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Kasoami from White Cassava (*Manihot esculenta* Crantz) as Butoneese Functional Food: Phytochemical Screening, Antioxidant and Antidiabetic

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Abstract:
Background*: Kasoami, traditional food from Buton, is a functional food with antidiabetic activity. Kasoami is made up of Kaopi from cassava (Manihot esculenta Crantz). This study aimed to examine the Kaopi and Kasoami from white cassava as antidiabetic food by its antioxidant capacity.*
Materials and Methods*: Kaopi and Kasoami were macerated with ethanol. The extracts obtained were qualitatively screening, and quantitatively measured their total phenolic and flavonoid content by colorimetric methods. Simultaneously, Kaopi and Kasoami were assayed their antioxidant capacity by DPPH and ABTS methods, and the antidiabetic was assayed in vivo.*
Results*: According to results conducted, both Kaopi and Kasoami contained phenolic compounds, flavonoids, and alkaloids. They were followed by the determination of total phenolic and flavonoid content. The total phenolic content of Kaopi and Kasoami were 27,94±0,79 mgGAE/g extract and 35,11±1,41 mgGAE/g extract, respectively. Simultaneously, the total flavonoid content was 1,83±0,29 mgQE/g extract and 2,74±0,56 mgQE/g extract. The antioxidant capacity of Kaopi and Kasoami were 110.69±1.93 mg/L for ABTS and 112.42±1.43 mg/L for DPPH, and 85.45±3.97 mg/L for ABTS and 87.16±2.92 mg/L for DPPH, respectively. For antidiabetic food assay, Kaopi and Kasoami at concentration of 0.05, 0.1, and 0.2 mg/mL decreased blood glucose level in diabetic model mice at minute 60 to 180. They were significant to the negative control used ($p<0.05$).*
Conclusion: *The phenolic compounds and flavonoids in Kaopi and Kasoami from white cassava provided antioxidant capacity, thus decreased blood glucose levels in diabetic-induced mice models.*
Key Word*: Kaopi; Kasoami; White Cassava (Manihot esculenta Crantz); Antioxidant; Antidiabetic*

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I. Introduction

The philosophy of eating has undergone many shifts in meaning. Eating is not just to be full, but also can provide health benefits. Food is expected to provide more than just nutrients as the body's basic needs and sensory satisfiers, but is also functional[1,2,3]. The concept of food as medicine has existed since the Hippocrates and has been around for a long time, developed in Japan, Korea, and China[1,4,5,6]. Functional foods in various countries are often referred to by various terms: designer food, food for specified health use, functional food, natural food, nutraceutical, pharmafood, phytofood, real food, and vitafood. Functional foods are generally defined as foods capable of providing beneficial effects on health and the nutritional effects that food has fundamentally[7,8]. This definition indicates that functional foods are widely used to define foods that benefit from influencing physiological processes, thereby improving health and preventing disease.

Kasoami, as one of the most popular specialties in Southeast Sulawesi, has the value of civilization, economic, strategic, and functional food. The value of civilization is that Kasoami is typical food for the Butonese people and a medium for kinship and brotherhood[9]. Kasoami, as a functional food, is thought to be due to satiety, which is longer than consuming white rice. It is because Kasoami has a relatively high fiber content (due to its bulky nature). Kasoami is made from Kaopi (Onggok). Onggok has a fiber content of 31.6 to

33.10%. However, there are differences in the process of making Kaopi and Onggok, namely: The shredded fresh cassava leaves are wrapped in flour sacks. Then it is clamped/pressed, thus the water content and part of the starch can be reduced[9]. In contrast, Onggok is the optimal residual yield to obtain starch from grated[10].

Kasoami made from cassava with the Latin name *Manihot esculenta* Crantz, also known as the Latin name *Manihot utilissima*, contains flavonoids and polyphenols in the stems tubers. Flavonoids and polyphenols are a source of antioxidants. Antioxidants are compounds that can inhibit the oxidation process. This oxidation process is a chemical process that produces free radicals, which cause a chain reaction that can damage the cells of organisms. Oxidizing substances can be in the form of ROS (reactive oxygen species) or RNS (reactive nitrogen species), which are naturally produced by the body due to metabolic waste, which can be harmful to the body. In diabetic patients, there is an increase in the free radical formation and a lack of endogenous antioxidant activity, which causes oxidative damage to cell components. Diabetes, or commonly known as diabetes mellitus (DM), is a group of metabolic diseases characterized by high blood glucose levels or hyperglycemia caused by disturbances in insulin secretion or insulin action. A person is said to have diabetes if their blood glucose level is more than 200 mg/dL[11,12,13,14,15,16,17].

Inhibition of intracellular free radical formation is one strategy that can be developed in the management of DM. One of them is by using substitute foods containing phenolic compounds and flavonoids proven as antioxidants. Kasoami, which is processed from cassava containing phenolic and flavonoid compounds, is an alternative treatment for diabetic patients. Thus, this study aims to examine the secondary metabolite metabolites contained in Kaopi and Kasoami from white cassava (*Manihot esculenta* Crantz), and their antioxidant capacity, as well their antidiabetic activity from Kaopi and Kasoami.

II. Material And Methods

Sample Preparation: This study's sample was Kaopi and Kasoami from white root cassava varieties (*Manihot esculenta* Crantz). Kaopi was processed by removing the root's skin using a knife, cutting it lengthwise, and pulling the skin out. The white cassava was then washed under running water to remove the dirt and sap on cassava peels' surface and continued by draining them. After that, the cassava was shredded with a grater machine.

Following by the grated cassava was pressed with a hydraulic press to extract the juice. It aimed to reduce the water content, HCN, and odor. The residue was named as **Kaopi.** After that, Kaopi was steamed with pot for 30 minutes to produce **Kasoami.**

Extraction: Both sample **Kaopi (Kp)** and **Kasoami (**Kss) were extracted with 96% ethanol (Merck®) for 24 hrs. The filtrate was separated and re-macerated for 3 days. All filtrates were collected and extracted under vacuum pressure using a rotary evaporator at 40℃(Buchi®).

Phytochemical Screening: Phytochemical screening was conducted according to colorimetric methods[18].

1. Phenols and Tannins
   The sample was added with 2% $FeCl_3$ solution (2 mL). The blue-greenish or black indicates the presence of phenols or tannins.
2. Flavonoids
   The sample was added with 2% NaOH solution (2 mL) and a few diluted acids. The yellow solution discoloration into a colorless solution indicates the presence of flavonoids.
3. Steroids
   The sample was added with chloroform (2 mL) and H_2SO_4 (2 mL). The red or green layer formed in the lower layer of chloroform indicate the presence of steroid.
4. Terpenoids
   The sample was added with H_2SO_4 (2 mL) and heated for 2 min. The greyish color formed indicates the presence of terpenoids.
5. Alkaloids
   The sample was added with 1% HCl (2 mL) and heated gradually, following by adding Mayer's reagent in the mixture. The turbidity of the resulting deposit indicates the presence of alkaloids.

Total Phenolic Content: Total Phenolic content measurement was conducted according to Chun et al. (2003) colorimetric method with Gallic acid (GAE) as standard[19].

1. Preparation of 7% Na_2CO_3
   Na_2CO_3 was weighed for 3.5 g and dissolved in distilled water up to 50 mL.
2. Measurement of Gallic Acid Standard Solution

Each concentration used (10; 20; 30; 40; and 50 ppm) was added with Folin-Ciocalteau (0.4 mL), shaken and left for 4-8 min, added by 7% Na2CO3 solution (4 mL), shake until homogeneous. Following by adding with distilled water up to 10 mL and left for 2 hrs at room temperature. The absorbance was measured under spectrophotometer (Jenway) at 750 nm, and the calibration curve was made for the relationship between gallic acid concentrations (mg/L) and the absorbances.

3. Preparation of Sample Solution
   The sample was prepared by weighing 10 mg and dissolved with ethanol up to 10 mL.
4. Total Phenolic Content Measurement
   Each sample (1 mL) was pipetted and added with Folin-Ciocalteau reagent (0.4 mL), shaken and left for 4-8 min, continued by adding 7% Na_2CO_3 (4 mL), shaken until homogenous. Distilled water was added up to 10 mL and left for 2 hrs at room temperature. The absorbance was measured under spectrophotometer (λ 750 nm) in triplicates to obtain the concentration equivalent to gallic acid/g samples.

Total Flavonoid Content: Total Flavonoid content measurement was conducted according to the colorimetric method by Chang et al., (2002) with quercetin (QE) as standard[20].

1. Preparation of quercetin solution standard
   Standard quercetin 1000 ppm was made by weighing quercetin (10 mg) and dissolved in ethanol (10 mL). 1 ml of quercetin solution standard 1000 ppm was pipetted and dissolved in 10 mL of ethanol to obtain 100 ppm. By 100 ppm quercetin solution standard, 10; 20; 30; 40; and 50 ppm of quercetin were made. Each concentration was added with methanol (3 mL), 10% $AlCl_3$ (0.2 mL), 1 M potassium acetate (0.2 mL), and added with distilled water up to 10 ml. Continued by incubating the concentration for 30 min at room temperature and the absorbance was measured with spectrophotometer UV-Vis Jenway at 431 nm.
2. Preparation of Sample Solution
   The sample was prepared by weighing 10 mg and dissolved with ethanol up to 10 mL.
3. Total Flavonoid Content Measurement
   Each sample (1 mL) was pipetted and added with methanol (3 mL), 10% $AlCl_3$ (0.2 mL), and distilled water up to 10 mL, incubated for 30 min in a dark room at room temperature). The absorbance of the sample was measured under spectrophotometer Uv-vis (λ 431 nm) in triplicates.

Antioxidant Assay:

1. Free radical Scavenger Activity of DPPH (1,1-Diphenyl-2-Picrylhydrazyl)
   The assay was conducted according to the modified Blois (1958) method[21]. DPPH (HIMEDIA) was prepared in a concentration of 0.1 mM in methanol solvent, while the extract was prepared in different concentrations (10, 20, 30, 40, and 50 mg / L). DPPH solution (1 mL) was mixed with a sample solution (2 mL) at each concentration. The mixture was then incubated in the dark at room temperature for 30 minutes. Control was made by mixing the DPPH solution (1 mL) with methanol. The absorbance was measured under the spectrophotometer (Jenway) (λ 517 nm). The lower absorbance of the reaction mixture indicates a higher DPPH free radical inhibitory activity. Ascorbic acid (Sigma-Aldrich) was used as control. Samples were prepared and measured in triplicates. The percentage of inhibitory activity of each sample on the DPPH radical was calculated as % DPPH inhibition (I%) using the following equation:
   $I\% = [(Ao-As) / Ao] \times 100$
   Ao is the absorbance of the control and As is the absorbance of the sample solution tested.
2. Free radical Scavenger Activity of ABTS [2,2'-Azinobis(3-Ethylbenzothiazoline-6-Sulphonic Acid)]
   The assay was conducted according to the modified Re et al. (1999) method[22]. The ABTS ● + stock solution is prepared by mixing ABTS (Sigma Aldrich) solution (7 mM) with an equal amount of 2.45 mM potassium persulfate (Merck) solution, leaving the mixture in the dark at room temperature for 12-16 hrs prior use. The ABTS ● + working solution was obtained by diluting the stock solution in methanol to give an absorbance of 0.70 ± 0.02 (λ 734 nm). The sample solutions were prepared in different concentrations (10, 20, 30, 40 and 50 mg / L). Next, ABTS ● + solution (2 mL) was mixed with 1 mL of each sample. The mixture was then incubated in the dark at room temperature for 10 min. Control was made by mixing ABTS ● + solution (2 mL) with 1 mL of methanol. The absorbance was measured using a spectrophotometer (Jenway) (λ 734 nm). Ascorbic acid (Sigma-Aldrich) was used as control. Samples were prepared and measured in triplicates. The percentage of inhibitory activity of each sample on the ABTS radical is calculated as% inhibition of ABTS (I%) using the following equation:
   $I\% = [(Ao-As) / Ao] \times 100$
   Where Ao is the absorbance of the control and As is the absorbance of the sample solution tested.
3. IC_{50} Determination
   The IC_{50} of samples is calculated according to the percentage of inhibition to radicals of each sample solution concentration. After obtaining the percentage of inhibition (y) of each concentration (x), the points

(x and y) are plotted on the coordinate plane, then the equation for the line y = ax + b is determined using linear regression calculations where a and b are constants, x is the sample concentration (mg / L), and y is the percentage of inhibition (%). Antioxidant capacity is expressed by Inhibition Concentration 50 (IC50), namely the concentration of the sample (x), which can reduce 50% of radicals (y = 50).

Animals: A total of 24 white mice (*Mus muscullus*) were used as experimental animals in this study. These mice were obtained from animal farms in Surabaya. The animals were acclimatized for 7 days at standard conditions (temperature 25±1ºC, humidity 55±5%, and 12:12h light : dark cycle). The animals are also given free access to food and drinks *ad libitum.* Animals involved in this study were conducted under the ethical committee of Halu Oleo University (No. 737/UN29.20/PPM/2019).

Antidiabetic Assay: In the antidiabetic activity test of **Kaopi (KP)** and **Kasoami (KSS)**, initiated by inducing the mice with alloxan intraperitoneally (175 mg / KgBW). After 24 hours, mice who experienced an increase in blood glucose levels> 200 mg / dL were then divided into 8 groups (n = 3) and treated as follows: positive control group (administration of glibenclamide, negative control group (CMC-Na 0.5%), Kasoami 0.05 mg / mL (kss 50), Kasoami 0.1 mg / mL (kss 100), Kasoami 0.2 mg / mL (kss 200), Kaopi 0.05 mg / mL (kp 50), Kaopi 0.1 mg / mL (kp 100), and Kaopi 0.2 mg / mL (kp 200). After that, all mice were checked for blood glucose levels using a glucometer (Nessco) at 0, 30, 60, 90, 120, 150, and 180 minutes which was carried out in triplicates.
The collected data were then analyzed using the SPSS program by conducting a One-way Analysis of Variance (ANOVA) testing, and the data is considered significant if the p-value is less than 0.05 ($p < 0.05$).

III. Result and Discussion

Extraction. The extraction method used in this study was maceration to extract chemical compounds from sample tissue. A total of 1009 g of Kaopi from white cassava (Kp) and 1016 g of Kasoami from white cassava (kss) was macerated and obtained concentrated extract 4.09 g (0.41%) and 9.69 g (0.95%), respectively.

Phytochemical Screening.Phytochemical screening is a preliminary step of the sample to provided chemical compounds in the sample used, qualitatively. The phytochemical screening was conducted according to the colorimetric method[18]. The samples used contained phenolic compounds, flavonoids, and alkaloids (**Table 1**).

Table 1. Phytochemical Screening of Samples

No	Sample	Secondary metabolites				
		Phenolic	**Flavonoid**	**Steroid**	**Terpenoid**	**Alkaloid**
1	Kaopi from White cassava (Kp)	+	+	-	-	+
2	Kasoami from White Cassava (Ks)	+	+	-	-	+

Total Phenolic Content. In determining the total phenolic content, a series of standardized gallic acid solutions were prepared to obtain a regression equation used to determine the sample's total phenolic content by measuring the absorbance at 750 nm. The concentrations used were 10, 20, 30, 40, and 50 mg/L. Linear regression is obtained from the results of these measurements as y = 0.063x + 0.1284 (**Figure 1**).

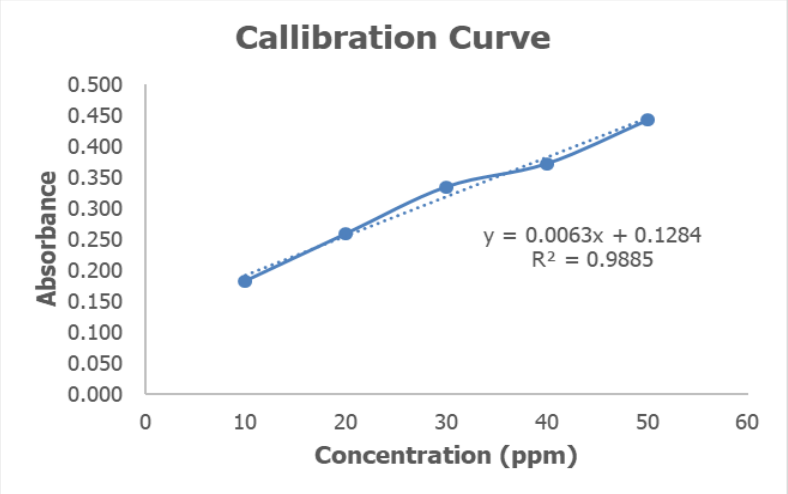

Figure 1. Calibration Curve of Gallic Acid Solution Standard

According to results conducted, both Kaopi (Kp) and Kasoami (kss) had total phenolic content, which was 27,94±0,79 mgGAE/g extract and 35,11±1,41 mgGAE/g extract, respectively (**Table 2)**. The results were along to a preliminary screening, which mentioned that Kaopi from white cassava (Kp) and Kasoami from white cassava (kss) contained phenolic compounds (**Table 1**).

Table 2. Total Phenolic Content Measurement of Samples

Sample	Replication	Absorbance	Total Phenolic (mgGAE/g extract)	Total Phenolic Mean (mgGAE/g extract)
Kaopi from White cassava (Kp)	1	0,314	28,06	27,94±0,79
	2	0,309	28,67	
	3	0,306	27,11	
Kasoami from White Cassava (Ks)	1	0,357	34,56	35,11±1,41
	2	0,343	34,06	
	3	0,369	36,72	

Total Flavonoid Content. In determining total flavonoid contents, a series of quercetin standard solutions with concentrations of 10, 20, 30, 40, and 50 ppm was prepared to obtain a regression equation by measuring the absorbance of 431 nm. The linear regression obtained was y = 0.0178x + 0.0398 (**Figure 2**).

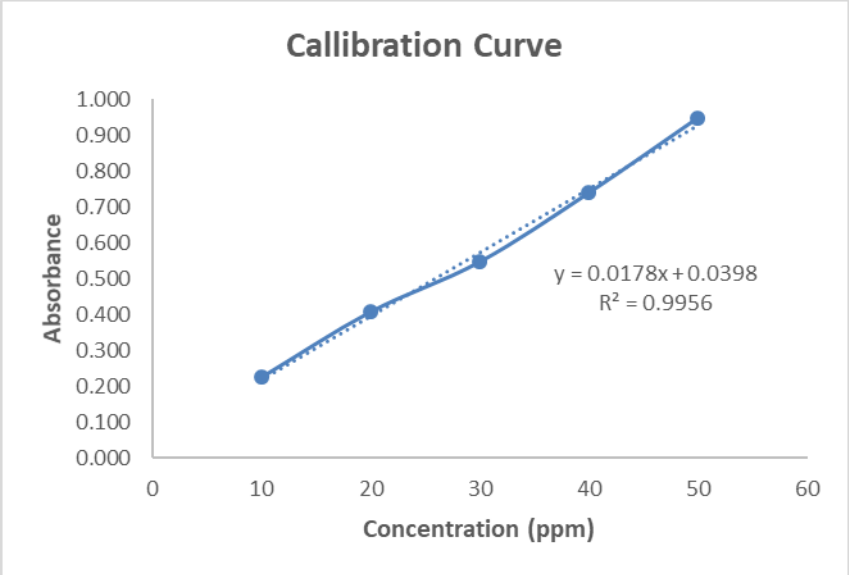

Figure 2. Calibration Curve of Quercetin Standard Solutions

According to results conducted, both Kaopi (Kp) and Kasoami (kss) contain flavonoids, which were 1,83±0,29 mgQE/g extract and 2,74±0,56 mgQE/g extract, respectively (**Table 3**). They were along to preliminary results conducted in phytochemical screening (**Table 1**).

Table 3. Total Flavonoid Content Measurement of Samples

Sample	Replication	Absorbance	Total Flavonoid (mgQE/g extract)	Total Flavonoid Mean (mgQE/g extract)
Kaopi from White cassava (Kp)	1	0,075	1,88	1,83±0,29
	2	0,077	2,09	
	3	0,068	1,52	
Kasoami from White Cassava (Ks)	1	0,094	2,90	2,74±0,56
	2	0,097	3,21	
	3	0,079	2,12	

Antioxidant Capacity. According to the antioxidant results by ABTS and DPPH methods, it was shown that both samples had antioxidant capacity (**Table 4**). Kasoami from white cassava (Kss) provides the lowest IC50 value than the Kaopi from white cassava (Kp), which were 85.45±3.97 mg/L for ABTS 87.16±2.92 mg/L for DPPH. Meanwhile, Kp's IC50 value was 110.69±1.93 mg/L for ABTS and 112.42±1.43 mg/L for DPPH, respectively. The results were along to results total phenolics and flavonoids content contained in samples

(**Table 2**) and total flavonoid levels (**Table 3**) of the sample. Phenolics compound and flavonoids are potential as antioxidants.

Table 4. Antioxidant capacity of samples by DPPH and ABTS

Sample	Concentration (mg/L)	% Inhibition		IC_{50} (mg/L)	
		ABTS	DPPH	ABTS	DPPH
Kaopi from White cassava (Kp)	10	5,51	16,39	110,69±1,93	112,42±1,43
	20	11,03	20,49		
	30	15,96	24,15		
	40	19,89	27,08		
	50	22,75	29,20		
Kasoami from White Cassava (Ks)	10	16,81	24,79	85,45±3,97	87,16±2,92
	20	22,50	29,01		
	30	27,50	32,73		
	40	30,22	34,75		
	50	34,34	37,82		
Ascorbic acid	10	53,87	54,52	9,58±0,57	7,73±0,43
	20	58,21	57,75		
	30	73,17	68,90		
	40	86,95	79,17		
	50	98,73	87,95		

Phenolic compounds have potential as antioxidants. Phenolic compounds can reduce free radicals by donating hydrogen atoms, electrons, and chelating metal cations[23]. Meanwhile, flavonoid compounds play a vital role in reducing free radical elements, chelating metal substances, suppressing the work of enzymes that play a role in the formation of free radicals, and stimulating the production of endogenous antioxidant enzymes[24].

Antidiabetic Activity. According to **Table 5**, it can be explained that the average blood glucose levels of mice (*Mus muscullus*) in the positive, negative, Kss 50, Kss 100, Kss 200, Kp 50, Kp 100, and Kp 200 groups increased after being induced with alloxan. Alloxan induces diabetes due to alloxan's toxic nature, which is selective against pancreatic beta cells that function to produce insulin. Alloxan interferes with the insulin-carrying processes in the pancreas' beta cells; thus, the insulin secretion is disturbed. Alloxan binds to sulfhydryl groups (-SH) in the glucose binding area of the glucokinase enzyme, which results in the formation of disulfide bonds and enzyme inactivation. It causes dialuric acid formation, which causes reactive oxygen species (ROS) and superoxide radicals. Besides, alloxan also damages DNA, which stimulates poly-ADP-ribosylation, which plays a role in DNA repair of pancreatic beta cells[25].

Tabel 5. The Measurement of Blood Glucose Levels of Mice

No	Group	Blood Glucose Levels Mean ± SD (mg/dL)	
		Pre-Induced	Post-Induced
1	Positive	98,3 ± 12,58	182 ± 12,12
2	Negative	97,3 ± 14,84	181 ± 8,54
3	Kss 50	99,6 ± 10,40	220 ± 10
4	Kss 100	89,6 ± 9,60	230,6 ± 25,83
5	Kss 200	88,6± 8,14	221,6 ± 31,21
6	Kp 50	91 ± 6	213,3 ±28,04
7	Kp 100	82,6 ±10,11	173 ±6,08
8	Kp 200	80 ±2,64	191,3 ± 5,50

It was explained on **Figure 3** and **Figure 4** that the blood glucose mean levels of mice (*Mus muscullus*) in the Kasoami from white cassava (kss) and Kaopi from white cassava at minutes 0, 30, 60, 90, 120, 150, and 180 for the positive, negative, Kss 50, Kss 100, Kss 200, Kp 50, Kp 100 and Kp 200 were decreased, while the negative control group experienced an increase of blood glucose levels.

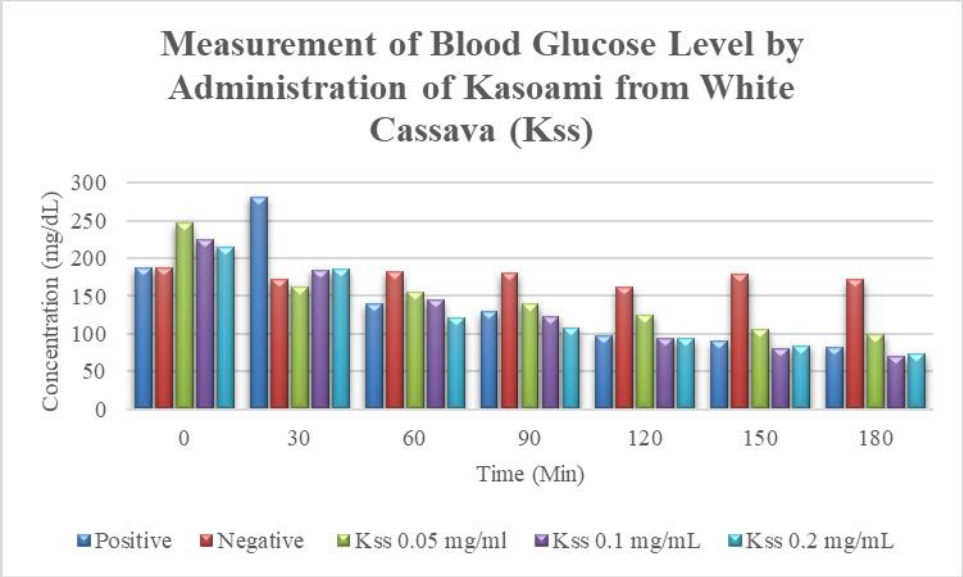

Figure 3. Blood Glucose Level Measurement of Kasoami from White Cassava (kss) in mean ± SD. (0 : blood glucose levels at min-0 (mg/dL); 30 : blood glucose levels at min-30 (mg/dL); 60 : blood glucose levels at min-60 (mg/dL); 90 : blood glucose levels at min-90 (mg/dL); 120 : blood glucose levels at min-120 (mg/dL); 150 : blood glucose levels at min-150 (mg/dL); 180 : blood glucose levels at min-0 (mg/dL))

Statistically, at minute 0, all groups on Kasoami (kss) exhibited a significant difference marked with a p-value of less than 0.05 ($p < 0.05$) to the negative control, while kaopi (kp) exhibited no significant difference ($p. > 0.05$) to the negative control. In the all kss group, which experienced a significant difference in negative control, the blood glucose level was higher than the negative control. It indicates that both the Kss and Kp groups have not had the expected effect in minute 0.

At 30 minutes, positive controls still experienced increased blood glucose levels compared to negative controls ($p < 0.05$). On the other hand, all groups did not significantly differentiate negative controls ($p > 0.05$). It indicates that both the positive control, kss, and kp groups have not provided a hypoglycemic effect.

At 60 to 180 minutes, both positive control and treatment groups (kss and kp) experienced a significant difference where the levels of the treatment group were lower than the negative control ($p < 0.05$). It demonstrated that positive control and treatment groups (kss and kp) provided a hypoglycemic effect starting from the 60th minute.

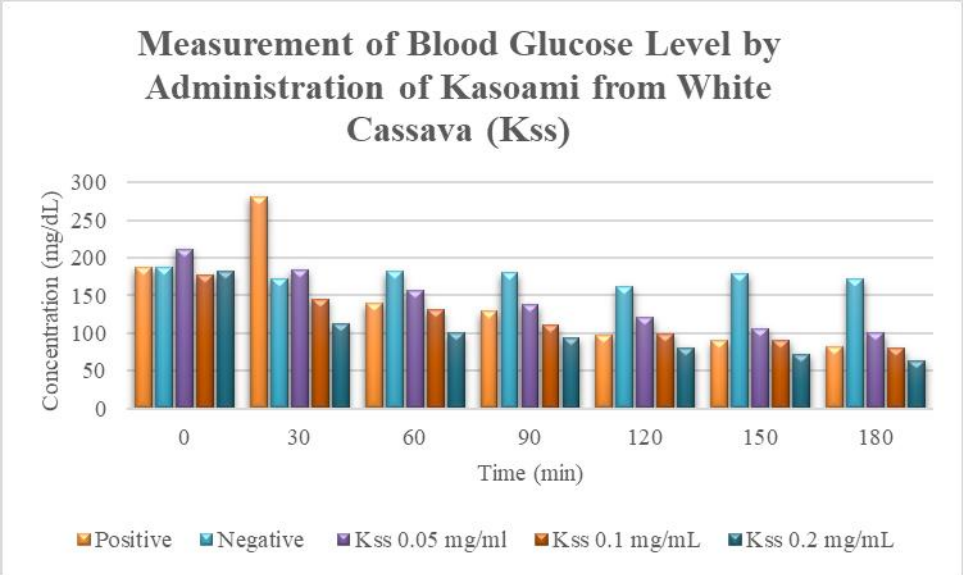

Figure 4. Blood Glucose Level Measurement of Kaopi from White Cassava (Kp) in mean ± SD. (0 : blood glucose levels at min-0 (mg/dL); 30 : blood glucose levels at min-30 (mg/dL); 60 : blood glucose levels at

min-60 (mg/dL); 90 : blood glucose levels at min-90 (mg/dL); 120 : blood glucose levels at min-120 (mg/dL); 150 : blood glucose levels at min-150 (mg/dL); 180 : blood glucose levels at min-0 (mg/dL))

The results according to the **Table 6**, the highest percentage decreasing was Kss 100 group with 69.51%, followed by the Kss 200 group with 66.92%, the Kp 200 group with 66.75%, the Kss 50 group with 55.31%, positive group with 54.78%, Kp group with 53.98%, Kp 50 group with 52.83%, and negative control group with 5.19%.

Tabel 6. The percentage of Decreased Blood Glucose Levels

Group	Decreased Percentage
Positive	54,78 %
Negative	5,19 %
Kss 50	55,31 %
Kss 100	69,51 %
Kss 200	66,92 %
Kp 50	52,83 %
Kp 100	53,98 %
Kp 200	66,75 %

The decrease in blood glucose levels in alloxan-induced in diabetic mice model is caused by the antioxidant content of phenolic compounds and flavonoid compounds contained in the sample. Antioxidants may protect pancreatic beta cells from alloxan toxicity. Reactive oxygen species (ROS) capable of oxidizing cellular proteins, nucleic acids, and lipids. Studies and clinical evidence have proven that the generation of ROS increases the incidence of diabetes, which is closely related to oxidative stress primarily through oxidation, glycation of non-enzymatic proteins, and oxidative degradation of glycated proteins. Increased ROS, such as mitochondrial superoxide in endothelial cells and endoplasmic reticulum stress, is followed by decreased antioxidant defense mechanisms that trigger cell and enzyme damage and lipid peroxidation, which then leads to the development of insulin resistance and hyperglycemia. Phenolic compounds and flavonoids are thought to be useful in the management of diabetes mellitus. Apart from their antioxidant ability, which can protect against the damaging effects of hyperglycemia, flavonoids and phenolic compounds also increase the inhibition of α amylase and α glucosidase enzymes in processing carbohydrates into monosaccharides in the intestine. In addition to their antioxidant effects, flavonoids can act on biological targets involved in type 2 diabetes mellitus such as α-glycosidase and DPP-4. As radical scavengers, flavonoids, and phenolic compounds can effectively prevent or manage type 2 diabetes mellitus[26,27].

IV. Conclusion

Kaopi and Kasomi from white cassava (*Manihot esculenta* Crantz) is a functional food used in diabetic patients. According to results conducted, Kaopi and Kasoami from white cassava can decrease blood glucose levels at a concentration of 0.05, 0.1, and 0.2 mg/mL. Phenolic compounds and flavonoids in Kaopi and Kasoami might play a vital role in decreasing blood glucose levels with their antioxidant capacity. Both Kaopi and Kasoami provided antioxidant capacity measured by DPPH and ABTS methods.

References

[1]. Silalahi Jansen. Makanan Fungsional. Yogyakarta: Penerbit Kanisius. 2006.
[2]. Handayani THW. Makanan Sebagai Produk Budaya Dalam Menghadapi Persaingan Global. Proceeding in Seminar Nasional 2015 "Pengembangan SDM Kreatif dan Inovatif untuk Mewujudkan Generasi Emas Indonesia Berdaya Saing Global". UNY. 2015.
[3]. Widyaningsih TD, Wijayanti N, Nugrahini NIP. Pangan Fungsional: Aspek Kesehatan, Evaluasi, dan Regulasi. Ub Press. Malang. 2017
[4]. Marsono Y. Prospek Pengembangan Makanan Fungsional. Jurnal Teknologi Pangan dan Gizi, 2008; 7(1):19-27
[5]. Darwis W. Tanaman Obat Yang Terdapat Di Kota Bengkulu Yang Berpotensi Sebagai Obat Penyakit Dan Gangguan Pada Sistem Pencernaan Manusia. Konservasi Hayati, 2012; 8(1):1-15
[6]. Palupi IA, Martosupomo. Buah Merah: Potensi Dan Manfaatnya Sebagai Antioksidan. Jurnal Tumbuhan Obat Indonesia, 2009; 2(1):42-48
[7]. Andriyani. Kajian Literatur pada Makanan dalam Perspektif Islam dan Kesehatan. Jurnal Kedokteran dan Kesehatan, 2019; 15(2):178-198
[8]. Alam AS. Pemenuhan Hak Mendapatkan Pelayanan Kesehatan dan Makanan Bagi Deteni di Rumah Detensi Imigrasi Makassar. Phinisi Integration Review, 2019; 2(2):201-217
[9]. Amin H. PENGOLAHAN KASOAMI: Uji Mutu dan Masa Simpan. Unsultra Press. Kendari. 2018
[10]. Maghfiroh L, Hanum KF, Sedyadi E, Nugraha I, Nurlaili FA. Synthesis and Characterization of Biodegradable Plastic with Basic Materials of "Singkong Onggok"Pectin Peel of "Jeruk Bali"(Citrus Maxima) - Plasticizer. In *Proceeding International Conference on Science and Engineering,* 2019; 2, pp. 201-205
[11]. Azizah Z, Elvis F, Zulharmita Z, Misfadhila S, Chandra B, Yetti RD. Penetapan Kadar Flavonoid Rutin pada Daun Ubi Kayu (*Manihot Esculenta* Crantz) Secara Spektrofotometri Sinar Tampak. Jurnal Farmasi Higea, 2020; 12(1):90-98

[12]. Karundeng G, Suryanto E, Sudewi S. Aktivitas Tabir Surya Dari Ekstrak Fenolik Periderm Umbi Ubi Kayu (*Manihot Utilissima*). Pharmacon, 2014; 3(2):115-120
[13]. Rachman F, Hartati S, Sudarmonowati E, Simanjuntak P. Antioxidant Activity of Leaves and Tuber from Six Types of Cassava (*Manihot utilissima* Pohl). BIOPROPAL INDUSTRI, 2016; 7(2):47-52.
[14]. Gagola C, Suryanto E, Wewengkang D. Aktivitas Antioksidan Dari Ekstrak Fenolik Cortexumbi Ubi Kayu (*Manihot Esculenta*) Daging Putih Dan Daging Kuning Yang Diambil Dari Kota Melonguane Kabupaten Kepulauan Talaud. Pharmacon, 2014; 3(2):127-133
[15]. Salehi B, Martorell M,Arbiser JL, Sureda A, Martins N, Maurya PK, Sharifi-Rad M, Kumar P, Sharifi-Rad J. Antioxidants: Positive or Negative Actors?. Biomolecules, 2018; 8(4), 124: 1-11.
[16]. Bajaj S, Khan A. Antioxidants and Diabetes. Indian J Endocrinol Metab, 2012; 6(Suppl 2): S267–S271.
[17]. Kharroubi AT, Darwish HM. Diabetes mellitus: The epidemic of the century. World J Diabetes, 2015; 6(6):850-867.
[18]. Yadav RNS, Agarwala M. Phytochemical Analysis of Some Medicinal Plants. Journal of Phytology, 2011; 3(12):10–14.
[19]. Chun OK, Kim DO, Moon HY, Kang HG, Lee CY. Contribution of Individual Polyphenolics to Total Antioxidant Capacity of Plums. J. Agric. Food Chem, 2003; 51:7240-7245
[20]. Chang CC, Yang MH, Wen HM, Chern JC. Estimation of Total Flavonoid Content in Propolis by Two Complementary Colorimetric Methods. Journal of Food and Drug Analysis, 2002; 10(3):178-182
[21]. Blois MS. Antioxidant Determinations by the Use of a Stable Free Radical. Nature, 1958; 181: 1199-1200.
[22]. Re R, Pellegrini N, Proteggente A, Pannala A, Yang M, Rice-Evans C. Antioxidant Activity Applying An Improved Abts Radical Cation Decolorization Assay. Free Radical Biology & Medicine, 1999; 26(9/10):1231-1237
[23]. Pourreza N. Phenolic Compounds as Potential Antioxidant. Jundishapur J Nat Pharm Prod. 2013 Nov; 8(4): 149–150.
[24]. Banjarnahor SD, Artanti N. Antioxidant properties of flavonoids. Med J Indones, 2015;23(4):239-44
[25]. Rohilla A, Ali S. Alloxan Induced Diabetes: Mechanisms and Effects. IJRPBS, 2012; 3(2):819-823
[26]. Sarian MN, Ahmed QU, Mat So'ad SZ, Alhassan AM, Murugesu S, Perumal V, Mohamad SNAS, Khatib A, Latip J. Antioxidant and Antidiabetic Effects of Flavonoids: A Structure-Activity Relationship Based Study, BioMed Research International, 2017; 2017 (8386065): 1-14.
[27]. Putri, EPK, Hamzah B, Rahman N. Analisis Kualitatif Zat Bioaktif pada Ekstrak Daun Alpukat (*Persea Americana Mill*) dan Uji Praklinis dalam Menurunkan Kadar Glukosa Darah pada Mencit (*Mus musculus*). J.Akad Kim, 2012;2(3):119-127