

Influence of Baking Method, Fat, and Sweetener on Colored Sweet Potato and Black Soybean Based Diabetic Snack Bar Organoleptic Profile

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Abstract - Diabetes mellitus (DM) is a metabolic disease, that can be prevented by blood glucose control. Strategy to control blood glucose is food selection. Colored sweet potato and black soybean based snack bar is one of the options. This research aims to seek influence of baking method, fat type, sweetener type and concentration on the snack bar perception. Three baking method was analyzed, LPG oven, pan baking and microwave baking; two fat type was analyzed, margarine and butter; three sweetener was analyzed, inulin, isomalt, and sweetener premix, nine sweetener concentration analyzed 0,1,2,3,4,5,6,7,8,9 g. snack bar produced by microwave has dry and compact texture, rather than LPG oven that produce soft product and pan baking that produce burn product. The fat choice fell to margarine due to the products has no significant different in organoleptic, but had longer shelf life. Snack bar used by premix has the best perception, meanwhile inulin produced hard texture and isomalt produced unstable structure. In order to reach best sweetness intensity and minimum after taste 3 g of premix was used. The best perception for baking method for snack bar was microwave, the best fat type was margarine, and the best sweetener type was premix at 3 g.

Keywords: *Baking method, fat, sweetener, sweet potato, soybean, snack bar, organoleptic*

I. INTRODUCTIONS

Diabetes mellitus (DM) is a metabolic disease, characterized by blood glucose increase exceeds normal (hyperglycemia). Uncontrolled hyperglycemia can lead to death. (Gustaviani, 2006). Diabetes mellitus is progressive, so it need prevention through blood glucose control in order to limit micro and macro vascular complications risk. (Franz, 2012; Whitney, Rolfes, & Pinna, 2002).

One strategy to control blood glucose is diet management by the quantity, type and schedule. Daily diet is not only from macronutrient, but also micronutrient, antioxidant, and fiber (20-35 g/ day) (Perkeni, 2011; Sukardji, 2011; Yunir & Soebardi, 2006). Adequate fiber consumption can provide metabolic benefits to control blood glucose, hyper insulinemia and plasma lipid levels. (Whitney et al., 2002).

Glycemic Index (GI) helps food selection in diet management of DM patient. GI is a measurement on how a particular food rise blood glucose. This index is used as a reference to determine the amount and type of carbohydrate, in order to control blood glucose. (Rimbawan & Sinagan, 2004).

Sweet potatoes and black beans can be used as raw material for making a food product, so as to increase the value of the program to also support food diversification

Antioxidants intake needed by patients with DM to overcome the free radical production that lead to insulin resistance and complications such as nephropathic diabetic and cardiovascular diseases. (Koya et al., 2003; Laight, Carrier, & Anggard, 2000).

Sweet potatoes have a low IG (44) (Rimbawan & Sinagan, 2004), high in fiber and antioxidant such as; β -carotene, vitamin C, vitamin E and anthocyanin (Persagi, 2005; Teow et al., 2007). Fiber content in 100 g for red var. is 0,7g, 4g for yellow var., and 4,72g for purple var. (Nisviaty, 2006; Persagi, 2005). β -carotene content vary and depend on varieties, for yellow var. is 2.900 μ g and white var. is 260 mg. Purple var. contains 110-210 mg anthocyanin /100 g, 1208 mg β -carotene / 100 g, and 10,5 mg vitamin C /100 g (Jawi, Suprpta, & Subawa, 2008; Persagi, 2005). Sweet potato contains less protein, so to meet the nutrient requirement, it needs to add high protein food such as black soybean in the diet (Persagi, 2005).

Soy bean is the main source of vegetable protein in Indonesia. Soy bean has a low IG (31)(Rimbawan & Sinagan, 2004). Black soybeans contain total polyphenols, flavonoids and anthocyanins higher than yellow soybeans, ie 6.13 mg / g, 2.19 mg / g, 0.65 mg / g respectively (Malencic, Cvejic, & Miladinovic, 2012; Ambarsari, Sarjana, & Choliq, 2009). One food product that can be developed from the sweet potatoes and black beans are a snack bar.

Snack bar is a convenient snack, has a long shelf life and complete nutrition content. (Kimberlee, 2007). The combination of sweet potatoes and black soybeans can be used as the main ingredient for the manufacture of snack bars for DM patients. In order to produce high quality snack bar in terms of nutritional and eating quality, there is need a series of experiments the process of making the snack bar which consists of determining the formulation, the baking method selection, the selection of the type of fat, the choice of sweetener type and quantity.

II. METHOD FORMULATION

Formulation process was obtained by adjusting the snack bar composition with nutritional needs of DM patients using Nutrisurvey 2005 program.

Snack bar manufacturing

Materials used in the manufacture of snack bars included sweet potato, sweet potato flour, black soybeans, egg yolk, skim milk powder, isomalt, inulin, and Tropicana Slim Diabetics premix from PT. Nutrifood, margarine and butter.

Snack bar manufacturing consisted of a few steps. First, sweet potatoes are washed, steamed, peeled and softened with a kneaded by hand, mashed and crush with a wiring blender. Second, black soybeans washed, steamed, blended, mixed evenly using a mixer and poured into pyrex and baked using microwave at 140 °C for 5 minutes, LPG oven at 70 °C for 30 minutes, pan at low heat for 30 minutes.

Sweeteners were used, isomalt (8 g), inulin (8 g), and premix sweetener (8 g). Sweetener quantity is than qualitatively measured by sensory tests by 24 semi trained panelists using 4 scale, i.e. 0 for no perception, 1 for a bit strong; 2 for medium, and 3 for strong (Setyaningsih, Apriyantoro, & Sari, 2010).

III. RESULT AND DISCUSSION

Formulation

Formulation, that was used to get the best formula, was based on nutrition requirement of DM patients during snacking. RDA (Recommended Daily Intake) for snack for adult is 10 % of average daily requirement (2000 kcl), which is 200 kcal / snack / day. To fulfill those quantity, the compositions were carbohydrate 55% (27.5 g), protein 20% (10 g) and fat 25% (5.56 g), fiber 20-25 g/ day, and 5% sucrose (2.5 g) (Franz, 2012; Perkeni, 2011).

Nutrition calculation using *Nutrisurvey* acquired 70 g sweet potatoes, 30 g soy bean, 5 g margarine or fat, 8 g skim milk, sweetener 15 gram for inulin and isomalt, or 8 g for premix.

Snack bar manufacturing

Snack bar manufacturing included the choices of baking method, fat type used, sweetener type and quantity.

Baking method

Snack bar baked by pan resulted product with burn surface, and undercook inner part. Baking by pan classified into conventional heating. Heat was transferred from the heat source to pan material by radiation, and than was transferred to the snack bar by conduction, heat transferred slowly from outer part to the inner part. This method made surface of the snack bar to be exposed by more heat than the inner part, so the surface burned fast, and water vapor from inside could not escape. Snack bar baked with LPG oven used temperature 70-80 °C for 30 minute. This process was classified into conventional heating. There was case hardening process, it was perceivably better compared to pan baking. Snack bar produced by LPG oven has mushy texture because heat transfer was not optimal (Muhtadi & Ayustaningwarno,2010)

Table 1. Snack bar description with various baking methods

Product description	Baking method		
	Microwave	LPG Oven	Pan
Color	Bright and evenly	Darker, not even at bottom.	Bright, some part burn.
Aroma	Strong sweet potato and beany aroma	Burn and beany aroma	Burn and beany aroma
Texture	Dry and compact	Soft	Soft
Flavor	Strong sweet potato and soybean flavour, beany flavour.	Strong sweet potato and soybean flavour, beany flavour.	Strong sweet potato and soybean flavour, beany flavour, burn flavour.

Microwave baked snack bar has the best texture among other baking process. Snack bar produced has dry and compact texture. Heat generated by microwave oven come from water in the product vibrated when exposed to microwave. During vibration process, water heated and the heat transferred to the rest of the product. Because

water was distributed evenly in the product, heat produced was also distributed evenly. It was noted that the container was used during microwave baking. Metallic materials were not allowed in the microwave heating because it will produce sparks and eventually explode. It is advisable to use Pyrex glass or porcelain or

microwave proof glass or ceramic (Muhtadi & Ayustaningwarno, 2010).

In the third production, test of selection consists of fat margarine and butter that were used for emulsifying fat.

The purpose is to give savory flavour and soften the dough. Fat option for snack bar was margarine and butter. Fat addition used to gave mouth feel and pleasant texture (Hanafi, 1999).

Table 2. Snack bar description with fat variety

Product Description	Fat	
	Margarine	Butter
Colour	Light	Light
Aroma	Margarine aroma	Butter and milky aroma
Texture	Slight hard	Slight hard
Flavour	Tasty	More tasty than margarine added

Snack bar with butter has tastier and more pleasant taste compared to snack bar with margarine, but have a shorter shelf life. This fact is confirmed when the snack was kept in a closed box at room temperature. There was rancid flavour. Butter application needed to give savoury taste, but after learned that the product rancid faster than snack used margarine, fat ingredient decided to use margarine. Snack with butter easily went rancid caused by butter that has more nutrient compared with margarine. In 100 grams of butter, it contained 499 kcal of energy; 0 grams of carbohydrates; 3.3 grams of protein, 55.1 grams of fat; 34.32 grams of saturated fat, and 106 mg of cholesterol, whereas in 100 grams of margarine contained 424 kcal of energy; 0.86 grams carbohydrates, 0.2 grams

of protein, 47.53 grams of fat; 8.79 grams of saturated fat, and 1 mg of cholesterol (USDASR25, 2012).. Higher fat content also lead to cardiovascular complication in diabetic patient.(Franz, 2012).

During sweetener option, there was 3 option, isomalt, inulin, and sweetener premix, all sweetener used 15 g. Organoleptic test result for this options was the sweetener premix has the highest taste perception, meanwhile others organoleptic properties, not difference each other. This perception as a result of synergism effect of sweetener premix, the premix ingredient include sorbitol and sucralose, those combination resulted sweeter taste, sucralose/sorbitol (1:1128) increased 15% sweetening power and saved 13% sweetener.(Beys, 1989)

Table 3. Organoleptic properties of snack bar with sweetener variety

Formula	Color		Aroma		Teksture		Taste	
	Average	Note	Average	Note	Average	Note	Average	Note
Isomalt	3,21±0,83	Neutral	3,79±0,88	Liked	2,88±0.85 ^a	Neutral	3.04±0.96 ^a	Neutral
Inulin	3,08±0,93	Neutral	3,50±0,93	Liked	3,21±0.83 ^{a,b}	Neutral	2.38±0.77 ^b	Not liked
Tropicana Diabetes sweetener	2,92±0,72	Neutral	3,50±1,02	Liked	3,54±0.88 ^b	Liked	4.08±0.78 ^c	Liked
	p = 0,122		p = 0,229		p = 0,016		p = 0,000	

Note: Figures followed by different superscript letters indicate significant difference

Panelist that did not like snack color, described that snack bar color was too dark, those color result of combination of purple sweet potato and black soybean. Other said that the color was not distributed evenly, this defect caused by mixing process and baking process not done perfectly. There is suggested to create lighter purple color so the color difference will be bold, or darker so the color difference can't be notified.

Snack bar with premix has best texture; it is not too hard or soft. Meanwhile, snack with inulin has harder texture, this result caused by inulin characteristic that improved structure and crispness (Auerbach, Craig, & Mitchell, 2006). Product with isomalt has soft and easy to break, this characteristic as result of hygroscopic properties of isomalt (Sentko & Willibald-Ettle, 2006).

Water in the snack adsorbed into isomalt, and not stabilized the structure. To reduce sweetener added, organoleptic trial for premix usage from 0 to 8 g.

The organoleptic shows that along with sweetener concentration increase, the sweetness intensity, aroma and aftertaste perception increased at different speed. Sweetness intensity has linier increment, this linearity controlled by sucralose sweetness profile that have linier sweetness intensity (Molinary & Quinlan, 2006). Increased sweetener concentration also increase aftertaste sucralose didn't have bitter aftertaste, but the sweet aftertaste is noted compared with sucrose (Molinary & Quinlan, 2006). Meanwhile sorbitol have cooling effect that has fun effect (Kearsley & Deis, 2006).

Table 4. Organoleptic properties of snack bar with different sweetener quantity

Quantity	Aroma		Kemanisan		Aftertaste	
	Average	note	Average	note	Average	note
0 g	1,88 ± 6,8 ^b	A bit strong	0,08±0,28 ^b	None	0,67±0,70 ^{a,b,c}	A bit strong
1 g	1,13 ± 0,54 ^{a,c}	A bit strong	0,63±0,49 ^a	A bit strong	0,46±0,59 ^a	None
2 g	1,17 ± 0,82 ^{c,e}	A bit strong	1,17±0,76 ^c	A bit strong	0,75±0,74 ^b	A bit strong
3 g	1,29 ± 0,62 ^{d,c,e,f}	A bit strong	1,67±0,64 ^{d,e}	Strong, medium	0,96±0,95 ^{b,c,e}	A bit strong
4 g	1,65±1,01 ^{b,d}	Strong, medium	1,63±0,71 ^c	Strong, medium	1,04±0,86 ^{c,d,e}	A bit strong
5 g	1,50±0,93 ^{b,c,e}	Strong, medium	2,04±0,75 ^{f,g}	Strong, medium	1,29±0,95 ^{d,f}	A bit strong
6 g	1,58±0,93 ^{b,c,e}	Strong, medium	1,88±0,85 ^{e,g}	Strong, medium	1,21±0,9 ^{d,e,f}	A bit strong
7 g	1,75±1,1 ^{b,f}	Strong, medium	2,25±0,79 ^{f,g}	Strong, medium	1,50±1,10 ^f	Strong, medium
8 g	1,58±0,83 ^{b,e}	Strong, medium	2,30±0,76 ^f	Strong, medium	1,50±0,9 ^{f,g}	Strong, medium
p	0,007		0,000		0,000	

Note: Figures followed by different superscript letters indicate significant difference

There was significant different in aroma, sweetness, and aftertaste. Increased sweetener addition, increase aftertaste, the aftertaste noted was slightly bitter. The best result was 3 g sweetener. At that concentration, the optimum sweetness and minimum aftertaste were observed.

IV. CONCLUSIONS

The best perception for baking method for snack bar was microwave, the best fat type was margarine. The best sweetener type was premix at 3 g.

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