Journal of Science and Technology
ISSN: 2456-5660 Volume 5, Issue 6, Nov-December 2020

www.jst.org.in *DOI: https://doi.org/10.46243/jst.2020.v5.i6.pp49-66*

A Comparative Study on The Effect of Spice Capsules on The Lipid Profile of The Diabetes

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To Cite this Article
Dr.M.Sivasakthi, "A Comparative Study on The Effect of Spice Capsules on The Lipid Profile of The Diabetes ", Journal of Science and Technology, Vol. 05, Issue 06, Nov-December 2020, pp49-66

Article Info
Received: 25-06-2020 Revised: 05-09-2020 Accepted: 14-09-2020 Published: 27-09-2020

Abstract: *The current study aims at analysing the health status of the male adults in the Government District Headquarters Hospital, Periyakulam at Theni District in Tamil Nadu State. For the purpose of the initial survey 120 adults receiving treatment at the Hospital were interviewed with the help of the doctors. From the 120 adults, fifty male members from lower socio-economic category in the age group of 40 to 60 years were approached and based on the clinical symptoms and general weakness as identified by a Physician, subjects were selected for the study. The subjects were supplemented with capsules made from cinnamon and cloves each 2g refers experimental group E_1 and E_2, whereas combination of cinnamon and cloves 1.5 g+0.5g refers E_3 and 0.5g+1.5g refers group E_4. Significant difference was observed in BMI of all the experimental groups due to significant reduction in mean body weight of the diabetics after supplementation, and also the haemoglobin and lipid 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 at 5 per cent level, whereas control group did not show any significant change.*

Keywords: *cinnamon, cloves, Body Mass Index, lipid profile*

I. Introduction

Hippocrates rightly expressed that "Let food be thy medicine". It has become clear that the type of food we consume determines our health status. A healthy well being requires a balanced diet, which provides bioactive phytochemicals such as dietary fibre, antioxidants and neutraceuticals which have positive health benefits against deleterious effects of free radicals to enhance the normal functioning of cells apart from environmental contaminants, food additives, industrial effluents and radiations which ultimately lead to degenerative diseases like Diabetes Mellitus, Cancer and Cardiovascular diseases (Food and Drug Administration, 2001).

Recently it is reviewed that people of 21st century have stress, restless life and decreased metabolic functions which adversely affect the immune system which acts as the security force for our body. To safeguard our immune system, therapy must be essential in terms of diet and healthy lifestyle. Borek (2008) investigated that science in many cases is beginning to emerge providing validation of traditional medicinal practices and revealing that effective amount of a particular herb or spice needs to be consumed in order to see a benefit.

Globally Diabetes affects 246 million people, which is about six percent of the total adult population. It is the fourth leading cause of death by disease and every ten seconds one person dies from Diabetes related causes in the world. International Diabetes Federation estimated that the number of diabetic patients in India are more than doubled from 19 million in 1995 to 40.9 million in 2007, it is projected to increase to 69.9 million by 2025. Currently up to 11 per cent of India's urban population and 3 per cent of rural population above the age of 15 have Diabetes (Wild et al., 2004)

Spices like garlic, turmeric, fenugreek, onion, cumin, mustard, poppyseeds, fennel, nutmeg, ginger, chillies, rosemary, oregano etc., have many therapeutic applications. But spices like cinnamon and cloves have more pronounced effect on Diabetes and Hypercholestraemia (Jellin and Gregory, 2007).

Cinnamon belongs to the family Lauraceae. Its native place is Srilanka and India. Cinnamon is now found growing in tropical forests worldwide at an altitude of 1500 feet above sea level. Traditionally cinnamon was taken for colds, flu and digestive problems (Kurian, 1999) and (Baker and Guttieriz, 2008).

Studies have suggested that cinnamon may improve the glucose utilization among people having Type 2 diabetes. It significantly reduced blood glucose and lipid levels about 18 to 29 per cent gradually. Cinnamon has excellent nutrients like manganese, dietary fiber, iron and calcium (National centre for Complementary and Alternative medicine, 2007).

Clove was extensively used in the ancient Indian and Chinese civilizations and it spread to other parts of the world, including Europe during the seventh and eighth centuries (Castleman and Michael, 2001). The key components present in cloves are eugenol (70-85 %), eugenol acetate (15 %) and β-Caryophyllene (15-12 %) and contributes 99 per cent of the oil (Siddiqui, 2001).

With this background the present study was undertaken with the following objectives to:

1. Assess the lifestyle pattern and clinical status and awareness of diabetic diets among the selected Diabetics
2. Analyze the bio-chemical parameter serum lipid levels of the selected Diabetics
3. Prepare Spice powder capsules and analyze the nutrients present and
4. Evaluate the effect of supplementation of Spice Capsules on selected adult Diabetics.

II. Material and Methods

Phase I

A. Selection of Area and Adult Diabetics

The study was carried out in Government District Headquarters Hospital, Periyakulam at Theni District in Tamil Nadu State, as the investigator is familiar with these areas. Moreover the hospital authorities were very helpful and gave permission to conduct the study.

For the purpose of the initial survey, hundred and twenty adults receiving treatment at the Government District Headquarters Hospital, Periyakulam were interviewed with the help of the doctors. From the 120 adults, fifty male members from lower socio-economic category in the age group of 40 to 60 years were approached and based on the clinical symptoms like polyuria, polyphagia, obesity and general weakness as identified by a Physician were selected for the study.

B. Eliciting the Background Information of the Selected Diabetics

An interview schedule was formulated to collect the information on the socio-economic background, meal pattern and the health status of the selected 120 diabetics. The socio-economic background included details on the type of family, monthly income and associated aspects and diet related data on meal pattern, daily food intake and health status of subjects along with their life style pattern, duration of disease condition and awareness on diabetic diets and consumption of spices.

C. Assessment of the Body Mass Index of the Selected Diabetics

Body Mass Index

BMI is a widely accepted and reasonably accurate means of assessing body weight in relation to health for most people aged 20 to 65. BMI is helpful for predicting abdominal obesity (American Diabetes Association, 2008).

BMI was calculated using the following formula

$$BMI = \text{Weight (Kg)}/\text{Height (m}^2\text{)}$$

Grades of obesity based on BMI values

Cut of value	Grades of obesity
18.5-24.9	Normal
25.0-29.9	Overweight
30.0-34.9	Moderate grade-I
35-39.9	Severe Grade-II
>40	Very severe Grade-III

(WHO, Diabetes Care, 2004)

Clinical Assessment

Clinical examination was done for all the individuals with the help of a medical practitioner and the investigator who got trained in clinical examination. The observations were entered in the interview schedule.

Bio Chemical Assessment

Biochemical parameters such as haemoglobin and also serum lipids were determined for the fifty diabetic subjects.

Blood haemoglobin

In the present study, haemoglobin estimation was carried out by cyanmethaemoglobin method for the subjects.

Total cholesterol

Total cholesterol reference values as given by National Cholesterol Education Program (2001) are as follows:

Desirable : <200 mg/dl, Borderline high: 200 to 239 mg/dl, High risk: >239 mg/dl.

Total cholesterol was estimated by using the Enzymatic Calorimetric test CHOD-PAP method suggested by Carl et al, 2006). Cholesterol esters were hydrolysed to produce cholesterol. Hydrogen peroxide was then produced from oxidation of cholesterol by cholestrol oxidase. The indicator quinoneimine was formed from hydrogen peroxide and 4-aminoantipyrene in the presence of phenol and peroxide. The absorption of the red quinoneimine dye was proportional to the concentration of the cholesterol in the sample. Ten µl of the serum was mixed and incubated for 10 minutes at 37° C. The optical density at 500nm was measured within 60 minutes against a reagent blank.

Triglycerides

A high triglyceride level is used to measure the amount of triglycerol, a type of fat in the blood. A high triglyceride level may lead to atherosclerosis, which increases the risk of heart attack, stroke and even diabetes. Serum triglycerides were estimated by Enzymatic GPO-PAP method (Carl et al, 2006) and the standard triglyceride values recommended by NCEP are Desirable: <150 mg/dl, Borderline high: 150-199 mg/dl, High: 200-499 mg/dl, Very high: >500 mg/dl.

HDL cholesterol

The normal values for HDL cholesterol as given by National Cholesterol Education Programme (2001) include, Low: <40 mg/dl, Intermediate: 40-59 mg/dl, High: >60 mg/dl.

HDL cholesterol estimation was done using the enzymatic method suggested by Friedwald et al., (1972).

LDL cholesterol

LDL cholesterol represents the fraction of cholesterol, which is the most deleterious and has been directly correlated with epidemiological and clinical studies. Too much LDL, commonly called "bad cholesterol" can lead to CVD and can clog arteries. The reference values of LDL as given by (NCEP, 2001) are given below: Optimal: <100 mg/dl, Near/above optimal: 100-129 mg/dl, Borderline high: 130-159 mg/dl, High: 160-189 mg/dl,Very high: >189 mg/dl. LDL cholesterol was calculated using Friedwald's equation (1972), LDL cholesterol = Total cholesterol - Triglyceride / 5 – HDL cholesterol.

VLDL cholesterol

The function of VLDL is to transport endogenously synthesized triglycerides and cholesterol into peripheral tissue. It is considered as "bad cholesterol" because it helps cholesterol build up on the walls of arteries. Normal VLDL cholesterol level is below 5 and 40 mg/dl (NCEP, 2001). VLDL cholesterol values were computed using Friedwald formula (1972), VLDL cholesterol = Triglycerides / 5.

D. Selection Of Spices And Preparation Of Spice Powders And Their Capsules

Cinnamon and Cloves were the spices selected for the study (Plate-IV) since they have strong potential in controlling blood glucose and hyperlipidemia (Bharate, 2001). They are nutrient dense spices, a remedy from plant derivatives and enhance normal physiological functions or prevent the abnormal function that underlies disease (Ashwell, 2001). The selected spices namely cinnamon and cloves were got from Departmental stores and cleaned to remove the dirt and other impurities, washed and allowed to dry by using mechanical driers to remove the moisture to a safe low level. The temperature during milling (pulverising) was maintained at 42° C, conditioning or chilling of spices prior to their grinding prevents the loss of volatile flavour during both milling and storage conditions. The overall processing of spices comprises of cleaning, mechanical drying, pulverizing and the final product (Plate V) was kept in air-tight containers. Studies had revealed that supplementation of approximately one to six grams of Cloves and Cinnamon in the form of capsules will significantly reduce the elevated blood sugar and cholesterol levels (Anderson, 2003). Hence the investigator prepared capsules from respective spice powders for supplementation. If cinnamon given in powder form, it is rendered ineffective by contact with saliva, and its lack of solubility in water will make it indigestible (Herz, 2009) and so capsules of spices were preferred. The capsules were prepared using capsule filling machines and each capsule consisted of 500 mg of spice powders which is the dosage recommended for each capsule for the supplementation study.

E. Nutrient Analysis Of The Selected Spices

The selected spices were analyzed for energy, moisture, carbohydrate, protein, fat, crude fiber and minerals such as calcium, phosphorus, potassium, iron and vitamins such as thiamine, riboflavin and vitamin A and C using standardised procedures given in the Laboratory Manual (NIN, 2005).

Phase II

F. Conduct Of The Supplementation Study

Cinnamon powder with eugenol as an active principle and Methyl Chalcone Polymers (MHCP), a potential compound against insulin metabolism (www.diabetesnews.co.in). Cinnamon capsules were prepared, each containing 500 mg of pure powder. 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 (Plate-VI).

Each clove capsules contained 500 mg of pure clove powder. The selected diabetic adults of Experimental group II were given 4 capsules per day (Plate-VI) 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 (Plate-VI).

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 (Plate-VI). The intake of spice capsules by the diabetic subject is given in Plate-VII.

Control group received no supplementation.

G. Evaluation of the effect of supplementation of Spice powder capsules on Selected Diabetics

Anthropometric measurements BMI and the bio chemical parameter namely serum lipids of the selected subjects were recorded before and after supplementation of spice powder capsules for both Experimental and Control groups and compared to find out the effect of supplementation.

H. Analysis of the Data

Data collected were classified, tabulated and the results analyzed and interpreted with statistical appraisal using statistical tools like t' test -SPSS package version 16.

III. Results and Discussion

The results of the study is presented and discussed under the following headings:

Life Style Pattern of the Selected Diabetics

Table I. Life style pattern of the selected diabetics (N=120)

Details	Number	Percent
Type of Exercise		
Walking	36	30
Jogging	7	6
Yoga	24	20
Nil	53	44
Smoking Pattern		
Smokers	103	86
Non-Smokers	17	14
Alcohol Consumption		
Alcohol consumption	53	44
No-alcohol Consumption	67	56

Chewing Habits		
Yes	54	45
No	66	55
Beverage Consumption		
Coffee	35	29
Tea	34	28
Milk	21	18
Health drinks	30	25

It is clear from the Table that nearly 14 and 12 per cent of the diabetics had the habit of walking 1/2 an hour and one hour daily respectively and 6 per cent , 20 per cent had the habit of jogging and yoga respectively, while 44 per cent of them did not do any type of exercises.

It is found that a majority of 86 of per cent of the diabetics were smokers and 14 per cent non-smokers. Among them, 51 and 48 per cent consumed cigarettes and beedi daily, of which a majority of 60.5 per cent were consuming 6-10 cigarettes /beedi daily and the duration of smoking among them revealed that nearly 50 per cent of the diabetics had this habit for more than 10 years. It is also revealed that almost all the diabetics smoked everyday which is very much deleterious to their health.

With regard to alcohol consumption, a majority of 56 were consuming alcohol. Wine, whisky and beer were the alcoholic drinks consumed by them. The quantity of alcohol consumed by a majority of the diabetics ranged from 50-100 ml/day.

It is also observed that, a majority of 64 per cent of the diabetics had the habit of alcohol consumption for more than 10 years and only 14 per cent of them were taking alcohol daily.

Forty five per cent of the diabetic subjects had the habit of consuming tobacco/panparak/betel leaves daily, while 55 per cent of them did not take any of the items.

The beverage consumption among the diabetics revealed that about 29, 28, 18 and 25 per cent of the diabetics were consuming coffee/tea/milk/health drinks daily. It is found that 13-16 per cent of the diabetics consumed beverages without sugar and 42 per cent consumed 2 cups of beverages daily and only 6 per cent of the diabetic subjects consumed more than 4 cups daily.

Moderate consumption of alcohol (1-3 drinks/day) has been consistently associated with low incidence of Diabetes Mellitus. An inverse association between coffee consumption and risk of Type II Diabetes, while sugar sweetened beverages have been associated with higher risk of diabetes. Walking half an hour daily will reduce the body fat gradually and it is the simplest way of maintenance of body weight (Jackicic et al., 2003).

Disease Condition of the Selected Diabetics

Table II. Disease condition of the selected diabetics

Details	Number	Per cent
Duration of Diabetes		
1-5 years	38	32
6-10 years	49	41
11-20 years	33	27
Familial History		
Both Parents	17	14
One of the Parents	49	21
Grand Parents	34	28
Relatives	20	17

It is revealed from the Table, that a majority of diabetic subjects had this disease for a period of 6-10 years whereas 27 per cent were suffering from the disease for a longer period of 11-20 years.

Familial history indicated that a majority had grand parents or one of the parents with the disease. Few of them had both the parents and their relatives suffering from the disease.

Clinical Status of the Selected Diabetics

Table III. Prevalence Of Clinical Symptoms Among The Selected Diabetics (N=120)

Symptoms*	Number	Per cent
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

* Multiple response

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

Nutrient content of Cinnamon and Cloves

Table IV. Nutrient content of Cinnamon and Cloves (100g)

Nutrients	**Cinnamon**	**Cloves**
Energy (Kcal)	186.3	281.0
Carbohydrates (g)	37.6	34.1
Protein (g)	7.12	7.80
Fat (g)	0.81	1.72
Calcium (mg)	578.3	563.2
Potassium (mg)	0.210	0.024
Iron (mg)	0.006	0.007
Phosphorus (mg)	0.06	71.1
Thiamine (mg)	0.09	0.16
Riboflavin (mg)	0.04	0.09
Niacin (mg)	0.61	0.14
Vitamin A (µg)	52.8	21.2
Vitamin C (mg)	29.3	36.0

Moisture (g)	6.3	14.3
Crude Fiber (g)	9.59	14.63

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 also observed that protein, fat, vitamin C and crude fibre content of cloves was 7.8 g, 1.72 g, 36 mg and 14.63 g per 100 g respectively which was slightly higher than cinnamon which had 7.12 g, 0.81 g, 29.3 mg and 9.59 g respectively. Calcium content of cinnamon was 578.3 mg which was slightly higher than cloves which contained 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 21.2µg of β carotene. Cloves was found to have slightly higher amount of moisture (14.3 g) than cinnamon (6.3 g).

Effect of Supplementation of Spice Powder Capsules on The Anthropometric Measurements of The Selected Diabetics

Body Mass Index

Table V. Mean body mass index of the diabetics before and after supplementation

Groups	**Body Mass Index [kg/(m)^2]**		**Mean Difference**	**'t' value Initial Vs Final**	**'t' value Between Groups**
	Initial	**Final**			
Experimental group I (E_1) (Cinnamon-2g)	27.71 ± 2.23	27.37 ± 2.29	0.33 ± 0.31	3.20 *	E_1Vs E_2 0.58 NS E_1Vs E_3 0.69 NS E_1Vs E_4 1.46 NS E_1Vs C 1.44 NS
Experimental group II (E_2) (Cloves-2g)	27.29 ± 1.36	26.86 ± 1.59	0.43 ± 0.56	2.30 *	E_2Vs E_3 0.92 NS E_2Vs E_4 1.42 NS E_2Vs C 1.42 NS
Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	25.79 ± 1.06	25.55 ± 1.16	0.24 ± 0.27	2.66 *	E_3Vs E_4 0.78 NS E_3Vs C 0.91 NS

Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	26.32 ± 1.53	26.15 ± 1.46	0.16 ± 0.16	3.00 *	E_4Vs C 0.16 NS
Control group (C)	27.9 ± 2.42	28.06 ± 2.44	0.14 ± 0.25	1.72 NS	-

* Significant at 5% level NS - Not Significant.

According to ADA (2001), Body Mass Index (BMI) is an effective index to know if an individual is normal or over weight. Significant difference was observed in BMI of all the experimental groups due to significant reduction in mean body weight of the diabetics after supplementation, whereas control group did not show any significant change. No statistically significant difference was observed between groups either with experimental or with 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] as compared with the standards given by WHO (2004) on Body Mass Index Classification. Risk of diabetes will increase significantly with all obesity measures (Rosenthal, 2003).

Waist Hip Ratio

Table VI. Mean waist hip ratio of the diabetics before and after supplementation

Groups	**Waist Hip Ratio**		**Mean Difference**	**'t' value Initial Vs Final**	**'t' value Between groups**
	Initial	**Final**			
Experimental group I (E_1) (Cinnamon-2g)	0.926 ± 0.025	0.925 ± 0.028	0.001 ± 0.005	1.0 NS	E_1Vs E_2 0.4 NS E_1Vs E_3 0.8 NS E_1Vs E_4 0.5 NS E_1Vs C 0.4 NS
Experimental group II (E_2) (Cloves-2g)	0.92 ± 0.029	0.918 ± 0.031	0.002 ± 0.006	1.0 NS	E_2Vs E_3 0.5 NS E_2Vs E_4 0.00 NS E_2Vs C 0.20 NS

Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	0.932 ± 0.034	0.929 ± 0.033	0.003 ± 0.006	1.5 NS	E_3Vs E_4 0.5 NS E_3Vs C 0.00 NS
Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	0.917 ± 0.020	0.915 ± 0.018	0.002 ± 0.004	2.00 NS	E_4Vs C 0.22 NS
Control group (C)	0.92 ± 0.020	0.923 ± 0.025	0.003 ± 0.014	0.75 NS	-

NS - Not Significant

The mean Waist Hip Ratio (WHR) of the experimental groups before and after supplementation showed a very negligible change and hence no statistically 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). This in turn showed insulin resistance and inefficient management of diabetes.

Mean Blood Haemoglobin levels

Table VII. Mean blood haemoglobin levels of the diabetics before and after supplementation

Groups	**Blood Haemoglobin (g/dl)**		**Mean Difference**	**'t' value Initial Vs Final**	**'t' value Between groups**
	Initial	**Final**			
Experimental group I (E_1) (Cinnamon-2g)	13.39 ± 0.99	13.65 ± 1.07	0.26 ± 0.27	2.8*	E_1Vs E_2 0.07 NS E_1Vs E_3 0.08 NS E_1Vs E_4 1.04 NS E_1Vs C 1.30 NS

Experimental group II (E_2) (Cloves-2g)	13.24 ± 1.47	13.49 ± 1.37	0.25 ± 0.33	2.27*	E_2Vs E_3 0.14 NS E_2Vs E_4 0.97 NS E_2Vs C 1.04 NS
Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	13.19 ± 1.21	13.46 ± 1.23	0.27 ± 0.27	3.0 *	E_3Vs E_4 0.96 NS E_3Vs C 1.40 NS
Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	14.55 ± 1.65	14.94 ± 1.61	0.39 ± 0.27	4.2 **	E_4Vs C 4.3**
Control group (C)	13.32 ± 0.96	13.2 ± 0.90	0.12 ± 0.18	1.92 NS	-

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

None of the diabetics were found to be anaemic as revealed from the Table XVI, 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 statistically significant at five per cent level among E_1, E_2 and E_3 only whereas a one per cent level of significance was observed among E_4 group.

A comparison made between the groups E_1, E_2, E_3 and E_4 and control group revealed that group E_4 showed a significant difference at one per cent level with control group while the differences were not statistically significant among other experimental groups 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 blood haemoglobin level was proved.

I. Effect of Supplementation of Spice Powder Capsules on the Lipid Profile.

Mean Total Cholesterol levels

Table VIII. Mean total cholesterol levels of the diabetics before and after supplementation

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_1Vs E_2 0.41 NS E_1Vs E_3 1.18 NS E_1Vs E_4 1.66 NS E_1Vs 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_2Vs E_3 1.16 NS E_2Vs E_4 3.23 ** E_2Vs 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_3Vs E_4 4.26** E_3Vs 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_4Vs C 4.75 **
Control group (C)	237.4 ± 35.58	235.6 ± 34.80	1.8 ± 6.22	0.86 NS	-

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

The differences in initial and final values were statistically significant at one per cent level among E_2 and E_4 groups, whereas at five per cent 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 as capsules would decrease significant amount of serum triglycerides, total cholesterol and LDL cholesterol.

Mean Triglyceride levels

Table IX. Mean triglyceride levels of the diabetics before and after supplementation

Groups	Triglycerides (mg/dl)		Mean Difference	't' value Initial Vs Final	't' value Between groups
	Initial	Final			
Experimental group I (E_1) (Cinnamon-2g)	203.6 ± 33.69	196.9 ± 34.79	6.7 ± 6.71	2.9*	E_1Vs E_2 1.09 NS E_1Vs E_3 0.17 NS E_1Vs E_4 1.83 NS E_1Vs C 2.52 *
Experimental group II (E_2) (Cloves-2g)	195.3 ± 27.12	184.6 ± 29.12	10.7 ± 8.73	3.6**	E_2Vs E_3 0.86 NS E_2Vs E_4 0.42 NS E_2Vs C 3.33 **
Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	238.3 ± 29.93	231.0 ± 35.15	7.3 ± 7.97	2.7*	E_3Vs E_4 1.46NS E_3Vs C 2.37 *
Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	219.5 ± 33.26	207.3 ± 36.62	12.2 ± 6.17	5.9 **	E_4Vs C 5.13 **
Control group (C)	195.9 ± 25.86	196.5 ± 26.29	0.6 ± 2.87	0.62 NS	-

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

The initial and final triglyceride values of the diabetics were found to be higher than the standard values (<150 mg/dl) reported by NCEP (2001). 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 per cent level among groups E_1 and E_3 and at one per cent level among E_2 and E_4 groups after supplementation.

Vasantlad (2004) recommended that sprinkling cinnamon on morning cereal, toast or coffee may give more than just a flavour boost and also it improves serum triglycerides and cholesterol levels of which 2-6 grams daily was suggested.

Mean LDL Cholesterol levels

Table X. Mean Ldl Cholesterol Levels Of The Diabetics Before And After Supplementation

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_1Vs E_2 1.47^{NS} E_1Vs E_3 1.92^{NS} E_1Vs E_4 1.35^{NS} E_1Vs 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_2Vs E_3 1.27^{NS} E_2Vs E_4 0.53^{NS} E_2Vs 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_3Vs E_4 1.80^{NS} E_3Vs 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_4Vs C 7.58 **
Control group (C)	164.5 ±	163.2 ±	1.3 ±	1.23^{NS}	-

	40.59	40.12	3.16		

** 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 spice supplementation ranging from 8.1 to 24.6 mg/dl among all the experimental groups with slight reduction in the control group. A statistically significant reduction at one per cent level was observed in groups E_2 and E_4, while a statistically significant difference at five per cent level was observed among groups E_1 and E_3 after supplementation and no statistically significant difference in the control group. Anderson et al., (2001) revealed that cinnamon and clove capsules of 1/4 to 1/2 teaspoons twice a day is recommended for diabetic patients for the management of cholesterol and blood glucose levels of which 20 per cent reduction in LDL cholesterol was observed.

Mean HDL Cholesterol levels

Table XI. Mean HDL cholesterol levels of the diabetics before and after supplementation

Groups	**HDL Cholesterol (mg/dl)**		**Mean Difference**	**'t' value Initial Vs Final**	**'t' value Between groups**
	Initial	**Final**			
Experimental group I (E_1) (Cinnamon-2g)	35 ± 3.19	37.6 ± 3.80	2.6 ± 2.45	3.18*	E_1Vs E_2 2.11 * E_1Vs E_3 0.77 NS E_1Vs E_4 0.86 NS E_1Vs C 3.07 **
Experimental group II (E_2) (Cloves-2g)	31 ± 3.55	31.7 ± 3.62	0.7 ± 1.15	1.82	E_2Vs E_3 1.47 NS E_2Vs E_4 0.76 NS E_2Vs C 1.53 NS
Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	31 ± 3.71	32.8 ± 4.49	1.8 ± 1.93	2.79 *	E_3Vs E_4 1.06NS E_3Vs C 2.62*

Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	31.8 ± 4.07	32.8 ± 4.61	1.0 ± 1.24	2.41*****	E_4Vs C 2.14*****
Control group (C)	33 ± 4.32	32.9 ± 4.17	0.1 ± 0.31	0.94 NS	-

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

The HDL cholesterol values of the subjects were found to coincide with the value of 35-60mg/dl recommended by (NCEP, 2001) and there was a slight increase in HDL cholesterol levels observed after supplementation.

It was observed that there was a significant increase in HDL cholesterol values among groups E_1, E_3 and E_4 at five per cent level, whereas E_2 and control group did not show any statistically significant improvement in HDL cholesterol levels. Babyskaria et al., (2007) reported that oral administration of cinnamon will significantly improve blood lipid levels.

Mean VLDL Cholesterol levels

Table XII. Mean VLDL cholesterol levels of the diabetics before and after supplementation

Groups	**VLDL Cholesterol levels (mg/dl)**		**Mean Difference**	**'t' value Initial Vs Final**	**'t' value Between Groups**
	Initial	**Final**			
Experimental group I (E_1) (Cinnamon-2g)	42.5 ± 11.96	28.0 ± 7.85	14.5 ± 6.62	6.57******	E_1Vs E_2 3.20 ****** E_1Vs E_3 2.26 NS E_1Vs E_4 1.60 NS E_1Vs C 4.13 ******
Experimental group II (E_2) (Cloves-2g)	40.8 ±	35.6 ±	5.2 ±	2.7*****	E_2Vs E_3 0.61 NS E_2Vs E_4 2.28 *****

	7.00	9.57	5.67		E_2Vs C 1.09 ^{NS}
Experimental group III (E_3) (1½ g Cinnamon, ½ g Cloves)	44.5 ± 9.57	37.4 ± 10.97	7.1 ± 7.29	2.9 *	E_3Vs E_4 1.21^{NS} E_3Vs C 1.56 ^{NS}
Experimental group IV (E_4) (½ g Cinnamon, 1½ g Cloves)	43.7 ± 6.65	33.3 ± 8.13	10.4 ± 3.86	8.07 **	E_4Vs C 3.52**
Control group (C)	39.0 ± 5.07	41.2 ± 4.58	2.2 ± 5.99	1.10 ^{NS}	-

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

A statistically significant reduction in mean VLDL levels was observed in E_1 and E_4 (42.5 to 28 mg/dl) at one per cent level after three months of spice capsules supplementation, while a significant difference at five per cent level was noticed among groups E_2 and E_3 with no significant difference in control group.

Regarding the comparison of VLDL cholesterol levels between groups, a greatest difference at one per cent level was observed between groups E_1 and E_4 with control. Among the experimental groups, E_1 and E_2 showed a statistically significant difference at one per cent level. It was also observed that a statistically significant difference at five per cent level was seen between groups E_1 and E_3 and also between E_2 and E_4.

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.

IV. Conclusion

The present study concluded that the supplementation of spice capsules in four permutations and combinations showed significant difference in serum lipids upon comparison of pre and post test results at 5% significant level ($p \leq 0.05$). The spice capsules acted as a best source of medicine to curb diabetes, despite other allopathic ailments. The supplementation of the spice capsules for a period of 3 months reduced the complications of diabetes more effectively.

Acknowledgement

The author shows gratitude to the Department of Food Science and Nutrition, Avinashilingam University for having provided the laboratory facilities and support for the successful conduct of the study.

References

1. Allen, NE., Appleby, and Davey (2000), Hormones and diet, low-insulin like growth factor-but normal bioavailable androgens in vegan men, Br J cancer , Vol.83, pp.93- 97.
2. American Diabetes Association (2004), Nutrition Principles and Recommendations in diabetes, Diabetes care, Vol.27, Pp.36-46.
3. Anderson (2003), American Journal of Nutrition, Vol.22, Pp.331-339.
4. Anderson, R.A., Broadhurst, C.L., Polansky, M.M., Schmidt, W.F., (2001), Isolation and characterization of chalcone polymers from cinnamon with insulin like biological activities, Manuscript in preparation, Pp.225.
5. Babyskaria, P., Joy, P.P., Samuel Mathew, Gracy Mathew, Ancy Joseph, (2007), Horticulture science series-1, Aromatic Plants, New India Publishing Agency, Pitampura, New Delhi, Pp.73-91.
6. Baker, W., Guttieriz, D., (2008), "The effect of cinnamon on glucose control and lipid parameters", Diabetes Care, Vol.31, Pp.43-48.
7. Bauer JM., Vogl T., and Wicklein S., (2005), Mini Nutritional Assessment, Nutritional Risk Screening and assessment, Gerontol Geriat, vol.38, Pp.322-327.
8. Bender, A.E., (2005), Food and Nutrition Concepts, A Dictionary of Food and Nutrition, P.65.
9. Bharate, R., (2001), Department of Natural Products, National Institute of Pharmaceutical Education and Research (NIPER), India, P.34
10. Borek, C., (2008), Antioxidants and Phytochemistry in radio-activity Protection therapy, Wallingford, U.K., Pp. 141-150.
11. Carl A Burtis, Edward R, Ashwood, David E, Burns (2006), Elsevier, Elsevier India Pvt Ltd., 17-A/1, Main Ring road, Laipat Nagar-IV, New Delhi, India, Pp.915-955.
12. Castleman and Michael (2001), The New Healing Herbs: The Classic Guide to Nature's Best Medicines Featuring the Top 100 Time-Tested Herbs. Rodale. p.15.
13. Christie, Catherine and Mitchell, Susan (2000), Handbook of Medical Nutrition Therapy ; the Florida Diet Manual Light House point, Florida Dietetic Association.
14. Farooqui, A.A., and Sreeramu, B.S., (2001), Text Book of Clinical and Aromatic Plants, University Press India Ltd., Hydrabad, P.518.
15. Food and Drug Administration, (2001), Food security and Health Promotion,Vol. 90, P.77.
16. Friedewald WT, Levy RI, Fredrickson DS.,(1972), Estimation of the concentrationof low- density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem 1972;Vol.18:Pp.499–502.
17. Gopalan, G., Ramasastri, BV. And Balasubramanian, S.C., (2004), Nutritive value of Indian foods, NIN, Indian Council of Medical Research, Hyderabad, Pp.34-94.
18. Herz RS. (2009), "Aroma therapy facts and fiction: a scientific analysis." Int J Neurosci. 119:26-
19. HUDCO, (2004), "Housing Finance Publishing Division", Patiala House, New Delhi, P.232.
20. ICMR, (2004), "Dietary Guidelines for Indians", NIN, ICMR, Hyderabad, Pp.72-74.
21. Jackicic JM, Matcers BM, and Gallagher KI, (2003), "Effect of exercise duration and intensity on weight loss in over weight, sedentary women, A randomized trial, JAMA, Vol.290, Pp.1323-30.
22. Jakubowicz (2008), Effect of food consumption pattern among the diabetes, ENDO Meeting, Pp.1686-1694.
23. Jellin and Gregory, E., (2007), "Herbal medicines: balancing benefits and risks". Pp.283- 290.
24. Kent Michael, (2007), Oxford Dictionary of Sports Science and Medicine, A Colloborative Study, P.43.
25. Kral Z, Gulbahce E, and Vonter (2002), "Dietary Mono and PUFA similarly affect LDL size in healthy men and women", J Nutr, Vol.132, No.715-8.
26. Kurian, J.C., (1999), Herbal supplementation , Plants that Heal, 2nd Edition, Oriented Watchman Publishing House, Pune, India, Pp.39-42.
27. Ladeia (2008), Palm oil rich diet may decrease serum lipids in healthy young individuals, Nutrition, Vol.24, Pp.11-15.
28. NIN (2005), A manual of laboratory techniques, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad.
29. Rajamani, S., Suganthi, R., Ravichandran, M.K., and Anuradha, (2005), Food seasoning spices mixture improves glucose metabolism and lipid profile in fructose-fed hyperinsulinemic rats, Journal of Medicinal Foods, Vol.8, No.4, Pp.502-7.
30. Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, The Expert Panel, (2001), Arch. Intern. Med. 148 (1): 36–69.
31. Riccardi G., Rivellese AA., Giacco R., (2008), "Role of glycemic index and glycemic load in the healthy state, in prediabetes and in diabetes, Am J Clin Nutr, Vol.87, Pp.269- 274.
32. Rosenthal (2003), Body fat distribution and risk of diabetes. International Journal of Obesity, Vol.136, Pp.614-619.
33. Shakuntala Manay., (2007), Food facts and principles, New Age International Publishers, P.28.
34. Siddiqui, A., (2001), American Journal of Medicine and Aromatic Plant science, Vol.76, No.22, Pp.223-231.
35. Srilakshmi, B., (2007), Dietetics, 4th Edition, New Age International (P) Ltd., Publishers, New Delhi, Pp.1-3.
36. Standards of Medical care in diabetes, American Diabetes Association (2008), Diabetes care, Vol.31, No.1, Pp.s12-s54.
37. U.S. National Center for Complementary and Alternative Medicine, National Institutes of Health, clinical trials into the effectiveness of herbal medicine, (2007).
38. Walter J. Daly and D. Craig Brater (2000), "Medieval contributions to the search for truth in clinical medicine", Perspectives in Biology and "The Value of Plants Used in Traditional Medicine for Drug Discovery", P.90.