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Research Article

IMPROVING GLYCEMIC & LIPIDEMIC PROFILE WITH AMLA POWDER (EMBLICA OFFICINALIS) SUPPLEMENTATION IN ADULTS WITH TYPE 2 DIABETES MELLITUS

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ABSTRACT
Diabetes Mellitus, long considered a disease of minor significance to world health, is now taking its place as one of the major threat to human health in the 21st century. According to estimates of International Diabetes Federation, the total number of diabetic subjects is around 40.9 million in India which is further set to rise to 69.9 million by the year 2025, thereby making more than 19 percent of total population of diabetic patients of the world. A lot of plants and their different parts have been used in preventing the disease from getting severe & also delay its complications. Amla is widely used in the Indian system of medicine and plays an important role in prevention of diabetes mellitus. The present study was conducted with the aim of assessing the impact of Amla powder on Blood Glucose level, HbA1c, lipid profile and heamoglobin levels of T2DM subjects. A total of 90 men & women suffering from Type 2 Diabetes Mellitus, fulfilling the inclusion criteria, were selected purposively from a Diabetes Clinic and divided into Experimental group (n=60) and Control group (n= 30). The experimental group was given 10gm of amla powder/day for a period of 90 days. The amla powder for the present study was provided by Arjuna Natural Extracts, Ltd, Kerala. Blood Glucose levels, HbA1c, Lipid profile and Heamoglobin levels were assessed at baseline and after intervention. The Biochemical estimation was done using Autoanalyser. Approval by the ethics committee was taken for conducting the present study. The mean age of the subjects was 40 years for men & 39.6 years for women. In the experimental group, the mean values for Fasting, Post Prandial Blood Glucose, HbA1c & lipid profile decreased significantly & mean Hb levels increased after intervention with Amla Powder. A statistically significant difference in the mean blood glucose levels & lipid profile was observed between subjects belonging to experimental and control groups. Supplementation with Amla powder improved the glycemic & lipidemic profile of the adults with Type 2 Diabetes Mellitus.

Keywords: *Amla, Blood Glucose levels, HbA1c, Lipid Profile & Type 2 Diabetes Mellitus*

INTRODUCTION
The diabetes epidemic is accelerating in the developing world, with an increasing proportion of affected people in younger age groups. This is likely to increase further the burden of chronic diabetic complications worldwide (WHO, 2006). Diabetes is a group of diseases marked by high levels of blood glucose resulting from defects in insulin production, insulin action or both (National Diabetes Statistics, 2011). Diabetes is a chronic disorder of carbohydrate, fat and protein metabolism characterized by increased fasting and post prandial blood sugar levels (Gupta *et al.*, 2005). The number of people with diabetes is increasing due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity.

India leads the world with largest number of diabetic subjects earning the dubious distinction of being termed the "diabetes capital of the world". According to the Diabetes Atlas 2006, published by the International Diabetes Federation, the number of people with diabetes in India currently around 40.9 million is expected to rise to 69.9 million by 2025 unless urgent preventive steps are taken. Over the last few years the changes in the lifestyle, particularly the westernization of the diet and a relatively sedentary lifestyle have led to an increased frequency of lifestyle related disorders such as hyperlipidemia, diabetes

mellitus, and atherosclerosis. The principle metabolic causes of atherosclerosis include hyperlipidemia, hypertension, obesity, insulin resistance, and diabetes mellitus (Grundy *et al.*, 2004; Lioyd *et al.*, 2010). Diabetes is diagnosed if the (venous) fasting plasma glucose (FPG) value is $\geq$ 7.0 mmol l/1 (126 mg dl/1), or if the plasma glucose value is $\geq$ 11.1 mmol l/1 (200 mg dl/1), or if the plasma glucose value 2 hours after a 75g oral load of glucose $\geq$ 11.1 mmol l/1 (200 mg dl/1). In asymptomatic subjects, performing the test on one occasion is not enough to establish the diagnosis (i.e. basis to treat diabetes). This must be confirmed by carrying out at least one further test on a subsequent day (WHO, 2006).

Traditional Medicines derived from medicinal plants are used by about 60% of the world's population. Indian herbal drugs and plants are used in the treatment of diabetes, especially in India (Modak, 2007).

Amla (*Emblica officinalis*) is widely used in the Indian system of medicine and is believed to increase defense against disease. It has a beneficial role in cancer, diabetes, liver diseases, heart diseases, ulcer, anemia and other disease. Similarly, it has application as an antioxidant, immunomodulatory, antipyretic agent, gastroprotective agent and lowers cholesterol levels (Khan, 2009). *Emblica officinalis* berries have the highest amount of naturally occurring heat stable vitamin C than any other ripe fruit in the world used as a traditional food. The biological effects of amla have been attributed to the antioxidant properties of the low-molecular weight hydrolysable tannins present in the fruit (Antony *et al.*, 2008). Phenolic compounds and flavonoids are a unique category of plant phytochemicals especially in terms of their vast potential health-benefitting properties. Tannins are potential antioxidants. The capacity of tannins to enhance glucose uptake and inhibit adipogenesis makes them potential drugs for the treatment of non-insulin dependent diabetes mellitus (Kumari and Jain, 2012).

Objective

The present study was conducted with the aim of assessing the impact of Amla powder on Blood Glucose levels, HbA1c, lipid profile and heamoglobin levels of T2DM subjects.

MATERIALS AND METHODS

Methodology

Study Design: For the present study a total of 90 men & women suffering from NIDDM, fulfilling the inclusion criteria, were selected purposively from a Diabetes Clinic. Out of these, 60 adults comprised the Experimental group and 30 comprised the Control group. The subjects belonging to the experimental as well as control groups were taking Metformin + Glimepiride (1:500 /day).

The subjects in the experimental group were given 10gm of amla powder supplementation per day for a period of 90 days. No supplementation was given to the subjects belonging to control group.

Inclusion Criteria

- Subjects with type II diabetes mellitus aged 35 to 45 years.
- Subjects with fasting blood glucose level >125mg/dl.
- Subjects who were willing to participate in the study.
- Residents of Jaipur city.

Intervention and Assessments: The experimental group was given 10gm of amla powder/day for a period of 90 days. Blood Glucose levels, HbA1c, Lipid profile and Haemoglobin levels were assessed at baseline and after intervention. Secondary data was taken for biochemical estimation which was done using Autoanalyser in a diagnostic laboratory. Approval by the ethics committee was taken for conducting the present study.

10 gm of amla powder was weighed on the digital weighing balance and packed in a sachet (zip lock pouches) and sealed properly so as to make it air tight then and numbered. Each subject was given 15 sachets for 15 days (one for each day). The researcher was in constant touch with the subjects either through follow up visit of the subjects to the clinic or telephonically. This was done to ensure compliance.

Preparation of Amla powder: The amla (whole fruit) was boiled for 10-15 minutes in a covered vessel, after which it was deseeded. The wedges were naturally dried and powdered in a mixer. The powder was sieved & coarse powder was again ground in a mixer. For the present study, the amla powder was obtained from Arjuna Natural Extracts Ltd, Kerala.

RESULTS AND DISCUSSION

Results

The mean age of the subjects in the experimental group was approximately 40 years for men & 39.6 years for women. The Body Mass Index of subjects belonging to experimental group reduced significantly ($p<0.01$). This could be attributed to a significant reduction in weight ($p<0.01$) of the subjects as a result of amla powder supplementation. The effect of Amla powder supplementation on Blood glucose levels and Lipid profile of the subjects has been presented below.

Amla Powder Supplementation and Blood Glucose Levels

The results of the present study indicate that there was a statistically significant reduction ($p<0.01$) in the mean Blood Glucose Levels i.e. Fasting, Post Prandial & HbA1c levels (Figure 1) and a significant increase in the mean hemoglobin levels after intervention with Amla Powder.

The mean difference in the above mentioned parameters (i.e. difference in the mean values from pre to post intervention) is depicted in Table No. 1. It is evident from the results that there was highly significant reduction in all the Blood Glucose parameters in subjects belonging to the experimental group.

On comparing the results of the subjects belonging to the control and experimental group, it was observed that there was a greater reduction in the mean values for Fasting, Post Prandial & HbA1c levels after amla supplementation as compared to the control group. Similar results were observed in both men & women (Table 1).

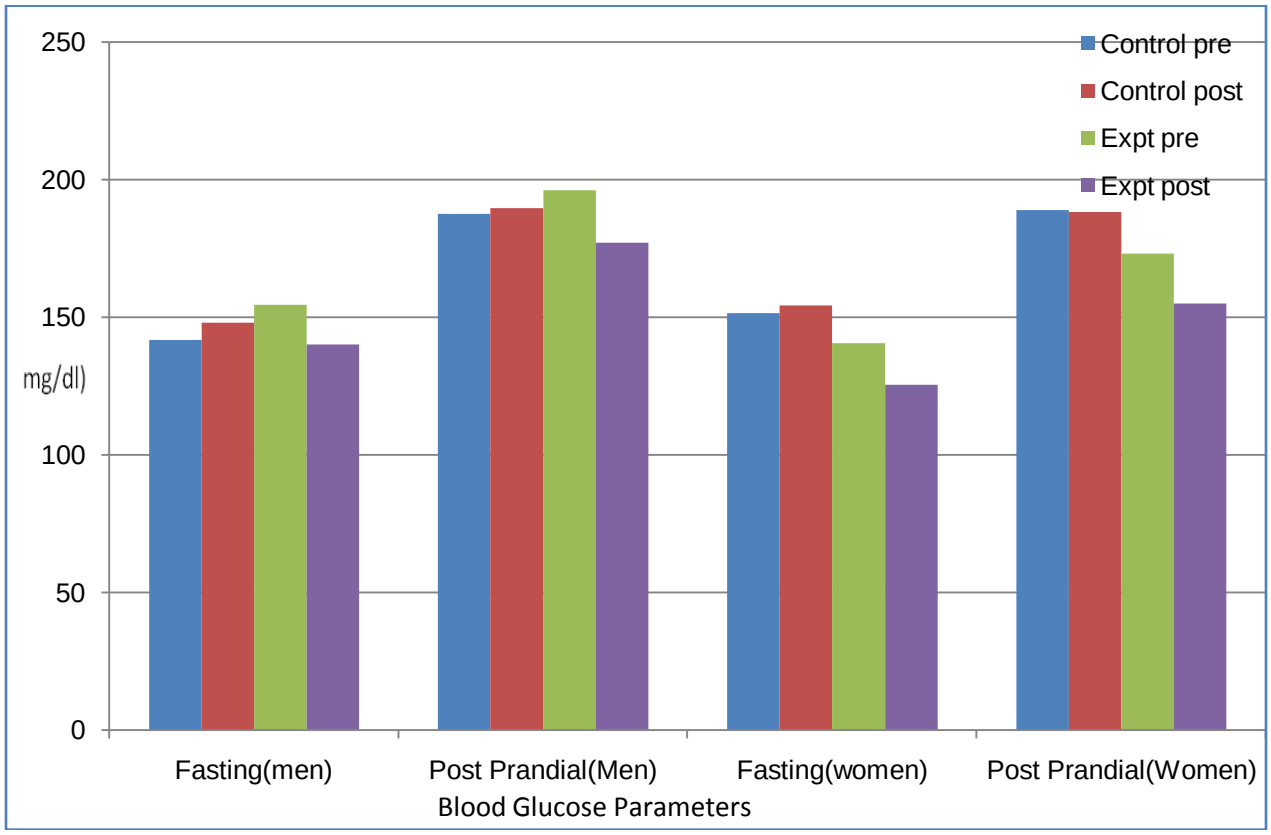

Figure 1: Comparison of Mean Blood Glucose Levels of the subjects prior to and after intervention

Amla powder supplementation and lipid profile: A significant reduction ($p<0.01$) in the mean triglyceride, total cholesterol, LDL-C & VLDL-C levels as well as a significant increase in HDL levels was observed after intervention with Amla powder (Figures 2 and 3).

On comparing the mean difference (i.e. the difference in the mean values from pre to post intervention) of lipid profile of the subjects, a statistically significant different was observed between the two groups

(Table No.2). Subjects belonging to the experimental group exhibited a greater reduction in the mean levels of triglyceride, total cholesterol and LDL-C as compared to the subjects belonging to the control group (Table No. 2).

Table 1: Comparison of Mean difference in Blood Glucose Parameters & Heamoglobin levels of the subject belonging to control and experimental groups

Parameters	**Men** (n = 45)			**Women** (n = 45)		
	Mean difference (Pre to Post Intervention)		**t-test**	**Mean difference (Pre to Post Intervention)**		**t-test**
	Control	**Experimental**		**Control**	**Experimental**	
1. Blood Glucose Levels						
Fasting	6.20	-14.50	-10.799**	2.80	-14.97	-6.584**
Post Prandial	1.93	-19.27	-7.869**	-0.60	-18.27	-8.181**
HbA1c	0.00	-0.52	-6.900**	0.07	-0.54	-4.115**
2. Hemoglobin	0.26	1.50	6.573**	0.20	1.30	6.105**

***p< 0.01*

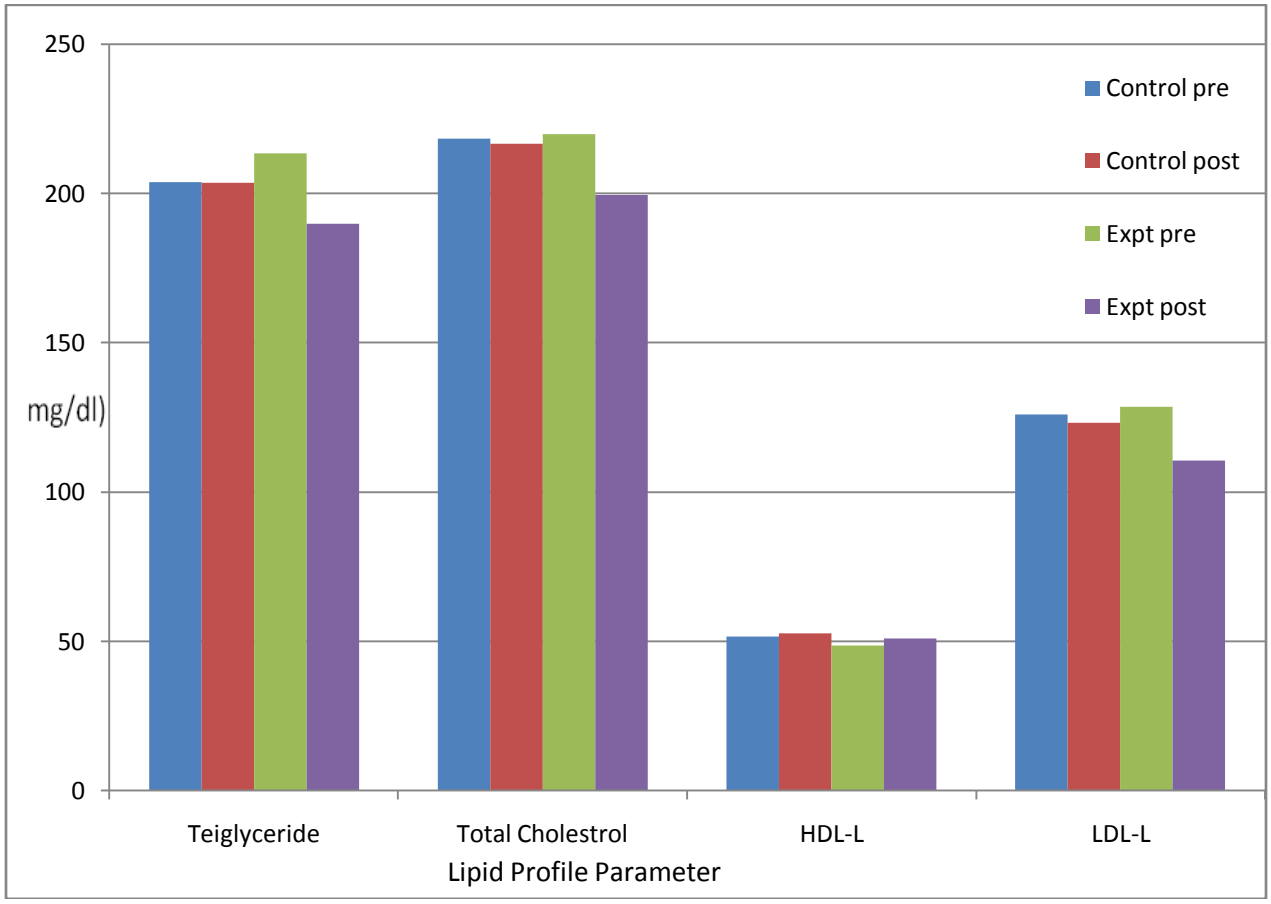

Figure 2: Comparison of Mean Lipid profile Levels of the male subjects prior to and after intervention (Control & Experimental Groups)

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Table 2: Comparison of Mean difference in lipid profile levels of subjects belonging to control and experimental groups

Lipid Profile Parameters	Men (n = 45)			Women (n= 45)		
	Mean difference (Pre to Post Intervention)		t-test	Mean difference (Pre to Post Intervention)		t-test
	Control	Experimental		Control	Experimental	
Triglyceride	-0.13	-23.43	-7.160**	7.60	-24.30	-6.413**
Total Cholesterol	-1.67	-20.47	-6.232**	-0.13	-16.97	-3.873**
HDL-C	1.07	2.20	1.773	-0.13	-0.20	-0.063
LDL-C	-2.71	-17.98	-4.807**	-1.52	-11.91	-2.129*
VLDL-C	-0.03	-4.69	-7.160**	1.52	-4.86	-6.413**

**p< 0.05; **p< 0.01*

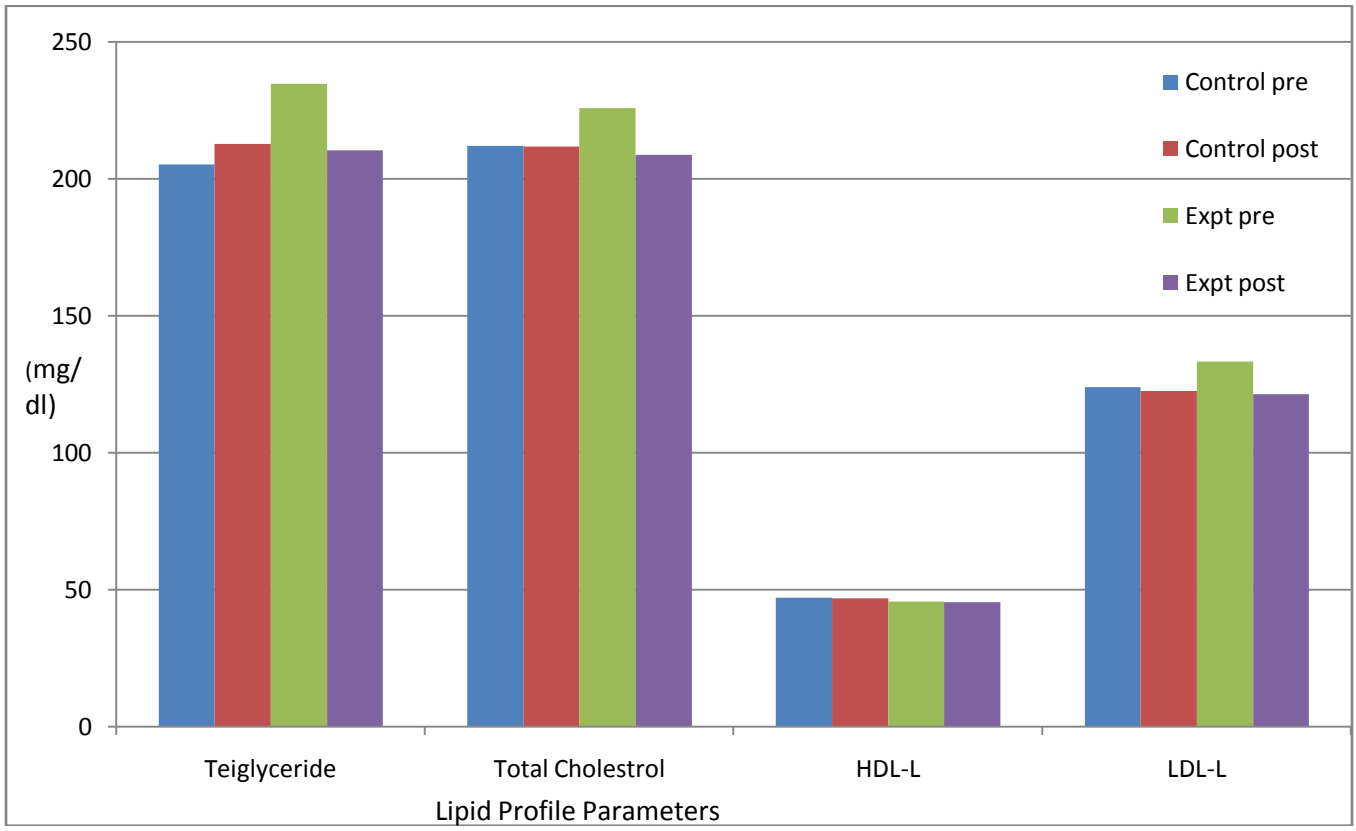

Figure 3: Comparison of Mean Lipid profile Levels of the female subjects prior to and after intervention (Control & Experimental Groups)

Discussion

Diabetes is an important human ailment afflicting many from various walks of life in different countries. In India it is proving to be a major health problem, especially in the urban areas. Though there are various approaches to reduce the ill effects of diabetes and its secondary complications, herbal formulations are preferred due to lesser side effects and low cost (Mehrotra *et al.*, 2004).

Amla is probably the richest known natural source of vitamin C. The fruit pulp is reported to contain as much as 600 mg of the vitamin per 100 g and pressed juice as much as 920 mg/100 ml; nearly twenty times as much as in orange juice. One tiny Amla is equal in vitamin C value to one or two oranges (NIN,

2004). Amla is highly nutritious as it contains minerals, amino acids, glutamic acid, aspartic acid, alanine gallic acid and tannin besides vitamin C (Reddy *et al.,* 2010; Khan, 2009). In the present study, results reveal that Amla Powder Supplementation significantly reduces the weight and BMI in subjects belonging to the experimental group.

The present study demonstrated that supplementation of amla powder for 90 days resulted in significant ($P<0.01$)) reduction of Mean Blood Glucose levels in the experimental group. The findings of the present study are in accordance with the research conducted by Sri *et al.,* (2013) Akhtar *et al.,* (2011), Shah *et al.,* (2010) & Suryanarayana *et al.,* (2004) who have concluded that amla supplementation is effective in reducing the Fasting & Post Prandial blood glucose levels and HbA1c levels. The earlier reports of phyllanthus species were found to be involved in regeneration and rejuvenation of beta cells, thus leading to an increased insulin production and secretion. This mechanism decreases the blood sugar levels (Daisy *et al.,* 2004). Evidence indicates that the aqueous extract of *E. officinalis* has definite hypoglycemic potential as well as anti-diabetic activity (Mehta *et al.,* 2009). Polyphenolic compounds are present in a number of medicinal plants that are reported to possess antidiabetic activity thus it is possible that polyphenols abundant in *E officinalis* fruit juice (541.3 mg gallic acid equivalent/1 g extract) might be responsible for glucose-lowering effects of fruit juice, which may be responsible for cardioprotective effects (Patel *et al.,* 2011). Antihyperglycaemic properties of E Officinalis have been reported by Kimhy *et al.,* (2010) also. The tannoids of *E. officinalis* are potent inhibitors of Aldose Reductase (AR) and suggest that exploring the therapeutic value of natural ingredients that people can incorporate into everyday life may be an effective approach in the management of diabetic complications (Suryanarayana *et al.,* 2004). Supplementation with amla brings about significant changes in the Lipid profile of the diabetic subjects. The favorable redistribution of Lipoproteins with amla supplementation has a significant positive impact on the atherogenic indices lowering the risk of CHD on the subjects (Lyer *et al.,* 2009). A significant reduction of total serum cholesterol, LDL- C and triglycerides and elevation of HDL-C cholesterol after supplementation with amla products was observed by Lyer *et al.,* (2009) and Antony *et al.,* (2006). Amla extract decreases the synthesis of cholesterol by inhibiting HMGCoA reductase activity. It's antioxidant action prevents LDL oxidation, thereby inhibiting endothelial dysfunction and formation of atheromatous plaques (Antony *et al.,* 2008). Polyphenols abundantly present in E.officinalis fruits juice possess antihyperlipidemic activity and might exert a lipid lowering effect, which in turn may be responsible for cardioprotective effects (Patel *et al.,* 2011). Amla powder showed significant antihyperlipidemic, hypolipidemic and anti atherogenic effects. All these effects may contribute to its anti atherogenic activity (Jeevangi *et al.,* 2013). E. Officinalis powder, administered in hyperlipidemia rats can elicit a profound influence on the lipid metabolism. Lipid peroxidation is a free radical mediated process which has been implicated in a variety of disease states. HDL concentration and HDL ratio would be useful in diseases like diabetes mellitus and coronary heart disease, because of their inverse relationship. High LDL levels are usually associated with atherosclerosis (Byron *et al.,* 2002; Vinson *et al.,* 2002). From the results, it is clear that intervention with Amla powder showed a favorable impact on the Blood Glucose Profile and lipid profile of the subjects in this study. The galleoellagi tannins in the fruit preserve the vitamins under all conditions. Amla, being the richest source of vitamin C, polyphenols and a mixture of phytochemicals can act as a hypolipidemic agent reducing the risk of cardiovascular complications in diabetics. Thus amla may be used as a supportive therapy for diabetics.

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