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Chemical Composition and Organoleptic Properties of Emulsion-Type Lamb Meat Sausage with Different Fat Levels

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Abstract. Various lamb-based processed products have become popular in many countries, including Indonesia that are well known for lamb satay, lamb curry, grilled lamb, and others. Processing lamb meat into sausages is a potential alternative to diversify lamb-based processed food. This study aims to develop a lamb-based processed product in form of emulsion sausage. We used mixed lamb meat and fat of Batur lamb (0, 5, 10, 15, 20 and 25%) that was coarsely ground and added with 2.0% salt, 0.5% dextrose, 0.5% garlic powder, 0.5% pepper powder, 0.3% paprika powder and 0.5% chili powder. Meat, fat, and other ingredients are mixed evenly and then put into collagen casings and measured 10-cm long. Next, the sausage was steamed for ±45 minutes, then cooled and drained. We used an experimental method with a Completely Randomized Design (CRD) assigning 6 treatments and 4 replicates. The treatments included T_0: Lamb sausage without fat; T_1 : Lamb sausage + 5% fat; T_2 : Lamb sausage + 10% fat; T_3 : Lamb sausage + 15% fat; T_4 : Lamb sausage + 20% fat and T_5 : Lamb sausage + 25% fat. The observed characteristics of sausages were chemical content (moisture, protein, fat, and ash content) and organoleptic properties (preferred colour, aroma, texture, taste, and acceptability). F test (anova) results showed that the treatment had a significant effect ($P<0.05$) on the moisture, protein, fat, and ash content of lamb sausage, as well as on preference for colour, aroma, texture, taste, and acceptance of lamb sausage. The results showed that the addition of 10% lamb fat produced emulsion-type lamb sausage with the most optimal characteristics, containing 63.290% water, 15.245% protein, 12.518% fat and 2.536% ash. The preferred colour, aroma, texture, taste and acceptance have satisfied the neutral criteria.

Keywords: lamb meat, emulsion-type sausage, different fat level

Abstrak. Berbagai produk olahan berbahan dasar daging domba menjadi populer di berbagai negara, termasuk Indonesia yang terkenal dengan sate kambing, gulai domba, domba bakar, dan lain-lain. Pengolahan daging domba menjadi sosis merupakan alternatif yang potensial untuk diversifikasi pangan olahan berbahan dasar daging domba. Penelitian ini bertujuan untuk mengembangkan produk olahan berbahan dasar daging domba berupa sosis emulsi. Kami menggunakan campuran daging domba dan lemak domba Batur (0, 5, 10, 15, 20 dan 25%) yang ditumbuk kasar dan ditambahkan garam 2,0%, dekstrosa 0,5%, bubuk bawang putih 0,5%, merica bubuk 0,5%, bubuk paprika 0,3 % dan bubuk cabai 0,5%. Daging, lemak, dan bahan lainnya dicampur secara merata kemudian dimasukkan ke dalam selubung kolagen dan diukur panjangnya 10 cm. Selanjutnya sosis dikukus selama ±45 menit, kemudian didinginkan dan ditiriskan. Kami menggunakan metode eksperimen dengan Rancangan Acak Lengkap (RAL) dengan 6 perlakuan dan 4 ulangan. Perlakuannya meliputi T0: Sosis domba tanpa lemak; T1: Sosis domba + 5% lemak; T2: Sosis domba + 10% lemak; T3: Sosis domba + 15% lemak; T4: Sosis domba + 20% lemak dan T5: Sosis domba + 25% lemak. Sifat sosis yang diamati adalah kandungan kimia (kadar air, protein, lemak, dan abu) dan sifat organoleptik (preferensi warna, aroma, tekstur, rasa, dan daya terima). Hasil uji F (anova) menunjukkan bahwa perlakuan berpengaruh nyata ($P<0,05$) terhadap kadar air, protein, lemak, dan abu sosis domba, serta terhadap kesukaan terhadap warna, aroma, tekstur, rasa, dan daya terima dari sosis domba. Hasil penelitian menunjukkan bahwa penambahan lemak domba 10% menghasilkan sosis domba tipe emulsi dengan karakteristik paling optimal, mengandung air 63,290%, protein 15,245%, lemak 12,518%, dan abu 2,536%. Warna, aroma, tekstur, rasa dan penerimaan yang disukai telah memenuhi kriteria netral.

Kata kunci: daging domba, sosis tipe emulsi, level lemak berbeda

Introduction

Sheep are local livestock with a very strategic position in the community because they have economic, social and cultural functions. Sheep can be raised for its meat, skin, and fur. The market potential of lamb meat continues to grow, and the direction of product demand is currently starting to develop towards products

that are relevant to consumer needs. Some processed lamb meat that are well known to Indonesian people include lamb satay, lamb curry, lamb barbecue and others. Up until today, there have been limited practice of processing of lamb meat into sausages. Therefore, processing lamb meat into sausages is a potential alternative to diversify lamb-based processed food products.

Meat sausage is a food product obtained from ground meat (containing meat not less than 75%) mixed with flour or starch and with or without additional seasonings and other food additives safe for incorporation into sausage casings (BSN, 1995). Until now, information about the composition and characteristics of emulsion-type lamb sausage is still limited. Since chemical properties and organoleptic properties are two determining factors to consumer acceptance, it is essential to have the right formulation to produce sausages with optimal chemical composition and can satisfy consumer preference. One of the components that contribute to the quality of sausage is fat. Research on Bologna sausages has shown that fat plays an important role in texture and other characteristics (Baer and Dilger, 2014; Camara and Pollonio, 2015), which is also reported in the texture and colour of sausages made from horse meat (Lorenzo and Franco, 2012). With proper processing, lamb sausage not only has the opportunity to be a product favored by consumers but can also be developed into functional food with health benefits (Teixeira et al., 2020).

Materials and Methods

Ingredients

This study used lamb meat and fat of Batur sheep aged 5-6 months obtained from sheep breeders in Banjarnegara. The meat was the combination of lamb thigh meat, intermuscular fat and deep fat. Other ingredients for making the dough include salt, tapioca flour, and seasonings. The casing was made of 10-cm cellulose. The equipment used were sausage-making equipment (meat grinder, food processor, sausage stuffer), Food Texture Analyzer, and laboratory equipment including autoclaves and others.

Methods

Emulsion-type sausages were prepared according to the procedure described by Thohari et al. (2017). The sausage dough was made from coarsely ground lamb mixed with different level of lamb fat (0, 5, 10, 15, 20 and 25%) added with other ingredients namely 2.0% salt, 0.5% dextrose, 0.5% garlic powder, 0.5% ground pepper, 0.5% paprika powder, and 0.5% chili powder. Meat, fat and other ingredients were mixed well, then put into collagen casing to produce 10-cm long sausage. The sausage was steamed for 45 minutes, then cooled and removed from the steamer.

We conducted an experimental study in the laboratory using a completely randomized design (CRD) with 6 treatments and 4 replicates each. The treatments were T0: Lamb sausage without fat; T1: Lamb sausage + 5% fat; T2: Lamb sausage + 10% fat; T3: Lamb sausage + 15% fat; T4: Lamb sausage + 20% fat and T5: Lamb sausage + 25% fat. The observed parameters observed included: proximate composition (moisture, fat, protein, and ash content), and organoleptic preferences (colour, aroma, texture, taste, and acceptability) obtained through panellist tests. Each organoleptic parameter gets a score that varies from 1 to 5, namely (1) Dislike strongly, (2) Dislike, (3) Neutral, (4) Like, (5) Like strongly.

The proximate analysis of fresh lamb sausage used the SNI method 01-2891-1992 (National Standardization Agency, 1992), and the organoleptic analysis of sausages was carried out using a 2-mm thick sample according to the procedure described by Cavalheiro et al., (2019) with 15 trained panellists.

The data were interpreted through the F test (ANOVA) and the difference between the mean

values of the treatments was determined by Duncan's Multiple Range Test (DMRT) at a significance level of 5% (Gomez and Gomez, 1984) using the General Linear Model (GLM) procedure of the Statistical Analysis System (Gomez and Gomez, 1984). SAS® Institute Inc., Cary, NC, USA) version 9.4.

Results and Discussion

Sausage Proximate Analysis

The results of the proximate analysis of fresh lamb sausage are presented in Table 1. The results of statistical analysis showed significant differences (P<0.05) in the water, protein, fat, and ash content of lamb sausage. The addition of fat changed the chemical characteristics of different sausages.

Water content is an important component that affects food ingredients because water content can affect the appearance, taste, and texture of food ingredients. The water content of sausages ranged from 61.628% (T5) to 67.199% (T0) which remained within the standard range of good sausage according to the Indonesian National Standard (SNI). The maximum water content of meat sausage according to SNI:3820 was 67% (BSN, 2015). The addition of fat in lamb meat (T1 to T5) significantly (P<0.05) caused different water content in sausage from that of control (T0). The greater the percentage of fat added, the lower the water content of the sausage. It is in accordance with Heinz and Hautzinger (2007) that water content is inversely proportional to the fat content. Additionally, Guerra et al. (2011) observed a decreased water and protein in Mortadella goat sausage due to the increased fat percentage. Lower water content in sausage affects its juiciness and moisture, indicating low water holding capacity. The decreased water content in sausages indicates that the water is not bound to protein and meat fat, thus exudes when the sausage is heated.

The highest protein content (16.285%) was observed in sausage in T0 and the lowest (14.526%) was in T5. The difference in the percentage of fat addition gave a significant effect on sausage protein content (P<0.05). The protein content of the research sausage still meets the standard of SNI: 3820 which requires a sausage protein content of at least 13% (BSN, 1995). Table 1 shows that the protein content decreased across treatments from T1 to T5 which is due to increased fat content in sausages that exceeded the protein. Increased fat content has a positive effect in reducing the percentage of fat in emulsified meat products which eventually increased cooking loss and decreased hardness (Youssef and Barbut, 2011; Alvarez and Barbut, 2013).

Fat plays a role in the characteristics of juiciness, texture, taste, and aroma of meat emulsion products (Bapda and Saghir, 2014; Barbut, 2015). The fat content of sausages in the study ranged from 11.965% (T0) to 14.396% (T5). The higher the percentage of fat added to lamb, the higher the fat content in the sausage. The fat content of sausages from the research still meets the standard of SNI: 3820 which requires a maximum fat content of 20% (BSN, 1995).

Table 1. Proximate composition of lamb sausage*

Fat addition	Water content (%)	Protein content (%)	Fat level (%)	Ash level (%)
T0=0%	67.199+0.315^{a}	16.285+0.251^{a}	11.965+0.095^{a}	2.732+0.026^{a}
T1=5%	65,279+0.920^{b}	16.120+0.262^{a}	12.235+0.097^{b}	2.718+0.114^{a}
T2=10%	63.290+0.350^{c}	15.245+0.257^{b}	12.518+0.099^{c}	2.536+0.146^{b}
T3=15%	63.063+0.386^{c}	15.012+0.103^{bc}	12.518+0.099^{c}	2.503+0.054^{b}
T4=20%	62.001+0.186^{d}	14,828+0.091^{c}	13,579+0,100^{e}	2.482+0.070^{b}
T5=25%	61.628+0.594^{d}	14.526+0.078^{d}	14,396+0.121^{f}	2.308+0.063^{c}

* Mean values (± standard deviation) followed by different letters in the same column show significant difference at 5% level in the DMRT test.

The difference in the percentage of fat added to lamb has significantly affected fat content of sausages (P<0.05). According to Guerra et al. (2011) the fat content in sausages should be subject of concern because high fat content can be problematic for consumers (Lengkey et al. 2016).

The results of the proximate analysis of ash content in sausage showed that the average ash content ranged from 2.308% (T5) to 2.732% (T0). According to BSN (2015), the standard maximum ash content of meat sausages is 3.0%, so that the ash content of the research results still meets the SNI standard: 3820. The ash content of sausages was significantly different (P<0.05) decreased gradually during the boiling time as a result of from water loss. Ash content (expressed in percent) is the amount of minerals contained in the material or product derived from elements and mineral compositions that are not evaporated during the ashing process. The ash content of sausages describes roughly the content of minerals, especially the components of magnesium, calcium, iron, and manganese.

Sausage Organoleptic

The organoleptic assessment included preferences for colour, aroma, texture, taste, and acceptance obtained from the panellist test using a hedonic test questionnaire. The panellists' level of acceptance of sausages is influenced by the organoleptic properties of the sauage. Sausage that has been boiled will experience protein denaturation, flour gelatinization, and changes in colour and texture. Sausage is an oil-in-water emulsion (continuous phase) in which a colloidal complex system of gelatine, protein, minerals, and vitamins occurs. Meanwhile, the dispersion phase is fat granules. The stability of the continuous phase is determined by the ability of the product to bind water and the fat binding ability of the meat protein. The score of preference for the colour and aroma of sausage without the addition of fat is T0 (0%), the value is low.

The colour of the lamb sausage judged by the panellists is the outer and inner colour of the sausage. The results of the organoleptic test showed no increase in the level of colour preference, in which the highest level was T1 (like) and the lowest was T0 and T4 (dislike).

The addition of fat percentage was significantly different (P<0.05) in the colour preference score of lamb sausage, the higher the addition of fat, the higher the value of consumer acceptance because the higher the fat content in the sausage dough, the higher the sausage appearance value. Because the addition of fat affects the fat content of the sausage, so the sausage is not dry and looks more appealing. The highest colour preference score is T1 (addition of 5% fat) under "like" category, and the lowest is T0 (without added fat) and T4 (addition of fat 20%) under "dislike" category.

Aroma is the smell of a food product, as a response when volatile compounds from a portion of food enter the nasal cavity and are perceived by the olfactory system.

Table 2. Results of organoleptic analysis of lamb sausage*

Parameter sensory	Fat gain treatment (score)					
	T0 (0%)	T1 (5%)	T2 (10%)	T3 (15%)	T4 (20%)	T5 (25%)
Colour	1.9+0.8^{c}	3.6+0.6^{a}	3.4+0.8^{a}	3.4+0.8^{a}	1.5+0.8^{c}	2.6+0.7^{b}
Aroma	1.8+1.0^{c}	3.3+0.9^{ab}	3.3+0.9^{ab}	2.7+1.0^{b}	1.3+0.5^{c}	3.6+0.7^{a}
Texture	3.3+0.7^{a}	2.1+ 1.0^{c}	3.3+0.8^{a}	2.0+1.0^{b}	3.6+0.7^{a}	3.6+0.7^{a}
Flavour	3.4+0.7^{abc}	3.3+0.7^{bc}	3.5+0.6^{ab}	3.3+0.9^{bc}	3.8+0.4^{a}	3.0+0.6^{c}
Reception	3.3+0.7^{abc}	3.6+0.5^{c}	3.3+0.6^{ab}	2.3+0.9^{bc}	1.8+0.8^{a}	3.3+0.8^{c}

* The mean scores (± standard deviation) followed by different letters in the same row are significantly different at the 5% level on Duncan's test.

Aroma is one of the organoleptic properties of a product that can be used to assess food quality by conducting organoleptic tests using a sensitive sense of smell. The addition of different fat percentages had a significant effect (P<0.05) on the preference for the aroma of lamb sausage. The test results show that the highest aroma preference is T5 (like) and the lowest is T0 and T4 (dislike). According to SNI 3820:2015 regarding the manufacture of sausages, the smell of delicious sausage is the distinctive aroma of the sausage raw material that does not disappear completely. The aroma of sausages that can captivate consumers' tastes comes from the aroma of spices, meat, and fat (Pinto et al., 2018).

Texture is a characteristic of a material as a result of a combination of several physical properties which include size, shape, amount, and the elements that make up the material that can be felt by the senses of touch and taste, including the sense of taste. mouth and eyesight (Midayanto and Yuwono, 2014). Food processing by heating has a positive effect, namely getting sausages that have a compact texture in the presence of protein coagulation, and highlight colour (Muchtadi and Ayustaningwarno, 2010). The addition of fat in lamb had a significant effect (P<0.05) on the preference value of lamb sausage texture. The preference scores for the lamb sausage texture ranged from 2.0 (dislike) in T3 to 3.6 (like) at T4 and T5. The texture of the sausage is influenced by the addition of fat to the sausage dough, causing the sausage texture to be softer than without the addition of fat. This result confirms Ruiz-Capillas et al. (2012) that fat content and water content will affect the texture of the product. The emulsion of sausage dough will make the sausage soft. According to Anggraini et al., (2016) the texture of sausage products includes elasticity, bite, hardness, and juiciness.

Taste sensations (sweet, bitter, sour, salty, and delicious) of a food product arise due to the taste compound, which is one of the determining factors to food quality. The taste of sausage is influenced by the type of seasoning, the concentration of the seasoning, and the addition of fillers or binders. (Purnomo et al., 2011). The addition of fat had a significant effect (P<0.05) on the taste preferences of lamb sausage, in which the sausage taste score ranged from 3.0 (neutral) at T5 to 3.8 (like) at T4.

Reception of sausages is determined by the five senses through the eyes, nose, ears, tongue, and skin which respond to and assess the sausages that are tasted. Choi et al. (2015) suggested that in addition to the organoleptic quality, the physical and microbiological qualities of sausages also affect the acceptance of sausages. Meanwhile, according to Tarwendah (2017), product taste is the fulfilment of consumer expectations, which is the most important factor that affects product acceptance. The acceptance score of lamb sausage between all treatments was significantly different (P<0.05), in which the average score of sausage acceptance ranged from 1.8 (dislike) on T4 to 3.6 (like) on T1.

Conclusions

The addition of fat to lamb affects the proximate composition (moisture, protein, fat, ash content) and organoleptic preferences (colour, aroma, taste, texture, acceptability). The addition of fat to the dough formulation that can produce emulsion-type lamb sausage with the most optimal characteristics is 10%, with 63.290% water content, 15.245% protein, 12.518% fat, 2.536% ash. The preference for colour, aroma and texture is at the level of neutral acceptance.

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