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Evaluation of *Aegle marmelos* (Bael) as Hyperglycemic and Hyperlipidemic Diminuting agent in type ii diabetes mellitus Subjects

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Abstract

Background: Diabetes mellitus is possibly the world's largest growing metabolic disease. The International Diabetes Federation (IDF) estimates the total number of people in India with diabetes to be around 50.8 million in 2010, rising to 87.0 million by 2030. With such incidence, mere nutrition and medical therapies cannot be relied upon. Currently, a challenge is to identify such healthy foods that remain in the realms of obscurity and to establish them as functional foods to prevent the progression of metabolic complications. *Aegle Marmelos* is one of the most widely used medicinal and nutraceutical plant. Leaves, fruits, stem and roots of *Aegle Marmelos* have been used in ethno medicine to exploit its various medicinal properties including antioxidant, antimicrobial, antidiarrheal, antidiabetic, antiproliferative, hepatoprotective, anti-inflammatory, antihyperlipidemic antiasthmatic and antiulcer activities. Therefore, this study was undertaken to evaluate the effect of *Aegle Marmelos* fruit pulp powder on type II diabetic subjects.

Methods: Type II diabetic subjects were selected from main campus of Banasthali University, Newai Rajasthan and divided into experimental and control groups (Age group: 30-60 years). *Aegle Marmelos* fruit pulp powder was incorporated in khakre and administered to the experimental group daily for 60 days. Biochemical evaluations of blood sample of the subjects were done.

Results: The present study indicates that *Aegle Marmelos* fruit pulp powder showed a significant effect on blood glucose and lipid parameters.

Conclusion: *Aegle Marmelos* purport to alleviate the symptoms of diabetes in a natural manner having no side effects on health and inexpensive than other hypoglycemic drugs.

Keywords: *Aegle Marmelos*, Blood glucose parameters, Lipid parameters, metabolic complications.

1. Introduction

Diabetes Mellitus is a major health problem and has been regarded as a chronic, progressive condition, capable of amelioration but not cure (Lim *et al.*, 2011) [10]. Diabetes Mellitus is a chronic metabolic disorder characterized by hyperglycemia caused by defective insulin secretion, resistance to insulin action or a combination of both. Alterations of lipid and protein metabolism are also important manifestations of these defects in insulin secretion or action (FDA, 2008) [4], resulting from defects in insulin secretion, insulin action or both. According to estimation by global diabetes prevalence has more than doubled over the last three decades, with prevalence rate far increasing (Basu *et al.*, 2013) [3]. Nearly one in ten adults worldwide is affected by diabetes. The International Diabetes Federation (IDF) estimates the total number of diabetic subjects to be around 40.9 million in India and this is further set to rise to 69.9 million by the year 2025 (Sicree *et al.*, 2006) [15].

Management of diabetes is a huge burden. It has been seen that orally administered drugs have various side effects for example, alpha-glucosidase inhibitor may cause diarrhoea while thiazolidinediones may increase LDL level (Pandey *et al.*, 2011; Joseph and Rushakoff, 2010) [11]. Thus, it is now realized that the ultimate therapy for type I and type II diabetes lies in the herbal approach. Though the recovery is slow but still is popular because of its inability to cause side effects and combat antibiotic resistant microorganisms (Rawat and Uniyal, 2003) [12]. *Aegle Marmelos* (L.), commonly known as bael belonging to the Rutaceae family is a popular medicinal plant in ayurveda and siddha systems of medicine and folk medicines used to treat a wide variety of ailments. Various parts of this plant such as leaves, fruit and seed possess hypoglycemic, hypolipidemic and blood pressure lowering property (Lambole *et al.*, 2010) [9]. It is stated that India's herbal medicinal heritage is sliding down towards extinction and bael having tremendous therapeutic potential is not fully utilized (Sharma *et al.*, 2007) [13]. This research was embarked on study the hypoglycemic and hypolipidemic property of *Aegle*

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marmelos fruit pulp powder in type II diabetes mellitus subjects.

2. Materials and Methods

2.1 Collection of Plant material

The fruit pulp powder of *Aegle marmelos* was collected from Patanjali Herbal Garden and Agro Research Department Haridwar, Uttarakhand.

2.2 Chemicals

All the chemicals and solvents were of analytical grade. Sigma Chemical Co. (Saint Louis, MO, USA), HiMedia Labs. (L.B.S Marg Mumbai) and other chemicals and solvents were purchased from Merck chemicals Mumbai, India

2.3 Experimental design

All the diabetic subjects were randomly divided into two groups with six subjects each. All subjects were between the age group 30-60 years, including both male as well as female.

- Group A (Experimental group)
- Group B (Control) (N=6 per group)

Fasting blood glucose levels as well as glycosuria were assessed to confirm the diabetic state. Only subjects with a fasting blood glucose level of at least 250 mg/dl and positive urine glucose were considered diabetic and used in the experiment. They were fed with 2g fruit pulp powder of *Aegle marmelos* incorporated in khakre for 60 days.

Group A was supplemented with 2g *Aegle marmelos* fruit pulp powder in the form of khakre for 60 days respectively. After 60 days biochemical evaluations of subjects were done. Approximately 5ml fasting blood sample was collected from each subject on day 0 and day 60 and was used for further evaluation. Blood glucose was measured with elegance glucometer (CT-X10, Convergent Technologies, Germany) at

0 day and 60 day after daily administration of fruit pulp powder of *Aegle marmelos* incorporated in khakre.

2.4 Blood Glucose and Lipid profile

On day 60, blood was collected by glucometer. The values were expressed as mg/dl of blood with glucometer was assayed by the method of Blood glucose level was estimated by GOD/ POD enzymatic method. Glycosylated haemoglobin (HbA1c) was estimated by Ion Exchange Rasin Method Total cholesterol was estimated by CHOD-PAP method. HDL-cholesterol was estimated by PEG-CHOD-PAP method. Total triglyceride was estimated by LDL and VLDL were estimated by Friedewald equation

2.5 Statistical analysis

All the data were expressed as mean ± SEM. Statistical analysis was carried using Student's t-test to analyze the significance between the groups.

3. Results

This study was carried out to observe the hypoglycemic and hypolipidemic effect of *Aegle Marmelos* fruit pulp powder in type II diabetes mellitus subjects.

3.1 Effect of *Aegle Marmelos* fruit pulp powder on Fasting Blood Glucose Level and Post Prandial Blood Glucose Level

The result shows a significant decrease at both level ($p \leq 0.01$) and ($p \leq 0.05$) in the mean fasting blood glucose level in experimental group A whereas B has no significant change ($p \leq 0.05$) in pre and post intervention stages. The calculated value of t is greater than the tabulated value, hypothesis is accepted. Hence the supplement is useful for diabetic patients at ($p \leq 0.01$).

Table 1: Effect of *Aegle Marmelos* fruit pulp powder on Fasting Blood Glucose Level and Post Prandial Blood Glucose Level

	Group	Pre intervention (Mean±SD) (mg/dl)	Post intervention (Mean±SD) (mg/dl)	Mean (Difference between pre and post intervention)	Paired t test
Fasting Blood Glucose Level	A	153.4±9.05	148.0±9.30	-5.4	5.33**
	B	179.0±0.90	180.9±32.61	+1.9	0.833*
Post Prandial Glucose Level	A	263.0±17.1	255.1±17.34	-7.9	6.54**
	B	252.8±0.76	253.6±0.45	+0.8	0.10*

**Significant level ($p \leq 0.01$) and ($p \leq 0.05$)

*Non-Significant

3.2 Effect of *Aegle Marmelos* fruit pulp powder on Glycosylated Hb Level

The result shows a significant decrease at both level ($p \leq 0.01$) and ($p \leq 0.05$) in the mean glycosylated Hb level in experimental group A whereas group B has no significant

change ($p \leq 0.05$) in pre and post intervention stages. The calculated value of t is greater than the tabulated value, hypothesis is accepted. Hence the supplement is useful for diabetic patients at ($p \leq 0.01$).

Table 2: Effect of *Aegle Marmelos* fruit pulp powder on Glycosylated Hb Level

Group	Pre intervention (Mean±SD) (mg/dl)	Post intervention (Mean±SD) (mg/dl)	Mean (Difference between pre and post intervention)	Paired t test
A	10.9±0.49	9.8±0.53	-1.1	9.08**
B	6.9±1.07	6.9±0.98	0	0.94*

**Significant level ($p \leq 0.01$) and ($p \leq 0.05$)

*Non-Significant

3.3 Effect of *Aegle marmelos* fruit pulp powder on Total Cholesterol Level

The result shows a significant decrease at both level ($p \leq 0.01$) and ($p \leq 0.05$) in the mean total cholesterol level in experimental group A whereas group B has no significant

change ($p \leq 0.05$) in pre and post intervention stages. The calculated value of t is greater than the tabulated value, hypothesis is accepted. Hence the supplement is useful for diabetic patients at ($p \leq 0.01$).

Table 3: Effect of *Aegle marmelos* fruit pulp powder on Total Cholesterol Level and Total Triglyceride Level

	Group	Pre intervention (Mean±SD) (mg/dl)	Post intervention (Mean±SD) (mg/dl)	Mean (Difference between pre and post intervention)	Paired t test
Total Cholesterol Level	A	219.3±13.52	216.8±13.09	-2.5	7.74**
	B	219.9±15.56	221.6±9.52	+1.7	0.10*
Total Triglyceride Level	A	193.7±28.34	178.3±28.83	-15.4	7.57**
	B	149.1±10.08	151.3±5.81	+2.2	0.10*

**Significant level (p≤0.01) and (p≤0.05)

*Non-Significant

3.4 Effect of *Aegle marmelos* fruit pulp powder on Total HDL-Cholesterol Level

The result shows non-significant changes at both level (p≤0.01) and (p≤0.05) in the mean HDL cholesterol level in experimental group A and also in group B no changes were

seen in pre and post intervention stages. The calculated value of t is smaller than the tabulated value, hypothesis is rejected. Hence the supplement didn't show any effect on HDL-cholesterol level.

Table 4: Effect of *Aegle marmelos* fruit pulp powder on Total HDL-Cholesterol Level

Group	Pre intervention (Mean±SD) (mg/dl)	Post intervention (Mean±SD) (mg/dl)	Mean (Difference between pre and post intervention)	Paired t test
A	54.1±0.04	54.7±1.02	+0.6	0.37**
B	46.7±5.84	46.1±4.68	-0.6	0.11*

**Significant level (p≤0.01) and (p≤0.05)

*Non-Significant

3.5 Effect of *Aegle marmelos* flower on Total LDL-Cholesterol Level and Total VLDL Cholesterol Level

The result shows a significant decrease at both level (p≤0.01) and (p≤0.05) in the mean total LDL-cholesterol level in experimental group A whereas group B has no significant

change (p≤0.05) in pre and post intervention stages. The calculated value of t is greater than the tabulated value, hypothesis is accepted. Hence the supplement is useful for diabetic patients at (p≤0.01).

Table 5: Effect of *Aegle marmelos* flower on Total LDL- Cholesterol Level and Total VLDL Cholesterol Level

	Group	Pre intervention (Mean±SD) (mg/dl)	Post intervention (Mean±SD) (mg/dl)	Mean (Difference between pre and post intervention)	Paired T test
Total LDL Level	A	126.4±11.33	122.8±12.24	-3.6	8.86**
	B	144.3±9.62	145.1±5.30	+0.8	0.09*
Total VLDL Level	A	38.7±5.66	35.6±5.76	-3.1	5.48**
	B	26.8±5.22	24.9±5.36	+6.8	0.09*

**Significant level (p≤0.01) and (p≤0.05)

*Non-Significant

4. Discussions

In the present study, the fruit pulp powder of *Aegle marmelos* has shown a significant reduction of serum lipid levels with hyperlipidemia viz. total cholesterol and triglyceride. It was well reported that aqueous seed extract of *Aegle marmelos* possess anti-diabetic and hypolipidemic effects in diabetic rats (Kesari *et al.*, 2006) [8]. Singh and Kochhar (2012) [16]; Gohil *et al* (2010) [5]; Sivaraj *et al* (2009) [17] and Sharma *et al* (2007) [14] also revealed in their study that *Aegle marmelos* has hypolipidemic property. Also, the results obtained here are in confirmatory with other study results that say that fruit pulp powder has the potential to reduce blood glucose level (Baishnab *et al.*, 2012; Vidya *et al.*, 2011; Arumugam *et al.*, 2008) [2, 18, 1]. Recently another study also demonstrated the hypoglycemic activities of aqueous extracts of fruits of *Aegle marmelos* (Kamalakkanan *et al.*, 2005) [7]. Thus, the result obtained confirms various studies being pursued and the results thus obtained.

5. Conclusion

From this study, we can conclude that *Aegle marmelos* fruit pulp powder supplementation decreased fasting and post prandial blood glucose level, glycosylated hemoglobin, total cholesterol, total triglyceride, LDL-C, VLDL-C and there was no effect on HDL-C parameter due to short period of

supplementation. *Aegle marmelos* has a beneficial role in diabetes having no ill effects on human health, easily available and can be used as a dietary supplement. In the light of our pharmacological studies *A. marmelos* leaf extracts can be useful, at least as an adjunct.

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