The Effect of *Moringa oleifera* Leaves Addition on The Characteristic of Tuna (*Thunnus albacares*) Fishball

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**Abstract.** Indonesia has many potential marine source, such as tuna (*Thunnus albacares*) fish, and supported with rich biodiversity including *Moringa oleifera* leaves. Tuna fish is a very potential protein source which can be develop in many potential food product, such as fishball. This research was conducted to determine the effect of *Moringa oleifera* leaves addition on the characteristic of tuna fishball. The fishball were made from tuna fish, mixed with local flour, i.e. modified cassava flour (mocaf) flour, tapioca flour, and sago flour. Fresh moringa leaves was added to fishball with three different concentration (10%, 20%, 30%) and followed by the evaluation of chemical characteristic, including water content, ash content, protein content, fat content, carbohydrate content, antioxidant activity, and sensory characteristic, including hedonic test and descriptive test. The chemical analysis of the fishball showed that the addition of moringa leaves increased the water content to 4.84%, protein content to 7.25%, antioxidant activity to 3.03% and decreased the fat content to 0.18%. The most preferred fishball product from the sensory analysis was the fishball with 10% moringa leaves addition. The hedonic sensory test showed that the overall acceptance of the fishball with 10% moringa leaves addition was not significantly different with the fishball without moringa leaves addition. This study indicated that a healthy fishball could be made from tuna fish mixed with local flour and moringa leaves.

1. **Introduction**

Indonesia is known as a country rich in potential biodiversity, especially marine biodiversity such as fish. Fish is popular as a very potential food source for its protein content. One of the potential fish is tuna. Tuna (*Thunnus albacares*) is the second most important species of tuna, which accounts for about 30% of the global catch. Tuna fish are commonly produced for canning and freezing [1]. Tuna fish also can be develop in many potential food product, such as fishball [2,3,4]. Fishballs are processed fishery products using raw materials for whole fish or fish meat (minced) or surimi, added with starchy fillers and spices, which are formed in round shapes [4]. Fishballs are often boiled, steamed or deep-fried, with boiling being the most common cooking method [5].

Beside marine biodiversity, Indonesia also known with agricultural biodiversity that potential to develop, for instance, *Moringa oleifera* leaves. *Moringa oleifera* leaves contain protein [6], bioactive phenolic compounds [7,8] and have functional properties, such as antioxidant [9,10], anti-inflammatory [11], hypoglycemic, and hypolipidemic effect [12]. Therefore, it has potential to use the...
moringa leaves in food applications, especially in fishball processing. In this research, fishball were made from tuna fish and added with fresh moringa leaves. The aim of this study were to determine the effect of *Moringa oleifera* leaves addition on the characteristic of tuna fishball. The chemical characteristic, including water content, ash content, protein content, fat content, carbohydrate content, antioxidant activity, and sensory characteristic, including hedonic test and descriptive test were evaluated.

2. Methodology

2.1. Materials

The main raw material used was tuna (*Thunnus albacares*) obtained from Gunungkidul, Yogyakarta. Other raw materials used in this study were modified cassava flour (mocaf) flour obtained from Small Medium Enterprises (SME) Putri 21, Playen, Gunungkidul, sago flour, tapioca flour (Rose brand), garlic spices, salt, eggs, jelly powder, pepper were purchased from local market. Fresh *Moringa oleifera* leaves was obtained from Playen District, Gunungkidul, Yogyakarta.

2.2. Surimi processing

The tuna surimi processing method was refers to the Center for Testing the Application of Fisheries [13]. Tuna fish were cleaned and filleted. The fillet then was minced and added with ice cube to keep the temperature (< 22°C). The minced fish were mixed with fish meat, then stirred and washed with cold water (at 5-10°C). After that, add 0.3% of salt into the mixture and mixed. The minced fish meat was pressed with a hand press technique then added with 2% of sugar. The surimi was then stored at -20°C until used in fishball processing.

2.3. Fishball processing

Tuna fishballs were produced from surimi, mocaf flour, sago flour, tapioca flour, other ingredients (garlic, onion, salt, eggs, jelly powder, pepper), and fresh moringa leaves. Fresh moringa leaves were added in 3 concentration, i.e. 10% (TF 10), 20% (TF 20), and 30% (TF 30) of total surimi weight. Surimi, mocaf flour, sago flour, tapioca flour, other ingredients, and fresh moringa leaves were weighed based on the formulation and kneaded by hand until well mixed and homogenous. Once it done, the fish ball dough was shaped manually into balls with 2 cm diameter, and boiled in boiling water until the fishballs float. The fishball were then cooled it at room temperature for 30 minutes.

2.4. Fishball analysis

The fishballs were then analysed to identify the chemical characteristic, including proximate analysis: water content using thermogravimetry method, ash content using oven method, protein content using Kjeldahl method, fat content using Soxlet method [14], carbohydrate content by difference, antioxidant activity using DPPH method [15], and sensory characteristic. Sensory analysis of the fishball was conducted using a hedonic test and descriptive test [16], using twenty three untrained panelists. For hedonic analysis, the panelists were asked to evaluated the fishball parameter, i.e. color, aroma, taste, texture and overall acceptance using a 7-point hedonic scale, where 1 was extremely unacceptable and 7 was extremely acceptable. For descriptive sensory analysis, panelists were asked to evaluated fishball parameter, i.e. color, aroma, taste, and texture, where 1 was very dark and 7 was very light for color; 1 was extremely unpleasant and 7 was extremely pleasant for aroma; 1 was very bitter and 7 was extremely not bitter for taste; and 1 was very not chewiness and 7 was very chewiness for texture.

3. Result and Discussion

3.1. Proximate analysis of tuna fishball
Proximate analysis of tuna fishball without moringa leaves (fishball control) and tuna fishball with addition of fresh moringa leaves can be shown in Table 1 (% wet basis) and Table 2 (% dry basis).

**Table 1.** Proximate analysis of tuna fishball (% wet basis)

| Sample | Water content (%) | Ash content (%) | Protein (%) | Fat (%) | Carbohydrate (%) |
|--------|-------------------|----------------|----------------|--------|------------------|
| Control | 68.1104<sup>a</sup> | 2.2210<sup>b</sup> | 10.5924<sup>b</sup> | 0.7017<sup>a</sup> | 18.3745<sup>b</sup> |
| TF 10  | 69.8902<sup>ab</sup> | 2.8421<sup>b</sup> | 9.2179<sup>b</sup> | 0.3141<sup>a</sup> | 17.7358<sup>ab</sup> |
| TF 20  | 70.4861<sup>b</sup> | 1.8574<sup>a</sup> | 10.0209<sup>ab</sup> | 0.5574<sup>a</sup> | 17.0782<sup>ab</sup> |
| TF 30  | 72.9548<sup>c</sup> | 1.9706<sup>ab</sup> | 9.9451<sup>ab</sup> | 0.6656<sup>a</sup> | 14.4638<sup>ab</sup> |

Note: The same superscript symbol in the same column indicates that samples are not significantly different at a significance level of 95%

Many factors affect the chemical characteristic of tuna fishball. Budalaga [4] reported that water content and protein content were decreased in red tuna and white oyster mushroom meatball during storage time. In this recent study, the addition of moringa leaves increased water content of tuna fishball. As the juice of fresh moringa leaves was added, the water content in the tuna fishballs was increased.

**Table 2.** Proximate analysis of tuna fishball (% dry basis)

| Sample | Ash content (%) | Protein (%) | Fat (%) | Carbohydrate (%) |
|--------|-----------------|-------------|--------|------------------|
| Control | 6.9764<sup>ab</sup> | 32.7944<sup>a</sup> | 2.5174<sup>c</sup> | 57.5972<sup>a</sup> |
| TF 10  | 8.4766<sup>b</sup> | 34.3646<sup>a</sup> | 1.2263<sup>a</sup> | 59.0466<sup>a</sup> |
| TF 20  | 6.5177<sup>a</sup> | 39.9443<sup>a</sup> | 1.7798<sup>ab</sup> | 57.4537<sup>a</sup> |
| TF 30  | 7.2905<sup>bc</sup> | 40.0449<sup>a</sup> | 2.3367<sup>bc</sup> | 53.3167<sup>a</sup> |

Note: The same superscript symbol in the same column indicates that samples are not significantly different at a significance level of 95%

As shown in Table 2, ash content of tuna fishball was increased with addition of moringa leaves. Moringa leaves contain high ash content due to the mineral content, esp. calcium [17]. Addition fresh moringa leaves 10-30% will increased protein content to 1.57%, 7.15%, and 7.25%, The moringa leaves was a good protein source, which contain protein 22.2 - 34.4% [18], so it will increased the total protein content in tuna fish ball. Moringa oleifera leaves also contain protein with a balanced amino acid profile [19]. Fat content of tuna fishball was decreased to 1.29%, 0.74%, and 0.18% with addition of moringa leaves. Moringa leaves contain a low fat content [17].

### 3.2. Antioxidant activity of tuna fishball

As shown in Figure 1, addition of fresh moringa leaves 10-30% will increase antioxidant activity. Moreover, addition fresh moringa leaves 30% doubled the antioxidant activity. The moringa leaves contain phenolic compounds especially flavonoids which have antioxidant activity [20,21,22]. Peptide in moringa oleifera leaves also has antioxidant activity to inhibit DPPH and ABTS radical [23], and scavenge reactive oxygen species (ROS) [24].
3.3. Sensory analysis of tuna fishball

3.3.1. Hedonic sensory analysis
Hedonic sensory analysis of tuna fishball with parameters i.e. color, aroma, taste, texture, and overall acceptance were done as shown in Table 3. For color parameter, there was a tendency that more addition of moringa leaves will decrease the noodle color parameter. The tuna fishball with moringa leaves produced tend to be green color because the green color from moringa leaves. In addition, the preference value for color in tuna fishball with 10% moringa leaves (TF 10%) was not significantly different from that of the control.

Table 3. Hedonic sensory test of tuna fishball

| Sample | Color     | Aroma   | Taste    | Texture  | Overall acceptance |
|--------|-----------|---------|----------|----------|--------------------|
| Control | 5.00<sup>a</sup> | 4.71<sup>a</sup> | 4.95<sup>a</sup> | 4.76<sup>a</sup> | 4.90<sup>a</sup> |
| TF 10  | 4.52<sup>ab</sup> | 4.29<sup>ab</sup> | 4.19<sup>b</sup> | 4.05<sup>ab</sup> | 4.29<sup>ab</sup> |
| TF 20  | 3.90<sup>bc</sup> | 3.52<sup>bc</sup> | 3.62<sup>bed</sup> | 3.62<sup>bed</sup> | 3.62<sup>bed</sup> |
| TF 30  | 4.00<sup>bc</sup> | 3.33<sup>c</sup> | 3.00<sup>d</sup> | 2.86<sup>d</sup> | 2.90<sup>c</sup> |

Note: The same superscript symbol in the same column indicates that samples are not significantly different at a significance level of 95%

The preference of tuna fishball value, i.e. aroma, taste, and texture also decreased with addition of fresh Moringa oleifera leaves. Addition of moringa leaves would provide specific aroma and taste of moringa leaves, and thus affects the sensory preference. However, the aroma of the control tuna fishball and TF 10 were not significantly different. The addition of fresh moringa leaves increased the water content of tuna fishball, and reduce the value of texture sensory parameter. The more addition of moringa leaves, the less the texture sensory parameter. However, the texture of tuna fishball control and TF 10 were not significantly different. For overall, the acceptance of fishball made with 10% of moringa leaves addition was not significantly different with that of the control fishball, and this product (TF 10%) might be categorized as the most preferred product.
3.3.2. Descriptive sensory analysis

Descriptive sensory analysis of tuna fishball with parameters i.e. color, aroma, taste, and texture can be seen in Table 4.

| Sample  | Color | Aroma | Taste | Texture |
|---------|-------|-------|-------|---------|
| Control | 6.43a | 5.48a | 5.81a | 4.90a   |
| TF 10   | 3.52b | 4.05b | 4.81b | 3.90b   |
| TF 20   | 2.00d | 3.43bc| 3.90cd| 3.05cd  |
| TF 30   | 1.62d | 2.95c | 3.67d | 2.33cd  |

Note: The same superscript symbol in the same column indicates that samples are not significantly different at a significance level of 95%

The description of sensory analysis of tuna fishballs was showed that the addition of fresh moringa leaves produced fishball with darker color and having specific aroma as well as taste from the moringa leaves. The addition of fresh moringa oleifera leaves was also decrease the chewiness texture of the fishball.

4. Conclusion

The addition of moringa leaves affects the chemical and sensory characteristic of tuna fishball. The moringa leaves addition increased the water content to 4.84%, protein content to 7.25%, antioxidant activity to 3.03% and decreased the fat content to 0.18%. The most preferred fishball product based on the sensory analysis was the fishball with 10% moringa leaves addition. The hedonic sensory test shown that the overall acceptance of the fishball with 10% Moringa oleifera leaves addition was not significantly different with that of the fishball without moringa leaves addition. Results obtained in this study indicated that a healthy fishball could be made from tuna fish mixed with local flour and added with moringa leaves.

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