FS 011

Sorghum Flakes: Studies of the Type and Concentration of Sorghum Flour

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ABSTRACT

This study aimed at finding the best treatment combination of sorghum flakes using Randomized Block Design (RBD) 2 factors with 3 repeated measures. Factor I:. types of flour (T): T_1: red sorghum flour (Sorghum bicolor) and T_2: white sorghum flour (KD Factor II: Concentration (K): K_1: 25%; K_2: 50%; K_3: 75% and K_4: 100%. Observations: organoleptic test on parameters of taste, color, flavour and crispness, moisture content and starch. Data analysis used organoleptic test with Friedman test, while the water content and starch used analysis of variance test (ANOVA) at the 5% level followed by Duncan'Test. The results: 1) Flake sorghum was one of the alternative forms of diversification products based on sorghum flour, 2) a combination of the best treatment for sorghum flakes T_1K_2 (treatment type sorghum flour (T): T_1 = Red Flour/Sorghum bicolor (T_1) and the concentration (K) : K_2 = 50%), the results of Organoleptic parameters were: taste of 4,68 (really like) , color of 4,62 (really like), flavor of 4,58 (really like), crispness 4,68 (really like), water content 2,19% and starch 20,8% and 3) a combination of the best treatments for sorghum flakes second: T_2K_2 (types ofsorghum flour treatment (T): white flour / KD4 (T_2) and concentration (C): K_2 = 50%), the results of organoleptic parameter were taste of 4,62 (really like), color of 4,65 (really like), flavor of 4,52 (really like), crispness of 4,62 (really like), water content of 2,17% and starch of 34,42%.

Keywords: sorghum flour, flakes, organoleptic testing, moisture content and starch

I. INTRODUCTION

Sorghum (Sorghum bicolor) as the world's food source is the fifth rank after wheat, rice, corn and barley. Sorghum has the potential of relatively higher yield than rice, wheat and maize. Sorghum yields can exceed 6-7 tonnes/ha. Sorghum development in Indonesia is now considered indispensable either as a material for industrial or alternative food materials, its production is used as food, beverages, animal feed and other industrial interests. The pictures of sorghum gardens are presented in Figure 1.

Figure 1. Sorghum gardens in Keyongan Village - Babat Subdistrict Lamongan District

One of sorghum results is sorghum flour. A product that can be made from sorghum flour is sorghum flakes. Flake is one of food products that uses cereal foods such as rice, wheat or corn and tubers for examples potatoes, cassava, sweet potatoes. Flake is classified into the types of ready made which is processed and modified depending on the types and forms. To understand the existence of the development of sorghum plant towards the environment (implications of its existence), if it is developed maximally will be creating a chain of the development of national sorghum cluster which support the economy of Indonesia, and open up the opportunities of sorghum plant development, which is directed in line with the effort to increase the empty land productivity (marginal land, idle land, and other non-productive land). That effort is a step to safe the environment. The objective of the research at: introducing the alternative food sources, namely sorghum flour; increasing the potential of sorghum into flake product with added value; and obtaining the best treatment for the combination of sorghum flakes.

II. MATERIALS AND METHODS

The materials used in this research were in the form of red sorghum flour (*Sorgum bicolor*), white sorghum flour (KD 4), wheat flour, sugar, margarine, and egg yolk. Tools used in this research were knife, basin, cutting board. oven, grinding, mixer, flour grinding machine, and flakes mold.

This research used Randomized Block Design (RBD) of 2 factors with 3 repeated measures. Factor I: types of sorghum flour (T): T_1: red sorghum flour (Sorghum bicolor) and T_2: white sorghum flour (KD 4). Factor II: Concentration of sorghum fluor (K): K_1: 25%; K_2: 50%; K_3: 75% and K_4: 100%. Flow diagram of sorghum flakes process can be seen in Figure 2. Analysis Method: Chemical Analysis conducting on

sorghum flakes products was water content and starch Analysis, and organoleptic test was conducted by using scoring method. In this method, panelists were asked to rate the level of their favorite tastes, colours, flavours, and crisps of sorghum flakes products by providing value or score as below: 5 = really like, 4 = like, 3 = neutral, 2 = somewhat like, and 1 = dislike. Panelists on this research were around 30 persons, which were selected by random, so they were expected to represent overall consumers.

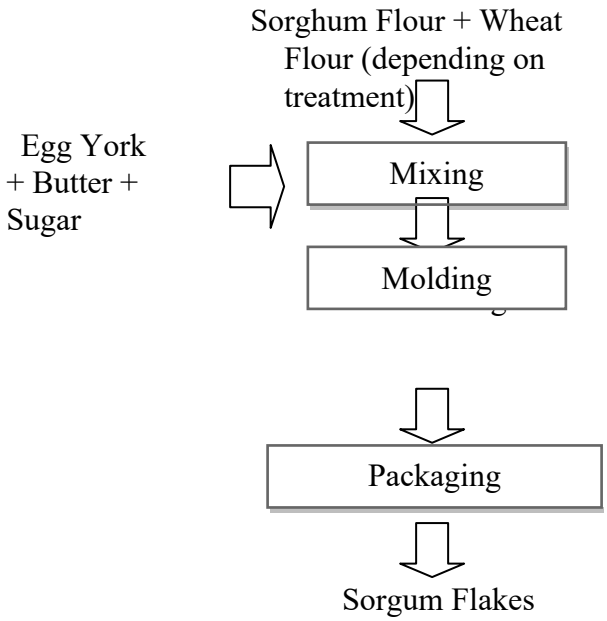


Figure 2. Flow Diagram of Sorghum Flakes Process

Data processing for water and carbohydrate contents of sorghum flakes were conducted by using variant analysis, if there were differences then Duncan Test wasconducted at the 5% confidence level, whereas for the organoleptic test with Friedman test. Alternative selection aimed at finding of the best alternative process. It was based on the concept of the acquisition of the expected value. The decision concept of expected value is to select a decision which has the maximum payoff (profit or usefulness). According to Siagian (1987), mathematical equation for payoff of the expected value is as below:

$$E_{pj} = \sum_{i=1}^{n} P(x_i) \,.\, f(x_i , d_j)$$

Note: E_{pj} = Expected value of payoff
$P(x_i)$ = The probability of each x_i ground state
x_i = Different ground state
d_j = Decisions which are taken into account
$f(x_i , d_j)$ = Acquisition of the ground state and d_j decision

III. RESULTS AND DISCUSSION

Observation results of organoleptic test for sorghum flakes with taste, color, flavor, and crispness parameters are presented in Figure 3, 4, 5, and 6, while results of Friedman test for sorghum flakes is presented on Table 1.

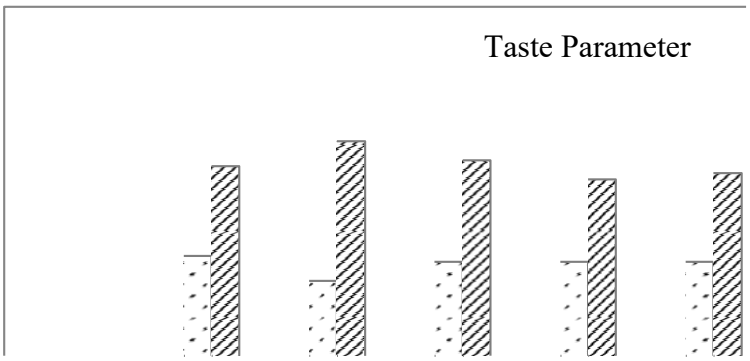
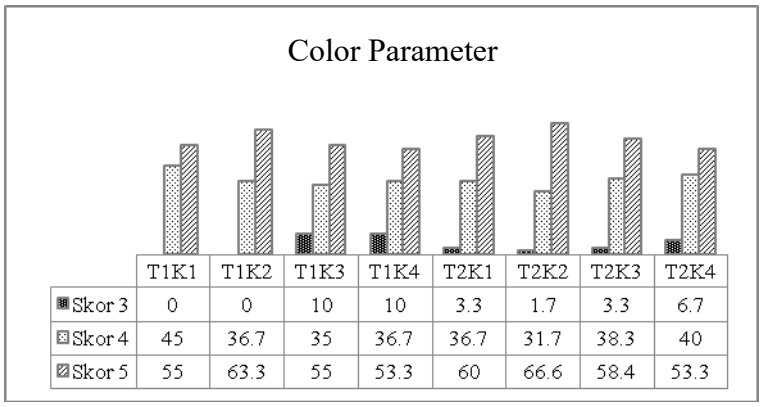


Figure 3. Calculation of results from organoleptic test percentage of taste parameter

Table 1. The result of the Friedman Test for sorghum flakes products

Parameter	Taste	Color	Flavour	Crispness
N	60	60	60	60
Chi-Square	12,476	19,893	7,470	3,403
df	7	7	7	7
Asymp. Sig.	0,086	0,006	0,382	0.845

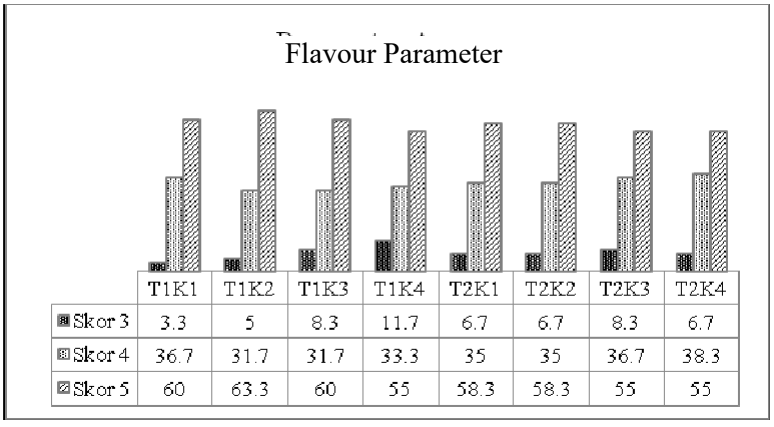
a. Friedman Test



	T1K1	T1K2	T1K3	T1K4	T2K1	T2K2	T2K3	T2K4
Skor 3	0	0	10	10	3.3	1.7	3.3	6.7
Skor 4	45	36.7	35	36.7	36.7	31.7	38.3	40
Skor 5	55	63.3	55	53.3	60	66.6	58.4	53.3

Figure 4. Calculation of results from organoleptic test percentage of color parameter

Based on the result of organoleptic test for sorghum flakes were: taste, color, flavor, and crispness parameters, showed that the highest score for taste parameter wasin the treatment of T1K2 (T1= T1= red flour / *Sorghum bicolor* (T1) and sorghum flour concentration K2= 50%), with percentage of 68.3% score 5 (really like), the second was in treatment of T2K2 (T1= white flour / KD4 (T2) and sorghum flour concentration K2= 50%), with percentage of 63.3.% score 5 (really like) and thetreatment T1K3 (T1= red flour / *Sorghum bicolor* (T1) and sorghum flour concentratioK3= 75%);



	T1K1	T1K2	T1K3	T1K4	T2K1	T2K2	T2K3	T2K4
Skor 3	3.3	5	8.3	11.7	6.7	6.7	8.3	6.7
Skor 4	36.7	31.7	31.7	33.3	35	35	36.7	38.3
Skor 5	60	63.3	60	55	58.3	58.3	55	55

Figure 5. Calculation of results from organoleptic test percentage of flavour parameter

Figure 6. Calculation of results from organoleptic test percentage of crispness parameter

The highest score for color parameter was in the treatment of T2K2 (T1= white fluor / KD4 (T2) and sorghum flour concentration K2= 50%), with percentage of 66.6.% score 5 (really like), the second was in the treatment of T1K (T1= T1= red flour / *Sorghum bicolor* (T1) and sorghum flour concentration K2= 50%), with percentage of 63.3.% score 5 (really like); the highest score for flavour parameter was in the treatment of T1K2 (T1= T1= red fluor / *Sorghum bicolor* (T1) and sorghum flour concentration K2= 50%), with percentage of 63.3.% score 5 (very favorable), the second was in the treatment of T1K1 and T1K3 (T1= T1= red flour / *Sorghum bicolor* (T1) and sorghum flour concentration K1= 25% and K3= 75%), with with percentage of 60.0% score 5 (really like); the highest score for crispness parameter was in the treatment of T1K2 (T1= T1= red flour / *Sorghum bicolor* (T1) and sorghum fluor concentration K2= 50%), with percentage of 68.3% score 5 (really like), the second was in the treatment of T2K1 (T1= white flour / KD4 (T2) and sorghum flour concentration K2= 50% and K3= 75%), both of them have percentage of 65% score 5 (really like).

On Table 1, it can be seen the result of Friedman Test for sorghum flakes showed that color parameter was significantly different (Sig 0,006 < 0,05), while taste parameter (Sig 0,086 > 0,05), flavor (Sig 0,382 > 0,05) and crispness (Sig 0,845 > 0,05) were not significantly different. This means that for color parameter of sorghum flakes was influenced by both factors, the type and sorghum flour concentration. Color of sorghum flakes was very influenced by color of sorghum fluor and the more flour was used, then the color was getting darker. The result of water content test was presented in Figure 7, showed that water content of sorghum flakes was around 2.17-2.22%.

The result of variant analysis showed that water content of soghum flakes was around Sig 0,144 > 0,05, meant thatwater content of sorghum flakes was not significantly different. This was in accordance with the result of organoleptic test for crispness, average percentage of more than 63% score 5 (really like).

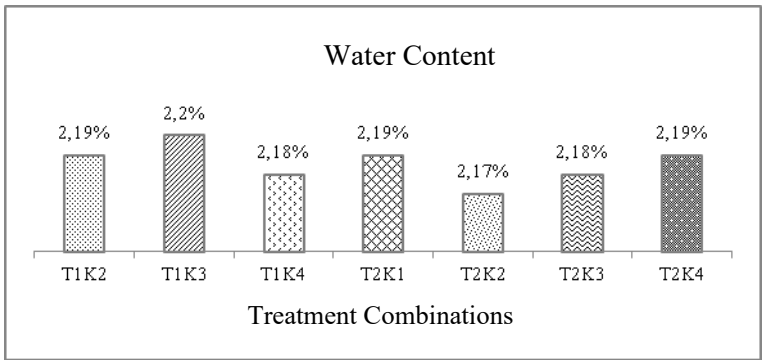


Figure 7. Calculation of results from water content of sorghum flakes

The result of starch test was presented in Figure 8, showed that starch of sorghum flakes was around 18.13-35.08. The result of variant analysis showed that starch of sorghum flakes was around Sig 0,00 < 0,05, this meant that starch of sorghum flakes was significantly different and there was an interaction Sig 0,00 < 0,05. Data analysis for starch of sorghum flakes was continued by Duncan Test at the confidence level of 5% such as presented on Table 2, showed that there was difference between starch of the both sorghum fluor, in which red sorghum fluor highest starch lowest than white fluor and the more fluor was used.

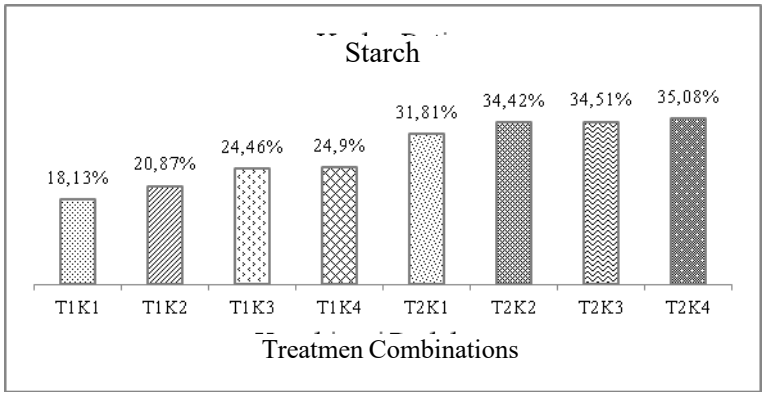


Figure 8. Calculation of results from starch

Table 2. Calculation of results from an interaction of treatment combinations for starch

Starch (%)										
	Interaction Type and Concentration Flour	N	Subset							
			1	2	3	4	5	6	7	8
Duncan[a,,b]	Interaction T1 and K1	3	18.1300 a							
	Interaction T1 and K2	3		20.8700 b						
	Interaction T1 and K3	3			24.4600 c					
	Interaction T1 and K4	3				24.8967 d				
	Interaction T2 and K1	3					31.8100 e			
	Interaction T2 and K2	3						34.4167 f		
	Interaction T2 and K3	3							34.5067 g	
	Interaction T2 and K4	3								35.4100 h
	Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = ,002.
a. Uses Harmonic Mean Sample Size = 3,000.
b. Alpha = ,05.
c. Mean in colums with noted by different alphabets show a significant level (Duncan Test at 5%)

And then starch of sorghum flakes was increasing Calculation of results for probability of sorghum flakes was presented in Figure 9. Probability or opportunity was confidence level of a person against anuncertain event. Probability analysis was conducted to determine the probability of each ground state. Ground state of quality includes taste, color, flavour, crispness, water content, and starch. Probability value showed the interest rate of a ground state, the greater the probability value of a ground state, then

the most important that ground state. In the interest of sorghum flakes, taste parameter (24.5%) was considered as the most important parameter when compared to the other parameter, i.e.color (20.25%), crispness (19%), water content (15.25%), starch (12.75%), and flavor (8.25%) respectively.

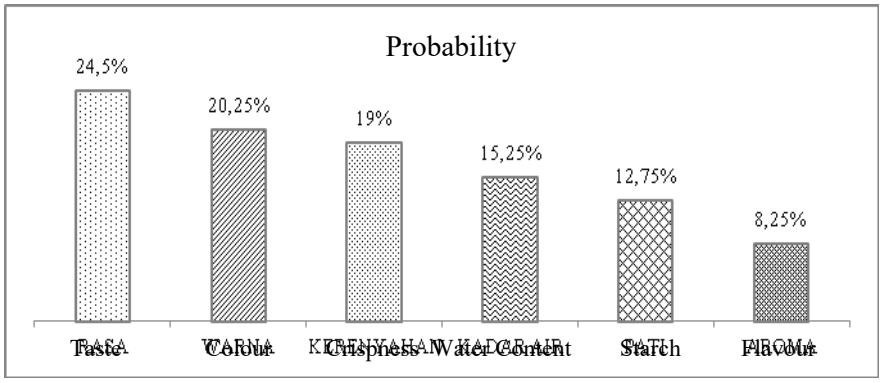


Figure 9. Calculation of results for probability of sorghum flakes based on the highest order.

The existing alternative process was compared to determine the optimal process. This alternative selection was conducted by calculating the expected value which was obtained from each alternative process. Calculation of results for the expected value of each alternative process was presented in Figure 10.

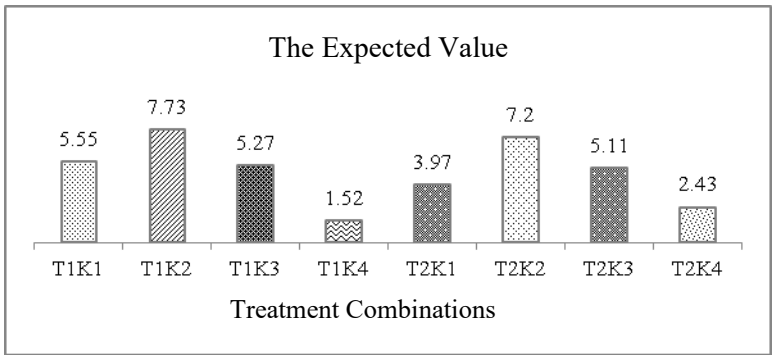


Figure 10. Calculation of results for the expected value of sorghum flakes.

Based on calculation of results for the expected value, then the alternativetreatment selected was the treatment of T1K2 (T1= red flour / *Sorghum bicolor* (T1) and sorghum flour concentration K2= 50%), with calculation of results for the expected value was about 7.73, the second was the treatment of T2K1 (T2= white flour /

KD4 (T2) and sorghum flour concentration K2= 50%), with calculation of results for the expected value was about 7.2. This means that treatment was based on the best quality if compared to the other treatment. Picture of materials and products of sorghum flakes was presented in Figure 11.

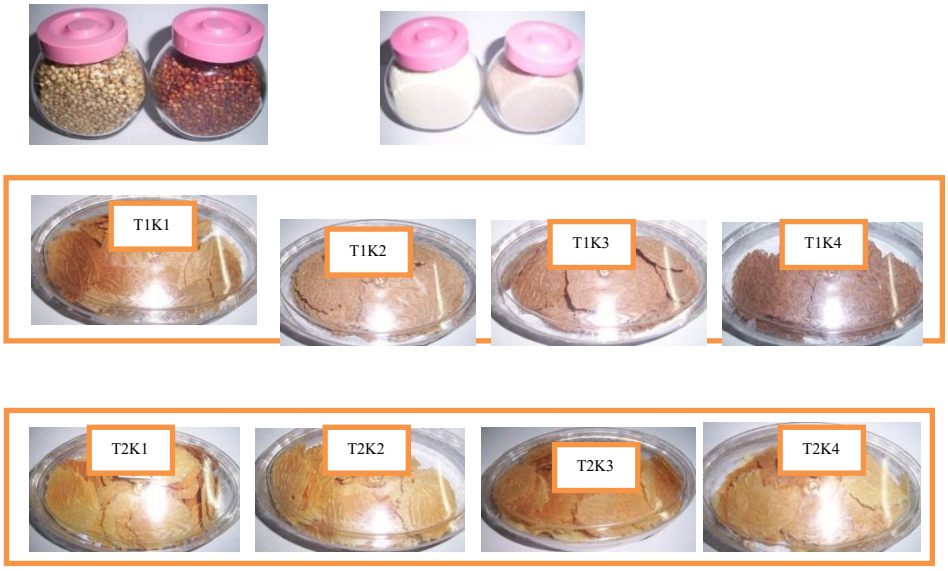


Figure 11. Materials and Products of Sorghum Flakes

The Best Treatment Combinations of Sorghum Flakes

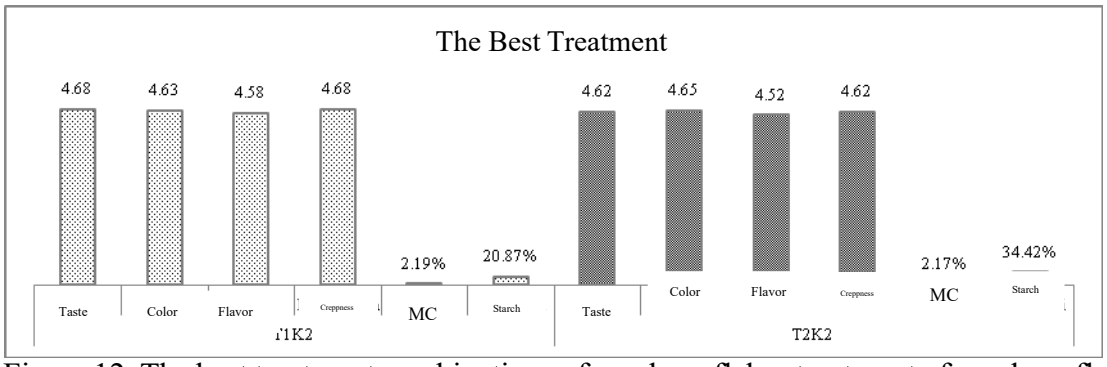


Figure 12. The best treatment combinations of sorghum flakes treatment of sorghum flour type (T): T1= red flour / *Sorghum bicolor* (T1) *Sorghum bicolor* (T1) and white flour / KD4 (T2); treatment of sorghum flour concentration (K): K2= 50%.

IV. CONCLUSIONS

Based on research findings, it can be concluded that: Sorghum flakes is an alternative product diversification based on soghum fluor. The best treatment combinations for sorghum flakes is the treatment of T_1K_2 (treatment of sorghum flour type (T): T1= red flour / *Sorghum bicolor* (T1) andtreatment of sorghum flour concentration (K): K2= 50%), and the treatment of T2K2 (treatment of sorghum flour type (T): white flour / KD4 (T2) and treatment ofsorghum flour concentration (K): K2= 50%).

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