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INCORPORATING MORINGA AND KATUK LEAF EXTRACTS IN THE PRODUCTION OF SAGO BASED LIQUID SUGAR: SENSORY PROPERTIES, GLUCOSE CONTENT AND ANTIOXIDANT ACTIVITY

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ABSTRACT

Incorporation of the extracts of Moringa and Katuk leaves in the production of sago based liquid sugar was one way to diversify and improved its added value. The liquid sugar produced had a better anti-oxidant activity, but had a lower sensory properties. A pilot plant scale production of this liquid sugar was attempted in collaboration with a small scale enterprise in Moramo,Southeast Sulawesi. This study was aimed to determine the fortification effect of Moringa and Katuk leaf extract on the properties of sensory, and anti-oxidant activity of the sago liquid sugar. The sugar was produced enzymatically through liquefaction and saccharification processes employing commercial alfa-amylase and amylo-glucosidase. The sugar was then fortified with the extract of Moringa and Katuk leaves, with various concentrations, i.e. G_0 (100 % liquid sugar as a control); G_1 (95% liquid sugar + 5% Katuk extract), G_2 (95% liquid sugar + 5% Moringa extract), G_3 (90% liquid sugar + 5% Moringa extract + 5% Katuk extract), G_4 (85% liquid sugar + 5% Moringa extract + 10% Katuk extract), and G_5 (85% liquid sugar + 10% Moringa extract + 5% Katuk extract). The results showed that fortification of Moringa and Katuk leaf extract had a significant effect on the sensory properties, and anti-oxidant activity. The G_1 treatment produced better sensory properties. Increasing the content of leaves extracts had also increased the anti-oxidant activity. There was no significant differences in the glucose content of the sugar. Considering various aspects of the results obtained, the G_3 formula was then scaled up for pilot plant production by a small scale enterprise. This study had indicated that a nutritional food ingredients and added value may be made through a diversified process of sago flour.

Keywords: Moringa, katuk, sago liquid sugar, anti-oxidant, sensory properties

INTRODUCTION

The use of sago as a food has long been recognized and has even become one of the staple foods of people in various regions. Flach (1997) states that sago (*Metroxylon sp*), is one of the oldest plants used by people in Southeast Asia and Oceania. There are around 2 million hectares of sago plants in the world with a production capacity of 2.5 - 5.5 tons of dried sago starch per hectare. Especially in Indonesia, sago is one of the basic food sources for some people in several regions such as Papua, Maluku, Central Sulawesi, Southeast Sulawesi and West Sumatra (Mentawai) and Riau.

Diversification of sago-based food products has been made (Karim et. Al., 2008; Ansharullah et al., 2019), one of which is the production of liquid sugar. The advantages of sago liquid sugar compared to similar products from other sources of starch is the lower GI (Glycemic Index) content. Pramuditya (2013) found that sago has a low GI of less than 55, so it is healthier to consume because of not causing fluctuations in blood sugar levels.

Currently, people and industry in Indonesia are still heavily dependent on sugar from sugar cane. This can be seen from sugar consumption which continues to increase year by year, and it must be imported from other countries. Imported sugar was increasing from 2012 by 2.74 million tons and in 2013 amounted to 3.34 million tons (BPS, 2013). Many food industry has used liquid sugar in their production, because it has several advantages, among others are not crystallizing, easier to process due to higher solubility, more practical, and has a more attractive appearance compared to sugar in general (Ayu and Fitria, 2015). In addition, liquid sugar is a monosaccharide, while granulated sugar is a disaccharide so the liquid sugar will be quickly converted into energy rather than ordinary sugar.

Research on the production of liquid sugar from sago starch has been carried out (Maksum et al., 200; Pratama, 2015; Mukarramah et al., 2016; Murtias et al., 2016; Unji et al., 2016). However, the production of such sago liquid sugar from these studies still has disadvantages, namely the low anti-oxidant activity. Leaves of moringa (*Moringa oleifera*) and katuk (*Sauropus androgynus* L. Merr) are natural herbal ingredients which contain high compound of anti-oxidant of flavonoids (Jonni, 2008; Lutfiah and Edi, 2010; Mahmood, 2011; Rukmana and Hararap, 2003; Andarwulan et al., 2012, and Ikalinus et al ., 2015). The antioxidants can inhibit the formation of free radicals in cells and tissues. Fortification with the extract of Moringa and katuk leaves in the production of sago liquid sugar would increase the added value and nutritional quality of the product.

This study was aimed to determine the fortification effect of Moringa and Katuk leaf extract on the properties of sensory, glucose content and antioxidant activity of the sago liquid sugar.

MATERIALS AND METHODS

Materials

The main materials used in this study were: sago starch, α-amylase Termamyl 120L, amyloglucosidase, extracts of Moringa and Katuk leaves.

Production of Sago Liquid Sugar

The process of liquid sugar production and fortification process was carried out as in Figure 1.

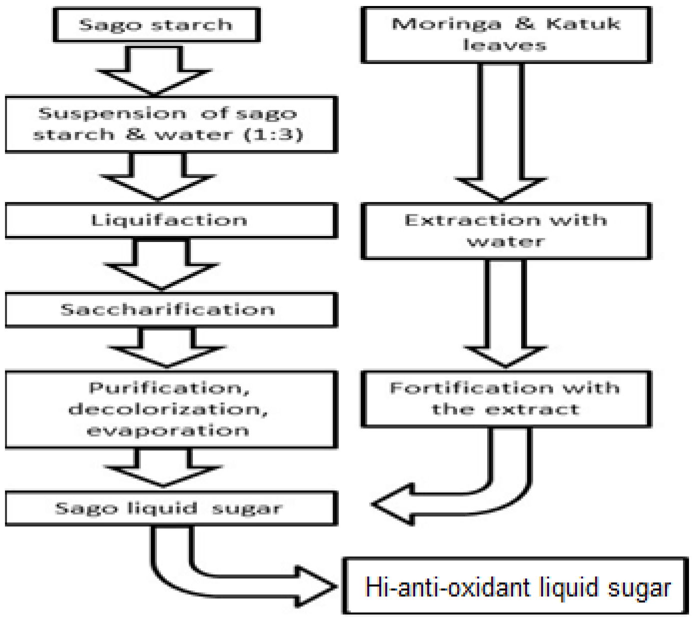


Figure 1. The flow chart of production of high anti-oxidant of sago liquid sugar.

The enzymatic method of making liquid sugar was through two main stages, namely liquefaction and saccharification. The liquefaction process was carried out by making a starch suspension from sago pulp in a stirred tank. The sago starch (20 kg) was mixed with water (60 L) and stirred until well blended. Then, alpha-amylase enzyme (Termamyl 120L) was added as much as 1 mL for 1 kg of starch. The pH of suspension was adjusted between pH 6.2 to 6.4 with the addition of $Ca(OH)_2$. The suspension was then boiled at 100°C, and subsequently cooled to 60°C. The mixture was then put into the saccharification tank by adding amyloglucosidase (dextrozyme) of 1 mL/ kg starch. The saccharification process was carried out for 48 hours; and the liquid sugar produced was further decolorized with activated charcoal, filtered and evaporated.

Fortification of Moringa and Katuk Leaves Extract in Sago Liquid Sugar

Forty g of fresh Moringa land katuk leaves were washed thoroughly, then blanched for 5 minutes in a separate container. The leaves were drained and then blended with the addition of 120 mL water (1:3). Moringa and katuk leaves extract was obtained after filtering with gauze. The sago liquid sugar which has been incubated for 48 hours was then fortified with Moringa and katuk leaf extract, with a formula according to the treatment. The liquid sugar was then packaged in a glass bottle, sterilized with steam for 5 minutes, and stored in a refrigerator for 24 hours for further analysis.

Treatments applied were: G_0 (100% liquid sugar as a control); G_1 (95% liquid sugar + 5% katuk extract); G_2 (95% liquid sugar + 5% Moringa extract); G_3 (90% liquid sugar + 5% katuk + 5% Moringa extract); G_4 (85% liquid sugar + 10% katuk extract + 5% Moringa extract); and G_5 (85% liquid sugar + 5% katuk extract + 10% Moringa extract). The variables observed were sensory properties (color, aroma, taste, viscosity), glucose content, and anti-oxidant activity.

Analysis of Antioxidant Activities

The assay of antioxidant activity was carried out using 1,1-diphenyl-2-picrylhydrazyl (DPPH) as free radicals according to Banerjee et al. (2005). Samples were extracted using ethanol. The test began with the making of a series of concentrations, namely 50, 100, 150, 250, 500, 7500 ppm. Each series of concentration piped 1 mL was added 1 mL of DPPH 0.25 mM solution and 3 ml of ethanol. Next, the sample and DPPH were mixed with cortex for 1 minute then incubated for 30 minutes in the dark room and room temperature. The absorbance was measured using the Shimadzu Mini-UV U-1240 Spectrophotometer at a wavelength of 513 nm. Inhibition Concentration (IC50) values were recorded as the number of sample concentrations to reduce the DPPH concentration by 50%. Percentage inhibition was calculated by formula:

$$\% \text{ Inhibition} = \frac{\text{Absorbance of blank} - \text{Absorbance of DPPH}}{\text{Absorbance of blank}} \text{ x } 100\%$$

RESULTS AND DISCUSSION

Sensory Properties

The inclusion of extract of the katuk and moringa leaves had significantly influenced some of the sensory properties of the liquid sugars produced, including color, taste, and aroma. As shown in Figure 2, the color of G_3 was most preferred by the panelist, while the other sensory properties were about similar to those of other treatments. The color of G_3 product was light green; as a comparison, the color of G_0 product was light yellowish and that of G_5 product was dark green.

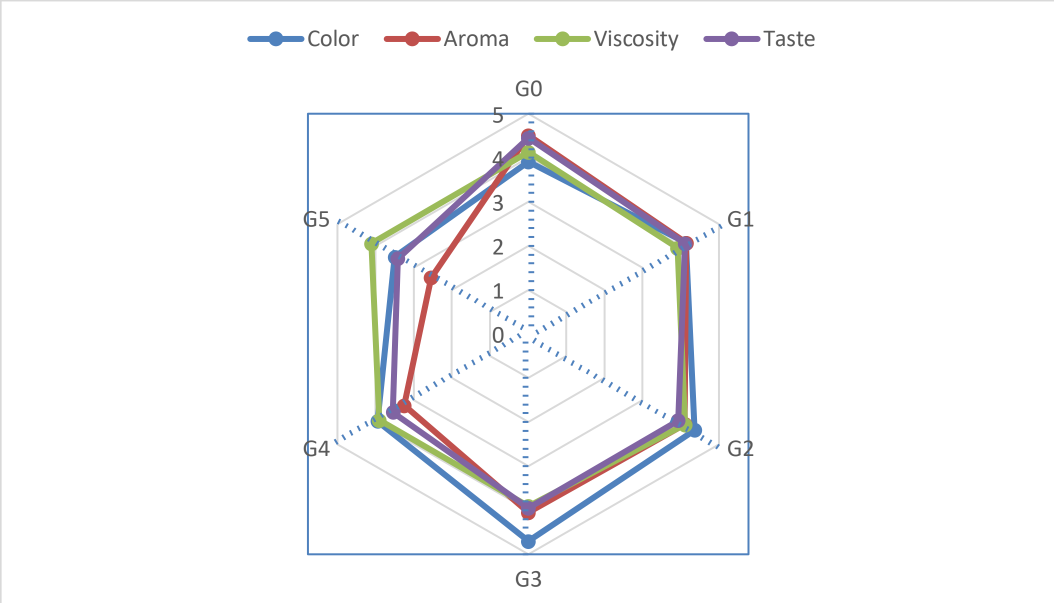


Figure 2. Sensory properties of the sago liquid sugars fortified with various katuk and moringa leaves extracts.

Glucose Content

Glucose was a simple monosaccharide that plays a very important role of energy source. Glucose contained in sago starch liquid sugar was produced from two stages, namely the first stage of liquefaction where the starch was gelatinized first and hydrolyzed by the α-amylase enzyme to dextrin then the second stage of saccharification, i.e. at this stage starch would be converted to glucose (Yunianta et al., 2010). Both of these stages were influenced by various factors, such as enzyme concentration, substrate concentration, pH, temperature, processing time and the presence of inhibiting compounds.

The glucose content of sago liquid sugar fortified with Moringa leaf extract and katuk leaf extract can be seen in Figure 3. Glucose levels of sago starch sugar ranged from 69.70% - 83.70%. Fortification of Moringa and katuk leaf extract did not influence the glucose level of sago starch sugar liquid. The highest glucose level was the control (G_0) with glucose level of 83.70%. This was in accordance with the findings of Mayasari (2016), where the glucoamylase enzyme breaks down starch from the outside by removing end glucose units rather than reducing starch polymers so that the reaction results were only glucose. While the lowest glucose level was in the G5 treatment, which was 69.70%.

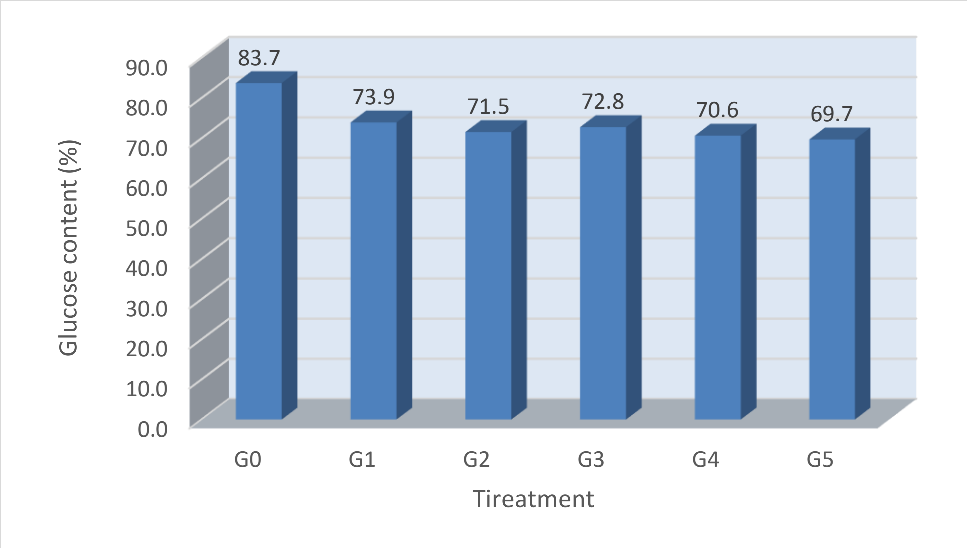


Figure 3. Glucose content of the sago liquid sugar fortified with Moringa and katuk leaf extracts.

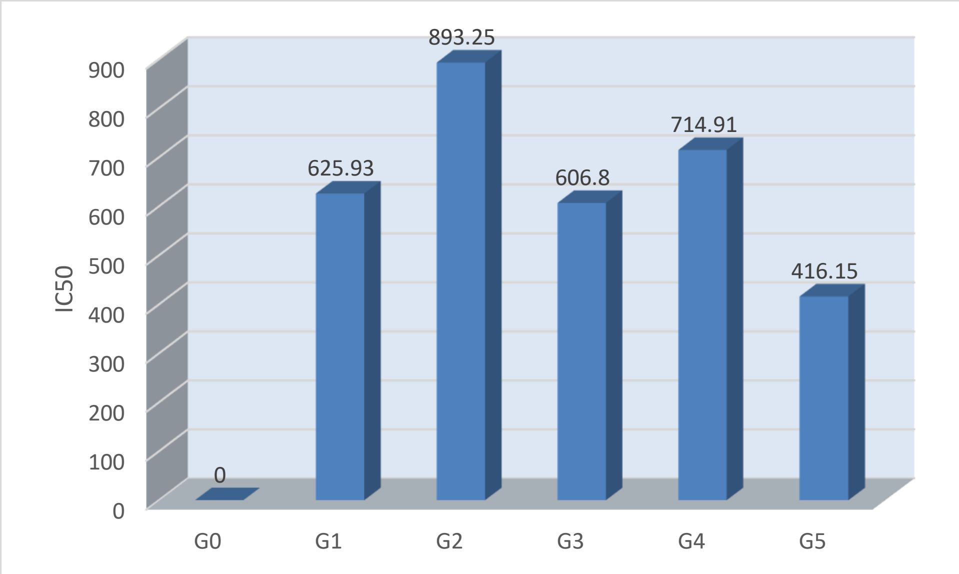
In Figure 3, it can be seen that the average glucose level of sago liquid sugar decreased as the extracts of moringa and katuk leaves was increased. This was in line with the findings by Robby et al., (2017) of the various treatments of moringa and flour variations in the making of brownies. It was seen that the more moringa was added, the less glucose levels appeared.

Antioxidant Activity

The results of the analysis of the antioxidant activity of sago liquid sugar fortified with Moringa and Katuk leaf extract was shown in Figure 4. The percent inhibition of DPPH radical (% inhibition) increased with the increase in Moringa fortified sugar from 13.83% to 34.00 %. The lowest antioxidant activity was in the treatment of G1 (liquid sugar 95 mL and 5 mL Katuk leaf extract) because katuk leaves have lower antioxidant activity than Moringa leaves.

The highest antioxidant activity was in the treatment of G5 (85 mL liquid sugar, 10 mL Moringa leaf extract and 5 mL Katuk leaf extract). This was in accordance with Hardiyanthi (2015) who have found the highest value of antioxidant activity in cream samples was increased with the increasing percentage of Moringa leaf extract. This showed that the strength of the antioxidant activity of Moringa leaves was better than those of the katuk leaves.

Yuliani and Desmira (2015) found that Moringa leaf positively contained flavonoids, saponins, tannins, terpenoids and negatively contained alkaloids while according to Djamil and Sarah (2016) methanol extracts of katuk leaves contained flavonoid compounds, saponins, tannins, terpenoids.



CONCLUSION

Fortification of Moringa leaf extract and katuk leaf extract on sago starch liquid sugar has a very significant effect on sensory properties, and antioxidant activity, but it has no significant effect on glucose levels. The best treatment of moringa leaf extract and katuk leaf extract on sago starch liquid sugar for sensory properties, in terms of color, aroma, and taste was G1 treatment (95% liquid sugar + 5% Katuk extract). There was significant differences on the glucose content; while the highest anti-oxidant activity was in the G5 treatment (85% liquid sugar + 10% Moringa extract + 5% Katuk extract) with IC50 value of 416.15. This study had indicated that sago flour may have a good prospect in producing a variety of nutritional food ingredients, and at the same time its added value may be made.

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