Results and Discussion

IV. RESULTS AND DISCUSSION

The findings of the present study on **"EFFECT OF SUPPLEMENTATION OF SELECTED NEUTRACEUTICALS ON TYPE II DIABETICS"** are discussed under the following headings.

A. BACKGROUND INFORMATION OF THE SELECTED DIABETIC SUBJECTS

1. Age and sex of the selected diabetic subjects
2. Educational qualification
3. Activity pattern
4. Type of family
5. Monthly income levels

B. MEDICAL HISTORY OF THE SELECTED DIABETIC SUBJECTS

1. Personal history
2. Family history
3. Type of treatment
4. Exercise history
5. Complications
6. Life style pattern

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2. Dietary and food consumption pattern

D. MEAN ACCEPTABILITY SCORES OF THE NEUTRACEUTICAL INCORPORATED RECIPES

E. BLOOD GLUCOSE AND SERUM LIPID PROFILE OF THE SELECTED DIABETIC SUBJECTS

1. Mean blood glucose and glycosylated hemoglobin levels of the selected diabetic subjects
2. Mean lipid profile levels of the selected diabetic subjects

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4. Effect of supplementation with artichoke
5. Effect of supplementation with amla
6. Effect of supplementation with soyabean
7. Effect of supplementation with bay leaves
8. Effect of supplementation with flaxseed
9. Effect of supplementation with stevia
10. Effect of supplementation with jambolin seed

A. BACKGROUND INFORMATION OF THE SELECTED DIABETIC SUBJECTS

Background information collected with regards to age, sex, educational qualification, employment status, type of family and income level of the selected subjects were consolidated, tabulated and presented as follow.

1. Age and sex of the selected diabetic subjects

Age and sex of the one thousand five hundred diabetic subjects were categorized and tabulated in Table 4.1.

TABLE 4.1

AGE AND SEX OF THE SELECTED DIABETIC SUBJECTS

Age (in year)	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
35-40	188	24.1	142	19.8	330	22
41-45	315	40.3	295	41.0	610	40.7
46-50	147	19.0	187	26.0	334	22.3
51-60	79	10.1	61	8.5	140	9.31
61-65	51	6.5	35	4.7	86	5.74
Total	**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

From the above table, it is clear that among the 780 male subjects selected for the study, 24.1 per cent of the subjects were in the age group of 35-40 years, 40.3 per cent were in the age group of 41-45 years, 19 per cent were in the age group of 46-50 years, 10.1 per cent were in the age group of 51-60 years and 6.5 per cent were in the age group of 61-65 years.

Among the female subjects, 19.8 per cent were in the age group of 35-40 years, 41 per cent were in the age group of 41-45 years, 26 per cent were in the age group of 46-50 years, 8.5 per cent were in the age group of 51-60 years and 4.7 per cent were in the age group of 61-65 years.

From the above table it is clearly evident that there is no sex difference for the onset of diabetes. The results revealed that the age of precipitation of diabetes mellitus may be between 41-45 years both in female and male sexes. Risk for Type II diabetes increase with age and occurs most often in people over 45 years (Eesee Health India.Com).

2. Educational qualification

Educational qualifications of selected subjects are presented in Table 4.2

TABLE 4.2

EDUCATIONAL QUALIFICATION OF THE SELECTED DIABETIC SUBJECTS

Educational Qualification	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Illiterate	42	5.4	54	7.5	96	6.4
Up to primary school	85	10.9	130	18.0	215	14.4
Up to high school	121	15.5	95	13.2	216	14.4
Up to Higher secondary school	151	19.4	285	39.6	436	29.0
Up to collegiate	381	48.5	156	21.7	537	35.8
Total	**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

From the picture shown in the above table, it is clear that among the 1500 diabetic subjects 5.4 per cent of males and 7.5 per cent of females were illiterate. Among the literates 10.9 per cent of males and 18 per cent of females were educated upto primary school, 15.5 per cent of males and 13.2 per cent females were educated upto high school level, 19.4 per cent of males and 39.6 per cent of females were educated upto higher secondary level and 48.5 per cent of males and 21.7 per cent of females were graduates. This indicates that the educated populations are equally affected by diabetes mellitus.

3. Activity pattern

The following Table 4.3 depicts the activity pattern of the selected diabetic subjects.

TABLE 4.3

ACTIVITY PATTERN OF THE SELECTED DIABETIC SUBJECTS

Activity pattern	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Sedentary	365	46.8	342	47.5	707	47.1
Moderate	283	36.3	306	42.5	589	39.3
Heavy	132	16.9	72	10.0	204	13.6
Total	**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

Among the 780 male diabetic subjects, 46.8 per cent were doing sedentary activity, 36.3 per cent were doing moderate activity and only 16.9 per cent were doing heavy activity pattern.

Among the 720 female diabetic subjects, 47.5 per cent were doing sedentary activity, 42.5 per cent were in moderate activity and only 10 per cent were doing the heavy activity pattern.

Hu (2003) explained the association between sedentary life style such as prolonged television watching leads to obesity, which in turn leads to diabetes.

4. Type of family

Table 4.4 depicts the family type of the selected diabetic subjects

TABLE 4.4

TYPE OF THE FAMILY OF THE SELECTED DIABETIC SUBJECTS

Family Type	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Nuclear	409	52.4	294	40.8	703	46.9
Joint	371	47.6	426	59.2	797	53.1
Total	**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

From the above table it is clear that 52.4 per cent of males and 40.8 per cent of the females belonged to nuclear family and 47.6 per cent of males and 59.2 per cent of the females were belonged to joint family.

5. Monthly income levels

Table 4.5 shows the income level of the selected subjects

TABLE 4.5

MONTHLY INCOME LEVELS OF THE SELECTED SUBJECTS

Monthly Income (HUDCO, 2004)	Number	Per cent
Low Income (Rs. 2500 – Rs. 4500)	481	32.0
Middle Income (Rs. 4501– Rs.7500)	712	47.5
High Income (Above Rs. 7501)	307	20.5
Total	**1500**	**100.0**

Among the selected diabetics 32 per cent had an income below Rs. 3000 per month, 47.5 per cent had an income range of Rs. 3000/- to Rs. 7000 per month and 20.5 per cent had income above Rs. 7000 per month.

The major percentage of the selected subjects belonged to low income and middle income group than high income group.

Prevalence of diabetes was found to be lower in the low socio-economic group living in urban areas compared with the high income group. This was probably related to the physical activity of the low income group (LIG) as most of them were involved in moderate to strenuous physical activity at work (Ramachandran *et al.*, 2002).

B. MEDICAL HISTORY OF THE SELECTED DIABETIC SUBJECTS

1) Personal history of selected diabetic subjects

a) Age at the onset of diabetes

Table 4.6 shows the age at the onset of diabetes among the selected diabetic subjects.

TABLE 4.6

AGE AT THE ONSET OF DIABETES

Onset of diabetes (Age in years)	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
35 – 45	485	62.2	398	55.3	883	58.9
46 – 55	196	25.1	169	23.5	365	24.3
56 – 65	99	12.7	153	21.2	252	16.8
Total	**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

Nearly 62.2 per cent of males and 55.3 per cent of females were affected with diabetes at the age of 35-45 years, about 25.1 per cent of males and 23.5 per cent of females were affected at the age of 46 – 55 years. Age at the onset of diabetes for rest of the males (12.7 per cent) and females (21.2 per cent) was ranged from 56 to 65 years respectively.

Harris *et al.* (2003) reported that the risk of Type II diabetes increases with age beginning after 30 years. Nearly 20 per cent of population aged 60-74 has diabetes. Pre-diabetic conditions also increases in older people and are thought to contribute to heart disease and other problems. Ahuja (2000) studied that most of the NIDDM are more than 40 years of age.

b) Duration of diabetes

Duration of diabetes suffered by the selected subjects is shown in Table 4.7.

TABLE 4.7

DURATION OF DIABETES

Duration	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
≤ 1 year	226	29.0	210	29.2	436	29.0
≤ 5 years	351	45.0	401	55.7	752	50.2
≤ 10 years	182	23.3	85	11.8	267	17.8
> 10 years	21	2.70	24	3.30	45	3.0
Total	**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

Among the 780 males, 29 per cent were having the disease for nearly ≤1 year, 45 per cent were suffering from diabetes for ≤ 5 years, 23.3 per cent were suffering from ≤10 years and 2.7 per cent males were suffering from the diabetes for >10 years. Among the 720 females, 29.2 per cent females were suffering from the diabetes for ≤1 year, 55.7 per cent were suffering from the diabetes for ≤5 years, 11.8 per cent females were suffering from the diabetes for ≤10 years and 3.3 per cent females were suffering form the diabetes for >10 years.

c) Symptoms

Symptoms of the selected diabetic subjects at the time of diagnosis and at present are given in Table 4.8.

TABLE 4.8

SYMPTOMS OF THE SELECTED DIABETIC SUBJECTS

Symptoms*	At the time of diagnosis				At present			
	YES		NO		YES		NO	
	N	Per cent	N	Per cent	N	Per cent	N	Per cent
1. Polyuria	341	15.9	1159	14.2	125	10.3	1375	7.5
2. Polydipsia	416	19.4	1084	16.7	245	20.1	1255	83.6
3. Weight Loss	231	10.8	1269	18.2	110	9.03	1390	7.7
4. Hyperglycemia	425	19.8	1075	13.45	345	28.3	1155	6.3
5. Poor wound healing	316	14.7	1184	78.9	185	15.2	1315	7.2
6. Glycosuria	189	8.8	1311	87.4	82	6.7	1418	7.8
7. Visual disturbances	75	3.5	1425	95	75	6.2	1425	95
8. Ketosis	-	-	1500	12.6	-	-	1500	8.3
9. Renal upset	12	0.6	1488	12.5	14	1.2	1486	8.2

*** Multiple responses**

Among the selected 1500 subjects of both sexes the disease at the time of diagnosis shows symptoms such as hyperglycemia (19.8 per cent) polydipsia (19.4 per cent), polyuria (15.9 per cent), poor wound healing (14.7 per cent) and weight loss (10.8 per cent). Most of them do not exhibit the symptoms like renal upset (12.5 per cent), visual disturbances (95 per cent), poor wound healing (78.9 per cent) at the time of diagnosis. Most of them were unaware of the symptom like ketosis as a symptom of uncontrolled diabetes.

But the symptoms after the onset of disease were mostly hyperglycemia (28.3 per cent), polydypsia (20.1 per cent) poor wound healing (15.2 per cent) and polyuria (10.3 per cent) etc. More than 90 per cent of the selected diabetic subjects do not exhibit the above listed symptoms after the diagnosis and no one is having ketosis among the selected diabetic subjects.

The present study is on par with the study conducted by Punnosse (2001).

Punnosse (2001) suggested that the common indication of diabetes is polyurea, polydipsia, weight loss, tiredness, blurred vision, increased hunger etc.

Common symptoms and warning signs that accompany diabetes during the preliminary and upgrading stages are polydipsia, polyuria, polyphagia, sudden unexplained weight loss, slow healing cuts, bruises or skin infections, recurrent infections, blurred vision, unexplained weakness, extreme exhaustion, vaginitis and sweet smelling breath (Srinivasan, 2002).

2. Family history

Family history in relation to the development of diabetes mellitus among the family members is tabulated in Table 4.9.

TABLE 4.9

FAMILY HISTORY IN RELATION TO DIABETES MELLITUS AMONG THE SELECTED DIABETIC SUBJECTS

Relationship	FAMILY HISTORY	
	Number	Per cent
Mother	307	28.8
Father	270	25.4
Brother	218	20.5
Grand Parents	131	12.3
Sister	80	7.5
Son	38	3.6
Daughter	21	1.97
Total	**1065**	**100.0**

Among the 1500 subjects 71 per cent (1065) of them have the family history of diabetes mellitus and 29 per cent (435) do not have any history related to diabetes. Among the 71 per cent answered, mother of the subjects (28.8 per cent) and father of the subjects (25.4 per cent) had diabetes. Among

the other subjects, 20.5 per cent of subject's brother, 12.3 per cent of subject's grand parents and 7.5 per cent of the subject's sister had diabetes. 3.6 per cent of subject's son and 1.9 per cent of subject's daughter had diabetes.

The majority of familial history as a risk factor to the development of diabetes is mostly from mother's and father's side than the other relationship. According to Shaw *et al.* (1998) insulin sensitivity has been found to be a familial trait and this raises the hypothesis that the insulin resistance syndrome may also occur as familial trait in association with the development of NIDDM. Fletcher *et al.* (2002) also indicated that strong family history of diabetes mellitus identifies those individuals at higher risk. Women with a history of gestational diabetes as well as their children are at greater risk for progressing to Type II diabetes. Results of the present study is on par with the above studies.

3. Type of treatment taken by the selected diabetic subjects before and during the study period

Type of treatment before and during the study period of the selected diabetic subjects is presented in the Table 4.10.

TABLE 4.10

TYPE OF TREATMENT TAKEN BY THE SELECTED DIABETIC SUBJECTS BEFORE AND DURING THE STUDY PERIOD

Type of treatment	Before study period				During study period			
	Male		Female		Male		Female	
	N	Per cent	N	Per cent	N	Per cent	N	Per cent
Ayurvedic	23	2.9	15	2.08	-	-	-	-
Siddha	14	1.8	20	2.8	-	-	-	-
Homeopathy	-	-	7	1.0				
Unani	-	-	-	-	-	-	-	-
Naturopathy	52	6.7	48	6.7	-	-	-	-
Allopathy	682	87.4	625	86.8	776	99.5	719	99.9
No Medication	9	1.2	5	0.7	4	0.5	1	0.1
Total	**780**	**100.0**	**720**	**100.0**	**780**	**100.0**	**720**	**100.0**

Before the study period, among 1500 diabetic subjects selected 2.9 per cent of males and 2.08 per cent of females were under ayurvedic treatment, 1.8 per cent of males and 2.8 per cent of females were under went siddha one per cent of females were underwent homeopathy treatment, about 6.7 per cent of both males and females were under went naturopathy treatment and about 87.4 per cent of males and 86.8 per cent females were in allopathic treatment. Nearly 1.2 per cent of males and 0.7 per cent of females were not in any of the above treatment for the disease. No one was underwent the unani type of treatment. During the study period, above 99.5 per cent of both males and females were in allopathic treatment and less than 0.5 per cent from both sexes were not undergoing any particular treatment.

Thus before and during the study period most of the diabetic subjects were at allopathic treatment when compared to other types of treatment.

4. Exercise history

1. Exercise pattern

The habit of doing exercise of one thousand five hundred diabetic subjects is consolidated in Table 4.11.

TABLE 4.11

EXERCISE PATTERN OF THE SELECTED DIABETIC SUBJECTS

Duration (Hrs)	Male (682)						Female (398)			
	Light intensity		Moderate intensity		Heavy intensity		Light intensity		Moderate intensity	
	N	Per cent	N	Per cent	N	Per cent	N	Per cent	N	Per cent
< ½	312	70.4	92	55.0	43	59.7	204	67.5	63	65.6
> ½	131	29.6	75	45.0	29	40.3	98	32.5	33	34.4
Total	**443**	**100.0**	**167**	**100.0**	**72**	**100.0**	**302**	**100.0**	**96**	**100.0**

Among the selected 1500 diabetic subjects 72 per cent were having the habit of doing exercise among them 63 per cent were males and 37 per cent were females. Among the selected males, 64.9 per cent were doing light intensity activity like walking, yoga, gardening etc., 24.5 per cent of males were doing moderate intensity activity like playing badminton, cricket, etc. and 10.6 per cent of males were doing heavy intensity exercise like jogging, swimming, cycling etc.

Among the selected females, 75.9 per cent were undergoing light intensity exercise and 24.1 per cent were doing moderate intensity and none of them were in the category of heavy intensive exercise pattern.

According to Santo (2003) aerobic exercise of mild to moderate intensity, including walking and jogging 10-30 minutes a day, 3-5 days a week is recommended for the diabetic subjects to reduce the blood glucose level. Karin *et al.* (2002) explained that appropriate exercise can improve insulin sensitivity and glycemic control and decrease the need for oral medications.

2. Time and duration of exercise

The time and duration of doing exercise by the selected subjects is categorized in the following Table 4.12.

TABLE 4.12

TIME AND DURATION OF EXERCISE OF THE SELECTED DIABETIC SUBJECTS

Time and duration of Exercise	Male (682)		Female (398)		Total (1080)	
	N	Per cent	N	Per cent	N	Per cent
Early Morning	451	66.1	96	24.1	547	50.6
Evening	162	23.8	230	57.8	392	36.3
Half an hour after any major meal	20	2.9	11	2.8	31	2.9
One or two hours after any major meal	31	4.6	26	6.5	57	5.3
More than 2 hours after any major meal	18	2.6	35	8.8	53	4.9
Total	**682**	**100.0**	**398**	**100.0**	**1080**	**100.0**

Among 1500 diabetic subjects 66.1 per cent males and 24.1 per cent females were doing the exercise in early morning. About 23.8 per cent males and 57.8 per cent females were doing in the evening and nearly 2.9 per cent of males and 2.8 per cent of females were doing the exercise half an hour later after any major meals, about 4.6 per cent of males and 6.5 per cent of females were doing exercise one or two hours after any major meal and 2.6 per cent of males and 8.8 per cent of females were exercising more than 2 hours after any major meal.

Thus majority of males were doing exercise in the early morning and majority of females were doing exercise in the evening due to lack of time in the morning hours.

5. Complications

Complications at the time of diagnosis and at present for all the selected diabetic subjects are given in Table 4.13.

TABLE 4.13

COMPLICATIONS OF THE SELECTED DIABETIC SUBJECTS

Complications	At the time of diagnosis				At present			
	Yes	Per cent	No	Per Cent	Yes	Per cent	No	Per cent
ACUTE								
Hypoglycemia	-	-	-	-	625	30.9	875	58.3
Hyperglycemia	921	77.0	579	38.6	553	36.9	947	63.1
CHRONIC								
Heart disease	-	-	1500	16.5	85	4.2	1415	16.2
Diabetic retinopathy	-	-	1500	16.5	106	5.2	1394	16.0
Diabetic neuropathy	-	--	1500	16.5	92	4.5	1408	16.1
Diabetic nephropathy	-	-	1500	16.5	165	8.2	1335	15.3
Diabetic foot syndrome	4	0.3	1496	16.6	246	12.2	1254	14.4
Hypertension	271	22.7	1229	13.6	552	27.3	948	10.9

*** Multiple responses**

Among the selected 1500 diabetic subjects of both sexes the complications at the time of diagnosis is mainly hyperglycemia (77 per cent) and hypertension (22.7 per cent) and most of them were free from the complications like heart disease, diabetic retinopathy, neuropathy and diabetic nephropathy.

But the complications after the onset of disease were mostly hypoglycemia (30.9 per cent), hyperglycemia (36.9 per cent), heart disease (4.2 per cent), diabetic retinopathy (5.2 per cent), neuropathy (4.5 per cent),

nephropathy (8.2 per cent), diabetic foot syndrome (12.2 per cent), and hypertension (27.3 per cent). Even after the onset of the disease 58.3 per cent and 63.1 per cent were not having the complications like hypoglycemia and hyperglycemia.

According to Martin *et al.* (2004) diabetic mellitus is the most common cause of neuropathy in the western world. Recent studies estimated the prevalence around 28.5 per cent but results vary depending on measure used to define diabetic nephropathy. Agarwal (2002) found that diabetic nephropathy is a major cause of end stage renal disease.

6. Life style pattern

1. Pattern of alcohol consumption

Among the 1500 diabetic subjects, 625 subjects(41.6 per cent) had the habit of consuming alcohol and the rest 875 diabetic subjects does not have the habit of consuming alcohol. Frequency of alcohol consumption as expressed by the diabetic subjects and the average quantity consumed are presented in the Table 4.14.

TABLE 4.14

FREQUENCY AND QUANTITY OF ALCOHOL CONSUMPTION AS EXPRESSED BY THE DIABETIC SUBJECTS

Type of alcohol	Average amount in(ml)	Frequency of Consumption*											
		Daily				Frequently				Occasionally			
		Before		After		Before		After		Before		After	
		N	Per cent	N	Per cent	N	Per cent	N	Per cent	N	Per cent	N	Per cent
Arrack	150-250	230	36.8	70	23.3	80	12.8	50	16.6	250	40.0	50	16.7
Toddy	150-250	150	24	110	36.7	100	16.0	180	60.0	150	24.0	95	31.7
Whisky	100-150	90	14.4	30	10	70	11.2	30	10.0	110	17.6	70	23.2
Brandy	100-250	110	17.6	50	16.7	250	40.0	20	6.7	95	15.2	20	6.7
Beer	150-250	45	7.2	40	13.3	125	20.0	20	6.7	20	3.2	65	21.7

* Multiple responses

Among the 625 diabetic subjects 36.8 per cent and 24 per cent of males had the habit of consuming arrack and toddy daily and they took about 150-250 ml per day. Fourteen per cent of the subjects had the habit of consuming whisky, 17.6 per cent took brandy and they consumed about 100-250 ml per day. Beer was consumed by 7.2 per cent of the subjects daily.

After diagnosis the percentage of the subjects consuming different types of alcohols daily, had reduced to some extent though not remarkably.

About 12.8 per cent of diabetic subjects consumed arrack frequently and 16 per cent of the subjects took toddy, while whisky and brandy were consumed by 11.2 per cent and 40 per cent of the diabetic subjects respectively. About 20 per cent of the diabetic subjects had the habit of consuming beer frequently before the diagnosis of disease.

Nearly 40 per cent of the diabetic subjects had the habit of consuming arrack occasionally, toddy, whisky and brandy were consumed occasionally by 24 per cent, 17.6 per cent and 15.2 per cent respectively. About 3.2 per cent had the habit of consuming beer occasionally before diagnosis, while after diagnosis the per cent using all types of alcohol drinks were occasionally reduced among the selected diabetic subjects.

2. Pattern of smoking

In the present study none of the female subjects were in the habit of smoking. Table 4.15 pin points the pattern of smoking among the male diabetic subjects as expressed by them out of 780 male subjects only 521 were smokers.

TABLE 4.15

PATTERN OF SMOKING AMONG THE MALE DIABETIC SUBJECTS

Pattern of smoking	Diabetic subjects(N-780)			
	Before (N-521)		After (N-310)	
	Number	Per cent	Number	Per cent
Yes	521	66.8	310	39.7
No	259	33.2	470	60.3
Total	**780**	**100.0**	**460**	**100.0**
Types				
Cigarette	225	43.2	95	30.6
Beedi	175	33.6	115	37.1
Cigar	121	23.2	100	32.3
Total	**521**	**100.0**	**310**	**100.0**
Numbers per day				
1-5	82	15.8	41	13.2
6-10	210	40.3	95	30.6
11-20	120	23.0	80	25.8
21-30	109	20.9	94	30.4
Total	**521**	**100.0**	**310**	**100.0**

Out of the 521 male diabetic subjects 66.8 per cent had the habit of smoking before the incidence of diabetes and 39.7 per cent were smoking even after the diagnosis. Cigarette was used by 43.2 per cent of subjects before and 30.6 per cent of subjects after diagnosis. Beedi was used by 33.6 per cent (175 subjects) before and 37.1 per cent (115 subjects) after diagnosis. Cigar was used by 23.2 per cent before and 32.3 per cent of subjects after diagnosis of diabetes. One to five member (either cigarette or beedi or cigar) were using daily by 15.7 per cent of subjects before and 13.2 per cent of subjects after diagnosis. Six to ten members were smoked by 210 subjects (40.3 per cent) before and 95 subjects (30.6 per cent) after diagnosis of diabetes. Hundred and twenty subjects (23.0 per cent) smoked 11-12 numbers per day before, while 80 subjects (25.8 per cent) used the same numbers after diagnosis of the disease. Hundred and nine subjects (20.9 per cent) smoked 21-30 numbers per day before and 94 subjects (30.4 per cent) used the same numbers after diagnosis of the disease.

According to Nilsson *et al.* (2002) smoking was found to be hazardous in Type II diabetes and it was a marker for an unhealthy life style and nicotine could deteriorate glucose metabolism by negatively influencing insulin sensitivity among the diabetic subjects.

3. Consumption pattern of coffee/ tea

Table 4.16 shows the beverages taken and number of cups per day by their selected diabetic subjects.

TABLE 4.16

CONSUMPTION PATTERN OF COFFEE/ TEA*

Particulars	Diabetic subjects			
	Before		After	
	Number	Per cent	Number	Per cent
Items				
Coffee	407	52.2	115	25.6
Tea	351	45.0	95	21.1
Not using	22	2.8	240	53.3
Number of cups per day				
2 cups	300	38.5	150	33.3
3 cups	210	26.9	130	28.9
4 cups	150	19.2	95	21.1
5 and above	120	15.4	75	16.7

*** Multiple responses**

Among the selected subjects 52.2 per cent had reported the consumption of coffee before the onset of the disease, but it was reduced to 25.6 per cent after the diagnosis of the disease.

Tea was consumed by 45 per cent of the subjects before and it was decreased to 21.1 per cent after the onset of the disease. About 2.8 per cent of the subjects did not drink tea or coffee before and it was increased to 53.3 per cent after the diagnosis of diabetes.

Before the onset of the disease 38.5 per cent of the subjects consumed 2 cups, 26.9 per cent consumed 3 cups, 19.2 per cent consumed 4 cups and 15.4

per cent consumed 5 cups and above, every day. After the onset of the disease due to dietary counseling given in the hospitals 33.3 per cent used only 2 cups, 28.9 per cent used 3 cups and 21.1 per cent took 4 cups and only 16.7 per cent took more the 5 cups.

According to Osaka (2006), consumption of green tea and coffee was inversely associated with risk of developing diabetes after adjustment for risk factors including body mass index (BMI), age and sex; consuming greater than six cups of green tea or three cups of coffee reduced the risk by 33 per cent and 42 per cent, respectively. There was no association seen between consumption of black or oolong teas and diabetes risk. Total caffeine intake from these beverages was associated with a 33 per cent reduced risk for diabetes, with the effects more pronounced in women and in overweight men.

C. NUTRITIONAL ASSESSMENT

1. Anthropometric measurements

A. Mean height of the selected subjects

The following table 4.17 presents the mean height of the selected subjects.

TABLE 4.17
MEAN HEIGHT OF THE SELECTED DIABETIC SUBJECTS

Height (cm)	Male			Female		
	Number	Per cent	NCHS* Standard (cm)	Number	Per cent	NCHS* Standard (cm)
141-150	82	10.5	175	365	50.7	161.5
151-160	192	24.6		321	44.6	
161-170	385	49.4		20	2.8	
171 and above	121	15.5		14	1.9	
Total	**780**	**100.0**		**720**	**100.0**	

* Brahmam *et al.*, 2005 (NCHS – Measuring change in nutritional status, WHO, 1983).

Among the diabetic subjects 10.5 per cent of males and 50.7 per cent of females had a height in the range of 141-50cm, 24.6 per cent of the males subjects and 44.6 per cent of the female subjects had a height in the range of

151-160 cm and 49.4 per cent of males and 2.8 per cent of females had a height in the range of 161-170 cm and 15.5 per cent of males and 1.9 per cent of females had their height in the range of 171cm and above.

b. Mean weight of the selected subjects

Mean weight of the subjects is given in Table 4.18.

TABLE 4.18

MEAN WEIGHT OF THE SELECTED DIABETIC SUBJECTS

Weight (Kg)	Male			Female		
	Number	Per cent	NCHS* Standard (kg)	Number	Per cent	NCHS* Standard (kg)
41-50	19	2.4	79.4	16	2.2	67.6
51-60	101	13.0		251	34.9	
61-70	274	35.1		225	31.3	
71-80	67	8.6		112	15.6	
81 and above	319	40.9		116	16.0	
Total	**780**	**100.0**		**720**	**100**	

* Brahmam *et al.*, 2005 (NCHS – Measuring change in nutritional status, WHO, 1983).

Results of the above table indicated that 2.4 per cent of males and 2.2 per cent of females had their weight in the range of 41-50 kg, 13 per cent of males and 34.9 per cent of females had their weight range between 51-60 kg and 35.1 per cent of males and 31.3 per cent of females had the weight in the range of 61-70 kg, 8.6 per cent of males and 15.6 per cent of females had it between 71-80 kg and finally 40.9 per cent of males and 16 per cent of females had the weight range above 81 kg.

According to Henry and Gumbiner (1991) weight reduction is one of the most effective therapies for obese non- insulin dependent diabetic subjects.

c. BMI values of the selected subjects

The BMI values of the selected diabetic subjects are depicted in the Table 4.19.

TABLE 4.19

BMI VALUES OF THE SELECTED SUBJECTS

BMI Classification (IOTF)*	Obesity grade	Male		Female		Total	
		N	Per cent	N	Per cent	N	Per cent
≤18.5	Under weight	18	2.3	22	3.0	40	2.7
18.5-22.9	Normal	194	24.9	116	16.1	310	20.7
23.0-24.9	At risk of obesity	212	27.2	262	36.4	474	31.6
25.0-29.9	Obese-I	122	15.6	136	18.9	258	17.2
≥30.0	Obese-II	234	30.0	184	25.6	418	27.8
Total		**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

***International Obesity Task Force (IOTF), 2002**

Among the 1500 selected subjects 30 per cent of males and 25.6 per cent of females belonged to grade II obesity, 15.6 per cent of males and 18.9 per cent females belonged to grade I obesity, 27.2 per cent males and 36.4 per cent females were at the risk of obesity, 24.9 per cent males and 20.7 per cent of females were at the normal grade and 2.3 per cent males and three per cent females belong to under weight range.

Diabetes puts people at risk of developing critical illness and dying in early age but obesity without diabetes does not. A research study reveals that individual suffering from diabetes is three times more at risk of developing critical illness and dying in young age than individuals who do not have diabetes (www.sciencedaily.com).

d. Waist Hip Ratio (WHR) of the selected subjects

The waist Hip Ratio (WHR) of the selected subjects are depicted in Table 4.20.

Table 4.20

WAIST / HIP RATIO OF THE SELECTED DIABETIC SUBJECTS

WHR* classification	Male		WHR classification*	Female		Total	
	N	Per cent		N	Per cent	N	Per cent
≤ 0.95 Normal	333	42.7	< 0.8 Normal	197	27.4	530	35.3
≥ 0.95 Obese	447	57.3	≥ 0.8 Obese	523	72.6	970	64.7
Total	**780**	**100.0**	**Total**	**720**	**100.0**	**1500**	**100.0**

* Brahmam *et al.*, 2005

Among the thousand five hundred diabetic subjects, 42.7 per cent males were having normal waist hip ratio (≤0.95) when compared with the standard, 57.3 per cent of males were having obesity (≥0.95) and 35.3 per cent of females having normal waist hip ratio (≤0.8), 64.7 per cent of females were having obesity (≥0.8).

Various research works depicted that intra abdominal obesity is probably the most powerful risk factor for the development of Type II diabetes.

2. Dietary and food consumption pattern

A. Food habit of the selected diabetic subjects

The food habits of the selected subjects is given in Table 4.21

TABLE 4.21

FOOD HABITS OF THE SELECTED DIABETIC SUBJECTS

Food habit	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Vegetarian	159	20.4	285	39.6	444	29.6
Non-Vegetarian	552	70.8	345	47.9	897	59.8
Ova-Vegetarian	69	8.8	90	12.5	159	10.6
Total	**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

From the above table, it is clear that among the 780 males subjects 20.4 per cent were vegetarians, 70.8 per cent were non- vegetarians and 8.8 per cent were ova vegetarians.

Among the 720 female diabetic subjects, 39.6 per cent were vegetarians, 47.9 per cent were non-vegetarians and 12.5 per cent were ova vegetarians.

Kusano (2000) reported that NIDDM can be better controlled and sometimes even eliminated through a low fat vegetarian diet. In many parts of the world, people who eat traditional diets high in fiber have a low risk of Type II diabetes. Vegetarians, who typically eat high-fiber diet, have been reported to be at lower risk of being diagnosed with Type II diabetes.

b. MEAN FOOD AND NUTRIENT INTAKE OF SELECTED DIABETIC SUBJECTS

Food and Nutrient intake of selected 35 subjects both male and female were calculated from the weighment survey done for 3 consecutive days. The mean food intake of 17 male subjects was discussed below.

1. Mean food intake of selected male subjects

Mean daily food intake of selected male subjects is given in Table 4.22.

TABLE 4.22

MEAN FOOD INTAKE OF SELECTED MALE SUBJECTS

Food Groups (g)	RDA*	Experimental group		Control group	
		Intake	Per cent Deficit / Surplus	Intake	Per cent Deficit / Surplus
Cereals	420	321	-23.5	330	-21.4
Pulses	54	62	+14.8	60	+11.1
Leafy vegetables	90	80	-11.1	91	+1.1
Other Vegetables	90	68	-75.5	57	-36.6
Roots and tubers	180	41	-77.2	39	-78.3
Fruits	90	49	-45.5	41	-54.4
Sugars	22.5	3	-86.6	4	-82.2
Mill and its products (ml)	270	102	-62.2	110	-59.2
Fats and Oils	18	10	-44.4	11	-38.8

*** Recommended Dietary Allowances (2003) (Dietary guidelines for Indian)**

Mean daily food intake of the selected male subjects shows that except pulses, all the other food group intake were inadequate when compared with Recommended Dietary Allowances (RDA). Totally their pulses consumption of both group were adequate and higher than RDA.

Consumption of sugar was inadequate since they are all suffering from diabetes mellitus and so strictly avoids the intake of sugar in their diet. Consumption of milk and its products, cereals, green leafy vegetables, other vegetables, roots and tubers, fruits, and fats and oils were also inadequate when compared with the RDA given by Indian Council of Agriculture Research (ICMR).

The main reason for the inadequacy of food was, they were all in the diet control and menus are planned and supplied to the subjects depending upon the health condition, physical nature concerned subjects only.

2. Mean daily nutrient intake of selected male subjects

The mean daily nutrient intake of selected male subjects was calculated and is depicted in Table 4.23

TABLE 4.23
MEAN NUTRIENT INTAKE OF SELECTED MALE SUBJECTS

Nutrients	RDA*	Experimental groups		Control groups	
		Intake	Per cent Deficit / Surplus	Intake	Per cent Deficit / Surplus
Energy	2182.5	1610	-25.9	1582.2	-27.4
Protein (g)	54	58.9	+9.0	53.5	-0.9
Fat(g)	18	13.7	-23.8	14.6	-18.8
Calcium (mg)	360	301.3	-16.3	258.6	-28.1
Iron (mg)	28	29.9	+6 7	29.6	+5.7
Retinal (mg)	600	611	+1.8	646.3	+7.7
Thiamin (mg)	1.2	0.87	-27.5	0.77	-35.8
Riboflavin (mg)	1.4	0.98	-30.0	0.86	-38.5
Niacin (mg)	60	11.1	-30.6	13.2	-17.5
Vitamin C (mg)	40	67.6	+69.0	71.0	+77.5

*** Recommended Dietary Allowances (Gopalan *et al.*, 2004)**

Among the mean nutrient intake of the selected male subjects, when compared with RDA (ICMR, 2004) standards, the mean nutrient intake of nutrients like fat and calcium of both the experimental and control group were found to be inadequate.

The energy intake of both the groups was inadequate. But the protein, iron and retinal intake was adequate and higher than RDA allowances.

The water soluble vitamins like thiamin, riboflavin and niacin were inadequate. Vitamin C intake of both groups was more adequate and higher than RDA allowances.

The reason behind the inadequacy of nutrients is the less consumption of food, poor eating habits, poor purchasing power and most of them were mainly

from the low income group which results in faulty dietary habits and unawareness over the selection of foods.

3. Mean daily food intake of the selected female subjects

Mean daily food intake of selected female subjects is shown in Table 4.24.

TABLE 4.24
MEAN FOOD INTAKE OF SELECTED FEMALE SUBJECTS

Food groups (g)	RDA*	Experimental group		Control group	
		Intake	Per cent Deficit / Surplus	Intake	Per cent Deficit / Surplus
Cereals	270	184	-3.8	195	-27.7
Pluses	54	59	+9.2	56	+3.7
Leafy vegetables	90	79	-12.2	80	-11.1
Other vegetables	90	71	-21.1	74	-17.1
Roots and tubers	90	32	-64.4	35	-61.1
Fruits	90	52	-72.2	30	-66.6
Sugars	18	5	-72.2	3	-83.3
Milk (ml)	270	90	-66.6	95	-64.8
Fats and oils	18	20	+11.1	23	+27.7

*** Recommended Dietary Allowances (2003) (Dietary guidelines for Indian)**

From the above table, the mean daily intake of cereals was inadequate among the female subjects. Leafy vegetables, other vegetables, roots and tubers, fruits, and milk and milk products were inadequate and pulses were more adequate when compared to RDA suggested ICMR.

The mean intake of fats and oils were higher in both the experimental and control group which is one of the cause of obesity among the diabetic subjects.

The mean intake of sugar was extremely low when compared with RDA. The main reason for the low intake of sugar was, they were all diabetics. So the intake of sugar is strictly limited.

The mean intake of other food groups also lacks in quantity, may be because of the diet control and most of them belongs to low income group and so quite naturally it results in poor purchasing power.

4. Mean nutrient intake of the selected female subjects

The mean nutrient intake of the selected female subjects is tabulated in the following Table 4.25.

TABLE 4.25

MEAN NUTRIENT INTAKE OF SELECTED FEMALE SUBJECTS

Nutrients	RDA*	Experimental group		Control group	
		Intake	Per cent of Deficit / Surplus	Intake	Per cent of Deficit / Surplus
Energy	1687.5	1231.9	-27.2	1356.1	-19.6
Protein (g)	45	46.1	+2.4	45.3	+0.6
Fat (g)	18	19.2	+6.6	21.1	+17.2
Calcium(mg)	400	232.4	-41.9	316.1	-21.0
Iron (mg)	30	20.5	-31.6	18.2	-39.3
Retinal (µg)	600	495.7	-17.3	511.4	-14.7
Thiamin (mg)	0.9	0.63	-30.0	0.74	-17.7
Riboflavin(mg)	1.1	0.8	-27.2	0.86	-21.8
Niacin (mg)	12	7.2	-40.0	7.68	-36.0
Vitamin C(mg)	40	68.5	+71.25	78.9	+97.25

*** Recommended Dietary Allowances (Gopalan *et al.*, 2004)**

From the above table, nutrients like calcium, iron and retinal were found to be inadequate when compared with Recommended Dietary Allowances for both the study group and control group.

Energy intake was inadequate in both the groups. Water soluble vitamins like thiamine, riboflavin and niacin were also inadequate. Vitamin C,

fat and protein was adequate when compared with Recommended Dietary Allowances for both the study group and control group.

c. Type and quantity of fats and oils used for cooking

Type and quantity of fats and oils consumed by the selected subjects is presented in Table 4.26.

TABLE 4.26

TYPE OF FATS AND OIL USED FOR COOKING

Type of fats and oils	Number	Per cent
Sunflower oil	1151	76.7
Refined oil	1012	67.4
Ground nut oil	731	48.7
Gingelly oil	692	46.1
Palm oil	359	23.9
Vanaspathi	241	16.0
Coconut oil	132	8.8
Ghee	125	8.3
Rice bran oil	35	2.3

***Multiple Responses**

Out of 1500 subjects, 76.7 per cent of the subjects used sunflower oil, 67.4 per cent used refined oil, 48.7 per cent used groundnut oil, 46.1 per cent were consuming gingelly oil, 23.9 per cent used palm oil, 16.0 per cent of the subjects used vanaspathi oil, 8.8 per cent used coconut oil, 8.3 per cent used ghee and only 2.3 per cent of them used rice bran oil. Most of them used refined oil and sunflower oil, because they considered it as good for health and also contained more amounts of poly unsaturated fatty acids.

Among the selected subjects it is found that 56 per cent of subjects consumed 0-10ml of oil per day, 26 per cent of subjects consumed 11-20ml of

oil per day and the rest 18 per cent were consumed above 20ml of oil per day through their diets.

Dam (2003) depicted that higher consumption of whole grain products and exchanging unsaturated fat for saturated fat may lower risk for Type II diabetes. Uusitupa *et al.* (2004) revealed that diets high in fat, especially saturated fat, worsen glucose tolerance and increase the risk of Type II diabetes. In contrast, glucose intolerance has been improved by diets high in monosaturated oils.

d. Consumption pattern of prepared /fast foods

Consumption pattern of prepared /fast foods by the selected subjects is presented in Table 4.27.

TABLE 4.27

CONSUMPTION PATTERN OF PREPARED/FAST FOODS

Particulars	Male (780)		Female (720)	
	Number	Per cent	Number	Per cent
Habit of consumption of prepared/fast foods				
No	32	4.10	48	6.7
Yes	748	95.90	672	93.3
Total	**780**	**100.00**	**720**	**100.0**
Sweets	30	4.0	51	7.6
Savories	83	11.1	30	4.5
Baked items				
Biscuits	110	14.7	61	9.2
Cakes	70	9.4	65	9.7
Vathal	50	6.7	55	8.2
Vadam	120	16.0	150	22.3
Pickles	130	17.4	130	19.3
Fast foods	125	16.7	50	7.4
Beverages	30	4.0	80	11.9
Total	**748**	**100.0**	**672**	**100.0**

Regarding the habits of taking prepared/ fast foods of selected subjects showed that among the 1500 subjects 95.9 per cent of males and 93.3 per cent

of the females were in the habit of taking prepared/fast foods and 4.1 per cent of males and 6.7 per cent of females were not having the habit of taking prepared/fast foods. Among the males selected, four per cent consuming sweets, 11 per cent consuming savories, 14.7 per cent consuming biscuits, 9.3 per cent consuming cakes, 16 per cent consuming vadam, 17.4 per cent consuming pickles, 16.7 per cent consuming fast foods and 4 per cent were consuming beverages.

Among the females selected, 7.59 per cent consuming sweets, 4.4 per cent consuming savories, 9.2 per cent consuming biscuits, 9.7 per cent consuming cakes, 22.3 per cent consuming vadam, 19.3 per cent consuming pickles, 7.4 per cent consuming fast foods and 11.9 per cent were consuming beverages in their food intake.

According to Anderson (2001) excess consumption of sweets has been proposed as an etiological factor in diabetes and obesity.

e. Mean fiber intake per day

Mean fiber intake per day by the selected diabetic subjects is given in Table 4.28.

TABLE 4.28

MEAN FIBRE INTAKE PER DAY

Fiber intake (g) per day	Male		Female		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
5-10	250	32.2	240	33.3	490	32.7
11-15	210	26.8	170	23.6	380	25.3
16-20	270	34.6	190	26.4	460	30.7
21-25	50	6.4	120	16.7	170	11.3
Total	**780**	**100.0**	**720**	**100.0**	**1500**	**100.0**

Results of the above table indicated that out of 1500 diabetic subjects 32.2 per cent of males and 33.3 per cent of females consumed 5-10grams of fiber per day in their diet, 26.8 per cent of males and 23.6 per cent of females consumed about 11-15 grams of fiber per day, 34.6 per cent of males and 26.4 per cent of females were consumed 16-20 grams of fiber per day and 6.4 per cent of males and 16.7 per cent of females consumed 21-25 grams of fiber per day in their daily diet.

Jenkin (2002) reported that a high fiber diet help the diabetic subject in reducing postprandial hyperglycemia and insulin secretion and in decreasing the raised plasma lipids and also help in the reduction of body weight. As per the present study consumption of fiber was less than the RDA among the selected subjects.

D. MEAN ACCEPTABILITY SCORES OF THE NEUTRACEUTICAL INCORPORATED RECIPES

The mean acceptability scores of the developed recipes with the incorporation of various levels of neutraceuticals through the organoleptic evaluation are discussed below.

1. Mean acceptability scores of the onion extract, cinnamon bread, cuminseed masala chapattis, artichoke biscuits and okara sevai

The acceptability scores of appearance, colour, texture, flavour and taste obtained for onion extract, cinnamon bread, cuminseed masala chappathies, wheat biscuits and okara sevai were shown in Table 4.29.

Mean acceptability scores of the onion extract, incorporated butter milk indicated that there was a decrease in scores for appearance, colour, texture, flavour and taste compared to the standard butter milk. The overall acceptability scores of onion extract incorporated butter milk were slightly lowered from the standard butter milk. Percentage of overall acceptability of onion extract incorporated butter milk was 87.33 per cent.

TABLE 4.29
MEAN ACCEPTABILITY SCORES OF THE ONION JUICE, CINNAMON BREAD, CUMIN SEED MASALA CHAPPATHIES, ARTICHOKE BISCUITS AND OKARA SEVAI

S. No	Characteristics	Onion Juice		Cinnamon Bread		Cumin seed masala chapattis		Artichoke Biscuits		Okara Sevai	
		S	I	S	I	S	I	S	I	S	I
1.	Appearance	3.0 ± 0	2.7 ± 0.46	2.9 ± 0.3	2.8 ± 0.4	3.0 ± 0	2.9 ± 0.3	3.0 ± 0	2.7 ± 0.46	3.0 ± 0	2.8 ± 0.4
2.	Colour	2.5 ± 0.5	2.3 ± 0.64	3.0 ± 0	2.7 ± 0.46	3.0 ± 0	2.5 ± 0.5	1.7 ± 3.4	2.5 ± 0.5	2.9 ± 0.3	2.6 ± 0.6
3.	Texture	2.9 ± 0.3	2.7 ± 0.46	2.6 ±0.49	2.9 ± 0.3	2.9 ± 0.3	2.6 ± 0.49	2.9 ± 0.3	2.6 ± 0.66	3.0 ± 0	2.9 ± 0.3
4.	Flavor	2.9 ± 0.3	2.8 ± 0.4	3.0 ± 0	2.2 ± 0.98	2.8 ± 0.4	2.9 ± 0.3	2.9 ± 0.3	2.1 ± 0.8	2.7 ± 0.46	2.5 ± 0.5
5.	Taste	2.7±0.46	2.6 ± 0.66	2.7 ±0.46	2.6 ± 0.4	2.9 ± 0.3	2.8 ± 0.4	2.6 ± 0.49	2.2 ± 0.98	3.0 ± 0	2.7 ± 0.46
	Overall acceptability	14 ±0.28	13.1±0.26	14.2± .28	13.2±0.26	14.6 ± 0.289	13.7 ± 0.26	13.1±0.26	12.1±0.24	14.6±0.289	13.5±0.267
	Overall acceptability percentage	93.33	87.33	94.66	88.00	97.33	91.33	87.33	80.66	97.33	90.00

* Maximum scores for each characteristics – 3.0 S - Standard I - Incorporated

Mean acceptability scores for cinnamon bread showed that there was a slight decrease in appearance, colour, texture and taste, but moderate difference was seen between the standard and incorporated cinnamon bread in case of flavour due to the incorporation of cinnamon powder. The overall acceptability for cinnamon bread is 13.2±0.26 which was slightly less than the standard scores (14.2±0.28). The overall acceptability of cinnamon bread was 88 per cent.

The mean acceptability scores obtained for cumin seed incorporated masala chapattis through sensory evaluation shows that overall acceptability scores for the cumin seed masala chapattis was less (13.7±0.26) when compared to standard (14.6±0.28). The percentage of overall acceptability was 91.33 per cent for the chapattis.

The mean acceptability scores of biscuits incorporated with artichoke powder shows that the appearance, colour, texture, flavour and taste remains slightly lower when compared to the scores obtained for the standard. The overall acceptability scores for the artichoke biscuits were about 12.1±0.24 and the percentage of overall acceptability was 80.66 per cent compared to standard biscuits.

From the above table it was noted that there was a slight decrease in scores of okara sevai for all the characteristics when compared with standard. Scores about the overall acceptability was found to be 13.5±0.267 with the percentage acceptance of 90 per cent when compared to the standard sevai.

2. Mean acceptability scores of the bay leaves chapattis, flaxseed bread, stevia leaves tea and jambolin seeds dosa

The mean acceptability scores of appearance, colour, texture, flavour and taste obtained for bayleaves chappathies, flaxseed bread, stevia leaves tea and jambolin seed dosa were shown in Table 4.30.

TABLE 4.30
MEAN ACCEPTABILITY SCORES OF BAYLEAVES CHAPPATHIES, FLAXSEED BREAD, STEVIA LEAVES TEA AND JAMBOLIN SEEDS DOSA

S.No.	Characteristics	Bay leaves incorporated chapattis		Flaxseed Bread		Stevia leaves tea		Jambolin seeds dosa	
		S	I	S	I	S	I	S	I
1.	Appearance	2.8 ± 0.4	2.6 ± 0.49	3.0 ± 0	2.9 ± 0.32	3.0 ± 0	3.0 ± 0	2.9 ± 0.3	2.7 ± 0.46
2.	Colour	3.0 ± 0	2.7 ± 0.46	2.7 ± 0.46	2.6 ± 0.49	2.9 ± 0.32	2.8 ± 0.4	2.8 ± 0.4	2.6 ± 0.49
3.	Texture	2.9 ± 0.3	2.5 ± 0.5	2.8 ± 0.4	2.7 ± 0.46	2.7 ± 0.46	2.6 ± 0.49	2.7 ± 0.46	2.5 ± 0.5
4.	Flavour	2.7 ± 0.46	2.2 ± 0.98	2.6 ± 0.49	2.6 ± 0.49	2.6 ± 0.49	2.5 ± 0.5	2.4 ± 0.48	2.2 ± 0.98
5.	Taste	2.7 ± 0.46	2.3 ± 0.64	2.9 ± 0.3	2.6 ± 0.49	2.7 ± 0.46	2.6 ± 0.49	2.7 ± 0.46	2.6 ± 0.49
	Over all acceptability	14.1 ± 0.28	12.3 ± 0.244	14 ± 0.28	13.4 ± 0.26	13.9 ± 0.26	13.5 ± 0.267	13.5 ± 0.26	12.6 ± 0.24
	Overall acceptability percentage	94	82	93.33	89.33	92.67	90	90	84

* Maximum scores for each characteristics – 3.0 S - Standard I - Incorporated

Mean acceptability scores of the bay leaves chapattis indicated that there was a decrease in scores for appearance, colour, texture, flavour and also in taste compared to the standard chapattis. The overall acceptability scores of bay leaves chapattis was slightly lowered from the standard scores. The percentage of overall acceptability of bay leaves chapattis is 82 per cent.

The mean acceptability scores of flaxseed bread obtained through sensory evaluation shows that overall acceptability scores for the flaxseed bread was less (13.4±0.26) when compared to standard scores (14±0.28) and the percentage of overall acceptability was 89.33.

Mean acceptability scores results of stevia tea showed that there was a slight decrease in the scores for colour, texture, flavour and taste. The mean scores for appearance remain the same as that of standard tea.

From the above table it was noted that there was a decrease in scores of jambolin seed dosas (pancakes) for all the characteristics when compared with standard. Scores obtained for the overall acceptability was found to be 12.6±0.24 when compared to standard dosa (13.5±0.26) and the percentage of acceptance was about 84 for the jambolin seeds dosa which remains slightly less than the plain dosa.

E. MEAN BLOOD GLUCOSE AND LIPID PROFILE OF THE SELECTED DIABETIC SUBJECTS

1. Mean fasting, post prandial blood glucose and glycosylated haemoglobin levels of the selected subjects.

Mean fasting, post prandial blood glucose and glycosylated haemoglobin level of the selected NIDDM subjects is shown in Table 4.31.

TABLE 4.31

MEAN FASTING, POST PRANDIAL BLOOD GLUCOSE AND GLYCOSYLATED HAEMOBLOBIN LEVEL OF SELECTED DIABETIC SUBJECTS

Blood parameters	Mean ± S.D	Desirable levels
Fasting blood glucose(mg/dl)	162.91±4.77	80-115*
Post prandial blood glucose (mg/dl)	260.97±6.50	120-160*
Glycosylated haemoglobin (per cent)	10.12±0.50	<8 *

*** Bamji *et al.* (2003)**

Among the 1500 diabetic subjects the mean fasting and post prandial level of blood glucose was 162.91±4.74 and 260.97±6.50 respectively. The mean glycosylated hemoglobin values for all the selected subjects are 10.12±0.5 percentage.

It has been shown that all diabetic subjects were having elevated blood glucose levels both fasting and post prandial and glycosylated haemoglobin than that of the desirable values.

2. Mean lipid profile of the selected diabetic subjects

Mean lipid profile levels of the selected diabetic subjects are shown in Table 4.32.

TABLE 4.32

MEAN LIPID PROFILE LEVELS OF THE SELECTED SUBJECTS

Blood parameters	Mean ± S.D	Desirable levels
Total cholesterol	221.63±6.82	150-200*
High density lipoprotein	36.31±3.91	30-60*
Low density lipoprotein	162.63±5.23	66-178*
Very low density lipoprotein	32.49±1.96	6-30*
Triglycerides	165.77±12.5	30-170*

*** NCEP (2001)**

The mean total cholesterol level of the diabetic subjects are 221.63±6.82, which was greater than the desirable values. The mean HDL level and LDL level of the diabetic subjects are 36.31±3.91 and 162.63±5.23 respectively. The values of mean VLDL and triglyceride levels of the diabetic subjects are 32.49±1.96 and 165.77±12.5 respectively.

Hore *et al.* (2002) reported that diabetes greatly increases the risk of heart diseases and stroke. Part of the reason for this cardiovascular disorder is that diabetes affects cholesterol and triglyceride level.

F. EFFECT OF SUPPLEMENTATION OF SELECTED NEUTRACEUTICAL COMPONENTS ON BLOOD GLUCOSE AND LIPID PROFILE OF THE DIABETIC SUBJECTS

From the diabetic subjects participated in the study, sub samples were selected for supplementation of different neutraceutical components and the effect of supplementation was assessed, before and after the study period of 90 days.

1. Effect of supplementation with Onion

Table 4.33 and Figure I give the effect of (*Allium cepa*) onion extract on the blood glucose level of the selected diabetic subjects.

From the Table, the mean fasting blood glucose level of the experimental group was found to be 163.84 mg/dl which was reduced to 144.78 mg/dl at the end of the onion extract supplementation period, the mean difference was statistically analyzed and found to significant at ($P<0.01$) level. The mean post prandial blood glucose level of the experimental group was found to be 262.96 mg/dl in the beginning of the study and it was reduced to 243.02mg/dl at the end of supplementation period. When the values were statistically analysed and the difference was found to be significant at ($P<0.01$) level.

TABLE 4.33

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH ONION

S.No	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	163.84 ± 6.414	144.78 ± 6.405	24.508**	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	262.96 ± 5.785	243.02 ± 5.473	13.375**	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	9.908 ± 0.586	6.408 ± 0.379	28.604**	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

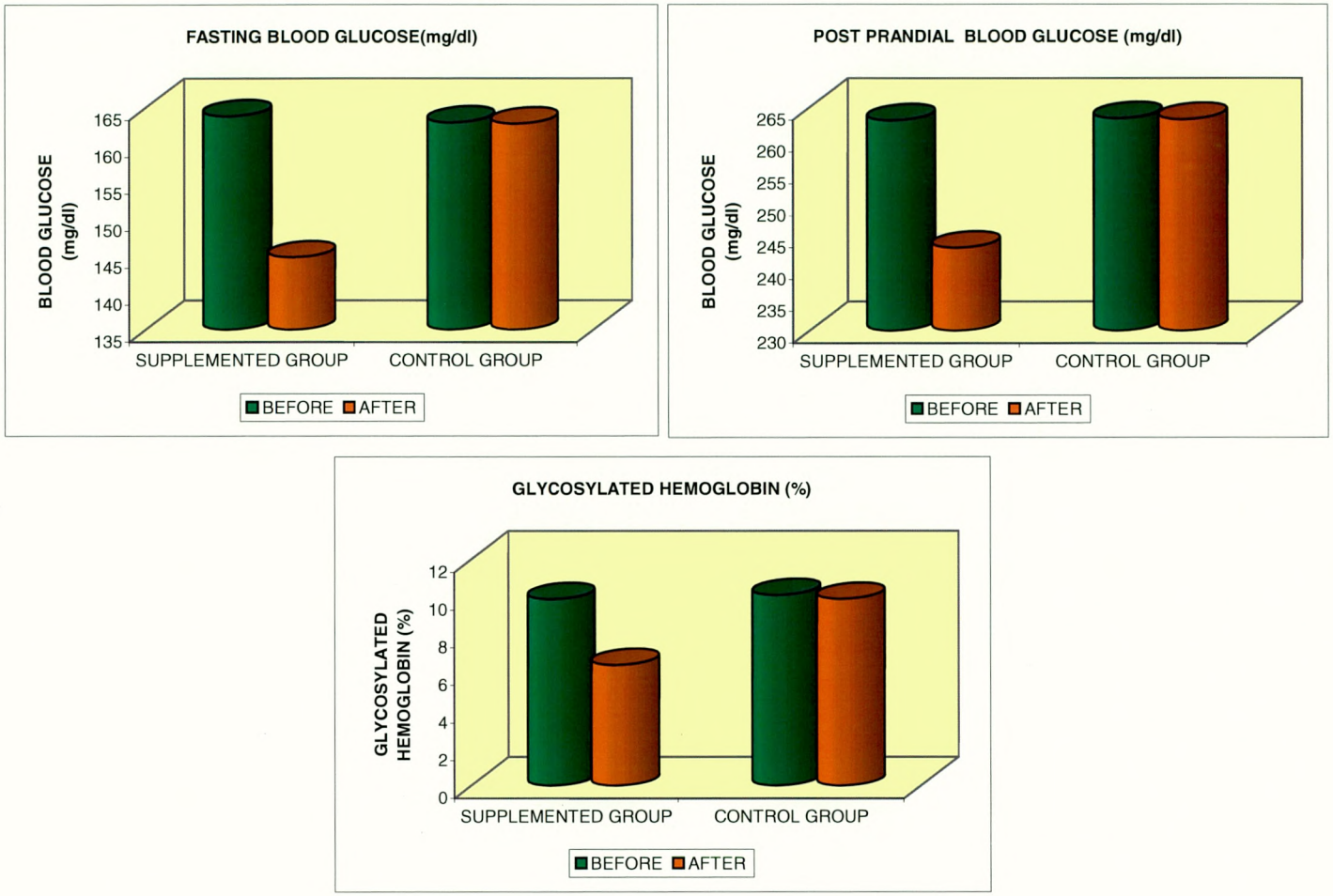


FIGURE I

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH ONION

The mean glycosylated hemoglobin level of the onion extract supplemented group was found to be 9.90 per cent in the initial stage of the study and it was reduced to 6.40 per cent at the end of supplementation period. The values were statistically analysed, the difference was significant at ($P<0.01$) level.

The mean blood glucose levels both fasting and post prandial and also mean glycosylated hemoglobin level of the control group had reduced from 162.98mg/dl to 162.81mg/dl, 263.28mg to 263.14mg/dl and 10.12 per cent to 9.92 per cent respectively after the supplementation period. However the difference between the level was not found to be significant statistically.

Similar findings have been observed by Kurian (1999) according to whom onion eaten raw is good for various metabolic disorders and onion extract (5 drops) in one table spoon of water given for every three hours showed good hypoglycemic effect.

Table and 4.34 and Figure II give the levels of different fractions of cholesterol and triglycerides of the selected diabetic subjects.

Results of the lipid profile revealed that the mean initial total cholesterol level of the diabetic subjects was 243.36mg/dl and it had decreased to 235.39mg/dl after onion extract supplementation for a period of three months. This decrease was found to be statistically significant at ($P<0.01$). The mean total cholesterol level of the control group was 254.42mg/dl at the beginning of the experimental study and decreased to 254.10mg/dl after the supplementation period. This reduction was not found to be significant statistically.

TABLE 4.34

SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH ONION

S.No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	243.36 ± 5.48	235.36 ± 5.302	8.7088**	254.42 ± 7.957	254.1 ± 7.951	0.8403 NS
2.	HDL cholesterol	30 – 60	38.22 ± 3.44	48.61 ± 4.37	94.948**	36.94 ± 3.456	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	164.36 ± 6.435	148.80 ± 6.585	23.709 **	164.7 ± 6.216	164.55 ± 6.294	0.8860 NS
4.	VLDL cholesterol	6 – 30	31.90 ± 1.078	29.00 ± 0.980	3.212 **	31.86 ± 1.077	31.37 ± 1.061	0.1977 NS
5.	Triglyceride	30 – 170	165.55 ± 6.848	138.72 ± 5.738	13.834**	164.51 ± 6.549	164.37 ± 6.652	0.8457 NS

** Significant at (P<0.01) level NS- Not significant

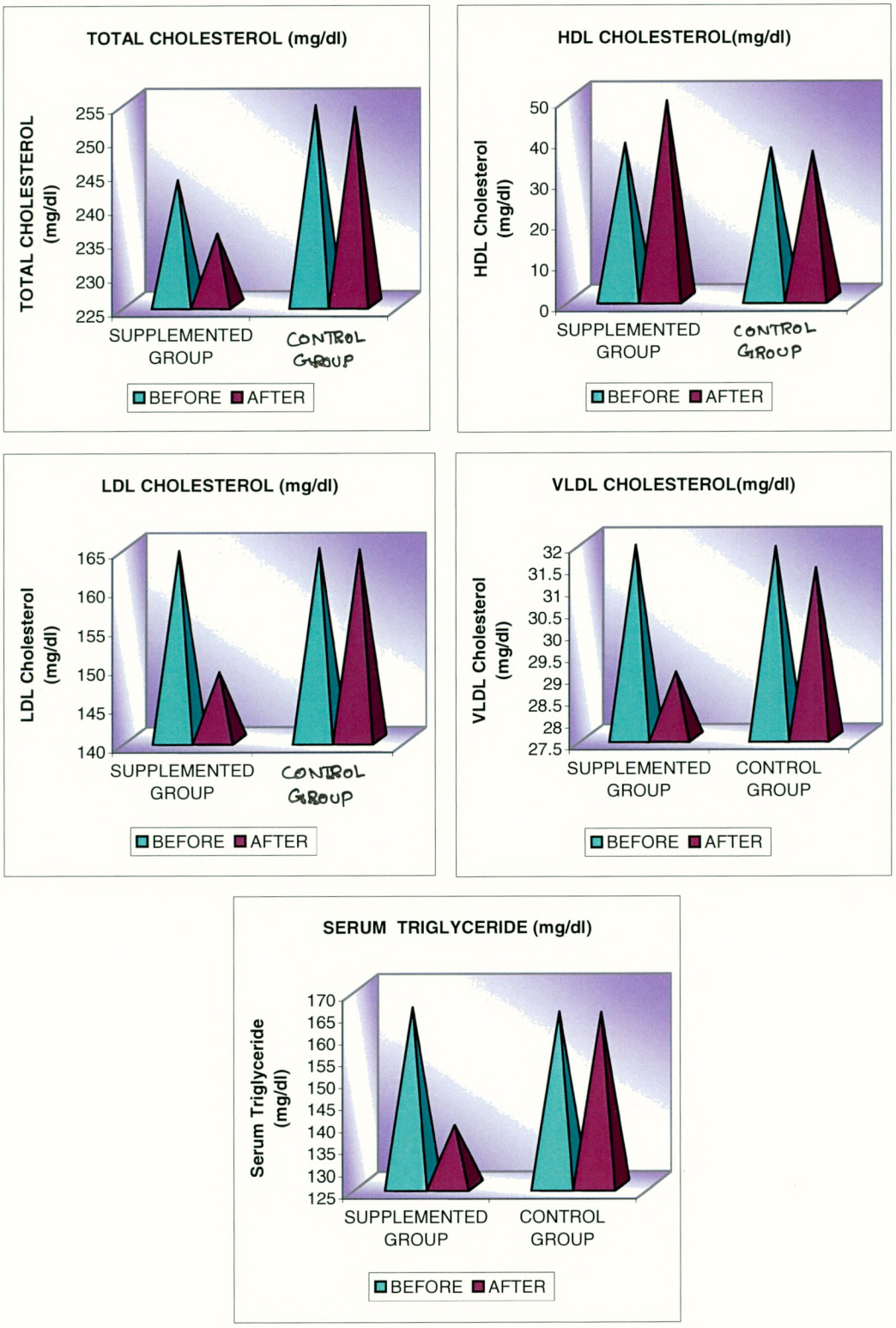


FIGURE II
SERUM LIPID PROFILE
LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH ONION

The mean HDL-cholesterol level of the diabetic subjects was 38.22mg/dl before supplementation which had increased to 48.61mg/dl after supplementation and the difference between the two levels was found to be statistically significant at ($P<0.01$). The mean HDL-cholesterol level of the control group were found to be 36.94mg/dl at the beginning of the study and 36.06mg/dl at the completion of the study period. No significant difference was noticed between these levels of the study groups.

The mean LDL-cholesterol level of the diabetic subjects was 164.36mg/dl before supplementation and the same was significantly decreased to 148.80mg/dl after supplementation period. The mean initial LDL-cholesterol level of the control group was 164.70mg/dl and it was recorded as 164.56mg/dl after the supplementation period. This difference was not found to be statistically significant. The VLDL-cholesterol levels of the diabetic subjects were 31.90 mg/dl before supplementation and the same had decreased to 29.00mg/dl after supplementation. The difference between the two values was found to be statistically significant at ($P<0.01$) level. The mean VLDL-cholesterol level of the control group was found to be 31.86mg/dl before and 31.37mg/dl after the study period. No significant difference was recorded between the two values.

The main therapeutic properties of onion include cardiovascular support and hypoglycemic action. The onion also may be of benefit in cardiovascular disease, as it possesses hypolipidemic effects and has antiplatelet actions and retarding thrombosis (Blumenthal *et al.*, 2000).

The mean triglyceride level of the diabetic subjects was 165.55mg/dl before supplementation, which was reduced to 138.72mg/dl after supplementation, indicating a statistically significant at ($P<0.01$) level. No significant difference was noticed between the mean initial (164.51mg/dl) and final value (164.37mg/dl) of the triglyceride level with regard to the control group.

Onion supplemented group has lower blood glucose and glycosylated hemoglobin level and also lipid profile levels when compared to control. It might be due to the effect of supplementation of onion extract for the period of 90 days.

2. Effect of supplementation with cinnamon

Table 4.35 and Figure III present the mean fasting and post prandial blood glucose, glycosylated hemoglobin of the selected diabetic subjects before and after supplementation with cinnamon powder.

The mean fasting blood glucose level of the experimental group was 163.37 mg/dl which was reduced to 137.4 mg/dl at the end of the cinnamon powder supplementation and the values were statistically analysed, the differences were significant at ($P<0.01$) level. The mean post prandial blood glucose level of the experimental group was found to be 263.14 mg/dl in the beginning of the study and it was reduced to 228.28 mg/dl at the end of the study period, when the values were statistically analysed, the difference was significant at ($P<0.01$) level.

The mean glycosylated hemoglobin was 11.12 per cent before supplementation and had decreased to 5.11 per cent after supplementation with a significant difference at ($P<0.01$) level.

The findings of the present study are in tune with the study conducted by Nagasaki *et al.*, (2004). In their study, they concluded that the Type II diabetic subjects who consumed anti-diabetic drugs had increased insulin output. Intake of small doses of cinnamon ranging from a pinch to nearly one gram produce a reduction in blood sugar level and increases secretion of insulin in their body and also lowers their blood cholesterol level in the range of 10 to 26 per cent.

TABLE 4.35

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH CINNAMON POWDER

S.No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	163.37 ± 4.308	137.49 ± 4.299	13.605**	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	263.14 ± 5.446	228.28 ± 4.724	16.985 **	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	11.12 ± 0.588	5.11 ± 0.552	39.840 **	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

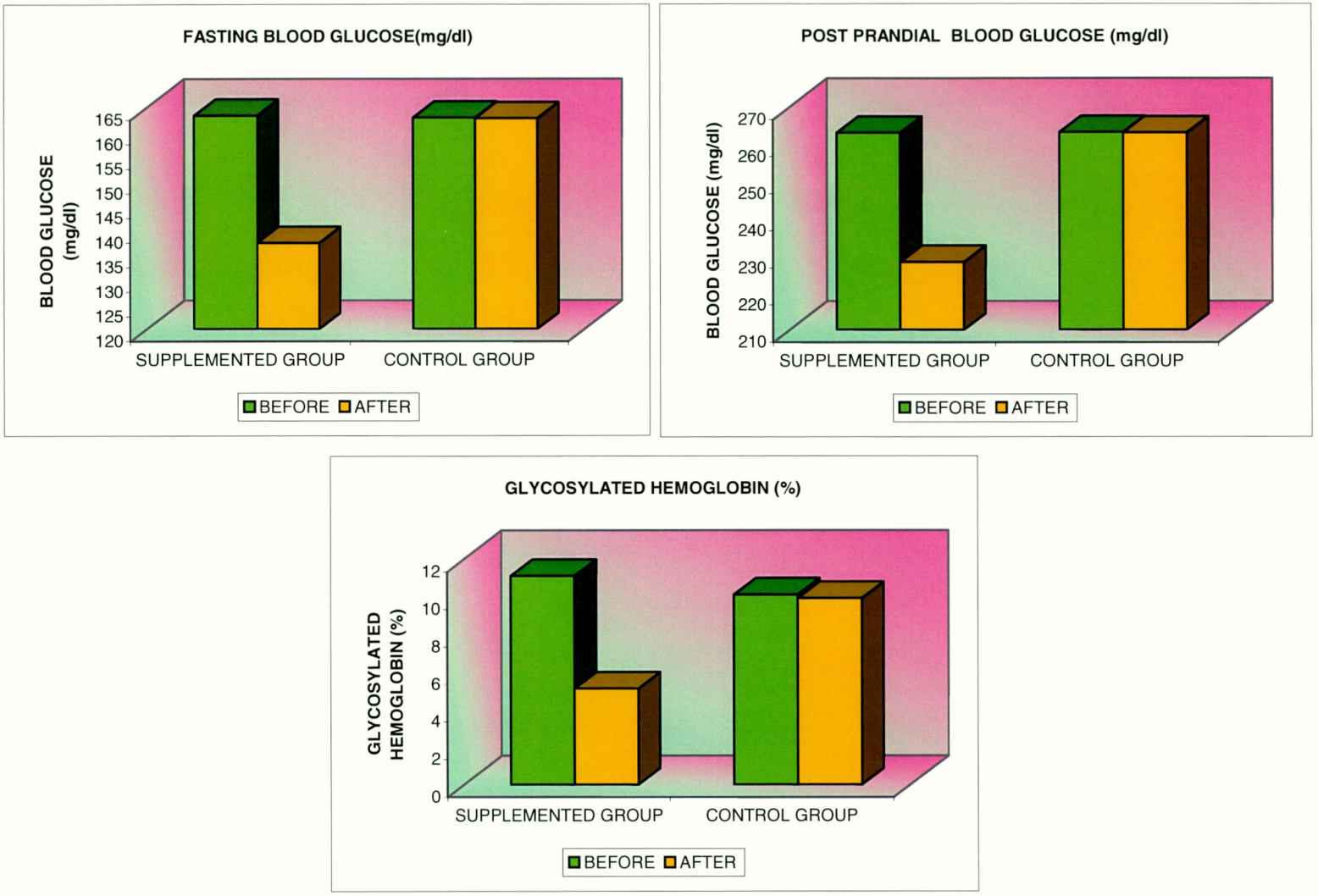


FIGURE III

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH CINNAMON

The mean initial fasting, post prandial blood glucose and the mean glycosylated hemoglobin levels of the control group had their levels of 162.98mg/dl, 263.28mg/dl and 263.14 and 10.12 per cent respectively. After the supplementation period of 90 days, there was a reduction in fast blood glucose level (162.98-162.8 mg/dl, post prandial blood glucose (263.28-263.14mg/dl) and glycosylated haemoglobin level (10.12-9.92 per cent). However the differences between the levels were not statistically significant.

Table 4.36 and Figure IV give the levels of different fractions of cholesterol and triglycerides of the selected diabetic subjects before and after supplementation with cinnamon powder.

Results of the lipid profile revealed that the mean total cholesterol level of the diabetic subjects was 243.5mg/dl and it was decreased to 231.11mg/dl after cinnamon powder supplementation for a period of three months. This decrease was found to be statistically significant at ($P<0.01$) level.

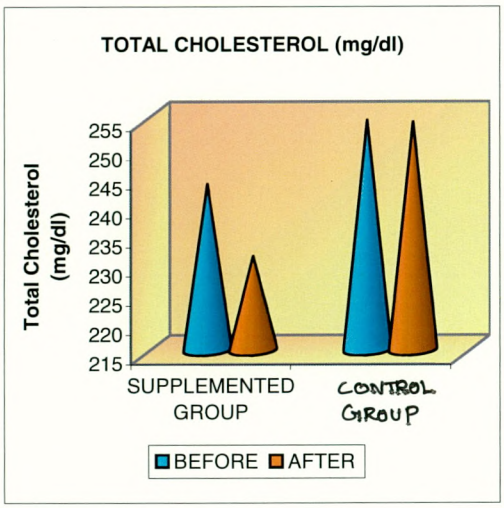
The mean HDL cholesterol was 36.46 mg/dl before supplementation and increased to 52.44 mg/dl after supplementation with a significant difference ($P<0.01$). The mean value of LDL-cholesterol was 160.92 mg/dl before supplementation and the same was significantly ($P<0.01$) decreased to 141.91mg/dl after supplementation. The mean value of VLDL cholesterol was 32.77 mg/dl before supplementation and decreased to 25.00 mg/dl after supplementation. The difference between these values were statistically analysed and it was found to be significant at ($P<0.01$) level. The mean triglyceride level of the diabetic subjects was 163.86 mg/dl before supplementation and reduced to 130.58 mg/dl after supplementation. The difference between these values were found to be statistically significant at ($P<0.01$) level.

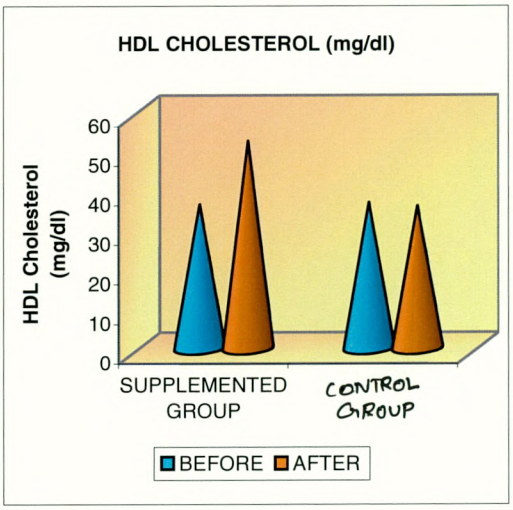
TABLE 4.36

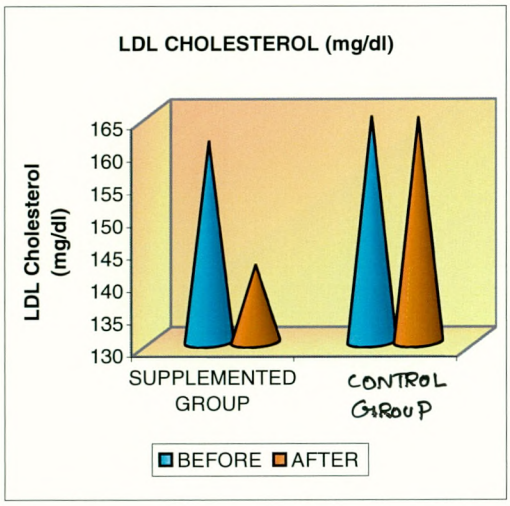
SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH CINNAMON POWDER

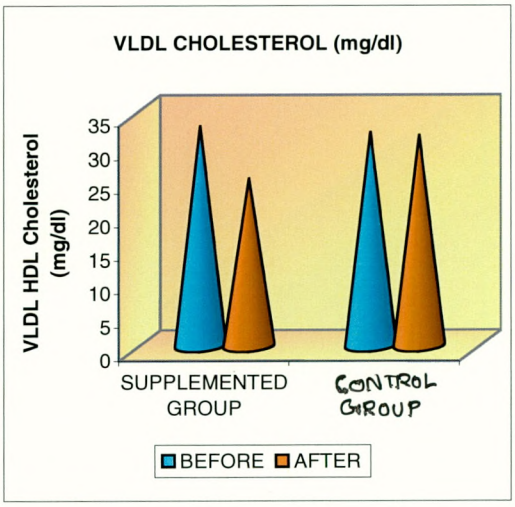
S. No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	243.5 ± 7.681	231.11 ± 8.047	58.035 **	254.42 ± 7.957	254.1 ± 7.951	0.8403 NS
2.	HDL cholesterol	30 – 60	36.46 ± 4.038	52.44 ± 3.346	7.0214 **	36.94 ± 3.456	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	160.92 ± 5.57	141.91 ± 6.59	14.173 **	164.7 ± 6.216	164.55 ± 6.294	0.8860 NS
4.	VLDL cholesterol	6 – 30	32.77 ± 1.107	25.005 ± 0.845	11.909 **	31.86 ± 1.077	31.37 ± 1.061	0.1977 NS
5.	Triglyceride	30 – 170	163.86 ± 6.219	130.58 ± 4.956	11.010 **	164.51 ± 6.549	164.37 ± 6.652	0.8457 NS

** Significant at (P<0.01) level NS- Not significant









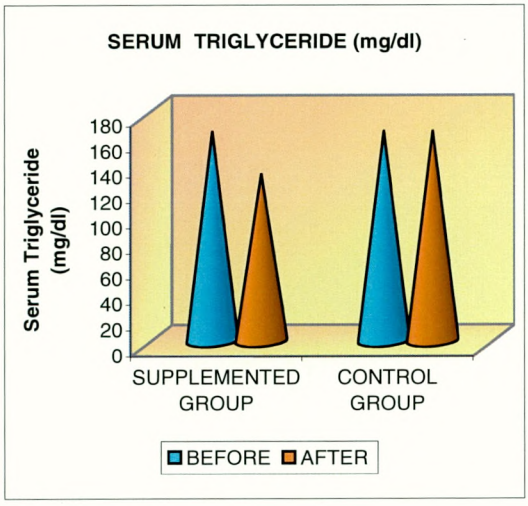


FIGURE IV
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH CINNAMON

The mean total cholesterol level of the control group was 254.42 mg/dl and it reduced to 254.10 mg/dl at the end of the study period. The difference was not statistically significant. The triglyceride level in the control group was found to be 164.51 mg/dl and reduced to 164.37 mg/dl but no statistical significant difference was observed. With regard to the various fractions of cholesterol, the difference between the initial and final values are not statistically significant.

Thus cinnamon powder supplemented group showed lower blood glucose and lipid profile levels when compared to non-cinnamon powder consuming group after the study period of 90 days..

3. Effect of supplementation with cumin seed

The blood glucose level of the supplemented group with cumin seed powder and control group before and after supplementation period is depicted in Table 4.37 and Figure V.

The data given in Table 4.37 clearly indicates that the mean fasting blood glucose level of the diabetic subjects was 160.93 mg/dl which was reduced to 140.14 mg/dl after supplementation with cumin seed powder and statistical analysis revealed that there was a significant difference at ($P<0.01$) level. The mean post prandial blood glucose level was 259.61mg/dl before supplementation and reduced to 236.72 mg/dl after supplementation in the experimental group. The difference between the two initial and final values were statistically analysed and found it was significant at ($P<0.01$) level.

The mean glycosylated haemoglobin level of the cumin seed powder supplemented group was found to be 9.56 per cent in the initial stage of the study and it was reduced to 7.00 per cent, at the end of supplementation period. When the values were statistically analysed, the difference was significant at ($P<0.01$) level.

TABLE 4.37

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH CUMIN SEED

S.No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	160.93 ± 5.188	140.14 ± 4.517	19.967 **	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	259.61 ± 4.32	236.72 ± 3.210	14.823 **	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	9.56 ± 0.3115	7.004 ± 0.225	5.2625 **	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

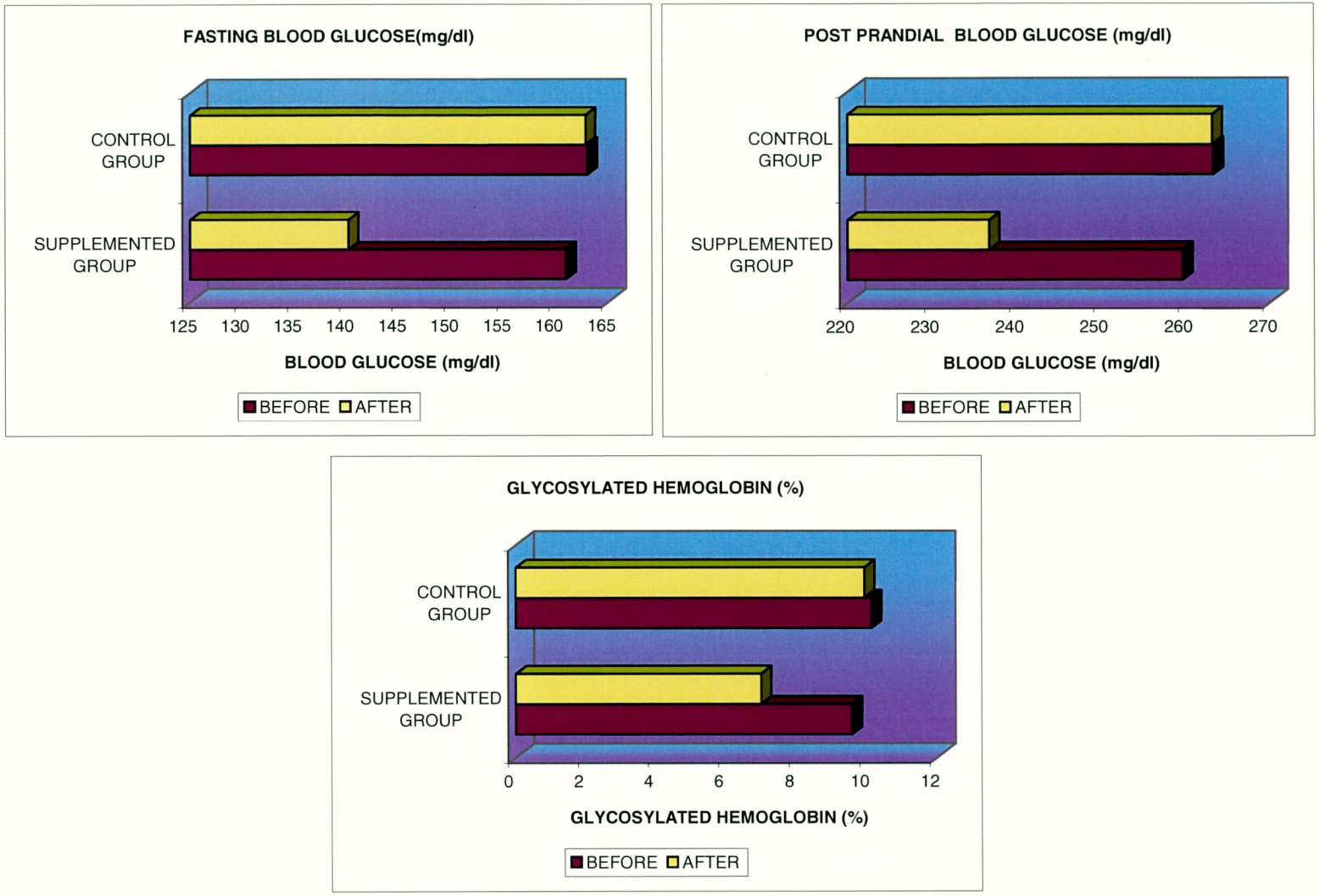


FIGURE V

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH CUMIN SEED

The mean fasting blood glucose level of the control group was 162.98 mg/dl which was slightly reduced to 162.81 mg/dl at the end of the study period. It might be due to the awareness created by in the investigator. The mean post prandial blood glucose level of the control group was 263.28mg/dl before, and decreased to 263.14 mg/dl, after the study period of 90 days. The mean initial and final glycosylated haemoglobin levels of the control group was 10.12 per cent and 9.92 per cent respectively. This difference was not statistically significant.

The lipid profile level of the supplemented group with cumin seed powder and control group before and after supplementation period is depicted in Table 4.38 and Figure VI.

From Table 4.38, it was noted that the mean total cholesterol level of the diabetic subjects was 246.35 mg/dl which was reduced to 223.98 mg/dl after supplementation with cumin seed powder, with a statistical significance ($P<0.01$). Thus, cumin seed powder consumption have an important role in the reduction of serum total cholesterol level of the supplemented group whereas the mean HDL-cholesterol of the diabetic subjects was 36.09 mg/dl which was increased to 40.18 mg/dl after the supplementation with a statistical significant at ($P<0.01$) level.

The mean LDL-cholesterol of the supplemented group was 162.45mg/dl and it was reduced to 151.05mg/dl after supplementation with cumin seed powder, which was statistically significant ($P<0.01$) and the mean VLDL-cholesterol levels of the supplemented group was 35.60mg/dl which was reduced to 32.67mg/dl after supplementation, and the difference was significant ($P<0.01$) when statistically analysed. The mean triglyceride value of the supplemented group was 175.29 mg/dl which was reduced to 163.40 mg/dl after supplementation period. When statistically analysed, the difference was significant at ($P<0.01$) level.

TABLE 4.38

SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH CUMIN SEED

S. No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	246.35 ± 7.942	223.98 ± 7.221	7.1644 **	254.42 ± 7.957	254.1 ± 7.951	0.8403 NS
2.	HDL cholesterol	30 – 60	36.09 ± 1.163	40.188 ± 1.295	26.177 **	36.94 ± 3.456	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	162.45 ± 5.237	151.05 ± 4.869	7.544 **	164.7 ± 6.216	164.55 ± 6.294	0.8860 NS
4.	VLDL cholesterol	6 – 30	35.60 ± 1.128	32.67 ± 1.051	4.339 **	31.86 ± 1.077	31.37 ± 1.061	0.1977 NS
5.	Triglyceride	30 – 170	175.29 ± 5.651	163.4 ± 5.268	6.767 **	164.51 ± 6.549	164.37 ± 6.652	0.8457 NS

** Significant at (P<0.01) level NS- Not significant

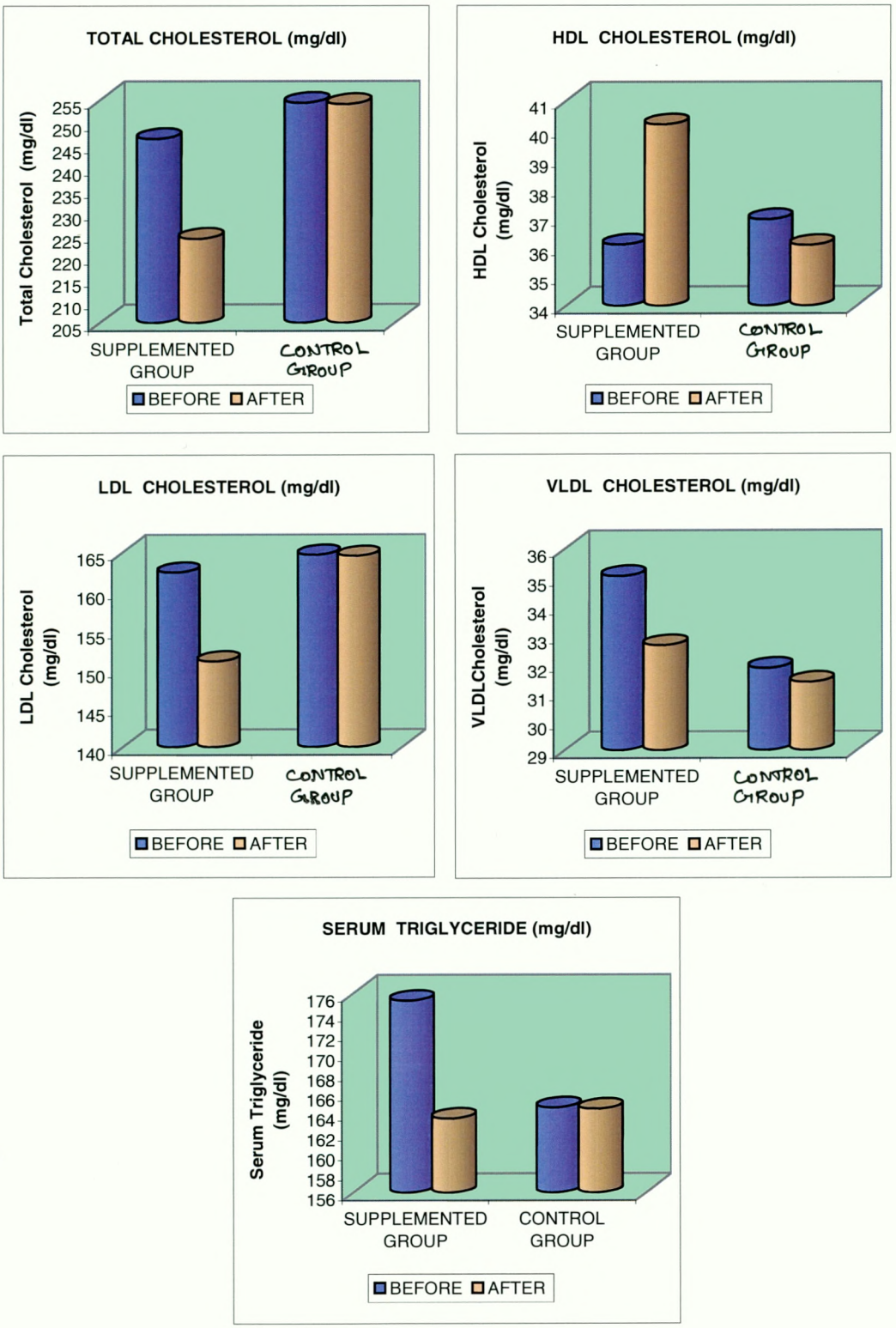


FIGURE VI
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH CUMIN SEEDS

According to Dhandapani *et al* (2002) oral administration of 0.2g of cumin seed per kg body weight showed significant reduction in blood glucose, blood cholesterol, and blood triglycerides.

Table 4.38 showed that the mean total cholesterol level of the control group was 254.42 mg/dl before supplementation and 254.1 mg/dl at the end of the study period. The mean initial HDL-cholesterol level of the control group was 36.94 mg/dl and decreased to 36.06 mg/dl after the study period of 90 days.

The LDL cholesterol was found to be 164.7 mg/dl at the initial stage and reduced to 164.55 mg/dl at the end of the supplementation period. Initially mean value of the VLDL of the control group was 31.86 mg/dl and slightly reduced to 31.37 mg/dl at the end of the study period and the mean triglyceride level was found to be 164.51mg/dl in the beginning of the study which was decreased to 164.37mg/dl after the study period. All the mean value of cholesterol fractions and triglycerides of the control group were analysed statistically and it was found that none of the values were statistically significant.

According to Gaylapp and John (2002) hyperglycemic condition in Type II diabetes can be treated successfully by dietary control before the complication engrave. Spicies and condiments normally added in the diet have got hypoglycemic effect. Supplementation of both cinnamon and cumin powders brought about a significant reduction in body weight, blood pressure, blood glucose level and lipid profile in 90 days but the hypoglycemic effect of cinnamon powder was higher compared to cumin seed powder (Anuradha and Anusuya devi, 2004).

From the present study, it is evident to note that cumin seed powder more is helpful in reducing blood glucose, glycosylated hemoglobin, total cholesterol, LDL cholesterol, VLDL cholesterol and triglyceride levels and also helps to increase the HDL cholesterol level.

4. Effect of supplementation with artichoke

Table 4.39 and Figure VII highlight the blood glucose levels and glycosylated hemoglobin of the diabetic subjects before and after supplementation with artichoke powder for the period of 90 days.

Data sited in Table 4.39 indicated that the mean fasting blood glucose levels of the diabetic subjects was 165.49mg/dl initially which was reduced to 155.26mg/dl after supplementation with artichoke powder, with a statistical significance at ($P<0.01$) level.

The mean post prandial blood glucose level was 264.9mg/dl before supplementation and decreased to 252.64mg/dl after supplementation in the experimental group. The difference between the initial and final values were statistically analysed and it was found to be significant at ($P<0.01$) level. The mean glycosylated hemoglobin level of the artichoke powder supplemented group was 9.72 per cent in the initial stage of the study and it was reduced to 8.99 per cent at the end of supplementation period. When the values were statistically analysed the difference was significant at one per cent level ($P<0.01$). The mean fasting, post prandial blood glucose and mean glycosylated haemoglobin levels of the control group was reduced from 162.98 to 162.81mg/dl, 263.28 to 263.14mg/dl and 10.12 to 9.92 per cent respectively after the study period. Since the difference between initial and final was megre, it was found to note that there was no statistical significant.

TABLE 4.39

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH ARTICHOKE

S. No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	165.49 ± 7.231	155.26 ± 6.784	5.284**	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	264.90 ± 11.57	252.64 ± 11.038	12.623**	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	9.72 ± 0.419	8.99 ± 0.388	5.280**	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

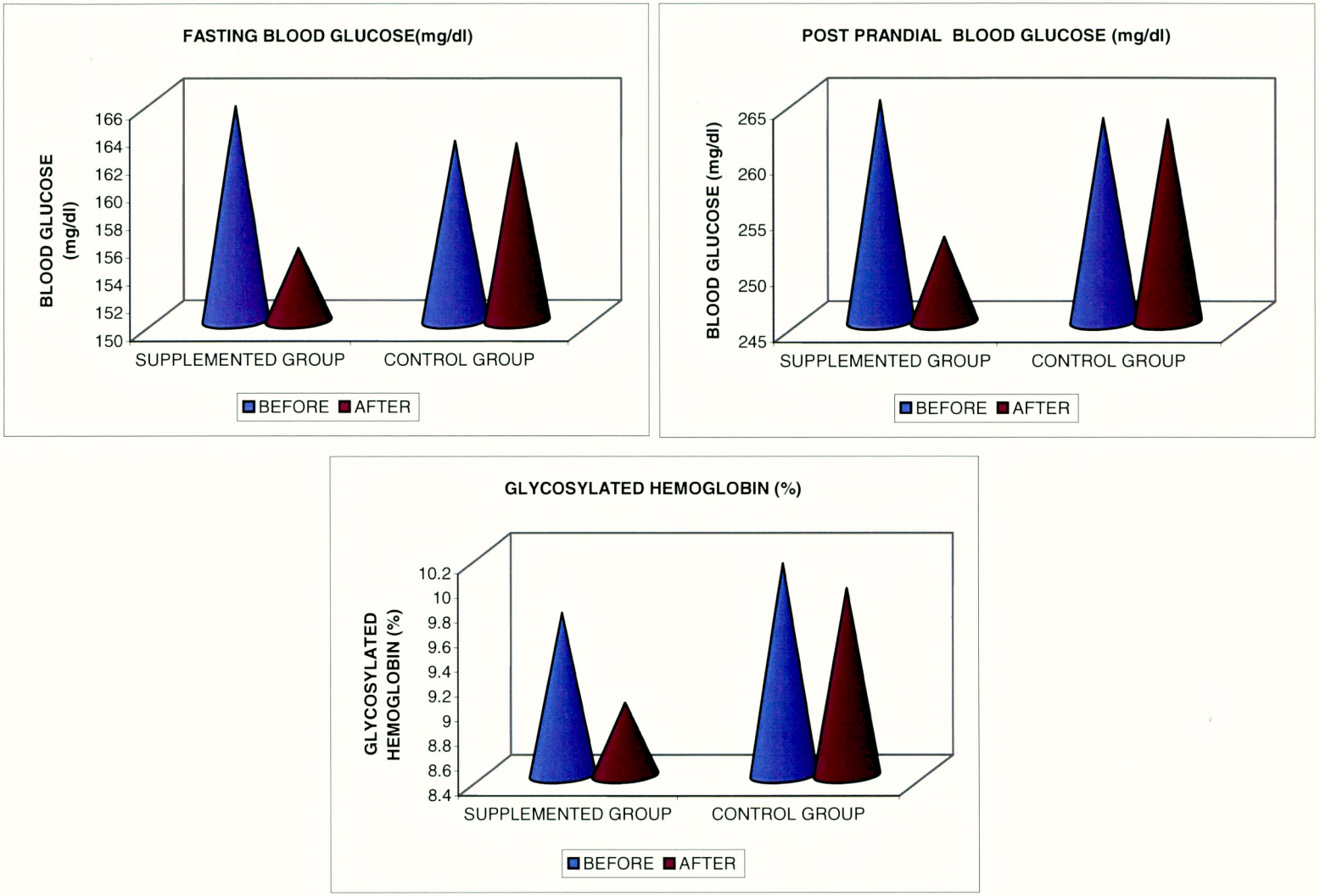


FIGURE VII

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH ARTICHOKE

Table 4.40 and Figure VIII give the details related to the lipid profile of the diabetic subjects before and after supplementation with artichoke powder for the period of 90 days.

Results of the Table 4.40 revealed that the mean total cholesterol level of the experimental diabetic subjects supplemented group was 238.0mg/dl and it was decreased to 232.01mg/dl after artichoke powder supplementation for a period of three months. This decrease was found to be statistically significant ($P<0.01$). The mean total cholesterol level of the control group subjects was 254.42mg/dl at the beginning of the study and it was slightly reduced to 254.1mg/dl after the study period of three months. It was not statistically significant.

The mean HDL-cholesterol level of the experimental subjects supplemented group was 34.52mg/dl before supplementation and it was increased to 36.92mg/dl after supplementation. It was interesting to note that the difference between the initial and final levels was found to be statistically significant at ($P<0.01$) level.

The mean HDL-cholesterol level of the control group was found to be 36.94 mg/dl at the start of the study and 36.06mg/dl at completion of the study. No significant difference was noticed between these levels. The mean LDL-cholesterol level of the diabetic subjects in supplemented group was 161.05mg/dl before supplementation and the same significantly decreased to 154.71mg/dl after supplementation at ($P<0.01$) level.

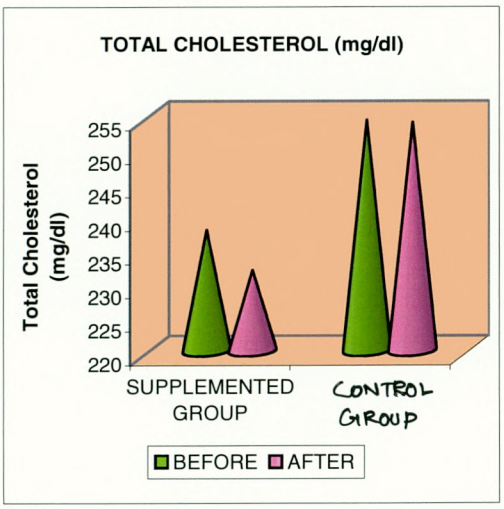
With regard to the subjects who were undergoing only allopathic treatment (control group) the mean LDL-cholesterol level before the supplementation was 164.7mg/dl and it was recorded as 164.55mg/dl after the study period though the difference was not statistically significant.

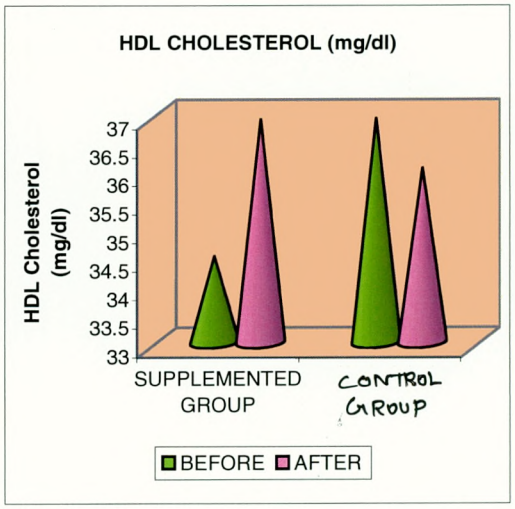
TABLE 4.40

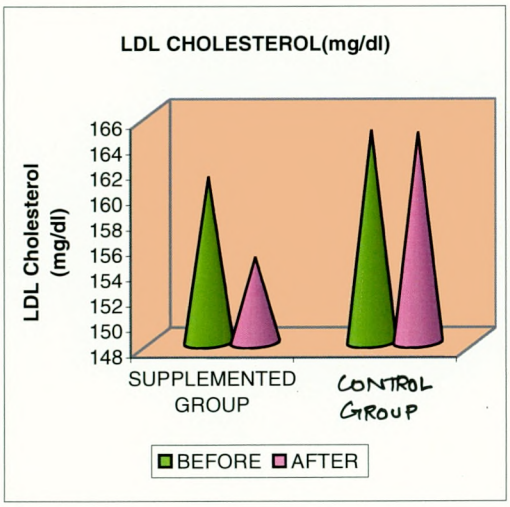
SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH ARTICHOKE

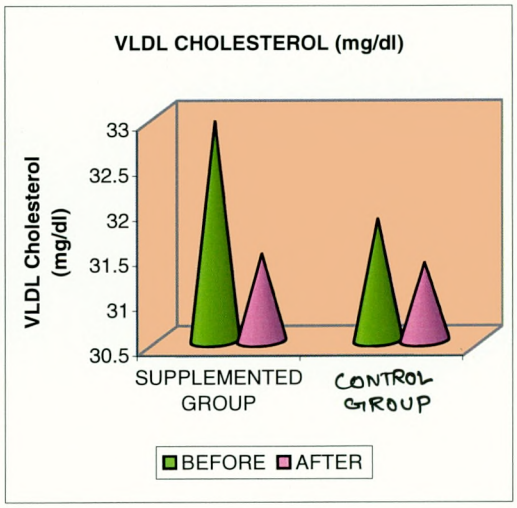
S. No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	238.02 ± 10.39	232.01 ± 10.1	6.435 **	254.42 ± 7.95	254.1 ± 7.95	0.8403 NS
2.	HDL cholesterol	30 – 60	34.52 ± 1.511	36.92 ± 1.61	5.342 **	36.94 ± 3.45	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	161.05 ± 6.95	154.71 ± 6.67	6.356 **	164.7 ± 6.21	164.55 ± 6.29	0.8860 NS
4.	VLDL cholesterol	6 – 30	32.94 ± 1.439	31.47 ± 1.37	4.969 **	31.86 ± 1.07	31.37 ± 1.06	0.1977 NS
5.	Triglyceride	30 – 170	164.68 ± 7.195	157.34 ± 6.87	7.382 **	164.51 ± 6.54	164.37 ± 6.65	0.8457 NS

** Significant at (P<0.01) level NS- Not significant









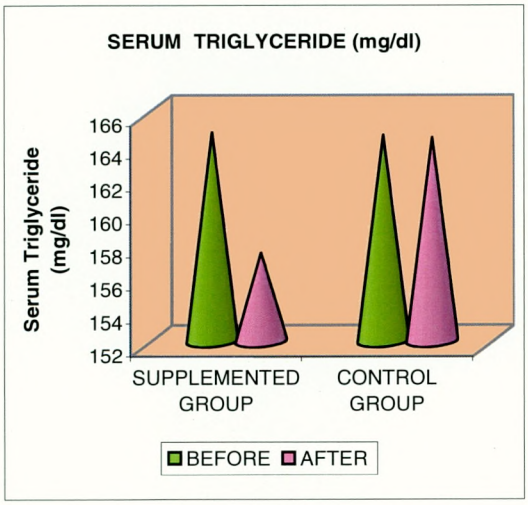


FIGURE VIII
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH ARTICHOKE

The mean VLDL-cholesterol levels of the diabetic subjects in supplemented group were 32.94mg/dl before supplementation and the same was decreased to 31.47mg/dl after supplementation. The difference between two values was found to be statistically significant at (P<0.01) level.

Regarding the control group VLDL-cholesterol level, the difference between mean values of initial and final was found to be only 0.49mg/dl which was not statistically significant.

The mean triglyceride level of the diabetic subjects in the experimental group was 164.68mg/dl before supplementation which had reduced to 157.34mg/dl after supplementation, indicating a statistically significant difference at (P<0.01) level. With regard to the triglyceride level the difference between the initial and final value of the control group was found to be 0.14mg which was not statistically significant.

According go Wregner and Fintelmann (1999) inclusion of artichoke in the diet reduces the blood glucose, cholesterol and blood pressure.

5. Effect of supplementation with amla

Table 4.41 and Figure IX give the various parameters of blood glucose of diabetic subjects in supplementation group, before and after the supplementation with amla for the period of 90 days.

The results indicated in Table 4.43 clearly indicate the mean fasting blood glucose level of the diabetic subjects was 163.06mg/dl which was reduced to 135.52mg/dl after supplementation with amla, with a statistical significant (P<0.01) level.

The mean post prandial blood glucose was 261.59mg/dl before supplementation and decreased to 229.80mg/dl after supplementation in the supplemented group. The difference between these values, were statistically analysed and it was found to be significant (P<0.01).

TABLE 4.41

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH AMLA

S.No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	163.06 ± 3.991	135.52 ± 3.317	12.813**	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	261.59 ± 5.451	229.80 ± 4.788	9.490 **	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	10.54 ± 0.257	7.404 ± 0.180	5.2994 **	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

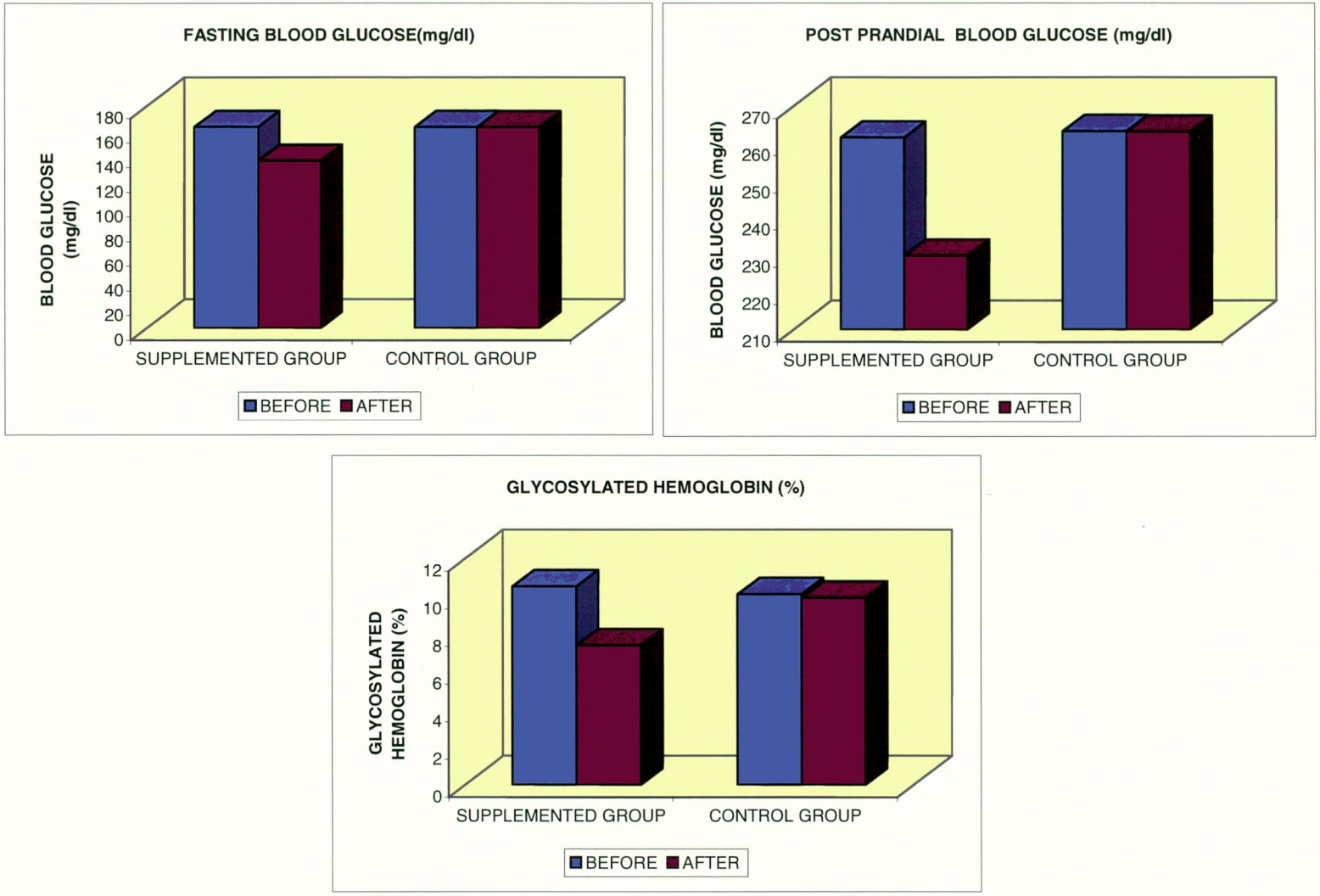


FIGURE IX

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH AMLA

The mean glycosylated hemoglobin level of the amla supplemented group was found to be 10.54 per cent in the initial stage of the study and it was reduced to 7.40 per cent after supplementation with significant difference at ($P<0.01$) level.

The mean fasting, post-prandial blood glucose and glycosylated hemoglobin levels of the control group had levels from 162.98mg/dl, 263.28mg/dl and 10.12 per cent respectively after the study period. There was a slight reduction in the mean fasting blood glucose level (162.98-162.81mg/dl), post-prandial blood glucose level (263.28-263.14mg/dl) and glycosylated haemoglobin (10.12-9.92 per cent). However the difference between the levels was not statistically significant.

Amla is widely used against many chronic ailments including diabetes and lipid disorders. Findings of the research conducted by Sharma *et al.* (2004) revealed that tannoids of amla possess certain therapeutic value and incorporation of this fruit into every day's life is very effective in the management of diabetic complications.

Table 4.42 and Figure X give the lipid profile of diabetic subjects in supplementation group, before and after the supplementation with amla for the period of 90 days.

Results of Table 4.42 revealed that the mean total cholesterol level of the diabetic subjects in the supplemented group was 236.01mg/dl and it decreased to 208.43mg/dl after amla supplementation for a period of three months. This decrease was found to be statistically significant at ($P<0.01$) level.

TABLE 4.42

SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH AMLA

S. No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	236.01 ± 12.63	208.43 ± 10.91	21.951 **	254.42 ± 7.95	254.1 ± 7.95	0.8403 NS
2.	HDL cholesterol	30 – 60	34.75 ± 1.86	44.75 ± 2.40	6.1925**	36.94 ± 3.45	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	156.02 ± 8.38	146.04 ±7.84	8.465 **	164.7 ± 6.21	164.55 ± 6.29	0.8860 NS
4.	VLDL cholesterol	6 – 30	26.94 ± 0.65	31.76 ± 1.07	7.198 **	31.86 ± 1.07	31.37 ± 1.06	0.1977 NS
5.	Triglyceride	30 – 170	165.33 ± 4.04	139.03 ± 3.40	21.483 **	164.51 ± 6.54	164.37 ± 6.65	0.8457 NS

** Significant at (P<0.01) level NS- Not significant

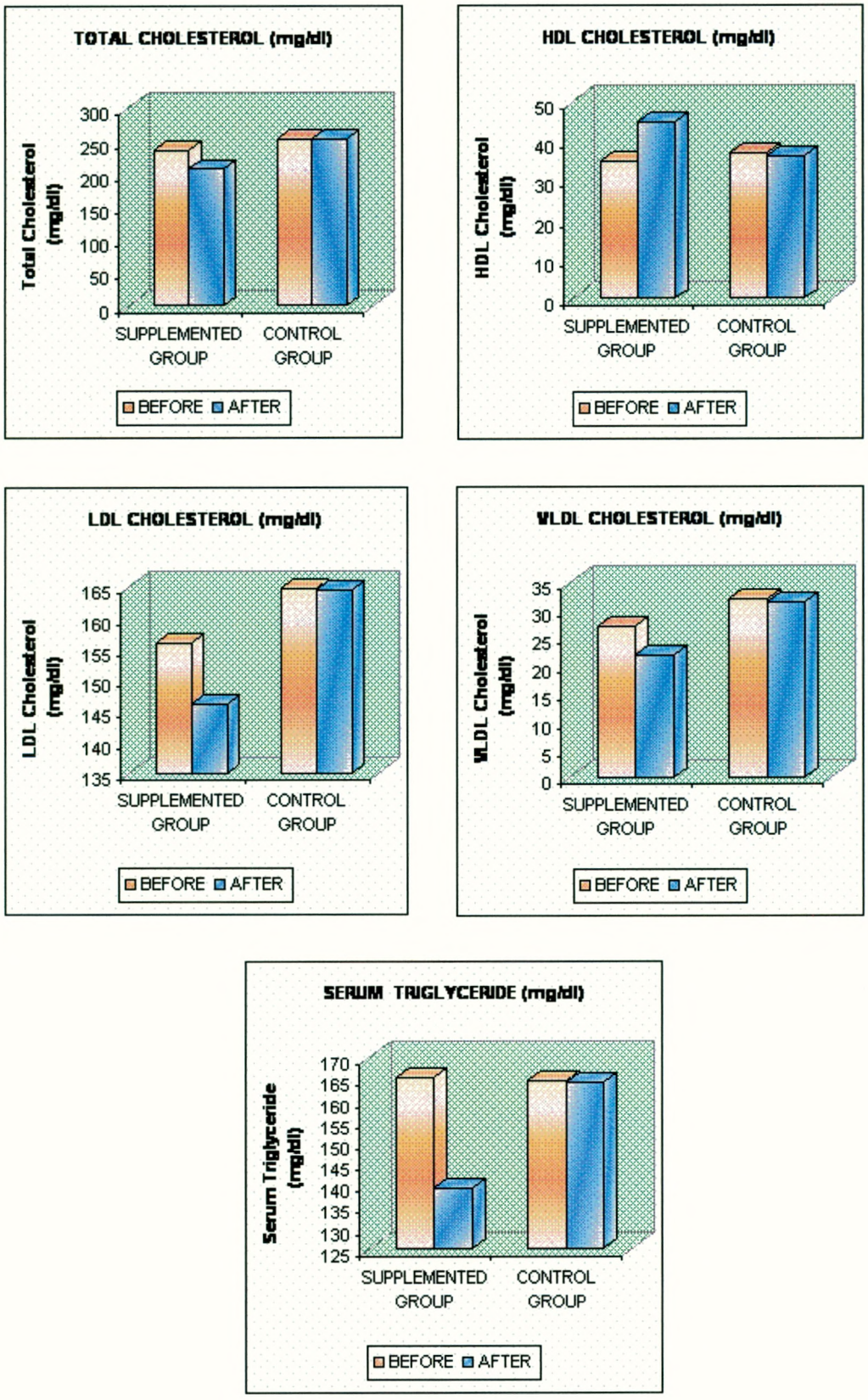


FIGURE X
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH AMLA

The mean HDL cholesterol was 34.75mg/dl before supplementation and had dramatically increased to 44.75mg/dl after supplementation with a significant difference at ($P<0.01$) level. The mean value of LDL cholesterol of the experimental group was 156.02mg/dl before supplementation and the same was significantly decreased to 146.01mg/dl after supplementation. The mean value of VLDL cholesterol was 26.94mg/dl before supplementation and had decreased to 21.76mg/dl after supplementation. When the difference between the two values were statistically analysed, it was found to be significant ($P<0.01$). The mean triglyceride level of the diabetic subject was 165.33mg/dl before supplementation and had reduced to 139.03mg/dl after supplementation and the difference was found to be statistically significant ($p<0.01$).

The mean total cholesterol level of the diabetic subjects in the control group was 254.42mg/dl and it had reduced to 254.1mg/dl at the end of the study period. The difference did not show any statistical significance. The triglyceride level in the control group was found to be 164.51mg/dl and had reduced to 164.37 mg/dl but no statistical significant difference was observed. With regard to the various fractions of cholesterol also showed the difference between the initial and final values but the values are not statistically significant.

Vitamin C present in amla and wheat grass was more effective in improving blood glucose and insulin metabolism and high cholesterol level (Kitigakara *et al.*, 2002). Vitamin C helps in the conversion of cholesterol to bile acids which can indirectly induce diabetes mellitus (Robinson, 1999).

Thus the amla supplemented group showed lower blood glucose and lipid profile levels and increased HDL level when compared to the control group.

6. Effect of supplementation with soyabean

Table 4.43 and Figure XI give the various blood glucose levels of the diabetic subjects in supplementation group, before and after the supplementation with okara powder prepared from soyabean for the study period of 90 days.

Table 4.43 showed that the mean initial fasting blood glucose level of the supplemented group was 163.16mg/dl which was reduced to 135.28mg/dl at the end of okara powder supplementation. When statistically analysed, the differences were significant at ($P<0.01$) level.

The mean post prandial blood glucose level of the experimental group was found to be 264.74mg/dl in the beginning of the study and it was reduced to 234.71mg/dl at the end of the study period when the values were statistically analysed, the difference was significant at ($P<0.01$) level.

The mean glycosylated haemoglobin was 10.38 per cent before supplementation and had decreased to 5.69 per cent after supplementation with a significant difference at ($P<0.01$) level.

The mean fasting, post prandial blood glucose and glycosylated hemoglobin levels of the control group were 162.98mg/dl, 263.28mg/dl and 10.12 per cent respectively. After the study period, there was a slight reduction in these parameters. However, the differences between these levels were not statistically significant.

TABLE 4.43

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH SOYABEAN

S.No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	163.16 ± 4.30	135.28 ± 3.55	34.838 **	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	264.74 ± 4.65	234.71 ± 4.18	25.619 **	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	10.38 ± 0.656	5.69 ± 0.705	2.862 **	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

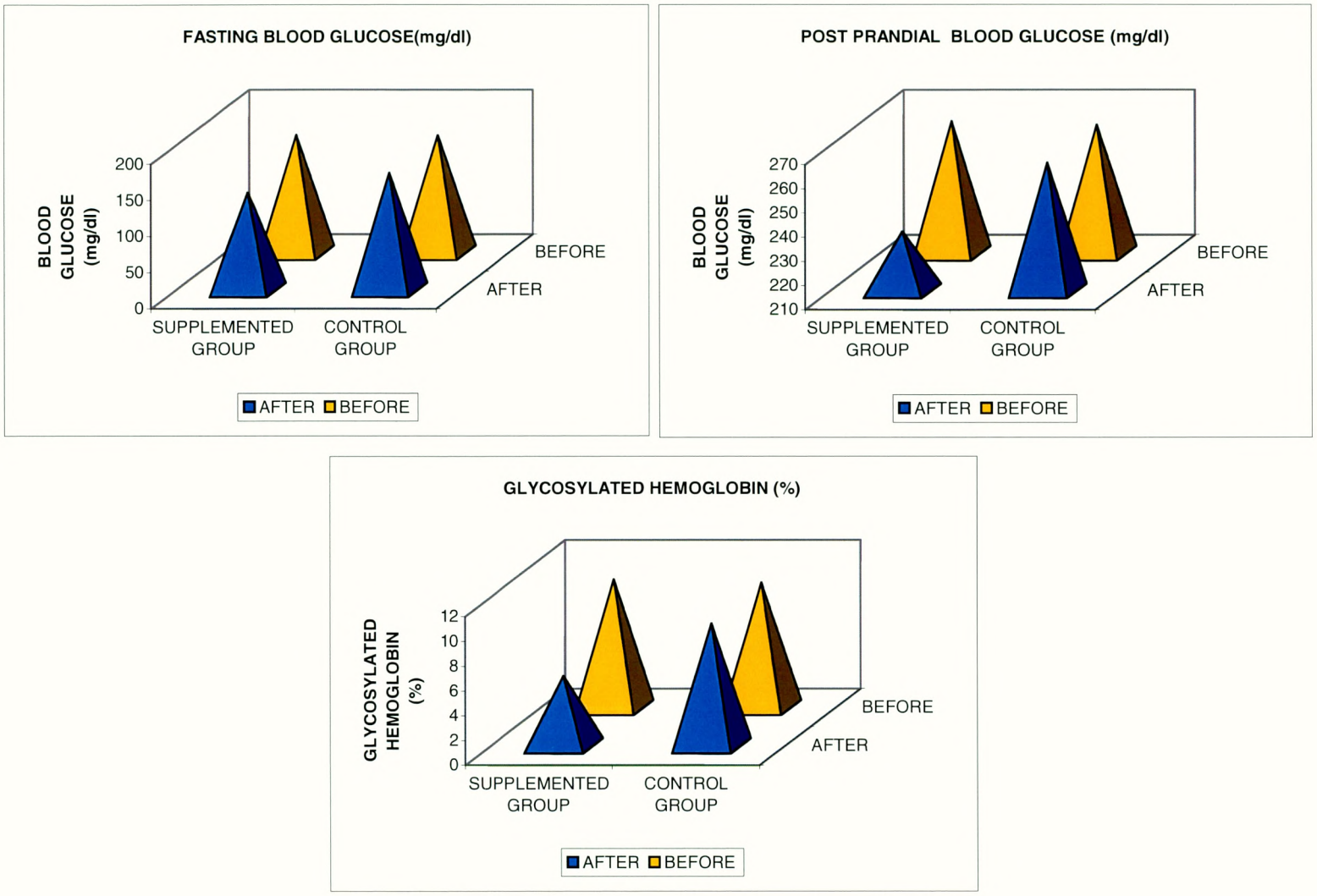


FIGURE XI

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH SOYABEAN

Table 4.44 and Figure XII show the lipid profile of the diabetic subjects in supplementation group, before and after the supplementation with okara powder prepared from, soyabean for the study period of 90 days.

Results of Table 4.44 depicted that the mean total cholesterol level of the diabetic subjects in the supplemented group was 244.01mg/dl and it decreased to 225.01mg/dl after okara powder supplementation for a period of three months. This decrease was statistically analyzed and found to be significant at ($P<0.01$) level.

The mean HDL cholesterol level was 37.01mg/dl before supplementation and it effectively increased to 45.49mg/dl after supplementation, with a significant difference at ($P<0.01$) level. The mean value of LDL cholesterol was 164.49mg/dl in the initial stage of the study and decreased to 150.72mg/dl after supplementation. The difference between the two values were statistically analysed and was found to be significant at ($P<0.01$) level.

The mean value of VLDL cholesterol level was 33.22mg/dl in the initial stage of the study and had decreased to 28.45mg/dl after supplementation. The difference between the two values when statistically analyzed was found to be significant at ($P<0.01$) level.

Results of mean triglyceride level of the diabetic subjects was 166.11mg/dl before supplementation and reduced to 142.26mg/dl at the end of supplementation and the difference was found to be statistically significant ($P<0.01$).

TABLE 4.44

SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH SOYABEAN

S.No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	244.01 ± 4.35	225.01 ± 4.184	11.923 **	254.42 ± 7.957	254.1 ± 7.951	0.8403 NS
2.	HDL cholesterol	30 – 60	37.01 ± 2.750	45.49 ± 3.383	15.299 **	36.94 ± 3.456	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	164.49 ± 5.58	150.72 ± 5.12	17.031**	164.7 ± 6.216	164.55 ± 6.294	0.8860 NS
4.	VLDL cholesterol	6 – 30	33.22 ± 1.117	28.45 ± 0.957	7.414 **	31.86 ± 1.077	31.37 ± 1.061	0.1977 NS
5.	Triglyceride	30 – 170	166.11 ± 4.701	142.26 ± 4.107	4.643 **	164.51 ± 6.549	164.37 ± 6.652	0.8457 NS

** Significant at (P<0.01) level NS- Not significant

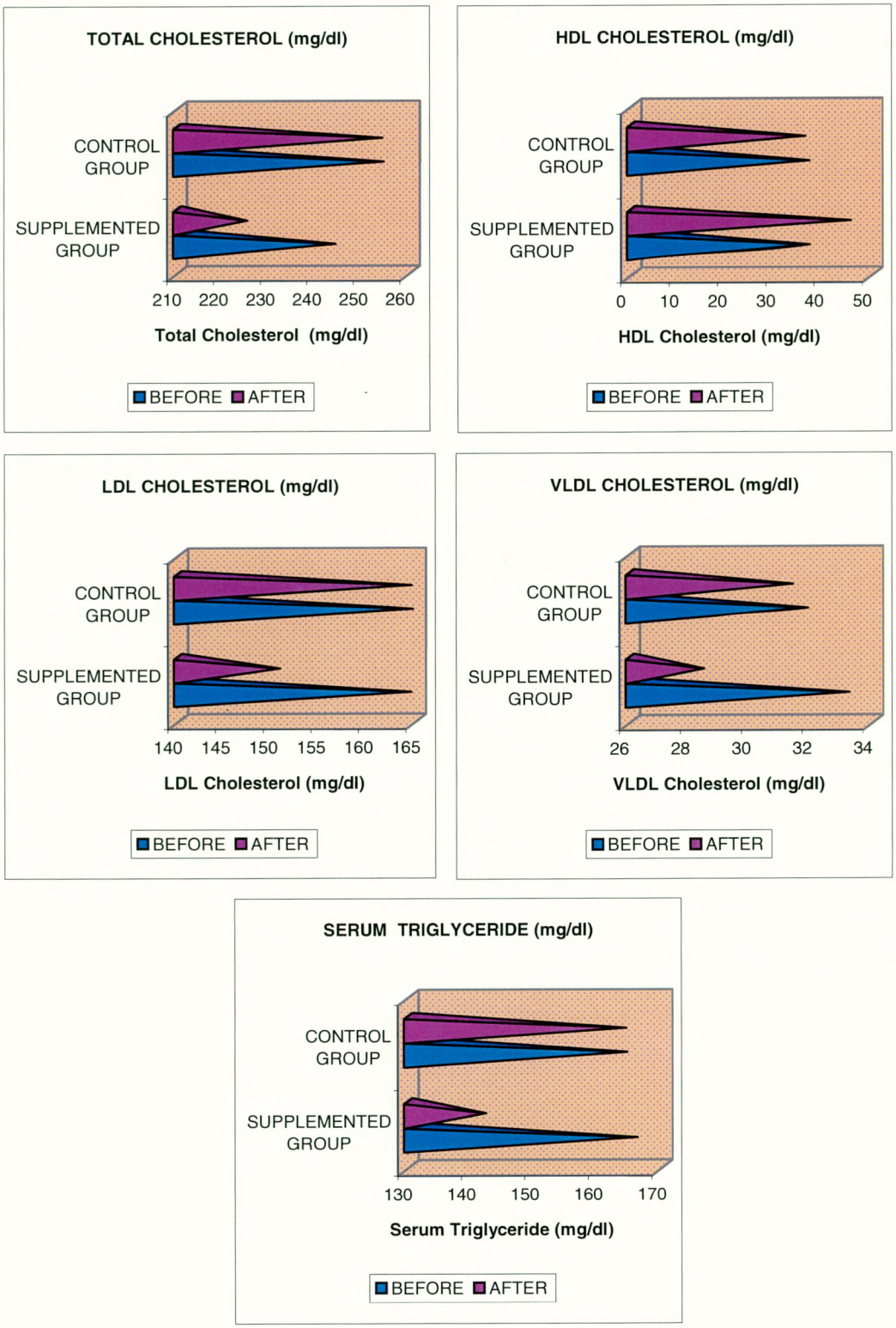


FIGURE XII
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH SOYABEAN

Okara has a very low glycemic index and is a very good healthy component in diabetic diet. The soluble fiber present in okara is commonly included to baked recipes in place of wheat flour. The fibre content helps to control diabetes by making the body more sensitive to insulin in the blood stream while slowing the release of glucose into the blood. Due to high quality protein okara has the ability to lower LDL cholesterol in the blood (www.soyafoods.com).

The mean total cholesterol level of the control group was reduced from 254.42 to 254.1 mg/dl but the difference did not show any statistical significance. The triglyceride level in the control group was found to be 164.51mg/dl and decreased to 164.37mg/dl but no statistical significant difference was observed. In case of HDL cholesterol in control group, the initial value was 36.94mg/dl and it reduced to 36.06mg/dl at the end of the study period. With regard to the other fractions of cholesterol like LDL and VLDL also the difference between the initial and final values are not statistically significant.

7. Effect of supplementation with bay leaves

Table 4.45 and Figure XIII give the various parameters of blood glucose level of the diabetic subjects before and after the supplementation with bay leaves.

The data depicted in Table 4.45 clearly indicate that the mean fasting blood glucose level of the diabetic subjects was 164.35mg/dl which was reduced to 146.53mg/dl after supplementation with bay leaves powder with a statistical significant at ($P<0.01$) level. The mean post prandial blood glucose level was 251.93mg/dl before supplementation and decreased to 232.58mg/dl after supplementation in the experimental group. The difference between these two values were statistically analysed and it was found to be significant at ($P<0.01$) level.

TABLE 4.45

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH BAY LEAVES

S. No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	164.35 ± 5.56	146.53 ± 4.96	48.83 **	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	251.93 ± 5.25	232.58 ± 4.84	45.35 **	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	10.43 ± 0.67	7.61 ± 0.49	6.1123 **	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

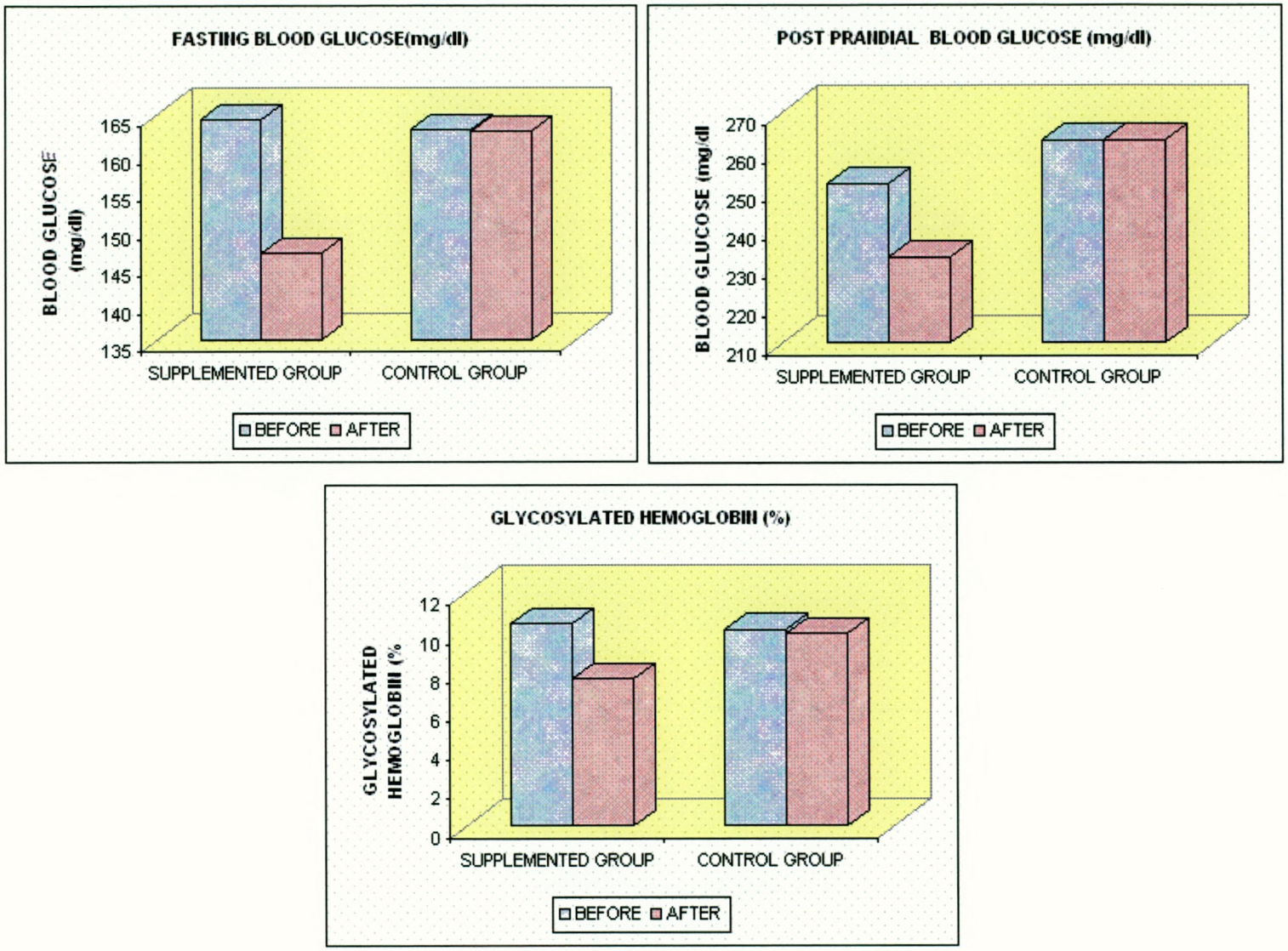


FIGURE XIII

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH BAY LEAVES

The mean glycosylated hemoglobin level of the bay leaves powder supplemented group was found to be 10.43 per cent in the initial stage of the study and it was reduced to 7.61 per cent at the end of the supplementation period, when the values were statistically analysed and the difference was found to be significant at ($P<0.01$) level.

The mean fasting blood glucose level of the control group was 162.98mg/dl initially and it was recorded as 162.81mg/dl at the end of the study period with no statistical significant difference. The mean post prandial blood glucose level of the control group was 263.28mg/dl before, which may found to be 263.14mg/dl after the study period and the difference was not significant. The initial mean glycosylated hemoglobin level of the control group was 10.12 per cent and after the study period the value was 9.92 per cent. This difference was not found to be statistically significant.

The lipid profile of the diabetic subjects, before and after the supplementation of bay leaves powder for a period of 90 days is depicted in Table 4.46 and Figure XIV.

Table 4.46 showed that the mean total cholesterol level of the diabetic subjects in the study group was 244.69mg/dl and it decreased to 231.62mg/dl after bay leaves powder supplementation for a period of three months. This decrease was found to be statistically significant ($P<0.01$).

The mean HDL cholesterol was 38.33mg/dl before supplementation and increased to 46.08mg/dl after supplementation, with a significant difference ($P<0.01$). The mean value of LDL-cholesterol was 163.9mg/dl before supplementation was reduced to 149.94mg/dl after supplementation with bay leaves powder, which was statistically significant at ($P<0.01$) level. The mean VLDL-cholesterol level of the supplemented group was 32.92mg/dl which was reduced to 29.26mg/dl after supplementation with bay leaves powder and the difference was significant ($P<0.01$), when statistically analysed.

TABLE 4.46

SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH BAY LEAVES

S.No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	244.69 ± 7.445	231.62 ± 7.04	15.514 **	254.42 ± 7.957	254.1 ± 7.951	0.8403 NS
2.	HDL cholesterol	30 – 60	38.33 ± 3.662	46.08 ± 4.402	5.6560 **	36.94 ± 3.456	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	163.9 ± 5.54	149.94 ± 5.078	11.6321**	164.7 ± 6.216	164.55 ± 6.294	0.8860 NS
4.	VLDL cholesterol	6 – 30	32.92 ± 1.106	29.26 ± 0.9838	8.1571 **	31.86 ± 1.077	31.37 ± 1.061	0.1977 NS
5.	Triglyceride	30 – 170	164.6 ± 11.157	146.32 ± 9.918	9.2193 **	164.51 ± 6.549	164.37 ± 6.652	0.8457 NS

** Significant at (P<0.01) level NS- Not significant

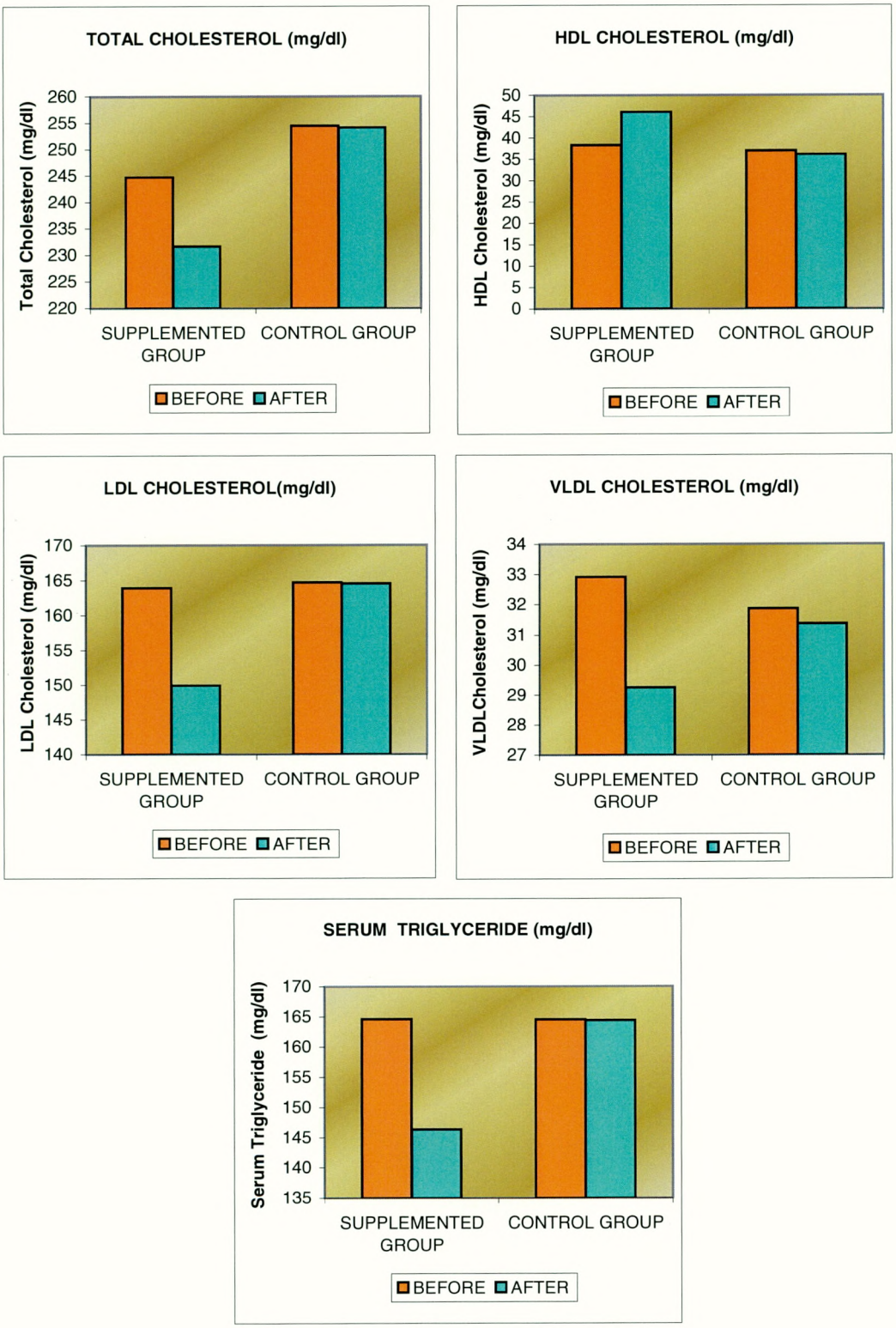


FIGURE XIV
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH BAY LEAVES

The mean triglyceride value of the supplemented group was 164.6mg/dl which was reduced to 146.32mg/dl after supplementation of bay leaves powder when statistically analysed the difference was significant.

Polanski (2003) showed that the positive effect of bay leaves extract on insulin activity and also reducing glucose and improving insulin metabolism of diabetic subjects.

Table 4.46 showed that the mean total cholesterol level of the control group was 254.42mg/dl before supplementation and 254.1mg/dl at the end of the study period.

The high density lipoprotein cholesterol level was found to be 36.94mg/dl before, which had slightly decreased to 36.06mg/dl after the study period.

The LDL-cholesterol was found to be 164.7mg/dl at the beginning of the study, and slightly reduced to 164.55mg/dl at the end of the study period. It might be due to allopathic treatment. The mean initial value of VLDL-cholesterol of control group was 31.86mg/dl and slightly reduced to 31.37mg/dl at the end of the experimental study.

The mean triglyceride level was found to be 164.51mg/dl in the beginning of the study and decreased slightly to 164.37mg/dl after the study period. The mean value of cholesterol fractions and triglycerides of the control group were analysed statistically and it was found that none of the values were statistically significant.

The present study confirmed that the bay leaves powder is very effective in reducing blood glucose, glycosylated hemoglobin, and total cholesterol, LDL cholesterol, VLDL cholesterol and triglyceride levels. It will be more effective for the person who is consuming it for long time.

8. Effect of supplementation with flaxseed

Table 4.47 and Figure XV give the details of the blood glucose, glycosylated hemoglobin of the diabetic subjects, before and after supplementation with flaxseed powder.

Results of Table 4.47 showed that the mean fasting blood glucose level of the diabetic subjects in the supplemented group was 165.08mg/dl which was reduced to 157.28mg/dl after supplementation with flaxseed powder with a statistical significance ($P<0.01$).

The mean post prandial blood glucose level of the experimental group was found to be 264.44mg/dl in the beginning of the study and it was reduced to 254.1mg/dl at the end of the study period, when the values were statistically analysed the difference was significant at ($P<0.01$) level. The mean glycosylated hemoglobin levels of the flaxseed powder supplemented group were found to be 9.168 per cent in the initial stage of the study and it was reduced to 7.89 per cent at the end of supplementation period, when the values were statistically analysed the difference was significant at ($P<0.01$) level.

The mean fasting blood glucose levels of the control group was 162.98mg/dl which had slightly reduced to 162.81mg/dl at the end of the study period. The mean post prandial and glycosylated hemoglobin levels of the control group was 263.28mg/dl and 10.12 per cent before which had reduced to 263.14mg/dl and 9.92 per cent respectively at the end of study period.

TABLE 4.47

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH FLAXSEED

S. No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	165.08 ± 4.299	157.28 ± 4.095	4.004 **	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	264.44 ± 5.515	254.1 ± 5.299	6.410 **	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	9.168 ± 0.561	7.89 ± 0.482	5.137 **	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

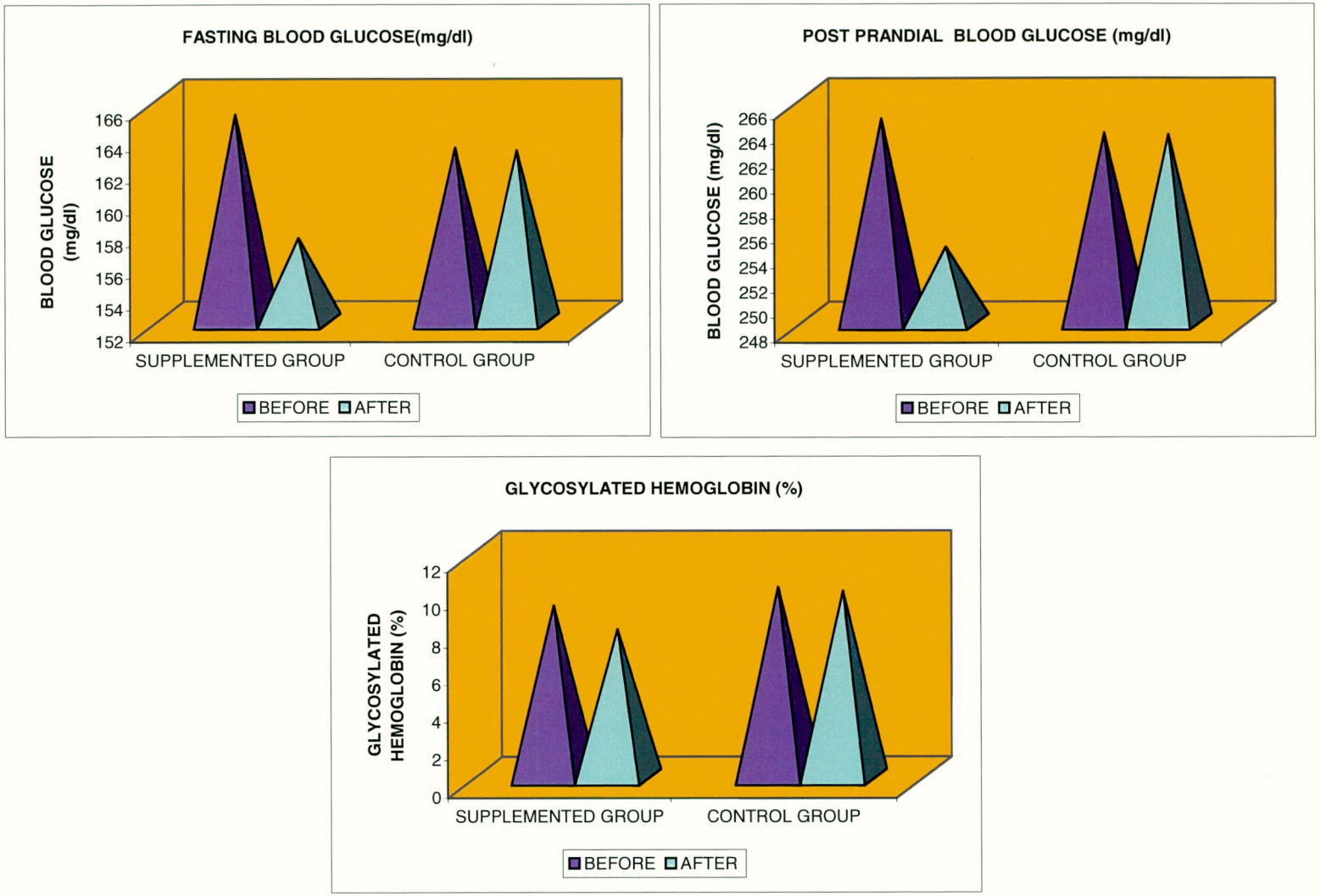


FIGURE XV

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH FLAX SEED

Table 4.48 and Figure XVI give the details regarding the lipid profile of the diabetic subjects, before and after supplementation with flaxseed powder.

Results of Table 4.48 revealed that the mean total cholesterol level of the diabetic subject was 245.19mg/dl and it had decreased to 240.71mg/dl after flaxseed powder supplementation for a period of three months. This decrease was found to be statistically significant ($P<0.01$). The mean total cholesterol level of the control subjects was 254.42mg/dl at the start of the study and had decreased to 254.1mg/dl after the supplementation periods (three months). This reduction was not found to be statistically significant.

The mean HDL-cholesterol level of the diabetic subjects was 37.44mg/dl before supplementation which increased to 42.35mg/dl after supplementation and the difference between the two levels was found to be statistically significant ($P<0.01$).

The mean HDL-cholesterol level of the control group was found to be 36.94mg/dl at the start of the study and 36.06mg/dl at completion of the study. No significant difference was noticed between these levels. The mean LDL-cholesterol level of the diabetic subjects in the experimental group was 163.86mg/dl before supplementation and the same significantly ($P<0.01$) decreased to 142.48mg/dl after supplementation.

The mean LDL-cholesterol level of the control group was 164.7mg/dl before and 164.55mg/dl after supplementation period. This difference was not found to be statistically significant.

The mean VLDL-cholesterol level of the diabetic subjects in the supplemented group were 33.06mg/dl before supplementation and the same had decreased to 29.72mg/dl after supplementation. The difference between the two values was found to be statistically significant ($P<0.01$). The mean VLDL-cholesterol level of the control diabetic group was found to be 31.86mg/dl

before and 31.37mg/dl after the study period. No significant difference between the two values was observed.

The mean triglyceride level of the supplemented subjects was 165.32mg/dl before supplementation was reduced to 147.48mg/dl after supplementation indicating a statistically significant difference at ($P<0.01$) level.

No significant difference was noted in the mean initial (164.51mg/dl) and final (164.37mg/dl) level of the mean triglyceride level of the control group.

Bhathena *et al.* (2003) indicated that the market hypotriglyceridemic and hypocholesterolemic effects of flaxseed meal may have important therapeutic implications in subjects with hypertriglyceridemia and hypercholesterolemia.

Thus flaxseed powder supplemented group showed lower blood glucose and glycosylated hemoglobin levels and lower lipid levels and increased HDL-cholesterol level when compared to non-supplemented group.

TABLE 4.48

SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH FLAXSEED

S.No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	245.19 ± 7.460	240.71 ± 7.316	4.9375 **	254.42 ± 7.957	254.1 ± 7.951	0.8403 NS
2.	HDL cholesterol	30 – 60	37.44 ± 3.576	42.35 ± 4.044	5.475 **	36.94 ± 3.456	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	163.86 ± 5.549	142.48 ± 4.82	12.027 **	164.7 ± 6.216	164.55 ± 6.294	0.8860 NS
4.	VLDL cholesterol	6 – 30	33.06 ± 1.146	29.72 ± 1.147	8.668 **	31.86 ± 1.077	31.37 ± 1.061	0.1977 NS
5.	Triglyceride	30 – 170	165.32 ± 5.71	147.48 ± 4.82	8.378 **	164.51 ± 6.549	164.37 ± 6.652	0.8457 NS

** Significant at (P<0.01) level NS- Not significant

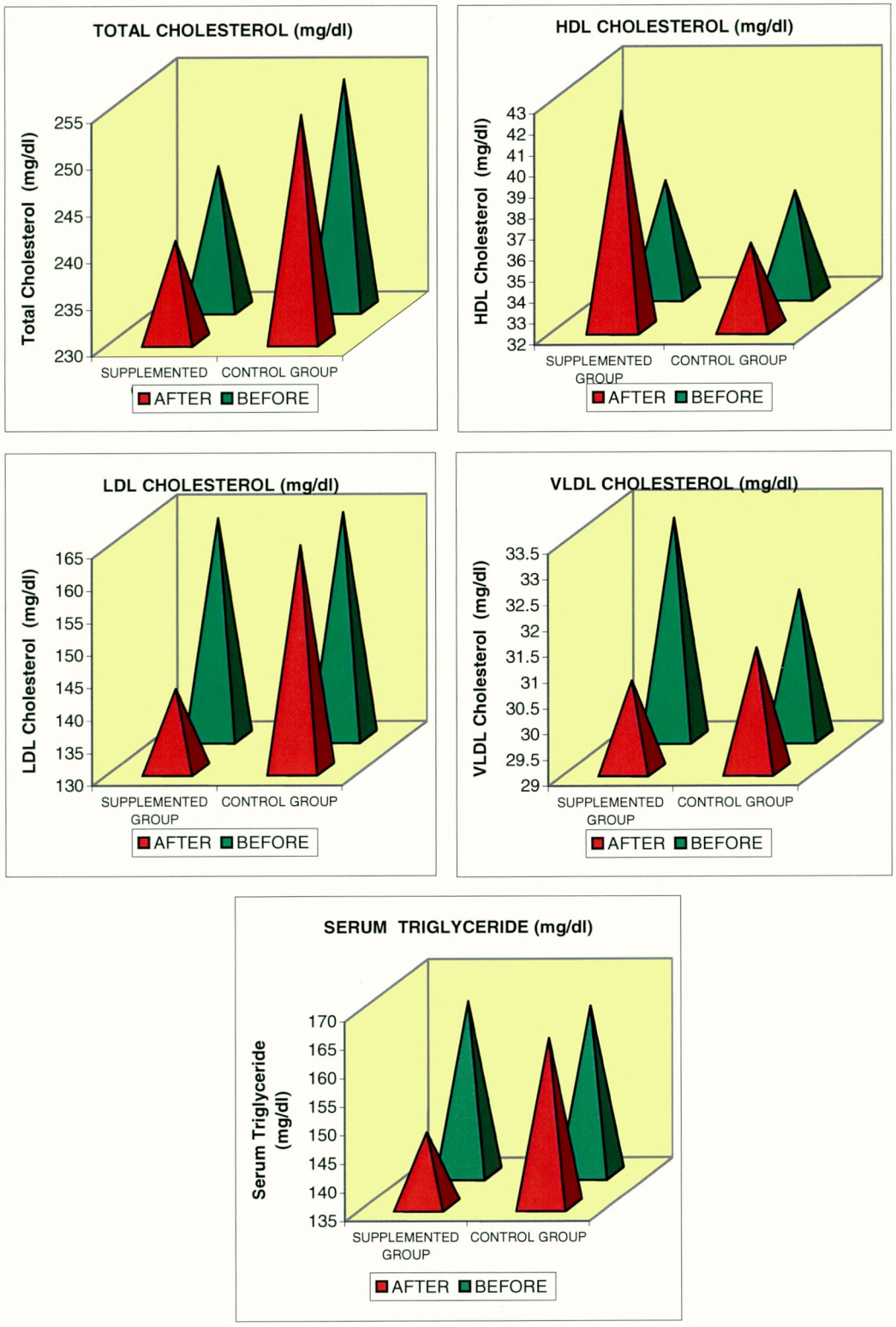


FIGURE XVI
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH FLAX SEED

9. Effect of supplementation with stevia

Table 4.49 and Figure XVII present the mean fasting and post prandial blood glucose, glycosylated hemoglobin of the selected diabetic subjects before and after supplementation of stevia powder.

Results of Table 4.49 revealed that the mean fasting blood glucose levels of the experimental group was 167.46mg/dl which was reduced to 156.53mg/dl at the end of the supplementation with stevia powder and when statistically analysed, the differences were significant at one per cent level.

The mean post prandial blood glucose level of the experimental group was found to be 265.49mg/dl in the beginning of the study and it was reduced to 247.90mg/dl at the end of the study period, when the values were statistically analysed the difference was significant at ($P<0.01$) level.

The mean glycosylated hemoglobin level was 10.06 per cent before supplementation and had decreased to 7.00 per cent after supplementation with a significant difference ($P<0.01$).

Robert *et al.* (1994) stated that the human body do not metabolize the sweet glycosides (they pass right through the normal elimination channels) from the leaf of any of its processed forms; the body obtains no calorie from stevia. This mechanism helps in reducing blood glucose in diabetic subjects.

The mean fasting, post prandial blood glucose and the mean glycosylated hemoglobin levels of the control group had levels from 162.98 to 162.81mg/dl, 263.28 to 263.14g/dl and 10.12 to 9.92mg/dl respectively after the supplementation period. However the difference between the levels was not statistically significant.

TABLE 4.49

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH STEVIA LEAVES

S.No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	167.46 ± 3.474	156.53 ± 3.24	10.531**	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	265.49 ± 5.83	247.90 ± 5.44	4.8993 **	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	10.06 ± 0.2085	7.008 ± 0.145	5.7832 **	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

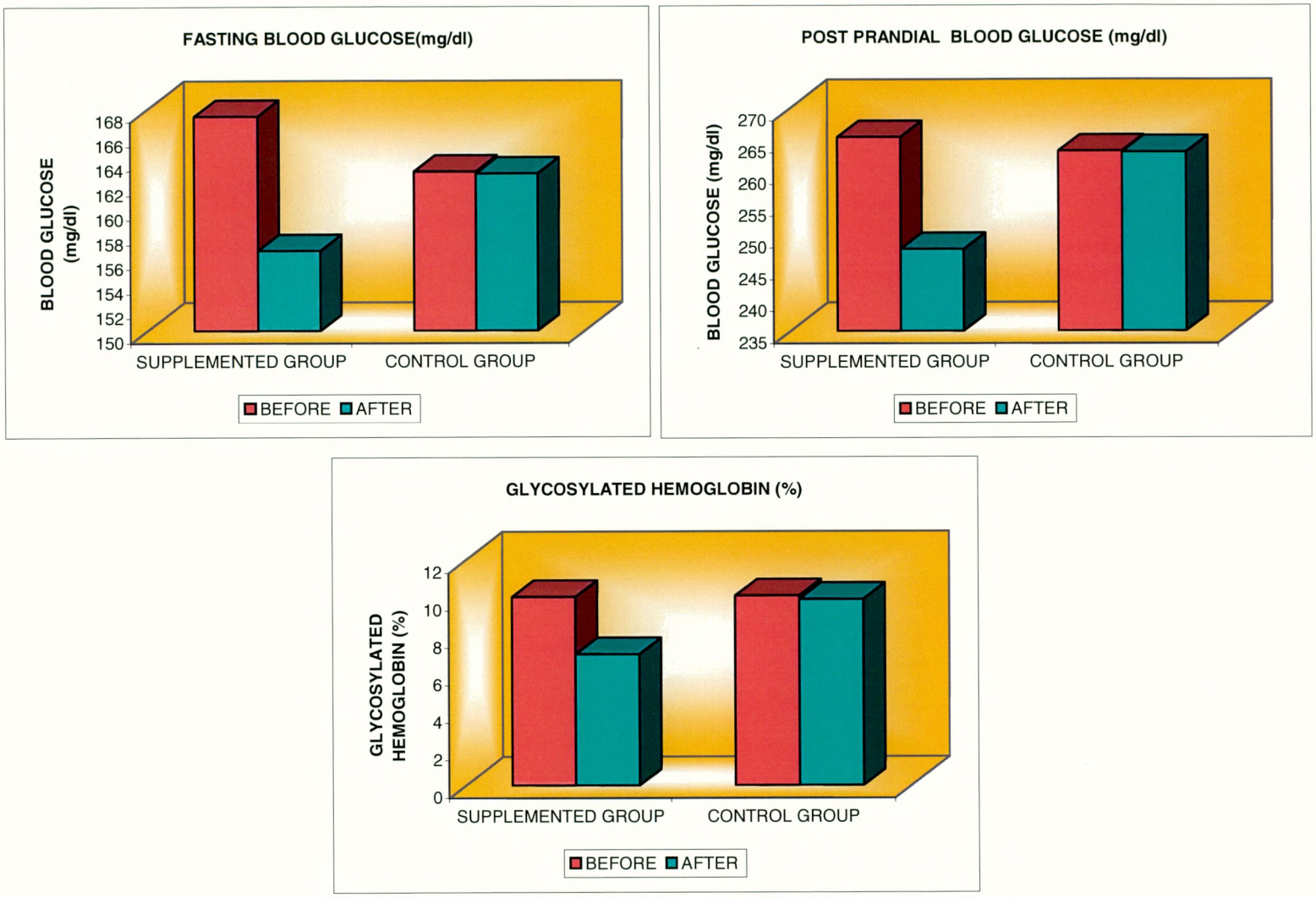


FIGURE XVII

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH STEVIA LEAVES

Table 4.50 and XVIII showed the levels of different fractions of cholesterol and triglycerides of the selected diabetic subjects before and after supplementation of stevia powder.

Results of Table 4.50 revealed that the mean total cholesterol level of the diabetic subjects was 245.09mg/dl and it decreased to 235.62mg/dl after stevia powder supplementation for a period of three months. This decrease was found to be statistically significant ($P<0.01$). The mean HDL cholesterol level was 36.57mg/dl before supplementation and increased to 44.95mg/dl after supplementation with a significant difference ($P<0.01$). The mean value of LDL cholesterol level was 159.7mg/dl before supplementation and the same significantly ($p<0.01$) decreased to 153.9mg/dl after supplementation. The mean value of VLDL cholesterol was 33.43mg/dl before supplementation and decreased to 32.70mg/dl after supplementation. The difference between the two values when statistically analysed was found to be significant ($P<0.01$). The mean triglyceride level of the diabetic subjects was 167.23mg/dl before supplementation and reduced to 151.20mg/dl after supplementation and the difference was found to be statistically significant ($P<0.01$).

The mean total cholesterol level of the control diabetic subjects was 254.42mg/dl and it reduced to 254.1mg/dl at the end of the study period. The difference did not show any statistical significance. The triglyceride level in the control group was found to be 164.51mg/dl and had reduced to 164.37mg/dl but no statistical significant difference was observed. With regard to the various fractions of cholesterol also showed the difference between the initial and final values are not statistically significant.

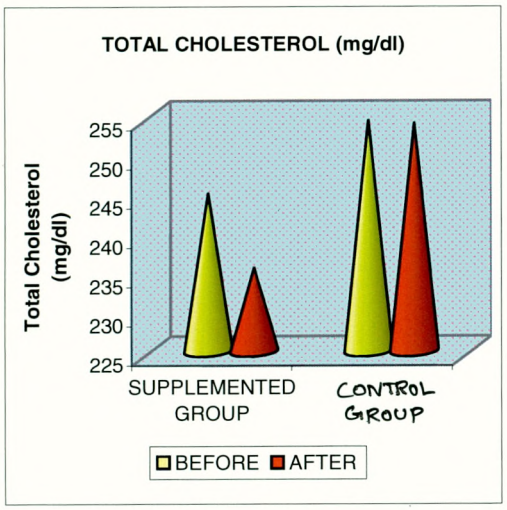
Thus stevia leaves powder supplemented group showed hypoglycemic and hypolipedemic effect when compared to non-stevia leaves powder consuming group.

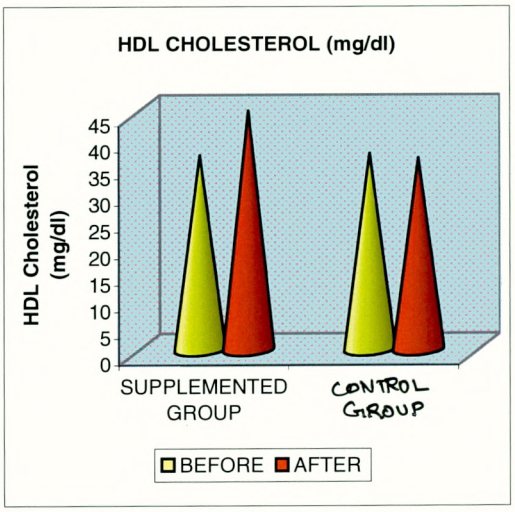
TABLE 4.50

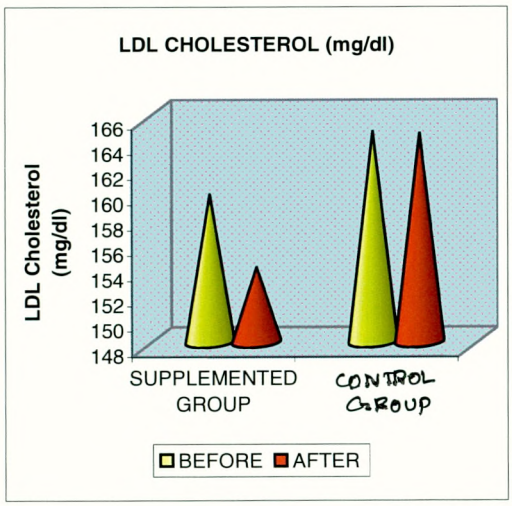
SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH STEVIA LEAVES

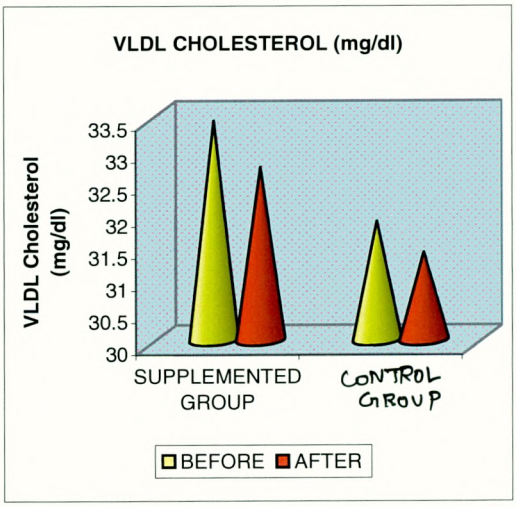
S.No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	245.09 ± 5.079	235.62 ± 4.882	5.9667 **	254.42 ± 7.957	254.1 ± 7.951	0.8403 NS
2.	HDL cholesterol	30 – 60	36.57 ± 0.758	44.95 ± 0.932	3.4508 **	36.94 ± 3.456	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	159.7 ± 4.203	153.94 ± 4.051	24.45 **	164.7 ± 6.216	164.55 ± 6.294	0.8860 NS
4.	VLDL cholesterol	6 – 30	33.43 ± 1.130	32.70 ± 1.105	6.523 **	31.86 ± 1.077	31.37 ± 1.061	0.1977 NS
5.	Triglyceride	30 – 170	167.23 ± 4.08	151.20 ± 3.68	8.899 **	164.51 ± 6.549	164.37 ± 6.652	0.8457 NS

** Significant at (P<0.01) level NS- Not significant









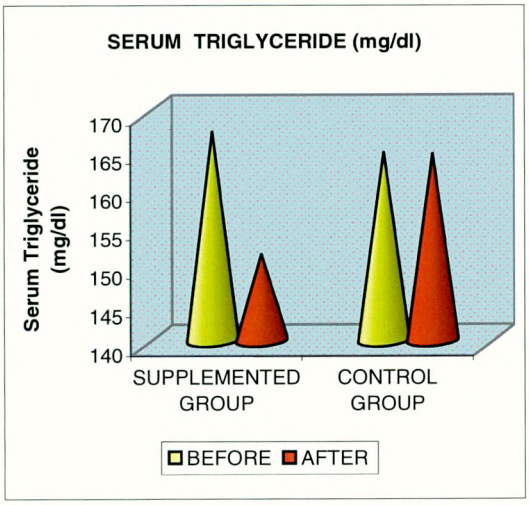


FIGURE XVIII
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH STEVIA LEAVES

10. Effect of supplementation with Jambolin seed

Table 4.51 and Figure XIX present the mean fasting and post prandial blood glucose, glycosylated hemoglobin of the selected diabetic subjects before and after supplementation with jambolin seed powder.

Results of Table 4.51 showed that the mean fasting blood glucose levels of the experimental group was 164.5mg/dl which was reduced to 144.52mg/dl at the end of jambolin seed powder supplementation and when statistically analysed, the differences were significant at ($P<0.01$) level.

The mean post prandial blood glucose level of the experimental group was found to be 263.68mg/dl in the beginning of the study and it was reduced to 230.73mg/dl at the end of the study period, when the values were statistically analysed the difference was significant at ($P<0.01$) level.

The mean glycosylated hemoglobin level was 10.22 per cent before supplementation and decreased to 7.15 per cent after supplementation with a significant difference ($P<0.01$).

Similar findings were observed by the study of Achrekar et al., (1991) and their study revealed that the extract of jambolin seed has hypoglycemic activity. Regular consumption of jambolin seed powder is effective in improving insulin activity, to bring to normoglycemic effect among diabetic subjects.

Regarding the mean fasting, post prandial blood glucose and the mean glycosylated hemoglobin levels of the diabetic subjects in control group did not bring any reduction in the mean values after the study period.

TABLE 4.51

BLOOD GLUCOSE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH JAMBOLIN SEED

S.No.	Blood Glucose	Desirable level*	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Fasting (mg/dl)	80-115	164.508 ± 5.615	144.52 ± 5.428	15.143**	162.98 ± 6.14	162.81 ± 5.98	0.3636 NS
2.	Post-Prandial (mg/dl)	120-160	263.68 ± 6.55	230.73 ± 5.679	86.781 **	263.28 ± 5.78	263.14 ± 5.82	0.8137 NS
3.	Glycosylated (Hb%)	<8	10.22 ± 0.593	7.15 ± 0.726	19.859 **	10.12 ± 0.598	9.92 ± 0.782	0.9011 NS

* Bamji *et al.*, 2003; ** - Significant at (P<0.01) level; NS – Not Significant

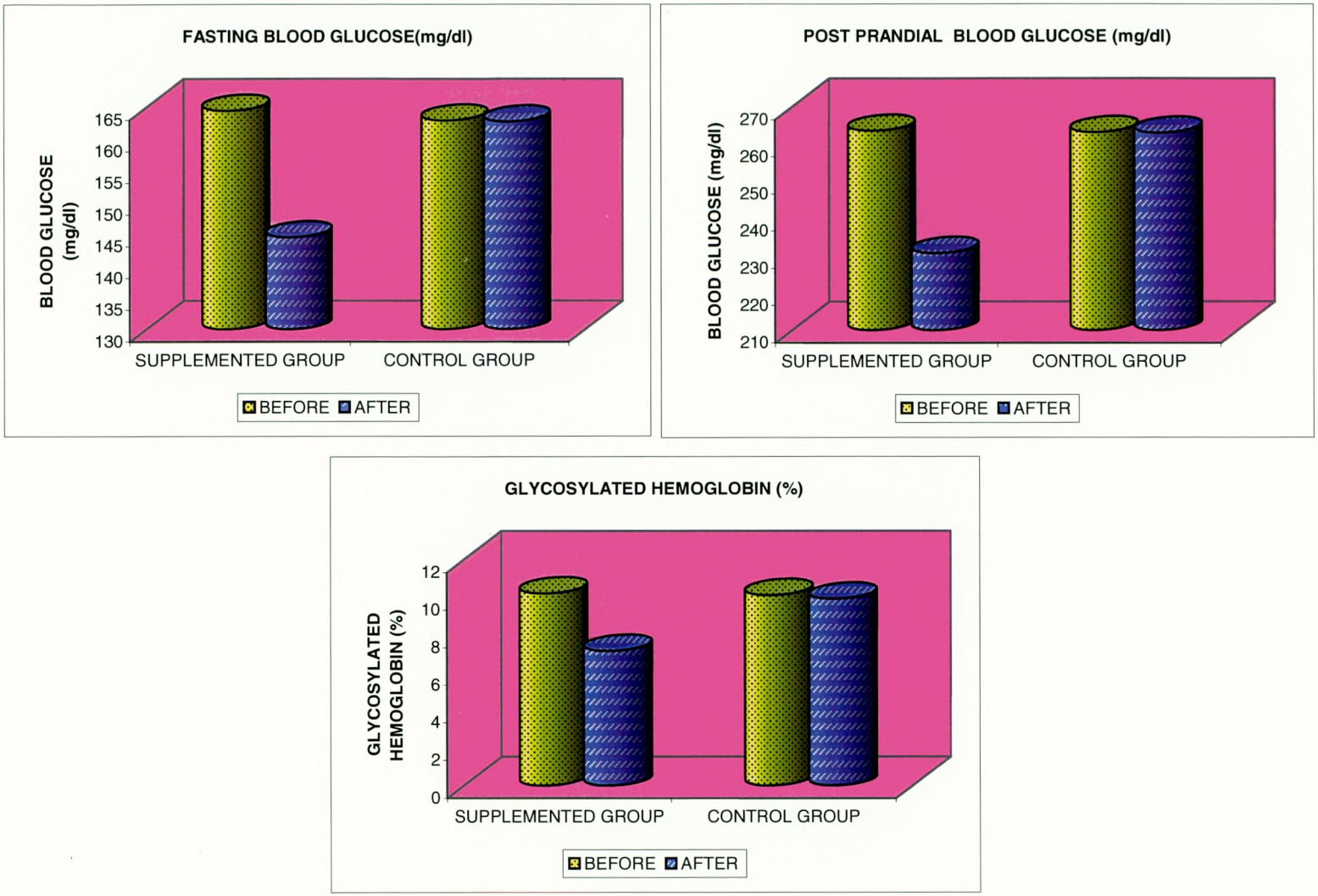


FIGURE XIX

BLOOD GLUCOSE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH JAMBOLIN SEED

Table 4.52 and Figure XX showed the levels of different fractions of cholesterol and triglycerides of the selected diabetic subjects before and after supplementation with jambolin seed powder.

Results of Table 4.52 revealed that the mean total cholesterol level of the diabetic subjects was 263.60mg/dl and it decreased to 218.75mg/dl after the jambolin seed powder supplementation for a period of three months. This decrease was found to be statistically significant ($P<0.01$).

The mean HDL cholesterol was 36.96mg/dl before supplementation and increased to 47.50mg/dl after supplementation with a significant difference at ($P<0.01$) level.

The mean LDL cholesterol of the supplemented group was 163.84mg/dl after supplementation with jambolin seed powder it was decreased to 148.50mg/dl which was statistically significant ($P<0.01$).

The mean VLDL cholesterol levels of the supplemented group was 30.94mg/dl which was reduced to 27.03mg/dl after supplementation with jambolin seed powder and the difference was significant at ($P<0.01$) level when statistically analysed.

The mean triglyceride value of the supplemented group was 163.73mg/dl which was reduced to 144.17mg/dl after supplementation of jambolin seed powder, when statistically analysed the difference was significant statistically . The mean total cholesterol level of the control group was 254.42mg/dl before supplementation and 254.1mg/dl at the end of the study period.

The mean HDL cholesterol level of the control group was 36.94mg/dl before, which had decreased to 36.06mg/dl after the study period. The mean LDL cholesterol level of the control group was found to be 164.7mg/dl at the beginning of the study, which had slightly recorded as 164.55mg/dl after the study period and the difference was not statistically significant.

TABLE 4.52

SERUM LIPID PROFILE LEVELS OF THE SELECTED DIABETIC SUBJECTS BEFORE AND AFTER SUPPLEMENTATION WITH JAMBOLIN SEED

S.No.	Lipids	Desirable level (mg/dl) (NCEP, 2001)	Supplemented Group			Control Group		
			Mean ± SD			Mean ± SD		
			Before	After	't' value	Before	After	't' value
1.	Total cholesterol	150 – 200	263.60 ± 19.478	218.75 ± 17.59	27.181 **	254.42 ± 7.957	254.1 ± 7.951	0.8403 NS
2.	HDL cholesterol	30 – 60	36.96 ± 3.456	47.50 ± 5.83	18.424 **	36.94 ± 3.456	36.06 ± 3.37	0.8201 NS
3.	LDL cholesterol	66 – 178	163.84 ± 5.81	148.50 ± 5.27	55.129 **	164.7 ± 6.216	164.55 ± 6.294	0.8860 NS
4.	VLDL cholesterol	6 – 30	30.94 ± 1.041	27.032 ± 0.909	9.2403 **	31.86 ± 1.077	31.37 ± 1.061	0.1977 NS
5.	Triglyceride	30 – 170	163.73 ± 6.421	144.17 ± 6.04	43.621 **	164.51 ± 6.549	164.37 ± 6.652	0.8457 NS

** Significant at (P<0.01) level NS- Not significant

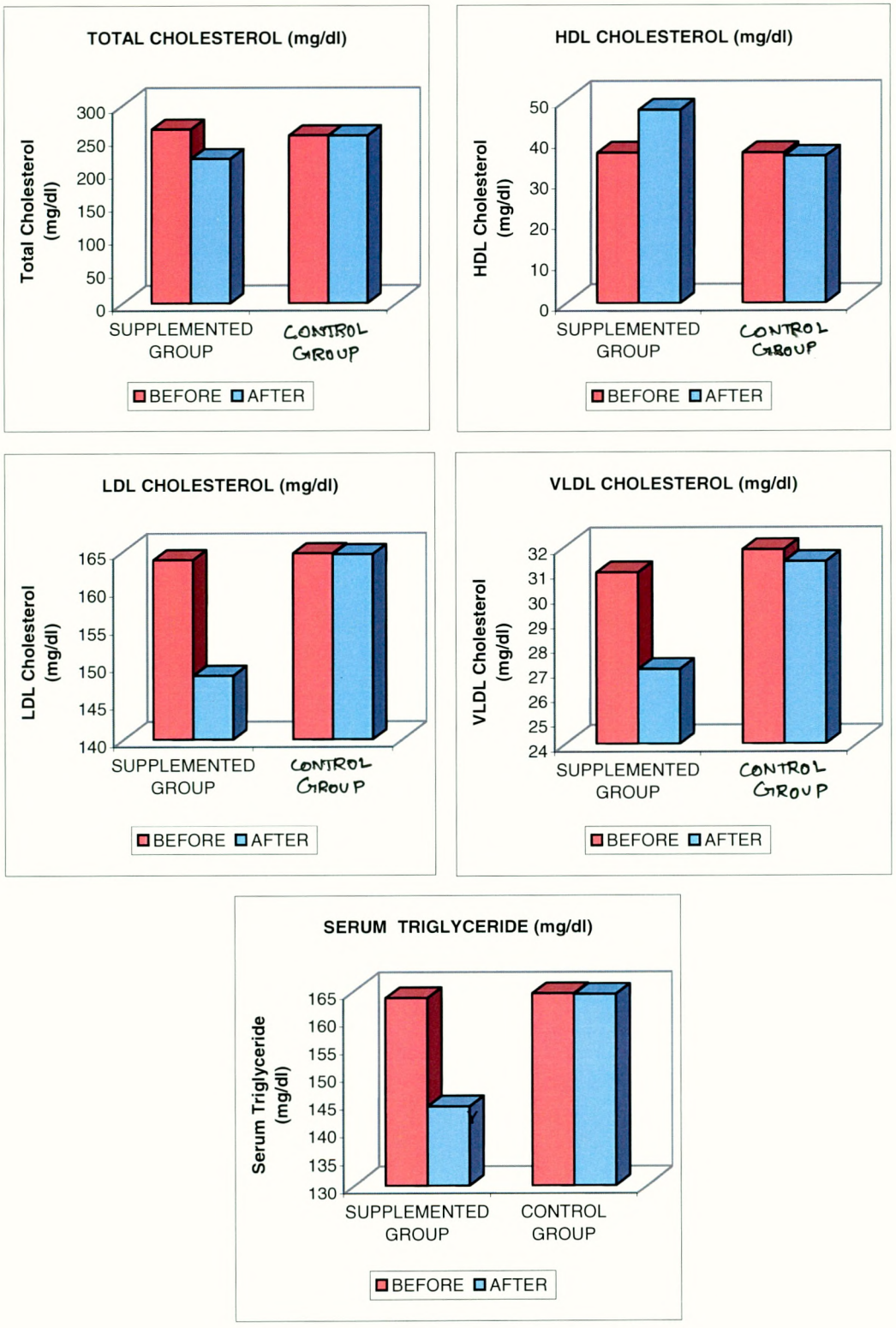


FIGURE XX
SERUM LIPID PROFILE LEVELS BEFORE AND AFTER SUPPLEMENTATION WITH JAMBOLIN SEED

The initial mean value of VLDL cholesterol of the control group was 31.86mg/dl and which had mildly reduced to 31.37mg/dl at the end of the study period without any significant change.

The triglyceride level was found to be 164.51mg/dl in the start of the study which had decreased to 164.37mg/dl after the study period, the difference was not significant.

All the mean values of cholesterol fractions and triglycerides of the control group were analysed statistically and it was found that none of the values were statistically significant.

Thus it appears from the study that jambolin seed powder is helpful in reducing blood glucose, glycosylated hemoglobin, and total cholesterol, LDL cholesterol, VLDL cholesterol and triglyceride levels and significant increase in the HDL cholesterol level.