Efficacy of Supplementation of Cloves and Cinnamon Capsules on Type II Diabetics

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Abstract

According to the famous quote of Hippocrates "Let food be thy medicine and medicine be the food", natural plants, herbs, spices and phytochemicals serves as the wonderful foods for healthy life to rescue our life from dreadful ailments. Also the present study emphasise on supplementation of cinnamon and cloves powder enclosed in capsules to the diabetics showed favourable results on blood glucose and lipid profiles apart from other anthropometric indices. Experimental groups E_1, E_3 and E_4 showed a significant weight reduction at 5% level. Significant difference was observed in BMI of all the experimental groups due to significant reduction in mean body weight of the diabetics after supplementation. The fasting blood glucose level between the experimental and control group revealed that groups E_1, E_2, E_3 and E_4 showed a significant difference at 1% level. As blood sugar level is an important aspect of the diabetics to be monitored to keep the values in the recommended range to lead a healthy life.

Volume 1 Issue 4 July 2017

Introduction

Diabetes is a world-wide metabolic disorder, with a cumulative global trend and of particular concern to India. International Diabetes Federation estimates that number of diabetic patients in India doubled from 19 million in 1995 to 40.9 million in 2007. It is probable to increase to 69.9 million by 2025 (Neogi, 2007). The indigenous preparations from various parts of herbal plants are used for functional food preparations, which provide additional health benefits beyond basic nutrition for treatment of diabetes (CSPI, 2002).

Spices like cinnamon and cloves have insulin potentiating activity and due to this property, they might have a role in glucose and lipid metabolism. Cinnamon acts as an antiseptic, antibacterial, antifungal, astringent and aids in digestion, antispasmodic, antiviral, antinausea, antiflatulence, anti-diarrhoeal, carminative, hypoglycemic, promoting sweat, uterine stimulant and also a warming stimulant (Baker and Guttieriz, 2008). The health benefits of clove oil are noted as antibacterial, antimicrobial, antifungal, antiseptic, antiviral, aphrodisiac and stimulating properties (Encyclopedia of Medicinal Plants, 2000). The present study focused on effect of supplementation of cloves and cinnamon on Type II Diabetics around the age group of 40-60 years.

Materials and Methods

The study was carried out in Government Hospital, Periyakulam at Theni District in Tamil Nadu State, as the investigator is familiar with these areas. The hospital authorities were very helpful and gave permission to conduct the study. For the purpose of the initial survey, 120 diabetics receiving treatment at the Hospital were interviewed with the help of the doctors. From the 120 adults, fifty members, each 10 consisted in the 4 Experimental groups and the remaining 10 formed the control group who were in the age group of 40 to 60 years were approached and based on the clinical symptoms as identified by a Physician were selected for the study.

Supplementation of spice capsules

Anti-diabetic spices Cinnamon with eugenol as an active principle and Methyl Chalcone Polymers (MHCP), a potential compound against insulin metabolism and Cloves (Bharate, 2001) were the spices were obtained from Departmental store, cleaned and the pulverized product was kept in air-tight containers. Each capsule consisted of 500 mg of spice powders which is the dosage recommended for each capsule for the supplementation study. For the diabetics of Experimental group I, four capsules of cinnamon amounting to 2g were given daily and requested to consume 2 capsules along with their breakfast and 2 capsules after the dinner. This supplementation was conducted for a period of 90 days. Each clove capsules contained 500 mg of pure clove powder. The diabetics of Experimental group II were given 4 capsules per day and asked to consume 2 capsules with breakfast and 2 after dinner.

For the Experimental group III, a mixed proportion of cinnamon and cloves in the ratio of 1.5:0.5g (2g) was supplemented and instructed to consume 2 capsules of 500 mg each along with breakfast and dinner for a period of 3 months. Likewise, a mixed proportion of cinnamon and cloves in the ratio of 0.5:1.5g (2g) was supplemented for Experimental group IV and 2 capsules of 500 mg was taken along with breakfast and dinner, whereas Control group received no supplementation.

Assessment of the nutritional status

The diabetics were weighed using weighing balance to the nearest 0.1 kg and heights were measured using non-flexible fiberglass tape to the nearest 0.1 cm. BMI was calculated using the formula, BMI = Weight (Kg)/ Height (m^2), (WHO, Diabetes Care, 2004). Waist Hip Ratio was also calculated for the diabetics.

Analysis of bio-chemical parameters

Biochemical parameters were determined for the 50 diabetics. For the analysis, 5ml of the blood was drawn from all the diabetics before and after supplementation. Blood glucose levels of the subjects were estimated using the standard procedure of Enzymatic Calorimetric test GOD-PAP method given by Trinder (1972). Haemoglobin and glycosylated haemoglobin was estimated by cyanmethaemoglobin method (WHO, 1999) and Immuno assays (Frank, 1988).

Total cholesterol was estimated by using the Enzymatic Calorimetric test CHOD-PAP method suggested by Carl., *et al.* 2006) and Serum triglycerides by Enzymatic GPO-PAP method (Carl., *et al.* 2006). HDL cholesterol, estimation was done using the enzymatic method suggested by Friedwald., *et al*. (1972). Similarly, serum LDL-C and VLDL-C were calculated using the equation given by Fried Wald (1972).

Statistical analysis

The data collected on food intake, bio-chemical parameters of the subjects was analyzed using appropriate statistical package like t-test and interpreted.

Results and Discussion

Background information

The background information on the subjects revealed that a majority of 38 % were in the age group of 51-55 years. Regarding their educational status, 20 % were illiterates and almost 19, 18, 17 and 14 % have studied up to higher secondary, high school, primary and

under graduate education respectively. It was observed that only 12% were post graduates. Regarding the occupational status, a majority of 46% of them were involved in business.

As far as income is concerned, 62% belonged to low income group based on HUDCO (2004) classification and 38 % had a monthly income between Rs.4500-Rs.7500 and none of them had a monthly income above Rs. 7501. It is also observed that a majority of 52% belonged to nuclear family system. Regarding food expenditure, a majority of 42 % of the diabetics spent between Rs.1001–1500 monthly followed by 28% of diabetics who spent Rs.1501-2000 monthly for food and it was noted that none of them had spent more than Rs.2500 for food. Among the diabetics, 63 % of them were involved in moderate work and 28 %were sedentary workers.

Dietary pattern

Among the 120 diabetics, a majority of 85% were non-vegetarians and 13 % of them were vegetarians. With regard to the meal pattern, a majority of 85% had the habit of consuming three meals per day. Only 9 and 6% of the diabetics had the habit of taking less than 3 meals and more than 3 meals per day respectively. Vegetarians had lower plasma fat than the meat eaters (Allen., *et al*. 2000).

Consumption of fats and oils

Regarding the consumption of fats and oils, it is revealed that a majority of 29% of the diabetics were consuming palm oil because of its low cost, followed by nearly 20% consuming sunflower oil. About 18% of them were consuming gingelly oil and refined oil, whereas only 9% consumed ground nut oil. Riccardi., et al. (2008) documented that a diet based on low fat, low carbohydrate and high fiber content may protect against diabetes.

Food consumption pattern

A majority of 68% of the diabetics were consuming cereals daily and 25% weekly once, 59% of the diabetics had consumed pulses daily. A maximum of 65% were using vegetables weekly in their diet, A majority of 67% of the diabetics consumed other vegetables weekly once while 23% daily. Consumption of roots and tubers revealed that 44 and 38% were consuming fortnightly. It is revealed that, a maximum of 58 and 44%of the diabetics were consuming non-vegetarian food items and junk food items weekly and occasionally respectively. Jakubowicz (2008) reported that higher intake of fruits and vegetables will decrease the risk of diabetes.

Life style pattern

It is clear that nearly 12-14% of the diabetics had the habit of walking 30 and 60 minutes daily respectively, while 44 % of them did not do any type of exercises. It is found that a majority 86% of the diabetics were smokers. About 50 % of the diabetics had smoking habit for more than 10 years and a majority of 56% was consuming alcohol. Forty five per cent of them had the habit of consuming betel leaves daily. The beverage consumption among them revealed that about 29, 28, 18 and 25% were consuming coffee/tea/milk/health drinks daily. Walking is the simplest way of maintenance of body weight (Jackicic., *et al.* 2003).

Disease Condition

A majority of diabetics had this disease for a period of 6-10 years whereas 27% were suffering from the disease for a longer period of 11-20 years. Familial history indicated that a majority had grandparents or one of the parents with the disease. Few of them had both the parents and their relatives suffering from the disease.

Clinical Status

Table I depicted that a majority of 13% each of the diabetics had polyphagia and excessive sweating and each 7-8 % of them had shivering, hypertension, constipation and insomnia. Nearly 3-4% of the diabetics had other symptoms of breathlessness, blurred vision, polydipsia, delayed wound healing, nocturia, fatigue, inability to work, palpitation and peptic ulcer.

Symptoms*	Number	Percent
Polyuria	11	9
Polydipsia	5	4
Polyphagia	15	13
Delayed wound healing	5	4
Blurred vision	3	3
Hypertension	10	8
Nocturia	5	4
Constipation	9	8
Fatigue	5	4
Shivering	8	7
Inability to work	5	4
Palpitation	5	4
Breathlessness	4	3
Peptic Ulcer	5	4
Insomnia	10	8
Excessive sweating	15	13

Table I: *Prevalence of Clinical Symptoms among Diabetics.*

*Multiple responses

Mean food intake

It is clear that there was a higher deficit in the mean intake of roots and tubers (68%), other vegetables (68%), sugars (59%), cereals (57%), milk and milk products (56%) and green leafy vegetables (55%) by the diabetics. The deficits were found to be lesser for pulses (30%) and fruits (43%). Intake of fats and oils and meat and fish were slightly higher by 8 and 23% respectively. Individuals of high risk Type II diabetes should be encouraged to achieve USDA recommendation for dietary fiber (14g fiber/1000 Kcal) and foods containing whole grains (ADA, 2004).

Mean nutrient intake

It is clear that there was a 77.5% deficit in the intake of fiber, 54.4 deficit in β-carotene, 34.5% in energy intake, 27.5% in carbohydrates and 20.3% in protein respectively when compared with the RDA values given by ICMR (2004). There was an excess mean intake of niacin by 75%, vitamin C by 62.3%, and riboflavin by 61.4%. There was a slightly higher intake of fat (31.4%) and of calcium (11%), thiamine (8.3%) and intake of iron (13.3%) was observed as the least deficits of nutrients among the diabetics. In general, the intake of foods and nutrients by the diabetics was found to be imbalanced.

Awareness regarding diabetic diets

About 42% of diabetics reported fruits are the antioxidant rich foods, 48% agreed that spices have anti-diabetic property, while 52% opined that ragi can be included in the diet, whereas 78% opined that rice and wheat could be avoided from the diet as they increase blood sugar level. WHO estimates that 80% of the World's population presently uses herbal and spice medicine as primary health care (Walter., *et al*. 2000).

Nutrient content of Cinnamon and Cloves

Among the two spices analyzed, energy content of cloves was found to be 281.0 Kcal being higher than cinnamon which contained 186.3 Kcal for 100 grams. It was observed that protein, fat, vitamin C and crude fibre content of cloves was 7.8g, 1.72g, 36 mg and 14.63

g per 100g respectively which was slightly higher than cinnamon which had 7.12g, 0.81g, 29.3 mg and 9.59g respectively. Calcium content of cinnamon was 578.3 mg which was slightly higher than cloves 563.2 mg. The phosphorus content of cinnamon (0.06 mg) was much lower than cloves which had 71.1mg. Carbohydrate, thiamine, riboflavin, niacin and potassium content of both spices were found to be similar, whereas higher amount of 52.8μg of β carotene was found in cinnamon than cloves which had only 21.2 μg of β carotene. Cloves were found to have slightly higher amount of moisture (14.3g) than cinnamon (6.3g) (NIN manual, 2007).

Impact of Supplementation of functional ingredient capsules on anthropometric indices

Height

The mean height of the diabetics showed very negligible change after supplementation and no significant difference was noticed between initial and final values between the different groups.

Weight

The mean weight of all the experimental groups showed a reduction in weight ranging from 0.41 kg to 1.15 kg, the control group showed an increase of 0.37 kg. Experimental groups I, III and IV showed a significant weight difference between initial and final values at 5% level. The weight of all the diabetics were more than the weight of a reference Indian man (60 kg), Verma (2000).

Body Mass Index

Significant difference was observed in BMI of all the experimental groups due to reduction in mean body weight after supplementation except control group. However the mean BMI of the groups before and after supplementation was identified under the category of Grade I Overweight [(25-29.9) kg/m^2], (WHO (2004).

Waist Hip Ratio

The mean WHR of the experimental groups before and after supplementation showed a very negligible change and hence no significant difference was observed in all the groups. Diabetes Care, WHO (2001) pointed out that waist hip ratio more than 0.80 in women and 0.90 in men indicate central body fat distribution. In the present study, most of the diabetics were under central body fat distribution, because their WHR was above the normal level (0.90) showed insulin resistance and inefficient management of diabetes.

Impact of Supplementation of functional ingredient Capsules on Blood Profile

Mean Fasting Blood Glucose levels

Groups	Fasting Blood Glucose (mg/dl)		Mean Difference	't' value Initial Vs Final	't' value Between Groups
	Initial	Final			
Experimental group I (E_1) (Cinnamon-2g)	166.1 ± 19.09	147.4 ± 19.66	18.7 ± 4.85	11.56**	E_1 Vs E_2 1.13[NS] E_1 Vs E_3 0.61[NS] E_1 Vs E_4 0.40[NS] E_1 Vs C 4.22**
Experimental group II (E_2) (Cloves-2g)	165.8 ± 17.45	144.1 ± 19.51	21.7 ± 6.32	10.30**	E_2 Vs E_3 0.37[NS] E_2 Vs E_4 1.29[NS] E_2 Vs C 4.79**
Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	158.8 ± 24.93	138.3 ± 23.73	20.5 ± 7.29	8.43 **	E_3 Vs E_4 0.87[NS] E_3 Vs C 4.27**

Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	171 ± 12.86	153.5 ± 12.94	17.5 ± 7.41	7.08**	E_4 Vs C 3.47**
Control group (C)	156.9 ± 17.56	160.4 ± 18.77	3.5 ± 9.65	1.08[NS]	-

Table 2: *Mean fasting blood glucose levels of the diabetics.*

**Significant at 1% level NS - Not Significant.

The fasting blood glucose values of the diabetics were higher than (70-110 mg/dl) normal values given by ADA (2006) shown in Table II. The mean fasting blood glucose level in experimental groups showed a reduction ranging from 17.5 to 21.7 mg/dl with E_2 showing a higher decrease. The differences were statistically significant at 1% level among all the experimental groups than control group. The decrease in blood glucose level of the patients may be attributed to eugenol and cayophyllene present in cinnamon and cloves (Khan., *et al.* 2003).

Mean Post Prandial Blood Glucose levels

The final post prandial blood glucose values of all the diabetics of the experimental groups were found to decrease from the initial values except the control group after supplementation. The differences between the initial and final values were statistically significant among the experimental groups E_1, E_2, and E_4 at one per cent level and in group E_3 supplemented with a combined proportion of cinnamon and clove capsules (1½: ½ g) it was significant at 5% level. While on comparison, E_1 was found to be better than E_3 and E_4 groups and with control group at 1% level of significance. Sharma (2003) revealed that cinnamon and clove plays an indispensable role in the management of blood glucose and lipid levels.
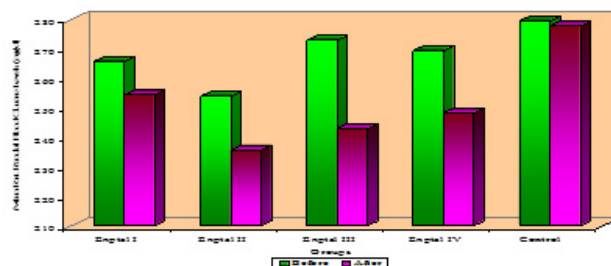
Mean Post Prandial Blood Glucose levels

Figure 1: *Mean Post Prandial blood glucose levels of the diabetics.*

Mean Glycosylated Haemoglobin levels

The initial HbA1c values of the diabetics were above the good control range of (5.6 to 7%) recommended by Praful., *et al.* (1998). The mean initial percentage of HbA1c levels of groups E_1, E_2, E_3 and E_4 before supplementation was observed to be 9.43, 9.64, 9.73 and 9.34 respectively and notably it was reduced to 8.78, 9.07, 9.11 and 9%t after supplementation, and the differences were significant at 1% level among groups. The differences between experimental and control groups revealed that groups E_1, E_2 and E_3 showed significant differences when compared with control group at 1% level. It was proved that group E_2 supplemented with 2g of cloves which consists of eugenol had significantly reduced the mean HbA1c after supplementation (Babu., *et al.* 2007). None of the diabetics were found to be anaemic, when compared with the normal values (13.5 to 16.5 g/dl) for adult men given by Carl., *et al.* (2006). All the experimental groups showed a slight increase in the haemoglobin values ranging from 0.25 to 0.39 g/dl which were significant at 5% level among E_1, E_2 and E_3 only whereas a 1% level of significance was observed among E_4 group.

On comparison, the groups E_1, E_2, E_3 and E_4 and control group revealed that group E_4 showed a significant difference at 1% level with control group. Group E_4 supplemented with a combination of 1½ g of cloves and ½ g of cinnamon powder had a significant role in increasing haemoglobin level was proved.

Groups	Glycosylated Haemoglobin (%)		Mean Difference	't' value Initial Vs Final	't' value Between Groups
	Initial	Final			
Experimental group I (E_1) (Cinnamon-2g)	9.43 ± 0.66	8.78 ± 0.98	0.65 ± 0.66	2.9*	E_1 Vs E_2 0.28[NS] E_1 Vs E_3 0.10[NS] E_1 Vs E_4 1.23[NS] E_1 Vs C 2.94**
Experimental group II (E_2) (Cloves-2g)	9.64 ± 1.40	9.07 ± 1.57	0.57 ± 0.52	3.27**	E_2 Vs E_3 0.19[NS] E_2 Vs E_4 1.09[NS] E_2 Vs C 3.08**
Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	9.73 ± 1.66	9.1 ± 1.86	0.62 ± 0.58	3.16*	E_3 Vs E_4 1.27[NS] E_3 Vs C 3.08**
Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	9.34 ± 1.01	9.0 ± 1.08	0.34 ± 0.36	2.83*	E_4 Vs C 2.58*
Control group (C)	10.79 ± 1.53	10.83 ± 1.52	0.004 ± 0.06	0.17[NS]	-

***Table 3:** Mean glycosylated haemoglobin levels of the diabetics.*

**Significant at 1% level *Significant at 5% level NS - Not Significant.

Mean Total Cholesterol levels

Groups	Total Cholesterol (mg/dl)		Mean Difference	't' value Initial Vs Final	't' value Between Groups
	Initial	Final			
Experimental group I (E_1) (Cinnamon-2g)	225.7 ± 19.64	217.4 ± 19.49	8.3 ± 8.45	2.94*	E_1 Vs E_2 0.41[NS] E_1 Vs E_3 1.18[NS] E_1 Vs E_4 1.66[NS] E_1 Vs C 1.86[NS]
Experimental group II (E_2) (Cloves-2g)	220.7 ± 14.30	213.7 ± 15.79	7.0 ± 4.44	4.7*	E_2 Vs E_3 1.16[NS] E_2 Vs E_4 3.23** E_2 Vs C 2.04[NS]
Experimental group III (E_3), (1½ g Cinnamon, ½ g Cloves)	210.2 ± 20.49	205.7 ± 23.48	4.5 ± 4.83	2.7*	E_3 Vs E_4 4.26** E_3 Vs C 1.03[NS]
Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	207.4 ± 14.27	193.9 ± 14.43	13.5 ± 4.14	9.78**	E_4 Vs C 4.75**
Control group (C)	237.4 ± 35.58	235.6 ± 34.80	1.8 ± 6.22	0.86[NS]	-

***Table 4:** Mean total cholesterol levels of the diabetics.*

**Significant at 1% level * Significant at 5% level NS - Not Significant.

The differences in initial and final values were significant at 1% level among E_2 and E_4 groups, whereas at 5% level among E_1 and E_3 groups. There was a reduction in the mean cholesterol levels of diabetics after supplementation of spice capsules ranging from 4.5 to 13.5 mg/dl among experimental groups with a maximum reduction among E_4 group. Control group also showed a slight reduction. Falcon (2002) described that supplementation of 1-3 grams of cloves and cinnamon powder would decrease serum triglycerides, total cholesterol and LDL cholesterol.

Mean Triglyceride levels

The mean triglyceride levels of groups after supplementation of spice capsules were found to decrease among experimental groups ranging from 6.7 to 12.2 mg/dl with a slight increase of 0.6 mg/dl among control group. There was a significant difference in mean total cholesterol levels at 5% level among groups E_1 and E_3 and at 1% level among E_2 and E_4 groups after supplementation. All the experimental groups showed significant difference with the control group, with E_2 and E_4 groups showing a highly significant difference at 1% level whereas E_1 and E_3 showed a difference at 5% level. The differences among the experimental groups were not significant. Vasantlad (2004) stated cinnamon improves serum triglycerides and cholesterol levels of which 2-6 grams daily was suggested.

Mean LDL Cholesterol levels

Groups	LDL Cholesterol (mg/dl)		Mean Difference	't' value Initial Vs Final	't' value Between groups
	Initial	**Final**			
Experimental group I (E_1) (Cinnamon-2g)	160.5 ± 45.93	135.9 ± 53.98	24.6 ± 24.35	3.03*	E_1 Vs E_2 1.47[NS] E_1 Vs E_3 1.92[NS] E_1 Vs E_4 1.35[NS] E_1 Vs C 2.84*
Experimental group II (E_2) (Cloves-2g)	148.5 ± 14.51	136.2 ± 16.02	12.3 ± 5.61	6.56 **	E_2 Vs E_3 1.27[NS] E_2 Vs E_4 0.53[NS] E_2 Vs C 5.14 **
Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	135.5 ± 22.95	127.4 ± 24.31	8.1 ± 8.18	2.97*	E_3 Vs E_4 1.80[NS] E_3 Vs C 2.33*
Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	130.9 ± 17.40	117.4 ± 17.80	13.5 ± 3.74	10.82**	E_4 Vs C 7.58**
Control group (C)	164.5 ± 40.59	163.2 ± 40.12	1.3 ± 3.16	1.23[NS]	-

Table 5: *Mean Ldl Cholesterol Levels of The Diabetics.*

**Significant at 1% level *Significant at 5% level NS - Not Significant.

From the table it is revealed that the LDL cholesterol levels of diabetics decreased after supplementation ranging from 8.1 to 24.6 mg/dl among all the experimental groups with slight reduction in the control group. A significant reduction at 1% level was observed in groups E_2 and E_4, while significant difference at 5% level was observed among groups E_1 and E_3 after supplementation and no significant difference in the control group.

Mean HDL Cholesterol levels

A comparison between HDL cholesterol levels of groups revealed that a significant increase at 1% level was observed among group E_1 and control group, whereas a significant increase at 5% level was found among E_3 and E_4 compared with control group and also

between groups of E_1 and E_2. Babyskaria., *et al*. (2007) reported that oral administration of cinnamon which has methyl chalcone polymers will significantly improve blood lipid levels.

Mean VLDL Cholesterol levels

It is reported that most of the diabetics had VLDL values above the recommended range, but the level was reduced after supplementation. The mean VLDL cholesterol levels showed a decrease after the supplementation ranging from 5.2 to 14.5 mg/dl with a maximum reduction among E_4 group and control group also showed a slight reduction. A significant reduction in mean VLDL levels was observed in E_1 and E_4 (42.5 to 28 mg/dl) at 1% level after 3 months of spice capsules supplementation. Rajamani., *et al*. (2005) reported that the administration of spice mixture of cloves and cinnamon maintains glucose metabolism and plasma lipid profile especially LDL and VLDL cholesterol levels.
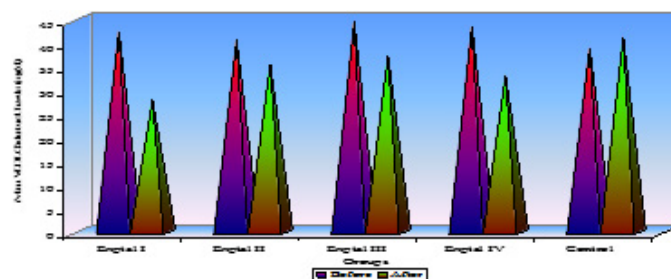

Figure 2: Mean VLDL cholesterol levels of the diabetics.

Conclusion

1. Effect of supplementation of spice powder capsules for a period of 3 months to the diabetics revealed that there was very negligible changes observed in the mean height and Waist Hip Ratio between the different groups. whereas Significant difference was observed in BMI of all the experimental groups due to significant reduction in mean body weight of the diabetics after supplementation.

2. The mean fasting blood glucose level in experimental groups showed a reduction ranging from 17.5 to 21.7 mg/dl with E2 showing a higher decrease at 1% level of significance, whereas E_4 showed a lower reduction. The final post prandial blood glucose levels of all the diabetics of the Experimental groups E_1, E_2, E_3 and E_4 found to decrease than the initial values except the control group after supplementation of spice capsules. The findings of glycosylated haemoglobin revealed that, one per cent significance was observed among group E_2 while 5% significance was observed among experimental groups E_1, E_3 and E_4 except control group which showed no difference significantly. The haemoglobin level of the diabetics revealed a significant increase at 1% level.

3. The total cholesterol values of the diabetics revealed a higher difference among groups E_2 and E_4 at 1% level, whereas groups E_1 and E_3 at 5% level. The triglyceride levels of the diabetics after supplementation found that, there was a significant difference at 5% level among groups E_1 and E_3 and at 1% level among E_2 and E_4. LDL cholesterol level of the diabetics showed a significant reduction at 1% level among groups E_2 and E_4. There was a significant difference in HDL cholesterol values among groups E_1, E_3 and E_4 at 5% level, whereas E_2 and control group did not show any improvement. The mean VLDL cholesterol levels of the diabetics revealed a statistically significant reduction in mean VLDL levels. Supplementation of functional ingredient capsules showed a significant improvement in the bio chemical parameters. It is inferred from the results that supplementation of cloves and cinnamon brought down hypoglycemic and hypocholesterolemic effects on diabetics (40-60) years with normal diet.

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