

PAPER • OPEN ACCESS

Amylopectin Content, Expand Ability, and Organoleptic Properties of Yam Flour Cracker

To cite this article: Y Magfiroh *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **292** 012024

View the [article online](#) for updates and enhancements.

Amylopectin Content, Expand Ability, and Organoleptic Properties of Yam Flour Cracker

Y Magfiroh, W Hersoelistyorini, Nurrahman

Food Technology Department, Universitas Muhammadiyah Semarang, Indonesia

Corresponding author: wikanastri@unimus.ac.id

Abstract. The fulfillment of wheat flour in Indonesia is still by imports from other countries. To reduce the import dependency of wheat flour, food diversification based on tubers including yams needs to be done. Yam flour has potential as ingredient in crackers production. This study aims to determine the effect of substitution by yams flour and wheat flour on amylopectin content, expand the ability and organoleptic properties of yam crackers. This research using the Completely Randomized Design comprising two factors: Factor I, the proportion of yam flour (0, 1, 2 and 3 portion) and factor II, the proportion of wheat flour (17,18, 19 and 20 portion). The results showed that the best proportion treatment comprised 5 percent of yam flour and 100 percent of wheat flour, which produced expandability of 57,29 % and amylopectin content 53,04 %. Results of organoleptic tests included: Sense by 2,87 (slightly favored), color by 2,6/ (slightly favored) texture by 2,87/ (slightly favored), and smell by 2,87 (neutral).

Keywords: amylopectin, crackers, expandability, yams

1. Introduction

Crackers is a type of biscuits which have tasty, crunchy texture and suitable as a complement of tea. The high contents of carbohydrate and simple sugar in crackers make its commonly consumed as a snack or at breakfast^[1]. Generally, crackers are made from wheat flour, fat, and salt which is fermented with yeast^[2]. Some of the food products are using wheat flour as the main ingredient. Therefore, the demand for wheat flour continues to increase every year and makes the Indonesian government issues a policy of importing wheat flour.

One of the efforts to reduce the dependency of wheat flour is by increasing the potential of local commodities in Indonesia such as tubers. Gadung is one type of tubers belonging to the yam groups. Yam is very abundant in Indonesia, but it has not been used optimally. One of the methods to use yams is made into flour which then can be used as various processed food products such as noodles, sticks, cookies, and crackers^[3].

Amylopectin in food products is stimulating the puffing which derived from starch with high amylopectin content then be mild, porous, crispy and crunchy^[4]. In other cases, to get maximum growth power, the crackers dough must be in proportion of the flour and balanced fillers^[5]. The substitution of yams flour used in crackers products, in addition to having an effect on amylopectin levels and expandability will also affect the organoleptic of the crackers produced. Therefore, based on this study, the product of crackers with substitute of yams flour needs to be carried out by organoleptic testing related to sensory properties favored by the people.



2. Materials and Method

2.1. Materials and Tools

The used ingredients in the production of crackers biscuits are yams flour, wheat flour (Segitiga Biru), salt, sugar, cold water, baking powder (Hercules), skim milk (Leckers), margarine (Blueband) and yeast (Fermipan). Materials for chemical analysis include aquadest, H_2SO_4 dense, phenol, NaOH, HCl, $\text{Na}_2\text{B}_4\text{O}_7$, CH_3COOH , selenium, MO and PP indicators. While the tools used include pasta grinders, scales, ovens, mixers, trays, spoons, pizza cutters, measuring cups and basins. Equipment for analysis used oven, cabinet dryer, dexator, Kjeldhal tools, a set of extraction tools, weighing bottles, analytical balance sheets, burettes, stations, glass funnels, pipettes, flask, beaker glass, furnaces and fume hoods.

2.2. Research Procedure

Crackers Formulation

In this study, making crackers used wheat flour substituted with yams flour. Variations, in addition, are the proportion of wheat flour (20, 19, 18, 17) and the proportion of yams flour (0, 1, 2, 3). Formulations of crackers making are described in Table 1.

Process of Making Crackers

The making of crackers is by determining the formulation of basic ingredients, namely the proportion of yams flour and wheat flour according to the treatment of flour ratio which can be seen in Table 1. The process was conducted using a procedure according to the modified Ministry of Industry^[6]. Making crackers begins with mixing the ingredients, fermentation I for 30 minutes, flaking into sheets, cutting sheets, fermentation II and roasting. The parameters determined in the process of making crackers are temperature and roasting time.

2.3. Research Design

The experimental design in this study using Complete Random Design Factorial. The dependent variables in this study were amylopectin levels, expandability, and organoleptic testing, while the independent variables included the proportion of wheat flour and yams flour. Each experiment was repeated twice so that the experimental unit was 32 units.

Table 1. Formulation of making yams flour crackers substitution

Ratio of flour:yams flour	Sugar (%)*	Salt (%)*	Cold Water (%)*	Baking powder (%)*	Margarine (%)*	Yeast (%)*	Skim Milk (%)*
20 : 0	5	1,67	50	0,27	27,78	1,39	13,89
19 : 0	5	1,67	50	0,27	27,78	1,39	13,89
18 : 0	5	1,67	50	0,27	27,78	1,39	13,89
17 : 0	5	1,67	50	0,27	27,78	1,39	13,89
20 : 1	5	1,67	50	0,27	27,78	1,39	13,89
19 : 1	5	1,67	50	0,27	27,78	1,39	13,89
18 : 1	5	1,67	50	0,27	27,78	1,39	13,89
17 : 1	5	1,67	50	0,27	27,78	1,39	13,89
20 : 2	5	1,67	50	0,27	27,78	1,39	13,89
19 : 2	5	1,67	50	0,27	27,78	1,39	13,89
18 : 2	5	1,67	50	0,27	27,78	1,39	13,89
17 : 2	5	1,67	50	0,27	27,78	1,39	13,89
20 : 3	5	1,67	50	0,27	27,78	1,39	13,89
19 : 3	5	1,67	50	0,27	27,78	1,39	13,89
18 : 3	5	1,67	50	0,27	27,78	1,39	13,89
17 : 3	5	1,67	50	0,27	27,78	1,39	13,89

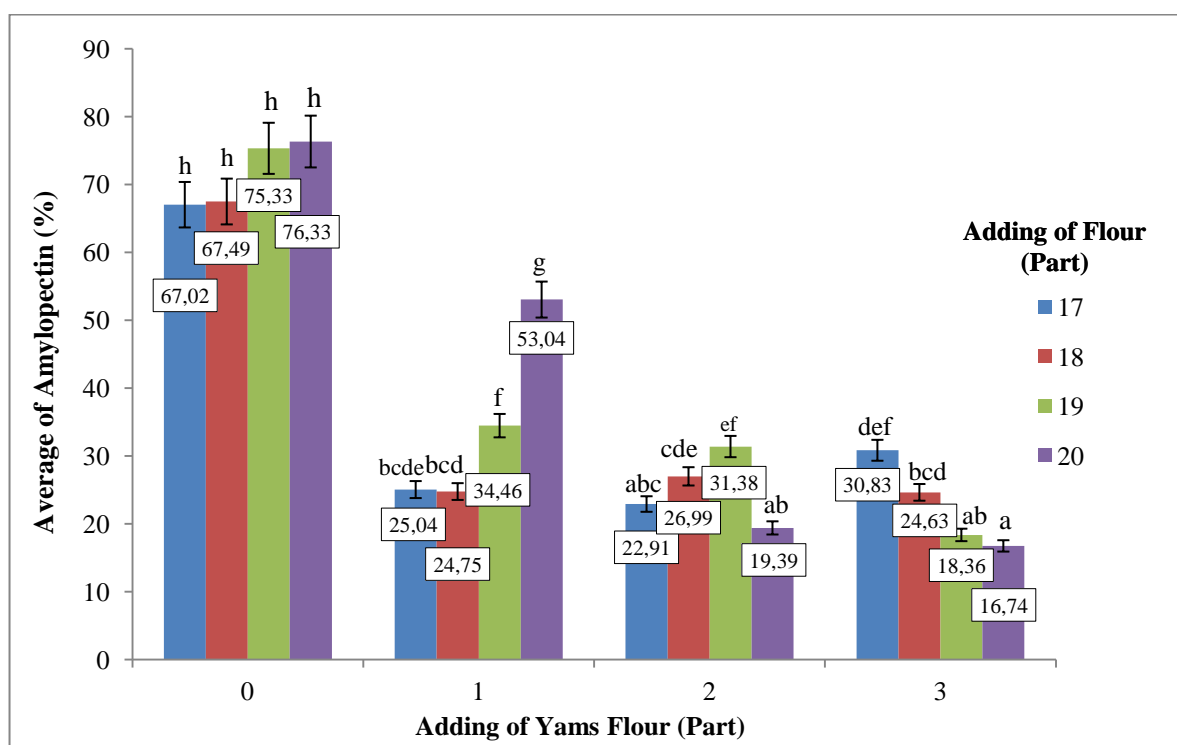
* The percentage is calculated based on the total amount of flour used

3. Result and Discussion

Crackers are one type of crispy biscuits and likely taste savory and salty. In this study, the main process of making crackers is fermentation and roasting. The addition of yams flour aims to substitute the use of wheat flour as the main ingredient. Furthermore, crackers products will be analyzed physical, chemical and organoleptic properties to get the best results and be tested proximate. The results of research from yams flour substitution crackers are as follows:

3.1. Amylopectin Content

Starch is the main source of carbohydrates in food. Starch is usually shaped as discrete particles called granules. The main component in starch is amylose and amylopectin. The results of the analysis of amylopectin levels can be seen in Figure.1



Note:: Different superscripts show significantly different results ($p < 0.05$), the lowest value starts from superscript a, b, c then d.

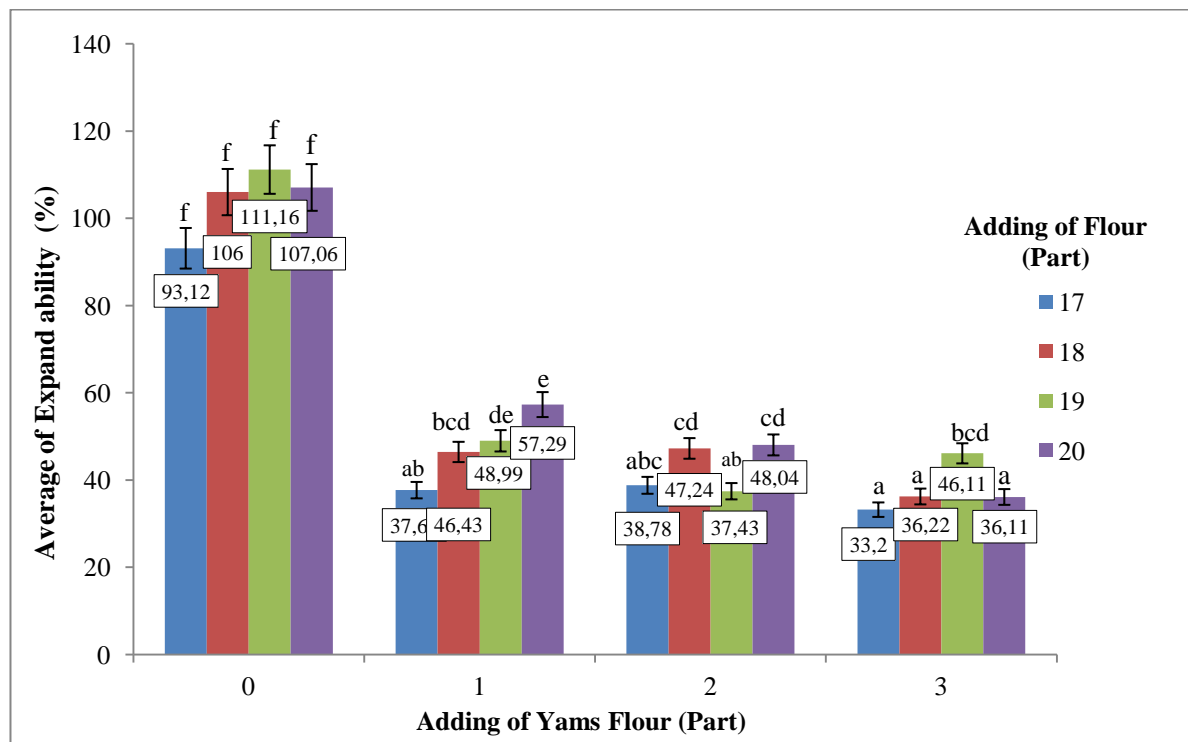
Figure 1. Average levels of amylopectin crackers substituted for yams flour

Based on the results of statistical analysis showed a significant effect of the addition of yams on the levels of amylopectin crackers indicated by a p-value of 0,000 ($p < 0.05$). Whereas the addition of flour also had a significant effect on the levels of amylopectin crackers with a p-value of 0.015 ($p < 0.05$). The interaction between yams flour and wheat flour also significantly affected the crackers expandability which was indicated by a p-value of 0,000 ($p < 0.05$). Furthermore, the different test using the Duncan method with a confidence level of 95 percent indicating that crackers with the formulation of addition of 0 parts yams flour have the highest amylopectin content both with the addition of 17, 18, 19 and 20 parts of wheat flour. Amylopectin crackers (control only using wheat flour) showed a significant difference in crackers with the proportion of adding gadung 1, 2 and 3 parts.

Based on Figure 1. shows that amylopectin content in crackers tends to decrease with increasing yams flour addition. This is because wheat flour which contains higher levels of amylopectin is equal to 75.03 percent compared to amylopectin content in yams flour as much as 47.75 percent^[7]. The function of Amylopectin is to give crispy properties to crackers.

3.2. Expand Ability

Analysis of the expandability of crackers in substitution of yams flour is done by measuring the length, width and height before and after the crackers are baked. The results of the flower power analysis can be seen in Figure 2.



Description: Different superscripts show significantly different results ($p < 0.05$), the lowest value starts from superscript a, b, c then d.

Figure 2. Average of Growth Power Crackers Yams FlourSubstitutions

The results of the statistical analysis showed that there was a significant effect of the addition of yams flour to the expand ability of crackers which was shown by a p value of 0,000 ($p < 0.05$). Whereas the addition of flour also had a significant effect on the expandability of crackers with a p value of 0.008 ($p < 0.05$). The interaction between yams flour and wheat flour also significantly affected the crackers expandability which was indicated by a p value of 0.014 ($p < 0.05$). Furthermore, the further test using the Duncan method with a confidence level of 95 percent indicating crackers with the addition of 0 parts yams flour and flour 1, 2 and 3 parts have the best development expandability compared to other formulation crackers. The expandability of the control crackers (only the use of flour) showed a significant difference in crackers with the proportion of yams flour 1, 2 and 3 parts added.

The expandability of crackers is influenced by the presence of gluten. This is in accordance with the statement of Anggraeni et al., (2015) that the more additions to substitute flour will create the smaller expandability of the product produced^[8]. This is because the gluten content in the dough gets lower with the addition of yams flour. The absence of gluten in yams flour results in the role of gluten as an air trap and maintains the development of the volume of food is getting weaker so that the power of crackers can not be maximized.

3.3. Organoleptic Properties

Color

According to Winarno (2008) besides being a factor that determines quality, color can also be used as an indicator of freshness or maturity^[9]. Whether or not the method of mixing or processing can be characterized by the presence of uniform and even colors. The following are the results of sensory testing of the colors of the crackers shown in Figure 3:

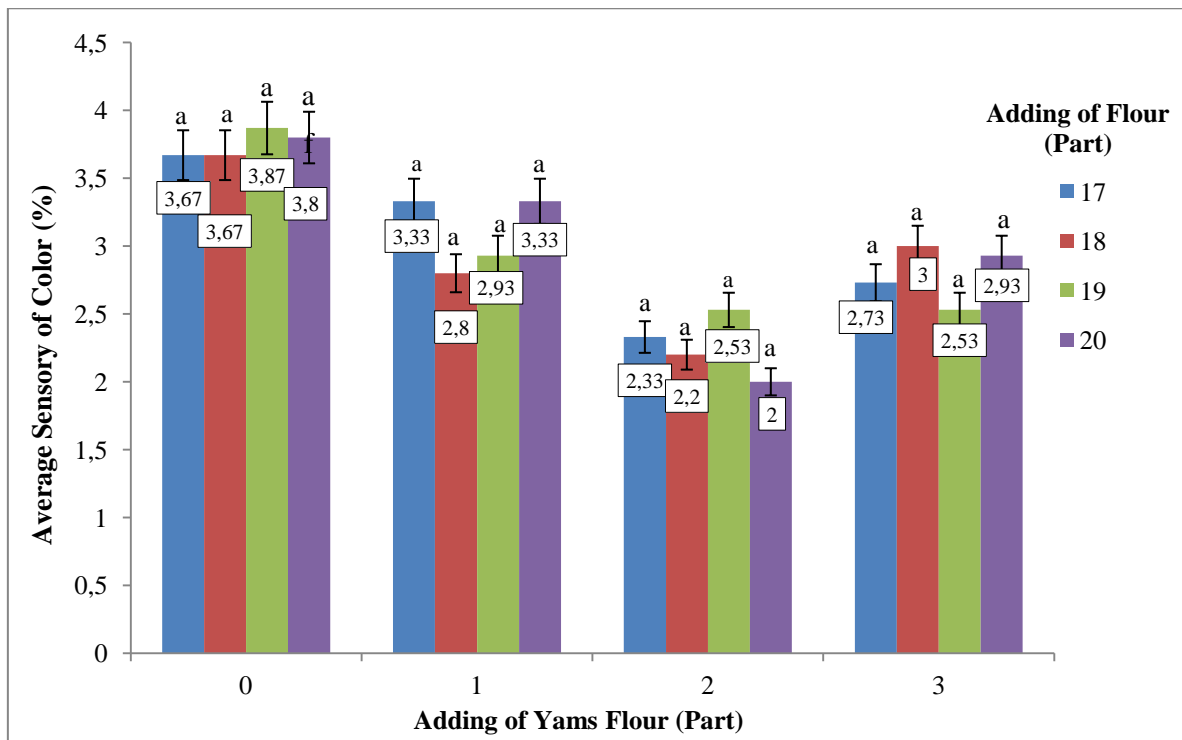


Figure 3. The average level of preference of panelists for the color of crackers substituted for yam flour

Description: The same superscript shows results that are not significantly ($p > 0.05$).

The results of the statistical analysis showed that there was an interaction of adding yam flour and wheat flour which did not significantly affect the panelists' preference for color in crackers, this was indicated by the p-value of 0.207 ($p < 0.05$). Figure 3. shows there is no real difference in color between control crackers (only the use of wheat flour) with crackers adding yam flour 1, 2 and 3 parts. As for the color of the average crackers, the panelists preferred the crackers with the addition of 0 parts flour both with the addition of wheat flour 17, 18, 19 and 20 parts.

The brownish yellow color of crackers is obtained naturally from the addition of yam flour and wheat flour which will form a brownish yellow color on crackers after roasting which is commonly called a non-enzymatic browning reaction or a Maillard reaction. Maillard reaction is a reaction between reducing sugars and proteins (amino acids). The results of these reactions produce brown ingredients^[8].

Taste

Taste is an important factor in determining the acceptance or rejection of food by the panelists. Taste can be assessed as a response to stimulus derived from chemical compounds in food that give the impression of sweet, bitter, sour, and salty^[10]. The following are the sensory test results for the taste in the crackers shown in Figure 4.

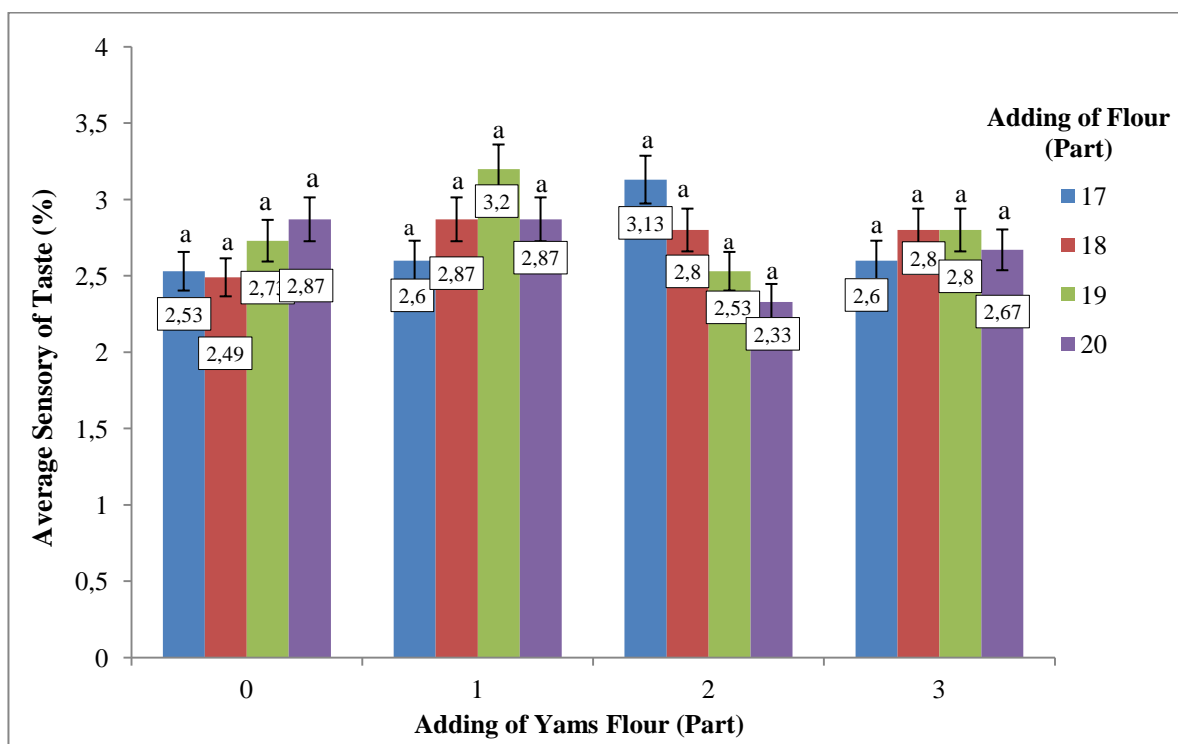


Figure 4. Average panelist preference for taste of substitution yam flour crackers

Description: The same superscript shows results that are not significantly different ($p > 0.05$)

Based on the results of the test, statistical analysis showed that there was no interaction of addition of yam flour and wheat flour so that it did not have a significant effect on the acceptability of the taste of crackers by the panelists. This is indicated by a p value of 0.054 (> 0.05). As for the taste of crackers, which on average are favored by panelists with a confidence level of 95 percent are crackers with the addition of 1 part yam flour with various additions of flour both 17, 18, 19 and 20 parts. The preference of panelists for the taste of crackers is greatly influenced by the addition of additional ingredients such as margarine, skim milk and salt. Addition of margarine can enhance the taste of a food product. In addition, skim milk also gives the milk a distinctive taste to the crackers so that it is favored by panelists and the addition of salt which gives the crackers a salty taste.

Flavor

Aroma is the result of chemical stimulation of the olfactory nerves located at the end of the nasal cavity. Aroma determines the delicacy of many foods and is more related to the five senses of smell. The organoleptic test results of aroma crackers after roasting can be seen in Figure 5 below:

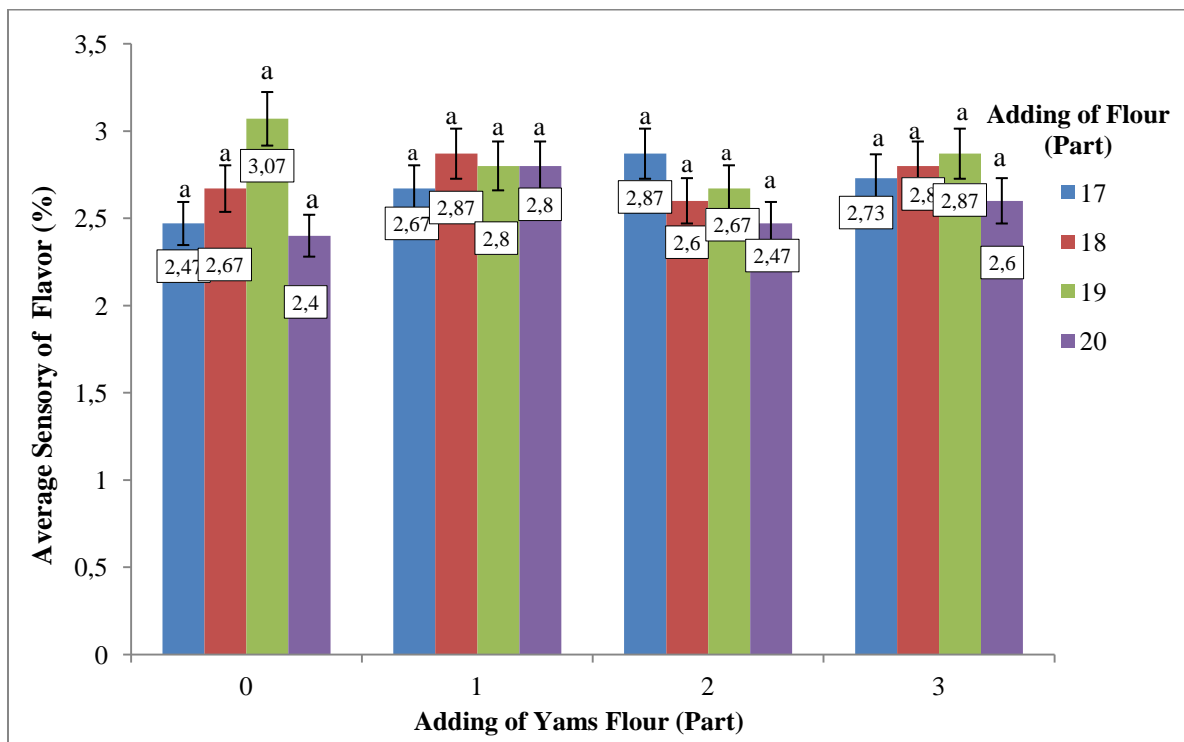


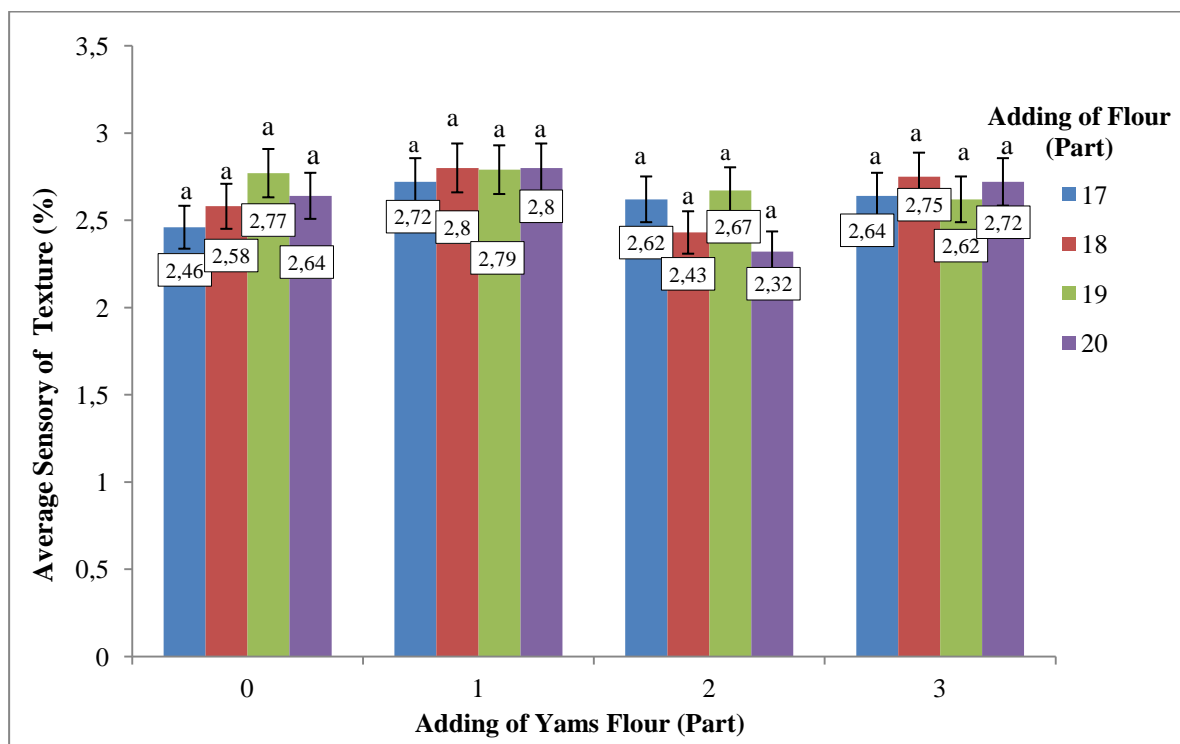
Figure 5. The average level of preference of panelists for the aroma of crackers substituted for yam flour

Description: The same superscript shows results that are not significantly different ($p > 0.05$)

Based on the results of statistical tests, there was no interaction between the addition of yam flour and wheat flour so that it did not have an effect on the aroma acceptance of crackers. This is indicated by the p value of 0.118 (> 0.05) with a confidence level of 95 percent. The average flavor preferred by panelists is crackers with the addition of yam flour 1 part good addition of wheat flour 17, 18, 19 and 20 parts. But the most preferred flavor of crackers is the addition of 0 parts yam flour and 19 parts gadung flour.

Texture

Texture is one of the important elements of a food product that is sometimes more important than aroma and taste. Texture has a significant influence on food, which makes the food or product worthy of being liked^[11]. The following are the sensory test results for the taste in the crackers shown in Figure 6.



Description: The same superscript shows results that are not significantly different ($p > 0.05$)

Figure 6. The average level of preference of panelists for the texture of crackers substituted for yam flour

Based on the results of statistical analysis, the addition of yam flour to crackers did not affect the level of texture preference by panelists, as indicated by the P value of 0.437 (> 0.05). Meanwhile, based on Figure 10., the average panelist likes the texture of crackers with the addition of yam flour, 1 part is good for the addition of wheat flour 17, 18, 19 and 20 parts.

The crispness of a food product can be judged based on the sound produced when the product is broken. Usually, for products that are crisper, they will produce a louder sound^[12]. Amylopectin functions to give crisp and crisp properties to crackers. Addition of sugar and butter also has an influence on the texture of crackers.

4. Conclusion

Based on the research, the best amylopectin levels were found in crackers with a proportion of 1 part yam flour and 20 parts wheat flour. The results of testing the best expandability crackers substitute for yam flour are found in crackers with a proportion of 1 part yam flour and 20 parts wheat flour. The results of testing the best sensory properties of crackers substitute for yam flour are found in crackers with a proportion of 1 part of yam flour and 20 parts of wheat flour.

Acknowledgment

This research was funded by "The Applied Product Research Program Kemenristek Dikti 2017" obtained by Hersoelistyorini Wikanastri.

Reference

- [1] Driyani, Y. 2007. *Biskuit Crackers Substitusi Tepung Tempe Kedelai sebagai Alternatif Makanan Kecil Bergizi Tinggi*. Skripsi. Jurusan Teknologi Jasa dan Produksi Fakultas Teknik, Universitas Negeri Semarang, Semarang.
- [2] Manley, D.J.R. 1983. *Technology of Biskuit, Crackers, and Cookies*. Ellis Horwood Limited Publisher, London.
- [3] Suismono, P. 1998. *Kajian Teknologi Pembuatan Tepung Gadung dan Evaluasi Sifat Fisikokimianya*. PATPI. PAU Pangan dan Gizi UGM. Yogyakarta.
- [4] Koswara, S. 2009. *Teknologi Modifikasi Pati*. eBookPangan.com. Diakses 19 Oktober 2017.
- [5] Soemarmo. 2005. *Kerupuk Udang*. Fakultas Teknologi Pertanian. Institut Pertanian Bogor. Bogor.
- [6] Departemen Perindustrian. 1990. Standar Industri Indonesia (SII). Standar Mutu Biskuit (SII: 0177-90).
- [7] Setiawan, H. 2014. *Karakteristik Tepung Gadung Dayak Hasil Proses Pengolahan Secara Basah, Semi Basah dan Kering*. Skripsi. Jurusan Teknologi Hasil Pertanian Fakultas Teknologi Pertanian, Universitas Jember. Jember.
- [8] Anggraeni Y., Windarti W. S., Praptiningsih Y. 2015. Karakteristik roti tawar dengan substitusi tepung gayam (*Inocarpus edulis* Fors). Jurnal Ilmiah Teknologi Pertanian Universitas Jember. Vol : 12 No. 2: 23-26.
- [9] Winarno, F.G. 2008. *Kimia Pangan dan Gizi*. PT Gramedia Pustaka Utama. Jakarta.
- [10] Soekarto, Soewarno. 1985. *Penilaian Organoleptik untuk Industri Pangan dan Hasil Pertanian*. Bharatara Karya Aksara, Jakarta.
- [11] Trenggono dan Sutardi. 1990. Biokimia dan Teknologi Pasca Panen. Pusat Antar Universitas Pangan dan Gizi UGM, Yogyakarta.
- [12] Palupi T.H., Zainul A., dan Nugroho. 2011. Pengaruh pre gelatinisasi terhadap karakteristik tepung singkong. Telnologi Pangan Vol 1 No. 1.