General status and effect of bael and nutrition intervention on sign, symptoms and physical activity of type 2 diabeties patient

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The one hundred twenty non-insulin dependent diabetic selected subjects from Punjab Agricultural University and Civil Hospital of Ludhiana were divided into four groups *viz.*, group I, II, III and IV having thirty subjects each. The subjects of group I was not given any treatment. The nutrition education was given for three months after fifteen days interval to the subjects of group II, III and IV through individual and group contact and gain in nutrition knowledge was assessed after the study. General information, diabetic information and dietary pattern of the subjects were recorded. Significant improvements were seen in physical activity, sleeping pattern and dietary pattern of the subjects of group II, III and IV after study. Therefore, it can be reported from the results that supplementation of bael (*Aegle marmelos* L.) leaf, pulp and seed powder along with nutrition counseling significantly improved the general status of the diabetic patients.

Key Words : Bael leaf, Pulp and seed powder, Diabetes

INTRODUCTION

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces (WHO, 2009). Diabetes is fast becoming a leading cause of morbidity, mortality and disability across the world. Diabetes mellitus is a global metabolic epidemic affecting essential biochemical activities in almost every age group (Gupta *et al.*, 2008).

Aegle marmelos family rutaceae is highly reputed medicinal tree commonly known as the bael. It is medium sized tree growing throughout the forest of India of altitude 1200 meter. It is found all over India, from sub-Himalayan forest, Bengal, central and south India. The different parts of this plant contain number of coumarins, alkaloids, sterols and essential oils. Various parts of this plant such as leaves, fruit and seed possess hypoglycaemic, hypolipidemic and blood pressure lowering property (Lambole *et al.*, 2010). The peel of the fruit which is a very hard shell and green to brown in colour depends on ripening stage. The appearance of yellow or orange edible pulp is like a boiled pumpkin, possesses a slightly sweet taste and a characteristic floral, terpene-like aroma, very fragrant and pleasantly flavored. Seeds are surrounded by slimy transparent mucilage (Suvimol and Prance, 2008).

METHODOLOGY

One hundred twenty male diabetic subjects were selected from Punjab Agricultural University Hospital

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and Civil hospital of Ludhiana and divided into four groups *viz.*, Group I, Group II, Group III and Group IV having thirty subjects each. The subjects of group I was not given any treatment. The subjects in group II, III and IV were supplemented with bael (*Aegle marmelos* L.) leaf, pulp and seed powder, respectively for a period of three months and supplementation was continued along with nutrition counseling for the next three months. The nutrition education was given for three months after fifteen days interval to the subjects of group II, III and IV through individual and group contact and gain in nutrition knowledge was assessed by using diabetic knowledge questionnaire.

General and diabetic information pertaining to age, education, marital status, occupation, size and type of family, physical activities, food habits was recorded for all the subjects through questionnaire schedule.

Statistical analysis:

The data on general information was analyzed statistically. The mean standard error, percentages, paired t- test and their statistical significance was ascertained using a computer programme package.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

General information :

Table 1-6 show the general information, economic status and etiology of diabetes, family history of diabetes, sign and symptoms and physical activity pattern of the 120 selected subjects. General information of the subjects showed that majority of the subjects belonged to the age group of 35-45 years and studied up to high school. Most of them had their own business. Majority of the subjects belonged to Sikh religion and had joint family with a family size of 5-6 members. All the ninety subjects were married. Majority of the subjects had family income above Rs. 30000 per month and per capita income was above Rs. 7000 per month.

Most of the subjects *i.e.* 56.7, 43.3, 50.0 and 46.7 per cent have diabetes due to heredity in group I, II, III

Table 1 : General information of the subjects

Characteristics	Group I	Group II	Group III	Group IV
Age (years)				
35-45	13(43.3)	15(50.0)	17(56.7)	18(60.0)
46-55	13(43.3)	8(26.7)	9(30.0)	8(26.7)
56-65	4(13.3)	7(23.3)	4(13.3)	4(13.3)
Religion				
Hindu	11(36.7)	15(50.0)	12(40.0)	13(43.3)
Sikh	19(63.3)	15(50.0)	18(60.0)	17(56.7)
Education				
Illiterate	3(10.0)	2(6.7)	2(6.7)	2(6.7)
High School	17(56.7)	18(60.0)	19(63.3)	17(56.7)
Higher Secondary	8(26.7)	7(23.3)	5(16.7)	4(13.3)
Graduate	2(6.7)	3(10.0)	4(13.3)	7(23.3)
Occupation				
Business	23(76.7)	19(63.3)	24(80.0)	27(90.0)
Service	7(23.3)	11(36.7)	11(36.7)	3(10.0)
Type of family				
Nuclear	6(20.0)	12(40.0)	10(33.3)	13(43.3)
Joint	24(80.0)	18(60.0)	20(66.7)	27(90.0)
Family size				
2-4	7(23.3)	12(40.0)	7(23.3)	6(20.0)
5-6	18(60.0)	14(46.7)	19(63.3)	19(63.3)
7-8	5(16.7)	6(20.0)	4(13.3)	5(16.7)

Figures in parenthesis are percentage

and IV, respectively. Most of the subjects in group I, II, III and IV had a diabetic father 20.0, 16.7, 23.3 and 20.0 per cent, respectively, followed by diabetic mother in group I, II, III and IV were 13.3, 10.0, 16.7 and 16.7 per cent. Choudhary (2010) reported that 20 per cent subjects had a positive family history with diabetic father, 16.7 diabetic mothers, 10 per cent both and 6.7 per cent siblings. The most common symptoms observed in the subjects of group I, II, III and IV were polydipsia (60.0, 56.7, 53.3 and 63.3%), polyurea (56.7, 46.7, 53.3 and 50.0 %), tiredness (46.7, 43.3, 46.7 and 50.0 %), loss of weight (40.0, 23.3, 16.7 and 13.3 %) and nocturea (40.0, 33.3, 36.7 and 33.3 %). After the study it was seen that there was decrease in the symptoms experienced by the subjects in Group II may be due to presence of active compound *i.e.* skimmianine, aegeline 2, lupeol, citral, citronellal and eugenol in bael leaf, decrease in the symptoms experienced by the subjects in group III may be due to presence of active component *i.e.* aurapten and psoralen in bael pulp and decrease in the symptoms experienced by the subjects in group IV due to presence of active component like β-sitosterol and luvangetin in bael seed (Maity *et al.*, 2009).

Majority of the subjects *i.e.* 80.0, 66.7, 80.0 and 76.7 per cent in group I, II , III and IV, respectively were not doing any kind of physical exercise and rest of them *i.e.* 20.0, 33.3, 20.0 and 23.3 per cent subjects in group I, II, III and IV were doing some kind of physical exercise. After nutrition intervention 53.3, 33.3 and 30.0 per cent of the subjects in group II, III and IV started some kind of physical exercise while there was no change in the subjects of group I. During each counseling session the subjects were motivated to initiate the physical activity and were educated that how physical activity improves the physical fitness, increases energy expenditure, helps appetite regulation, favorably decreases the risk of coronary artery disease.

Food habits and dietary pattern :

Table 7 showed that majority of the subjects in group I, II, III and IV were vegetarians *i.e.* 66.7, 70.0, 83.3 and 80.0 per cent, respectively and 33.3, 30.0, 16.7 and 20.0 per cent of the subjects were non-vegetarian. Data reveals that 60.0, 63.3, 70.0 and 80.0 per cent of the subjects in

Table 2 : Economic status of the subjects

Economic Status	Group I	Group II	Group III	Group IV
Family income /Month (Rs.)				
10000-20000	2(6.7)	3(10.0)	7(23.3)	6(20.0)
20000-30000	8(26.7)	12(40.0)	8(26.7)	8(26.7)
>30000	20(66.7)	15(50.0)	15(50.0)	16(53.3)
Per capita income/Month (Rs.)				
3000-5000	2(6.7)	3(10.0)	7(23.3)	6(20.0)
5000-7000	8(26.7)	12(40.0)	8(26.7)	8(26.7)
>7000	20(66.7)	15(50.0)	15(50.0)	16(53.3)

Figures in parenthesis are percentage

Table 3 : Etiology of disease of the subjects

Sr. No.	Factors	Group I	Group II	Group III	Group IV
1.	Heredity	17(56.7)	13(43.3)	15(50.0)	14(46.7)
2.	Obesity	10(33.3)	14(46.7)	10(33.3)	12(40.0)
3.	Others	3(10.0)	3(10.0)	5(16.7)	4(13.3)

Figures in parenthesis are percentage

Table 4 : Family history of diabetic subjects

Sr. No.	Characteristics	Group I	Group II	Group III	Group IV
1.	Diabetic father	6(20.0)	5(16.7)	7(23.3)	6(20.0)
2.	Diabetic mother	4(13.3)	3(10.0)	5(16.7)	5(16.7)
3.	Both	2(6.7)	2(6.7)	4(13.3)	3(10.0)
4.	Siblings	-	1(3.3)	-	2(6.7)

Figures in parenthesis are percentage

Table 5 : Signs and symptoms of the subjects before and after supplementation of Bael (*Aegle marmelos* L.) leaf, pulp and seed powder and nutrition intervention

Signs and symptoms	Group I			Group II			Group III			Group IV		
	Before	After		Before	After		Before	After		Before	After	
		3 months	6 months		SB	NI		SB	NI		SB	NI
Polydipsia	18(60.0)	17(56.7)	16(53.3)	17(56.7)	14(46.7)	10(33.3)	16(53.3)	14(46.7)	12(40.0)	19(63.3)	17(56.7)	15(50.0)
Polyurea	17(56.7)	17(56.7)	15(50.0)	14(46.7)	11(36.7)	8(26.7)	16(53.3)	14(46.7)	9(30.0)	15(50.0)	13(43.3)	12(40.0)
Tiredness	14(46.7)	14(46.7)	14(46.7)	13(43.3)	10(33.3)	7(23.3)	14(46.7)	12(40.0)	10(33.3)	15(50.0)	14(46.7)	12(40.0)
Loss of weight	12(40.0)	12(40.0)	12(40.0)	7(23.3)	5(16.7)	3(10.0)	5(16.7)	4(13.3)	3(10.0)	4(13.3)	3(10.0)	3(10.0)
Nocturea	12(40.0)	12(40.0)	12(40.0)	10(33.3)	7(23.3)	4(13.3)	11(36.7)	9(30.0)	7(23.3)	10(33.3)	8(26.7)	7(23.3)
Polyphagia	11(36.7)	11(36.7)	10(33.3)	9(30.0)	6(20.0)	4(13.3)	8(26.7)	6(20.0)	4(13.3)	8(26.7)	6(20.0)	4(13.3)
Hypertension	11(36.7)	11(36.7)	11(36.7)	17(56.7)	12(40.0)	8(26.7)	12(40.0)	9(30.0)	7(23.3)	11(36.7)	9(30.0)	7(23.3)
Excessive weating	4(13.3)	4(13.3)	4(13.3)	6(20.0)	4(13.3)	2(6.7)	7(23.3)	6(20.0)	4(13.3)	7(23.3)	5(16.7)	5(16.7)
Itching	2(6.7)	2(6.7)	2(6.7)	4(13.3)	2(6.7)	1(3.33)	3(10.0)	1(3.33)	0(0.0)	5(16.7)	4(13.3)	0(0.0)
Delayed healing	2(6.7)	2(6.7)	2(6.7)	1(3.33)	0(0.0)	0(0.0)	1(3.33)	0(0.0)	0(0.0)	1(3.33)	0(0.0)	0(0.0)

Figures in parenthesis are percentages
SB- Supplementation of bael (*Aegle marmelos* L.) leaf, pulp and seed powder
NI- Supplementation of bael (*Aegle marmelos* L.) leaf, pulp and seed powder + Nutrition counseling

Table 6 : Physical activity pattern of the subjects

	Group I			Group II			Group III			Group IV		
	Before	After		Before	After		Before	After		Before	After	
		3 months	6 months		SB	NI		SB	NI		SB	NI
Physical exercise												
Yes	6(20.0)	6(20.0)	6(20.0)	10(33.3)	10(33.3)	16(53.3)	6(20.0)	6(20.0)	10(33.3)	7(23.3)	7(23.3)	9(30.0)
No	24(80.0)	24(80.0)	24(80.0)	20(66.7)	20(66.7)	14(46.7)	24(80.0)	24(80.0)	20(66.7)	23(76.7)	23(76.7)	21(70.0)
Type of exercise												
Walking	5(16.7)	5(16.7)	5(16.7)	6(20.0)	6(20.0)	12(40.0)	3(10.0)	3(10.0)	9(30.0)	4(13.3)	4(13.3)	8(26.7)
Yoga	3(10.0)	3(10.0)	3(10.0)	4(13.3)	4(13.3)	6(20.0)	1(3.3)	1(3.3)	4(13.3)	4(13.3)	4(13.3)	5(16.7)
Sleeping pattern												
Disturbed sleep (5-6 hrs)	14(46.7)	14(46.7)	12(40.0)	16(53.3)	10(33.3)	7(23.3)	12(40.0)	10(33.3)	9(30.0)	10(33.3)	11(36.7)	9(30.0)
Sound sleep (7-8 hrs)	16(53.3)	16(53.3)	18(60.0)	14(46.7)	20(66.7)	23(76.7)	18(60.0)	20(66.7)	21(70.0)	20(66.7)	19(63.3)	21(70.0)

Figures in parenthesis are percentages

Table 7 : Food habits of the subjects

Sr. No.	Food habits	Group I	Group II	Group III	Group IV
1.	**Vegetarian/ non vegetarian**				
	Vegetarian	20(66.7)	21(70.0)	25(83.3)	24(80.0)
	Ova/Non-Vegetarian	10(33.3)	9(30.0)	5(16.7)	6(20.0)
2.	**Food likes and dislikes**				
	Sweet food				
	Liked	18(60.0)	19(63.3)	21(70.0)	24(80.0)
	Disliked	12(40.0)	11(36.7)	9(30.0)	6(20.0)
	Salty food				
	Liked	24(80.0)	22(73.3)	19(63.3)	25(83.3)
	Disliked	6(20.0)	8(26.7)	11(36.7)	5(16.7)
	Fried food				
	Liked	19(63.3)	20(66.7)	24(80.0)	18(60.0)
	Disliked	11(36.7)	10(33.3)	6(20.0)	12(40.0)
	Fast food				
	Liked	22(73.3)	19(63.3)	24(80.0)	18(60.0)
	Disliked	8(26.7)	11(36.7)	6(20.0)	12(40.0)

Figures in parenthesis are percentage

group I, II, III and IV, respectively had craving for sweet foods. The corresponding figures for the subjects in group I, II, III and IV who liked salty foods were 80.0, 73.3, 63.3 and 83.3 per cent, fried foods were 63.3, 66.7, 80.0 and 60.0 per cent and fast foods were 73.3, 63.3, 80.0 and 60.0 per cent, respectively. The frequency of food consumption of the cereals by the subjects of group I, II, III and IV was 100 per cent thrice a day. The frequency of consuming pulses by the subjects in group I, II, III and IV were 80.0, 83.3, 80.0 and 76.7 per cent, respectively once a day initially and after study it was 83.3, 90.0, 86.7 and 83.3 per cent by the subjects of group I, II, III and IV, respectively. Before the study, 36.7, 46.7, 43.3 and 40.0 per cent of the subjects in group I, II, III and IV used to consume GLV's twice a week. After the study, 40.0 per cent of the subjects in group I consumed GLV's twice in a week and 60.0, 56.7 and 56.7 per cent of the subjects in group II, III and IV, respectively consumed GLV's thrice in a week. The consumption of root and tuber by the subjects were 60.0, 13.3, 20.0 and 16.7 per cent in group I, II, III and IV thrice a week and 10.0, 73.3, 66.7 and 83.3 per cent in the subjects of group I, II, III and IV once in a day. After the study the consumption pattern was decreased to 50.0, 60.0 and 53.3 per cent in the subjects of group II, III and IV, respectively once in a day and consumption of root and tubers in the subjects of group I was 63 per cent thrice a week.

Initially, the consumption of fruits were 53.3, 13.3,

56.7 and 73.3 per cent by the subjects of group I, II, III and IV twice a week and 36.7, 60.0, 16.7 and 13.3 per cent consumption of fruits by the subjects of group I, II, III and IV thrice a week. Later on, after the study the per cent consumption of fruits by the subjects of group II, III and IV were 26.7, 46.7 and 43.3 thrice a week and 53.3, 36.7 and 30.0 per cent once a day, respectively. Before the study, 43.3, 20.0, 30.0 and 40.0 per cent of the subjects in group I, II, III and IV consumed milk and milk products, respectively four times a day and 30.0, 46.7, 40.0 and 30.0 per cent of the subjects in group I, II, III and IV consumed milk and milk products, respectively thrice a day. Milk consumed was mainly in the form of tea, curd and drinking milk. After the study, there is no change in group I but per cent figure recorded for group II, III and IV was 40.0, 40.0 and 43.3 per cent subjects consumed milk and milk products, respectively twice a day. Initially, before the study 13.3, 23.3, 20.0 and 16.7 per cent subjects in group I, II, III and IV used to consume flesh foods occasionally. After study the corresponding figures were recorded 13.3, 16.7, 6.7 and 10.0 per cent. Similar work related to the present investigation was also carried out by Gupta and Gupta (2011); Choudhary and Sachan (2015); Choudhary and Kochhar (2012) and Singh and Kochhar (2013).

Summary and conclusion :

The investigation of the present study revealed that

supplementation of bael (*Aegle marmelos* L.) leaf, pulp and seed powder along with nutrition counseling improved their food intake. Hence it can be inferred from the results that supplementation of bael (*Aegle marmelos* L.) leaf, pulp and seed powder along with nutrition counseling significantly improved the general status of the diabetic patients.

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