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Effect of Using Sophia Traditional Beverages with Different Alcohol Concentrations on pH, Moisture Content and Organoleptic Quality of Na'an Maran (Dried Meat)

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ABSTRACT

The purpose of this study was to determine the effect of Sophia concentration with different alcohol concentrations in the processing of Na'an Maran (dried meat), which was conducted at the Animal Product Technology Laboratory, Faculty of Animal Husbandry, Marine and Fisheries. Using 20 kg of fresh beef, Sophia with 10%, 12% and 14% alcohol concentration and 2% salt per 1 kg of meat. This study employed four treatments and five replicates. Where P0: Beef + 2% salt (Control), P1: Beef + 2% salt + 10% alcohol concentration, P2: beef + 2% salt + 12% alcohol concentration, P3: beef + 2% salt + 14% alcohol concentration. Furthermore, organoleptic properties, pH and moisture content were tested. The data obtained were analysed using ANOVA and followed by Duncan's test to determine if there were significant differences between treatments. Organoleptic data were analysed using the Kruskal-Wallis non-parametric test, followed by the Mann-Whitney test if significant differences were found. The results showed that the use of Sophia with different alcohol concentrations had a significant effect ($P < 0.01$) on organoleptic properties and pH, while having no significant effect ($P > 0.05$) on water content. It can be concluded that Sophia can improve the organoleptic quality of Na'an Maran with the best treatment at 10% alcohol concentration.

Keywords: Dried meat, water content, organoleptic, pH, Sophia

INTRODUCTION

Animal food is a material that is easily damaged due to physical, chemical, sensory and biological changes. A change will follow the process of colour decay, accompanied by an increase in bacterial growth. Microbial activity during storage breaks down chemicals in meat. If meat is left at room temperature, microbial activity increases, leading to more bacterial growth and eventual decay. Raw beef is easily spoiled or damaged due to chemical changes or microbial contamination. Therefore, meat preservation aims to extend shelf life, improve taste according to consumer preferences and nutritional value. (Arcanjo *et al*., 2019)

In East Nusa Tenggara (NTT), there are many processed meat products typical of various regions, such as se'i, Suu Wu'i, and *Na'an Maran*. *Na'an Maran* is a processed, dried meat originating from the Belu-Malaka Regency, where the meat is prepared by sprinkling it with salt and then drying it in the sun until it is scorched. Na'an Maran and se'i share the same physical form, resembling a rope, but they differ in processing and quality. Se'i processing involves fermenting the meat, followed by smoking. The result is se'i, a bright red product that can be consumed immediately. In contrast, Na'an Maran, after being coated with salt, is dried in the sun, much like beef jerky. The result is that Na'an Maran is harder/tougher. If stored for a long time, the red colour of Na'an Maran gradually changes to black, and if you want to consume Na'an Maran, it must be pounded first so that it can be chewed.

Traditional preservation methods for Na'an Maran result in a product with undesirable characteristics, causing the meat quality to fall below standard in terms of physical, chemical, and organoleptic properties. The physical and organoleptic quality of dried meat is significantly influenced by factors such as pH, water content, water-holding capacity, and cooking loss, as well as organoleptic properties like colour, aroma, texture, and taste. According to Istrati et al. (2012), the sensory characteristics of meat, such as taste, tenderness, and colour, have been considered essential because they influence consumers' choices of processed food products. Shackelford et al. (2001) stated that tenderness is a crucial organoleptic value for consumers. There are several ways to improve or increase the quality of Na'an Maran, such as enhancing its organoleptic properties — colour, taste, and tenderness — by adding additional food ingredients during processing. Several types of food additives that have been widely used to improve the quality of processed meat include the use of rosella (Wete *et al.,* 2019), the Use of starfruit (Averrhoa Bilimbi Linn.) (Hertanto *et al.,* 2012) or adding alcohol such as beer and red wine (Melo *et al.,* 2008) and the use of wine to tenderise beef muscle (Istrati *et al.,* 2012).

The use of alcoholic beverages in food processing, in addition to adding flavour, can also change the texture of the food. Alcohol can help break down tough meat and soften its texture. Alcoholic beverages, such as beer and red wine, along with other traditional drinks, contain bioactive compounds like polyphenols, tannins, and organic acids that possess antimicrobial and antioxidant properties. One of the alcoholic beverages originating from NTT that can be used in meat processing is Sophia. Sophia is a traditional drink made from palm sap/tuak, which has a high sugar content ranging from 10-15% and organic acids or natural enzymes that can help soften the meat, resulting in a more tender texture. Meat processing using alcohol can enhance the quality of beef by improving tenderness and taste, and it can also eliminate odours in meat. Based on the description above, a study has been conducted on "The Use of Sophia with different alcohol concentrations to improve the quality of Na'an Maran"

MATERIALS AND METHODS

This study employed a completely randomised design (CRD) experimental method with four treatments and five replications to obtain 20 experimental units. P0 = control, P1 = 10% alcohol concentration, P2 = 12% alcohol concentration, P3 = 14% alcohol concentration the main ingredients used in this study were fresh beef thigh muscle without fat and alcohol with an alcohol content of 45% and table salt (NaCL), The tools used in this study were gloves, containers, knives, slicing boards, scales, meat hangers, label paper.

Research variables

pH

Analysis of pH using the method (Sunando *et al.,* 2016) Namely, by chopping 10 grams of a dried meat sample, adding 50 ml of distilled water, then inserting the pH meter and taking several measurements to obtain accurate pH value results. When measuring pH with different samples, calibrate the tip of the pH meter with distilled water and dry it with a tissue or a cloth before using it. Then, measure and dip the pH meter alternately into the distilled water solution until the numbers displayed are stable.

Determination of Dry Materials

Place the porcelain cup in the oven at 105 °C for 1 hour. Remove the porcelain cup and cool in a desiccator for 30 minutes. Weigh the porcelain cup carefully (recorded as A g). The scale used is digital, and the weight of the sample is determined, recorded, and then zeroed to ensure the number indicator reads zero. Immediately, add 1-2g of the sample to the cup and weigh it (recorded as B g). Place the cup containing the sample in the oven at 105 °C for at least 20 hours. The cup containing the sample is removed from the oven, placed in a desiccator for 30 minutes, and then weighed (recorded as Cg).

Formulation:

Dry matter moisture content = $\frac{C-A}{B} \times 100\%$

Water content = 100 – % Dry matter

Organoleptic

The purpose of the sensory test is to determine the panellists' perception of the provision of alcohol in the processing of dried beef. Sensory assessment of dried beef is carried out based on information provided by the panellists. The number of panellists used is 20. Before conducting the sensory test, first tell the panellists how to make an assessment based on the scores listed in Table 1. The assessment scores are as follows:

Table 1. Organoleptic assessment scores

Score	Sensory		
	Color	Taste	Tenderness
5	Brownish red	Very savory	Meat taste
4	Blackish red	Savory	Savory taste
3	Blackish brown	Quite savory	Quite savory
2	Pale Brown	Strong alcohol	Tough
1	Very Black	Alcohol	very tough

Data Analysis

The data obtained were analysed using ANOVA and continued with Duncan's further test if there was a significant difference between treatments, and organoleptic data using non-parametric Kruskal-Wallis if there was a difference between treatments, continued with the Mann-Whitney test (SPSS 26)

RESULTS AND DISCUSSION

pH Na'an Maran

The pH value of meat significantly affects the sensory quality, including colour, texture, and flavour, of processed products. (Ke et al., 2009). The addition of alcohol at different concentrations had a significant effect (P<0.05) on the pH value of Naan Maran.

Table 2. Physical properties of Na'an Maran

Parameters	Treatments				
	P0 (control)	P1(10%)	P2(12%)	P3(14%)	*P-value*
pH	6.22±0.46[a]	5.61±0.15[b]	5.45±0.18[b]	6.05±0.39[b]	0.005
Water content	51.22±4.70	48.34±5.41	46.21±2.83	41.82±3.22	0.208

Note: Different superscripts in the same row indicate significant differences (P<0.05)

Statistical tests showed that the addition of Sophia with different alcohol concentrations had a highly significant effect (P < 0.01) on the pH value of Na'an Maran. The highest pH value was observed in the control at 6.22, while the lowest was recorded at P2 with a pH of 5.45 when Sophia was given an alcohol concentration of 12%, as shown in Table 4. The results of Duncan's further test showed that the control treatment (P0) was significantly different from the Sophia addition treatments (P1, P2, P3), as indicated by the superscript differences. The decrease in the pH level of meat in the Sophia addition treatment was attributed to the presence of alcohol, which contained compounds that could lower the pH level of meat during the drying process. The compounds contained in alcohol and could lower the pH of beef were organic acids (acetic acid and lactic acid), which could reduce the pH of meat by increasing hydrogen ions (H+ +) in beef, which were toxic to bacteria, thus inhibiting bacterial growth. Marinating meat with organic acids, such as acetic acid, citric acid, lactic acid, or malic acid, can lower the pH of the meat, thereby inhibiting bacterial growth.

The pH value of Na'an Maran in this study is still relatively low compared to previous studies. (Lee et al. 2011) In the processing of pork, red wine is added with a control pH value of 5.99 and a treatment pH of 5.90, which affects aspects of meat quality, such as colour, taste, and tenderness. The pH value of meat significantly affects the sensory quality, such as colour, texture and flavour, of processed meat products (Ke et al, 2009) (Ambedkar et al, 2021) state that pH affects the tenderness of meat. If the pH value is 6.4-6.7, it is generally less tender compared to beef with a medium or normal pH value of 5.5-6.1. Furthermore, Krvavica & Friganovic (2012) stated that low pH values can decrease water activity, thereby inhibiting microbial growth and extending the shelf life of meat. The overall effect of meat pH when dried depends on the compounds that lower and increase the pH of the meat. According to Kırkyol & Akköse (2023), in their research on drying Pastirma meat, changes in pH during the drying process are influenced by several components, including water content, salt content, and chemical reactions that occur during the process.

Water Content

Based on the statistical analysis (Table 2), it is evident that varying the alcohol concentration for Sophia has no significant effect (P > 0.05) on water content. The water content of Na'an Maran tends to decrease as the alcohol concentration increases. This is because alcohol evaporates faster than water. Additionally, alcohol functions as a dehydrating agent that can draw water from meat tissue, thereby reducing the total water content in meat. (Silva et al. 2018) Stated that alcohol can increase the rate of water evaporation during the drying process, thus accelerating the process of reducing water in meat. The water content of Na'an Maran is higher than that of Biltong in the study. (Petit et al. 2014) The water content of Biltong produced ranges from 21.5% to 25.3%. This is because the processing of Biltong uses oven drying, which can be adjusted for temperature, drying time, and the presentation of water content in food products.

The total moisture content of Na'an maran is classified as a dry meat product based on the standard of processed dry meat (Biltong) originating from South Africa, which is 20-50% and Charqui from Brazil, where, according to Brazilian legislation, the range of moisture content of dry meat (Charqui) is between 40-50% (Jones et al., 2017). According to (Mediani et al., 2022) States that reducing the water content in meat during the drying process is very important in preventing microbial growth and the presence of harmful substances.

Organoleptic

Based on statistical analysis tests, it was shown that adding Sophia with different alcohol concentrations had a highly significant effect ($P < 0.01$) on colour, taste, and tenderness.

Table 3. Average organoleptic value of Na'an Maran

Parameters	Alcohol Concentration				
	P0 (0%)	P1 (10%)	P2 (12%)	P3 (14%)	*P-Value*
Colour	3.85 ± 0.88^{c}	4.52 ± 0.87^{d}	3.40 ± 1.31^{b}	3.07 ± 1.49^{a}	0.000
Taste	3.41 ± 0.60^{a}	3.57 ± 0.84^{b}	3.67 ± 0.67^{b}	3.70 ± 0.59^{b}	0.001
tenderness	2.72 ± 0.79^{a}	3.42 ± 0.96^{b}	3.32 ± 0.95^{b}	3.30 ± 0.97^{b}	0.000

Note: Different superscripts in the same row indicate significant differences ($P<0.05$)

The organoleptic test results in a colour score for Na'an Maran ranging from 4.5 to 3.8 (dark red to blackish brown). Where the colour score on Na'an Maran for each treatment is P0: brownish red (score 4), P1: dark red (score 5), P2 and P3: blackish brown (score 3), the addition of alcohol to each treatment has been proven to change the colour of Na'an Maran meat. The addition of alcohol with a concentration of 10% yields a better meat colour, as indicated by the organoleptic colour test score. Meanwhile, alcohol levels above 10% in P2 and P3 produce unattractive colours that tend to be black. At the same time, the colour in P0 is better than that in P2 and P3.

The colour change in this process is thought to be due to alcohol dissolving pigments that affect the colour of meat when dried. Myoglobin, the primary pigment in meat, is partially dissolved in alcohol, thereby changing the meat's colour. According to Wahyuningtyas (2015), the colour change of meat is caused by the presence of two pigments, myoglobin, and haemoglobin. Alcohol can accelerate or slow down the reaction between pigments and oxygen, depending on the concentration and drying conditions. (Lawrie, 2003) stated that the concentration of myoglobin pigment in meat is the primary determining factor in meat colour. (Kuntoro et al., 2013) explain that when meat is exposed to oxygen ($O2$), there will be a reaction between myoglobin and oxygen, which produces a bright red colour on the meat. Still, if exposed for too long, the meat will turn a brownish colour.

The colour of dried meat (Dendeng), which is blackish-brown, is considered better, like its natural colour. This is due to the protein content in meat, which triggers the Maillard reaction. The Maillard reaction is a chemical reaction that occurs between carbohydrates, especially sugars, and primary amino groups, resulting in the production of a brown product. Alcohol can also affect the rate of the Maillard reaction during the drying process. The Maillard reaction occurs when amino acids and reducing sugars react, producing a brownish colour on the meat as it dries. Research conducted by Mishra et al. (2017) on the processing of dried meat (Ham) indicates that drying with sunlight changes the colour of the meat to blackish-brown. This occurs due to the Maillard reaction, where changes happen in the carbonyl group of reducing sugars reacting non-enzymatically with the amino group of meat proteins and amino acids, causing a reddish-brown colour in the meat. (Dariyani et al., 2019) said that meat that is dried at high temperatures for a long time can cause the surface of the meat to change, one of which is in terms of colour. The ethanol content in alcohol helps accelerate the Maillard reaction, also known as caramelisation, in dried meat, resulting in a darker colour. Additionally, alcohol can break down the muscle tissue of the meat, ultimately making it more tender. Meanwhile, Na'an maran added with Sophia with an alcohol concentration of 10%, 12% and 14% has the same taste score and is higher than the control (without alcohol). The average overall organoleptic value for taste is 3.5-4.0 (quite savoury to savoury). This means that there is no alcohol taste, because alcohol evaporates quickly and interacts with fat, resulting in more juice and a more savoury flavour. Alcohol can cause protein denaturation and interact with meat fat, altering the texture and taste of the meat, where Arcanjo et al. (2019) state that alcohol inhibits protein oxidation and enhances the flavour of meat due to compounds derived from alcohol.

During the drying process, proteolytic reactions, lipolytic processes, and lipid oxidation contribute to enhancing the flavour of meat. Proteolysis results in the formation of peptides and amino acids that contribute to flavour, and lipolysis involves the breakdown of fat into free fatty acids that can enhance the taste of meat. Lipid oxidation occurs when fat reacts with oxygen to form volatile compounds that can enhance or change the flavour of beef. Van et al. (2014) said that the drying process increases several volatile compounds formed from lipid oxidation and Maillard reactions. In alcohol, there are volatile compounds such as ethanol, aldehydes, and esters, which enhance aroma and improve the taste of dried meat. Taste is one of the key factors that influence consumer decisions to accept or reject a product. Although other assessment criteria may be more important, consumers will reject a product if it tastes bad. The taste profile itself consists of salty, sweet, bitter, and rancid notes.

Statistical analysis of tenderness tests revealed that the lowest tenderness value was observed at P0, with a score of 2.72 (tough), compared to the assessments at P1, P2, and P3, where the assessor scores ranged from 3.30 to 3.42 (quite tender). This indicates that the treatment of adding alcohol was more effective than the control. This is thought to be because adding alcohol with concentrations of 10%, 12%, and 14% can cause the meat myofibrils to wilt and stretch, making the meat quite tender. Alcohol can also cause protein denaturation, where the protein structure in the meat changes shape. This denaturation can make muscle fibres softer and easier to chew. Istrati et al. (2012) stated that soaking meat in alcoholic beverages, such as Red Wine, can increase meat tenderness, reduce myofibrillar protein fragmentation and affect the colour quality of beef. Alcohol has denaturing properties against proteins, which helps soften meat during marination. Meat tenderness also depends on four main components: the level of myofibril degradation, sarcomere length, connective tissue content, and the presence of proteolytic enzymes. (Kaur et al., 2021). The degradation of myofibrils by natural enzymes will increase tenderness. (Kim et al., 2018). Apart from that, the level of tenderness of Na'an Maran is influenced by the structure of the meat, where the higher the distance between the meat fibres and the more collagen, the tougher the meat.

CONCLUSION

This study concludes that the use of Sophia with different alcohol concentrations affects Organoleptic and pH properties, while it does not affect water content. Sophia can enhance the organoleptic quality of Na'an Maran with optimal treatment at an alcohol concentration of 10%.

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