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Characterizations of milkfish (*Chanos chanos*) meatballs as effect of nanoencapsulation liquid smoke addition

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Abstract. Milkfish meatballs are one of the value-added product that is potential to be developed because this product is favored by consumers. The aims of this study were mainly to evaluate the effect of nano encapsulation liquid smoke addition to the properties of milkfish meatballs. The different concentration (0%, 1%, 3% and 5%) of nano encapsulation liquid smoke was treated into milkfish meatballs with three replications. Test parameters used include texture (hardness, deformation and gel strength); proximate (moisture, protein, fat, ash and carbohydrates content); sensory (organoleptic and hedonic). Parametric data were analysis using ANOVA and non-parametric parameters using Kruskal Wallis test. Analysis of variant shows that nanoencapsulation gave significant effect on the hardness, deformation, and gel strength; protein, lipid, ash and water content($P<0,05$), but gave no significant effect on carbohydrate ($P>0.05$). The best texture characteristic was obtained by milkfish meatball added with 1% of nanoencapsulation liquid smoke indicated by the moisture water; protein; fat; ash and carbohydrate content: 66,35%; 12,69%; 6,75%; 2,42% and 5,93% respectively. The best organoleptic and hedonic value of milkfish meatballs was achieved by a panelist at the sample with the addition of 1% liquid smoke, but this sample found gave no significance different to control in terms of sensory valle.

Key words: milkfish meatball, liquid smoke, nanoencapsulation

1. Introduction

Fish is one of the most important food sources because it contains the essential amino acids and essential fatty acids the body needs [1-4]. Nevertheless, some societies are less fond of fish in their original form to increase the joy and level of public consumption. One form of processed fish that is popular with meatballs. Meatballs are one of the fish pasta products known to originate from the Chinese plains and are now widely distributed in Asian countries. The meatball industry has grown in

Asian countries since 1980 [5]. Fish meatball is popular enough for the community for this product is still being developed. All types of fish, in general, can be used as raw material for meatballs, but not from white fleshy fish so that the resulting gel can be optimal. Nonwhite fleshy fish can be used as raw material for meatballs, but it is necessary to increase the strength of the gel.

Milkfish is one of the cultivated fish whose production continues to increase from year to year. The high production makes milkfish not only consumed fresh but also processed to provide added value. Milkfish can be processed into various products such as soft-boned milkfish, meatballs, meatballs and others. Diversification of processed milkfish continues to be developed to provide a variety of products so that milkfish consumption can be improved and also provide added value. Meatball fish that exist today has the original taste of fish as raw materials. High competition, high technology investment is required to obtain high-quality products. Fish meat that now has the original taste, the addition of a different flavor in the meatballs will provide a variety of products preferred by consumers. The addition of different flavors to fish meatballs is expected to provide a variety of products and attract consumers to try. One of the natural flavors that can be used is liquid smoke.

Liquid smoke is a liquid form of wood burning through pyrolysis process. Liquid smoke is used to provide flavor, color, texture and in some cases can increase the shelf life of the product. Liquid smoke is obtained from thermal degradation reactions of cellulose, hemicellulose, and lignin [6](Ramakrishnan and Moeller, 2002). The smoke flavor had several advantages over traditional fumigation techniques such as ease of application, speed, product uniformity, consistent end product characteristics, in-app cleanliness and decreased polycyclic aromatic hydrocarbon content[7]. In relation to consumer preferences, indicating that consumers do not like the same type of product, some people prefer strong smells and flavors, others prefer flavors of certain smoke [8]. Research on liquid smoke has been conducted among others as an antibacterial agent [9-10]; preservatives in foodstuffs [8][11] [12] [13][14]. Currently, liquid smoke has been developed in powder form. The powder of liquid smoke is obtained from the process of encapsulation of liquid smoke with an encapsulation material. Research on liquid smoke encapsulation has been done by Saloko et al. [15]; Saloko et al. [16] and Petzold et al. [17] showing the use of chitosan and maltodextrin and ca-alginate as encapsulation. Liquid smoke in the form of powder is easier in handling and application. A study of the application of nanopedic liquid smoke has not been widely practiced. The purpose of this study was to determine the effect of various types and concentrations of nano-encapsulate liquid smoke on the texture, sensory and proximate fishballs meat-fish.

2. Materials and Methods

2.1. Materials

The material used in the production of meatballs is milkfish with size 250 ± 25 g. Milkfish is obtained from cultivation in Central Java which is sold in the fish market. Liquid smoke used is nanostsulated liquid smoke. Addition of meatballs used includes wheat flour, bread, pepper, and onion. Materials for proximate analysis, among others, H2SO4, HCl, NaOH, H2SO4, HCl, NaOH, HBrO3, Kjeldahl Tablets, N-hexane. The tools used in the production of meatballs include filet knife, food processor, steamer. The tool for texture analysis is TATX Texture type analyzer. Tools for proximate analysis include Oven; Kjeldahl Apparatus, Soxhlet Apparatus, digital scales, furnace.

2.2. Preparation of Fishballs

Milk with size 250 ± 25 g in fillet then ground into the pulverized meat. Spices consisting of pepper, onion, and salt are crushed. Furthermore, the dough is made by mixing the flesh of creamed fish, seasonings, flour and liquid smoke with different concentrations (1%, 3%, and 5%). The type of liquid smoke used is panoptic liquid smoke. The dough is then boiled twice with different temperature. The temperature was 50 ° C for 20 minutes, and the temperature was 80 ° C for 30 minutes and cooled. The parameters performed on milkfish meatballs, i.e.

texture (Hardness, deformation and Gel strength); Sensory (organoleptic and hedonic); proximate levels (water, protein, fat, ash and carbohydrate content).

2.3. Procedure Analysis

2.3.1. Textural Analysis

The texture analysis consists of hardness, deformation and gel strength. The texture analysis of milkfish meatballs was done using a texture analyzer (Model TA Plus, LLOYD Instrument, UK). Three milk fish meatball samples of each treatment (height 2.5 cm, width 2 cm) prepared and tested. Hardness and deformation were measured using texture analyzer textures equipped with ball probes (5 mm in diameter, depression rate of 60 mm per minute). The gel strength is calculated by the following equation:

gel strength (g.cm) = Hardness (gf) x Deformation (cm)

2.3.2. Proximate Analysis

Proximate analysis consists of moisture, protein, fat, ash and carbohydrates based on AOAC [18]

2.3.3. Sensory Analysis

The sensory analysis consists of organoleptic and hedonic tests. Panelists used as many as 30 people. Organoleptic test according to Indonesian National Standardization Agency No: SNI-01-6683-2002 and hedonic based on Indonesian National Standardization Agency No: SNI 01-2346-2006

2.3.4. Statistical Analysis

All treatments were performed in three replications. Analysis of parametric data using ANOVA. If the actual treatment of further test is done by Tukey test (Steel & Torrie, 1980). Nonparametric data were analyzed by Kruskal Wallis Test and continued with Mann Whitney test. The analysis was performed using SPSS (SPSS 17.0 for Windows, SPSS Inc., Chicago, IL, USA

3. Results and Discussion

3.1. Texture

The texture of fish balls with additional nano encapsulation is presented in Table 1. Statistical analysis shows the concentration of liquid smoke encapsulation has significant effect on all characteristic parameters of meatball texture (Hardness, deformation and gel strength) ($P < 0.05$)

Table 1. Characteristics of Meatball Texture with Additional Nanoencapsulated Liquid Smoke

Parameter	Concentration			
	0%	1%	3%	5%
Hardness (gf)	1560.61±47.23^{a}	1727.09±31,69^{a}	1253.73±160.37^{b}	1132.81±147.74^{b}
Deformation(cm)	1.97±0.14^{c}	2.33±0.04^{ab}	2.43±0.05^{a}	2.071±0.15^{bc}
Gel strength (g.cm)	3072.25±202.71^{b}	4017.81±60.06^{a}	3040.24±371.02^{b}	2333.96±149.57^{c}

Data with different superscripts on the same line show a significantly different

Statistical analysis shows the addition of nano-encapsulated liquid smoke significantly affect the hardness of fish balls. The concentration of 1% liquid smoke nano-encapsulation improves hardness 11% compared to control. At concentrations of 3% and 5%, addition of liquid smoke powder decreases the hardness of meatballs.

The addition of nano-encapsulated liquid smoke had a significant effect on the deformation of milkfish meatballs (P <0.05). The highest deformation of meatballs with the addition of liquid smoke powder 3% but no significant effect on the meatballs with the addition of 1%. The control treatment showed lower values of treatment of 1% and 3% but not significantly different from the 5% treatment.

Variance analysis showed that the addition of nanoencapsulation liquid smoke had a significant effect on the gel strength of fish balls (P <0.05). The highest gel strength is achieved by fish meatballs with 1% liquid smoke powder while meatballs in liquid smoke powder 3% and 5% lower than control. This shows that the concentration of 1% can increase the strength of milkfish meatballs gel up to 30% compared to control.

Increasing the texture characteristics of hardness, deformation and gel strength in milkfish meatballs only at 1% concentration whereas a higher concentration indicates a decrease in texture. Improved texture of fish meatballs may be due to the addition of liquid smoke with chitosan encapsulation. Liquid smoke with a high phenol content can interact with proteins forming complex crosslinks that enhance the texture. The ability of phenolic compounds to interact with proteins (especially proline-rich proteins including casein) has been described Luck et al. [19] (1994), and both hydrophobic interactions and hydrogen bonds appear to be the main driving force of the reaction between liquid smoke in this case phenol with proteins [20]. In excess of liquid smoke, this can reduce the texture because the high phenol content has lower solubility, so difficult to interact with the protein so that the impact on texture decline [21].

3.2. Proximate Content

The proximate data of milkfish meatballs with different liquid smoke is presented in Table 2. The type and concentration of liquid smoke had a significant effect on water content, protein, fat, and ash, but no significant effect on carbohydrate of milkfish meatballs.

Table 2. Proximate Content of Milkfish meatball with Different Concentration of nanoencapsulation of Liquid Smoke

Parameter	Concentration			
	0%	1%	3%	5%
Moisture	70.02±0.66^{a}	66.35±0.62^{c}	68.11±0.66^{b}	65.96±0.03^{c}
Protein	10.93±0.30^{c}	12.69±0.05^{a}	12.09±0.21^{b}	11.81±0.06^{b}
Lipid	6.13±0.02^{b}	6.75±0.13^{a}	6.88±0.06^{a}	6.85±0.07^{a}
Ash	1.99±0.05^{c}	2.42±0.02^{b}	2.57±0.03^{a}	1.85±0.07^{d}
Carbohydrate	5.84±0.39^{a}	5.93±0.10^{a}	5.15±0.58^{a}	6.62±1.78^{a}

different letter (a,b, c,) in the same line indicate significances different (P<0.05)

The concentration of nano-capsulated of liquid smoke had a significant effect on the water content of milkfish meatballs (P <0.05). The control water content (without liquid smoke powder) showed the highest water content, while the lowest was at 5% concentration but not significantly different with the treatment of 1% concentration. The affluence of treatment especially the control treatment showed higher moisture value. The lowest moisture content was achieved in milkfish meatballs with the highest concentration (5%). The addition of liquid smoke powder impact on the composition of solids in fish balls.

Analysis of variance showed that nano-capsulated concentration of liquid smoke had a significant effect on the protein content of milkfish meatballs (P <0.05). The highest protein content was achieved in milkfish meatballs treatment of 1% nanoencapsulation of liquid smoke, while the lowest protein content in non-smoked liquid nano-fish meatballs. All treatments showed that protein content had met Indonesian national standards of at least 10%.

The fat content of milkfish meatballs was influenced by the concentration of nanoencapsulation liquid smoke (P <0.05). The nano-encapsulated liquid smoke treatment showed the highest fat content, but all treatments with the addition of liquid smoke showed no significant difference in the fat content.

Addition of liquid smoke nanoencapsulation liquid smoke significantly affects the ash content of fish balls (P <0.05). The highest ash content was found in fish meatballs with the addition of 2% nano-encapsulated liquid smoke and the lowest in milkfish meatballs with nano-encapsulated 5% liquid smoke.

The addition of liquid smoke has no significant effect on the carbohydrate content of fish balls (P> 0.05). Carbohydrate content ranged from 5.15% -6.62%. Carbohydrates in fish meatballs is a contribution of adding tapioca starch to fish meatballs

3.3. Sensory

3.3.1. Organoleptic

The organoleptic value of milkfish meatballs is described in Table 3. The results of the organoleptic analysis showed that the concentration of liquid smoke had a significant effect on the organoleptic value of fish balls (P <0.05). Overall, fish meatballs meet Indonesian national standards with a value of> 7 except on fish meatballs with the addition of nano-encapsulated 5% liquid smoke.

Table 3. Organoleptic of Milkfish Bakso with Different type and Concentration of Liquid Smoke

	Specification				
Concentration	Appearance	Smell	Taste	Texture	Total
0%	8.00±0.23	7.44±0.1	8.27±0.24	8.38±0.17	8.02±0.10
1%	8.02±0.14	7.42±0.10	8.33±0.33	8.47±0.18	8.06±0.13
3%	7.87±0.20	5.98±0.10	7.11±0.84	7.82±0.34	7.19±0.14
5%	6.84±0.50	5.76±0.04	4.84±0.37	6.82±0.37	6.07±0.15

Overall, the organoleptic value of the largest fish balls in the addition of 1% but not significantly different from the control, while the lowest was found in the meatballs with the addition of nano-encapsulated 5% liquid smoke.

The addition of liquid smoke significantly affects the value of the appearance of milkfish meatballs. The appearance of fish meatballs at concentrations of 0% and 1% were not significantly different. The higher concentration of liquid smoke indicates the value of the appearance decreases. This is due to the addition of liquid smoke nanoencapsulation causes the appearance of fish meatballs tend to be dark so that the appearance of less clean so that the value becomes down.

The organoleptic value of the odor shows the same trend that is with increasing concentration indicating the organoleptic value of the odor decreases. The 1% concentration was not significantly different from the control; it showed 1% increase indicated the fish's distinctive odor in meatballs was still detected by panelists while at higher concentrations the fish meatball smell was reduced and the dominant smell of liquid smoke.

The addition of liquid smoke significantly affects the taste of fish meatballs. In taste specifications also showed 1% concentration was not significantly different with control. The taste of fishfish meat-fish with the addition of liquid nanoencapsulation smoke up to 3% still by Indonesian national standards, but the concentration of 5% is considered unfit for consumption by panelists.

The addition of liquid smoke significantly affects the value of the texture specification on fish meatballs. The highest texture value is found in fish meatballs with 1% liquid smoke addition and decreases with the liquid smoke enhancer.

3.3.2. Hedonic

Hedonic test method based on BSN [21] (2006) according to SNI 01-2346-2006 on Guidelines for sensory testing on fishery products. Hedonic test consists of 4 specifications, the appearance, smell, taste and texture with a score of 9 scala i.e. 1 = strongly dislike; 2 = dislikes; 3 = rather dislike; 4 = ordinary; 5 = rather like; 6 = likes; 7 = very like; 8 is very fond of; 9 = very, very fond.

The hedonic value of milkfish meatballs with different concentrations of nano-capsulated liquid smoke is presented in Table 4. The results of the hedonic data analysis show the addition of different nano-encapsulated liquid smoke to give different effects on the hedonic level. Overall, milkfish meatballs with 0% and 1% liquid smoke additions are favored by panelists (> 7), while concentrations of 3% and 5% tend to be favored by panelists (> 6). 1% The addition of nano-encapsulated liquid smoke provides a unique flavor without leaving a taste of the fish, so the panelist gives an average rating above 7 which means very fond.

Table 4. Hedonic Scale of Milkfish Bakso with Different Concentration of Nano-encapsulation Liquid Smoke

Concentration	Specification					TOTAL
	Appearance	Colour	Smell	Taste	texture	
0%	7.48±0.30	7.41±0.19	7.27±0.35	7.50±0.24	7.34±0.05	7.40±0.19
1%	7.43±0.28	7.46±0.27	7.08±0.21	7.16±0.10	7.73±0.14	7.37±0.13
3%	7.49±0.18	7.09±0.08	5.91±0.30	5.87±0.32	7.39±0.29	6.75±0.07
5%	7.14±0.29	7.11±0.14	4.36±0.59	4.31±0.26	7.41±0.33	6.07±0.20

The appearance of milkfish meatballs with the addition of liquid smoke filtration 1% higher than the concentrations of 3% and 5%, but overall is very favored by the panelists. The highest value of the meatballs achievement was achieved with the liquid smoke of nano-encapsulated 3% but not significantly different with concentrations of 0% and 1%.

The color of the milkfish meatballs was rated highly favorably by panelists with values above 7 in all treatments with the highest value in fish meatballs with 1% nano-encapsulated liquid smoke, but not significantly different from the treatment at 0% concentration. The lowest color value is fishballs meatballs with the addition of nanoencapsulation 5% liquid smoke. Liquid smoke gives a distinctive color of smoke in fish balls. The phenol component plays an important role in providing a distinctive color to the meatballs. The lowest value in the color of fish balls with nano-capsulated 5% liquid smoke may be due to the dark color of the meatball so that the panelists give the lowest value but are still in the category favored because the value is above 7.

Analysis of hedonistic value data showed that the difference of nano-strucan liquid smoke concentration significantly affected the smell and taste of milkfish meatballs. The panelist's assessment of the specification baud a flavor implies the same tendency. At the treatment of 0% and 1% baud, a flavor of milkfish meatballs is favored by the panelists. At concentrations of 3%, the panelists tend to be rather fond of whereas at 5% concentration the usual rate panelists. This indicates the increasing concentration of liquid smoke baud fishballs tastes increasingly less favored by the panelists. The odor and smell of smoke that is too sharp on the fish meatballs with higher concentrations are less favorable to the panelists.

Different concentrations of liquid smoke have a significant effect on hedonic texture value of milkfish meatballs, but overall the texture of meatballs is well-liked. Concentrations of 1% nanostructured liquid smoke had the highest texture hedonic value compared to concentrations of 3% and 5%, as a whole the addition of liquid smoke had a preferred texture over the control.

4. Conclusion

The addition of liquid nano-encapsulated liquid with different concentrations significantly affected the value of hardness, deformation, gel strength, moisture content, protein, fat, ash, organoleptic and hedonis, but no significant effect on the carbohydrate content of milkfish meatballs. The best treatment was achieved in fish balls with liquid smoke nano-encapsulation concentration of 1%

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