Original Research Article

NUTRITIONAL QUALITY OF SEMPOL WITH DIFFERENT MEAT VARIANTS

ABSTRACT

Aims: This study aimed to examine the effect of different types of meat on the chemical and organoleptic properties of sempol.
Study design and Methodology: It employed an experimental method with Fully Randomized Design (FRD) in three treatments, each of which was applied to DA (chicken), DS (beef), and DK (lamb), and repeated four times each. The observed variables were chemical composition (moisture, protein, fat, ash, and carbohydrate content), organoleptic quality (taste, aroma, texture, and color), microstructure, and element composition of sempol.
Place and Duration of Study: It was conducted in March - April 2022 at West Waru, Pamekasan for sempol production, Nutrition Laboratory of UMM for testing the chemical content,Bioscience Laboratory of Universitas Brawijayafor SEM testing.
Results: The study provided a significant effect (p<0.05) on the physicochemical composition except fat and protein (p>0.05), due to the physicochemical content of the meat used. The average physicochemical value of moisture was 58.22%, ash 3.06%, fat 23.76%, protein 10.81%, and carbohydrate 35.38%. The physicochemical content of sempol meets Indonesian National Standard (SNI) 2014 except for fat and carbohydrate. Based on sensory properties, panelists preferredsempolwith chicken. The use of different types of meat insempol did not provide a significant effect (p>0.05) on organoleptic taste, aroma, and texture, except color. Meanwhile, the microstructure of sempolbeef has a better shape. The cavity surface tissue forms more uniformly and creates a fibrous three-dimensional metric compared to that of chicken and lamb. Some of the elements detected in sempolbeef were carbon (C), oxygen (O), sodium (Na), silicon (Si), sulfur (S), chlorine (Cl), potassium (K), and zirconium (Zr). The most complete chemical elementswas detected only in sempol lamb.
Conclusion: The use of different types of meat affects moisture, ash, and carbohydrate content, yet it does not affect protein and fat content. The organoleptic qualities of texture, taste, color and aroma are accepted by the panelists.

Keywords: Beef, chicken, chemical quality, lamb, organoleptic

1. INTRODUCTION

Meat is a food product with high protein value, containing complete and balanced essential amino acids [1]. It is, therefore, the ideal medium for the growth of microorganism, thus categorized as perishable food [2]. To reduce meat spoilage or prolong the shelf life, meat products such as sempol can be produced from meat.Sempol is a finely ground meat processed product, mixed with spices, tapioca flour and wheat flour, then wrapped around a

30 cm long bamboo skewer, boiled, fried half cooked, dipped in egg solution, then fried again with hot oil. Sempol is a meat restructured product modified with the presentation of fried foods that use cooking oil as an introduction to heat. Sempol frying process with high temperatures can cause damage to amino acids that affect changes in the chemical composition and sensory propertiesof sempol[3].

Sempol can be made from chicken, beef, lamb, and other types ofmeat. Chicken is among the widely used meat in the production of sempolas it is easy to find, and the price is affordable. Based on information from Directorate General of Animal Husbandry and Animal Health, chicken production in Indonesia in 2021 is amounted to be3,426,042 tons, greater than that ofbeef 437,783 tons, and lamb 61,724 tons [4]. The use of chicken, beef, and lamb exerts different consequences to the resulting product, which can be influenced by the characteristics of each meat.

Chicken has a good source of animal protein, contains complete essential amino acids in a balanced ratio, and has a fat content of 12.12% [5]. It might provide a distinctive taste and aroma, as well as a soft texture. Beef (DS) has aconnective tissue and protein of 18.26% [6]. Beef protein plays a major role as a binder and emulsifier, so it can bind moisture and fat, by which the aroma, texture, and distinctive taste improves. Lamb has a darker color and smooth fiber and contains a low fat (8.35%) [7]. It can affect the hard and chewy texture of sempol products. Each type of meat provides a source of diversity, so different meat may produce varied quality of sempol.

Producing sempol with different types of meat (chicken, beef, and lamb) is expected to contribute to its diversity of chemical and organoleptic properties.

2. METHODOLOGY

2.1. Materials

Sempol was produced in West Waru, Pamekasan, East Java. The research was conducted at the Livestock Product Technology Laboratory, Faculty of Animal Husbandry, Universitas Brawijaya from March-April 2022.In this study, samples were coded as chicken (DA), beef (DS), and lamb (DK).It used an experimental method with fully random design in three treatments, and 4 replications to obtain 12 experimental units from P1 (sempol chicken), P2 (sempol beef), and P3 (sempol lamb). The formulation of producing sempol with different types of meat still refers to the manufacture of chicken nuggets combination with 23% minimum percentage of meat [8]. The following is the formulation of sempol after Trial-and-Error Test presented in Table 1. The process of producing sempolis shown in Figure 1.

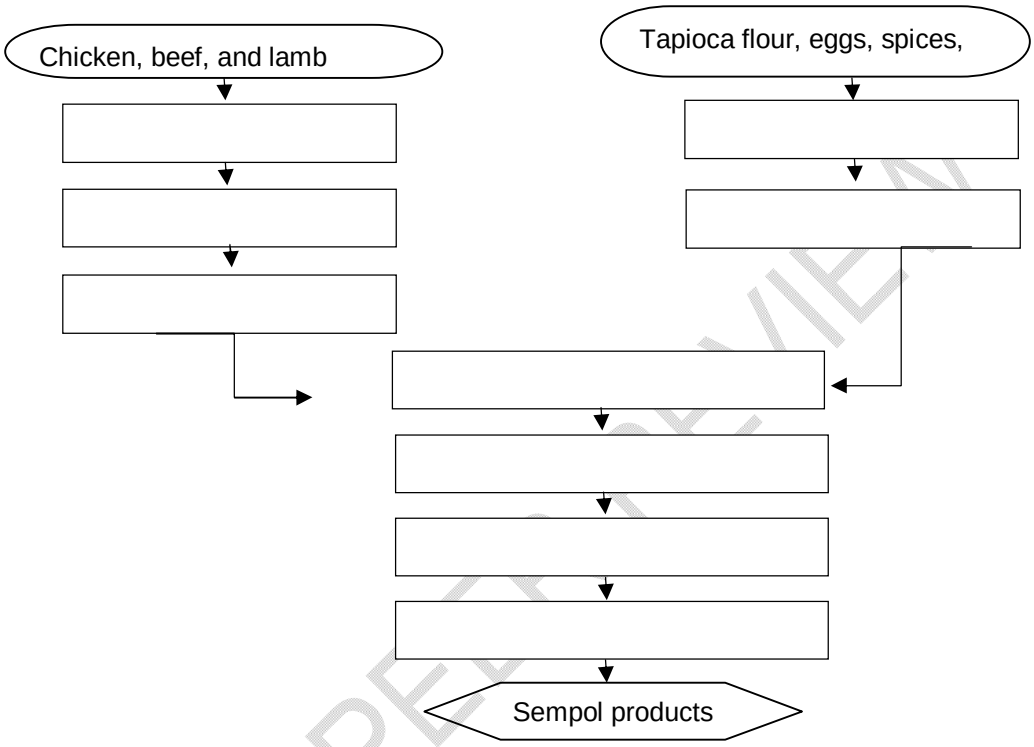
Table 1. Sempol formulations with different types of meat

Material	Composition		
	P1	P2	P3
Chicken (gr)	46	-	-
Beef (gr)	-	46	-
Lamb (gr)	-	-	46
Tapioca flour (gr)	100	100	100
Wheat flour (gr)	5	5	5
Egg (gr)	45	45	45
Garlic (gr)	15	15	15
Red onion (gr)	15	15	15
Onion (gr)	15	16	15
Salt (gr)	5	5	5
Pepper (gr)	0.6	0.6	0.6

Sugar (gr)	2.5	2.5	2.5
Total	**250**	**250**	**250**

Description: The percentage of meat refers to the douch weight

2.2. SempolMaking Process



Description:

: Raw Material : Production Process : Products

Figure 1. The process of making sempol with different types of meat

2.3. Research Variable

The moisture content was calculated on the basis of the weight lost during heating in the oven at a temperature of (125 ± 1) °C. The ash content was calculated based on its weight formed during combustion in the furnace at 550 ± 5°C until white ash was formulated. The fat was hydrolyzed in the sample using HCI and then extracted with petroleum ether. The petroleum ether extract obtained was evaporated to dry, and the fat was calculated in gravimetric. Protein contentwasextracted to release nitrogen from proteins as ammonium salts. The ammonium salt was decomposed into NH3 at the time of distillation using NaOH. NH3 released and bound with boric acid produced ammonium borate, which was quantitatively titrated with acid raw solution to obtain total nitrogen. The protein was obtained from the product of total nitrogen by multiplicationwith 6.25. Carbohydrates were made by difference, the reduction result of 100% with moisture, ash, protein, and fat so that the carbohydrate depends on the reduction factor [8].

[carbohydrates = 100% - (Moisture + Ash + Protein + Total Fat]

Organoleptic test was conducted by hedonic test method as a scientific measure with human senses, the sense of taste to know the taste, the sense of smell to know the aroma, the sense of touch to know the texture, and the sense of sight to see the color. The test adopted hedonic method with a scale of 1-5 from extremely like to extremely dislike. The sample was randomly presented to 30 untrained panelists to give assessment [9].

SEM (Scanning Electron Microscopy) was usedto determine the pore size and morphology of the composite and used EDX (Energy Dispersive X-Ray) to analyze the chemical elements or characteristics of a material. The pore morphology of sempol composites with different types of meat was also compared with the morphology of the fibers that had been activated. The characterization was completed with the SEM-EDX instrument. The working principle of Scanning Electron Microscopy (SEM) is utilizing an electron beam to interact with the sample and scan the entire surface of the sample. As a result, the sample will emit new detectable electrons. The results captured by detector are then sent to the monitor so that the monitor translates the information in the form of sample surface topography [10].

2.4. Statistical Analysis

The data obtained from the study results were analyzed using Analysis of Variance (ANOVA). If the result of data analysis indicated that the value of Fcount< F table 0.05, the treatment of the use of different types of meat is not significantly different ($p>0.05$), so the data analysis is not performed with Duncan's Multiple Range Test (MRT). If it showed the value of Fcount> F table 0.05, the use of different types of meat proved significant differences ($p<0.05$). Furthermore, to determine the differences among treatment levels, it is necessary to further examine with Duncan's Multiple Range Test (MRT).

3. RESULTS AND DISCUSSION

3.1. Chemical Composition of Sempol

The results of chemical composition (average value) of sempolmadewith different types of meat are shown in Table 2.

Table 2. The average moisture, ash, fat, protein, and carbohydrate of sempol with different types of meat.

Treatment	Parameters				
	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrates (%)
DA	59.27 ± 6.58^{a}	3.69 ± 0.23^{a}	24.39 ± 1.14^{a}	11.00± 0.37^{a}	36.86 ± 0.98^{a}
DS	58.95 ± 0.50^{b}	2.38 ± 0.23^{b}	23.73 ± 1.08^{a}	10.80 ± 0.53^{a}	37.11 ± 0.57^{b}
DK	56.44 ± 0.87^{b}	3.10 ± 0.36^{c}	23.15 ± 2.20^{a}	10.63 ± 0.56^{a}	35.38 ± 0.56^{b}

a,b,c different superscripts on the same line show a noticeable difference ($p<0.05$).
DA:*Sempol made with chicken;* ***DS:****Sempol made with beef;* ***DK:****Sempol made with lamb*

3.2. Moisture Content of Sempol

The variety analysis demonstrated that different types of meat in sempol products have a significant effect ($p<0.05$) on the moisture content of sempol products. The treatment of sample DA was significantly different from that of sample DS and sample DK; the treatment of sample DS is significantly different from that of sample DA and was not significantly

different from that of sample DK; the treatment of sample DK was significantly different from that of sample DA and wasnot significantly different from that of sample DS. On the contrary, Ahmadi et al [11] foundthat the use of this type of meat in the raw material for meatballs does not affect the meatball moisture content. Our study found that the moisture contentof sempolmadewith different types of meat was into an average value of 56.44% – 59.27%. The high moisture in sample DA treatment might be caused by the higher moisture in chicken than that foundin beef and mutton. The high moisture of meat will remove a lot of water bound in the meat[12]. Therefore, the high moisture within food can decompose the food substances into water and increase moisture in the product produced. The low moisture in sample DK was influenced by the low moisture and protein level bound in the lamb. The protein within the lamb was18.72% [13]. The protein plays a roleas an emulsifier and has a compact structure in binding water, so the lower the ability of the proteins to bind water, the lower the percentage of water foundin sempol. It affirms the finding of Khasrad et al [14]that high levels of meat protein led to an increased ability to bind water so as toa lower free moisture, and vice versa.
The moisture of sempolmadewith different types of meat ranged from 56.44% - 59.27% w/w. This meets the quality standards of SNI 2014 about chicken nugget combination with a maximum limit of moisture in 60% w/w.

3.3. Ash Content of Sempol

The resultsshowed that different types of meat in sempol have a significant effect ($p<0.05$) on the ash content of sempol products. All the treatments of sample DA, DS and DK provided a noticeable difference. The results of the analysis on the ash content of sempol with different types of meat showed an average value between 2.38% – 3.69% w/w. The highest ash content was obtained in sample DA, and the lowest was found in sample DS. The ash content of sempol was perceived to be caused by the organic matter and minerals bound inside the meat. Qurniawan et al [15]argued that the meat poses minerals that can increase the ash content in the resulting product. The ash in the lamb is 1.11% [16]. The mixture of foodstuffs in the production of sempol also affects the ash content of sempol because they contain minerals and inorganiccomponent. Inorganic or mineral components inside the foodstuffs can increase the production of ash content [17]. The process of boiling and frying sempol products affects the content of ash content of sempol because during the cooking process they will release organic matter and minerals out dissolved in water. It goes in line with the idea of Andika et al that the lower the concentration and cooking temperature, the lower the value of the ash content produced. This occurs due to the release of minerals dissolved in water[18].
The lowest ash content inside sempolwaws found in sample DK (2.38%), and the highest onewasfound in DA 3 (69%) (Table 2). The ash content in SNI 2014 on the combination nugget is not listed, so comparison is not required.

3.4. Fat Contentof Sempol

The fat contentof sempolmadewith different meat was found to vary.That of sample DA was 24.39%while that ofsample DS was 23.73%, and ofsample DK was23.15%. The variety analysis proved that different types of meat exert no significant effect ($p>0.5$) on sempol's fat content. This does not agree with the finding of Rahim Taha et al [3]who foundthat the use of different types of meat as fillers affected the fat of ilabolu. The results of the variety analysis of sempol with different types of meat demonstrated that the average value of the lowest fat content lies in the treatment of sample DK, which is 23.15%, while the highest fat content lies in the treatment of sample DA, 24.39%. The fat level of sempolwas influenced by the type of meat used asthe fat of chicken is higher than that of lamb. Therefore, the higher the fat of the meat, the higher the fat of sempol. According to Rahmadaeni et al[12], the fat of

broiler chicken is 12.12%, while that of lamb is 8.56%. A long processing with high temperature can cause damage to fat as fat functions as a heat conducting medium that causes the product emulsion.This agrees with the idea of Basuny et al [19]and Dhanapal et al [20]that the shrinkage of the fat is affected by the rupture of the emulsion which causes the tissue fluid to be lost during the cooking process.
The fat content of sempolmadewith different types of meat ranged from 23.15% - 25.39% (Table 2). Referred to the SNI 2014 on meat nugget combination, the maximum limit of fat is 20% w/w. Therefore, the fat of sempol with different types of meat approaches the quality requirements of SNI on all treatments.

3.5. Protein of Sempol

The results of statistical analysis of sempol with different types of meat proved no significant difference ($p>0.05$) to the protein content of each treatment, sample DA 11.00%, DS 10.80% and DK 10.63%. Thisdoes not agree with the findings of Rahim Taha et al [3]that the use of different types of meat as fillers affect the fat of ilabolu. The test result of sempol protein levels is available in table 2. The highest protein content in sempol products with different types of meat is found in the treatment of chicken (DA) 11.00%, and the lowest is in the treatment of lamb (DK) 10,63%. This wasinfluenced by the protein bound inside the meat used. The protein inside the meat as the raw materials affects the protein of the resulting product[11]. The protein content of chicken is higher compared to that of the lamb. The protein of chicken is 33.03% while the protein of lamb is 29.59%[21]. Protein in meat plays as a binder for the damage of meat that can form a compact structure. Therefore, the higher the protein content of meat, the higher the levels of protein produced in sempol products, and vice versa. The cooking process can also affect the low protein content in sempol products due to protein denaturation during the boiling and frying process. Inarest[22]stated that protein denaturation can performed in various ways, such as by heat, pH, chemicals, mechanics, and so on. Water-soluble protein will break down due to boiling, thereby reducing protein levels [3].
The protein of sempol with different types of meat ranged from 11.00%. - 10.63% (Table 2). Meanwhile, the minimum limit of quality standard protein of meat nuggets combination according to SNI 2014 is 9%. Therefore, the use of different types of meat in sempol have met the quality standards of SNI 2014 based on protein content.

3.6. Carbohydrate Levels of Sempol

The results showed that the use of different types of meat in sempolmakinghas a significant effect on its carbohydrate content ($p<0.05$) in each treatment, sample DA 36.86%, sample DS 37.11%, and sample DK 35.38%. The treatment of sample DA wassignificantly different from that of sample DS and DK; the treatment of sample DS wassignificantly different from that of sample DA and wasnot significantly different from that of sample DK; the treatment of sample DK wassignificantly different from that of sample DA and wasnot significantly different from that of sample DS. The result showed that the average value of carbohydrate content ranged from 35.38% to37.11%. The highest carbohydrate is obtained from beef treatment (DS) while the lowest one is found in lamb (DK). This happenedasthe carbohydrate content of each meat wasrelatively different. The carbohydrate of beef is much higher than that of lamb, and it causes the levels of carbohydrate in sempol products. The carbohydrate of beef reaches 3.78%[23]. while that of lamb is 0.5%[24].Tapioca flour filler material affects the carbohydrate content of sempoldue to its amylose and amylopectin properties. When it is poured into water, the starch granules will absorb and swell to make it hard and sticky. Lekahena[25]stated that tapioca flour helps the gel formation process by binding water during the blending and cooking process.

Sempol carbohydrate content with different types of meat had the lowest value of 35.38% in sample DK samples and the highest of 37.11% in sample DS (Table 2). According to SNI 2014, the maximum carbohydrate of meat nugget combination is 25% w/w. Therefore, sempol products with different types of meat did not meet the quality standards of SNI 2014 in all treatments based on the carbohydrate levels.

3.7. Sempol Organoleptic Test with Different Types of Meat

The analysis results of the effect of the use of different types of meat on organoleptic characteristics of sempol, which includes taste, aroma, texture and color, can be seen in Table 3.

Table 3. The average organoleptic value of taste, aroma, texture and color of sempol products with different types of meat.

Treatment	Parameters			
	Taste (%)	Aroma (%)	Texture (%)	Color (%)
DA	4.50[a]	4.30[a]	4.50[a]	4.37[b]
DS	4.50[a]	4.50[a]	4.50[a]	4.50[a]
DK	4.50[a]	4.50[a]	4.50[a]	4.37[b]

a,b,c Different superscripts on the same line show a noticeable difference (p<0.05).
DA:*Sempol made with chicken;* ***DS:****Sempol made with beef;* ***DK:****Sempol made with lamb*

3.8. Taste of Sempol

The highest taste indicators (4.50%) in sempolmadewith different types of meat were found in the use of chicken (DA), whilethe lowest (4.13%) onein the use of beef (DS). The result of statistical analysis on the hedonic taste of sempolshowed no significant difference (P>0.05) between the treatment of sample DA (4.50%), DS (4.13%), and sample DK (4.37%) (Table 3).
The most preferred taste of sempol by the panelists wassempol which uses chicken because chicken has the highest source of proteinas compared to beef and lamb. The protein of fresh broilerchicken is 33.03% [21]. The use of chicken mixed with fillers can lead to interaction of food constituent components, such as protein, fat and other components that may cause chemical reactions to create a distinctive and good taste of sempol. The taste is influenced by the use of chicken and seasonings [26]. Ismanto et al [27] found that the combination of food ingredients can cause chemical reactions that can create a distinctive taste to the resulting product.

3.9. Aroma of Sempol

The highest mean value for aroma of sempol (4.50%) was found in sample DA, while sample DS had the lowest (4.13%) mean value for aroma. The result of hedonic statistical test of the aroma of sempol showed no significant effect (p>0.05) on the sempol aroma of chicken (4.30%), beef (4.03%), and lamb (4.07%) (Table 3).
Panelists preferred the aroma of sempol with chicken because the fat of chicken is higher than that of beef and lamb. The fat contentof chicken is 12.12%[5]. The meat that contains a lot of fat will cause flavor aroma of sempol at the time of the cooking process because the evaporation raises the volatile compounds of sempol. The process of releasing fat bonds is caused by the influence of spices, temperature, and cooking process that causes aroma[28]. The aroma of sempol can also be influenced by additional ingredients used during the production process, such as seasonings and fillers, because the bound fat and protein do not completely come out during cooking. Ismanto et al[27]states that proteins and fats are

bound by transglutaminase because the precursor aroma of meat does not come out much during cooking.

3.10. The Texture of Sempol

The texture of sempolhad an average value that ranged from 4.03% - 4.17%. The highest value was found in the treatment of sempol with chicken (DA) and the lowest onein that withbeef (DS). The results of statistical tests of hedonic texture of sempol with different types of meat showed no significant difference (p>0.05) on all treatments,sample DA 4.17%, DS 4.03%, and DK 4.13% (Table 3). This does not agree with the research result of kho et al[11]that the use of different types of meat affects the texture of meatballs.

Panelists prefer the texture of sempol chicken because the texture is softer and smoother than that of sempol with beef and lamb which is chewy. It was influenced by the bonding mechanism of starch with chicken protein when mixing the filler material, resulting in the extraction process of chicken meat protein that might be fused during the cooking process. This finding agrees with the argument of Putri [26]that chicken proteins can coalesce during cooking. Rosita et al[29] also argue that the coagulation of proteins, the release of water and starch gelatinase can affect the texture of meat processed products. The chewy texture of sempolwas influenced by the use of beef as beef has a high fiber content that can cause high emulsion. Beef has myosin protein that can form gel formation, resulting in a chewy texture. Myosin protein is contained in beef [30].

3.11. The Color of Sempol

The average level of panelists' preference for the color of sempol products with different types of meat obtained the results ranged from 3.73% – 4.37% (dislike - extremely like). The highest value was obtained in the treatment of sempol with chicken (4.37%) and the lowest one was found in the treatment of sempol with beef (3.73%) (Table 3). The variety analysis showed that sempol with different types of meat has a very significant effect on the color of sempol(p<0.05). The treatment of sampleDA wassignificantly different from that of DS but not significantly different from that of sampleDK. SampleDS treatment wassignificantly different from that of sampleDA and sampleDK. The treatment of sampleDK wasnot significantly different from that of sampleDA but significantly different from that of sampleDS.

The sempol color that waspreferred most by the panelists wasthe color of sempol chicken because it had a golden yellow color while sempol beef and lamb had a blackish brown color, which was influenced by the ioglobin inside the meat. The color of chicken is yellowish white, and the color of beef is dark red [31][32]. Sempol color wasalso influenced by the duration of the frying process because it experiences the interaction of polysaccharides and proteins that can prevent the components in the product along with the duration of the cooking process. The interaction of polysaccharides and proteins can prevent the components in the product, especially those that are sensitive to heat, one of which is fat [33]. The cooking process can cause discoloration to brown [26].

3.12. The Test Results of Scanning Electron Microscopy (SEM)

SEM is a tool that can be adopted to see the surface morphology of the material of sempol with different types of meat. It works by using electrons for the imaging source as well as electromagnetic fields for the lens. SEM can be equipped with EDX (Energy Dispersive X-ray) to determine the composition of the constituent elements of the material. SEM-EDX results in the form of graphs whose characterization is analyzed based on the peak intensity or element quantity. Then, the value ratio or the element ratio within is calculated (34).

The results of SEM demonstrated that sempol chicken has many cavities with a large size formed from a three-dimensional metric. It was perceived that the interaction of chicken meat protein gelatinization with tapioca starch during the cooking process to form a less

homogeneous metric (Picture 1). Less homogeneous and less compact three-dimensional metric cannot hold other components due to gelatinization of food protein[35][36]. Rahardiyan[37]argued that the cavities are assumed to be shrinkage of tissue proteins as a result of cooking loss.

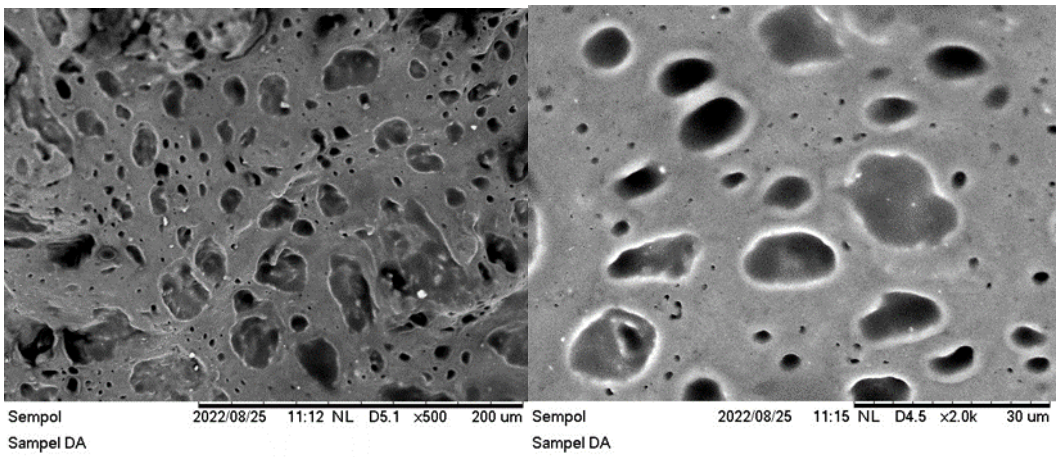


Figure 2. Sempol chicken meat in 500x and 2000x zoom

The microstructure of sempol beef has fewer rough and more open cavities and the formed metric wasthicker and fibrous when compared to that of sempol chicken and lamb (Figure 2). The less cavity formed the more the resulting product[38]. Because beef has sarcomeres of long muscle fibers interconnected with proteins, resulting in a fibrous three-dimensional metric with few rough cavities. Changes in the structure of fibrous cavities and metrics are caused by changes in proteins due to Maillard reactions during frying [36]. Rahardiyan[37]also argued that fibrous three-dimensional tissue can lead to a coarser and more open structure of space due to cooking loss.

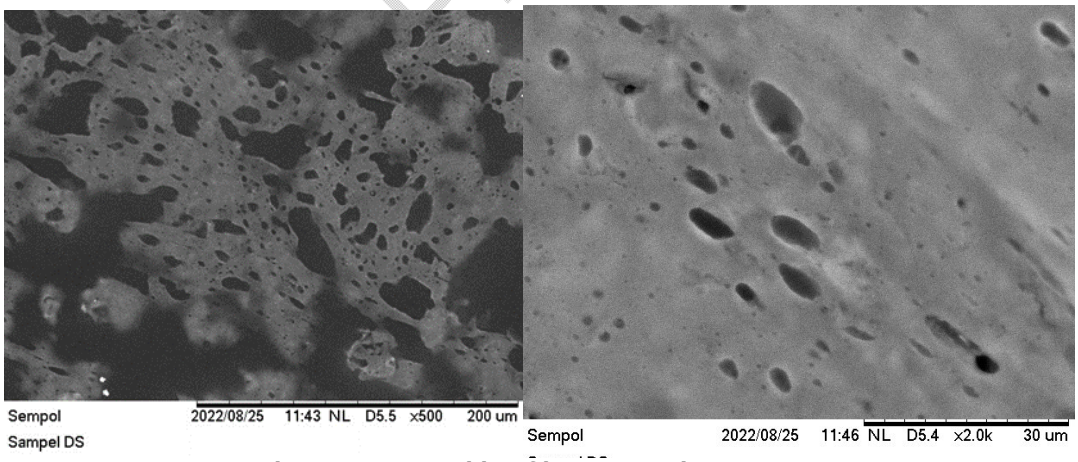


Figure 3. Sempol beef in 500x and 2000x zoom

Sempol lamb contains fat globules trapped on the protein metric (Figure 3). It is affected by the low content of protein levels of sempol lamb (Table 2), which cannot absorb globule fat formed by the nature of the oil during the frying process. Globule fat is trapped in the protein metrics damaged by the frying process for the evaporation of water [36]. Fellows [39]argued that the increased fat content is caused by the presence of absorption during the frying

process. Alugwu et al[40] also argued that the process of frying with a high temperature can lead to high fat content.

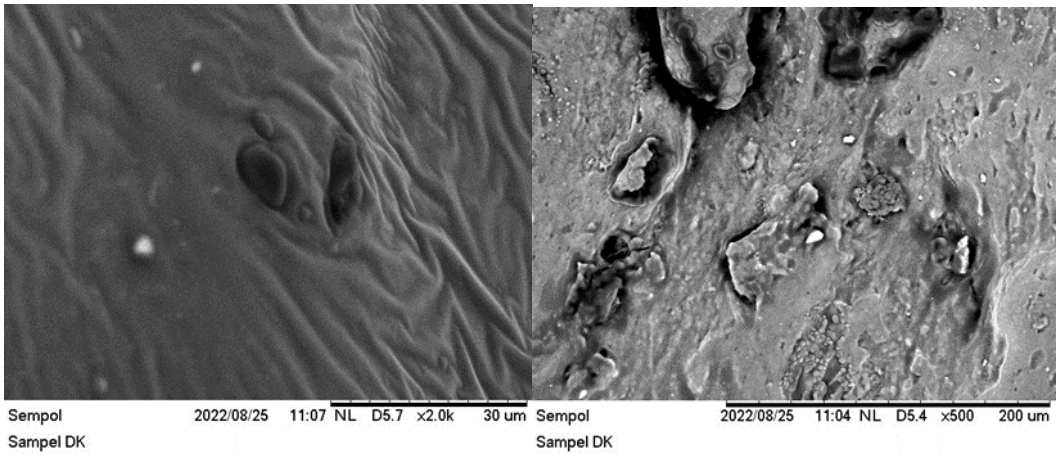


Figure 4. Sempol lamb in 500x and 2000x zoom

The results of element composition of sempol with different types of meat showed a number of elements contained in sempol chicken, beef, and lamb which lies in the unity of weight (Weight; Wt) and unity of atom (Atomic; At). The elements detected in sempol chicken, sempol beef, and sempol lamb can be seen in table 4.

Table 4. The process of making sempol with different types of meat

No	Element	*Weight* (Wt %)			*Atomic* (At %)		
		DA	DS	DK	DA	DS	DK
1.	Carbon (C)	0.000	49.805	64.127	0.000	57.335	72.513
2.	Oxygen (C)	81.731	48.255	30.386	88.534	41.704	25.795
3.	Natrium (Na)	6.597	0.983	0.953	4.973	0.591	0.563
4.	Silicon (Si)	6.138	-	0.098	3.787	-	0.048
5.	Sulphur (S)	-	-	0.179	-	-	0.076
6.	Chlorine (Cl)	5.535	0.856	1.441	2.706	0.334	0.552
7.	Potassium (K)	-	0.101	0.171	-	0.036	0.059
8.	Zirconium (Zr)	-	-	2.645	-	-	0.394

DA:*Sempol made with chicken;* ***DS:****Sempol made with beef;* ***DK:****Sempol made with lamb*

There are five elements detected in sempol chicken, one of which is carbon (C) with the lowest percentage compared to sempol beef and sempol lamb (Table 4). This is thought to be due to protein shrinkage by the cooking process with high temperatures that cause damage to the carbon structure (C), so a lot of large cavities are formulated (Figure 1). Protein shrinkage is caused by increasing the concentration of oil adsorbed in the frying process, so a low protein layer is formed and the protein charge decreases [41]. Shofa[42]also argued that the damage to the structure of carbon (C) is caused by the high temperature during the frying process, resulting in the formation of many cavities.
The amount of carbon (C) and oxygen (O) in sempol beef had the highest percentage ascompared to theother elements that are the main constituents of high protein in sempol beef (Table 4). Proteins are composed of carbon (C) and nitrogen (N) [43]. Proteins which are interconnected with beef muscle fibers can raise fibrous three-dimensional metrics and

rough cavity structures (Figure 2). The formed protein metric seems to befibrous as influenced by protein strands that are interconnected to form a three-dimensional structure [44]. Rahardiyan[37]also argued that the structure of the cavity space is rough due to cooking loss.
Sempol lamb has a lot of elements compared with sempol chicken and sempol beef (Table 4). However, the highest elementsare carbon (C) and oxygen (O) as the main constituents of fat because fatty acids forming globule fat are based on the number of elements of carbon atoms (C) [45][46]. Fats are composed of fatty acids and glycerol obtained from the hydrolysis of fats, oils, and other lipid compounds, resulting in a large fat globule (Figure 3). Glubola fat replaces water that evaporates during the frying process [36].

4. CONCLUSION

The use of different types of meat affects the physicochemical propertiesmoisture, ash, and carbohydrate content and does not affect fat and protein content. The physicochemical content of sempol has met SNI 2014 standards referring to combination meat nuggets, except the fat and carbohydrate content.
Based on sensory properties, panelists preferredsempol using chicken. The use of different types of meat does not affect the organoleptic taste, aroma, and texture but affects the organoleptic color, as influenced by the color of the meat.
The result of SEM-EDX in sempol with different types of meat demonstrated that the surface microstructure of sempol beef wasmore compact with smaller and uniform cavity. In addition, the presence of carbon (C) and oxygen (O) in sempol beef in high amounts can indicate that the main content of sempol beef wasprotein.

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