

Research Article

Effect of High Fiber Biscuit Supplementation on the Anthropometric Measurements, Selected Biochemical Parameters and Blood Pressure Levels in Obese Women

Rajeshwari K and D. Annette Beatrice*

Women's Christian College, Chennai, Tamil Nadu, India.

ABSTRACT

Globally, the prevalence of chronic, non communicable diseases is increasing at an alarming rate. The prevalence of overweight and obesity has also increased substantially in the nutritional transition countries, and the health burden of obesity-related complications is growing. Biscuits and cookies represent the largest category of snack items among baked foods all over the world and are generally made with refined flour and hydrogenated fat which increases the risk of obesity. The trans fat present in these raises the low-density lipoprotein and lowers the high-density lipoprotein. It also increases the level of triglycerides which may contribute to hardening of the arteries. Hence, this study aimed to develop a biscuit which is healthy with high fibre and high protein content by using horse gram, green gram and barley as a replacement for refined cereals and also replacing rice bran oil rich in MUFA and PUFA for saturated fat. The sensory quality is assessed using 5 point score card. The effect of the high fibre biscuit supplementation on anthropometric measurements, selected biochemical parameters and blood pressure levels were assessed. The sensory analysis revealed that the newly developed biscuit had a very good acceptability score. The newly developed high fibre biscuit when supplemented for obese women, had a positive effect on the anthropometric measurements, selected biochemical parameters and blood pressure levels by reducing the body weight, total cholesterol, LDL-c, VLDL-c, TG and fasting plasma glucose level and blood pressure levels and increasing the HDL cholesterol significantly.

INTRODUCTION

In the past 20 years, the rates of obesity have tripled in developing countries that have been adopting a western lifestyle involving decreased physical activity and overconsumption of cheap, energy-dense food (Hill and Peters, 2005). Worldwide, at least 2.8 million people die each year as a result of being overweight or obese, and an estimated 35.8 million (2.3%) of global DALYs are caused by overweight or obesity. Overweight and obesity lead to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Mortality rates increase with increasing degrees of overweight, as measured by body mass index (WHO, 2011). Consumption of processed foods, eating outside home and nibbling between meals is accompanied by increased rates of obesity and growing risks of chronic diseases (Becquey et al., 2010). Biscuits and cookies represent the largest category of snack items among baked foods all over the world. It has become one of the most desirable snacks for children and adults due to their low cost, taste

and shelf life. The refined cereal, saturated fat and trans fat present in the traditional biscuit are replaced with legumes such as horse gram and green gram, whole grains cereal like barley, and saturated fat being replaced by unsaturated fat would make the product attractive and tasty and at the same time provide a product that could alleviate symptoms leading to chronic diseases. The unsaturated fatty acid lowers LDL cholesterol and improve overall heart health (Mensink et al., 2003).

MATERIALS AND METHODS

Objectives

1. To develop a high fibre biscuit and to evaluate the sensory quality using a 5 point score card.
2. To assess the nutritional status of the women using anthropometric parameters, selected biochemical parameters, blood pressure levels and dietary intake.
3. To study the effect of the newly developed high fibre biscuit on the anthropometric measurements, selected biochemical

parameters and blood pressure levels of obese women (experimental group) before and after supplementation and compare the same with obese women (control group) without any supplementation.

Design of the Study

The study was a pre-test, post-test experimental design. The study was designed to determine the effect of a newly developed high fibre biscuit on the anthropometric measurements, selected biochemical parameters and blood pressure levels of the subjects before and after supplementation.

Selection of Samples

The subjects were selected based on purposive sampling technique. Twenty four obese subjects were selected for the study. Twelve subjects were assigned to the control group and twelve subjects to the experimental group.

Criteria for Selection of Samples

- Women in the age group of 25-50 years participated in the study.
- Obese women with no complications
- Subjects who were not on any other supplementation.
- Willingness of the subjects to participate in the study.

Duration of the Study

The study was carried out for a period of 45 days. The anthropometric measurements, biochemical parameters and clinical parameters were assessed on the 1st day and 46th day.

Development and Sensory Quality Assessment of Newly Developed High Fibre Biscuit

A high fibre biscuit was developed using maida, horse gram, barley, green gram and rice bran oil. The refined cereal, saturated fat and trans fat present in the traditional biscuit are replaced with legumes such as horse gram and green gram, whole grains cereal like barley, and saturated fat being replaced by unsaturated fat. The acceptability of the newly developed high fibre biscuit was checked by a panel of judges using sensory method of evaluation. The panel members were briefed about the purpose of the study and they were instructed on the method of scoring. The high fibre biscuit was evaluated using a 5 point score card. The high fibre biscuit was evaluated for attributes like appearance, colour, texture, taste, flavour and over-all

acceptability and was given a maximum score of 5 for excellence and a minimum score of 1 for poor quality.

Assessment Parameters

Anthropometric measurements were used to assess the obese women. Height, body weight, waist circumference, hip circumference were measured and the anthropometric indices like body mass index and waist-hip ratio were calculated.

Biochemical Parameter

The blood samples for biochemical analysis were drawn after a 12- hour overnight fasting. The following biochemical estimations were carried out in the clinical laboratory, Chennai.

- Estimation of fasting plasma glucose concentration by the Hexokinase method.
- Estimation of serum total cholesterol levels by the CHOD-PAP enzymatic method.
- Estimation of serum HDL cholesterol by the direct enzyme clearance method
- Estimation of serum triglyceride by the GPO-PAP method

The subjects were briefed about the significance of the study by the investigator and they were instructed to be in a 12 hour fasting state and requested to report at the Department of Home Science, Women's Christian college, Chennai between 7.00 am to 8.00 am for blood collection. The experimental and control group women were assessed for the anthropometric parameters such as height, body weight, waist circumference and hip circumference. The biochemical parameters such as fasting plasma glucose and serum lipid profile were assessed and blood pressure level were recorded before and after the study period. The newly developed high fibre biscuit was given as a supplement to the experimental group and they were instructed to consume them as a mid-morning or as evening snack or can also distribute the biscuit throughout the day as per their convenience, for a period of 45 days. The obese women received three biscuits per day as a replacement of their daily snacks such as fried items (vada, bajji, samosa and chips) and bakery products (cakes, puffs, pasteries and cookies). The biscuits were hygienically packed in sealed plastic covers and handed over to the subjects personally by the investigator daily. The feedback and compliance was assessed through questionnaire. The subjects in the control group were not given any

supplementation and were requested to follow their habitual dietary pattern. The effect of the newly developed high fibre biscuit on the anthropometric measurement, selected biochemical parameters, blood pressure levels and dietary intake of obese women was assessed after the supplementation period (46th day) and compared with the anthropometric measurement, selected biochemical parameters, blood pressure levels and dietary intake of the control group after the study period.

RESULTS AND DISCUSSION

Sensory Quality

The sensory quality was assessed for the attributes appearance, colour, taste, texture, flavour and overall acceptability and the mean sensory scores of high fibre biscuit is given in table 1.

The attribute taste had the highest mean score of 4.2 to a maximum mean score of 5.0. This is followed by texture and flavour with the mean score of 4.0. The newly developed high fibre biscuits had an overall acceptability of 4.0 to a

maximum mean score of 5.0. The newly developed biscuit had a very good acceptability score.

Anthropometric Measurements

The mean values of the anthropometric measurements of the experimental group is given in Table 2.

It can be observed that in the experimental group, the mean body weight of the subjects decreased after the supplementation. Consequently, the calculated body mass index of the subjects also decreased after supplementation. The decrease in the body weight ($p \leq 0.00$) and BMI ($p \leq 0.000$) was found to be highly significant. The decrease in hip circumference ($p \leq 0.017$) was also found to be statistically significant. The waist circumference ($p \leq 0.086$) and waist-hip ratio ($p \leq 0.468$) decreased after supplementation, but it was not statistically significant.

The mean values of the anthropometric measurements of the control group is given in Table 3.

Table 1: Mean Scores of Attributes of High Fibre Biscuits

	Appearance	Colour	Taste	Texture	Flavour	Overall Acceptability
High Fibre Biscuit	3.7	3.7	4.2	4.0	4.0	4.0

Table 2: Mean values of the Anthropometric Measurements of the Experimental Group

Variables	Experimental group (N=12)				
	Before Mean±S.D	After Mean±S.D	Mean difference	't' value	'p' value
Height (cms)	160±0.06	160±0.06	-	-	-
Body Weight (kg)	86.27±15.13	84.09±15.55	↓2.18	4.70	0.000
BMI(kg/m ²)	33.7±4.96	32.9±5.18	↓0.8	4.94	0.000
Waist circumference (cm)	100.9±11.2	99.3±10.1	↓1.6	1.92	0.086
Hip circumference(cm)	117.9±13.78	116.8±13.74	↓1.1	2.90	0.017
Waist-hip ratio	0.86±0.06	0.85±0.06	↓0.01	0.75	0.468

Table 3: Mean values of the Anthropometric Measurements of the Control Group

Variables	Control group (N=12)				
	Before Mean±S.D	After Mean±S.D	Mean difference	't' value	'p' value
Height (cms)	156±4.40	156±4.40	--	---	---
Body Weight (kg)	77.66±10.87	78.53±11.26	↑0.92	-4.01	0.002
BMI(kg/m ²)	31.87±3.66	32.22±3.80	↑0.39	-4.03	0.002
Waist circumference (cm)	94.08±5.9	94.50±6.2	↑0.42	-3.10	0.010
Hip circumference (cm)	99.83±6.03	100.10±6.21	↑0.25	-2.60	0.026
Waist- hip ratio	0.85±0.04	0.85±0.04	↑0.004	-1.94	0.078

It is observed that in the control group, the mean body weight of the subjects increased after the study period and therefore, the calculated Body Mass Index of the subjects also increased after the study period. The mean waist circumference, hip circumference of the subjects increased and there was no change in the mean waist-hip ratio (0.85 ± 0.04) of the subjects comparing before and after the study period. The increase in the body weight ($p \leq 0.002$), BMI ($p \leq 0.002$), waist circumference ($p \leq 0.002$), hip circumference ($p \leq 0.010$) was found to be statistically significant. There was no significant difference in the waist-hip ratio.

Biochemical Parameters

The mean values of serum lipid profile of the experimental group is given in Table 4

It is observed that in the experimental group, the mean serum total cholesterol, LDL-c, VLDL-c, TG and fasting plasma glucose level of the subjects was found to decrease after the supplementation. The mean HDL cholesterol of the subjects before the supplementation was 39.67 ± 5.87 mg/dl and it increased to 44.58 ± 6.14 mg/dl after the supplementation.

The decrease in the total serum cholesterol level ($p=0.006$), TG ($p=0.002$), LDL-c ($p=0.008$), VLDL-c ($p=0.008$) was found to be statistically significant. The decrease in the fasting plasma glucose level ($p=0.000$) was also found to be highly significant. The increase in the HDL-c

($p=0.002$) was found to be statistically significant.

The mean values of serum lipid profile of the control group is given in Table 5

In the control group the mean serum total cholesterol, LDL-c, VLDL-c, TG and fasting plasma glucose level of the subjects increased after the study period. The mean HDL cholesterol was found to be 58.04 ± 7.50 mg/dl before the study period and it decreased to 56.50 ± 7.80 mg/dl after the study period.

The increase in the total serum cholesterol level ($p < 0.00$) was found to be highly significant. The increase in the LDL-c ($p < 0.001$), VLDL-c ($p=0.041$), TG ($p=0.001$) and fasting plasma glucose level ($p < 0.030$) was found to be statistically significant. The decrease in the HDL cholesterol ($p < 0.001$) was also found to be significant.

Blood Pressure Levels

In the experimental group, the mean systolic blood pressure decreased from 127.90 ± 7.8 mmHg to 127 ± 7.7 mmHg and diastolic pressure decreased from 83.7 ± 4.0 mmHg to 82.5 ± 3.5 mmHg. The difference was not statistically significant. In the control group the systolic blood pressure increased from 121 ± 8.3 mmHg to 122 ± 8.3 mmHg and diastolic pressure increased from 77 ± 5 mmHg to 78 ± 6.3 mmHg but was not statistically significant.]

Table 4: Comparison of Mean values of the Serum Lipid Profile and Fasting Plasma Glucose Level of the Experimental Group

Biochemical parameters	Experimental group (N=12)				
	Before Mean±S.D	After Mean±S.D	Mean difference	't' value	'p' value
Total cholesterol (mg/dl)	205.25±32.81	187.25±34.72	↓18	3.392	0.006
LDL cholesterol (mg/dl)	140.83±23.10	128.42±21.42	↓12.4	3.224	0.008
VLDL cholesterol (mg/dl)	20.42±10.84	13.83±6.12	↓6.0	3.193	0.008
HDL cholesterol (mg/dl)	39.67±5.87	44.58±6.14	↑5	3.853	0.002
TG cholesterol (mg/dl)	119.83±30.51	98±33.61	↓21.8	3.865	0.002
Fasting plasma glucose level (mg/dl)	100.08±13.37	86.33±6.95	↓13.8	5.775	0.000

Table 5: Comparison of Mean values of the Serum Lipid Profile and Fasting Plasma Glucose Level of the Control Group

Variables	Control group (N=12)				
	Before Mean±S.D	After Mean±S.D	Mean difference	't' value	'p' value
Total cholesterol(mg/dl)	255.20±49.03	256.96±40.96	↑-1.80	-7.96	0.00
LDL cholesterol (mg/dl)	128.70±8.93	129.90± 9.4	↑-1.23	-4.74	0.001
VLDL cholesterol (mg/dl)	50.4±20.82	51.10±21.10	↑-0.71	-2.32	0.041
HDL cholesterol (mg/dl)	58.04±7.50	56.50±7.80	↓1.56	-4.41	0.001
TG cholesterol (mg/dl)	302.70±77.63	304.77±78.10	↑-2.04	-4.70	0.001
Fasting plasma glucose level (mg/dl)	125.50±30.84	127.20±32.40	↑-1.70	-2.5	0.03

CONCLUSION

The newly developed high fibre biscuit when supplemented for obese women, had a positive effect on the anthropometric measurements, selected biochemical parameters and clinical parameters by reducing the body weight, total cholesterol, LDL-c, VLDL-c, TG and fasting plasma glucose level and blood pressure levels and increasing the HDL cholesterol, therefore it can be concluded that the high fibre biscuit can reduce the metabolic risk factors of obesity.

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