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Identification of Potential Consumer Segments of Smoked Tuna (*Thunnus spp.*) through E-commerce

Tian Nur Ma'rifat[1*], Febriyani Eka Supriatin[1], Eko Waluyo[1], Arief Rahmawan[2]

[1]Faculty of Fisheries and Marine Science, Universitas Brawijaya, Malang, Jawa Timur, 65145, Indonesia
[2]Faculty of Science and Technology, Universitas Darussalam Gontor, Ponorogo, Jawa Timur, 63471, Indonesia
[*]Email Correspondence: tiannurm@ub.ac.id

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ABSTRACT*: This study explores consumer segmentation for smoked seafood in Indonesian e-commerce, aiming to identify distinct buyer groups and their preferences. The problem lies in the limited understanding of market segmentation and the absence of smoked tuna trade through e-commerce platforms in Indonesia, despite the country's significant tuna production capacity. The research categorizes different consumer segments by analyzing key factors shaping their purchasing decisions. Data were collected from 246 respondents who had purchased smoked tuna from Prigi Beach and had prior e-commerce experience. K-means clustering analysis was applied to classify respondents into two clusters based on their demographic characteristics, behaviors, and perceptions. The study observed three key behavioral variables: Perceived Social Norm (PSN), Perceived Relative Advantage (PRA), and Perceived Health Benefit (B). Cluster 1, comprising 53% of respondents, is characterized by younger, health-conscious individuals, predominantly female, with a higher frequency of purchasing through e-commerce. They perceive e-commerce as a faster, more cost-effective option and show stronger intentions to buy smoked seafood due to its nutritional value, distinctive taste, halal certification, affordability, and convenience. In contrast, Cluster 2, accounting for 47% of respondents, has a more varied demographic and lower frequency of online purchases. The findings suggest that Cluster 1 presents a more promising target for producers. By focusing on this segment's preferences and leveraging digital platforms, businesses can optimize their marketing strategies, enhance consumer engagement, and expand market reach. These results highlight the potential of e-commerce as a transformative platform for the seafood industry, offering insights into consumer segmentation and strategic opportunities for market growth.*

Keywords: *cluster; consumers; market potential; online platforms*

1. INTRODUCTION

The e-commerce sector has experienced significant growth in recent years, establishing itself as a dominant distribution channel in Indonesia for various products, including processed foods. In 2022, expenditure in the food sector in e-commerce ranked second after electronics with an estimated value of USD 6.09 million. (Kementrian Perdagangan, 2023). Several benefits of e-commerce perceived by SMEs are expanding market access, boosting sales, enhancing external communication, elevating brand image, and accelerating processing speed (Rahayu & Day, 2017). Its convenience, purchasing flexibility, and growing digital literacy have made e-commerce highly appealing to consumers (Hendriana, 2021). In the context of food product, sellers in e-commerce face several challenges despite the advantages of online platforms. E-commerce sellers encounter challenges related to food safety due to a short shelf-life of the products (Nurfadila et al., 2024), and lack of capacity (Aprilianti & Amanta, 2020). Besides, sellers need to maintain a resilient food supply chain to handle demand fluctuations, seasonal stock, and logistics issues (Harahap et al., 2023). Despite these challenges, the continued growth and adoption of e-commerce highlight its potential as a transformative platform for the processed seafood industry in Indonesia.

The smoking process of seafood enhances the flavor, adds value, and boosts the competitiveness of seafood products in domestic market. Smoking significantly enhances the aroma, taste, texture, and color of seafood, making it more appealing to consumers (Arvanitoyannis & Kotsanopoulos, 2012). Smoking introduces a variety of volatile compounds such as phenols, furans, aldehydes, and ketones, which contribute to the unique smoky flavor and aroma of seafood products(Lacalle-Bergeron et al., 2020). This traditional preservation method also extends the shelf life of the product by preventing lipid oxidation and microbial growth(Baten et al., 2020), making it more suitable for broader distribution (Lelwela et al., 2021). By transforming raw seafood into a processed product, smoking increases its market value. Although this processing method offers numerous advantages, limitations exist regarding standardization of smoking methods and challenges in maintaining consistent quality during e-commerce distribution.

While e-commerce has significantly transformed the distribution and marketing of food products, including seafood, limited research has specifically examined its application to smoked seafood. Because of this reason, this paper mainly focuses on smoked seafood. Existing studies primarily focus on e-commerce logistics (Tsang et al., 2021)(H. Zhang et al., 2020), or consumer behavior in online food purchases (Lin et al., 2021)(Wang & Somogyi, 2018). However, little is known about the market potential of smoked seafood through e-commerce platforms in Indonesia. Indonesian consumers, particularly younger, urban demographics, increasingly prioritize health, sustainability, and convenience, driving demand for responsibly-sourced seafood through online channels (Statista, 2025). While earlier studies have focused separately on e-commerce logistics, online food purchasing behavior, or general consumer perceptions of smoked seafood, this research uniquely combines these elements to identify distinct buyer segments with specific preferences, thereby providing actionable insights for businesses to develop targeted strategies in an emerging market where both digital adoption and seafood consumption are experiencing simultaneous growth.

This research uses smoked tuna as the main focus because tuna production is one of Indonesia's leading commodities. Tuna belongs to the TCT group (Tuna, Skipjack, Little Tunny) and contributed 19 percent of global production in 2018 (KKP, 2020). Despite Indonesia's significant tuna production capacity, a specific problem exists at the smoked tuna production center in Prigi Beach, Trenggalek, where producers

have yet to utilize e-commerce for marketing their products. This research represents significant value-added processing that extends shelf life and increases market value and demonstrates traditional processing integration with modern e-commerce, making it an ideal product for studying consumer segmentation in digital seafood marketing.

This research is a follow-up study about consumer perception to buy smoked seafood on e-commerce (Ma'rifat & Rahmawan, 2023) (Ma'rifat et al., 2023). This paper aims to identify distinct groups of buyers based on factors influencing consumer behavior. By analyzing these segments, the study uncover specific market nieche, consumer needs and preferences, enabling businesses to design targeted marketing strategies and optimize e-commerce platforms for better engagement.

2. MATERIALS AND METHODS

The data collection method for this study utilizes an online questionnaire designed to gather comprehensive insights from respondents efficiently. The number of respondents gained in this study is 246 respondents who have purchased smoked tuna in Prigi Beach, Trenggalek which could represent potential customers of smoked tuna on e-commerce.

The statistical analysis for this study employs the K-means clustering method to identify and classify distinct consumer groups based on their characteristics, behaviors, and perceptions regarding the purchase of smoked seafood through e-commerce. K-means clustering is algorithm that organizes data into a predetermined number of clusters, ensuring that members within the same cluster have similar characteristics while differing significantly from those in other clusters (Shmueli et al., 2017). K-means clustering was selected over alternative clustering methods due to its computational efficiency, and clear interpretability of results for practical marketing applications (Prastyabudi et al., 2024). Unlike hierarchical clustering which becomes computationally intensive with larger datasets, K-means provides distinct, non-overlapping segments that allow for straightforward strategic implementation (Sari et al., 2018). The software used to analyse statistical test is SPSS.

Respondents were selected based on two criteria to ensure relevant and accurate data. First, respondents must have previously purchased and consumed smoked tuna products from the Prigi Beach area in Trenggalek Regency. Second, they must have experience buying food through e-commerce platforms, ensuring informed feedback on the potential and challenges of purchasing smoked seafood online.

The segmentation analysis is determined based on the results of consumer behavior analysis on the intention to buy smoked seafood through e-commerce. The variables significantly influenced the consumer behavior are listed in Table 1. These variables serve as the foundation for identifying consumer segments.

Table 1. Variables of Consumer Behavior

Num.	Variables	Description
1	Perceived Social Norm (PSN)	The influence of social pressure or norms on an individual's decision to buy smoked seafood through e-commerce.
2	Perceived Relative Advantage (PRA)	The perceived benefits or advantages of purchasing smoked seafood online compared to traditional methods.
3	Perceived Health Benefit (B)	The extent to which consumers believe that smoked seafood purchased online offers health benefits.

3. RESULTS AND DISCUSSION

The first step of statistical analysis by using K-means clustering is determining the optimal number of clusters through a dendrogram (Figure 2). This step involves

employing hierarchical clustering techniques to construct a dendrogram, a rooted tree which visually represents the relationships among data points based on their similarity (Cheng & Shwe, 2019). Figure 2 resulted the number of cluster is two (k=2). It can be concluded that potential consumers for purchasing smoked seafood through e-commerce consist of two major groups. Producers can focus on these two groups and adjust their strategies based on the characteristics of each group, which will be explained further.

The next step is cluster analysis using K-Means Clustering. By applying K-Means Clustering with k=2, this method is known for its simplicity and speed, making it a practical choice for quick binary clustering tasks (Ismkhan, 2018). In addition, using (k=2) can serve as an initial exploratory step to understand the basic structure of the data before deciding on a more complex clustering strategy (Ikotun et al., 2023). The result of the analysis in SPSS is in Table 2.

Table 2. Number of Cluster Members

Numbers of Cases in each Cluster	
Cluster 1	130.000
Cluster 2	116.000
Valid	246.000
Missing	000

From the output, it was found that Cluster 1 consists of 130 respondents or 53%, while Cluster 2 has 116 respondents or 47% from all the respondents.

3.1. Demographic Characteristics of Clusters

Next is a demographic analysis for each cluster. Using K-Means Clustering for each demographic variable, the results are as follows in Figure 1.

Consumers characteristics results based on demographic and perception attributes of each cluster listed in Table 3. Based on the table 3, it is evident that Cluster 1 presents unique characteristics that make it a more strategic target for producers. More detailed explanation for each characteristic is described below.

3.1.1 Gender

Both Cluster 1 and Cluster 2 are dominated by females (Figure 2). In Cluster 1, 65.4% of the respondents are female, whereas in Cluster 2, the percentage is 72.4%. This is because women predominantly handle food shopping, as they play a key role in household management and are primarily responsible for purchasing essential household supplies.

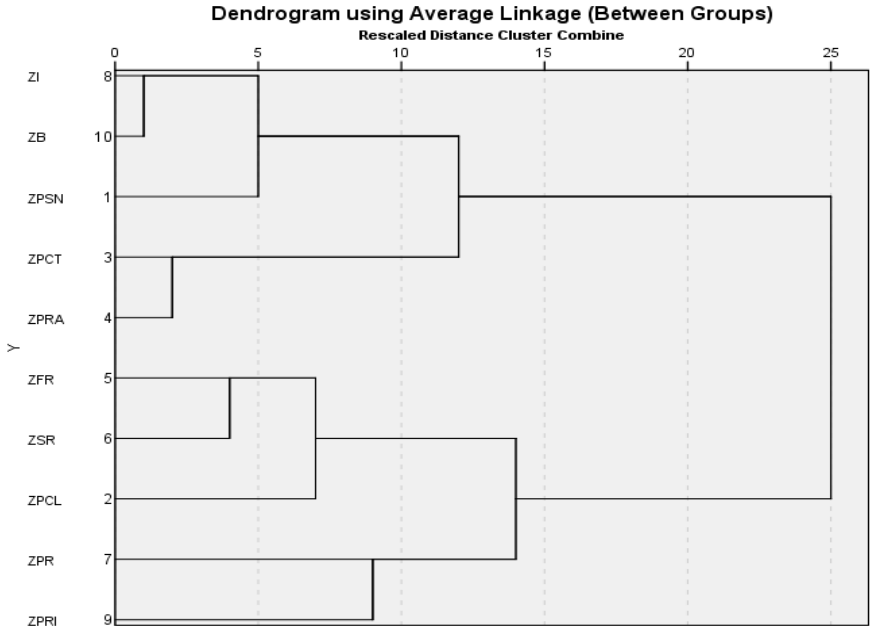

Figure 1. Dendrogram

Table 3. The Summary of Cluster Characteristics

No.	Characteristics	Cluster 1	Cluster 2
1	Size of cluster	53%	47%
2	Gender	Dominated by women	Dominated by women in higher number
3	Age	Mostly young aged	Mostly young aged, more varied
4	Education	Dominated by high school graduates, bigger proportion for higher degree education	Dominated by high school graduates
5	Income	Dominated by low level income in higher proportion	Dominated by low level income
6	Frequency of Purchasing Food Products in a Week	More frequent	Less frequent
7	Perceived Social Norm	more dependent on family members and close friends	Less dependent
8	Perceived Relative Advantage	Higher perception about faster option that offers better discounts.	Lower perception
9	Perceived Health Benefits	More intention to buy due to health benefits	Less intention

This gender distribution suggests that marketing campaigns for smoked seafood should primarily target female consumers, who hold significant decision-making power regarding food purchases. However, the slightly higher percentage of females in Cluster 2 (72.4% vs 65.4%) indicates that Cluster 1 has a more balanced gender representation, potentially suggesting that online seafood purchasing is beginning to see increased male participation compared to traditional shopping patterns. This demographic insight aligns with previous research by (Permana et al., 2015), indicating women's greater concern with household expenditure, and should inform messaging, visual content, and promotional strategies across e-commerce platforms for smoked seafood producers.

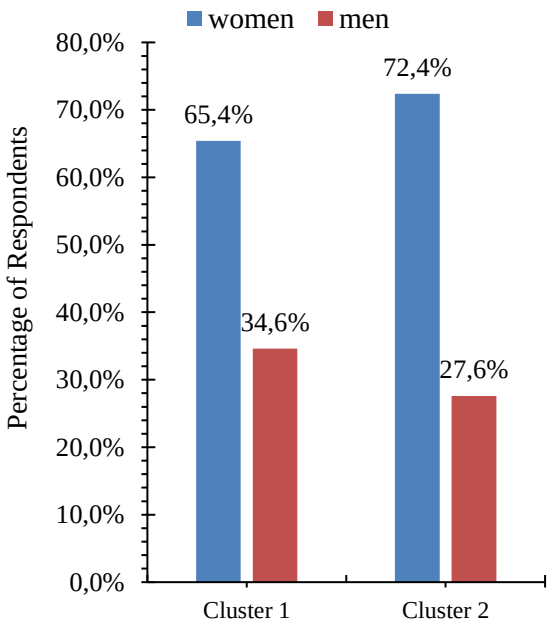

Figure 2. The Cluster based on Gender (Percentage of Respondents by Gender)

3.1.2 Age

Based on the respondents' ages, both Cluster 1 and Cluster 2 are dominated by individuals aged 12–25 years (Figure 3). In Cluster 1, 97.7% of the respondents fall within this age group, while in Cluster 2, the percentage is 95.7%. This striking demographic concentration has several important marketing implications.

First, it confirms that the e-commerce smoked seafood market primarily appeals to digital natives who are comfortable with technology and online shopping platforms. This suggests marketing strategies should heavily emphasize digital channels, social media engagement, and mobile-friendly interfaces. The slightly higher percentage of young consumers in Cluster 1 (97.7% vs 95.7%) further reinforces this cluster's identity as the more digitally engaged segment. When combined with earlier findings about Cluster 1's higher frequency of online purchases, this suggests they represent the ideal target for e-commerce seafood marketing. This phenomenon also happened in research of (Raman, 2019) that there is a possibility that many young women prefer to shop online for convenience. This demographic profile also aligns with findings from Kim et al., (2022) that Millennials and Gen Z show greater interest in new technology and safety concerns. For smoked seafood e-commerce, this implies that product listings should highlight safety certifications, transparent sourcing information, and contactless delivery options.

The near-absence of older consumers (46-65) in both clusters (0% in Cluster 1 and only 0.9% in Cluster 2) indicates a significant opportunity gap. Seafood businesses might consider developing specific strategies to attract this underrepresented demographic, who may have greater purchasing power but less familiarity with e-commerce platforms.

3.1.3 Education

Based on the respondents' educational backgrounds, both Cluster 1 and Cluster 2 are dominated by high school graduates or equivalent (Figure 4). In Cluster 1, 80% of the respondents are high school graduates, while in Cluster 2, the percentage is 86.2%. This indicates that high school graduates form the largest educational demographic in both clusters. Moreover high school graduates, primarily university students, demonstrate high levels of health awareness (Z. Zhang et al., 2024). However, Cluster 1 has a higher proportion of respondents with a diploma or bachelor's degree compared to Cluster 2. Additionally, Cluster 1 includes one respondent with a master's degree.

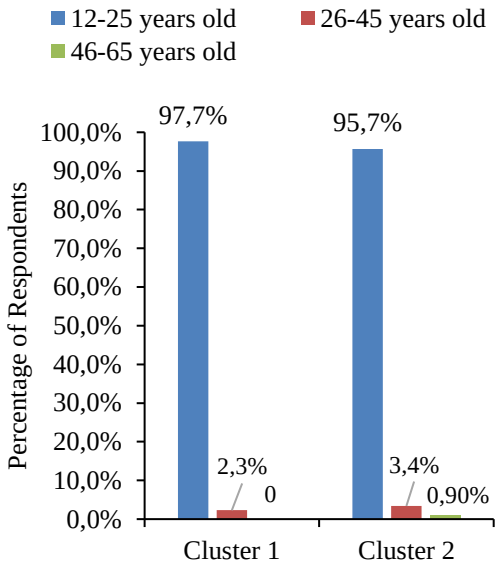

Figure 3. The Graph of Cluster based on Age (Percentage of Respondents byAge)

The educational distribution analysis reveals several key implications for marketing strategies aimed at both clusters. The dominance of high school graduates in both clusters (80% in Cluster 1 and 86.2% in Cluster 2) aligns with the young age demographic previously identified and suggests these are likely college/university students. This educational profile indicates consumers who are developing independence in purchasing decisions while potentially having limited disposable income.

Notably, Cluster 1 shows greater educational diversity with a higher proportion of respondents holding diploma or bachelor's degrees (18.5% compared to 12.9% in Cluster 2) and the presence of a

master's degree holder (0.8%). This educational difference, though modest, reinforces Cluster 1's profile as potentially more informed consumers who may respond better to detailed nutritional information and health benefits messaging.

The correlation between education level and health awareness, as supported by (Z. Zhang et al., 2024) suggests that both clusters would be responsive to marketing that emphasizes the nutritional benefits of smoked seafood. This presents an opportunity for e-commerce platforms to feature health-oriented content and educational materials about seafood benefits.

For marketing purposes, the educational profile indicates that content should be accessible and appealing to consumers with high school education while still incorporating evidence-based health claims that would resonate with the more educated segment within Cluster 1. Visual content, clear information presentation, and straightforward purchasing processes would likely be effective across both clusters.

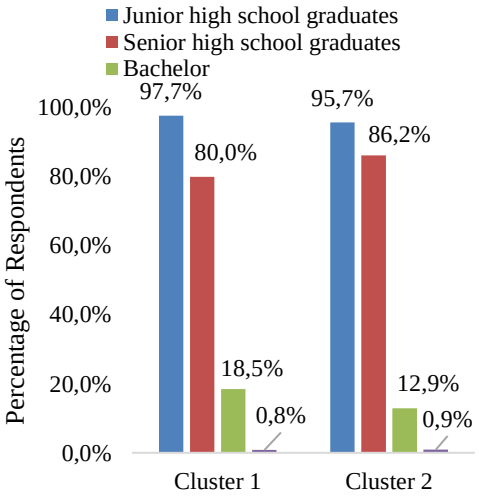

Figure 4. The Graph of Cluster based on Education (Percentage of Respondents by Education)

3.1.4 Income

Based on the respondents' income levels, the majority in both Cluster 1 and Cluster 2 have incomes of less than Rp 2,000,000 (Figure 5). In Cluster 1, 84.6% of the respondents fall into this income bracket, while in Cluster 2, the percentage is 80.2%. However, Cluster 2 has a higher proportion of respondents with incomes exceeding Rp 2,000,000. Therefore, Cluster 2 members have a slightly higher level of economic capability than those in Cluster 1. It can impact the purchasing behavior of consumer. This is contradictory with the previous study stated that higher income positively influences the propensity for online grocery shopping (Olumekor et al., 2024). This suggests non-economic factors like digital literacy and health consciousness may drive smoked seafood e-commerce behavior. Marketing implications include emphasizing price sensitivity through smaller packaging options, flexible payment methods, and value-oriented messaging highlighting cost-to-nutrition benefits, while potentially developing targeted premium offerings for the higher-income segment within Cluster 2.

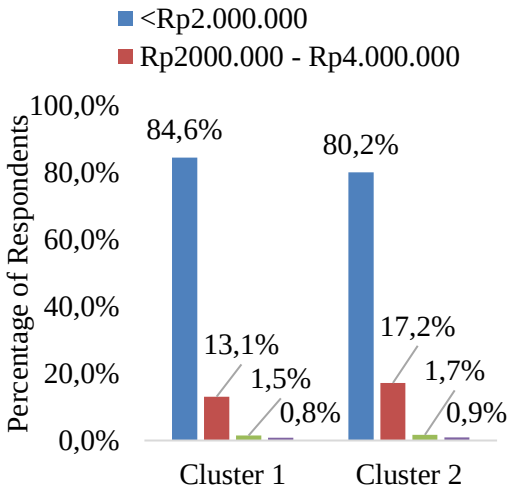

Figure 5. The Graph of Cluster based on Income (Percentage of Respondents by Monthly Income)

3.1.5 Frequency of Purchasing Food Products in a Week

The frequency of respondents in Cluster 1 purchasing food products using e-commerce is predominantly 1–2 times per week, whereas respondents in Cluster 2 use e-commerce less frequently within the same period (Figure 6).

The purchase frequency analysis reveals a critical behavioral distinction, with Cluster 1 demonstrating significantly higher e-

commerce engagement (45.4% purchasing 1-2 times weekly and 17.7% purchasing 3+ times weekly) compared to Cluster 2's lower engagement (47.4% rarely using e-commerce and only 7.8% purchasing 3+ times weekly). This purchasing pattern confirms Cluster 1 as the prime target for smoked seafood e-commerce initiatives due to their established online shopping habits, greater comfort with digital platforms, and potentially higher lifetime value as customers. For marketing applications, this suggests implementing loyalty programs and subscription models matching Cluster 1's regular purchasing behavior, while developing educational content and trust signals for the more hesitant Cluster 2. The significant difference in purchasing frequency provides clear direction for resource allocation, with primary focus on Cluster 1 for immediate sales growth while developing longer-term strategies to convert the more resistant Cluster 2 segment.

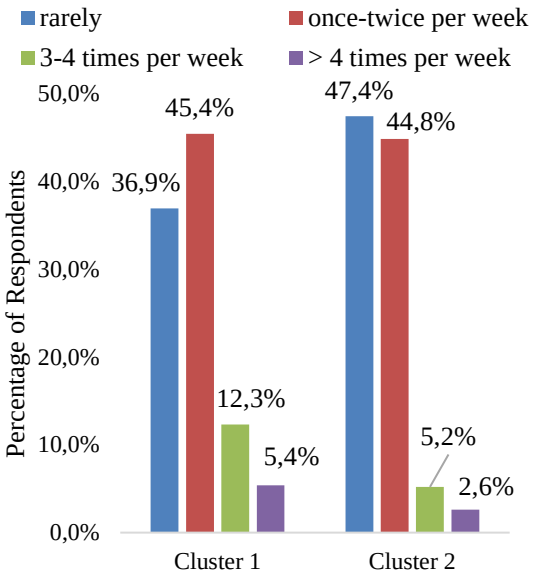

Figure 6. The Graph of Cluster based on Buying Frequency (Percentage of Respondents by Food Purchase Frequency on e-commerce)

This result can be a reference for the projection of smoked seafood repeat purchasing frequency on e-commerce. To predict purchasing pattern of consumers for a specific food product in e-commerce, several papers proposed models by using time-series data and numerical test (Tian et al., 2015), and also machine learning algorithm (Côté et al., 2022) .

3.2. Characteristics of Cluster based on Variables

The results of the cluster characteristic analysis based on variables are presented through the average values of the respondents' rating scale, ranging from 1, which indicates strongly disagree, to 5, which indicates strongly agree with the variable items.

3.2.1 Perceived Social Norm

The result of perceived social norm is in Table 4. From the output below, it can be concluded that Cluster 1 represents a group that is more heavily influenced by family members and close friends in purchasing food products through e-commerce. In contrast, Cluster 2 consists of individuals who are only slightly influenced by family members and close friends. In fact, based on the previous research, peer social norms significantly affect young people's food intake (Stok et al., 2016). Moreover, the comunication among family members can enhance compliance with social norms which further positively impact promotes socially acceptable consumption behaviors, such as choosing healthy foods or making donations (Melnyk et al., 2021).

3.2.2 Perceived Relative Advantage

The result of perceived social norm is in Table 5. Statement items in this variable measure the response of food products, not specifically on smoked seafood, since there are rarely smoked seafood products available in Indonesian e-commerce. The output indicates that Cluster 1 views e-commerce as a more time-efficient option that also provides greater discounts compared to shopping directly in stores, making it their preferred platform for purchasing. This align with findings from previous studies. Lv et al.,

(2020) stated that e-commerce businesses should set reasonable discount strategies to increase sales and create a sustainable shopping environment. There are also many other research found that e-commerce can provides convenience and efficient way of shopping (Duarte et al., 2018)(Li et al., 2020)(Wang et al., 2020).

Table 4. The Result of Perceived Social Norm

	Cluster Number of Case		
	1	2	Total
Items	Mean	Mean	Mean
I buy food products through e-commerce because of my family members.	**3.83**	2.87	3.38
I buy food products through e-commerce because of my close friends.	**4.10**	3.01	3.59
My family members believe that buying food products through e-commerce is a good thing.	**4.05**	3.02	3.57
My close friends believe that buying food products through e-commerce is a good thing.	**4.30**	3.41	3.88

3.2.3 Perceived Health Benefits

The outcomes related to perceived health benefits are presented in Table 6. If smoked seafood is available on e-commerce platforms, Cluster 1 is more interested in purchasing it compared to Cluster 2. This is because respondents in Cluster 1 perceive smoked seafood as having high nutritional value, a distinctive taste, being halal, affordable, and easy to prepare. These results reinforce the analysis of the demographic characteristics of Cluster 1, which consists of a larger proportion of young individuals and Gen Z, who are more aware to maintain health and overall well-being in food consumption(Pocol et al., 2021).

Table 5. The Result of Perceived Relative Advantage

	Cluster Number of Case		
	1	2	Total
Items	Mean	Mean	Mean
Buying food products through e-commerce saves more time compared to buying directly in stores.	**4.28**	3.36	3.85
Buying food products through e-commerce offers more discounts compared to buying directly in stores.	**4.60**	3.74	4.20

Halal products are also getting raising awareness from Indonesian consumers since majority of them are as muslim (Kusuma, 2023). Moreover, smoked seafoods production involves heat process resulting in enhanced organoleptic properties which also improve consumer acceptance (Ma'rifat, 2020) .

Table 6. The Result of Perceived Health Benefits

Items	Cluster Number of Case		
	1 Mean	2 Mean	Total Mean
If smoked tuna products are available on e-commerce platforms, I would purchase them because of their high nutritional value.	**4.32**	3.17	3.78
If smoked tuna products are available on e-commerce platforms, I would purchase them because of their distinctive taste.	**4.37**	3.15	3.79
If smoked tuna products are available on e-commerce platforms, I would purchase them because they are halal.	**4.36**	3.37	3.89
If smoked tuna products are available on e-commerce platforms, I would purchase them because they are affordable.	**4.42**	3.34	3.91
If smoked tuna products are available on e-commerce platforms, I would purchase them because they are easy to prepare.	**4.36**	3.28	3.85

4. CONCLUSIONS AND RECOMMENDATIONS

This study identifies two consumer clusters for smoked seafood in e-commerce, with Cluster 1 showing greater potential due to its larger proportion of young, health-conscious, and e-commerce-savvy individuals. The cluster analysis reveals four key differentiating factors between consumer segments : (1) digital engagement level, with Cluster 1 showing significantly higher e-commerce adoption (63.1% purchasing weekly or more often versus 52.6% in Cluster 2); (2) perception of e-commerce benefits, with Cluster 1 strongly valuing time-efficiency and cost-effectiveness; (3) health consciousness, with Cluster 1 demonstrating greater intention to purchase smoked seafood for nutritional benefits and distinctive taste; (4) and social influence receptiveness, with Cluster 1 being more influenced by family and friends in purchasing decisions. These distinctions suggest strategic priorities for seafood businesses: prioritizing Cluster 1 for immediate marketing initiatives, developing segment-specific messaging approaches that emphasize health benefits for Cluster 1 while building e-commerce trust for Cluster 2, and implementing pricing strategies that capitalize on Cluster 1's higher perception of online value.

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