumilir Village, North Cilacap, Indonesia. The study was carried out as a follow-up to a community service program that provided training for Integrated Health Post (Posyandu) cadres on the production of innovative skipjack fish-based products as nutritious food for toddlers (Atmaka et al., 2026). A case study approach was employed to evaluate the added value of processing skipjack fish into fish rolade and fish balls.

A purposive sampling technique was used to select the respondents. A total of 15 Posyandu ILP Alamanda 18 cadres who participated in the product processing training and were directly involved in producing skipjack fish rolade and fish balls were selected as respondents. Primary data were collected through direct observation of the processing activities and structured interviews with the respondents. The data included raw material requirements, labor utilization, production output, input costs, selling prices, and other production-related expenses required for the value-added analysis. Secondary data were collected from the 2026 statistics published by the Cilacap Regency Statistics Office (BPS Kabupaten Cilacap) and relevant literature on skipjack fish processing and value-added analysis. The added value of processing skipjack fish into fish rolade and fish balls was analyzed using the Hayami method.

Results and Discussion

Processing skipjack fish into rolade and fish balls represents a form of product diversification that enhances both the utilization and economic value of skipjack fish. In addition to expanding consumer choices, processing transforms fresh skipjack fish into value added products with greater market potential, thereby contributing to increased income (Intyas and Firdaus, 2020). Previous studies have demonstrated that value added fish processing not only diversifies fishery products but also improves the utilization of low-value or underutilized fish resources and increases economic returns by enhancing nutritional quality, convenience, and consumer acceptance (Silva et al., 2020; Hoque et al., 2021; Islam et al., 2022). Furthermore, the incorporation of vegetables, starches, protein isolates, and locally available ingredients has been widely applied in skipjack and other fish-based products to improve nutritional quality, texture, and overall marketability.

Table 1. Raw Materials and Prices for Processing of Skipjack Fish Rolade

No	Material	Quantity	Unit	Price (IDR)	Total Price (IDR)
1	Skipjack Fish	1	Kg	35,000	35,000
2	Carrot	0.1	Kg	32,000	3,200
3	Chayote	0.5	Kg	16,000	8,000
4	Tapioca Flour	0.12	Kg	22,000	2,640
5	Flour	0.18	Kg	14,500	2,610
6	Garlic	0.03	Kg	49,000	1,470
7	Shallot	0.06	Kg	67,000	4,020
8	Scallions	0.02	Kg	26,000	520
9	Egg	0.36	Kg	28,000	10,080
10	Sugar	0.02	Kg	19,000	380
11	Salt	0.02	Kg	24,000	480
12	Lime	0.05	Kg	30,000	1,500
13	Packaging	4	Sheet	1,000	4,000
Total					38,900

Table 2. Raw Materials and Prices for Processing of Skipjack Fish Balls

No	Material	Quantity	Unit	Price (IDR)	Total Price (IDR)
1	Skipjack Fish	1	Kg	35,000	35,000
2	Carrot	0.1	Kg	32,000	3,200
3	Tapioca Flour	0.15	Kg	22,000	3,300
4	Flour	0.06	Kg	14,500	870
5	Garlic	0.03	Kg	49,000	1,470
6	Shallot	0.06	Kg	67,000	4,020
7	Scallions	0.02	Kg	26,000	520
8	Egg	0.12	Kg	28,000	3,360
9	Vermicelli	1	Pack	2,000	2,000
10	Sugar	0.02	Kg	19,000	380
11	Salt	0.01	Kg	24,000	240
12	Lime	0.05	Kg	30,000	1,500
13	Packaging	4	Sheet	1,000	4,000
Total					24,860

(Tampubolon et al., 2025). The production processes for skipjack fish rolade and fish balls, together with the corresponding raw materials and their prices, are presented in Tables 1 and 2.

In this study, the nutritional value of skipjack rolade was increased by adding vegetables in the form of carrots and chayote. Fish-based rolade has a high protein content that can be increased in nutritional value by adding other ingredients such as vegetables (Anggadiotama et al., 2023). The addition of carrots and chayote to skipjack rolade is consistent with earlier studies showing that fish-based products can be nutritionally improved by combining fish protein with complementary plant ingredients or carbohydrate matrices (Litaay et al., 2022; Tukan et al., 2025). Carrots are a source of provitamin A with a high β -carotene content, while chayote is high in minerals and contains vitamin C (Que et al., 2019; Vieira et al., 2019). Just like in the skipjack fish rolade product, the skipjack ball product in this study was increased in nutritional value by adding carrots. Its appearance, texture, and nutrition are enriched by the addition of vermicelli as an additional source of carbohydrates in the product. The use of carrots in skipjack balls and vermicelli as a carbohydrate source aligns with prior evidence that fillers and additives help determine water-holding capacity, elasticity, gel strength, and overall texture in fish-ball systems (Tampubolon et al., 2025).

The added value of fish rolade and fish balls was calculated using the Hayami method. The results are presented in Table 3 and are discussed as follows:

Outputs, Inputs, and Prices

In a single production cycle, both skipjack fish rolade and skipjack fish balls produced four packages of finished products from 1 kg of fresh skipjack fish as the primary raw material. Thus, the conversion factor for both products was identical, with each kilogram of raw material yielding four packages of finished products. In terms of labor utilization, the production of each product required one man-day of work per production cycle.

The conversion factor for both skipjack fish rolade and fish balls was 4, indicating that each kilogram of fresh skipjack fish yielded four packages of finished products. The labor coefficient, defined as the amount of labor required per unit of raw material processed, was 1 man-day (8 working hours) per kilogram of raw material

for both products. This labor requirement covered all production stages, including raw material preparation, ingredient mixing, product shaping, cooking, and packaging.

The output price of skipjack fish rolade was IDR 35,000 per package, whereas skipjack fish balls were sold at IDR 30,000 per package. The higher selling price of rolade reflects its more complex production process and higher perceived consumer value. More complex fish processing generally produces higher-value products than raw or minimally processed fish (Venkatappa et al., 2025). The raw material cost was identical for both products, with fresh skipjack fish priced at IDR 35,000/kg, and the labor wage was IDR 50,000 per man-day.

Income and Profits

The amount of other input contributions issued for skipjack rolade is IDR 38,900/kg production, while for skipjack balls is IDR 24,860/kg production. This difference in input contribution is due to the need for different additional materials, where rolade requires wrapping materials so that it is more complex than fish balls. Other input contributing components include flour, spices, vegetables, and packaging materials.

Added value represents the added value created in a commodity as a result of the commodity undergoing a processing and production process. Processing raises the unit value of raw fish, extends market options, and can create economic gains through changes in form, shelf life, convenience, and product differentiation (Ababouch et al., 2023; Eldein Shaltout, 2025). In an economic sense, added value is the difference between the value of output in the form of finished products and the value of inputs in the form of raw materials used in production activities (Haidi et al., 2020). The activity of processing fresh skipjack fish into fish rolls is able to create an added value of IDR 66,100 for each kilogram of raw materials, which is equivalent to an added value ratio of 47.21% of the final product value. On the other hand, the production of skipjack fish balls from fresh skipjack raw materials produces an added value of IDR 60,140 per kilogram with an added value ratio of 50.12%, indicating a relatively higher value conversion.

The labor in the manufacture of rolade and skipjack balls for both products is IDR 50,000 per kg. The share of labor from the added value produced for

Table 3. Calculation of Added Value on Skipjack Fish Rolade and Skipjack Fish Balls

Variable	Skipjack Fish Rolade		Skipjack Fish Balls	
	Value	Unit	Value	Unit
Outputs, Inputs, and Prices:				
Product Output	4	Pack	4	Pack
Raw Material Input	1	Kg	1	Kg
Workforce	1	Man-day	1	Man-day
Conversion Factors	4	-	4	-
Labor Coefficient	1	-	1	-
Product Price	35,000	IDR/Pack	30,000	IDR/Pack
Labor Wages	50,000	IDR/Man-day	50,000	IDR/Man-day
Income and Profits:				
Raw Material Input Price	35,000	IDR/kg	35,000	IDR/kg
Other Input Price	38,900	IDR/kg	24,860	IDR/kg
Product Value	140,000	IDR/kg	120,000	IDR/kg
Added Value	66,100	IDR/kg	60,140	IDR/kg
Added Value Ratio	47.21	%	50.12	%
Labor Income	50,000	IDR/kg	50,000	IDR/kg
Labor Share	75.64	%	83.14	%
Profit	16,100	IDR/kg	10,140	IDR/kg
Profit Rate	24.36	%	16.86	%
Reward to Production Factor:				
Margin	105,000	IDR/kg	85,000	IDR/kg
Labor Income	47.62	%	58.82	%
Other Input Contributions	37.05	%	29.25	%
Owner Profit	15.33	%	11.93	%

skipjack rolade is 75.64%, while for skipjack fish balls is 83.14%. The high share of labor in fish balls indicates that the proportion of added value enjoyed by the workforce is greater. That pattern matches the general meaning of labor share as the portion of gross value added going to employee compensation (Barkai, 2019; Donangelo, 2019).

Profit is defined as an economic surplus resulting from the difference between the income earned from the sale of a product or service and the total costs or expenses invested in the production process and operations of the business (Prasad et al., 2018). Based on the calculations carried out, it shows that the skipjack rolade processing is able to generate a profit of IDR 16,100 for each kilogram of raw materials processed, which is equivalent to a profit rate of 24.36% of the production output value. On the other hand, the production of skipjack balls provides lower profits, namely IDR 10,140 per kilogram with a profit percentage of 16.86% of the value of the product produced. The higher profit rate of the fish rolade shows that although the production cost is larger, the premium selling price is able to provide a better profit margin than the skipjack fish ball. That result is plausible in the wider seafood literature because processors can earn strong margins when value-added products command better prices, although profit capture varies widely across value chains and is not always proportional to processing effort (Wickrama et al., 2022; Mzingirwa et al., 2025).

Reward to Production Factor

The process of processing each kilogram of the main raw material into fish rolade products, obtained a

business margin of IDR 105,000 per kilogram. The margin is then distributed into three main components, including, compensation for labor which absorbs 47.62% of the total margin, contribution to other inputs of 37.05%, and net profit received by employers of 15.33% of the total margin. Meanwhile, for skipjack fish balls, a margin of IDR 85,000/kg was obtained with a distribution for labor compensation of 58.82%, other input contributions of 29.25%, and business profits of 11.93%. A comparison of the margin distribution of the two products shows a different pattern. Skipjack rolade has a larger margin with a higher proportion of business profits, but a lower share of labor rewards. In contrast, skipjack balls although have a smaller margin, but provide a larger share in the labor rewards. Margin differences across fish products are common, with actors in comparable chains earning very different returns per kg or channel (Wickrama et al., 2022). More differentiated fish products can return stronger processor margins, while labor is a major cost or margin component in fish enterprises (Olukunle, 2017; Pasch and Palm, 2021).

The amount of added value and the level of profit generated by the fish processing industry have a strong correlation with the structure of production costs incurred in the production process. In the context of these two products, skipjack rolade shows better performance in terms of profitability with a profit rate of 15.33%, so it can be a preferable product to be developed. Nevertheless, skipjack fish balls still have appeal due to their relatively simpler production process with lower input contributions, making them suitable for market penetration strategies at more affordable prices. Simpler products often remain attractive because lower input

burdens can support affordable pricing and easier market entry (Dolorosa and Nurliza, 2017). But affordable products can still be attractive when they are easier to produce, fit cottage-scale operations, and reach broader consumer segments (Delfino, 2023).

Conclusion

Processing skipjack fish into both fish rolade and fish balls generates high added value, demonstrating the economic potential of product diversification in the skipjack fish processing industry. Skipjack fish rolade generated an added value of IDR 67,450/kg with an added value ratio of 48.18%, while skipjack fish balls generated an added value of IDR 60,140/kg with an added value ratio of 50.12%. Based on the value-added ratio classification, both products fall into the high added-value category (>40%). Although skipjack fish balls exhibited a slightly higher added-value ratio, skipjack fish rolade achieved greater profitability, indicating that the two products offer different economic advantages. These findings provide useful insights for selecting appropriate product diversification strategies to support the development of a more profitable and sustainable skipjack fish processing industry.

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