The Chemical And Organoleptic Analysis Of The Sago-based Snacks As Additional Food For Diabetes Mellitus Patients

Frans A. Asmuruf[1], Yohanis I. Mandik[1], Mirnawati D.R Ansanay[1], Natasia Sihite[1]

[1]*Department of Chemistry, Faculty of Mathematics and Science, Cenderawasih University, Jayapura*
Corresponding Author: fasmuruf@gmail.com

ABSTRACT

Sago is one of Indonesia's native food plants that produce sago starch (Metrox-ylon sago Rottb.) which can be processed into food. It also uses as a source of amylose and amylopectin in a snack consumed by people with diabetes mellitus (DM). This is possible because of the glycemic index (GI) value of sago starch. This research was carried out experimentally and divided into two major activities, namely making snacks and characterization. Making snacks following the formulation of A, B, C, and D code, where A and B code are for the snack made from sago, whereas C and D code are for comparison. Characterization was running in terms of proximate analysis and organoleptic tests. The first analysis shows that sago-based snacks have the potential as a meal for people with diabetes mellitus because they have low reduced sugar levels that range from of 0 to 49%. However, the snacks are rich in protein, carbohydrates, and energy. Organoleptic tests also showed that color, taste, texture, and aroma were favored by panelists.

Keywords: Sago Starch, Formulations, Snacks, Diabetes Mellitus

INTRODUCTION

Sago is a typical Papua plant that is used as the primary food source until now in certain areas in Papua. Based on BPS Papua data in 2015 figures, sago plants have a land area of 12,716 hectares, which ranks fourth in the use of estate crops after Chocolate, Coconut, and Palm Oil. With the use of such vast land, 42,793 tons of sago has been produced, which is the most extensive plantation product in Papua (BPS, 2015).

Sago starch has white characteristics resembling white powder, which can be directly processed into Papeda - traditional Papuan food- and grilled sago. Many cakes and food utilize sago starch, including used as a source of amylose and amylopectin in the meal for people with diabetes mellitus (DM). This is possible because the glycemic index (GI) value of sago starch is low. Research conducted by Wahyuningsih et al. (2016) showed that sago rice had GI 40.7, whereas ordinary rice had GI 80. Based on its GI value, food groups into 3, namely low GI food (GI <55), moderate (55-70), and high (> 70) (Siagian, 2004).

GI of foodstuffs is characterized by amylose and amylopectin incorporated. In sago starch, the amylose and amylopectin contents are reported of 27 and 73% (Abdorreza et al., 2012). In comparison, rice flour has an amylose content of around 25. It is also notorious that the protein content in sago flour is too low, which is approximately 0.2 grams (Auliah A, 2012). For the sake of making snacks, the protein content in sago flour needs to be increased. One food ingredient that can be used is red beans that have relatively high protein content, approximately 24% wb (Riskiani, et al, 2014). Consumption of high biological value protein increases the absorption and use of nitrogen, thereby reducing the rest of the metabolism of protein in the body and not aggravating the kidney of DM sufferers. Also, red beans contribute positively to the physiological effects of reducing blood sugar (Pomeranz, 1991) due to the content of active compounds such as arginine, which is 600 mg / 100g (Audu and Aremu, 2011). Arginine acts as an anti-diabetic, specifically the regeneration of pancreatic cells to increase the stimulation of insulin secretion (Monti et al., 2013).

One of the food products that are practical but rich in nutrition is a snack. According to Ladamay (2014), snacks can be developed with sufficient calories, protein, fat, and other nutrients so that they can use as a functional food. Along this line, it can be seen that the potential of sago of Papua Province that can be utilized to produce practical with a low GI value but rich in nutrition. Thus, the main objective of this research is, first, to make snacks from sago flour, red beans, and tempeh, secondly, the characterization of artificial through proximate analysis. And the third is organoleptic quality analysis in the form of a study based on color, aroma, texture, and taste.

METHODS

This research was conducted experimentally and divided into three major activities, namely making snacks, proximate analysis, and organoleptic test. The proximate analysis includes testing of several vital parameters of food ingredients, namely water content, ash, protein, fat, carbohydrates, energy, and reducing sugars. This analysis was carried out at the Bogor Center for Agro-Industry (BBIA). Organoleptic test was also carried out in the form of color, aroma, taste, and texture. This research was designed with two main mixing treatments, particularly mixing sago flour and red beans versus sago flour and tempeh flour. The variation of the formulation being compared is as in the following table.

	Sago Flour	Red Beans Flour	Tempeh Flour	Wheat Flour
Code A (% b/b)	80	20	-	-
Code B (% b/b)	80	10	10	-
Code C (% b/b)	-	-	20	80
Code D (% b/b)	-	20	0	80

Supply of Sago Flour

Sago flour collects from the market in Jayapura City. This flour treats as the main ingredient in making the snacks.

Red Beans Flour Making

Making red bean flour is done according to the method of Sulaeman (1994). Red beans are washed repeatedly and then soaked for 24 hours and boiling for 90 minutes. The immersion and boiling time refers to the research of Mohamed et al. (2011) that 24-hour immersion with a ratio of red beans and water 1: 10 (w / v) can reduce phytic acid content by 23.9%. And also, if it boils for 90 minutes, it can reduce the acid by 19.1 %. The cooked red beans are then dried in an oven at 50^0C until the water content reaches 6-6.5% using a moisture tester. The final stage of this process is the sealing and sifting of 80 mesh.

Making Tempeh Flour

Tempeh is cut into 1 x 1 x 1 cm dice, then steamed for 10 minutes at 80^0C. Then drying using an oven at a temperature of 100^0C. After it is scorched, tempeh is mashed using a blender and then sieved using an 80 mesh.

Making Snacks

The snacks are formulated with a comparison of sago flour, red bean flour, and tempeh flour, referring to table 1. Making refers to the procedure from Amalia (2011) with slight modifications. The resulting dough is printed in the form of flat bars, which are then baked in an oven at a temperature of 150^0C for 50 minutes.

Organoleptic Quality Analysis

Organoleptic testing uses a hedonic test involving 15 reasonably trained panelists to assess the product that has been produced. The results of the panelists' assessment were then analyzed to find out the most preferred outcomes by the panelists based on color, aroma, texture, and taste. The hedonic scale used is (1) intensely dislike, (2) dislike, (3) neutral, (4) like, (5) intensely like (Carpenter, 2000; Kaponda, 2018).

RESULTS AND DISCUSSION

Making snack produces four formulations, where one formulation with code A is shown in the following figure.

Figure 1. Snack with code A

Proximate Test Result

The results of the proximate analysis, as shown in table 2, which displays eight results of content analysis. The discussion will be organized with a focus on containing sago starch and then comparing them with those that do not contain sago. Proximate analysis of control sago is needed to see changes in nutritional content after sago flour mixes with red bean flour and tempeh flour.

Tabel 2. The proximate analysis results

Parameters	Units	Control Sago	Code A	Code B	Code C	Code D	Procedures
Moisture	%	42	4.65	2.41	7.07	12.6	SNI 2973:2011
Ash	%	0.03	0.59	1.1	0.87	0.98	SNI 01-2891-1992
Protein	%	0.05	5.4	6.8	13.3	12	SNI 2973:2011

Lipid	%	0.17	22.4	20.9	23.3	15.4	SNI 01-2891-1992
Carbohydrate	%	57.8	67.0	68.8	55.6	59.0	IK 7.2.3
Energy	Cal/100 g	343[a]	491	490	484	423	IK 7.2.3
Total Sugar	%	0.17	0	0.75	1.79	2.82	SNI 01-2892-1992
Reduc. Sugar	%	0.42-0.47[b]	0	0.49	0.4	1.54	SNI 01-2892-1992

[a] Parama Tirta, dkk (2013)

[b] Eka Febryanti Tyanjani dan Yunianta (2015)

Moisture Content

The freshness and storability of food are determined by the water content in the material. High water content makes it easy for bacteria, mold, and yeast to develop so that there will be changes in food (Winarno, 2004). The lower the water content, the slower the growth of microorganisms multiply so that the decomposition process will take place more slowly (Nurbaya, 2017). Proximate moisture content for snack made from sago starch is 4.64 and 2.41%, which is lower between 3-8% compared to snacks made from non-sago. Also, lower of 6 and 11 % from control sago.

Ash content

Food consists of 96% inorganic material and water, while the rest are mineral elements (Sudarmadji et al. 2003). Ash is an organic substance from the combustion of organic material. The ash content of foodstuffs and their composition depends on the type of material and how they are ignited. Ash content has to do with minerals of an ingredient. Ash content in a food item indicates the presence of inorganic mineral content in the food material. Ash content is a material that is left behind when food is flattened and burned at a temperature of 500-800^{0}C (Winarno FG, 2004; Puwastian P. et al., 2011). The results of testing the snacks ash content of sago starches showed that ash content was 0.59 and 1.1%, while the snacks ash content of non-sago ingredients had values close to 1%.

Protein Content

Protein is high molecular weight complex organic compounds-polymers of amino acid monomers-that are linked to each other by peptide bonds. Protein molecules contain carbon, hydrogen, nitrogen, and sometimes there is sulfur and phosphorus. Protein acts as the body's energy source and oxygen carried in the blood (Suarni and Widowati, 2008). Besides serving as a source of nutrition, protein from different sources has a

specific functional characteristic that influences the aspects of food products (Paramita, 2012). The proximate test showed that protein content for the snacks made from sago is of 5.4 and 6.8%. These values are two times lower than the snacks made from non-sago, however, higher significantly from sago control.

Fat content

Fat content serves the percentage of the amount of fat contained in food, and for determining whether safe or not for consumption (deMan, 1997). Hydrophobic lipids are chemical compounds that do not dissolve in water composed by elements of carbon, hydrogen, and oxygen. The highest fat content was given by snack code C, which was 23.3%. Fat content that is too high in addition to being a consideration of nutritional factors is also considered less profitable in the process of storing flour because it can cause rancidity (Ambarsari et al., 2009). As for snacks for DM sufferers, lower fat content is even more desirable. So snacks with code B, with a fat content of 20.9%, is suitable as snacks made from sago.

Carbohydrate Content

Carbohydrates are natural products that have many essential functions in plants and animals. Through photosynthesis, plants convert carbon dioxide into carbohydrates, in the form of cellulose, starches, and sugars. Carbohydrates in flour consist of carbohydrates in the form of simple sugars, pentose, dextrin, cellulose, and starch (Setiyono, 2011). Most carbohydrates, especially monosaccharides and disaccharides such as glucose, fructose, galactose, and lactose, have reducing properties. Knowing the carbohydrate content in food is very important, especially for DM recipients. From the analysis, snacks made from sago has a carbohydrate content of 67.0 and 68.8%, respectively. The value is greater than 8-13% of snacks made from non-sago.

Energy Content

Each food ingredient produces a different amount of energy, depending on the amount of carbohydrate, protein, and fat contained in it. The amount of energy contained in the snacks test results is the total energy derived from carbohydrates, proteins, and fats that are in the snacks. Types of snacks made from sago flour have a higher energy value, which is equal to 490 and 491 cal per 100 g, compared to snacks made from non-sago.

Total and reducing Sugar Content

Glucose is a monosaccharide sugar that can be directly absorbed by the body and converted into energy. Glucose levels in food include monosaccharides that are already available or derived from the breakdown of polysaccharides (starch) in these ingredients. The process of breaking down polysaccharides into monosaccharides can occur during food processing or through hydrolysis that catalyzed by acids and enzymes in the digestive tract (Wang & Copeland, 2015). Sugar proximate analysis results show that snacks made from sago have a meager amount of sugar that is equal to 0 and 0.75%.

For the purpose of eating as food for people with DM, the value of reducing sugars is important to discuss. The results of the reducing sugar test show that snacks made from sago flour has a low, reducing sugar content of 0 and 0.49%.

Organoleptic Quality Analysis Results

Organoleptic testing uses hedonic testing involving a panel of reasonably trained as many as 15 people to assess the product that has been produced. The results of the panelists' assessment were then analyzed to find out the most preferred outcomes by the panelists based on color, aroma, texture, and taste. The hedonic scale used is (1) intensely dislike, (2) dislike, (3) neutral, (4) like, and (5) intensely like.

Further discussion of this analysis is through a plot graph between the number of panelists and the hedonic scale for each of the criteria for color, aroma, texture, and taste, as depicted in figure 2 for the sample of code A.

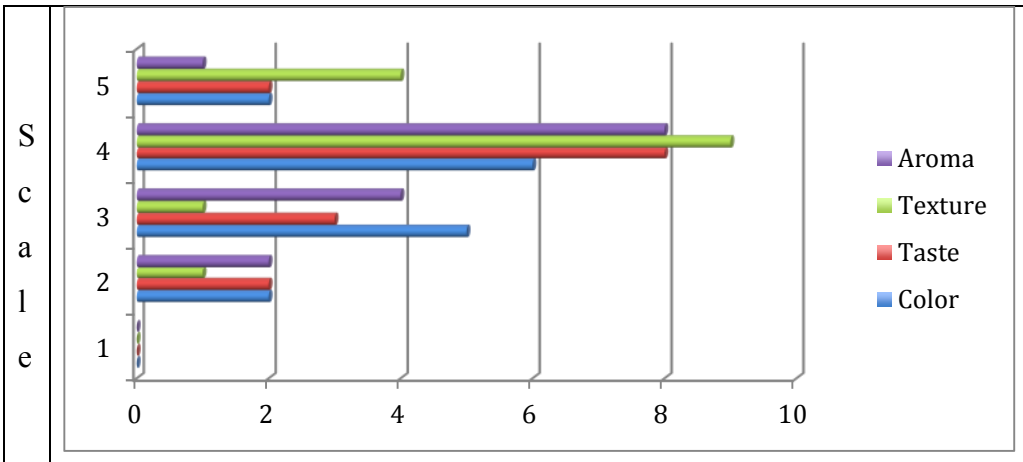

Figure 2. The snack acceptability respond

The color and texture are the main factors in snacks attractiveness. Figure 2 shows that as many as 40 and 60% of panelists agreed to like the colors and texture, respectively. Thus, as many as 53% of panelists like both the taste and aroma of the snack.

CONCLUSIONS

Following the objectives of this study, snacks made from sago, red beans, and tempeh, have been successfully formulated. Proximate and organoleptic analysis has also been carried out. The first analysis shows that sago-based snacks have the potential as a meal for people with diabetes mellitus because they have low reduced sugar levels, but are rich in protein, carbohydrates, and energy. Organoleptic tests also showed that color, taste, texture, and aroma were favored by panelists.

ACKNOWLEDGEMENT

The Authors would like to thank the Uiversity of Cenderawasih for the grants and to the Bogor Center for Agro-Industry (BBIA) for the analysis of proximate content.

REFERENCES

Abdorreza, M.N., Robal, M., Cheng, L.H., Tajul, A.Y. dan Karim, A.A., 2012. Physicochemical, thermal, and rheological properties of acid-hydrolyzed sago (*Metroxylon sagu*) starch. LWT-Food Science and Technology, *46*(1), p.135-141.

Amalia, R. 2011. Kajian Karakteristik Fisikokimia Dan Organoleptik Snack Bar Dengan Bhan Dasar Tepung Tempe Dan Buah Nagka Kering Sebagai Alternatif Pangan CFGF. Skripsi. Surakarta: UNS.

Ambarsari I. S dan Choliq A. 2009. Rekomendasi Penetapan Standar Mutu Tepung Ubi Jalar. Jurnal Standarisasi Vol. 11 No. 3 Tahun 2009: p.212-219.

Audu S.S and Aremu MO. 2011. Effect of Processing on Chemical Composition of Red Kidney Bean (*Phaseolus vulgaris L.*) Flour. Pakistan J Nutr. 10(11). p.1069–75.

Auliah, A. (2012). Formulasi Kombinasi Tepung Sagu dan Jagung Pada Pembuatan Mie. Jurnal Chemical Vol 13(2): p. 33-38.

BPS. 2015. *Papua Dalam Angka 2015*. Badan Pusat Statistik Provinsi Papua, p.1-677.

Carpenter RP, Lyon DH, and Hasdell TA. *Guidelines for Sensory Analysis in Food Product Development and Quality Control*. Second Edition. Maryland: Aspen Publishers, Inc.

deMan, J. M. 1997. *Kimia Makanan*. Bandung: Institut Teknologi Bandung.

Eka Febryanti Tyanjani dan Yunianta. 2015. Pembuatan Dekstrin Dari Pati Sagu (*Metroxylon Sagus Rottb*) Dengan Enzim β – Amilase Terhadap Sifat Fisiko Kimia. Jurnal Pangan dan Agroindustri Vol. 3 No 3 p.1119-1127,

Kaponda, P. and Kapute, F. 2018. Effect of Delayed Processing on Sensory Quality, Organoleptic Test, Nutritional Composition and pH of Fresh Engraulicypris Sardella (Usipa) Stored at Ambient Temperature. IFRJ 25(2): p.670-675.

Ladamay, Nidha Arfa et al. 2014. Pemanfaatan Bahan Lokal Dalam Pembuatan Foodbars (Kajian Rasio Tapioka : Tepung Kacang Hijau Dan Proporsi Cmc). Malang: Jurusan Teknologi Hasil Pertanian, FTP, Universitas Brawijaya Malang.

Mohamed, R., E.A. Abou-Arab, A.Y. Gibriel, N.M.H. Rasmy, F.M. Abu Salem. 2011. Effect of Legume Processing Treatments Individually or In Combination on Their Phytic Acid Content. African Journal of Food Science and Technology Vol. 2(2) p. 036-046.

Monti LD, MC Casiraghi, E Setola, E Galluccio, MA Pagani, L Quaglia, et al,. 2013. L-Arginin Enriched Biscuit Improve Endothelial Function and Glucose Metabolism: A Pilot Study in Healthy Subjects and A Cross-over Study in Subjects with Impaired Glucose Tolerance and Metabolic Syndrome. Metabolism Clinical and Experimental. 62. p.255-264.

Nurbaya. 2017. Modifikasi Pembuatan Bolu Gulung dengan Penambahan Jeruk Nipis dan Strawberry. Skripsi. Makassar : Pendidikan Teknologi Pertanian. Fakultas Teknik. Universitas Negeri Makassar.

Parama Tirta W.W.K., Novita I., Riyanti E. 2012. Potensi Tanaman Sagu (*Metroxylon sp.)* dalam Mendukung Ketahanan Pangan di Indonesia. Pangan. Vol. 22. No. 1. p.61-67.

Paramita O. 2012. Kajian Proses Pembuatan Tepung Buah Mangga (*Mangivera Indica L*) Varietas Arumanis Dengan Suhu

Perendaman Yang Berbeda. Jurnal Bahan Alam Terbarukan. Vol. 1, No. 1. p.32-41.

Pomeranz Y. 1991. *Functional Properties of Food Components*. Second Edition. Academic Press. New York.

Puwastien P. et,al. 2000. Asean manual of nutrient analysis, Regional Centre of ASEAN Network of Food Data System, Institute of Nutrition, Mahidol University, Thailand.

Riskiani, dkk., 2004. Pemanfaatan Tepung Umbi Ganyong (*Canna Edulis Ker*.) Sebagai Pengganti Tepung Terigu Dalam Pembuatan Biskuit Tinggi Energi Protein Dengan Penambahan Tepung Kacang Merah (*Phaseolus Vulgaris L.*). Jurnal Teknosains Pangan. Vol 3 No 1 Januari 2014.

Setiyono, L. 2011. Pemanfaatan Biji Kurma (*Phoenix Dactylifera L*.) Sebagai Tepung Dan Analisis Perubahan Mutunya Selama Penyimpanan. Bogor: Institut Teknologi.

Siagian RA. 2004. Faktor Faktor yang Mempengaruhi Indeks Glikemik Pangan, Indeks Glikemik dan Beban Glikemik Beberapa Jenis Pangan Indeks Glikemik Pangan: Cara Mudah Memilih Pangan yang Menyehatkan. Jakarta: Penebar Swadaya p. 33-40, 105-12.

Suarni dan Widowati S. 2008. *Struktur, Komposisi, dan Nutrisi Jagung. Balai Penelitian Tanaman Serealia*, Maros.

Sudarmadji, S., B. Haryono, dan Suhardi. 2003. *Prosedur Analisis untuk Bahan Makanan dan Pertanian*. Liberty. Yogyakarta.

Sulaeman. 1994. *Makanan Balita dan Prinsip Pengembangannya*. Jurusan Gizi Masyarakat dan Sumberdaya Keluarga. Fakultas Pertanian IPB. Bogor.

Wahyuningsih, S.B., Marsono, Y., Haryanto, B. dan Praseptiangga, D. 2016. Resistant Starch Content and Glycaemic Index of Sago (*Metroxylon* spp) starch and Red Bean *(Phasealus vulgaris*) Based Analogue Rice. Pakistan Journal of Nutrition 15 (7) p.667-672.

Wang, S. & Copeland L. (2015). Effect of Acid Hydrolysis on Starch Structure and Functionality: A Review. J Critical Rev in Food Sci and Nutr; 55(8); 108197.

Winarno FG. Kimia pangan dan gizi. Jakarta: PT. Gramedia Pustaka Utama. 2004.