Effects of maize flour substitution on the organoleptic characteristics and nutritional values of fried peanut products (*Arachys hypogaea* L.) applied by bokashi plus fertilizer in improved agroforestry system in Napabalano District, Muna Regency

I Karimuna¹, Halim², A Ansi³, W E Marfi³, N Asyik⁴, and L Hasanuddin⁵

¹ Agrotechnology Department, Faculty of Agriculture, University of Halu Oleo Kendari, Southeast Sulawesi, Indonesia, and the Dean at the Faculty of Agriculture, Lakidende University, Unaaha
² Agrotechnology Department, Faculty of Agriculture, University of Halu Oleo Kendari, Southeast Sulawesi, Indonesia
³ Forestry Department of Wuna Agriculture High Education (STIP-Wuna), Muna Regency, Southeast Sulawesi, Indonesia
⁴ Food Sciences and Tecnology Department, Faculty of Agriculture, University of Halu Oleo Kendari, Southeast Sulawesi, Indonesia
⁵ Government Official for Food Crops, Horticulture and Plantation, Muna Regency, South East Sulawesi, Indonesia

*E-mail: lkarimuna@hotmail.com*

**Abstract.** The objective of this paper was to analyze the effects of maize flour substitution on the organoleptic characteristics and nutritional values of fried peanut products in improved agroforestry system through the use of bokashi plus fertilizer in intercropping maize and peanut. The research was arranged using randomized completely block design (RCBD) with one single factor of maize flour substitution (M), consisting of four levels: 0% (M0), 10% (M1), 20% (M2) and 30% (M3). Data on organoleptic and nutritional values of peanut products were recorded and analyzed using analyses of variances with 95 percent confidence level. The organoleptic of taste, aroma, texture, color of fried peanut products were tested covering carbohydrate, lipids, protein, ash and water contents were determined using standardized proximate analyzes. The results of research showed that the substitution of maize flour gave a significant effect on the organoleptic characteristics of fried peanut products for taste, aroma, texture, and color. The nutritional values for carbohydrate, lipids, protein, ash and crude fiber contents were commonly significant different at various doses of maize flour substitution. It was concluded that the substitution of maize flour might result in maintaining a better nutritional values of fried peanut products on 20% maize flour substitution.

1. Introduction

Peanut is one of the most important annual crops cultivated in agricultural landscapes which are commonly found in tropical countries. Peanut can be planted both in monoculture and in intercropping
pattern with maize and other crops which may produce sufficient yield of crop [1]. Nowadays, the development of cropping system has been achieved. As reported by [2] revealed that the integration of cultivation among annual and perennial crops was commonly practiced by the farmers for long time and developed significantly in a proper way to meet the improvement of agriculture production. This program has been successful in North Buton regency, indicated to the better growth and yields of those crops at the early growth of teak trees in West Kulisusu district in 2017. Sustainable Creative Agroforestry was set up to search the ecosystem function under the financial support from the Ministry of Research, Technology and Higher Education, Republic of Indonesia, held from 2019 to 2021.

Napabalano District was selected where abundant natural resources were found and farmers are being practiced agroforestry system by planting annual crops integrated with forestry crops with low productivity and quality of grain crops. Data released from Statistic Central Bureau in 2018 [3], the productivity of peanut in SE Sulawesi Province declined in 2017 compared to 2016. The decreasing crop productivity was caused by more directed to marginal land, low cultivation techniques and using low quality seeds. The improvement of soil fertility using bokashi plus fertilizer, proper arrangement of crops and introduction of superior local varieties were highly recommended to solve the problems of soil nutrient deficiency and to assure the better quality of grain as reported by [4] and [5].

The cultivation of intercropped maize and peanut under early growth of teak trees is interested to be studied in the arrangement of annual crops between the rows early growth of teak trees may sustainably use natural resources provided in terms of nutrient, space and time in the development of simile forest ecosystem which lead to the prevention of soil erosion in one aspect [6], [7] and the contribution the success of sustainable growth and production agroforestry system. Therefore, it is needed to have a new strategy on sustainable creative agroforestry system to achieve sustainable biological diversity [8] and to maintain the productivity of agricultural crops. The provision of organic fertilizer derived from natural secondary vegetation had been studied to increase soil fertility as reported by Karimuna [9], and the application of secondary vegetation as mulch [10]. The use of organic fertilizer in North Buton Regency to improve agricultural production has been predominantly proclaimed as priority program of the government [11].

Best practices of a better agroforestry system in North Buton regency was introduced to the farmers in Napabalano district under improved agroforestry approach called sustainable creative agroforestry through the integration of planting annual crops such as maize, peanut and soybean in intercropping system as well as the application of bokashi plus fertilizer. When a plant from annual crops grows well without disturbances, then it will produce a better 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. The yield of maize and peanut was used to evaluate the degree of panelists acceptance and nutritional values of products. Maize is processed to make maize flour and maize flour is used to substitute wheat flour in the making of fried peanut products-called “kacang telor” preferred by the panelists. There are 36.067 various based peanut products found in the community. The substitution of maize flour from wheat flour may affect the organoleptic characteristics and nutritional values of products. Organoleptic tests were used to examine a product, process control during processing, and as a method of observation and measurement of quality properties in a study [12]. The product quality includes carbohydrate, fat, protein, ash and crude fiber contents.

The nutritional values of 100 g dry weight of grain might be varied depending on crops. Peanut protein content was 25% - 30%, 40% - 50% fat, 12% carbohydrate, and vitamin B1, while for maize grain of 100 g dry weight, the nutritional values were determined by amyllum (73.4%), protein (9.1%), lipid (4.4%), ash (1.4%) and fiber (9.5%) as reported by [13]. Ideally, there is a consistency fact that the use of increase doses of organic fertilizer in a certain quantity will improve the crops production that may also lead to a better quality of grain [14] and [15]. However, how the substitution of maize flour affect organoleptics and nutritional values of a fried peanut product produced in intercropping system treated by bokashi plus fertilizer under early growth of teak trees behave has been unknown. The main objectives of this paper were to analyze the effects of maize flour substitution on the organoleptic characteristics and nutritional values of fried peanut products in intercropped maize and
peanut under early growth of teak trees in sustainable creative agroforestry system in Napabalano District, Muna Regency.

2. Materials and methods

2.1. Place and time
This research was carried out in Lambiku and Pentiro villages, Napabalano District about 4 hours by public transportation (bus and ferry) from Kendari city to reach the location. Peanut seed used in this study was obtained in two farmers land where those locations were used as demonstration plots in improved and conventional agroforestry system. The analyses of organoleptic characteristic and nutritional values were conducted in Food Science and Technology Laboratory, Faculty of Agriculture, University of Halu Oleo, Kendari, Southeast Sulawesi Province, Indonesia. The results of nutritional values of peanut products were confirmed at Biotrop Service Laboratory, Bogor. This research was held from December 2019 to April 2020.

2.2. Materials and equipment
Materials used in this research were peanut seeds produced in intercropped local peanut and maize ecotype, materials for making fried peanut products like peanut seeds 2 kg, maize flour, coconut oil 1 l, coconut milk 0.5 l, garlic gloves 10 seeds, salt, lime leaves 10 sheets 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, busin, spoon, furnace, electric cooker and pan.

2.3. Methods
The yields of peanut were harvested from the demonstration plot at the two villages of Lambiku and Pentiro as the experimental design. Maize and peanut were intercropped and planted between the rows of 2 years of age teak plantation. Two years of teak trees were regularly planted using 6 m x 6 m space distance and there was enough space to cultivate food crops between the rows of teak trees. In order to obtain sufficient light of staple food, crops grow in between, bottom and old teak leaves and branches were pruned. Selected local maize and peanut were cultivated in intercropping system with crop spacing for maize 120 cm x 50 cm, and for peanut 30 cm x 40 cm were used in all plots. The research was designed using a Completely Randomized Block Design with single factor of the substitution of maize flour (M), consisting of four levels; 0% (M0), 10% (M1), 20% (M2) and 30% (M3). Each treatment was repeated four times, so in all there were 16 experimental units.

To analyze the organoleptic characteristics and nutritional values of fried peanut products, peanut yields was prepared separately according to the treatments and locations. Peanut seeds were separated from peanut pods that had been dried to obtain 15 percent water content. Sixteen experimental units were prepared and mixed with maize flour according to treatment. Fried peanut products was processed from peanut seeds using coconut oil for about 30 minutes. Fried peanut as called kacang telor was served and ready to eat or traded after secure packaging. The characteristics of organoleptic for taste, aroma, color and texture of fried peanut products were recorded using 1-5 scoring system of 1 (very dislike), 2 (dislike), 3 (rather like), 4 (like) and 5 (very like) resulted from sustainable creative agroforestry practices using 30 trained panelists by filling hedonic format provided, while the nutritional values of fried peanut products covering carbohydrate (by difference method as applied by [16], lipids [17], protein (biuret method) [18], ash [17] and crude fiber (as applied by [19]) contents were determined using appropriate laboratory methods at the Laboratory of Food Science and Technology, Faculty of Agriculture, University of Halu Oleo. Data were analyzed using analyses of variances (ANOVA) and if significant different, then followed by Honestly Significant different (HSD) with 95 percent confidence level.
3. Results and discussion

3.1. Results

3.1.1. Organoleptics test of fried peanut products. The effects of maize flour substitution on the organoleptic test of fried peanut products was carried out on the taste, aroma, color and texture. Peanut seeds were resulted from the application of various doses bokashi plus fertilizer in sustainable creative agroforest system, conducted in two villages of Lambiku and Pentiro. The average hedonic score of organoleptic test on taste, aroma, color and texture was illustrated in Table 1, 2, 3 dan Table 4.

Table 1 showed that in improved agroforestry system, the highest score of hedonic for taste in Lambiku village was 4.80 (very like) recorded in the substitution of 20% (M2) significant different compared with 30% (M3), but not significant different to without substitution (M0) and 10% (M1). Similar to Pentiro village, the highest score of hedonic for taste was 4.79 (very like) obtained in the substitution of 20% (M2) significant different compared with 30% (M3), but not significant different to 0% (M0) and 10% (M1). While in conventional one, the highest score of hedonic for taste in Lambiku village was 4.76 (very like) identified in the substitution of 20% (M2) significant different compared with 0% (M0) and 10% (M1). Similar to Pentiro village, the highest score of hedonic for taste was 4.62 (very like) gained in the substitution of 20% (M2) but not significant different to other treatments.

Table 2 showed that in improved agroforestry system, the highest score of hedonic for aroma in Lambiku village was 4.69 (very like) gained in the substitution of 20% (M2) significant different compared with 30% (M3), but not significant different to 0% (M0) and 10% (M1). Similar to Pentiro village, the highest score of hedonic for aroma was 4.75 (very like) obtained in the substitution of 20% (M2) significant different compared with 30% (M3), but not significant different to 0% (M0) and 10% (M1). While in conventional system, the highest score of hedonic for aroma in Lambiku village was 4.55 (very like) obtained in the substitution of 20% (M2) significant different compared with 0% (M0), but not significant different to the substitution 10% (M1) and 30% (M3). Similar to Pentiro village, the highest score of hedonic for aroma was 4.53 (very like) obtained in the substitution of 20% (M2) significant different compared to 0% (M0), but not significant different to the substitution 10% (M1) and 30% (M3).

Table 1. Effects of maize flour substitution on the average taste hedonic score of fried peanut products under improved and conventional agroforestry system in Lambiku and Pentiro villages, Napabalanado district.

| Levels of Maize Flour Substitution | Improved Agroforestry System | Conventional Agroforestry System |
|-----------------------------------|-----------------------------|---------------------------------|
|                                   | Lambiku                     | Pentiro                         |
|                                   | 0% maize flour substitution | 4.33ab                          | 4.32ab                          |
| 10% maize flour substitution      | 4.52ab                      | 4.62ab                          | 4.51ab                          |
| 20% maize flour substitution      | 4.80a                       | 4.79a                           | 4.76a                           |
| 30% maize flour substitution      | 4.31b                       | 4.31b                           | 4.02b                           |
| HSD 0.05                          | 0.41                        | 0.47                            | 0.68                            |
| Note: The figures in column followed by the difference letters were significant different using Honestly Significant different (HSD) at 95 confidence level. Ns = non-significant different. |
Table 2. Effects of maize flour substitution on the average aroma hedonic score of fried peanut products under improved and conventional agroforestry system in Lambiku and Pentiro villages, Napabalano district.

| Levels of Maize Flour Substitution | Improved Agroforestry System | Conventional Agroforestry System |
|-----------------------------------|-----------------------------|---------------------------------|
|                                   | Lambiku | Pentiro | Lambiku | Pentiro |
| 0% maize flour substitution (M0)  | 4.28b   | 4.38b   | 3.95ab  | 3.88b   |
| 10% maize flour substitution (M1) | 4.54ab  | 4.44ab  | 4.34ab  | 4.34ab  |
| 20% maize flour substitution (M2) | 4.69a   | 4.75a   | 4.55a   | 4.53a   |
| 30% maize flour substitution (M3) | 4.22b   | 4.31b   | 3.81b   | 3.91ab  |
| HSD 0.05                         | 0.36    | 0.34    | 0.62    | 0.64    |

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

Table 3 showed that in improved agroforestry system, the highest score of hedonic for color in Lambiku village was 4.72 (very like) obtained in without maize flour substitution (M0) but not significant different compared with other treatments. Similar to Pentiro village, the highest score of hedonic for color was 4.62 (very like) obtained in without maize flour substitution (M0) significant different compared with 30% (M3) and 10% (M1), but not significant different to the substitution 20% (M2). While in conventional system, the highest score of hedonic for color in Lambiku village was 4.52 (very like) obtained in without maize flour substitution (M0) significant different compared with 30% (M3), but not significant different to the substitution 10% (M1) and 20% (M2). Similar to Pentiro village, the highest score of hedonic for color was 4.45 (like) obtained in the substitution of 20% (M2) but not significant different compared with other treatments.

Table 3. Effects of maize flour substitution on the average color hedonic score of fried peanut products under improved and conventional agroforestry system in Lambiku and Pentiro villages, Napabalano district.

| Levels of Maize Flour Substitution | Improved Agroforestry System | Conventional Agroforestry System |
|-----------------------------------|-----------------------------|---------------------------------|
|                                   | Lambiku | Pentiro | Lambiku | Pentiro |
| 0% maize flour substitution (M0)  | 4.72    | 4.62a   | 4.52a   | 4.43    |
| 10% maize flour substitution (M1) | 4.44    | 4.40b   | 4.24ab  | 4.22    |
| 20% maize flour substitution (M2) | 4.69    | 4.41ab  | 4.35ab  | 4.45    |
| 30% maize flour substitution (M3) | 4.55    | 4.36b   | 4.06b   | 4.24    |
| HSD 0.05                         | ns      | 0.20    | 0.32    | Ns      |

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

Table 4 showed that in improved agroforestry system, the highest score of hedonic for texture in Lambiku village was 4.82 (very like) recorded in without maize flour substitution (M0) significant different compared with 30% (M3), but not significant different compared with 10% (M1) and 20% (M2). Similar to Pentiro village, the highest score of hedonic for texture was 4.79 (very like) obtained
in the substitution of 20% (M2) significant different compared with 10% (M1), but not significant different to the substitution 30% (M3) and without maize flour substitution (M0). While in conventional system, the highest score of hedonic for texture in Lambiku village was 4.68 (very like) obtained in without maize flour substitution (M0) but not significant different compared with other treatments. In Pentiro village, the highest score of hedonic for texture was 4.74 (very like) obtained in without maize flour substitution (M0) significant different compared with 10% (M1) and 30% (M3), but not significant different compared with 20% (M2).

Table 4. Effects of maize flour substitution on the average texture hedonic score of fried peanut products under improved and conventional agroforestry system in Lambiku and Pentiro villages, Napabalano district.

| Levels of Maize Flour Substitution | Improved Agroforestry System          | Conventional Agroforestry System        |
|-----------------------------------|---------------------------------------|----------------------------------------|
|                                   | Lambiku                               | Pentiro                                |
|                                   |                                        |                                        |
| 0% maize flour substitution (M0)  | 4.82a                                 | 4.78a                                  |
| 10% maize flour substitution (M1) | 4.45ab                                | 4.18b                                  |
| 20% maize flour substitution (M2) | 4.60ab                                | 4.79a                                  |
| 30% maize flour substitution (M3) | 4.41b                                 | 4.31ab                                 |
|                                   | **HSD 0.05**                           |                                        |
|                                   | **0.24**                              | **0.52**                               |
|                                   |                                        |                                        |
|                                   |                                        |                                        |
|                                   |                                        |                                        |

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

3.1.2. Nutritional Values of Fried Peanut Products. Peanut seeds were processed with the addition of maize flour to create new products that can have added-values. Peanut seeds were fried to form fried peanut. In order to determine the nutritional values for carbohydrate, protein, fat, ash and crude fiber contents, maize and peanut samples in contentional and improved agroforestry system carried out in two villages were carefully taken. The results of nutritional value analyses of peanut products were figured out in Table 5, 6, 7, 8 and Table 9.

Table 5. The average carbohydrate content (%) of fried peanut products substituted by maize flour under improved and conventional agroforestry system of Lambiku and Pentiro villages, Napabalano district.

| Levels of Maize Flour Substitution | Improved Agroforestry System          | Conventional Agroforestry System        |
|-----------------------------------|---------------------------------------|----------------------------------------|
|                                   | Lambiku                               | Pentiro                                |
|                                   |                                        |                                        |
| 0% maize flour substitution (M0)  | 12.48a                                | 11.82                                  |
| 10% maize flour substitution (M1) | 11.56a                                | 11.86                                  |
| 20% maize flour substitution (M2) | 11.43ab                               | 11.34                                  |
| 30% maize flour substitution (M3) | 10.57b                                | 11.73                                  |
|                                   | **HSD 0.05**                           |                                        |
|                                   | **1.06**                              | **1.22**                               |

Note: The figures in column followed by the difference letters were significant different using Honestly Significant different (HSD) at 95 confidence level. Ns = non-significant different.
Table 5 showed that in improved agroforestry system, the highest averages of carbohydrate content of fried peanut products in Lambiku village was 12.48% determined in without maize flour substitution (M0) significant different compared with 30% (M3), but not significant different compared with 10% (M1) and 20% (M2). In Pentiro village, the highest average carbohydrate content was 11.86% obtained in the substitution of 10% (M2) but not significant different compared with other treatments while in conventional system, the highest averages carbohydrate contents in Lambiku village was 12.42% obtained in without maize flour substitution (M0) significant different compared with 30% (M3), but not significant different compared with 10% (M1) and 20% (M2). In Pentiro village, the highest average carbohydrate content was 12.06% obtained in without maize flour substitution (M0) significant different compared with 30% (M3), but not significant different compared with 10% (M1) and 20% (M2).

Table 6 showed that in improved agroforestry system, the highest protein content of fried peanut products in Lambiku village was 31.45% identified at the substitution of 30% (M3) significant different compared to without (M0) and 10% (M1), but not significant different compared with 20% (M2). In Pentiro village, the highest protein content was 30.58% obtained in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0) and 10% (M1), but not significant different compared with 20% (M2). While in conventional system, the highest protein contents in Lambiku village was 13.02% obtained in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0), 10% (M1) and 20% (M2). In Pentiro village, the highest protein content was 29.16% obtained in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0) and 10% (M1), but not significant different compared with 20% (M2).

| Levels of Maize Flour Substitution | Improved Agroforestry System Lambiku | Pentiro | Conventional Agroforestry System Lambiku | Pentiro |
|-----------------------------------|------------------------------------|---------|------------------------------------------|---------|
| 0% maize flour substitution (M0)  | 25.51b                             | 25.33b  | 20.37c                                   | 22.44b  |
| 10% maize flour substitution (M1) | 25.42b                             | 27.45b  | 21.30c                                   | 24.26b  |
| 20% maize flour substitution (M2) | 28.46ab                            | 29.91a  | 27.65b                                   | 28.52a  |
| 30% maize flour substitution (M3) | 31.45a                             | 30.58a  | 31.02a                                   | 29.16a  |
| HSD 0.05                         | 3.61                               | 2.26    | 3.25                                     | 2.04    |

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

Table 7 showed that in improved agroforestry system, the highest fat content of fried peanut products in Lambiku village was 47.27% obtained in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0) and 10% (M1), but not significant different to 20% (M2). Similar to Pentiro village, the highest fat content was 48.18% found in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0) but not significant different to 10% (M1) and 20% (M2). In conventional agroforestry system, the highest fat content in Lambiku village was 49.54% identified in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0), but not significant different compared to 10% (M1) and 20% (M2). Similar to Pentiro village, the highest fat content was 50.46% gained in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0) and 20% (M2). but not significant different compared to 20% (M2).
Table 8 showed that in improved agroforestry system, the highest ash content of fried peanut products in Lambiku village was 7.32% obtained in the substitution of 20% (M2) but not significant different compared to without maize flour substitution (M0), 10% (M1) and 30% (M3). While in Pentiro village, the highest ash content was 7.40% gained at the substitution of 20% (M2) significant different compared to without maize flour substitution (M0), but not significant different compared with 10% (M1) and 30% (M3). In conventional agroforestry system, the highest ash content in Lambiku village was 8.62% identified at the substitution of 20% (M2) significant different compared to without maize flour substitution (M0) and 10% (M1), but not significant different compared to 30% (M3). Similar to Pentiro village, the highest ash content was 8.75% found in the substitution of 20% (M2) significant different compared to without maize flour substitution (M0) and 10% (M1), but not significant different compared to 30% (M3).

Table 7. The average fat content (%) of fried peanut products substituted by maize flour under improved and conventional agroforestry system in Lambiku and Pentiro villages, Napabalano district.

| Levels of Maize Flour Substitution | Improved Agroforestry System | Conventional Agroforestry System |
|-----------------------------------|-----------------------------|---------------------------------|
|                                   | Lambiku                     | Pentiro                         | Lambiku                     | Pentiro                           |
| 0% maize flour substitution (M0)  | 39.41c                      | 38.36b                          | 39.84b                      | 38.71c                            |
| 10% maize flour substitution (M1) | 41.25bc                     | 44.54a                          | 43.55ab                     | 42.83bc                           |
| 20% maize flour substitution (M2) | 44.82ab                     | 45.62a                          | 47.09a                      | 47.96ab                           |
| 30% maize flour substitution (M3) | 47.27a                      | 48.18a                          | 49.54a                      | 50.46a                            |
| HSD 0.05                          | 5.26                        | 6.20                            | 6.26                        | 7.34                              |

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

Table 8. The average ash content (%) of fried peanut products substituted by maize flour under improved and conventional agroforestry system in Lambiku and Pentiro villages, Napabalano district.

| Levels of Maize Flour Substitution | Improved Agroforestry System | Conventional Agroforestry System |
|-----------------------------------|-----------------------------|---------------------------------|
|                                   | Lambiku                     | Pentiro                         | Lambiku                     | Pentiro                           |
| 0% maize flour substitution (M0)  | 5.72                        | 4.64b                           | 5.43c                       | 5.52b                             |
| 10% maize flour substitution (M1) | 5.16                        | 5.16ab                          | 6.04bc                      | 6.16b                             |
| 20% maize flour substitution (M2) | 7.32                        | 7.40a                           | 8.62a                       | 8.75a                             |
| 30% maize flour substitution (M3) | 6.27                        | 6.08ab                          | 7.70ab                      | 7.24ab                            |
| HSD 0.05                          | Ns                          | 2.25                            | 2.24                        | 2.34                              |

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

Table 9 showed that in improved agroforestry system, the highest crude fiber content of peanut products in Lambiku village was 1.27% determined in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0) and 10% (M1), but not significant different to 20% (M2). While in Pentiro village, the highest crude fiber content was 1.16% obtained in the substitution of 30% (M3) but statistically not significant different compared with other treatments.
In conventional agroforestry system, the highest crude fiber content in Lambiku village was 1.13% found in the treatment of 30% maize flour substitution (M3) significant different compared to without maize flour substitution (M0), but not significant different compared to 10% (M1) and 20% (M2). Similar to Pentiro village, the highest crude fiber content was 1.26% gained in the substitution of 30% (M3) significant different compared to without maize flour substitution (M0) and 10% (M1) but not significant different compared to 20% (M2).

Table 9. The average crude fiber content (%) of fried peanut products substituted by maize flour under improved and conventional agroforestry system in Lambiku and Pentiro villages, Napabalano district.

| Levels of Maize Flour Substitution | Improved Agroforestry System | Conventional Agroforestry System |
|-----------------------------------|-----------------------------|---------------------------------|
|                                   | Lambiku | Pentiro | Lambiku | Pentiro |
| 0% maize flour substitution (M0)  | 0.82c   | 1.08    | 0.84b   | 0.98b   |
| 10% maize flour substitution (M1) | 0.91bc  | 1.05    | 0.91ab  | 0.93b   |
| 20% maize flour substitution (M2) | 1.15ab  | 1.12    | 0.96ab  | 1.14a   |
| 30% maize flour substitution (M3) | 1.27a   | 1.16    | 1.13a   | 1.26a   |
| HSD 0.05                         | 0.26    | Ns      | 0.22    | 0.24    |

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

3.2. Discussion

The substitution of maize flour in the making of fried peanut products gave a significant effect on the average hedonic score and the average nutritional values recorded both in improved and in conventional agroforestry system applied by bokashi plus fertilizer of Lambiku and Pentiro villages. Table 1, 2, 3 and Table 4 indicated a beneficial substitution of maize flour on the averages hedonic score of taste, aroma, color and texture of fried peanut products. The substitution of maize flour up to 20% instead of wheat flour increased the average hedonic score of taste and aroma, but further addition of maize flour gave adverse effect on the average organoleptic taste and aroma. However, the substitution of maize flour of fried peanut did not increase the degree of hedonic score on color and texture as shown in Table 3 and Table 4, even though there was a tendency that the use of 100% wheat flour gave a non-significant different compared with 20% maize flour substitution. This was assumed that the substitution of maize flour in fried peanut might provide high quantity of protein and fat contents within products that give better taste and aroma and improve the degree of panelist acceptance to fried peanut products. Based on INS 01-3727-1995 [20] of maize flour reported that the nutritional value of carbohydrate was lower than that of wheat flour, except for protein and fat contents, they were higher. Therefore, the increasing quantity of maize flour on the making products of fried peanut formulation did not increase the averages carbohydrate and ash contents, except for crude fiber ingredients was highly significant increased by the addition of maize flour substitution. This was relevant to the findings reported by Suarni and Firmansyah [21], stated that the nutritional values of maize flour as a functional food on protein, fat, crude fiber contents were not less important compared with wheat flour since maize flour contained high crude fiber content and other elements, such as mineral Fe and β-carotene. Moreover, Suarni [22] reported that based on chemical composition and nutritional values, maize flour had a better prospect as a source of food and industrial raw material due to higher contents of crude fiber, protein and fat compared with wheat flour.

The better quality of products might directly be influenced by the use of proper doses of bokashi plus fertilizer in intercropping system of maize and peanut under sustainable creative agroforestry pattern. Organic fertilizer derived from bokashi plus contains sufficient nutrient content that might be
absorbed by plant roots and transported to the whole plant parts, in particular to the formulation of high quantity and quality of plant seeds. Best quality of plant seeds may affect the degree of people acceptance on the products resulted in organoleptic test as shown Table 1, 2, 3 and Table 4. The variability of nutritional values on the peanut products gave an interesting fact on the contribution of different amount of bokashi plus given to the development of plant growth to produce good quality of agricultural products as figured out in Table 5, 6, 7, 8 and Table 9. This phenomenon was relevant to findings reported by Welch [23] that the accumulation of micronutrient elements in seeds and grains is controlled by a number of processes including root-cell uptake, root-shoot transfer, and the ability of leaf tissues to load these nutrients into the vascular phloem elements which are ultimately responsible for delivering these nutrients to developing seeds and grains via the phloem sap. Bokashi plus used is composed of organic materials derived from secondary vegetation dominated by Chromolaena odorata L., chicken manure, mycorrhiza and EM4. Therefore, organic fertilizer of bokashi plus is completely decomposed and easily be available to plant growth and development [24]. Sustainable agriculture based on using biological fertilizers is an effective solution for overcoming the problems of soil nutrient deficiency [25] and [26]. Biological fertilizers can effect on yield and quality of product. Biological fertilizers containing useful enzymes and microorganisms that can increase plant growth and quality of crops, and reduce the cost of fertilizer and pesticide application [27].

Table 1, 2, 3 and Table 4 showed that the degrees of people acceptance on taste, aroma, color and texture was commonly significantly higher and better at the treatment of higher bokashi plus application, indicating high quantity of plant seeds come up with the increasing quality of seeds that may lead to the increase of organoleptic preference. It was cleared that the growth of annual crops was sufficient and not influenced by the presence of teak trees in its surroundings since the soil media provide enough quantity of nutrient, water and other elements that might affect to the generative components, organoleptic and nutritional values, as explained by Karimuna et al., [4] and Karimuna et al., [5], Welch [23].

Regarding with the nutritional values of fried peanut products as shown in Table 5, 6, 7, 8 and Table 9 revealed that the dynamic change of carbohydrate, protein, fat, ash and crude fiber contents was resulted in the best response of maize flour substitution on the making of products. Looking at the fact mostly the substitution of 20% gave the best significant and better impact on the organoleptic and nutritional values of fried peanut products. The highest nutritional values of peanut products for carbohydrate, protein, fat, ash and crude fiber contents were 12,48%, 31,45%, 50,46%, 8,75% and 1,27%, respectively, generally achieved at the substitution of 30%. This indicated that the increase of maize flour quantity might improve the nutritional values of protein and fat, except for carbohydrate. This was caused by the nutritional values of maize flour was higher than that of wheat flour as reported by [28] and [20]. According to INS for peanut grain, the proximate analyses were carbohydrate 21,1%, protein 25,3%, fat 42,8%, water content 4%, energy calory 428 and ash 1,5% [20]. This result was comparable to the nutritional values analysed in Biotrop Bogor for fried peanut, even though carbohydrate and ash contents were little higher.

The substitution of maize flour in the making fried peanut products both improved and conventional agroforestry system proved to increase the panelists degree acceptance degree of peanut products on taste, aroma, color and texture with averages categorized from like to very like. This indicated that the increase quantity of maize flour substitution on the formulation of peanut products might contribute to meet the degree of acceptance and nutritional values of products and gave a positive effect on the seed quality of peanut. Moreover, it was proved that the higher the doses of bokashi plus applied to the soil, the increase the nutritional values of peanut produced [5, 29]. The results of these organoleptic and nutritional values of peanut products were generally lower compared to the finding facts reported. However, how the increase of bokashi plus fertilizer applied to peanut growth and development may improve the degree of panelists acceptance and nutritional values of peanut products needs to be further studied.
4. Conclusion
The results of research described above conducted in two villages of Lambiku and Pentiro, Napabalano district, Muna regency could be concluded that as follows (1) There was a significant effect and better response of maize flour substitution on the organoleptic characteristics and nutritional values of fried peanut products produced in intercropped maize and peanut applied by bokashi plus fertilizer in improved and conventional agroforestry system, (2) The best average values of organoleptic characteristics for fried peanut products on taste and aroma were 4.80 (very like) and 4.75 (very like), respectively, achieved at the treatment of 20% maize flour substitution, whilst color and texture were 4.72 (very like) and 4.82 (very like), respectively, achieved at the treatment of without maize flour substitution or 100% wheat flour, but not significant different compared with 20% maize flour substitution, (3) The highest nutritional values of fried peanut products for carbohydrate, protein, fat, ash and crude fiber contents were 12.48%, 31.45%, 50.46%, 8.75% and 1.27%, respectively, mostly achieved at the substitution of maize flour 30% in improved agroforestry system, except for fat and ash contents in conventional one, and (4) In order to achieve the best organoleptic and nutritional values of fried peanut products in intercropping maize and peanut between the rows of 2 years of age teak trees in agroforestry system, the substitution maize flour 20% was recommended.

References
[1] Karimuna L 2011 Multiple Cropping, Theory and Its Application, (Kendari: University of Halu Oleo Press) p.352
[2] Karimuna, L, Halim, Resman, M Rufendi, W E Marfi, and S Akri 2018 Agroforestry in West Kulisusu, North Buton Regency, (Kendari: Research and Higher Education, Institution of Research and Community Services, University of Halu Oleo) p.132
[3] Central Bureau of Statistics. 2019 Southeast Sulawesi in the Number 2018 (Kendari: Central Bureau of Statistics in Southeast Sulawesi) p.503
[4] Karimuna, L, Halim, Resman, M Rufendi, W E Marfi, and S Akri 2017 Agroforestry in West Kulisusu, North Buton Regency (Kendari: Research and Higher Education, Institution of Research and Community Services, University of Halu Oleo) p.129
[5] Karimuna L, Halim, Azhar Ansi, W E Marfi and Samaruddin L 2019 Application of Integrated Bokashi Plus Fertilizer on The Growth and Yields of Intercropped Maize and Peanut under Early Growth of Teak Plantation in Napabalano District, Muna Regency, Indonesia, Proc. on the 8th Kuala Lumpur Int. Agriculture, Forestry & Plantation Conf. 15 – 16 July 2019
[6] Karki A M 2019 Agroforestry and its benefits, Sustainable Resource Management at the Technical University of Munich, Online Article 19 August 2020
[7] Sabarnurdin, M S 2004 Agroforestry: Concept, Prospect, and Challenges. Presentase Workshop Agroforestry. Faculty of Forestry, (Yogyakarta: Gadjah Mada University Press)
[8] Young A, 1990. Agroforestry for Soil Conservation, C A B International International Council for Research in Agroforestry, ICRAF, p.648
[9] Karimuna L 2000 Floristic Composition and Biomass of Fallow Vegetation in Abandoned Agricultural Fields of Southeast Sulawesi. Georg-August-University Goettingen, Cuvillier Verlag Goettingen. p.218
[10] Karimuna L, S Leomo and L Indriyani 2009 Application of mulching technology and bokashi vegetation secondary to increased production of intercropping of corn and peanut. Implementation of Science and Technology of Community Service (Kendari: University of Halu Oleo Press)
[11] Statistical Central Biureau 2017 Southeast Sulawesi in Number 2016 (Kendari: Central Biureau of Statistics in Southeast Sulawesi) p.487
[12] Hidayat, S, Iskandar M and Ahmad F 2008 Increased Protein Levels and Acceptability of Gaplek Flour with Soybean Flour Substitution (Jakarta: Muhammadiyah University of Malang Indonesia) p.201

[13] Watson 2003 Corn: chemistry and technology (St. Paul Minnesota: American Association of Cereal Chemistry, Inc.) p.54

[14] Ayoola O T 2010. Yield performance of crops and soil chemical changes under fertilizer treatments in a mixed cropping system. Afr. J. Biotechnol. 9 (26) 4018-4021

[15] Zarei I, Yousef S, Gholam R H, Ali J and Khosro M 2012 Effects of biofertilizers on grain yield and protein content of two soybean (Glycine max L.) cultivars Afr. J. Biotechnol. 11(27) 7028-7037

[16] Winarno F G 2004 Food Chemical and Nutrition 11th Ed. (Jakarta: Gramedia Pustaka Utama)

[17] Association of Official Analytical and Chemists (AOAC) 2005 Official Methods of Analysis, 18th Ed. Washington DC. USA (Maryland USA: AOAC International), p.2000

[18] Association of Official Analytical and Chemists (AOAC), 1990. Official Methods of Analysis, 16th. Washington, DC. USA, (Maryland USA: AOAC International), p.1141

[19] Sudarmadji S 2007 Analytical Procedures for Food and Agricultural Ingredients Bogor

[20] INS Peanut Product 1995 Nutritional Content of Ingredients for Making Tempe and Oncom and Several Types of Tempe (Attached 3) Library of UNIKA p.15

[21] Suarni and Firmansyah I U 2005 Corn rice: Proceedings and nutritional content as a staple food, p. 393-398. ed Suyanto Proc. Nat. Corn Sem. and Workshop, Makassar, September 29-30 2005. Center for Food Crops Research and Development, Bogor, p.426

[22] Suarni 2009 Prospects of Using Corn Flour for Cookies, J Agr. Res. and Dev. 28(2) 63-71

[23] Welch RM 2002 The impact of mineral nutrients in food crops on global human health. Kluwer Academic Publishers. Printed in the Netherlands, Plant and Soil 247 83–90

[24] Purwanti D 2007 The Effect of Kinds and Concentrations of Organic Fertilizers on the Growth and Yield of Green Mustard Plants (Brassica juncea L.) Hydroponically, (Surakarta: Faculty of Agriculture, UNS) p.96

[25] Darzi M T, Ghalavand A, Rejali F and Sefydkan F 2006 Study of application of biological fertilizers on the yield and yield components of fennel herbs. J. Med. Arom. Plants Res. 22(4) 276-292

[26] Ekin Z, Oguz F, Erman M and Ogun E 2009 The effect of Bacillus sp. OSU-142 inoculation at various levels of nitrogen fertilization on growth, tuber distribution and yield of potato (Solanum tuberosum L.). Afr. J. Biotechnol. 8(18) 4418-4424

[27] Chen J 2006 The combined use of chemical fertilizer and/or biofertilizer for crop growth and soil fertility. Taipei Food Fertilizer Technol. Bull. 17 1-9

[28] Budiarti A E 2017 Effect of modified Corn Starch (Zea mays L.) substitution on the organoleptic characteristics and nutritional value of Tulban Cake, Thesis (Kendari: Faculty of Technology and Agricultural Industry, Halu Oleo University) p.91

[29] Saputri Y, Yusriana, Munawar AA 2019. Infrared spectroscopic features of turmeric powder. In: IOP Conference Series: Earth and Environmental Science. Institute of Physics Publishing.

Acknowledgments
This research of study was financed by the Ministry of Research, Technology and Higher Education, Republic of Indonesia, under Scheme of Regional Collaboration Program for the second year in 2020. We would like to express our special thanks to the Rector of Halu Oleo University and the Head of Research and Extension Services Institution for their beneficial assistance. We would like to thanks to Mr. La Ode Ndimusu, Mr. Asnar Subuh, SP, Mr. La Ode Hasanudin and all undergraduate students of Faculty of Agriculture and Agriculture Higher Education Science of Wuna for their significant contributions in data collection and analysis.