Journal of Home Economics
Volume 27, Number (3), 2017

Journal of Home Economics

http://homeEcon.menofia.edu.eg

ISSN 1110-2578

Hypoglycemic Effect of AzollaAlgae *(Azollacaroliniana)* on Rats Injected by Alloxan

Sherif S. Ragab – Emad M. El-Kholie – Abeer N. Ahmad
Safaa G.Arafa
Department of Nutrition and Food Science, Faculty of Home Economics, Minoufia University, Shebin El-Kom, Egypt

Abstract:

This study aimed to investigate the effect of *Azollacaroliniana* on diabetic rats. Twenty five white male albino rats, weighting 150-160 g were used in this study. The animals were divided into two main groups. The first main groups (n=5) was kept as a control (-ve) group, while the second (n=20) were injected by alloxan to induce diabetes. One of them was kept as a control (+) group and the other three groups treated with different percentages of Azolla algae (1%, 2.5% and 5%) from the basel diet. At the end of experimental period (28 days) rats were fasted over night before sacrificing and blood was collected then centrifuged to separate the serum and estimate serum glucose,liver functions (AST,ALT and ALP) kidney functions (urea, creatinine and uric acid) and lipid profile (T.C, T.G and HDL-c) while LDL-c and VLDL-c were calculated. The obtained results revealed that, treated groups by alloxan led to significant decrease in body weight gain% and increase serum glucose, cholesterol, triglycerides, LDL-c, VLDL-c, uric acid, urea, creatinine, ALP, ALT, AST, and decreased HDL-c. Treating groups which fed on *Azollacaroliniana* showed significantly ($P \leq 0.05$) decreased levels of serum glucose, AST, ALT, ALP, urea, creatinine and uric acid. It could be concluded that *Azollacaroliniana*were effective as protecting against diabetic rats not only decreased the level of serum glucose but also has beneficial effect on lipids profile and liver functions. Therefore, we recommended this tested algae by a moderate amount to be included in our daily diets.

Key words: Diabetic rats ,*Azollacaroliniana*, glucose level, lipid profile, liver functions.

Introduction

Diabetes mellitus is a systemic metabolic disease characterized by hyperglycemia, hyper lipedemia, hyper aminoacidemia, and hypo-insulinaemia. It leads to decrease in both insulin secretion and insulin action **(Maiti *et al*., 2004 and (Wadkar *et al*., 2008).**

In type 1 diabetes, the body does not produce insulin, and daily insulin injections are required. Type 1 diabetes is usually diagnosed during childhood or early adolescence. Type 2 diabetes is the result of failure to produce sufficient insulin and insulin resistance. Elevated blood glucose levels are managed with reduced food intake, increased physical activity, and eventually oral medications or insulin. It is typically diagnosed during adulthood However with the increasing incidence of childhood obesity and concurrent insulin resistance, the number of children diagnosed with type 2 diabetes has also increased worldwide **(Rosenbloom *et al*., 1999).** In addition to**Kempf *et al*., (2008)** reported that insulin injections, glucose-lowering drugs and lifestyle changes, such as exercise, weight control and diet therapy, are recommended for treating diabetes.

Medicinal plants have always been considered as a healthy source of life for all people due to its rich therapeutic properties and being 100% natural.They are widely used by the majority of populations to cure various diseases and illness and have a high impact on the world's economy **(Edeoga *et al*., 2005)**.

Azollais a small aquatic fern which flows on the water surface. The name is referred to conjugation of two Greek words, azo (to dry) and allyo (to kill) because the fern is killed by drought. Use of Azolla was initially limited as green manure but its use as mosquito inhibitor, herbicide, water saver, water purifier, nitrogen fertilizer saver **(Van-Hove and Lejeune,1996)**, as drug, for reclaiming saline soils and as bioremediation **(Sood *et al*., 2012 and Yadav *et al*., 2014)** are also been investigated.

The Asians have recognized benefits of growing Azolla as biofertilizer, human food and medicine, besides its role in environmental management and as controlling agent for weeds and mosquitoes. It also improves water quality by removal of excess quantities of nitrate and phosphorus and is also used as fodder, feed for fish, ducks and rabbits**.** Besides its extensive use as a N supplement in rice-based ecosystems, it

has also been used in other crops such as taro, wheat, tomato and banana (**Wagner, 1997)**.

Azollacontains all essential amino acids and carotene **(Mandal *et al*., 2012)**. Feeding trials on pigs and poultry reported improved feed conversion efficiency, average daily gain, dry matter intake and other growth performances on Azolla supplementation. Limited studies on cattle and buffaloes indicated improvement in daily gain and efficiency with reduced feed cost when concentrate mixture or protein meal are partially replaced by Azolla**(Kumar *et al*., 2012a and Murthy *et al*., 2013)**.

Azolla is reach in protein; total protein is 25-30%. Other constituents in Azolla are minerals, chlorophyll, carotinoids, amino acids, vitamins etc. It is also a potential source of nitrogen and is a potential feed ingredient for livestock (**Pannerker,1988)**.

Azolla is also rich in Fe (1000– 8600ppm dw), Cu (3–210 ppm dw) and Mn (120–2700 ppm dw) (**Leonard, 1997).**Also,**Paoletti *et al*., (1987)** reported that Azolla contains 0.8–6.7% dw crude fat, with 6.1–7.7% and 12.8– 26.4% total fat for polyunsaturated fatty acids (PUFA) omega 3 and omega 6. Azolla seems to be rich in some vitamins, notably carotenes and vitamin A (300–600 ppm /dw).

Algal extracts contain compounds such as carbohydrates, proteins, minerals, oil, fats, polyunsaturated fatty acids as well as bioactive compounds such as antioxidants (polyphenols, tocopherols [vitamin E], vitamin C, mycosporine-like amino acids), and pigments, such as carotenoids (carotene xanthophyll), chlorophylls, and phycobilins (phycocyanin, phycoerythrin), which possess antibacterial, antiviral, antifungal, antioxidative, anti-inflammatory, and antitumor properties **(Michalak and Chojnacka , 2015).**

Considering its nutrient content (**Balaji *et al*., 2009)**, Azolla algaewas started to be used as feed ingredients for poultry, pig and livestock species. Though variable results were observed, most of the researches suggested improvement on production and reproduction parameters in poultry bird when birds were fed with *Azolla*meal replacing basal diets upto a certain level. Backyard poultry farming is now-a-day's promoted in India considering socio-economic condition of Indian farmers. Different central Government agencies are developing several strains of poultry birds for backyard farming. This is developed

by Central Poultry Development Organization (CPDO). Considering, the potential of using Azollameal as a partial replacement of commercial broiler feed inbird chicken.

This study aimed to investigate the effect of Azolla algae on the diabetic rats induced by alloxan.

Materials And Methods

Materials

Azolla:

Azolla algae *(Azollacaroliniana)* were obtained during 2016 from LakeBurullus, Kafr- El Sheikh, Egypt.

Rats:

Twenty five adult male albino rats, weighting 150-160g, were obtained from Medical Insects Research Institute, Doki, Cairo, Egypt.

Rats were housed in wire cages under the normal laboratory condition, in the animal house of the Faculty of Home Economics, Menoufia University and were fed on standard diet for a week as an adaptation period. Diet was offered to rats in special food cups to avoid looser conditions of food, water was provided to the rats by glass tubes supported to one side of the cage, food and water checked adaily and rats weighed weekly.

Alloxan

Alloxanwas obtained from El- Gomhoriya Company for treading Drug, Chemicals and Medical Instruments, Cairo, Egypt, and used as a dose of 150 mg/kg bogy weight.

Methods

Preparation of materials

Azolla was cleaned to separate and remove any foreign matters, and dried in sunbeams and milled to powder by using hands, then the grained dried algae was sieved to obtain ahomogenous particles with the same size and kept in dusky stoppered glass bottles in a cool and dry location till use according to **Russo, (2001)**, who reported that al herbs and plants are pest kept in a cool, dry, and dark location to reduce oxidation of their contents.

Biological experiments

Basal diet

The basic diet prepared according to the following formula as mentioned by **(AIN, 1993)** as follow: protein (10%), corn oil (10%),

vitamin mixture (1%), mineral mixture (4%), choline chloride(0.2%), methionine (0.3%), cellulose (5%), and the remained is corn starch (69.5%). The used vitamin mixture component was that recommended by **Muller, (1964)**while the salt mixture used was formulated according to**Campbell, (1963**).

The induction of experimental diabetes

Diabetes was induced in normal healthy male albino rats by intraperitioneal injection of alloxan 150 mg/kg body weight, according to the methods described by **Desai and Bhide, (1985).**One week after the injection of alloxan, fasting blood samples were obtained to estimate fasting serum glucose 200 mg/dl rats which were considered diabetes **(NDDG 1994)**.

Experimental design

The experimental was done in the Faculty of Home Economics, Menoufia University, Shebin El-Kom. Rats were housed in wire cages in a room temperature 25C0 and kept under normal healthy condition.

The rats will be divided into two main groups as following:

-The first main group :(n=5) will fed on the basal diet as control negative.

-The second main group: (n = 20) diabetic rats.In this group rats were injected by Alloxan by 150 mg\kg, then divided into the following subgroups:-

- Diabetic rats + basel diet (positive control).
- Diabetic rats + 1% Azollaalgae.
- Diabetic rats + 2.5% Azollaalgae.
- Diabetic rats + 5% Azollaalgae.

Biological evaluation:

During the experimental period (28days), the diet consumed was recorded every day and body weight was recorded every week. The body weight gain (BWG %), feed efficiency ratio (FER), and organ/ body weight% were determined according to **Chapman *et al.*, (1959).** Using the following equations:

$$\text{BWG \%} = \frac{\text{(Final weight - Initial weight)}}{\text{Initial weight}} \times 100$$

$$FER = \frac{\text{Grams Gain in body weight (G)}}{\text{Grams Food consumed (G)}}$$

Blood sampling

At the end of experiment period, 28 days, blood samples were collected after 12 hours fasting using the abdominal aorta and rats were scarified under ether anesthetized. Blood samples were received into clean dry centrifuge tubes and left to clot at room temperature, then centrifuged for 10 minutes at 3000 rpm to separate the serum according to **Drury and Wallington, (1980).** Serum was carefully aspirate, transferred into clean covet tubes and stored frozen at -20^{o}C until analysis.

Hematological analysis

Different tested parameters in serum were determination using specific methods as follow: serum glucose according to **Young, (2001);**cholesterol (**Allain, 1974)**, tri glycerides(T.G) (**Fassati and Prencipe 1982) ,** high density lipoprotein(HDL-C)**(Lopez, 1977),** low density lipoprotein(LDL-C)**(Lee and Nieman, 1996),** very low density lipoprotein(VLDL-C)**(Lee and Nieman, 1996);**alanine aminotransferase (ALT) **(Yound, 1975),** aspartate aminotransferase (AST) **(Tietz, 1976) and (Yound, 1975)**, alkaline phsphatase(ALP)**(Belfield and Goldberg, 1971);**urea **(Patton and Crouch, 1977)**,creatinine**(Henry, 1974)**, uric acid **(Schultz, 1984)** andatherogenic index (A.I) **Kikuchi *et al*., (1998).**

Statistical analyses

The data were statisticallyanalyzed using a computerized costat program by one way ANOVA. The results are presented as mean ± SD. Differences between treatments at **$P \leq 0.05$**were considered significant.

Results and Discussion

Effect of Azolla algae on Body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) of diabetic rats.

Table (1) show the mean value of BWG (%)of diabetic rats fed on azolla. It could be noticed that the mean value of BWG% of control (+) group was lower than control (-) group, being 37.62 ± 1.25 and 34.37 ± 0.75, respectively, showing significant differences. The percent of increases were 9.45 % of control (-) as compared to control (+). All diabetic rats fed on azolla by different percentages showed significantly

decreases when compared with control (+). The values were 31 ± 0.57, 29 ± 0.81 and 26.25 ± 1.70 for azolla 1%, 2.5% and 5%, respectively. The percent of decrease were -9.80%, -15.62% and -23.62% for groups 3, 4 and 5, respectively. The best BWG% was recorded for group 5 diabetic rats fed on azolla 5% when compared to control (-).Similar results were obtained by **Basak *et al*. (2002) and Querubin *et al*. (1986)** recorded the highest weight gain in birds on diet contining 5% Azolla meal, while**Cambel (1984)** found better results using 10 and 15% Azolla meal. Variations observed in weight gain at different levels of Azolla meal could be attributed to differences in the strain and nutrient composition of Azolla used, and the type and physiological state of the experimental animal used. Considering FI (g /day) of diabetic rats fed on azolla, it could be noticed that the mean value of feed intake (FI) g /day of control (+) group was higher than control (-) group, being 12.25± 1.707 and 11.50± 1.290, respectively, showing non significant differences. The percent of decreases were -6.12% of control (-) as compared to control (+). All diabetic rats fed on azolla by different percentages showed decreases when compared with control (+), but this reduction didn't show any significant differences. The values were 10.25 ± 1.707, 14.00 ± 0.816 and 9.75 ± 0.957 for azolla 1%, 2.5% and 5% respectively. The percent of decreases were -16.32% and -20.40% for groups 3 and 5, while, the percent of increase for group 4 was 14.28%. The best feed intake (FI) g /day was recorded for group 3(diabetic rats fed on azolla 1%) when compared to control (-).**Castillo *et al*. (1981) and Basak *et al*. (2002)** found that inclusion of Azolla meal in broiler diet didn't affect feed consumption. However,**Bacerra *et al*. (1995)** explained the decrease in dry matter intake as the inability of the birds to eat more of the Azolla meal based diet. On the other hand, the mean value of feed efficiency ratio (FER) of diabetic rats fed on azolla. It could be indicated that the mean value of feed efficiency ratio (FER) of control (+) group was higher than control (-) group, being 6.29± 1.389 and 4.35± 0.597, respectively, showing non significant differences, the percent of decreasing was -30.84% of control (-) as compared to control (+). All diabetic rats fed on azolla by different percentages in mean values as compared with control (+) group. The values were 5.93 ± 0.903, 5.05 ± 0.803 and 3.98 ± 0.253 for azolla 1%, 2.5% and 5%, respectively. The percent of decreases were -5.72%, -19.71% and -

36.72% for groups 3, 4 and 5, respectively, The best feed efficiency ratio (FER) was recorded for group 3 (diabetic rats fed on azolla 1%) when compared to control (-).Lower feed conversion ratio of the Azolla meal based diets compared with the control suggests abenifit from the Azolla meal supplementation **Bacerra *et al*. (1995)** in studies with growing ducks observed that growth rate was linearly related to protein intake.

Table (1): Effect ofAzollaalgae on body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) of diabetic rats

Groups		BWG (%)		FI (g/day)		FER	
		Mean±SD	% of change	Mean±SD	% of change	Mean±SD	% of change
Control (-)		37.62± 1.25^{a}	9.45	11.50 ± 1.290^{ab}	-6.12	4.35 ± 0.597^{ab}	-30.84
Control (+)		34.37± 0.75^{b}	---------	12.25± 1.707^{ab}	---------	6.29± 1.389^{a}	---------
Azollacaroliniana	1%	31± 0.57^{c}	-9.80	10.25 ± 1.707^{b}	-16.32	5.93 ± 0.903^{a}	-5.72
	2.5%	29± 0.81^{d}	-15.62	14.00± 0.816^{a}	14.28	5.05± 0.803^{ab}	-19.71
	5%	26.25 ± 1.70^{e}	-23.62	9.75 ± 0.957^{b}	-20.40	3.98 ± 0.253^{b}	-36.72
L.S.D (p≤0.05)		1.13		2.13		1.43	

Means in the same column with different letters are significantly different at $p \leq 0.05$.

Effect of Azolla algae on serum glucose level of diabetic rats

Data given in Table (2) revealed the mean value of serum glucose mg/dl of diabetic rats fed on azolla. It could be illustrated that the mean value of serum glucose mg/dl of control (+) group was significantly higher than control (-) group, being 208.25 ± 5.377 and 98.95 ± 8.220, respectively. The percent of decrease was -52.48% of control (-) as compared to control (+). All groups fed on azolla by different percentages showed significantly decreaseas compared to control (+) group. The values were 163.25 ± 17.461, 143.00 ± 3.162 and 127.75 ± 2.362 for azolla 1%, 2.5% and 5%, respectively. The percent of decreases were -21.60%, -31.33% and -38.65% for groups 3, 4 and 5, respectively. The best serum glucose was recorded for group 5 (diabetic rats treated with azolla 5%) when compared to control (-). This result agree with **(Mishra *et al*., 2016)** They found that feeding Azolla by 5% reduced blood glucose in chicken. Similar results obtained by **Jin-DaQing *et al*. (2004)** found that rats fed on brown algae reduced blood

glucose level. These results are in agreement with those obtained by **Lamela *et al*. (1989)** who found that diabetic rats fed on seaweeds reduced blood glucose levels comparing with normal rats.

Table (2): Effect of Azollaalgae on serum glucose level (mg\dl) of diabetic rats

Variables	Control (-)	Control (+)	*Azollacaroliniana*			*L.S.D*
			1%	2.5%	5%	
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	(p ≤ 0.05)
Glucose	98.95 ± 8.220^{e}	208.25± 5.377^{a}	163.25 ± 17.461^{b}	143.00± 3.162^{c}	127.75 ± 2.362^{d}	12.47
%change of positive control	-52.48	---------	-21.60	-31.33	-38.65	

Means in the same row with different letters are significantly different, at $p \leq 0.05$.

Effect of Azolla algae on liver functions (AST, ALT and ALP) of diabetic rats

Data tabulated in Table (3) noticed the mean value of serum AST,ALT and ALP (U/L) of diabetic rats fed on azolla. It could be represented that (AST,ALT and ALP) of control (+) group was significantly higher than control (-) group, by the ratio of -27.38%, -54.01% and -85.34%. Diabetic rats fed on *azollacaroliniana* by different percentages showed significant decreases in serum AST,ALT and ALP compared with the rats injected by alloxan. The percent of decreases as compared to control (+) group were -9.009%, -11.89% and -16.78% for AST and -23.66%, -36.16% and -40.17% for ALT and -16.04%, -29.30% and -50.69% for ALP for *Azollacaroliniana* by 1, 2.5, 5% respectively, considering serum AST,ALT and ALP, *Azollacaroliniana* 5% group recorded that the best treatment was observed for when compared to control (-) group.This results disagree with (**Mishra *et al*., 2016)**, they found that feeding chicken with different levels of Azolla increased serum AST and significantly decreasing serum ALP but didn't show any significantly differences concerning serum ALT comparing control (-) group.

Table (3): Effect ofAzollaalgae on liver functions (U/L) of diabetic rats

Groups		AST		ALT		ALP	
		Mean±SD	% of change	Mean±SD	% of change	Mean±SD	% of change
Control (-)		100.75 ± 8.421^{d}	-27.38	25.75 ± 1.707^{d}	-54.01	15.75 ± 2.986^{e}	-85.34
Control (+)		138.75± 8.732^{a}	---------	56.00± 5.477^{a}	---------	107.50± 7.767^{a}	---------
Azollacaroliniana	1 %	126.25 ± 2.872^{b}	-9.009	42.75 ± 1.707^{b}	-23.66	90.25 ± 5.315^{b}	-16.04
	2.5 %	122.25± 4.787^{bc}	-11.89	35.75± 1.258^{c}	-36.16	76.00± 5.597^{c}	-29.30
	5 %	115.50 ± 2.645^{c}	-16.75	33.50 ± 2.081^{c}	-40.17	53.00 ± 12.355^{d}	-50.69
L.S.D ($p \leq 0.05$)		8.34		4.15		11.17	

Means in the same column with different letters are significantly different at $p \leq 0.05$.

Effect of Azolla algae on kidney functions (urea, creatinine and uric acid) of diabetic rats

Data presented in Table (4)noticed the mean value of serumurea, creatinine and uric acid of diabetic rats fed on basal diet containing three levels of azolla. It could be represented that**(**urea, creatinine and uric acid) of control (+) group was significantly higher than control (-) group, by the ratio of -34.61%, -33.33% and -54.89% respectively. Diabetic rats fed on *azollacaroliniana* by different percentages showed significant decreases in serum urea, creatinine and uric acidcompared with the rats injected by alloxan. The percent of decreases as compared to control (+) group were -16.66%, -23.07% and -26.28% for urea and -10.83%, -17.5% and -26.66% for creatinine and -18.39%, -30.26% and -42.43% for uric acid for *Azollacaroliniana* by 1, 2.5, 5% respectively, considering serum urea, creatinine and uric acid, *Azollacaroliniana*5% group recorded that the best treatment was observed for when compared to control (-) group.Similar results were obtained by **Vasanthi *et al*. (2003)** come to same conclusion using the brown Algae reduced the serum urea, uric acid, creatinine level.**Khider, Abeer (2006)** reported that Algae corrected the rend function disorders.This result disagree with **(Mishra *et al*., 2016)**, they found that feeding chicken on Azolla

increasing serum creatinine and increasing serum uric acid by different levels.

Table (4): Effect of Azollaalgae on kidney functions (mg/dl) of diabetic rats

Groups		Urea		Creatinine		Uric Acid	
		Mean±SD	% of change	Mean±SD	% of change	Mean±SD	% of change
Control (-)		25.50 ± 1.914^{d}	-34.61	0.80 ± 0.046^{c}	-33.33	1.52 ± 0.125^{e}	-54.89
Control (+)		39.00± 2.000^{a}	---------	1.20± 0.061^{a}	---------	3.37± 0.301^{a}	---------
Azollacaroliniana	**1 %**	32.50 ± 1.732^{b}	-16.66	1.07 ± 0.075^{b}	-10.83	2.75 ± 0.129^{b}	-18.39
	2.5 %	30.00± 0.816^{c}	-23.07	0.99± 0.050^{b}	-17.5	2.35± 0.173^{c}	-30.26
	5 %	28.75 ± 0.957^{c}	-26.28	0.88 ± 0.023^{c}	-26.66	1.94 ± 0.184^{d}	-42.43
L.S.D (p≤0.05)		2.18		0.09		0.21	

Means in the same column with different litters are significantly different at $p \leq 0.05$.

Effect of Azolla algae on total cholesterol and triglycerides level (mg/dl) of diabetic rats

Table (5) represented the mean value of serum (T.C and T.G) of diabetic rats fed on basal diet containing three levels of *azollacaroliniana*. It could be represented that (T.C and T.G) of control (+) group was significantly higher than control (-) group, by the ratio of -50.68% and -49.68% respectively. Diabetic rats fed on *azollacaroliniana* by different percentages revesled significant decreases in serum (T.C and T.G)(T.C and T.G)compared with the rats injected by alloxan. The percent of decreases as compared to control (+) group were -21.08%, -26.19% and -38.21% for T.C and -15.49%, -20.80% and -38.21% for T.G for *Azollacaroliniana* by 1, 2.5, 5% respectively, considering serum (T.C and T.G), *Azollacaroliniana*5% group recorded that the best treatment was observed for when compared to control (-) group. These results different from those reported by **Mishra *et al*., (2016)** reported that feeding on Azolla didn't show any significantly differences in serum total cholesterol but increasing serum triglycerides when feeding chicken on it by difference levels.**Yanase *et al*. (1985)** found that there was no

effect of algae diet on plasma cholesterol. **Ooshima *et al.* (2003)** reported that rats fed on seaweeds had increased triglycerides levels compared to the control group.

Table (5): Effect of Azollaalgae on total cholesterol (TC) and triglycerides (TG) level (mg/dl) of diabetic rats

Groups		TC		TG	
		Mean±SD	% of change	Mean±SD	% of change
Control (-)		36.25 ± 6.898^{c}	-50.68	59.25 ± 6.130^{d}	-49.68
Control (+)		73.50± 16.360^{a}	---------	117.75± 11.729^{a}	---------
Azollacaroliniana	**1 %**	58.00 ± 0.816^{b}	-21.08	99.50 ± 4.795^{b}	-15.49
	2.5 %	54.25± 0.957^{b}	-26.19	93.25± 3.685^{b}	-20.80
	5 %	45.25 ± 1.500^{bc}	-38.43	72.75 ± 4.031^{c}	-38.21
L.S.D (p≤0.05)		11.44		8.39	

Means in the same column with different letters are significantly different at $p \leq 0.05$.

Conclusion:

In conclusion, the tested Azolla in the present study had a good effect in protecting against diabetic rats induced by aloxan. These results supported our hypothesis that Azolla contain a lot amount of compounds such as protein, total dietary fiber, amino acids, total phenolics, polyphenols, and total caroteinoides that are able to decrease serum glucose, serum lipids, also it could be improvement liver functions. So, we recommended that our daily diets and drinks should be contained up to 5% of *Azollacaroliniana* algae.

References

AIN, (1993): American Institute of Nutrition. Purified diet for laboratory Rodent, Final report. J. Nutrition. 123:1939-1951. and O. compactumeBenth. J. essential oil Res. 8 (6): 657-664.

Allain, C. C. (1974): Cholesterol enzymatic colorimetric method. J. of Clin. Chem., (20): 470 - 475.

Bacerra, M.; Preston, T. R. and Ogle, B. (1995): Effect of replacing whole boiled soya beans with azolla in the diets of growing ducks. Livest. Res. Rural Dev., 7:1-11.

Balaji, K.; Jalaludeen, A.; Churchil, R.R.; Peethambaran,P.A. and Senthil, K.S. (2009): Effect of dietary inclusion of Azolla(*Azollapinnata*) on production performance of broiler chicken. Indian J. Poult. Sci., 44 (2): 195-198.

Basak, B. M. d.; pramanik, A. H.; Rahman, M. S.; Tarafdar, S. U. and Roy, B.C. (2002): Azolla (*Azollapinnata*) as a feed ingredient in Broiler Ratio.International Journal of Poutry Science 1 (1): 29-34.

Belfied, A. and Goldberg, D. M. (1971): "Alkaline Phosphatase colorimetric method". J. of Enzyme, (12): 561.

Cambel, I.M. (1984): Growth performance of broilers fed with varying levels of azolla meal. Kabacan, North Cotabato (Philippines), pp: 66.

Campbell, J.A. (1963): Methodology of protein evaluation. RAG.Nutr. Document R. 10 Led. 37: June Meeting. New York, NY.Care ;22(2):345-354.

Castillo, L.S.; Gerpacio, A.L. and Pascual, F.S. D. (1981): Exploratory studies on Azolla and fermented rice hulls in broiler diets. College Laguna (Philippines) pp: 6.

Chapman, D.G.; Castilla, R. and Champbell, J.A. (1959): Evaluation of protein in food. I.A. Method for the determination of protein efficiency ratio-Can. J.; Biochemistry. Physiology, 37: 679-686.

Desai, A. and Bhide, M. (1985): "Hypoglycemic effect of Hanitoniasuavecolens". Idian. J. med., 81:86-91.

Drury, R.A.; and Wallington, E.A. (1980): Carlton's Histological Technique. 5th ed. Oxford University press, London, New York, Toronto, Medical publications, P:344 - 345 .

Edeoga, H. O.; Okwu, D. E. and Mbaebie, B. O. (2005): Phytochemical constituents of some Nigerian medicinal plants. Afr J Biotechnol; 4: 685-688.

Fassati, P. and Prencipe, L. (1982): Triglyceride enzymatic colorimetric method. J. of Clin.CHem., (28):2077- 2080.

Henry, R. J. (1974): Clinical Chemistry Principal and Techniques. Znd Ed. Harper and Publisher. New York. P. 641.

Jin-DaQing.; Li, G.; Kim, J.; Yong, C. and Huh, K. (2004): Prevention effect of*Laminaria japonica* aqueous extract on the oxidative stress and xanthine oxidase activity in streptozotocin induced diabetic rat liver. Biological and pharmaceutical Bulletin; 27(7): 1037-1040.

Kempf K, Rathmann W, and Herder, C. (2008): Impaired glucose regulation and type 2 diabetes in children and adolescents. Diabetes Metab. Res Rev 2008, 24(6):427-437.

Khider, Abeer, A. A. (2006): Evaluation of Some Therapeutic Effects of Marine Algae. Ph.D. Thesis, Faculty of Home Economics, Minufiya University.

Kikuchi, H.; Onodera, N.; Matubara, S.; Yasudo, E.; Chanon, O.; Takahashi, R. and Ishikawa, F. (1998): " Effect of soya milk on lipid metabolism in aged ovariectomized rats:. Bioscience Biotechnology and biochemistry, 62 (9): 1688.

Kumar, D.S.; Prasad, R. M. V.; Kishore, K. R. and Rao, E. M. R. (2012a): Effect of Azolla*(Azollapinnata*) based concentrate mixture on nutrient utilization in buffalo bulls. Indian J Anim Res 46 (3): 268-271.

Lamela, M.; Anca, J.;Villar, R.; Otero, J. and Calleja, J. M. (1989): Hypoglycemic activity of several seaweed extracts.Jornal of Ethnopharmacology, 27(1-2):35-43.

Lee, R. and Nieman, D. (1996): National Assessment. Znd Ed., Mosby, Missouri, USA. MI.

Leonard, V. (1997): Use of Aquatic Fern (*Azollafiliculoides*) in Two Species of Tropical Fish (Oreochromisniloticus and Tilapia rendalli). PhD Thesis.Presses Universitaires de Namur, Belgium, 276 pp.

Lopez, M.F. (1977): HDL- Cholesterol colorimetric method. J. of Clin. Chem., (23), 230:282.

Maiti, R.; Jana, D.; Das, U. K. and Ghosh, D. (2004): Antidiabelic effect ofaqueous extract of seed of Tamarindusindica in streptozotocin induced diabetic rats. Journal of Ethnopharmacology; 92:85-91.

Mandal, R. N.; Pandey, B. K.; Chattopadhyay, D. and Mukhopadhyay, P. K. (2012): Azolla – an aquatic fern of significance to small-scale aquaculture. Aquaculture Asia 17(1):11-15.

Michalak, L. and Chojnacka, K. (2015): Algae as production systems of bioactive componds, Engineering in life sciences. J. 15: 160-176.

Mishra, D.B.; Roy, D.; Kumar, V.; Bhattacharyya, A.; Kumar, M.; Kushwaha, R. and Vaswani, S. (2016): Effect of feeding different levels of AzollaPinnata on blood biochemical, hematology and immunocompetence traits of Chabro chicken, VeteinaryWorla, 9 (2): 192- 198.

Muller, A. (1964): "Vitamin mixture". J. Biol. Chem., 150:305.

Murthy, T. N. K.; Ashok, M.; Thirumalesh, T.; Umesh, B. U. and Nataraju, O. R. (2013): Effect of partial replacement of Azolla for concentrate supplement on lactating crossbred cows. Environ Ecol 31 (2):415-417.

N.D.D.G, (1994): Nation Diabetes Data Group. Densification and diagnosis of diabetes mellitus and other categories of glucose intolerance. J. of Diabetes, 28:1039-1075.

Ooshima,K.; Higashino, H.; Tajiri, T. and Fujita, T. (2003): Effects of seaweed carbide powder on the rats given foods deficient in trace elements. Journal of Traditional Medicines, 20(6): 251-257.

Pannaerker, S. (1988): Azolla as a livestock and poultry feed. Livestock Adviser, 13:22-26.

Paoletti, C.; Bocci, F.; Lercker, G.; Capella, P. and Materassi, R. (1987): Lipid composition of Azollacaroliniana biomass and its seasonal variation. Phytochemistry 26, 1045–1047.

Patton, C. J. and Croush, S. R. (1977): Enzymatic determination of urea. J. Aral.Chem., 49: 464-469.

Querubin, L. J. P. F.; Alcantara and Princesa, A.O. (1986): Chemical composition of three Azolla species (*A. pinnata, A.Caroliniana*and *A. microphylla*) and feeding value of Azolla meal (*A. microphylla*)

in broiler ration. Philippines Agriculturist (Philippines), 69:479-490.

Rosenbloom, A. L.; Joe, J. R.; Young, R. S. and Winter, W. E. (1999): Emerging epidemic of type 2 diabetes in youth. Diabetes

Russo, E. (2001):"Hand book of Psychotropic Herbs A scientific Analysis of Herbal Remedies for Psychiatric conditions". The Howrth Herbal press. Inc. NU, USA.

Schultz, A. (1984): Uric Kaplan A. Clin Chem. Mosby Co. St. Louis Toronto. Princeton, 1261- 1266 and 418.

Sood, A.; Uniyal, P. L.; Prasanna, R. and Ahluwalia, A. S. (2012): Phytoremediation potential of aquatic macrophyte, Azolla. Ambio 41(2):122–137.

Tietz, N. W. (1976): Fundamentals of clinical chemistry. Philadelphia. B. W. standers, P. 243. New York, NY. USA.

Van Hove, C. and Lejeune, A. (1996): Does Azollahave any future in agriculture? In: Rahman, M., Podder, A.K., Van Hove, C., Znt, B., Heulin, T. and Hartmann, A., editors. Biological Nitrogen Fixation Associated with Ric.

Vasanthi, H. R.; Jaswanth, A.; Sarawathy, A. and Rajamanickam, G. V. (2003): Control of urinary risk factor of stones by *Padindboegesenii*(Allanderand Kraft), a brown algae in experimental hyperoxaluria. Jornal of Natural Remedies, 3 (2): 189-194.

Wadkar, K.A.; Magdum, C.S.; Patil, S.S. and Naikwade, N.S. (2008): Antidiabetic potential and Indian medicinal plants. Journal of Herbal Medicine and Toxicology; 2: 45-50.

Wagner, G. M. (1997): "Azolla: A review of its biology and utilization" Botanical Reviews, 63:1–26.

Yadav, R.K.G.; Abraham, Y.; Singh, V. and Singh, P.K. (2014): Advancements in the utilization of *Azolla anabaena* system in relation to sustainable agricultural practices. Proc. Indian Natl. Sci. Acad., 80(2): 301-316.

Yanase, M.; Arai, K. and Kikuchi, R. (1985): Digestibility of atangle (*Laminariaangustata* var. *Longissima*).Bulletin of Tokai Regional Fisheries, 115: 11-15.

Yound, D.S. (1975): Determination of Got. Clin. Chem., 22 (5): 21.

Young, D.S. (2001): "Effect of Disease on Clinical lab" Tests, 4th Ed AA CC pages 1850.

Journal of Home Economics, Volume 27, Number (3), 2017

التأثير الخافض للسكر لطحلب الأزولا(Azollacaroliniana) علي الفئران المحقونة بالالوكسان

شريف صبري رجب مكاوي، عماد محمد عبد الحليم الخولي،عبير نزيه عبد الرحمن، صفاء جمال محمد عرفه

قسم التغذية وعلوم الاطعمة ، كلية الاقتصاد المنزلي ، جامعة المنوفية ، شبين الكوم ، مصر .

الملخص العربي

تم اجراء الدراسة الحالية لمعرفة تأثير استخدام طحلب الازولا لتحسين مرض البول السكري. أجريت الدراسة علي25 فأر البينو ذكور تتراوح اوزانهم من 150 ± 10 جم ، تم تغذيتهم علي الوجبة الاساسية لمدة اسبوع، ثم قسمت بعد ذلك الي مجموعتين اساسيتين، المجموعه الاولى 5 فئران (المجموعة الضابطة السالبة) حيث تم تغذية هذه المجموعة علي الوجبة الاساسية طوال فترة التجربة.ثم تم حقن أربعة مجموعات بالألوكسان وعددهم 20 فأر بمقدار 150 ملجم/ كجم من وزن الجسم بمادة الالوكسان بهدف اصابة الفئران بمرض السكر ثم تم تقسيمهم الى مجموعات فرعية كالتالي: المجموعة الضابطة الموجبة حيث تم تغذيتها علي الوجبة الاساسية طوال مدة التجربة.- بينما الثلاثة مجموعات الاخري تم اضافة طحلب الازولا بنسب 1% ،2.5% ،5% من الوجبة الاساسية علي الترتيب. وفي نهاية التجربة ثم وزن الفئران ثم ذبحهم وتجميع عينات الدم بعد صيام 12 ساعة وتم قياس انزيمات الكبد (ALT,ALP and AST)، الكولسترول الكلي، الجلسريدات الثلاثية، ووظائف الكلي (اليوريا ، الكرياتنين، حمض اليوريك)، ومستوى السكر في الدم. وقد اظهرت نتائج هذه الدراسة ان التغذية على طحلب الازولا قد نتج عنها تحسن في وظائف الكبد والكلي ودهون الدم وانخفاض مستوى الجلوكوز بالدم لدى الفئران البيضاء المصابة بالسكري.

الكلمات المفتاحية :- وظائف الكبد ، وظائف الكلي ، دهون الدم ، سكر الدم ، طحلب الازولا.