ORGANOLEPTIC CHARACTERISTICS AND NUTRITIONAL VALUES OF MAIZE PRODUCTS (*ZEA MAYS L.*) PRODUCED IN INTERCROPPED MAIZE AND PEANUT APPLIED BY BOKASHI PLUS FERTILIZER IN ULTISOLS

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ABSTRACT

This study was aiming at determining the organoleptic characteristics and nutritional values of maize products produced in intercropping maize and peanut treated by bokashi plus fertilizer in Ultisols. The yields of fresh young maize with the addition of palm sugar were processed to make maize products as called Katumbu-a traditional food of Muna regency. This research was conducted in Food Technology Laboratory of Agricultural Faculty and Agrotechnology Laboratory of Agronomy Unit of Agriculture Faculty of Halu Oleo University, held from May to July 2020. This research was conducted by using randomized completely design (RCD) of a single factor with the addition of palm sugar to provide a maize paste, consisting four levels, namely without the addition palm sugar (G0), the addition of palm sugar 15% (G1), the addition of palm sugar 30% (G2), the addition of palm sugar 45% (G3). Each treatment was repeated four times, so that there were 16 experimental units in all. Variables observed for the organoleptic characeristics of katumbu maize products preferred by panelists were included taste, aroma, color and texture using scoring system of very like (5) to very dislike (1) and the analysis of nutritional values using standardized proximte analysis included carbohydrates, fat levels, protein levels, ash content and crude fiber content. All data collected were analyzed using analysis of variances (ANOVA) and if significant different, followed by Duncan's Multiple Range Test (DMRT) at 95 % confidence level ($\alpha = 0.05$). The results of research showed that the organoleptic evaluation on the addition of palm sugar was significant different on all variables tested especially for color 4,20 (like), aroma 3,76 (like), taste 4,45 (very like), and texture 3,92 (like) and the nutritional values of best katumbu maize products were obtained at the addition of 30% palm sugar with moisture content 16.67%, protein content 20.18%, fat content 29.23%, carbohydrate 50.21%, ash content 2,59% and crude fiber content 7.12%. It was recommended that in order to get the best quality of Katumbu maize products in terms of organoleptic properties and nutritional values, the addition of 30 % palm sugar was better and healthy for human daily consumption. This indicated that the use of palm sugar added in the making of maize paste to produce katumbu might increase the economical values of palm sugar and solve the social problems of the community.

Key words: bokashi plus fertilizer, intercropping, maize, nutritional value, organoleptic

INTRODUCTION

Ultisol is a marginal soil dominantly found in Southeast Sulawesi. However, it has been intensively cultivated for agricultural lands, lately. The soil was reported to have low aggregate stability due to high clay and low soil organic matter (SOM) (Pasolon, 1998; Yulnafatmawita, *et al*., 2013). Soil nutrient deficiency lead to low agriculltural crops production and new strategy is needed to improve soil fertility. Many approaches have been introduced to solve these problems on the efforts to improve agricultural production, but the results of each strategy have not yet been achieved. The high acidity and relatively low quantities of plant-available Ca, Mg and K associated with most Ultisols make them poorly suited for continuous agriculture without the use of fertilizer and lime. With these inputs, however, Ultisols can be very productive as long as the application of organic fertilizer is adequate. They occupy approximately 8.1 percent of the global ice-free land area and support 18 percent of the world's population. The main issue faced by the farmers in tropical countries is not only the low quantity of agricultural crops production per unit area

but also the low quality of food crops. An alternative in using bokashi plus fertilizer is one of most appropriate solution to increase nutrient availability to the soil, and may effect on the increase growth and yields of such agricultural crops as maize, peanut and soybean, as reported by Karimuna, *et al*., (2019) and the arrangement of plants cultivated through intercropping system as well as the use organic fertilizer was one of the appropriate strategies to maintain physical, chemical and biological soil conditions.

The farmers of Muna regions have practiced intercropping pattern to use effectively space, energy and time, and may improve agricultural production sustainably. Intercropping system can be defined as a sort of cropping pattern that may grow and produce more than one crop in one time and place. This pattern has been experienced for along time by the farmers. Formerly, maize and peanut are commonly cultivated in mixed cropping pattern without crop space arrangement. Therefore, the productivity of crops has not yet been satisfied. Proper space arrangement of annual crops may sustainably use natural resources provided in terms of nutrient, space and time which may lead to the prevention of soil erosion in one aspect and the contribution the success of sustainable growth and production agricultural system. The provision of organic fertilizer derived from natural secondary vegetation has been studied to increase soil fertility and agriculture production (Karimuna, 2000), and maintain the environmental stability in various agricultural landscapes.

The use of organic fertilizer on adaptation testing of various local peanut planted in intercropping with maize for the first year 2019 was reported by Karimuna, *et al*, (2019), revealed that the application of bokashi plus fertilizer 18 t ha^{-1} might doubled increase maize, peanut and soybean yields in intercropping system and improve the quality of grain. When a plant from annual crops grows well without disturbances, then it will produce a beter quality of grain. In similar case, a plant that is cultivated in two or three crops in one time and space, they will compete each other to absorb nutrients and water. This will affect the yields, and turn into affect on the organoleptics and nutritional values of crops grain. *Katumbu* maize product has been known to the Muna local community as a staple food and mainly has specific taste and aroma preferred by the people. Organoleptic tests are generally used to examine a product, process control during processing, and as a method of observation and measurement of quality properties in a study (Hidayat *et al*., 2008). Sort of maize product in this study was *katumbu*, a delicious traditional food made of young maize originated from the community of Muna regency. *Katumbu* maize products are commonly processed as usual without other food additives and the products have normal taste and aroma which lead to few consumen preferred. A new creative offerred in this approach was the addition of palm sugar to increase the degree of panelists acceptance and improve nutrition of *katumbu* maize products. In order to obtain suitable food products preferred by consumen, proper formulation of food additives is necessary. For maize products, Gusnawati (2019) revealed that the addition of palm sugar with different quantity might affect the preference of the panelists and nutritional values of the *katumbu* maize product quality including carbohydrate, fat, protein, ash content and crude fiber content. Maize kernels used in this study was young maize harvested in the field This

The quality of maize products was differed young maize and mature one. To determine the quality of corn seed in mature maize products, 100 g of maize dry weight, the nutritional values of crops might be varied. Suwardjono (2004) stated that maize grain of 100 g dry weight, the nutritional values were determined of amylum (73.4%), protein (9,1%), lipid (4.4%), ash (1.4%) and crude fiber (9.5%) as reported by Watson (2003). The addition of palm sugar gave significant effect on the hedonic properties and nutirional values of sweetener *katumbu*, but how the addition of various palm sugar concentration affect organoleptics and nutritional values of *katumbu* maize products produced specifically in intercropping system of maize and peanut treated by bokashi plus fertilizer in Ultisols has been unknown. The main purpose of this paper was to determine the effects of palm sugar addition on the organoleptic characteristics and nutritional values of *katumbu* maize products produced in intercropped maize and peanut treated by bokashi plus fertiizer in Ultisols of Lamaeo, Kontumere and Kasaka villages, Muna regency.

MATERIALS AND METHODOLOGY

Place and Time

This research was conducted in Lamaeo, Kontumere and Kasaka villages, Kabawo District, Muna Regency about 4,5 hours from Kendari city to reach those locations by public transportation using bus and ferry. Six demonstration plots were set up in the farmers of three villages with various topographical conditions. Maize was planted intercropped with peanut and the yields of young maize were harvested to collect young maize kernels, then *Katumbu* with various palm sugar addition was produced. The organoleptic characteristics and nutritional values of *katumbu* maize products were analyzed in Food Science and Technology Laboratory, Faculty of Agriculture, University of Halu Oleo, Kendari, Southeast Sulawesi Province, Indonesia. The nutritional values analyses of maize products-called *katumbu* were confirmed at Biotrop Service Laboratory, Bogor. This research was held from December 2019 to June 2020.

Materials and Equipment

Materials used in the field of research were maize products of *katumbu* produced in intercropped local maize and peanut ecotype, materials for making katumbu products (young maize kernels 2 kg, palm sugar, garlic gloves 10 seeds, salt and 2 teaspoon of sugar), bokashi plus fertilizer, paper, labels, pouches of plastic, newsprint and chemicals for proximate analyses, while equipment used in this research were analytic scales, meter, water pump, watering tools, ropes, plastic pouches, scissors, digital camera, stationery writing, electric oven, and for cooking tools covering baking sheet, basin, hand mill, spoon, furnace, electric gas, electric cooker and pan.

Methods

Young maize products were harvested from six demonstration plots at the three villages of Lamaeo (LMO1 and LMO2), Kontumere (KTR1 and KTR2) and Kasaka (KSK1 and KSK2) as the experimental design. Maize and peanut were intercropped with crop spacement for maize 120 m x 50 cm, and three lines of peanut crop spacement of 30 cm x 40 cm planted between the rows of maize were used in all plots. The yield of young maize from each plot was harvested, labelled separately and put into big sack. From each labelled sack, young maize was directly peeled corn husks, then young maize kernels was separated from corn cob. All young maize kernels were hand milled to produce a maize paste and collected into baking sheet. The addition of palm sugar into baking sheet was differred depending on the treatment for making *katumbu* maize products. Then mixture of maize paste was wrapped up using corn husk and all wrapped maize paste were carefully arranged into the pan, then steamed for 45 minutes and finally cooked *katumbu* maize products was ready to be served for human consumption.

This research was conducted by using randomized completely design (RCD) of a single factor with the addition of palm sugar to provide a maize paste, consisting four levels, namely without the additon palm sugar (G0), the addition of palm sugar 15% (G1), the addition of palm sugar 30% (G2), the addition of palm sugar 45% (G3). Each treatment was repeated four times, so that there were 16 experimental units in all. Variables observed for the organoleptic characteristics of *katumbu* maize products preferred by panelists were included color, texture, aroma, and flavor using scoring system of 1 (very dislike), 2 (dislike), 3 (rather like), 4 (like) and 5 (very like) using 30 trained panelists by filling hedonic format provided, and the analysis of nutritional values using standardized proximte analysis included carbohydrate (by difference method as applied by Andarwulan *et al*., (2011), lipids (AOAC 2005), protein (biuret methods AOAC 1990), ash (AOAC 2005) and crude fiber (as applied by Sudarmadji, 2007) contents were determined using appropriate laboratory methods at the Laboratory of Food Science and Technology, Faculty of Agriculture, University of Halu Oleo. The results of nutritional values of *katumbu* maize products were confirmed in the Laboratory services of Biotrop Bogor. All data collected were analyzed using analysis of variances (ANOVA) and if significant different, followed by Duncan's Multiple Range Test (DMRT) at 95 % confidence level.

RESULTS AND DISCUSSION

Results

a. Organoleptics Properties of *Katumbu* maize Products

Organoleptic test was determined using 30 trained panelists preference on the taste, aroma, color and texture of *Katumbu* maize products using scoring system of hedonic test from 1 very dislike to 5 very like. *Katumbu* maize products were processed using the addition various levels of palm sugar where maize produced from the application of various doses bokashi plus fertilizer in Ultisols, conducted in three villages of Lamaeo, Kontumere and Kasaka. The average hedonic score of organoleptic test on taste, aroma, color and texture of *Katumbu* maize products was figured out in Table 1.

Table 1 showed that the highest score of hedonic for taste in Lamaeo1 and Lamaeo2 was 4,87 (very like) and 4,79 (very like), respectively, recorded in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), bu not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3). In Kontumere1 and Kontumere2, the highest score of hedonic for taste was 4,61 (very like) and 4,76 (very like), respectively, obtained in the treatment of 30% palm sugar addition (G2) but not significant different compared with 0% palm sugar addition (G0), 15% palm sugar addition (G1) and 45% palm sugar addition (G3). While in Kasaka1 and Kasaka2, the highest score of hedonic was 4,56 (very like) and 4,45 (like), respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1), but not significant different to 45% palm sugar addition (G3).

For aroma in Table 1, the highest score of hedonic in Lamaeo1 and Lamaeo2 was 4,69 (very like) and 4,76 (very like), respectively, recorded in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1) but not significant different compared with 45% palm sugar addition (G3), while others were not significant. In Kontumere1 and Kontumere2, the highest score of hedonic test was 4,77 (very like) and 4,53 (very like), respectively, obtained in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), 15% palm sugar addition (G1), but not significant different to 45% palm sugar addition (G3). While in Kasaka1 and Kasaka2, the highest score of hedonic aroma was 4,50 (very like) and 4,62 (very like), respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1), but not significant different to 45% palm sugar addition (G3), while others were not significant.

Table 1. Effects of palm sugar addition on the average hedonic score of organoleptic test on taste, aroma, color and texture of *Katumbu* maize products in Lamaeo, Kontumere and Kasaka villages, Kabawo district, Muna regency

Treatment of palm sugar addition	Locations of Demonstration plot					
	LMO1	LMO2	KTR1	KTR2	KSK1	KSK2
			Taste			
0% palm sugar (G0)	4.35a	3.98a	4.27	3.97	3.95a	3.92a
15% palm sugar (G1)	4.34a	4.44ab	4.26	4.21	4.04ab	3.91ab
30% palm sugar (G2)	4.87b	4.79b	4.61	4.76	4.56c	4.45c
45% palm sugar (G3)	4.56ab	4.46ab	4.52	4.34	4.32bc	4.23bc
HSD 0.05	**0.42**	**0.66**	**ns**	**Ns**	**0.47**	**0.32**
			Aroma			
0% palm sugar (G0)	4.24	4.09a	3.98a	3.86	3.85a	3.76a
15% palm sugar (G1)	4.25	4.11ab	4.21ab	3.91	4.04ab	3.90a
30% palm sugar (G2)	4.69	4.74c	4.77c	4.53	4.50b	4.62b
45% palm sugar (G3)	4.56	4.43bc	4.52bc	4.31	4.22ab	4.24ab
HSD 0.05	**ns**	**0.32**	**0.44**	**ns**	**0.52**	**0.64**
			Color			
0% palm sugar (G0)	4.48	4.29	4.18a	4.16	4.08a	3.98a
15% palm sugar (G1)	4.42	4.32	4.32ab	4.14	4.22ab	4.12ab
30% palm sugar (G2)	4.62	4.67	4.85b	4.47	4.43b	4.50c
45% palm sugar (G3)	4.50	4.45	4.53ab	4.25	4.21ab	4.23bc
HSD 0.05	**ns**	**ns**	**0.57**	**ns**	**0.21**	**0.31**
			Texture			
0% palm sugar (G0)	4.06a	4.18a	4.15	3.98a	3.98	3.86a
15% palm sugar (G1)	4.44ab	4.32ab	4.32	4.12ab	4.02	4.10ab
30% palm sugar (G2)	4.82b	4.79b	4.73	4.65b	4.54	4.66c
45% palm sugar (G3)	4.62b	4.50ab	4.76	4.35ab	4.35	4.42bc
HSD 0.05	**0.51**	**0.56**	**ns**	**0.46**	**ns**	**0.40**

Notes: 1. LMO = Lamaeo, KTR = Kontumere, KSK = Kasaka
2.The figures in column followed by the difference letters were significant difference using Honestly Significant Difference (HSD) at 95 confidence level.

For color, the highest score of hedonic test in Lamaeo1 and Lamaeo2 was 4,62 (very like) and 4,67 (very like), respectively, recorded in the treatment of 30% palm sugar addition (G2) but not significant different compared with 0% palm sugar addition (G0), 15% palm sugar addition (G1) and 45% palm sugar addition (G3). In Kontumere1 and Kontumere2, the highest score of hedonic test was 4,85 (very like) and 4,47 (like), respectively, obtained in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different compared with 15% (G1) and 45% palm sugar addition (G3), while others were not significant. While in Kasaka1 and Kasaka2, the highest score of hedonic aroma was 4,43 (like) and 4,50 (very like), respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different to 15% palm sugar addition (G1) and 45% palm sugar addition (G3) as shown (Table 1).

For texture in Tabel 1, the highest score of hedonic test in Lamaeo1 and Lamaeo2 was 4,82 (very like) and 4,79 (very like), respectively, recorded in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3). In Kontumere1 and Kontumere2, the highest score of hedonic test was 4,73 (very like) and 4,65 (very like), respectively, obtained in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant. While in Kasaka1 and Kasaka2, the highest score of hedonic texture was 4,54 (very like) and 4,66 (very like), respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different to 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant.

b. Nutritional Values of *Katumbu* Maize Products

Young maize kernels were selectively processed to create new products that can have added-values. Maize kernels were peeled from corn husk and hand milled to form maize paste. Then palm sugar was added to the maize paste in order to increase the degree of consumen acceptance and improve nutritional values of maize products. Representative sample was carefully taken in order to determine the nutritional values for carbohydrate, protein, fat, ash and crude fiber contents. The results of nutritional value analyses of *Katumbu* maize products were figured out in Table 2, 3, 4, 5 and Table 6.

Table 2. The average nutritional values of carbohydrate content (%) of *Katumbu* maize products in Lamaeo, Kontumere and Kasaka villages, Kabawo district

Treatment of palm sugar addition	Locations of Demonstration plot (%)					
	LMO1	LMO2	KTR1	KTR2	KSK1	KSK2
0% palm sugar (G0)	62.41	63.25a	65.35a	66.24a	65.34a	68.54
15% palm sugar (G1)	64.55	68.46ab	67.02b	69.46ab	68.56ab	70.36
30% palm sugar (G2)	69.80	71.67b	70.34c	72.43b	74.33c	73.26
45% palm sugar (G3)	67.72	68.83ab	69.69c	70.17ab	71.68bc	71.80
HSD 0.05	**ns**	**7.05**	**2.18**	**5.25**	**3.68**	**ns**

Note: The figures in column followed by the difference letters were significant difference using Honestly Significant Difference (HSD) at 95 confidence level. Ns = non-significant different

Table 2 showed that the highest carbohydrate content in Lamaeo1 and Lamaeo2 was 69,80% and 71,67%, respectively, recorded in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), bu not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant. In Kontumere1 and Kontumere2, the highest carbohydrate content was 70,34% and 70,34%, respectively, obtained in the treatment of 30% palm sugar addition (G2) but not significant different compared with 0% palm sugar addition (G0), 15% palm sugar addition (G1) and 45% palm sugar addition (G3). While in Kasaka1 and Kasaka2, the highest carbohydrate content was 74,33% and 73,26%, respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1), but not significant different to 45% palm sugar addition (G3), while others were not significant.

Table 3. The average nutritional values of protein content (%) of *Katumbu* maize products in Lamaeo, Kontumere and Kasaka villages, Kabawo district

Treatment of palm sugar addition	Locations of Demonstration plot (%)					
	LMO1	LMO2	KTR1	KTR2	KSK1	KSK2
0% palm sugar (G0)	6.54a	6.87a	7.12a	6.82	6.54a	6.88a
15% palm sugar (G1)	7.66ab	7.74ab	7.76ab	7.07	6.76ab	6.85a
30% palm sugar (G2)	8.92b	9.06b	9.27b	7.66	7.23b	7.34b
45% palm sugar (G3)	8.28ab	8.55b	8.63ab	7.24	7.25b	7.08a
HSD 0.05	**2.02**	**1.42**	**0,95**	**ns**	**0.56**	**0.33**

Note: The figures in column followed by difference letters were significant different using Honestly Significant Difference (HSD) at 95 confidence level. Ns = non-significant different

Table 3 showed that the highest protein content in Lamaeo1 and Lamaeo2 was 8,92% and 9,06%, respectively, recorded in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), bu not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant. In Kontumere1 and Kontumere2, the highest protein content was 9,27% and 7,66%, respectively, obtained in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3). While in Kasaka1 and Kasaka2, the highest protein content was 7,23% and 7,34%, respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1), but not significant different to 45% palm sugar addition (G3).

Table 4. The average nutritional values of fat content (%) of *Katumbu* maize products in Lamaeo, Kontumere and Kasaka villages, Kabawo district

Treatment of palm sugar addition	Locations of Demonstration plot (%)					
	LMO1	LMO2	KTR1	KTR2	KSK1	KSK2
0% palm sugar (G0)	3.05a	2.92a	3.68	2.82a	3.06a	3.86
15% palm sugar (G1)	3.82a	3.67ab	3.63	3.45ab	3.63ab	3.82
30% palm sugar (G2)	4.54b	4.48b	4.55	4.42b	4.35b	4.34
45% palm sugar (G3)	4.57b	4.15ab	4.09	4.08b	4.14ab	4.07
HSD 0.05	**1.24**	**1.23**	**ns**	**1.22**	**0,98**	**ns**

Note: The figures in column followed by the difference letters were significant difference using Honestly Significant Difference (HSD) at 95 confidence level. Ns = non-significant different

Table 4 showed that the highest fat content in Lamaeo1 and Lamaeo2 was 4,57% and 4,48%, respectively, recorded in the treatment of 45% palm sugar addition (G3) for LMO1 and at the treatment of 30% palm sugar addition (G2) for LMO2, significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1) for LMO1, bu not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3). In Kontumere1 and Kontumere2, the highest fat content was 4,55% and 4,42%, respectively, obtained in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant different. While in Kasaka1 and Kasaka2, the highest fat content was 4,35% and

4,34%, respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant different.

Table 5. The average nutritional values of ash content (%) of *Katumbu* maize products in Lamaeo, Kontumere and Kasaka villages, Kabawo district

Treatment of palm sugar addition	Locations of Demonstration plot (%)					
	LMO1	LMO2	KTR1	KTR2	KSK1	KSK2
0% palm sugar (G0)	1.24a	1.36	1.28a	0.94a	1.05	0.96a
15% palm sugar (G1)	1.36ab	1.32	1.24ab	1.02ab	1.12	1.08ab
30% palm sugar (G2)	1.56c	1.42	1.51b	1.41c	1.32	1.33b
45% palm sugar (G3)	1.42bc	1.46	1.43ab	1.25bc	1.38	1.22ab
HSD 0.05	**0.17**	**ns**	**0.24**	**0.24**	**ns**	**0.31**

Note: The figures in column followed by the difference letters were significant difference using Honestly Significant Difference (HSD) at 95 confidence level. Ns = non-significant different

Table 5 showed that the highest ash content in Lamaeo1 and Lamaeo2 was 1,56% and 1,46%, respectively, recorded in the treatment of 30% palm sugar addition (G2) for LMO1 significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1), but not significant different compared with 45% palm sugar addition (G3), while others were not significant. In Kontumere1 and Kontumere2, the highest ash content was 1,51% and 1,41%, respectively, obtained in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3). While in Kasaka1 and Kasaka2, the highest ash content was 1,38% and 1,22%, respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), but not significant different to 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant different.

Table 6 showed that the highest crude fiber content in Lamaeo1 and Lamaeo2 was 9,41% and 9,58%, respectively, recorded in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), bu not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant. In Kontumere1 and Kontumere2, the highest crude fiber content was 9,45% and 9,24%, respectively, obtained in the treatment of 45% palm sugar addition (G3) for KTR1 significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1), but not significant different compared with 45% palm sugar addition (G3), while for KTR2 significant different compared with 0% palm sugar addition (G0) and 15% palm sugar addition (G1). While in Kasaka1 and Kasaka2, the highest crude fiber content was 9,07% and 9,46%, respectively identified in the treatment of 30% palm sugar addition (G2) significant different compared with 0% palm sugar addition (G0), not significant different compared with 15% palm sugar addition (G1) and 45% palm sugar addition (G3), while others were not significant different.

Table 6. The average nutritional values of crude fiber content (%) of *Katumbu* maize products in Lamaeo, Kontumere and Kasaka villages, Kabawo district

Treatment of palm sugar addition	Locations of Demonstration plot (%)					
	LMO1	LMO2	KTR1	KTR2	KSK1	KSK2
0% palm sugar (G0)	8.94	8.55a	8.46a	8.58a	8.46a	8.39
15% palm sugar (G1)	8.92	8.83b	8.73a	8.79ab	8.67ab	8.32
30% palm sugar (G2)	9.41	9.58c	9.44b	9.24c	9.07b	9.46
45% palm sugar (G3)	9.15	9.24c	9.45b	9.05bc	8.83ab	9.14
HSD 0.05	**ns**	**0.23**	**0.45**	**0.34**	**0.42**	**Ns**

Note: The figures in column followed by the difference letters were significant difference using Honestly Significant Difference (HSD) at 95 confidence level. Ns = non-significant different

Discussion

The effects of palm sugar addition on *katumbu* maize products preferred by the panelists on the organoleptic characteristics of taste, aroma, color and texture were highly significant different, as shown in Table 1. Interestingly was that *katumbu* maize products without the addition of palm sugar (G0) for all organoleptic properties were lower compared to the addition of palm sugar given into maize paste (Table 1), indicating the rejection of panelists towards *katumbu* maize products or very few panelists gave better hedonic score. The addition of palm sugar proved to increase the panelists preference on *katumbu* maize products from 15% to 30%. The increase quantity of palm sugar given to maize paste in order to make *katumbu* maize products, increased the degree of panelists acceptance of organoleptic values for taste, aroma, color and texture. However, further addition of palm sugar up to 45% (G3) decreased the degree of maize products acceptance in all organoleptic charactristics eventhough the taste of products became sweeter and reddish. This indicated that the addition of palm sugar in a certain quantity might improve the quality of products as long as the processing technology was intensively considered, so it would not destroy nutritional and functional values of products. This finding was relevant to previously reported by Khongsak, *et al*., 2019. He revealed that palm sugars have been widely used as a traditional sweetener for thousands of years in Asia. It is now gaining popularity globally because of its natural

source, minimal processing, and healthiness. One of the major health claims is its glycaemic index (GI). Palm sugars are normally marketed as low GI foods, though only a few published papers are evidenced.

In general, the addition of palm sugar into maize paste on *katumbu* processing technology up to 45% resulted in the increase nutritional values of carbohydrate, protein, fat, ash and crude fiber contents of the products compared with lower quantity of palm sugar addition (Table 2, Table 3, Table 4, Table 5 and Table 6). This was similar to the finding reported by Khongsak, *et al*., 2019 that traditional sweetener derived from palm sugars could present nutritionally significant quantities of minerals and vitamins, including antioxidant properties (Victor and Orsat, 2018). It has been reported that palm sugar (gula anau) exhibits the highest level of antioxidant activity compared to various types of cane sugars, having an antioxidant activity equivalent to 1.7 mg of vitamin C per 1 g of sugar (Sia, *et al*., 2019). Recent publications have highlighted that unrefined sugars, as parts of non-centrifugal cane sugars, have nutritionally and functionally significant quantities of minerals, vitamins, and phenolics, among other constituents, as well as antioxidant capacities (Jaffe, 2015). Chemical composition and nutritional values of 100 g maize seed were as follows: energy 129 calories, protein 4,1%, fat 1,3%, carbohydrate 30,3%, calsium 5%, phosphor 108,0% and water content 63,5% (Balitsereal Litbang Deptan.go.id/bjagung/tiganol.pdf) as reported by Fita, (2019). Corn husk is characterized by a high crude fiber content, namely 86.7%, consisting of hemicellulose (67%), cellulose (23%), and lignin (0.1%). On the other hand, endosperm is rich in starch (87.6%) and protein (8%), while the fat content is relatively low (0.8%). The germs are characterized by high levels of fat (33%), protein (18.4%), and minerals (10.5%). Based on these data, it can be determined whether the product to be processed requires whole corn kernels, or if the husk or germ has been removed (Suarni and Widowati, 2007). According to Munarso and Mudjisihono (1998), the chemical composition of maize varies between different varieties and for the same variety on different plants. Corn contains fat and protein whose amount depends on the age and variety of the corn.

The preference of panelists on the products depends on the processing food technology used and the additional of substances as flavoring, sweetener, scent giver or nutrient enhancer. In this research, Table 1 showed that the higher the addition of palm sugar given to maize paste for making *katumbu*, the higher the hedonic score of acceptance on the maize products. This finding was only caused by the increase quantity of palm sugar added to make maize paste, but also the high quality of young maize kernels produced due to adequate quantity of nutrient content since the soil media provide enough quantity of nutrient, water and other elements that might effect on better generative and generative components of plant crops, as explained by Karimuna, *et al*., 2019, and others. This finding was relevant to findings reported by Pasaribu, *et al*., (2014), Andila, *et al*., (2016), Rahayu, *et al*., (2006) and Ekowati and Nasir, 2011), as described that the proper intercropping system of maize and peanut in Ultisols might maintain the stable production of annual crops planted. The high quality of maize seed produced was caused by sufficient and adequate nutrient content available in the soil. This might affect the better nutritional values of *Katumbu* maize products and the degree of acceptance such as taste, aroma, texture, color and nutritional values. The texture of the organic corn *Katumbu* is also much influenced by the composition of the ingredients, the heating process and the ingredients that form the organic corn *Katumbu* dough. Dewi *et al*., (2013) said that the texture of food is very much determined by the water content, fat content, and the amount of water as well as the types of carbohydrates and ingredients in their constituents.

Table 2, Table 3, Table 4, Table 5 and Table 6 showed that the increase quantity of palm sugar given to make *katumbu* maize products up to 30% proved to increase the panelists acceptance degree of maize products on taste, aroma, color and texture with averages categoried from like to very like, but further addition of palm sugar up to 45%, the degree of panelists acceptance was decreased. This was caused by not only the increase palm sugar content but also the quality of maize kernels produced as positive effects of increase doses of bokashi plus fertilizer applied that might contribute to additional mineral content to the soil. Moreover, the higher the doses of bokashi plus apllied to the soil, the increase the quality of grain produced. The appropriate biotechnology bokashi plus fertilizer in marginal soil in order to achieve high efficiency and effectiveness through the utilization of natural resources especially secondary vegetation in the study region was compulsory, as reported by Karimuna, *et al*., 2019. This finding was also relevant to the results of research stated by (Karimuna *et al*., 2009; Kasno *et al*., 2006; Nursyamsi, 2004; Karimuna, 2000; Pasolon, 1998). However, it was through the management and cultivation of good ways, dry land have the potential of very marginal potential for regional development of peanuts and other crops (Fachruddin, 2000; Sopandie, 2006; Karimuna *et al*., 2001), where the application of appropriate technology by using bokashi plus can increase the potential for fertility of land on marginal land, so that the potential productivity of crops planted in demonstration plot might be achieved.

The results of organoleptic and nutritional values of *katumbu* maize products were generally lower compared to the previously findings reported. However, the results of this research played an important role on the guarantee of high yield and quality of maize. Higher nutritional values on carbihydrate, protein and ash were assumed by the proper food processing technology and better quality of maize kernels. Astawan's research (2009) stated that the nutritional content per 100 g consists of fat content of 1.3 g, protein 4.7 g, water 60 g. So that it can increase the fat content of corn katumbu. This is consistent with the statement of Fellow (2000) that the increase in fat content is largely determined by the water content and protein content of food. Furthermore, Winarno (2004) states that, there are several factors that can affect taste, including chemical compounds, temperature, concentration and interactions of other taste components. The odor produced from food determines the delicacy of these foodstuffs (Rampengan et al., 2012). Carbohydrates are compounds formed from carbon, hydrogen and oxygen molecules. As a type of nutrient, the main function of carbohydrates is to produce energy in the body. Every 1 g of carbohydrates consumed will produce 4 kcal of energy and the energy from the oxidation (burning) process of these carbohydrates will then be used by the body to carry out various functions such as breathing, heart and muscle contraction and also to carry out various physical activities such as exercising or work (Irawan,2007). Dian et al (2015) stated that the decrease in fat levels after boiling is due to the nature of the fat that cannot withstand heat during the cooking process, the fat melts and even evaporates (volatile) into other components such as flafors. Based on the research of Suparti et al (2007) Nutritional content per 100 g, consists of carbohydrate content 95 g, water content 4 g, calcium content 75 mg, iron 3 mg. So that it can increase levels of carbohydrate corn *katumbu*. However, it should be noted that improper processing will affect the crude fiber content because about 20-50 cellulose and 50-80% lignin, and 80-85%

hemicellulose are lost during wrong processing. The results of research clarified that the addition of palm sugar gave a significant and better effect on the organoleptic and nutritional values of *katumbu* maize products, but need further study and evidence on the direct relationship between the good quality of *katumbu* maize products affected by application of bokashi plus fertilizer in intercropping system. The results of research proved the increasing trend of panelists acceptance on the addition of palm sugar up to 30% in the making of *Katumbu* maize products, indicating the high potential of using palm sugar as food additives naturally that has no adverse effect on health, rather than the use of palm water-called *nira* as a source of alcoholic beverages that might have social problems to the community.

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CONCLUSION AND RECOMMENDATION

The results and discussion of research described above conducted in three villages (Lamaeo, Kontumere and Kasaka), Kabawo district, it could be concluded that as follows

1. There was a positive effect of palm sugar addition on the organoleptic characteristics of *katumbu* maize products produced in intercropping maize and peanut, treated by bokashi plus fertilizer in Ultisols. The higher the addition of palm sugar consentration up to 30%, the higher the organoleptic values obtained, indicating the increase of panelists preference on *katumbu* maize products.
2. Nutritional values of *katumbu* maize products were affected by the addition of palm sugar due to high nutritional and functional contents of palm sugar. The addition of 30% palm sugar on *katumbu* maize products was the highest values for most of nutritional properties recorded.
3. The application of bokashi plus fertilizer treatment consistency gave the best response on the organoleptic characteristics and nutritional values of *katumbu* maize products intercropped maize and peanut planted in Ultisols.
4. The organoleptic evaluation on the addition of palm sugar was significant different on all variables tested especially for color 4,20 (like), aroma 3,76 (like), taste 4,45 (very like), and texture 3,92 (like) and the nutritional values of best *katumbu* maize products were obtained at the addition of 30% palm sugar with moisture content 16.67%, protein content 20.18%, fat content 29.23%, carbohydrate 50.21%, ash content 2,59% and crude fiber content 7.12%.
5. It was recommended that in order to achieve the best organoleptic and nutritional values, the addition of 30% palm sugar was used for *katumbu* maize products produced intercropped maize and peanut treated by bokashi plus fertilizer. The use of palm sugar on the making of *Katumbe* maize products might reduce the social problems due to alcoholic beverages of the community.

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