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The Effects Of The Concentration Of Brown Sugar And The Comparison Of Cassava (*Dioscorea Alata)* Pasta Proportion To The Making Of "Dodol"(Indonesian Food)

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Abstract: *Cassava (Dioscorea alata) also known as "ubi"/"uwi" by local people have been used as a food source in the region of Maluku Indonesia. The potential for the cassava proliferation include in Western Southeast Maluku of 5,879 tons, Southeast Maluku of 3,296 tons, Central Maluku of 3,366 tons, Buru of 2,614 tons, West Seram of 1,410 tons, East Seram and Aru Islands of 754 and 671 tons. In general, cassavas Dioscorea alata in Maluku are only sold in the form of a pile at a price of between Rp 5000-10000 per stack and then processed in a simple method such making boiled-cassava or compote with sweet coconut milk, etc. One potential development effort is processing the cassavas Dioscorea alata pasta to produce "dodol". In relation to the making "dodol", the purpose of this activity was to determine the effect of the proportion of cassava pasta Dioscorea alata and brown sugar concentration on the quality and consumer acceptance to the products of Dioscorea alata "dodol". This study was conducted in Kamarian village, Sub-district of Kairatu, West Seram, Post-Harvest Institute for Agricultural Technology Laboratory Maluku and Center of Industry Ambon within January to December 2012. The study was designed by using a complete randomized design (CRD) with 2 factorial replications by using 2 factors. Factor 1 is the concentration of sugar (5 %, 10 %, 15 %) and factor 2 is the proportion of cassava pasta and glutinous rice flour (80:20 %, 70:30 %, 60:40 %). The data were analyzed by using Analysis of Variance (ANOVA) and continued Honestly Significant Difference (HSD) test with the confidence level of 5 %, while the organoleptic test results were gathered by using the Hedonic Scale observation. Research results revealed that the best treatment of Dioscorea alata "dodol" was with the proportion of cassava pasta : glutinous rice flour of (80:20 %) with brown sugar 15% concentration has a water content of 24.29 %, carbohydrate content of 63.45 %, protein content of 4.38 %, fat content of 5.41 %, ash of 0.41 %, and rough fiber 1.51 %, while the best treatment based on organoleptic has color assessment 3.85 (rather favorable), the aroma of 3.56 (rather favorable), taste of 3.60 (rather favorable), and texture (rather favorable), elasticity of 3.80 (rather favorable) and overall acceptance of 3.53 (rather favorable).*
Keywords*: brown sugar concentration, cassava pasta, dioscorea "dodol", pasta proportion,*

I. Introduction

Maluku Province is one of many areas that has a very high diversity of biological resources, including local food source crops. Several types of local food such as sweet potatoes, yams and *gembili* (*Discorea*, sp.), has been consumed by the local people for generations. Local food source has been widely used by the people in Maluku for their needs of carbohydrate, and their process for the food is very traditional. By seeing this traditional way of the process, there is a need to expand the process of the commodity to become more advanced and major food source for the people such as in the form of semi-finished products or finished products; this development might reduce the dependence of the community on food derived from rice. Nowadays, the local food sources such as potatoes and yams and cassavas are consumed by the people only by boiling them in the form of boiled-cassavas or mixing them as part of traditional beverage namely sweet compote with coconut milk (in the local terms it is called "*kolak*"). Over various reasons, this is because of the lack of diversified technology package to process the yams or cassavas. Therefore local food process which is still very traditional in relation to the availability of cassavas needs to be studied and developed to obtain a processing acceptable and economically beneficial technology. In general, the production of cassavas produced by the farmers is still largely sold in fresh or raw form, without any further process. The price is very fluctuate and there is a very wide price gap between at the moment there is no season which is the price is very high, but during the harvest time, the price of cassavas at the market in production centers is very low Rp 5,000-10,000 per stack (the average of the stack is as much as 8-10 pieces). Regarding that unpromising situation, the farmers expect further process to the cassavas in order to increase the selling price of cassava *Dioscorea*.

Cassava *Dioscorea alata* is a prospective source of carbohydrates that can be developed to meet the needs for the foods, particularly in dry land areas. Besides rice as staple food companion, there also has been the potential for industrial processing that is expected to be able to produce a variety of refined products of

cassavas. It also can be counted on to support food security and income sources for the farmers in that area. Currently the processing of cassava *Dioscorea alata* is very simple, which is processed in a way, such as boiled or steamed, then made a sweet dough, printed thin, fried or made into dough savory cakes, molded round, fried (fritters), compote (mixed with sweet coconut milk). As a staple food, the cassava *Dioscorea alata* is boiled and consumed completed with fish and vegetable as dishes. As food, cassava *Dioscorea alata* has a pretty good nutrient composition (further data is presented on Table 1). Besides for being source of carbohydrates, cassava *Dioscorea alata* also contains relatively high protein.

Table 1 Chemical composition of cassava *Dioscorea alata*

Components	*White Cassava*	*Purple Cassava*
Water	77.55	83.16
Starch	11.30	11.07
Protein (%)	2.71	1.57
Rough fiber (%)	1.36	1.44
Sugar total (%)	2.80	4.48

As a source for carbohydrates, cassava *Dioscorea alata* needs to be developed into various forms of processed products that are more attractive in appearance as well as the taste; this is to satisfy the tastes of the general public and increase the consumption and the image of cassava *Dioscorea alata*. The process of development is conducted by processing fresh cassavas into ready foodstuffs for consumption (finished product) is made into other products, such as "dodol" (such traditional food or taffy made of sticky rice, cassava, coconut, milk and brown sugar).

"Dodol" is one kind of traditional food that is quite popular in Indonesia. In general "dodol" is made of glutinous and sticky rice flour, brown sugar and coconut milk, being simmered until thick. These foods taste sweet and savory, soft-textured brown and these foods are classified as semi-moist foods. "Dodol" is categorized semi-moist foods (Intermediate Moisture Food) which has a moisture content of 10-40%; Aw .70 to .85; soft texture; has elastic characteristic and edible; it does not require refrigeration and durable during storage (Astawan and Wahyuni, 1991).

"Dodol" made of cassava *Dioscorea alata* is an example of processed product that is made of steamed cassava *Dioscorea alata* pasta added with sugar and other food additives such as glutinous rice flour. The addition of glutinous rice flour here serves to improve the texture, making it not too soft and through this method might increase the nutritional value of "dodol". "Dodol" that is processed of cassava *Dioscorea alata* has less soft texture, without preservatives and artificial sweeteners, and do not easily rancid (Desrosier, 2008). By processing cassava *Dioscorea alata* to become "dodol" is expected to increase the value of the cassava *Dioscorea alata*. This study is aimed to determine the effect of the proportion of cassava *Dioscorea alata* yam pasta and palm sugar concentration on the quality of consumer acceptance to the quality of "dodol" made of cassava *Dioscorea alata*.

II. Material And Methods

The study was conducted at the Laboratory of Post-Harvest and Laboratory of Industry Center of Ambon in March to December 2012. The raw materials used in this study were cassava *Dioscorea alata* that were obtained from Kamarian Village, District of Kairatu, West Seram covered glutinous rice flour, rice flour, brown sugar, granulated sugar, coconut, butter and water and chemicals to test the chemical properties and test organoleptic. The equipment used in this study was frying pan, stove, measuring cups, wooden stirrer, pot, strainer coconut milk, bowl, blender, mold pan, knife, digital scales and some equipment for testing chemical and organoleptic properties.

2.1 The process of Cassava *Dioscorea* "Dodol"

This study was preceded with the processing cassava *Dioscorea alata* pasta by using fresh cassavas through several stages of the process included: (1) cassava *Dioscorea alata* was washed with water (2) the skin of the cassava was peeled and cut into small dice-shaped, and then (3) the cassava was steamed for about 30 minutes. (4) the cassava was mashed in order to make it into pasta. After the process of making pasta from cassava, the making of "dodol" was conducted by considering the formulas as presented on Table 2.

Table 2. Recipe to make cassava *Dioscorea spp* "dodol"

Ingredients	Proportion %
Glutinous rice flour	30
Rice flour	15
Sugar	20
Brown sugar	10
Coconut milk	22
Butter	3

Source: modified from Heni (2002)

The making of cassava *Dioscorea* "dodol" is presented in on flowchart diagram as on Figure 1. The study was designed by using a completely randomized design (CRD) with 2 (two) factorials and replications by using 2 factors. Factor 1 was the concentration of sugar (5 %, 10 %, 15 %) and factor 2 was the proportion of cassava pasta and glutinous rice flour (80 % : 20 %, 70 % : 30 %, 60 % : 40 %). The data were analyzed by Analysis of Variance (ANOVA) and the test was continued *Honestly Significant Difference* (HSD) with a confidence level of 5 %. Organoleptic test results was collected by using the Hedonic Scale. Parameters observed in this study were chemical properties included: moisture content, ash content, protein and carbohydrate levels (AOAC, 1995), and the nature of organoleptic included color, aroma, flavor, texture, elasticity and overall acceptance from the public (Rahayu, 1986). This experiment used Completely Randomized Design (CRD) with factorial 3 x 3 x 2 replicates = 18. Test was conducted on 25 organoleptic description somewhat trained panelists with assessment scores as follows: 5 = like very much, 4 = like, 3 = moderate, 2 = do not like , 1 = do not like very much.

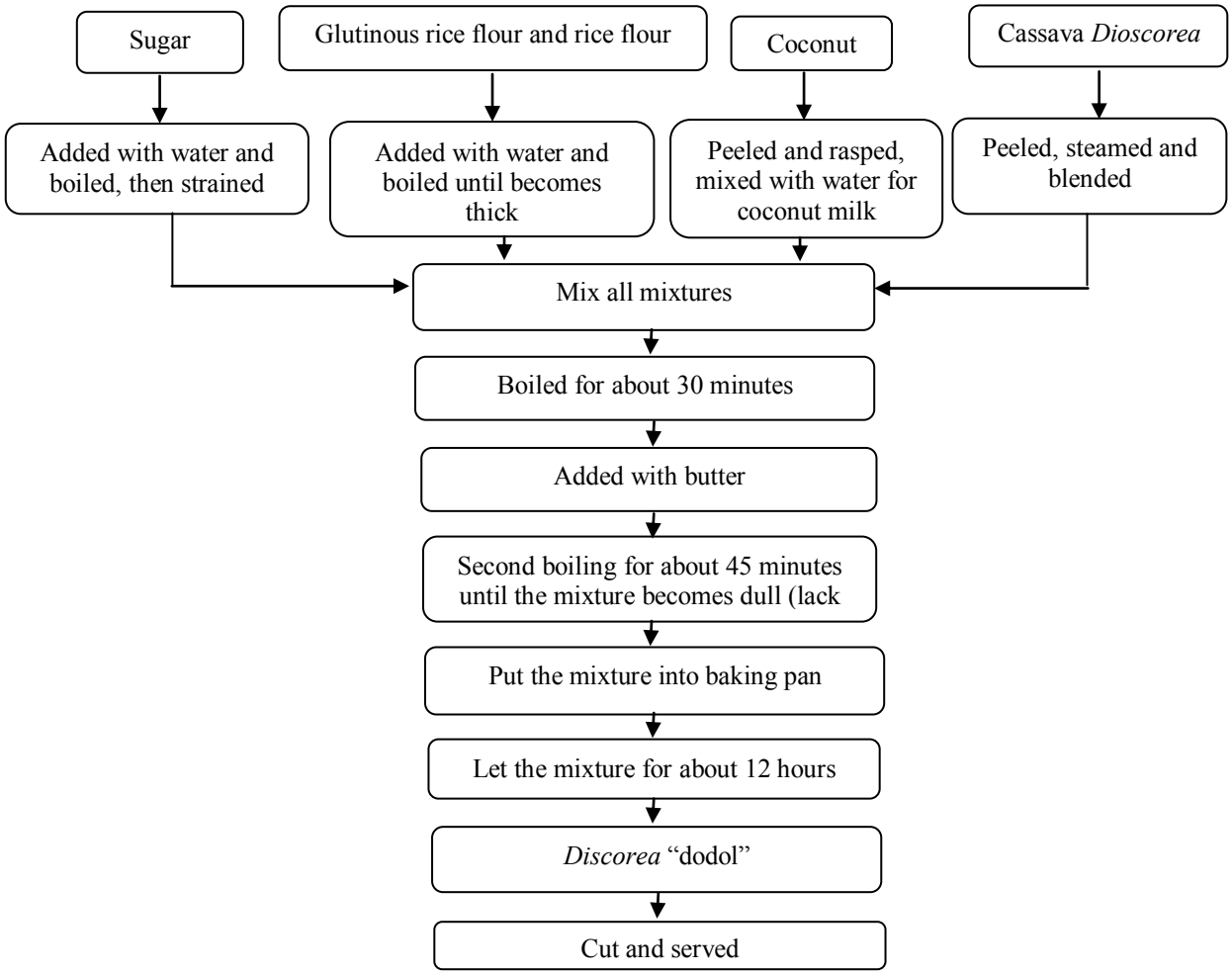

Figure 1. Flowchart diagram of the making of *Dioscorea* "dodol"

III. Results And Discussions

3.1 Composition of chemical characteristic value of selected *Diosorea* "dodol"

The most favorable Dioscorea "dodol" based on the panelists is the treatment with 5% of sugar concentration and treatment with comparisons between cassava and glutinous rice flour pasta was 80: 20% (A1B1) with a score of 3.53 with the highest value of the chemical composition as listed in Table 3. Tests were carried out to analyze the chemical properties of the chemical properties change of *Dioscorea alata* "dodol". This test was also conducted to compare the chemical properties of *Dioscorea* "dodol" into Indonesian National Standard.

Table 3. Composition of chemical characteristic value of selected *Dioscorea* "dodol"

Chemical composition of *Dioscorea* "dodol"	Total
Water content (%)	24.29
Protein content (%)	4.38
Fat content (%)	5.41
Ash content (%)	0.94
Rough fiber (%)	1.51
Carbohydrate (%)	63.45

3.1.1 Water content

The average water content in the selected *Dioscorea* "dodol" was 24.29%. *Dioscorea* "dodol" was produced in this study still contains higher water content than the provisions of National Standards Council (1992). It would require a longer heating time to produce maximum water content that is 20%. Although the difference is not too big, but the water content of the resulting Dioscorea "dodol" is still in accordance with the value proposed by Purnomo (1995).

3.1.2 Protein content

The average value of protein content in the selected *Dioscorea* "dodol" was 4.38%. *Dioscorea* "dodol" produced in this study had protein content that met the standards, even exceeding the specified levels of protein compared to the National Standards Council (1992) on SNI 01-2986-1992 which stipulates that "dodol" should contains protein of at least 3%. Too high of protein content based on SNI 01-2986-1992*Dioscorea* "dodol" is due to the composition of cassava *Dioscorea* as the raw material, besides glutinous rice flour, rice flour and brown sugar.

3.1.3 Fat content

The average fat content in the selected *Dioscorea* "dodol" was 5.41%. *Dioscorea* "dodol" generated in this study produced a lower fat content of the fat content determined by the Board of National Standards (1992) on SNI 01-2986-1992 which stipulates that "dodol" should contain fat of at least 7%. Dioscorea "dodol" contained lower level than SNI 01-2986-1992, and it is due to the composition of cassava *Dioscorea* as the basic material having a fat content of only 0.68%, in addition to glutinous rice flour, rice flour and brown sugar. Moreover, the use of coconut milk and additional margarine on the boiling stage II might give effects to the fat content in *Dioscorea* "dodol".

3.1.4 Ash content

The average ash content in the selected Dioscorea "dodol" was 0.94%. Dioscorea "dodol" produced in this study contained lower ash content of the recommended ash content by the Board of National Standards (1992) which stipulates that the SNI 01-2986-1992 ash content in "dodol" should contain ash of at least 1.5%. The ash content produced by Dioscorea "dodol" was lower than the recommended SNI 01-2986-1992, and it is due to the composition of cassava *Dioscorea* as the basic material that contains ash of only 0.96%, in addition to glutinous rice flour, rice flour and brown sugar. The low ash content Dioscorea "dodol" is because it does not use salt and only use margarine that gives a salty taste, it might also give effects to the ash content of Dioscorea "dodol".

3.1.5 Carbohydrate

The mean level of carbohydrates in the selected Dioscorea "dodol" was 63.45%. Carbohydrate content contained in the raw material might give effects to the carbohydrate levels in the Dioscorea "dodol". The main source of carbohydrate in "dodol" is derived from cassava *Dioscorea*, in addition to rice flour, glutinous rice flour and brown sugar. According Wijandi (1981), brown sugar is a chemical compound belonging to the group of carbohydrates has a sweet taste and soluble in water. While the rice flour and glutinous rice flour has higher levels of carbohydrates, respectively 79.03% and 78.93% (Rohmah, 1997).

3.2 *Dioscorea spp* "dodol" organoleptic testing

Organoleptic test is one of the most important parameters in assessing food products. Organoleptic test to the products of "dodol" cover some aspects such as color, aroma, flavor, texture, elasticity, and over-all preference testing by using hedonic scale of 1-5, where the score of 5 as the best value and the acceptance limit on the value of 1. Organoleptic test results will indicate whether the products *Dioscorea* "dodol" are accepted by the consumers. Organoleptic test were carried out by 25 semi-trained panelists. The mean results of these organoleptic tests on the product are presented on Table 4.

3.2.1 Color

Color is one of the determinants to measure the quality products in relation to "dodol" marketing; over other visual factors to be considered, the color would be the determinant to the attractiveness or even rejection by consumers (Misnawi et al., 2008). Based on the organoleptic observations indicate that the treatment with 5 % sugar concentration and treatment with the comparison between cassava glutinous rice flour pasta 80:20 % (A_1B_1) could give preferred color by the panelists with the score value of 3.85 as it is presented in more detail on Table 4; during the observation on the products, the panelists preferred color that is bright or in specific light brown. This bright brown color is preferred due to it is eye-catching; this color might be due to the low concentration of the brown sugar and the high concentration of cassava pasta that generates light brown color on the products. While the color with the lowest preference value obtained during the observation was the treatment with sugar concentration of 15 % and the ratio between glutinous rice and cassava pasta of 70:30 % (A_3B_2) with the score value of 2.59. The results of the analysis of the variance showed that single treatment A (sugar concentration) and treatment B (comparison of proportions of cassava pasta and glutinous rice flour) did not give significant effect, whereas the treatment interaction effect was considered highly significant ($P > .01$). The color being resulted from this treatment was in order to produce "dodol" with dark brown. It was predicted that the dark color might be due to the high concentration of sugar and the process of *caramelization* occurred due to prolonged agitation over the fire. According to Hodge and Ozman (1976) in relation to the products that are added with sugar when the longer boiling process was conducted, the *caramelization* process might occur as well and that is non-enzymatic browning reactions; the caramel formed during the boiling process that gives darker brown color in food.

Table 4. The result of organoleptic tests to *Dioscorea* "dodol" with the treatment of borwn sugar concentration and sugar and cassava pasta.

Treatment	Organileptic parameter					
	Color	Aroma	Flavor	Texture	Elasticity	Over-all preference
A_1 B_1	3.85	3.56	3.44	3.41	3.08	3.53
A_1 B_2	3.50	3.35	3.29	3.38	3.38	3.28
A_1 B_3	3.61	3.32	3.32	3.35	3.35	3.40
A_2 B_1	3.00	3.26	2.85	2.82	2.91	3.00
A_2 B_2	3.06	3.14	3.05	3.00	3.06	3.10
A_2 B_3	3.59	3.38	3.29	3.27	3.50	3.41
A_3 B_1	2.73	2.78	2.70	2.70	2.65	2.87
A_3 B_2	2.59	3.21	3.15	3.06	3.15	3.16
A_3 B_3	3.03	3.03	3.09	2.94	3.03	3.12

Information **:**

A_1 = brown sugar concentration 5%, B_1= proportion between cassava pasta and glutinous rice flour 80:20
A_2= brown sugar concentration 10%, B_2= proportion between cassava pasta and glutinous rice flour 70:30
A_3= brown sugar concentration 15%, B_3= proportion between cassava pasta and glutinous rice flour 60:40

3.2.2 Aroma

In terms of parameter in aroma, brown sugar concentration of 5 % and the treatment with the comparison of cassava pasta and glutinous rice flour of 80:20 % (A_1B_1) gave preferred flavor for the panelists to score with the highest score of 3.56. By adding 5% brown sugar affects better aroma and it was preferred by the panelists. On the other hand, the lowest score to the aroma value was obtained to the treatment with sugar concentration of 15 % and the ration of cassava pasta and glutinous rice flour of 80:20 % (A_3B_1) with a score value of 2.79, but over-all preference was still acceptable by panelists with the average score value of 3.53. The results of analysis of variance showed that single treatment A (sugar concentration) and treatment B (comparison of proportions cassava pasta and glutinous rice flour) did not give significant effect, whereas the treatment interaction effect was highly significant ($P >.01$). The emergence of aroma might be due to the formation of aroma compounds as the result of new mixing process on the fire. According Winarno (1992), *caramelization* is caused by a reaction of reducing sugars with primary amine groups or the use of high temperatures on sucrose. The browning process is deliberately designed to create desired aroma and flavor.

3.2.3 Flavor

The result from hedonic test in terms of flavor, the treatment with 5% brown sugar concentration and the treatment with comparison between cassava pasta and glutinous rice flour of 80: 20% (A_1B_1) gave preferred flavor based on the panelists with a score of 3.44; this was considered as the highest score, while the lowest score was obtained based on the treatment with brown sugar 15% concentration and the treatment with comparisons between cassava pasta and glutinous rice flour of 80: 20% (A_3B_1) with a score value was 2.70 as the complete result can be seen on Table 4. The results presented on Table 4 describe how the responses of

acceptance in terms of flavor parameter fluctuate. There were unanimous comments about the taste of all the products displayed during the observation that the products were a bit too sweet for the panelists. The results of analysis of variance showed that single treatment A (sugar concentration) and treatment B (comparison of proportions pasta potatoes and glutinous rice flour) did not give significant effects, whereas treatment interaction effect was highly significant (P> 0.01).

3.2.4 Texture

Organoleptic observations to the texture of "dodol" showed that the sugar concentration might give significant effects on the final product of "dodol". The highest score value was obtained in terms texture of "dodol" with the brown sugar 5% concentration and the treatment with the comparison between cassava pasta and glutinous rice flour of 80:20% (A_1B_1), while the lowest value was obtained in terms of texture for the brown sugar 15% concentration and the treatment with comparisons of cassava pasta and glutinous rice flour of 80:20 % (A_3B_1) with a score value of 2.70. The results of organoleptic test to the texture of "dodol" are presented on Table 4. Results of analysis of variance showed that single treatment A (sugar concentration) and treatment B (comparison of proportions pasta potatoes and glutinous rice flour) did not give significant effect, whereas treatment interaction effect was highly significant (P> 0.01).

3.2.5 Thickness

Based on the hedonic test results in terms of thickness parameter, the treatment with brown sugar 10% concentration and comparisons cassava pasta and glutinous rice flour of 60:40 % (A_2B_3) gave preferred thickness based on the panelists with a score of 3.50 and this was considered as the highest score, while the lowest score for the thickness was obtained for the treatment with brown sugar 10% concentration and the treatment with the comparisons of cassava pasta and glutinous rice flour of 80:20 % (A_3B_1) with a score value of 2.91. This was probably due to the addition of starch to the mixture of cassava pasta in and glutinous rice flour, making the comparison changed of 60:40 % (A_2B_3). The complete data in relation the result in terms of thickness are presented on Table 4. The results of analysis of variance showed the single treatment A (sugar concentration) and treatment B (comparison of proportions pasta potatoes and glutinous rice flour) did not give significant effect, whereas treatment interaction effect was highly significant (P> 0.01).

3.2.6 Overall acceptance

Nilai *over all* merupakan variabel yang ditentukan oleh gabungan dari persepsi komponen organoleptik seperti: warna, aroma, rasa, tekstur dan kekenyalan dari suatu produk. Hasil analisis keragaman menunjukkan bahwa perlakuan tunggal A (Konsentrasi gula merah) maupun perlakuan B (perbandingan proporsi pasta ubi : tepung ketan) tidak memberikan pengaruh yang nyata, sedangkan perlakuan interaksi memberikan pengaruh yang sangat nyata (P>0.01). The overall acceptance by the panelists to the product of "dodol" was observed by using a 1-5 hedonic scale on organoleptic components such as color, odor, taste, and texture appearance. Overall acceptance test results can be seen on Table 4. Based on Table 4, it can be seen that the products of "dodol" which were processed in a simple method were favored by the panelists. The average score for the overall acceptance was between 2.87 to 3.53. For the highest overall acceptance value in the treatment with sugar 5% concentration and treatment with the comparisons between cassava pasta and glutinous rice flour 80:20 % (A_1B_1) with the highest score value of 3.53. The value of overall acceptance is a variable which is determined by a combination of sensory perception components such as: color, aroma, flavor, texture, and elasticity of a product. The results of analysis of variance showed that single treatment A (sugar concentration) and treatment B (comparison of proportions pasta potatoes and glutinous rice flour) did not give significant effect, whereas treatment interaction effect was highly significant (P > 0.01).

IV. Conclusion

From the research that has been conducted in the laboratory of Ministry of Agriculture, Center of Industry Ambon, Bogor Institute of Post-Harvest can be summed up as follows:

1. The potentials of the tubers in Maluku based on Center of Statistics (BPS) in 2007 were amounted to 0.289 to 0.867 ha with a total production of 11-29 tonnes / ha.
2. The post-harvest process to the cassavas has not been done properly and the cassavas are only sold in the form of stack / sacks, in other words, the simple process is by boiling and made compote with sweet coconut milk.
3. Cassava *Dioscorea* used in this assessment study is a type of sweet coconut cassava consisting protein, fat, ash, water, and crude fiber that are respectively 1:05, 0.68, 67.71, 0.96 and 5:36.
4. Based on the hedonic test results, it can be concluded that *Dioscorea* "dodol" treated with 5% brown sugar composition and cassava pasta ratio 80:20 % (A_1B_1) is the most preferred "dodol".

5. The results of chemical composition analysis to the selected *Dioscorea* "dodol" given treatment with brown sugar 5% concentration and cassava pasta ratio of 80:20 %, containing of protein, fat, ash, water, rough fiber and carbohydrate respectively were 24.29, 4.38, 5 , 41, 0.94, 1.51, 63.54.

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