The Pharma Innovation Journal 2021; 10(3): 412-416

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2021; 10(3): 412-416

www.thepharmajournal.com
Received: 11-01-2021
Accepted: 27-02-2021

Dr. Mamoni Das
Principal Scientist, All India Coordinated Research Project on Home Science, Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Pranati Das
Professor and HOD, Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Lipika Chatterjee
Senior Research Fellow, All India Coordinated Research Project on Home Science, Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Asha Gohain
Technical Assistant, All India Coordinated Research Project on Home Science, Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Corresponding Author:
Dr. Mamoni Das
Principal Scientist, All India Coordinated Research Project on Home Science, Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Impact of fibre supplement on the Obesity related risk factors

Dr. Mamoni Das, Pranati Das, Lipika Chatterjee and Asha Gohain

Abstract
Background: Obesity is a heavy burden of multiple and serious, co-morbidities including metabolic syndrome, type 2 diabetes and cardiovascular diseases. Being obese can have a serious impact on health consequences such as cardiovascular disease, type 2diabetes, musculoskeletal disorders, etc. may cause premature death and substantial disability. This study was aimed to assess the efficacy of developed high fibre supplement made from locally available food resource on the management of obesity.
Results: A randomized clinical trial on 30 obese subjects was carried out for a period of 120 days. The supplementation was provided to meet 1/3rd daily requirement of calories. The supplement had protein content of 13.42±0.56g/100g, fat 2.39±0.23g/100g, energy 335.31±2.42kcal/100g, carbohydrate 61.84±0.62g/100g and dietary fibre25.35±0.12g/100g. At the end of the intervention programme, significant reduction ($p< 0.05$) in weight (67.74±7.99kg to 55.38±8.38kg) leading to reduction in body mass index (29.27±2.54kg/m^2 to 23.13±2.61kg/m^2), reduction in hip circumference (99.27±3.76cm to 90.12±3.11cm) and waist circumference (88.77±2.96cm to 81.28±2.89cm) was observed. Significant decrease ($p< 0.05$) in total cholesterol, triglyceride, LDL, HDL and VLDL was observed at the end of intervention period.
Conclusion: This intervention study showed desirable effects on body weight and biochemical parameters and provides substitutional evidence that high fibre supplement can reduce obesity and related risk factors.

Keywords: Obesity, fibre, dietary intervention, body mass index, lipid profile

1. Introduction
Obesity is a condition of excessive fat accumulation in the body that leads to impaired health conditions. Obesity is one of the risk factors for morbidity and mortality including type 2 diabetes, cardiovascular, osteoarthritis, malignant and metabolic diseases [1]. Person having BMI value of 23 to 24.99kg/m^2 are classified as overweight and 25 and above as obese [2]. The prevalence of obesity in India varies due to age, gender, geographical environment, socio-economic status, etc. Overweight and obesity are posing great threat to the health of the people of India in both urban and rural areas as with increasing industrialization and urbanisation, the standards of living also rise, which results in weight gain. The prevalence of obesity was more in urban areas, educated and affluent population (26.2%) than in rural area (16.72%).The rural agricultural population is still unaware of the hazards of obesity, though the epidemic is fast seeping into the rural areas too. In India, the increased levels of obesity areprimarily associated with the transformation from rural to urban lifestyle with low physical activity, excessive intake of high energy foods, poor consumption of fruits and vegetables and smoking and drinking alcohol which in turn promotes obesity [3], which leads to excessive fat accumulation in the body that later on leads to a failure to regulate normal physiological processes, and increases the risk of chronic diseases like diabetes, certain cancers, cardiovascular diseases, hepatic diseases, gallstones and gastrointestinal disturbances [4]. Modern lifestyle associated with easy access and consumption of high salt, sugar and fat food, lack of exercise, sedentary lifestyle, calorie dense foods and excessive television viewing contribute to the development of non-communicable diseases. A primary factor in controlling and preventing obesity and associated chronic diseases is through effective nutrition, health education giving emphasis to physical activity, as well as wellness living. A dietary regime of high fibre and protein rich food could be a primary solution to overcome obesity. Considering the importance of dietary fibre rich foods, the present study was planned to develop and evaluate the efficacy of high fibre supplement for the management of obesity among farm women.

Methods

Standardization of fibre rich supplement

A Ready to Use (RTU) high fibre supplement was developed using fibre rich locally available food ingredient such as whole wheat, red rice, roasted bengal gram flour and roasted green gram flour, kidney beans, fenugreek leaves. All the ingredients used for the preparation were procured from the local market of Jorhat district and RARS Gossaingaon, Kokrajhar. Fenugreek leaves were washed thoroughly, blanched for one minute, dried in cabinet dryer at 60 ºC and madeinto flour. Further, whole green gram and Bengal gram were cleaned, roasted and made into flour. The high fibre mix was prepared by mixing all the flours in standardized proportions and kept in HDPE pouches for further nutrient analysis and product development.

Organoleptic evaluation

Organoleptic evaluation was done in the Department of Food Science and Nutrition, Sensory testing laboratory by a panel of 10 semi trained judges from the Department of Food Science and Nutrition and Department of Food Science and Technology for evaluating the sensory attributes using 9 point hedonic scale.

Nutrient analysis

Proximate composition of developed high fibre mix was analyzed using standard Association of Official Analytical Chemists protocol [5]. Further, carbohydrate content was calculated by differential method and calorific value was obtained by multiplying the carbohydrate and protein content by four and fat by nine. Dietary fibre was analyzed by an enzymatic gravimetric method and micronutrients *viz*., iron, zinc and calcium were analyzed by atomic absorption spectrometer and flame photometer [6].

Anthropometric measures

Height, body weight, BMI, MUAC, WC and HP measurements were obtained with participants wearing lightweight clothing and no shoes. Weight was measured using a electronic measuring balance, height was measured using anthropometric rod with feet parallel and placed together, and arms hanging at the sides in a natural manner, MUAC, WC and HP were measured with the help of measuring tape. Body Mass Index (BMI) and Waist/Hip ratio was calculated based on anthropometric measurements by following the method outlined by.

Biochemical assessment

Blood samples of the selected obese subjects were drawn by trained technicians under the medical supervision and analyzed for lipid profile under clinical setting at baseline and also at the end of the 120 days intervention. Blood samples were collected after 12 hour of fasting using traditional methods of antecubital venepuncture, under aseptic conditions. The samples were then processed after 1hr of collection at room temperature, and then analyzed by enzymatic colorimetric method for lipid profile using Human Analyzer.

Sample selection

Randomized trial was conducted and a total of 260 farm women were screened from five villages namely *PirakataBhorolua, DewanBhorolua, Napam Bhorolua, Mudoijan Bhorolua and Badulipukhurimazgaon* of *Sipahikhula* block of Jorhat district with age as criteria from18-50 years. Out of the screened subjects, only 60 subjects having BMI>22.99 were selected for the study for a period of 120 days and divided into two groups namely control group and experimental group using 30 samples in each group. (Fig 1).Prior to intervention study, a written consent was obtained from the selected subjects for their willingness to participate in the dietary intervention and an Institutional ethical committee was obtained.

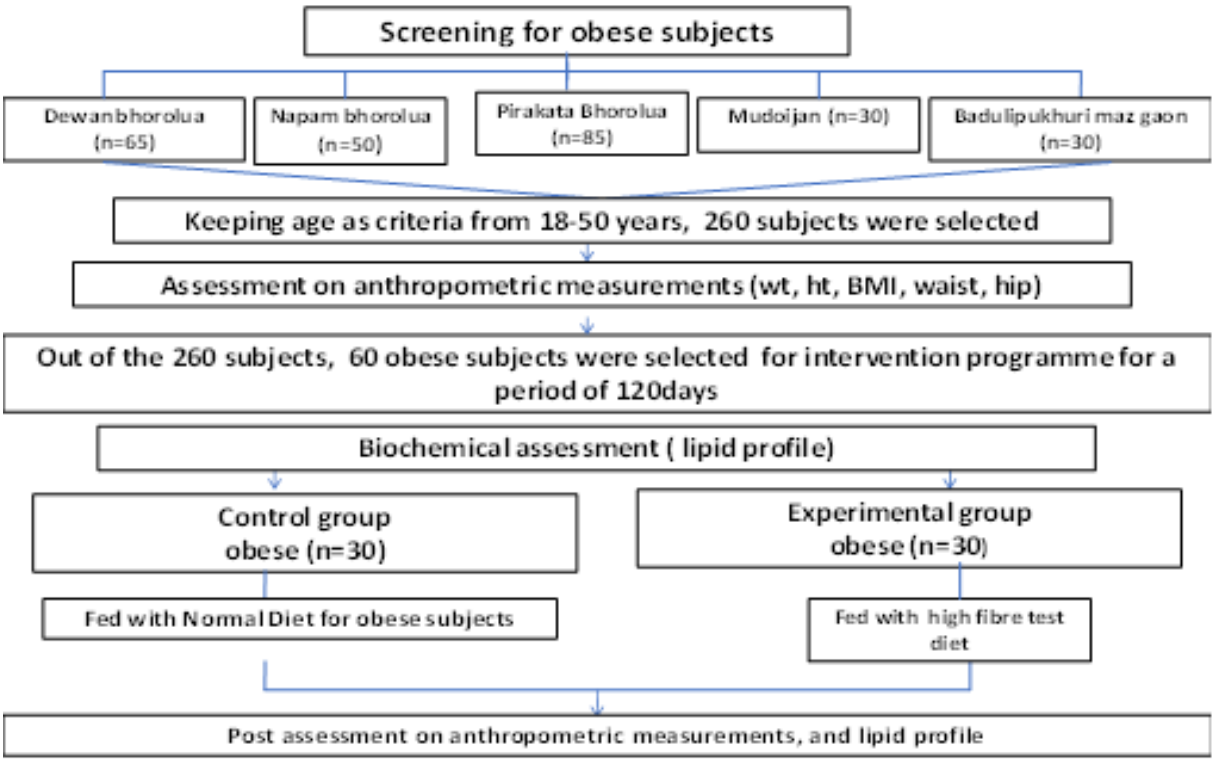

Fig 1: Flow chart of subjects participating in the study

Dietary intervention

Food based dietary intervention was carried out for a period of 120 days. Control group (n=30) was fed with their normal diet and the experimental group (n=30) was fed on a test diet consist of 125g of high fibre supplement either in breakfast or dinner in the form of Roti. The amount fed to the experimental group was calculated based on the guideline provided by National Institute of Nutrition. To meet the 1/3rd requirement of calories, it was fixed to provide 458 kcal from the supplementation. Therefore, the high fibre supplement was fixed to be 125g as it contains 420kcal and the rest of the calories (38kcal) will be derived from the adjuncts consumed along with the *roti* prepared from fibre rich supplement taken mostly in the breakfast or dinner. Pre and post anthropometric measurements and biochemical profile of the subjects were measured accordingly.

Data Analysis: The data obtained were analyzed using IBM SPSS Statistics 20. Mean and standard deviation were calculated for each studied variable. Statistical differences between pre and post evaluation results of the experimental and control groups were assessed using paired t-test with significance at $p< 0.05$.

Results and Discussion

Organoleptic evaluation of the *Roti* developed from high fibre supplement: The standardized product namely *Roti* was prepared and was evaluated organoleptically for various quality attributes like colour and appearance, flavour, texture, taste and overall acceptability using a 9 point hedonic scale (Fig 2). The sensory scores were found to be highly acceptable. The scores obtained for overall acceptability was 7.90±0.59, taste was 8.00±0.71, colour was 7.40±0.51, flavour was 7.80±0.57 and texture was found to be 7.60±0.53.

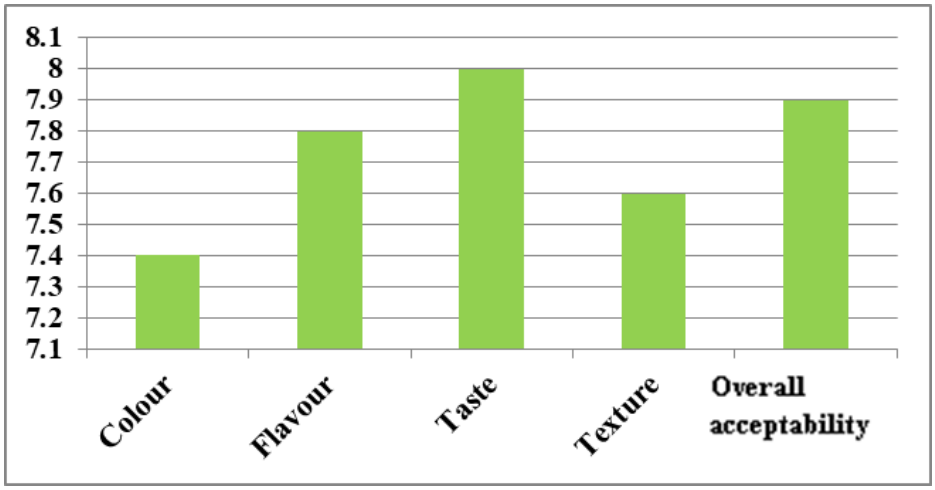

Fig 2: Sensory evaluation scores of product prepared from high fibre supplement

Nutrient composition of the developed high fibre supplement

The proximate composition, mineral composition and dietary fibre of the formulated mix were analyzed using standard methods and are presented in Table 1. The developed high fibre supplement contains 9.64±0.04g/100g of protein, 3.11±0.03g/100g of crude fibreand 25.35±0.09g/100g of dietary fibre. The carbohydrate and energy content were 67.18±0.13g/100g and 358.79±0.21kcal/100g respectively. The iron and calcium content wasfound to be 5.61±0.08mg/100g and 105.64±0.24mg/100g respectively. The use of kidney beans, whole Bengal gram and whole green gram may be the contributing factors for higher proteinand low carbohydrate content because legumes are an excellent source of good quality protein with 20-45% protein that is rich in the essential amino acid lysine. The high protein content can be attributed to their association with the activity of the nitrogen-fixing bacteria in their roots, which converts the unusable nitrogen gas into ammonium which the plant then incorporates into protein synthesis. Several studies have suggested that the consumption of legumes could aid in weight loss. This could be attributed to the low fat and high dietary fibre nature of legumes. The low GI nature of legume carbohydrates also aids in stabilising blood sugar and insulin levels resulting in the consumer feeling satiated for increased periods of time. This in turn results in less and infrequent eating which is ideal for weight management [7]. Many studies revealed that legumes helps to enhance the functioning of the cholecystokinin hormone making the body feel full after eating and also improves the metabolism rate, thus contributing to controlling weight. Incorporation of green leafy vegetables in addition to whole grainsincreased the dietary fibre content. Several epidemiological studies showed an inverse relationship between dietary fibre intake and weight loss [8]. Fibres have the ability to displace the energy from other nutrients by adding bulk and weight to the meal. Thus, increasing the satiety and decreasing the intake of food. Many studies have shown that low fat, high protein diets also increase weight loss and mitigate reduction in fat free mass [9. 10] by increasing the production of hormones like PYY and GLP-1, both of which helps to feel full and satisfied. GLP-1 or Glucagon-like-peptide-1, is a naturally occurring incretin (hormone), is released subsequent to food intake and stimulates the secretion of insulin, inhibits the release of glucagon, delays gastric emptying, and decreases food intake through increased satiety. Gut hormones play an important role in appetite regulation, and GLP-1 is one of the significant gut hormones which helps in suppressing glucagon secretion and delaying gastric emptying, its positive effects on weight loss results from its actions in the brain, where it induces satiety, thereby reducing food intake [11]. In addition, high protein diet also helps to reduce levels of ghrelin (hunger hormone), responsible for stimulating hunger.

Table 1: Nutrient composition of high fibre supplement

Nutrients	Quantity (per 100g)
Moisture (g)	9.76±0.42
Crude protein (g)	13.44±0.56
Crude fat (g)	2.39±0.23
Total minerals (g)	2.48±0.02
Crude fibre (g)	10.11±0.04
CHO (g)	61.84±0.62
Energy (Kcal)	335.31±2.42
Total dietary fibre (g)	25.35±0.12
Iron (mg)	5.61±0.03
Calcium (mg)	105.64±1.31
Zinc (mg)	2.11±0.03

Anthropometric assessment of the obese subjects

Anthropometric indices play a major role in the nutritional status of an individual at various age groups. The anthropometric parameters of the obese volunteers are presented in Table 2. Significant decrease in the mean weight was observed after 120days of fed with test diet from 67.74±7.99kg to 55.38±8.28kg.The mean Body Mass Index (BMI) significantly reduced (p<0.05) from 29.45±2.54kg/m^2 to 23.13±2.61kg/m^2. Mean waist and hip circumference of the experimental group decreased significantly (p< 0.05) from 88.77±2.96cm to 81.28±2.89cm and 99.27±3.76cm to 90.12±3.11cm respectively. Significant decrease (p< 0.05) in the anthropometric measurements may be due to the inclusion of high amount of dietary fibre [12]. Dietary fibre is a type of carbohydrate that cannot be easily digested [13]. Sufficient fibre in the diet tend to prevent excessive food intake and fat accumulation by decreasing the calorie density of the diet, slowing rate of food ingestion, promoting intestinal satiety and interfering with efficiency of energy absorption, thus reducing the body weight [14]. Several epidemiological studies showed an inverse relationship between dietary fibre intake have the ability to displace the energy from other nutrients by adding bulk to the meal, thereby decreasing the intake of food[8]. Protein diets acts as a promising strategy for weight loss by providing the twin benefits of improving satiety and decreasing fat mass by increasing the secretion of satiety hormones (GIP, GLP-1) and reducing the orexigenic hormone secretion (ghrelin) [15]. The incretin hormone like Glucagon-like-peptide-1 (GLP-1), is secreted from the gut and is likely to be a physiological regulator of appetite and food intake. The decreased gastric emptying observed with GLP-1 may contribute to weight loss as it is known that gastric retention is also associated with decreased food intake thereby reducing weight [16]. GIP (glucose-dependent insulinotropic polypeptide) is also a gut incretin hormone which effects lipid metabolism. GIP stimulates insulin secretion, suppress lipolysis in adipose tissue, induce appetite and reduce energy expenditure in the brain which may lead to weight loss. In addition, high protein diet also helps to reduce levels of ghrelin (hunger hormone), responsible for stimulating hunger and is released primarily from cells in the stomach and travels to the brain [11].

Table 2: Mean anthropometric measurements of obese subjects

Parameter	Control			Experimental		
	Pre	Post	t value	Pre	Post	t value
Height (cm)	152.00±0.08	152.00±0.08	-	152.00±0.08	152.00±0.08	-
Weight (kg)	67.24±6.98	69.45±5.83	1.49^{NS}	67.74±7.99	55.38±8.28	24.32*
BMI (kg/m2)	29.27±0.84	30.04±1.09	19.06*	29.45±2.54	23.13±2.61	22.26*
Waist circumference (cm)	85.25±1.68	87.19±1.81	9.98*	88.77±2.96	81.28±2.89	18.01*
Hip circumference (cm)	94.78±3.03	96.78±2.13	5.43*	99.27±3.76	90.12±3.11	16.29*
Waist to hip ratio	0.90±0.01	0.90±0.02	0.10^{NS}	0.89±0.02	0.91±0.16	4.96*

Significance at p=<0.05
NS: Non-significant

Impact of fibre rich supplement on the biochemical profile of the Obese subjects: Biochemical result showed significant reduction (p<0.05) in the total cholesterol, triglyceride, LDL, HDL and VLDL among the experimental group (Table 3).Supplementation trial of high fiber supplement on obese subjects showeda significant reduction (p< 0.05) in the serum cholesterol level from an initial value of 185.67±24.17mg/dl to 164.47±21.09mg/dl. Significant decrease (p< 0.05) in the serum triglycerides, serum HDL cholesterol, serum LDL cholesterol and VLDL cholesterol from 147.47±34.62mg/dl to 131.93±28.87mg/dl, 49.10±10.18mg/dl to 45.17±8.16mg/dl, 94.87±16.48mg/dl to 85.97±13.36mg/dl and 27.27±7.99mg/dl to 25.13±5.73mg/dl respectively when compared to the control group. The decrease in the lipid profile of the subjects supplemented with high fibre multigrain mix may be due to the presence of dietary fibre which helps to alter the absorption of fat and cholesterol, either by binding bile acids or by increasing small intestinal viscocity [14]. Dietary fibre in legumes have the potentiality to lower total cholesterol, LDL and triglyceride level in blood by binding bile acids or cholesterol during the intraluminal formation of micelles in intestinal wall during absorption [17]. The physicochemical properties of dietary fibre alter the metabolic pathways of cholesterol and lipoprotein metabolism, resulting in lowering of plasma LDL-cholesterol [18]. The fiber binds with bile acids cholesterol during the formation of micelles (viscous gel like structure), which results in reduction of cholesterol content of hepatic cells. This results in up-regulation of the LDL receptors and further increases clearance of LDL cholesterol from the blood circulation. This gel formation also slows gastric emptying, maintains satiety and helps in reducing weight [19, 20]. Alternatively, dietary fibre may also alter serum sex hormone concentrations, which could affect the lipid metabolism.

Table 3: Impact of fibre rich supplement on the biochemical profile of the obese subjects

Parameters	Control (Normal diet)			Experimental (Test diet)		
	Pre	Post	t value	Pre	Post	t value
Total serum cholesterol(mg/dl)	158.63±22.01	163.41±24.31	7.23*	185.67±24.17	164.70±21.09	8.79*
Serum triglycerides(mg/dl)	129.63±30.92	133.13±34.02	7.22*	147.47±34.62	131.93±28.87	6.38*
Serum HDL cholesterol (mg/dl)	46.59±6.08	48.00±7.35	5.47*	49.10±10.18	45.17±8.16	4.57*
Serum LDL cholesterol(mg/dl)	83.44±15.05	86.06±15.72	5.79*	94.87±16.48	85.97±13.36	5.66*
Serum VLDL cholesterol (mg/dl)	24.18±6.70	25.91±7.31	4.54*	27.27±7.99	25.13±5.73	4.06*
Total cholesterol / HDL ratio	3.43±0.47	3.52±0.53	1.92^{NS}	4.05±1.24	3.82±0.89	2.79*
LDL/HDL ratio	1.87±0.32	1.89±0.34	0.53^{NS}	2.01±0.49	1.98±0.44	1.26*

Significance at p=<0.05
NS: Not significance

Conclusion
The present study shows anassociation between high fibre intake and low BMI and lipid profile in obese populations.In conclusion, evidences show that dietary fibre enriched diet may beneficially influence all parameters of weight management and metabolic disorders related to obesity. Fibre in the diet helps to increases the satiety by different effects contributing to disrupt the mechanisms leading to positive energy balance. As the prevalence of obesity is increasing rapidly in most India, management of obesity through dietary modification, weight control and regular exercise are the main approaches towards the management of obesity.Therefore, a dietary approach in which foods rich in saturated fatty acids and simple sugars are substituted with fibre-rich food is suitable for managing obesity related risk factors.

Acknowledgments
The research team acknowledges the Indian Council of Agricultural Research (ICAR) - Central Institute for Women in Agriculture (CIWA), Government of India and Assam Agricultural University, Jorhat, Assam for funding the research.

Ethical committee approval
Institutional ethical committee clearance certificate was obtained prior to the initiation of the intervention study (Ref No. AAU/CS/FSN/IEC/2018-19/709 and approved on 06.07.2018).

Conflicts of interest
The authors declare no conflict of interest.

References
1. Chau JV, Van der HP, Merom D, Chey T, Bauman AE. Cross sectional associations between occupational and leisure-time sitting, physical activity and obesity in working adults. Preventive medicine 2012;54:195-200.
2. Lad Hasit D, Vasudha KC. A study of the levels of urinary microalbumin in non- diabetic normotensive obese individuals. Adv Biol Chem 2012;2:171-175.
3. Laht-Koshi M, Pietinen P, Heliovaara M, Vartiainen E. Association of body mass index and obesity with physical activity, food choices, alcohol intake and smoking in the 1982-1997 FINRISK Studies. The American J. of Clinical Nutri 2002;75:809-817.
4. Eslick GD. Gastrointestinal symptoms and obesity: a meta-analysis. Obesity Reviews 2012;13:469-479
5. AOAC. Official Methods of Analysis (17ed.). Association of Official Analytical Chemists, Washington DC, 2000,231-236, 413-420p.
6. Aboagarib AAE, Yang R, Hua X, Azhari S. Chemical compositions, nutritional properties and volatile compounds of Guddaim (GrewiaTenax. Forssk) Siddeeg 2014;2:187-192.
7. Maphosa Y, Jideani VA. The role of legumes in human nutrition 2017. Doi:10.5772/interchopen.69127
8. Koh-Banerjee P, Rimm EB. Whole grain consumption and weight gain: A review of the epidemiological evidence, potential mechanisms and opportunities for future research. Proce Nutr Soc 2003;62:25-29.
9. Flechtne MM, Boehm BO, Wittmann R, Thoma U, Ditschuneit HH. Enhanced weight loss with protein enriched meal replacements in subjects with the metabolic syndrome. Diabetes Metab Res Rev 2010;26:393-405.
10. Layman DK, Evans EM, Erickson D, Seyler J, Weber J, Bagshaw D *et al*. A moderate protein diet produces sustained weight loss and long-term changes in body composition and blood lipids in obese adults. J Nutr 2009;139:514-521.
11. Suzuki K, Jayasena CN, Bloom SR. The gut hormones in appetite regulation. J. Obes 2011,528401
12. Geetha K, Geetha YM, Hiremath N. Effect of high fibre food mix on lipid profile and body weight in obese subjects. Biomedical Research 2019;30(4):655-658.
13. Itallie TB. Dietary fibre and Obesity. Am J Clin Nut 1978,43-52
14. Narayan S, Lakshmipriya N, Vaidya R, Ramya M, Sudha V, Krishnaswamy K *et al*. Association of dietary fibre intake with serum total cholesterol and low density lipoprotein cholesterol levels in Urban Asian-Indian adults with type 2 diabetes. Ind. J. of Endocrinology and Metab 2014;18(5):624-630
15. Dominik HP, Varman TS. A high-protein diet for reducing body fat: mechanisms and possible caveats. Nutrition & Metabolism 2014;11:53
16. Holst JJ. Incretin hormones and the satiation signal. Int. J. Obes 2013;37:1161-1168
17. Mackie AR, Macierzanka A, Balazs HB. Sodium alginate decreases the permeability of intestinal mucus 2016.
18. Fernandez ML. Soluble fiber and non digestible carbohydrate effects on plasma lipids and cardiovascular risk. Curr Opin Lipidol 2001;12:35-40.
19. Bowman BA, Russell RM. Present Knowledge in Nutrition. 9th ed. International Life Science Inst.; Washington DC 2006,592.
20. Whitney EN, Rolfes SR. Understanding Nutrition. 8th ed. Minn: West Publishing Co 1999,140-145