

ANALYSIS OF NANIURA PRODUCT DEVELOPMENT IN INDONESIA

Junianto, Natalia Situmorang, Shabrina Ainun Mufidah, Yohana Damayanti, Firsya Fitria Khoirunnisa, Auliya Su-ripto

Author Details

Department of Marine Science, Faculty of Fisheries and Marine Science, Universitas Padjadjaran, Jalan Raya Bandung Sumedang KM 21, Jatinangor, Sumedang Regency, West Java 45363, Indonesia. E-mail: natalia22004@mail.unpad.ac.id

Department of Marine Science, Faculty of Fisheries and Marine Science, Universitas Padjadjaran, Jalan Raya Bandung Sumedang KM 21, Jatinangor, Sumedang Regency, West Java 45363, Indonesia. E-mail: yohana22007@mail.unpad.ac.id

KeyWords

Naniura, ikan mas, fermentation, shelf life, marketing.

ABSTRACT

Naniura is a traditional Batak Toba dish made from ikan mas (*Cyprinus carpio*) marinated in natural acidic extracts and spices. This study aims to analyze the development of Naniura in terms of raw materials, fermentation process, spices, shelf life, packaging, and marketing strategies to improve product quality, safety, and economic value. The research uses a descriptive literature review approach based on previous studies and supporting field observations. The results indicate that the use of natural acid sources such as jungga lime extract, citric acid, and acetic acid effectively lowers product pH and inhibits the growth of spoilage microorganisms. Spices including andaliman, ginger, garlic, and turmeric enhance the distinctive aroma while functioning as natural antimicrobial agents. The application of vacuum packaging and modified atmosphere packaging (MAP) technologies significantly extends the shelf life of Naniura up to 12–30 days under cold storage conditions. Nutritional content remains relatively stable throughout storage, and the product retains bioactive compounds derived from spices, which contribute to its functional value. From the marketing perspective, digital-based strategies and e-commerce platforms provide great potential to expand market reach and enhance competitiveness. Attractive, informative, and hygienic packaging design that reflects local identity strengthens Naniura's image as a culturally rich and economically valuable traditional food. Integrating technological innovation, modern packaging, and strategic marketing can position Naniura as a flagship regional product capable of competing in national and international markets.

INTRODUCTION

Indonesia possesses a diverse range of traditional cuisine that reflects the cultural identity and local wisdom of each region. One such dish is Naniura, a signature Batak Toba food often dubbed the "Batak sashimi" because its preparation process does not involve heating. Naniura, or Dengke Naniura, is a traditional food of the Batak people prepared by marinating the fish using acidic jungga lime and a mixture of spices such as andaliman, turmeric, shallots, garlic, ginger, candlenut, and torch ginger stems (Sitorus *et al.* 2023). The use of these various spices not only adds flavor but also plays a role in improving the texture and appearance of the fish meat (Manik 2020). This dish is commonly served at various Batak Toba traditional ceremonies, such as weddings, housewarming parties, and thanksgiving events in places of worship. Naniura can be consumed directly or served with rice as an accompaniment.

Traditional products with distinctive flavors and high cultural value need to be developed towards an industrial scale to provide greater economic value and competitiveness. According to Hidayat (2021), the development of traditional cuisine can be achieved through the application of simple and hygienic processing technology principles without eliminating its original taste. Therefore, the commercialization of Naniura is an important step to expand market access while maintaining the sustainability of this traditional cuisine through innovation in processing, packaging, and marketing.

In principle, Naniura is prepared by soaking carp (*Cyprinus carpio*) in a natural acidic solution like squeezed jungga lime juice (a distinctive Batak kaffir lime) until the meat softens, and then marinating it again in a special blend of spices such as andaliman, turmeric, ginger, shallots, garlic, candlenut, and torch ginger stems (Pakpahan *et al.* 2020; Sitorus *et al.* 2023). This principle is known as acid marination without heating, where a chemical process causes protein denaturation and results in a characteristic texture and flavor. The spices used also function as natural preservatives due to their content of essential oils and bioactive compounds like terpenoids and flavonoids, which have antimicrobial properties (Hutapea *et al.* 2019).

In its development, Naniura has undergone various forms of product enhancement in terms of ingredients, processing techniques, and marketing strategies. According to Prihantoro (2020), product development is defined as a systematic process of improving or modifying an existing product through innovation in ingredients, technology, packaging, and distribution to enhance functional value and market competitiveness. Therefore, the modernization of Naniura is directed not only at improving organoleptic quality and product safety but also at packaging innovation such as vacuum packaging and the implementation of digital marketing that is adaptive to current consumer behavior. This study aims to examine the product development of Naniura through a review of the fish raw materials used, the fermentation ingredients and natural acidic solutions that play a role in the chemical maturation process, and the use of additional spices that affect the flavor and product shelf life. Furthermore, this research also discusses marketing strategies as part of the effort to commercialize Naniura, so that it can be developed into a leading regional product capable of competing in the modern market without abandoning its cultural and traditional values.

MATERIALS AND METHODS

This study uses a literature review method with the aim to analyze and examine various relevant scientific sources related to product innovation of naniura. The review is conducted by tracing various literature including journal articles, books, and research reports discussing the topic of naniura product innovation as a traditional Batak food.

In addition, this study also employs an observation method by directly observing the processing and sales of naniura at restaurants and traditional markets in the Batak Toba region. This observation aims to complement the literature data with concrete field information regarding innovation practices and consumer acceptance firsthand.

Data collection is carried out by selecting sources published within the last ten years to obtain up-to-date and relevant information. Each literature is analyzed based on raw materials, processing methods, technological innovations, taste, nutritional value, and consumer acceptance of the naniura product.

The analysis in this study is conducted descriptively and qualitatively by reviewing and interpreting various findings from the literature sources and observations. This approach aims to gain a comprehensive understanding of the forms, directions, and trends in the development of innovations related to the naniura product.

RESULT AND DISCUSSION

Ingredients

Naniura products traditionally use freshwater fish primarily *Cyprinus carpio* (carp), which is often called "dekke" in Batak culture as the main raw material. Research on Naniura indicates that carp is the primary choice due to its availability and the meat characteristics, which are well-suited for the acid marination process without heat cooking. In modern developments, various raw material innovations have been introduced to enhance production availability and sustainability. Several studies are now exploring other local fish, such as Nile tilapia (*Oreochromis niloticus*) and Mozambique tilapia (*Oreochromis mossambicus*), as alternative raw materials for Naniura, as they possess physical and textural characteristics similar to carp, yet are easier to cultivate and hold higher economic value.

Furthermore, one of the distinctive raw material elements of Naniura is the use of an acidic solution including asam jungga (kaffir lime) or regular lime juice. Innovations in developing the composition of the acid and spices include combining jungga lime with star fruit acid (*Averrhoa bilimbi*) or regular lime to achieve a stable pH and a more balanced flavor (Yuliani *et al.* 2021). The use of standardized natural ingredients and the addition of spices with antimicrobial activity, such as andaliman and ginger, also bolster food safety

without altering the characteristic sensory properties of Naniura. This acid serves to "*chemically mature*" the raw fish meat, lowering the pH, reducing the fishy odor, and transforming the meat's texture to be softer (Pakpahan *et al.* 2020).

Aside from the fish and the acidic solution, Naniura also utilizes various traditional spices as part of its raw materials, such as andaliman (Batak pepper), torch ginger, turmeric, shallots, garlic, candlenut, peanuts, and chili. These spices not only impart characteristic aroma, taste, and color, but also possess the added function of acting as antimicrobial agents and inhibitors of fishy odor. For instance, andaliman (*Zanthoxylum acanthopodium*) contains volatile compounds like limonene, linalool, and citronellal, which have the potential to act as natural antiseptics in the processing of raw fish (Hutapea *et al.* 2019).

Processing Method

The processing of Naniura is a form of traditional acidification technique that utilizes natural acids to "cook" the fish without heat. Traditionally, the main ingredient fresh carp (*Cyprinus carpio*) is cleaned of scales and entrails, and then marinated in squeezed jungga lime (*Citrus nobilis* var. *microcarpa*) or kaffir lime (*Citrus hystrix*) juice for 4-5 hours until the fish meat undergoes chemical protein denaturation. This process causes the meat's texture to become soft, its color to become lighter, and develops a distinct sour aroma, which signifies that the fish is "cooked" without being subjected to heat.

After the acid marination stage, a mixture of characteristic Batak spices is incorporated, such as andaliman (*Zanthoxylum acanthopodium*), shallots, garlic, ginger, candlenut, turmeric, chili, and rias (galangal). These spices are ground and mixed together with the acid-denatured fish meat. Besides enriching the flavor, these spices play a crucial role as natural antimicrobials that suppress the growth of spoilage bacteria (Hutapea *et al.* 2019). The limonene and linalool content in andaliman is proven to function as bioactive volatile compounds that provide a natural antiseptic effect on the raw fish product.

Innovations in the Naniura processing method now focus on standardizing the pH and marination time, using combined organic acids (such as jungga lime and star fruit), and implementing modern packaging to extend shelf life. Research by Yuliani *et al.* (2021) indicates that variations in the type of organic acid can influence the final pH value, color, and texture of the fish, where a combination of lime and star fruit acid yielded the best sensory results. Packaging using Modified Atmosphere Packaging (MAP) is also starting to be applied to maintain the fresh aroma and prevent microbial contamination. Thus, the Naniura processing method reflects a synergy between local wisdom and modern scientific principles, where the biochemical reaction of acidification and the utilization of natural spices shape the unique characteristics and simultaneously maintain the food safety of this product.

Shelf Life of Naniura

The determination of the shelf life of naniura was carried out using the Extended Storage Studies (ESS) method, also known as the conventional method. This technique is performed by storing the product under environmental conditions that resemble normal, daily circumstances, followed by periodic observations of quality changes until the product reaches the limit of its consumption feasibility (Syarif *et al.* 1989). In this study, naniura was stored at room temperature, approximately 27°C–28°C, with a relative humidity of around 75%. The storage process was conducted for seven days in a tightly sealed container to maintain the product's stable condition.

The storage period of naniura was determined based on the observations of changes in the values of several quality parameters during the storage period. Based on these results, water content, texture, and total microbes were the most influential factors affecting the product's durability. Since there is no specific standard yet regarding the expiry limit for naniura products, the reference used is the Indonesian National Standard (SNI) of 2009 and quality standards for other fermented fish products, especially regarding the maximum limit of microorganisms allowed in food ingredients.

In accordance with the provisions of SNI 2009, the maximum limit for the total number of microorganisms in fermented fish products, both with and without added salt, is 5×10^5 colonies per gram. Furthermore, research conducted by Silalahi (1994) on the production of naniura from snakehead fish (*Ophiocephalus striatus*) showed that the product fermented using 1% acetic acid (vinegar) experienced a decline in quality and was rejected on the fourth day of the fermentation process.

The addition of acidifying agents such as citric acid or acetic acid can lower the pH and inhibit the growth of spoilage microbes, thereby stabilizing product quality (Das *et al.* 2021). Several studies indicate that the use of natural acidifying agents at a concentration of 0.5–1.5% is capable of extending the shelf life of fermented fish to approximately 7–14 days at room temperature, and can reach 12–30 days when combined with vacuum packaging and cold storage (Gopal & Ravishankar 2005).

Nutritional Content

Dekke Naniura is a traditional food of the Batak people, prepared from raw carp fish soaked in the juice of Unte Jungga (a unique sour lime/citrus fruit from Tapanuli) and a mixture of various traditional spices. The organic acid content, such as citric acid and ascorbic acid, in the fruit juice plays a vital role in neutralizing the fishy odor through a chemical reaction with the trimethylamine (TMA) compound found in the meat. This reaction produces new compounds that are able to reduce the unpleasant aroma, as well as help soften the meat tissue and release fine bones (Tarigan *et al.* 2016). Research conducted by Hadiwiyoto (2009) and Purba (2011) explains that differences in the water content of Unte Jungga and the duration of soaking affect the number of bacterial colonies that grow on the product. The marinating process causes protein denaturation which lowers the pH, water content, and protein content of the fish. Although it does not cause a noticeable change in appearance and texture, it has a significant impact on the flavor, aroma, and moisture of the meat (Tarigan *et al.* 2016).

Besides the use of Unte Jungga juice, Andaliman fruit (*Zanthoxylum acanthopodium* DC.) is also an essential ingredient in the making of Dekke Naniura. This spice not only provides a spicy sensation and a distinctive aroma but also functions to extend the product's

shelf life. Andaliman contains various bioactive compounds such as terpenoids, flavonoids, alkaloids, and steroids that possess antimicrobial properties (Wijaya *et al.* 2002). Studies by Sitanggang *et al.* (2019) and Amelia *et al.* (2019) found that terpenoid compounds, especially ethyl acetate, are effective in inhibiting the growth of *Escherichia coli*, a pathogenic bacterium that causes digestive disorders such as diarrhea, nausea, and vomiting.

Packaging

Packaging is a crucial aspect in maintaining the quality, safety, and shelf life of processed fishery products, including Naniura, which is a traditional Batak food made from raw carp fish fermented using Unte Jungga juice. Given that its base ingredient is fresh fish, which is highly perishable, the packaging serves to protect the product from external factors such as oxidation, microbial contamination, and changes in water content (Susanti & Rudiyanto 2024). Oxygen entering the packaging can accelerate the decomposition process and reduce sensory quality, including the product's color, aroma, and texture.

Vacuum packaging technology is considered effective in extending the shelf life of fish-based products because it can inhibit the growth of microorganisms and slow down the rate of fat oxidation (Setiawan *et al.* 2025). The application of this technology to Naniura can preserve the natural acidic flavor resulting from fermentation and maintain the soft texture of the fish meat during storage. In addition to its protective function, the aesthetic and informative aspects of the packaging are also important in attracting consumer interest. Package designs that include information on raw ingredients, nutritional value, and product legality can increase consumer confidence and positive perception regarding food safety (Hafiludin *et al.* 2025). Thus, the development of Naniura packaging that meets both functional and visual standards can support efforts to preserve and commercialize this traditional cuisine (Sosianika *et al.* 2025).

Spices such as garlic, ginger, pepper, and lime leaves can strengthen the distinctive aroma of Naniura while also serving as natural antimicrobials and antioxidants. The addition of spices has been proven to suppress the activity of spoilage-causing microbes and maintain the sensory quality of the product during storage (Chitra 2024). Other studies show that the combination of spices in cold storage helps to keep the fish's color, aroma, and taste fresh for longer (International Journal of Food Science & Technology 2024).

Marketing

Marketing aspects are crucial factors in broadening the reach and increasing the economic value of Naniura. Currently, the product is still limited to local marketing due to a lack of effective promotional strategies. Utilizing digital technology, such as social media and e-commerce platforms, represents a potential strategy for introducing Naniura to a wider audience, especially the younger generation (Halimah *et al.* 2024). This approach enables more interactive communication between producers and consumers and enhances the visibility of traditional products in the global market.

Besides digital promotion, packaging innovation can also support the marketing strategy. Hygienic, attractive packaging with distinctive local character plays a role in building a positive image of the product and differentiating it from other processed fish products (Sitorus 2023). Collaboration among entrepreneurs, local government, and research institutions in developing innovative packaging and integrated promotion can enhance Naniura's competitiveness in both national and international markets (Hafiludin *et al.* 2025). The combination of packaging innovation and digital marketing strategies makes Naniura not only culturally valuable but also possess high economic potential as a superior regional product (Wijaya *et al.* 2022).

The implementation of innovations such as acidification, the addition of spices, and modern packaging directly influences the quality and durability of Naniura. Products that are more durable and have a distinctive aroma tend to be more desirable, especially by consumers outside the region. This condition triggers an increase in market demand and expands distribution opportunities (Das *et al.* 2021). Other research indicates that improving quality and innovating packaging for fermented fish products can boost consumer purchase interest and enhance economic potential at both the local and national levels (Setiarto *et al.* 2024).

Table 1. Naniura Marketing: Former and Current Status

Aspect	Former	Current
Market scope	Only local or small communities	Wider, covering large cities and online sales
Product shelf life	3–7 days	7–14 days (room temperature) / 12–30 days (with cooling and vacuum)
Consumer trust	It is still low due to unstable quality	Increased through labeling, legality, and packaging information
Promotion strategy	Word of mouth, traditional markets	Digital promotion, social media, and culinary event collaborations
Demand volume	Limited	Experiencing an increase because the product is more durable (or has a longer shelf life)
Selling price	Low–medium	Likely to increase due to value addition

Conclusion

The development of Naniura demonstrates that innovation in ingredients, fermentation methods, and packaging technology can effectively improve product quality and safety while preserving its traditional and cultural values. Natural acid sources such as jungga

lime and acetic acid are effective in reducing pH and inhibiting spoilage microorganisms, while spices like andaliman and ginger strengthen its characteristic aroma and enhance preservation. The use of vacuum packaging or modified atmosphere packaging extends the product's shelf life up to twice that of conventional storage methods.

Beyond technical improvements, marketing plays a vital role in ensuring the sustainability of Naniura commercialization. Utilizing digital media, social platforms, and e-commerce for promotion, along with collaboration between small enterprises and local governments, can effectively increase product visibility and consumer trust. Attractive and culturally inspired packaging design also contributes to building Naniura's branding as a unique Indonesian culinary heritage.

In summary, the sustainable development of Naniura requires synergy between technological innovation, branding enhancement, and adaptive marketing strategies to meet modern consumer trends. These combined efforts will help Naniura evolve from a traditional Batak Toba delicacy into a nationally and globally competitive food product.

Suggestion

The development of innovation for Naniura products must continuously be directed towards enhancing food safety, diversifying raw materials, and modernizing processing techniques without compromising its distinctive traditional flavor. Future researchers are encouraged to undertake experimental studies to evaluate the effectiveness of these innovations in terms of sensory quality, nutritional value, and consumer acceptance using measurable criteria.

Moreover, collaboration among researchers, industry stakeholders, and local government authorities is essential to preserve and promote naniura as a premier regional product rooted in local wisdom. Strengthening branding initiatives and consumer education is also crucial to improve public understanding of the nutritional benefits and uniqueness of naniura as a culinary heritage of the Indonesian archipelago, with strong potential to develop into a commercially valuable product.

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References

- [1] Amelia, S., Lubis, N.D.A., Balatif, R., Rozi, M.F., Sidhi, S.P. 2019. Antibacterial Effect of Andaliman (*Zanthoxylum acanthopodium*) Against Contaminant in Raw Common Carp (*Cyprinus carpio* Linnaeus). The 1st International Conference on Agricultural and Bioindustry 2019. IOP Conf. Series: Earth and Environmental Science 425 (2020) 012036. IOP Publishing.
- [2] Chitra, G. 2024. Preservative effect of herbs and spices on the microbial and sensory qualities of *Scomberomorus guttatus* and *Lutjanus gibbus*. International Journal of Advanced Research, 1148–1153.
- [3] Das, S., Goyal, A. K., Lam, S. S., & Sarma, H. 2021. Fermented fish products in South and Southeast Asian cuisine: Indigenous technology processes, nutrient composition, and cultural significance. Journal of Ethnic Foods, 8(1), 33. <https://doi.org/10.1186/s42779-021-00109-0>
- [4] Febrian, G. M., Julianti, E., & Rusmarilin, H. 2016. Pengaruh Berbagai Jenis Asam Jeruk dan Lama Perendaman Terhadap Mutu Ikan Mas Naniura. Jurnal Rekayasa Pangan dan Pertanian, 4(4), 471-481.
- [5] Gopal, T. K. S., & Ravishankar, C. N. 2005. Modified atmosphere packaging of fish - a review. Fishery Technology, 42(2). <https://doi.org/10.56093/ft.v4i2i.16909>
- [6] Hadiwiyoto, S. 2009. Teknologi Pengolahan Hasil Perikanan Jilid I. Yogyakarta: Liberty
- [7] Hafiludin, H., Chandra, A. B., Alfisuma, M. Z., & Pratiwi, W. S. W. 2025. Peningkatan nilai tambah produk perikanan pesisir dengan perbaikan kemasan dan pemasaran. Jurnal Pembelajaran Pemberdayaan Masyarakat (JP2M), 6(3), 695–711.
- [8] Halimah, A. S., Muis, A. A., & Yushra, Y. 2024. Packaging technology and digital marketing of fish Dempo to increase sales productivity. ABDIMAS: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang, 9(4), 948–959.
- [9] Hidayat A. 2021. Inovasi pengembangan makanan tradisional berbasis bahan alami dalam menghadapi pasar modern. Jurnal Teknologi Pangan Indonesia 13(2): 67–75.
- [10] Hutapea, A. H., Sihombing, A., & Situmorang, M. 2019. Kajian kandungan gizi dan senyawa bioaktif andaliman (*Zanthoxylum acanthopodium* DC.) sebagai rempah khas Batak. Biodik: Jurnal Ilmiah Pendidikan Biologi, 5(1), 45–52.
- [11] Kusuma R. D. 2024. Strategi pemasaran digital dalam penguatan daya saing produk kuliner lokal. Jurnal Ekonomi Kreatif dan Digitalisasi Usaha 6(1): 55–64.
- [12] Lestari N. 2023. Aplikasi teknologi kemasan vacuum untuk meningkatkan daya simpan produk perikanan. Jurnal Pengolahan Hasil Perikanan Nusantara 11(2): 77–85.

- [13] Manik, M., 2020. Karakterisasi Kimia dan Mikrobiologis Serta Pengujian Potensi Probiotik dari Dengke Naniura Sebagai Makanan Tradisional Hasil Fermentasi Ikan Mas (*Cyprinus carpio*) Asal Kawasan Danau Toba. Universitas Sumatera Utara. Repositori institusi USU.
- [14] Pakpahan, I. F., Sumardianto, S., & Fahmi, A. S. 2020. Pengaruh Lama Waktu Perendaman Bumbu Yang Berbeda Terhadap Karakteristik Naniura Ikan Mas (*Cyprinus carpio*). Jurnal Ilmu dan Teknologi Perikanan, 2(2), 7-12.
- [15] Pakpahan, J., Yuliani, S., & Cahyono, E. 2020. Pengaruh lama perendaman terhadap mutu fisik dan kimia Naniura ikan mas (*Cyprinus carpio*). Jurnal Ilmu dan Teknologi Pangan Indonesia, 6(2), 89-98.
- [16] Prihantoro D. 2020. Manajemen Pengembangan Produk Pangan Tradisional Indonesia. Yogyakarta: Deepublish.
- [17] Purba, S.A. 2011. Pengaruh Proses Pembuatan Dekke Naniura terhadap pertumbuhan bakteri. Skripsi. Fakultas Farmasi. Universitas Sumatera Utara. Medan.
- [18] Setiarto, R. H. B., et al. 2024. Exploring Bekasam, an indigenous fermented fish product of Indonesia: Nutritional, microbial, and cultural perspectives. Journal of Ethnic Foods, 11(2), 45.
- [19] Setiawan, R. D., Juliarsi, I., Sandy, I. P., Melia, S., Vebriyanti, E., Sukma, A., Hasanah, Z. 2025. Improving product quality through the implementation of good manufacturing practices and vacuum packaging in smoked catfish businesses in Pasaman. Indonesian Journal of Community Services, 7(1): 85-92.
- [20] Sihombing, S., Herawati, N., & Hidayat, M. 2024. Kandungan logam berat (Pb dan Cd) serta mikroba patogen pada Naniura ikan mas (*Cyprinus carpio*) di Kabupaten Samosir. [Undergraduate thesis, Universitas Gadjah Mada]. UGM Repository.
- [21] Silalahi, J.R.S. 1994. Studi Pengolahan Naniura Ikan Gabus (*Ophiocephalus striatus*) Dengan Penambahan Asam Asetat Berbeda. Skripsi Sarjana. Riau University. Riau
- [22] Simanjuntak P. 2022. Nilai budaya dan simbolisme dalam makanan tradisional Batak Toba. Jurnal Antropologi Indonesia 45(1), 13-22.
- [23] Sitanggang, F.M.C., Danuaji, A.S., Kartika, D.P. 2019. Daya Hambat Ekstrak Buah Andaliman (*Zanthoxylum acanthopodium* DC.) Dalam Etil asetat Terhadap Pertumbuhan *Ascherichia coli*. Fakultas Teknologi Pertanian. Universitas Udayana. Bali
- [24] Sitorus, Y. R., & Navia, Z. I. 2023. Analisis Mikrobiologi Dengke Naniura Ikan Mas (*Cyprinus carpio* L) Terhadap Pengaruh Konsentrasi Andaliman (*Zanthoxylum acanthopodium* DC). Biotropic: The Journal of Tropical Biology, 7(2), 1-9.
- [25] Sitorus, Y. R. 2023. Analisis Mikrobiologi Dengke Naniura Ikan Mas (*Cyprinus carpio*). Jurnal Saintek Perikanan Indonesia, 19(1), 55-62.
- [26] Sosianika, A., Setiawati, L., Kania, R., Amalia, F. A., & Senalajari, W. 2025. Re-branding kemasan produk GEMIO418: Kemasan kreatif untuk olahan lele konsumsi manusia dan maggot pakan ternak. Bakti Budaya: Jurnal Pengabdian kepada Masyarakat, 8(1), 70-86.
- [27] Suantika, R., Suryaningsih, L., & Gumilar, J. 2017. Pengaruh Lama Perendaman dengan Menggunakan Sari Jahe Terhadap Kualitas Fisik (Daya Ikut Air, Keempukan dan pH) Daging Domba. Jurnal Ilmu Ternak, 17(2), 67-72.
- [28] Susanti, R., & Rudiyanto, M. 2024. Strategi pengembangan kemasan berbasis kualitas untuk produk ikan: Studi implementasi di Desa Tlesah, Pamekasan. SAFARI: Jurnal Pengabdian Masyarakat Indonesia, 4(3), 228-239.
- [29] Syarief, R dan H. Halid. 1993. Teknologi Penyimpanan Pangan. Penerbit Arcan. Jakarta
- [30] Tarigan, O. J., Lestari, S dan Widiastuti, I. 2016. Pengaruh Jenis Asam dan Lama Marinasi Terhadap Karakteristik Sensori, Mikrobiologis, Kimia Naniura Ikan Nila (*Oreochromis niloticus*). Jurnal Teknologi Hasil Perikanan, 5(2):112-122.
- [31] Use of herbs and spices in fish preservation at chilled temperature storage: Opportunities and challenges. 2024. International Journal of Food Science & Technology, 59(10), 6758-6768. <https://doi.org/10.1111/ijfst.17372>
- [32] Wijaya, C.H., Irene, T.H., Apriyantono, A. 2002. Identification of Volatile Compounds and Key Aroma Compounds of Andaliman Fruit (*Zanthoxylum acanthopodium* DC.). Food Science Biotechnology. Vol. 11 No. 6, pp. 680 - 683.
- [33] Wijaya, R., Parhusip, A., & Sitanggang, D. 2022. Pengembangan Pemasaran Digital Produk Pangan Lokal Berbasis UMKM. Jurnal Agroindustri dan Bisnis, 10(3), 211-220.
- [34] Yuliani, S., Mahendra, D., & Prasetyo, R. 2021. Analisis tekstur dan mutu sensoris Naniura ikan mas (*Cyprinus carpio*) hasil perendaman dengan variasi asam organik. Fishtech: Jurnal Teknologi Hasil Perikanan, 10(1), 12-20.