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The Application of Purple Yam Flour for Stick Crackers

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***Abstract*— This study was conducted to determine the effect of substitution of wheat flour with purple yam flour on the physicochemical and organoleptic characteristics of sticks cracker and to obtain the appropriate concentration of purple yam flour for the best physicochemical and organoleptic characteristics of stick crackers. This study used a completely randomized design (CRD) with 6 levels of purple yam flour (0, 12.5%, 25%, 37.5%, 50%, and 62.5%) and 4 replications. The purple yam flour substitution gave a significant effect on physical parameters, namely hardness and color (L*, a*, b* and hue), anthocyanin content of stick crackers, and on the color and texture of sticks cracker, but gave no significant effect on its taste and aroma. The purple yam flour substitution increased the water, ash, fat, and crude fiber content, but decreased the value of carbohydrate and protein content when compared to the control. It is suggested that stick crackers be made with substitution of 50% purple yam flour. This level of substitution produced stick crackers with hardness value 1.55 gF, L* 14.58, a* 4.60, b* 0.19, 54.87% carbohydrate, 4.35% water, 28.87% fat, 9.34% protein, 2.57% ash, 0.67% crude fiber and anthocyanin 62.48 mg cyanidin3-glucoside equivalent/100 g.**

Keywords— **Purple yam; stick crackers; substitution**

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I. INTRODUCTION

Stick crackers are a fried snack made out of wheat flour, fat, eggs and water and have a flat long shape, salty, crunchy texture [1]. Stick crackers are generally made out of medium or low protein content of wheat flour since it doesn't need to be developed, indeed the gluten content influences the texture of the stick crackers. Purple yam tubers, on the other hand, does not contain any gluten but contain natural antioxidants such as anthocyanin. Purple yam anthocyanin content is 31 mg/100 g dry matter [2]. Purple yam tuber flour (Dioscorea alata L.) is a type of local food flour that contains carbohydrates (77.95%) as the main component, protein (10.49%), fat (0.29%), and ash (2.46 %) [3]. Stick crackers generally use medium protein flour (9.5%-11%) and high in carbohydrates (77.3%) that is similar to purple yam flour composition. Substitution of wheat flour with purple yam flour, especially in the manufacture of stick crackers as an alternative to increase the added value of local food ingredients. The substitution of wheat is known to affect the physicochemical and sensory properties of the cracker. The changes in protein type and content, in particular, changes the hardness, cohesiveness and so the acceptance of the panelist [4][5][6]. Based on this background, this research was carried out to determine the effect of substitution of wheat flour with purple yam flour on the physicochemical and sensory properties of sticks cracker and to obtain the appropriate concentration of purple yam flour for the best physicochemical and sensory properties of sticks cracker.

II. MATERIAL AND METHODS

A. Material

The main materials used in this study was purple yam tuber of a local variety with a weight of ±1.5 kg/tuber which were obtained from Pulau Tengah Village, Jangkat District, Merangin. The chemicals used consisted of buffer pH 1 and 4.5, and hexane. The tools used in this research were 60 mesh sieve, blender, mixer, analytical balance, desiccator, pasta maker, kitchen tools, desiccator, filter paper, spectrometer, color box, centrifuge, vortex, mortar, and laboratory glassware.

B. Methods

This research was conducted using a completely randomized design (CRD), with 6 levels of treatment (wheat flour substitution using purple yam flour) and 4 replications. The levels of substitution were:
P0= Purple yam flour 0% (control)
P1= purple yam flour 12.5%
P2= Purple yam flour 25%
P3= Purple yam flour 37.5%
P4= Purple yam flour 50%
P5= Purple yam flour 62.5%

Preparation of purple yam flour was carried out using method described by Lavlinesia et al (2023).[7]

Preparation of Stick Crackers [8]
Dry ingredients consisted of purple yam flour and wheat were mixed in a bowl. Wet ingredients which consisted of eggs (50 g), margarine (15 g), flavoring (2 g), mashed garlic (30 g) and fine salt whipped with a mixer at medium speed for 3 minutes. Dry and wet ingredients were mixed and to this mixture was added water. The dough was kneaded until smooth, sheeted using a pasta maker with a thickness of 3 mm. The sheets were further cut using a pasta maker with a length of 6 cm, fried until golden brown and cooled.

Texture of Stick Crackers
Texture measurements were carried out using a Steven LFRA (Leatherhead Food Research Association) Texture Analyzer. Steven's LFRA Texture Analyzer was set up before taking measurements. Steven LFRA Texture Analyzer tool settings as follows. Mode: measure force in compression (measuring the amount of force required to compress the sample), Plot: Final, Option: Normal, Trigger: Auto 4g standards, Distance: 3mm, Speed : 0,5 mm/s. The stick crackers to be measured were placed on the slab of the holding table. Press the start button on the Texture Analyzer tool. The probe pressed the onion stick at a speed of 0.5 mm/s up to a pressure distance of 3 mm. The probe used was cylindrical with a diameter of 2 mm. The trigger type used was the auto type. The probe was automatically search for the sample surface. The texture value was displayed on the tool display. Texture values were expressed in units of gram force (gF).

Chemical Composition of Stick Crackers
The chemical composition was determined using proximate, crude fiber, and anthocyanin content analysis. Water content was determined using SNI 2973, 2011[9] while the fat, protein and ash content were determined using AOAC (2005)[10], crude fiber [11] and the total of anthocyanin content [12]

Color of Stick Crackers
Color of the stick crackers was measured in CIE system and measured using the method described previously [13]. The sample was placed in the color box and photographed using a Fuji Finepix HS25XR digital camera (resolution 4608 x 3456). The distance from the camera to the sample ±40 cm. Photos were analyzed using Adobe Photoshop CS5 to determine the color distribution using a histogram window so that L* (light/bright), a* (red/green), and b* (yellow/blue) values can be displayed. These values were used to obtain the color description in www.colorhexa.com.

Scalar Test
The scalar test is a test where the panelists state the magnitude of the impression they obtain after consumption. This quantity can be expressed in the form of a scalar or numerical quantity. Line scalar test is a scalar test that uses a line as a certain parameter of an impression or sensory stimulation. The sensory evaluation of purple yam stick crackers was carried out using scalar testing involving color, aroma, taste and texture. The test used a panel of 25 people consisting of semi-trained panelists from Agricultural Product Technology students, University of Jambi. The panelists were asked to give an assessment according to their evaluation on the intensity for color, aroma, texture and taste by using an unstructured 5 scales straight line.

Data Analysis
ANOVA was applied to obtain the effect of the treatment. The ANOVA tests were followed by DnMRT post test if the significant difference was presented at $p<5\%$.

III. Result and Discussion

Purple Yam Flour
Purple yam tubers have dark or light purple flesh. The inner skin of the tuber has a deep purple color and contain a lot of mucus on the surface when peeled or sliced. The outer skin of the purple yam has a brown color with fine and rough roots and irregular shapes. The following is the composition value of purple yam flour (**Table 1**).

TABLE I
Major Chemical Composition of Purple Yam Flour

Composition	Amount (%)
Moisture	11.84
Protein	5.43
Fat	0.21
Carbohydrate	80.71
Ash	1.81

C. Stick Crackers

Stick cracker is a snack with the basic ingredients of wheat flour, fat, eggs and water which have a flat and long shape, a savory taste, a crunchy texture and the final process by frying

[1]. Based on our research, stick cracker with the above formulation can't be made by replacing 100% wheat with purple yam flour. It needs a binding agent to produce a compact dough. Stick crackers with partly purple yam flour substitution produces stick crackers with a more brittle structure if higher substitution is applied (**Fig. 1**).

Fig. 1 Stick crackers with several levels of purple yam flour substitution

The substitution of wheat flour using purple yam flour affected chemical composition of the stick crackers. The higher water and oil absorption capacity of purple yam flour when compared to wheat flour, leads to a higher water and fat content of stick crackers with an increasing level of substitution (**Table II**). At substitution higher than 12.5%, the moisture contents were above moisture contents for normal crackers which should be in the range of 3% [6]. The supplementation of protein into the formulation of stick crackers using substitution of purple yam flour is another important issue to be addressed as the protein content of the present stick cracker is much lower than functional cracker [4][5][6]. Similar to moisture content, the increasing parameter's value with increasing substitution level, was also observed for anthocyanin content. The effect of frying was also detected as the increasing of anthocyanin content in stick crackers occurred in lower slope than it should be.

TABLE II
CHEMICAL COMPOSITION OF STICK CRACKERS WITH SEVERAL LEVEL OF PURPLE YAM FLOUR SUBSTITUTION

Purple Yam Flour (%)	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Crude Fiber (%)	Antosianin (mg cyanidin 3-glucoside equivalent/100g sample)
0	2.08^{a}	2.21±0.11	25.56±0.62	10.66±0.39	59.49±0.13	0.48±0.09	0^{a}
12.5	3.67^{b}	2.34±0.09	29.86±0.31	10.23±1.00	53.91±0.91	0.57±0.08	24,04^{b}
25	4.69^{e}	2.41±0.21	29.58±4.71	9.65±1.81	53.67±3.31	0.76±0.21	46,23^{c}
37.5	4.66^{d}	2.63±0.12	28.75±0.75	9.76±1.66	54.20±2.59	0.92±0.11	58,99^{d}
50	4.35^{c}	2.57±0.07	28.87±0.90	9.34±2.25	54.87±2.10	0.67±0.24	62,48^{e}
62.5	5.56^{f}	2.62±0.03	29.87±0.63	9.05±2.66	52.90±3.54	0.84±0.13	74,81^{f}

Note: the numbers followed by different superscript in the same column are significantly different according to DNMRT.

D. Physical Characteri

E. stics of Stick Crackers

The most obvious effect of substitution of wheat flour using purple yam flour in the stick crackers was its physical appearance. The higher the substitution level, the darker stick cracker produced as shown by its L* value and the more brittle crackers as shown by its hardness value (**Table III**). The less compact dough in increasing amount of purple yam flour presumably could lead to brittle stick crackers. Need further analysis on the cohesiveness of the crackers to confirm this. The viscoelasticity of the dough which is responsible for the hardness of the crackers is influenced by the type and amount of protein in the dough. Similar to a result reported by Nicole [5] that a lower amount of wheat gluten decreased hardness of the crackers. In contrast, a study reports that the increase in whey protein isolate in the dough decreases the hardness of the crackers [4].

TABLE III
PHYSICAL CHARACTERISTICS OF STICK CRACKERS WITH SEVERAL LEVEL OF PURPLE YAM FLOUR SUBSTITUTION

Purple Yam Flour (%)	Hardness (gF)	L*	a*	b*
0	9.05^{f}	67.52^{e}	4.37^{c}	38.90^{f}
12.5	4.17^{e}	35.81^{d}	3.70^{b}	7.40^{e}
25	2.92^{de}	20.32^{c}	4.91^{f}	2.34^{d}
37.5	2.10^{cd}	17.32^{b}	4.59^{d}	-0.25^{a}
50	1.55^{bc}	14.58^{a}	4.60^{e}	0.19^{c}
62.5	0.6^{a}	14.6^{a}	3.28^{a}	-0.33^{b}

Note: the numbers followed by different superscript in the same column are significantly different according to DnMRT

F. Sensory Characteristics of Stick Crackers

The intensity of purple colour, crunchiness, delicious and yam flavour were increasing with the increasing amount of purple yam flour in the crackers (**Table IV**). Although the colour of purple in the flour changed due to air and heat exposure during processing, the panellists could detect the colour and scored as high intensity of purple in the product. In contrast to the moisture content presented in Table II and the hardness presented in Table III, the increase in substitution level increased the crunchiness of the product. Purple yam flour doesn't release a specific aroma that can be detected in the product leading to a low intensity of yam aroma of the crackers.

TABLE IV
SENSORY CHARACTERISTICS OF STICK CRACKERS WITH SEVERAL LEVEL OF PURPLE YAM FLOUR SUBSTITUTION

Purple Yam Flour (%)	Color*	Texture**	Taste***	Aroma****
0	1.00^{a}	3.56^{a}	3.76^{c}	1.44^{a}
12.5	1.96^{bc}	3.6^{b}	3.56^{a}	2.2^{bc}
25	4.16^{cd}	3.76^{c}	3.6^{b}	2.56^{cd}
37.5	4.4^{d}	4.08^{d}	4.08^{d}	2.76^{de}
50	4.56^{ef}	4.16^{e}	4.16^{f}	2.88^{ef}
62.5	4.76^{f}	4.24^{f}	4.12^{e}	2.96^{f}

Note:
The numbers followed by different superscript in the same column are significantly different according to DnMRT
Increasing intensity of: * purple; ** crunchiness; *** delicious; **** aroma of yam
The maximum value of intensities was "5"

III. CONCLUSION

The substitution of wheat using purple yam flour increased the water, ash, fat, and crude fiber content, but decreased the carbohydrate and protein content. The use of purple yam flour increased the crunchiness and the delicious taste of the crackers. It is suggested that stick crackers be made with 50% purple yam flour. This level of substitution produced a crunchy stick cracker with quite low protein content but high in anthocyanin content.

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REFERENCES

[1] Pratiwi, F. (2013). Pemanfaatan Tepung Daging Ikan Layang untuk Pembuatan Stik Ikan. In Universitas Negeri Semarang.

[2] Fang. Z., Wua. D., Yu. D., Ye, X., Liu. D., & C. J. (2011). Phenolic compounds in chinese purple yam and changes during vacuum frying. Food *Chemistry* 128:943-948. DOI:10.1016/j.foodchem. 2011.03.123.

[3] Afidin, M. N., Hendrawan, Y., & Yulianingsih, R. (2014). Analysis of Physical and Chemical Properties of the Making of Purple Uwi (Discorea alata), Yellow Uwi (Discorea alata) and White Uwi (Discorea alata) Flour. Jurnal Keteknikan Pertanian Tropis Dan Biosistem, 2(3), 297–303. http://jkptb.ub.ac.id/index.php/jkptb/article/view/234

[4] En Tay, R. R., Agatha, T., Somang, G., Yuliarti, O., & Lin Tan, E. L. (2022). Structuring wheat flour-based crackers using whey protein isolate. *International Dairy Journal, 128*. doi:10.1016/j.idairyj.2021.105314

[5] Nicole, T. Z. H., Nichelle, T. S., Elizabeth, T. E., & Yuliarti, O. (2021). Formulation of functional crackers enriched with fermented soybean (tempeh) paste: rheological and microstructural properties. *Future Foods, 4*. doi:10.1016/j.fufo.2021.100050

[6] Faccioli, L. S., Klein, M. P., Borges, G. R., Dalanhol, C. S., Machado, I. C. K., Garavaglia, J., & Dal Bosco, S. M. (2021). Development of crackers with the addition of olive leaf flour (Olea europaea L.): Chemical and sensory characterization. *Lwt, 141*. doi:10.1016/j.lwt.2021.110848

[7] Lavlinesia, Monica E., & Ulyarti. (2023). The Antioxidant Activity of Fresh Yam and Its Changes During Processing into Flour and Storage. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 8686–8694. https://doi.org/10.29303/jppipa.v9i10.3752

[8] Utomo, N. (2019). Pembuatan stik pangsit dengan penambahan tepung ampas kelapa. Prosiding Temu Teknis Jabatan Fungsional Non Peneliti, 17–19.

[9] Badan Standarisasi Nasional. (2011). SNI 2973: Biskuit.

[10] AOAC International (Association of Official Agricultural Chem ist. (2005). Official Methods of Analysis of AOAC International. 18th Edition.

[11] Lestario, L. N., Susilowati, M., & Martono, Y. (2010). Pemanfaatan Tepung Labu Kuning (Cucurbita Moschata Durch) Sebagai Bahan Fortifikasi Mie Basah. Prosiding Seminar Sains dan Pendidikan Sains VII. Jakarta: FMedia (Imprint Agro Media Pustaka).

[12] Ulyarti, Nazarudin, & Lisani. (2019). Optimization of Anthocyanin Content in Uwi Flour (Dioscorea alata) Using Response Surface Methodology. *Indonesian Food Science Technology Journal, 1*(2), 61-64. doi:https://doi.org/10.22437/ifstj.v1i2.6006

[13] León, K., Mery, D., Pedreschi, F., & León, J. (2006). Color measurement in L∗a∗b∗ units from RGB digital images. *Food Research International, 39*(10), 1084-1091. doi:10.1016/j.foodres.2006.03.006