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THE REVIEW OF SNACK BAR FROM CHIA - MOCAF AS AN ANTIDIABETIC FOOD

Saskia Revinka Maharani, Vega Yoesepa Pamela*, Septariawulan Kusumasari
Department of Food Technology, Faculty of Agriculture, Universitas Sultan Ageng Tirtayasa
Jalan Raya Jakarta Km 4 Pakupatan, Serang-Banten
*E-mail: vega.yoesepa@untirta.ac.id

ABSTRACT

Due to the high activity, plus the problem of communicable and non-communicable diseases such as diabetes, there is an increasing public awareness of the need for food that is practical and has an effect on improving body health. the Snack bar is convenient food that has complete nutritional content. Some food ingredients that can be used as raw material for making anti-diabetic snack bars are chia seeds (*Salvia hispanica* L) and cassava (*Manihot esculenta*). Based on existing research, chia seed and modified cassava flour (MOCAF) have a hypoglycemic function which is closely related to reducing blood sugar levels so that it can reduce the risk of diabetes. Chia seeds are well known for their high oil content, are rich in polyunsaturated fatty acids, especially omega- 3 and omega-6 fatty acids, and are high in protein and fiber which increase their potential as a functional food product. The content mocaf flour in 100 grams are protein 1.2%, fat 0.4%, and 3.4% fiber. Chia seed flour has been shown to increase AMPK expression, while mocaf can increase insulin sensitivity in type 2 diabetes mellitus.

Keywords: Antidiabetic, Chia Seeds, Mocaf, Snack Bar

INTRODUCTION

In this current era, many people are becoming aware of their health so that eating patterns are not only full and delicious but can also affect the optimal level of health and fitness. The high level of community activity causes frequent consumption of fast food so that practical healthy food is needed that does not need to be cooked first, ready to eat, can be taken anywhere, and can be eaten at any time but can improve health. One of the food that contains practically complete nutrients is a snack bar.

A snack bar is a product that distant light that has a shaped rod (bar) and a mixture of different materials such as cereals, fruits, nuts are fastened to one another with the aid of a binding agent (binder). In Indonesia, the consumption of snack bars is still very rare and some people do not even know about these foods. Only 34.5% of Indonesians know about this bar (Septiani *et al.*, 2015).

Currently, there is a functional food trend due to people's concern for healthy food which is also triggered by the dual problems experienced by the Indonesian people, which are not only infectious disease problems but also non-communicable disease problems such as those caused by metabolic syndrome.

Metabolic syndrome is a symptom characterized by metabolic process disorders that lead to non-communicable diseases such as hyperlipidemia and diabetes mellitus. People with diabetes mellitus cannot control blood sugar levels within normal limits, causing hyperglycemia in the long term (Kilpatrick *et al.*, 2007; Arumsari *et al.*, 2020).

To control blood sugar can be done by eating foods that have a low glycemic index

and long starch digestibility. The glycemic index value with an increase in blood sugar is closely related. If the food on the glycemic index is high, the increase in blood sugar levels will be faster, conversely, if the food on the glycemic index is low, the blood sugar will increase slowly. The condition when the glycemic index is low is called hypoglycemic. Generally, fiber-rich foods have a low glycemic index, although not always.

Healthy snacks are not only rich in energy, but should also contain dietary fiber, protein, antioxidants, vitamins, and minerals that are important for health (Christian, 2011).

Chia seeds or chia seeds (*Salvia hispanica L.*) are one of the natural ingredients with health potential, which can be used as an alternative to developing functional food products. This plant comes from Central America, especially Mexico and Guatemala. Chia seeds and their derivative products are promising sources to be developed, for example as a ready-to-eat product, or an alternative in the development of functional foods (Safari, *et al.*, 2016). It is known that chia seeds have a hypoglycemic function which is closely related to reducing blood sugar levels so that they can reduce the risk of diabetes.

Apart from chia seeds, another product that has potential as an antidiabetic is mocaf. Mocaf is cassava flour made using the principle of fermentation of cassava cell modification. Mocaf flour is usually used as a substitute for wheat flour which produces enzymes that can destroy cassava cell walls and liberate starch granules. Mocaf has characteristics like wheat flour but has a coarser texture than wheat flour, so it can be used as a substitute for flour or a flour mixture of 30% -100% and can reduce the cost of flour consumption by 20% -30% (Philia, *et al.*, 2020; Manullang *et al.*, 2018; Subagyo, 2006).

Chia Seed (*Salvia hispanica* L)

Chia seeds are generally oval, have a smooth and shiny surface, and come in various colors, namely dark brown, gray, white, and black. These chia seeds are small and flat with a length of about 2 - 2.5 mm, a width of 1.2 - 1.5 mm, and a thickness of 0.8 - 1 mm (Safari *et al.*, 2016).

Chia seeds contain protein (15-25 %), fat (30-33 %), carbohydrates (26-41 %), fiber (18-30 %), and minerals (4-5 %). Chia seeds also contain omega 3 fatty acids (linolenic acid) by 17.83 percent (Ixtaina *et al.*, 2008).

Making chia seed flour is done by preparing 250 grams of chia seeds which are roasted for 6 minutes while stirring. The results of the toasted chia seeds are then blended until smooth and sieved with a 60 mesh flour sieve (Arumsari *et al.*, 2020).

Cassava (*Manihot esculenta*)

Modified Cassava Flour (MOCAF) is a renewal product from cassava or cassava flour (*Manihot esculenta*) with the principle of modifying cassava cells by fermentation with the help of lactic acid bacteria (LAB). Mocaf flour is often and widely used in various food products (Putri *et al.*, 2018).

Mocaf has advantages over ordinary cassava flour, namely whiter color, higher viscosity, better rehydration power, and a covered cassava flavor. 100 grams of mocaf flour contains 1.2% protein, 0.4% fat, and 3.4% fiber (Asriasih *et al.*, 2020).

Mocaf does not contain gluten and has the potential to be processed to produce resistant starch 3 (rs3) which is needed by diabetics so that it can be used as food processing for diabetics (Philia *et al.*, 2020).

Making mocaf begins by selecting cassava that is 10 months old, then peel the cassava and wash it clean using water. After that, cut it into thin strips using a slicer until it becomes chips. The cassava chips are then subjected to a fermentation process with the addition of a starter and 1: 1000 water. There

are two different grinding methods. In the method of dry milling, cassava chips fermented dried by the sun (sun drying) to produce chips Mocaf, then ground using a blender for one minute and finally sieved with a 100 mesh sieve. In the wet milling method, the fermented cassava chips are ground by adding 6: 1 water using a wet blender for one minute until they become pureed. The slurry is then dried in the sun then milled again using a dry blender for one minute and finally sieved with a 100 mesh sieve (Putri *et al.*, 2018).

SNACK BAR PRODUCTION

The making of this snack bar begins by preparing all the ingredients and weighing them according to the snack bar making formulation, then mocaf flour and chia seed flour are mixed with other ingredients (sugar, salt, margarine, eggs, and pineapple jam), then mixed for 20 minutes. After everything is well blended, put the dough into a sized baking sheet 26.5x10x3.5 cm. After the printing process, then bake the snack bar dough at 120 ^{o}C for 40 minutes, then bake it again at 140 ^{o}C for 5 minutes. The cooked snack bar is left to stand for 30 minutes at room temperature (Septiani, *et al.*, 2015).

The more concentration of mocaf flour is used, the resulting color will be slightly lighter. The color produced on the snack bar with 75% mocaf flour formulation is slightly lighter than the non- mocaf flour at all which produces a brownish snack bar. The resulting texture is not too hard, the resulting protein content of 5.6% is low because it is caused by roasting using high temperatures. The higher the temperature and the longer the processing time, the higher the protein damage that occurs in these foodstuffs. However, this snack bar has a low water content so that it can be stored for a long time (Septiani *et al.*, 2015; Sundari et al, 2015).

Based on research by Singh *et al.* (2020), snacks made with the addition of chia flour show a high fiber content in the product. Because 100 g of chia seeds contain up to 50 g of dietary fiber which provides good water holding capacity and high emulsifying activity. So that the more the concentration of chia seeds, the moisture content in the snack bar will decrease causing an increase in product shelf life. The amount of protein concentration increases gradually as the concentration of chia seeds increases because the high amount of protein in chia seeds increases the mineral content. The trend of increasing this mineral is because chia seeds have a high mineral content, especially Mg, Ca, Fe, Zn, Mg, Co, and Se. Organoleptic test results showed a high value of the public interest in snack bars with a mixture of 10% chia seed flour.

MECHANISM AS AN ANTIDIABETIC

Diabetes mellitus type 2 is a complex disease related to lifestyle and diet. Many studies have shown the addition of type 3 resistance starch in the daily diet may play a role in the route of treatment of diabetes associated with or without gut microbes. Mocaf contains high amylose so that it can increase resistance starch (Firdaus, *et al.*, 2018). Resistant starch is a starch fraction that is resistant to hydrolysis of digestive enzymes because it has a compact molecular structure and starch granules which can prevent damage to the starch structure by digestive enzymes, causing a slow increase in glucose in the blood (Herawati, 2010).

Amylose affects the response of increasing resistance starch through the retrogradation process. Besides, in foods containing high amylose, it can decrease the glycemic response. The research of Firdaus, *et al.* (2018), showed that administration of Mocaf and Mocaf type 3 resistant starch can increase insulin sensitivity in people with type 2 diabetes mellitus. Resistance starch granules from a special adhesion pattern in the upper intestine so that probiotic bacteria

such as Lactobacillus sp. Resistance starch is then fermented to produce short-chain fatty acids (SCFA). SCFA plays a role in increasing the production and secretion of endogenous GLP-1 and Peptide YY (PYY) in the intestinal wall. Increased GLP-1 will induce pancreatic beta-cell proliferation, increase insulin secretion, and control glucagon while increasing PYY will decrease appetite.

On chia seeds, Marineli, *et al.* (2015), found that chia oil and chia flour can improve glucose and insulin tolerance in mice fed the HFHF diet. According to Enes, *et al.* (2020), Chia flour can increase AMPK expression, which increases glucose uptake and oxidation, as well as enzyme glycolysis that results in improved glucose tolerance. AMPK, which is considered a sensor for energy deficiency, is lowered during bouts of obesity and metabolic syndrome, and in conditions of an imbalanced diet, as HFHF and disturbs energy balance. To activate this compound, you need to do exercise, restrict calories, and eat foods that contain antidiabetic compounds such as chia seeds. The results of this study indicated that the expression of the liver AMPK gene increased after consuming chia flour as much as 3.8 times that of HFHF. AMPK activation can reduce blood glucose levels by phosphorylation of AS160 protein. This protein plays a role in overcoming glucose transporters, increasing glucose uptake in non-insulin-dependent pathways. Therefore, chia flour appears to modulate AMPK expression as an insulin-independent mechanism for enhancing glucose metabolism. Besides, chia flour was effective in increasing levels of AKT and PFK mRNA (Enes *et. al.*, 2020).

OTHER ANTIDIABATIC SNACK BARS FLOUR

The existence of snacks for people with diabetes mellitus needs further attention. What needs to be considered in the diet for diabetics is the low fiber content and glycemic index. This is because eating foods high in fiber and low on the glycemic index can improve insulin sensitivity, reduce glucose absorption rates, and are useful in controlling blood glucose so that it can reduce the risk of complications in people with diabetes mellitus. Generally, food materials that have a low glycemic index and high fiber are in the cereals, seeds, nuts, tubers, and products like flour (Marlina *et al.*, 2019).

In a snack bar made with sorghum flour as a base, it contains high amylose and resistant starch so that the anti-diabetic mechanism in the body is the same as that of the consumption of Mocaf flour. However, after becoming a food bar, the resistant starch content in sorghum flour decreased. Sorghum flour can also reduce systolic blood pressure ≥ by 20 mmHg so that it can be called an antihypertensive. Hypertension is a result of the pathological process of diabetes that occurs simultaneously with diabetes (Fathurrizqiah and Panunggal, 2015; Arifani, *et al.*, 2019).

Also, the nutrimat bar of soybean and red bean flour from the research results of Wiranata, *et al.* (2017), the best formulation of soybean flour 25%: 75% red bean flour has a delicious taste, savory aroma, brown color, and soft texture, and contains nutrients in the form of energy 232.18 kcal, protein 12.75 g, fat 4, 71 g, carbohydrates 35.36 g and antioxidants 84.69 mg /L GAEAC. The resulting brown color is the result of the presence of high proanthocyanidins (condensed tannins). These compounds are the best source of antioxidants. The anti-diabetic mechanism of processed food is different from chia flour and Mocaf flour. The presence of these secondary antioxidants can help fight free radicals that cause oxidative stress. In patients with type 2 diabetes mellitus, oxidative stress can cause a

decrease in the function of primary antioxidants in the body so that secondary antioxidants are needed to help the primary antioxidant function. Secondary antioxidants work by breaking the lipid peroxide oxidation chain and also act as an antidiabetic by protecting pancreatic beta cells from oxidative stress due to increased glucose. Another food ingredient that also has secondary antioxidants is sweet potato flour (Wiranata, *et al.*, 2017; Muslimin, *et al.*, 2018).

CONCLUSION

Chia seed flour (*Salvia hispanica L.*) and mocaf flour have been shown to reduce the risk of diabetes mellitus from literature review of research. To be able to consume and enjoy it easily, the chia seed flour and mocaf flour are processed in a snack bar. A snack bar is a block-shaped snack that is processed by mixing chia seed flour and mocaf flour which is then molded and baked. Even though they have the same function, these two flours have different antidiabetic mechanisms. Chia seed flour can increase AMPK expression so that oxidation and glucose uptake in the body increase. Whereas in mocaf flour, resistance starch helps increase insulin sensitivity in people with diabetes mellitus.

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