Research Article

Chemical and Organoleptic Quality of Ground Duck Jerky with the Addition of Sonication Liquid Smoke

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Abstract | This study aims to determine the effect of the addition of sonication coconut shell liquid smoke at different times on the activity of water (Aw), water, fat, ash, carbohydrates by difference, and organoleptic quality (color, texture, aroma, and taste). The research material used was jerky made from duck meat with the addition of coconut shell liquid smoke and spices such as salt, coconut sugar, garlic, galangal, coriander and tamarind. The method used was a laboratory experimental method using a completely randomized design (CRD) with 6 treatments and 4 repetitions, namely P0: without the addition of liquid smoke (control), P1: liquid smoke without sonication, P2: sonication liquid smoke for 5 minutes, P3: sonication liquid smoke for 10 minutes, P4: sonication liquid smoke for 15 minutes, and P5: sonication liquid smoke for 20 minutes. The results showed that the addition of sonication liquid smoke had no significant effect (P>0.05) on protein, ash, and organoleptic quality, could have a very significant effect (<0.01) on water, fat, and carbohydrates, and had a significant effect (P<0.05) on Aw . The best value was obtained by sonication liquid smoke for 20 minutes with Aw content of 0.65, water 40.04%, fat 9.09%, protein 29.14%, ash 0.37%, carbohydrates 21.37%, color 4, 35, texture 4.15, aroma 4.10, and taste 4.20. It can be concluded from this study that the addition of sonication coconut shell liquid smoke can reduce Aw, water, fat, protein and increase ash content, carbohydrates and organoleptic quality so that it can be accepted by consumers and can be applied in the development of the latest innovations in the production of beef jerky by the public.

Keywords | Chemical, Duck jerky, Liquid smoke, Organoleptics, Sonication

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INTRODUCTION

Meat is a food product of animal origin that is easily damaged and serves as a medium for microbial growth due to its complete nutritional content. The nutritional content of Peking duck meat in 100 grams includes 70.8% water, 12.8% protein, 13.8% fat, and 75 mg of cholesterol (Damayanti, 2006). Preservation and processing of meat into various processed products aim to reduce quality degradation and extend the shelf life while adding value to the meat products produced. One of the ways of processing meat so that it is not easily damaged is by processing fresh meat into beef jerky. Dendeng is an Intermediate Moisture Food (IMF) product that generally has an Aw range of 0.60-0.90 and a moisture content of 10-50% (Josopandojo et al., 2019). Dendeng is in the form of plates made from sliced or grounds fresh meat seasoned and dried.

Assidiq et al. (2018) stated that coconut shell liquid smoke can be used to preserve food ingredients that are safe for consumption. Coconut shell liquid smoke did not find Polycyclic Aromatic Hydrocarbon (PAH) compounds, in-

cluding benzo[a]pyrene. Coconut shell liquid smoke can be an alternative food preservative that is safe for consumption and provides sensory characteristics in the color, aroma, and tastes unique to food products. The content of phenolic compounds in liquid smoke functions as an antioxidant that can extend the shelf life of a food ingredient and can prevent the growth of a microbe in the food ingredient. So the addition of coconut shell liquid smoke in the manufacture of duck jerky is expected to extend the shelf life and affect the physical and chemical quality of the duck jerky.

The high-fat content in duck meat, which is 13.8%, can cause a greater chance of rancid odor and damage to beef jerky, mostly caused by microorganisms and damage due to fat oxidation. Oxidation of fats in foodstuffs will result in an unpleasant taste and smell, called rancidity, and can also reduce nutritional quality. Adding liquid smoke is expected to be an alternative food preservative to overcome fat oxidation and improve the taste. Purnamasari et al. (2013) revealed that the addition of liquid smoke can inhibit bacterial growth, slow down fat oxidation, and give flavor to the meat. Meat that contains fatter usually tends to produce a greater off-flavor, such as rancidity, because meat contains many unsaturated fatty acids, which are larger and easily oxidized. Lipid oxidation is the main reaction of food spoilage which causes a significant reduction in food quality.

Handaratri and Yuniati (2019) sonication is a non-thermal extraction method that can increase the mass transfer rate and break up sample particles so that it will shorten the processing time in reducing particles and homogenizing by dissolving without damaging the molecular structure, and using low temperatures can reduce heat loss, and prevent the loss or evaporation of compounds that have low boiling points, because this sonication method has been used for food processing. Sani et al. (2014) stated that the effect of the sonication method can increase the penetration of the solution into the sample and increase mass transfer so that it can speed up the time needed for sample breakdown. The sonication method can be applied to food processing, one of which is to homogenize coconut shell liquid smoke. Based on the statement of Candani et al. (2018), sonication can accelerate the process of dissolving a material with the principle of solving intermolecular reactions to form nano-sized particles. Sonication can produce nanoparticles, such as nanoemulsions and nanocrystals. Sonication can also be used to break down intermolecular interactions and analyze molecular dynamics and reaction kinetics in molecule cleavage to be useful for stirring samples. The sonication method is a type of top-down method in manufacturing nanomaterials. The sonication wave is channeled into the liquid medium to produce cavitation bubbles, namely the formation, growth, and rupture of bubbles containing gas inside, which can cause particles to have diameters on the nanoscale.

Research on the addition of sonicated coconut shell liquid smoke to the production of duck jerky has not been widely studied. Therefore this study aims to determine the effect of the addition of sonicated coconut shell liquid smoke at different times on the chemical and organoleptic quality of ground duck jerky.

MATERIAL AND METHODS

Materials and Tools

The research material used in this study was beef jerky made with the basic ingredients of Peking duck meat harvesting 50 days of male sex with the addition of coconut shell liquid smoke and spices such as salt, coconut sugar, garlic, galangal, coriander, and tamarind. Equipment for the production of duck jerky includes a Philips brand chopper, knife, analytical scale, label, glass mold, beaker glass, stirrer, dropping pipette, PE (polyethylene) plastic, Tiross LT-O6 food dehydrator, spoon, cutting board, and slicer.

Equipment for analysis includes:
1. Analysis of protein, fat, and water using FOSS Food Scan and sample containers.
2. Analysis ash equipment uses ovens, furnaces, porcelain dishes, cup clamping pliers, and desiccators.
3. Analysis carbohydrates by difference using the formula % Carbohydrate Content = 100% - (protein content + ash content + moisture content + fat content).
4. Organoleptic test equipment: cutlery, tissue, score sheet, and drinking water. The score sheet used by the panelists aims to provide a score for the product that has been tried. This study used 5 trained panelists.
5. Testing water activity (Aw) using an Aw meter.

Research Methods

The research used an experimental laboratory method using a Completely Randomized Design (CRD) with 6 treatments and 4 replications. The treatment used is:
1. P0: Control or no treatment
2. P1: Liquid smoke without sonication
3. P2: Liquid smoke with sonication for 5 minutes
4. P3: Liquid smoke with sonication for 10 minutes
5. P4: Liquid smoke with sonication for 15 minutes
6. P5: Liquid smoke with sonication for 20 minutes

Procedure for Making Duck Jerky

Making duck jerky begins by separating the fat from the meat, taking the breast, thigh, and wing meat, then washing the meat thoroughly under running water and draining it, and then the meat is ground until smooth. The ground

meat is soaked for 30 minutes in sonicated liquid smoke according to the treatment, and then the meat is drained. After that, the meat is seasoned with spices such as salt, coconut sugar, garlic, galangal, coriander, and tamarind which have been mashed and mixed thoroughly. Then, the meat is printed with a glass mold with a thickness of 3mm and placed on PE plastic (polyethylene), then placed in a food dehydrator for 3 hours and 15 minutes at 500C with occasional turning so that it cooks evenly. Jerky was removed from the food dehydrator and aerated and analyzed for chemical and organoleptic quality.

Parameters Observed

Analysis of protein, fat, and water uses the FOSS Food Scan method (AOAC, 2007). Analysis of ash content using the AOAC method (AOAC, 2005). Analysis of carbohydrate levels by difference uses the total carbohydrate method by difference (AOAC, 2005). Analysis of water activity (Aw) uses an Aw meter (Ulfah et al., 2018). Organoleptic quality testing used the descriptive test method using 5 trained panelists (Tarwendah, 2017).

Data Analysis

The data obtained were analyzed using ANOVA (Analysis of Variance) using a Completely Randomized Design (CRD).

RESULT AND DISCUSSION

Ground Duck Jerky Protein Content

The results of the analysis of variance showed that the addition of coconut shell liquid smoke at different sonication times did not have a significant effect on the protein of ground duck jerky (P>0.05). Data in Table 1 shows the average protein value of ground duck jerky with the addition of sonicated coconut shell liquid smoke ranges from 28.75% to 29.14%. The highest average was at P3, namely the addition of liquid smoke with 10 minutes of sonication, and the lowest average was at P0, namely as a control or without the addition of liquid smoke. In the control treatment or without the addition of liquid smoke and liquid smoke without sonication, and sonication for 5 and 10 minutes, the protein levels of ground duck jerky increased. This was due to the presence of phenolic compounds contained in liquid smoke such as 3-Octene, (E) - (CAS) (E)-3-Octene, Phenol, 2-methyl- (CAS) o-Cresol, 2-methoxy- (CAS) Guaiacol, and 2,6-dimethoxy- (CAS) which function as antioxidants and antibacterial smoked products. Based on the results of Adjis and Sugiarto, (2019), sliced beef jerky with the addition of 1% coconut shell liquid smoke with long soaking time without immersion (control), 2, 4, 6, and 8 hours of immersion. The results showed that the longer the beef was soaked in liquid smoke, the higher the protein content. Soaking beef jerky can improve taste, protein, and consumer acceptance. Soaking meat can also improve the quality of chemical, physical and sensory. Cent et al. (2021) stated that the increase in protein content in beef jerky was allegedly due to the influence of one of the compounds in liquid smoke, namely, phenolic compounds and organic acids, which function as antibacterials so that they can inhibit pathogenic bacteria that hydrolyze acids, an amino acid. The results of research by Masengki et al. (2022) regarding adding 0, 10, 20, and 30 ml of betel leaf cooking water to broiler meat at protein levels. Adding 0 and 10 ml of betel leaf decoction increased the protein content, and adding 20, and 30 ml of betel leaf decoction decreased the protein content of broiler meat. Increased protein levels because betel leaves contain phenolic compounds that function as antibacterial.

The sonication method is used to reduce the liquid smoke particles. The longer the sonication time, the smaller the particle size of the liquid smoke, making it easier for the liquid smoke to enter the meat during the soaking process so that the phenol content in the meat will increase. According to Rengga et al. (2019), the longer the sonication time, the smaller the sample particle size, which leads to stable nanoparticle size and reduced clumping. This is because the sonication method's shock waves can separate particles' agglomeration.

Adding liquid smoke with sonication for 15 and 20 minutes decreased the protein content of ground duck jerky, and this was due to the more phenolic compounds present in the meat during soaking. Based on Ina and Sirappa, (2021) the addition of coconut shell liquid smoke was added to beef with a concentration of 3%, 6%, and 9%. Protein levels tend to decrease because the smoke submerged in the meat causes lysis of the dissolved components in the cells. The greater the concentration of liquid smoke, the greater the number of dissolved components, including cell proteins that undergo lysis. This is under the statement of Aggraini et al. (2019) that the phenol content in liquid smoke will react with protein components, so the greater the amount of protein that reacts with phenol, the total the protein content tends to decrease. This reaction causes the protein to be denatured and become new bonds, which decreases the protein value of the product that is given liquid smoke.

Hutomo et al. (2015) reported that the effect of liquid smoke concentration on the smoke. The concentration of liquid smoke used is 0%, 5%, 10%, and 15%. The higher the concentration of liquid smoke, the lower the protein content of smoked eel (*monopterus albus*). Processing with liquid smoke reduces protein levels during the liquid smoke immersion process, and phenol will react with protein components so that the greater the amount of protein

Table 1: Average values of Protein, Fat, Water, Ash, Carbohydrate by difference, and Activity Water

Variables	Treatments					
	P0	P1	P2	P3	P4	P5
Protein (%)	28,75 ± 0,19	29,18 ± 0,47	29,20 ± 0,39	29,22 ± 0,31	29,16 ± 0,38	29,14 ± 0,11
Fat (%)	10,10 ± 0,30^{c}	10,02 ± 0,30^{c}	9,58 ± 0,39^{bc}	9,36 ± 0,23^{b}	9,18 ± 0,11^{ab}	9,09 ± 0,12^{a}
Water (%)	44,11 ± 0,70^{cd}	43,40 ± 0,38^{cd}	43,02 ± 0,44^{bc}	42,32 ± 0,49^{b}	40,37 ± 0,62^{ab}	40,04 ± 0,43^{a}
Ash (%)	0,25 ± 0,03	0,27 ± 0,02	0,29 ± 0,02	0,31 ± 0,07	0,34 ± 0,06	0,37 ± 0,08
Carbohydrate by difference (%)	16,80 ± 0,43^{a}	17,13 ± 0,55^{ab}	17,92 ± 0,56^{b}	18,79 ± 0,57^{bc}	20,95 ± 0,93^{c}	21,37 ± 0,40^{cd}
Activity Water (Aw)	0,76 ± 0,03^{c}	0,73 ± 0,04^{bc}	0,70 ± 0,01^{bc}	0,68 ± 0,03^{ab}	0,66 ± 0,06^{ab}	0,65 ± 0,06^{a}

that reacts with phenol, the total protein content tends to decrease. Phenol compounds tend to react with the sulfur-hydrogen groups of proteins. This reaction results in denatured proteins and the formation of new bonds, which decreases the protein value of the smoked material. Mekarsari et al. (2017) stated that liquid smoke has a high osmotic pressure so that it can draw water from the meat and cause protein denaturation and coagulation, resulting in shrinkage of the meat and separating proteins.

Ground Duck Jerky Fat Content

The analysis of variance showed that adding coconut shell liquid smoke with different sonication times had a very significant (P<0.01) effect on ground duck jerky fat. Data in Table 1 shows the average fat value of ground duck jerky with the addition of coconut shell liquid smoke ranges from 9.09% to 10.10%. The highest average was found at P0 as control or without the addition of sonicated liquid smoke, and the lowest average was at P5, namely the addition of liquid smoke with sonication for 20 minutes. As the sonication time increases, the fat content in ground duck jerky decreases because more and more phenolic compounds function as inhibitors of fat oxidation in ground duck jerky. Assidiq et al. (2018) showed that with the addition of liquid smoke with concentrations of 0%, 1%, 1.5%, 2%, and 2.5%, as the concentration of liquid smoke increases, the fat content of beef decreases. The highest fat content was found in control or without liquid smoke, which was 12.69%, and the lowest content was found in the addition of 2.5% liquid smoke, with an average of 6.77%. This is because liquid smoke contains phenolic compounds, which act as antioxidants, so they can prevent damage to a food product by donating hydrogen so that in very small amounts, it effectively inhibits fat oxidation by oxygen. Beef contains high fat, so it is easily oxidized and causes rancidity. Liquid smoke contains antioxidant compounds, namely phenol compounds which can inhibit fat oxidation in the meat.

Adding liquid smoke to food can inhibit bacterial growth, slow fat oxidation, and give the meat a distinctive taste (Purnamasari et al., 2013). Based on the results of the compounds contained in liquid smoke by GC-MS analysis, there are phenolic compounds such as phenyl ester, 2-methyl- (CAS) o-Cresol, 2-methoxy- (CAS) Guaiacol, 2,6-dimethoxy- (CAS) which function as antimicrobial so it can reduce fat content. This is finline with Silaban et al. (2018) who stated that liquid smoke can preserve food because it contains acid, phenolic, and carbonyl compounds. Liquid smoke can be used as a food preservative because of its antimicrobial and antioxidant properties, such as aldehydes, carboxylic acids, and phenols. Previously, Budi et al. (2021) revealed that the use of coconut shell liquid smoke on the fat content of duck meat decreased as the concentration of liquid smoke increased. The concentrations used were 0%, 4%, 8%, and 12%. The decrease in fat content in the meat was due to the coconut shell liquid smoke used to decompose the fatty acids of gutted duck meat. Soaking duck meat in coconut shell liquid smoke causes the decomposition of fatty acids in the meat so that the fat content is lower. Furthermore, Malelak et al. (2014) stated that the phenolic compounds usually present in liquid smoke include guaiacol, eugenol, 2,6-methoxyphenyl, and 2,6-dimethoxy-4-ethylphenol. Especially in coconut shell liquid smoke are 2- Methoxyphenol (guaiacol), 3,4-Dimethoxyphenol, Phenol, 2-methoxy-4- methyl phenol, 4-Ethyl-2-methoxy phenol.

Ground Duck Jerky Water Content

The analysis of variance showed that adding coconut shell liquid smoke with different sonication times had a significant effect (P<0.01) on the water content of ground duck jerky. The data in Table 1 shows that the average water content of ground duck jerky ranges from 40.04% to 44.11%. Over time sonication of liquid smoke can reduce the water content of ground duck jerky. Based on the statement of Anwar et al. (2021) moisture content is an important parameter for determining the quality of a product. Water contained in food can affect the appearance, texture, and taste of food. Moisture content can affect microbial

activity. Foodstuffs with higher water content will usually experience damage faster due to increased microbial activity. The drying process can reduce the water content, which causes the product's weight to be lower so that the value of the water content decreases. Lower water content is expected to slow down the growth of spoilage microbes to extend the product's shelf life longer.

The water content in ground duck jerky with the addition of liquid smoke has a higher average value than Indonesian National Standard (SNI 2908:2013), the water content of beef jerky is a maximum of 12%. According to Husna et al. (2014) ground beef jerky has a higher water content than beef jerky processed by the incision method. This is because in the manufacture of ground beef jerky, food additives in the form of spices are absorbed into the beef jerky produced, thereby increasing the weight of the beef jerky produced, while the seasoned beef jerky does not completely absorb into the processed beef jerky produced. Dry jerky using a food dehydrator for 3 to 15 hours to dry it to last longer in its shelf life. The food dehydrator functions to dry the beef jerky by removing the water content contained in the beef jerky and the excess of using a food dehydrator, namely, the temperature and time can be adjusted as needed, and the food can be cooked evenly. Previously, Chandra and Witono, (2018) reported that a food dehydrator is the best drying method compared to sunlight and an incubator oven because it takes a short time to reduce the water content, and the food does not experience excessive physical or chemical damage.

Data in Table 1 shows that the highest average is found in P0 as a control with an average of 44.11%, and the lowest average is found in P5, namely the addition of liquid smoke with 20 minutes of sonication with an average of 40.04%. The test results for the content of compounds found in liquid smoke contained ester and phenol compounds, which could reduce the water content in beef jerky. This follows the research of Masengki et al. (2022) giving 10, 20, and 30 ml of betel leaf boiled water to broiler meat experienced a decrease in water content as the addition of betel leaf boiled water was given due to the antimicrobial properties found in betel leaves. Betel leaves contain lots of phenolic compounds and flavonoid compounds. Antimicrobial properties are closely related to the water content in food ingredients. The presence of phenols, esters, flavonoids, alkaloids, and benzoic acid also causes the antimicrobial properties of betel leaves. The water content decreases because liquid smoke has an acidic component that impacts protein denaturation, and proteins lose their biological properties in binding water (Ina et al., 2022). This follows the statement of Budiarti et al. (2016) stating that the acidic nature of liquid smoke affects the water being dispersed so that the water content in the smoked product decreases.

Ground Duck Jerky Ash Content

The analysis of variance showed that adding coconut shell liquid smoke with different sonication times had no significant effect (P>0.05) on the ash content of ground duck jerky. Table 1 shows that the average ash content ranges from 0.25% to 0.37%. The highest average was found in treatment P5, 0.37%, namely the addition of sonicated liquid smoke for 20 minutes. The lowest was found in P0, which was 0.25%, as a control or without liquid smoke. The longer the sonication time on the liquid smoke, the higher the ash content in the ground duck jerky because the liquid smoke seeps more into the meat with a sonication time of 20 minutes. Based on the research results of Hutomo et al. (2015) the addition of coconut shell liquid smoke to the ash content of smoked eels with liquid smoke concentrations of 0%, 5%, 10%, and 15%, the higher the concentration of liquid smoke can increase the ash content in eels smoke, this is because the chemical composition of coconut shell liquid smoke contains ash so that the remaining burning material becomes more. The chemical composition of the coconut shell includes several parameters, namely ash content 0.61%, lignin 36.51%, fiber 53.06%, pentosan 20.54%, cellulose 32.52%, and hemicellulose 27.70%. Most of the food ingredients, which are about 96%, consist of organic matter and water, and the remainder consists of mineral elements, namely inorganic substances or what is known as ash content.

The ash content of a food material shows the number of minerals contained in the food material. The ash content shows the number of minerals not burned into volatile substances. Decreasing the water content in foodstuffs will cause an increase in the concentration of ash content (Purnamasari et al., 2013). Based on the research of Budiarti et al. (2016) a study on the addition of liquid smoke to a smoked eel with a liquid smoke concentration of 6% with a soaking time of 15, 25, and 35 minutes with the longer eel immersion in liquid smoke can increase the ash content. The change in the value of the ash content is caused by the addition of liquid smoke which can increase the mineral content in the product. The difference in immersion time in liquid smoke can affect the mineral content (ash) penetrating the food. The longer the soaking, the greater the mineral content in the liquid smoke penetrating the food. Ash comprises mineral components such as K, P, Na, Mg, Ca, Fe, Mn, and Cu.

Ground Duck Jerky Carbohydrates by difference Content

The analysis of variance showed that adding coconut shell liquid smoke with different sonication times had a significant effect (P<0.01) on the carbohydrate content of ground duck jerky. Table 1 shows that the average carbohydrate

content ranges from 16.80% to 21.37%. The longer sonication time in liquid smoke can increase the carbohydrate content in ground duck jerky. Based on the research results of Hutomo et al. (2015), adding coconut shell liquid smoke to smoked eel carbohydrate levels with liquid smoke concentrations of 0%, 5%, 10%, and 15%. Adding coconut shell liquid smoke can increase the carbohydrate value of smoked eel. This is because the coconut shell contains lignin and cellulose. Lignin and cellulose are the constituent ingredients of carbohydrates in the food, so the more coconut shell liquid smoke is added, the more the carbohydrate content in a food ingredient will increase. Carbohydrates are abundant in vegetable materials, simple sugars, hexoses, and carbohydrates with high molecular weights, such as lignin and cellulose. Carbohydrates are the main source of calories. The number of calories produced by 1 gram of carbohydrates is 4 kcal.

Budiarti et al. (2016) research the addition of liquid smoke to smoked eel with a liquid smoke concentration of 6% with immersion times of 15, 25, and 35. The longer the eel immersion in liquid smoke can increase the carbohydrate content. Coconut shell contains lignin and cellulose. Lignin and cellulose are the constituent ingredients of carbohydrates in the food, so the longer the immersion time in liquid smoke, the higher the carbohydrate content in a food ingredient will increase. Carbohydrates have a role in determining the characteristics of food ingredients, such as taste, color, texture, and so on. Carbohydrates function to prevent ketosis, excessive breakdown of body protein, and loss of minerals and help metabolize fats and proteins.

Ground Duck Jerky Activity Water Content

The analysis of variance showed that adding coconut shell liquid smoke with different sonication times had a significant effect ($P<0.05$) on the water activity level of ground duck jerky. The data in Table 1 shows that ground duck jerky's average water activity level ranges from 0.65 to 0.76. The highest average was at P0, namely as control or without the addition of sonicated liquid smoke, and the lowest average was at P5, namely the addition of 20 minutes of sonicated liquid smoke. Based on the statement of Delviana et al. (2021) food ingredients with a high water activity or Aw generally go bad quickly. The water content present in food ingredients will affect the food's resistance to microbial attack, which is expressed by Aw, which is the amount of free water that can be used by microorganisms for their growth. High levels of Aw will make it easy for microbes to grow and can cause food spoilage. Ground beef jerky has an Aw value with an average range between 0.71-0.77.

The decrease in water activity level (Aw) due to the drying process can inhibit the growth of microorganisms. Based on the statement of Ratnawati et al. (2022) the minimum Aw requirements for viable microbes for bacteria are 0.9, yeast 0.80–0.90, and mold 0.60–0.70. Based on the statement of Leviana and Paramita, (2017) that the way to reduce the Aw value is by adding a compound that can bind water, generally, drying is done either by drying in the sun or using a dryer. The drying method removes the water content in a solid (solid) or gas mixture using a heat source. The drying process is affected by the drying water and the thickness of the dried material. The results of research by Evanuarini and Huda, (2011) added sugar to making jerky as a flavor enhancer and can also reduce the Aw of jerky. The use of high levels of sugar will bind water so that the activity of jerky water is reduced. Sucrose, as the main component of sugar, contributes to reducing Aw.

Organoleptic Quality of Ground Duck Jerky

The variance analysis showed that adding coconut shell liquid smoke with different sonication times did not have a significant effect ($P>0.05$) on the color of ground duck jerky based on organoleptic quality. Table 2 shows that the average color score of ground duck jerky ranges from 4.05 to 4.35. The highest average color score was at P5, namely the addition of liquid smoke sonicated for 20 minutes, with an average of 4.50. The lowest average was at P0 as a control or without adding liquid smoke, with an average of 4.05. In the control treatment or without the addition of liquid smoke, the addition of liquid smoke without being sonicated and the addition of liquid smoke by sonication for 5, 10, 15, and 20 minutes had the same color criteria, namely brown beef jerky. The brown color in the production of jerky occurs because of the presence of Javanese sugar in the manufacture of jerky, resulting in the jerky's color being brown. Based on the research results of Cent et al. (2021) with the addition of coconut shell liquid smoke with concentrations of 0%, 1%, 1.5%, and 2% in the preparation of sliced beef jerky shows that the liquid smoke treatment has no significant effect on the color of the jerky beef cow. The color of the beef jerky given the liquid smoke treatment had the same average panelist preference score as the control. The average color score between the liquid smoke treatment and the same control was brownish red due to the Maillard reaction during drying. The reaction between free amino acids from proteins or other nitrogenous components with carbonyl groups derived from sugars or other carbohydrates causes the formation of a brown color. The brownish-red color is caused by brown sugar, which gives a caramelization effect and causes the color to turn brown. The carbonyl compounds also cause the change in color to brown in beef jerky production in the liquid smoke. The addition of liquid smoke causes the smoke components to seep into the meat and cause the appearance of a brown color. Coconut shell liquid smoke contains 13.28% carbonyl. Based on the statement of Unyu

Table 2: Organoleptic Quality Score of Ground Duck Jerky

Treatments	Color	Texture	Aroma	Flavor	Overall Acceptance
P0	4,05 ± 0,50	3,15 ± 0,96	2,85 ± 0,50	2,85 ± 0,50	4,00 ± 0,82
P1	4,10 ± 0,58	3,35 ± 0,96	3,50 ± 0,58	3,50 ± 0,58	4,20 ± 0,82
P2	4,20 ± 0,82	3,60 ± 0,82	3,65 ± 0,50	3,60 ± 0,82	4,25 ± 0,96
P3	4,30 ± 0,58	3,65 ± 0,50	4,00 ± 0,82	4,00 ± 0,82	4,30 ± 0,58
P4	4,25 ± 0,96	4,00 ± 0,82	4,05 ± 0,96	4,10 ± 0,58	4,35 ± 0,50
P5	4,35 ± 0,96	4,15 ± 0,96	4,10 ± 0,58	4,20 ± 0,82	4,50 ± 0,58

et al. (2017) organic acids in coconut shell liquid smoke can give a red color, while phenols and carbonyls contribute to giving the smoke a brown color.

Carbonyl compounds in smoke are compounds that play an important role in the formation of color. During the smoking process, carbonyl compounds have a major influence on the product's color due to the interaction between the carbonyl and the amino groups in the product. Carbonyl has the greatest effect on the formation of brown color in smoked products. Carbonyl compounds in smoke affect the coloring and flavor of smoked products. The carbonyl compounds in liquid smoke include vanillin and syringaldehyde (Mekarsari et al., 2017). Study by Ina et al. (2022) reported that the formation of color in smoked products is caused by carbonyl compounds seeping into the meat so that the smoked meat becomes slightly brownish. Liquid smoke contains acids, carbonyls, and phenols, which play a role in the formation of color, enhancing the distinctive taste, where the carbonyls react with proteins, and the presence of phenolic compounds as a source of antioxidants in their mechanism of action interacts with carbonyls and amino groups so that brown color is formed in jerky products and has an effect on consumers' liking for the product.

Organoleptic Quality of Ground Duck Jerky Texture

The analysis of variance showed that adding coconut shell liquid smoke with different sonication times had no significant effect (P>0.05) on the texture of ground duck jerky based on organoleptic quality. Table 2 shows that the average texture score of ground duck jerky ranges from 3.15 to 4.15. The highest average score was at P5, namely the addition of sonicated liquid smoke for 20 minutes, with an average score of 4.15 and the lowest average score was at P0 as a control or without the addition of liquid smoke, with an average score of 3.15. In the control treatment, the addition of liquid smoke without sonication and the addition of liquid smoke with sonication for 5 and 10 minutes had the same criteria, namely the texture of ground beef jerky with the criteria of a bit soft and the treatment of adding liquid smoke with sonication for 15 and 20 minutes had the criteria of soft.

Study by Meha et al. (2022) on adding kesambi wood liquid smoke to sliced beef jerky with concentrations of adding liquid smoke of 10%, 15%, 30%, and 45%, resulted that treatment of different concentrations of kesambi wood liquid smoke did not significantly affect the increase in the typical texture of jerky products. The criteria for adding 10% and 15% liquid smoke are rather soft. This is due to the lower water content, so the texture is wrinkled and rough. The dried meat's surface will harden as it loses its water content during heating. In the treatment of the addition of liquid smoke, 30% and 45% have soft criteria. Based on the statement of Ina et al. (2022) that the texture of the meat becomes tender because the liquid smoke seeps into the meat cells so that the space filled with water is semi-free and affects the ability of the meat to bind water and on the other hand the looseness of the fiber bonds myofibrils so that the texture of the meat becomes tender.

The longer the liquid smoke sonication time, the score of the organoleptic texture increases. The results of Ina and Sirappa, (2021) regarding the addition of liquid smoke with a concentration of 3%, 6%, and 9% show that the greater the concentration of the liquid smoke given can increase the texture score on the sliced beef jerky. At a concentration of 9%, it has rather soft criteria, and concentrations of 3% and 6% have unsoft criteria. Panelists assessed with rather soft criteria because of the presence of volatile compounds in liquid smoke, which can affect the tenderness of beef jerky, making it easier to bite or chew. The smoking concentration of up to 9% has a relative effect on tenderness because the bioactive components contained therein can hydrolyze the peptide bonds in a jerky beef protein. According to Indiarto et al. (2012) liquid smoke, apart from being antioxidant and antimicrobial, can also act as a binder and tenderizer, which can improve the texture of meat with its mechanism of action in tenderizing meat the same as during the meat maturation process where there are gaps between muscle fibers, which allows semi-free and free water to fill the free space so that the water holding capacity of the meat increases.

Organoleptic Quality of Ground Duck Jerky Aroma

The variance analysis showed that adding coconut shell

liquid smoke with different sonication times did not have a significant effect (P>0.05) on the aroma of ground duck jerky based on organoleptic quality. Table 2 shows that ground duck jerky's average organoleptic aroma score ranges from 2.85 to 4.10. The highest average score was at P5, namely, the addition of sonicated liquid smoke for 20 minutes, and the lowest average was at P0, without the addition of liquid smoke. The longer the sonication time of liquid smoke can increase the panelists' preference for the aroma of ground duck jerky. Adding spices also affects the aroma of beef jerky, which consumers can accept. In the control treatment or without the addition of liquid smoke, the criteria only smelled of spices, the addition of liquid smoke without sonication and the addition of liquid smoke with 5 minutes of sonication had the criteria of slightly smelling spices and smoke, and in the treatment of adding liquid smoke with sonication times of 10, 15, and 20 minutes has the criteria of smelling spices and smoke. Cent et al. (2021) showed that the addition of coconut shell liquid smoke with concentrations of 0%, 1%, 1.5%, and 2% in the manufacture of sliced beef jerky that the treatment with the addition of liquid smoke was not significantly different in the aroma of a jerky beef cow. The insignificant effect was due to the optimum amount of liquid smoke concentration, and the addition of distilled water also reduced the smell of smoke to maintain the stability of the jerky beef aroma. Adding herbs and spices can also help reduce the smell of smoke and even give the beef jerky a distinctive aroma so that consumers can accept it. This follows the statement of Kemalawaty et al. (2019) that adding spices can help reduce rancidity and even give a distinctive aroma to the jerky produced. The addition of sugar, salt, and other seasonings will give rise to a distinctive aroma, and during the making of jerky, a caramelization process will occur, namely, the Maillard reaction, which gives rise to the aroma of jerky.

Based on the results of the content of coconut shell liquid smoke compounds with GC-MS analysis found in liquid smoke which can give aroma to beef jerky, namely compounds 2-methoxy- (CAS) Guaiacol, phenyl ester, 2-methyl- (CAS) o-Cresol, 1,2-dimethoxy- (CAS) Veratrol, 2,6-dimethoxy- (CAS) which functions to give a distinctive aroma so it can enhance the taste. Kadir et al. (2010) stated that the phenolic compounds that are the main components that provide aroma in liquid smoke are phenol, p-cresol, o-cresol, guaiacol, 4-methyl guaiacol, 4-ethyl guaiacol, syringe, eugenol, 4- propylguaicol and isoeugenol. Based on the results of a study by Arizona et al. (2011), the higher the concentration of liquid smoke, the more smokey the aroma of beef jerky, this is because the phenolic compounds contained in liquid smoke play a role in the formation of flavors in smoked food. Phenol compounds that play a role in forming smoke flavor are siringol, guaiacol, 4-methyl guaiacol, 4-methylsiringol, and eugenol. Mekarsari et al. (2017) phenol and ester compounds in liquid smoke also play a role in giving the aroma of smoked products.

Organoleptic Quality of Ground Duck Jerky Flavor

The analysis of variance showed that adding coconut shell liquid smoke with different sonication times had no significant effect (P>0.05) on the taste of ground duck jerky based on organoleptic quality. Table 2 shows that ground duck jerky's average organoleptic aroma score ranges from 2.85 to 4.20. The highest average score was at P5, namely, the addition of sonicated liquid smoke for 20 minutes, and the lowest average was at P0 without the addition of liquid smoke. The presence of phenol content in coconut shell liquid smoke can give a distinctive taste to smoked beef jerky, and the addition of spices such as Javanese sugar, garlic, coriander, galangal, salt, and tamarind also gives a taste to ground duck jerky to produce a taste acceptable to the panelists. In the control treatment or without the addition of liquid smoke, the criteria only tasted meat, the addition of liquid smoke without sonication and the addition of liquid smoke with 5 minutes of sonication had the criteria of slightly tasting meat and smoke, and in the treatment with the addition of liquid smoke with sonication 10, 15 and 20 minutes have the criteria of meat and smoke. Based on the research results of Ina et al. (2022) giving, corncob liquid smoke to the texture of sliced chicken jerky with liquid smoke concentrations of 3%, 6%, 9%, and 12%. Panelists assessed chicken jerky with the addition of liquid smoke at a concentration of 3% and 6%, with the lowest scores of 2.92 ± 1.05 and 2.89 ± 0.87 with the criteria of slightly smoked taste. This is because the low concentration of smoking affects the absorption of phenol in the meat to be less so that the taste of smoke that sticks to the tongue when consumed is reduced. In the treatment with the addition of 9% and 12% liquid smoke, the highest score was 3.07 ± 0.85 and 3.50 ± 0.88 with the criteria of smoke taste. This is due to the high liquid smoke given to the meat and the long soaking time so that the phenolic compounds in the smoke seep into the cell walls of the meat so that a distinctive smoked taste is formed in jerky.

Compounds in liquid smoke such as phenol, 2-methoxy-(CAS) guaiacol, phenol, 2 methyl-(CAS), phenol 2,6-dimethoxy-(CAS), benzene, 1,2-dimethoxy-(CAS) veratol and phenol, 2-methyl-(CAS) o-cresol functions as a flavor and aroma enhancer in jerky so that it can improve the flavor of jerky. This follows Halid and Gobel, (2021) that the phenolic compounds that form the smoke flavor are guaiacol, 4-methyl guaiacol, and 2,6-dimethoxy phenol. Guaikol gives a smoked taste, while syringol gives a smoked aroma to food products. Based on the statement

of Cent et al. (2021) that smoke compounds produced from liquid smoke can give the meat a distinctive taste, slow down the fat oxidation process and inhibit bacterial growth. According to Varlet et al. (2007), the components in liquid smoke include p-cresol, ocresol, guaiacol, 4-memethyguaiacol, 4-ethyl guaiacol, eugenol, 4-proppyguaiacol, and isoeugenol also play a role in the aroma and taste of the product with the addition of liquid smoke.

Organoleptic Quality of Ground Duck Jerky Overall Acceptance

The variance analysis showed that adding coconut shell liquid smoke with different sonication times did not have a significant effect (P>0.05) on the overall acceptability of ground duck jerky based on organoleptic quality. Table 2 shows that the average acceptance score for ground duck jerky ranges from 4.00 to 4.50. The highest average score was at P5 namely, the addition of sonicated liquid smoke for 20 minutes, and the lowest average was at P0 without the addition of liquid smoke. The control treatment or without the addition of liquid smoke, the addition of liquid smoke without sonication, and the addition of liquid smoke with sonication for 5, 10, 15, and 20 minutes had the same overall acceptance score, which was acceptable to the panelists. Based on the results of the coconut shell liquid smoke test using GC-MS, there are phenolic compounds contained in liquid smoke such as carbamic acid, phenyl ester (CAS), phenyl carbamate, phenol, 2-methoxy (CAS) guaiacol, phenol 2,6-dimethoxy- (CAS)), 3-Octene, (E)- (CAS) (E)-3-Octene, phenol, 2-methyl- (CAS), benzene 1,2 dimethoxy (CAS) veratol, and phenol, 2-methyl- (CAS) o-Cresol which can improve the sensory quality of ground duck jerky based on organoleptic quality. Kadir et al. (2010) stated that in coconut shell liquid smoke, phenolic compounds play a role in improving and enhancing the quality of smoked products such as phenol, o-cresol, guaiacol, 4-methyl guaiacol, 4-ethyl guaiacol, syringe.

The longer the sonication time for coconut shell liquid smoke, the higher the score, this indicates that the longer the sonication time for coconut shell liquid smoke, the overall panelist acceptance is more acceptable. Based on the statements of Riyadi and Atmaka, (2010) the overall product acceptance score is very important for comparing the sensory quality of products that function to determine the level of consumer acceptance. Treatment P5, namely coconut shell liquid smoke sonication for 20 minutes, had the highest overall acceptance value, so liquid smoke sonication for 20 minutes was more acceptable to the panelists.

CONCLUSION

The addition of coconut shell liquid smoke with different sonication times in the production of ground duck jerky did not affect the levels of protein, fat, ash, and organoleptic quality but could affect the moisture content, carbohydrates with a difference, and water activity. Based on the average results of chemical quality, liquid smoke with sonication for 20 minutes was the best treatment in making ground duck jerky, and from the organoleptic quality, it was stated that sonication of liquid smoke for 20 minutes was the most acceptable to the panelists.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest.

NOVELTY STATEMENT

This study highlights the effect of adding coconut shell liquid smoke using the sonication method in the production of ground duck jerky to improve nutritional quality and determines the formulation of seasonings to improve the taste that is acceptable to the public.

AUTHORS CONTRIBUTION

Nitya Salsabila made samples, obtained data for analysis, analyzed parameters, analyzed data, and compiled manuscripts. Agus Susilo and Djalal Rosyidi developed the research design, provided guidance, revised the manuscript, and approved the final manuscript.

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