



Results and Discussion

RESULTS AND DISCUSSION



The results pertaining to the present study entitled “**Effect of Selected Spices on Hyperlipidemic and Diabetic Adults**” is discussed under the following headings:

- A. Demographic and Lifestyle Pattern of the Selected Adults**
- B. Dietary Pattern and Medical History of the Selected Adults**
- C. Nutritional Awareness on the Consumption of Spices among the Selected Adults**
- D. Nutrient Analysis of the Selected Spices and Cost of the Spice Capsules**
- E. Mean Food and Nutrient Intake by the Hyperlipidemics and Adults with Hyperlipidemia and Diabetes Mellitus**
- F. Effect of Supplementation of the Selected Spices on the Symptoms Experienced by the Hyperlipidemics and Adults with Hyperlipidemia and Diabetes Mellitus**
- G. Effect of Supplementation of the Selected Spices on the Nutritional Status of the Hyperlipidemics and Adults with Hyperlipidemia and Diabetes Mellitus and**
- H. Effect of Supplementation of the Selected Spices on the Biochemical Profile of Hyperlipidemics and Adults with Hyperlipidemia and Diabetes Mellitus**

A. Demographic and Lifestyle Pattern of the Selected Adults

The background information of the hyperlipidemics and the adults with hyperlipidemia and diabetes mellitus such as age and sex, educational status, occupation, type of family, monthly income and life style pattern of the adults

such as doing yoga, exercise, habit of smoking, alcohol consumption, chewing habits, consumption of tea, coffee and health drinks are discussed under the following headings:

1. Age and Sex of the Adults

Age has been postulated as the most significant risk factor for diabetes in Indian population (Rao *et al.*, 1998). The age and sex wise distribution of the adults are tabulated in Table I.

TABLE I
AGE AND SEX WISE DISTRIBUTION OF THE ADULTS

N=500

Age in years	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
40 – 45	78	26.4	74	36.1	152	30.4
46 – 50	63	21.4	61	29.8	124	24.8
51 – 55	98	33.2	37	18.0	135	27.0
56 – 60	56	19.0	33	16.1	89	17.8
Total	295	100	205	100	500	100

A majority of 33.2 per cent of the males were in the age group of 51 to 55 years, whereas only 19 per cent of the males were in the age group of 56 to 60 years. Among the females a majority of 36.1 per cent were in the age group of 40 to 45 years with a minority of 16.1 per cent in the age group of 56 to 60 years. Among the 500 adults surveyed a majority of 30.4 per cent belonged to the age group of 40 to 45 years.

As reported by Rao *et al.*, (1998), in Indian population age had been postulated as the most significant risk factor for diabetes. In India, diabetes starts at the age of 25 to 30 years and by 35 to 45 years a significant number of people become victims. The findings of the present study also revealed a similar trend of a higher prevalence of diabetes and hyperlipidemia among

adults of 40 to 45 years. Guyton and Hall (2000) also reported that there is increased risk of diabetes mellitus among adults above 40 years. Currently, upto 11 per cent of India's urban population and three per cent of rural population above the age of 15 have diabetes (IDF, 2007).

2. Educational status of the Adults

Table II gives the educational status of the five hundred adults of the present study.

TABLE II
EDUCATIONAL STATUS OF THE ADULTS

N=500

Level of Education	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Primary School	2	0.7	16	7.8	18	3.6
High School	27	9.2	21	10.2	48	9.6
Higher Secondary	40	13.5	43	21.0	83	16.6
Graduate	151	51.2	125	61.0	276	55.2
Professional Degree	75	25.4	0	0	75	15.0
Total	295	100	205	100	500	100

It is evident from the table that all the adults were literates. It is observed that only 0.7 per cent of males and 7.8 per cent of females have studied upto primary school. It is a welcome observation that about 51 per cent of males and 61 per cent of females are graduates and 25 per cent of males have completed professional courses. This finding revealed that in the present day world the significance of education has been realized by population at large.

Education facilitates the understanding and acquisition of healthy lifestyles and since women are generally more health conscious than men, the combination of both factors might explain the greater protection against metabolic syndrome in educated women (Booth *et al.*, 2001). Social factors, educational level, and economic indicators are strongly interrelated. These

factors influence nutritional habits, physical activity, and healthy behaviours possibly affecting the clustering of metabolic disorders (Drewnowski and Specter, 2004).

3. Occupational Status of the Adults

The occupational status of the adults is given in Table III.

TABLE III
OCCUPATIONAL STATUS OF THE ADULTS

N=500

Occupation	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Engineers	69	23.4	0	0	69	13.8
Government / Private concern	121	41.0	59	28.8	180	36.0
Business	78	26.4	19	9.3	97	19.4
Retired adults	27	9.2	14	6.8	41	8.2
Home-makers	0	0	113	55.1	113	22.6
Total	295	100	205	100	500	100

Twenty three per cent of the males are engineers. 41 per cent of males and 29 per cent of females are employed either in government or private concerns. Twenty six per cent males are engaged in business and 9 per cent are retired adults. Nine per cent of the females are self-employed, 7 per cent retired and majority of 55 per cent of the females are housewives. All the adults are sedentary workers.

Men and women with chronic work stress were nearly twice as likely to develop the syndrome, a cluster of factors that increases the risk of heart disease and type 2 diabetes than those with no exposure to work stress (Gupta *et al.*, 1997). In the present study also a greater percentage of adults working in government / private concern are suffering from hyperlipidemia and diabetes mellitus might be due to work stress.

4. Type and Size of the Family of the Adults

The details about the type of family either joint or nuclear and the number of members in the family are presented in Table IV.

TABLE IV
TYPE AND SIZE OF THE FAMILY OF THE ADULTS

N=500

Details	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Type of the family						
Joint	103	35	133	64.9	236	47.2
Nuclear	192	65	72	35.1	264	52.8
Total	295	100	205	100	500	100
Size of the family						
3 - 5	260	88.1	154	75.1	414	82.8
Above 5	35	11.9	51	24.9	86	17.2
Total	295	100	205	100	500	100

It is clearly seen from the table that 47 per cent of the families are joint and 53 per cent of them are nuclear type. Among the males, 88 per cent are living in 3 to 5 membered families whereas remaining 12 per cent are having more than five membered families. Among the females, 75 per cent have 3 to 5 membered families and 25 per cent of them are having more than five membered families. Eighty per cent of families in India are nuclear type (Year book of India, 2000). The trend is not so in the present study.

Various lifestyle coronary risk factors like illiteracy, nuclear family, crowded housing (> or = 3 persons / room), greater than or equal to 4 children are directly associated with Coronary Heart Disease (CHD) (Gupta, 1998). In the present study also, the females in joint family and with more family members are prone to health problems.

5. Monthly Income of the Adults

Housing status is an indicator of social position that is linked to household income. Accommodation status might aggregate several indicators of social position that influence the risk of metabolic syndrome (Dallongeville *et al.*, 2005). Table V gives the monthly income of the adults.

TABLE V
MONTHLY INCOME OF THE ADULTS

N=500

Income Group	Monthly Income (Rs.)*	Male		Female		Total	
		Number	Percent	Number	Percent	Number	Percent
Low	< 4500	15	5.1	28	13.7	43	8.6
Middle	4501 – 7500	67	22.7	59	28.8	126	25.2
High	> 7500	213	72.2	118	57.5	331	66.2
Total		295	100	205	100	500	100

* HUDCO Classification (2004)

According to the HUDCO classification, the income groups of the adults are categorized as low, middle and high income groups. Majority of the adults i.e. 72 per cent of the males and 58 per cent of the females are from high income group (> Rs. 7500). Among the males, 23 and 5 per cent are from middle and low income group respectively. Fourteen per cent of females are from low and 29 per cent of females are from middle income group.

This is in accordance with Singh *et al.*, (1998) who reports that diabetes is a disease of social class i.e. high and middle income group. Dudeja *et al.*, (2001) also reported that prevalence of diabetes was lower among those with low income than among the high income group. Indicators of social position, wealth, and educational level are highly interrelated, which makes it difficult to determine the precise individual contribution of each factor (Ecob and Smith, 1999).

6. Yoga Practice by the Adults

Physical activity is a medium for fitness and good health which keeps away a heart specialist from an individual. Table VI gives the details of the yoga practices by the adults.

TABLE VI
YOGA PRACTICE BY THE ADULTS

N = 500

Yoga Practice	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Yes	145	49.2	81	39.5	226	45.2
Daily (1/2 to 1 hour)	67	22.7	48	23.4	115	50.9
Weekly once	56	19.0	18	8.8	74	32.7
Weekly twice	22	7.5	15	7.3	37	16.4
No	150	50.8	124	60.5	274	54.8
Total	295	100	205	100	500	100

Yoga is practised by 45 per cent of the adults either daily, weekly once or twice and 55 per cent of the adults are not practising yoga. Twenty three per cent of the adult males reported that they practised yoga daily for half an hour to one hour, 19 per cent weekly once and 7 per cent weekly twice depending upon the availability of time. Similarly, 23, 9 and 7 per cent of the female adults practised yoga daily, weekly once and weekly twice respectively.

Meditation and yoga could help relax stress and stress has been found to be a causative factor for diabetes though no one knows how (Deccan Chronicle, 2005). Yoga effectively reduces stress, thus reducing glucagons and possibly improving insulin action. Muscular relaxation and improved blood supply to muscles enhance insulin receptor expression on muscles causing increased glucose uptake by muscles and thus reducing blood sugar and increased cholesterol levels. Many yogic postures do produce stretch on the pancreas, which is likely to stimulate the pancreatic function (Chandratreya, 2008).

7. Exercise Pattern of the Adults

The best six doctors anywhere and no one can deny it are sunshine, water, rest, air, exercise and diet. The type and duration of the exercise done as revealed by the adults is tabulated in Table VII.

TABLE VII
EXERCISE PATTERN OF THE ADULTS

N=500

Exercise Pattern	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Yes	157	53.2	18	8.8	175	35
No	138	46.8	187	91.2	325	65
Total	295	100	205	100	500	100
Duration of Exercise by 157 males and 18 females (in minutes)						
0 – 30	129	82.2	16	88.9	145	82.8
30 – 60	13	8.3	2	11.1	15	8.6
> 60	15	9.5	0	0	15	8.6
Total	157	100	18	100	175	100
Type of Exercise* (Number of adults)						
Walking	143		18		161	
Jogging	23		0		23	
Gardening	14		5		19	
Cycling	8		0		8	
Household work	52		205		257	
Swimming	29		0		29	
Games (physical)	29		0		29	
Climbing stairs	16		8		24	
Aerobic exercise	86		12		98	

* Multiple response

Thirty five per cent of the adults reported that they do exercise regularly from half an hour to one hour in order to keep their body fit and to control the disease condition. All the adults who exercised either go for walking or jogging.

Gardening was done by 14 males, cycling by 8, swimming by 29 and games like playing shuttle cock, tennis or playing cricket with children by 29 males. All the females are engaged in household work and 52 males do household work. Sixteen and eight male and female adults climb stairs at their home, and 86 males and 12 females do aerobic exercises in the morning as soon as they get up. About 47 per cent of males and 91 per cent of females expressed that they do not do any extra activity other than household work. Helmrich *et al.*, (1991), reported that lack of physical activity has been constantly and independently related to the development of type 2 diabetes.

Patients can help control their blood sugar with enough exercise and maintain healthy weight. Maintaining body weight helps them control their blood fat and lower blood pressure (Deccan Chronicle, 2005). People with diabetes who do exercise are less likely to experience a heart attack or stroke than diabetics who do not exercise regularly. Regular exercise helps to control blood glucose levels and improve the body's ability to use insulin (Gregg, 2003). Physical activity has long been related to a reduced risk of Coronary Heart Disease (CHD), including Acute Myocardial Infarction (AMI) (Altieri *et al.*, 2004). People with diabetes who do exercise for at least half an hour a day have better glucose control and a much lower risk of complications from cardiovascular disease than those who do not do exercise. Exercise also lowers total cholesterol, raises HDL (good) cholesterol, lowers triglycerides and reduces blood pressure (Braunstein, 2003).

8. Smoking Pattern and Alcohol Consumption by the Adults

The following Table VIII shows the smoking pattern and alcohol consumption by the selected male adults.

It is evident from the table that almost 74 per cent of the males are having the habit of cigarette smoking. Among them 55 per cent of the adults are regular smokers, 15 per cent occasional smokers and 30 per cent are ex-smokers. Forty three per cent of the adults developed the habit of smoking in

the past ten years and about 15 per cent of them from their college days i.e. for the past 21 to 30 years. About 47 per cent of the adults use less than 5 cigars per day and a majority of 31 per cent 5 to 10 cigars per day, whereas 10 per cent of adults use more than 20 cigars per day. Only 26 per cent of the adults do not have the habit of smoking.

TABLE VIII
SMOKING PATTERN AND ALCOHOL CONSUMPTION
BY THE SELECTED MALE ADULTS

N = 295

	Smoking pattern		Alcohol Consumption	
	Number	Percent	Number	Percent
Yes	219	74.2	185	62.7
No	76	25.8	110	37.3
Pattern				
Regular	121	55.3	58	31.3
Occasionally	32	14.6	64	34.6
Ex-smoker / alcoholic	66	30.1	63	34.1
Total	219	100	185	100
Duration of Smoking (in years)				
< 10	52	43.0	73	59.8
11 – 20	33	27.2	24	19.7
21 - 30	18	14.9	3	2.5
> 30	18	14.9	22	18.0
Total	121	100	122	100
Number of Cigar Smoked per Day				
< 5	57	47.1		
5 – 10	37	30.6		
11 - 20	15	12.4		
> 20	12	9.9		
Total	121	100		

It is observed from the table that out of 295 adult males, 110 adults are not used to alcohol. With regard to the duration of alcohol consumption, 60 per cent consumed for the past 10 years, 20 per cent for the past 11 to 20 years, 2 per cent for the past 21 to 30 years and 18 per cent for more than 30 years. With regard to the frequency of consumption, 31 per cent of the adults

consumed regularly and 34 per cent occasionally. After the onset of the disease, about 34 per cent of adults stopped consuming alcohol. It is heart warming to note that none of the female adults neither had the habit of smoking nor consuming alcohol.

Smoking is the biggest risk factor for sudden death; up to 18 in every 100 deaths from heart disease are associated with smoking. People who smoke cigarettes have twice the risk of a heart attack as those who do not. The risk of heart disease is ten times greater for a smoker who is under 50 years than a non-smoker of the same age. Smoking is an important modifiable risk factor for diabetes, the metabolic syndrome (Oh, 2005). The incidence of atherosclerotic diseases, especially coronary heart disease, is lower among light-to-moderate drinkers than among nondrinkers (Wannamethee and Shaper, 1998), whereas the incidence of stroke increases in heavy drinkers (Hillbom, 1998). The harmful effects of heavy drinking are mainly due to the action of alcohol on blood pressure (Marmot *et al.*, 1994). Drinking alcohol induces an acute increase in insulin resistance (Shelmet *et al.*, 1988). On the other hand, light-to-moderate drinking reduces the incidence of type 2 diabetes and that alcohol decreases insulin resistance (Rimm *et al.*, 1995). Moreover, habitual drinking does not affect glucose tolerance in patients with type 1 and type 2 diabetes (Koivisto *et al.*, 1993)

9. Habit of Chewing by the Selected Adults

The habit of chewing is practised by a substantial portion of the world's adult population due to its stimulant activity. The habit of chewing tobacco, pan masala and betel leaves by the selected adults are depicted in Table IX.

Among the males, 67 per cent did not have the habit of chewing neither tobacco, pan masala nor betel leaves. Among the remaining 33 per cent males, majority of them consumed betel leaves (43) and pan masala (25) and 14 of them consumed tobacco. Twenty three males stopped chewing after the onset of the disease. Among females, 60 per cent had the habit of chewing and

only 40 per cent did not have this habit. None of the women had the habit of chewing pan masala, but a majority of 77 per cent of women consumed betel leaves. Twenty eight per cent of males and 18 per cent of females had the habit of chewing for the past 30 years. A majority of men (45 %) and women (38 %) had the habit of chewing for the past 11 to 20 years.

TABLE IX
HABIT OF CHEWING BY THE SELECTED ADULTS

N=500

Chewing Habits	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Yes	98	33.2	123	60	221	44.2
No	197	66.8	82	40	279	55.8
Total	295	100	205	100	500	100
Duration of Chewing (in years)						
< 10	12	12.2	33	26.8	45	20.4
11 – 20	44	44.9	47	38.2	91	41.2
21 - 30	15	15.3	21	17.1	36	16.2
> 30	27	27.6	22	17.9	49	22.2
Total	98	100	123	100	221	100
Type of chewing* (Number of adults)						
Tobacco	14		48		62	
Pan masala	25		0		25	
Betel leaves	43		77		120	
Ex-chewer	23		19		42	

* Multiple response

In animals, a chemical in betel nut alters blood sugar levels. Although human study is lacking in this area, caution is advised in people with diabetes or glucose intolerance, and in those taking drugs, herbs, or supplements that affect blood sugar. Betel nut chewers may have a higher risk of developing type 2 diabetes (Mannan *et al.*, 2000). Betel nut may slow or raise the heart rate and could alter the effects of drugs that slow the heart, such as beta-blockers, calcium channel blockers, or digoxin (Tung *et al.*, 2004). Pan masala intake causes acute increase in pulse and Blood Pressure (Sharma *et al.*, 2000).

B. Dietary pattern and Medical History of the Selected Adults

The dietary pattern of the selected adults such as food consumption pattern, meal pattern, cooking methods adopted, type of fats and oils used, consumption of beverages and the medical history such as duration of the disease, familial trait, mode and duration of treatment are tabulated and discussed in the following pages:

1. Food Consumption Pattern of the Selected Adults

Table X gives the food consumption pattern of the selected adults.

TABLE X
FOOD CONSUMPTION PATTERN OF THE SELECTED ADULTS

N=500

Food Consumption Pattern	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Vegetarian	86	29.2	56	27.3	142	28.4
Ova-vegetarian	29	9.8	23	11.2	52	10.4
Non-vegetarian	180	61.0	126	61.5	306	61.2
Total	295	100	205	100	500	100

A majority of the male and female adults sixty one and sixty two per cent respectively were non – vegetarians. Pure vegetarians among the males accounted for 29 per cent and among the females 27 per cent. A group of 10 per cent of males and 11 per cent of females consumed only egg along with the vegetarian diet and are considered as Ova vegetarians. Vegetarians suffer markedly lower mortality from coronary heart disease compared to non-vegetarians (Caron and White, 2001).

All the male and female adults consumed three meals a day. When the meal pattern of the adults was considered, it is seen that a great majority (80 %) of the adults consumed either idli or dosai i.e. rice based food items for their breakfast and very less percentage (20 %) of the adults consumed either

chapathi, uppuma or wheat or ragi based food items which is comparatively lower. All the adults consumed full lunch i.e. rice along with sambar, vegetables and greens. It is note worthy to find that they included greens atleast thrice a week in their lunch and whole grams atleast once in a week in the form of sundal. Majority of the adults consumed snacks like baked foods such as biscuits, bread, bun etc. along with tea in the evening and very few included fried items and sweets. Fruits like apple, banana, mosumbi, pomegranate, guava and papaya were consumed by 53 per cent of the adults in the evening along with tea. About 55 per cent of the adults had wheat based food items and the remaining 45 per cent had rice based preparations for dinner. A great percentage of the adults avoided roots and tubers as they were very much concerned about their disease condition.

The incidence of coronary heart disease mortality was 28 per cent lower in vegetarians compared with matched non-vegetarians; after all non dietary factors had been taken into consideration (Thorogood, 1994). Burr and Butland (1988) found vegetarians to suffer significantly lower mortality from heart disease than health conscious non-vegetarians. Mortality from ischemic heart disease was 57 per cent lower in vegetarians than the general population and 18 per cent lower than in non-vegetarians following a healthy lifestyle. Deaths due to cerebro vascular disease were 43 per cent lower in the vegetarians compared with the general population. Thorogood (1990) found vegetarians to have cholesterol levels 10 per cent lower than health conscious meat-eaters. A California Lifestyle Heart Trial had indicated that a low fat vegetarian diet together with other lifestyle changes such as exercise and stress management can in fact reverse the progress of heart disease, by reducing cholesterol plaques in coronary arteries (Ornish, 1990).

2. Methods of Cooking and Types of Fats and Oils Used by the Selected Adults

The details on the methods of cooking and the types of fats and oils used for cooking by the selected adults are presented in Table XI.

TABLE XI
COOKING METHODS AND TYPES OF FATS AND OILS
USED BY THE SELECTED ADULTS

N=500

Cooking Methods*	Male	Female	Total	Per cent
Raw / salad	128	137	265	53
Frying	136	128	264	53
Steaming	295	205	500	100
Stewing	156	149	305	61
Roasting	295	205	500	100
Baking	159	123	282	56.4
Boiling	295	205	500	100
Types of Fats & Oils used*				
Ghee	105	119	224	44.8
Butter	42	48	90	18
Hydrogenated oil	21	18	39	7.8
Groundnut oil	156	146	302	60.4
Rice bran oil	123	0	123	24.6
Gingelly oil	215	132	347	56.4
Refined oil	295	205	500	100
Olive oil	28	23	51	10.2

* Multiple response

From the table, it is heart warming to note that 53 per cent of adults included raw salad i.e chopping vegetables to pieces and adding salt, lime and pepper to have along with their diet. All the adults used steaming, roasting and boiling as a method of cooking which is also considered as the best method of cooking. About 53 and 61 per cent of adults adopted frying and stewing methods for cooking. Bakery items were used by 56 per cent adults. Majority of the adults used moist heat methods for various food preparations.

It is evident from the table that majority of the adults used gingelly oil (56 %) and groundnut oil (60 %) for cooking. All the adults used refined oil for cooking various food preparations. Ten per cent of the adults used olive oil for various food preparations. Consumption of olive oil can lower the risk of

coronary heart disease by reducing blood cholesterol levels and blood clot formation, reduces the risk of diabetes and possibly, a delayed onset of complications in established diabetes. It is rich in monounsaturated fatty acids and has cholesterol-lowering properties due to the presence of a minor component called oryzanol (Muralidharan, 2007). In the present study forty five per cent adults used ghee and 18 per cent used butter for consumption by adding to several dishes. According to Indian medical systems, ghee contains several medicinal properties. Nutritionally, like butter, it also contains saturated fats and cholesterol which, when consumed in excess, leads to heart disease (Bantle *et al.*, 2006).

3. Consumption of Beverages by the Selected Adults

The consumption of tea, coffee and other beverages by the selected adults is depicted in Table XII.

TABLE XII
CONSUMPTION OF BEVERAGES BY THE SELECTED ADULTS

N=500

BEVERAGES	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Coffee with sugar	23	7.8	23	11.2	46	9.2
Coffee without sugar	17	5.8	19	9.3	36	7.2
Tea with sugar	45	15.3	23	11.2	68	13.6
Tea without sugar	57	19.3	30	14.6	87	17.4
Both with sugar	52	17.6	32	15.6	84	16.8
Both without sugar	57	19.3	39	19.0	96	19.2
Milk only	12	4.1	13	6.4	25	5.0
No beverage	32	10.8	26	12.7	58	11.6
Total	295	100	205	100	500	100
Others* (Number of adults)						
Horlicks / Boost	32		29		61	
Green / Black tea	16		3		19	
Soups	29		67		96	
Fruit juices	68		83		151	
Tender coconut	49		28		77	

* Multiple response

Data collected regarding the consumption of beverages revealed that majority of the adults consumed both tea and coffee either with (17 %) or without sugar (19 %) depending on their disease condition. About 17 per cent of the adults consumed tea without sugar. Twelve per cent of the adults did not consume any beverage.

It is evident from the table that 68, 49, 32, 29 and 16 males consumed fruit juices, tender coconut, health drinks, soups and green or black tea respectively along with tea or coffee either weekly twice or once according to their convenience and availability of time. Among females about 83 and 67 of them consumed fruit juices and soups, 29 females had health drinks, 28 had tender coconut to quench thirst and very few (3) females consumed either black or green tea.

Chlorogenic acids in coffee have been shown *in vitro* to have an antioxidant capacity and to reduce the potential of LDL cholesterol to be oxidized. Thus consumption of coffee decreases the risk of cardiovascular disease (Natella *et al.*, 2007). The more coffee and caffeine a person consumed, the lower the chances that they were to get type 2 diabetes (Greenberg *et al.*, 2005). The catechins present in tea are thought to act as powerful antioxidants that can help protect against various diseases including heart disease and tea also decreases glucose levels in the blood and therefore slows down the damaging effects on the eyes of the diabetic patient. Green tea has about 27 per cent catechins, oolong tea has about 23 per cent catechins and black tea has approximately 4 per cent catechins (Johnston *et al.*, 2003). The findings of the present study revealed that only a minimum of 19 adults were consuming green tea.

4. Foods Included and Foods Avoided by the Selected Adults

The foods included and foods avoided by the selected adults in the present study are given in Table XIII.

TABLE XIII
FOODS INCLUDED AND AVOIDED BY THE SELECTED ADULTS

N=500

Foods	Hyperlipidemia				Hyperlipidemia and Diabetes Mellitus			
	Male (148)	Female (97)	Total (245)	Per cent	Male (147)	Female (108)	Total (255)	Per cent
Foods included *								
Oats porridge	34	22	56	22.9	18	19	37	14.5
Green tea	4	3	7	2.9	2	0	2	0.8
Wheat products	13	29	42	17.1	68	76	144	56.5
Pulses and grams	35	43	78	31.8	67	59	126	49.4
Greens, Vegetables and fruits	53	49	102	41.6	64	62	126	49.4
Foods avoided *								
Non-vegetarian	29	56	85	34.7	86	96	182	71.4
Snacks / bakery / junk foods	34	64	98	40.0	94	102	196	76.9
Fried foods	37	94	131	53.5	59	92	151	59.2
Nuts and oil seeds	59	102	161	65.7	81	89	170	66.7
Roots and tubers	39	53	92	37.6	72	102	174	68.2
Sweets	37	38	75	30.6	82	106	188	73.7
Salt	124	129	181	73.9	34	39	73	28.6
Coconut	89	118	207	84.5	69	99	168	65.9
Milk and its products	64	38	102	41.6	38	26	64	25.1
No avoidance	24	18	42	17.1	3	2	5	2.0

*Multiple response

Out of the 245 hyperlipidemic adults, a majority of 42 and 32 per cent of consumed green leafy vegetables, vegetables and fruits as special food items. This was followed by pulses and grams and oats kanji (32 % and 23 %). Many adults expressed that they included oats to reduce or maintain their body

weight. It was seen that 50 per cent of the adults with hyperlipidemia and diabetes mellitus included more pulses and grams, green leafy vegetables and vegetables along with their regular diet. Majority of the (57 per cent) adults added wheat products and a minority of (14.5 per cent) adults included oats porridge along with their diet.

Eighty five and 74 per cent of hyperlipidemic adults avoided coconut and salt in their diet. Sixty six per cent of adults avoided nuts and oil seeds and 54 per cent avoided deep fat fried foods as they contain more oil. It was also observed that many adults avoided junk foods (40 %), milk and milk products (42 %) and non-vegetarian items (35 %). About 17 per cent of the hyperlipidemic adults did not follow any dietary modifications.

Out of the group (255) of hyperlipidemic with diabetic adults, majority of the adults avoided junk foods, bakery items and snacks (77 %) and sweets (74 %) saying that it may raise the sugar level. Coconut (66 %), non-vegetarian items (71 %) and fried foods (59 %) were avoided by many adults. Nuts and oil seeds were avoided by 67 per cent adults. Poor diet (no fruit and vegetable consumption), smoking, heavy alcohol consumption and physical inactivity are all associated with higher odds of the syndrome (Science daily, 2006). Majority of the adults of the present study were aware of the beneficial effects of consuming greens, vegetables and fruits.

5. Duration of the Disease and Familial Trait of the Selected Adults

The chance of cardiovascular disease is greater among people who have a family history of the disease. Table XIV gives the duration and the familial trait of the selected adults.

TABLE XIV
DURATION OF THE DISEASE AND FAMILIAL TRAIT
OF THE SELECTED ADULTS

N=500

Duration of the disease (in years)	Hyperlipidemia						Hyperlipidemia and Diabetes Mellitus					
	Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
< 1	23	15.5	18	18.6	41	16.7	33	22.4	28	26.0	61	23.9
1 – 5	44	29.8	19	19.6	63	25.7	33	22.4	23	21.3	56	22.0
5 – 10	26	17.6	17	17.5	43	17.6	38	25.9	24	22.2	62	24.3
10 – 15	32	21.6	24	24.7	56	22.9	24	16.4	25	23.1	49	19.2
15 - 20	23	15.5	19	19.6	42	17.1	19	12.9	8	7.4	27	10.6
Total	148	100	97	100	245	100	147	100	108	100	255	100
Family trait												
Father	23	15.5	13	13.4	36	14.7	34	23.1	9	8.3	43	16.9
Mother	21	14.3	8	8.2	29	11.8	19	13.0	12	11.1	31	12.2
Both parents	37	25.0	29	29.9	66	26.9	39	26.5	26	24.0	65	25.4
Grand parents	29	19.6	15	15.5	44	18.0	13	8.9	24	22.2	37	14.5
Other relatives	11	7.4	9	9.3	20	8.2	8	5.4	19	17.7	27	10.6
None	27	18.2	23	23.7	50	20.4	34	23.1	18	16.7	52	20.4
Total	148	100	97	100	245	100	147	100	108	100	255	100

It is observed that among the 500 adults, 245 adults had hyperlipidemia and 255 adults had both hyperlipidemia and diabetes mellitus. It is found that 44 males and 19 females had hyperlipidemia for the past five years. About 32 males and 24 females had this problem for about 10 to 15 years. Twenty three males and 18 females had the symptoms for the past one year and 23 males and 19 females for about 15 to 20 years. Regarding the familial trait, majority of the males (37) and females (29) both parents had either hyperlipidemia or diabetes mellitus. About 27 males and 23 females did not show any familial history of hyperlipidemia.

Out of the 255 hyperlipidemic adults with diabetes mellitus, it is found that 179 adults had diagnosed the condition within ten years, 49 within 10 to 15

and 27 within 15 to 20 years. Only 34 per cent of males and 18 per cent of females did not have the familial history of the condition. All others had either mother, father, grand parents or other relatives had suffered from either diabetes mellitus or hyperlipidemia. It is evidently seen from the table that 39 males and 26 females' parents had suffered from the disease condition. Moreover fathers of 34 males and 9 females; mothers of 19 males and 12 females, grand parents of 13 males and 24 females and other relatives of 8 males and 19 females had suffered from either of the disease.

The American Diabetes Association, American Heart Association and National Cholesterol Education Program have shown that family history is an independent risk factor for diabetes. People who have one or more parents, siblings, or children with diabetes are 2 to 6 times more likely to have the disease than the people with relatives not affected (Purnell *et al.*, 2003). Family history is also an established risk factor for CVD. In one large study, the 14 per cent of families that had a known family history for heart disease accounted for 72 per cent of cases of early heart disease (before age 55) (Rankinen *et al.*, 2002).

6. Type and Duration of Treatment of the Selected Adults

Table XV gives the type and duration of treatment taken by the hyperlipidemic and diabetic adults.

A total of 8 per cent of the hyperlipidemic adults were taking treatment for a period of 1 to 5 years. In the case of adults with hyperlipidemia and diabetes, except 7.5 per cent of adults all of them were taking treatment with a majority of 28.6 per cent taking treatment from 1 to 5 years. Nearly 18 per cent of such adults were taking 10 to 15 years of treatment. This finding revealed that when people are suffering from twin or more diseases, they are very much concerned about treatment options and durations. From the table, it is evident that among the hyperlipidemic adults about 80 per cent of males and 92 per cent of females did not take any treatment to control the disease. They were maintaining their lipid levels through the diet modification.

TABLE XV
TYPE AND DURATION OF TREATMENT OF THE SELECTED ADULTS

N=500

Duration of treatment (in years)	Hyperlipidemia						Hyperlipidemia and Diabetes Mellitus					
	Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
< 1	7	4.7	2	2.1	9	3.7	38	25.9	28	26.0	66	25.9
1 – 5	14	9.5	6	6.2	20	8.2	40	27.2	33	30.6	73	28.6
5 – 10	3	2.0	0	0.0	3	1.2	31	21.1	19	17.6	50	19.6
10 – 15	5	3.4	0	0.0	5	2.0	30	20.4	17	15.7	47	18.4
None	119	80.4	89	91.7	208	84.9	8	5.4	11	10.1	19	7.5
Total	148	100	97	100	245	100	147	100	108	100	255	100
Type of Treatment Undertaken												
Allopathy	26	17.6	4	4.1	30	12.2	66	44.9	54	50.0	120	47.0
Siddha	0	0	0	0	0	0	20	13.6	19	17.6	39	15.3
Ayurveda	3	2.0	4	4.1	7	2.9	53	36.1	24	22.3	77	30.2
None	119	80.4	89	91.8	208	84.9	8	5.4	11	10.1	19	7.5
Total	148	100	97	100	245	100	147	100	108	100	255	100

With regard to the type of treatment a majority (12 %) of hyperlipidemic adults went for allopathic treatment with three per cent taking ayurvedic treatment. None of them went for Siddha treatment.

Among adults with hyperlipidemia and diabetes mellitus a majority of 47 per cent again went for allopathic treatment and 30 per cent took ayurvedic treatment. Siddha treatment was selected by 15 per cent of the hyperlipidemic and diabetic adults.

C. Nutritional Awareness on the Consumption of Spices among the Selected Adults

The spice cabinet proves to be a source of help for diabetic patients. Some of the most commonly used dried herbs and spices may help block the inflammation believed to drive diabetes and other chronic diseases. Table XVI gives the picture on the awareness about the spices by the selected adults.

TABLE XVI
AWARENESS ABOUT SPICES BY THE SELECTED ADULTS

N=500

Awareness about the spices	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Aware	129	43.7	95	46.3	224	44.8
Not aware	166	56.3	110	53.7	276	55.2
Total	295	100	205	100	500	100
Spices* (Number of adults)						
Honey + Cinnamon	11		12		23	10.3
Garlic	13		19		32	14.3
Khus khus	5		4		9	4.0
Cloves	6		5		11	4.9
Ginger	6		10		16	7.1
Badam	7		2		9	4.0
Pepper + Cumin	8		13		21	9.4
Fenugreek + Jeera	53		50		103	46.0

* Multiple response

It is evident from the table, that only 43.7 per cent males and 46.3 per cent females were aware that spices could help to control or fight against disease conditions. About 56 per cent of males and 54 per cent females with an overall percentage of 55 did not have any idea regarding the medicinal properties of spices. About 53 males and 50 females were aware that fenugreek mixed with jeera could control diabetes mellitus. The medicinal value of garlic was reported by 13 males and 19 females (overall 14 %). Very few mentioned about cinnamon and honey, cloves, ginger and khus khus. Seven males and two females expressed the hypocholesterolemic effect of consuming badam. It is evident that some awareness is found among the public about the role of spices in medicine.

D. Nutrient Analysis of the Selected Spices and Cost of the Spice Capsules

1. Nutrient Analysis of the Selected Spices

The nutrients present in the spice powders selected for the study namely cinnamon, cloves, garlic and turmeric were analysed in the laboratory and the results are presented in Table XVII.

TABLE XVII
NUTRIENT CONTENT OF THE SELECTED SPICES AS
ANALYSED (in 100 g)

Nutrients	Cinnamon	Cloves	Garlic	Turmeric
Moisture (g)	6.11	14.11	8.17	6.38
Energy (Kcal)	190	270	220	310
Protein (g)	7.15	7.7	11.23	3.96
Fat (g)	0.85	1.72	0.2	1.54
Carbohydrate (g)	39.75	33.05	26.56	44.25
Ash (g)	4.08	7.66	4.41	7.61
Calcium (mg)	580	560	370	390
Phosphorus (mg)	0.06	70	68	71
Sodium (mg)	0.028	0.029	0.032	0.035
Potassium (mg)	0.021	0.024	0.029	0.031
Iron (mg)	0.006	0.007	0.008	0.009
Thiamine (mg)	0.09	0.13	0.21	0.19
Riboflavin (mg)	0.03	0.09	0.06	0.08
Niacin (mg)	0.59	0.14	0.13	0.23
Vitamin A (μ g)	49	21	106	91
Vitamin C (mg)	28	36	6	14
Crude Fibre (g)	9.59	14.68	7.38	12.6
Trace elements				
Lead (mg)	bdl	bdl	bdl	bdl
Copper (mg)	0.001	0.001	0.002	0.003
Zinc (mg)	bdl	bdl	bdl	bdl
Arsenic (mg)	bdl	bdl	bdl	bdl
Chromium (mg)	bdl	bdl	bdl	bdl
Active Principles				
Cinnamaldehyde (mg)	24	19.6	14	36
Eugenol (mg)	0.1	0.04	0.18	0.08
Allicin (mg)	5.14	1.39	3.68	9.32
Curcumin (mg)	0.03	0.09	0.14	0.21

bdl – below detectable limits

The nutrient analysis of the selected spices, namely, cinnamon, cloves, garlic and turmeric revealed that maximum moisture content was seen in cloves (14.11 g/100g) and a least moisture content of 6.11 g/100g in cinnamon. The energy content was high in turmeric with 310 Kcal and cinnamon with 190 Kcal per 100 g. The protein content was found to be high in garlic with 11.23 g with a fat content of only 0.2 g per cent. Maximum fat content was present in cloves 1.72 g followed by turmeric with 1.54 g in 100g. Carbohydrate content was found to be highest in turmeric with 44.25 g per cent whereas garlic had only 26.56 g per cent. Ash content ranged from 7.61 to 7.66 per cent in turmeric and cloves with a lower value of 4.08 and 4.41 g per cent in cinnamon and garlic.

Minerals like phosphorus, sodium, potassium and iron were high in turmeric with 71 mg, 0.035 mg, 0.031 mg and 0.009 mg respectively, whereas calcium was high in cinnamon (580 mg). B complex vitamins like thiamine was maximum in garlic with 0.21 mg, riboflavin in cloves with 0.09 mg and niacin with 0.59 mg in cinnamon. Vitamin A was found to be high in garlic with 106 µg and vitamin C of 36 mg in cloves. The crude fibre was also maximal in cloves with 14.68 g and least in 7.38 g per cent.

The trace elements like lead, zinc, arsenic and chromium were found to be below the detectable limits, whereas only copper was found among the spices in traces ranging from 0.001 to 0.003.

The active principles present in cinnamon included 24 mg of cinnamaldehyde, 0.1 mg of eugenol, 5.14 mg of allicin and 0.03 mg of curcumin. Cloves contained 19.6 mg of cinnamaldehyde, 0.04 mg of eugenol, 1.39 mg of allicin and 0.09 mg of curcumin. With regard to garlic, 3.68 mg of allicin and 14 mg of cinnamaldehyde, 0.18 mg of eugenol and 0.14 mg of curcumin were present. Maximum quantities of curcumin was present in turmeric (0.21 mg %), cinnamaldehyde (36 mg %) and allicin (9.32 mg %) compared to the other three spices.

The nutrient content of selected spices i.e. cinnamon, cloves, garlic and turmeric could not be compared with the standard ICMR values because ICMR values were analysed for fresh samples whereas in the present study the dried spice powders were analysed.

2. Cost of the Spice Capsules

Table XVIII gives the cost comparison of the spice capsules.

TABLE XVIII
COST COMPARISON OF SPICE CAPSULES

Particulars	Cinnamon	Cloves	Garlic	Turmeric
Cost of Raw material (Rs./Kg)	120	210	110	85
Dehydration and powdering charges (Rs./Kg)	700	1500	2950	450
Capsuling charges for 1000 capsules	240	240	240	240
Total (Rs.)	1060	1950	3300	775
No. of Capsules (per Kg)	2040	2035	2020	2030
Cost per capsule (Rs.)	0.52	0.96	1.63	0.38
Cost per 1000 capsules (Rs.)	520	960	1630	380

It is found out that the cost of one capsule of cinnamon was Re. 0.52, cloves was Re. 0.96, garlic was Re. 1.63 and turmeric was Re. 0.38 with a high cost for garlic capsule and minimum cost for turmeric capsule. The cost of drying and powdering of garlic was found to be the maximum (Rs. 2950) because garlic had a high moisture content which needed more electricity and time. The cost of some common allopathic drugs used for controlling hyperlipidemia such as Aztor EZ, Aztor 10, Simvotin 5 and Avistatin ranged from Rs. 5.50 to Rs. 10.00 per capsule / tablet. The cost of drugs used for controlling diabetes mellitus like Daonil, Glyciphage, Glucomate, Cetapin and Gemer 1 cost ranges from Rs. 0.90 to Rs. 7.50 per capsule / tablet. Cost comparison between the spice capsules used for the study and allopathic drugs revealed that the capsules prepared out of spices were very much cheaper.

Thus, the spice capsules are cost effective and could be afforded by all classes of people. This kind of capsule preparation can be undertaken at small scale level by women entrepreneurs to make them more economically empowered.

E. Mean Food and Nutrient Intake by the Hyperlipidemics and Adults with Hyperlipidemia and Diabetes Mellitus

1. Mean Food Intake

The mean food intake of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus is given in Table XIX.

TABLE XIX
MEAN FOOD INTAKE BY THE SELECTED ADULTS

N = 75 each

Food groups	Hyperlipidemics			Hyperlipidemia and Diabetes Mellitus		
	RDA*	Mean intake	% excess or deficit	RDA*	Mean intake	% excess or deficit
Cereals (g)	140	295	+53.6	250	255	+2.0
Pulses (g)	30	35	+16.7	20	25	+25.0
Green leafy vegetables (g)	100	45	-55.0	200	135	-32.5
Roots and tubers (g)	100	155	+55.0	-	-	-
Other vegetables (g)	150	110	-26.7	200	110	-45.0
Fruits (g)	100	60	-40.0	200	80	-60.0
Milk and milk products (g)	200	190	-5.0	400	275	-31.3
Fats and oils (g)	15	20	+33.3	20	28	+40.0
Fleshy foods (g)	50	60	+20.0	70	75	+6.7

*ICMR (2004)

It was observed that the consumption of cereals was more than the recommended allowance by 53.6 per cent among the hyperlipidemic adults. Consumption of pulses followed the same trend with 16.7 per cent among the adults. The intake of green leafy vegetables and other vegetables was deficit

by 55 and 26.7 per cent respectively. The consumption of roots and tubers was in excess among the hyperlipidemic adults by 55 per cent. The intake of fruits (40 per cent), milk and milk (5 per cent) products was also generally inadequate among the males. The consumption of fleshy foods, fats and oils were in excess of 20 and 33 per cent respectively. The findings revealed that a high intake of fleshy foods and fats and oils might have predisposed the selected adults for hyperlipidemic conditions.

An increase of only two per cent was seen in the intake of cereals and 25 per cent increase in pulses among the adults with hyperlipidemia and diabetes mellitus. There was an excess percentage of 40 and seven in the consumption of fats and oils and fleshy foods. Intake of green leafy vegetables and other vegetables were severely deficit compared to the RDA to the tune of 33 and 45 per cent respectively. The consumption of fruits and milk and milk products was also deficit in the range of 60 and 31 per cent respectively. The general observation with regard to food intake is that cereals, pulses, fleshy foods and fats and oils were consumed in excess whereas protective foods such as greens, other vegetables, fruits and milk and milk products were consumed inadequately.

2. Mean Nutrient Intake

The mean nutrient intake of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus is given in Table XX.

There was an excess intake in the consumption of energy to the tune of 11 per cent by the hyperlipidemic adults. Compared to the RDA there was an excess in the consumption of proteins and fat by 47 and 13 per cent respectively. When B vitamins namely thiamine and riboflavin were considered there was an excess of 33.3 per cent among both. There was a deficit of 60 per cent in the consumption of vitamin C. Minerals like calcium was deficit in the range of 49 per cent. There was a severe deficit in the consumption of fiber to the tune of 56 per cent.

TABLE XX
MEAN NUTRIENT INTAKE BY THE SELECTED ADULTS

N = 75 each

Nutrients	Hyperlipidemics			Hyperlipidemia and Diabetes Mellitus		
	RDA*	Mean intake	% excess or deficit	RDA*	Mean intake	% excess or deficit
Energy (Kcal)	1000	1115	+11.5	1500	1545	+3.0
Protein (g)	38	56	+47.4	60	65	+8.3
Fat (g)	22	25	+13.6	37	40	+8.1
Calcium (mg)	800	401	-49.9	400	650	+62.5
Beta carotene (µg)	4000	1600	-60.0	2400	1550	-35.4
Thiamine (mg)	0.9	1.2	+33.3	1.2	1.2	0
Riboflavin (mg)	0.9	1.2	+33.3	1.4	1.3	-7.1
Vitamin C(mg)	135	53	-60.7	40	23	-42.5
Fibre (g)	35	15.3	-56.3	40	15	-62.5

*ICMR (2004)

The calorie intake of the adults with hyperlipidemia and diabetes mellitus was three per cent excess than the RDA. There was an eight per cent excess in the intake of both proteins and fats which might be due to increased intake of fleshy foods and pulses. The calcium intake was very high compared to the RDA to the tune of 63 per cent. The carotene intake was markedly deficit among the diabetics with 35 per cent. There was a marked deficit in the intake of vitamin C and fibre with 43 and 63 per cent respectively. The B vitamins i.e. riboflavin was deficit by seven per cent whereas thiamine was taken adequately.

The general observation from the nutrient intake data revealed that there was an excess intake of energy, protein and fat than the RDA whereas a deficit intake of beta carotene, vitamin C and fibre which requires proper diet counselling among the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus.

F. Effect of Supplementation of the Selected Spices on the Symptoms Experienced by the Hyperlipidemics and Adults with Hyperlipidemia and Diabetes Mellitus

1. Clinical Symptoms Experienced by the Hyperlipidemic Adults Before and After Supplementation

The symptoms experienced by the hyperlipidemic adults before and after supplementation of capsules of spice powders are given in Table XXI.

TABLE XXI
SYMPTOMS EXPERIENCED BY THE HYPERLIPIDEMIC ADULTS
BEFORE AND AFTER SUPPLEMENTATION

Symptoms	Cinnamon (N = 15)		Cloves (N = 15)		Garlic (N = 15)		Turmeric (N = 15)		Control (N = 15)	
	B	A	B	A	B	A	B	A	B	A
Polyuria	0	0	0	0	1	0	1	1	0	0
Polyphagia	1	0	0	0	2	1	0	0	0	0
Polydypsia	0	0	1	0	0	0	1	1	1	1
Insomnia	0	0	0	0	1	1	2	2	4	4
Oedema	0	0	0	0	2	2	0	0	0	0
Headache	3	0	1	0	2	0	1	0	0	0
Excessive sweating	0	0	0	0	0	0	0	0	2	2
Nocturia	3	0	0	0	3	3	3	3	3	3
Wight loss	0	0	0	0	2	0	3	3	2	2
Wight gain	2	0	1	0	2	0	1	1	4	4
Fatigue	0	0	2	0	0	0	0	0	0	0
Giddiness	1	0	3	0	2	1	1	0	3	3
Shivering	1	0	0	0	1	1	0	0	3	3
Breathlessness	3	0	0	0	1	1	3	1	4	4
Palpitation	1	0	2	0	0	0	3	1	3	3
Hypertension	1	0	2	0	3	3	4	4	4	4
Peptic ulcer	0	0	0	0	0	0	1	1	0	0
Wheezing / asthma	0	0	0	0	1	0	1	0	0	0
Skin aller gy	0	0	0	0	0	0	1	1	0	0
Inability to work	1	0	0	0	0	0	0	0	0	0
Myocardial infarction	0	0	0	0	0	0	1	1	1	1
None	4	15	7	13	4	7	3	4	2	2

B – Before; A - After

The clinical symptoms observed among hyperlipidemic adults like polyphagia, polydypsia, headache, nocturia, weight gain, fatigue, giddiness, shivering, breathlessness, palpitation, hypertension, inability to work were found to disappear after a three months period of supplementation with cinnamon and cloves. Among the adults supplemented with garlic and turmeric the symptoms like polyuria, polyphagia, polydypsia, insomnia, oedema, headache, nocturia, weight loss, weight gain, fatigue, giddiness, shivering, breathlessness, palpitation, hypertension and asthma showed a minor change after supplementation.

It was seen that all the fifteen and thirteen adults did not suffer any clinical symptoms after consumption of capsules of cinnamon and cloves whereas only very few adults moved to such a stage in garlic and turmeric supplementation groups. No change or improvement was observed in control group.

2. Clinical Symptoms Experienced by the Adults with Hyperlipidemia and Diabetes Mellitus Before and After Supplementation

The symptoms experienced by the adults with hyperlipidemia and diabetes mellitus before and after supplementation are given in XXII.

Initially, the triad symptoms of diabetes namely polyuria, polyphagia and polydypsia and other symptoms experienced by adults with hyperlipidemia and diabetes mellitus i.e. insomnia, oedema, headache, excessive sweating, nocturia, weight loss, constipation, fatigue, giddiness, shivering, burning sensation during micturition, frequency and hesitancy during micturition, breathlessness, palpitation, hypertension, inability to work were not seen after a period of three months of supplementation with cinnamon and cloves. Among the groups supplemented with garlic and turmeric very few adults reported to have no symptoms after supplementation.

TABLE XXII
SYMPTOMS EXPERIENCED BY ADULTS WITH HYPERLIIDEMIA AND
DIABETES MELLITUS BEFORE AND AFTER
SUPPLEMENTATION

Symptoms	Cinnamon (N = 15)		Clove (N = 15)		Garlic (N = 15)		Turmeric (N = 15)		Control (N = 15)	
	B	A	B	A	B	A	B	A	B	A
Polyuria	4	0	7	1	9	7	5	5	7	7
Polyphagia	8	2	8	0	7	5	9	9	11	11
polydypsia	7	2	9	0	8	5	7	7	11	11
Insomnia	6	1	5	0	2	2	5	5	9	9
Oedema	5	0	1	0	2	0	5	4	1	1
Headache	5	0	3	0	6	0	3	0	6	6
Excessive sweating	6	0	3	0	5	0	7	0	8	8
Nocturia	6	1	6	0	6	3	7	7	7	7
Weight loss	8	0	1	0	7	7	4	4	6	6
Weight gain	1	0	0	0	1	1	1	1	1	1
Constipation	3	0	1	0	1	0	0	0	0	0
Fatigue	1	0	5	0	2	0	3	0	0	0
Giddiness	5	0	4	0	1	0	6	0	7	7
Shivering	8	0	1	0	3	0	3	0	3	3
Burning sensation during micturition	5	1	2	0	2	2	3	3	1	1
Frequency of micturition	2	0	2	1	1	1	2	2	0	0
Hesitancy during micturition	3	0	0	0	0	0	0	0	0	0
Visual disturbance	3	3	1	1	4	4	1	1	0	0
Breathlessness	6	0	4	0	2	0	5	3	6	6
Palpitation	2	0	2	0	2	0	2	0	2	2
Hypertension	4	0	2	0	3	1	4	2	2	2
Obesity	5	0	1	0	1	1	1	1	0	0
Peptic ulcer	1	1	0	0	0	0	0	0	0	0
Wheezing / asthma	0	0	0	0	0	0	1	0	1	1
Tiredness	0	0	0	0	0	0	0	0	1	1
Inability to work	4	0	4	0	4	2	5	0	4	4
None	0	12	1	13	1	7	0	6	0	0

B – Before; A - After

The symptoms like oedema, headache, excessive sweating, constipation, fatigue, giddiness, shivering, breathlessness and palpitation disappeared on supplementation with garlic and turmeric whereas other symptoms did not show any change. Supplementation with cinnamon, cloves, garlic and turmeric revealed that 12 adults experienced no symptoms in cinnamon group, 13 in cloves group, seven in garlic group and six in turmeric supplemented group after a period of three months. No change was observed in the clinical symptoms in the control group.

G. Effect of Supplementation of the Selected Spices on the Nutritional Status of the Hyperlipidemics and Adults with Hyperlipidemia and Diabetes Mellitus

1. Changes in the Body Weight of the Selected Adults

Table XXIII gives the changes in the mean weight of the selected hyperlipidemics and adults with hyperlipidemia and diabetes mellitus after supplementation.

The mean body weights of the hyperlipidemic adults before supplementation with cinnamon, cloves, garlic, turmeric and control groups were 71.73 kg, 70.87 kg, 71.6 kg, 69.8 kg and 76.07 kg respectively. After a period of three months of spice capsule supplementation it was observed that there was a weight reduction of 1.86 kg in cinnamon and 1 kg in cloves supplemented groups. This was followed by garlic supplemented group with a mean difference of 0.57 kg. Whereas there was an increase in weight among the adults supplemented with turmeric with a mean difference of 0.75 kg. The reduction in weight in cinnamon supplemented group was statistically significant at one per cent level and the increase in weight among turmeric group was statistically significant at one per cent level. When compared between the four groups and control it was observed that the weight reduction or increase was not significant.

TABLE XXIII
CHANGES IN THE MEAN BODY WEIGHT OF THE SELECTED ADULTS

Groups	Weight (Kg) Mean \pm SD			't' value	
	Initial (I)	Final (F)	Difference	I Vs F	Between Groups
Experimental I – Hyperlipidemics (75)					
Cinnamon HA	71.73 \pm 8.09	69.87 \pm 7.82	-1.86 \pm 1.92	3.76**	HA Vs HE 0.67 ^{NS}
Cloves HB	70.87 \pm 11.2	69.87 \pm 11.24	-1.0 \pm 2.07	1.54 ^{NS}	HB Vs HE 0.23 ^{NS}
Garlic HC	71.6 \pm 10.51	71.03 \pm 9.44	-0.57 \pm 1.84	0.98 ^{NS}	HC Vs HE 0.02 ^{NS}
Turmeric HD	69.8 \pm 8.51	69.87 \pm 8.63	+0.75 \pm 0.61	3.91**	HD Vs HE 0.66 ^{NS}
Control I HE	76.07 \pm 8.03	75.53 \pm 7.91	-0.53 \pm 7.2	0.24 ^{NS}	
Experimental II - Hyperlipidemia with Diabetes Mellitus (75)					
Cinnamon HDA	70.73 \pm 5.2	69.13 \pm 5.33	-1.6 \pm 2.29	2.70*	HDA Vs HDE 1.46 ^{NS}
Cloves HDB	72.47 \pm 5.97	68.6 \pm 5.0	-3.87 \pm 2.45	6.12**	HDB Vs HDE 4.99**
Garlic HDC	72.0 \pm 7.16	70.73 \pm 6.15	-1.27 \pm 2.46	1.99 ^{NS}	HDC Vs HDE 1.01 ^{NS}
Turmeric HDD	76.13 \pm 6.14	73.53 \pm 4.55	-2.6 \pm 2.75	3.66**	HDD Vs HDE 2.40*
Control II HDE	75.87 \pm 5.93	75.47 \pm 5.87	-0.4 \pm 2.06	0.75 ^{NS}	

* P < 0.05; Significant at 5 per cent level

** P < 0.01; Significant at 1 per cent level

^{NS} Not Significant

Among the adults with hyperlipidemia and diabetes mellitus it was observed that the initial body weight was 70.73 kg in cinnamon supplemented group, 72.47 kg in cloves, 72 kg in garlic, 76.13 kg in turmeric and 75.87 kg in control group. There was a reduction of 3.87 kg in cloves supplemented group which was statistically significant at one per cent level. This was followed by 2.6 kg in turmeric group (significant at one per cent level), 1.6 kg in cinnamon group (significant at five per cent level) and 1.27 in garlic supplemented group

(not significant). A reduction of 0.4 kg was observed in the control group which was not significant. When compared between the groups and control group it was observed that the adults supplemented with cloves and turmeric showed weight reduction significant at one and five per cent level respectively. The groups supplemented with cinnamon, garlic and control groups were not significant. The overall observation revealed that cinnamon and cloves supplementation resulted in appreciable weight loss followed by garlic group among both categories of adults but turmeric supplementation increased the weight of hyperlipidemics but decreased the weight of adults with hyperlipidemia and diabetes mellitus. The U.K. Prospective Diabetes Study (UKPDS) illustrated that individuals newly diagnosed with type 2 diabetes experienced a 2 per cent reduction in hemoglobin A1 results, the largest reduction observed in the study through diet therapy and weight loss (UKPDS study group, 1990).

2. Body Mass Index of the Selected Adults

Body Mass Index was calculated using height and weight of the selected adults and is given in Table XXIV. (Appendix II and III)

TABLE XXIV
CHANGES IN THE BODY MASS INDEX OF THE SELECTED ADULTS

BMI Classification*	Obesity Grade	Hyperlipidemics		Hyperlipidemia and Diabetes Mellitus	
		Before	After	Before	After
< 18.5	Underweight	-	-	-	-
18.5 to 22.9	Normal	14	20	10	12
23.0 to 24.9	At risk of obesity	26	20	28	32
25.0 to 29.9	Obese I	31	31	37	31
≥ 30.0	Obese II	4	4	-	-
Total		75	75	75	75

* WHO (1999)

There is a direct relationship between the degrees of obesity and the risk of developing type 2 diabetes and this holds true for adults. It is estimated that the chance to develop diabetes doubles for every 20 per cent increase over desirable body weight (Sicree and Maria, 2004). From the table, it is evident that none of the adults included for the study were of underweight category as per BMI less than 18.5. Out of 75 adults in each category only 14 and 10 were in the normal weight category initially but after the supplementation of spices the number of normal weight adults increased to 20 and 12 in both categories revealing the effect of supplementation. In the present study, majority were obese and only a few were of normal weight range indicating the need to control and maintain the disease condition so as to reduce the risk of cardiovascular complications. After supplementation, there was a shift in the BMI i.e. among the 26 at risk of obesity adults, six moved to the normal group and those in the obese I and II category remained in the same group. This shows that the hyperlipidemic adults apart from the consumption of spices daily in the form of capsules, they were maintaining their calorie intake and exercised regularly as per the advice of the doctor and counselling by the investigator.

Thirty one adults of obese I category and 4 adults of obese II category in hyperlipidemics group remained the same even after supplementation. It is a welcome observation that the number of obese I category decreased from 37 to 31 after supplementation among adults with hyperlipidemia and diabetes mellitus. Surprisingly the number of at risk of obesity increased to 32 from 28 in adults with hyperlipidemia and diabetes mellitus. A BMI > 25 kg/m² is associated with several metabolic abnormalities and diseases, including type 2 diabetes, which in turn is associated with cardiovascular diseases (Beebe, 2003).

3. Waist Hip Ratio of the Selected Adults

Table XXV gives the changes in the Waist Hip Ratio of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus. (Appendix IV and V)

TABLE XXV
CHANGES IN THE WAIST HIP RATIO OF THE SELECTED ADULTS

WHR*	Grade	Hyperlipidemics		Hyperlipidemia and Diabetes Mellitus	
		Before	After	Before	After
≤ 0.95	Normal	45	56	26	33
≥ 0.95	Obese	30	19	49	42
Total		75	75	75	75

* Brahma *et al.*, 2005

Before supplementation among the hyperlipidemic adults 45 were in the normal WHR category of ≤ 0.95 and 30 were in the obese WHR category of ≥ 0.95 . But after a period of three months of supplementation with spice capsules it is observed that only 19 were of obese WHR category. The number of normal category WHR adults increased to 56 from 45. A similar trend was observed among the adults with hyperlipidemia and diabetes mellitus. Before supplementation with spice capsules 26 adults were in WHR category which increased to 33 after supplementation. It is also evident that 49 adults under obese WHR category decreased to 42 after supplementation. The findings revealed that spice supplementation has a scope of reducing the WHR.

4. Blood pressure of the Selected Adults

Table XXVI depicts the changes in the blood pressure among the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus before and after the supplementation period of three months with the capsules of spice powders.

TABLE XXVI
CHANGES IN THE BLOOD PRESSURE OF THE SELECTED ADULTS

Blood Pressure	Hyperlipidemics		Hyperlipidemia and Diabetes Mellitus	
	Before	After	Before	After
Normal	21	37	37	45
Above or below normal	54	38	38	30
Total	75	75	75	75

Normal: 120 / 80 mm Hg

It is evident from the table that among 54 hyperlipidemic adults whose blood pressure was either above or below normal 16 moved to the normal blood pressure category after supplementation of spices for a period of three months. Among adults with hyperlipidemia and diabetes mellitus 45 of them were found to be in normal category of blood pressure after supplementation with spices whereas the number was 37 before supplementation. Eight of the adults moved from above or below normal category to normal category after the supplementation of spice capsules.

H. Effect of Supplementation of the Selected Spices on the Biochemical Profile of Hyperlipidemics and Adults with Hyperlipidemia and Diabetes Mellitus

1. Changes in the Blood Haemoglobin Levels of the Selected Adults

Table XXVII give the changes in the blood haemoglobin values of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus before and after spice supplementation. (Appendix VI and VII)

The initial blood haemoglobin values of the hyperlipidemic adults of all the groups supplemented with cinnamon, garlic, turmeric and even control group except cloves group were found to be in the normal range of 13.5 to 16.5 g/dl suggested by Ashwood *et al.*, (1994). None of the selected adults were found to suffer from anaemia. A gradual increase in the blood haemoglobin levels were observed among the cloves (13.93 mg/dl) supplemented group followed by garlic (14.32 mg/dl) over the three months period which were found to be significant at one per cent level. There was slight increase in haemoglobin levels among the other groups but not at a significant level. A comparison of supplemented groups with control group revealed a high significant (1%) change in haemoglobin levels among cloves and garlic supplemented with no significant change among other groups in the case of hyperlipidemic adults. This clearly indicate that over a period of three months of time cloves and garlic supplementation was effective in raising the blood haemoglobin levels with a minimum increase among cinnamon and turmeric supplementation.

TABLE XXVII
CHANGES IN THE MEAN BLOOD HAEMOGLOBIN VALUES
OF THE SELECTED ADULTS

Groups	Blood Haemoglobin (mg/dl)			't' value	
	Mean \pm SD			I Vs F	Between Groups
	Initial (I)	Final (F)	Difference		
Experimental I - Hyperlipidemics					
Cinnamon HA	13.86 \pm 0.91	14.05 \pm 0.64	+0.19 \pm 0.76	0.98 ^{NS}	HA Vs HE 1.23 ^{NS}
Cloves HB	13.27 \pm 0.79	13.93 \pm 0.66	+0.66 \pm 0.6	3.44 ^{**}	HB Vs HE 4.02 ^{**}
Garlic HC	13.85 \pm 1	14.32 \pm 0.7	+0.47 \pm 0.55	2.68 [*]	HC Vs HE 3.23 ^{**}
Turmeric HD	14.32 \pm 1.14	14.22 \pm 1.14	-0.10 \pm 0.99	0.39 ^{NS}	HD Vs HE 0.07 ^{NS}
Control I HE	13.87 \pm 1.18	13.79 \pm 1.27	-0.08 \pm 0.32	0.79 ^{NS}	
Experimental II - Hyperlipidemia with Diabetes Mellitus					
Cinnamon HDA	14.08 \pm 0.93	14.25 \pm 0.75	+0.17 \pm 0.24	2.76 [*]	HDA Vs HDE 2.41 [*]
Cloves HDB	13.89 \pm 0.9	14.08 \pm 0.49	+0.19 \pm 0.59	1.23 ^{NS}	HDB Vs HDE 1.18 ^{NS}
Garlic HDC	13.51 \pm 0.64	13.77 \pm 0.5	+0.26 \pm 0.29	3.41 ^{**}	HDC Vs HDE 3.14 ^{**}
Turmeric HDD	13.94 \pm 0.99	13.99 \pm 0.83	+0.05 \pm 0.28	0.65 ^{NS}	HDD Vs HDE 0.62 ^{NS}
Control II HDE	13.49 \pm 0.7	13.47 \pm 0.65	0 \pm 0.11	0	

Normal values: Males 13.5 to 16.5 g / dl (Ashwood *et al.*, 1994).

* P < 0.05; Significant at 5 per cent level

** P < 0.01; Significant at 1 per cent level

The mean blood haemoglobin levels of the adults with hyperlipidemics and diabetes mellitus before supplementation was 14.08 mg/dl, 13.89 mg/dl, 13.51 mg/dl, 13.94 mg/dl and 13.49 mg/dl in the cinnamon, cloves, garlic,

turmeric and control groups respectively which were in the lower side of the normal range of 13.5 mg/dl to 16.5 mg/dl. The increase in the mean blood haemoglobin level was found to be 0.26 mg/dl among garlic supplemented group which was statistically significant at one per cent level and 0.17 mg/dl among cinnamon supplemented group which was statistically significant at five per cent level. All other groups also showed slight changes in haemoglobin values but not statistically significant. No change was seen among the control group. When compared with control group there existed a highly significant increase among garlic group at one per cent and cinnamon group at 5 per cent with no significant changes among other groups of adults with hyperlipidemia and diabetes mellitus. From the above results, it appears that garlic and cinnamon were comparatively effective than other spices in raising the blood haemoglobin levels among the adults with hyperlipidemia and diabetes mellitus.

2. Changes in the Total Cholesterol Levels of the Selected Adults

Table XXVIII and Figures 4 and 5 present the total cholesterol levels of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus. (Appendix VIII and IX).

The mean total cholesterol levels of the hyperlipidemic adults before spice supplementation was 253.53 mg/dl in cinnamon group, 251.93 mg/dl in cloves group, 245.8 mg/dl in garlic group, 244.53 mg/dl in turmeric group and 249.47 mg/dl in control group which were much higher than the normal desirable range of < 200 mg/dl (NCEP, 2001). It is observed that the total cholesterol level in the cinnamon group came down to 184.87 mg/dl with a mean difference of 68.67 mg/dl over a period of three months whereas in the cloves group the mean difference was found to be 51.47 mg/dl followed by garlic group with 36.6 mg/dl. Among both the cinnamon and cloves supplemented groups the total cholesterol levels came down to the normal range which were found to be significant at one per cent level ($P < 0.01$).

TABLE XXVIII
CHANGES IN THE MEAN TOTAL CHOLESTEROL LEVELS
OF THE SELECTED ADULTS

Groups	Total cholesterol (mg / dl) Mean \pm SD			't' value	
	Initial (I)	Final (F)	Difference	I Vs F	Between Groups
Experimental I - Hyperlipidemics					
Cinnamon HA	253.53 \pm 25.55	184.87 \pm 14.44	-68.67 \pm 26.07	10.19**	HA Vs HE 10.50**
Cloves HB	251.93 \pm 20.1	200.47 \pm 14.78	-51.47 \pm 16.88	9.69**	HB Vs HE 12.00**
Garlic HC	245.8 \pm 20.6	209.2 \pm 13.15	-36.6 \pm 18.23	6.39**	HC Vs HE 8.37**
Turmeric HD	244.53 \pm 13.43	234.00 \pm 17.52	-10.53 \pm 18.17	2.24*	HD Vs HE 3.38**
Control I HE	249.47 \pm 19.1	256.47 \pm 20.44	+7.00 \pm 6.88	3.24**	
Experimental II – Hyperlipidemia with Diabetes Mellitus					
Cinnamon HDA	249.67 \pm 10.1	195.93 \pm 8.87	-53.73 \pm 10.17	20.44**	HDA Vs HDE 17.94**
Cloves HDB	258.4 \pm 11.85	205.6 \pm 8.77	-52.8 \pm 11.57	17.66**	HDB Vs HDE 15.77**
Garlic HDC	249.07 \pm 11.65	217.93 \pm 10.79	-31.13 \pm 6.64	18.14**	HDC Vs HDE 14.34**
Turmeric HDD	251.2 \pm 12.05	217.00 \pm 11.03	-34.2 \pm 7.85	16.86**	HDD Vs HDE 13.96**
Control II HDE	253.07 \pm 7.59	252.4 \pm 8.86	-0.67 \pm 4.37	0.59 ^{NS}	

Desirable : <200 mg / dl
 Borderline high : 200 to 239 mg / dl
 High risk : > 239 mg / dl (NCEP, 2001)
 * P < 0.05; Significant at 5 per cent level
 ** P < 0.01; Significant at 1 per cent level

The differences in the levels of turmeric group and control group were negligible. Comparison of the mean total cholesterol levels between the control and supplemented groups showed that all the four spices were more effective in reducing the total cholesterol level during the supplementation period of three months. A one per cent drop in serum cholesterol reduces the risk for Coronary Heart Disease (CHD) by two per cent (Nathan *et al.*, 2005).

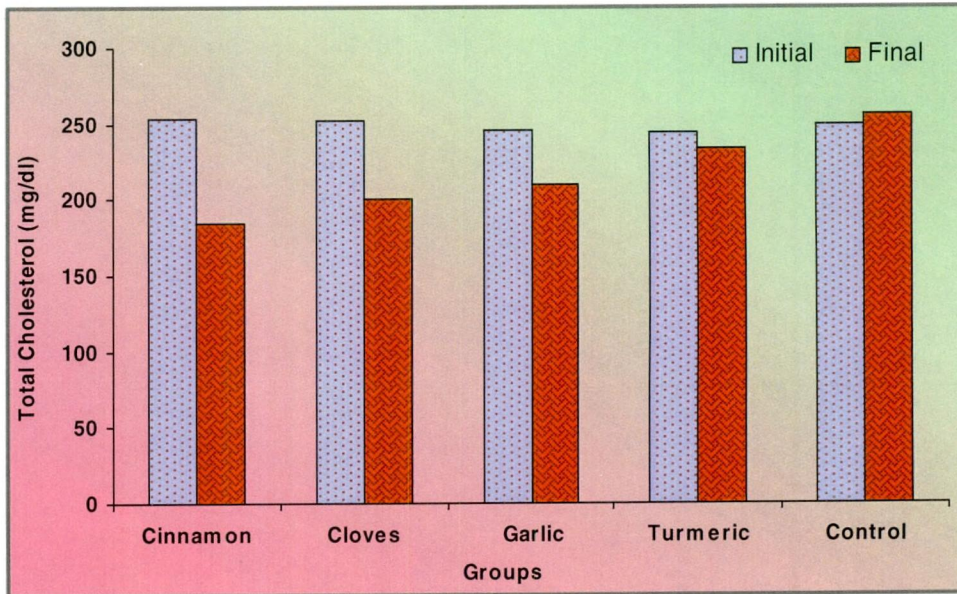


FIGURE 4
TOTAL CHOLESTEROL LEVELS OF HYPERLIPIDEMIC ADULTS BEFORE AND AFTER SPICE SUPPLEMENTATION

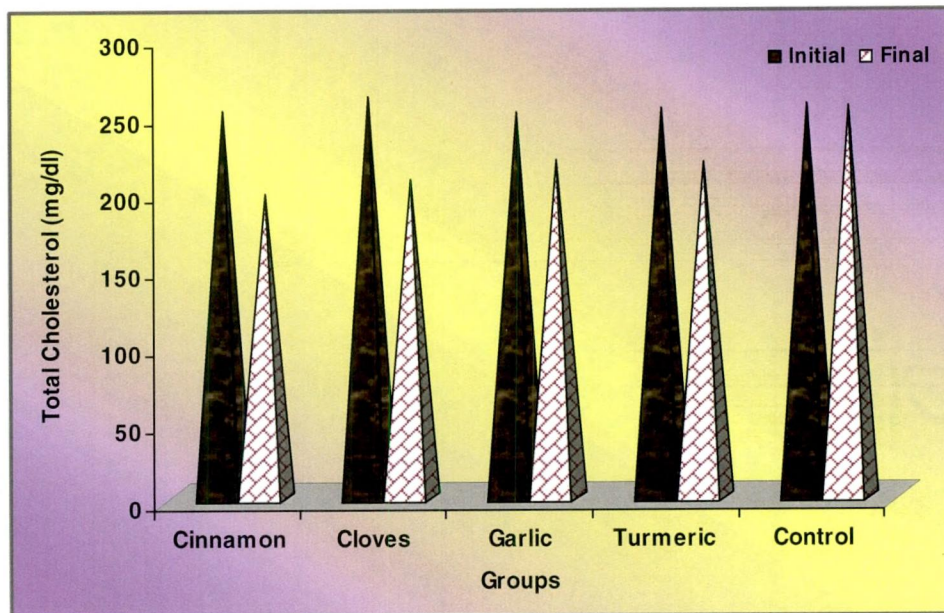


FIGURE 5
TOTAL CHOLESTEROL LEVELS OF ADULTS WITH HYPERLIPIDEMIA AND DIABETES MELLITUS BEFORE AND AFTER SPICE SUPPLEMENTATION

The total cholesterol levels of the adults with hyperlipidemia and diabetes mellitus in the cinnamon supplemented group was 249.67 mg/dl, cloves group was 258.4 mg/dl, garlic group was 249.07 mg/dl, turmeric group was 251.2 mg/dl and control group was 253.07 mg/dl before supplementation which were above the normal desirable level of < 200 mg/dl and placed in high risk group. A reduction in total cholesterol levels by 195.93 mg/dl, 205.6 mg/dl, 217.93 mg/dl and 217 mg/dl was observed among the cinnamon, cloves, garlic and turmeric supplemented groups but no significant change was observed in the control group after a period of three months. The reduction in all the supplemented groups were significant at one per cent level ($P < 0.01$). A comparison between the groups revealed that cinnamon group was more effective followed by cloves, garlic and turmeric group and was significant at one per cent level. However, the trend of supplementation with spices in lowering the total cholesterol levels gradually is a promising indication that longer periods of supplementation could probably bring down the value to normal values even in garlic and turmeric supplemented groups. Spices being a food supplement is less harmful to human system and probably the most cost effective and sustainable source, use of spices have promising implications and needs long term supplementation studies.

3. Changes in the Triglyceride Levels of the Selected Adults

Table XXIX and Figures 6 and 7 depict the mean triglyceride levels of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus before and after spice supplementation. (Appendix X and XI)

Initially the serum triglyceride levels of the hyperlipidemic adults, among cinnamon, cloves, garlic, turmeric and control groups were found to be in the borderline high category of 150 to 199 mg/dl as per NCEP (2001). After three months of supplementation with spices the triglycerides reached a level of 147 mg/dl in cinnamon group, 140.93 mg/dl in cloves group and 138.67 in garlic group which were well within the desirable level of <150 mg/dl. There was a slight increase in the turmeric supplemented group of 188.6 mg/dl and with a

minimum change in the control group. The turmeric group had levels in the borderline high category all through. A remarkable reduction by 47.73 mg/dl was evident among the garlic supplemented group than the cloves and cinnamon supplemented groups which were significant at 5 per cent level.

TABLE XXIX
CHANGES IN THE MEAN TRIGLYCERIDE LEVELS
OF THE SELECTED ADULTS

Groups	Triglyceride (mg / dl)			't' value	
	Mean \pm SD			I Vs F	Between Groups
	Initial (I)	Final (F)	Difference		
Experimental I - Hyperlipidemics					
Cinnamon HA	190.33 \pm 24.81	147.00 \pm 17.34	-43.33 \pm 13.3	12.61**	HA Vs HE 10.42**
Cloves HB	185.6 \pm 21.61	140.93 \pm 14.71	-44.67 \pm 13.29	10.69**	HB Vs HE 10.75**
Garlic HC	186.4 \pm 15.58	138.67 \pm 17.85	-47.73 \pm 19.6	7.74**	HC Vs HE 8.45**
Turmeric HD	178.27 \pm 22.29	188.6 \pm 27.88	+10.33 \pm 13.92	2.8*	HD Vs HE 2.31*
Control I HE	195.4 \pm 31.57	195.73 \pm 28.22	+0.33 \pm 8.3	0.13 ^{NS}	
Experimental II - Hyperlipidemics with Diabetes Mellitus					
Cinnamon HDA	174.87 \pm 12.71	138.67 \pm 10.97	-36.2 \pm 10.13	13.83**	HDA Vs HDE 11.98**
Cloves HDB	173.33 \pm 13.85	140.53 \pm 8.42	-32.8 \pm 7.05	18.00**	HDB Vs HDE 13.85**
Garlic HDC	169.33 \pm 10.95	154.8 \pm 9.14	-14.53 \pm 6.4	8.79**	HDC Vs HDE 6.85**
Turmeric HDD	170.8 \pm 10.97	158.87 \pm 10.33	-11.93 \pm 4.37	10.58**	HDD Vs HDE 6.78**
Control II HDE	177.07 \pm 12.12	178.67 \pm 12.74	+1.6 \pm 6.06	1.02 ^{NS}	

Normal : < 150 mg / dl
 Borderline high : 150 to 199 mg / dl
 High : 200 to 499 mg / dl
 Very high : > 499 mg / dl (NCEP, 2001)

* P < 0.05; Significant at 5 per cent level

** P < 0.01; Significant at 1 per cent level

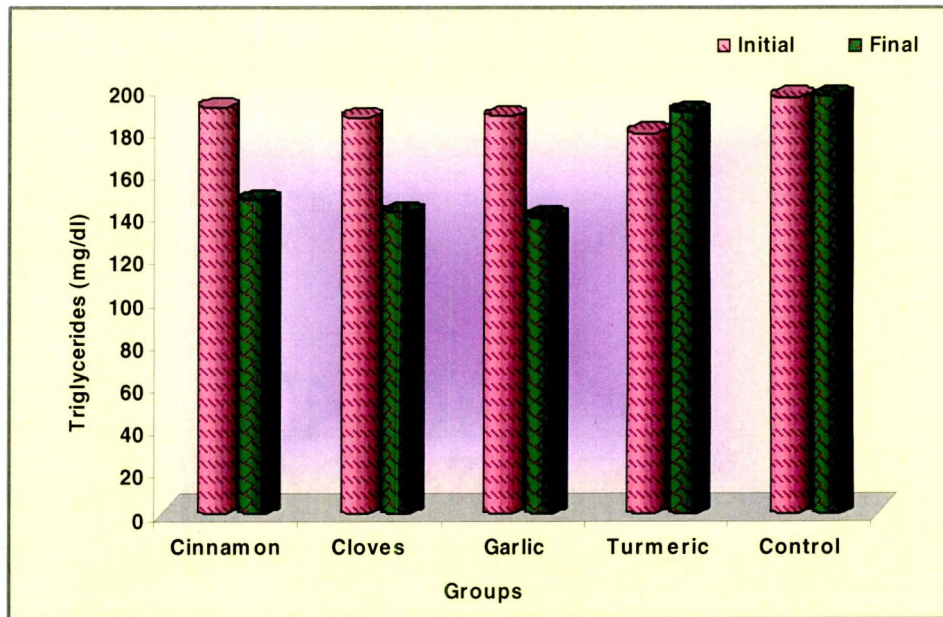


FIGURE 6

TRIGLYCERIDE LEVELS OF HYPERLIPIDEMIC ADULTS BEFORE AND AFTER SPICE SUPPLEMENTATION

When compared between groups with control the cloves, cinnamon and garlic supplemented groups were significant at one per cent level. There was a five per cent increase in the triglyceride level was observed among turmeric group in comparison with the control. These results revealed that the triglyceride levels were brought well within the desirable range among clove, cinnamon and garlic supplemented groups. A comparison of the final triglyceride levels with initial values indicated a reduction ranging from 43.33 mg/dl to 47.73 mg/dl among cinnamon, cloves and garlic groups which were found to be statistically significant at one per cent level.

Serum triglyceride levels of adults with hyperlipidemia and diabetes mellitus supplemented with cinnamon, cloves, garlic, turmeric and control groups were found to be in the borderline high category of 150 to 200 mg/dl initially ranging from 169.33 mg/dl to 177.07 mg/dl. After a period of three months of supplementation with spices namely cinnamon, cloves, garlic and turmeric there was a mean reduction in the serum triglyceride levels by 36.2 mg/dl, 32.8 mg/dl, 14.53 mg/dl and 11.93 mg/dl respectively which was found to be statistically significant at one per cent level.

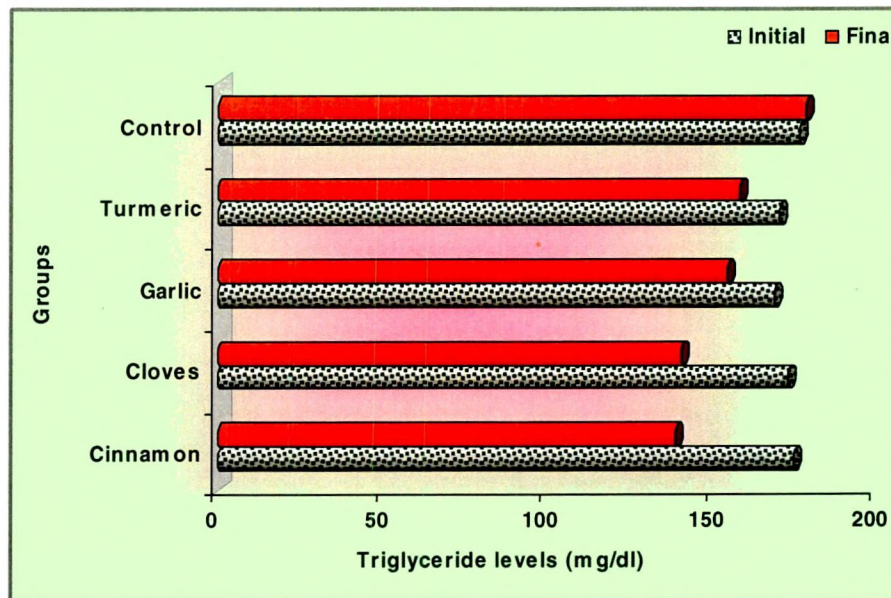


FIGURE 7

TRIGLYCERIDE LEVELS OF ADULTS WITH HYPERLIPIDEMIA AND DIABETES MELLITUS BEFORE AND AFTER SPICE SUPPLEMENTATION

A greater reduction was observed in the cinnamon and cloves supplemented group which brings out the potential benefits of cinnamon and cloves in lowering the triglyceride levels among the hyperlipidemic with diabetic adults. No significant change was observed in the control group with regard to triglyceride levels. Lowering triglycerides and increasing HDL cholesterol is associated with a reduction in cardiovascular events in patients with type 2 diabetes mellitus (Klausen *et al.*, 2004).

4. Changes in the HDL Cholesterol Levels of the Selected Adults

The mean HDL cholesterol levels of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus before and after supplementation are presented in Table XXX and Figures 8 and 9. (Appendix XII and XIII)

The desirable level of HDL cholesterol ranges between 40 to 60 mg/dl (NCEP, 2001). In the present study, the initial HDL cholesterol level was found to be in the desirable range among all the five group of hyperlipidemic adults.

However, HDL cholesterol level in the cinnamon, cloves and turmeric supplemented groups showed a gradual increase from the initial values and after three months of supplementation the increase in HDL cholesterol was found to range between 0.83 to 3.83 with a lowest increase for garlic (0.83 mg/dl) group and with a highest increase (3.83 mg/dl) for cloves supplemented group.

TABLE XXX
CHANGES IN THE MEAN HDL CHOLESTEROL LEVELS
OF THE SELECTED ADULTS

Groups	HDL Cholesterol (mg / dl) Mean \pm SD			't' value	
	Initial (I)	Final (F)	Difference	I Vs F	Between Groups
Experimental I - Hyperlipidemics					
Cinnamon HA	40.53 \pm 2.93	43.31 \pm 1.83	+2.77 \pm 2.96	3.62**	HA Vs HE 2.56*
Cloves HB	37.61 \pm 2.78	41.44 \pm 2.04	+3.83 \pm 1.62	7.52**	HB Vs HE 5.30**
Garlic HC	39.91 \pm 4.6	40.74 \pm 4.26	+0.83 \pm 2.29	1.15 ^{NS}	HC Vs HE 0.55 ^{NS}
Turmeric HD	38.68 \pm 3.88	41.42 \pm 3.13	+2.74 \pm 1.87	5.68**	HD Vs HE 3.38**
Control I HE	39.97 \pm 3.69	40.37 \pm 3.06	0.4 \pm 1.8	0.71 ^{NS}	
Experimental II - Hyperlipidemia with Diabetes Mellitus					
Cinnamon HDA	36.95 \pm 2.22	44.08 \pm 2.28	+7.13 \pm 2.01	13.72**	HDA Vs HDE 12.10**
Cloves HDB	38.94 \pm 2.97	43.2 \pm 2.22	+4.26 \pm 1.76	9.35**	HDB Vs HDE 8.02**
Garlic HDC	38.01 \pm 2.6	40.17 \pm 2.63	+2.16 \pm 1.09	7.69**	HDC Vs HDE 5.66**
Turmeric HDD	39.06 \pm 1.62	40.36 \pm 1.54	+1.30 \pm 0.75	6.68**	HDD Vs HDE 4.06**
Control II HDE	38.93 \pm 1.74	38.91 \pm 2.17	-0.02 \pm 0.85	0.33 ^{NS}	

Low : < 40 mg / dl

High : > 60 mg / dl (NCEP, 2001)

* P < 0.05; Significant at 5 per cent level

** P < 0.01; Significant at 1 per cent level

^{NS} Not Significant

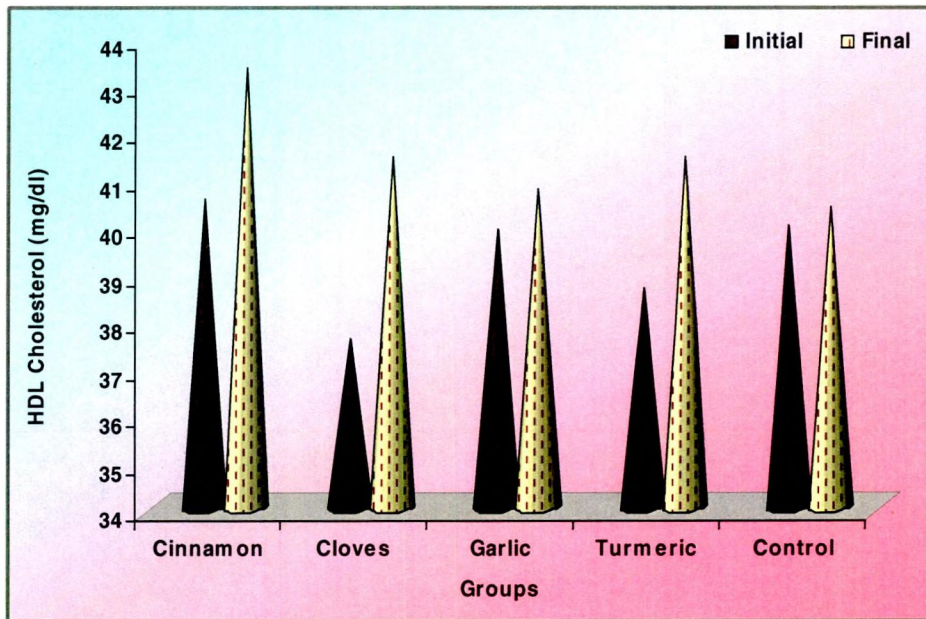


FIGURE 8

HDL CHOLESTEROL LEVELS OF HYPERLIPIDEMIC ADULTS BEFORE AND AFTER SPICE SUPPLEMENTATION

The differences between initial and final were found to be significant for cinnamon, cloves and turmeric group at one per cent level ($P < 0.01$). No significant change was observed in the initial and final values among garlic and control group. This difference in the spice supplemented group probably indicates the effect of cinnamon, cloves and turmeric in increasing the HDL cholesterol levels and maintaining a lower risk for lipid profile among hyperlipidemics. When compared with the control group, the increase in HDL was more significant among cloves and turmeric group which was statistically significant at one per cent level.

HDL cholesterol levels initially in the cinnamon, clove, garlic and turmeric supplemented group of adults with hyperlipidemia and diabetes mellitus were 36.95 mg/dl, 38.94 mg/dl, 38.01 mg/dl and 39.06 mg/dl respectively which were closer to the lower range of normal values of < 40 mg/dl. After three months of supplementation an increase of 7.13 mg/dl, 4.26 mg/dl, 2.16 mg/dl and 1.3 mg/dl were observed in the HDL levels among cinnamon, cloves, garlic and turmeric supplemented groups with a highest increase in cinnamon (7.13 mg/dl) supplemented group.

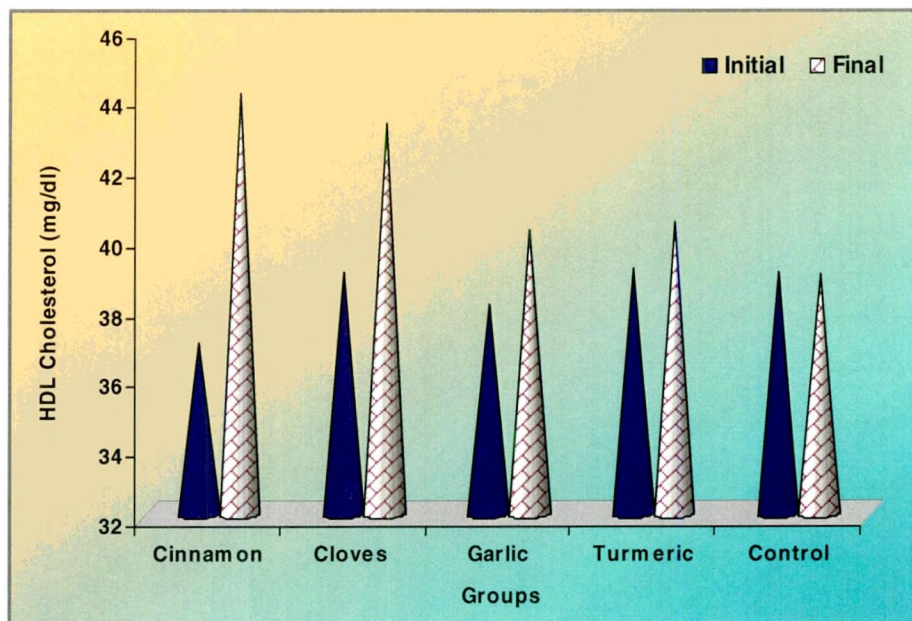


FIGURE 9

HDL CHOLESTEROL LEVELS OF ADULTS WITH HYPERLIPIDEMIA AND DIABETES MELLITUS BEFORE AND AFTER SPICE SUPPLEMENTATION

The increase in HDL levels among all the four groups was found to be highly significant at one per cent level. There was no significant difference in increase in the control group. A comparison of the four groups with the control group with regard to the increase in HDL values revealed a statistically significant difference at one per cent level. Maximum increase was seen in the cinnamon supplemented group followed by cloves, garlic and turmeric groups. Results of the study revealed greater scope for increasing the HDL cholesterol levels by supplementing spices such as cinnamon, cloves, garlic and turmeric. Elevated levels of HDL cholesterol actually lower the risk of CHD (greater than or equal to 60 mg/dl) and is considered a negative risk factor for CHD (Gardner *et al.*, 2007).

5. Changes in the LDL Cholesterol Levels of the Selected Adults

The changes in the LDL cholesterol levels of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus before and after spice supplementation are presented in Table XXXI and Figures 10 and 11. (Appendix XIV and XV)

TABLE XXXI
CHANGES IN THE MEAN LDL CHOLESTEROL LEVELS
OF THE SELECTED ADULTS

Groups	LDL Cholesterol (mg / dl) Mean \pm SD			't' value	
	Initial (I)	Final (F)	Difference	I Vs F	Between Groups
Experimental I - Hyperlipidemics					
Cinnamon HA	174.93 \pm 27.22	112.16 \pm 16.06	-62.77 \pm 27.39	8.87**	HA Vs HE 9.07**
Cloves HB	177.2 \pm 23.41	130.84 \pm 15.55	-46.36 \pm 17.51	8.42**	HB Vs HE 10.23**
Garlic HC	168.61 \pm 22.36	140.73 \pm 14.3	-27.88 \pm 17.74	5.00**	HC Vs HE 6.58**
Turmeric HD	170.2 \pm 16.2	154.86 \pm 16.1	-15.34 \pm 18.41	3.22**	HD Vs HE 4.06**
Control I HE	170.42 \pm 16.11	176.95 \pm 17.01	+6.53 \pm 8.24	2.52*	
Experimental II - Hyperlipidemia with Diabetes Mellitus					
Cinnamon HDA	177.74 \pm 9.66	124.12 \pm 8.45	-53.62 \pm 10.41	19.93**	HDA Vs HDE 17.48**
Cloves HDB	184.79 \pm 10.27	134.29 \pm 9.22	-50.5 \pm 11.69	16.72**	HDB Vs HDE 14.92**
Garlic HDC	177.19 \pm 12.64	146.8 \pm 11.21	-30.39 \pm 7.21	16.31**	HDC Vs HDE 13.10**
Turmeric HDD	177.98 \pm 11.47	144.87 \pm 10.03	-33.11 \pm 8.12	15.77**	HDD Vs HDE 13.10**
Control II HDE	178.73 \pm 8.18	177.76 \pm 9.16	-0.31 \pm 4.67	0.26 ^{NS}	

Optimal : < 100 mg / dl
Near optimal : 100 to 129 mg / dl
Borderline high : 130 to 159 mg / dl
High : 160 to 189 mg / dl
Very high : > 189 mg / dl (NCEP, 2001)
** P < 0.01; Significant at 1 per cent level

The LDL cholesterol levels of hyperlipidemic adults before supplementation of cinnamon, cloves, garlic and turmeric were 174.93 mg/dl, 177.2 mg/dl, 168.61 mg/dl and 170.2 mg/dl respectively and found to be in the higher range of 160 to 189 mg/dl (NCEP, 2001).

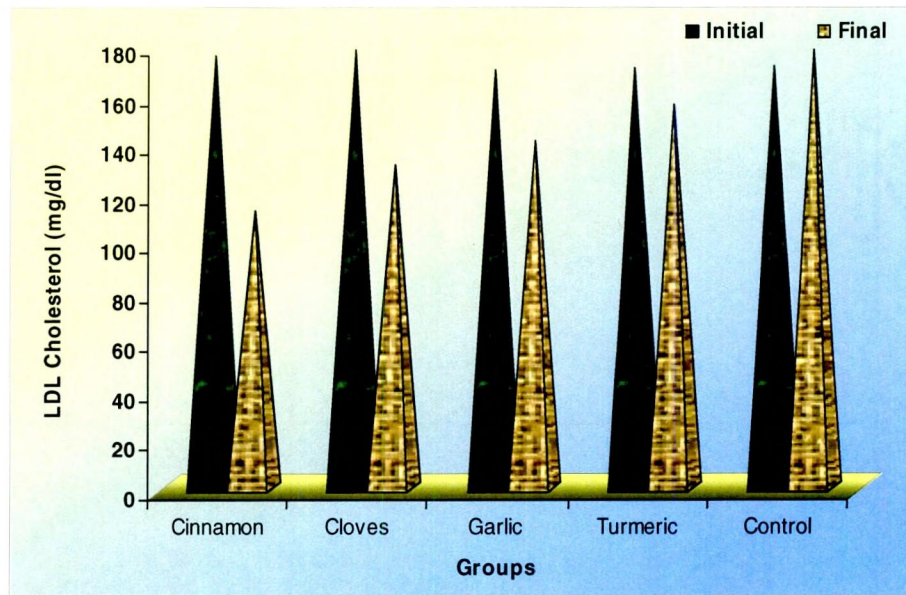


FIGURE 10

LDL CHOLESTEROL LEVELS OF HYPERLIPIDEMIC ADULTS BEFORE AND AFTER SPICE SUPPLEMENTATION

It showed a reduction of 62.77 mg/dl, 46.36 mg/dl, 27.88 mg/dl and 15.34 mg/dl among the cinnamon, cloves, garlic and turmeric supplemented groups respectively after three months of supplementation. These values were found to be in the near optimal range of 100 to 129 mg/dl (NCEP, 2001) in cinnamon and cloves supplemented groups. Though the LDL cholesterol levels decreased in garlic and turmeric supplemented groups they were still in the borderline high risk category of 130 to 159 mg/dl. The differences in the LDL cholesterol levels in all the four supplemented groups were statistically significant at one per cent level.

There was a significant increase in the LDL cholesterol level in the control group at five per cent level. The changes in the LDL cholesterol levels of the four groups with the control group was also found to be significant at one per cent level ($P < 0.01$) with a higher reduction in the cloves supplemented group followed by cinnamon group. Half teaspoon of cinnamon per day can lower LDL cholesterol (Khan *et al.*, 2003).

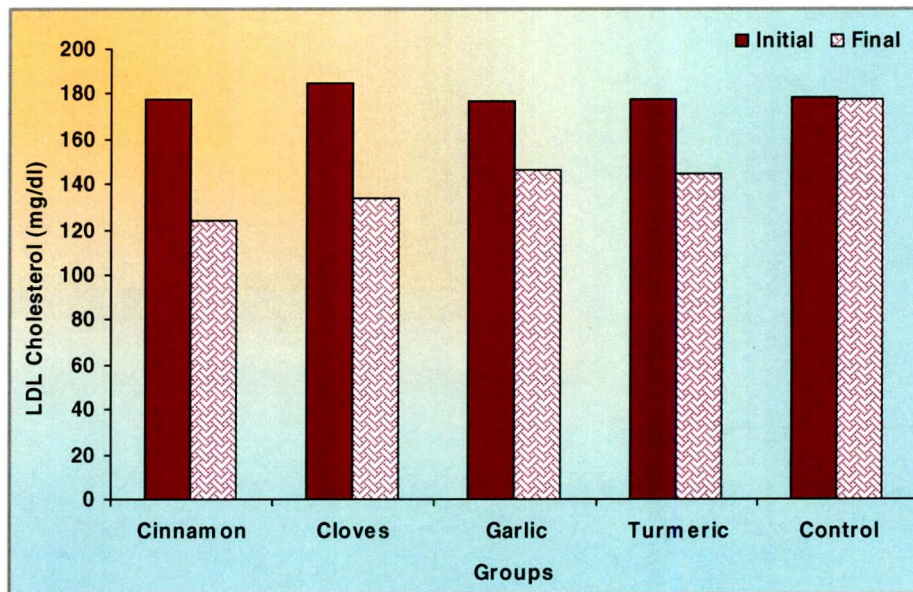


FIGURE 11

LDL CHOLESTEROL LEVELS OF ADULTS WITH HYPERLIPIDEMIA AND DIABETES MELLITUS BEFORE AND AFTER SPICE SUPPLEMENTATION

LDL cholesterol levels in the cinnamon, cloves, garlic and turmeric groups of adults with hyperlipidemia and diabetes mellitus were found to be in the high risk category of 160 to 189 mg/dl initially ranging from 177.74 mg/dl to 184.79 mg/dl. After supplementation with spices for three months there was a reduction in the LDL cholesterol levels in the cinnamon group by 53.62 mg/dl and cloves group 50.5 mg/dl which were found to be significant at one per cent level. A lower reduction was found in the garlic group (30.39 mg/dl) and turmeric group (33.11 mg/dl). LDL cholesterol level in the control group did not show any change. The reduction in the LDL cholesterol levels in all the four spices supplemented groups compared with control group was found to be significant at one per cent level. Maximum reduction between groups was seen in the cinnamon and clove supplemented group.

6. Changes in the VLDL Cholesterol Levels of the Selected Adults

Table XXXII and FigureS 12 and 13 gives the VLDL cholesterol levels of the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus before and after supplementation of spices. (Appendix XVI and XVII)

TABLE XXXII
CHANGES IN THE MEAN VLDL CHOLESTEROL LEVELS
OF THE SELECTED ADULTS

Groups	VLDL Cholesterol (mg / dl) Mean \pm SD			't' value	
	Initial (I)	Final (F)	Difference	I Vs F	Between Groups
Experimental I - Hyperlipidemics					
Cinnamon HA	38.07 \pm 4.96	29.4 \pm 3.47	-8.66 \pm 2.66	12.61**	HA Vs HE 10.42**
Cloves HB	37.12 \pm 4.32	28.19 \pm 2.94	-8.93 \pm 2.66	10.69**	HB Vs HE 10.74**
Garlic HC	37.28 \pm 3.12	27.73 \pm 3.57	-9.55 \pm 3.92	7.74**	HC Vs HE 8.46**
Turmeric HD	35.65 \pm 4.46	37.72 \pm 5.58	+2.07 \pm 2.78	2.87*	HD Vs HE 2.31*
Control I HE	39.08 \pm 6.31	39.15 \pm 5.64	+0.07 \pm 1.66	0.13 ^{NS}	
Experimental II - Hyperlipidemia with Diabetes Mellitus					
Cinnamon HDA	34.97 \pm 2.54	27.73 \pm 2.19	-7.24 \pm 2.03	13.83**	HDA Vs HDE 12.38**
Cloves HDB	34.67 \pm 2.77	28.11 \pm 1.68	-6.56 \pm 1.41	18.00**	HDB Vs HDE 14.48**
Garlic HDC	33.87 \pm 2.19	30.96 \pm 1.83	-2.91 \pm 1.28	8.79**	HDC Vs HDE 7.37**
Turmeric HDD	34.16 \pm 2.19	31.77 \pm 2.07	-2.39 \pm 0.87	10.58**	HDD Vs HDE 7.45**
Control II HDE	35.41 \pm 2.42	35.73 \pm 2.55	0.48 \pm 1.15	1.61 ^{NS}	

Normal value : 5 to 40 mg / dl (NCEP, 2001)

* P < 0.05; Significant at 5 per cent level

** P < 0.01; Significant at 1 per cent level

The initial serum VLDL cholesterol levels in the experimental groups of cinnamon, cloves, garlic, turmeric and control groups of hyperlipidemic adults were 38.07 mg/dl, 37.12 mg/dl, 37.28 mg/dl, 35.65 mg/dl and 39.08 mg/dl respectively and their values were in the higher range of normal values of 5 to 40 mg/dl as per NCEP (2001).

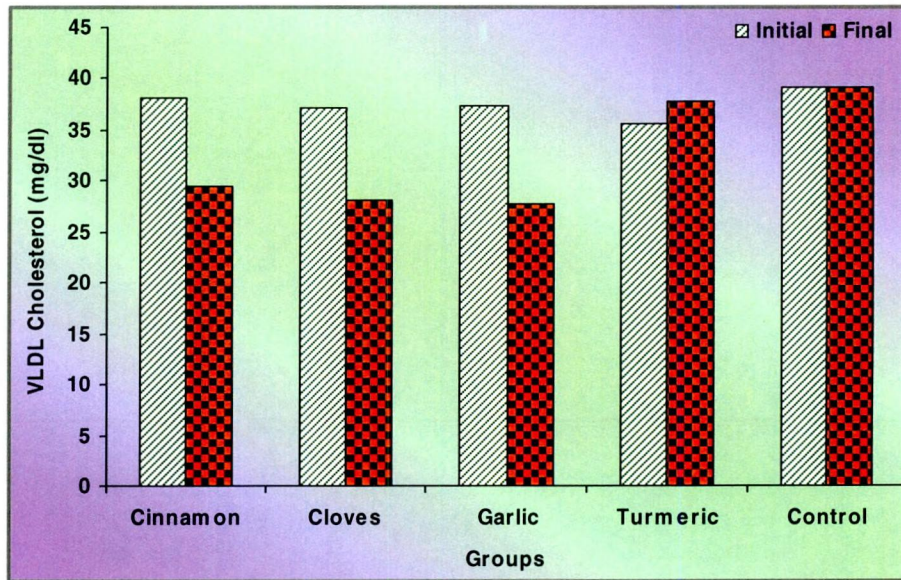


FIGURE 12

VLDL CHOLESTEROL LEVELS OF HYPERLIPIDEMIC ADULTS BEFORE AND AFTER SPICE SUPPLEMENTATION

At the end of the supplementation period of three months there was a reduction in the VLDL cholesterol levels among the cloves, cinnamon and garlic group. There was a slight increase of 2.07 mg/dl in the turmeric supplemented group and no change was observed in the control group. The reduction in the VLDL cholesterol levels in the cinnamon, clove and garlic supplemented groups were found to be significant at one per cent level ($P < 0.01$). A comparison of all the four spice groups with the control group revealed a statistically significant difference at one per cent level except turmeric group which showed a five per cent level of significance.

The mean initial VLDL cholesterol levels in the experimental and control groups of adults with hyperlipidemia and diabetes mellitus were 34.97 mg/dl (cinnamon group), 34.67 mg/dl (clove group), 33.87 mg/dl (garlic group) 34.16 mg/dl (turmeric group) and 35.41 mg/dl (control group) which were closer to the higher range of normal values. On supplementation with spices, the cinnamon group showed a reduction of 7.24 mg/dl being the maximum followed by 6.56 mg/dl among the cloves supplemented group which was in the desirable range bringing out the potentials of cinnamon and cloves.

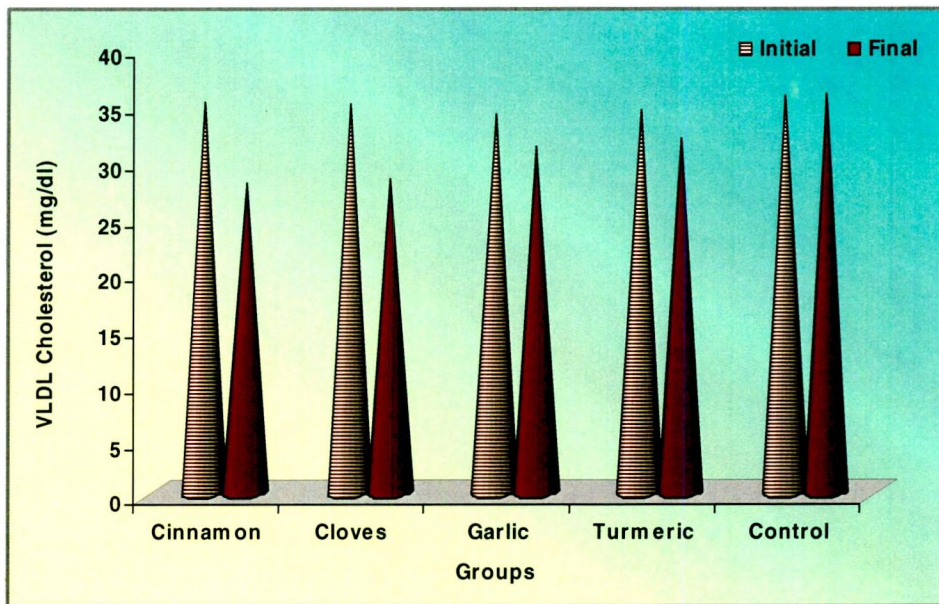


FIGURE 13

VLDL CHOLESTEROL LEVELS OF ADULTS WITH HYPERLIPIDEMIA AND DIABETES MELLITUS BEFORE AND AFTER SPICE SUPPLEMENTATION

The mean VLDL cholesterol levels reduced by 2.91 and 2.39 mg/dl respectively among the garlic and turmeric supplemented groups. The decrease in the VLDL cholesterol levels between initial and final values was significant at one per cent level in the experimental groups whereas the difference in the control group was not significant. Differences in the VLDL cholesterol levels in the spices supplemented groups with control group were also statistically significant at one per cent level. The findings revealed that all the four selected spices had the potential of lowering the risky VLDL cholesterol levels among adults.

7. Changes in the Fasting Blood Sugar Levels of the Selected Adults

Table XXXIII and Figure 14 present the fasting blood sugar levels among adults with hyperlipidemia and diabetes mellitus before and after supplementation of spices. (Appendix XVIII).

TABLE XXXIII
CHANGES IN THE MEAN FASTING BLOOD SUGAR LEVELS
OF THE SELECTED ADULTS

Groups	Fasting Blood Sugar (mg/dl) Mean \pm SD			't' value	
	Initial (I)	Final (F)	Difference	I Vs F	Between Groups
Cinnamon HDA	161.00 \pm 9.51	113.93 \pm 6.3	-47.07 \pm 9.57	19.03**	HDA Vs HDE 18.10**
Cloves HDB	163.93 \pm 7.71	124.2 \pm 3.73	-39.73 \pm 7.91	19.45**	HDB Vs HDE 18.31**
Garlic HDC	163.53 \pm 12.15	136.47 \pm 6.3	-27.07 \pm 8.68	12.07**	HDC Vs HDE 11.49**
Turmeric HDD	165.07 \pm 9.91	149 \pm 9.66	-16.07 \pm 7.51	8.28**	HDD Vs HDE 7.89**
Control II HDE	165.87 \pm 9.24	165.33 \pm 9.48	+0.4 \pm 2.16	0.72 ^{NS}	

Desirable level : 80 to 115 mg / dl (Bamji *et al.*, 2003)

* P < 0.05; Significant at 5 per cent level

** P < 0.01; Significant at 1 per cent level

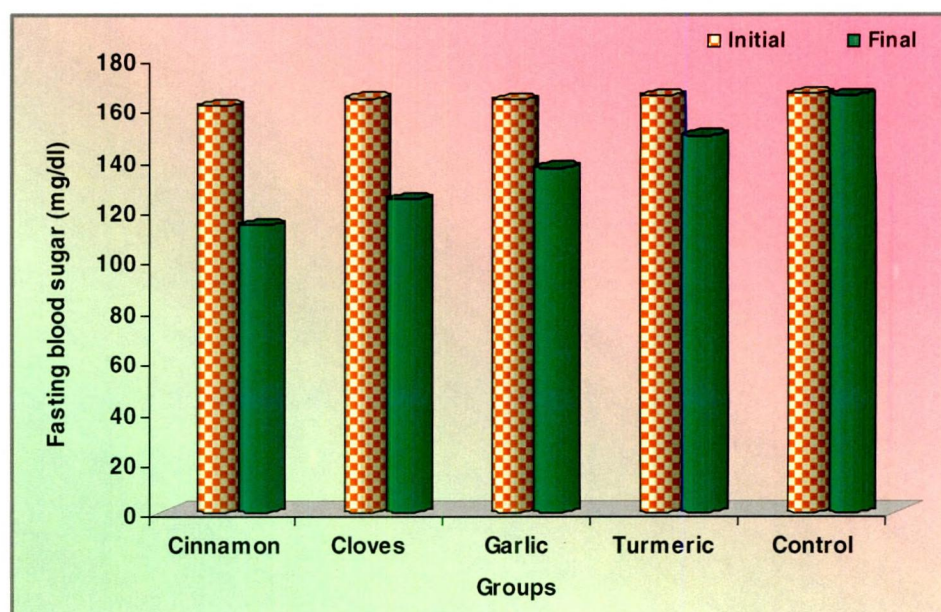


FIGURE 14

FASTING BLOOD SUGAR LEVELS OF ADULTS WITH HYPERLIPIDEMIA
AND DIABETES MELLITUS BEFORE AND AFTER SPICE
SUPPLEMENTATION

The initial mean fasting blood sugar level in the control and experimental groups of adults with hyperlipidemia and diabetes mellitus were 161 mg/dl in the cinnamon group, 163.93 mg/dl in the cloves group, 163.53 mg/dl in the garlic group, 165.07 mg/dl in the turmeric group and 165.87 mg/dl in the control group which were well above the normal range of 80 to 115 mg/dl (Bamji *et al.*, 2003). Adults in the supplementation group improved their fasting blood sugar levels after three months period. A maximum reduction of fasting blood sugar level was seen among the cinnamon group with 47.07 mg/dl, cloves group with 39.73 mg/dl followed by garlic group with 27.07 mg/dl and turmeric group with 16.07 mg/dl.

The fasting blood sugar levels were brought to normal among cinnamon and cloves supplemented groups bringing out the impact of supplementation of spices whereas in garlic and turmeric group the levels remained slightly higher. This decrease in the initial and final values in the experimental groups with regard to fasting blood sugar levels were significant at one per cent level whereas the difference in the control group was not significant. Difference in the fasting blood sugar levels between the experimental and control groups also revealed a statistically significant reduction at one per cent level.

8. Changes in the Post Prandial Blood Sugar Levels of the Selected Adults

Table XXXIV and Figure 15 give the post prandial blood sugar levels of the adults with hyperlipidemia and diabetes mellitus before and after supplementation with spices. (Appendix XIX)

The mean post prandial blood sugar levels before supplementation was 262.6 mg/dl, 265.33 mg/dl, 270.13 mg/dl, 261.27 mg/dl and 259.53 mg/dl in the cinnamon, cloves, garlic and turmeric supplemented groups with control group which was much higher than the normal range of 120 to 160 mg/dl (Bamji *et al.*, 2003). There was a reduction observed in the post prandial blood sugar levels due to supplementation with spices over a period of three months.

TABLE XXXIV
CHANGES IN THE MEAN POST PRANDIAL BLOOD SUGAR LEVELS
OF THE SELECTED ADULTS

Groups	Post Prandial Blood Sugar (mg / dl) Mean \pm SD			't' value	
	Initial (I)	Final (F)	Difference	I Vs F	Between Groups
Cinnamon HDA	262.6 \pm 11.69	206.6 \pm 9.7	-56.0 \pm 9.57	22.65**	HDA Vs HDE 17.56**
Cloves HDB	265.33 \pm 19.33	215.67 \pm 15.18	-42.47 \pm 28.66	5.73**	HDB Vs HDE 4.83**
Garlic HDC	270.13 \pm 13.22	235 \pm 13.15	-35.13 \pm 9.8	13.87**	HDC Vs HDE 10.20**
Turmeric HDD	261.27 \pm 15.74	239.47 \pm 19.4	-21.8 \pm 9.2	9.17**	HDD Vs HDE 5.99**
Control II HDE	259.53 \pm 13.31	254.67 \pm 14.97	-4.87 \pm 5.21	3.62**	

Desirable level : 120 to 160 mg / dl (Bamji *et al.*, 2003)

** P < 0.01; Significant at 1 per cent level

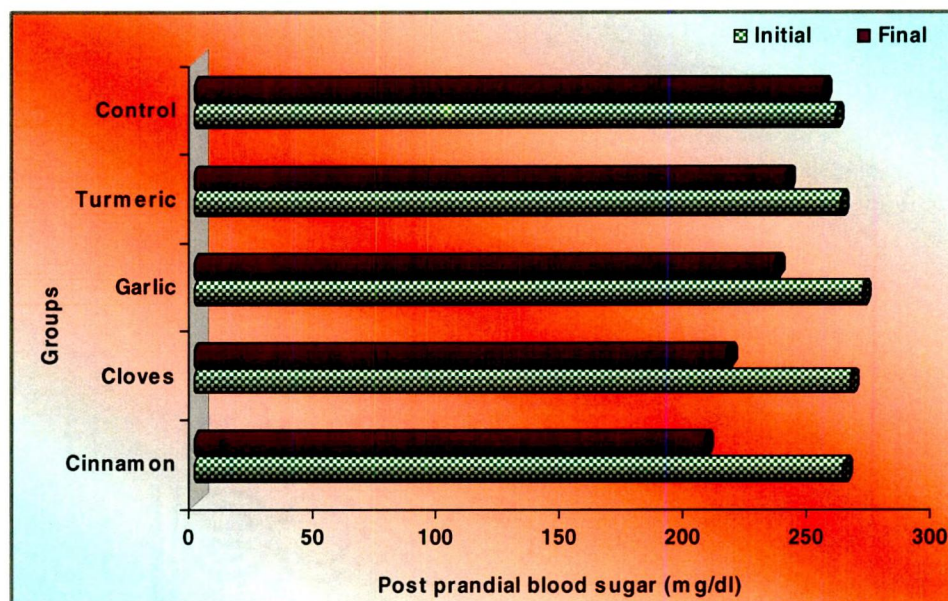


FIGURE 15
POST PRANDIAL BLOOD SUGAR LEVELS OF ADULTS WITH HYPERLIPIDEMIA
AND DIABETES MELLITUS BEFORE AND AFTER
SPICE SUPPLEMENTATION

The reduction in the post prandial blood sugar levels were found to be 56 mg/dl, 42.47 mg/dl, 35.13 mg/dl and 21.8 mg/dl among the cinnamon, cloves, garlic and turmeric supplemented groups which were found to be statistically significant at one per cent level. Even the control group showed a reduction in the post prandial sugar levels of 4.87 mg/dl which was negligible. This reduction in the supplemented groups was significant at one per cent level. Comparison of post prandial blood sugar levels between the experimental and control groups showed that all the groups were significant at one per cent level. But cinnamon was more effective in reducing the post prandial sugar level than other spices over the supplementation period of three months.

9. Changes in the Glycosylated Haemoglobin Levels of the Selected Adults

Table XXXV and Figure 16 present the blood glycosylated haemoglobin levels among the adults with hyperlipidemia and diabetes mellitus before and after supplementation of spices. (Appendix XX)

TABLE XXXV
CHANGES IN THE MEAN GLYCOSYLATED HAEMOGLOBIN LEVELS OF THE SELECTED ADULTS

Groups	Glycosylated Haemoglobin (per cent / 100 ml) Mean \pm SD			't' value	
	Initial (I)	Final (F)	Difference	I Vs F	Between Groups
Cinnamon HDA	7.91 \pm 0.52	5.96 \pm 0.55	-1.95 \pm 0.67	11.29**	HDA Vs HDE 10.78**
Cloves HDB	8.1 \pm 0.48	7.25 \pm 0.6	-0.85 \pm 0.86	3.79**	HDB Vs HDE 3.64**
Garlic HDC	8.16 \pm 0.51	7.95 \pm 0.53	-0.21 \pm 0.19	4.11**	HDC Vs HDE 3.70**
Turmeric HDD	8.15 \pm 0.45	7.95 \pm 0.41	-0.2 \pm 0.16	4.97**	HDD Vs HDE 4.07**
Control II HDE	7.85 \pm 0.43	7.84 \pm 0.41	-0.01 \pm 0.07	0	

Non diabetic : 4 to 5.6 per cent

Good control : 5.6 to 7 per cent

Fair control : 7 to 8 per cent

Poor control : above 8 per cent (Trivedi *et al.*, 1978)

** P < 0.01; Significant at 1 per cent level

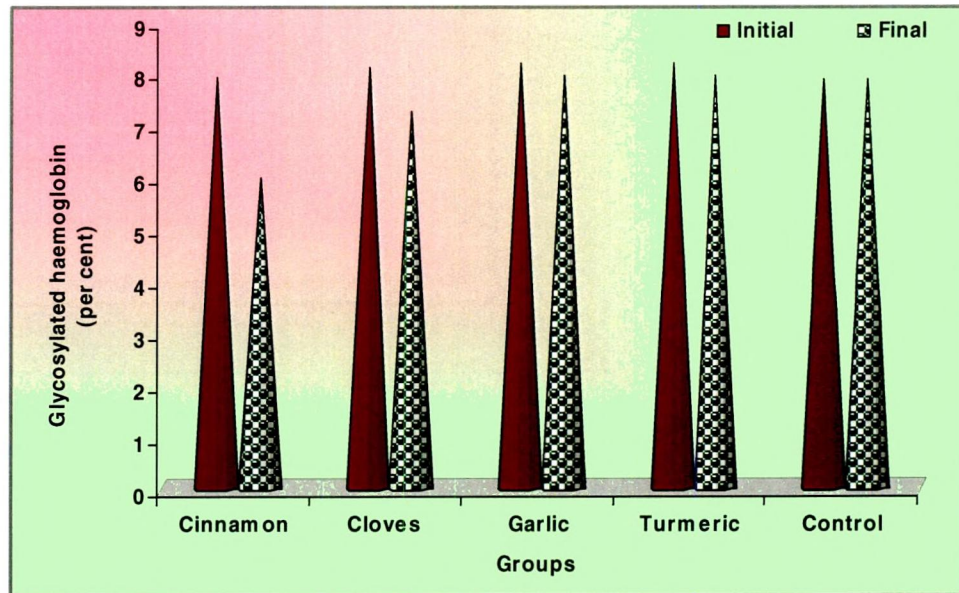


FIGURE 16

GLYCOSYLATED HAEMOGLOBIN LEVELS OF ADULTS WITH HYPERLIPIDEMIA AND DIABETES MELLITUS BEFORE AND AFTER SPICE SUPPLEMENTATION

The mean glycosylated haemoglobin levels of the adults with hyperlipidemia and diabetes mellitus were 7.91 per cent/100 ml, 8.1 per cent/100 ml, 8.16 per cent/100 ml, 8.15 per cent/100 ml and 7.85 per cent/100 ml among cinnamon, cloves, garlic, turmeric supplemented groups and control groups respectively which were nearer to poor control levels of more than 8 per cent/100 ml initially (Trivedi *et al.*, 1978). A reduction of 1.95 per cent / 100 ml was observed in the cinnamon group but among other groups the reduction was found to range from 0.2 to 0.85 per cent/100 ml after a period of three months of supplementation. The decrease in experimental groups was found to be statistically significant at one per cent level ($P < 0.01$). No change was observed in the control group. A comparison of all the groups with the control group revealed a statistically significant reduction at one per cent level with regard to glycosylated haemoglobin levels.

10. Comparison of the Selected Spices on the Biochemical Profile of the Hyperlipidemic Adults

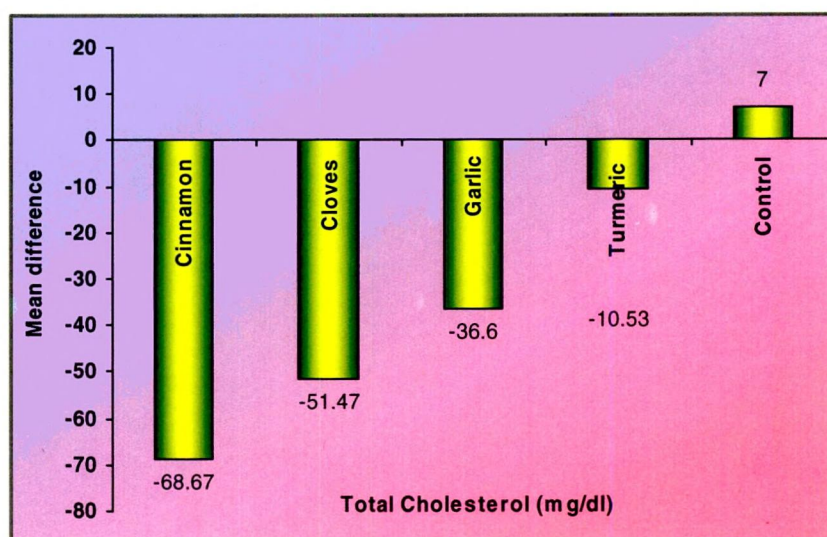
Table XXXVI gives the comparison on the biochemical profile of the hyperlipidemic adults before and after supplementation with spices.

TABLE XXXVI

COMPARISON OF THE SELECTED SPICES ON THE BIOCHEMICAL PROFILE OF THE HYPERLIPIDEMIC ADULTS

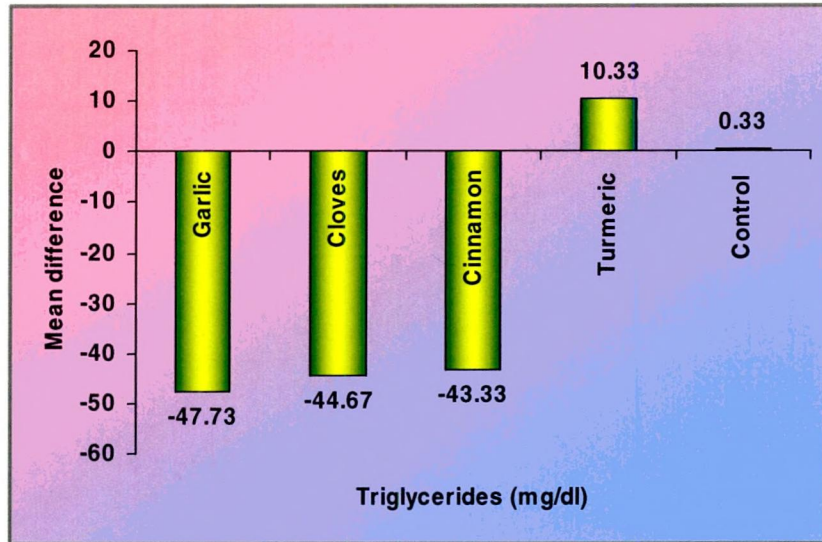
Lipid profile	Groups / Mean difference				
	1	2	3	4	5
Total cholesterol (mg/dl)	Cinnamon -68.67	Cloves -51.47	Garlic -36.6	Turmeric -10.53	Control +7.00
Triglycerides (mg/dl)	Garlic -47.73	Cloves -44.67	Cinnamon -43.33	Turmeric +10.33	Control +0.33
HDL cholesterol (mg/dl)	Cloves +3.83	Cinnamon +2.77	Turmeric +2.74	Garlic +0.83	Control +0.71
LDL cholesterol (mg/dl)	Cinnamon -62.77	Cloves -46.36	Garlic -27.88	Turmeric -15.34	Control +6.53
VLDL cholesterol (mg/dl)	Garlic -9.55	Cloves -8.93	Cinnamon -8.66	Turmeric +2.07	Control +0.07

a. Total Cholesterol



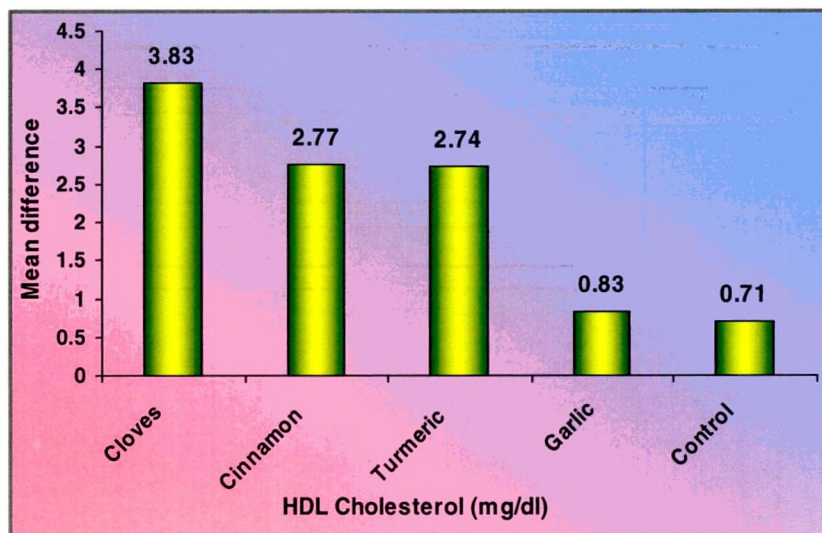
It is observed that a maximum reduction of 68.67 mg/dl of total cholesterol was shown in the cinnamon supplemented group followed by cloves, garlic and turmeric supplemented groups with 51.47 mg/dl, 36.6 mg/dl and 10.53 mg/dl respectively. The present study revealed that to lower the total cholesterol level among the hyperlipidemics cinnamon is highly effective.

b. Triglycerides



A maximum reduction of triglyceride levels among the hyperlipidemic adults was observed in the garlic supplemented group with 47.73 mg/dl followed by cloves with 44.67 mg/dl, cinnamon with 43.33 mg/dl and an increase in turmeric 10.33 mg/dl supplemented groups. Triglyceride levels of the hyperlipidemic adults are better lowered by supplementing with garlic, cloves and cinnamon powders.

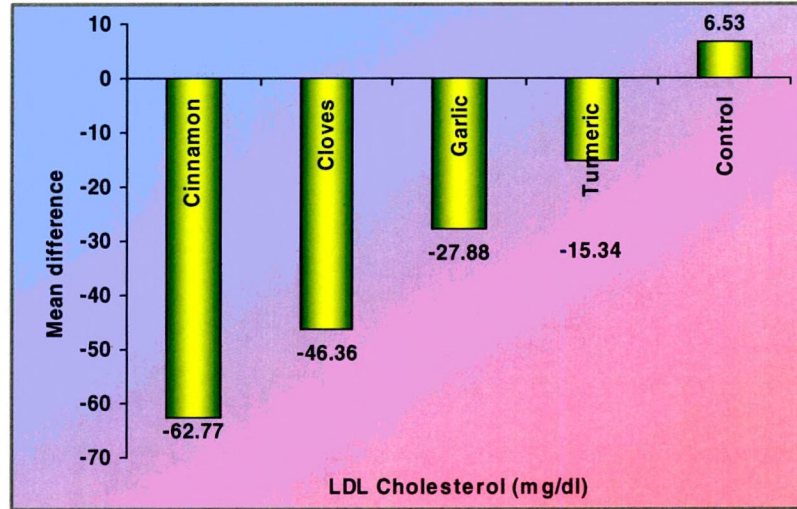
c. HDL Cholesterol



In the case of HDL cholesterol, an increase of 3.83 mg/dl was observed in groups supplemented with cloves after a period of three months. Among

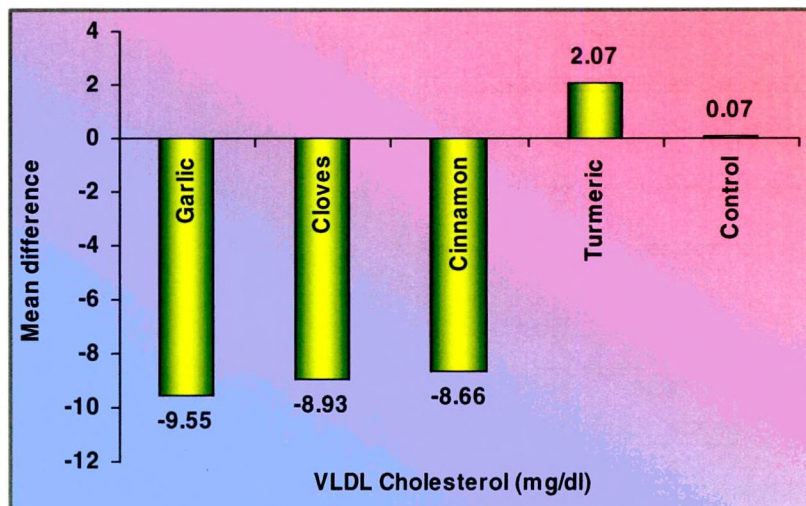
cinnamon supplemented group an increase of 2.77 mg/dl was observed followed by turmeric with 2.74 mg/dl and garlic with 0.83 mg/dl. Thus, an increase of HDL cholesterol levels of the hyperlipidemic adults could be achieved by cloves supplementation.

d. LDL Cholesterol



As far as LDL cholesterol is concerned, 62.77 mg/dl decrease was observed in the group supplemented with cinnamon. This was followed by cloves, garlic and turmeric with 46.36 mg/dl, 27.88 mg/dl and 15.34 mg/dl respectively. A maximum reduction in the LDL cholesterol among hyperlipidemic adults could be achieved through the consumption of cinnamon powders.

e. VLDL Cholesterol



Among the hyperlipidemic adults supplemented with the spices it was clearly seen that a maximum reduction of 9.55 mg/dl in VLDL cholesterol was observed in adults who were supplemented with garlic followed by 8.93 mg/dl reduction in cloves group and 8.66 mg/dl in cinnamon group whereas an increase of 2.07 mg/dl among turmeric group. According to the present study to reduce the VLDL cholesterol levels of the hyperlipidemic adults it is recommended to supplement the diet with garlic, cloves and cinnamon powders.

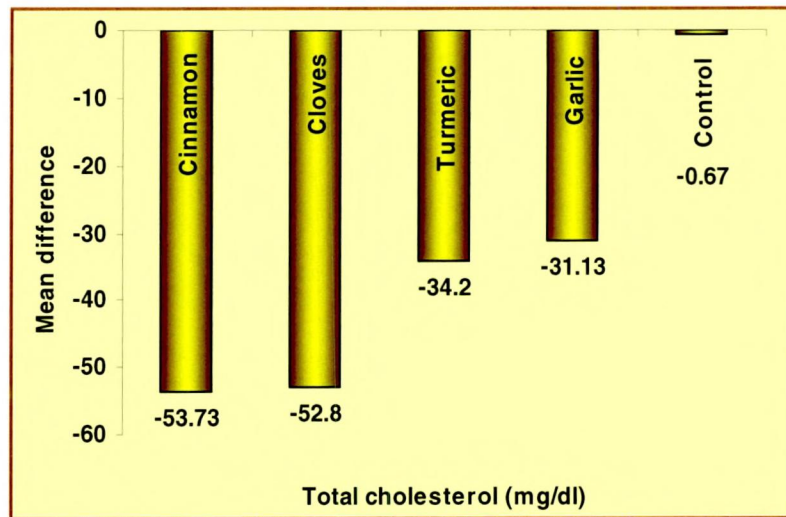
11. Comparison of the Selected Spices on the Biochemical Profile of the Adults with Hyperlipidemia and Diabetes Mellitus

Table XXXVII gives the comparison on the biochemical profile of the adults with hyperlipidemia and diabetes mellitus before and after supplementation with spices.

**TABLE XXXVII
COMPARISON OF THE SELECTED SPICES ON THE BIOCHEMICAL PROFILE OF THE ADULTS WITH HYPERLIPIDEMIA AND DIABETES MELLITUS**

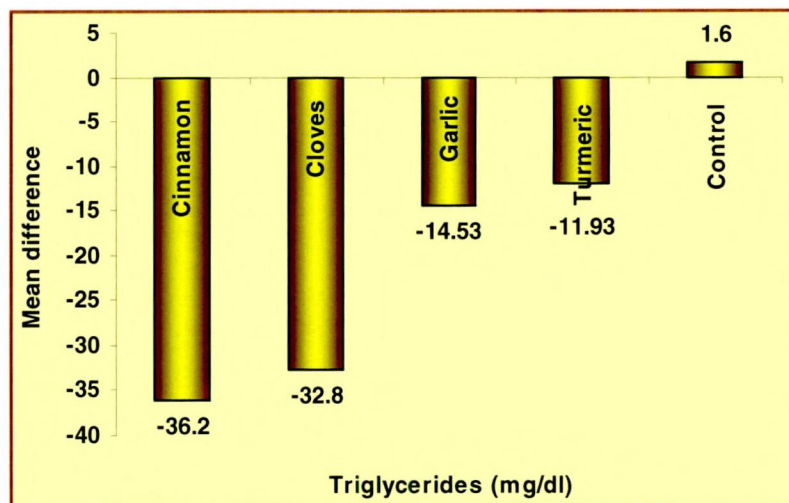
Blood Parameters	Groups / Mean difference				
	1	2	3	4	5
Total cholesterol (mg/dl)	Cinnamon -53.73	Cloves -52.8	Turmeric -34.2	Garlic -31.13	Control -0.67
Triglycerides (mg/dl)	Cinnamon -36.2	Cloves -32.8	Garlic -14.53	Turmeric -11.93	Control +1.6
HDL cholesterol (mg/dl)	Cinnamon +7.13	Cloves +4.26	Garlic +2.16	Turmeric +1.3	Control 0.02
LDL cholesterol (mg/dl)	Cinnamon -53.62	Cloves -50.5	Turmeric -33.11	Garlic -30.39	Control -0.31
VLDL cholesterol (mg/dl)	Cinnamon -7.24	Cloves -6.56	Garlic -2.91	Turmeric -2.39	Control +0.48
Blood sugar					
Fasting blood sugar (mg/dl)	Cinnamon -47.07	Cloves -39.73	Garlic -27.07	Turmeric -16.07	Control +0.4
Post prandial blood sugar (mg/dl)	Cinnamon -56.0	Cloves -42.47	Garlic -35.13	Turmeric -21.8	Control -4.87
Glycosylated haemoglobin (per cent/100ml)	Cinnamon -1.95	Cloves -0.85	Garlic -0.21	Turmeric -0.2	Control -0.01

a. Total Cholesterol



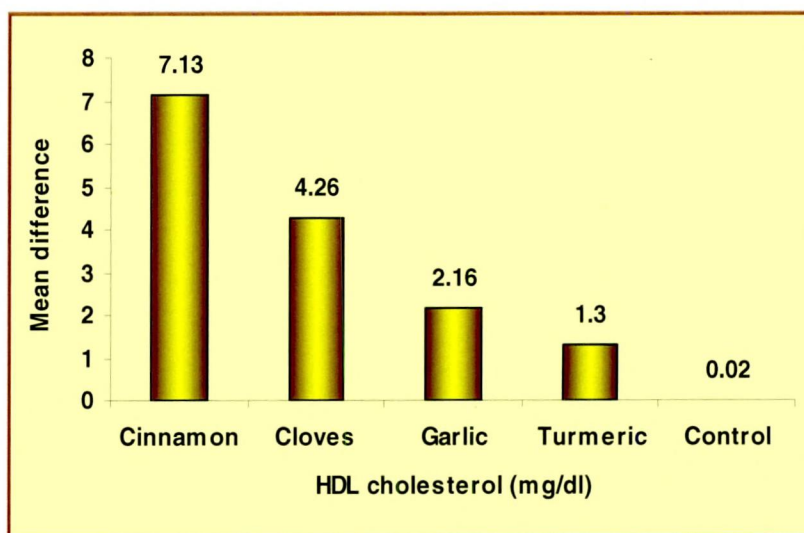
It is observed among the adults with hyperlipidemia and diabetes mellitus, that, the total cholesterol levels had a maximum reduction in the group supplemented with cinnamon with a mean difference of 53.73 mg/dl, followed by cloves with 52.8 mg/dl, turmeric 34.2 mg/dl and garlic with 31.13 mg/dl.

b. Triglycerides



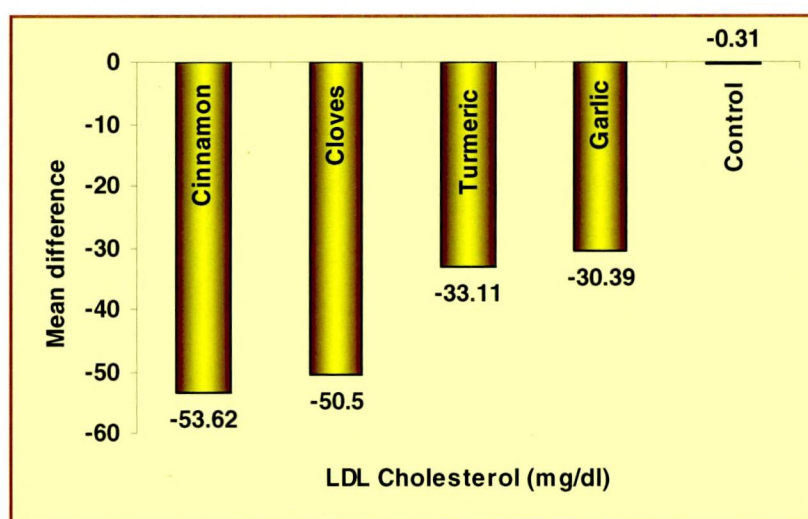
Maximum reduction in triglycerides among the adults with hyperlipidemia and diabetes mellitus was observed in cinnamon supplemented group with 36.2 mg/dl followed by cloves, garlic and turmeric with a mean difference of 32.8 mg/dl, 14.53 mg/dl and 11.93 mg/dl respectively.

c. HDL cholesterol



The adults with hyperlipidemia and diabetes mellitus who consumed cinnamon for a period of three months showed a maximum increase in the HDL cholesterol with a mean difference of 7.13 mg/dl whereas cloves supplemented group showed a mean difference of 4.26 mg. A minimal change in HDL cholesterol was observed in the garlic (2.16 mg/dl) and turmeric (1.3 mg/dl) supplemented groups.

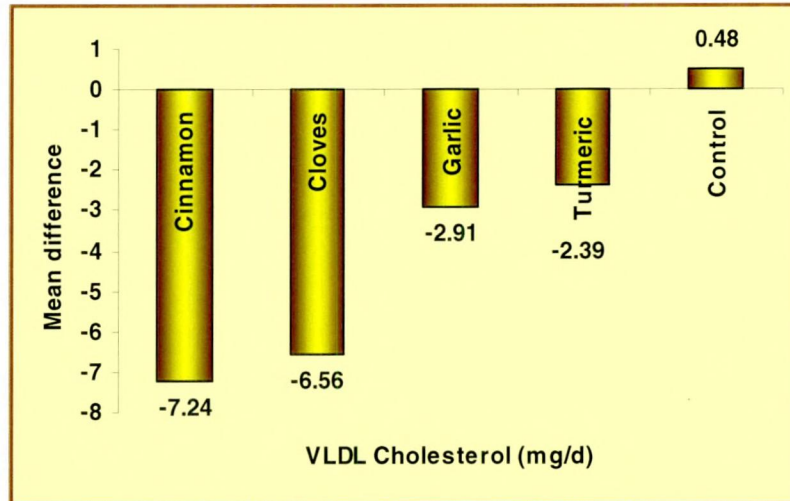
d. LDL cholesterol



A maximum decrease in LDL cholesterol in the adults supplemented with cinnamon and cloves with 53.62 mg/dl and 50.5 mg/dl whereas the reduction

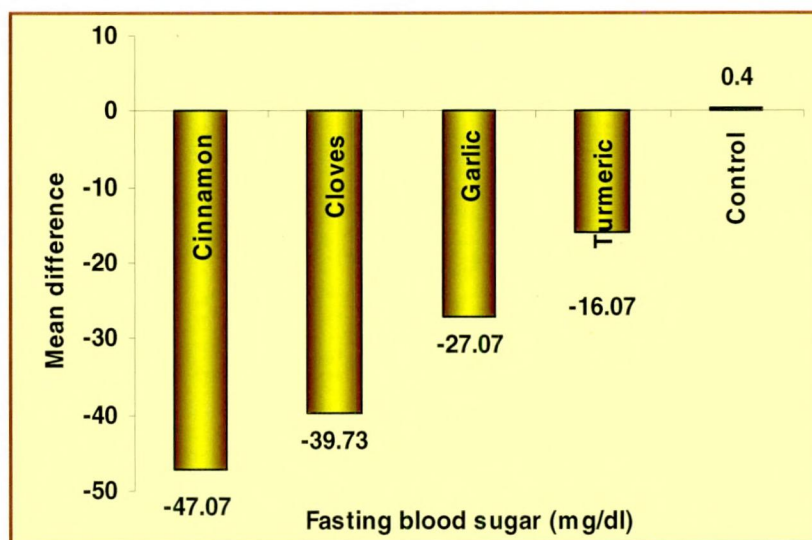
was less among turmeric (33.11 mg/dl) and garlic (30.39 mg/dl) groups over a three months period of supplementation.

e. VLDL cholesterol



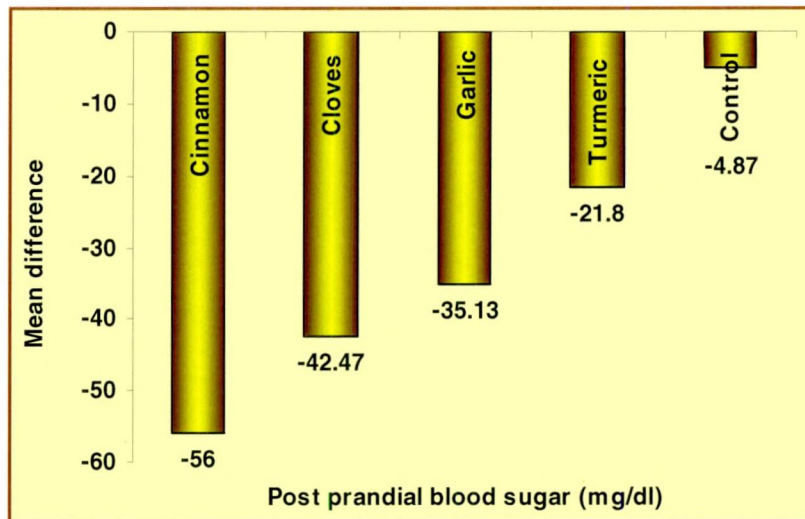
It was seen that among the adults with hyperlipidemia and diabetes mellitus a maximum reduction in VLDL cholesterol was observed in groups supplemented with cinnamon (7.24 mg/dl), followed by cloves (6.56 mg/dl), with a minimum reduction among garlic (2.9 mg/dl) and turmeric (2.39 mg/dl) groups respectively.

f. Fasting blood sugar



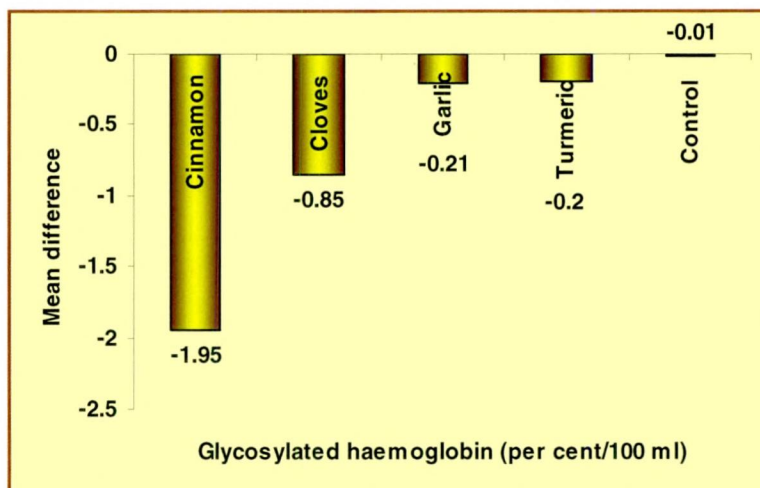
Fasting blood sugar levels showed a maximum reduction of 47.07 mg/dl in cinnamon supplemented group among the adults with hyperlipidemia and diabetes mellitus followed by cloves group with 39.73 mg/dl, garlic 27.07 mg/dl and turmeric 16.07 mg/dl.

g. Post prandial blood sugar



The post prandial blood sugar of the hyperlipidemic with diabetes mellitus adults showed a mean difference of 56 mg/dl in cinnamon supplemented group. This was followed by cloves with 42.47 mg/dl, garlic with 35.13 mg/dl and turmeric with 21.8 mg/dl after a supplementation of three months.

h. Glycosylated haemoglobin



Among the adults with hyperlipidemia and diabetes mellitus the glycosylated haemoglobin showed a maximum mean difference of 1.95 per cent/100ml in cinnamon supplemented group. Cloves supplemented group showed a mean difference of 0.85 per cent/100 ml, garlic with 0.21 per cent/100 ml and turmeric with 0.2 per cent/100 ml.

11. Feedback from the Adults of the Supplementation Study

The feedback obtained from the hyperlipidemic adults and adults with hyperlipidemia and diabetes mellitus revealed that the adults supplemented with cinnamon and cloves reported that they were very active and brisk throughout the study period of three months. They were able to work round the clock without any tiredness inspite of work stress and tensions until they go to bed. Also, they felt refreshed when they wake up in the morning. The adults supplemented with garlic and turmeric expressed that they did not come across any infections like cold, cough, asthma, wheezing and fever during the three months. All the adults said that they had no headache, giddiness, fatigue, stomach upsets like indigestion and diarrhoea. Many adults expressed that they were relieved of gastric problems and acidity particularly the adults supplemented with garlic capsules.

From the foregoing parameters on lipid profile and sugar levels on the hyperlipidemics and adults with hyperlipidemia and diabetes mellitus on supplementation with spices namely cinnamon, cloves, garlic and turmeric it could be clearly seen that the cinnamon and clove supplementation were more effective than the garlic and turmeric supplementation. Further long term supplementation studies are required to give conclusive evidence. Comprehensive spicy therapeutic regimen thus offers time tested safe and effective support to conventional therapy in the management of hyperlipidemia and diabetes. This in combination with adequate nutritional support and lifestyle management would provide an integrated approach to the management of hyperlipidemia and type 2 diabetes.