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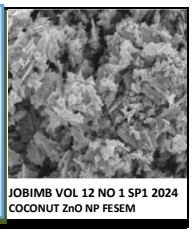


# Development of Korean-Style Fish Cake Mixed with Lokan (*Polymesoda expansa*), Physicochemical Properties, and Its Acceptability

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**ABSTRACT**

Lokan (*Polymesoda expansa*), a mollusk with high nutritional value, is often overlooked due to its unappealing texture and color. This study explores the feasibility of incorporating Lokan meat into Korean-style fish cakes (KSFC) to enhance its utilization. The minced Lokan was blended with surimi, wheat flour, cassava flour, egg white powder, oil, and water, and then steamed in molds. A panel of 30 individuals evaluated the KSFC with varying Lokan concentrations. Formulation B, containing 40% Lokan, emerged as the most accepted variant based on appearance, color, texture, flavor, odor, and overall acceptability. Physicochemical analysis revealed formulation B to have 71.20% moisture, 2.17% ash, 16.69% crude protein, 0.76% crude fat, and 8.98% carbohydrate content. Lokan addition inversely affected moisture and fat while positively influencing ash, protein, and carbohydrate content. Incorporating Lokan also impacted KSFC hardness and lightness, with increased Lokan correlating with higher hardness and reduced lightness. In conclusion, the successful creation of Lokan-infused fish cakes represents a promising stride in innovating with underutilized resources, presenting new possibilities for diverse and sustainable food products.

## INTRODUCTION

Seafood can effectively prevent several noncommunicable diseases and treats frequent nutritional deficiencies [1]. Many types of seafood have become food products such as canned tuna, crab sticks, fish balls, and dried fish. Fish cake is a high-value food that is widely consumed in Korea and Japan [2]. Lokan (marsh clam) is one type of the mollusk. Despite being widely distributed throughout the Indo-Pacific region, the marsh clam is also found in the coastal areas of the southeast region of Asia. Marsh clams live in the soft soil deposited around the roots of the mangrove trees and spend a significant portion of their lives exposed to air in mangrove swamps where salinity varies dramatically [3]. Lack of utilization of Lokan in food production hinders widespread enjoyment of its taste and nutritional benefits. This study focuses on enhancing Korean-style fish cake (KSFC) with Lokan *(Polymesoda expansa)* by selecting an optimal formulation through sensory evaluation. It also goes into the physicochemical qualities of the finished product, addressing issues associated to Lokan's soft texture and less appealing colour.

## MATERIALS AND METHODS

### KSFC Mixed with Lokan Preparation

KSFC was prepared whereby, Sample A (control): formulation KSFC with 0% Lokan meat paste; Sample B, formulation KSFC with 40% Lokan meat paste; Sample C, formulation KSFC with 50% Lokan meat paste; Sample D, formulation KSFC with 60% Lokan meat paste.

### Sensory Evaluation

The sensory evaluation involved a 7-point hedonic scale with 30 UMT students assessing color, texture, appearance, taste, odor, and overall acceptability. The highest-rated formulation proceeded to a detailed physicochemical analysis.

### Physicochemical Properties

Moisture, ash, crude fibre, crude protein, crude fat, and carbohydrate contents were determined by using AOAC (2023) methods [4]. According to Mi et al. [5], with slight modification, the texture of KSFC mixed with Lokan was measured using a TA. XT Plus Texture Analyzer that is equipped with a 36mm cylinder probe with radius (P/36R) and a 5kg load cell. According to

Cropotova et al. [6], the value of color was assessed using a colorimeter (Konica Minolta Chroma metre CR-400). CIE classified color in three dimensions which are L* for brightness which is for black to white, a* for red to green color, and b* for yellow to blue color.

**Statistical Analysis**

Formulations of KSFC mixed with Lokan were compared using ANOVA with a 95% confidence interval. A *p*-value of 0.05 indicated significant differences between treatments. Tukey Test facilitated multiple comparisons for significant distinctions in mean values.

## RESULTS AND DISCUSSION

**Sensory evaluation**

**Table 1** shows acceptability scores for KSFC mixed with Lokan, assessed by 30 panelists. No significant differences ($p>0.05$) were found among KSFC formulations in texture, odor, taste, and overall acceptance except for appearance and color. Despite Sample D (60% Lokan) scoring lower in appearance and color, the overall Lokan mixture was deemed acceptable. Sample B (40% Lokan) had the highest score and was the most preferred.

**Table 1.** Mean score of sensory acceptability of KSFC Mixed with Lokan.

| | Korean-style Fish Cake | | | |
|---|---|---|---|---|
| Attributes | A | B | C | D |
| Appearance | $6.30 \pm 0.99^{a}$ | $5.90 \pm 0.92^{ab}$ | $5.53 \pm 1.20^{b}$ | $5.40 \pm 1.30^{b}$ |
| Color | $6.00 \pm 1.05^{ab}$ | $6.00 \pm 1.02^{a}$ | $5.43 \pm 1.22^{ab}$ | $5.30 \pm 1.26^{b}$ |
| Texture | $5.60 \pm 1.25^{a}$ | $5.90 \pm 0.96^{a}$ | $5.50 \pm 1.28^{a}$ | $5.40 \pm 1.10^{a}$ |
| Odor | $5.73 \pm 1.26^{a}$ | $5.47 \pm 1.17^{a}$ | $5.30 \pm 1.39^{a}$ | $5.37 \pm 1.19^{a}$ |
| Taste | $5.27 \pm 1.39^{a}$ | $5.93 \pm 1.02^{a}$ | $5.73 \pm 1.17^{a}$ | $5.60 \pm 1.50^{a}$ |
| Overall Acceptance | $5.47 \pm 1.48^{a}$ | $6.07 \pm 0.94^{a}$ | $5.50 \pm 1.11^{a}$ | $5.50 \pm 1.33^{a}$ |

**Proximate composition**

Significant differences ($p<0.05$) were observed between samples (**Fig. 1**). KSFC moisture content decreases with increasing Lokan percentage. Threadfin bream fish has 81.04% moisture at 40°C; surimi from threadfin bream has 77.99% [7]. Lokan's moisture content is 89.37% [8]. Ash content in KSFC mixed with Lokan was higher than in control KSFC. The ash component primarily comprises minerals and inorganic substances remaining after burning away organic matter. The washing and dewatering processes of surimi remove minerals, including calcium, from fish meat.

The highest mineral content in Indian mackerel and the lowest in cockle [9]. However, all KSFC formulations exhibited zero fiber content because seafood derived from muscle typically contains minimal fiber Lokan addition influences protein content in KSFC; Sample C, with more Lokan, has higher protein. Japanese threadfin bream has 18.17% protein, cockles have 15.99% [10], and Lokan has 7.08% crude protein [8]. Surimi post-manufacturing has 12.85% protein, with salt treatment removing soluble proteins [11].

Increased Lokan addition correlated with a decrease in fat content in KSFC. Fish has 5-20% of fat content [12] while clams contain 0.97% of fat [13]. Lokan has a crude fat content of 0.82% [8]. Shellfish is regarded as a low-fat [14]. Carbohydrate content in KSFC rises with Lokan addition. Shellfish generally have higher carbs than fish. Japanese threadfin bream lacks carbs, while cockles and oysters have 1.5% and 6.54% respectively [10]. Lokan*'s* carb content is 2.44% [8].

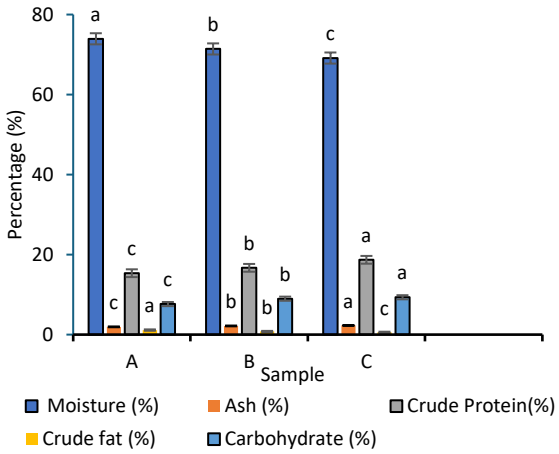


**Fig. 1.** Proximate composition of different KSFC formulation.

**Physical Analysis**

**Table 2** reveals that samples A and B exhibit no significant difference ($p>0.05$) in hardness, indicating that Lokan meat addition has minimal impact on fish cake texture. Sample C, with the highest Lokan content, exhibits the highest hardness. A study by Halmi and Sarbon [15] suggests that increased hardness may result from water loss and elevated fat and protein content which contributed to an increase in the gumminess and chewiness. Table 3 indicates significant differences ($p<0.05$) in color among formulations. L* values decrease with Lokan addition, with Sample A having higher whiteness due to 0% Lokan. Lokan*'s* darker muscle contributes to color variations [6].

**Table 2.** Texture value of different KSFC formulation.

| Texture Profile | | | |
|---|---|---|---|
| Formulations | Hardness (g) | Chewiness (g) | Cohesiveness (g) |
| A | $1093.90 \pm 66.70^{b}$ | $764.79 \pm 9.84^{b}$ | $0.81 \pm 0.00^{a}$ |
| B | $1265.70 \pm 41.10^{b}$ | $930.68 \pm 10.73^{b}$ | $0.80 \pm 0.00^{b}$ |
| C | $1761.00 \pm 229.00^{a}$ | $1293.70 \pm 119.60^{a}$ | $0.80 \pm 0.00^{b}$ |

**Table 3.** Color values of KSFC with different formulations.

| Color Profile | | | |
|---|---|---|---|
| Formulations | L* | a* | b* |
| A | $81.63 \pm 0.19^{a}$ | $-1.63 \pm 0.01^{c}$ | $10.97 \pm 0.01^{c}$ |
| B | $64.94 \pm 0.10^{b}$ | $-0.59 \pm 0.02^{b}$ | $15.47 \pm 0.07^{b}$ |
| C | $63.07 \pm 0.07^{c}$ | $-0.43 \pm 0.03^{a}$ | $15.71 \pm 0.15^{a}$ |

## CONCLUSIONS

The development of KSFC mixed with Lokan has been successfully developed in this study Formulation B was highly accepted by panelists for sensory evaluation that was carried out. There is no significant difference among samples for the attributes evaluated which are texture, odor, taste and overall acceptance, except for the color and appearance attributes. This showed that the higher Lokan percentage has influenced the appearance of the KSFC. Mixing Lokan into KSFC could successfully produce a healthier alternative (increased protein and reduced fat) with better consumer acceptability. For physical analysis, the texture attributes which are hardness and chewiness, increase as the amount of Lokan added into the KSFC increases, and the color of the KSFC showed the L* values decreased values as the percentage of Lokan added increased. Further study is recommended for the utilization of Lokan fortified in other seafood products. Besides that, the physicochemical properties of surimi made from Lokan can also be further studied to get more

data on Lokan products. Further study on the shelf life of fish cake mixed with Lokan stored in different conditions is supposed to be done to ensure that the product is safe for consumption.

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## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

## AUTHOR DISCLOSURE STATEMENT

The authors declare no conflict of interest.

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