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Research Article

Characteristics Jerky (yilepao) of Nike Fish Using Sweet Potato Flour (*Ipomea batatas*) as a Filler and Binder

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Abstract: This study aims to make a formula of nike jerky (*yilepao*) using sweet potato flour and the characteristics of the formula. The formulation begins with the manufacture of sweet potato flour. Furthermore, the formulation of spices and concentrations of sweet potato flour will be used in making nike fish jerky (*yilepao*). Furthermore, the drying process is carried out using a drying oven at a temperature of 60-70 ° C. The dried beef jerky was tested for the characteristics of organoleptic quality, chemical quality and microbiology (TPC). The data from the test results were then analyzed using the Kurskal Wallis non-parametric test for organoleptic data, and the RAL for chemical and microbiological tests of jerky products (*yilepao*). If it is significantly different, a further test is carried out using the Duncan method. The treatment in this study is the concentration of sweet potato flour used (20%, 30% and 40%). Based on the research results of nike fish jerky using sweet potato flour as a binder and filler organoleptically the 3 formulas in all test parameters were at the standard limit of panelist acceptance. The jerky formula with 30% sweet potato flour concentration has the highest favorite value. Characteristics of the quality of the formula, namely; a) organoleptically has a rather neat appearance, brown to yellowish brown, slightly cracked solid texture, aroma of fish and strong spices, criteria for good taste, fish taste and strong seasoning, sweet potato tasteless; b) the chemical characteristics are as follows: water content of 47.35%; protein content 22.96%; fat content 6.56%; ash content of 1.55% and carbohydrate content of 14.70%. Tilapia TPC 4.41 cfu / g Based on the research results of nike fish jerky using sweet potato flour as a binder and filler organoleptically the 3 formulas in all test parameters are at the standard limit of panelist acceptance. Tilapia TPC 4.41 cfu / g

a) organoleptically has a rather neat appearance, brown to yellowish brown, slightly cracked solid texture, aroma of fish and strong spices, criteria for good taste, fish taste and strong seasoning, sweet potato tasteless; b) the chemical characteristics are as follows: water content of 47.35%; protein content 22.96%; fat content 6.56%; ash content of 1.55% and carbohydrate content of 14.70%. *Tilapia* TPC 4.41 cfu / g a) organoleptically has a rather neat appearance, brown to yellowish brown, slightly cracked solid texture, aroma of fish and strong spices, criteria for good taste, fish taste and strong seasoning, sweet potato tasteless; b) the chemical characteristics are as follows: water content of 47.35%; protein content 22.96%; fat content 6.56%; ash content of 1.55% and carbohydrate content of 14.70%. *Tilapia* TPC 4.41 cfu /g.

Keywords: nike jerky, *yilepao*, *Sweet Potato*, *fish jerky*,

1. INTRODUCTION

Nike fish is one of the endemic fish species found in Gorontalo waters. Nike fish is a schooling of gobiidae^[1]. This fish is a type of fish that is small in size and is widely available on the coast of Tomini Bay. This fish is one of the important economical fish in Gorontalo. Indicated by the high market demand for this fish. Currently, Nike fish is a menu that is characteristic of Gorontalo. Nike fish processed products are a favorite menu for tourists who are fond of culinary tourism.

Nike fish is an amphidromy fish where these fish spawn in fresh water, the eggs are placed on the substrate at the bottom of the water, after the eggs hatch, the larvae drift to the sea, then the juveniles return to the river of origin of their mother after a while in the sea^[2]; Olii *et al.*^[3].

Fish from the gobi group in Hawaiian waters, just like Nike fish, are amphidromy and live and develop in marine waters, initially these fish hatch their larvae in the waters of the Gobi river by river currents, the larvae are brought to the sea, live and develop until sometime until they become juvenile, then will return to their habitat in fresh water^[4]. The results of research conducted by Yusuf^[5](2011) indicate that Nike fish contains high nutritional value, namely; 16.89% protein, 0.3% fat, 14.81% DHA, 8.50% oleic acid, 2.22% EPA, Calcium 677.34 ppm, iron (Fe) 15.77 ppm, zinc (Zn) 17.88 ppm, and 0.079 ppm iodine.

Studies on the use of nike fish in other more innovative processed forms have been carried out, among others; savory chips^[6], Nugget^[7]. In addition to containing high nutrition, based on the type and physical form, Nike fish has the potential to be used as raw material for various types of preparations. Yilepao nike fish is a type of processed nike fish with the addition of spices and sago flour then grilled. The problem with *ilepao* products is that they do not have a long shelf life and must be consumed immediately after cooking. One solution is to modify yilepao products into jerky products.

Dendeng is one of the preserved meat products by drying with the addition of preservatives (salt, sugar, saltpeter) and other ingredients to get the desired taste^[8](Ikhsan et al 2016). Dendeng is a dry meat processed product that uses antioxidant-rich spices as a spice^[9](Suryati et al 2012). Dendeng is a combination of curing and drying processes in the form of thin sheets with added salt of salt, sugar and table salt and spices such as coriander, garlic, shallots, laos and ginger^[10].

Utilization of sweet potato flour in the formulas of nike jerky (*ilepao*) aims to exploit the regional potential in the form of tubers that are widely available in Gorontalo. The carbohydrate content in sweet potatoes has a low glycemic index value, which is a type of carbohydrate which if consumed will not increase blood sugar drastically. The glycemic index content of sweet potatoes is relatively lower than rice and corn, so sweet potatoes are very good for consumption by diabetics. The form of processed

sweet potato that is widely used in the food industry is sweet potato flour. This study aims to characterize the organoleptic, chemical and microbiological qualities of the jerky formula product.

2. RESEARCH METHODS

2.1. Tools and Materials: The tools used for the manufacture of sweet potato flour and Nike fish jerky products consist of: digital balance, plate, spatula, plastic baking sheet, food processor, flour sieve, spoon, oven drying knife, cutting board.

Equipment for chemical analysis consists of: analytical balance, oven, furnace, desiccator, kjeldhal flask, soxhlet, burette, thermometer, porcelain dish, spectrophotometer type Spektronic 200, filter paper, incubator, shaker, and other glassware. Questionnaire sheet for organoleptics. The ingredients used for the manufacture of Nike fish jerky products consist of: Nike fish obtained from TPI Tenda Kota Gorontalo, sweet potatoes, salt, garlic, shallots, cayenne pepper and coriander powder. The ingredients for making sweet potato flour are sweet potatoes.

Materials used for the analysis of the nutritional content of Nike fish and quality testing of Nike fish jerky include: distilled water, H_2SO_4 , HCl, NaOH, $CuSO_4$, boric acid, indicators of Brom cresol green-methyl red, selenium, NaCl, Na_2SO_4 , methyl ester, hexane. .

2.2. Place and time of research: This research will be conducted for 1 year. The stage of making sweet potato flour and nike fish jerky will be carried out in the Biotechnology Laboratory and hasper characterization. Testing the quality of flour, formulation and characteristics of nike fish jerky in the Lab. BPPMHP Prov. Gorontalo.

2.3. Research procedure: The research is planned to be carried out in 1 year. Divided into 2 stages, namely preliminary research to make sweet potato flour. The main research is making formulas and characterizing the physicochemical, organoleptic and microbiological qualities of the resulting jerky.

2.4. Making Sweet Potato Flour: The manufacture of sweet potato flour refers to a modified 2013 Utiahman study. With the following procedure: 1) sweet potato is washed and cleaned of dirt and then cut into thin strips; 2) Sweet potato that has been cut and then dried using a drying oven at 600C for 6 hours until dry; 3) then mash the dried sweet potatoes using a food processor until smooth, then sifted using a sieve until it becomes sweet potato flour

2.5. Making Nike fish jerky: This stage is the initial stage of the formulation of Nike fish jerky. In the initial formulation stage, the objective is to obtain a spice composition for curing the processing method of Nike fish jerky. The seasoning formula used is shallots, cayenne pepper, coriander, salt and sugar and the amount of flour used.

In this study, the treatment at this formulation stage was the concentration of sweet potato flour added to the manufacture of nike fish jerky, namely 20.30 and 40% based on fish weight. The next research stage is the stage of characterization of the nike fish jerky product.

The test parameters in this study were the organoleptic test of hedonic quality, the physico-chemical test and the microbiological test of the formulated jerky. The testing procedure refers to AOAC^[12]. The analysis of orleb data used the Kruskal Wallis method, and the physico-chemical and micro-physical parameters used RAL. If it is significantly different, then continue to test using the Duncan test.

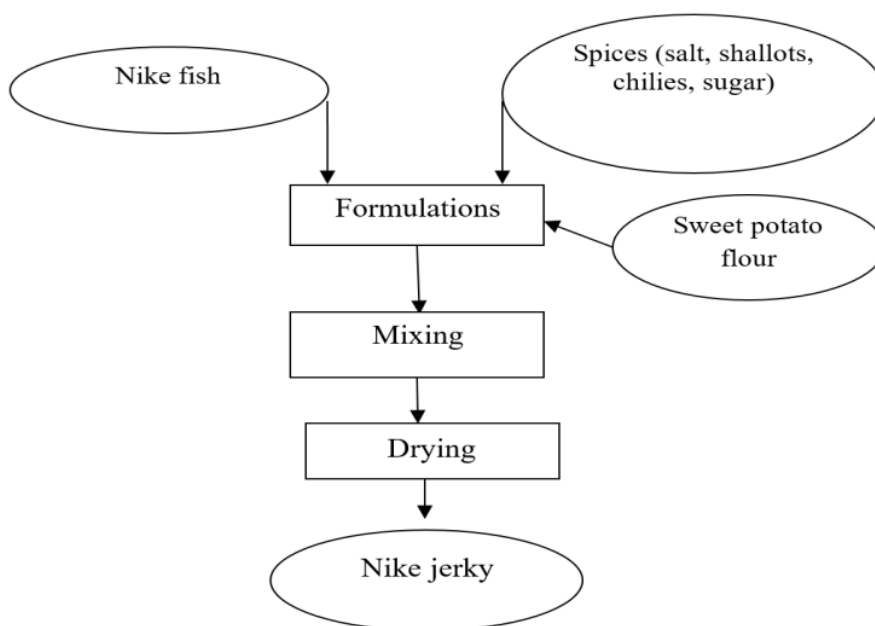


Figure 1: Chart of making Nike fish jerky

Table2. The composition of the Nike jerky in the main study (for 500 grams of fish)

material	Amount of Material (gr)
Sweet potato flour	100, 150, 200
Shallot	15
Cayenne pepper	9
sugar	20
Salt	5
Garlic	10
Coriander	5

Note: The basic formula for Nike fish jerky is based on a trial error.

3. RESULTS AND DISSCUSION

3.1 Characteristics of the Nike Fish Jerky Formula (Yilepao):

3.1.1. Organoleptic Characteristics of Jerky (Yilepao) Nike Fish: The physical characteristics of a product can be determined through organoleptic testing. Based on the results of the Kruskal wallis test, the quality characteristics are shown in **Table 2**.

Table 2: Kruskal wallis test results, hedonic quality value of Nike fish jerky (*yilepao*)

Hedonic Quality Score	Treatment		
	Formula A (Sweet Potato flour 20%)	Formula B (Sweet Potato Flour 30%)	Formula C (Sweet Potato Flour 40%)
Appearance	7.56a	7.33a	6.40a
Color	6.61a	6.94a	6.00a
Texture	6.67a	4.50b	6.39a
Aroma	7.56a	8.00a	6.94a
Taste	6.39a	7.67b	6.33a

(1).**Appearance:** Based on the results of the hedonic quality test, the appearance of jerky, the formulation results are at a value of 6.5-7.56 or are at a value of 7-8. This value is in the characteristics of neat or *oleptic* quality. It is characterized by uniform shapes and cuts even though it looks a bit dull brown. Based on the results of the Kruskal Wallis test, it shows that the use of different concentrations of sweet potato flour does not affect the appearance of the jerky product. The hedonic quality value of the appearance of nike jerky (*yilepao*) is shown in **Table 2**

Based on the test results showed that the appearance of the nike jerky product (*yilepao*) in organoleptic quality was somewhat less tidy, this was due to the addition of lajar sweet potato flour with a different amount, the appearance of the product was homogeneous but slightly cracked, especially in the addition of 40% sweet potato flour.

This is because the higher the amount of flour that is added to the product tends to be drier so that when drying the surface of the jerky it cracks a little which causes it to look less neat and brown. The neatness and uniformity of the product will attract consumers to try the product. The appearance of a product is not only seen from color, but also the shape and size uniformity visually also have an effect ^[13]. The appearance of Nike fish jerky is shown in **Figure 2**.



Figure 2: The appearance of Nike fish jerky (*yilepao*)

(2).Color: The organoleptic characteristics of the jerky color using different flour concentrations were at a value of 6-6.9 or at a value of 6-7. This value is in the product color criteria for a slightly dull brown to yellowish brown. Based on the results of the Kruskal wallis test, it shows that the use of different flour concentrations does not have a significant effect on the color of the formulated jerky products. The hedonic quality value of the nike jerky color (*yilepao*) is shown in **Table 2**.

Based on the test results of the color characteristics of the jerky (*yilepao*), the resulting nike fish is brown to yellowish brown. The coloration of this jerky product (*yilepo*) occurs after the drying process. Drying is done using a drying oven with a drying temperature of 60-70 ° C for 2 hours. This is because during the drying process water evaporation occurs in the sample which is followed by a chemical reaction between the raw material of the nike fish and the additives in the form of spices and flour in the product. The color change reaction in this product is known as the browning reaction or the Maillard reaction.

The Mailard reaction occurs between carbohydrates, especially reducing sugars, with primary amino groups that are usually found in ingredients as amino acids or proteins^[14]. The formation of color occurs at the amadori reaction stage to form amino ketose, then the amino ketose compound that is formed is dehydrated to form furfuraldehyde. The active aldehyde groups are polymerized by including an amino group (called an aldol condensation) or by an amino group to form a brown compound called melanoidin^[15].

(3).Texture: The test results for the texture characteristics of the nike fish jerky are at a value of 4.5-6.67 or at a value of 5-7. This value is in the solid and crack criteria until it is solid slightly cracked. The texture characteristic of the formula that has the highest value is the texture in formula A, which is the solid criteria with slightly cracks.

Based on the results of the Kruskal wallis test (**Table 2**) shows that the use of different concentrations of sweet potato flour in the jerky formula affects the texture characteristics of the formulated nike fish jerky. Based on Duncan's continued test, it shows that the texture of the jerky formula A (20% sweet potato flour) is not significantly different from the texture of the jerky formula C (40% sweet potato flour) but is significantly different from the texture of the jerky formula B (30% sweet potato flour). The hedonic quality value of jerky texture (*yilepao*) is shown in **Table 2**.

(4).Aroma: The organoleptic results of the jerky aroma characteristics test were at the value of 6.94-8. Or at a value of 7 to 9. This value is in the criteria of fish aroma and less strong spices to strong fish aroma and spices. The highest value of hedonic aroma quality is in formula B (30% sweet potato flour). Based on the results of the Kruskal Wallis test, it shows that the difference in the concentration of sweet potato flour in the Nike jerky formula does not have an effect on the hedonic quality value of the nike jerky aroma (*yilepao*).

Based on the test results (**Table 2**) shows that in formula A (20% sweet potato) and formula B (30% sweet potato flour) the organoleptic characteristics of the aroma are fish and the resulting spices are strong products. This is because the concentration of flour used is not too much so that during the drying process the dominant aroma of the jerky product is the aroma of fish and spices used, while the aroma of sweet potato flour is not detected by the sense of smell.

The aroma produced in the product is due to the reaction that occurs between the fish as the main raw material and the spices used. Seasonings used It is also added that the high glutamate content in Nike fish gives a distinctive taste and aroma to the product. Kilcast^[16] suggests that the smell of food is detected as a volatile compound that enters the nasal cavity, either directly through the nose or indirectly via the

retronasal route, namely the mouth. Aroma is usually the result of a mixture of several, sometimes many, odorous compounds. Materials or compounds that are added to food to improve taste are usually substances that contain volatile compounds ^[17].

(5).Taste: The characteristics of the jerky taste after frying based on the results of the organoleptic test are at a value of 6.33 to 7.67. Or on a value of 6 to 8. This value is in the criteria of good taste, less strong fish taste, less flavorful spices, tasteless sweet potato and on the criteria of good taste, fish taste and strong seasoning, sweet potato taste less. The jerky formula that has the highest taste criteria is the jerky formula with a 30% concentration of sweet potato flour. But in general, the three formulas are criteria for good taste and the panelists like them.

The hedonic quality value of jerky is shown in **Table 2**. Based on the Kruskal wallis test results showed that the use of different flour concentrations affected the hedonic organoleptic characteristics of the formulation results. Based on the results of Duncan's continued test, it shows that the jerky formula A (20% sweet potato flour) is not significantly different from the taste characteristics of the product with the sample formula C (40% sweet potato flour) but the two formulas have significantly different taste characteristics with formula B (40% sweet potato flour). %).

Formula B (30% sweet potato flour) has the highest taste criteria because of the dominant taste of fish in jerky (*yilepao*). When the jerky product (*yilepao*) is fried, the dominant flavor of the fish gets stronger. In addition, the mixing of the distinctive taste of the nuke fish with the flavor of the spices in the product dominates the taste of the jerky so that the product tastes good with the distinctive taste of fish and spices, while the sweet potato flour has no taste.

Spices are a mixture of two or more ingredients that are added and provide a functional balance in the food processing process ^[17]. The interaction of other taste components with the main component of the primary taste may increase the intensity of taste or decrease the intensity of taste (taste compensation) ^[18].

3.1.2. Chemical and microbiological characteristics of Nike Fish Jerky: The nutritional content tested in this research of Nike jerky (*yilepao*) is a proximate test, namely water content, protein, fat, ash, carbohydrates and a microbiological test, namely TPC. Based on the results of the test and analysis of variance, the proximate values were obtained as shown in **Table 3**.

Table3: Results of Analysis of Variety of Proximate Values and Microbiology of Nike Fish Jerky (*yilepao*)

Proximate and Microbiology	Treatment		
	Formula A (Sweet Potato flour 20%)	Formula B (Sweet Potato Flour 30%)	Formula C (Sweet Potato Flour 40%)
Water	34.94a	47.35c	38.88b
Protein	23.88b	22.96b	21.76a
Fat	4.03a	6.56c	5.52b
Ash	1.75b	1.55a	1.67b
Carbohydrate	17.02b	14.70a	14.02a
TPC	3.76a	4.41ab	5.27b

Ket. Different letters indicate significantly different values

(1).Water content: The results of the jerky product water content test were in the range of 34.94% - 47.35%. The water content value of the nuke fish sample is shown in Table 2. Based on the results of the

variance test, the addition of sweet potato flour with different concentrations to the jerky formula has a significant effect on the water content of the nike jerky product (*yilepao*). Based on the results of the Duncan further test showed that the water content of jerky in the 3 formulas showed different results.

The water content value in formula B (30% sweet potato flour) was higher than formula C and A, which was 47.35%. The high water content evaporating in the jerky product is thought to be due to the jerky formula which adds sweet potato flour as a binder and filler for jerky. This caused during the drying process not all the water contained in the jerky samples could be bound by the sweet potato flour. Water that is not bound with flour evaporated. The presence of a binding agent in food products can bind water to food [19].

Research conducted by Maysaroh *et al.*[4] on nile jerky products using sugar and brown sugar with different concentrations shows that the concentration of sugar used affects the water content of the product. Husna[20] adds that drying the jerky aims to reduce the moisture content of the products in food so that it can inhibit the growth of microorganisms that cause damage to foodstuffs.

(2).Protein Content: The test results for the protein content of beef jerky products were in the range of 21.76% - 23.88% (Table 3). The results of the analysis showed that the higher the concentration of flour with added protein jerky decreased.

Based on the results of the variance test, the addition of sweet potato flour with different concentrations to the formula had a significant effect on the protein content of the nike jerky product (*yilepao*). Based on the results of Duncan's continued test, it showed that the protein content of jerky in formula A and B showed no significant difference, but the two formulas were different from formula C.

The high protein content of nike jerky (*yilepao*) (above 20%) is because the main raw material for jerky is nike fish. During the drying process the nutritional content of the product can increase along with the reduced moisture content of the product. This is because the jerky product has undergone a further processing process, namely the provision of seasoning and drying at 60-70 ° C for 2 hours. The drying process causes the water content in the Nike product to decrease which causes the other nutritional content contained in the ingredients to increase, one of which is the protein content. The same result also occurred in a study conducted by Yusuf[5] (2011) where the protein value of nike fish increased after the fish was processed into fish chips coated with flour. In research by Ikhsan *et al.*[21] on dumbo catfish jerky products dried at a temperature of 60-70 ° C. The protein content in the research results of the nike fish jerky meets the SNI 2908[22]: 2013 standard of beef jerky, which is at least 18% [23].

(3).Fat level: The test results for the fat content of jerky products were in the range of 4.03% -6.56% (Table 3). The results of the analysis showed that the higher the concentration of flour that was added, the value of jerky protein decreased.

The results of the analysis of the variety of nike fish jerky showed that the addition of different concentrations of sweet potato flour had a significant effect on the fat content of the formulated jerky products. Based on the results of Duncan's continued test, it showed that the 3 concentrations of flour added to the jerky formula showed significantly different results.

The test results showed that the higher the concentration of flour added, the fat content contained in the jerky increased. Even though formula C (flour concentration of 40% flour) has a slightly lower fat content than formula B. In general, the fat content in the formulated jerky is higher when compared to the quality standards based on SNI for beef jerky, namely with a maximum standard of 3%.

The fat content of the nike jerky is higher than the quality requirements of jerky, presumably because the drying process carried out on the jerky causes an increase in the fat content of the product, this is because

the drying process causes the water content in the product to decrease which causes the fat content in the jerky to increase. This is in accordance with the statement of Maisyaroh *et al.*^[4] that during the drying process, foodstuffs lose water content which causes an increase in nutrient levels in the lagging period. The amount of protein, fat, and carbohydrates that are present in dry food ingredients is greater than in fresh food. Zuhra *et al.*^[25] (2012) added that the increase in fat content with temperature and drying time is due to a decrease in water content so that there is an increase in the fat content in the product.

(4).Ash content: The test results for the ash content of the jerky products were in the range of values from 1.55% to 1.756% (**Table 3**). The test results showed that the higher the concentration of flour added, the value of jerky ash decreased.

The analysis of variance showed that the addition of sweet potato flour with different concentrations had a significant effect on the ash content of the nike jerky formula (*yilepao*). The results of Duncan's continued test showed that the ash content of formula A (20% sweet potato) was not significantly different from the ash content in formula C, but the two formulas were significantly different from the ash content of formula B.

The test results showed that the ash content in the jerky formula A was higher than the ash content in Formulas B and C. In general, the ash content in nike jerky was higher when compared to the standard quality of ash content in jerky, namely a maximum of 0.5%. however, the ash content required in SNI is the ash content that is not acid soluble. In this study, the measured ash content was the total ash content in the jerky samples.

Acid insoluble ash content indicates the presence of mineral residue contamination that is insoluble in acid. A high ash content value indicates the presence of impurities or minerals that cannot dissolve in acid. The high value of ash content in jerky products is thought to be due to the mineral content in jerky products. This is because the nike fish used in jerky products is whole nike fish, which means that all parts of the nike fish including bones are also used up. Based on the results of Yusuf's^[5] research, important mineral content contained in nike fish include calcium 677.34 ppm, magnesium 211.58 ppm, iron 15.77 ppm, zinc 17.88 ppm, iodine 0.079 ppm.

(5).Carbohydrate levels: Kadar carbohydrates in Nike fish jerky are produced from reducing the amount of water, protein, fat and ash content. The carbohydrate content of the nike fish jerky products is in the range of 14.20-17.02% (**Table 3**). Based on the results of the variance test, it shows that the different concentrations of sweet potato flour in the jerky formula have a significant effect on the carbohydrate content of the product. Based on the results of Duncan's continued test, it showed that formula B (30% flour) was not significantly different from formula C (40% flour), but the two formulas were significantly different from formula A (**Table 3**). The carbohydrate content in the jerky made from the main ingredient of nike fish is due to the addition of sweet potato flour to the jerky formula. Sweet potato flour is a food ingredient that is a source of carbohydrates. This is in accordance with research conducted by Maisyaroh *et al.*^[4] on tilapia jerky. The results of this study indicate that the addition of sugar concentration in the jerky product increases the carbohydrate content of the product.

(6).Microbiological Value (TPC): The microbiological value measured in this study was the total bakteri value (TPC) contained in the Nike fish jerky formula. Based on the test results, the total value of bacteria in jerky was 3.76 cfu / g - 5.27 cfu / g (**Table 3**).

Based on the analysis of variety, it shows that the use of different concentrations of sweet potato flour in the jerky formula has a significant effect on the TPC value of jerky. Based on Duncan's continued test, it shows that formula A (20% flour), the TPC value was not significantly different from the addition of

formula B sweet potato flour (30% sweet potato flour) but significantly different from Formula C (40% sweet potato flour). The TPC value in formula B is not different from the TPC value in formula C.

The difference in TPC values in the jerky formula is closely related to the water content in the jerky samples. The high water content in jerky can increase the TPC value of these products. Eko and Ibrahim^[27] stated that the increase in the number of bacteria in the product was due to the water content in the product. The high moisture content of the product tends to increase the bacterial value of the product. The TPC value in 3 jerky formulas still meet the quality standard of jerky based on SNI 2908;^[22] 2013, which is 1×10^5 colony / g^[20]

CONCLUSION

Based on the research result of nike fish jerky using sweet potato flour as a binder and filler it can be concluded that; The organoleptic and chemical characteristics of the nike fish jerky formula that have the best quality value are those that use 30% sweet potato flour with the following characteristics; a) organoleptically has a rather neat appearance, brown to yellowish brown, slightly cracked solid texture, aroma of fish and strong spices, criteria for good taste, fish taste and strong seasoning, sweet potato tasteless; b) the chemical characteristics are as follows: water content of 47.35%; protein content 22.96%; fat content 6.56%; ash content of 1.55% and carbohydrate content of 14.70%. Total Bacteria Value 4.41 CFU / g.

SUGGESTION

Based on the research results, it is suggested to be able to assess the packaging technique and the rate of change of the best beef jerky formula during packaging and storage.

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