Anti-hyperglycemic effect of Aloe vera peel extract on blood sugar level of alloxan-induced Wistar rats

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Abstract. *Aloe vera* peel contains flavonoids, alkaloids, tannins, saponins, and sterols as its secondary metabolites. This research explores the effect of *Aloe vera* peel extract on blood glucose levels of alloxan-induced Wistar rats in a laboratory experimental scale. Blood glucose examination was performed by using GOD-PAP method. Twenty five 2 months old-white rat (*Rattus norvegicus*) male wistar strain weigh 150-200 grams body weight, and in healthy condition, was randomly divided into five groups. Those five groups were negative control group (K-), positive control group (K+), treatment group 1 (P1), treatment group 2 (P 2) , and treatment group 3 (P 3). Each group was fed by standard diet and ad-libitum drinking. Treatments were given for 28 days. On the day 29, blood glucose level of all groups were analyzed. The results showed that the highest blood glucose levels in control group rat were positive (191.2 mg/dl). *Aloe vera* extract was able to decrease blood sugar level up to 104,6mg/dl in P3 group treatment rats (served *Aloe vera* extract 350 mg/kg BW/day). It comes to the conclusion that giving *Aloe vera* peel extract for 28 days decreases blood sugar level of hyperglycemic rat.

1. Introduction

In 2013, diabetes mellitus (DM) in Indonesia is suffered by more than 12 million people aged ≥ 14 years, has doubled compared to 2007 [1]. DM disease increases due to lack of public awareness about the dangers of high food consumption of carbohydrate and lipids [2]. High frequent intake of high sugar foods will effected an absorption of sugar by insuline-dependent cells such as muscle cells and adipose cells will increase sugar oxidation rate, then increasing production of hydrogen nicotinamide adenine dinucleotide (NADH) and flavin adenine dinucleotide hydrogen (FADH2) automatically. NADH and FADH flooded respiratory electron transport system (RETS) in mitochondria and increased the formation of superoxide free radicals ($^{-}O2$) [3,4]. Furthermore, excess sugar, also affects activation of aldose reductase inhibitors that binding adenine dinucleotide hydrogen phosphate (NADPH) and glutathione reductase (GRs) [5,6], this reaction results in the decrease levels of GRS and increased radicals oxygen species (ROS) [7].

The excessed sugar is converted become triglycerides, then together with triglycerides from foods stored in adipose cells as caloric reserves. When the body needs energy, the pile of triglycerides inside adipose cells is broken down as an energy source and produce free fatty acids (FFAs) and glycerol. FFA enters liver and muscle cells then converted to Long Chain Fatty Acid (LCFA) and acyl-CoA. While glycerol transferred into the liver cells, then it converted into glucose molecule. When LCFA-CoA and glucose metabolism increases then endogenous antioxidants such as GRs decreases,

production of free radical will increase. It resulting accumulation of free radicals that inhibit tricarboxylic cycle (TCA) and causing damage of mitochondria and cell [8]. The fatal result in the cell is occurrence of insulin resistance that leading to DM.

An alternative that can be used to overcome DM problems is medicinal potential plants consumption such as *Aloe vera*. *Aloe vera* has a number of nutrients, contain number vitamin C and E, which acts as an antioxidant. *Aloe vera* or *Aloe vera* is also a relatively safe herb consumed and does not cause fatal side effects.

2. Methods

This research was an experimental study of Post Test only control Group Design [9]. Twenty five male Wistar rats 2-months-old with 200-210 gram weight were used in this study. Twenty-five rats were divided randomly into five groups consisting of negative control group (K-), positive control group (K +), treatment group 1 (P1), treatment group 2 (P2), and treatment group 3 (P 3). Each group is fed standard ad-libitum. Every treatment P1, P2 and P3 groups were supplemented with *Aloe vera* leaf extract at a dose of 87.5 mg/kg BW, 175 mg/kg BW and 350 mg/kg BW, respectively. All of the rats in the group except K- received alloxan induction of mg/kg BW via intra-peritoneal or IP [10]. Treatment was administered for days, at day 29, blood glucose levels of all groups were measured using the GOD-PAP method according to the manufacturer's instructions

The research was conducted in Animal Physiology Laboratory of Biology Department Faculty of Mathematics and Natural Sciences Semarang State University for rat treatment. The calculation of blood sugar level was examination using GOD-PAP method in Biochemistry Laboratory of Biology Department FMIPA Semarang State University. Preparation and Analysis of Preparation Preparations was conducted in Anatomy Pathology Laboratory of Gadjah Mada University, Yogyakarta.

Aloe vera leaves that have been washed and dried in the oven temperature 50 ºC for two days, weighed as much as 5 kg and then macerated using 96% ethanol 10 litter during the day. Ethanol in the maceration results evaporated and concentrated using a rotary evaporator until the resulting extracts of 360 grams

From the results of research on the effect of *Aloe vera* peel extract on blood sugar levels of hyperglycemic rats, then the data were tested with one way ANOVA followed by Tukey Test

3. Results and discussion

The results showed that blood glucose levels were highest in the control group of positive mice (191.2 mg / dl). *Aloe vera* skin extract was able to decrease blood sugar level up to 104.6 mg / dl in P3 group treatment rats (presented orally 350 mg/kgBW/day). Up to the conclusion that giving *Aloe vera* peel extract for 28 days lowers blood sugar level of hyperglycemic rat.

Based on the results of research on antioxidant content analysis of *Aloe vera* leaf extract, obtained data of EKLB antioxidant activity test result with free radical damping method using DPPH reagent obtained IC50 value as can be shown in table 1.

Table 1. Results Analysis of antioxidant activity with DPPH method.

Sample	Analysis result	
	Consentration	Antioxidant IC_{50} (ppm)
Aloe vera peel extract	10 20 30 40 50	152.87 ppm

Based on Table 1. results of antioxidant activity testing found that *Aloe vera* skin has antioxidant activity that is classified with IC50 value of 152.87 ppm. The higher the IC50 value the antioxidant activity of the sample will decrease [11]

The results reported that decreased blood sugar occurred in P3 the group given *with Aloe vera* extract dose (350 mg / kg BW). The mean rate of decreased blood glucose levels is presented in Table 2.

Table 2. Average blood sugar levels (mg / dl) of alloxan-induced wistar rats

No	Treatment	Blood glucose (mg/dl)
1	K-	97.6[a]
2	K+	191.2[b]
3	P1	158.6[c]
4	P2	137.2[d]
5	P3	104.6[a]

Based on table 2, the mean blood glucose level of group K- was 97.6 mg/dl. While K+ had the highest mean blood glucose level of 191.2 mg/dl, blood sugar levels in this group was the highest blood sugar level when compared with other groups. This is due to the positive control group induced alloxan thus causing damage to pancreatic beta cells. In the treatment group I (dose 87.5 mg / kg BW) was significantly different with P2 and P3, while P2 group (dose 175 mg/kg BW) was significantly different with P3 (dose 350 mg/kg BW). The Tukey test results are presented in Figure 1.

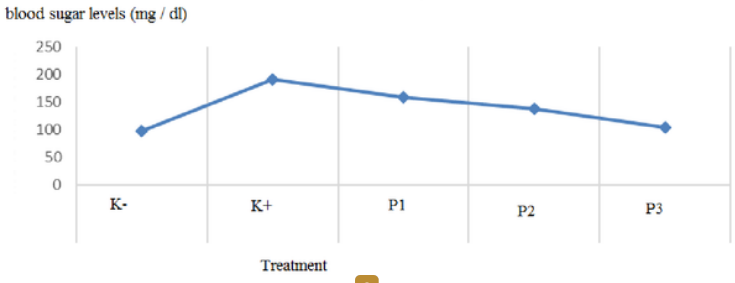

Figure 1. Graph of Tukey test result of average blood glucose level of alloxan- induced Wistar rats.

The results showed that *Aloe vera* peel extract can lower blood glucose levels in alloxan-induced hyperglycemia rats. It can be explained that the mechanism of alloxan toxicity begins with the entry of alloxan into the pancreatic beta cells and the retrieval rate will determine the alloyan diabetogenic properties. Damage to β cells occurs through several processes simultaneously, ie through the oxidation of sulfidryl groups and the formation of free radicals. The mechanism of action of alloxan produces damage to pancreatic β cells mainly invades cellular compounds containing sulfidryl groups, amino acids cysteine and proteins that bind to SH groups (including enzymes containing SH groups). The alloxan reacts with two SH groups attached to the sides of the protein or amino acids to form disulfide bonds to inactivate proteins which result in impaired protein function [12]. Alloxan-induced mice 120 mg/kg BW via IP (Intra Peritoneal) experienced hyperglycemia conditions indicated by elevated blood sugar levels ≥ 126 mg / dl [13]. Aloxan also causes depolarization of pancreatic beta cell membranes thus increasing membrane permeability. Membrane damage will facilitate the destruction of pancreatic beta cells resulting in decreased insulin production [14].

Decreasing blood glucose levels due to *Aloe vera* peel extract supplementation can be caused by the presence of bioactive compounds contained in EKLB which can prevent the occurrence of oxidation in pancreatic β cells so that damage can be minimized. The bioactive compounds contained in *Aloe vera* leaf extract of phytochemical screening from the study [15], *Aloe vera* ethanol extracts contain secondary metabolites including flavonoids, alkaloids, tannins, saponins, and sterols.

Flavonoids can prevent complications or progressivity of diabetes mellitus by clearing excessive free radicals, breaking free radical reaction chains [16], binding to chelating metals, and blocking polyol pathways by inhibiting aldose reductase enzyme [17]. Flavonoids also have an inhibitory effect on alpha gukosidase enzyme by hydroxylation bond and substitution on β ring. This principle of inhibition is similar to that of acarbose which has been used as a drug for the treatment of diabetes mellitus, by producing hydrolysis of carbohydrate and disaccharide delays and glucose absorption and inhibiting the metabolism of sucrose into glucose and fructose [18].

Alkaloids work by stimulating the hypothalamus to increase the secretion of Growth Hormone Releasing Hormone (GHRH), so the secretion of Growth Hormone (GH) in the hypophysis increases. High GH levels will stimulate the liver to secrete Insulin-like Growth Factor-1 (IGF-1). IGF-1 has an effect in inducing hypoglycemia and lowering gluconeogenesis so that blood glucose levels and insulin requirements decrease. IGF-1 through negative feedback system will normalize GH levels [19].

Tanin is known to boost the metabolism of glucose and fat so that the second pile of these calories in the blood can be avoided. Tannins also have hypoglycemic activity that is by increasing glycogenesis. In addition, tannin also serves as an astringent or chelating agent that can wrinkle the intestinal epithelial membrane thus reducing the absorption of the juice of the food and as a result inhibits sugar intake and the rate of increase in blood sugar is not very high [20].

4. Conclusion

Based on the research that has been done, it can be concluded that *Aloe vera* peel extract for 28 days have an effect on lowering blood sugar level of hyperglycemic rat. But it should do more research with varying doses in order to obtain optimal dose bark extract beneficial *Aloe vera* as a drug therapy to lower blood sugar levels and improve pancreatic histology alloxan-induced hyperglycemic rats.

References

[1] PUSDATIN PIDdI 2014 *Situasi dan Analisis Diabetes.* (Jakarta: Kementerian Kesehatan Republik Indonesia).
[2] Khazrai Y, Defeudis G and Pozzilli P 2014 *Diabetes/metabolism research and reviews* **30** 24
[3] Tangvarasittichai S 2015 *World J Diabetes* **6** 456
[4] Campos C 2012 *Postgraduate medicine* **124** 90
[5] Ventura L L, Fortes N C, Santiago H C, Caliari M V, Gomes M A and Oliveira D R 2017 PeerJ **5** e2967.
[6] Banerjee M and Vats P 2014 *Redox biology* **2** 170
[7] Taniyama Y and Griendling KK 2003 *Hypertension* **42** 1075.
[8] Szendroedi J, Phielix E and Roden M 2012 *Nature Reviews Endocrinology* **8** 92
[9] Campbell D T and Stanley J C 2015 *The Separate- Sample Pretest-Posttest Control Group Design. In: Experimental and Quasi-Experimental Designs for Research.*(Chicago: Rand Mc Nally College Publishing Company).
[10] Abbasi S P, Abbasi S T, Khoharo K, Talpur K H and Siddiqui S M 2014 *Eur J Mol Biol Biochem* **1** 63
[11] Raka A, Asih I A, Sudiarta IW and Wulan Suci AA 2015 *Jurnal Kimia* **9** 35
[12] Szkudelski T 2001 *Physiological research* **50** 537
[13] Arika W M, Abdirahman Y A, Mawia M M, Wambua K F, Nyamai D M Ogola P E, Kiboi N G, Nyandoro H O, Njagi S M, Agyirifo D S 1, Ngugi M P and Njagi E N M 2015 *J Diabetes Metab* **6** 624
[14] Muqsita V, Sakinah EN and Santosa A 2015 *Pustaka Kesehatan* **3** 235
[15] Choi S W, Son B W, Son Y S, Park Y I, Lee S K and Chung M H 2001 *British Journal of Dermatology* **145** 535
[16] Song Y, Manson J E, Buring J E, Sesso H D and Liu S 2005 *Journal of the American College of Nutrition* **24** 376

[17] Singh M, Kapoor A, McCracken J, Hill B and Bhatnagar A 2017 *Chemico-biological interactions* **265** 16
[18] Rezaei-kelishadi M, Nuri M, Erfani Z, Palizban A and Parandin R 2014 *Journal of Biology and Today's World* **3** 206
[19] Hennighausen L and Robinson GW 2008 *Genes & development* **22** 711
[20] Dalimartha S 2015 *Tanaman Obat di Lingkungan Sekitar* (Jakarta : Puspa Swara)

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