Buletin SK 10(2)(2026): 167-175
https://doi.org/10.17576/bsk-2026-10(2)-10 ISSN 2250-1852

Ulasan Artikel/Review Article

Keropok Lekor: Origin, Production Process, Nutritional Content and Innovations

Keropok Lekor: Asal Usul, Proses Penghasilan, Kandungan Pemakanan dan Inovasi

SEE MENG LIM[1,2], JIA AI LIM[1] & HASNAH HARON[2,3*]

[1]Centre for Community Health Studies (ReaCH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia

[2]Planetary Nutrition Research Group, Universiti Kebangsaan Malaysia, 43600 Bangi, Malaysia

[3]Centre for Healthy Ageing and Wellness (H-Care), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia

*Corresponding author; email: hasnaharon@ukm.edu.my

Received date: 19 July 2026
Revised date: 22 October 2026
Accepted date: 23 October 2026
Published date: 26 October 2026

ABSTRACT

Keropok lekor is a traditional protein-rich fish-based snack that holds significant cultural and economic importance in Malaysia, particularly in the coastal regions of Terengganu. Despite its popularity, there is a critical need to synthesise existing knowledge on its production standards and nutritional profile, specifically regarding high sodium content and low dietary fibre, both of which are of increasing concern to modern health-conscious consumers. This review provides an overview of traditional and commercial production processes, including fish cleaning, dough kneading with sago flour, and hand-rolling into cylindrical shapes. It specifically examines the role of primary ingredients and marine fish species in determining the final texture, elasticity, and quality of the product. Additionally, a comparative evaluation of nutritional data from national databases and recent empirical studies highlights significant variations in sodium and caloric content. The review also discusses critical innovations in functional food science, such as the partial substitution of fish flesh with oyster mushrooms, banana blossoms, and other plant-based ingredients to enhance nutritional value without compromising sensory acceptance. These findings suggest that such innovations offer a viable pathway toward developing healthier and more sustainable traditional food products.

Keywords: Keropok lekor, nutritional content, product innovation, traditional food

ABSTRAK

Keropok lekor merupakan makanan tradisional berasaskan ikan yang kaya dengan protein dan mempunyai kepentingan budaya serta ekonomi yang signifikan di Malaysia, khususnya di kawasan pesisir pantai Terengganu. Walaupun makanan ini popular dalam kalangan masyarakat, terdapat keperluan untuk menghimpunkan maklumat sedia ada berkaitan standard penghasilannya dan profil pemakanannya, terutamanya berhubung kandungan natrium yang tinggi dan serat diet yang rendah, yang semakin menjadi perhatian dalam kalangan pengguna yang mementingkan kesihatan. Ulasan ini membincangkan proses penghasilan keropok lekor secara tradisional dan komersial, termasuk pembersihan ikan, pengadunan isi ikan dengan tepung sagu, serta pembentukan doh secara manual kepada bentuk silinder. Peranan bahan-bahan utama dan spesies ikan marin yang digunakan turut diperincikan kerana faktor-faktor ini mempengaruhi tekstur, keanjalan dan kualiti akhir produk. Selain itu, perbandingan data pemakanan daripada pangkalan data kebangsaan dan kajian empirikal terkini menunjukkan wujudnya variasi yang ketara dalam kandungan natrium dan kalori. Ulasan ini juga membincangkan inovasi dalam bidang makanan fungsian, termasuk penggantian sebahagian isi ikan dengan cendawan tiram, jantung pisang dan bahan berasaskan tumbuhan yang lain bagi meningkatkan nilai pemakanan tanpa menjejaskan penerimaan sensori pengguna. Dapatan ulasan ini menunjukkan bahawa inovasi tersebut berpotensi menjadi pendekatan yang berdaya maju untuk menghasilkan produk makanan tradisional yang lebih sihat dan mampan.

Kata Kunci: Keropok lekor, kandungan pemakanan, inovasi produk, makanan tradisional.

Copyright © 2026 Faculty of Health Sciences UKM. All right reserved

INTRODUCTION

Keropok lekor is a traditional fish-based snack and a local-flavoured food popular in Malaysia. It is widely considered an iconic snack originating from Terengganu due to its coastal location and abundance of seafood (Aqil 2020). Although it originated in Terengganu, *keropok lekor* can now be found throughout Malaysia (Atiqah et al. 2024). *Keropok lekor* is a type of fish cracker, typically made from a mixture of fish flesh and sago flour (Arrisha et al. 2021). Common types of fish used include fringescale sardine, round scad, dorab wolf herring, fivelined threadfin bream and mackerel, although fringescale sardine or round scad are often preferred for their taste. The ingredients are mixed and kneaded, shaped into cylindrical forms with a diameter of 2-5 cm, and then boiled in water until floating or fried in hot oil until golden brown and expanded (Che Rohani et al. 2013). *Keropok lekor* is one of several types of fish-based crackers available in Malaysia, alongside sliced *keropok* and instant *keropok* (Siaw et al. 1985; Ealangov et al. 2023).

Due to its popularity as a local-flavoured food, understanding the production methods, ingredient composition, packaging practices and nutrient profiles of *keropok lekor* is essential. While raw *keropok lekor* provides protein (Nur Yuhasliza et al. 2022), it is generally high in sodium and low in fibre, although some analyses show fibre content (Health Promotion Board 2011; Institute for Medical Research 2015; Atiqah et al. 2024; Qurratul et al. 2024). In recent years, researchers have explored innovative approaches to enhance the nutritional value and sensory attributes of *keropok lekor*. These innovations include incorporating ingredients such as herbs and spices (Irfan Uddin Zim et al. 2019), oyster mushrooms (Lokman et al. 2023; Nor Salasiah et al. 2023), banana blossoms, and grated coconut (Afiqah & Faridah 2024). The findings suggest that these innovations have the potential to offer healthier alternatives without compromising consumer acceptance.

This review aims to summarise key findings on the production, nutritional content, and innovation of *keropok lekor*. It also explores the types of *keropok lekor* found in the market and the packaging methods. By doing so, it provides a comprehensive overview for future developments in *keropok lekor* production and innovation. Continuous innovation in formulation, processing and packaging is considered essential to meet modern consumer preferences for healthier and more convenient food products while preserving the traditional essence.

LITERATURE SEARCH STRATEGY

This review was conducted using a narrative literature review approach. Relevant publications were identified through searches in Google Scholar, Scopus, and ScienceDirect databases. Search terms included "*keropok lekor*", "fish cracker", "nutritional composition", "food packaging", "processing methods", and "product innovation". Articles published in English or Malay from 2000 to 2024 were considered. Additional references were identified through citation tracking of relevant studies. Studies focusing on the origin, production process, ingredients, nutritional composition, packaging methods, and innovations related to *keropok lekor* were included, whereas publications lacking sufficient methodological information or relevance to the topic were excluded.

ORIGIN AND TYPES

Keropok lekor is a traditional fish-based snack and a local-flavoured food popular in Malaysia, catering to Malaysian taste preferences. It is widely considered an iconic snack originating from Terengganu, a state often regarded as its birthplace due to its coastal location and abundance of seafood (Aqil 2020). Although it originated in Terengganu, *keropok lekor* can now be found throughout Malaysia and is frequently sold at roadside stalls and night markets (Atiqah et al. 2024). It remains a beloved traditional food of the country's culinary heritage. *Keropok lekor* did not have a specific name and was named based on its method of preparation. Villagers would mix fish flesh with sago flour, and after mixing and kneading, the dough was pounded, producing a "*keropok*" sound. Over time, the word "*keropok*" came to refer to this food (Arrisha et al. 2021). The word "*lekor*" refers to "*lingkar*" (roll) in Terengganu Malay, where the spelling "ar" is replaced with "or" at the end of the syllable. Therefore, *keropok* lekor means a roll-shaped fish cracker (Muhamad Rafiq & Muammar Ghaddafi 2018).

There are several variations of *keropok lekor* found in the market, reflecting regional preferences and evolving consumer tastes. These include the original *keropok lekor*, the classic version typically made from a mixture of fish flesh and sago flour. It can be either boiled or fried before consumption (Muhamad Rafiq & Muammar Ghaddafi 2018). Losong *keropok lekor* refers to *keropok lekor* that is famous in Kampung Losong, Terengganu, renowned for its soft interior and crispy exterior texture. Although essentially the same as regular *keropok lekor*, it is named after its place of origin. Thin *keropok lekor,* also known as "*keropok selipar*" in Terengganu, is another variation which resembles sliced *keropok* but does not expand when fried. Additionally, crispy *keropok lekor* features a crunchier texture (Nurfardlina 2023). Modern variations such as *keropok lekor* coated with sweet spicy sauce and cheese *keropok lekor* have also

emerged, adding value and introducing a modern element in line with current trends.

Fundamentally, *keropok lekor* is available in two primary forms: boiled *keropok lekor* and fried *keropok lekor*. Boiled *keropok lekor* can be eaten immediately, offering a chewy texture, or it can be fried first and enjoyed with chilli sauce to enhance the flavour (Mohd Najib et al. 2020). Frying in hot oil until it expands and turns a golden-brown colour ensures that the inside remains soft while the outside becomes crispy (Qurratul et al. 2024). Several types of *keropok lekor* are widely available across Malaysia, each with unique textures and flavours, as illustrated in Figure 1, which showcases the original, thin, crispy and sweet-spicy coated varieties.

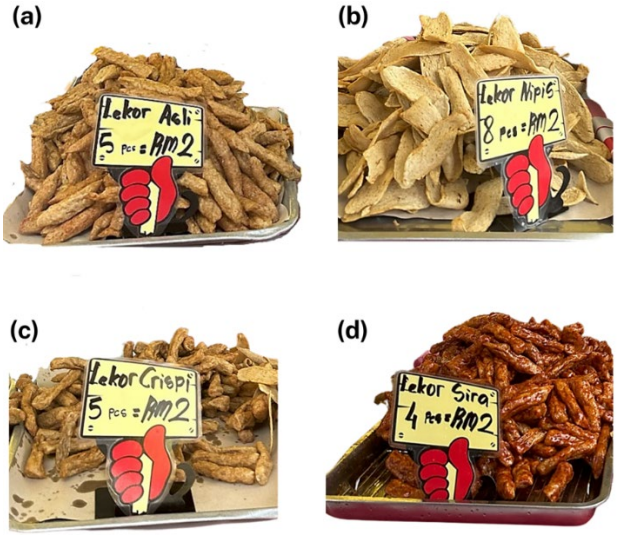


FIGURE 1 Varieties of *keropok lekor* commonly found in Malaysia: (a) Original *keropok lekor*; (b) Thin *keropok lekor*; (c) Crispy *keropok lekor*; (d) *Keropok lekor* coated with sweet and spicy sauce.

TABLE 1 Ingredients used in the production of *keropok lekor*.

Ingredient	Purpose
Main Ingredients	
Fish flesh	Provides the primary source of protein
Sago flour	Acts as a binding agent and contributes to a soft and pleasant texture
Salt	Enhances flavour and aids in protein gel formation
Sugar	Improves flavour and imparts a brownish colour during frying
Monosodium glutamate (MSG)	Intensifies the savoury flavour
Cold water / Shaved ice	Maintains fish freshness and elasticity by lowering the dough temperature
Additional Ingredients	
Corn flour	Softens the texture and improves dough pliability
Starch or tapioca flour	Enhances crispiness of the final product
Baking soda / Baking powder	Promotes expansion and lightness during cooking
Margarine or cooking oil	Produces a moister and softer texture
Black pepper powder	Adds mild spiciness and enhances flavour

Source: Afni et al. 2023; Atiqah et al. 2024; Qurratul et al. 2024

INGREDIENTS USED

The formulation of *keropok lekor* relies on a combination of primary and supplementary ingredients that contribute to its characteristic texture, flavour and nutritional value. The primary ingredients typically include fish flesh, sago flour, salt, sugar, flavouring agents, monosodium glutamate (MSG) and cold water (Che Rohani et al. 2013; Mohd Najib et al. 2020). Fish flesh is the most important component and serves as the main protein source. Various types of marine fish are used in *keropok lekor* production, depending on local

availability and cost. Common species include fringe-scale sardine (*Sardinella fimbriata*), round scads (*Decapterus* spp.), dorab wolf herring (*Chirocentrus dorab*), five-lined threadfin bream (*Nemipterus nematophorus*) and different types of mackerel (*Rastrelliger* spp.), including Indo-Pacific mackerel (*Rastrelliger brachysoma*), locally known as ikan pelaling. When using bony fish such as dorab wolf herring, the flesh must be finely ground to ensure a smooth and uniform dough. The quality and sensory appeal of the final product are influenced by the type and freshness of the fish as well as the ratios of key ingredients and processing methods employed (Che Rohani et al. 2013; Kaewmanee et al. 2015; Mohd Najib et al. 2020).

Sago flour is the second most essential ingredient and functions as a binding agent. It plays a crucial role in giving *keropok lekor* its soft, elastic texture. In some formulations, sago flour may be partially or wholly substituted with tapioca starch, depending on local preferences and availability. The ratio of fish to flour varies, typically ranging from 2:1 to 3:1, with fish content comprising approximately 50% to 60% of the total formulation (Kaewmanee et al. 2015; Mohd Najib et al. 2020). The balance between fish and flour affects not only texture and flavour but also the nutritional profile of the product. Other basic ingredients include salt, sugar, MSG and ice water. Salt is added to enhance taste and assist in protein gel formation, which improves the cohesiveness of the dough. Sugar contributes mild sweetness and aids in browning during frying. MSG is commonly used as a flavour enhancer to intensify the umami profile of the product. Ice water or shaved ice is used during the mixing process to keep the fish flesh cold, thus preserving its quality and preventing protein degradation. Cold temperatures also make the dough easier to handle and shape (Qurratul et al. 2024; Mohd Najib et al. 2020).

In addition to the core ingredients, various supplementary components may be included to improve texture, appearance or sensory attributes. Corn flour may be added to soften the dough and improve rollability. Starch or tapioca flour is often incorporated to enhance crispiness, particularly in fried versions (Atiqah et al. 2024). Leavening agents such as baking soda and baking powder can be used to promote expansion and create a lighter texture. Some formulations also include margarine or cooking oil to increase moisture retention and improve mouthfeel (Qurratul et al. 2024; Atiqah et al. 2024). To enhance flavour, spices such as black pepper powder are occasionally added (Afni et al. 2023). The use of these supplementary ingredients varies among producers and may be influenced by regional traditions, consumer preferences or the desired characteristics of the final product. Traditional recipes tend to favour minimal additives, whereas commercial producers may adopt modified formulations to appeal to broader markets or health-conscious consumers. The ingredients used in the production of *keropok lekor* are outlined in Table 1, which summarises both the main and additional ingredients along with their specific functions in the formulation process.

PRODUCTION PROCESS

The traditional process of making keropok lekor comprises five main stages: preparation of fish flesh, dough formation, shaping, boiling and frying. Each step plays a critical role in determining the final product's quality, texture, and shelf stability.

(1) Preparation of fish flesh: Fresh fish are thoroughly cleaned, deboned and then ground into a fine paste using a blender or grinding machine. In some commercial settings, processed frozen fish flesh is used and must be thawed before grinding to achieve the required consistency. The fineness of the fish paste is important to ensure a smooth dough and desirable mouthfeel in the final product (Qurratul et al. 2024; Atiqah et al. 2024).

(2) Preparation of the dough: The fish paste is combined with sago flour or tapioca flour, along with salt, sugar, MSG and, in some cases, other additives. This mixture is kneaded manually or using a mechanical mixer to form a homogeneous dough. Some producers incorporate ice or cold-water during mixing to control the temperature, thereby preserving the freshness of the fish protein and improving the dough's workability. The kneading process typically lasts 30 to 40 minutes to achieve optimal consistency and elasticity (Qurratul et al. 2024).

(3) Shaping the keropok lekor: The dough is first divided into small portions, which are weighed to maintain a consistent size and cooking time. These portions are then rolled into cylindrical shapes by hand, producing *keropok lekor* with a diameter of approximately 2 to 4 centimetres and a length ranging from 15 to 30 centimetres. Hand-rolling not only preserves the artisanal value of the product but also allows the producer to detect and remove any remaining bones. In some commercial operations, rolling machines may be employed to increase efficiency and standardisation (Qurratul et al. 2024).

(4) Boiling: The shaped dough is immersed in boiling water at approximately 100°C. Cooking is typically complete once the *keropok lekor* floats to the surface, an indication that it is thoroughly cooked. Boiling

time varies depending on the size and thickness of the pieces. After boiling, the products are drained and dried. At this stage, they can be vacuum-packed and stored at -18°C to extend shelf life. Boiled *keropok lekor* may be consumed directly or subjected to a final frying step to enhance flavour and texture (Qurratul et al. 2024; Atiqah et al. 2024).

(5) Frying: The boiled *keropok lekor* is fried in hot oil until it expands and develops a golden-brown colour. This frying process creates a desirable contrast between the crispy outer layer and the soft, chewy interior (Qurratul et al. 2024). Proper control of frying temperature and duration is essential to prevent excessive oil absorption or burning.

Throughout the production process, several factors influence product quality, including the type and freshness of fish, the fish-to-flour ratio and adherence to standardised mixing and cooking techniques. Maintaining hygiene in the processing environment and controlling raw material quality are also critical to ensuring consistent flavour, texture, and safety. The method of mixing, the temperature during processing, and the duration of each step all contribute significantly to the sensory and nutritional attributes of the final product (Karrila 2011; Najwa et al. 2017; Marina et al. 2021). Figure 2 provides a step-by-step illustration of the traditional process, beginning with raw fish and ending with the final product.

PACKAGING METHODS

Packaging plays a crucial role in extending the shelf life of *keropok lekor*, preventing spoilage, and minimising microbial contamination. An effective packaging system serves as a barrier against external contaminants such as moisture, light, odours, bacteria and dust, while maintaining the quality and safety of the food product (Awulachew 2022). According to Atiqah et al. (2024), various packaging methods are employed by *keropok lekor* producers in Selangor, Malaysia. These include vacuum packaging, sealed plastic packaging tied with a string and packaging using boxes or paper bags. Among these, vacuum packaging is one of the most effective methods.

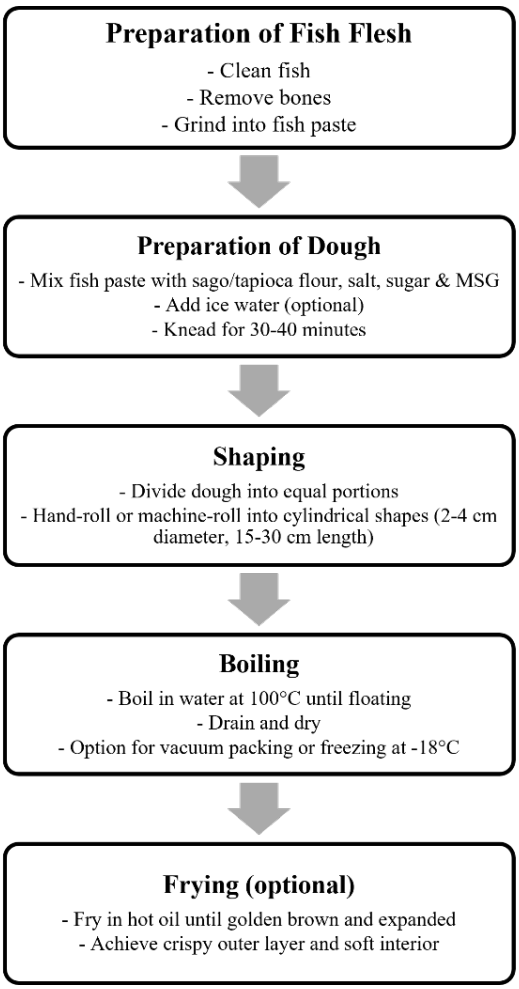


FIGURE 2 Summary of the *keropok lekor* production process.

TABLE 2 Nutrient content of raw *keropok lekor* (per 100 g).

Nutrient	Malaysian Food Composition Database (MyFCD), Malaysia	Energy and Nutrient Composition of Food Database, Singapore	Qurratul et al. (2024), Terengganu, Malaysia	Atiqah et al. (2024), Selangor, Malaysia
Calories (kcal)	336	336	202	202
Protein (g)	16.1	16.1	13.4	14.1
Carbohydrate (g)	66.0	66.0	33.4	31.1
Fat (g)	0.8	0.8	1.6	2.1
Fibre (g)	0	2.3	-	-
Sodium (mg)	1047	1047	606	372

It typically involves three key steps: printing product information on the packaging (including ingredients, production date, and expiry date), inserting the boiled and cooled *keropok lekor* into the packaging, and removing air via a vacuum-sealing process. The vacuum-packed product is then stored in a blast freezer or a cold storage facility. Products frozen using a blast freezer can be promptly packed into boxes and distributed to wholesalers without extended holding times (Espinoza Rodezno et al. 2013).

The types of plastic commonly used in vacuum packaging include polyethylene (PE) and nylon-polyethylene (Nylon-PE) composites. PE is preferred by many producers due to its cost-effectiveness and relatively low moisture permeability (Atiqah et al. 2024; Bugatti et al. 2021). However, it has a lower melting point compared to Nylon-PE, which limits its suitability for high-temperature applications. Nylon-PE, though more expensive, offers better heat resistance and mechanical strength (Bugatti et al. 2021). In contrast, plastic packaging tied with a string is often used for local distribution where delivery distances are short (typically within one to two hours), offering a practical yet less airtight solution. Meanwhile, box and paper bag packaging are typically reserved for *keropok lekor* that is intended for immediate sale and consumption by walk-in customers (Atiqah et al. 2024). Each packaging method is selected based on the intended distribution channel, shelf-life requirements, and economic considerations.

NUTRIENT CONTENT

Keropok lekor, being predominantly fish-based, provides protein and is a natural source of iodine (Nur Yuhasliza et al. 2022). However, it is also characterised by relatively high sodium content and low dietary fibre, raising some concerns about its suitability for individuals requiring restricted sodium intake. The nutritional composition of *keropok lekor* can vary significantly depending on ingredients, recipes and regional production methods. According to the Malaysian Food Composition Database (MyFCD), 100 grams of raw *keropok lekor* contains approximately 336 kcal of energy, 16.1 g of protein, 66.0 g of carbohydrates, 0.8 g of fat and 1047 mg of sodium (Institute for Medical Research 2015). Comparably, the Energy and Nutrient Composition of Food database in Singapore reports a similar nutrient profile but includes 2.3 g of dietary fibre per 100 g (Health Promotion Board 2011), which is not listed in the MyFCD data.

In contrast, recent empirical studies using recipe-based analysis have reported lower energy and sodium values. For example, Qurratul et al. (2024) evaluated the nutritional composition of nine *keropok lekor* recipes from producers in Terengganu using the Nutritionist Pro software and reported that 100 g of raw *keropok lekor* contained 202 kcal, 13.4 g of protein, 33.4 g of carbohydrates, 1.6 g of fat, and 606 mg of sodium. Similarly, Atiqah et al. (2024) estimated the nutrient content using Nutritionist Pro from five producers in Selangor and found that the average values were 202 kcal, 14.1 g of protein, 31.1 g of carbohydrates, 2.1 g of fat and a lower sodium content of 372 mg per 100 g. The substantial variation in sodium content reported across studies (372–1047 mg/100 g) may be attributable to differences in ingredient proportions, particularly the relative amounts of fish flesh, starch, added salt, and seasonings, as well as regional formulation practices shaped by local consumer preferences. Variations in processing methods, ingredient brands, and the use of flavour enhancers such as monosodium glutamate may also contribute to these differences. Furthermore, methodological differences in nutrient assessment may partly explain the observed variation, as the MyFCD and Singapore food composition databases primarily

provide database-derived nutrient values, whereas the more recent studies by Qurratul et al. (2024) and Atiqah et al. (2024) used recipe-based calculations in Nutritionist Pro. These findings highlight the potential for substantial variation in the nutritional composition of *keropok lekor* and support efforts to reformulate the product to reduce sodium content and improve its fibre content. A detailed comparison is presented in Table 2.

INNOVATIONS

Recent innovations in *keropok lekor* production have primarily focused on enhancing its nutritional profile, expanding flavour diversity and aligning the product with modern consumer preferences for healthier and more functional snack options. Several studies have experimented with incorporating alternative ingredients and flavouring agents to achieve these goals. For instance, Irfan Uddin Zim et al. (2019) explored flavour diversification by integrating a variety of herbs and spices, such as garlic, onion, ginger, green chilli, fennel, coriander, cinnamon, cardamom, bay leaves, nutmeg, and cloves, into the traditional recipe. Among the developed formulations, the breadcrumb-coated and fried sample received the highest sensory evaluation scores for colour, aroma, texture, flavour, taste and overall acceptance, highlighting the potential of such innovations to improve consumer appeal.

Other studies have investigated the partial substitution of fish flesh with plant-based ingredients to enhance fibre and micronutrient content, although such substitutions may also reduce protein content. Lokman et al. (2023) developed formulations using oyster mushrooms to replace 25% (Sample A) and 50% (Sample B) of the fish content. Sample B emerged as the most preferred in terms of texture, taste and overall acceptance, and both samples demonstrated increased moisture, carbohydrate and ash contents compared to the control. Similarly, Nor Salasiah et al. (2023) formulated *keropok lekor* using grey oyster mushrooms (*Pleurotus sajor caju*) at concentrations of 15% to 45%, with the 45% formulation scoring the highest across multiple sensory attributes. In another study, Afiqah and Faridah (2024) produced thirteen formulations enriched with banana blossoms, grated coconut, oyster mushrooms, and potatoes. All variations were well received by sensory panellists, with banana blossom-enriched *keropok lekor* notably contributing higher levels of fibre, vitamins and minerals. Nevertheless, replacing fish flesh with plant-based ingredients may reduce protein content, depending on the ingredients and substitution levels. Therefore, improvements in sensory acceptance and selected nutritional components should not be interpreted as evidence of an overall improvement in nutritional quality without considering the complete nutrient profile, particularly protein content.

Beyond nutritional improvements, flavour-based innovations have also gained popularity in the marketplace, leading to the emergence of contemporary *keropok lekor* varieties such as cheese, black pepper, curry and sweet-spicy versions. These novel products reflect the ongoing effort to modernise traditional foods while catering to evolving consumer tastes and lifestyle demands. Collectively, these innovations not only enhance the sensory and nutritional quality of *keropok lekor* but also broaden its market appeal across diverse demographic segments.

CONCLUSION

Keropok lekor continues to serve as an iconic traditional snack that reflects Malaysia's rich culinary heritage and contributes significantly to local economies, particularly in coastal regions such as Terengganu. A review of its production process, packaging methods and nutrient composition reveals that it is a protein- and carbohydrate-rich food product, though its sodium content may pose health concerns when consumed in excess. Recent innovations have demonstrated potential for enhancing selected nutritional attributes and sensory appeal of *keropok lekor*, particularly through the incorporation of functional ingredients such as herbs, spices, mushrooms and plant-based additives like banana blossoms. These enhancements align with consumer interest in healthier snack options and may expand the product's marketability, although improvements in selected nutritional components do not necessarily indicate an overall improvement in nutritional quality. As the available evidence is largely based on individual formulation studies, laboratory analyses and sensory evaluations, further research is needed to establish long-term consumer acceptance, nutritional outcomes and commercial scalability. Moving forward, sustained efforts in reformulation, processing optimisation and innovative packaging are essential to ensure the continued relevance of *keropok lekor* in a modern food environment while preserving its traditional value and cultural identity.

ACKNOWLEDGEMENT

This study received no external funding.

REFERENCES

Afni, A., Dayang, N.A.K., & Azlan, L. 2023. Impak latihan sangkut terhadap pembangunan usahawan Sabah dalam bidang pemprosesan keropok lekor. In S. Shamsudin (Ed.), *Buletin*

Pemindahan Teknologi MARDI (pp. 21–29). Selangor: Institut Penyelidikan dan Kemajuan Pertanian Malaysia (MARDI).

Afiqah, M.N. & Faridah, K. 2024. Physicochemical properties and sensory evaluation of 'keropok lekor banana heart'. *Enhanced Knowledge in Sciences and Technology* 4(2): 562-573. doi.org/10.30880/ekst.2024.04.02.061.

Aqil, N. 2020, March 18. Food Origins: Keropok Lekor. Masses. https://masses.com.my/food/food-origins-keropok-lekor/

Arrisha, S.S., Wan Izzah, M.W.L., Wan Abdul, M.W.A. & Nik Azliza, N.A. 2021. Makanan warisan Terengganu (Keropok Warisan Losong). *Jurnal Sejarah Lisan Malaysia* 5(3): 280-300. https://ir.uitm.edu.my/id/eprint/92549/1/92549.pdf

Atiqah, A.S., Fatin, M.R., Hidayat, A. & Hasnah, H. 2024. A survey of the use of ingredients and packaging in the manufacture of fish-based snack in Selangor. *Malaysian Journal of Health Sciences* 22 (2): 83-99. doi.org/10.17576/JSKM-2024-2202-06.

Awulachew, M.T. 2022. A review of food packaging materials and active packaging system. *International Journal of Health Policy Planning* 1(1): 28-35. doi.org/10.33140/ijhpp.01.01.03.

Bugatti, V., Zuppardi, F., Viscusi, G. & Gorrasi, G. 2021. Active packaging based on coupled nylon/PE pouches filled with active nano-hybrid: Effect on the shelf life of fresh milk. *Nanomaterials (Basel)* 11(8): 1881. doi.org/10.3390/nano11081881.

Che Rohani, A., Rokiah, M., Mohd Ariff, W. & Normah, A. 2013. *Manual teknologi pemprosesan produk ikan*. Kuala Lumpur, Malaysia: Institut Penyelidikan dan Kemajuan Pertanian Malaysia (MARDI).

Ealangov, S., Nurul Huda, M. & Mardhiah, Z. 2023. *14 PRODUK BERASASKAN IKAN*. Pahang: Kolej Komuniti Beera Pahang.

Espinoza Rodezno, L.A., Sundararajan, S., Solval, K.M., Chotiko, A., Li, J., Zhang, J., Alfaro, L., Bankston, J.D. & Sathivel, S. 2013. Cryogenic and air blast freezing techniques and their effect on the quality of catfish fillets. *LWT - Food Science and Technology* 54(2): 377-382. doi.org/10.1016/j.lwt.2013.07.005.

Health Promotion Board. 2011. Keropok ikan, mentah. Energy & Nutrient Composition of Food. Singapore. https://focos.hpb.gov.sg/eservices/ENCF/FoodAnalysis.aspx?p=1

Institue for Medical Research. 2015. Fish Crackers, Raw (Keropok Ikan, Mentah). Malaysian Food Composition Database Programme. https://myfcd.moh.gov.my/myfcd97/index.php/site/detail_product/110109/0/10/keropok%20/0/0/

Irfan Uddin Zim, A.F.M., Afruza, A., Mohammad, S.A., Wakil, A.A., Shamima, A. & Zamri, A.I.B. 2019. Proximate composition, texture analysis and sensory evaluation of keropok lekor formulated with herbs and spices. *Food Research* 3(6): 635-639. doi.org/10.26656/fr.2017.3(6).050.

Kaewmanee, T., Karrila, T. & Benjakul, S. 2015. Effects of fish species on the characteristics of fish cracker. *International Food Research Journal* 22(5): 2078-2087.

Karrila, T. 2011. Cracker "Keropok": A review on factors influencing expansion. *International Food Research Journal* 18(3): 855-866.

Lokman, L.A, Norlelawati, A., Nur Huda, F. & Nurzazarina, R. 2023. Physicochemical properties and sensory preference of keropok lekor with partial replacement of fish flesh with oyster mushroom. *Malaysian Journal of Science Health & Technology* 9(2): 128-135. doi.org/10.33102/mjosht.v9i2.357.

Marina, T., Nurul Shazini, R., Nor Khaizura, M.A.R., Radhiah, S. & Mohammad Rashedi, I. 2021. Comparison of boiling, steaming, air frying, deep-frying, microwaving and oven-cooking on quality characteristics of keropok lekor (Malaysian fish sausage). *Malaysian Applied Biology* 50 (3): 77-85. doi.org/10.55230/mabjournal.v50i3.2000.

Mohd Najib, A.H., Norfuzi Bidin & Syaifurazi Marjuki, M. 2020. Memproses Keropok Lekor. In Nurul Husna, A.H. (Ed.), *Pemprosesan Makanan Tingkatan 4 dan 5* (pp. 50-55). Kajang, Malaysia: Kementerian Pendidikan Malaysia.

Muhamad Rafiq, A.B. & Muammar Ghaddafi, H. 2018. Perusahaan keropok lekor makanan tradisi Melayu Terengganu. *Jurnal Wacana Sarjana* 2(3): 1 -7. doi.org/10.17576/jws.v2i3.169.

Najwa, S.M., Mohamad Afifi, I., Mahmud, A.R.N. & Mohammad Rashedi, I. 2017. The effect of mixing time and mixing sequence during processing on the physicochemical and sensory properties of keropok lekor. *Journal of Science and Technology* 9(4): 88-95.

Nor Salasiah, M., Faridah, H., Noorzainah, A., Ashadi, Y., Rawaida, R. & Mazliana, B. 2023. Mushroom keropok lekor, an innovative food product. *Food Research* 6(Suppl. 2): 268-276. doi.org/10.26656/fr.2017.6(S2).043.

Nurfardlina, I.M. (2023, July 10). 'Losong nama tempat, bukan jenis keropok'. *Sinar Harian*. https://www.sinarharian.com.my/article/279

627/edisi/terengganu/losong-nama-tempat-bukan-jenis-keropok

Nur Yuhasliza, A.R., Musaalbakri, A.M., Khairul, F.P., Nazamid, S. & Fadzlie Wong, F.W. 2022. Evaluation of antioxidant and antibacterial activities of fish protein hydrolysate produced from Malaysian fish sausage (Keropok Lekor) by-products by indigenous Lactobacillus casei fermentation. *Journal of Cleaner Production,* 347: 131303. doi.org/10.1016/j.jclepro.2022.131303.

Qurratul, A.F.F., Suzana, S., Zaliha, H., Mohd, N.H.A. & Hasnah, H. 2024. Survey on the salt usage among Fish Cracker (Keropok lekor) manufacturers in several districts of Kuala Terengganu, Malaysia. *Malaysian Applied Biology* 53(3): 71-82. doi.org/10.55230/mabjournal.v53i3.2814.

Siaw, C.L., Idrus, Z. & Yu, S.Y. 1985. Intermediate technology for fish cracker (Keropok) production. *International Journal of Food Science & Technology* 20: 17-21. doi.org/10.1111/j.1365-2621.1985.tb01898.x.