Grouper : Jurnal Ilmiah Perikanan
Vol. 16 No. 2 (2025) pp. 318-332
pISSN: 2086-8480 | eISSN: 2716-2702
Journal Homepage: https://grouper.unisla.ac.id/index.php/grouper

Multifactor Evaluation of Good Manufacturing Practices Implementation on Cuttlefish Products in Cold Storage PPN Brondong, Lamongan

Hikmatul Aulia Farinsyah[1*], Wahyu Santoso[1], Gyska Indah Harya[2]

[123]Program Studi Agribisnis Fakultas Pertanian Universitas Pembangunan Nasional "Veteran" Jawa Timur, Surabaya, Indonesia

*Correspondence Author: wahyu.agri@upnjatim.ac.id

Submitted: 4 June 2025 Revised: 21 September 2025 Accepted: 30 September 2025

Keywords:
GMP; Cuttlefish; Factor Analysis; Cold Storage; PPN Brondong.

ABSTRACT

This study aims to evaluate the main components of Good Manufacturing Practices (GMP) in the processing of cuttlefish products at the Cold Storage facility of PPN Brondong, Lamongan. GMP plays a crucial role in ensuring the quality and safety of fishery products to meet export standards. Data analysis was conducted using a factor analysis approach with the assistance of SPSS version 25. The results of the KMO test (0.777) and Bartlett's test indicate that the data is suitable for analysis. Eight GMP variables were successfully grouped into five main factors, which together explain more than 90% of the data variation. The most influential factors identified were packaging and labeling, storage, sanitation facilities, transportation, and the selection of raw and auxiliary materials. The strength of this research lies in its comprehensive approach to evaluating eight key GMP variables through factor analysis, an approach that has rarely been applied in similar studies. These findings provide a critical foundation for strengthening GMP implementation to enhance the quality and competitiveness of Indonesian cuttlefish products in the global market.

INTRODUCTION

Sotong (Sepia sp.) is one of Indonesia's leading export commodities, which belongs to the Cephalopoda group along with squid and octopus. Based on Indonesia's export data for fishery products from 2017–2021, types of cephalopods such as squid, cuttlefish, and octopus showed annual increases of 9.6% and 13.24%, respectively, in both volume and value. The latest data from the Ministry of Marine Affairs and Fisheries (KKP) in 2024 also shows a significant increase of 14.63% compared to the previous year for the export of squid, cuttlefish, and octopus. These figures reflect the high demand from the international market, especially from European Union countries, the United States, Japan, ASEAN, China, and South Korea (KKP, 2024).

This situation opens up numerous opportunities for Indonesia to optimize squid exports as one of the high-value commodities. However, as global demand increases, importing countries are also becoming stricter in setting quality and food safety standards. The main challenge in squid processing lies in the suboptimal post-catch handling. Based on the research by Prabhakar et al. (2020) improper handling can result in microbial contamination that damages product quality. Additionally, the biological characteristics of cuttlefish, which have a high water content, make them prone to quality deterioration (Widiastuti et al., 2019), thus requiring proper and hygienic.

Freezing cuttlefish is one method of keeping its quality from declining. Food can be preserved by freezing it by bringing its temperature down below its freezing point. Almost all of the water in the fish meat is turned into ice during this procedure. The texture of frozen fish returns to that of fresh fish when it thaws. When compared to traditional refrigeration, the frozen state prolongs the shelf life of fish by inhibiting bacterial and enzymatic activity (Zega et al., 2017). Fishery goods have been shown to have a longer shelf life when frozen. But with this method, there is still a chance of contamination before, during, and after the freezing process, particularly if the cold chain and sanitation protocols are not followed correctly. Thorough quality control is essential throughout the whole production process, not just during the freezing phase. Good Manufacturing Practices (GMP) are one component of a continuous quality assurance system that must be put in place to guarantee that frozen cuttlefish products fulfill international standards. From the selection of raw materials to processing, packaging, storage, and distribution, GMP provides a technical guideline for the correct execution of food manufacturing operations. The goal of GMP implementation is to create high-quality, safe, and hygienic products that are risk-free from contamination. The Regulation of the Minister of Industry of the Republic of Indonesia Number: 75/M-IND/PER/7/2010 on Guidelines for Good Manufacturing Practices (GMP) for Processed Food Products and the Decision of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia No. 52A/KEPMEN-KP/2013 on Quality and Safety Requirements for Fisheries Products in the Production, Processing, and Distribution are two examples of national regulations that regulate GMP. These regulations cover 18 areas of requirements, ranging from location, buildings, sanitation, and production facilities to supervised processing.

Cold storage at the Nusantara Fishing Port (PPN) Brondong is one of the important facilities in the processing and storage chain for fishery products. PPN Brondong, as a port with high fishing activity, plays a crucial role in maintaining post-harvest quality, including through the provision of storage and processing facilities that meet standards. However, there are still several environmental issues that could potentially affect the quality of the catch. In the second quarter of 2024, although monitoring of the Environmental Management Plan and Environmental Monitoring Plan was carried out fairly well, laboratory test results showed that the total ammonia (NH_3-N) parameter exceeded the quality standard. This is likely due to fish washing activities during loading and unloading, as well as the presence of an oil layer generated by traditional fishing vessels that are not equipped with oil-water separators. Additionally, the increase in waste volume and liquid waste from washing and cutting fish has not been adequately managed because the Wastewater Treatment Plant (WWTP) is not functioning properly (PPN, 2024). This situation can degrade the quality of the surrounding aquatic environment and directly impact the quality of fisheries product handling, including squid, which is highly sensitive to cleanliness and sanitation aspects.

Cold Storage PPN Brondong, as an export support processing unit, has a major responsibility in maintaining product quality and safety. In order to meet international market demand, every stage of the production process, from location, sanitation programs, sanitation facilities, raw material reception, washing, processing, freezing, to storage, must be carried out in accordance with GMP principles. Evaluating the implementation of GMP at Cold Storage PPN Brondong is crucial to ensuring that food quality and safety standards are consistently applied. This is particularly important given the high demands from export destination countries regarding product sustainability and quality. Any non-compliance in GMP implementation can lead to reduced product quality, increased risk of microbial contamination, and rejection by the global market (G. I. Harya, 2018). A comprehensive evaluation of the key components of GMP implementation is not only beneficial for assessing compliance levels but also serves as a foundation for continuous improvement in enhancing production efficiency and product competitiveness (G. Harya et al., 2024; G. I. Harya et al., 2024), particularly for Indonesian cuttlefish products in the international market.

The objective of this study was to evaluate the main components of Good Manufacturing Practices (GMP) in cuttlefish products at PPN Brondong.

LITERATURE REVIEW

Cuttlefish *(Sepia sp.)* are marine organisms classified under the Cephalopoda class, typically inhabiting shallow to moderate waters, especially in tropical and subtropical areas. Their habitat consists of sandy or muddy seabeds at depths ranging from around 10 to 200 meters. The cuttlefish possesses an oval or slightly rounded body form, in contrast to the more elongated squid. Squids possess an internal structure known as a cuttlebone, which functions as a buoyancy assist. This shell is oval, white, composed of calcium carbonate, and situated within the mantle. The squid possesses a comparatively tiny body that resembles a pouch, featuring eight short arms and two elongated tentacles utilized for seizing prey. Furthermore, cuttlefish possesses significant economic worth owing to its tender texture and elevated nutritional content. Processed products, including fresh, frozen, and dried meat, have emerged as significant commodities in both local and international markets (Mukhlis, 2016).

A crucial phase in the processing of fisheries goods is freezing, which serves as a preservation technique by reducing the product's temperature to significantly below the freezing point, specifically between -18°C and -30°C. At this temperature, enzyme activity and the proliferation of harmful microorganisms can be markedly inhibited, consequently prolonging the shelf life of fisheries goods. In contrast to cooling, freezing nearly entirely transforms the water content in fish into ice. It is essential to guarantee that the quality and inherent characteristics of the fish are preserved post-thawing. Consequently, freezing is a crucial component of the cold chain system for preserving the quality of processed items like squid (Dewayani, 2016).

Good Manufacturing Practices (GMP) or Good Food Production Practices are protocols designed to ensure food safety and quality, particularly in the home business. Good Manufacturing Practices (GMP) comprise the essential principles of safe and high-quality food processing, including the selection of raw materials, sanitation, manufacturing facilities, and storage and distribution networks. The principal objective of GMP is to ensure that food products are safe for consumption and adhere to the standards set by both domestic consumers and international markets (Nugraha & Purwadhi, 2020). The proficient implementation of Good Manufacturing Practices (GMP) can improve production efficiency, maintain product quality, and expand access to global markets in seafood processing industries, such as squid (Dewi & Anggraeni, 2022).

METHOD

Research Location and Time

This research was conducted at the Nusantara Brondong Fishing Port Cold Storage. This research was conducted from December 2024 to February 2025.

Data Collection Method

The sampling method used purposive sampling, which is a technique of selecting respondents deliberately based on certain criteria (Sugiyono, 2013(K3 The research respondents were divided into two categories, namely internal and external parties. Internal parties consisted of 1) Cold Storage Managers and 2) Cold Storage Officers. External parties consist of 1) Processing Managers and 2) Production Department Employees. Thus, the total sample size is 26 respondents. The data collection methods used are observation, interviews, questionnaires, and literature review.

Analysis Method

The data analysis methods used include descriptive analysis and inferential analysis. Descriptive analysis is performed first as an initial stage, which includes presenting, grouping, and simplifying data Maratussholihah dan Santoso, 2019). Next, inferential analysis is performed through factor analysis with the help of IBM SPSS Ver. 25 software. The results of the factor analysis show that there are two types of factors: unique factors and common factors. Unique factors are only related to one variable, while common factors are a combination of several variables. The factor analysis model is expressed by the following formula:

$$Fi = Wi1X1 + Wi2X2 + Wi3X3 + \ldots + WikXk$$

where:

Fi = Estimated factor i

Wi = Weight or factor score coefficient

Xk = Number of X variables in factor k

The variables measured as factors in this study are:

X1 = Location

X2 = Sanitation Facilities

X3 = Selection of Raw Materials and Auxiliary Materials

X4 = Production Process Supervision

X5 = Storage

X6 = Packaging and labeling

X7 = Product transportation

X8 = Maintenance and sanitation programs

The above variables are a combination of the Indonesian Minister of Industry Regulation No. 75/M-IND/PER/7/2010 and Kepmen No. 52A/Kepmen-KP/2013, which were then adjusted to the conditions in the field.

RESULT AND DISCUSSION

Fishery goods are a primary commodity that considerably contributes to Indonesia's economic growth, particularly via the export industry. The quality and safety of fishery products are crucial in fulfilling ever rigorous international market standards. Mandang et al. (2022) assert that their research highlights the necessity of regulating the microbiological and organoleptic quality of processed fish products during storage, which corresponds with the imperative to implement quality standards in the fisheries sector. The application of Good Manufacturing Practices (GMP) is crucial to guarantee that the manufactured items are safe, of superior quality, and comply with the regulatory norms of the destination country for export. The implementation of GMP encompasses the production process as well as the management of raw materials, sanitation, facilities, and comprehensive documentation.

Cold Storage PPN Brondong, as one of the strategic fishery product processing units in the Lamongan region, plays a very important role in ensuring the quality and safety of products before they are marketed overseas. However, challenges in raw material management, production processes, and product storage require continuous evaluation of the implementation of Good Manufacturing Practices (GMP). The urgency of evaluating the key components of GMP implementation is particularly important, as each production stage has the potential to become a source of contamination if not managed in accordance with applicable standards. Regular evaluations of GMP implementation at fisheries processing units are proactive steps to maintain product quality, reduce the risk of export rejection, and strengthen the position of Indonesian products in the global market. Research by Dewi et al. (2024) shows that consistent implementation of GMP and SSOP can improve the quality of processed fish products, such as tuna loin, to meet national and international standards. This study emphasizes the importance of continuous evaluation of GMP aspects to ensure the safety and quality of fishery products.

a. Bartlett's Test of Sphericity

Bartlett's Test of Sphericity is conducted to assess the significance of correlations between variables in the correlation matrix, where the acceptance criterion is indicated by a significance value (p) of less than 0.05. The results in Table 1 show a significance value of 0.00 ($p < 0.05$), indicating a fairly strong relationship between the variables in the model. This test is based on the transformation of the correlation matrix determinant into a chi-square statistic. Sample adequacy testing was performed using the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy. This index measures the proportion of variance among variables that can be attributed to underlying factors. Based on the results in Table 1, the KMO value obtained was 0.783, which exceeds the minimum threshold of 0.5. Therefore, it can be concluded that the data in this study are suitable for further analysis using factor analysis.

Table 1. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure Of Sampling Adequacy		.777
Barlett's Test of Sphericity	Approx Chi-Square	78.405
	Df	28
	Sig.	.000

Source: Processed Primary Data (2025)

b. Measure of Sampling Adequacy (MSA) Test

The MSA test is conducted to measure the extent to which certain variables can be predicted or explained through other variables in factor analysis. This test is very important to determine the adequacy of data in factor analysis. The results of the variables formed after the MSA test are presented in Table 2 below.

Table 2. Measure of Sampling Adequacy (MSA) Test

Variable	**MSA Value**
Location (X1)	0.803
Sanitation Facilities (X2)	0.603
Raw Material and Auxiliary Material Selection (X3)	0.788
Production Process Supervision (X4)	0.846
Storage (X5)	0.740
Continuation of Table 2.	

Variable	MSA Value
Packaging and Labeling (X6)	0.730
Transportation (X7)	0.888
Maintenance and Sanitation Program (X8)	0.778

Source: Processed Primary Data (2025)

The findings of the anti-image correlation test indicate that the Measure of Sampling Adequacy (MSA) value for each variable is as follows: The Location variable (X1) possesses an MSA value of 0.803, indicating that it may be accurately predicted by other variables, as its value surpasses the minimum threshold of 0.5. Additionally, the Sanitation Facilities variable (X2) exhibits an MSA value of 0.603, signifying its appropriateness for future examination. The Raw Material and Auxiliary Selection variable (X3) possesses an MSA value of 0.788, signifying that X3 is adequately predictable by other factors. Likewise, variables X4, X5, X6, X7, and X8 has MSA values exceeding 0.5. Consequently, all variables satisfy the eligibility criteria for factor analysis and are suitable for further examination.

c. Factor Extraction

Table 3. Communalities Value Testing

Variable	Initial	Extraction
Location (X1)	1.000	.941
Sanitation Facilities (X2)	1.000	.945
Raw Material and Auxiliary Material Selection (X3)	1.000	.935
Production Process Supervision (X4)	1.000	.803
Storage (X5)	1.000	.914
Packaging and Labeling (X6)	1.000	.874
Transportation (X7)	1.000	.981
Maintenance and Sanitation Program (X8)	1.000	.859

Source: Processed Primary Data (2025)

Based on Table 3 above, Communalities show the proportion of variance of a variable that can be explained by all factors in the factor analysis model. The analysis results show that the initial communality value for each variable from X1 to X8 is 1. This indicates that at the initial stage, all variables are assumed to have full contribution to the overall factor structure. This value is entered into the main diagonal of the correlation matrix. Meanwhile, the total variance explained indicates the amount of variance that can be explained by the factors extracted from the analysis. Factors with eigenvalues greater than one are retained in the model, as factors with values below one are considered unable to optimally explain the variable structure and are therefore not included in the factor formation process (Maratussholihah dan Santoso, 2019).

According to Table 3, the extraction communalities for each variable demonstrate a significant contribution to elucidating the variation attributed to the principal factors. The initial variable (X1) possesses a value of 0.941, indicating that almost 94% of its variance may be attributed to the primary component. The second variable (X2) is valued at 0.945 (about 94%), whereas the third variable (X3) is valued at 0.935 (roughly 93%). The fourth variable (X4) is valued at 0.803, or roughly 80%; the fifth variable (X5) is valued at 0.914 (91%); the sixth variable (X6) is valued at 0.874 (87%); and the seventh variable (X7) is valued at 0.981 (98%). The eighth variable (X8) has a value of 0.859, indicating that around 86% of its variance is attributable to the primary factor. Consequently, all variables exhibit elevated communalities, signifying that each variable merits more examination within the framework of component analysis.

d. Determining the Number of Factors

The main goal of factor extraction is to identify the main factors or components that can explain a large proportion of the variation in the data. One approach used to determine significant factors is to look at the eigenvalue. Factors with eigenvalues greater than 1 are considered to have a significant contribution and are worth considering in factor analysis. This extraction process is carried out using SPSS software, and the factor extraction results are presented as follows:

Table 4. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums Of Square Loading			Rotation Sums Of Square Loading		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.967	49.590	49.590	3.967	49.590	49.590	2.333	29.168	29.168
2	1.406	17.580	67.171	1.406	17.580	67.171	1.584	19.802	48.970
3	.887	11.085	78.256	.887	11.085	78.256	1.364	17.056	66.026
4	.563	7.040	85.296	.563	7.040	85.296	1.145	14.308	80.334
5	.427	5.339	90.635	.427	5.339	90.635	.824	10.301	90.635
6	.304	3.794	94.429						
7	.224	2.804	97.233						
8	.221	2.767	100.000						

Source: Processed Primary Data (2025)

Based on the results shown in Figure 4 (Total Variance Explained), it is known that there are five factors that have eigenvalue values greater than 1. These five factors are new components formed through the extraction process from the initial data. The first factor has an eigenvalue of 3.967 and explains 49.59% of the total variation in the data. The second factor has an eigenvalue of 1.406 and explains approximately 17.58% of the variation, while the third factor, with an eigenvalue of 0.887, explains 11.1% of the total variation. The fourth factor has an eigenvalue of 0.563, explaining 7% of the variation, and the fifth factor has an eigenvalue of 0.427, contributing 5.33%. Thus, these five factors collectively explain approximately 90.63% of the total variation in the data, indicating that most of the information in the data can be represented through these five factors.

Scree plots are utilized to ascertain the number of variables. A scree plot is a graphical representation illustrating the correlation between components and eigenvalues. The Y-axis denotes eigenvalues, whilst the X-axis indicates the number of components. The quantity of elements considered is dictated by the pronounced gradient between consecutive components.

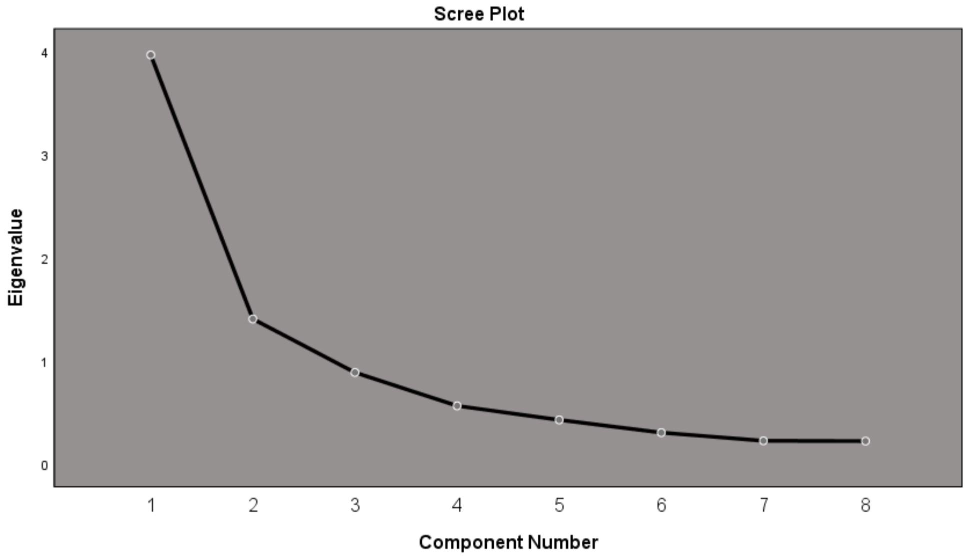

Figure 1. Scree Plot Diagram

Figure 1 shows the pattern of decreasing eigenvalues of the eight components generated in the factor analysis process. It can be seen that the first component has the highest eigenvalue, which is around 4, indicating that this component explains the largest proportion of variation in the data. After the first component, there is a sharp decline in the second component, followed by a more gradual decline up to the eighth component. This pattern forms a fairly clear elbow point at the second component, which is an important indicator in determining the number of relevant factors. Based on Kaiser's criterion, which suggests retaining components with eigenvalue values greater than 1, and considering the pattern in the scree plot, it can be concluded that two main factors are worth retaining. The subsequent factors have a relatively small contribution to the overall data variation.

e. Factor Rotation

Factor rotation is a method used to change the orientation of factors generated from the initial analysis. The aim is to make these factors easier to understand and interpret. The rotated component matrix table is as follows:

Table 5. *Rotated Component Matrix*

	Component				
	1	2	3	4	5
Location (X1)	.926	.102			
Sanitation Facilities (X2)	.900		.159		.129

	Component				
	1	2	3	4	5
Raw Material and Auxiliary Material Selection (X3)	.688	.436		.318	.193
Production Process Supervision (X4)	.121	.880		.144	.324
Storage (X5)	.346	.661	.553	.230	-.158
Packaging and Labeling (X6)			.928	.178	.218
Transportation (X7)	.129	.198	.235	.913	.193
Maintenance and Sanitation Program (X8)	.196	.357	.337	.316	.746

Source: Processed Primary Data (2025)
Extraction Method: Participal Component Analysis
Rotation Methode: Varimax with Kaiser Normalization
Rotation converged in 7 iterations

Table 5 presents the results of the Rotated Component Matrix from the factor analysis conducted using the Principal Component Analysis (PCA) method with Varimax rotation. This matrix is used to identify and group variables into main factors based on the highest loading values in each component. Based on Table 5, five main components were obtained after the rotation process converged at the sixth iteration. The analysis results show that the Packaging and Labeling variables have the highest factor loading value of 0.926 on Component 1, so they are classified into the first component. Furthermore, the Storage variable has the highest factor loading value in Component 2, which is 0.880. The Sanitation Facilities variable has a high correlation with Component 3, with a loading value of 0.928. The Transportation variable has the highest value in Component 4, at 0.913, while the Raw Material Selection and Auxiliary Materials variables are classified into Component 5 because they have the highest loading factor of 0.746.

Packaging is a key step in the product handling process because it protects the contents from physical damage, contamination, and quality changes throughout distribution and storage. Furthermore, packaging helps to preserve product quality stability, lengthen shelf life, and make the distribution process more efficient. Meanwhile, labels are an essential component of packaging that informs customers about the product's identification and qualities. Labels normally feature the following information: brand, size, net weight, approval number, manufacture date, expiration date, and ingredients. This information is critical for maintaining transparency and ensuring that consumers obtain safe and high-quality products. According to the Food and Drug Supervisory Agency (2019), in Regulation No. 20 of 2019 on Food Packaging, packaging materials must meet technical criteria such as physical strength, resistance to steam, gas, and odor, non-contamination, and no impact on product quality during freezing or storage processes.

Cuttlefish products stored in cold storage facilities at PPN Brondong use polyethylene (PE) plastic packaging and master cartons. Polyethylene is known for its physical properties that support product quality, such as transparency, water resistance, and flexibility, making it ideal for frozen products (Hafina et al., 2021). Meanwhile, master cartons serve as secondary or final packaging that provides additional protection against physical damage, aids in product identification, facilitates distribution, and enhances the product's aesthetic value (Zulfikar, 2016). Labeling on master cartons is done as a form of communication between producers and consumers, containing important information such as product type and contents, producer name, production code, ingredients, net weight, expiration date, and storage instructions. This information is crucial in ensuring product quality remains intact until it reaches the end consumer, especially for products whose quality cannot be directly assessed through physical observation (Suryanto & Sipahutar, 2020).

Storage is a critical phase in the food product supply chain, involving the placement of products under certain environmental conditions to preserve quality and prolong shelf life (Harya et al., 2020). The preservation of fisheries goods seeks to avert microbiological contamination and preserve product quality, specifically concerning freshness, texture, color, and nutritional content (Karo et al., 2017). The storage of cuttlefish goods is conducted at a core temperature of -18°C, which effectively inhibits microbial growth and mitigates chemical reactions that lead to quality degradation. Zulfikar (2016) asserts that the purpose of cold storage for cuttlefish is to preserve product freshness throughout the interim period before marketing or export, so guaranteeing the quality is maintained until it reaches the final consumer. The storage procedure is executed methodically, with staff utilizing hand pallets to transfer master cartons of frozen cuttlefish, which are subsequently organized in the cold storage area via forklifts to prevent direct floor contact and reduce contamination risk.

Transportation, referred to as loading, constitutes the final phase in the product handling process prior to distribution or marketing. Currently, frozen cuttlefish products, packaged in master cartons and stored in cold storage, are being loaded onto transport vehicles for delivery to domestic and international markets. This procedure utilizes equipment like hand pallets or forklifts to enhance transportation and reduce physical harm to the products. Transportation is executed meticulously to ensure consistent product temperature during the transit procedure. This stage is crucial; improper execution may result in temperature variations and heighten the danger of product quality degradation, including alterations in texture, aroma, and potential microbiological infection. Inadequate handling and distribution can lead to a deterioration in fish quality, adversely affecting food safety and the market value of fisheries products (Maruli et al., 2023).

The selection of raw and auxiliary materials is a critical phase in guaranteeing the quality and safety of processed fishing products. The raw materials utilized must originate from reputable sources and adhere to defined quality criteria, including seafood freshness and absence of chemical, microbiological, and physical contaminants. The absence of rigorous selection procedures may lead to the incorporation of inappropriate raw materials, thus diminishing the quality of the final product and jeopardizing consumer health. Auxiliary materials, such ice, water, and food additives, must adhere to food safety requirements, as they might act as vectors for pollutants if inadequately regulated. Consequently, the execution of Good Manufacturing Practices (GMP) necessitates rigorous selection protocols for raw and auxiliary components. This selection include physical and sensory inspections, as well as documentation of the source of origin and laboratory testing as required (BPOM RI., 2020).

Sanitation facilities are a crucial component of the quality assurance system in the fish processing sector. These facilities encompass the infrastructure and resources employed to uphold the cleanliness of the work environment, equipment, and workers, ensuring that the generated goods stay safe and suitable for consumption. Frozen squid processing facilities are equipped with sanitation amenities, including handwashing stations, hygienic restrooms, wastewater drainage systems, and cleaning supplies such as antiseptic soap and disinfectants. Proper sanitation of the environment and facilities can avert cross-contamination between raw materials and finished goods. Substandard sanitation facilities can serve as a source of microbial contamination, jeopardizing safety and diminishing the quality of fishing products (Chaerul et al., 2021). Effectively designed and professionally executed sanitation facilities will substantially enhance the preservation of product quality throughout the production process until distribution. Sanitation facilities are integral to the execution of the Hazard Analysis Critical Control Point (HACCP) system and Good Manufacturing Practices (GMP), which fish processing operations must adhere to in order to meet national and international quality requirements.

CONCLUSION

The results and discussion indicate that Principal Component Analysis (PCA) effectively categorized the Good Manufacturing Practices (GMP) variables into five principal components that substantially impact the quality and efficacy of GMP implementation at Cold Storage PPN Brondong. The components are: packing and labeling (component 1), storage (component 2), sanitation facilities (component 3), transportation (component 4), and selection of raw materials and auxiliaries (component 5). All five components have been effectively executed in the use of

Good Manufacturing Practices for cuttlefish goods at Cold Storage PPN Brondong. The diligent and uniform application of all facets of GMP is essential to avert product quality deterioration and prevent potential rejection in export markets. Consistent assessments and reinforced GMP execution are essential proactive measures to improve the quality and competitiveness of Indonesian fisheries products in the global market.

REFERENCES

BPOM RI. (2020). *Pedoman Cara Produksi Pangan Olahan yang Baik (CPPOB)*. Jakarta: Badan Pengawas Obat dan Makanan Republik Indonesia.

Dewayani, G. M. (2016). *Penerapan Metode Air Blast Freezing (ABF) pada Pembekuan Ikan Salmon Chum (Oncorhynchus Keta) di PT. Marine Cipta Agung, Pasuruan, Jawa Timur.* Universitas Airlangga.

Dewi, N. P. K., Pandit, I. G. S., & Darmadi, N. M. (2024). Penerapan GMP dan SSOP terhadap Mutu Ikan Tuna Loin Segar (*Thunnus Sp.)* Di PT. Bahari Lancar Abadi Badung, Bali. *Gema Agro*, *29*(2), 59–64. https://doi.org/10.22225/ga.29.2.8955.59-64

Dini, K., Chaerul, D. P., Kidri Alwi, M., Hardi, I., Keselamatan, P., Kerja, K., Masyarakat, K., Muslim Indonesia, U., & Gizi, P. (2021). Penerapan Higiene Dan Sanitasi Rumah Tangga Pengolahan Tahu Di Kelurahan Bara-Baraya Kota Makassar. In *Window of Public Health Journal* (Vol. 1, Issue 5).

Hafina, A., Sipahutar, Y. H., & Siregar, A. N. (2021). Penerapan GMP Dan SSOP Pada Pengolahan Udang Vannamei (*Litopenaeus vannamei*) Kupas Mentah Beku Peeled Deveined (PD). *Aurelia Journal*, *2*(2), 117–131

Harya, G. I. (2018). Analisis Faktor-Faktor yang Mempengaruhi dan Upaya Meningkatkan Daya Saing Kakao Jawa Timur. *Berkala Ilmiah Agribisnis AGRIDEVINA*, *7*(1).

Harya, G. I., Hanani, N., Asmara, R., & Muhaimin, A. W. (2024). Study of Technical Efficiency of The Cocoa Industry Using Data Envelopment Analysis. *Revista Iberoamericana de Viticultura Agroindustria y Ruralidad*, *11*(33), 130–145. https://doi.org/10.35588/rivar.v11i33.6257

Harya, G. I., Sudiyarto, & Santoso, W. (2020). Model Prioritas Untuk Kinerja Rantai Pasok Kakao di Jawa Timur, Indonesia. *Jurnal Sosio Agribis*, *20*(1).

Harya, G., Kuswanto, K., Asmara, R., Ibrahim, J., Maulidah, S., & Budiwitjaksono, G. (2024). Taking a Deeper Look at The Priority of Agricultural Industry Efficiency Through The Use of Data Envelopment Approach. *Agroalimentaria*, *29*(57), 167–177. https://doi.org/10.53766/agroalim/2024.29.57.08

Karo, Y. C. Br., Nopianti, R., & Lestari, S. D. (2017). Pengaruh Variasi Suhu Terhadap Mutu Abon Ikan Ekonomis Rendah Selama Penyimpanan. *Fishtech-Jurnal Teknologi Hasil Perikanan*, *6*(1), 80–91.

Kementerian Kelautan dan Perikanan. (2024). *Laporan Kinerja Kementerian Kelautan dan Perikanan*. Jakarta: Kementerian Kelautan dan Perikanan Republik Indonesia.

Kementerian Perindustrian. 2010. Peraturan Menteri Perindustrian Republik Indonesia Nomor: 75/M-IND/PER/7/2010 Tentang Pedoman Cara Produksi Pangan Olahan yang Baik (Good Manufacturing Practices). In *Kementerian Perindustrian Republik Indonesia*. www.djpp.depkumham.go.id

Mandang, M. S. S., Mentang, F., Dien, H. A., Palenewen, J. C. V., Montolalu, R. I., & Pandey, E. V. (2022). Mutu Mikrobiologis Dan Organoleptik Penyedap Rasa Alami Hasil Samping Ikan Cakalang Selama Penyimpanan. *Media Teknologi Hasil Perikanan*, *10*(3), 165–170. https://doi.org/10.35800/mthp.10.3.2022.34480

Mar'atussolihah, E. D., & Wahyu, S. (2019). Kajian Multidimensional Faktor Penerapan Good Retailing Practices (GRP) Produk Pangan Segar Asal Tumbuhan Di Supermarket Kota Surabya. *Berkala Ilmiah Agribisnis AGRIDEVINA*, *8*(2), 145–158.

Maruli, S., Damayanti, P., Solihin, A., & Ahmadi, N. (2023). Strategi Penguatan Mutu Ikan Dalam Transportasi Dan Distribusi Ikan Di Ambon. *COJ (COASTAL AND OCEAN JOURNAL)*, *07*(1), 17–30. https://journal.ipb.ac.id/index.php/coj;

Menteri Kelautan dan Perikanan. 2013. Keputusan Menteri Kelautan dan Perikanan Republik Indonesia Nomor 52A/KEPMEN-KP/2013 Tentang Persyaratan Jaminan Mutu dan Keamanan Hasil Perikanan pada Proses Produksi, Pengolahan dan Distribusi. In *Menteri Kelautan dan Perikanan Republik Indonesia*.

Mukhlis, N. (2016). *Identifikasi Sumberdaya Sotong (Sepia sp) dan Kajian Biologi Spesies Sotong yang Dominan Didaratkan di Muncar, Banyuwangi Jawa Timur.* . Universitas Brawijaya.

Nugraha, fajar, & Purwadhi. (2020). Efektivitas Pelatihan Berbasis Gamifikasi dalam Meningkatkan Pemahaman Karyawan Terhadap Konsep Good Manufacturing Practices. *Jurnal Manajemen Jasa*, *2*(2), 89–99.

Pelabuhan Perikanan Nusantara Brondong. (2024). *Laporan Kinerja Pelabuhan Perikanan Nusantara Brondong Triwulan II Tahun 2024*.

Prabhakar, P. K., Vatsa, S., Srivastav, P. P., & Pathak, S. S. (2020). A comprehensive review on freshness of fish and assessment: Analytical methods and recent innovations. *Food Research International*, *133*.

Sugiyono. (2013). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D.* Bandung: Alfabeta.

Suryanto, M. R., & Sipahutar, Y. H. (2020). Penerapan GMP dan SSOP pada Pengolahan Udang Putih (Litopenaeus vannamei) Peeled Deveined Tail On (PDTO) Masak Beku di Unit Pengolahan Ikan Banyuwangi. *Seminar Nasional Kelautan Dan Perikanan Ke-VII*, 204–221.

Widiastuti, I., Ridho, M. H., & Arrahmi, N. Y. (2019). Karakteristik Sotong (Sepia recurvirostra) Asap Yang Diolah Dengan Berbagai Konsentrasi Asap Cair. *JPHPI*, *22*(1), 24–32.

Zega, O., Baehaki, A., & Herpandi. (2017). Pengaruh Ekstrak Apu-apu (Pistia stratiotes) terhadap Daya Simpan Fillet Ikan Patin (Pangasius sp.) yang Disimpan pada Suhu Dingin. *Jurnal FishtecH*, *6*(1), 69–79. https://doi.org/10.36706/fishtech.v6i1.4453.

Zulfikar, R. (2016). Cara Penanganan yang Baik Pengolahan Produk Hasil Perikanan Berupa Udang. Jurnal Aplikasi Teknologi Pangan, 5(2), 29–53. www.jatp.ift.or.id.