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Body compositional changes of overweight / obese adults with rice bran incorporated pasta – a feeding trial

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ABSTRACT

The effect of rice bran in reducing the weight of the overweight / obese individuals was carried out with the following objectives: to conduct the feeding trial for overweight / obese adults for a period of three months and assess the impact of feeding on the body composition, anthropometry and biochemical profile of the adults. Forty overweight / obese women (each 20) in the age group of 30 to 60 years with no other complications formed the basis for inclusion in the study. Assessment of body composition for the selected women was carried out using Biospace Inbody 720. Each adult was fed with 75 grams (uncooked) of rice bran pasta in the form of recipes during the lunch. Biochemical parameters among the overweight and obese adults before and after the feeding trial was analysed. Statistical analysis revealed that there was no significant change after the feeding trial. The body protein increased from 7.04 to 7.09 kg among the overweight and from 7.41 to 7.48 kg among the obese adults. Soft lean mass had increased from 33.9 to 34.05 kg in overweight adults and from 35.74 to 36.04 kg in obese adults. Body fat mass among the overweight adults reduced to 29.09 kg after the feeding trial. A high degree of positive correlation ($P<0.01$) was observed between fat free mass and protein, total body water, soft muscle mass and mineral among overweight and obese adults. In conclusion, the results indicate that the feeding trials with rice bran incorporated pasta at 15 per cent level for overweight and obese adults did not significantly contribute to the reduction of overweight and obesity.

Introduction

In India, the situation is quite alarming and the disease profile is changing rapidly. According to doctors say, a sedentary lifestyle combined with an increase in the consumption of fatty food and alcohol is to blame causes of obesity, diabetes, hypertension etc (Obesity-Social Report, 2008). As of 2005 the WHO estimates that at least 400 million adults (9.8 per cent) are obese, with higher rates among women than men (WHO, 2000). As of 2008, the World Health Organization claimed that 1.5 billion adults, 20 years and older, were overweight and of these over 200 million men and nearly 300 million women were obese (WHO, 2004). South-East Asia is presently undergoing nutrition transition, hence immediate efforts to collect data to set goals or a target to reduce its prevalence is needed. In Northern India, obesity was most prevalent in urban populations (male = 5.5 per cent, female = 12.6 per cent), followed by the urban slums (male = 1.9 per cent, female = 7.2 per cent). Obesity rates were the lowest in rural populations (male = 1.6 per cent, female = 3.8 per cent) (Yadav Krishna, 2008). Socioeconomic class also had an effect on the rate of obesity especially with respect to living conditions and nutritional intake. Diet composition is one of the factors that can influence its development - high-fat, high-sucrose and varied “cafeteria” diets may induce obesity (Anon, 2005 and Haslam, 2007).

Rice bran, a by-product of the rice milling process used as animal feed contains various antioxidants that impart beneficial effects on human health. A major rice bran fraction contains 12 to 13 per cent oil and highly unsaponifiable components (4.3 per cent). It contains high levels of both tocopherols and tocotrienols, which compromise vitamin E and act as antioxidants in the body. High levels of a mixture of complex compounds referred as oryzanol in rice bran act as an antioxidant, improves solubility in cell membranes and potentially lowers the plasma levels of various parameters of the lipid profile by competitive inhibition of absorption and synthesis. Rice bran also contains a high level of dietary fibres and large concentrations of several compounds that could potentially prevent chronic diseases such as coronary heart disease and cancer including obesity. Therefore, in the present study, an attempt has been made to report the effect of rice bran in reducing the weight of the overweight / obese individuals.

Objectives

The study was carried out with the following objectives:

- To conduct the feeding trial on for overweight / obese adults for a period of three months.
- To assess the impact of feeding on the body composition, anthropometry and biochemical profile of the adults.

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Materials and Methods

Selection of subjects

The study was conducted among the adults employed in an educational institution in Coimbatore in Tamil Nadu State. Forty overweight / obese women (each 20) in the age group of 30 to 60 years with no other complications formed the basis for inclusion in the study. Overweight / obese adults were selected based on the WHO classification of obesity with BMI 25-29.99 for overweight and 30-34.99 for obese class I adults (WHO 1995, WHO 2000 and WHO 2004). The adults with an implantable electrical device such as pacemaker, defibrillator, nerve stimulator or women within the first twelve weeks of pregnancy were excluded from the study. Women were screened for overweight and obesity using height, weight and BMI (anthropometric measurements) for age as parameters.

Assessment of body composition

Assessment of body composition for the selected women was carried out using Biospace Inbody 720 which gives a quantitative value for the various body compartments that equals the weight of each compartment, when put together it equals the person's weight. These obtained values were compared with the normal values. Body composition analyser works on the principle of Bioelectrical Impedance Analysis (BIA). BIA provides a useful technique for body composition analysis in healthy individuals and in those with a number of chronic conditions such as mild-to-moderate obesity, diabetes mellitus, and other medical conditions (National Institute of Health Technology, 1994). Parameters assessed include body composition analysis (proteins and minerals), muscle fat analysis (Skeletal Muscle Mass - SMM and Body Fat Mass – BFM), obesity diagnosis (Body Mass Index - BMI, Per cent Body Fat - PBF and Waist Hip Ratio - WHR) and fitness score. The test was carried out on an empty stomach and bladder. It was ascertained that the subjects did not carry out any exercise 4 to 6 hours prior to the test. While carrying out the test, the person was asked to wear light clothing, with all the ornaments removed and stand straight with the arms away from the sides without touching the body. The details such as name of the adult, height, age and sex were entered in the instrument and after complete assessment, a data sheet was obtained for interpretation.

Biochemical assessment

Biochemical assessment basically works on the principle that any variation in the quantity and composition of the diet is reflected by changes in the concentration of nutrients or their components in tissues and body fluids and or by appearance or disappearance of specific substances i.e. metabolites. Measuring these essential dietary constituents would, therefore, help assess the nutritional status. Biochemical profile namely lipid profile (total cholesterol, triglycerides, HDL, LDL and VLDL) was assessed for all the adults of the feeding trial initially before the start and at the end of the feeding programme. The blood samples were drawn from the adults using an experienced lab technician from a National Accreditation Board for Testing and Calibration Laboratories (NABL) after an overnight fasting.

Conduct of feeding trial

A feeding trial was carried out for 40 overweight and obese adults (experimental group I - 20 overweight adults and experimental group II – 20 obese adults) with rice bran incorporated pasta for a period of three months. Overweight / obese adults who expressed their willingness to be a part of the feeding trial formed the group for feeding rice bran incorporated pasta. Based on the extensive study carried on the sensory evaluation using trained panel members with rice bran incorporated pasta at 5, 10, 15 and 20 per cent levels it was observed that 15 per cent rice bran incorporated pasta was more acceptable compared with others. Hence rice bran pasta incorporated at 15 per cent level was selected for the feeding trial. Several recipes were developed and acceptability trials were carried out using the most acceptable form (15 per cent) of pasta. The recipes with high acceptability were used for the feeding trial in order to break the monotony in taste and to include all the food groups in the feeding trial. The recipes included dhal pasta, pasta pongal, vegetable pasta, cabbage peas pasta, curd pasta, capsicum pasta, mint peas pasta, coriander peas pasta, palak pasta and channa pasta. Each adult was fed with 75 grams (uncooked) of rice bran pasta in the form of recipes during the lunch along with a vegetable / raita / salad and buttermilk. Pasta recipes were prepared and packed in disposable aluminium foiled boxes and served during lunch to the adults of the feeding trial. Along with the main course, a vegetable / raita / salad and buttermilk packed in disposable containers covered with lid was also served. Proper care was ensured to maintain cleanliness and hygiene during the preparation of the lunch like cleaning and washing the vegetables, cooking pasta, packing, serving etc.

An ethical clearance was obtained from the University Human Ethical Committee for the conduct of the feeding trial (HEC.2011.12).

Statistical analysis and interpretation of data

Statistical tools namely 't' test and correlation tests were used to interpret the data obtained and to draw conclusions.

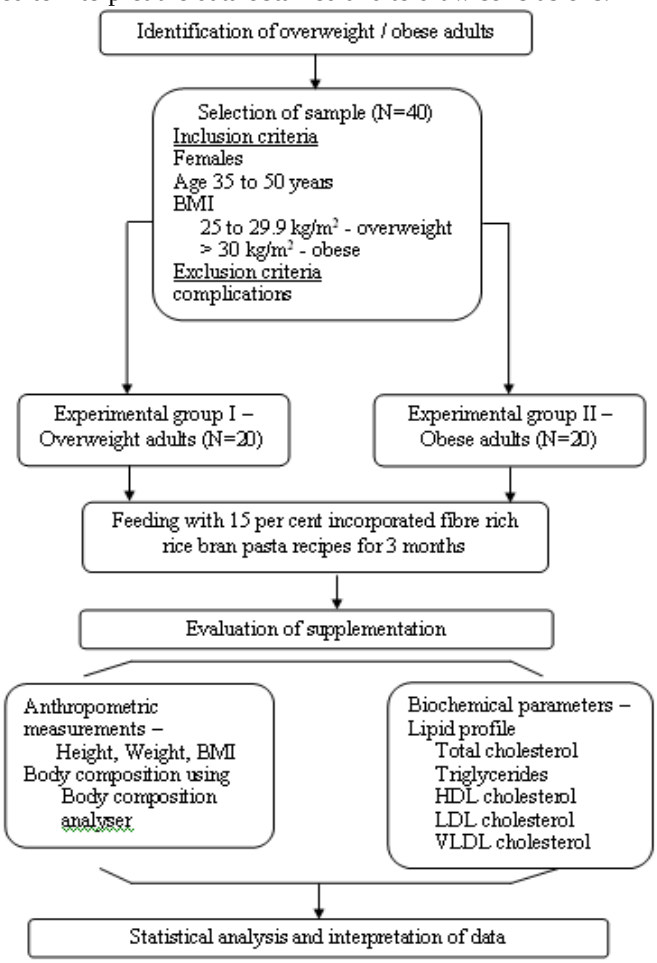

Figure 1. Methodology of the study

Results and Discussion

Nutritional composition of the rice bran pasta

Based on the extensive study carried out, it was observed that 15 per cent incorporation of rice bran was more acceptable compared with others. Hence nutrient analysis was carried out in this most acceptable form used for the feeding trial in IICPT, Thanjavur (Table I).

Table I
Nutritional Composition of 15 per cent Incorporated Rice Bran Pasta

Nutritional composition	Quantity in 100 g of rice bran pasta	Quantity in 75 g of the supplement
Moisture	10.94 g	8.20 g
Carbohydrates	75.57 g	56.67 g
Protein	6.94 g	5.20 g
Fat	2.85 g	2.14 g
Fibre	1.47 g	1.1 g
Ash	2.23 g	1.67 g
Phosphorus	682.1 mg	511.57 mg
Calcium	9.81 mg	7.35 mg
Potassium	8.59 mg	6.44 mg
Sodium	7.69 mg	5.76 mg
Iron	2.06 mg	1.54 mg
Zinc	4.03 mg	3.02 mg

It was found that the macronutrients present in 100 g of rice bran pasta was 75.57 g carbohydrates, 6.94 g protein, 2.85 g fat and 1.47g fibre. It had a moisture content of 10.94 g per 100 g. Rice bran had a mineral content of 682.1 mg phosphorus, 9.81 mg calcium, 8.59 mg potassium, 7.69 mg sodium, 2.06 mg iron and 4.03 mg zinc.

75 g of rice bran pasta contained 8.2 g carbohydrate, 56.67 g protein, 2.14 g fat and 1.1 g fibre. Other minerals included phosphorus, calcium, potassium, sodium, iron and zinc with 511.57 mg, 7.35 mg, 6.44 mg, 5.76 mg, 1.54 mg and 3.02 mg respectively.

Anthropometric measurements of the adults

Table II presents the anthropometric measurements namely weight, BMI, WHR, arm circumference and Arm Muscle Circumference (AMC) of the adults of the feeding trial.

The initial weight among overweight adults was found to be 65.95 kg which has reduced to 65.79 kg with a difference of 0.16 kg after three months feeding with rice bran pasta. But an increase in weight was observed from 76.35 to 76.43 kg with a difference of 0.08 kg among the obese adults. This decrease and increase in weight among overweight and obese adults had reflected in BMI, arm circumference and arm muscle circumference. An increase in BMI among overweight adults from 27.39 to 27.48 with an increase of 0.09 and from 32.69 to 32.73 with an increase of 0.04 among obese adults was seen. A reduction in arm circumference of 0.09 cm and arm muscle circumference of 0.05 cm in overweight adults was seen. But an increase in arm circumference of 0.2 cm and arm muscle circumference of 0.15 cm was noticed among obese adults. No change was observed in the WHR in both the groups. A comparison of the anthropometric parameters of the overweight and obese adults was found to be statistically not significant.

Biochemical parameters

The biochemical parameters of overweight and obese adults are presented in Table III.

The total cholesterol, triglycerides, LDL and VLDL cholesterol levels of the overweight and obese adults were well within the range of normal values. The HDL cholesterol levels were less than the normal values and the values decreased by 3.04 mg/dl in the overweight adults and increased by 0.93 mg/dl among the obese adults. An increase in the values of total cholesterol, triglycerides, LDL and VLDL cholesterol levels were seen after a three month period of feeding trial. But still the values were within the normal level except for LDL cholesterol which was slightly higher than the normal values.

On comparing the biochemical parameters among the overweight and obese adults before and after feeding statistical analysis revealed that there was no significant change after feeding trial. A significant increase at 1 per cent level in the LDL cholesterol and decrease at 5 per cent level in the HDL cholesterol levels among overweight adults were seen after the feeding trials.

Body composition measures of the adults

Body composition measures of the overweight and obese adults is presented in Table IV.

The protein content of the adults were well within the normal range of 6.8 to 8.3 kg. Over a period of three months of feeding trial it was observed that among the overweight adults, the protein increased from 7.04 to 7.09 kg and among the obese adults from 7.41 to 7.48 kg. Soft lean mass a component of the protein had increased from 33.9 to 34.05 kg in overweight adults and from 35.74 to 36.04 kg in obese adults with an increment of 0.15 kg in overweight and 0.3 kg of obese adults. Both protein and soft lean mass reflects good nutritional status of the adults.

A very little increase of 0.01 kg of minerals was seen among the overweight adults from 2.56 to 2.57 kg and a little more increase of 0.04 kg from 2.62 to 2.66 kg was observed among the obese adults and was in the normal range of 2.31 to 2.83 kg. This level of normal range of the mineral content indicates the low risk of osteoporosis among the adults. Mineral mass is closely related to soft lean mass. Hence in the present study also, an increase was observed in mineral, protein and soft lean mass among the adults.

Body fat mass reflects the body fat stored under the skin and in the abdomen which should be maintained by an adult for their standard weight. Body fat mass among the overweight adults was 29.25 kg initially which reduced to 29.09 kg after the feeding trial with a small decrease of 0.16 kg and was not statistically significant. Only a small difference of 0.2 kg was observed among the obese adults with initial and final values of 38.4 kg and 38.2 kg respectively.

The initial per cent body fat in overweight and obese adults were 44.7 and 50.26 per cent respectively. Per cent body fat is the percentage of body fat to body weight. The per cent body fat in the present study was doubly high when compared with the normal values of 18 to 28 per cent for females. As there was a decrease in the body fat a difference of 0.25 and 1.22 per cent of body fat was observed in overweight and obese adults with 44.45 and 49.95 per cent body fat after three months period of feeding trial.

Fat free mass refers to any body tissue that contains no fat. Fat free mass includes water, protein, bone mineral, soft tissue mineral and glycogen. As there was an increase in all the parameters mentioned an increase of 0.2 kg and 0.32 kg was seen in fat free mass of overweight and obese adults respectively.

A decrease of 0.58 cm^2 and 1.16 cm^2 was seen in visceral fat area of overweight and obese adults during the feeding trial. Visceral fat is the fat potentially stored around the abdominal organs is a risk indicator of developing cardiovascular disease, type 2 diabetes, high lipids and hypertension.

Table II
Anthropometric Measurements

Parameters	Standard value	Overweight				Obese			
		Initial	Final	Difference	't' value	Initial	Final	Difference	't' value
Weight (kg)		65.95±7.61	65.79±7.38	-0.16	0.36NS	76.35±6.08	76.43±5.72	+0.08	0.23NS
BMI (kg/m2)	25-29.9 30-34.99	27.39±1.58	27.48±1.81	+0.09	0.55NS	32.69±1.65	32.73±1.51	+0.04	0.26NS
WHR	0.75-0.8	0.92±0	0.92±0	0	0	1±0	1±0	0	0.23NS
Arm Circumference (cm)		31.82±1.61	31.73±1.67	-0.09	0.56NS	35.89±1.89	36.09±2.05	+0.2	0.59NS
Arm Muscle Circumference (cm)		23.40±0.92	23.35±0.97	-0.05	1.03NS	25.25±0.81	25.40±0.84	+0.15	0.85NS

NS Not Significant

Table III
Biochemical Parameters

Parameters	Standard value	Overweight				Obese			
		Initial	Final	Difference	't' value	Initial	Final	Difference	't' value
Total cholesterol	<200 mg/dl	173.85±30.67	178.61±22.65	+4.76	1.15NS	175.58±30.66	181.02±30.21	+5.44	0.78NS
Triglycerides	<150 mg/dl	103.75±45.06	113.46±60.32	+9.71	1.07NS	101.37±22.54	109.92±23.74	+8.55	1.53NS
HDL cholesterol	>50 mg/dl	41.60±7.31	44.64±8.54	-3.04	2.7*	43.19±9.32	44.12±9.18	+0.93	0.64NS
LDL cholesterol	<100 mg/dl	102.83±22.57	109.15±20.83	+6.32	3.37**	107.19±26.87	115.17±28.24	+7.98	1.39NS
VLDL cholesterol	<40 mg/dl	20.76±9.01	22.7±12.06	+1.94	1.07NS	20.27±4.50	21.98±4.74	+1.71	1.53NS
TC-HDL ratio		4.25±0.92	4.13±0.88	-0.12	1.26NS	4.24±1.18	4.25±1.06	+0.01	0.03NS

*Significant at 5 per cent level; ** Significant at 1 per cent level; NS Not Significant

Table IV
Body Composition Measures

Parameters	Standard value#	Overweight				Obese			
		Initial	Final	Difference	't' value	Initial	Final	Difference	't' value
Protein (kg)	6.8-8.3	7.04±0.72	7.09±0.72	+0.05	1.06NS	7.41±0.57	7.48±0.59	+0.07	1.05NS
Soft lean mass (kg)	33.8-41.1	33.9±3.47	34.05±3.44	+0.15	0.66NS	35.74±2.79	36.04±2.83	+0.3	1.03NS
Mineral (kg)	2.31-2.83	2.56±0.26	2.57±0.27	+0.01	0.71NS	2.62±0.27	2.66±0.23	+0.04	1.76NS
Fat free mass (kg)	35.9-43.6	36±3.69	36.2±3.68	0.2	0.77NS	37.92±2.98	38.24±3.02	+0.32	1.04NS
Body fat mass (kg)	9.8-15.7	29.25±4.4	29.09±4.53	-0.16	0.46NS	38.40±3.97	38.2±3.56	-0.2	0.84NS
Per cent body fat	18-28	44.70±3.62	44.45±3.66	-0.25	0.69NS	50.26±2.27	49.95±2.15	-0.31	1.22NS
Skeletal muscle mass (kg)	18.5-22.5	19.28±2.22	19.36±2.22	+0.08	0.58NS	20.38±1.77	20.55±1.81	+0.17	0.98NS
Visceral fat area (cm2)		118.03±18.52	117.45±18.96	-0.58	0.575NS	157.95±22.27	156.79±20.65	-1.16	1.01NS

Reference range as per 'In Body 720' body composition analyser data for normal subjects

NS Not Significant

In this feeding trial a positive trend was seen among the adults decreasing the risk of health complications.

No significant change was observed in the body composition parameters of the adults before and after feeding with rice bran incorporated pasta.

Correlation between body composition variables

The correlation between various body composition variables is shown in Table V.

Table V
Correlation between Body Composition Variables in Overweight and Obese Adults

Parameters	Overweight	Obese
BFM Vs PBF	0.775**	0.588*
BFM Vs FFM	0.388NS	0.514NS
BFM Vs TBW	0.387NS	0.501NS
BFM Vs Protein	0.345NS	0.503NS
BFM Vs Mineral	0.426NS	0.609*
FFM Vs Protein	0.997**	0.997**
FFM Vs TBW	1**	0.999**
FFM Vs SMM	0.997**	0.997**
FFM Vs Mineral	0.947**	0.95**
Protein Vs SMM	0.999**	0.998**
Mineral Vs BCM	0.921**	0.929**

*Significant at 5 per cent level
** Significant at 1 per cent level
NS Not significant

A high degree of correlation was seen between body fat mass and per cent body fat among overweight adults (significant at 1per cent level) and obese adults (significant at 5per cent level). No correlation was observed between body fat mass and fat free mass, total body water, protein among overweight and obese adults and was not statistically significant. Positive correlation was seen between BFM and mineral among obese adults and was significant at 5 per cent level. But no correlation was seen in overweight adults.

A high degree of positive correlation ($P<0.01$) was observed between fat free mass and protein, total body water, soft muscle mass and mineral among overweight and obese adults.

A positive correlation was seen between protein and soft muscle mass and is an indicator of good nutrition. This positive trend was statistically significant at one per cent level. Similar trend was seen between mineral and bone cell mass and is significant at one per cent level.

Relation between WHR and body composition variables

The relationship between WHR and body composition variables is given in Table VI.

Table VI
Correlation between WHR and Body Composition Variables

Parameters	Overweight	Obese
WHR Vs BFM	0.159NS	0.046NS
WHR Vs PBF	0.624*	0.68*
WHR Vs FFM	-0.659*	-0.686*
WHR Vs Protein	-0.669*	-0.664*

*Significant at 5 per cent level; NS Not significant

A positive correlation was seen between WHR and per cent body fat and was significant at 5 per cent level. Whereas the negative correlation between WHR and fat free mass and protein was significant at one per cent level. These results are in par with results obtained by Merchant *et al* (2005).

Correlation between weight and body composition variables

Table VII gives the relationship between weight and body composition variables.

Table VII
Correlation between Weight and Body Composition Variables

Parameters	Overweight	Obese
Weight Vs BFM	0.808**	0.893**
Weight Vs PBF	0.288NS	0.16NS
Weight Vs FFM	0.819**	0.845**
Weight Vs TBW	0.818**	0.837**
Weight Vs Protein	0.799**	0.837**
Weight Vs SMM	0.8**	0.839**
Weight Vs Mineral	0.798**	0.877**
Weight Vs BCM	0.798**	0.839**

** Significant at 1 per cent level
NS Not significant

A high degree of positive correlation was observed between weight and other body composition variables namely body fat mass, fat free mass, total body water, protein, soft muscle mass, mineral and bone cell mass and was statistically significant at one per cent level among overweight and obese adults. No correlation was observed between weight and per cent body fat.

Relation between BMI and body composition variables

Table VIII gives the relationship between BMI and other body composition variables.

Table VIII
Correlation between BMI and Body Composition Variables

Parameters	Overweight	Obese
BMI Vs BFM	0.883**	0.597*
BMI Vs PBF	0.81**	0.29NS
BMI Vs FFM	0.164NS	0.336NS
BMI Vs Mineral	0.136NS	0.344NS
BMI Vs Protein	0.106NS	0.206NS

*Significant at 5 per cent level
** Significant at 1 per cent level
NS Not significant

A positive correlation was seen between BMI and body fat mass and was statistically significant at 1per cent level among overweight and at 5 per cent level among obese adults. But no significant change was seen between BMI and fat free mass, total body water, mineral and protein before and after feeding trials with rice bran incorporated pasta.

Conclusion

In conclusion, the results indicate that feeding trials with rice bran incorporated pasta at 15 per cent level for overweight and obese adults did not contribute towards the prevention of overweight and obesity. Body composition and biochemical parameters were not modified by nutritional recovery with rice bran. Finally, the expected modulator role of fibre in rice bran in reducing the weight of the adults was not verified. Long term feeding of rice bran pasta may bring out tangible results for overweight / obese individuals.

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