Biochemical Effects of Aloe vera Gel Powder in Hyperglycemic Rats and Sensory Quality of its Supplemented Bread

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Abstract:

Use of natural products gained increasing interests due to its affordability and safe use; hence the present study aims to examine the effects of varied levels of *Aloe vera* gel (AVGP) diet on some biochemical parameters in hyperglycemic rats and to examine the effects of adding *Aloe vera* on quality characteristics of baked bread. Thirty adult male Spargue Dawely strain albino rats placed into two main groups, (1) the first group (6 rats) the negative control group; the second main groups (24 rats) were subjected to a single dose intraperitoneal injection with streptozotocin induce diabetes then divided equally into the following groups for 28 day, as follows; group (2) positive control group, (3) diabetic rats group fed on 1.25 % AVGP diet, group (4) diabetic rats group fed on 2.5 % AVGP diet and group (5) diabetic rats group fed on 5 % AVGP diet. Results showed that, treatments with AVGP reduced levels of blood glucose and enhanced insulin levels which suggest potential hypoglycemic effect of treatments with 2.5 and 5 % AVGP reduced blood glucose levels and enhanced levels of insulin; with decrements of MDA levels and kidney function parameters were enhanced in both groups compared with positive control diabetic rats. The lipid profile of treatments groups were enhanced by the addition of 2.5 and 5 % AVGP. The bread products with adding 1.25 and 2.5 % AVGP have acceptability and may be having potential for being used as a functional food.

Keywords: Hyperglycemia, rats, *Aloe vera*, lipid profile, kidney function and supplemented bread.

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Introduction:

Recently it was reported that, 589 million adults globally are suffering from diabetes and it expected to reach 853 million in 2050, and in Egypt the number of diabetic patient reach 13.2 million and expected in 2050 to be around 24.7 million adults; Egypt on a global level considered as one of the top 10 countries with increased number of diabetic adult **(diabetes atlas, 2025).** One of the main threats to human health is diabetes mellitus; which is complicated metabolic disorders, and the prevention of type II diabetes (T2DM) is an important measure to combat its negative health consequences including, coronary heart diseases, fatty liver and renal failure among other fatal disorder (**Wild *et al.*, 2000** and **Zhang *et al.*, 2016**).

Use of natural products gained increasing interests due to its affordability and safe use. *Aloe vera* plant (*Aloe barbadensis Miller*) known as a traditional medicine in Ancient Egyptian and many other cultures (**Grindlay and Reynolds, 1986,** and **Atherton P 1998)**; it contain many bioactive compounds with biological importance including anti-inflammatory, immune-modulating, and anticancer effects (**CIR, 2007**).

Industrial production of *Aloe vera* for making functional food such as yogurt and drinks have been emerged; and *Aloe vera* gel the white transparent mucilaginous gel found in the pulp of fresh plant; have the higher content of polysaccharides especially acemannan an acetylated glucomannan, considered as the most valuable bioactive compound in *Aloe vera* gel (**Guo and Mei, 2016**). Polyphenols and flavonoids are another bioactive compounds found in *Aloe vera* which were linked to beneficial health effects due to their antioxidant and anti-inflammatory properties (**Noor, 2021** and **Govindarajan et al., 2021**).

Plant flavonoids have been reported as a potential anti-diabetic due to its role in protecting b-cells from damages by Reactive Oxygen Sepecies (ROS) and their role in enhancing and increasing islet cell proliferation (**Panche *et al.*, 2016).** Therefore the aims of the present study were to investigate the effects of varied levels of *Aloe vera* diet on some

biochemical parameters in hyperglycemic rats and to examine the effects of adding *Aloe vera* on quality characteristics of baked bread.

Materials and Methods:

Materials: Fresh *Aloe vera* leaves were obtained from local farm, Giza, Egypt, the leaves were cleaned and washed under running water then the latex were removed and leaves' green layer were peeled and removed, the produced *Aloe vera* gel were soaked in 2% citric acid for 10 minutes then washed and soaked again in 2% ascorbic acid before drying at 40ºc for 96 hours. The obtained dry gel was then grounded with mixer grinder to obtain powder in accord to **Singha *et al*., (2021)** with some modification.

Kits for blood biochemical analysis and streptozotocin were supplied by Gamma trade, Cairo, Egypt. Ingredients for preparing of the standard and experimental diet were obtained from Morgan Co., Egypt.

Chemical composition and phenolic content determination: AVGP was analyzed for estimation of Moisture, Protein, fat, ash according to the methods mentioned in **AOAC (2015)**, carbohydrate were calculated. For estimation of total phenolic compounds the method of **Singleton *et al*,, (1999)** was applied; and flavonoids content were determined in accord to the method of **Marinova *et al*., (2005)**.

Study design: Thirty adult male *Spargue Dawely* strain albino rats (210±10gm) were provided by animal house of Organization for Biological Products and Vaccines (VACSERA), the animals all over the experiment were treated in accord to the International guide for animal care and use; The rats placed into two main groups, (1) the first group (6 rats) the negative control group kept on a standard diet (**Reeves *et al*., 1993**); the second main groups (24 rats) were subjected to a single dose intraperitoneal injection with 60mg streptozotocin/ kg body weight to induce diabetes (**Masiello *et al*., (1998)**; blood were collected 48 hours post-injection, and rats with glucose level >240 mg/dl (**OECD, 2001)** were approved to be included in the experimental groups (6 rats each) as follows**;** group (2) positive control group, (3) diabetic rats group fed on 1.25 % AVGP diet, group (4) diabetic

rats group fed on 2.5 % AVGP diet and group (5) diabetic rats group fed on 5 % AVGP diet.

By the end of experimental period (28 days) all rat groups were subjected to anesthesia and blood samples were collected in two parts, one and kept in a tubes with added heparin for the determination of blood glucose and blood GSH; the second part were centrifuged in order to obtain serum which kept in plastic vile at -18º C for further biochemical analysis.

The method of **Trinder (1969)** was applied to determine blood glucose level and method of **Defronzo *et al.*, (1979)** was followed for estimation of insulin**.** Where Malondialdehyde (MDA) were determined in accord to the method of **Draper *et al.*, (1993);** and the method of **Beutler, *et al.*, (1963)** was applied for determining of blood glutathione (GSH). Serum urea was determined in accord to **Searcy *et al.*, (1967);** and the method of **Bohmer, (1971)** was applied for the determination of serum creatinine; and uric acid was determined according to method mentioned by **Caraway (1955).** For the determination of serum triglycerides, total cholesterol, LDL, and HDL, the methods of **Fossati and Prencipe, (1982), Allain *et al.*, (1974), Friedwald *et al.*, (1972)** and **Burstein *et al.*, (1970)** respectively, were used**.**

Toast bread were prepared in accord to **Radwan and El maadawy (2022)** with the following recipe (wheat flour 100 g, yeast 2 g, salt 1 g, sugar 2.5 g and oil 2 g) and AVGP were added in replacement of wheat flour at predetermined level (1.25%, 2.5% and 5% AVGP). Evaluation of sensory quality characteristics by panels were undertaken in accord to **Moretti *et al.*, (2004);** as quality characteristics of baked toast bread were sensory evaluated on 9 points hedonic scale.

All data were presented as Mean± S.E.; and statistical analysis was applied using ANOVA and Duncan tests in accord to **Snedecor and Cochran, (1967);** using SPSS software version 16.0; and level of significant difference were considered at $P < 0.05$.

Results and Discussion:

Table (1) showed the proximate chemical composition and total phenolic and flavonoids of *Aloe vera* gel powder; it is noticeable that the carbohydrate, protein and ash represent the highest percentage where moisture and fat constitute the lower percentage. AVGP showed higher content of total phenolic and flavonoids content.

TABLE (١): Chemical composition and polyphenolic content in *Aloe vera* gel powder (MEAN± S.D.)

	AVGP
Moisture	12.83± 0.62 %
Protein	23.00± 0.33 %
Fat	1.97± 0.17 %
Ash	16.33± 1.24 %
carbohydrate	٤٥.٨7± 0.47 %
Total phenolic	18.83± 0.85 mg GAE/g
Total flavonoids	10.23± 0.61 mg QE/g

From figure (1) it could be noticed that, the positive control diabetic rats showed the significantly highest blood glucose level (237.26+ 19.03 mg/dl) when compared with negative control (79.74+ 2.17 mg/dl), the *Aloe vera* treated groups (1.25 % AVGP, 2.5 % AVGP and 5 % AVGP) demonstrated lowered blood glucose levels (107.74+ 4.03, 99.47+ 2.18 and 104.17+ 1.34 mg/dl, respectively) comparing to that of the positive control group.

Figure (2) displays serum insulin levels, positive control has the significantly lowest insulin level (2.56+ 0.08 µIU/ ml) compared to (6.94+ 0.20 µIU/ ml) of negative non-diabetic control rat group. Rat groups treated with varied levels of *Aloe vera* (1.25 % AVGP, 2.5 % AVGP and 5 % AVGP) show significant increases in insulin levels (4.93+ 0.23, 6.23+ 0.35 and 5.05± 0.35 µIU/ ml, respectively) compared to that of positive control diabetic group. As shown in figures (1& 2) addition of *Aloe vera* to diet of hyperglycemic rat groups enhanced insulin levels and decreased blood

glucose levels. The treatment with 2.5% AVGP showing the pronounced effect followed by group treated with 5% AVGP diet.

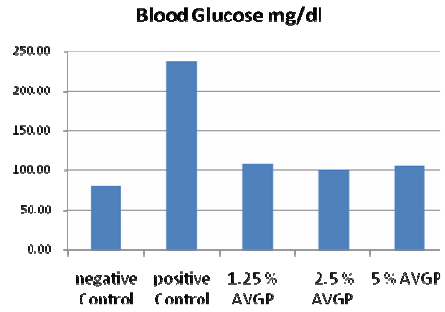

Figure (١): Mean blood glucose levels of hyperglycemic rat groups fed on varied levels of AVGP.

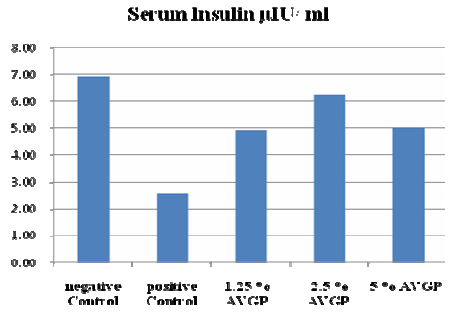

Figure (٢): Mean serum insulin levels of hyperglycemic rat groups fed on varied levels of AVGP.

These results implies that, treatments with AVGP significantly reduced blood glucose levels and enhanced levels of insulin which suggest potential hypoglycemic effect of AVGP; as *Aloe vera* gel may reduce glucose levels and enhance insulin sensitivity; a study on diabetic rats found that, *Aloe vera* extract normalized fasting glucose and increased serum insulin with the recovery of β- cell function (**Noor *et al.*, 2017**); where **Perez *et al.*, (2007**) found that, in obesity-induced diabetic mice, Polyphenol-rich extract of *Aloe vera* gel decreased glucose and enhanced insulin resistance; finding of **Kim *et al.*, (2009)** further confirmed that, processed *Aloe gel* in mice model of non-insulin-dependent diabetes mellitus lowered blood glucose by reducing insulin resistance. In recent study, by **Deora *et al.*, (2021)** stated that, ethanolic *Aloe* extract in obese-diabetic rats; improved β-cell function, increased serum insulin and decreased glucose levels and further improved insulin resistance markers (HOMA-b and HOMA-IR).

In a recent study by **Omer *et al.*, (2023)** it was reported that, acemannan the main polysaccharide in *Aloe vera*, an acetylated mannose-rich polysaccharide; acemannan decreases damage of β-cell in streptozotocin-induced diabetes, and improve secretion of insulin via inhibiting inflammatory cytokines and oxidative stress and apoptosis

pathway. Other study further suggested that, *Aloe vera* polysaccharides Aoeresin A, inhibited α- glucosidase enzymes which in turn enhanced glucose clearance by suppression of glucose absorption (**Govindarajan *et al.,* 2021)**. It was concluded that, evidences suggest some potential benefit of *Aloe vera* as anti-hyperglycemic (**Suksomboon *et al.,* 2016).**

In diabetic rats; Carbohydrate-rich fraction of *Aloe vera* enhanced glucose metabolism by enhancing glycogenesis and suppressing gluconeogenesis, in addition to its immune modulating effects (**Ulbricht *et al*., 2007and Giannakoudakis *et al*., 2018).** Increasing evidences on potentiality of *Aloe vera* and plant flavonoids as anti-diabetic have been presented; and their mechanisms of actions were thoroughly explained, they protected β- cells against damages from oxidative stress and increasing proliferation of islet cell, enhancing secretion of glucose-stimulated insulin, and suppressing α-glucosidase enzyme (**Panche *et al*., 2016**).

From figures (3 and 4) it can be noticed that, level of Malondialdehyde was increased significantly compared to that of negative control and *Aloe vera* groups, as it reach 6.32± 0.36 nmol/ ml where negative control was 2.13± 0.11 nmol/ ml and groups fed on 1.25% AVGP, 2.5 % AVGP and 5 % AVGP showed levels of 2.81± 0.12, 2.28± 0.11 and 2.08± 0.10 nmol/ ml, respectively. In contrast, the glutathione levels were significantly higher 25.57± 1.35 and 25.82± 1.36 µg/ ml in groups fed on 2.5% AVGP and 5 % AVGP respectively, in comparison of positive control value (21.47± 0.45 µg/ ml).

MDA is a marker of lipid peroxidation, and elevated MDA level is one of the effects of chronic diabetes, and reduction of body's antioxidants capacity; decreased GSH level in diabetes revealed its excessive usage to reduce oxidative stress (**Nicotera and Orrenius, 1986**), significant increments of GSH level was observed in *Aloe vera* extract treated rats with diabetes which indicates that the *Aloe vera* extract may increases biosynthesis of GSH or it may reduces oxidative stress (**Rajasekaran *et al.,* 2005**)

Aloe vera gel extract restored hepatic GSH, Catalase, SOD and decreased oxidative stress in azoxymethan-induced oxidative stress rats (**Anilakumar, *et al*., 2010**). Furthermore, **Klaikeaw *et al*., (2020)** reported that, in steatohepatitis rats administration of *Aloe vera* resulted in a decreased levels of hepatic MDA and a marked increment in GSH; they further concluded that *Aloe vera* reduced oxidative stress and hepatic inflammation.

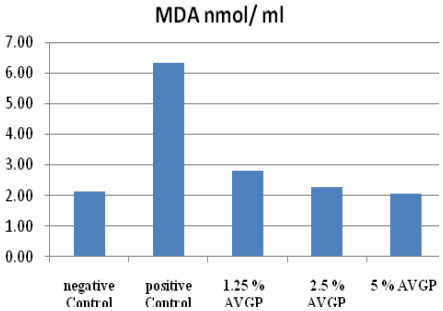

Figure (3): Mean serum MDA levels of hyperglycemic rat groups fed on varied levels of AVGP.

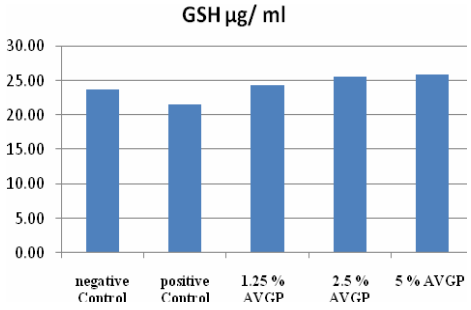

Figure (4): Mean blood glutathione levels of hyperglycemic rat groups fed on varied levels of AVGP.

From table (2) it was clear that, hyperglycemia affected the renal function as evident by marked and significant increments of serum urea and creatinine levels (68.17± 3.26 and 2.66± 0.04 mg/ dl, respectively) in positive control group compared with that of non-diabetic negative control group (25.60± 1.71 and 0.72± 0.11 mg/ dl, respectively); and the serum uric acid level in positive control group (5.28± 0.27 mg/ dl) was the highest value compared to other treatment groups. On the other hand diabetic rats fed on 1.25% AVGP, 2.5% AVGP and 5% AVGP diets, showed significant reduction of serum urea (58.27±1.98, 51.42±0.84 and 54.51±1.06 mg/ dl, respectively), and serum creatinine (1.97±0.03, 0.83±0.06 and 1.47± 0.08 mg/dl, respectively); also significant decreases in serum uric acid values at 2.5% AVGP and 5% AVGP in comparison with the values of positive control hyperglycemic rats. It is worth to note that, group fed on 2.5% AVGP was showing lowest serum urea and creatinine (51.42± 0.84 and

0.83± 0.06 mg/dl, respectively) comparing to that of positive control and other treated groups, where group fed on 5% AVGP showed lowest serum uric acid value of 4.74± 0.10 mg/ dl, compared to that of treatment groups.

Ahmad *et al.*, (2023) illustrated the effects of *Aloe vera* juice on enzymes of the kidneys; where *Aloe vera* protect the kidney from oxidative stress; *Aloe vera* protect against liver damage through decreasing of lipid peroxidase and elevation of GSH and SOD antioxidant enzyemes; other study in alcohol induced toxicity showed that, *Aloe vera* gel considerably decreased serum urea, creatinine and uric acid **(Akinloye *et al.*, 2021);** moreover **Chatterjee *et al.*, (2012)** confirmed that *Aloe vera* protect against damage of renal tubular;

Table (2): Mean serum urea, creatinine and uric acid levels of hyperglycemic rat groups fed on varied levels of AVGP (Mean±SE)

	Serum urea mg/ dl	Serum creatinine mg/ dl	Serum uric acid mg/ dl
Negative Control	25.60±1.71 ^{d}	0.72±0.11 ^{d}	3.39±0.73 ^{c}
Positive Control	68.17±3.26 ^{a}	2.66±0.04 ^{a}	5.28±0.27 ^{a}
1.25 % AVGP	58.27±1.98 ^{b}	1.97±0.03 ^{b}	5.18±0.07 ^{a}
2.5 % AVGP	51.42±0.84 ^{c}	0.83±0.06 ^{c}	4.78±0.09 ^{b}
5 % AVGP	54.51±1.06 ^{bc}	1.47±0.08 ^{b}	4.74±0.10 ^{b}

Values with dissimilar letter in the same column are significantly differed at P<0.05

From table (3) it could be noticed that, the hyperglycemic positive control group shows significantly increment levels of triglycerides (201.91± 9.13 mg/ dl), total cholesterol (223.97± 10.06 mg/ dl) and LDL cholesterol (159.15+ 8.87 mg/ dl) compared to the negative control group values (98.22± 3.21, 79.48 ± 1.22 and 21.13± 1.98 mg/dl respectively); both of 2.5% AVGP and 5% AVGP diet groups showed significant reductions in triglycerides (130.00± 3.43 and 128.7± 4.39 mg/dl, respectively) and total cholesterol (136.87± 5.41 and 141.36± 7.34 mg/dl, respectively) compared

to the values of positive control; the HDL cholesterol levels was significantly decreased in group of positive control diabetic rats (24.44+ 1.20 mg/dl) in comparison with the HDL level of negative control group (38.71+ 2.51 mg/dl); where groups fed on 2.5% AVGP and 5% AVGP diets showed HDL values of 31.40± 1.02 ad 32.09± 1.34 mg/dl respectively, which were significantly higher than that of positive control and the value for 1.25% AVGP were the least significant in the treated groups.

Rajasekaran *et al.*, (2006) confirmed that, in diabetic rats treatment with *Aloe vera*, improved fatty acid composition and lipid profile; and **Kim *et al.*, (2009)** reported that, *Aloe vera* gel administration reduced plasma and liver triglycerides. In a study by **Cock (2015)** who demonstrated that, *Aloe vera* treatment in diet induced-obese rats lowered visceral fat accumulation, and decreased cholesterol and triglycerides; and that might be due to its inhibition effect on lipase enzyme. **Zhang *et al.*, (2016)** showed that *Aloe vera* may decrease levels of fasting blood glucose, hemoglobin acylated, triglyceride, total cholesterol and LDL, and elevate HDL level in pre-diabetes and early non-treated patients with diabetic. **Deora and Venkatraman (2022)** illustrated that, *A. vera* anti-hyperlipidemic effects could be due to the inhibition of pancreatic lipase which can be due to the presence of Aloenin-a, a glycoside found in *A. vera*; they further suggested that the *Aloe vera* administered orally improve homeostasis of glucose and enhance metabolism of the lipid.

Table (3): Mean serum Triglycerides, Cholesterol, LDL, HDL and VLDL levels of hyperglycemic rat groups fed on varied levels of AVGP (Mean± SE)

	Triglycerides mg/dl	T. Cholesterol mg/dl	HDL mg/dl	LDL mg/dl	VLDL mg/dl
Negative Control	98.22± 3.21 [d]	79.48± 1.22 [d]	38.71± 2.51 [a]	21.13± 1.98 [e]	19.64± 1.09 [d]
Positive Control	201.91± 9.13 [a]	223.97± 10.06 [a]	24.44± 1.20 [d]	159.15± 8.87 [a]	40.38± 3.23 [a]
AV 1.25%	187.17± 8.04 [b]	209.43± 9.56 [b]	28.67± 2.89 [c]	143.33± 7.88 [b]	37.43± 2.61 [b]
AV 2.5%	130.00± 3.43 [c]	136.87± 5.41 [c]	31.40± 1.02 [b]	79.47± 4.62 [cd]	26.00± 1.08 [c]
AV 5%	128.70± 4.39 [c]	141.36± 7.34 [c]	32.09± 1.34 [b]	83.53±7.20 [c]	25.74± 0.88 [c]

Values with dissimilar letter in the same column are significantly differed at P<0.05

Sensory quality characteristics of AVGP supplemented toast:

As it can be noticed from table (4), adding of 1.25 % AVGP to toast bread have no significant differences with the control sample, where adding of 2.5 % AVGP resulted in significant decrements of taste, texture and overall quality of the toast bread; on other hand adding of 5% AVGP resulted in noticeable and significant reductions of all quality attributes. Color, texture and aroma are main characteristics of bakery products which affect consumer acceptability, from previous results it can be concluded that adding of 1.25 and 2.5 % AVGP were accepted by panelist while adding of 5% AVGP were unacceptable due to reduction of quality characteristic particularly appearance, texture and Aroma. **Singha *et al*., (2021)** illustrated that, the physical and sensory quality characteristics were negatively correlated with *Aloe vera* powder supplementation and that adding of up to 4% of *Aloe vera* powder had been accepted by panelist.

Table (4): Sensory quality characteristics of toast bread supplemented with AVGP (MEAN±SD)

	Appearance	Color	Taste	Texture	Aroma	Overall Quality
Control	8.50± 0.53 [a]	8.30± 0.48 [a]	8.60± 0.52 [a]	8.70± 0.48 [a]	8.20± 0.52 [a]	8.54± 0.33 [a]
1.25% AVGP	8.40± 0.70 [a]	8.20± 0.79 [a]	8.10± 0.88 [a]	7.70± 1.16 [ab]	7.90± 1.73 [ab]	8.06± 0.63 [ab]
2.5% AVGP	7.90± 1.20 [a]	7.30± 1.57 [a]	6.90± 1.91 [b]	7.30± 1.57 [b]	8.00± 1.63 [ab]	7.48± 1.11 [b]
5% AVGP	5.50± 0.97 [b]	5.50± 0.85 [b]	5.90± 1.29 [c]	5.90± 0.74 [c]	6.80± 1.62 [c]	5.92± 0.54 [c]

Values with dissimilar letter in the same column are significantly differed at P<0.05

From results of this study It could be concluded that adding of AVGP at 2.5 % level have potential hypoglycemic and hypolipidemic effects and its antioxidant content prevent damage of oxidative stress and enhanced kidney function parameters, and the supplemented toast bread were less affected at 1.25 and 2.5% level.

References:

- A.O.A.C. (2015): Official methods of analysis. 13th .ed, Pub. Association of Official Analytical Chemists. Washington, D.C., U. S. A.
- Ahmad, M.; Waseem S.;, Hameed A.; Amir M, Afzal M.; Umer, M.; Alsagaby, S.; Ashraf,J.; Imran, M.; Iqbal S.; , Ahmed,A., And Riaz, M.; (2023): Functional potential of *Aloe vera* juice against CCl_4 induced hepatotoxicity in animal model. Food Sci. Technol, Campinas, 43, e110321, https://doi.org/10.1590/fst.110321
- Akinloye, D., Ugbaja, R., Dosumu, O., Akamo, A., James, A., and Adeyemo, A. (2021). Restorative effects of *Aloe vera* gel on alcohol induced hepato-nephrocellular dysfunction. Folia Veterinaria, 65(1), 1-8. http://dx.doi.org/10.2478/fv-2021-0001
- Anilakumar, K.; Sudarshanakrishna, K.; Chandramohan, G.; Ilaiyaraja, N.; Khanum, F., and Bawa, A. (2010): Effect of *Aloe vera* gel extract on antioxidant enzymes and azoxymethan-induced oxidative stress in rats. J. Exp. Biol., 48 (8): 837-42.

- Atherton P (1998): *Aloe vera*: Magic or medicine? Nurs Stand. 12:49–54.
- Beutler, E.; Duron, O., and Kelly, B.M. (1963): Improved Method for the Determination of Blood Glutathione, J. Lab. Clin. Med., 61, 5: 882-888.
- Bohmer, H.B., (1971): Micro-determination of creatinine. clin. chem.Acta.32: 81-85.
- Caraway, W. (1955): Determination of serum urate. Am.J. Clin. Path. 25:840.
- Chatterjee, P., Mukherjee, A., & Nandy, S. (2012). Protective effects of the aqueous leaf extract of Aloe barbadensis on gentamicin and cisplatin–induced nephrotoxic rats. Asian Pacific J. Trop. Biomed., 2(3): S1754-S1763. http://dx.doi.org/10.1016/S22211691(12)60490-0.
- CIR (2007): Cosmetic Ingredient Review Expert Panel. Final report on the safety assessment of aloe and ongensis extract, aloe andongensis leaf juice, aloe arborescens leaf extract, aloe arborescens leaf juice, aloe arborescens leaf protoplasts, aloe barbadensis flower extract, aloe barbadensis leaf, aloe barbadensis leaf extract, aloe barbadensis leaf juice, aloe barbadensis leaf polysaccharides, aloe barbadensis leaf water, aloe ferox leaf extract, aloe ferox leaf juice and aloe ferox leaf juice extract. Int. J. Toxicol. 26(Suppl2):1–50.
- Cock IE. (2015): The genus aloe: phytochemistry and therapeutic uses including treatments for gastrointestinal conditions and chronic inflammation. Prog. Drug Res.70:179e235. https://doi.org/10.1007/978-3-0348-0927-6_6.
- Defronzo, R.A.; Tobin, J.D. and Andres, R. (1979): Glucose clamp technique: A method for quantifying insulin secretion and resistance. Am. J. Physiol., 237: 214-223.
- Deora, N., and Venkatraman, K. (2022): *Aloe vera* in diabetic dyslipidemia: Improving blood glucose and lipoprotein levels in pre-clinical and clinical studies. Journal of Ayurveda and Integrative Medicine 13: 100675. https://doi.org/10.1016/j.jaim.2022.100675
- Deora, N., Sunitha, M., Satyavani, M., Harishankar, N., Vijayalakshmi, M. A., Venkataraman, K., and Venkateshan, V. (2021): Alleviation of diabetes mellitus through the restoration of ß-cell function and lipid metabolism by *Aloe vera (L.) Burm. f.* extract in obesogenic WNIN/GR-Ob rats. J. Ethno-pharm. 272, 113921. http://dx.doi.org/10.1016/j.jep.2021.113921. PMid:33588009.

- Diabetes atlas (2025): Egypt, diabetes country report 2000-2050. IDF diabetes atlas, 11th ed., https://diabetesatlas.org/.
- Draper, H.; Squires J.; Mahmoodi, H.; Wu, J.; Agarwal S., and Hadley M. (1993): A comparative evaluation of thiobarbituric acid methods for the determination of malondialdehyde in biological materials. Free Radic. Biol. Med. 15(4): 353-63.
- Giannakoudakis, D.A.; Hosseini-Bandegharaei, A.; Tsafrakidou, P.; Triantafyllidis, K.S.; Kornaros, M., and Anastopoulos, I. (2018): *Aloe vera* waste biomassbased adsorbents for the removal of aquatic pollutants: a review. J Environ Manag 227:354e64. https://doi.org/10.1016/j.jenvman.2018.08.064
- Govindarajan, S.; Babu, S.; Vijayalakshmi, M.; Manohar, P., Noor, A. (2021): *Aloe vera* carbohydrate regulate glucose metabolism through improved glycogen synthesis and dwonregulation of hepatic gluconeogenesis in diabetic rats. J. Ethnopharma., 281:114556. http://doi.org/10.1016/j.jep.2021.114556
- Grindlay D, and Reynolds T. (1986): The *Aloe vera* phenomenon: A review of the properties and modern uses of the leaf parenchyma gel. J Ethnopharmacol.16:117–151.
- Guo, X., and Mei, N. (2016): *Aloe vera*: A review of toxicity and adverse clinical effects. J Environ Sci Health C Environ Carcinog Ecotoxicol Rev. 34 (2): 77–96.
- Kim, K.; Kwon, J.; Lee, S.; Kong, H.; Im, S.; Lee, Y.; Oh, S.; Jo, T.; Park, Y.; Lee, C., Kim, K.(2009): Hypoglycemic and hypolipidemic effects of processed *Aloe vera* gel in a mouse model of non-insulin-dependent diabetis mellitus. Phytomedicine. 16(9): 856-63.
- Klaikeaw, N.; Wongphoom, J.; Werawatganon, D.; Chayanuptkul, M, and Siriviriyakul, P. (2020): Anti-inflammatory and anti oxidant effects of *Aloe vera* in rats with non-alcoholic steatohepatitis. World J. Heptol. 12(7): 363-77.
- Marinova, D.; Ribarova, F. and Atanassova, M. (2005): Total phenolics and total flavonoids in Bulgarian fruits and vegetables. Journal of the University of Chemical Technology and Metallurgy, 40 (3): 255-260.
- Masiello, P.; Broca, C.; Gross, R.; Roye, M.; Manteghetti, M.; Hillaire, B.D. (1998): Development of a new model of type 2 diabetes in adultrats administered with streptozotocin and nicotinamide. Diabetes, 47: 224–229.

- Moretti, V.M., Madonia, G., Diaferia, C., Mentasti, T., Paleari M.A and Panseri, .S,(2004):Chemical and microbiological parameters and sensory attributes of a typical Sicilian salami ripened in different conditions. Meat Sci. 66 (4): 845–54
- Nicotera, P., and Orrenius, S. (1986): role of thiol in protection against biological reactive intermediates. Adv. Exp. Med.Biol. 197: 41-49.
- Noor, A.; Gunasekaran, S., and Vijayalakshmi M.A. (2017): Improvement of insulin secretion and pancreatic b-cell function in streptozotocin-induced diabetic rats treated with *Aloe vera* extract. Pharmacognosy Res., 9 (suppl 1): S99- S104.
- Noor A. (2021): Carbohydrate fraction of *Aloe vera* ameliorates inflammation through suppression of pro-inflammatory mediators and oxidative stress in vitro and rats with Freund's adjuvant induced paw edema. I. J. E. B., l59 (3): 2021.
- OECD, (2007):.Organization for economic co-operation and development. OECD Guidelines. Guidance document on acute oral toxicity testing (2001) series on testing and assessment no. 24; Paris: OECD environment, health and safety publications;
- Omer, A.; Altayb, H.; Al-Abbasi, F.; Gupta, G.; Ahmed, M.; Alghamdi, A.; Alzarea, S.; Sayyed, N.; Nadeem, M., and Kazmi, I. (2023): Acemannan ameliorates STZ-activated diabetes by attenuating high glucose via inhibiting inflammatory cytokines and apoptosis pathway. Int. J. Biol. Macromolecules. 253 (5): 127127. http://doi.org/10.1016/j.ijbiomac.2023.127172.
- Panche, A.N.; Diwan, A.D., and Chandra, S.R. (2016): Flavonoids: an overview. J Nutr Sci. 5:e47. https://doi.org/10.1017/jns.2016.41.
- Perez, Y.; Jimenez-Ferrer, A.; Zamilpa, A.; Hernandez-Valencia, M.; Alarcon-Aguilar, F.;Tortoriello, L., and Roman-Ramos, R.(2007): Effect of apolyphenol-rich extract from *Aloe vera* gel on experimentally induced insulin resistance in mice. Am. J. Chin. Med. 35 (6): 1037-46.
- Radwan, A.H., and Elmaadawy, A.A., (2022): Potential effect of toast bread supplemented with Lemon grass powder on kidney and liver functions in rats. JHE, 32(1): 151-162.
- Rajasekaran, S.; Ravi. K.; Sivagnanam, K., and Subramanian, S. (2006): Beneficial effects of *Aloe vera* leaf gel extract on lipid profile status in rats with

streptozotocin diabetes. Clin Exp Pharmacol Physiol. 33: 232e7. https://doi.org/10.1111/j.1440-1681.2006.04351.x

- Rajasekaran, S.; Sivagnanam, K., Subramanian, S. (2005): Antioxidant effect of *Aloe vera* gel extract in streptozotocin-induced diabetes in rats. Pharmacological Reports. 57: 90-96.
- Reeves, P.G.; Nielsen, F.H. and Fahey, G.C., (1993): AIN-93 purified diets for laboratory rodents: final report of the American Institute of Nutrition Ad HOC writing Committee on the reformulation of the AIN-76 a rodent diet. J. Nutr., 123(12): 1939-1951.
- Searcy R.L.; Reardon J.E., and Foreman J.A. (1967): A new photometric method for serum urea nitrogen determination. Am. J. Med. Technol. 33(1):15-20.
- Singha, D.; Jubayar, MD.; Deanath, K.; Akhter, D.; Ranganathan, T.; Rahman, MD., and Mazumder, A. (2021): Nutritional, Textural, and sensory quality of Aloea vera leaf gel powder fortified plain cake.www.preprint.org. doi:10.20944/preprints202106.0395.v1
- Singleton, V. L.; Orthofer, R. and Lamuela –Raventos, R. M. (1999): Analysis of total phenols and other oxidation substrates and antioxi-dations by mean of Folin-Ciocalteu reagent. Methods Enzym., 299, 152-178.
- Snedecor, G,W., and Cochran, W.G. (1967): Statistical Methods, Sixth Edition. Lowa State University Press, *Ames, IA.*
- Suksomboon, N.; Poolsup, N., and Punthanitisarn,S. (2016): Effect of *Aloe vera* on glycaemic control in prediabetes and type 2 diabetes: asystematic review and metaanalysis. J. Clin. Pharm. Ther. 41(2): 180-188.
- Trinder, P. (1969): Determination of blood glucose using an oxidase peroxidase system with a non-carcinogenic chromogen. J. Clin. Patho. 22: 158.
- Ulbricht C, Armstrong J, Basch E, Basch S, Bent S, and Dacey C, 2007;An evidence-based systematic review of *Aloe vera* by the natural standard research collaboration. J Herb Pharmacother 7:279e323. https://doi.org/10.1080/15228940802153339.
- Wild, S.; Roglic, G.; Green, A.; Sicree, R.; King, H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care 2004, 27, 1047–1053.

- Zhang, Y.; Liu, W.; Liu D.; Zhaoand, T., and Tian, H. (2016): Efficacy of *Aloe vera* Supplementation on Prediabetes and Early Non-Treated Diabetic Patients:A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Nutrients, 8: 388. doi:10.3390/nu8070388

التاثيرات البيوكيميائية لجل اوراق الصبار المجفف في الجرذان المصابة بارتفاع نسبة الجلوكوز بالدم وتقييم خصائص الجودة الحسية للخبز المدعم

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الملخص العربي

ان استخدام المنتجات الطبيعيىة قد اكتسب اهتمام متزايد نظرا لتوافرها واستخدامها الامن لذا هدف هذا البحث الى دراسة بعض الاثار البيوكيميائية المحتملة لاستخدام جل الصبار المجفف بتركيزات مختلفة في الجرذان المصابة بارتفاع مستوي سكر الدم ودراسة اثار اضافته على صفات الجودة الحسية للخبز. تم تقسيم ثلاثون من ذكور الجرذان البيضاء الى ٦ مجموعات تناولت ٣ مجموعات تركيزات مختلفة من مسحوق جل الصبار لمدة ٢٨ يوما. واظهرت النتائج تحسنا ملحوظا في مستويات سكر الدم وانخفاضا في مستويات دهون الدم والمالون داي الدهيد وارتفاع مضادات الاكسدة بالدم بالمجموعات التي تناولت ٢,٥ و ٥٪ من مسحوق جل الصبار. كما اظهرت نتائج التقييم الحسي للخبز المضاف اليه ١,٢٥ و ٢,٥ ٪ من مسحوق جل الصبار تقبلا بواسطة المحكمين مما يدعم فعالية محتملة لاستخدام جل الصبار من ضمن الاغذية الوظيفية.

الكلمات المفتاحية: ارتفاع نسبة سكر الدم- الجرذان جل الصبار- دهون الدم- وظائف الكلى والمخبوزات المدعمة

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