Journal of Medicinal Plants Studies

www.PlantsJournal.com

ISSN 2320-3862
JMPS 2014; 2(4): 46-49

Received: 04-07-2014
Accepted: 04-08-2014

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Beneficial effects of *Aegle marmelos* leaves on blood glucose levels and body weight changes in *alloxan*- induced diabetic rats

Leena Muralidharan

Abstract
Diabetes mellitus is one of the most recognized and clinically significant disorders of the endocrine system. It is characterized by the disturbances of carbohydrate, lipid and protein metabolism and an abnormal response to the glucose load. Feeding with aqueous extract of leaves of *Aegle marmelos* commonly called as *bael* in *alloxan*- induced diabetic rats significantly ($P<0.001$) decreased blood glucose levels and significant ($P<0.01$) increase in body weight changes were observed. In non- diabetic rats, the experimental *bael* leaves did not cause any hypoglycaemia effect and no significant body weight changes were found indicating that *Aegle marmelos* has anti- diabetic activity.

Keywords: *Aegle marmelos*, *Diabetes mellitus*, *Alloxan*, Blood Glucose level, Body weight.

1. Introduction
All over the world, *Diabetes mellitus* is increasing. India is predicted to have the largest number of people with *Diabetes mellitus* [4]. Though many new oral hypoglycaemia agents are now available, there is a great difficulty in choosing the right medication for longer period either because of their side effects or due to the poor response. Herbal drugs are traditionally used in various parts of the world to cure different diseases. The trend of using natural products has increased and the active plant extracts are frequently screened for new drug discoveries [6]. Growing demand for herbal medicines is due to their effectiveness, minimal side effects and economical aspects.
The plant *Aegle marmelos* (*Roxb*) is popularly known as *bael* in India. It is a spine tree belonging to the family *Rutaceae.* It grows up to a height of 3- 6 metres. The leaves of this tree are oval in shape and the flowers have pleasant fragrance. The medicinal properties of this plant have been described in the *Ayurveda*. In fact, as per Charaka (1500 B.C.), no drug has been longer or better known by the inhabitants of India than *bael*.
Aegle marmelos leaf extract has been reported to regenerate the damaged pancreatic β cells in the diabetic rats [5]. Fresh aqueous and alcoholic leaf extracts of *Aegle marmelos* were reported to have cardio tonic effects in mammals [2]. The ethanol extract of *Aegle marmelos* leaf possesses antispermatogenic [1].
Considering the importance of *bael*, the present study was undertaken to evaluate the anti-diabetic effect of *Aegle marmelos* on blood glucose level, body weight and behavioural changes in *alloxan*- induced diabetic rats to provide the scientific evidences on modern line.

2. Materials and Methods
Adult albino rats (Winstar strain) aged about 3 months weighing between 400-420 g and free from any kind of infections were used. The animals were maintained as per the guidelines. For experimental purposes, the rats were kept fasting overnight but were allowed free access to water. The standard protocol for laboratory animal care was followed. Twenty male albino rats (Winstar strain) were divided into four groups of five rats each by random block design and were housed individually in wire mesh cages. Animals were maintained under the laboratory conditions with standard stock diet and water.
Diabetes was introduced by intra- peritoneal administration of 150 mg/kg body weight of ice cold aqueous alloxan monohydrate [3] to two groups of rats served on diabetic control and diabetic experimental, respectively. After a fortnight, hyperglycaemia was observed in both the groups of rats. The other two groups were kept as non- diabetic control and non- diabetic

experimental, respectively. The rats were given high fibre and high protein diet. 20 g diets were fed and distilled water was provided ad libitum. The leftover food residues were collected to calculate the actual food intake.

The rats were weighed every week up to 4 weeks of experimental period to record the body weight changes. The initial and final blood glucose levels were measured from the tail veins with the help of glucometer. The results were compared with the control groups of non- diabetic and diabetic rats with the initial values of the same groups.

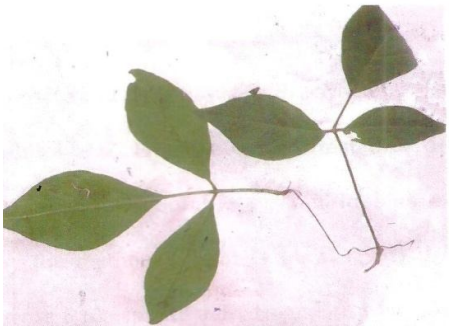


Fig 1: Experimental plant (*Aegle marmelos)*

Experimental leaves were collected from the garden and washed well with the distilled water. 50 g of air- dried leaves were extracted in one litre of boiling water for 2 hours and were concentrated to half the volume. The resulting brown extract was cooled and filtered using Whatman filter paper.

Leaf extract was introduced by intra- peritoneal administration of a single dose of 10 mg/ 100 g every day morning for a period of 30 days.

Urine sugar was checked by uristix strips from Bayer. The rats were observed continuously for gross behavioural changes. The data was analysed statistically using variances' test.

3. Results and Discussion

Experimental observation and preliminary data about the mechanism of action of *Aegle marmelos* is reported to offer scientific explanation towards the potential use of such plants for the treatment of *Diabetes mellitus.*

The study on LD^{50} of the leaf extract was observed to be appreciably high. No death occurred during the 30 days of experimental period. No mortality was seen even with the 20 times high dose feed of the leaf extracts. This further indicates high margin of safety. The leaf extracts of *Aegle marmelos* appears to be useful in inhibiting *glucose- 6- phosphate dehydrogenase*, hepatic glucose output and controlling the elevated blood glucose levels. *Aegle marmelos* changed the insulin action in tissues. It is an insulin sensitizer which can be used in the treatment of diabetes. It improves the glycaemia control by enhancing the insulin sensitivity in liver and muscle. Improved metabolic control with *Aegle marmelos* did not cause weight gain.

The behaviour of diabetic rats appeared sluggish and abnormally active initially but returned to normalcy after a week of treatment. The consumption of food increased initially which became normal in the treated rats. Fluid intake increased six times in the diabetic untreated rats while the intake of water was twice in *Aegle marmelos* treated rats.

Table 1: Effect on PPG & FBG levels in blood glucose of diabetic rats after 30 days treatment with *Aegle marmelos*

No.	Group	FBG (Initial) mg/ dl	FBG (Final) mg/ dl	PPG (Initial) mg/dl	PPG (Final) mg/dl
1	Control (Treated)	69 ± 8.6	74 ± 5.4	100 ± 9.8	102 ± 7.6
2	Control (Untreated)	68 ± 7.8	79 ± 5.8	102 ± 6.7	104 ± 9.8
3	Experimental (Treated)	275 ± 9.5	150 ± 3.8	278 ± 4.6	202 ± 6.2
4	Experimental (Untreated)	279 ± 9.4	438 ± 4.6	287 ± 5.7	523 ± 7.8

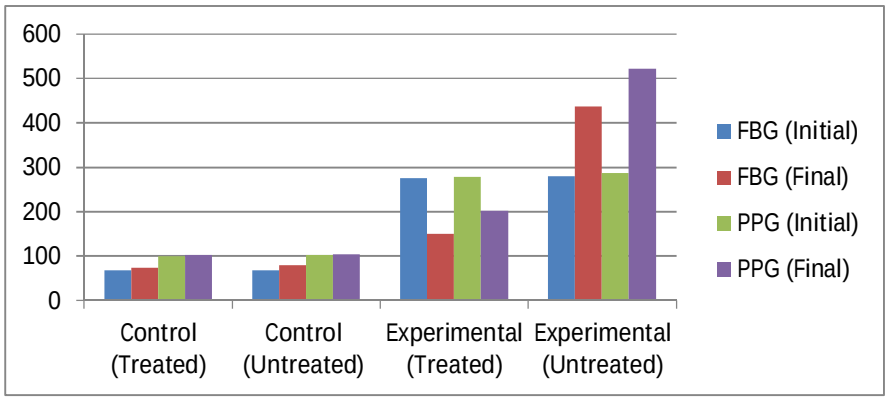


Table 2: Effect on Urine Sugar levels in diabetic rats after 30 day treatment with *Aegle marmelos*

Sr. No.	Group	Urine Sugar (Initial)	Urine Sugar (Final)
1	Control (Treated)	-ve	-ve
2	Control (Untreated)	-ve	-ve
3	Experimental (Treated)	+4	+1
4	Experimental (Untreated)	+4	+5

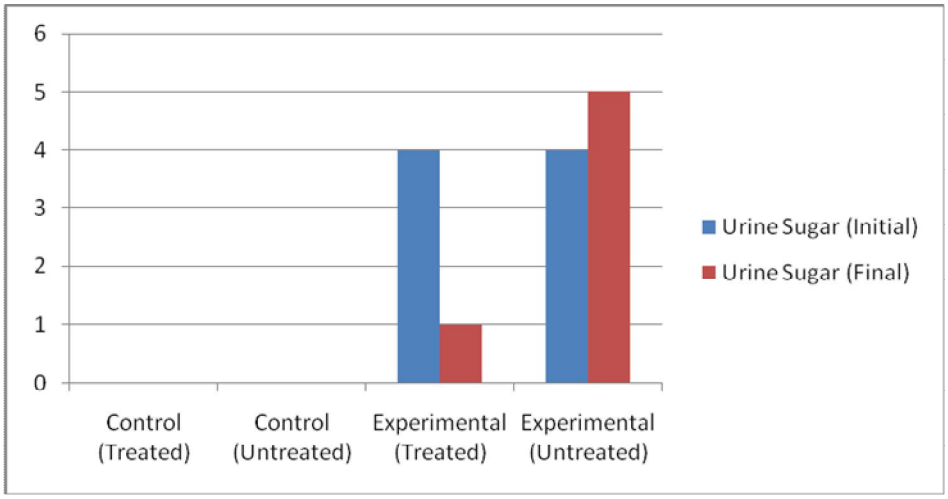
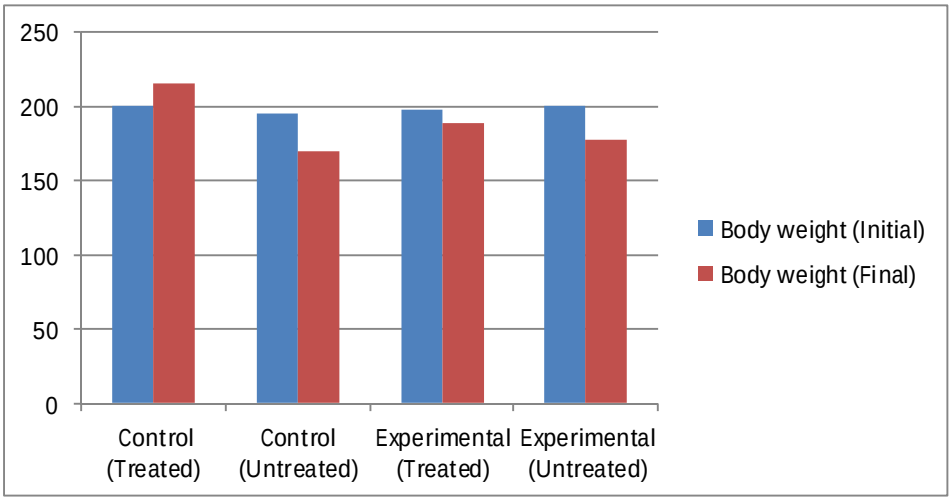


Table 3: Effect on body weight (B. W.) changes in diabetic rats after 30 day treatment with *Aegle marmelos*

No.	Group	Initial (g)	Final (g)
1	Control (Treated)	200 ± 5	215 ± 9
2	Control (Untreated)	195 ± 6	170 ± 4
3	Experimental (Treated)	198 ± 9	189 ± 10
4	Experimental (Untreated)	200 ± 6	178 ± 8



4. Conclusion

The present study concluded that the leaf extracts of experimental plant taken for the study i.e. *Aegle marmelos*, helps in regulating and maintaining the homeostatic metabolism in the body. Extracts were found to be effective as an anti- diabetic agent. A detailed study on the metabolites of plant extracts of *Aegle marmelos* on release of insulin, release of glucose and uptake of glucose is very essential to throw

light on its anti-diabetic activities.

5. Acknowledgement
I thank University of Mumbai for providing financial assistance in carrying out the experiment. I extends whole hearted gratitude for the support lent by the administrative and technical staff.

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