WHC and OHC of MOGAF (Modify Garut Flour) from Arrowroot Tuber (Maranta arundinaceae L.) Fermented Spontaneously with Different Time

Rina Yenrina

Fauzan Azima

Aan Saputra

Faculty of Agricultural Technology
Andalas University, Kampus Limau Manis-Padang. West Sumatera
Indonesia 25163

Abstract

This study aims to determine the effect of fermentation time toward physical properties of MOGAF flour that produced. This research conducted at the Laboratory of Agricultural Technology in Andalas University. The first step in this research is the making of MOGAF flour then continue with physical analysis. This research design in Completely Randomized Design (CRD) with five treatments and three replications. Data were analyzed statistically using ANOVA and if significantly different, followed by a test of Duncan's New Multiple Rang e Test (DNMRT) at 5% significance level with treatments: A(unfermented), B(fermentation time 24hours), C (fermentation time 48hours), D (fermentation time72hours) and E (fermentation time 96hours). Observations on MOGAF flour include yield, bulk density, WHC (Water Holding Capasity) and OHC (Oil Holding Capasity), viscosity, and whiteness degree. The results showed that fermentation time had a significant effect on yield, WHC (Water Holding Capasity) and OHC (Oil Holding Capasity), viscosity, and whiteness of MOGAF flour, and does not significantly affect the bulk density of MOGAF flour that produced.

Keywords: Arrowroot tuber, Fermentation, MOGAF, OHC, WHC.

1. Introduction

In Indonesia, many plants are able to thrive as a producer of carbohydrates such as sweet potato, canna, cassava and arrowroot. Arrowroot plant is a kind of tubers that grow wildly because not much use and cultivate. Though this arrowroot is plant potential as an alternative source of carbohydrates. One of the advantage of arrowroot plant is it does not require special land to cultivate because it is able to grow on the shady ground, the quantity of harvest is also quite a lot.

According Karjono (1998), productivity of arrowroot as raw material of flour is quite high, which is about 12.5 to 31 tons / ha. Besides, between the many sources of carbohydrates arrowroot tubers has the lowest glycemic index (Marsono, 2002). However, arrowroot tubers are rich in fiber so that if it used as the main material of flour it will has a low yield and the flour can not apply to all of food products as flour produced coarse and fibrous. And the appearance of the flour is not attractive because of less white.

Lately been developed MOCAF (Modified Cassava Flour) which is made by fermented cassava before flouring and the flour that produced has a much better characteristics than other cassava flour, but the fermentation is done by using a starter that difficult to apply in general public. Because of that, it needs to appliy the modification of arrowroot tubers with spontaneous fermentation to produce MOGAF (Modified Garut Flour), with the hope to obtain a better flour than the usual arrowroot flour.

Water Holding Capasity is the ability of material in holding water, beside *Oil Holding Capasity* is the ability to hold oil. The WHC and OHC capacities are essential functional properties that establish the texture and quality of food product that made of flour.

Based on the preface research that has been done known that the fermentation in less than 24 hours has not effect on the arrowroot tubers, while the fermentation more than 96 hours make arrowroot tubers become softer and has an alcoholic aroma.

Methodology

Place and Time

This research was conducted at the Laboratory of Agricultural Technology Andalas University in February 2014.

Materials and Equipments

Raw materials used in this study is a fairly old arrowroot tubers with pretty large size and some existing scales are chipped, sugar and water. Arrowroot tubers derived from Talang Petai district. V Koto, Regency of Muko-Muko Bengkulu province. Chemicals used are distilled water, MgO and other materials for analysis. The equipment used in this study include the blender and grinder, 80 mesh sieve, trays, basins, centrifuse, ColorFlex EZ, and Viscotester.

Research Design

This study used a completely randomized design (CRD) with 5 treatments and 3 replications. Data were analyzed statistically by F test and if significantly different, followed by Duncan's Multiple Range Test Test (DNMRT) at 5% significance level. The treatment in this study is the duration of fermentation of arrowroot tubers, as follows:
A = Without fermentation
B = fermentation time 24 hours
C = fermentation time 48 hours
D = fermentation time 72 hours
E = fermentation time 96 hours

Making MOGAF

Arrowroot tubers harvested and shelled then cleaned, followed by cutting the arrowroot tubers ± 1 cm, weighed 500 grams, added sugar 1% of the weight of tubers which are then dissolved in water at a ratio of tubers and water 1: 2 (w / v) covered and fermentation spontaneous performed according to the treatments, then do first draining and soaked with 5% salt water for 10 minutes, then do the second draining and then dried at 40^0C for 2 days until arrowroot tubers can be broken by hand, followed by flouring and sieving using 80 mesh sieve, then packed with aluminum foil.

Observation

The observations in this research are physical analysis include yield (Muchtadi *et al.*, 2010), Bulk Density (Khalil, 1999), Water Holding Capasity (SNI 01-2891-1992), Oil Holding Capasity, Viscosity (AOAC, 1995), and whiteness (SNI 7622-2011).

Results And Discussion

Table 1: Physical Analysis Result of MOGAF flour

Treatments	Yield (%)	Bulk Density (g/ml)	WHC (%)	OHC (%)	Viskosity (dPa.s)	Whiteness (%)
A	10,24 ± 0,06a	0,42 ± 0,01 a	120,82 ± 1,05 a	106,62 ± 1,23 c	0,49 ± 0,01 a	81,60 ± 0,87 a
B	12,85 ± 0,97a b	0,44 ± 0,02 a	122,70 ± 0,13 b	105,27 ± 1,53 c	0,49 ± 0,01 a	85,31 ± 0,39 b
C	16,64 ± 2,48 b c	0,44 ± 0,01 a	137,48 ± 0,47 c	103,43 ± 0,12 b	0,50 ± 0,00 a	86,24 ± 0,80 c
D	19,65 ±0,25 c	0,45 ± 0,04 a	140,79 ± 0,48 d	101,84 ± 0,12 a b	0,67 ± 0,06 b	87,09 ± 0,23 d
E	26,42 ± 6,90d	0,47 ± 0,01 a	161,94 ± 0,37 e	100,53 ± 0,18 a	0,67 ± 0,06 b	88,66 ± 0,02 e
CV	19,29%	7,02%	0,00%	0,00%	5,65%	0,43%

Description: Numbers in the same column followed by the same lowercase letter are not significantly different at 5% level according to DNMRT

The numbers in the same column followed by the same lowercase letter are not significantly different according to DNMRT at 5% significance level The numbers in the same column followed by the same lowercase letter are not significantly different according to DNMRT at 5% significance level Based on the above table it can be seen that the yield is highest in treatment E (fermentation time 96 hours) that is equal to 26.42% and the lowest yield on treatment A (withuot fermentation) that is equal to 10.24%. Results of analysis of variance showed that the fermentation time has a significant effect on the yield of MOGAF flour. The result of analysis can be seen as chart in figure 1. below.

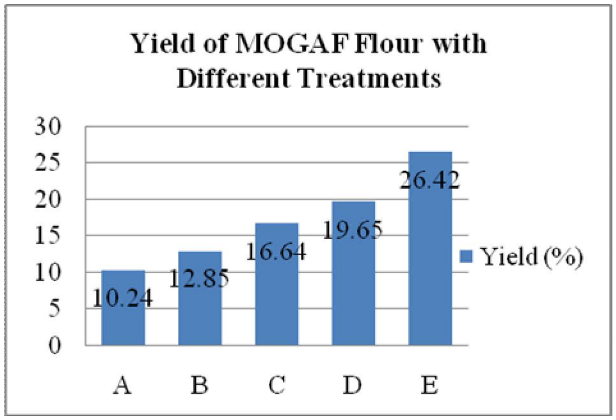

Figure 1: Yield of MOGAF Flour with Different Treatments

Increased yield of flour MOGAF are in line with the length of fermentation time. it is presumably because the longer the fermentation time, the more fiber that decomposes so that the amount of flour that pass 80 mesh sieve will increase and the yield generated MOGAF flour increased. While the raw materials without fermentation still contain high fiber so if powdered and sieved with a 80 mesh sieve are still many material that doesnt pass the sieve so that the treatment A has a lower yield than other treatments with fermentation.

Based on the results of the bulk density of MOGAF above can be seen that the bulk density is highest on treatment B (fermentation time 24 hours) that is equal to 0.47 g / ml and the lowest is in treatment D (fermentation time 72 hours) that is equal to 0.42 grams / ml. According to the results of analysis of variance known that fermentation time has no significant effect on the bulk density of MOGAF flour that produced. The result can be seen in figure 2.

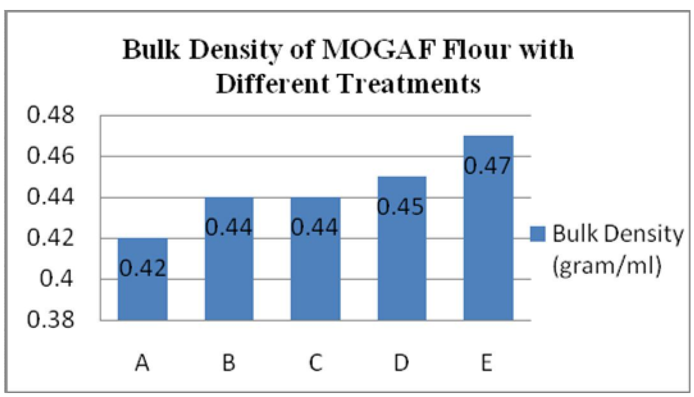

Figure 2: Bulk Density of MOGAF Flour with Different Treatments

WHC (*Water Holding capasity*) is a material's ability to absorb water. the longer the fermentation time, the higher WHC of MOGAF flour that produced, this is because during the fermentation any enzyme that is able to break down the components of arrowroot tubers so the texture of MOGAF becomes softer and porous and finally a lot of water bound freed (Agustawan, 2012). With the rise of the pores in the material then the flour become easier to absorb water and hydrophilic. In addition, the longer the fermentation time, the lower water content of the flour MOGAF, the greater the water holding ability of these materials (Winarno, 2002). Based on the analysis result MOGAF flour in this researh had WHC ranged from 120.82 to 161.94% this number is higher than WHC of wheat flour that is 63.80 (± 2.10) % (Shad *et al*, 2013).

OHC (*Oil Holding capasity*) is a material's ability to absorb oil. Based on Table 1 it can be seen the longer the fermentation time, the OHC of MOGAF flour tends to be decreased this case allegedly because some components of MOGAF flour is insoluble in fats or oils and fats fermiabelitas higher than flour and water so it is not easily absorbed by the flour, including MOGAF flour. Besides, the flour is more hydrophilic and it is consistent with the statement of Zayas (1997), stating that the material that is hydrophilic Oil Holding Capaasity (OHC) will tend to be low and Water Holding capasity (WHC) tend to rise and vice versa hydrophobic materials Oil Holding capasity (OHC) will tend to increase and Water Holding capasity (WHC) will tend to decline.Based on the analysis result MOGAF flour in this researh had OHC of 106.62 to 100.53% this number is higher than WHC of wheat flour that is 72.50 ± 2.00 % (Shad *et al*, 2013). WHC and OHC of product in different treatments can be seen as chart in figure 3.

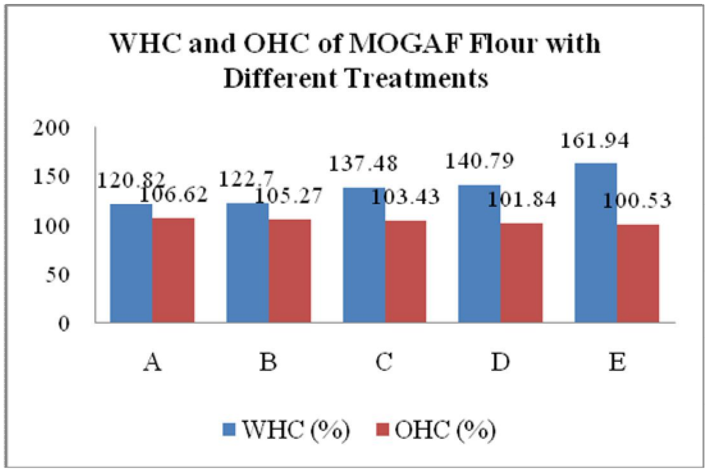

Figure 3: WHC and OHC of MOGAF Flour with Different Treatments

Based on the results of viscosity analysis in table above can be seen that the viscosity is highest in treatment E (fermentation time 96 hours) that is equal to 0.67 dPa.s and the lowest viscosity is on treatment A (without fermentation) that is equal to 0.49 dPa.s. the rewsult can be seen in figure 4. below.

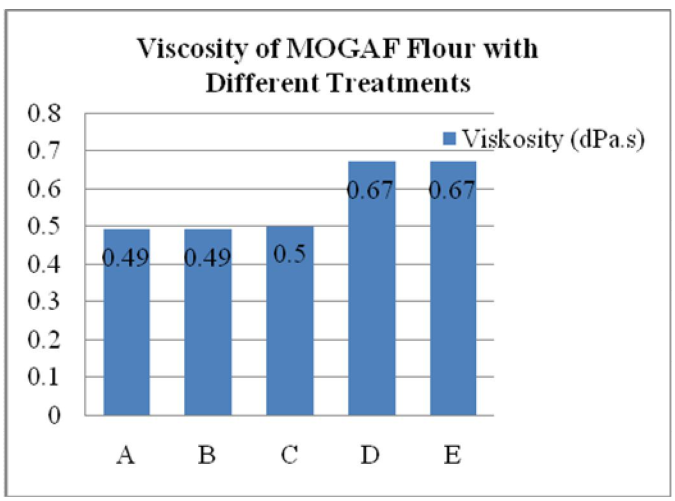

Figure 4. Viscosity of MOGAF Flour with Different Treatments

Based on the analysis of variance treatment A (without fermentation), B (fermentation time 24 hours) and C (fermentation time 48 hours) was not significantly different, but the treatment D (fermentation time 72 hours) and E (fermentation time 96 hours) was different but not significant. The difference is apparently due to the treatment D (fermentation time 72 hours) and E (fermentation time 96 hours) has a longer fermentation time so that the components of MOGAF flour more soluble in water. The longer the fermentation time, the stronger will MOGAF flour to absorb water so it will increase its viscosity, and is in line with the results of the WHC (Water Holding capasity) which obtained also increased with the length of fermentation time.

Based on the table 1 it can be seen that the highest degree of whiteness obtained in treatment E is 88.66% and the lowest in treatment A is 81.60%. According to the analysis of variance at 5% level is known that fermentation time, had a significant effect on the whiteness of MOGAF flour generated. When compared with SNI the maximum degree of whiteness of mocaf flour maximum 87%, then the only treatment E (fermentation time 96 hours) that do not meet the standards. This white grading standards use MgO with whiteness 94.6% . The longer the fermentation time, MOGAF flour that produced will tend to become white, this is due to the degradation of complex compounds by microorganisms so that the pigmented material in it also decompose and dissolve in water. Besides, the fermentation process is also able to inhibit the Maillard reaction which is capable of causing brownish products by overhauling the reducing sugars into organic acids.

Conclusion

The fermentation time of MOGAF flour significantly affect the yield and WHC of MOGAF flour, but it has no significant effect on bulk density, OHC and viscosity. The results of the physical analysis of MOGAF flour : yield range from 10.24 - 26.42%, bulk density from 0.40 - 0.47 g / ml, the viscosity of 0.49 - 0.67 dPa.s, while WHC and OHC ranged from 120.82 to 161.94% and 106.62 to 100.53%.

Advice

Examines the granular form and shelf life of MOGAF flour, and the applications of MOGAF flour to make food products.

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