

May Al-Muammar, M.F. Elsadek* and Mona El-Shafie

Department of Community Health Sciences, College of Applied Medical Sciences, King Saud University, P.O.Box 10219, Riyadh, 11433, Saudi Arabia.

*Corresponding author E-mail: mfelsadek@gmail.com

Abstract

Background: This study was designed to investigate (1) the potential use of *Aloe vera* juice (AVJ) for fortification of pan bread with evaluates the sensory characteristics and the nutritive value. (2) The possible beneficial role of 5% and 10% AVJ-fortified bread against diabetic rats.

Materials and Methods: Bread fortified with 5%, 10% and 20% AVJ investigated with panel test and the highest two scores (5%, 10%) were recorded and included for biological study. Forty male Albino rats weighted 200 ± 10 g were divided into 4 groups ($n=10$) (-) control, (+) diabetic control, 5% and 10% AVJ-fortified bread.

Results: Diabetic rats resulted in significant ($p<0.05$) increase in liver and kidney mass, blood glucose, serum hepatic biomarkers, malondialdehyde (MDA) and serum lipid profiles except serum high-density lipoprotein cholesterol (HDL-C) while serum insulin, albumin, and total antioxidant capacity (TAC) that had significant ($p<0.05$) reduction compared to control group. AVJ-fortified bread causes sufficient amelioration against the effects of diabetes with improving all tested biochemical parameters which were more pronounced in 10% AVJ-fortified group.

Conclusions: Based on the results, it appeared that consumption of AVJ-fortified bread has reduced blood glucose, lipid profiles and hepatic biomarkers with eliminated oxidative stress by virtue of its antioxidant properties.

Key words: *Aloe vera* Juice, Fortification, Pan Bread, Lipid Profiles, Diabetes.

Introduction

The prevalence and incidence of diabetes is increasing in most populations, being more prominent in developing countries. Insulin resistance is a major metabolic disorder that plays an important role in the development of type II diabetes mellitus (Erkelens, 2001). The number of people with diabetes worldwide is over 150 million and this is likely to increase to 300 million or more by the year 2025 (King et al., 1998; Shaw et al., 2010).

Aloe vera (family Liliaceae), is found predominantly in dry localities in most parts of the world. *Aloe vera* leaves reportedly have tremendous medicinal value. Its juice is commonly used on burns and minor cuts for enhancing healing of dermal wounds (Chitra et al., 1998). *Aloe vera* gel is approximately 99% water, Chemical components of aloe juice which are responsible for the many putative health benefits, although phenolics such as emodin are largely removed in aloe beverages, polysaccharides remain a major ingredient and these are immunostimulatory (Nada et al., 2013; Mona et al., 2015). The antidiabetic effects of *Aloe vera* have been investigated by many researchers (Kim et al., 2009; Tanka et al., 2006), but no attention was focused on that effects by addition of *Aloe vera* juice to bread which is consumed daily. Therefore, the present study was designed to investigate (1) the potential use of *Aloe vera* juice (AVJ) for fortification of pan bread with evaluates the sensory characteristics and the nutritive value. (2) the possible beneficial role of AVJ-fortified bread against diabetic rats.

Material and Methods

Chemicals

Alloxan, casein, vitamins, minerals, cellulose and choline chloride were purchased from El-Nasr Pharm. and Chem. Ind. Comp. Cairo, Egypt. Corn oil and corn starch were obtained from local market. Kits used to determine serum biochemical parameters were purchased from Alkan Pharm. Ind. Comp. Cairo, Egypt.

Experimental animals:

Preparation of Aloe Vera Juice (AVJ)

Aloe vera Juice was prepared according to the method described by Safer et al., (2005). Fresh stems of *Aloe vera* were washed thoroughly to get rid of all forms of debris. The leaves then sliced longitudinally to cut open the inner part of the leaves. The gel in the leaves was scrapped into a beaker and blended to obtain a finer and liquefied form of the gel, the aloe juice. The juice was refrigerated below 4°C for preservation.

Preparation of normal pan bread

The bread dough formulation expressed in table-1, wheat flour (100%), yeast (2%), salt (1.5%), sugar (4%), oil (2%), all dried materials were added together in a bowl and mixed well. The fermented yeast was added to flour and the remaining water was added while mixing all the ingredients together to make a ball of dough. The dough kept in a warm place to rise, then kneaded again and kept for the second fermentation time in a warm place. Gently the dough was punched down and turning the edges toward the center, then the dough was shaped into a rectangle and put in a Tefal pan about 19/9/6 cm. The dough was allowed to rise in the pan and was baked at 255°C for 20 min. The bread

making were determined using the modified method described by Badi et al., (1978). The bread was removed from the pan and cooled at room temperature before carefully getting sliced. Sensory characteristics of the products were evaluated.

Table-1: chemical components of mixture used in preparing pan.

Parameters	Wheat flour 72% extraction (g)	Water (ml)	Yeast (g)	Salt (g)	Sugar (g)	Oil (g)
Pan Bread	500	300	10	7.5	20	10

Supplementation of bread

In this study, bread ingredients were altered by partially replacing the percentage of water (300ml) added to solid ingredients by 5%, 10% and 20% of *Aloe vera* juice (AVJ).

Sensory Evaluation

Sensory evaluation of all samples (fortified and un-fortified bread with AVJ) was carried out according to Molander, (1960).

Chemical analysis of bread

Moisture, crude protein, crude fat, ash and crude fiber contents were determined in pan bread, according to A.O.A.C (2000), while total carbohydrates content were calculated by difference.

Experimental design and induction of diabetes

Forty male albino rats of Sprague Dawley Strain weighing 200 ± 10 g were kept in stainless steel cages in the animal house of Faculty of Home. Economics Helwan University, and they were maintained in an air conditioned room temperature ($25 \pm 1^\circ\text{C}$) with a 12 h light/12 h dark cycle. Feed and water were provided *ad libitum* for one week before the start of experiment for adaptation. The basal diet in the preliminary experiment consists of 20% casein (protein > 80%), corn oil 4%, cellulose 5%, vitamin mixture 1%, salt mixture 3.5%, choline chloride 0.2% and the remainder is corn starch (Reeves et al., 1993). After a period of adaptation on basal diet, the rats were randomly divided into two main groups as follows: The first main group: Ten rats (n=10) fed on basal diet (negative control). The second main group: Thirty rats (n=30) were injected with alloxan to induce diabetes. Then, divided into three subgroups as follows: The first subgroup: Ten rats fed on diet containing half amount of protein from un-fortified bread (diabetic control group). The second subgroup: Ten rats fed on diet containing half amount of protein from ground dried bread fortified with 5% AVJ. The third subgroup: Ten rats fed on diet containing half amount of protein from ground dried bread fortified with 10% AVJ.

Diabetes was induced by a single intraperitoneal injection with alloxan (100 mg / Kg body weight) (Lenzen 2008). Rats were fast overnight before injection with freshly prepared aqueous solution of alloxan monohydrate. Blood was extracted from the tail vein for glucose analysis and rats with fasting glucose ranging from 210-220 mg/dl, showing clear signs of polyuria, polyphagia and polydipsia were considered diabetic and were analyzed 48 hours after alloxan treatment. Animals with fasting blood glucose less than 200 mg/dl were rejected. During the experimental period (28 days), the diets consumed and body weights were recorded twice weekly. Biological evaluation for different groups was carried out by determination of food intake, body weight gain% and kidney weight/body weight%. At the end of the experimental period (6 weeks) the rats were fasted overnight and sacrificed from the abdominal aorta under ether anesthesia. Blood samples were collected in dry clean centrifuge tubes, and then centrifuged to separate the serum which kept frozen till analysis. Kidneys were removed, cleaned in saline solution and weighed to calculate the relative organ weight. Serum samples were used for determination of total cholesterol (TC) (Allain et al., 1974), triglycerides (TG) (Fossati and Prenape, 1982), high-density lipoprotein cholesterol (HDL-C) (Lopes-Virella, 1977), while serum low-density lipoprotein cholesterol (LDL-C) and very low-density lipoprotein cholesterol (VLDL-C) were calculated according to the equation of Friedewald et al. (1972). Serum samples were also used for determination of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activity (Reitman and Frankel, 1957). Alkaline Phosphatase (ALP) activity was measured according to the method described by Bergmeyer and Brent, 1974. From other hand serum urea nitrogen, uric acid and creatinine were determined according to the methods described by Patton and Grouch, (1977), Fossati et al., (1980) and Husdan and Rapoport, (1968) respectively. Burrin, and Price (1985) described the analytical method of serum blood glucose. The plasma insulin was measured by the method of Burgi et al., (1988). Albumin in the serum was estimated by Biuret method (Reinholdm, 1953). Malondialdehyde (MDA) was determined according to the colorimetric method described by Ohkawa et al. (1979). Total antioxidant capacity (TAC) was determined according to the colorimetric method described by Koracevic et al. (2001). MDA/TAC ratio was calculated as index of oxidative status.

Statistical analysis

Statistical analysis was carried out using SPSS statistical software version 11. The results were expressed as mean \pm SD. Data were analyzed by one way analysis of variance (ANOVA). The differences between means were tested for significance using least significant difference (LSD) test at $p < 0.05$.

Results and Discussion

Sensory evaluation of bread

Sensory evaluation of un-fortified and fortified bread with different percentages of AVJ was performed for appearance, taste, odor, color, volume, texture and general acceptability (GA). Samples of bread which have the best sensory characteristics were used in the biological experiments. Table-2 expressed the results of all sensory characteristics; the control sample (pan bread without fortification) recorded the highest scores in comparison with the other samples (5%, 10% and 20% AVJ-fortified bread). Appearance and color scores of 5% GT-fortified bread

decreased significantly ($P < 0.05$), as compared to the control. Meanwhile, there were no significant differences in taste, odor, volume, texture and GA between control and 5% AVJ-fortified bread.

Therefore, no consumer acceptability problem due to color was observed for AVJ fortified bread. On the other hand, there was a significant decrease in the mean scores of all sensory characteristics for the 10% AVJ-fortified bread, except the volume and GA, as compared with the control group. While all sensory characteristics for the 20% GT-fortified bread was recorded significant decrease ($P < 0.05$), as compared to the control sample. The best level of fortification which had the highest scores was the 5% AVJ-fortified bread followed by the 10% AVJ-fortified bread. The 20% AVJ-fortified bread recorded the lowest scores, so it was excluded from the biological study.

Table-2: Sensory evaluation of un-fortified and fortified bread with different ratios of *Aloe vera* juice (AVJ).

Characters Samples	APPEARANCE (20)	TASTE (15)	ODOR (10)	COLOR (15)	VOLUME (15)	TEXTURE (10)	GA (15)
Un-fortified bread (control)	18.45 ^a ±1.127	13.29 ^a ±1.215	9.04 ^a ± 1.06	13.78 ^a ± 1.060	13.86 ^a ±1.084	8.47 ^a ±1.215	13.51 ^a ±1.715
5% AVJ-fortified bread	16.81 ^b ±1.495	12.41 ^a ±1.514	8.24 ^{a,b} ± 0.840	12.22 ^b ±1.437	13.39 ^a ±1.491	7.87 ^{a,b} ±1.293	12.53 ^a ±2.202
10% AVJ - fortified bread	15.17 ^c ±2.202	11.14 ^b ±1.708	8.18 ^b ± 1.304	11.33 ^b ±1.645	13.22 ^a ±1.487	7.32 ^b ±1.022	12.47 ^{a,b} ±1.936
20% AVJ - fortified bread	13.76 ^c ±3.160	10.51 ^b ±2.111	6.91 ^c ± 1.477	10.11 ^c ±2.193	11.62 ^b ±2.282	6.59 ^c ±1.450	11.26 ^b ±1.808

* G A: General acceptability.

* Values are expressed as mean ± SD. Number of panelists = 20.

* Values in each column which have different letters are significantly different at ($p < 0.05$).

Chemical composition of bread

In this study the content of bread was analyzed and illustrated in Table-3. The content of moisture, Crude protein, Crude fat, ash, Crude fiber and carbohydrates were 30.04, 8.83, 1.630, 0.723, 0.518 and 58.529 g., respectively.

Table-3: Chemical composition of pan bread

Determinations Sample	g/100g.					
	Moisture	Crude Protein	Crude Fat	Ash	Crude Fiber	Carbohydrates
Pan Bread	30.04	8.83	1.630	0.723	0.518	58.529

* Each value represents the average of three determinations.

Biological evaluation of fortified bread

Table-4 represents the effect of AVJ fortified bread on feed intake, body weight gain% and liver and kidney weight/body weight% in diabetic rats. The mean value of feed intake (g/day/rat) for all treated groups was slightly reduced as compared to the negative control group. On the other hand, the body weight gain% showed a non-significant ($p < 0.05$) changes between treated groups and the positive control group. Organs weight/body weight % for liver and kidney in diabetic rats were raised which indicating inflammatory changes.

Concerning kidney and liver weight/body weight%, it could be observed that (+)control group produced significant elevation ($p < 0.05$) in kidney and liver weight/body weight% as a result of consuming AVJ fortified bread, as compared to the (-)control group. There were non-significant reduction ($p < 0.05$) in kidney and liver weight/body weight % within both treated groups.

Table-4: Effect of AVJ fortified bread on feed intake, Body weight gain % and Organs Weight / body weight % in diabetic rats.

Parameters Groups	Feed intake (g/day/rat)	Body weight gain %	Organs Weight / body weight %	
			Liver	Kidney
(-) Control	14.98	29.045 ± 4.260 a	2.786 ± 0.119c	0.566 ± 0.053c
(+) Control	12.84	12.688 ± 1.143 c	3.582 ± 0.090a	0.779 ± 0.071a
5% AVJ-fortified bread.	13.22	12.858 ± 1.143 bc	3.314 ± 0.087b	0.693 ± 0.059b
10% AVJ -fortified bread.	14.06	14.548 ± 0.860 bc	2.927 ± 0.059bc	0.623 ± 0.039b

Values are expressed as mean ± SD.

Values in each column which have different letters are significantly different at ($p < 0.05$).

The effect of AVJ fortified bread on blood glucose, insulin and albumin shown in table-5. Data revealed that the blood glucose level significantly ($p < 0.05$) elevated and insulin and albumin levels significantly ($p < 0.05$) reduced in diabetic rats. Feeding AVJ- fortified bread with ratios 5% and 10% lowered the blood glucose (figure-1) and elevated insulin and albumin and reverted back near normal level.

Table-5: Effect of AVJ fortified bread on blood glucose, insulin and albumin in diabetic rats.

Groups	Parameters	Blood Glucose mg/dl	Insulin (µU/ mL)	Albumin mg/dl
(-) Control.		80.61 ± 4.15d	16.62± 1.23 a	3.52± 0.34 a
(+) Control.		189.80 ± 5.26a	7.68± 0.91 d	2.22± 0.17 c
5% AVJ-fortified bread.		148.51 ±3.38b	9.39± 1.02 c	2.46± 0.24cb
10% AVJ -fortified bread.		135.16 ± 3.52 c	11.21± 1.33 b	2.84± 0.31b

Values are expressed as mean ± SD.

Values in each column which have different letters are significantly different at (p< 0.05).

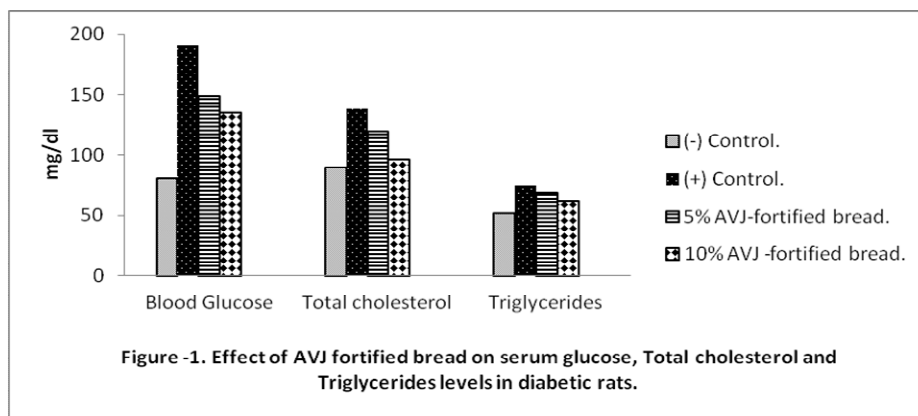
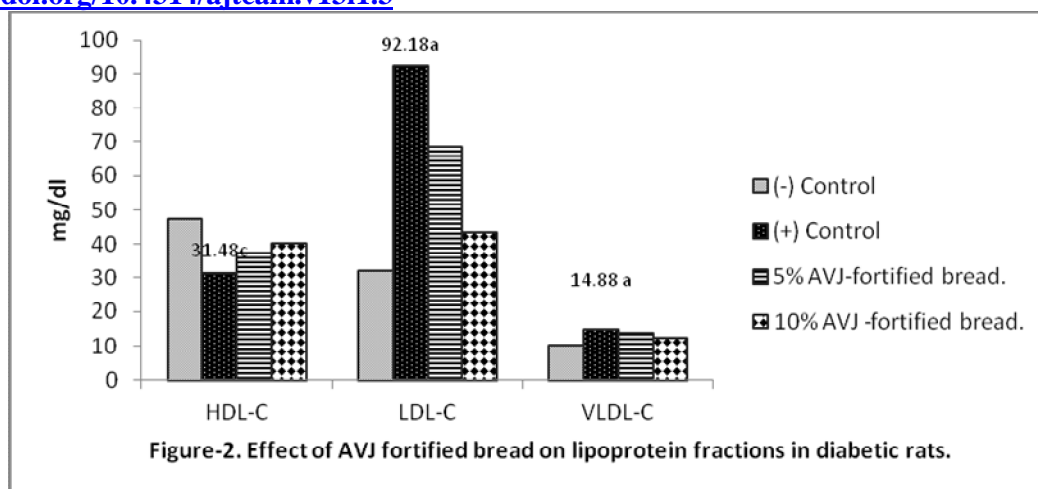


Table-6 shows the percentage of reduction for serum total cholesterol, triglycerides, high density lipoprotein, low density lipoprotein and very low density lipoprotein in diabetic rats. In diabetic rats, the total cholesterol was reduced significantly -30.81% and -13.66% for both 10% AVJ-fortified bread and 5% AVJ-fortified bread respectively. Triglyceride contents were significantly reduced according to the positive control group, which were -17.54% for 10% AVJ-fortified bread and -7.67% for 5% AVJ-fortified bread (Figure-1).

Figure-2 shows the values of lipoprotein fraction (HDL-C, LDL-C, and VLDL-C) in diabetic rats, along with table-6 illustrates the differences of lipoprotein fraction in diabetic rats according to positive control. It was observed that HDL-C levels were increased significantly in both AVJ-fortified bread, the increment percentage were 18.96%, 27.99% respectively for 5% AVJ-fortified bread and 10% AVJ-fortified bread. In contrast to HDL the levels of both LDL-C and VLDL-C were decreased than control group LDL-C levels were decreased by -25.78% for 5% AVJ-fortified bread and -53.04% for 10% AVJ-fortified bread.

Table-6: Percentage of the differences of lipoprotein fraction in diabetic rats according to positive control.

Treatments	Total cholesterol	Triglycerides	HDL-C	LDL-C	VLDL-C
(+) Control.	0	0	0	0	0
(-) Control.	-35.43% d	-31.14% d	50.22%	-65.37%	-31.12%
5% AVJ-fortified bread.	-13.66%	-7.67%	18.96%	-25.78%	-7.66%
10% AVJ-fortified bread.	-30.81%	-17.54%	27.99%	-53.04%	-17.54%



Effect of AVJ fortified bread on liver enzymes activities in diabetic rats.

Results in Figure-3 shows a significant changes in the levels of liver enzymes biomarkers (AST, ALT, ATP). Injection with alloxan caused significantly increasing in liver enzymes levels, Whereas AVJ-fortified bread both (5% and 10%) showed significant reduction for these liver enzymes levels as for AST which were -10.90% , and -19.34% for both 5% and 10% AVJ-fortified bread. Also for ALT levels was -11.69% for 5% AVJ-fortified bread and -17.74% for 10% AVJ-fortified bread. The ALP reduced respectively -13.30% and -26.58% for both 5% and 10% AVJ-fortified bread.

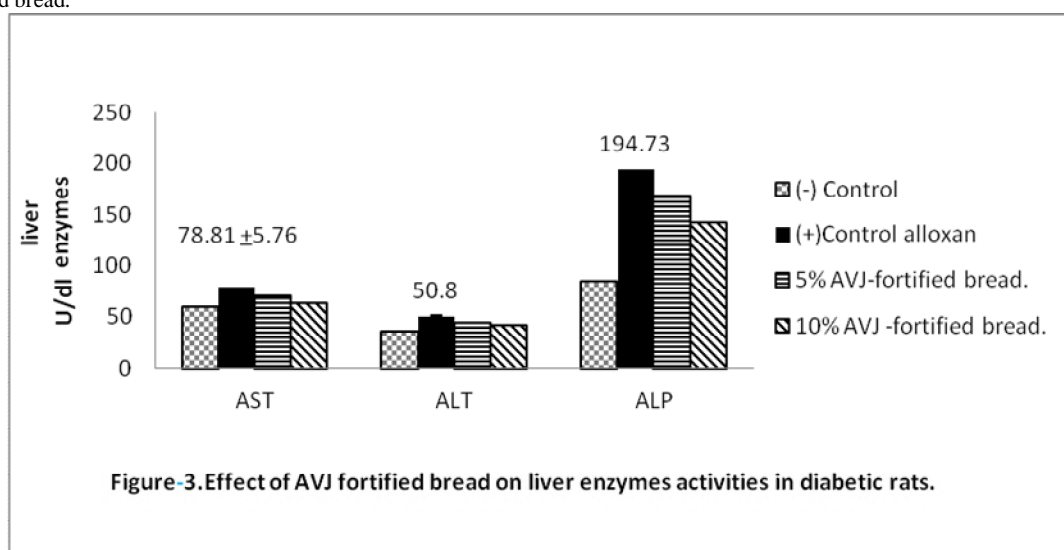


Table-7: Percentage of the reduction of liver enzymes in diabetic rats according to positive control

Treatments	AST	ALT	ALP
(+) Control.	0	0	0
(-) Control.	-24.02%	-29.49%	-56.29%
5% AVJ-fortified bread.	-10.90%	-11.69%	-13.30%
10% AVJ-fortified bread.	-19.34%	-17.74%	-26.58%

AST: Aspartate Amino Transferase

ALT: Alanine Amino Transferase

Alp: Alkaline phosphatase

Effect of AVJ fortified bread on serum MDA and total antioxidant capacity (TAC) in diabetic rats

The results showed significantly increase level of Malondialdehyde (MDA) in diabetic rats while, AVJ-fortified bread both (5% and 10%) showed significant reduction which were -117.00%, -32.57% respectively .

With regard to (TAC) total antioxidant capacity (TAC) presented a significant increment in both AVJ-fortified bread (5% and 10%) 42.00% and 63.64% respectively. AVJ-fortified bread 10% showed highly significant decreasing MDA/TAC Ratios -58.95% more than 5% AVJ-fortified bread which was -58.95%.

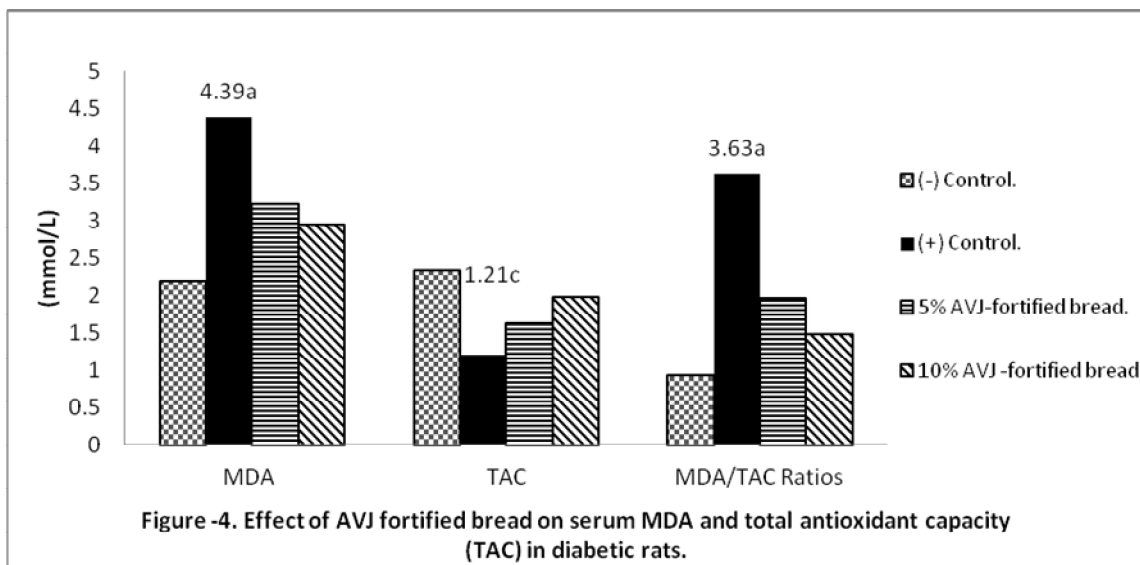


Figure-4. Effect of AVJ fortified bread on serum MDA and total antioxidant capacity (TAC) in diabetic rats.

Table-8: The Percentage of the differences of AVJ fortified bread on serum MDA and total antioxidant capacity (TAC) in diabetic rats according to positive control.

Treatments	MDA (mmol/L)	TAC (mmol/L)	MDA/TAC Ratios
(+) Control.	0	0	0
(-) Control.	-50.11%	93.39%	-74.38%
5% AVJ-fortified bread.	-117.00%	42.00%	-166.00%
10% AVJ -fortified bread.	-32.57%	63.64%	-58.95%

Discussion

Diabetes mellitus is the most common chronic endocrine disorder, affecting an estimated 5% to 10% of the adult population in industrialized Western countries, Asia, Africa, Central America and South America, and it has a large impact on society (Elhadd, Al-Amoudi, Alzahrani, 2007). Also it's a group of metabolic diseases with characteristic hyperglycemia associated with defects both in insulin secretion and insulin action. Moreover it is may be underreported as a cause of death. Studies have found that only about 35% to 40% of people with diabetes who died had diabetes listed anywhere on the death certificate and about 10% to 15% had it listed as the underlying cause of death (American Diabetes Association, 2015). While there are some evidences about the role of oxidative stress in the pathogenesis of diabetic complications, but relationship between the hyperglycemia and generation of oxidative stress is still unknown, but it is usually associated with increased oxidative stress and dyslipidemia which are main determinants for chronic (Kurban et al., 2011).

Oxidative stress results from an imbalance between the generation of reactive oxygen and protective mechanisms (Brownlee, 2001). Abnormally high levels of free radicals and the simultaneous decline of antioxidant defense mechanisms can lead to damage of cellular organelles and enzymes, increased lipid peroxidation, and development of insulin resistance. The main effects of oxidative stress the reaction with variety of biomolecules such as lipids, carbohydrates, proteins, nucleic acids and macromolecules of connective tissue. The oxidative stress is known to be a component of molecular and cellular tissue damage mechanisms in a wide spectrum of human diseases (Mude, et al., 2012). Oxidative stress in diabetic induced group (Alloxan) caused on the increasing glucose level, total cholesterol and Triglycerides and also reduce the HDL-c and increased LDL-C, VLDL-C which are considered as a biomarkers for CD . The liver and other tissues are more resistant to reactive Oxygen species comparison to pancreatic beta-cells and this resistance protects them against Alloxan toxicity (Ahmed, 2009).

The current results indicated that feeding on AVJ- fortified bread both treatments reduce the level of serum glucose, Total cholesterol and Triglycerides levels in diabetic rats.

The results suggest that *Aloe Vera* juice has potential in treating the incensement glucose levels, total cholesterol and triglyceride for diabetic rats, It has been reported that *Aloe Vera* gel and its derived phytosterols have a long-term blood glucose level control effect and would be useful for the treatment of type 2 diabetes mellitus (Tanaka et al., 2006).

In a study for Lim et al., (2003) which determined the efficiency of dietary *Aloe Vera* supplementation on hepatic cholesterol and oxidative status in rats. They reported that the aloe-supplemented groups showed approximately 30% lower in the hepatic cholesterol levels. They

concluded that life-long intake of aloe had superior anti-oxidative action against lipid peroxidation, as indicated by reduced levels of hepatic phosphatidylcholine hydroperoxide, and had hypocholesteremic efficacy.

Alloxan, itself, produces beta cell destruction in pancreas by producing reactive oxygen species leading to a highly compromised oxidant status (Ahmed, 2009), in the current study diabetic induced group (+)control group produced significant increase in kidney and liver weight/body weight% which may be as a results of organs dysfunctions, same results were observed by Hamden, Khaled, et al., 2009 reported that stress oxidant, resulted in liver, kidney dysfunction and histological changes induced by alloxan in male rats.

Increased oxidative stress of LDL particles which can then culminate into atherosclerosis in diabetes may be responsible for generation for free radicals during ischemia reperfusion which are considered as a risk factor for CAD in diabetic rats. The current treatments with AVJ-fortified bread can reduce the percentage of LDL -C which lead to CAD. The trace elements and antioxidant enzymes e.g. superoxide dismutase found in *Aloe Vera* are components of. *Aloe Vera* is considering an antioxidant nutritional supplement. Thus, it may help in alleviating diabetic complications, which are due to increased oxidative stress, CAD being one of them (Nwanjo., 2006).

HDL-C is Cardio protective properties as it is involved in reverse cholesterol transport, while LDL-C is considered bad cholesterol, which is transports cholesterol from liver to peripheral tissues. Thus, a decreased in HDL-C seen in diabetic induced treatment is an indicator of increased CAD, risk in diabetic rats, *Aloe Vera* juice fortified bread caused slightly significantly incensement than positive control group, leading to a good Cardio protective effects for diabetic rats (Dahiya et al., 2012).

Liver helps in maintaining normal blood glucose concentration in both fasting and postprandial conditions. Loss of insulin effect on the liver leads to glycogenolysis and an increase in hepatic glucose production. Abnormalities of triglyceride storage and lipolysis in insulin-sensitive tissue such as the liver are an early manifestation of conditions characterized by insulin resistance and are detectable earlier than fasting hyperglycemia (Lewis et al., 2002).

References noticed that levels of AST are increased in the blood in case of damaged or diseased heart or liver, moreover, Sattar, Naveed, et al. (2004) reported that aspartate amino transferase (AST) could be included in future diabetes prediction. Likewise, Findings of Voarova, Barbora, et al., (2002) indicated that high ALT is a marker of risk for type-2 diabetes and suggest a potential role of the liver in the pathogenesis of type 2 diabetes. Both fortifications treatments of AVJ-fortified bread have a protective effect of increasing (ALT) levels which considered as marker of risk for type-2. Whilst there isn't clearly evidence for ALP levels in diabetes, whereas, Kocabay et al., (2010) mentioned that, In addition to conventional risk factors such as age, presence of diabetes, female sex; higher levels of ALP may be considered as a risk factor linked to hepatic fibrosis in patients with type-2 diabetes. The current results represented that both fortifications treatments of AVJ-fortified bread have a protective effects of increasing (AST), (ALT) and (ALP) levels.

Malondialdehyde (MDA) level is commonly known as a marker of oxidative stress and the antioxidant status and also one of the final products of polyunsaturated fatty acids peroxidation in the cells (Gawel, et al 2003). In addition Measurement of total antioxidant capacity in diabetic patients can be used as an index of glycemic control and development of diabetic complications in both types of diabetes (Rahbani et al., 1999).

Compared with the diabetic induced control group, the total antioxidant capacity (TAC) was increased these as a results for increasing the percentage of polyphenols in AVJ-fortified bread which are considered as antioxidants (Botes, Van der Westhuizen & Loots, 2008).

The acceptability of the products have a vital role in consuming the products, so in our study the sensory evaluation results for AVJ fortified bread indicated that the best acceptable fortified pan bread was 5% than other treatments, therefore, no consumer acceptability problem due to color was observed for AVJ fortified bread so it can be used as functional products for diabetic. More studies are needed for improving sensory properties for the AVJ fortified bread by natural substances. There were non-significant decrease in kidney and liver weight/body weight % within both treated groups.

Conclusion

In this study concluded that the fortification of pan bread with 5% and 10% *Aloe Vera* Juice may have protective effects on the diabetes, oxidative stress and lipid fractions and bring these biomarkers toward normal levels, these effects may due to the content of polyphenols contain in *Aloe Vera* Juice which react as naturally occurring antioxidant components including total phenols, flavonoids, ascorbic acid and α -tocopherol.

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