Quality Development of Bagiak (Osing Ethnic's Snack) Using Gembili (*Dioscorea esculenta* L.) Flour

Herlina[1*], *Nita* Kuswardhani[2], *Lenny* Widjayanthi[3]

[1]Department of Agricultural Product Technology, Faculty of Agricultural Technology, University of Jember East Java Indonesia-68121,
[2] Department of Agricultural Industrial Technology, Faculty of Agricultural Technology, University of Jember East Java Indonesia-68121,
[3] Department of Agribusiness, Faculty of Agricultural, University of Jember East Java Indonesia-68121

Abstract. The development of food product for improving the product quality was costly, especially if it had to reformulate the product. Therefore, finding the alternative raw materials which nutritious food and has a bioactive component that beneficial for health, was one of the ways to reduce cost. One of the raw materials that has Glucomannan as a bioactive component, was Gembili tuber (*Dioscorea esculenta* L.) as a local tuber which was widely grown in Banyuwangi, East Java. Osing ethnic's snacks that are widely produced by the community in the district of Banyuwangi, East Java province is a Bagiak. Bagiak is cookies made from cassava starch (tapioca) and arrowroot starch. In the market, bagiak has low quality, un-uniform shapes, un-similar color, no value-added and causes obesity due to higher sugar content. The purpose of this research was to improve the quality of Bagiak through Gembili flour substitution. The result showed that substitution of 5% Gembili flour has higher fiber with 0.62% effectiveness index value of panelist (in term of color, taste, flavor, texture and crispness), baking loss 12.50±0.65 %; lightness 52.48±0.45; texture 689±1.09 g/1mm; Water Holding Capacity (WHC) 172.5±1.32%; water content 4.50± 0.33%; ash 0.5±0.04 %; protein 2.50±0.12 %; fat 8.50±1.09 % and carbohydrate 84.00±1.53 %.

Keywords— ethnic's osing, bagiak, gembili tuber flour, glucomannan

1 Introduction

Technological advances and increasing levels of education have led to increasing challenges for food producers. Today consumers are more critical in deciding which products they will consume as well as in the selection of food products. One important reason why consumers decide to buy or not buy food products on the market is health factors other than taste and price factors. For example, whether the food produced is related to obesity, cardiovascular disease, heart disease and beauty. Responding to consumers' needs for the emerging trends in the market, food businesses need to undertake a series of fundamental changes in response to these trends. The usual response is taken by improving the quality of products produced, for example by substituting foodstuffs containing nutritional components or bioactive components.

Osing ethnic snacks that are widely produced by the people in Banyuwangi district, East Java province is Bagiak. Bagiak is a kind of cookies made from tapioca (cassava starch) and arrowroot starch and mixed with sugar and other ingredients. The taste of this cake is sweet, savory and crispy with the cinnamon's flavor. Usually, the market-quality cakes are low, un-uniform shape, the color is not the same, no added value and causes obesity because the raw material consists of starch and sugar.

One of the local resources that is widely cultivated by the osing ethnic group in Gintangan village, Blimbingsari sub-district, Banyuwangi district is the gembili tuber (Dioscorea esculenta L.)[2]. Gembili is an important source of carbohydrates after rice, corn and cassava [1]. Until now, gembili tubers are still considered as inferior tubers whose utilization is still very limited such as boiled or steamed, not even harvested even though the harvest season arrives. According to [11], besides containing starch and high fiber, the gembili tuber also contains water-soluble polysaccharides in the form of glucomannan. Glucomannan can reduce cholesterol levels and blood glucose levels. With its glucomannan content, gembili bulbs not only function as a source of carbohydrates but also have health functional properties [8,9,17].

Gembili flour with a dry mechanical method through drying combination between sunlight and oven produces has yield ranging from 20-25%, the white degree between 58-60%, and 2.5% of glucomannan content [7]. The usefulness of gembili flour as glucomannan-rich flour is quite extensive, both in the field of food and non-food. In the field of food, gembili flour can be used as ingredients or food additives for various types of processed food products, such as noodles or pasta. These food additives will increase the water holding capacity, improve temperature stability, thickener, mouthfeel, and reduce starch solubility. Other functions are texture improver, stabilizer, foaming agent, gel strength, the substitution of gelatin, heat stability, moisture enhancers and others [4,5,12]. Other activities are drug delivery, bioadhesive properties improvement, cellular therapy, materials for cell immobilization, encapsulation materials, films and membranes, coating materials, cosmetics, emulsifiers, surfactants and others[14].

Moreover, the addition of glucomannan flour in food products can improve functional health as a source of dietary fiber (cholesterol), cholesterol-lowering

* Corresponding author: lina.ftp@unej.ac.id

(hypocholes- terolemia) [8,13,15] and blood sugar stabilizer (hypoglycemic) [6]. The benefits of glucomannan for health include reducing blood cholesterol, slowing the emptying of the stomach, and accelerating satiety so that it is suitable for diet foods for diabetics. Even products in the form of pasta which are claimed to be healthy from wheat added with glucomannan flour have been patented in the United States by US2008 / 02927696A1 by Tang and Wang (2008)[7]. In this study, variations in the substitution rate of gembili tuber flour will be carried out in the making of Bagiak, so it has good physical and chemical properties even more preferred by the customer.

2 METHODOLOGY

Materials and tools

The research materials used in this study were: gembili tuber flour, tapioca starch, arrowroot starch, granulated sugar, eggs, cinnamon powder, and butter. The analytical materials used in this study were aqua dest, selenium, H_2SO_4, 40% NaOH, red methyl, methyl blue, boric acid, HCl, petroleum benzene, and ethanol.

The tools used in this study are: baking pan, analytical scales, weighing bottles, tongs, eclipse, oven cabinet, measuring glass, color reader Minolta, rheotex SD-900, flask, kjehdal butchi flask, buret, soxhlet, Yenaco model YC-1180 centrifuge and tubes, vortex Maxi Max 1 Type 16700, porcelain crucible, furnace, Erlenmeyer, spatula, desiccator

Research Method

Gembili Tuber Flour Making

Gembili tubers were peeled, washed thoroughly to remove dirt and mucus. Furthermore, the chips were made with a thickness of 1-3 mm, and air-dried for 2 days, then oven 60 ° C to dry for 24 hours. The dried chips were then grinded and sifted with 80 mesh.

Making of Bagiak

Bagiak is made from combining gembili tuber flour, tapioca, and arrowroot starch as basic ingredients. The composition of the ingredients can be seen in Table 1.

Table 1 Ingredients of Bagiak per 250 g mixed flour

Ingredients(g)	P0	P1	P2	P3
Tapioca	125.00	118.75	112.50	106.25
Arrowroot starch	125.00	118.75	112.50	106.25
Gembili Flour	0.00	12.50	25.00	37.50
Sugar	125.00	125.00	125.00	125.00
Egg	12.50	12.50	12.50	12.50
Butter	25.00	25. 00	25.00	25.00
Keningar	7.00	7.00	7.00	7.00
Total	**419.50**	**419.50**	**419.50**	**419.50**

Bagiak was made through the following steps: sugar was cooked with water until it boils and allows it to cool down in minutes. Meanwhile, eggs were stirred until foamy, then mixed with butter, added with hot water and the cinnamon powder and stirring constantly, added melted sugar and stirred until smooth. After that add in half, the flour mixture and mix the batter *as little as possible* and stop mixing as soon as there is no more visible flour on the dough or at the bottom of the bowl. Scooped the dough and formed with a length of 5 cm, put on a baking sheet without butter and baked for 40 minutes with 150 ° C.

Experimental Design

The experimental design used a Completely Randomized Design (CRD) with one factor with 4 treatments and repeated 3 (three) times. Data were analyzed by ANOVA, and if there were significant differences, the Duncan Multiple Range Test (DMRT) was further tested [20] and Friedman test for organoleptic tests[10]. The best treatment will be known by effectiveness testing [19].

Research Parameters

Observation on the physical properties of Bagiak which are substituted for gembili tuber flour was baking loss, color brightness, texture, water holding capacity (WHC). While the parameter of chemical properties was moisture content, ash content, protein content [3] and organoleptic test: color, taste, flavor, texture, and crispness

3.RESULT AND DISCUSSION

Physical properties

The result of physical properties can be seen in **Table 2.**

Table 2 Physical analysis of Bagiak with various concentrations of gembili flour substitution

Treatment	Baking loss (%)	Lightness	Texture g/1mm	WHC (%)
P0	18.65±0.42c	54.62±0.54c	655±2.34a	158.63±1.45a
P1	12.50±0.65c	52.48±0.45c	689±1.09b	172.35±1.32b
P2	10±1.20b	50.01±0.76b	712±1.45c	198.00±1.23c
P3	9±0.91a	49.43±0.64a	720±1.34c	201.00±1.45c

Noted: the same letter indicated insignificantly different on level 0.05

ANOVA showed that the substitution of gembili tuber flour in making Bagiak has a significant effect on baking loss, lightness of color, texture, and WHC of cake produced. Table 1 shows that the higher the substitution of gembili tuber flour in the processing of cakes, the percentage of baking loss and the brightness of the color decreases, while the texture and WHC increase. The higher concentration of gembili tuber flour increase in texture and WHC due to the large enough WHC capacity, 350.34% [8] that will trap other components and form a matrix so that it causes the cookies structure is harder and can reduce baking loss. Glucomannan content in gembili tuber flour will increase WHC value because glucomannan is hydrocolloid [18]. The ability of flour to absorb water is influenced by the amylose content and the fiber content of food in the ingredients. [18] states that high amylose levels increase water absorption, [11], suggests that dietary fiber components provide functional characteristics that include water-binding capacity[16], capacity to expand and absorb oil. Whereas the ability of Bagiak to absorb water is influenced by glucomannan which is contained in gembili tuber.

The lightness of the color of Bagiak which is substituted with gembili tuber flour will decrease along with the increase in the concentration of gembili tuber flour, this is because the material of gembili tuber flour has a lower brightness of 58-60 [7], compared to tapioca (80.01) and arrowroot starch (72,56).

Chemical Analysis of Bagiak

Chemical properties of Bagiak that made from various concentration of Gembili flour was shown in **Table 3**.

Table 3. Chemical analysis result of Bagiak

Treatment	Water content (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)
P0	3.02± 0.23a	0.49± 0.23a	1.76± 0.34a	8.49± 1.34a	86.24± 1.02b
P1	4.50± 0.33b	0.50± 0.42a	2.50± 0.12b	8.50± 1.09a	84.00± 1,53b
P2	5.12± 1.02c	0.51± 023a	3.02± 0.87c	8.53± 0.99a	82.82± 1.23a
P3	5.35± 0.98c	0.52± 0.46a	3.27± 1.0c	8.54± 1.22a	82.32± 0.98a

Noted: the same letter indicated insignificantly different on level 0.05

Chemical analysis of the product is needed to determine the chemical composition of the final product because during its processing there must have been a change, especially in the reduction of nutrients due to the use of heat with a high temperature. ANOVA shows that the substitution of gembili tuber flour in the making of Bagiak has a significant effect on water content, protein and carbohydrates, while ash content and fat content have no significant effect. Table 3 shows that increasing the substitution of gembili tuber flour in the processing of Bagiak will increase water content, protein and reduce carbohydrate levels. Increased water content is caused of glucomannan content of the gembili tuber flour that will reduce the free water content, prevent the migration of water in the dough, increase the volume of Bagiak and slow down the drying process of Bagiak.

The increase in protein content in Bagiak along with an increase in the substitution of gembili tuber flour is due to its basic ingredients. Arrowroot starch protein content (0.23%) and tapioca starch (0.50%) are smaller than gembili tuber flour (2.56%), so that the greater concentration of gembili tuber flour substituted for baking, the protein content tends to increase. Whereas the decrease in carbohydrate levels is influenced by the content of other nutritional values such as ash, water, protein and fat content (by different calculation of carbohydrate levels). The more substitution concentration of gembili tuber flour, the carbohydrate content tends to decrease as well.

Organoleptic of Bagiak [22]

Organoleptic tests are carried out to determine the acceptance of prospective customers. The sensory test method includes color, flavor, texture, and taste to assess the organoleptic of a product. Based on the Friedman test, it can be seen that the substitution of gembili tuber flour in Bagiak has a significant influence on the level of color, texture, and crispness but not for taste and flavor.

The addition of gembili tuber flour produces browning color on the product and the production of gembili tuber flour of ≥ 10% shows the panelist's preference decreases, this is due to the darker color of the gembili tuber flour compared to tapioca and arrowroot starch. Besides that, substitution gembili tuber flour has higher protein content, thus triggering a Maillard reaction [21].

Texture and crispness of Bagiak which are substituted with gembili tuber flour of ≥ 10% showed a decrease in panelist preference, this is due to hydrocolloid-like glucomannan which is able to trap other components and form a matrix in the dough, causing the cake structure to be harder and less crisp.

Effectiveness Test

The effectiveness test is used to determine the treatment that has the highest or the best value for all the parameters analyzed. The effectiveness test helps to determine the best treatment of the product. The results of the effectiveness of cake for the test with various variations in the concentration of substitution of gembili tuber flour can be seen in **Table 4**.

Tabel 4. Effectiveness value of Bagiak

Treatment	Effectiveness value (%)
P0 (Gembili Flour 0 %)	0.56
P1 (Gembili Flour 5 %)	0.62
P2 (Gembili Flour 10 %)	0.40
P3(Gembili Flour 15 %)	0.35

The total value of the effectiveness test for Bagiak ranges from 0.35 to 0.62. Table 4 shows that Bagiak with the addition of 5% gembili tuber flour showed the highest effectiveness value (0.62%). It means that Bagiak with the addition of 5% gembili tuber flour has the best quality and is favored by consumers.

4.CONCLUSIONS

Based on the results of the study it can be concluded that substitution of gembili tuber flour at various concentrations has a significant effect on baking loss, color, texture, water holding capacity, water content, protein content, and carbohydrate content. Organoleptic tests have a significant effect on color preference, texture, and crispness. The substitution of 5% of gembili tuber flour is the best treatment with a total value of the effectiveness index of 0.62% with the preferences on the color, taste, aroma, texture, and crispness.

5.ACKNOWLEDGMENT

This work is ostensibly supported by the IsDB (*Islamic Development Bank*) through Food Security Consortium 4 in 1 IDB Project Contract Number : 268/UN25.7/PIU-IDB/2019.

REFERENCES

1. Anonim, Gembili, http://www.plantamor.com/index, 2008.
2. Anonim, Topografi Kabupaten Banyuwangi, http://www.google.com, 2010.
3. AOAC, Association of Official Analytical Chemists, Official Analytical Int., Washington, 2009.
4. M. Chaubey, V.P. Kapoor, Structure of Galactomannnan From Seeds of *Cassia angustifolia* Vahl., Mercel Dekker Inc. New York, 2001.
5. J.E. Fox, *Seed Gums*. *In*: Imeson, A. (ed.). Thickening And Gelling Agents for Food, Aspen Publisher, Inc. Gaithersburg, Maryland, 1999, pp.262-282.
6. D.J. Gordon, L. Probsfieldy, R. J. Garrison, J. D. Neaton, W. P. Castelli, J. D. Knoke, DR Jacobs, A. Tyroler, High-Density Lipoprotein Cholesterol & Cardiovascular Disease, Circulation, 79 : 8-15, 1989.
7. Herlina, Karakteristik Dan Aktivitas Hipolipidemik Serta Potensi Prebiotik Polisakarida Larut Air Umbi Gembili (*Dioscorea esculenta* L.), Disertasi. Malang. Universitas Brawijaya, 2012.
8. Herlina, Harijono, A. Subagio, and T. Estiasih, Potensi Hipolipidemik Polisakarida Larut Air Umbi Gembili (*Dioscorea esculenta* L.) Pada Tikus Hiperlipidemia. *Agritech* 33 (1): 8-15, 2013.
9. W.C. Hou, H.J.Chen, Y.H.Lin, Dioscorin from difference *Dioscorea* species all exhibit both carbonic anhydrase and trypsin inhibitor activities, Bot Bull. Acad. Sinica (Taiwan) 41: 191-196, 2000.
10. L.B. Mabesa, Sensory Evaluation of Foods Principles and Methods College of Agriculture, UPLB, Laguna, 1986.
11. Herlina, Deproteinase Effect of Hydrocolloid Flour made of Gembili Tuber (*Dioscorea esculenta* L.) on Chemical and Technical Functional Properties, IJASEIT, 5(4): 298-302, 2015.
12. J.M. De Man, Principles of Food Chemistry (3rd ed). Aspen Publishers, Inc. USA. p. 96-127, 1999.
13. P.T. Boban, B. Nasiban, and P.R. Sudhakaran, Hypolipidaemic Effect of Chemically Different Mucilages In Rats: a Comparative Study, *British* Journal of Nutrition, 96: 1021-1029, 2006.
14. T.Y. Myoda, T, Matsuda, T. Suzuki, T. Nakagawa, T. Nagai, and T. Nagashima, Identification of Soluble proteins and Interaction With Mannan In Mucilage of Dioscorea opposita Thunb. Chinese (Yam Tuber), Food Sci. Technol. Res., 12(4): 299-302, 2006.
15. V.Singh, A. Srivastava, M. Pandey, R. Sethi, and R. Shanghai, Ipomea turpetum seeds: A Potential Source of Commercial Gum". Carbohydrate Polymers, 51: 357-359, 2002.
16. V. Singh, A. Srivastava, M. Pandey, and R. Sethi, A Non-Ionic Water-soluble Seed Gum From *Ipomea campanulata*. Carbohydrate Polymers 74: 40-44, 2003.
17. A.J. Sjoblom, Emulsion and Emulsion Stability, Marcel Dekker, New York, 1996, p.234.
18. A.M. Stephen and S.C. Churms, Gums, and Mucilages in Food Polysaccharides and Their Applications in A.M. Stephen (ed). Marcel Dekker, Madison Avenue. New York.1996, p. 377-440.
19. E.P. De Garmo, W.E. Sullivan, C.R. Canada, *Engineering Economy*7th. New York: Macmillan Publishing co. Inc., 1984.
20. K.A. Gomez, A.A. Gomez., Prosedur Statistik Untuk Penelitian Pertania, Edisi ke-2, Universitas Indonesia, Jakarta, 1995.
21. F.G. Winarno, Kimia Pangan dan Gizi, Jakarta: PT Gramedia Pustaka, 2006.
22. Azis, R., dan Ingka, R. A. 2018. Karakteristik Tepung Ampas Kelapa. *Journal of Agritech Science.* Politeknik Gorontalo Vol. 2 No. 2