

A STUDY ON HYPOLIPIDEMIC ACTION OF TEENT
(Capparis decidua) ON HUMAN

By

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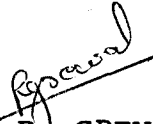
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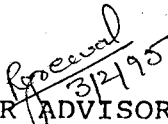
This is to certify that this thesis entitled, "A study on hypolipidemic action of teent on human" submitted for the degree of M.Sc. in the subject of Foods and Nutrition of the Chaudhary Charan Singh Haryana Agricultural University, Hisar, is a bonafide research work carried out by Miss Rajni Arora under my supervision and that no part of this thesis has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.


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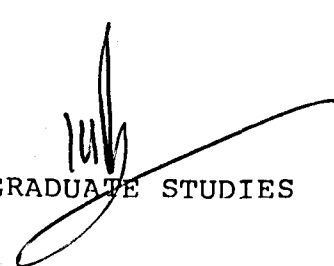
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Hisar

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[RANI ARORA]

CHAPTER - 1

INTRODUCTION

During the past few years, there has been a revival of interest in the fibre content of foods and the effect of its intake on man. A low fibre intake has been reported to be associated with isch-emic heart disease (IHD), diabetes, diverticular disease of the colon, cancer of the colon and other diseases of the gastro-intestinal tract. Epidemiological studies, animal experiments and clinical observations have now put it beyond reasonable doubt that hypercholesterolemia and especially elevated LDL and VLDL cholesterol, hypertriglyceridemia and hypertension are major risk factors for cardiovascular diseases. Efforts to decrease serum cholesterol levels in an attempt to alleviate IHD have long been the preoccupation of some sectors of medical research. Nutritional research has identified many dietary components which tend to decrease plasma cholesterol levels.

Due to urbanisation/industrialization, people are consuming more refined foods or ready-to-eat foods these days and these foods are low in fibre content. Importance of fibre in our diet has been overlooked mainly because it contributes

little nutritionally. This subject has gained attention and its importance in human physiology has been appreciated since mid 1970s. Dietary fibre is defined chemically as sum of polysaccharides and lignin which are not digested by endogenous secretion of gastro-intestinal tract (Trowell, 1985).

According to several epidemiological studies, the concept that a high dietary fibre intake may protect against coronary heart disease becomes more and more plausible (Kromhout et al., 1982; Lichtenstein et al., 1986; Khaw et al., 1987). Dietary fibre can lower serum lipids in mildly hypercholesterolemic human (Anderson et al., 1992). The most effective are water soluble non-starch polysaccharides such as guar gum and pectin. These fibres almost fermented in the colon, produce short chain fatty acids that affect glucose and lipid metabolism. On the other hand, dietary fibre may act similarly to commercial hypocholesterolemic resins, which sequester bile acids and cholesterol. As a result, fecal output is enhanced whereas more hepatic cholesterol is diverted into bile acids. The fact that pectin stimulates the receptor-mediated catabolism of low-density lipoprotein (LDL) (Fernandez et al., 1990) as resins do (Shepherd et al., 1980) supports the hypothesis of resemblance of fibres to resins.

By contrasts, the effects of insoluble fibre are uncertain. Their capacity to reduce serum cholesterol might be related to their water holding capacity and bulking characteristics (Kies et al., 1985). They can also decrease the

absorption of dietary fats (Borel et al., 1989). The mechanisms involved in the effects of fibres are complex.

A great deal of interest has generated in screening of various sources of dietary fibre for its hypolipidemic effect because of increasing incidence of coronary heart disease. The conventional sources of dietary fibre including wheat bran, oat bran, pulses, pectin, cellulose etc. have been studied for their hypolipidemic properties. On the other hand, very little work has been done on non-conventional sources of dietary fibre, though they are equally important in this aspect (Jain, 1988). Therefore, there is need to investigate non-conventional sources of dietary fibre from some uncommon foods.

Teent is an unripe fruit of ker (Capparis decidua), a xerophyte bush. It grows wild on barren soils of arid and semi-arid regions of India. Teent is berry shaped, 0.7 to 1.5 cm in diameter. Skin of fruit is thick, shiny, bony and contains golden yellow pulp and many white seeds. Teent generally consumed as vegetables and pickles forms an integral part of diet of people in desert and semi-desert areas of the country.

Agarwal and Chauhan (1988) had reported the hypolipidemic action of dietary fibre from some uncommon foods. Of the five plant foods, fibres from teent was found to have the strongest hypocholesterolemic action when included at 10 per cent level in cholesterol supplemented diets of weanling rats.

In order to know the hypolipidemic action of teent in hyperlipidemic human subjects, a study was undertaken with the following objectives:

1. To study the fibre composition of teent and to develop products from it acceptable to human palates.
2. To study the hypolipidemic effect of supplementing teent in the diet of hyperlipidemic persons.

CHAPTER - 2

REVIEW OF LITERATURE

The literature on the subject has been reviewed under the followed heads:

- 2.1 Definition of dietary fibre
- 2.2 Classification of dietary fibre
- 2.3 Sources and composition of dietary fibre
- 2.4 Fibre and blood lipids
 - 2.4.1 Fibre and blood total cholesterol
 - 2.4.2 Fibre and blood Lipoprotein (HDL and LDL) cholesterol
 - 2.4.3 Fibre and blood triglycerides
 - 2.4.5 Fibre and blood total lipids
- 2.5 Fibre and blood glucose
- 2.6 Fibre and blood total protein
- 2.7 Fibre and gastrointestinal tract (GIT) functioning

2.1 DEFINITION OF DIETARY FIBRE

The role of dietary fibre in health and nutrition was initiated in mid 1970s while the meaning of term 'dietary fibre' was still evolving. The oldest term crude fibre, has been a source of much confusion in the field of nutrition. Crude fibre has no direct application in human nutrition

(Spiller and Amon, 1975; Zilversmit, 1979). Crude fibre is the residue that remains after treating plant material with a fat solvent, hot acid and alkali. The treatment removes a large amount of hemicellulose, cellulose and lignin which makes the term very imprecise. Hipsley (1953), first described the term dietary fibre as "the unavailable carbohydrate" content of plant foods which he thought to be protective against pregnancy toxemia. Southgate (1969) described dietary fibre as sum of those non-starch polysaccharides and lignin that resist hydrolysis by the human digestive tract enzymes.

Kritchevsky et al. (1974) used the term "non-nutritive fibre" which clearly included both unavailable carbohydrate and non-carbohydrate portions such as lignin, cutin and minerals. Spiller and Amon (1975) suggested "nonpurified plant fibres" to any fibrous material ⁱⁿ its natural state with all cell wall ingredients present (polysaccharides, lignin, cutin, minerals, etc.) and "purified plant fibre" to the sum of polymerized fibrous components (lignin, cellulose, hemicellulose and pectins).

The history of fibre hypothesis and of fibre definition was traced by Trowell (1972) in great detail. He defined it as "that portion of food which is derived from the cellular walls of plants, which is digested very poorly by human beings". He further modified the term in 1985 and defined dietary fibre chemically as "the sum of polysaccharides and lignin which are not digested by endogenous secretion of human gastro-intestinal tract".

Spiller et al. (1975) used the word "plantix" for fibre and defined it as "structural polymers of plant residue". Anon (1994) proposed the definition of dietary fibre which states that "fibre is the part of oligo and polysaccharide and their (hydrophillic) derivatives which by human digestive enzymes cannot be decomposed to absor-able components in the upper alimentary tract".

2.2 CLASSIFICATION OF DIETARY FIBRE

Cellulose, non-cellulosic polysaccharide, a non-carbohydrate component, lignin and associated subsances forms the major components of dietary fibre. The components which make up the dietary fibre are listed in the Table 2.1.

From analytical standpoint, plant fibres have been divided into insoluble fibre and soluble fibre. The insoluble fibres include cellulose, lignin and most of hemicellulose. The soluble fibre include pectins and some hemicellulose, gum, mucilages, algae polysaccharide, etc. (Anderson and Chen, 1979).

2.3 SOURCES AND COMPOSITION OF DIETARY FIBRE

Dietary fibre occurs naturally in all plants and is available for the human diet through a wide variety of food sources. Cereals (wheat, barley and oats), legumes (peas, soyabean) and fruits and vegetables (apple and citrus fruits, carrot, potatoes, sugarbeet) are the major sources of dietary fibre (Seibel/ and Hanneforth, 1994). The primary origins of majority of dietary fibre are the structural components of plant cell walls.

Total dietary fibre, soluble and insoluble fibre of cereals pulses and fruits and vegetables are listed in the Table 2.2.

Table 2.1. Classification of dietary fibre components

Component	Major grouping	Chemical structure
A. Structural (Cell wall) polysaccharides	1. Cellulosic polysaccharides	
	a. Cellulose	beta (1.4) glucan
	b. Cellulose derivatives	beta (1.4) glucan
	2. Non-cellulosic polysaccharides	
	a. Hemicellulose	beta-xylans: beta-mannans; beta-arabinoglactans; beta-arabinans
	b. Pectin	alpha-galacturonans
	c. Gums isolated from cell walls	
	Carrageenans	(1.4) (1.3) linked sulfated galactans
B. Structural non-polysaccharide component	Alginic acid	linear copolymer
	Lignin	Phenylpropane polymers
C. Nonstructural polysaccharide components	1. Mucilages (e.g. guar and locust bean gums)	beta (1.4) galactomannans
	2. Exudates (e.g. gums : arabic, ghatti, karaya)	heteropolysaccharides
	3. Xanthan	heteropolysaccharides

Source: Schneeman (1986).

Table 2.2. Total dietary fibre, soluble fibre and insoluble fibre of some plant sources

Source	Total dietary fibre	Soluble fibre	Insoluble fibre	Reference
A. Cereals				
1 Rice bran	6.2-26.9	-	-	Saunders (1985)
Kernel	11.5	-	-	Frolich and Nyman (1988)
2 Oat Husk	83.9	-	-	
3 Pearl millet	20.33	1.33	11.16	Kamath and Belawady (1980)
Sorghum	14.34	1.43	6.19	
Wheat	17.22	2.69	7.90	
Ragi	18.64	1.47	4.65	
4 Wheat	10.1	-	-	Pak <u>et al.</u> (1990)
Rice	22.2	-	-	
Rye	-	3.3	-	
Oat	-	3.9	-	
5 Cereal bran	-	4-21	-	Schweizer and Wursch (1979)
6 Cereals	32.0	-	-	Anderson and Bridges (1988)
7 Cereals	1.2-17.0	-	-	Wang <u>et al.</u> (1991)
8 Cereals	0.2-26.0%	2-50%	-	Rosado <u>et al.</u> (1993)
9 Wheat bran	36.5	2.3	34.2	Thaender and Aman (1979)
Rye bran	28.1	2.5	25.6	
10 Cereals	-	2.2-19.8	8.0-59.5	Emelik (1987)
11 Corn bran	-	1.9	-	Weber <u>et al.</u> (1993)
B. Pulses				
1. Winged beans	35.2	-	-	Sharma (1986)
Bengal gram	26.0	-	-	

Source	Total dietary fibre	Soluble fibre	Insoluble fibre	Reference
Soyabean	20.8	-	-	
Kidney beans	19.6	-	-	
Khesari dhal	18.6	-	-	
2 Bengal gram	13.36	1.23	5.83	Kamath and Belawady (1980)
Black gram	13.61	2.64	6.90	
Red gram	13.42	1.71	8.62	
3 Pea	12.7	-	-	Pak <u>et al.</u> (1990)
Lupin	36.6	5.8	-	
Beans	-	5.8	-	
4 Legumes	-	19.59	-	Schweizer and Wursch (1979)
5 Fried beans	25.0	-	-	Anderson and Bridges (1988)
6 Legumes	16-52	-	-	Wang <u>et al.</u> (1991)
7 Legumes	3-7	-	-	Rosado <u>et al.</u> (1993)
8 Pea	-	1-4	9-34	Thaendar and Aman (1979)
9 Legumes	-	3.5-11.4	12.5-24.4	Cmelik (1987)
C. <u>Fruits</u>				
1 Apple	17.0	6.2	10.8	Schweizer and Wursch (1979)
Banana	9.6	2.9	6.7	
2 Apple	-	1-4	8-34	Thaender and Aman (1979)
3 Fruits	38.0	-	-	Anderson and Bridges (1988)
4 Grape	58.14	-	-	Igartuburu <u>et al.</u> (1989)
5 Dry fruits	29-79	-	-	Nahar <u>et al.</u> (1990)

Source	Total dietary fibre	Soluble fibre	Insoluble fibre	Reference
6 Fruits	1.5-3.6	-	-	Osmon (1990)
7 Fresh fruits	0.5-35%	-	-	Jones <u>et al.</u> (1990)
8 Fruits	20-56	-	-	Wang <u>et al.</u> (1991)
9 Berries				
a) Bilberry	-	4-11	19-23	Plaami <u>et al.</u> (1992)
b) Lignoberry	-	4.5	19-24	
10 Fruits	0.3-7%	-	-	Rosada <u>et al.</u> (1993)
11 Orange	20.3	-	-	Weber <u>et al.</u> (1993)
12 Guava	50.16	-	-	Binita (1990)
Karonda	37.71			
D. <u>Vegetables</u>				
1 Carrot	30.7	13.5	17.2	Schweizer and Wursch (1979)
Cauliflower	33.7	12.2	21.5	
Cabbage	32.2	13.7	18.5	
2 Potato and carrot	1-4	8-34	-	Thaender and Aman (1979)
3 Stink bean	5.6	-	-	Candlish (1987)
Lady's finger	4.9	-	-	
Snow pea	4.6	-	-	
4 GLV	1.2-4.8	-	-	Osmon (1990)
Leguminous Vegetables	3.2-6.8	-	-	
Fruit type vegetables	1.4-4.2	-	-	
5 Leafy vegetables	27-55	-	-	Wang <u>et al.</u> (1991)
6 Vegetables	0.9-45	-	-	Rosado <u>et al.</u> (1993)

2.4 FIBRE AND BLOOD LIPIDS

The first published research on the relationship between high dietary fibre and low fat diets, and low serum cholesterol levels was demonstrated in the South African Bantu (Walker and Arvidsson, 1954). This research was supported by epidemiological observations (Keys et al., 1960, 1961), associating the consumption of diets high in complex carbohydrates such as dietary fibre with a reduction in blood cholesterol. These early studies did not, however, stimulate much research until Trowell (1975) cited supporting evidences that dietary fibre could be protective against hyperlipidemia, a risk factor associated with coronary heart disease.

There are various mechanism by which dietary fibre alters lipid metabolism. Delayed lipid absorption from the upper small bowel by dietary fibre whether by limiting diffusibility of micellar lipids, binding bile acids or changing transit rate, can lead to decreased or modified overall absorption of lipids (Vahouny, 1982). Dietary fibre has two major influences on lipid absorption. The first is associated with micellar solubility and the other is related to intestinal lipoprotein production.

The potential effects of dietary fibres may influence the absorption of lipids at several level (Vahouny, 1982). This may be due to :

1. Reduced accessability of fatty acids, monoglycerides and cholesterol for absorption in the upper intestine. Depending on the extent of micellar sequestration, this might be reflected as an increase in fecal fat and cholesterol or its bacterial metabolites.

2. Reduced accessibility of biliary lecithin for resorption, which has major implications for the ability of the upper intestine to synthesize and secrete the transport lipoproteins.
3. Reduced bile acid resorption which could impact on several additional aspects of cholesterol metabolism. These include possible effects on cholesterol esterification required for efficient absorption and changes in level and composition of bile acids.

One of the possible mechanisms for the hypocholesterolemic effect of certain dietary fibre is their ability to sequester bile acids and other micellar components thus preventing their reabsorption in the ileum and increasing their fecal loss (Story, 1980; Eastwood and Brydon, 1985; Gallaher and Schneeman, 1986).

2.4.1 Fibre and Blood Total Cholesterol

During the last few years, considerable interest has been developed regarding the role of dietary fibre from different sources in reducing the serum cholesterol in hypercholesterolemic conditions. The type of dietary fibre determine the hypocholesterolemic action. Studies with the feeding of soluble fibre such as pectin and guar gum have shown significant decrease in serum cholesterol levels (Anon. et al., 1984; Dennis, 1989). Jenkins^{et al.} (1975) studied the effect of feeding wheat fibre, pectin or guar gum (36 g/d) for two weeks to 12 men along with their normal diet and reported a significant fall of 36.3 and 29.2 mg cholesterol with guar gum and pectin, respectively.

Durrington et al. (1976) observed a significant reduction in serum cholesterol when 12 g pectin was added to the diet of 12 healthy men for six weeks. In a similar study, Eastwood and Robertson (1978) have reported lower serum cholesterol with pectin, psyllium, seed colloid, large amount of cellulose and certain legumes.

A decrease in cholesterol absorption was found when pectin, gum acacia and agar was fed to rats at level of 5%, the effect was more due to pectin (Kelley and Tsai, 1978). A significant decrease in serum cholesterol level in rats was observed with 5 per cent pectin (Vorster, 1984) and pectin and gum acacia (Eastwood et al., 1986).

Jenkins (1980) observed reduction in serum total cholesterol with 13 g guar crisp bread in hyperlipidemic patients. Khan et al. (1981) found that guar gum intake in capsule form (9.0 g/d) significantly lowers serum total cholesterol. Taneja and Kapoor (1989) observed 16.7 and 12 per cent reduction in fasting total cholesterol level with 15 g guar gum and 15 g isabgol husk, respectively, when included in the diets of 50 overweight adults daily for 6 weeks.

Effect of different fibres on cholesterol levels was studied by Anderson and Chen (1979). They fed rats for three weeks with diet containing one per cent cholesterol and 10 per cent fibre as cellulose, pectin, guar gum or oat bran and control group had cellulose but no cholesterol; the mean cholesterol content in plasma were 133, 84, 105, 113 and 74 mg/100 ml, respectively. Whereas, Muller et al. (1983)

supplemented cholesterol free rat diets with four major components of dietary fibre (cellulose, hemicellulose, lignin and pectin). It was reported that none of these fibres had a significant effect on serum cholesterol levels. However, liver cholesterol was significantly higher in rats fed with cellulose diets.

Feeding of wheat bran (20 g/d) rich in hemicellulose and cellulose has been reported to decrease serum cholesterol level significantly (Persson et al., 1975). Similarly, Berge Henegoumen et al. (1979) found 10 per cent reduction in serum cholesterol on feeding 0.5 g chemically standardized coarse wheat bran product per kg body weight per day. Whereas, Jenkins et al. (1975) and Truswell (1978) reported that wheat bran was ineffective in lowering serum cholesterol level. Similarly, Moore et al. (1981) and Lindgarde and Larson (1984) also observed a non-significant decrease in serum cholesterol with supplementation of wheat fibre in the diet of volunteers.

Oats and oat bran have recently received considerable attention due to their cholesterol lowering properties. Kirby (1981) fed eight hypercholesterolemic men with oat bran at a level of 100 g/d and observed a 13 per cent reduction in total serum cholesterol. Similarly, Anderson et al. (1990) found a significant reduction (5.4%) in serum total cholesterol with 25 g oat bran supplement. Shinnick et al. (1991) also reported positive effect of oat bran on lowering serum cholesterol independent of changes in fat intake. Anderson et al. (1991) studied the effect of wheat bran and oat bran in

hypercholesterolemic men and observed 12.8 per cent decrease in total cholesterol with oat bran and no significant effect with wheat bran. Whyte et al. (1992) also studied the effect of oat and wheat bran and suggested that soluble oat fibre can lower total cholesterol.

Fabian et al. (1989) investigated the effect of a granulate with psyllium (44.3 g) and apple pectin (22.1 g) on serum cholesterol of 5 healthy subjects and reported significant decrease in cholesterol concentration. Lipsky et al. (1990) also observed a significant reduction in blood cholesterol with 10.2 g psyllium. Similarly, Anderson et al. (1992) reported that serum cholesterol decreased on feeding 114 g psyllium flakes.

McIntosh et al. (1991) reported that consumption of barley was associated with significant fall in plasma total cholesterol by 6 per cent. Oda et al. (1992) found that oat, barley and wheat suppress liver cholesterol accumulation, liver cholesterol value was significantly lower in oat and barley group than that in wheat group. Similarly, Lupton et al. (1993) observed a significant decrease in serum total cholesterol levels with addition of barley bran flour or barley oil.

Tsai et al. (1992) reported that diet including oil containing rice bran reduced total cholesterol level whereas diet including defatted rice bran did not affect serum cholesterol. Hegsted and Windausser (1993) reported a decrease in cholesterol from 226 to 210 mg/dl after 3 week feeding of 100 g rice rban. In a similar study, Rauanet et al. (1993) observed

that rice bran produce lower liver cholesterol concentration than wheat bran in rats.

Vorster et al. (1987) supplemented the habitual diets of 27 healthy volunteers with mineralized multifibre powder or a maize fibre tablet. They found that both supplements decreased serum cholesterol and the effect being significant for maize fibre. Earll et al. (1988) fed subjects soup containing purified maize fibre 18 g daily for first 6 weeks and 36 g for second 6 weeks and observed reduction in serum total cholesterol. Ratio of total cholesterol to HDL-cholesterol was also decreased.

Ranhotra et al. (1989) studied the effect of foods high in water soluble fibre in 17 hypercholesterolemic men and reported decrease in serum cholesterol from 1 to 17 per cent. Bell et al. (1990) also conducted a study to determine the effect of soluble fibre cereal in treatment of hypercholesterolemia. They reported that during cereal plus diet phase, total cholesterol dropped an additional 2.1 per cent. Similarly, Anderson et al. (1991) reported 6.4 per cent decrease in total cholesterol with 31 g soluble fibre.

The relation among intake of dietary fibre, fat and serum lipids was studied by Kay and Truswell (1980) and it was indicated that men who consumed significantly high amount of dietary fibre and proportionately less fat and energy had lower serum cholesterol concentration. Ranhotra et al. (1989) ^{found} that feeding 28.3 g fibre daily for 6 weeks to hypercholesterolemic men lowered serum total cholesterol significantly. Anderson

et al. (1992) conducted a study on moderately hypercholesterolemic subjects and fed low fat, low fat plus high fibre or usual diet for 12 months. They found greater average reduction (13%) in serum cholesterol with high fibre diet than did the low fat (9%) and usual diet (7%). A similar result was reported by Clevidence et al. (1992).

Lo and Cole (1990) conducted a study on hypercholesterolemic effect of soy cotyledon fibre and reported that supplementation with dietary fibre 15 g/day from soy cotyledon fibre significantly lowered plasma total cholesterol by 7.7 per cent. Uberoi et al. (1992) studied the hypocholesterolemic effect of dietary fibre from cereals (wheat and maize) and pulses (green seeded gram and soyabean). It was found that fibre lowered plasma and tissue cholesterol, the effect being prominent with soyabean and green seeded gram. Harland (1993) also observed reduction in blood cholesterol with dietary fibre from sugarbeet.

Jain (1988) studied the effect of teent on serum cholesterol levels of rats and observed that level of serum cholesterol decreased with an increase in the level of dietary fibre both from teent and cellulose. Binita (1990) investigated the effect of dietary fibre from different plant sources. The total cholesterol in serum and liver of rats decreased with plant fibre, the effect being prominent with lentil husk followed by gum acacia.

Stasse-Wolthus (1980) reported that consumption of fruits and vegetables in experimental diets lower plasma cholesterol.

Burr et al. (1985) observed lower plasma cholesterol among subjects who had high intake of dietary fibre from fruits and vegetables amounting to a decrease of 0.3 mmole/lit for every increase of fibre of 100 g weekly. Bobek et al. (1991) investigated the cholesterol lowering effect of mushroom. They fed rats with diet containing 1 per cent cholesterol and 4 per cent ground dried mushroom and reported a significant decrease in blood cholesterol after 7 weeks.

blood

2.4.2 Fibre and Lipoprotein (HDL and LDL) Cholesterol

During the latest decade increased interest has been focussed on the differential effect of various lipoprotein classes, specially the protective function of high density lipoproteins (HDL) against atherosclerosis has been firmly established (Miller and Miller, 1975), whereas increased levels of LDL are regarded as major risk factor for cardiovascular disease (Gordon et al., 1974).

Various sources of fibres namely cereals, pulses, fruits and vegetables had great role in lowering LDL cholesterol. Literature available on this aspect is presented in Table 2.3.

2.4.3 Fibre and Blood Triglyceride

Absorption and metabolism of triglyceride and fatty acids are influenced by plant fibre. Jenkins (1980) fed hyperlipidemic subjects with 13 g guar crisp bread and observed a significant reduction (13%) in serum triglyceride values. However, Khan et al. (1981) found no significant decrease in serum triglyceride in subjects fed with guar gum in capsule form.

Table 2.3. Effect of different sources of fibre on blood lipoprotein (HDL-LDL) cholesterol

Source of fibre	Amount	Experi- mental subject/ animal	Effect on lipo- protein		Reference
			LDL	HDL	
1 Guar gum	18 g/d	Human	-	No effect	Jenkins (1980)
2 Guar gum	21 g/d	Human	↓	-	Aro <u>et al.</u> (1981)
3 Guar gum capsule	9 g/d	Human	↓	No effect	Khan <u>et al.</u> (1981)
4 Guar gum	18 g/d	Human	↓(20%)	No effect	Simons <u>et al.</u> (1982)
5 Guar gum	6.6 g/d	Rats	↓	-	McIvor <u>et al.</u> (1986)
6 Guar gum & Isabgol husk	15 g/d	Human	↓	No change	Taneja (1989)
7 Pectin	9 g/d	Human	↓(10.5%)	No change	Nakamura <u>et al.</u> (1982)
8 Pectin & cholesterol	5%/d 1%/d	Rats	-	↓	Vorster (1984)
9 Wheat bran	0.5 g/kg BW/d	Human	↓	↓	Berge Henegoumen <u>et al.</u> (1979)
10 Wheat bran	26 g/d	Human	↓(21%)	No effect	Munoz <u>et al.</u> (1979)
11 Wheat bran	0.15 g/kg BW/d	Human	↓(46%)	↑(25%)	Moore <u>et al.</u> (1981)
12 Wheat bran	13.5 g/d	Human	-	↑	Agarwal (1984)
13 Wheat fibre (purified)	10.5 g/d	Human	↓	↑	Lindgarde and Larsson (1984)
14 Oat bran + beans	41 g/d 145 g/d	Human	↓(24%) ↓(29%)	No change ↑(9%)	Anderson <u>et al.</u> (1984)
15 Oat bran	25 g/d	Human	↓(8.5%)	-	Anderson <u>et al.</u> (1990)
16 Barley					
a) Bran flour	30 g/d	Human	↓(6.5%)	↓	Lupton <u>et al.</u> (1993)
b) Oil	3 d/g		↓(9.2%)	No change	

Source of fibre	Amount	Experi- mental subject/ animal	Effect on lipo- protein		Reference
			LDL	HDL	
17 Rice bran					
a) Defatted rice bran	30 g/d	Human	No effect	-	Tsai <u>et al.</u> (1992)
b) Oil containing rice bran	35.3 g/d		↓	-	
18 Rice bran	100 g/d	Human	↓	No effect	Hegested/Windauser (1993) and
19 Maize fibre	18 g/d	Human	-	No change	Earll <u>et al.</u> (1988)
20 Fibre	28.3 g/d	Human	-	↑	Ranhotra <u>et al.</u> (1989)
21 Carbohydrate + Fibre	42 % 20 g/d	Human	↓	No effect	Rivellese <u>et al.</u> (1980)
22 Soycoyledon fibre	15 g/d	Human	↓ (7.4%)	No effect	Lo and Cole (1990)
23 Fruit (Carrot, cabbage, apple)	20 g/d	Human	-	No effect	Jenkins <u>et al.</u> (1979)

↓ Decrease

↑ Increase

Similarly, Simons et al. (1982) found no decrease in serum triglycerides on feeding 6 g guar gum three times a day with meals for 3 months.

Santhakumari et al. (1982) found that feeding rats with guar decoction (40 g/kg) caused significant reduction in triglyceride level of serum in rats and rabbits previously fed on hypercholesterolemic diet. A significant reduction in triglyceride was also observed by Taneja and Kapoor (1989) when subjects were fed 15 g guar gum and 15 g isabgol husk.

Heaton and Pomare (1974) demonstrated that addition of 18 to 100 g unprocessed bran in the self-selected diet of subjects significantly reduced serum triglyceride. Similarly, 24 per cent reduction in serum triglyceride was observed by Berge-Henegoumen et al. (1979) when wheat bran product was fed in a dose of 0.5 g/kg body wt/day. However, Bremner et al. (1975) reported no change in serum triglyceride with addition of 25 g of unprocessed wheat bran in the diets of five men having ^{type-}IV hyperlipoproteinaemia.

O'Brien et al. (1985) found that 50 g of oat bran and wheat bran supplementation reduced triglyceride by 25-41 per cent in hypercholesterolemic patients. A similar study was done by Anderson et al. (1991) and they reported that both oat and wheat bran decreased serum triglyceride by 10 per cent. However, no change in serum triglyceride level was reported with barley and wheat foods (McIntosh et al., 1991).

Effect of rice bran on serum lipid metabolism in men was studied by Tsai et al. (1992). They fed subjects' diets supplemented with 30 g defatted rice bran for 18 days and observed that both the diets caused a significant decrease in triglyceride content. However, Hegsted and Windaus (1993) observed no significant change in serum triglyceride when hypercholesterolemic subjects were fed 100 g rice bran for 10 weeks duration.

Supplementation of multifibre powder or a maize fibre tablet in the diet has been reported to decrease serum triglyceride level significantly (Vorster et al., 1987). Similarly, Earll et al. (1988) observed reduction in serum triglyceride when subjects were fed soup containing purified maize fibre 18 g daily for 6 weeks and then 36 g for second 6 weeks period.

Ranhotra et al. (1989) fed hypercholesterolemic men with foods high in soluble fibre and reported a decrease in serum triglyceride between 3 to 46 per cent, whereas, no significant effect of soluble cereal fibre on level of triglyceride was observed by Bell et al. (1990).

Kay and Truswell (1980) studied the relation among intake of dietary fibre, fat and serum lipids and reported that men consuming diets high in dietary fibre and proportionately less fat and energy had lower serum triglycerides. Ranhotra et al. (1989) observed a significant decrease in serum triglyceride when subjects were given 28.3 g fibre daily for 6 weeks.

Binita (1990) fed rats with diets having dietary fibre from different plant sources and cholesterol (1%) and reported

a significant decrease in serum and liver triglyceride contents.

2.4.4 Fibre and Blood Phospholipids

Shurpalekar et al. (1971) found an increase in serum phospholipid on inclusion of cholesterol in the diet. But when cellulose was added along with cholesterol, the serum phospholipid levels decreased, whereas, Persson et al. (1975) found no change in serum phospholipid level when bran was added to the self-selected diets of 14 subjects. Kaur (1980) also reported no change in serum phospholipid with addition of cellulose in the diets of adolescent girls.

Taneja (1982) observed a significant increase in serum phospholipid on low fibre diet and decrease in serum phospholipid when isabgol husk (25 g) was added to the diets of adolescent girls. In another study, Taneja (1989) reported a significant decrease in serum phospholipid level when 15 g guar gum and isabgol husk was added to the diets of overweight adults.

Tsai et al. (1992) studied the effect of 30 g defatted rice bran and 35.3 g oil containing rice bran. They observed that defatted rice bran decreased the level of phospholipid whereas diet including oil containing rice bran significantly increased the level of phospholipid.

2.4.5 Fibre and Blood Total Lipids

There are many facets of research involving lipid metabolism and dietary fibre. Khalsa and Sharma (1980) fed 10 g

guar flour to 50 normal men and observed a progressive decrease in serum total lipids. Ebihara et al. (1981) also observed reduction in plasma total lipids in male rats with ingestion of pectin from various foods. Similarly, Taneja (1982) also reported a significant decrease in serum total lipids on high fibre diet. In another study, Taneja and Kapoor (1989) demonstrated the effect of guar gum and isabgol husk on total lipids and reported a significant decrease in plasma total lipids.

However, Prather (1964) observed no change in serum total lipids on supplementation of controlled diet with 13 g cellulose. Similarly, Kaur et al. (1981) reported no effect of 21 g pure cellulose on the serum total lipids of adolescent girls.

2.5 Fibre and Blood Glucose

The initial association of dietary fibre with glucose metabolism was developed from epidemiological observations linking a increased incidence of diabetes mellitus with consumption of fibre-depleted foods (Walker et al., 1970; Trowell, 1975).

Chen and Anderson (1979) have published possible mechanism through which dietary fibre act as hypoglycemic agent. Possible mechanism by which plant fibres alter absorption and metabolism of carbohydrate include: (i) delay in gastric emptying that may slow the absorption of carbohydrate as guar gum; (ii) the gel forming properties of most soluble fibres as guar gum and pectin may result in slower absorption

of carbohydrate from these intraluminal gels; (iii) available carbohydrate that is packaged in plant fibres may be insulated from digestive enzymes by its protective fibrous coat or plant fibre may partially inactivate digestive enzymes; (iv) alteration in gut hormone or pancreatic glucagon secretion may enhance glucose metabolism in the liver and account for post prandial glucose.

Review of work regarding effect of various sources of fibre on blood glucose cited in literature is presented in Table 2.4.

2.6 FIBRE AND BLOOD TOTAL PROTEIN

Khalsa and Sharma (1980) fed 10 g guar flour with each meal to 50 healthy male students and found increase in serum protein level, whereas Bhat et al. (1981) observed no apparent effect of addition of cellulose on serum protein levels in adolescent girls. Quazi et al. (1983) fed rats with polychlorinated biphenyl (PCB) and reported increased in serum proteins in rats.

2.7 FIBRE AND GASTRO-INTESTINAL TRACT (GIT) FUNCTIONING

Fibre had a great importance in the physiological functioning of gastro-intestinal tract. The overall effect of dietary fibres or specific fibre components on gastrointestinal physiology might be expected to be dependent upon the overall rate of passage of materials from mouth to anus. This rate varies greatly between individuals and depends on rates of gastric filling and emptying on rate of passage in the small

Table 2.4. Effect of different sources of fibre on blood glucose concentration in humans

Source of fibre	Amount	Experi- mental subject/ animal	Effect on blood glucose	Reference
1 Wheat bran (unprocessed)	0.15 g/kg BW/d	Human	No effect	Moore <u>et al.</u> (1981)
2 Wheat bran	13.5 g/d	Human	↓	Agarwal (1984)
3 Wheat bran	0.5 g/kg BW/d	Human	No effect	Liebman <u>et al.</u> (1983)
4 Guar gum and Isabgol	3.5-7.0 g/d 2.5-14.5g/d	Human	No effect	Jarjis <u>et al.</u> (1984)
5 Guar gum granulate	21 g/d	Human	↓	Aro <u>et al.</u> (1981)
6 Guar	15 g/d	Human	↓	Lakhdar <u>et al.</u> (1988)
7 Guar gum	30 g/d	Human	↓	Landin <u>et al.</u> (1992)
8 Fibre rich bread (soyabean)	40 g/d	Human	No effect	Madar <u>et al.</u> (1988)
9 Low fibre + soypoly-saccharide	25 g/d	Human	Glucose tolerance improved	Tsai <u>et al.</u> (1983)
10 High fibre diet	27 g/1000 Kcal	Human	No effect	Hollenback <u>et al.</u> (1986)
11 High fibre diet	40 g/d	Human	↓	Manojlovic <u>et al.</u> (1986)
12 Fenugreek	15 g/d	Human	↓	Madar <u>et al.</u> (1988)
13 Soluble fibre	15-28.3 g/d	Human		Ranhotra <u>et al.</u> (1989)
14 Cereal bran (wheat, rice and eat)	11.8 g/d	Human	No effect	Kestin <u>et al.</u> (1990)

↓-Decrease

intestine and on colonic metabolism and transit times (Smith and Eastwood, 1980).

Diets containing higher levels of plant fibres are bulkier and need more time for ingestion (McCance et al., 1953). This stimulates chewing and increases flow of saliva and dilution of oral contents. Chewing promotes the sense of satiety or fullness by direct effect on hypothalamus (Anand, 1974). Whereas, MacGregor et al. (1977) had reported that in stomach dietary fibre in general, can delay gastric emptying of nutrients because of more solid nature of the ingested food.

Dietary fibre deficiency has been linked to a number of diseases on both epidemiological and controlled experimental grounds (Vahouny and Kritchevsky, 1982, 1986). Diverticular disease of the large bowel has become a common clinical problem in affluent countries (Painter, 1970, 1975, 1985; Painter et al., 1972; Kirwan and Smith, 1977). The intake of high dietary fibre foods may help prevent the symptoms of diverticular disease in the following manner (Painter, 1985): (i) By increasing the volume of the feces which widens the large bowel diameter to prevent diverticular formation, and (ii) by reducing the transit time and by the passage of softer stool which strains the large bowel less, thereby not favouring the development of diverticula.

The action of wheat bran in reducing the symptoms of irritable bowel syndrome has been demonstrated (Soltoft et al., 1976; Manning et al., 1977; Thompson, 1986).

The increasing incidence of duodenal ulcer in affluent countries is due to consumption of refined carbohydrate foods. Traditional dietary treatment has been based on the notion that small, bland meals could reduce the secretion of acid and pepsin, buffer the acid that is secreted into stomach, reduce gastric motility and help maintain gastric mucosa resistance (Roth, 1966). Studies on relationship of diet and ulcer development have indicated ^{that} / high fibre diets have some therapeutic effect (Rydning and Berstad, 1986).

Constipation has probably plagued the human race from prehistory. During the last decade, a major focus of interest for both gastroenterologists and nutritionists has been on the relationship between dietary fibre and fecal output (Stephen, 1985).

The relationship between dietary fibre and large bowel cancer has been clearly brought to the public's attention in association with certain bran cereals. A number of studies indicate that diets particularly high in total fat and low in certain type of dietary fibre are associated with an increased risk of bowel cancer in humans (Wynder, 1975; Reddy et al., 1980; Kritchevsky, 1983, 1986; Bingham, 1986a,b).

CHAPTER - 3

MATERIALS AND METHODS

The present investigation was conducted in three phases.

3.1 PHASE I : PRELIMINARY SURVEY OF HYPERLIPIDEMIC ADULTS OF HISAR CITY

- 3.1.1 Selection of subjects
- 3.1.2 Development and pretesting of questionnaire
- 3.1.3 Collection of information

3.2 PHASE II : DEVELOPMENT, SELECTION AND STANDARDIZATION OF RECIPES USING TEENT

- 3.2.1 Procurement and processing of teent
- 3.2.2 Organoleptic evaluation of processed teent
- 3.2.3 Preparation of teent powder
- 3.2.4 Development of products using teent
- 3.2.5 Organoleptic evaluation of products
- 3.2.6 Selection of form of supplement

3.3 PHASE III: SUPPLEMENTATION OF DIET OF HYPERLIPIDEMIC SUBJECTS WITH TEENT AND STUDYING THE EFFECT OF TEENT SUPPLEMENTATION ON VARIOUS PARAMETERS OF BLOOD

- 3.3.1 Selection of subjects
- 3.3.2 Teent supplementation in the diets of hyperlipidemic subjects
- 3.3.3 Collection of food sample

3.3.4 Collection of blood sample

3.3.5 Analysis of food sample

3.3.6 Analysis of blood sample

3.4 STATISTICAL ANALYSIS

3.1 PRELIMINARY SURVEY OF HYPERLIPIDEMIC ADULTS OF HISAR CITY

A preliminary survey of hyperlipidemic obese adults (40-60 yrs) was conducted to investigate their dietary habits and other baseline information for selecting sub-sample for further experiment.

3.1.1 Selection of Subjects

Fifty hyperlipidemic adults (both male and female) of 40-60 years of age were randomly selected from Hisar city. The fasting blood sample of these subjects was collected. Plasma was separated and analyzed for total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, phospholipids, total lipids, glucose and total protein. The analysis of blood was carried in the Department of Livestock Production and Management and Veterinary Gynaecology and Obstetrics. Stools of these subjects were found to be free from parasitic infection and urine samples were free from albumin and sugar.

3.1.2 Development and Pretesting of Questionnaire

A questionnaire was designed to collect information relating to various aspects such as general information, dietary intakes, physical activities, personal habits, etc. of the subjects. For pretesting the questionnaire, 10 hyperlipidemic respondents including five male and five females located

in different areas were surveyed. Based on responses received during pretesting, a few necessary modifications were made in the questionnaire and pretested reconstructed schedule (Appendix - I) was used to collect actual data for the present study.

3.1.3 Collection of Information

The detailed information relating to various aspects was collected with the help of questionnaire. General information including name, age, sex, education, height and weight of the respondents was recorded. Weight was taken on bathroom scale with light clothing and without shoes. Height was recorded by taking their standard height against upright wall. Per cent obesity was calculated with LIC standard weight for height (Appendix-II). Information regarding complication of patients, family history of these complications and personal habits such as drinking, smoking, physical activities, type of occupation and frequency of defaecation was also collected.

Details of dietary intake were recorded by questionnaire-cum-twenty four hour recall method. Information regarding the intake of food for three consecutive days was collected from the respondents. This included actual amount of cooked weight of food consumed by the subjects. The information regarding ingredients used in each recipe consumed and method of preparation was also recorded. Cooked food consumed was converted into their raw equivalents (Taneja, 1989). The nutritive value of raw food.

equivalent was calculated using the food composition table (Gopalan et al., 1991). Dietary information regarding food habits, fasting habits and food trends was also recorded.

3.2 DEVELOPMENT, SELECTION AND STANDARDIZATION OF RECIPES USING TEENT

3.2.1 Procurement and Processing of Teent

Teent (Capparis decidua), used as a source of dietary fibre were procured from the local market. The stalks were removed and teent were washed with tap water and finally rinsed with distilled water. Hundred gram of teent (whole as well as coarsely ground) were immersed in 500 ml solution of 5% sodium chloride, 1% lac-tic acid and 1% acetic acid separately for 24 hrs. On second day, the solutions were discarded and fresh solutions were added and again kept for 24 hrs.

3.2.2 Organoleptic Evaluation of Processed Teent

The organoleptic evaluation of teent processed with different treatments was carried by a panel of 10 judges using 9-point hedonic scale (Appendix-III). The parameters used for organoleptic evaluation were colour, appearance, flavour and taste. The average of scores for these characteristics was expressed as overall acceptability. Treatment by which processed teent obtained highest overall acceptability score was used for further processing.

3.2.3 Preparation of Teent Powder

For preparation of teent powder, whole teent as well as coarsely ground teent were processed with 5% NaCl (3.2.1). After 24 hrs, solutions were drained off and residue was dried

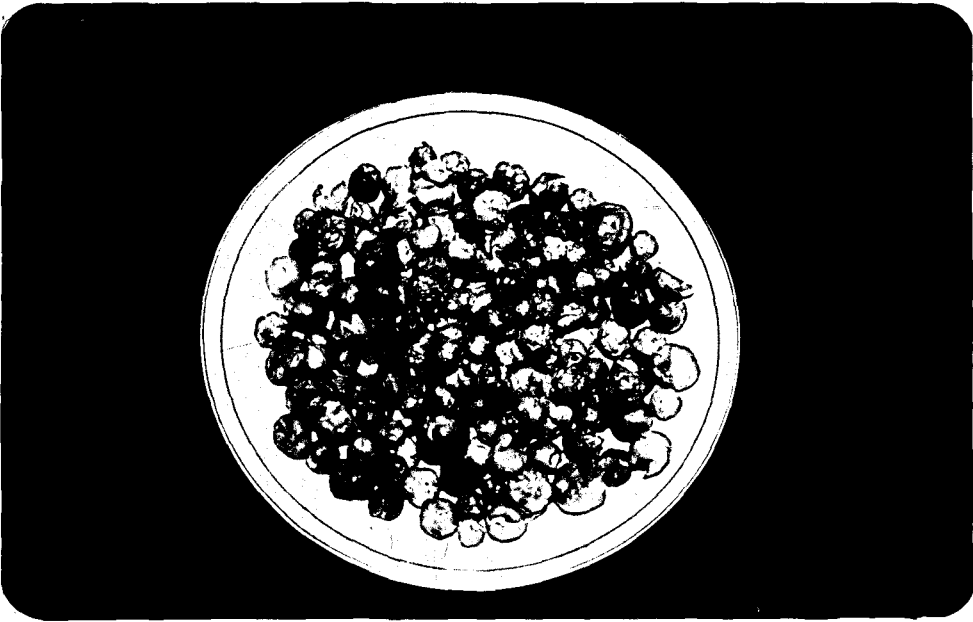


Plate 1. Dried teent

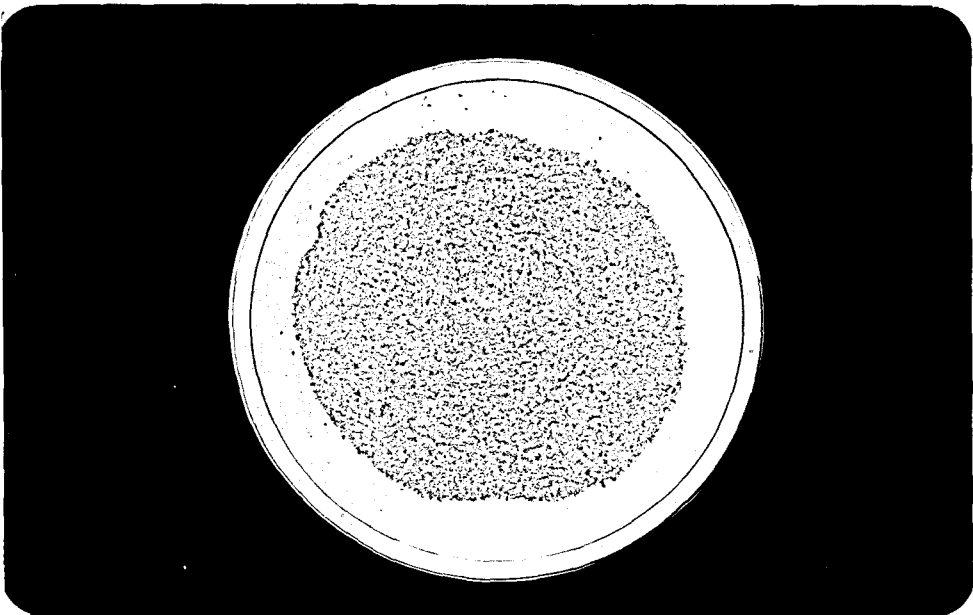


Plate 2. Teent Powder

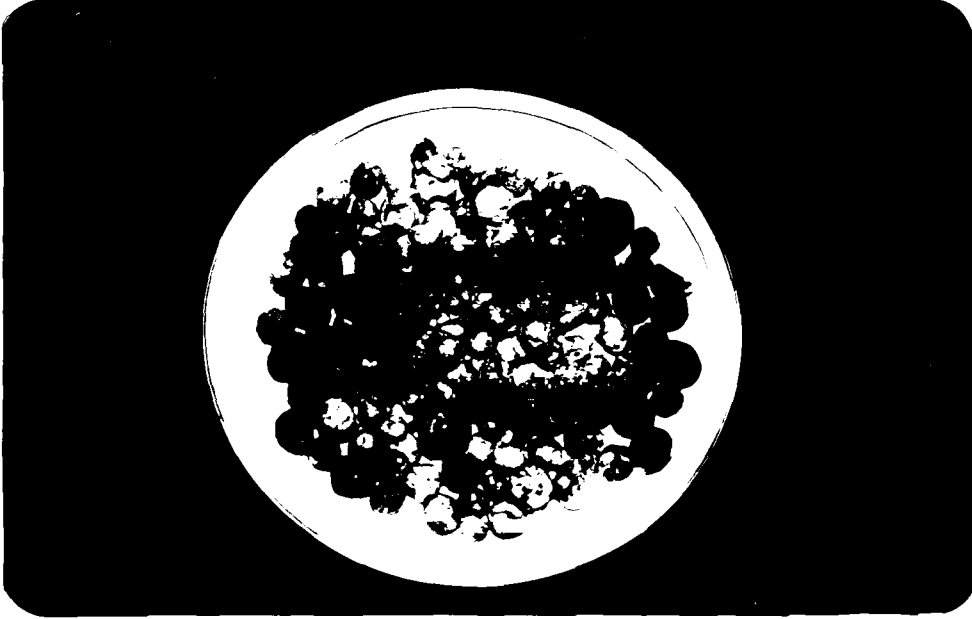


Plate 1. Dried teent

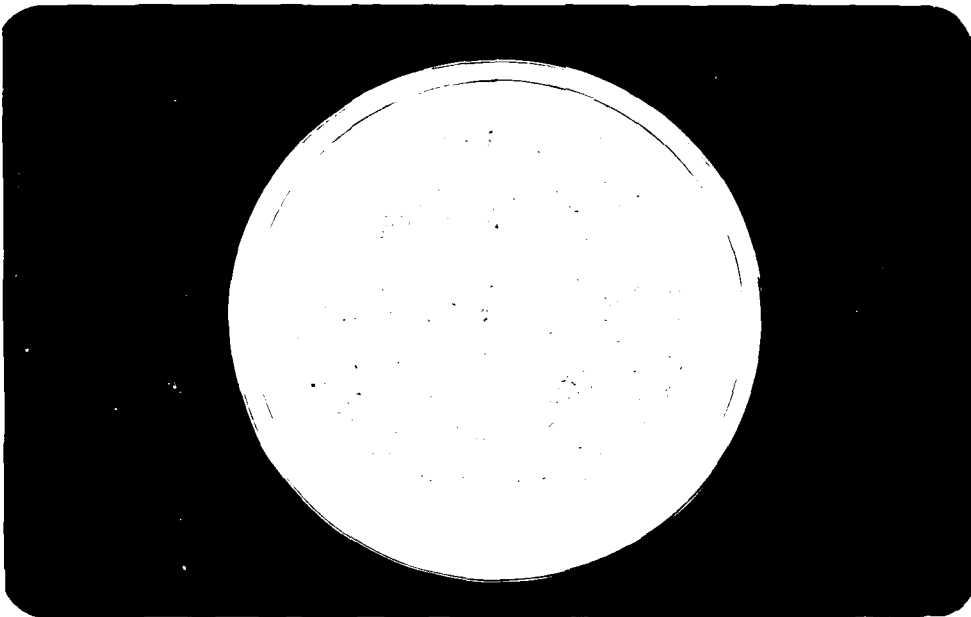


Plate 2. Teent Powder

in an oven at 60°C, ground to a fine powder (0.5 mm sieve) in cyclotec (MS Tecator Hoganas, Sweden) and stored in air tight containers till further use. Fibre components in teent powder prepared with whole teent (A) and coarsely ground teent (B) were analysed (Appendix-IV).

3.2.4 Development of Products Using Teent

Suitable recipes of teent having good taste and shelf life were tried out in the laboratory. Various recipes in which teent was incorporated were chutney, biscuit, panjiri, pakoda, chapati, and sev. Fresh teent was used for preparation of chutney, whereas teent powder (B) was used to prepare biscuit, panjiri, pakoda, chapati and sev.

3.2.4.1 Teent Chutney (Sour)

<u>Ingredients</u>	<u>Qty</u>
<u>Teent</u>	50 g
Onion	20 g
Ginger	05 g
Mint leaves	10 g
Lemon	01 No.
Green chillies	02 No.
Spices and salt	According to taste

Method: Fresh teent after removing the stalks were processed with 5% NaCl. Chopped the onion, green chillies and ginger. Removed the mint leaves from stalk and washed. Added small quantity of water and ground teent, mint leaves, green chillies, ginger and onion together to a fine paste in a

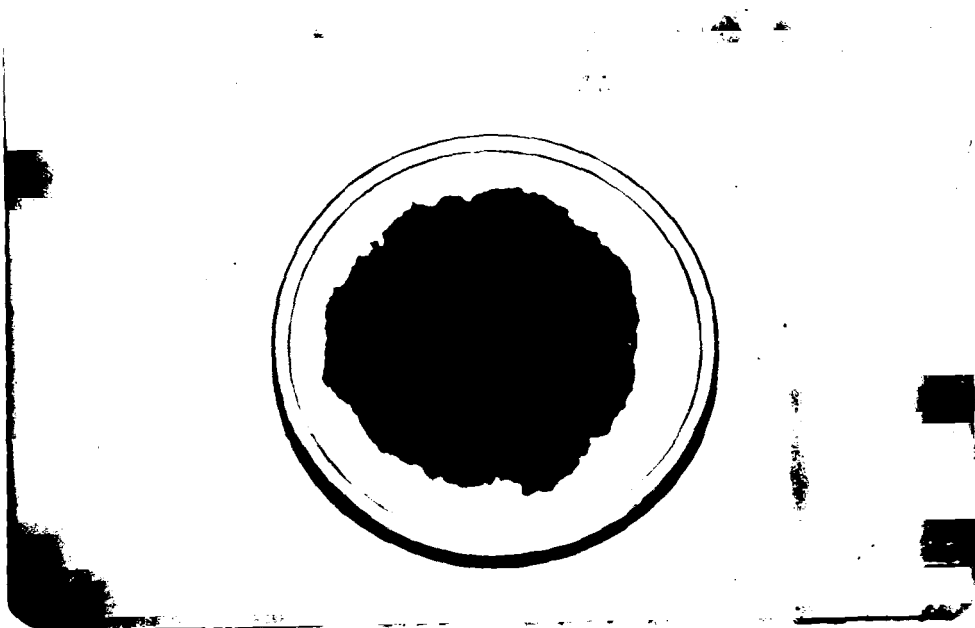


Plate 3. Teent chutney



Plate 4. Biscuits

an electric grinder. Added lemon juice, salt and other spices according to taste and mixed well.

3.2.4.2 Biscuit

<u>Ingredients</u>	<u>A</u>	<u>B</u>
<u>Maida</u>	50 g	50 g
Ghee	20 g	20 g
Water	20 ml	20 ml
Sugar	125 g	12.5 g
Salt	1.75 g	1.75 g
Ammonia powder	2.5 g	2.5 g
<u>Teent</u> powder	10 g	05 g

Method: Cream ghee and water. Added salt, ammonia powder, sugar and cream the mixture. Folded maida and teent powder in above mixture. The mixture was rolled and cut into small particular shape and baked at 170°C till brown.

3.2.4.3 Panjiri

<u>Ingredients</u>	
Wheat flour	50 g
<u>Teent</u> powder	05 g
Ghee	15 g
Sugar	35 g
Coconut powder	05 g

Method: Melted ghee in a pan. Added wheat flour in ghee and roasted it till light brown. Added ground sugar and coconut powder. After 2 min removed it from fire. Allowed it to cool and added teent powder. Mixed thoroughly and packed in small packets.

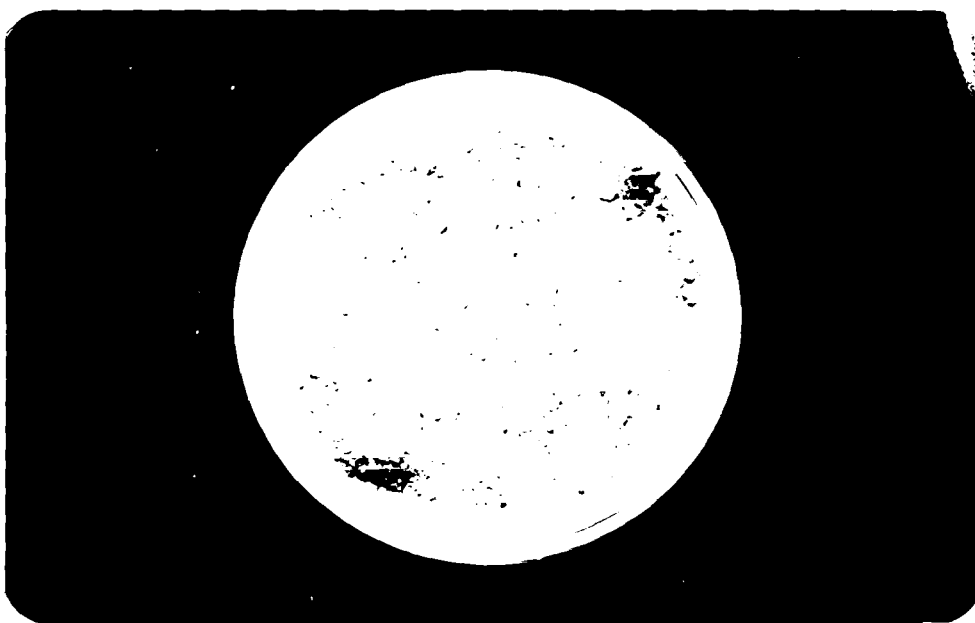


Plate 5. Panjiri



Plate 6. Sev

3.2.4.4 Pakoda

Ingredients

<u>Besan</u>	50 g
<u>Teent</u> powder	05 g
<u>Garam masala</u>	01 tsp
Green chillies	1-2
Salt	To taste
Red chilli powder	To taste
Ghee	For frying

Method: Mixed besan, teent powder and spices. Made into thick paste with water. Heated ghee and fried small portion of thick paste till golden brown.

3.2.4.5 Besan Sev

Ingredients

<u>Besan</u>	50 g
<u>Teent</u> powder	05 g
Salt	To taste
Ghee	For frying

Method: Mixed besan, teent powder and salt. Made into thick paste with water. The paste was pressed through sev machine and fried in heated ghee.

3.2.4.6 Chapati

Ingredients

Wheat flour	50 g
<u>Teent</u> powder	05 g
Salt	To taste
Ghee	To smear

Method: Sieved wheat flour, mixed the teent powder and salt. Kneaded into a dough with water. Made small balls and rolled into shape of chapati. Baked on preheated tawa. Smearred it with ghee.

3.2.5 Organoleptic Evaluation of Products

Teent supplemented recipes were subjected to organoleptic evaluation by a panel of 10 judges using 9-point hedonic scale. These were assessed for colour, appearance, flavour and taste. The mean of the scores for these characteristics was expressed as overall acceptability. Products with high overall acceptability score were used for supplementation.

3.2.6 Selection of Form of Supplement

On the basis of organoleptic evaluation, three products namely chutney, biscuit, and panjiri were used to supplement the diet of selected experimental subjects.

3.3 SUPPLEMENTATION OF DIET OF HYPERLIPIDEMIC SUBJECTS WITH TEENT AND STUDYING THE EFFECT OF TEENT SUPPLEMENTATION ON VARIOUS PARAMETERS OF BLOOD

3.3.1 Selection of Subjects

Two ml of fasting blood samples of hyperlipidemic subjects selected was collected before starting the experiment. Blood samples were collected from a vein at antecubital arm area into heparinised tubes. Plasma was separated and analysed for total lipids, triglycerides, total cholesterol, HDL-cholesterol, LDL-cholesterol, phospholipids, glucose and total proteins. According to the dietary habits, the subjects were divided into 3 groups - vegetarian, non-vegetarian and

eggetarian. Depending upon the blood profile of subjects, five hyperlipidemic subjects in each category were selected for experimental study.

3.3.2 Teent Supplementation in the Diets of Hyperlipidemic Subjects

The diets of selected subjects were supplemented with approximately 50 g teent (on fresh wt. basis) for 3 months. The study was carried out from 17th June to 17th September, 1994. As teent were available in the season at the start of study, so teent chutney was used as form of supplement for first 15 days. Fifty gram of teent were used to prepare the daily supplement of teent as chutney. Fresh chutney was prepared, filled in packets (85 g/d) and distributed to the subjects every third day.

For next 15 days, panjiri was prepared weekly (100 g/d) and distributed to subjects. Panjiri was not much relished by the subjects. Few of them reported fullness after consuming panjiri. So, for last 2 months, teent supplemented biscuits were used as a supplement. Biscuits were prepared weekly and distributed (100 g/d) to the subjects. Since biscuits and panjiri per serving contained 5 g teent powder on dry matter basis, so in addition to panjiri and biscuits, subjects also consumed teent powder (2 g/d). For this packets containing 2 g teent powder were prepared and distributed.

Subjects were educated regarding intake of supplement. They were advised to take their habitual diet during experimental period without making any deliberate changes in eating

pattern and to maintain their physical activities as usual. Home visits were made to ensure regular consumption of teent supplements as per instructions given to them.

3.3.3 Collection of Food Sample

During experimental period, one fifth sample of each food item consumed by each subject at every meal was weighed for three consecutive days, collected in their respective containers tightly covered with plastic lids and kept in deep freezer. Samples were homogenized in a mixer-cum-blender and stored in a deep freezer until analysis.

3.3.4 Collection of Blood Sample

The blood samples of each subject were taken in the fasting state at the end of feeding trial. Two ml of blood was drawn out from a vein at antecubital arm area using a clean sterilized syringe. The blood was collected in heparinised tube and centrifuged at a speed of 2000 rpm for 30 minutes. Plasma was separated and transferred into labelled screw capped plastic tubes and stored in deep freezer until analysis. Fresh plasma was used for estimation of glucose.

3.3.5 Analysis of Food Samples

Food samples were homogenized, dried in oven at 60°C to constant weight, made into powder and stored in plastic bottles till analysis. Moisture, proximate composition and different components of dietary fibre were chemically estimated in the food samples.

3.3.5.1 Moisture

Moisture content was determined by method of AOAC (1990).

3.3.5.2 Crude Protein

The crude proteins were estimated by the Micro Kjeldahl Method (AOAC, 1990).

Reagents

- (i) Conc. H_2SO_4
- (ii) Boric acid (4%)
- (iii) Sodium hydroxide (40%)
- (iv) Hydrochloric acid (N/100): Dissolved 0.88 ml conc. HCl to one litre distilled water
- (v) Mixed indicator: Took 0.5 g bromocresol green and 0.1 g methyl red and dissolved in 100 ml 95 per cent ethanol.
- (vi) Digestion mixture: 10 g potassium sulphate, 0.5 g copper sulphate and 2 g ferrous sulphate were mixed together and ground to a fine powder.

Procedure

Transferred 2 g sample to a Kjeldahl flask. Added 15 ml conc. H_2SO_4 , a pinch of salt mixture and a few glass beads to it. Carried out the digestion till a clean solution was obtained. Cooled the flask, added 15 ml water to it and transferred the solution to 50 ml volumetric flask. Rinsed the flask 2-3 times and made the volume to 50 ml. Took 10 ml boric acid in a conical flask, added mixed indicator (2-3 drops) to it. Attached the flask to the distillation apparatus. Ammonia liberated was trapped in the boric acid and continued distillation till all ammonia distilled off. The boric acid

4.4 is
made
micro
but
macro

41-43

containing ammonia was titrated against N/100 HCl. Per cent nitrogen was then calculated as:

$$\text{Nitrogen} = \frac{0.00014 \times \text{Vol. of N/100 HCl used} \times \text{Vol. of digested sample made (ml)}}{\text{Wt. of sample taken} \times \text{Vol. of aliquot taken}} \times 100$$

The protein was calculated by multiplying the nitrogen content with a factor of 6.25.

3.3.5.3 Crude Fat

Crude fat was estimated by using Soxhlet extraction apparatus (AOAC, 1990).

Procedure

Weighed 5 g of dry sample, transferred it to an extraction thimble. Placed the thimble in a Soxhlet extractor fitted with a condenser and flask containing sufficient petroleum ether. The extraction was carried out for 6 hrs. After the extraction, thimble was removed from the extraction apparatus and dried in a hot air oven to a constant weight, cooled in a desiccator to room temperature and weighed. The loss in weight of the thimble indicated the amount of fat in the thimble.

3.3.5.4 Crude Fibre (AOAC, 1990)

Reagents

- (i) HCL (1%, v/v)
- (ii) Sulphuric acid- Stock solution (10%, w/v): Took 55 ml conc. H₂SO₄ and diluted to one litre.
- (iii) Sulphuric acid - Working solution (1.25%): Diluted 125 ml of stock solution to 1 litre.
- (iv) Sodium hydroxide - Stock solution (10% W/v): Dissolved 100 g NaOH in water and diluted to one litre.

- (v) Sodium hydroxide - Working solution (1.25%): Diluted 125 ml of stock solution to one litre with distilled water.
- (vi) Antifoam - 2% silicon antifoam in CCl_4 .

Procedure

Weighed one g of fat free dried sample in one litre tall beaker. Added 200 ml 1.25% H_2SO_4 and few drops of antifoam. Kept the solution boiling for 30 min under bulb condensor. Beaker was rotated occasionally to mix to contents and removed the particles from the side. Filtered the contents of the beaker through funnel. Washed the sample back into the tall beaker with 200 ml 1.25% sodium hydroxide. Brought to boiling point. Boiled exactly for 30 minutes. Transferred all insoluble matter to the sintered crucible by means of boiling water till acid free. Washed twice with alcohol. Washed three times with acetone. Dried at 100°C to constant weight. Ashed in a muffle furnace at $550^\circ\text{C} \pm 10^\circ\text{C}$ for 1 hr. Cooled the crucible in a desiccator, reweighed and the percentage of crude fibre in the sample was calculated.

3.3.5.5 Ash (AOAC, 1990)

Placed the requisite number of silica crucibles in muffle furnace to heat at $550^\circ\text{C} \pm 10^\circ\text{C}$ for 15 minutes. Removed the crucibles, cooled in desiccator for 1 hr. Weighed accurately 5 g of material into each crucible. Heated each sample on a hot plate till smoking ceased and the sample became thoroughly charred. Placed the crucibles inside the muffle furnace and ashed at $550^\circ\text{C} \pm 10^\circ\text{C}$ for 5-6 hrs. When the ash became clear

and white in appearance, the crucibles were removed from furnace, cooled in a desiccator and weighed. The loss in weight represented the organic matter and residue, the ash content.

3.3.5.6 Nitrogen Free Extract (NFE)

The NFE was calculated by the method of AOAC (1990)

$$\text{NFE (\%)} = 100 - (\text{CP \%} + \text{CF\%} + \text{EF\%} + \text{Total ash \%})$$

Where,

CP = Crude protein

CF = Crude fibre

EF = Ether/crude fat

3.3.5.7 Energy

The energy content was calculated by Factorial Method.

$$\text{Energy} = (4 \times \text{protein}) + (9 \times \text{Fat}) + (4 \times \text{Carbohydrate})$$

(Kcal/d)

3.3.5.8 Dietary Fibre Constituents

Van Soest and Wines (1967) method as modified by Arora (1981) was employed for determining the constituents of dietary fibre in the foods.

3.3.5.8.1 Neutral Detergent Fibre

Reagent

(i) Acetone GR grade

(ii) Neutral detergent solution

Sodium lauryl sulphate	30 g
Disodium ethylene diaminetetra acetate dihydrate	18.61 g
Sodium borate decahydrate	6.81 g
Disodium hydrogen phosphate	4.56 g
Water	1 litre

Weighed disodium ethylene diamine-tetra acetate dihydrate and sodium borate decahydrate together in a large beaker. Added few ml of water and heated the solution till the contents were dissolved. Then added sodium lauryl sulphate. Weighed disodium hydrogen phosphate in a separate beaker and dissolved by heating in water and added it to the beaker containing other ingredients. Adjusted the pH to range between 6.9 to 7.1.

Procedure

Transferred one g finely ground fat free and oven dried sample to one litre beaker for refluxing. Added 100 ml cold neutral detergent solution to it and brought to boil within 10 minutes and then refluxed for 60 minutes with simmering heat. Filtered the solution through the previously dried and weighed Gooch crucibles on filter manifold using a low vacuum in the beginning and then increasing it gradually. Rinsed the beaker with hot water and when all the contents had filtered off, Washed the contents in the crucible with acetone. Dried the crucible with acetone. Dried the crucibles in oven at 100°C for 9 hr and recorded their final weight. The difference between initial and final weight gave the value of NDF.

3.3.5.8.2 Acid Detergent Fibre

Reagents

- (i) Acetone GR grade
- (ii) Acid detergent solution

Sulphuric acid (1 N)	1 litre
Cetyl trimethyl ammonium bromide (CTAB)	20 g
Added 20 g CTAB to one litre of 1N H ₂ SO ₄	

Procedure

Transferred one g finely ground and oven dried sample to a beaker for refluxing. Added 100 ml cold acid detergent solution to it and brought to boil within 10 minutes. Refluxed the solution for 60 minutes with simmering heat. Then filtered the solution through the previously dried and weighed Gooch crucibles on filter manifold using a low vacuum in the beginning and then increasing it gradually. Rinsed the beaker with hot water and when all the contents had filtered off. Washed the contents with acetone. Dried contents of crucible at 100°C in oven for nine hrs and recorded their final weight. The difference between the initial and the final weight of crucible gave the value of acid detergent fibre.

3.3.5.8.3 Hemicellulose

The hemicellulose was calculated as the difference between neutral detergent fibre and acid detergent fibre.

3.3.5.8.4 Cellulose

Reagents

- (i) Acid detergent fibre
- (ii) Sulphuric acid (72%)

Procedure

Covered the acid detergent fibre in crucible with cold (15°C) 72 per cent H_2SO_4 and stirred with a glass rod to a smooth paste. Crucibles were filled to about half with the acid and refilled with 72 per cent H_2SO_4 and stirred the contents at hourly intervals as the acid drained off. Repeated the process thrice. After three hours filtered off the acid under vacuum

and washed the contents with hot water till they were free from acid. Rinsed and removed the glass rod. Dried the crucible at 100°C, cooled in dessicator and weighed. Loss in weight gave the cellulose content.

3.3.5.8.5 Lignin

Ignited the contents of crucibles containing acid detergent in a furnace at 550°C for three hours, cooled at 100°C and weighed. Difference in weight after cellulose extraction and after ignition gave the value of lignin present in food samples.

3.3.5.8.6 Pectin

Total pectin (as calcium pectate) was determined by the method of Ranganna (1977).

Reagents

- (i) Acetic acid (1N): Diluted 30 ml acetic acid to 500 ml with water.
- (ii) Calcium chloride (1N): Dissolved 25.7 g anhydrous calcium chloride in water and made the volume to 500 ml.
- (iii) Sodium hydroxide (1N): Dissolved 20 g anhydrous sodium hydroxide in water and made the volume to 500 ml.
- (iv) Silver nitrate (1%): Dissolved one g silver nitrate in water and made the volume to 100 ml.

Procedure

Took 25 g sample in a flask. Added 200 ml water to it. Kept the flask on hot plate for an hour and maintained the water level constant. Cooled the contents and made the volume

to 250 ml. Then filtered through Whatman No. 41 filter paper. Added 100 ml water and 10 ml 1N NaOH to 100 ml of the above solution. Kept it overnight. Then added 50 ml 1N acetic acid and after five minutes added 25 ml of 1N calcium chloride with continuous stirring. Allowed to stand for an hour and filtered through previously dried and weighed the Whatman No. 41 filter paper. Washed the contents with water till they were free from chloride (tested with 1% AgNO_3). Dried the precipitates at 100°C for 24 hr. Cooled in dessicator and weighed. The difference in weight of the empty filter paper and that with precipitates gave the quantity of calcium pectate.

$$\text{Calcium pectate} = \frac{\text{Wt. of calcium pectate} \times \text{Vol. of content}}{\text{ml of filtrate taken} \times \text{Wt. of sample for estimation}} \times 100$$

3.3.6 Analysis of Blood Samples

The plasma was analysed for total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides, total lipids, phospholipids, glucose and total protein.

3.3.6.1. Plasma Total Cholesterol

Plasma total cholesterol was determined by Miles Auto Analyzer based on Enzymatic method (Richmond, 1973). In this method, cholesterol forms a red coloured compound, intensity of which is proportional to the concentration of cholesterol in the sample.

Reagents (Supplied in kits)

Reagent 1: Buffer/Enzyme/Chromogen

Reagent 2: Phenol

Reagent 3: Standard : Cholesterol 200 mg/dl

Working solution

Allowed the reagents to attain the room temperature. Solution (1): Added 64 ml distilled water to reagent 1. Mixed gently till contents were completely dissolved.

Reagent (2): Ready for use.

Daily working solution

Allowed the solution (1) and reagent (2) to attain the room temperature. One volume of solution (1) was mixed with one volume of reagent (2) and stored in dark bottle.

Procedure

The sample and the daily working solution were brought to room temperature before use. Following solutions were pipetted into cuvettes:

	Standard	Test
Solution	1.00 ml	1.00 ml
Standard	0.01 ml	-
Sample	-	0.01 ml

Mixed the contents of test tubes and incubated for 15 minutes at room temperature. Aspirated the reagent blank using the aspiration switch, waited while the instrument demanded for it. Waited again while the instrument was calculating the factor which was printed out. Finally aspirated the reacted Sample No. 1 and the concentration of total cholesterol was printed out by the instrument within five seconds. This was followed by Sample No. 2 and other samples.

3.3.6.2 High Density Lipoprotein Cholesterol

The HDL-cholesterol in plasma was measured by phosphotungstate method using Miles Auto Analyzer (Tarbuttor and Gunter, 1974).

The HDL-cholesterol fraction is separated from other lipoprotein present in plasma by precipitation. The precipitates were removed by centrifugation. The supernatant contains HDL-cholesterol which is assayed with enzymatic cholesterol method.

Reagents (Supplied in kits)

Reagent 1: HDL-cholesterol (Buffer/Enzymes/Chromogen)

Reagent 2: HDL-cholesterol (Phenol)

Reagent 3: Precipitating reagent

Reagent 4: HDL-cholesterol standard : 50 mg/dl

Precipitation of working solution

Allowed the reagents to attain the room temperature.

Solution (1): Added 29 ml distilled water to reagent 1 and mixed.

Reagent (2): Ready for use.

Precipitating reagent: Ready for use

Standard 50 mg/dl : Ready for use

Preparation of daily working solution

Allowed the solution (1) and the reagent (2) to attain the room temperature. Mixed one volume of solution (1) with one volume of reagent (2).

Procedure

The samples and the reagents were allowed to attain the room temperature.

I. Precipitation

Following solutions were pipetted into cuvettes:

Sample	: 0.20 ml (200 ul)
Precipitating reagent	: 0.20 ml (200 ul)

These solutions were mixed well and then centrifuged at 3500-4000 rpm for 10 min. The clear supernatant was separated immediately and the cholesterol content was determined as below:

II. Cholesterol assay

Following solutions were pipetted into cuvettes:

	Standard	Test
Daily working solution	1 ml	1 ml
Standard	0.02 ml	-
Sample (supernatant)	-	0.02 ml

Mixed the contents of test tubes and incubated for 30 minutes at room temperature. Aspirated the reagent blank using the aspiration switch, waited while the instrument demanded for it. Waited again while the instrument was calculating the factor which was printed out. Finally aspirated the reacted Sample No. 1 and the concentration of total cholesterol was printed out by the instrument within five seconds. This was followed by Sample No. 2 and other samples.

3.3.6.3 Low Density Lipoprotein Cholesterol

The value of LDL-cholesterol were calculated by using the equation of Friedwald et al. (1972).

$$\text{LDL-cholesterol (mg/dl)} = \text{Total cholesterol} - \frac{\text{Triglyceride}}{5} + \text{HDL-cholesterol}$$

3.3.6.4 Plasma Triglycerides

Plasma triglycerides were estimated by Autopak Reagent Kit method of Miles India based on Enzymatic DHBC colorimetric method (Fossati and Principle, 1982). In this method, triglycerides form red coloured complex with the reagent, intensity of which is proportional to concentration of triglycerides in the sample.

Reagents

Reagent 1: Enzymes/chromogen

Reagent 2: Buffer/chromogen

Reagent 3: Stabilizer

Reagent 4: Standard: 200 mg/dl

Preparation of working solution

Allowed the reagents to attain the room temperature. Added 5.5 ml of reagent 2 and 5.5 ml of reagent 3 to the contents of one bottle of reagent 1. Mixed to dissolve completely. The standard is ready for use.

Procedure

The samples and working solution should be brought to room temperature prior to use. Following solutions were pipetted into cuvettes:

	Standard	Test
Standard	0.01 ml	-
Sample	-	0.01 ml
Working solution	1 ml	1 ml

Mixed the contents of test tube and incubated for 15 minutes at room temperature. Aspirated the reagent blank using the aspiration switch, waited while the instrument demanded for it. Waited again while the instrument was calculating the factor for which printed out. Finally aspirated the reacted Sample No. 1 and the concentration of triglyceride was printed out by the instrument within five seconds. This was followed by Sample No. 2 and other samples.

3.3.6.5 Plasma Total Lipids

Plasma total lipids were estimated by Diagnostic Reagent Kit method of Span Diagnostic Systems (Annino, 1976). In this method, lipids on heating with concentrated sulphuric acid react with phosphovanillin reagent and produce pink coloured complex, which is measured colorimetrically.

Reagents (Supplied in kit)

Reagent 1: Sulphuric acid, 36 N

Reagent 2: Phosphovanillin reagent

Reagent 3: Working lipid standard 700 mg%

Procedure

A. For colorimeter

Step A Digestion with sulphuric acid

	Blank	Standard	Test
Plasma	-	-	0.1 ml
Reagent 3: Working lipid std 700 mg%	-	0.1 ml	-
Distilled water	0.01 ml	-	-
Reagent 1: Sulphuric acid, 36 N	2.0 ml	2.0 ml	2.0 ml

Above contents were mixed well, then kept in boiling water bath for 10 min and allowed to cool to room temperature.

Step B colour development

	Blank	Standard	Test
Above mixture (from Step A)	0.2 ml	0.2 ml	0.2 ml
Reagent 2: Phosphovanillin reagent	6.0 ml	6.0 ml	6.0 ml

Contents were mixed well and incubated at 37°C for 15 minutes. Optical density of standard was measured at 540 nm. Total lipid content of plasma was calculated as follows:

$$\text{Total lipid (mg/100 ml)} = \frac{\text{O.D. of test}}{\text{O.D. of standard}} \times 700$$

3.3.6.6 Total Phospholipids

The total phospholipids in plasma were estimated by the method of Connerty et al. (1961).

Reagents

- (i) Trichloroacetic acid solution (5%): Dissolved 50 g trichloroacetic acid in water and made the volume to 1 litre.
- (ii) Digestion mixture: Prepared a mixture of 50 ml water, 25 ml conc. H_2SO_4 and 25 ml perchloric acid.

- (iii) Sodium acetate solution: Dissolved 500 g sodium acetate trihydrate in water and made the volume to one litre.
- (iv) Ammonium molybdate solution: Dissolved 25 g ammonium molybdate in water and made the volume to one litre.
- (v) Metol (P-methylaminophenol sulphate): Prepared 1% metol solution in 3% sodium hydrogen sulphite solution.
- (vi) Standard phosphorus solution: Dissolved 4.083 g anhydrous monopotassium dihydrogen orthophosphate in water, added two ml conc. H_2SO_4 and made the volume to one litre with water. Diluted one ml of this to 250 ml to get a working standard solution of conc. 4.68 ug/ml.

Procedure

Took 0.2 ml plasma in a glass centrifuge tube. Added five ml trichloroacetic acid drop by drop. Centrifuged at 3000 rpm for five minutes and decanted the supernatant. Then added one ml digestion mixture and carried out the digestion in hot air oven at 150°C till the contents were clear. Cooled, added one ml water and boiled for a minute to convert pyrophosphate to orthophosphate. Then added one ml sodium acetate, 7.8 ml water, one ml ammonium molybdate and one ml metol solution. Mixed well and allowed to stand for 15 minutes and read the O.D. at 700 nm against a reagent blank. For standard curve, one to five ml working standard solution was taken in different tubes, it was evaporated to dryness and

treated in similar manner as for sample. An O.D. of 0.75 corresponded to 9.36 ug phosphorus.

3.3.6.7 Plasma Glucose

Plasma glucose was analysed by Ames Blood Analyzer based on GOD/POD method (Miles India Limited). In this method glucose forms red coloured complex with reagent. The intensity of red colour produced is proportional to glucose concentration (Trinder, 1969).

Reagents (supplied in kit)

- Vial 1 : Buffer/Enzymes (GOD, POD)/Chromogen
- Vial 1A : Phenol
- Standard : Glucose 100 mg/dl

Working solution

Solution 1: Contents of vial 1 were dissolved under stirring with 256 ml of distilled water. Contents of vial 1 A were added to this solution and mixed. Solution were filtered through Whatman No. 1 filter paper and stored in dark bottle.

Procedure

Following solutions were pipetted into cuvettes:

	Standard	Test
Sample	-	0.02 ml
Standard	0.02 ml	-
Solution (1)	3.00 ml	3.00 ml

Solutions were mixed by inverting the cuvettes two times. After 15 min of incubation, cuvettes were removed and inverted once. Instrument was switched to 'ON' position and cuvette containing the standard was inserted in test well and

calibrated to read 100 mg/dl. Cuvette was then replaced with test cuvettes one by one and result was read in mg/dl.

3.3.6.8 Plasma Total Protein

Plasma total protein were estimated by Miles Auto Analyzer based on biuret method (Henry & ^{Winkelman} 1974). Peptide bonds of protein form blue-violet coloured complex with cupric ion in an alkaline medium. Intensity of the colour is proportional to the number of peptide bonds.

Reagents

1 Biuret reagent

1 A surfactant

Standard: Albumin 6 g/dl. Ready for use.

Working solution

Allowed the reagents to attain the room temperature. Solution (1); Added 81.0 ml of distilled water to one bottle 1. Added the contents of one bottle 1A and mixed gently to avoid foaming and kept tightly closed.

Procedure

The samples and the working solution (1) should be brought to room temperature prior to use.

The following solutions were pipetted into cuvettes:

	Standard	Test
Standard	0.01 ml	-
Sample	-	0.01 ml
Working solution (1)	1.0 ml	1.0 ml

Mixed the contents of test tube and incubated for 20 minutes at room temperature. Aspirated the reagent blank using the aspiration switch, waited while the instrument demand for it. Waited again while the instrument was calculating which was printed out. Finally aspirated the reacted Sample No. 1 and the concentration of total protein was printed out by the instrument within five seconds. This was followed by Sample No. 2 and other samples.

3.4 STATISTICAL ANALYSIS

The data were subjected to analysis for analysis of variance and chi-square according to standard method (Chao, 1974).

RESULTS AND DISCUSSION

Teent known to have hypolipidemic effects in rats were processed, incorporated in indigenous recipes and approx. 50 g teent (fresh wt. basis) was supplemented in the diets of experimental subjects for 3 months to assess its effect on lipid profile of hyperlipidemic adults. The results obtained in the present study are discussed and presented under the following headings:

- 4.1 Information about respondents
 - 4.1.1 General information
 - 4.1.2 Complications present in respondents
 - 4.1.3 Family history of complications
 - 4.1.4 Dietary habits and nutrient intake
 - 4.1.5 Physical activities
 - 4.1.6 Personal habits
- 4.2 Organoleptic evaluation of processed teent
- 4.3 Composition of teent powder
- 4.5 Composition of diets of the experimental subjects
- 4.6 Daily nutrient intake of the experimental subjects
- 4.7 Effect of teent supplementation on:
 - 4.7.1 Plasma lipids
 - 4.7.2 Plasma glucose
 - 4.7.3 Plasma total protein

4.7.4 Total food intake

4.7.5 Frequency of defaecation

4.1 Information About Respondents

4.1.1 General Information

The information regarding age, sex, per cent obesity, occupation, education, marital status and family income is presented in Table 4.1. Sixty-four per cent of respondents were in age group of 40-50 years, 60 per cent were male and 40 per cent were female. It was found that maximum number (42%) of respondents were in category of <10 per cent obesity and minimum number were in category of above 20 per cent obesity. A majority of the respondents were graduate and above. Only two respondents were illiterate. A majority (80%) of subjects were in service and 20 per cent females were housewives. The maximum number of respondents (64%) had monthly income more than Rs.7500.

4.1.2 Complications Present in Respondents

Data regarding presence of various complications in respondents are presented in Table 4.2. It was found that hypertension, IHD, diabetes and constipation was present in 15, 3, 3 and 4 respondents, respectively. Eleven respondents had problem of hypertension along with other complications, whereas 14 respondents were free from these complications.

The data reveal that number of respondents suffering from hypertension, diabetes, hypertension + IHD and hypertension + constipation were more in 40-50 year age group whereas respondents suffering from IHD and hypertension + diabetes were more in the age group of 50-60 years.

Table 4.1. Personal variables of selected hyperlipidemic respondents

Sr. No.	Variable	Frequency (n-50)
1.	<u>Age</u> (yrs)	
	40-50	32 (64)
	50-60	18 (36)
2.	<u>Sex</u>	
	Male	30 (60)
	Female	20 (40)
3.	<u>Obesity</u> (%)	
	<10	21 (42)
	10-20	15 (30)
	Above 20	14 (28)
4.	<u>Occupation</u>	
	Service	40 (80)
	Housewife	10 (20)
5.	<u>Education</u>	
	Illiterate	02 (04)
	Middle school	08 (16)
	High school	06 (12)
	Graduate	10 (20)
	Post-Graduate	08 (16)
	Doctorate	16 (32)
6.	<u>Marital status</u>	
	Married	44 (88)
	Widowed	06 (12)
7.	<u>Family income</u> (Rs/month)	
	1500-3000	04 (08)
	3000-4500	04 (08)
	4500-6000	05 (10)
	6000-7500	05 (10)
	7500-9000	13 (26)
	Above 9000	19 (38)

Figures in parentheses indicate percentages.

Table 4.2. Complications present in respondents

Age (yrs)	Hyper-tension	IHD	Diabetes	Constipation	Hyper-tension + IHD	Hyper-tension + Diabetes	Hyper-tension + Cons-tipation	Absence of disease	Total (n=50)
40-50	10 (31.25)	1 (3.12)	2 (6.25)	2 (6.25)	2 (6.25)	1 (3.12)	3 (9.37)	11 (34.37)	32
50-60	5 (27.78)	2 (11.11)	1 (5.55)	2 (11.11)	1 (5.55)	4 (22.20)	0	3 (16.67)	18
Sex									
Male	8 (26.67)	3 (10.00)	1 (3.33)	2 (6.67)	1 (3.33)	5 (16.67)	1 (3.33)	9 (30.00)	30
Female	7 (35.00)	0	2 (10.00)	2 (10.00)	2 (10.00)	0	2 (10.00)	5 (25.00)	20
Obesity (%)									
<10	3 (15.00)	1 (5.00)	2 (10.00)	1 (5.00)	2 (10.00)	3 (15.00)	1 (5.00)	7 (35.00)	20
10-20	7 (43.75)	1 (6.25)	1 (6.25)	1 (6.25)	1 (6.25)	1 (6.25)	2 (12.50)	2 (12.50)	16
Above 20	5 (35.70)	1 (7.60)	0	2 (13.40)	0	1 (7.60)	0	5 (35.70)	14

Figures in parentheses indicate percentages.

iHD = Ischaemic Heart Disease.

It was also found that higher percentage of female respondents had problem of hypertension, diabetes, constipation and hypertension along with IHD and constipation, whereas IHD and hypertension + diabetes were not present in females (Table 4.2).

The findings show that per cent prevalence of IHD and constipation was higher with increase in per cent obesity. Association of obesity with other complications in respondents has been reported earlier too (Taneja, 1989). Keys et al. (1972) observed that obesity was associated with CHD in USA and Southern Europe. Chances of heart disease was doubled in obese persons, whereas chances of getting diabetic are three and a half times greater than non-obese subjects (Stanway, 1976).

4.1.3 Family History of Complications

Out of 15 respondents having hypertension, only 53.3 per cent had the family history of complications; parents of 20, 13, 6.7 and 13.3 per cent subjects reported problem of hypertension, obesity, IHD and hypertension along with obesity (Table 4.3).

Among respondents suffering from IHD and diabetes, two-third of subjects reported the family history of these diseases. Family history of obesity was found in only 25 and 33 per cent respondents suffering from constipation and hypertension + IHD, respectively. Among hypertension + diabetic respondents, 20 per cent had family history of hypertension and another 20 per cent had the multiple complications of

Table 4.3. Family history of complications and diseases

Complications present in respondents	Total (n-50)	Complications present in parents of respondents							Absence of tension disease + Diabetes + IHD
		Obesity	Hypertension	IHD	Diabetes	Hyper-tension + Obesity	Hyper-tension + IHD	Diabetes + IHD	
Hypertension	15	2 (13.3)	3 (20.0)	1 (6.7)	0	2 (13.3)	0	0	7 (50.0)
IHD	3	0	0	0	0	0	0	2 (66.7)	1 (33.3)
Diabetes	3	0	0	0	2 (66.7)	0	0	0	1 (33.3)
Constipation	4	1 (25.0)	0	0	0	0	0	0	3 (75.0)
Hypertension + IHD	3	1 (33.3)	0	0	0	0	0	0	2 (66.7)
Hypertension + Diabetes	5	0	1 (20.0)	0	0	0	0	0	3 (60.0)
Hypertension + Constipation	3	1 (33.3)	1 (33.3)	0	0	1 (33.3)	0	0	0
No complication	14	0	0	0	1 (7.1)	0	0	1 (7.1)	12 (85.7)

Figures in parentheses indicate percentages.
Multiple response table.

hypertension + diabetes + IHD. All the respondents suffering from hypertension + constipation had the family history either of obesity, hypertension or hypertension + obesity. Data reveal that out of 14 respondent having no complications only 14 per cent had family history of complication. On the contrary, Malhotra (1968) reported family history of heart disease in 50 per cent of heart patients.

4.1.4 Dietary Habits and Nutrient Intake

4.1.4.1 Eating habits

The respondents were divided into three groups depending upon their dietary habits viz., vegetarian, non-vegetarian and eggetarian. Out of 50 respondents surveyed, 46 per cent were vegetarian, 24 per cent non-vegetarian and 30 per cent were eggetarian. A higher per cent of subjects in the age group of 40-50 years were non-vegetarian and eggetarian. Among the respondents, 55 per cent of females and 40 per cent of males were vegetarian. Higher percentage of male had non-vegetarian habits whereas egg eating habit was same in both sexes.

With regard to per cent obesity, it was found that in category of <10 per cent obesity, 57 per cent were vegetarian, 19 per cent non-vegetarian and 24 per cent were eggetarian. With increase in per cent obesity, the percentage of respondents in vegetarian decreased and in non-vegetarian and eggetarian increased, however, differences were non-significant.

Table 4.4. Association of eating habits with age, sex and per cent obesity of respondents

	Vegetarian	Non-vegetarian	Eggetarian	Total (n-50)
<u>Age (yrs)</u>				
40-50	14 (43.75)	08 (25.00)	10 (31.25)	32 $\chi^2=0.26$
50-60	09 (50.00)	04 (22.22)	05 (27.78)	18 NS
<u>Sex</u>				
Male	12 (40.00)	09 (30.00)	09 (30.00)	30 $\chi^2=4.31$
Female	11 (55.00)	03 (15.00)	06 (30.00)	20 NS
<u>Obesity (%)</u>				
<10	12 (57.14)	04 (19.04)	05 (23.80)	21
10-20	05 (33.33)	05 (33.33)	05 (33.33)	15 $\chi^2=2.64$
Above 20	05 (35.70)	04 (28.60)	05 (35.70)	14 NS

Figures in parentheses indicate percentages.

Column 3 and 4 are merged for calculating χ^2 in case of obesity (%).

4.1.4.2 Type of visible fat consumed and complication of respondents

Majority of respondents having one or more complications used to consume either exclusively refined oil or its combination with desi ghee, hydrogenated fat or mustard oil, whereas 13.3 per cent subjects having hypertension consumed desi ghee, 13.3 per cent having hypertension and 33.3 per cent having hypertension + IHD consumed hydrogenated/desi ghee,/ 33.3 per cent subjects having IHD consumed hydrogenated fat (Table 4.5). Among diabetic subejcts, 66.7 per cent consumed refined + desi ghee and only 33.3 per cent subjects consumed combination of oil and ghee. Even in case of subjects having no complication, majority of them used to consume refined, refined + desi ghee or combination of refined and other ghee. Only 14.3 per cent consumed desi ghee alone or consumed hydrogenated + desi ghee. Data also reveal that 20 per cent of the total subjects consumed desi, hydrogenated or combination of these two.

The majority of the respondents were educated and they were aware of potential adverse effects of using hydrogenated fats. That may be the reason that majority of respondents were consuming refined oil or combination of refined and other oil or ghee. Only a few respondents who were either illiterate or due of unawareness, had habit of consuming hydrogenated fat.

4.1.4.3 Flour sieving practice

Data regarding flour sieving practice followed and complications present in respondents are presented in Table 4.6. It was observed that 52 per cent respondents were not sieving

Table 4.5. Type of visible fat consumed and complications of respondents

Type of visible fat	Complications						
	Hyper-tension	IHD	Diabetes	Cons-tipation	Hyper-tension + IHD	Hyper-tension + Diabetes + Cons-tipation	Absence of disease
Refined	3 (20.00)	1 (33.33)	0	2 (50.00)	2 (66.67)	2 (40.00)	1 (33.33) (21.43)
<u>Desi ghee</u>	2 (13.33)	0	0	0	0	0	2 (14.28)
Hydrogenated	0	1 (33.33)	0	0	0	0	0
Refined + <u>Desi ghee</u>	2 (13.33)	1 (33.33)	2 (66.67)	2 (50.00)	0	2 (40.00)	1 (33.33) (21.43)
Hydrogenated + <u>Desi ghee</u>	2 (13.33)	0	0	0	1 (33.33)	0	2 (14.28)
Refined + <u>Desi ghee</u> + <u>hydro-genated</u>	0	0	0	0	0	1 (20.00)	1 (7.14)
Refined + <u>Desi ghee</u> + <u>Mustard</u>	5 (33.33)	0	1 (33.33)	0	0	0	3 (21.43)
Refined + <u>Mustard</u>	1 (6.67)	0	0	0	0	0	1 (33.33) 0
Total	15	3	3	4	3	5	3 14

Figures in parentheses indicate percentages.

Multiple response table.

Mustard oil alone was not reported to be used by respondents.

the flour whereas 48 per cent of respondents were using flour after sieving. Data also indicate that among subjects having IHD, diabetes, constipation or having no complications, 66, 100, 75 and 64 per cent, respectively use flour, as such. Smith et al. (1980) had reported that wheat bran supplements were effective in preventing constipation in elderly subjects. Coarse bran is more effective in reducing transit time and increasing stool weight than fine bran (Brodribb and Groves, 1978; Smith et al., 1981). Similarly, Brown and Karmally (1985) had reported the beneficial effect of including a high fibre diet and decline in mortality from CHD in US.

On the contrary, more than 60 per cent respondents suffering from either hypertension or hypertension + IHD, hypertension + diabetes, hypertension + constipation follow practice of sieving flour. This showed that subjects with these complications were consuming flour and avoiding the bran. It may be that these subjects were not aware of importance of wheat fibre in their diet and they may be following this tradition of sieving flour. Wheat bran has been known to contribute to a proper functioning of bowel (Smith et al., 1980) and tended to lower the serum cholesterol in hyperlipidemic human subjects (Cara et al., 1992). On the other hand, consumption of low fibre foods has been known to play an important role in the etiology of diabetes (Cleave and Campbell, 1966; Trowel, 1974, 1975).

Table 4.6. Flour sieving practices followed and complications present in respondents

Complications	n-50	Flour sieving practice	
		Followed	Not followed
Hypertension	15	10	5
IHD	3	1	2
Diabetes	3	0	3
Constipation	4	1	3
Hypertension + IHD	3	2	1
Hypertension + Diabetes	5	3	2
Hypertension + constipation	3	2	1
None of the disease	14	5	9
Total		24	26

4.1.4.4 Fasting practices

A majority of respondents did not have habit of keeping fast and in total only 36 per cent respondents kept fast (Table 4.7). Among them, 56 per cent were observing fast once a week, 16 per cent twice a week and 28 per cent occasionally. No difference was observed in habit of fast keeping with regard to age and sex. Frequency of observing fast was more prevalent among the group with less than 10 and more than 20 per cent obesity as compared to those in the category 10-20 per cent obesity.

Fast keeping/^{habit}among respondents in less than 10 per cent obesity group may be because of their beliefs regarding loss of weight and restriction of diets. Whereas fast keeping habit among more than 20 per cent obesity group may be for restriction of diet to control their weight and they may be aware of health risk and obesity. Besides, a few respondents were observing fast in order to maintain socio-religious traditions and other cultural beliefs.

4.1.4.5 Nutrient intake

Protein intake of male (n=30) and female (n=20) respondents varied from 41.20 to 76.77 g and 43.92 - 85.62 g/d, respectively. The daily protein intake on an average was 62.80 g by male and 53.79 g by female respondents (Table 4.8). The mean intake of protein by respondents was at par with the RDA's (ICMR, 1989).

Table 4.7. Frequency of fast keeping with regard to age, sex and per cent obesity in respondents

	<u>Frequency of subjects observing fast</u>			Non-	Total
	Once/ week	Twice/ week	Occasio- nally	fasting subjects	(n-50)
<u>Age (yrs)</u>					
40-50	5 (15.6)	1 (3.1)	4 (12.5)	22 (68.7)	32
50-60	5 (27.8)	2 (11.1)	1 (5.5)	10 (55.6)	18
<u>Sex</u>					
Male	7 (23.3)	1 (3.3)	2 (6.7)	20 (66.7)	30
Female	3 (15.0)	2 (10.0)	3 (15.0)	12 (60.0)	20
<u>Obesity (%)</u>					
<10	5 (23.8)	1 (4.8)	1 (4.8)	14 (66.7)	21
10-20	2 (13.3)	0	0	13 (86.7)	15
Above 20	6 (42.9)	2 (14.3)	1 (7.1)	05 (35.7)	14

Figures in parentheses indicate percentages.

Table 4.8 Mean daily nutrient intake of respondents

Nutrient	Male (n-30)	Female (n-20)
Protein (g/day)	62.80 $\pm$ 13.12	53.79 $\pm$ 12.25
Fat (g/day)	81.21 $\pm$ 13.28	72.01 $\pm$ 15.12
Crude fibre (g/day)	9.86 $\pm$ 1.87	9.30 $\pm$ 1.91
Energy (Kcal/day)	2261 $\pm$ 195.17	2179 $\pm$ 179.23

Values are $\pm$ SE of replicates

The daily fat intake of male respondents was 81.21 ± 13.28 and of female respondents 72.01 ± 15.12 g (Table 4.8). The intake of fat by respondents was quite high than the RDA's (ICMR, 1989).

The daily intake of energy of male and female respondents varied from 1820-2344 Kcal and 1860-2526 Kcal with an average intake of 2262 and 2179 Kcal, respectively (Table 4.8). On an average the energy intake of female respondents was quite high than the RDA's for sedentary female, whereas energy intake of male respondents was at par with the RDA's men sedentary worker (ICMR, 1989). Daily intake of crude fibre was 9.86 ± 1.87 g and 9.30 ± 1.91 g by male and female respondents, on an average, respectively.

Data in the table reveal that intake of these nutrients was higher in males than female respondents. It was observed that intake of energy and protein by few respondents was higher than RDA's whereas it was lower than RDA by other respondents, however, fat intake was quite high among all the respondents. The extra intake of nutrient may be one of the reason for extra weight. Sclafani et al. (1980) observed that laboratory animals gained 26.9 per cent more weight than control when they were fed different super market diets which consisted of high nutrient level.

4.1.5 Physical Activities

4.1.5.1 Type of activity

The respondents were categorised into three groups on the basis of type of occupation : Sedentary group, slightly

moderate group and moderately active group. The sedentary group included subjects with desk and supervision type of job. Subjects with desk + supervision and desk + touring type of job were included in slightly moderate group and moderately active group included housewife and subjects with touring and supervision + touring type of job.

Out of 50 respondents surveyed, 50 per cent of the respondents were involved in sedentary type of work, 16 per cent in slightly moderate type of work and 34 per cent were moderately active (Table 4.9).

No significant association ($\chi^2=1.30$) was found between age and type of activity. However, significant difference in type of activity among male and female was observed. Majority (60%) of male respondents were sedentary workers whereas majority (60%) of female respondents were moderately active. A significant statistical association between sex and type of activity reveals that most of male respondents were involved in desk and supervision whereas majority of females were housewives.

A significant association between type of activity and per cent obesity existed ($\chi^2=14.15$). It was found that with increase in per cent obesity from less than 10 to 10-20 per cent and more than 20 per cent, the number of respondents involved in sedentary work increased significantly, whereas number of respondents involved in slightly moderate work decreased significantly. Number of respondents involved in moderate work decreased significantly with increase in obesity

Table 4.9. Association of type of activity with age, sex and per cent obesity of respondents

	Sedentary work	Slightly moderate work	Moderate work	Total (n-50)
<u>Age (yrs)</u>				
40-50	17 (53.1)	3 (9.4)	12 (37.5)	32 $\chi^2=1.30^{NS}$
50-60	8 (44.4)	5 (27.8)	5 (27.8)	18
<u>Sex</u>				
Male	18 (60.0)	7 (23.3)	5 (16.7)	30 $\chi^2=10.58^{**}$
Female	7 (35.0)	1 (5.0)	12 (60.0)	20
<u>Obesity (%)</u>				
<10	8 (38.1)	5 (23.8)	8 (38.1)	21
10-20	10 (66.7)	2 (13.3)	3 (20.0)	15 $\chi^2=14.15^{**}$
Above 20	7 (50.0)	1 (7.1)	6 (42.9)	14

Figures in parentheses indicate percentages.

Sedentary work includes (i) Desk, (ii) Supervision.

Slightly moderate work include (i) Desk + Supervision, (ii) Desk + Touring.

Moderate work include (i) House wife, (ii) Touring, (iii) Supervision + Touring.

Column 3 and 4 are merged together for calculating chi-square in case of per cent obesity.

χ^2 tabulated at d.f. = 2 at 0.01 level of significance = 9.21.

NS = Non-significant.

from less than 10 to 10-20 per cent whereas it increased with further increase in per cent obesity.

The increased ^{body}/weight of respondents may be because of sedentary type of activity. Brodis and Arora (1974) observed sedentary type of living in obese subjects. Thompson (1982) also found that obese persons were generally less active than their lean counterparts. US Department of Health and Human Services (1980) reported that in United States, 14 per cent of women between the ages 20 and 74 were obese and it was due to reduction of physical activity.

4.1.5.2 Type of activity and complications of respondents

With regard to association of type of activity with complications present in respondents, it was observed that majority of respondents having complications (hypertension, IHD, constipation or multiple complication) were involved in sedentary work. However, association was not found in case of respondents either suffering from diabetes or having no complication (Table 4.10).

Maximum number of subjects having various complications were doing sedentary work. A reduction in physical work is a prime candidate in the causation of constipation (Stephen, 1985). Subjects who were more energetic, they had less problem of constipation (Tucker et al., 1981). Chinese who had lower work history and physical indices has been reported to be overweight (Bassett and Schroffner, 1970).

4.1.5.3 Exercise habit

Data in Tabel 4.11 indicate that 60 per cent respondents

Table 4.10. Association of type of activity with complications present in respondents

Complications	Total (n=50)	Sedentary work	Slightly moderate work	Moderate work
Hypertension	15	10 (66.7)	1 (6.6)	4 (26.7)
IHD	3	2 (66.7)	1 (33.3)	0
Diabetes	3	1 (33.3)	0	2 (66.7)
Constipation	4	3 (75.0)	1 (25.0)	0
Hypertension + IHD	3	2 (66.7)	0	1 (33.3)
Hypertension + Diabetes	5	2 (40.0)	2 (40.0)	1 (20.0)
Hypertension + Constipation	3	2 (66.7)	0	1 (33.3)
None of the above	14	3 (21.4)	3 (21.4)	8 (57.2)

Figures in parentheses indicate percentages.

Table 4.11. Frequency of physical exercise by respondents

	Frequency of subjects doing exercise*		Subjects not doing exercise	Total (n=50)
	Daily	Occasio- nally		
<u>Age (yrs)</u>				
40-50	8 (25.0)	1 (3.1)	23 (71.9)	32
50-60	10 (55.5)	1 (5.5)	7 (38.9)	18
<u>Sex</u>				
Male	15 (50.0)	2 (6.7)	13 (43.3)	30
Female	3 (15.0)	0	17 (85.0)	20
<u>Obesity (%)</u>				
<10	9 (42.8)	2 (9.5)	10 (47.6)	21
10-20	2 (13.3)	1 (6.7)	12 (80.0)	15
Above 20	6 (42.9)	0	8 (57.1)	14

Figures in parentheses indicate percentages.

*all reported walking as exercise.

were not doing exercise. Walking was the mode of exercise practised by 40 per cent of respondents. None reported yoga, skipping or jogging. Majority of respondents were regular and had the habit of going to walk daily.

With regard to age, it was found that percentage of respondents practising daily walk was higher (55%) in 50-60 yrs age group as compared to 40-50 yrs age group. Among male and females, 50 per cent of male respondents were involved in daily walking, whereas only 15 per cent female respondents reported daily walking as routine exercise. None of the female and only 7 per cent of the male reported walking as exercise occasionally. Majority of females were housewives, do not get time for exercise. Whereas majority of males were doing desk work, so they were doing exercise regularly. Data in the table also indicate that with increase in per cent obesity from less than 10 to 10-20 and more than 20 per cent obesity, percentage of respondents not doing exercise increased from 48 to 80 and 57 per cent, respectively.

Exercise has been reported to be beneficial for maintaining body weight (Stern, 1983). It is well known that exercise can influence food intake. Lim et al. (1983) observed that exercise directly influence the obesity.

4.1.6 Personal Habits

4.1.6.1 Smoking habits and occurrence of disease

It was found that majority of subjects (76%) were non-smokers and only 12, 6 and 6 per cent had the habit of smoking

0-10, 10-20, 20-30 cigarettes daily, respectively (Appendix-V). Female respondents did not have habit of smoking.

4.1.6.2 Alcohol intake and occurrence of disease

Majority of respondents were not having the habit of consuming alcohol and those reported to consume alcohol daily, once in 15 days, once in a month and occasionally were 4, 2, 6 and 10 per cent, respectively (Appendix-VI). Female respondents did not have habit of consuming alcohol.

4.1.6.3 Frequency of defaecation

Data in Table 4.12 reveal that majority (70%) of respondents had habit of defaecating once in 24 hours and only 18 per cent had habit of defaecating twice in 24 hours. Only 4 and 8 per cent of respondents reported habit of defaecation more than twice in 24 hours and once in 48 hours, respectively.

4.1.6.4 Sleeping habits

The sleeping habits of respondents with regard to age, sex and per cent obesity is presented in Appendix-VII. No significant association has been found in sleeping habit with age, sex and per cent obesity.

4.1.6.5 Mode of transport used

Mode of transport used by majority of the respondents was car and scooter. Only 10 per cent respondents were using cycle. Among the respondents who did not have any mode of transport, 4 per cent used rickshaw and 10 per cent did not use any mode of transport (Appendix-VIII).

Table 4.12. Defaecation habit of respondents with regard to age, sex and per cent obesity

	Frequency of defaecation				Total (n-50)
	Above 2/24 hr	2/24 hr	1/24 hr	1/48 hr	
<u>Age (yrs)</u>					
40-50	2 (6.2)	7 (21.9)	30 (62.5)	3 (9.4)	32
50-60	0	2 (11.1)	15 (83.3)	1 (5.6)	18
<u>Sex</u>					
Male	1 (3.3)	8 (26.7)	20 (66.7)	1 (3.3)	30
Female	1 (5.0)	1 (5.0)	15 (75.0)	3 (15.0)	20
<u>Obesity (%)</u>					
<10	0	5 (23.8)	15 (71.4)	1 (4.7)	21
10-20	1 (6.7)	2 (13.3)	10 (66.7)	2 (13.3)	15
Above 20	1 (7.1)	2 (14.3)	10 (71.4)	1 (7.1)	14

Figures in parentheses indicate percentages.

4.1.6.6 Frequency of consuming medicine

Majority (62%) of respondents with some complications or no complications were not consuming any medicine regularly, whereas 38 per cent of the respondents suffering from hypertension, IHD, diabetes, constipation or multiple complications were consuming medicine regularly (Appendix-IX) on prescription of doctors.

4.1.6.7 Frequency of consuming tonic

Sixty-six per cent of the respondents with some complications or no complications were not consuming tonic (Appendix-X). Those who were having complications were taking tonic on advice of doctor.

4.2 Organoleptic Evaluation of Processed Teent

Mean scores for organoleptic evaluation of teent (whole and coarsely ground) processed with 5 per cent sodium chloride 1 per cent acetic acid and 1 per cent lactic acid are presented in Table 4.13 reveal that different treatments had no effect on the colour as well as appearance of teent and these characteristics were found to be 'moderately desirable'. Scores for aroma and taste were significantly higher in teent treated with sodium chloride than that of lactic acid and acetic acid. However, no significant differences were found in the aroma of whole and ground teent processed differently, whereas, taste improved significantly when coarsely ground teent was processed. Similarly, the overall acceptability of coarsely ground was better than whole teent processed with different

Table 4.13. Organoleptic evaluation* of teent processed with sodium chloride, lactic acid and acetic acid

Treatment	Colour	Appearance	Aroma	Taste	Overall** acceptability
Sodium chloride (5%)					
Whole	7.2 $\pm$ 0.42	7.8 $\pm$ 0.42	6.8 $\pm$ 0.83	5.9 $\pm$ 1.90	6.9 $\pm$ 0.59
Ground	7.2 $\pm$ 0.42	7.6 $\pm$ 0.48	7.8 $\pm$ 0.83	7.2 $\pm$ 0.33	7.4 $\pm$ 0.33
Lactic acid (1%)					
Whole	7.2 $\pm$ 0.43	7.7 $\pm$ 0.47	6.3 $\pm$ 0.67	4.9 $\pm$ 1.40	6.5 $\pm$ 0.46
Ground	7.2 $\pm$ 0.41	7.5 $\pm$ 0.50	6.3 $\pm$ 0.67	5.2 $\pm$ 1.30	6.6 $\pm$ 0.38
Acetic acid (1%)					
Whole	7.2 $\pm$ 0.42	7.5 $\pm$ 0.50	6.4 $\pm$ 0.83	5.9 $\pm$ 1.20	6.7 $\pm$ 0.45
Ground	7.1 $\pm$ 0.31	7.4 $\pm$ 0.51	6.3 $\pm$ 0.84	6.2 $\pm$ 1.10	6.8 $\pm$ 0.33
SE(m)	0.056	0.067	0.20	0.073	0.13
CD (P<0.05)	NS	NS	NS	NS	NS

Values are Mean $\pm$ SE of ten replicates.

*A 9-point Hedonic scale was employed.

**Means of all these characteristics represent overall acceptability.

treatments.. The score for overall acceptability was the highest in case of ground teent processed with sodium chloride.

4.3 Composition of Teent Powder

Teent powder contained 15.10, 8.02, 5.26 and 13.16 g protein, fat, ash, crude fibre per 100 g, respectively (Table 4.14). The amount of ADF and NDF present in teent powder were 15.29 ± 0.50 and 28.67 ± 0.47 g/100 g, respectively. Hemicellulose, cellulose, lignin and pectin contents in the teent powder were 13.06, 16.23, 9.42 and 4.12 g/100 g, respectively (Table 4.15). No significant differences were found in the fibre components of teent powder prepared with whole or ground teent processed with NaCl (Appendix-IV).

4.4 Organoleptic Evaluation of Products Supplemented with Teent

Data regarding mean scores for different products prepared with supplementation of teent are presented in Table 4.16. Biscuit A contained 10 g teent powder and biscuit B contained 5 g teent powder per supplement. It was found that increase in supplementation of teent powder adversely affected all the characteristics of organoleptic evaluation. Scores for colour, appearance, aroma, texture and taste were higher for biscuit B than that of biscuit A.

In other products, panjiri, chapti, pakoda and sev, 5 g teent powder was incorporated in daily supplement. Mean scores for colour, appearance, aroma and texture of panjiri, and chapati were 'moderately desirable' and of pakoda and sev were 'less desirable'. However, except pakoda, taste of panjiri,

Table 4.14. Macronutrients present in teent powder

Macronutrients	g/100 g (DM basis)
Moisture	86.00 $\pm$ 0.12
Protein	15.10 $\pm$ 0.07
Fat	8.02 $\pm$ 0.09
Ash	5.26 $\pm$ 0.30
Carbohydrate	58.46 $\pm$ 0.41
Crude fibre	13.16 $\pm$ 0.34

Table 4.15. Different components of total dietary fibre present in teent powder

Component	g/100 g (DM basis)
ADF	15.29 $\pm$ 0.50
NDF	28.67 $\pm$ 0.47
Hemicellulose	13.06 $\pm$ 0.36
Cellulose	16.28 $\pm$ 0.26
Lignin	9.42 $\pm$ 0.48
Pectin	4.12 $\pm$ 0.16

Table 4.16. Organoleptic evaluation* of products supplemented with teent

Product	Colour	Appearance	Aroma	Texture	Taste	Overall** acceptability
Biscuit (A)	6.5+0.92	5.9+0.86	6.8+0.56	6.4+0.56	5.8+1.10	6.3+0.58
(B)	6.9+0.83	6.9+0.83	7.5+0.50	7.4+0.59	7.5+0.63	7.3+0.50
<u>Panjiri</u>	7.5+0.50	7.5+0.50	7.8+0.42	7.2+0.42	7.5+0.55	7.5+0.30
<u>Chapati</u>	7.8+0.42	7.2+0.63	7.5+0.69	7.7+0.71	7.4+0.83	7.5+0.52
<u>Pakoda</u>	6.5+0.69	7.0+0.82	6.5+0.69	7.0+0.82	6.0+0.47	6.6+0.27
<u>Chutney</u>	8.1+0.57	7.9+0.74	8.5+0.50	7.4+0.79	8.5+0.50	8.1+0.36
<u>Sev</u>	6.4+0.51	6.9+0.74	7.1+0.87	6.9+0.74	7.3+0.64	6.9+0.74

Values are Mean + SE of ten replicates.

*A 9-Point Hedonic Scale was employed.

**Means of all these characteristics represent overall acceptability.

A - 10 g teent powder was incorporated in a day supplement.

B - 5 g teent powder was incorporated in a day supplement.

chapati and sev were 'moderately desirable'. Data suggest that 5 g teent powder can be incorporated very well in biscuit, panjiri and chapati and to some extent in sev and pakoda.

Teent chutney was also prepared after processing the coarsely ground teent with sodium chloride. Except texture, other organoleptic characteristics of teent chutney were highest and these characteristics were 'desirable'. Texture of chutney was 'moderately desirable'. Overall acceptability of these products indicate that chutney was 'desirable'. Panjiri chapati and biscuit prepared from 5 g teent powder were 'moderately desirable' whereas sev, pakoda and biscuit prepared from 10 g teent powder were 'slightly desirable'.

4.5 Composition of the Diets of the Experimental Subjects

On an average, the diet of experimental subjects contained 13.49 g, 13.35 g, 1.94 g, 4.25 g, 66.99g and 441.69 Kcal per 100 g (DM basis) of protein, fat, crude fibre, ash, carbohydrate and energy, respectively (Table 4.17). There were no significant differences in the content of these nutrients per 100 g of diet among vegetarian, non-vegetarian and eggetarian groups.

The amoutns of ADF and NDF contents in the diets were 3.28 and 5.19 g/100 g, respectively. Hemicellulose, cellulose, lignin and pectin contents in diets were 2.48, 2.05, 1.45 and 0.62 g/100 g, respectively (Table 4.18). No significant differences were observed in fibre contents among the three groups.

Table 4.17. Composition of diets consumed by subjects (g/100 g, on dry matter basis)

	Protein	Fat	Crude fibre	Ash	Carbohydrate	Energy
<u>Veg</u>						
1	13.19	14.44	1.62	3.39	67.66	453.36
2	14.48	11.21	1.91	3.21	69.19	435.57
3	13.14	12.02	1.94	5.78	67.12	429.22
4	13.19	14.60	2.38	3.73	66.10	448.56
5	14.04	14.07	2.59	3.60	65.70	445.79
Mean	13.61±0.20	13.27±1.38	2.09±0.10	3.94±0.25	67.15±1.23	442.5±8.83
<u>Non-Veg</u>						
1	12.14	11.31	1.64	4.66	70.25	431.35
2	12.83	10.79	1.51	3.76	71.11	432.87
3	12.67	15.03	2.18	5.29	64.83	445.27
4	13.24	11.23	1.89	4.40	69.24	430.99
5	13.82	13.98	1.68	3.42	67.10	449.50
Mean	12.94±0.19	12.47±1.70	1.78±0.06	4.31±0.18	68.51±1.99	437.99±7.81
<u>Egg</u>						
1	15.03	14.32	2.07	4.62	63.96	444.84
2	13.47	14.96	1.86	2.89	66.82	455.80
3	13.46	16.03	1.90	4.71	63.90	451.11
4	12.81	13.56	2.13	5.42	66.08	437.60
5	14.91	12.61	1.71	4.92	65.87	436.60
Mean	13.94±0.24	14.30±1.17	1.93±0.04	4.51±0.23	65.33±1.18	445.19±7.47
Overall mean	13.49±0.77	13.35±1.62	1.93±0.29	4.25±0.86	66.99±2.10	441.89±8.59
SE(m)	0.48	0.41	0.07	0.24	0.49	2.36
CD (P<0.01)	NS	NS	NS	NS	NS	NS
NS = Non-significant.						

Table 4.18. Composition of diet consumed by subjects (9/100 g)

	ADF	NDF	Hemi-cellulose	Cellulose	Lignin	Pectin
<u>Veg</u>						
1	4.58	6.43	2.47	1.91	1.49	0.54
2	3.91	5.74	2.38	1.89	1.54	0.63
3	2.98	4.68	2.25	2.18	1.66	0.67
4	3.14	5.59	3.07	2.04	1.66	0.77
5	3.47	5.74	2.90	2.18	1.47	0.81
Mean	3.62±0.55	5.64±0.54	2.61±0.29	2.04±0.18	1.56±0.08	0.68±0.05
<u>Non-Veg</u>						
1	2.67	4.52	2.35	1.89	1.30	0.58
2	3.55	5.33	2.33	2.16	1.47	0.63
3	3.42	5.72	2.89	2.16	1.58	0.74
4	3.22	4.69	1.94	2.18	1.09	0.46
5	2.84	4.44	2.15	2.01	1.27	0.54
Mean	3.14±0.33	4.94±0.47	2.34±0.28	2.08±0.09	1.34±0.14	0.59±0.09
<u>Egg</u>						
1	3.44	5.37	2.45	1.83	1.42	0.50
2	4.03	5.70	2.26	2.22	1.44	0.59
3	2.80	4.84	2.69	2.09	1.64	0.54
4	2.73	4.74	2.58	2.07	1.44	0.71
5	2.36	4.29	2.52	1.89	1.55	0.62
Mean	3.07±0.60	4.99±0.50	2.50±0.13	2.02±0.12	1.49±0.03	0.59±0.07
Overall mean	3.28±0.56	5.19±0.59	2.48±0.26	2.05±0.68	1.45±0.13	0.62±0.13
SE(m)	0.24		0.07	0.11	0.03	0.11
CD (P<0.01)	NS	0.15 NS	NS	NS	NS	NS
NS = Non-significant.						

4.6 Daily Nutrient Intake

The mean daily intake of total protein, fat, crude fibre, ash, carbohydrate and energy by subjects were 67.80 g, 66.52 g, 9.63 g, 21.38 g, 336.57 g, and 2214 Kcal respectively. There were no significant difference in the daily intake of these nutrients among three groups (Vegetarian/Non-Vegetarian/Eggetarian). The per day intake of protein and energy (for sedentary worker) was at par with the RDA (ICMR, 1989) whereas fat intake was quite high (Table 4.19).

Average daily intake of ADF, NDF, hemicellulose, cellulose, lignin and pectin by the subjects were 16.39 g, 25.91 g, 12.36 g, 10.12 g, 7.31 g and 3.17 g, respectively (Table 4.20). No significant differences were found in daily intake of different components of dietary fibre of vegetarian, non-vegetarian and eggetarian.

4.7 Effect of Teent Supplementation On:

4.7.1 Plasma Lipids

4.7.1.1 Plasma total cholesterol

The initial fasting plasma cholesterol concentration ranged from 183 to 271 mg/100 ml with an average concentration of 235.2 ± 21.85 mg/100 ml. Plasma total cholesterol concentration of the subjects was on the higher side of normal range of 120 to 260 mg/100 ml (Swaminathan, 1974). No significant differences in plasma total cholesterol concentration of vegetarian non-vegetarian and eggetarian were found. Teent supplementation in the diets of the subjects resulted in significant decrease

Tanle 4.19. Daily nutrient intake by subjects

	Protein (g)	Fat (g)	Crude fibre (g)	Ash (g)	Carbohydrate (g)	Energy (Kcal)
<u>Veg</u>						
1	60.67	66.44	7.47	15.59	311.30	2085.59
2	74.75	57.89	9.84	16.59	357.80	2248.50
3	65.16	61.16	9.85	29.42	341.50	2183.83
4	61.19	67.74	11.06	17.31	306.71	2081.36
5	63.14	63.37	11.68	16.23	295.89	2007.70
Mean	64.98±5.19	63.32±3.56	9.98±0.40	19.03±1.42	322.64±23.19	2121.40±84.69
<u>Non-Veg</u>						
1	68.18	63.52	9.23	26.15	394.52	2422.46
2	66.67	56.06	7.83	19.53	369.44	2248.93
3	60.99	72.35	10.49	25.45	312.06	2143.35
4	78.97	66.98	11.27	26.26	413.01	2570.84
5	71.99	72.80	8.75	17.81	349.44	2340.91
Mean	69.36±6.96	66.34±6.19	9.51±0.34	23.04±1.02	367.69±35.23	2345.30±146.22
<u>Egg</u>						
1	82.68	78.77	11.36	25.40	351.75	2446.44
2	64.41	71.19	8.51	13.74	317.95	2168.83
3	58.96	70.18	8.31	20.62	279.93	1976.18
4	63.12	67.79	10.51	26.68	325.52	2155.70
5	72.83	61.60	8.35	23.94	321.81	2133.06
Mean	69.06±6.97	69.91±5.54	9.41±0.36	22.08±1.26	319.39±23.02	2176.04±151.90
Overall mean	67.80±6.92	66.52±5.87	9.63±1.32	21.38±4.85	336.57±35.43	2214.24±162.16
SE(m)	1.09	1.50	0.38	1.31	8.04	37.86
CD (P<0.01)	NS	NS	NS	NS	NS	NS
NS = Non-significant.						

Table 4.20. Daily intake of different components of dietary fibre by subjects

	ADF	NDF	Hemicellulose	Cellulose	Lignin	Pectin
<u>Veg</u>						
1	21.06	29.59	11.37	8.79	6.84	2.51
2	20.21	29.65	12.28	9.78	7.93	3.27
3	15.16	23.82	11.47	11.10	8.46	3.39
4	14.58	25.97	14.23	9.49	7.72	3.59
5	15.64	25.87	13.07	9.84	6.61	3.65
Mean	17.33+2.73	26.98+2.29	12.48+1.07	9.80+0.75	7.50+0.69	3.28+0.14
<u>Non-Veg</u>						
1	15.02	25.38	13.20	10.67	7.31	3.26
2	18.45	27.69	12.09	11.22	7.65	3.29
3	16.45	27.55	13.94	10.41	7.59	3.55
4	19.22	27.97	11.59	10.85	6.49	2.75
5	14.78	23.12	11.18	10.46	6.63	2.82
Mean	16.78+1.79	26.34+1.86	12.40+1.02	10.72+0.79	7.13+0.48	3.13+0.35
<u>Egg</u>						
1	18.90	29.53	13.47	10.06	7.81	2.77
2	19.20	27.13	10.76	10.57	6.86	2.85
3	12.27	21.21	11.78	9.17	7.19	2.52
4	13.46	23.35	12.73	10.20	7.08	3.51
5	11.52	20.49	12.31	9.26	7.57	3.05
Mean	15.07+3.31	24.42+3.37	12.21+0.91	9.85+0.55	7.30+0.34	2.94+0.33
Overall mean	16.39+12.85	25.91+2.80	12.36+1.01	10.12+0.70	7.31+0.55	3.17+0.52
SE(m)	0.77	0.75	0.88	0.17	0.16	0.11
CD (P<0.01)	NS	NS	NS	NS	NS	NS
NS = Non-significant.						

($P < 0.01$) in total cholesterol concentration and the decrease varied from 5.60 to 26.19 per cent (Table 4.21).

Jain (1988) also reported decrease in the concentration of serum total cholesterol and increase in the excretion of cholesterol in the faeces by feeding teent. Similarly, decrease in serum cholesterol levels were observed with inclusion of 10 per cent fibre from different plant foods, dietary fibre from teent was found to have most pronounced hypocholesterolemic effects in rats (Agarwal and Chauhan, 1988). The increased excretion of cholesterol and bile in faeces has been reported to lower serum cholesterol. Decrease in serum cholesterol by oat bran (Anderson et al., 1984), guar gum and isabgol husk (Taneja and Kapoor, 1989) and pulses and cereals (Uberoi et al., 1992) has also been reported.

Dietary fibre may affect serum cholesterol by reducing cholesterol and bile acid absorption, by altering the metabolism and ratio of bile acids absorbed, by changing the intestinal secretion and hepatic production of lipoproteins and by modifying the peripheral disposal of lipoproteins (Chen and Anderson, 1986). According to Chang (1983), gel-forming properties of some soluble dietary fibres maintain a more acidic pH of the chyme which resulting in increase in cholesterol ester formation. Since cholesterol esters are not directly absorbed from the mucosal cells; which may explain the cholesterol lowering effect.

Table 4.21. Effect of teent supplementation on level of plasma total cholesterol (mg/100 ml)

	Initial level	Final level	% decrease
<u>Vegetarian</u>			
1	218	201	7.80
2	252	186	26.19
3	247	218	11.74
4	236	195	17.37
5	233	220	5.60
Mean	237.2 $\pm$ 11.86	204.0 $\pm$ 13.46	13.40
<u>Non-Vegetarian</u>			
1	246	227	7.72
2	226	170	24.78
3	224	183	18.30
4	183	159	13.11
5	221	189	14.48
Mean	220.0 $\pm$ 20.48	185.6 $\pm$ 23.16	15.68
<u>Egg</u>			
1	255	223	12.55
2	236	193	18.22
3	271	234	13.65
4	269	251	6.69
5	216	191	11.60
Mean	242.4 $\pm$ 28.62	218.4 $\pm$ 23.34	12.50
Overall mean	235.2 $\pm$ 21.85	202.67 $\pm$ 24.46	13.97
't' calculated 8.56** d.f. = 14			
't' tabulated at 0.01 level of significance = 2.98			
SE(m)	5.26	13.66	
CD(P<0.01)	NS	NS	

Normal value 120-240 mg/100 ml.

NS = Non-significant.

4.7.1.2 Plasma High Density Lipoprotein (HDL) cholesterol

At the start of experiment, fasting plasma HDL-cholesterol concentration of experimental subjects ranged from 34.7 to 51.1 mg/100 ml with an average concentration of 43.86 mg/100 ml. The normal range of HDL-cholesterol is from 30 to 70 mg/100 ml (Tarbuttor & Gunter, 1974). After feeding teent for three months, the concentration of HDL-choelsterol ranged from 33.4 to 50.5 mg/100 ml with an average concentration of 43.33 mg/100 ml. Non-significant differences were observed in HDL-cholesterol concentration of vegetarian, non-vegetarian and eggetarian group (Table 4.22).

Similarly, no significant change in HDL-cholesterol has been reported with oat bran (Kirby, 1981), guar gum and isabgol husk (Taneja and Kapoor, 1989) and wheat and oat bran (Anderson et al., 1991).

HDL-cholesterol is considered to have antiatherogenic properties, since there is negative correlation between HDL-cholesterol and risk of cardiovascular disease (Eder and Gidez, 1982). Low HDL-cholesterol concentrations are found with high frequency in patients with infarction (Vergani et al., 1978; Avogaro et al., 1975), while high HDL-cholesterol concentration are associated with longevity and reduced risk of coronary artery disease (Assmann et al., 1980).

4.7.1.3 Plasma Low Density Lipoprotein (LDL) cholesterol

The initial plasma concentration of LDL-cholesterol of subjects ranged from 124.2 to 197.2 mg/100 ml with an average concentration of 171.71 ± 18.32 mg/100 ml (Table 4.23). There

Table 4.22. Effect of teent supplementation on level of plasma HDL-cholesterol (mg/100 ml)

	Initial level	Final level	% change
<u>Veg</u>			
1	45.5	43.1	5.30
2	51.1	50.5	1.20
3	48.3	49.1	-1.60
4	34.7	33.4	3.70
5	39.2	38.5	1.80
Mean	43.76 $\pm$ 6.01	42.92 $\pm$ 6.41	2.24
<u>Non-Veg</u>			
1	44.5	43.9	1.30
2	41.7	43.1	-3.30
3	38.9	39.1	-0.50
4	43.5	42.7	1.80
5	45.1	43.3	4.00
Mean	42.74 $\pm$ 2.24	42.42 $\pm$ 2.90	0.66
<u>Egg</u>			
1	49.3	47.1	4.50
2	39.7	40.1	-1.00
3	49.1	48.3	1.60
4	50.0	49.6	0.80
5	37.3	38.2	-2.40
Mean	45.08 $\pm$ 5.43	44.66 $\pm$ 4.60	0.70
Overall mean	43.86 $\pm$ 4.94	43.33 $\pm$ 4.80	1.20
't' calculated 1.83 NS			
't' tabulated at 0.01 level of significance = 2.98			
SE(m)	1.40	1.35	
CD(P<0.01)	NS	NS	

Normal value 30-70 mg/100 ml.

NS = Non-significant.

Table 4.23. Effect of teent supplementation on level of plasma LDL-cholesterol (mg/100 ml)

	Initial level	Final level	% decrease
<u>Veg</u>			
1	154.2	142.1	7.80
2	186.1	122.3	34.30
3	179.7	153.2	14.70
4	184.3	146.8	20.30
5	169.4	161.2	4.80
Mean	174.74 $\pm$ 11.70	145.12 $\pm$ 13.09	16.38
<u>Non-Veg</u>			
1	179.1	163.4	8.80
2	163.0	108.7	33.30
3	165.4	128.0	22.60
4	124.2	103.9	16.34
5	153.7	127.4	17.10
Mean	157.08 $\pm$ 18.34	126.28 $\pm$ 20.94	19.62
<u>Egg</u>			
1	187.5	161.4	13.90
2	176.9	140.4	20.60
3	194.1	160.6	17.20
4	197.2	182.9	7.20
5	160.9	137.1	14.80
Mean	183.32 $\pm$ 13.19	156.48 $\pm$ 16.37	13.30
Overall mean	171.71 $\pm$ 18.32	142.63 $\pm$ 21.21	16.43
't' calculated 7.32**			
't' tabulated at 0.01 level of significance = 2.98			
SE(m)	4.25	4.96	
CD (P<0.01)	NS	NS	

Normal value - 75-142 mg/100.

NS = Non-significant.

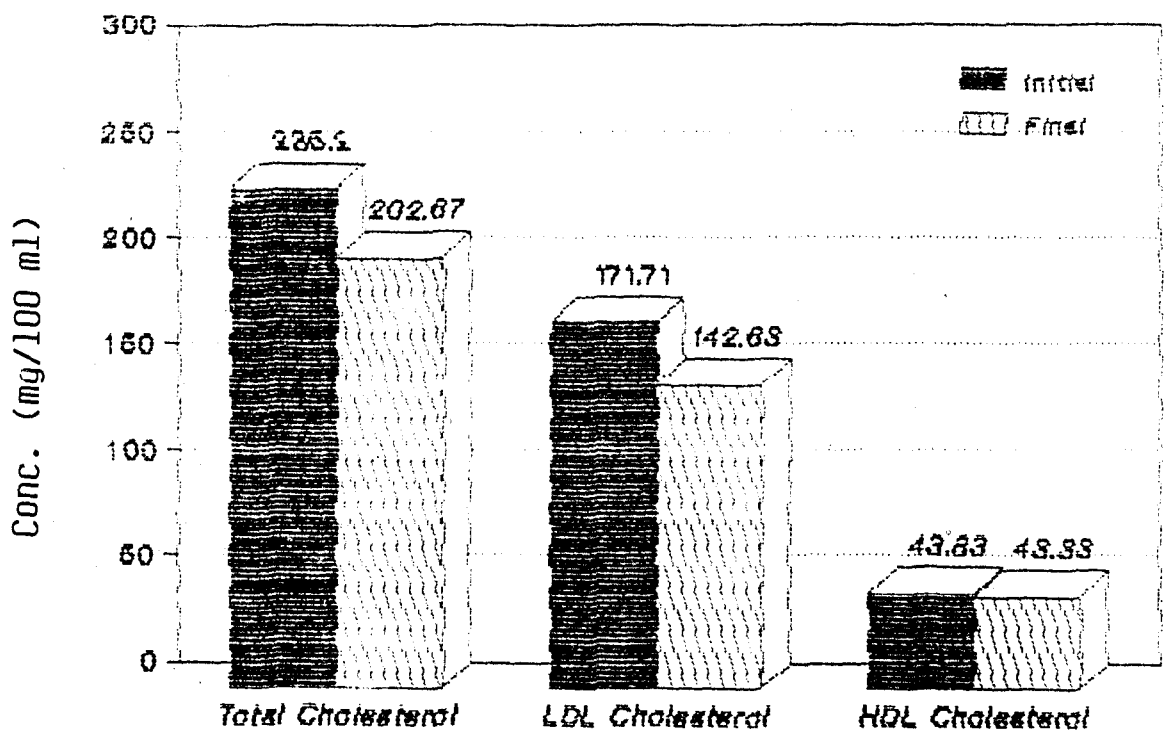


Fig. 1. Effect of teent supplementation on levels of plasma total, HDL and LDL cholesterol in subjects

were no significant differences in the concentration of LDL-cholesterol of vegetarian, non-vegetarian and eggetarian. After consumption of teent for three months, the average LDL-cholesterol decreased significantly ($P < 0.01$). Per cent decrease of LDL-cholesterol among subjects ranged from 7.2 to 34.3, average decrease observed was 16.43 per cent.

Similarly, decrease in serum LDL-cholesterol concentration with guar gum and isabgol husk (Taneja and Kapoor, 1989), wheat and oat bran (Anderson et al., 1991) and other various sources of dietary fibre (McIntosh, 1991; Whyte et al., 1992; Lupton et al., 1993) have been reported.

Kirby et al. (1981) proposed that dietary fibre intake exerts a reduction mainly in LDL-cholesterol. The effects of dietary fibre on lipoprotein cholesterol is due to its association with the absorption and transport of lipids (Story and Kelley, 1982). But the effect of dietary fibre on lipoprotein cholesterol appears to be strongly related to altered rate or site of intestinal absorption (Asp et al., 1983). The composition of lipoprotein produced in the intestinal lumen can be altered as the site of absorption is moved further down the intestinal tract. The affinity of these fibres for micellar phospholipid may also contribute to increase in size of cyclo-microns by limiting phospholipid availability along the intestine.

4.7.1.4 Ratio of Plasma Total Cholesterol/HDL-cholesterol

Ratio of total cholesterol/HDL-cholesterol, ranged from

Table 4.24. Effect of teent supplementation on ratio of plasma total cholesterol/HDL-cholesterol

	Initial ratio	Final Ratio	% decrease
<u>Veg</u>			
1	4.8	4.7	2.08
2	4.9	3.7	24.49
3	5.1	4.4	13.72
4	6.8	5.8	14.70
5	5.9	5.7	3.39
Mean	5.50 $\pm$ 0.76	4.86 $\pm$ 0.79	11.67
<u>Non-Veg</u>			
1	5.5	5.2	5.45
2	5.4	3.9	27.78
3	5.7	4.7	17.54
4	4.2	3.7	11.90
5	4.9	4.4	10.20
Mean	5.14 $\pm$ 0.54	4.38 $\pm$ 0.54	14.57
<u>Egg</u>			
1	5.2	4.7	9.60
2	5.9	4.8	18.60
3	5.5	4.8	12.73
4	5.4	5.1	5.55
5	5.8	5.0	13.79
Mean	5.56 $\pm$ 0.25	4.88 $\pm$ 0.14	12.05
Overall mean	5.40 $\pm$ 0.61	4.71 $\pm$ 0.39	12.76
't' calculated 7.14**			
't' tabulated at 0.01 level of significance = 2.98			
SE(m)	0.16	0.16	
CD (P<0.01)	NS	NS	

Normal value = 3.0 - 4.0

NS = non-significant.

4.2 to 6.8 with an average value of 5.4 ± 0.61 before the start of experiment. Ackerman (1963) reported the normal total cholesterol/HDL-cholesterol ratio from 3.0 to 4.0. Teent supplementation in the diets of subjects for three months decreased the ratio of total cholesterol/HDL-cholesterol significantly ($P < 0.01$). On an average, total cholesterol/HDL-cholesterol ratio decreased by 12 per cent (Table 4.24).

Similarly, decrease in ratio of total cholesterol/HDL-cholesterol has been observed with locust bean gum (Zavoral et al., 1983), oat bran (O'Brien et al., 1985) and guar gum and isabgol husk (Taneja and Kapoor, 1989).

The decrease in ratio of total cholesterol/HDL-cholesterol is due to reduction in total cholesterol or increase in HDL-cholesterol or both. Teent supplementation reduced significantly the level of total cholesterol but no change in HDL-cholesterol was observed which resulted in decrease in ratio of total cholesterol/HDL-cholesterol.

4.7.1.5 Plasma Triglycerides

The initial fasting plasma triglyceride concentration ranged from 74.2 to 139.0 mg/100 ml with an average value of 99.87 ± 16.61 mg/100 ml. Normal range of triglyceride concentration has been reported from 30 to 140 mg/100 ml (Oser, 1965). There were no significant differences in triglyceride concentration of three groups viz., vegetarian, non-vegetarian and egg vegetarian. After consumption of teent for three months, the plasma triglyceride concentration decreased significantly

Table 4.25. Effect of teent supplementation on level of plasma triglycerides

	Initial level	Final level	% decrease
<u>Veg</u>			
1	91.5	79.1	13.5
2	74.2	65.9	11.2
3	95.1	78.5	17.4
4	85.0	74.1	12.8
5	122.2	101.9	16.6
Mean	93.6 $\pm$ 15.96	79.9 $\pm$ 11.97	14.3
<u>Non-Veg</u>			
1	112.1	98.5	12.1
2	106.5	91.2	14.4
3	98.3	79.7	18.9
4	76.7	61.8	19.4
5	110.9	91.5	17.5
Mean	100.9 $\pm$ 13.03	84.5 $\pm$ 12.87	16.5
<u>Egg</u>			
1	91.1	72.6	20.3
2	97.2	62.7	35.5
3	139.0	125.6	9.6
4	109.0	92.5	15.1
5	89.1	78.5	11.9
Mean	105.1 $\pm$ 18.32	86.4 $\pm$ 21.85	18.5
Overall mean	99.87 $\pm$ 16.61	83.60 $\pm$ 16.42	16.9
't' calculated 10.28**			
't' tabulated at 0.01 level of significance = 2.98.			
SE(m)	4.75	4.68	
CD (P<0.01)	NS	NS	

Normal value = 30-140 mg/100 ml.

NS = Non-significant.

($P < 0.01$). Per cent decrease in triglyceride concentration ranged from 9.6 to 35.5.

Jain (1988) also reported a significant decreaseⁱⁿ triglyceride levels of hyperlipidemic rats after feeding dietary fibre from teent. A significant negative relationship between the levels of dietary fibre in the diet and serum triglyceride was also reported. Similarly, Agarwal and Chauhan (1988) reported lowest level of serum triglyceride in rats with teent compared with peepal banti, barbanti, gullar and khejri beans. Significant decrease in triglyceride levels of hypercholesterolemic men was demonstrated with inclusion of wheat bran (Anderson et al., 1991).

The fibre may alter intestinal handling of triglycerides and fatty acids, hepatic metabolism and release of other peripheral metabolism of lipoprotein (Anderson and Chen, 1979). This may explain the decrease in serum triglyceride levels in the subjects after feeding teent.

4.7.1.6 Plasma Phospholipids

The concentration of plasma phospholipid at the start of experiment ranged from 145 to 194 mg/100 ml. The normal concentration of phospholipids in plasma ranged from 50-250 mg/100 ml (Nath, 1976). There were no significant differences in concentration of phospholipids in three groups. Incorporation of teent in the diet of the subjects resulted in significant ($P < 0.01$) reduction in concentration of plasma

Table 4.26. Effect of teent supplementation on level of plasma phospholipid (mg/100 ml)

	Initial level	Final level	% decrease
<u>Veg</u>			
1	185	171	7.60
2	192	174	9.40
3	182	175	9.30
4	193	181	6.20
5	137	116	15.33
Mean	177.8 $\pm$ 20.82	163.4 $\pm$ 20.59	9.60
<u>Non-Veg</u>			
1	161	145	9.90
2	194	175	9.80
3	150	137	8.70
4	172	162	5.80
5	189	174	7.90
Mean	173.2 $\pm$ 16.56	158.6 $\pm$ 15.29	8.42
<u>Egg</u>			
1	156	140	10.20
2	145	133	8.30
3	155	143	7.70
4	163	154	5.50
5	167	156	6.60
Mean	157.2 $\pm$ 7.40	145.2 $\pm$ 8.65	7.66
Overall mean	169.4 $\pm$ 17.86	155.73 $\pm$ 18.79	8.56
't' calculated 13.68**			
't' tabulated at 0.01 level of significance = 2.98.			
SE(m)	4.60	5.32	
CD (P<0.01)	NS	NS	

Normal value = 50-250 mg/100 ml.

NS = Non-significant.

phospholipids. On an average, decrease in plasma phospholipid concentration was 8.56 per cent (Table 4.26).

Reduction in the concentration of phospholipids has been reported with isabgol (Taneja, 1982) and guar gum and isabgol husk (Taneja and Kapoor, 1989).

No specific mechanism is available to explain the phospholipid lowering effect of fibres. The ability of fibre to bind micellar components and interference with absorption of lipid due to unstirred layer and increased faecal excretion of lipid may be associated with decrease in phospholipids.

4.7.1.7 Plasma Total Lipids

Initial total lipids concentration of experimental subjects ranged from 375-685 mg/100 ml. Oser (1965) had reported the normal level of total lipids in plasma ranged from 400 to 900 mg/100 ml. No significant differences were observed in total lipid concentration of vegetarian, non-vegetarian and eggetarian. After consumption of teent for three months, a significant ($P < 0.01$) reduction in the level of total lipids of subjects was observed. On an average, per cent decrease in plasma total lipid concentration ranged from 5.60 to 18.25 per cent (Table 4.27).

A significant reduction in total lipids was found when dietary fibre from peepal banti, barbanti, gullar, teent and khejri beans was fed to hypercholesterolemic rats and teent was found to be more effective (Agarwal and Chauhan, 1988). Similarly, a significant reduction in total lipids was reported

Table 4.27. Effect of teent supplementation on level of plasma total lipid (mg/100 ml)

	Initial level	Final level	% decrease
<u>Veg</u>			
1	478	406	15.10
2	410	387	5.60
3	587	495	15.67
4	529	449	15.12
5	444	411	7.40
Mean	489.6 $\pm$ 62.59	429.6 $\pm$ 38.39	11.78
<u>Non-Veg</u>			
1	580	475	18.10
2	546	458	16.10
3	375	354	5.60
4	515	421	18.25
5	421	382	9.26
Mean	487.4 $\pm$ 77.22	418.0 $\pm$ 45.28	13.46
<u>Egg</u>			
1	685	589	14.00
2	478	412	13.80
3	627	530	15.50
4	597	528	11.60
5	410	387	5.60
Mean	559.4 $\pm$ 100.7	489.2 $\pm$ 76.86	12.10
Overall mean	512.13 $\pm$ 88.27	445.6 $\pm$ 64.16	12.40
't' calculated 8.42**			
't' tabulated at 0.01 level of significance = 2.98.			
SE(m)	23.58	16.18	
CD (P<0.01)	NS	NS	

Normal value = 400-700 mg/100 ml.

NS = Non-significant.

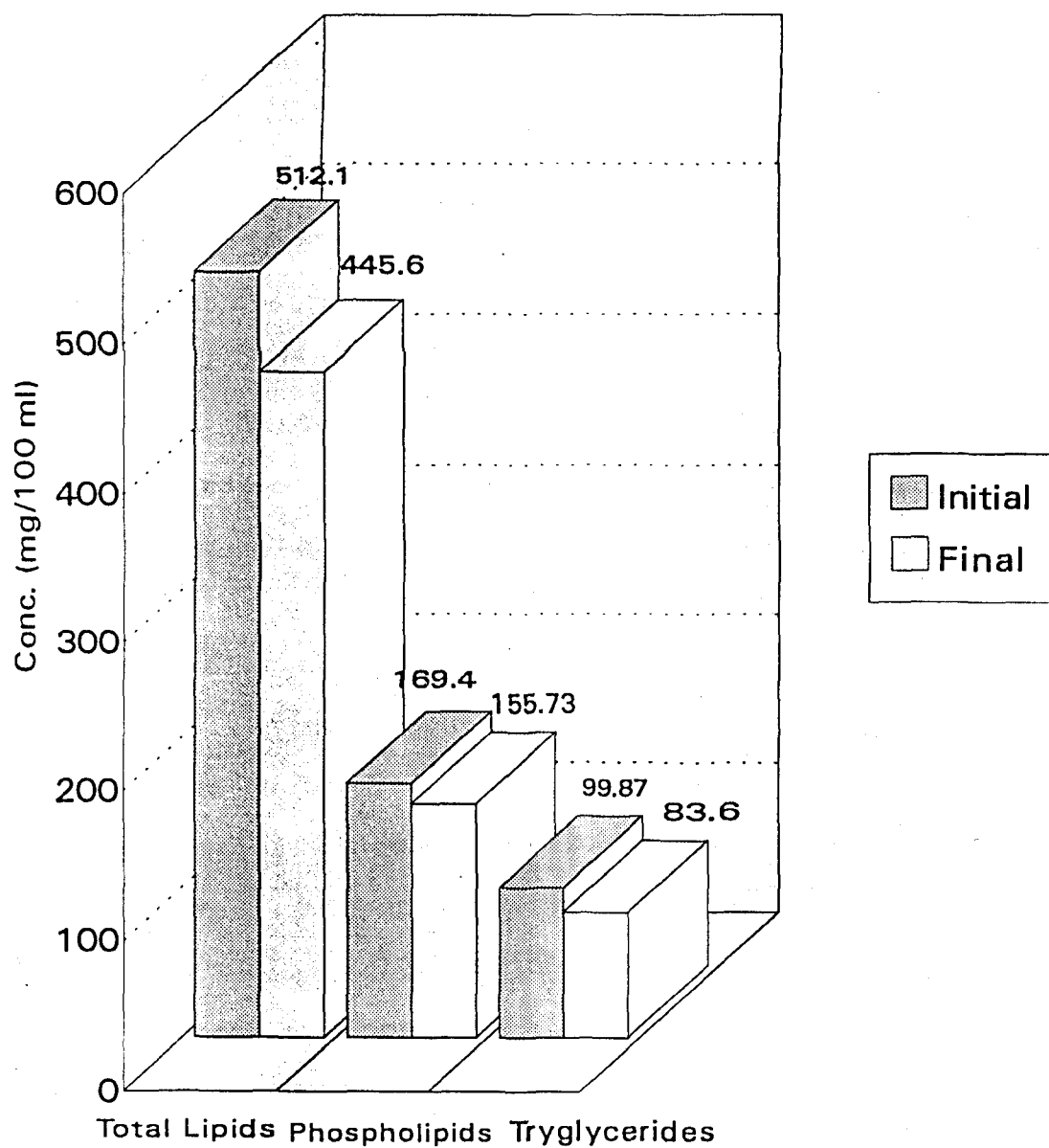


Fig. 2. Effect of *teent* supplementation on levels of plasma total lipids, phospholipids and tryglycerides in subjects

with guar flour (Khalsa and Sharma, 1980), bengal gram, kesari dal and soyabean (Sharma, 1987) and guar gum and isabgol husk (Taneja and Kapoor, 1989).

Ability of dietary fibre to sequester micellar components may suggest that the fibre have a direct interference with lipid absorption (Vahouny, 1982).

4.7.2 Plasma Glucose

At the start of experiment, fasting plasma glucose concentration of subjects ranged from 75-120 mg/100 ml (Table 4.28). There were no significant differences in glucose concentration of vegetarian, non-vegetarian and eggetarian groups. Normal range of plasma glucose is from 60-100 mg/100 ml (Nath, 1976). Teent supplementation in the diets of the subjects for three months resulted in significant reduction in the concentration of glucose. On an average, 11 per cent decrease in the glucose concentration was found.

Similarly, significant reduction in concentration of glucose was observed with guar gum granulate (Aro et al., 1981), guar gum and isabgol husk (Taneja, 1989) and high fibre diet (Manojlovic et al., 1986).

Dietary fibre has a dual effect on glucose metabolism (Bijlani, 1985). First, after a meal is consumed and possibly extending into the next meal, it helps in more efficient utilization of the carbohydrate load with less insulin release. Second, the prolonged consumption of dietary fibre leads to changes in the endocrine make-up which allows the individual to

Table 4.28. Effect of teent supplementation on level of plasma glucose (mg/100 ml)

	Initial level	Final level	% decrease
<u>Veg</u>			
1	100	80	20.00
2	90	81	10.00
3	120	90	25.00
4	95	82	13.70
5	95	87	8.40
Mean	100.0 $\pm$ 10.39	84.0 $\pm$ 3.77	15.45
<u>Non-Veg</u>			
1	80	74	7.50
2	100	82	18.00
3	75	71	5.30
4	75	72	4.00
5	85	72	5.90
Mean	83.0 $\pm$ 9.19	75.8 $\pm$ 4.94	8.14
<u>Egg</u>			
1	85	82	3.50
2	115	101	12.20
3	100	77	23.00
4	78	71	9.00
5	80	78	2.50
Mean	91.6 $\pm$ 14.07	81.8 $\pm$ 10.34	10.00
Overall mean	91.53 $\pm$ 13.36	80.53 $\pm$ 7.66	11.20
't' calculated 5.05**			
't' tabulated at 0.01 level of significance = 2.98.			
SE(m)	3.30	1.96	
CD (P<0.01)	NS	NS	

Normal value = 70-100 mg/100 ml.

NS = Non-significant.

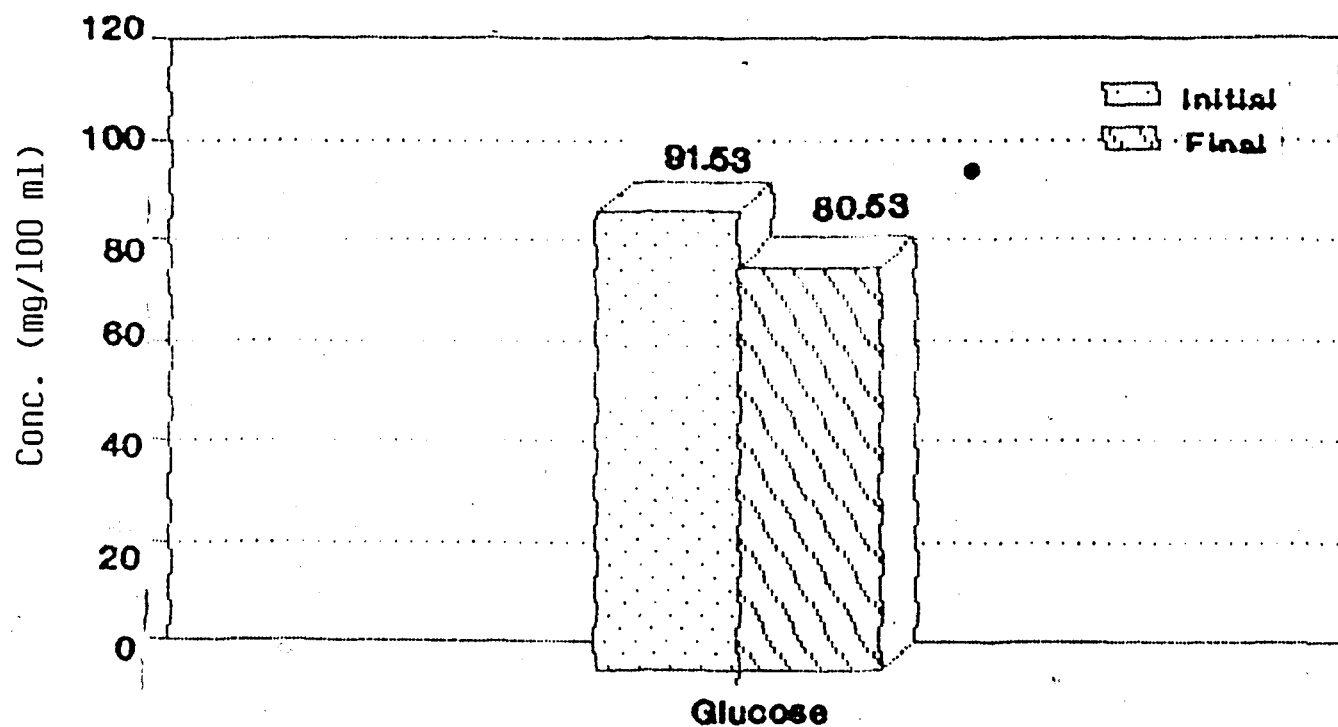


Fig. 3. Effect of teent supplementation on level of plasma glucose in subjects

be better able to handle the carbohydrate load efficiently. These physiological effects are important in the prevention and treatment of diabetes.

Delayed absorption of glucose is the major contributor to the reduction in post-prandial glycemia with high fibre diet (Vahouny, 1982; Mann, 1985). Delayed absorption is due to prolonged gastric emptying time (Holt et al., 1979), the entrapment of carbohydrates or digestive enzymes (Schneeman, 1982) and/or the interruption of transport across the unstirred water layers (Elsenhaus et al., 1980). High dietary fibre diets improve glucose metabolism without increasing insulin secretion (Anderson, 1982). These proposed mechanisms may explain the decrease in serum glucose levels observed in this study.

4.7.3 Plasma Total Protein

The initial fasting plasma total protein concentration of subjects ranged from 6.4 to 9.6 g/100 ml with a mean concentration of 7.63 ± 0.96 . No significant differences were observed in the concentration of total protein of three groups. Swaminathan (1974) had reported that normal concentration of total protein ranged from 6-8 g/100 ml. Non-significant differences in total protein concentration after supplementation of teent in the diets of the subjects was observed.

Similarly, no effect of cellulose (Bhat et al., 1981) and guar gum and isabgol husk (Taneja and Kapoor, 1989) on the level of total protein has been reported.

Table 4.29. Effect of teent supplementation on level of plasma total protein (g/100 ml)

	Initial level	Final level	% change
<u>Veg</u>			
1	6.4	6.6	3.1
2	7.8	7.5	-3.8
3	9.3	9.1	-2.1
4	6.4	6.9	7.8
5	8.1	8.0	-1.2
Mean	7.60 $\pm$ 1.1	7.62 $\pm$ 0.88	0.76
<u>Non-Veg</u>			
1	8.6	8.4	-2.3
2	7.5	7.7	2.7
3	6.8	7.0	2.9
4	7.5	7.2	-4.0
5	6.6	6.8	3.0
Mean	7.40 $\pm$ 0.70	7.42 $\pm$ 0.57	0.46
<u>Egg</u>			
1	9.6	9.4	-2.1
2	6.7	6.8	1.5
3	7.6	7.7	1.3
4	7.5	7.9	5.3
5	8.1	8.0	-1.2
Mean	7.90 $\pm$ 0.86	7.96 $\pm$ 0.83	0.96
Overall mean	7.63 $\pm$ 0.96	7.66 $\pm$ 0.81	0.73
't' calculated	0.517 (NS)		
SE(m)	0.27	0.22	
CD (P<0.01)	NS	NS	

Normal value = 6-8 g/100 ml.

NS = Non-significant.

4.7.4 Total Food intake (Fresh Weight Basis)

Total food consumed by the subjects was recorded before and after teent supplementation. The daily total food intake of the subjects ranged from 1675 to 2151 g at the start of the experiment. No significant difference in the total food intake of subjects in three groups (Vegetarian, non-vegetarian and eggetarian) was found. Teent supplementation in the diets of subjects resulted in significant reduction ($P < 0.01$) in total food intake. The reduction in food intake varied from 2.12 to 9.85 per cent. The average reduction in total food intake was 5.27 per cent (Table 4.30).

Similarly, Duncan et al. (1983) reported that diet high in dietary fibre requires a smaller amount of food intake for satiation than high caloric density, low dietary fibre foods. Also Porikos and Hayaman (1986) observed that obese subjects ate fewer sandwiches after a high fibre preload and ate significantly more than normal subjects on the low fibre treatment.

The reduction observed in total food intake in the present study may be due to effect of dietary fibre on slowing down the rate of ingestion. Foods rich in dietary fibre are difficult to chew and therefore, take longer to ingest (McCance et al., 1953). The intake of dietary fibre also stimulate the flow of saliva. The combined effect of dietary fibre intake and increased saliva production can rapidly fill the stomach, which can reduce the rate at which we eat and slow gastric

Table 4.30. Effect of teent supplementation on total food intake (g/day) in respondents

	Before supplementation	During supplementation	% decrease
<u>Veg</u>			
1	1890.0	1850.0	2.12
2	2135.0	2005.0	6.09
3	2112.5	1940.0	8.16
4	2040.0	1856.0	9.02
5	2152.0	2046.0	4.92
Mean	2065.9 $\pm$ 95.88	1939.4 $\pm$ 78.25	6.06
<u>Non-Veg</u>			
1	1910.0	1828.0	4.29
2	1966.7	1773.0	9.85
3	1850.0	1700.00	8.11
4	2070.0	1901.0	8.16
5	1700.0	1681.0	1.12
Mean	1899.34 $\pm$ 123.25	1776.6 $\pm$ 81.41	6.31
<u>Egg</u>			
1	1810.0	1760.0	2.76
2	2151.0	2110.0	1.91
3	1675.0	1585.0	5.37
4	2015.0	1941.0	3.67
5	1945.0	1876.0	3.55
Mean	1919.2 $\pm$ 164.39	1856.4 $\pm$ 175.95	3.45
Overall mean	1961.5 $\pm$ 150.51	1856.8 $\pm$ 137.78	5.27
't' calculated 7.04**			
't' tabulated at 0.01 level of significance = 2.98.			

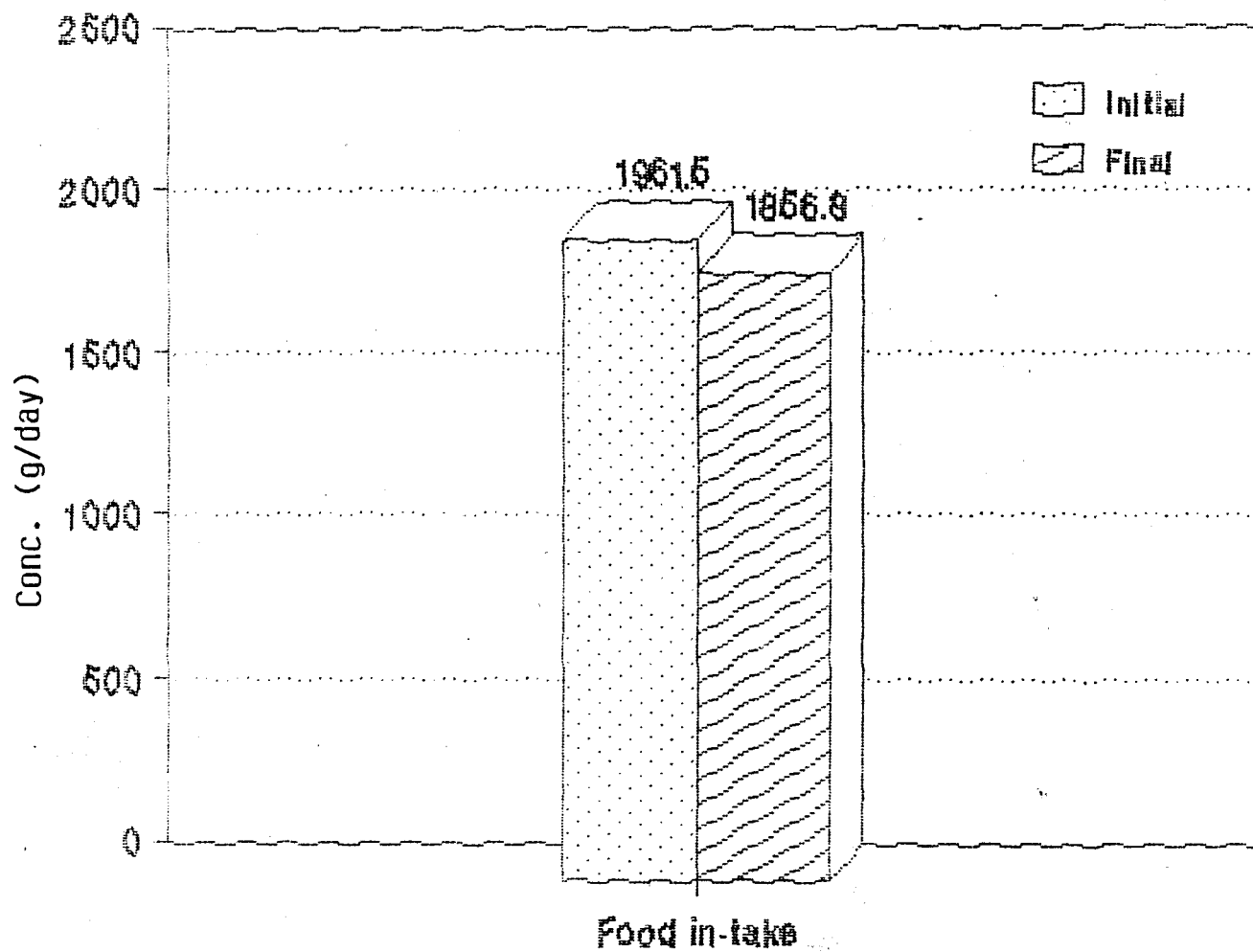


Fig. 4. Effect of teent supplementation on total food intake in subjects

emptying (Haber et al., 1977). The addition of viscous-type dietary fibres to a liquid appears to allow the stomach to handle the liquid meal in the manner of a solid meal, causing a slower emptying of stomach (Leeds, 1982).

4.7.5 Frequency of Defaecation

At the start of experiment, 7 subjects had frequency of defaecation once in 24 hr, 2 had frequency of defaecation twice in 24 hr, one had defaecation frequency more than twice in 24 hrs and 5 subjects had frequency once in 48 hrs (Table 4.31). After supplementation of teent, the frequency of defaecation increased, 11 subjects had frequency of defaecation once in 24 hr, 3 subjects had frequency of defaecation twice in 24 hr and only one subject had defaecation frequency more than twice in 24 hr. None subject reported defaecation frequency once in 48 hrs. Inclusion of teent, rich fibre in the diet of subjects might have improved the habit of defaecation.

Similarly, increase in frequency of defaecation was observed with addition of fibre to diet (Cowgill and Anderson, 1932; Taneja and Kapoor, 1989). Inclusion of fibre in the diet produces soft and considerably heavier stools which are usually passed without any discomfort (Chauhan and Kapoor, 1982). Fibre absorbs water and increased faecal bulk is due to increase in water content of stool. It is probable that the water holding property of fibre is due to its polysacchar-ide content. These compounds also have a cation exchange capacity and will, therefore, absorb sodium, potassium, calcium and other

Table 4.31. Effect of teent supplementation on frequency of defaecation

	<u>Frequency before supplementation</u>		<u>Frequency after supplementation</u>	
	Vegetarian	Non-vegetarian	Vegetarian	Non-vegetarian
1/24 hr	2	2	4	4
2/24 hr	1	1	1	0
Above 2/24 hr	0	0	0	1
1/48 hr	2	2	0	0

positively charged elements. It is possible, therefore, that water will be absorbed directly to the fibre and also indirectly as a result of adsorption of Na to source of dietary fibres. This explains the increase in faecal excretion with inclusion of dietary fibre (McConnel et al., 1974).

SUMMARY AND CONCLUSION

The importance of dietary fibre has become more appreciated over the past few decades with advances in our understanding its role in human physiology. The amount of dietary fibre consumed have been found to be inversely correlated with IHD, diabetes, cancer and other gastro-intestinal diseases. Role of various conventional sources of dietary fibre in this direction has been defined. Very little work has been done regarding non-conventional source of dietary fibre. Teent has been defined as an indigenous, cheap and non-conventional source of dietary fibre.

The present study was undertaken with the objectives to develop products from teent acceptable to human palate and to assess the hypolipidemic effect of teent in human subjects.

Fifty hyperlipidemic adults (40-60 year age group) who volunteered to participate in the study were randomly selected from Hisar city. A questionnaire was framed to collect the baseline and other informations. Data regarding general information of respondents, complications present, family

history of complications, their personal habits, physical activities, dietary habits and nutrient intake was collected.

The fasting blood sample of respondents was taken and analysed for plasma total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides, phospholipids, total lipids, glucose and total protein. On the basis of their blood lipid profile, 15 hyperlipidemic adults with different dietary habits were selected. The diets of these subjects were supplemented with approximately 50 g teent/day (fresh wt.) for three months.

Teent (Capparis decidua) procured from the local market were processed with different treatments. Whole as well as coarsely ground teent were treated with 5 per cent NaCl, 1 per cent lactic acid and 1 per cent acetic acid for two days. The solutions were changed after twenty four hours. The processed teent were subjected to organoleptic evaluation by a panel of 10 judges using 9-point Hedonic scale. Teent powder was prepared using best accepted treatment and analysed for protein, fat, crude fibre, ash and dietary fibre components.

Fifty gram of fresh teent per supplement was used for preparation of chutney. Teent powder was incorporated in panjiri, biscuit, sev, pakoda and chapati. Ten g teent powder was tried in biscuit per supplement, assessed organoleptically. Since products were graded as 'slightly desirable', so 5 g teent powder per supplement was used for the preparation of products. These products were evaluated organoleptically by a panel of 10 judges using 9-point Hedonic scale. Most accepted products were used for supplementation. Teent chutney was used

as form of supplement for first 15 days (85 g/d). For next 15 days, panjiri (100 g/d) was distributed to subjects. For the last two months, 100 g bisuits (B per day) were given to the experimental subjects. In addition to panjiri and biscuits, subjects were given 2 g teent powder daily.

During experimental period, one-fifth of the food samples of the subjects was collected for three consecutive days, dried in oven and analysed for proximate composition and total dietary fibre components. Energy was calculated using factorial method. At the end of feeding trial, the blood samples of the experimental subjects were collected in fasting state.

Information obtained through the questionnaire revealed that majority of the respondents were male and in age group of 40-50 years. Maximum number of respondents were obese, educated and had monthly income more than Rs. 7500. There was a direct relationship between the presence of complications (IHD and constipation) with per cent obesity. Forty per cent of the respondents having various complications had family history of these complications. No significant relationship was found between smoking habits and alcohol intake with the occurrence of disease. Majority of the respondents having various complications did not report consumption of tonic or medicine regularly.

A significant association between type of activity and per cent obesity was found. Majority of the subjects having various complications were involved in sedentary work. A similar trend was observed in case of association of exercise

habit and per cent obesity. Majority of the respondents were using refined or combination of refined, desi ghee or mustard oil. Fifty two per cent of respondents were not sieving flour for making chapati. Fast keeping habit was found more in case of obese respondents. The daily protein intake of the respondents was at par with the recommended dietary allowances of ICMR whereas fat intake was quite high. The energy intake of female respondents was high whereas energy intake of male respondents was at par with the RDAs of ICMR (Sedentary male).

Processing with 5 per cent NaCl was found to be most acceptable. Scores for overall acceptability was highest in case of coarsely ground teent treated with 5 per cent NaCl. Teent powder prepared after processing contained 15.10, 8.02, 5.26 and 13.18 g protein, fat, ash and crude fibre per 100 g, respectively. Hemicellulose, cellulose, lignin and pectin content were 13.06, 16.28, 9.42 and 4.12 g per 100 g, respectively. No significant differences were found in fibre components of teent powder prepared with whole or coarsely ground NaCl processed teent.

In terms of overall acceptability scores of products prepared after teent supplementation, teent chutney was found to be 'desirable' and biscuits (A), panjiri and chapati prepared with 5 g teent powder were 'moderately desirable', whereas, biscuits (B) prepared with 10 g teent powder, pakoda and sev were 'slightly desirable'.

Chemical analysis of diets of experimental subjects during experimental period revealed that on an average, protein, fat, crude fibre, ash and carbohydrate contents of the diet were 13.9, 13.35, 1.93, 4.25 and 66.99 g per 100 g, respectively. The components of dietary fibre viz., hemicellulose, cellulose, lignin and pectin of the diet were 2.48, 2.05, 1.45 and 0.62 g per 100 g, respectively. No significant difference was found in the composition of diets of subjects in three groups (Veg/Non-Veg/Egg).

The daily diet of the experimental subjects contained 67.6 ± 6.92 g protein, 66.5 ± 5.87 g fat, 9.6 ± 1.32 g crude fibre, 21.4 ± 4.85 g ash and 336.6 ± 35.43 g of carbohydrate. The mean energy content of the diet was 2214 ± 162.16 Kcal. The daily diet contained 16.39 ± 2.85 g ADF and 25.91 ± 2.60 g NDF. Hemicellulose, cellulose, lignin and pectin contents were 12.36 ± 1.01 , 10.12 ± 0.70 , 7.31 ± 0.55 and 3.17 ± 0.52 g, respectively. There was no significant difference in the average daily nutrient intake of the three groups.

The initial fasting plasma cholesterol concentration ranged from 183-271 mg/100 ml. No significant differences were found in the plasma total cholesterol concentration of vegetarian, non-vegetarian and eggetarian. Supplementation of teent resulted in 13.97 per cent reduction in plasma total cholesterol concentration.

On an average, the initial concentration of HDL-cholesterol was 43.86 ± 4.94 mg. There was no significant difference in the plasma HDL-cholesterol concentration of three

groups. After incorporation of teent in the diets of subjects no significant difference in the concentration of HDL-cholesterol was observed.

The initial plasma concentration of LDL-cholesterol of subjects ranged from 124.2 to 197.2 mg/100 ml. There was no significant difference in the concentration of LDL-cholesterol of vegetarian, non-vegetarian and eggetarian. After consumption of teent for three months, an average 16.43 per cent reduction in LDL-cholesterol was observed.

Ratio of total cholesterol/HDL-cholesterol ranged from 4.2 to 6.8. Teent supplementation in the diets of subjects for three months decreased the ratio of total cholesterol/HDL-cholesterol by 12 per cent.

The initial fasting plasma triglyceride concentration ranged from 74.2 to 139 mg/100 ml. After consumption of teent for three months, the plasma triglyceride concentration decreased significantly ($P < 0.01$). Per cent decrease in triglyceride concentration range from 9.6 to 35.5.

The mean initial fasting plasma phospholipid was 169.4 ± 17.86 mg/100 ml. There was no significant difference in the concentration of phospholipids in three groups. Incorporation of teent in the diets of subjects resulted in 8.56 per cent decrease in concentration of plasma phospholipids.

Initial total lipids concentration among experimental subjects ranged from 375-685 mg/100 ml. After consumption of teent in the diets of subjects, plasma total lipid concentration lowered from 5.6 to 18.1 per cent.

At the start of experiment, fasting plasma glucose concentration ranged from 75-120 mg/100 ml. Teent supplementation in the diets of subjects for three months resulted in significant reduction ($P < 0.01$) in the concentration of glucose. On an average, 11 per cent decrease in glucose concentration was found.

The mean initial fasting plasma total protein of experimental subjects was 7.63 ± 0.96 g/100 ml. Supplementation of teent in the diets of experimental subjects did not changed plasma total protein concentration significantly.

Total food consumed by the subject before the supplementation of teent was 1961.5 ± 150.51 g/day. After incorporation of teent in the diets of subjects, an average 5.27 per cent reduction in total food intake was observed. Inclusion of teent in the diets of subjects improved the habit of defaecation. At the start of experiment, 5 subjects had frequency of defaecation once in 48 hrs. After supplementation of teent, none subject reported defaecation frequency once in 48 hrs.

It may be inferred from the present investigation that incorporation of teent at level of 50 g/d significantly lowered total, LDL-choelsterol, triglyceride, phospholipid, total lipid and glucose. Elevated lipid levels have been reported risk factors for heart disease. Decrease in lipid profile are beneficial for health.

Thus, it may be concluded that teent may be included in the diets of hyperlipidemic adults to reduce the levels of blood lipids. Teent can be successfully incorporated fresh or as powder in various recipes which are acceptable to human palate. It can be answer to lower the lipid profile of hyperlipidemic subjects.

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APPENDICES

APPENDIX - I

PROFORMA USED FOR PRELIMINARY SURVEY OF HYPERLIPIDEMIC PERSONS

- | | |
|---------------------|----------------|
| 1. Name | 2. Address |
| 3. Age | 4. Sex |
| 5. Height | 6. Weight |
| 7. Per cent obesity | 8. Education |
| 9. Marital status | 10. Occupation |

Married

Unmarried

Widowed

Divorced

11. Family details:

S.No.	Family member	Age	Sex	Occupation	Income/Month
01					
02					
03					
04					
05					
06					
07					
08					

12. Do you have any of the following complications?

- | | | |
|--|--------|-------------------|
| a) Hypertension | Yes/No | When did it start |
| b) Ischemic heart disease | | |
| c) Diabetes | | |
| d) G.I. disease | | |
| - Colitis | | |
| - Gall bladder disease | | |
| - Malabsorption syndrome | | |
| - Constipation | | |
| e) Cerebrovascular disease (Paralysis) | | |
| f) Any other | | |

13. Family history of diseases:

Any of the parent is/was suffering from

- | | | |
|--------------------------------|---------------|---------------|
| a) Hypertension | <u>Mother</u> | <u>Father</u> |
| b) Obesity | | |
| c) Diabetes | | |
| d) Ischaemic heart disease | | |
| e) G.I. disorder | | |
| f) Cerebrovascular (Paralysis) | | |
| g) Any other disease | | |

14. Past history of blood tests, if any.

15. Whom do you consult for your medical advice and treatment?

- | | |
|-------------------|-------------|
| a) Private doctor | <u>Name</u> |
| b) Hospital | |

16. Do you consume any medicine regularly?

If yes, name Yes/No

17. Do you take any hypocholesterolemic drug?

If yes, name Yes/No

Diet history

18. Are you vegetarian/non-vegetarian/eggetarian?

19. If non-veg, then how many times a week do you take:

Egg

Meat

20. Do you consume any tonic or vitamin tablet?

If yes, name Yes/No

21. Which of the fats you consume for cooking?

- a) Refined oil
- b) Hydrogenated fat
- c) Desi ghee
- d) Mustard oil

22. Do you consume any extra source of dietary fibre?

Yes/No

If yes, mention it

23. Do you sieve flour for making chapati?

Yes/No

24. Do you fast?

Yes/No

If yes, state frequency/week

25. Frequency of defaecation:

More than twice in 24 hr

Twice in 24 hr

Once in 24 hr

Once in 48 hr

More than once in 48 hr

26. Dietary intake

Date

Day

<u>Meal</u>	<u>Menu</u>	<u>Ingredient</u>	<u>Household measure</u>	<u>Standard weight</u>	<u>Method of cooking</u>
-------------	-------------	-------------------	------------------------------	----------------------------	----------------------------------

Early morning

Break fast

Mid-morning

Lunch

Tea

Dinner

Bed time

Physical activities

27. Are you working/unemployed/retired/housewife?

28. If working, what is your occupation:

What type of job it is? Does it involve?

a) Desk

b) Supervision

c) Touring

d) Manual work

29. Working hours

30. Mode of transport

Car	Scooter
Bus	Walking
Bicycle	Rickshaw

31. Do you do any physical exercise?

Yes/No

If yes, then state

- i) Type
- ii) Frequency in a week
- iii) Time spent daily

32. Do you enjoy sound sleep?

Yes/No

33. How many hours do you sleep daily?

Personal habits

34. Do you smoke?

Yes/No

If yes, what and how much do you smoke per day?

35. Do you consume alcohol?

Yes/No

If yes, how often?

Daily	Twice a week
Once a week	Once in 15 days
Once in a month	Occasionally

36. How much do you drink at a time?

37. For how long have you been drinking?

APPENDIX - II

DESIRABLE WEIGHT FOR MEN AND WOMEN AGED 25 AND OVER
(in kilograms by height and frame in indoor clothing)

Men				Women			
(in shoes, 2.5 cm heels)		(in shoes, 5 cm heels)		(in shoes, 5 cm heels)		(in shoes, 5 cm heels)	
Height (cm)	Small frame	Medium frame	Large frame	Height (cm)	Small frame	Medium frame	Large frame
157	51-55	54-59	57-64	150	36-43	45-50	48-55
160	52-56	55-60	59-65	152	44-47	46-51	50-57
163	54-57	56-62	60-67	155	45-49	47-53	51-58
165	55-59	58-63	61-69	157	46-50	49-54	52-60
168	56-60	59-65	63-71	160	48-51	50-55	54-61
170	58-62	61-67	65-73	163	49-53	51-57	55-63
173	60-64	63-69	67-75	165	50-54	53-59	57-65
175	62-66	65-71	69-77	168	52-56	55-61	59-66
178	64-68	66-73	70-79	170	54-58	56-63	60-68
180	65-70	68-75	72-81	173	55-60	58-65	62-70
183	67-72	70-77	75-84	175	57-61	60-67	64-72

Source: Life Insurance Corporation of India.

APPENDIX - III

SCORE SHEET FOR TASTE PANEL/DATA UNDER HEDONIC SCALE

Name _____ Product _____

Test these samples and check how much you like or dislike each one. Use appropriate scale to show your attitude by assessing points that best describe your feeling about the samples. An honest expression of your feeling will help to obtain unbiased data.

Code No.	Colour	Appearance	Aroma/ flavour	Texture	Taste	Overall Acceptability
-------------	--------	------------	-------------------	---------	-------	--------------------------

<u>Rate</u>	<u>Organoleptic score</u>
Very desirable	9
Desirable	8
Moderately desirable	7
Slightly desirable	6
Neither desirable nor undesirable	5
Slightly undesirable	4
Moderately undesirable	3
Undesirable	2
Very undesirable	1

NOTE: Please rinse your mouth before and after testing each product.

SIGNATURE

APPENDIX - IV

TOTAL DIETARY FIBRE COMPONENTS OF PROCESSED TEENT

Component	Whole <u>teent</u> (A)	Coarsely ground teent (B)
ADF	16.40	15.29
NDF	29.40	28.67
Hemicellulose	13.00	13.06
Cellulose	15.19	16.28
Lignin	8.60	9.40
Pectin	4.01	4.12

APPENDIX - V

SMOKING HABIT AND OCCURRENCE OF DISEASE IN RESPONDENTS

Complications	Smoking subjects			Non-smoking subjects	Total (n=50)
	0-10 Cig.	10-20 Cig.	20-30 Cig.		
Hypertension	2 (13.3)	0	0	13 (86.7)	15
IHD	0	1 (33.3)	1 (33.3)	1 (33.3)	03
Diabetes	0	0	0	3 (100.0)	03
Constipation	0	0	1 (25.0)	3 (75.0)	04
Hypertension + IHD	0	0	0	3 (100.0)	03
Hypertension + Diabetes	1 (20.0)	1 (20.0)	0	3 (60.0)	05
Hypertension + constipation	1 (33.3)	0	1 (33.3)	1 (33.3)	03
None of the disease	2 (14.28)	1 (7.14)	0	11 (78.57)	14
Total	6 (12.0)	3 (6.0)	3 (6.0)	38 (76.0)	50

Figures in parentheses indicate percentage.

APPENDIX - VI

ALCOHOLISM AND OCCURRENCE OF DISEASE IN RESPONDENTS

Complications	Subject consuming alcohol				Not consuming alcohol	Total (n=50)
	Daily	Once/ 15 days	Once/ month	Occasio- nally		
Hypertension	0	0	1 (6.67)	2 (13.33)	12 (80.0)	15
IHD	0	0	1 (33.3)	0	02 (66.7)	03
Diabetes	0	0	0	0	03 (100.0)	03
Constipation	0	0	0	1 (25.0)	03 (75.0)	04
Hypertension + IHD	0	0	0	0	03 (100.0)	03
Hypertension + IHD	0	0	0	1 (20.0)	04 (80.0)	05
Hypertension + constipation	1 (33.3)	0	0	0	02 (66.7)	03
None of the disease	1 (7.14)	1 (7.14)	1 (7.14)	1 (7.14)	10 (71.43)	14
Total	2 (4.0)	1 (2.0)	3 (6.0)	5 (10.0)	39 (78.0)	50

Figures in parentheses indicate percentage.

APPENDIX-VII

ASSOCIATION OF SLEEPING HABIT WITH REGARD TO AGE, SEX AND
PER CENT OBESITY OF RESPONDENTS

	Sleeping hours				Total
	4-5 hrs	6-7 hrs	8-9 hrs	Above 9 hrs	(n-50)
<u>Age (yrs)</u>					
40-50	2 (6.25)	10 (31.25)	18 (56.25)	02 (6.25)	32
50-60	2 (11.11)	11 (61.11)	05 (27.78)	00	18
<u>Sex</u>					
Male	1 (3.33)	17 (56.67)	12 (40.00)	00	30
Female	3 (15.00)	04 (20.00)	11 (55.00)	02 (10.00)	20
<u>Obesity (%)</u>					
<10	2 (9.52)	08 (38.09)	10 (47.62)	01 (4.76)	21
10-20	0	09 (60.00)	05 (33.33)	01 (6.67)	15
Above 20	2 (14.30)	04 (28.60)	08 (57.10)	00	14

Figures in parentheses indicate percentages.

APPENDIX - VIII

MODE OF TRANSPORT USED BY RESPONDENTS WITH REGARD TO AGE, SEX AND PER CENT OBESITY

Age (yrs)	Car	Scooter	Cycle	Walking	Rickshaw	Car + scooter	Not applicable	Total (n-50)
40-50	4 (12.5)	6 (18.75)	3 (9.37)	3 (9.37)	2 (6.25)	5 (15.6)	9 (28.12)	32
50-60	6 (33.3)	7 (38.89)	2 (11.11)	2 (11.1)	0	0	1 (5.56)	18
Sex								
Male	7 (23.3)	13 (43.3)	5 (16.67)	0	0	5 (16.67)	0	30
Female	3 (15.0)	0	0	5 (25.0)	2 (10.0)	0	10 (50.0)	20
Obesity (%)								
<10	6 (28.57)	4 (19.05)	4 (19.05)	1 (4.75)	1 (4.76)	2 (9.52)	3 (14.28)	21
10-20	2 (13.3)	6 (40.0)	1 (6.67)	3 (20.0)	0	1 (6.67)	2 (13.3)	15
Above 20	2 (14.3)	3 (21.4)	0	1 (7.1)	1 (7.1)	2 (14.3)	5 (35.7)	14

Figures in parentheses indicate percentages.

APPENDIX - IX

FREQUENCY OF CONSUMING MEDICINE WITH REGARDS TO
COMPLICATIONS PRESENT IN RESPONDENTS

Complications	n-50	Subjects consuming medicine	Subjects not consuming medicine
Hypertension	15	7	8
IHD	03	2	1
Diabetes	03	1	2
Constipation	04	2	2
Hypertension + IHD	03	2	1
Hypertension + Diabetes	05	3	2
Hypertension + constipation	03	2	2
None of above	14	0	14

APPENDIX - X

FREQUENCY OF CONSUMING TONIC WITH REGARD TO
COMPLICATIONS PRESENT IN RESPONDENTS.

Complications	N-50	Subjects consuming tonic	Subjects not consuming tonic
Hypertension	15	9	6
IHD	03	2	1
Diabetes	03	1	2
Constipation	04	1	3
Hypertension + IHD	03	1	2
Hypertension + Diabetes	05	2	3
Hypertension + constipation	03	1	2
None of the above	14	0	14

