SUMMARY AND CONCLUSIONS

CHAPTER 6

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Inulin is a wide spread plant carbohydrate present in many food plants. They are linear (β-1) fructans that are polydispersed ranging from 2 to 60 or more, present in significant amounts in several fruits and vegetables (Roberfroid et al 2000). Inulin is used as a prebiotic either for its nutritional advantages or technological properties but it is often applied to offer a dual benefit (Franck 2002). Their average daily consumption has been estimated to be between 1 to 4 g in the US (MoshFegh et al 1999) and 3 to 11 g in Europe (Van Loo et al 1995), the most common sources being wheat, onion, banana, garlic and leek. In a wide variety of food formulations, inulin and oligofructose may significantly improve organoleptic characteristics due to its potential to improve taste and mouthfeel (Franck 2002). Inulin has a much lower solubility, improves the stability of foams and emulsions and shows exceptional fat-like characteristics when used in the form of a gel upon dispersing in water. Scientists have postulated that inulin and other fibers have potential health benefits that include improving or maintaining colon health as a prebiotic, lowering cholesterol and glucose in blood, increasing the absorption of minerals, particularly calcium, and improving immune function (Roberfroid and Salvin 2002). A number of investigations have shown that oligofructose promotes growth of bifidobacteria (Gibson GR, Wang X 1994 a,b) therefore, consumption of a probiotic containing food in combination with a suitable prebiotic (inulin) can result in synergistic effects by providing a readily available substrate for fermentation and increasing the establishment autochthonous *bifidobacteria* in the gut. *Lactobacilli* and *bifidobacteria* are the most frequently used probiotics in humans, and there is evidence that some of these organisms can increase resistance to gut infections by inhibiting pathogens (Yamazaki S et al 1985) and improving host immunity (Sekine K et al 1985). Probiotics and prebiotics (inulin) offer attractive means where by the unfavorable changes in the aging gut can be reduced and a more "healthy" intestinal microbiota can be maintained. This may also help to maintain normal bowel function and reduce susceptibility to infection in older adults. Dramatic reductions in serum triglycerides have been reported in studies with rats, upon addition of fairly high (50-200 g/kg) amounts of fructooligosaccharides to the diet (Levrat MA et al 1995; Delzenne and

Kok 1999). Lipid-lowering ability of prebiotics has been observed in hyperlipidemic and diabetic patients (Yamashita K 1984; Hidaka H et al 1991). Prebiotics are rapidly and completely fermented in the colon and the most common hypothesis for a lipid-lowering mechanism is that the fermentation products, especially propionate reaching the liver by the portal vein, could modulate cholesterol synthesis (Kok et al 1996a).

Dairy products containing *Bifidobacteria* have been shown to improve bowel habits in adults (Bartram et al 1994). Fermented milk is a very good medium for delivery of probiotics along with addition of inulin.

Keeping this background in mind the present study was planned with the following objectives:

1. To determine the inulin content of selected raw and processed Indian foods.
2. To develop and conduct acceptability trials of inulin incorporated products.
3. To study the effect of supplementation of probiotic and synbiotic fermented milk in diets of institutionalized elderlies.

Keeping the above objectives in mind the study was carried out in three phases and the findings of the study are summarized under following heads:

Section 6.1 Determination of Inulin content of selected raw and processed Indian foods.

6.1.1 Inulin content of cereals, pulses, vegetables, fruits and spices.

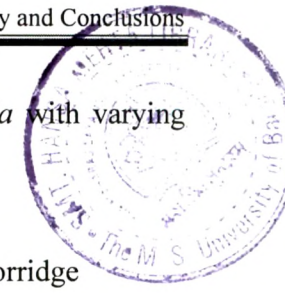
6.1.2 Determination of inulin content of the processed wheat based foods.

Section 6.2 Development and acceptability trials of inulin incorporated products.

6.2.1 Effect of substitution of refined wheat flour in bread with varying levels of inulin

6.2.2 Effect of substitution of fat in cookies with varying levels of inulin

6.2.3 Effect of substitution of whole wheat flour in *chapati* with varying levels of inulin



6.2.3 Effect of substitution of rice pulse flour mix flour in *dhokla* with varying levels of inulin

6.2.4 Effect of varying levels of inulin addition to the *potato bonda*

6.2.5 Effect of varying levels of inulin addition to the cereal pulse porridge

6.2.6 Effect of varying levels of inulin addition to the sweet orange juice

6.2.7 Effect of varying levels of inulin addition to the fermented milk

6.2.8 Proximate composition of all the products

Section 6.3 Effect of supplementation of probiotic and synbiotic fermented milk in diets of institutionalized elderlies.

6.3.1 Background information, activity pattern, anthropometry, disease and health profile of institutionalized older adults

a) Background information of the participants
b) Activity pattern of the older adult participants
c) Anthropometric profile of the older adult participants
d) Biochemical profile of the older adult participants
e) Diet profile of the older adult participants
f) Disease burden of the older adult participants
g) Association of biochemical parameters and various risk factors in older adult participants

6.3.2 Effect of probiotic and synbiotic fermented milk supplementation on various health parameters in the diets of older adults

a) Lipid Profile of the participants
b) Atherogenic indices of the participants
c) Plasma glucose of the participants
d) Changes in hypertension status body composition after supplementation of probiotic and synbiotic supplemented group
e) Lipid profile and atherogenic indices of older adult participants in relation to their initial TC values
f) Lipid profile and atherogenic indices of older adult participants in relation to their initial BMI

g) Lipid profile and atherogenic indices of older adults with hypertension as a complication.
h) Lipid profile and atherogenic indices of older adult participants in relation to both BMI and hypertension as a complication
i) Gut micro flora of participants before and after supplementation of probiotic and synbiotic fermented milk
j) Association between gut microflora and life style factors after supplementation of probiotic and synbiotic fermented milk
k) Gut microflora of the participants in relation to their initial TC values
l) Gut microflora of older adult participants in relation to their initial BMI
m) Gut microflora of older adult participants with hypertension as a complication
n) Gut microflora of older adult participants in relation to both BMI and hypertension as a complication
o) Nutrient intake of the participants before and after supplementation of probiotic and synbiotic supplemented group
p) Haematological indices of elderly subjects before and after supplementation of probiotic and synbiotic group
q) Fermented milk consumption pattern of the older adult participants before and after supplementation of the fermented milk
r) Mental health assessment before and after supplementation of probiotic and synbiotic fermented milk
s) Disease burden of the participants before and after supplementation of probiotic and synbiotic fermented milk

Section 6.1 Determination of Inulin content of selected raw and processed Indian foods.

For this phase of the study, samples of 6 variety of cereals, 5 variety of legumes, 8 samples of fruits, vegetables and spices and 7 samples of processed foods were analysed using HPLC.

The salient observations that emerged out of this phase are as follows:

6.1.1 Inulin content of cereals, pulses, vegetables, fruits and spices.

- Higher content of inulin was detected in garlic (12.7%) and onion (10.2%) followed by wheat (2.3 %), bread (2.2%), fried wheat product '*Puri*' (1.9%), spinach (0.5%), cabbage (0.3%) and brinjal (0.38%).
- Inulin was not detected in the popularly consumed legumes.
- Minor amounts were detected in rice, fenugreek leaves, fenugreek seeds and soyabean.

6.1.2 Determination of inulin content of the processed wheat based foods.

- Amongst the processed wheat products, four percent increase in inulin content was observed during roasting, followed by a loss of 17% in '*puris*' during frying and a maximum loss of 47% in '*steamed wheat porridge*'.

Section 6.2. Development and acceptability trials of inulin incorporated products.

The effect of varying levels of inulin incorporation on the physicochemical and organoleptic properties of bread, cookies, chapati, dhokla, porridge, potato bonda, juice and fermented milk was studied.

6.2.1 Effect of substitution of refined wheat flour in bread with varying levels of inulin

Five types of experimental bread were prepared wherein refined wheat flour was substituted at 5%, 10%, 15%, 20%, 22% level of inulin and its effect was studied on physicochemical and organoleptic characteristics of bread.

The results of physical and organoleptic characteristics of the standard and experimental breads are as follows:

- The loaf weight of the bread ranged from 228 g (standard) to 205 (22% of inulin substituted bread).
- There was gradual decrease in the loaf volume from 525 (standard) to 450 (22 % inulin incorporated bread).
- Water retention in inulin incorporated breads ranged from 30.5 ml (5% level) to 25.9 ml (22% level) against 30.7 ml in standard bread.
- The baking loss was 8.8% in standard bread compared to 18% in 22% inulin substituted bread.

- Significant differences were perceived for appearance, flavor, mouthfeel, aftertaste scores as the level of inulin substitution increased up to 22% level of inulin incorporation
- Bread was well accepted up to 20% level of inulin substitution

6.2.2 Effect of substitution of fat in cookies with varying levels of inulin

Fat in cookies was substituted by varying levels of inulin and the products have been studied for physicochemical and organoleptic properties.

- The average diameter of the control (without inulin) was 4.50 cm whereas that of inulin substituted cookies was from 4.51 cm (5 % level of inulin substitution) to 4.75 cm (20 % level of inulin substitution) whereas for 22% and 25% level the diameter was same as control.
- The average thickness of standard cookie was 0.88 cm and for inulin incorporated cookies ranged from 0.88 cm (5 % level of inulin substitution) to 0.95 cm (25 % level of inulin substitution).
- The spread ratio for the standard cookie was 5.11. The spread factor of cookie containing up to 15% inulin as a substitute of fat was slightly higher than the control thereafter a decrease in the spread ratio was observed for 22% and 25% of inulin substitution.
- Cookies were acceptable up to 20% level of inulin substitution.
- As the level of substitution increased up to 22% and 25% of inulin substitution, significant differences were perceived for softness, texture, flavor and after taste scores of cookies.
- Acceptability scores were higher for 15% level of inulin incorporated cookies

6.2.3 Effect of substitution of whole wheat flour in *chapati* with varying levels of inulin

Whole wheat flour in *chapati* was substituted with inulin at varying levels and was studied for physicochemical and organoleptic properties.

- Cooked weight of the *chapati* decreased 20 g (standard) to 19.39 g (20% level of inulin substitution) with increasing levels of inulin substitution
- The water absorption power varied from 71% (5% level of inulin incorporation) to 65% (20% level of inulin incorporation).

- *Chapatis* were well accepted up to 10% level of inulin substitution.
- As the level of inulin substitution increased upto 15% and 20 %, there was a significant decrease in scores for most of the organoleptic attributes.
- The *chapatis* when compared to the standard on the difference test, no significant difference was observed in organoleptic scores for all the attributes.

6.2.4 Effect of substitution of rice pulse mix flour in *dhokla* with varying levels of inulin

Substitution of rice pulse mix flour with varying levels of inulin was studied on physicochemical and organoleptic properties of *dhokla.*

- The bulk density of the prepared *dhokla* varied from 1.85 g/cc (0% level of inulin substitution) to 1.73 g/cc (20% level of inulin substitution)
- Organoleptic attributes like softness, color, absence of defects, texture and mouthfeel scored similar to the standard *dhoklas* whereas scores of after taste increased with increasing level of inulin substitution.
- Decrease was observed in mean scores for chewability and appearance as the level of substitution increased.
- For all the organoleptic attributes, inulin substituted *dhoklas* were acceptable upto 20% level of substitution.

6.2.5 Effect of varying levels of inulin addition to the *potato bonda*

- Adding inulin at varying levels did gradually increased the cooked weight of the *bondas* from 500 g (standard) to 508 g (20 % level).
- The oil absorbed was 62 g for standard *bondas* where there was decrease in absorption of oil as the level of inulin addition increased.
- There was a non significant increase in the scores for organoleptic attributes like crispness, flavour and after taste as the level of inulin addition increased in the *potato bonda.*
- Inulin enriched *potato bonda* was accepted quite well among the panel members upto 20% level of inulin addition.

6.2.6 Effect of varying levels of inulin addition to the cereal pulse porridge

- As the level of inulin addition increased from 0% level of inulin addition to 20% there was no change in water absorption power.
- Addition of inulin showed a gradual increase in the weight of porridge from 809 g (5% level) to 819 g (20% level).
- Inulin added cereal pulse porridge was acceptable up to 20% level.
- Compared to the standard porridge a non significant increase for all the organoleptic attributes was observed in 15% and 20% level of inulin addition

6.2.7 Effect of varying levels of inulin addition to the sweet orange juice

- The juice recovery for the standard juice prepared by peeling, crushing and pressing the whole sweet oranges was 72%.
- The density of the standard sweet orange juice was 1.1.
- A non significant decrease was observed for scores of color, clarity and appearance as the level of inulin addition increased in sweet orange juice.
- Scores for organoleptic attributes such as consistency, odour, sourness, bitterness and after taste, mouthfeel and overall acceptability were high for 15% and 20% added sweet orange juice when compared to the standard
- Inulin addition at varying levels in sweet orange juice was accepted quite well among panel members up to 20% level of incorporation.

6.2.8 Effect of varying levels of inulin addition to the fermented milk

- The curd enriched with inulin up to the level of 20% was well within the acceptable limits.
- The addition of inulin at all levels had a remarkable improvement in scores of experimental curds for texture and overall acceptability.

6.2.9 Proximate Composition of all the Food Products

- In the products wherein inulin was substituted for the base material i.e bread, *chapati* and *dhokla*, the total moisture, total ash, fat, protein content was low compared standard recipes. Whereas carbohydrate

content and energy value was high in bread *chapati, dhokla* substituted with 20% inulin

- Fat replaced by inulin in cookies showed lower fat content and energy value than the standard cookies whereas addition of inulin increased the energy value of porridge, *potato bonda,* juice and curd without any significant changes in the other nutrients.

Section 6.3 Effect of supplementation of probiotic and synbiotic fermented milk in diets of institutionalized elderlies.

For the study a total of 100 participants were enrolled from old age institutions of Vadodara. Data on background information, activity pattern, anthropometric measurements, biochemical parameters, disease burden, psychological background and nutrient intake was collected for all the participants at the baseline. The salient features of this subsection is given below:

6.3.1 Background information, activity pattern, anthropometry and disease profile of Institutionalized Older Adults at baseline.

a) Background information of the Participants:

- Most of the subjects (48%) aged between 60-70 years.
- The participants group under study had almost equal number of males and females and majority of the subjects (71%) were married.
- Almost all (98%) of the subjects were Hindus.
- 63% of the institutionalized elderlies were literate up to secondary and higher secondary levels.
- Per-capita income of majority of the subjects ranged between Rs 3000-7000/month.

b) ***Activity pattern of the older adult participants***

- Apart from sleep the institutionalized elderlies remained idle for most of their time (7.88 hours), followed by social and religious activities.
- Of all the elderly subjects studied, majority (66%) had sedentary lifestyle.

c) Anthropometric profile and hypertension status of the older adult participants

- The waist hip ratio was slightly higher for males as compared to females in the older adult participants.
- About 56 % of the participants had WHR higher than the recommended standards by Asia Pacific for South Asians.
- Prevalence of overweight was higher among institutionalized older adults using both, WHO (2004) and Asia Pacific (2004) classifications.
- According to Asia pacific classification, 42% of the participants were overweight and 8 % were obese.
- 66% subjects suffered from stage I and stage II hypertension.
- The mean systolic and diastolic blood pressure values reported were 135 mm Hg and 89 mm Hg respectively.

d) Biochemical profile of the older adult participants

- No cases of severe anemia were identified and majority of the participants were under normal and mild categories. Only 10 % of the participants were suffering from moderate anemia.
- The mean fasting blood glucose (117 mg/dl), total cholesterol (207 mg/dl) and low density lipoproteins (133 mg/dl) were slightly above the normal range whereas triglycerides (163 mg/dl) and very low density lipoproteins (32 mg/dl) were under normal range.
- The mean values for atherogenic indices (TC/HDL, LDL/HDL) of the subjects was higher above the normal range.

e) Diet profile of the older adult participants

- The mean intake for energy matched the RDA of 1350 Kcal for females where as it was lower for male subjects.
- Lower intake for protein, fiber and iron were observed for both male and female subjects.
- Intake of fat was high whereas iron and fiber intake was low when compared to RDA in both male and female participants.
- 73% and 44% subjects consumed fruits and vegetable less frequently.
- Almost 60% of the participants had frequent consumption of fat and sugar rich foods.

f) ***Disease burden of the older adult participants at baseline***

- Ninety percent participants had oral cavity problems which included difficulty in chewing due to missing teeth or denture.
- About 86% of the total participant had gastro intestinal problems which included gas, acidity, indigestion and flatulence.
- Fifty four percent of the participants had respiratory problems like cold, cough, running nose.
- Other problems like locomotor (67%), cardiovascular (15%) were also reported by the subjects.
- Geriatric depression scale revealed that 29% of the participants were suffering from mild depression whereas only 15% suffered from moderate and severe depression.

g) ***Association of biochemical parameters and various risk factors in older adult participants at baseline***

- A significant positive correlation was observed for BMI with TG.
- Waist hip ratio and physical activity showed a positive correlation ($p<0.01$) with total cholesterol.
- Low intake of fruits and BMI were significantly correlated with HDL levels.
- Fiber intake significantly co-related systolic and diastolic blood pressure also the GLV consumption co-related significantly with FBS.
- WHR significantly co-related with atherogenic indices such as LDL/HDL, TG/HDL/, TC/LDL and TC/HDL. Also the GLV consumption significantly co-related with TG/ HDL ratio.

6.3.2 Effect of probiotic and synbiotic fermented milk supplementation in the diets of older adults

Out of 100 older adults enrolled, 66 participants were selected and assigned to each of the three groups as Control group (n=20), Experimental group II (Probiotic fermented milk supplementation group) (n=20), Experimental group III (Synbiotic milk fermented supplementation group) (n=26). Pre and post intervention data of the selected older adults was collected.

a) ***Lipid Profile of the participants***

- Fermented milk supplementation resulted in 3.57% reduction in probiotic supplemented group ($p< 0.05$) and 6.9% reduction in synbiotic supplemented group ($p< 0.001$) with respect to TC values, with known significant rise in the HDL levels.
- A significant reduction in TG (4.3%) and LDL levels (8.3%) in group III was observed.
- A non significant reduction was seen in serum triglyceride levels of group II participants (2.96%)

b) ***Atherogenic indices of the participants***

- A significant reduction was seen in the atherogenic indices (LDL: HDL, and TC: HDL) in participants of group III whereas such reductions were not observed in group II participants.
- With regards to gender, reduction was observed for atherogenic indices in both male and female participants in group II and group III.
- Significant reduction was seen for TC: HDL ratio in male participants of group III.

c) ***Plasma glucose of the participants***

- Supplementation resulted in a statistically significant reduction of 5.2% and 7.8% in fasting plasma glucose values in group II and group III respectively.
- Little variation was seen in FBS levels with regard to gender, as the response was better in males of probiotic and synbiotic supplemented groups as compared to females.

d) ***Changes in hypertension status and body composition after supplementation of probiotic and synbiotic supplemented group***

- Significant reduction was observed in systolic and diastolic blood pressure from 142 to 137 and 92 to 89 mm Hg in the synbiotic supplemented group respectively whereas a non significant reduction was observed in the probiotic supplemented group.

- Significant variation was observed in blood pressure values with regards to gender as the response was better in male participants of synbiotic fermented milk supplemented group as compared to females.
- There was 1.15% decrease in BMI values ($p<0.001$) in the synbiotic supplemented group compared to a non significant 0.44% decrease in BMI values in the probiotic group.
- Statistically significant reduction was observed in BMI of male and female participants of group III.

e) ***Effect of probiotic and synbiotic fermented milk supplementation on the lipid profile and atherogenic indices of older adult participants in relation to their initial TC values***

- There was a 10.73% fall in TC, 13.04% in LDL-C and 5.47 % in TG in synbiotic fermented milk supplemented group with initial level of TC >210 mg/dl .
- A 7.29% reduction was observed in TG after 6 weeks of synbiotic fermented milk supplementation in participants who had TG>150 mg/dl.
- TG/HDL which represents the small dense lipoprotein was significantly lowered in participants having TG> 150 mg/dl (3.19 vs 2.88).
- A significant reduction was also observed in LDL/HDL and TC/HDL ratios.

f) ***Effect of probiotic and synbiotic fermented milk supplementation on the lipid profile and atherogenic indices of older adult participants in relation to their initial BMI***

- Favourable changes in the lipid profile and atherogenic indices of the experimental participants were seen in overweight and obese participants as compared to those who had BMI <23 in group II and group III participants.
- There was a significant decrease in TG, VLDL, TG/HDL, LDL/HDL, TC/HDL synbiotic fermented milk supplemented group participants with initial BMI>23.

g) ***Effect of probiotic and synbiotic fermented milk supplementation on lipid profile and atherogenic indices of older adults with hypertension as a complication.***

- Higher reduction was observed for TC, TG, LDL-C, and VLDL-C in older adult participants who suffered from hypertension of group II and group III than the normotensive subjects.
- There was a significant decrease in TC values with a corresponding increase in HDL values of hypertensive older adult participants in both the supplemented groups.
- Atherogenic indices were significantly lowered in hypertensive older adults after synbiotic fermented milk supplementation

h) ***Effect of probiotic and synbiotic fermented milk supplementation on lipid profile and atherogenic indices of older adult participants in relation to both BMI and hypertension as a complication***

- Probiotic fermented milk supplementation did not have significant impact on lipid profile of older adult participants who were overweight and hypertensive.
- A significant reduction in TC and LDL–C was observed in group III participants having both BMI and hypertension as a complication.

i) ***Gut micro flora of participants before and after supplementation of probiotic and synbiotic fermented milk***

- The mean log values in CFU/g (wet weight) increased significantly for *Bifidobacteria* (from 7.90 to 8.23) and *Lactobacilli* (6.43 to 6.86) in group II participants whereas the increase was higher ($p<0.001$) in synbiotic supplemented group for *Bifidobacteria* (from 7.82 to 8.58) and *lactobacilli* (6.92 to 7.65).
- Statistically significant reduction were observe in mean log counts of *E.coli* was observed from 6.66 to 6.28 and from 6.51 to 5.88 in probiotic and synbiotic group respectively.
- A significant increase in establishment of *Lactobacilli* was observed in male participants of group II and group III whereas the subjects

supplemented with synbiotic fermented milk shown significantly higher establishment of *bifidobacteria* and significant reduction in *E.coli* only in the male participant

- The bacterial species identified in stool samples of elderly subjects were B. bifidum, B. longum, B.brevis, L. acidophilus, L. casei, L. bulgaricus and L. leishmanii.

j) ***Association between gut microflora and life style factors after supplementation of probiotic and synbiotic fermented milk***

- Supplementation with probiotic and synbiotic fermented milk resulted in a negative correlation between TC, LDL-C, TC:HDL-C and beneficial microorganisms i.e. *bifidobacteria* and *lactobacilli.*
- A positive correlation was observed between establishment of *E.coli* and atherogenic parameters whereas establishment of *bifidobacteria, lactobacilli* and *E.coli* could be significantly correlated with TG, VLDL, and TG: HDL and FBS in group III participants only.

k) ***Gut microflora of the participants in relation to their initial TC and TG values***

- An increase in mean log counts of *lactobacilli* ($p<0.05$), *bifidobacteria* and significant decrease in mean log counts of *E.coli* ($p<0.05$) in older adult participants of group II and group III was observed in participants.
- Total cholesterol and triglycerides has an independent effect on the establishment of beneficial microflora in the gut in both the supplemented groups.

l) ***Gut microflora of older adult participants in relation to their initial BMI***

- BMI has an independent effect on the reduction in *E.coli* and establishment of beneficial microflora in the synbiotic fermented milk.

m) ***Gut microflora of older adult participants with hypertension as a complication***

- Hypertension does not have any independent effect on the rise in beneficial microflora in the gut in both the supplemented groups.

n) ***Effect of probiotic and synbiotic fermented milk supplementation on gut microflora of older adult participants in relation to both BMI and hypertension as a complication***

- Subjects with two complications such as BMI and hypertension did not exhibit an independent effect on the establishment of lactobacilli and E.coli in both the groups whereas an independent effect was observed in the establishment of bifidobacteria.

o) ***Nutrient intake of the subjects:***

- There was a significant increase in energy and calcium intake in the probiotic group.
- A decrease was observed for energy intake compared to a significant increase in calcium and fibre intake in synbiotic supplemented group.

p) ***Hematological indices of elderly subjects***

- There was 0.95% and 1.55% rise in hemoglobin levels in group II and group III ($P<0.01$) after supplementation of probiotic and synbiotic fermented milk.

q) ***Fermented milk consumption pattern***

- Majority of elderly subjects (81.8%) preferred curd in their diets at the beginning of study period.
- Individuals who preferred curd in their diets had occasional to once a week consumption of curd.
- The major reason for avoiding curd by elderly subjects was cough and cold followed by acidity and open wounds.

r) ***Mental health assessment before and after supplementation of probiotic and synbiotic fermented milk***

- 65% and 65.9% participants were normal at the baseline as compared to 80% and 76.9% after supplementation in probiotic and synbiotic groups respectively

s) ***Disease Burden of the elderly subjects:***

- 100% of the participants in both experimental groups had oral cavity problems.
- Supplementation resulted in decrease in the number of participants reporting gastrointestinal problems and respiratory problems, locomotor and problems of central nervous system with greater reduction seen in the synbiotic supplemented group that the probiotic supplemented group.
- There was decrease in the episodes of acidity, constipation, indigestion, gas formation, and stomachaches the being more prominent in group II than group III.
- After supplementation of probiotic and synbiotic fermented milk for a period of 6 weeks no participant reported problem of constipation whereas 65% to 15%; 76% to 26% participants reported reduction in acidity respectively (significant at $p < 0.05$)
- There was reduction in participants reporting reversal from episodes of flatulence from 25 % to 0% and 26% to 10% in both the groups respectively.
- Regarding respiratory problems there was decrease in percent participants reporting occurrence of cold from 30% to 0%; 38% to 20%, spells of sneezing from 15% to 5%; 31% to 15%, breathlessness from 15% to 5%; 19% to 5% in probiotic and synbiotic fermented milk supplemented groups.

CONCLUSIONS

Following conclusions can be drawn from the results obtained in the present study:

- HPLC analysis was found to be useful technique for the determination of inulin content of commonly consumed Indian foods.
- The results will allow for the quantification of inulin in the average daily diet of Indians.
- The data from this study will provide added information to the current database for inulin content of commonly consumed foods as well as its contribution to health.
- Acceptability trials of inulin incorporation in food products selected have shown that processing conditions does not affect the organoleptic attributes in foods and can be added or substituted up to 20% level in all the foods and acceptable chapatis can be prepared with 10% inulin incorporation.
- Inulin can be substituted (bread, cookies, chapati, dhokla) and added as dietary fibre to (cereal pulse porridge, juice, Potato bonda and in baked products as fat replacer (cookies).
- Regular consumption (daily) of 100 g of probiotic and synbiotic fermented milk (100 g of probiotic fermented milk with added 15 g of inulin) by the older adults for a period of 6 weeks in daily diet with moderately raised blood lipids, significantly reduces FBS and total cholesterol.
- A significant reduction in the serum TG (4.5%), LDL levels (8.3%) and a rise in hemoglobin levels was seen only in the synbiotic fermented milk supplemented group.
- The colonization of beneficial bacteria (Bifidobacterium and Lactic acid bacteria) improved significantly in both the experimental groups along with a reduction in E. coli in the gut.
- Supplementation with probiotic and synbiotic fermented milk resulted in a negative correlation between TC, LDL-C, TC:HDL-C and beneficial microorganisms.