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EFFECT OF OAT FERMENTED BLACK GLUTINOUS RICE COOKIES INTERVENTION ON OBESE WOMEN'S BODY WEIGHT, WAIST CIRCUMFERENCE, BODY MASS INDEX, AND PERCENT BODY FAT

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Abstract **Background**: The prevalence of obesity among adults in Indonesia is high. With the development of several anti-obesity foods, different attempts have been made to verify the antioxidant, insulin-sensitivity, and anti-inflammatory effects of anthocyanins. Increased consumption of dietary fiber has the potential to induce structural, physicochemical and gastrointestinal site-specific benefits that are relevant for the treatment of obesity and metabolic syndrome. The content of oat fermented black glutinous rice (OFBGR) cookies that contain anthocyanin, low calories, and high fiber is expected to be able to reduce obesity.

Objective: This study aimed to determine the effect of oat fermented black glutinous rice (OFBGR) cookies on obese women's body weight (BW), waist circumference (WC), Body Mass Index (BMI), and percent body fat (PBF).

Method: The study design was a true experiment with a control group. There were 20 obese women subjects (>20 years old) in each group, by purposive sampling method. Subjects were divided into two groups: the experimental group (OFBGR cookies administered for 30 days) and the control group no OFBGR cookies administration. BW, WC, BMI and PBF were collected pre and post intervention. Data analysis by double difference approach to compare BW, WC, BMI and PBF of the two groups.

Results: Administering OFBGR cookies significantly reduced BW, WC, BMI and PBF in obese women with a p-value of <0.001 and 0.039 ($p \leq 0.05$).

Conclusion: This study concluded that OFBGR cookies reduced BW, BMI, WC and percent body fat in obese women.

Keywords: OFBGR cookies, Obesity, Body Weight, Waist Circumferrence, Body Mass Index, Percent Body Fat

BACKGROUND

Obesity is a complex chronic progressive disease characterized by excess body weight and dysregulation in entero-endocrine and neurohormonal signalling pathways favouring increased appetite and energy storage (1). The latest statistics from the World Obesity Alliance's "2024 World Obesity Map" indicate that the global count of overweight and obese adults has exceeded 2.2 billion, with a continually rising obesity rate projected to reach 3.3 billion by 2035, accounting for over 54% of the global adult population (2). Obesity escalates the risk of numerous chronic diseases, including type 2 diabetes, hypertension cardiovascular diseases, kidney and liver diseases, and certain cancers (2). Dietary adjustment is a crucial approach to obesity management. Therefor many nutrition research on food have been explored for their effectiveness on weight loss.
Dietary fiber is a potent tool for the management of obesity (3). More recently, natural phytochemicals present in foods, including anthocyanins, due to their chemical structure, seem to be able to exert several pharmacologic activities, mainly antioxidant and anti-inflammatory actions [3]. It has been reported that the anthocyanins might play a role in attenuating obesity by producing a decrease in weight and adipose tissue (4). The content of OFBGR cookies that contain anthocyanin, low calories, and high fibre is expected to be able to reduce obesity.

METHODS

S*tudy setting and design*

This study was an experimental design with a control group. In the intervention group, samples were given OFBGR cookies for 30 days, while in the control group were not given OFBGR snack bars. The research was conducted in Pasirkaliki, Cimahi Utara, West Java, in October 2024.

Study population and sampling procedure

The Study population was the obese women in Pasirkaliki, Cimahi Utara, West Java. Samples were women who met the criteria and agreed to participate in the research by signing informed consent. Minimum samples were calculated by a hypothesis test to compare two means. There were 40 samples in total, or 20 subjects for each group. The sample criteria were female, BMI > 27 kg/m^2, aged 25 to 60 years old, and willing to participate in this research. Exclusion criteria were stroke or CAD or renal disease sufferers, professional athletes, and those not willing to participate in the research. The Sample was determined using a purposive sampling technique.

Data Collection and Variable Measurement

The data collection was performed using primary data by interviewing samples, and daily food intake with a 24-h food recall. Subjects' body weight was measured using digital scales, height with a stadiometer, waist circumference using a waist ruler, and percent body fat with Bioelectrical Impedance Analysis. Those were collected before OFBGR cookies were given, and after 30 days of intervention. Normality test for the data was done to check the normal distribution data. Bivariate analysis to test the efficacy of the OFBGR cookies by independent and dependent t-test when data are normally distributed, Mann-Whitney, and Wilcoxon Signed Rank test when data are not normally distributed. Our study limitation is no control over physical activities.

Ethic Consideration

The studies involving human participantswere reviewed and approved by the Research Ethics Committee from Poltekkes Kemenkes Bandung (No. 26/KEPK/EC/VI/2024). The participants provided their written informed consent to participate in this study.

RESULTS AND DISCUSSION

Oat Fermented Black Glutinous Rice (OFBGR) Cookies Nutrient Content

The cookies contain low calories, are high in fiber, and as a source of anthocyanin (table 1.). This is good for people who want to lose weight or maintain their weight. OFBGR cookies have a brown to violet color with a round shape and crispy texture (figure 1).

Table 1. Nutrient Content of OFBGR Cookies

Nutrient content per 100 grams (14 pieces)	Nutrient content per portion 21 grams (3 pieces)
Energy : 439,24 kcal Protein : 8,67 g Fat : 16,21 g Carbohydrate : 63,52 g Dietary fiber : 7,3 g Anthocyanin : 23,49 mg	Energy : 92, 24 kcal Protein : 1,82 g Fat : 3.40 g Carbohydrate : 13,34 g Dietary fiber : 1,53 g Anthocyanin : 4,93 mg

SIG Laboratory test results

Figure 1. Oat Fermented Black Glutinous Rice Cookies

Characteristics of Respondents

Table 2 displays the characteristics of the study's respondents. The findings revealed that the average age, WC, BMI, and PBF of the intervention and control groups were almost similar.

	Intervention group		Control group	
	Min-max	Mean	Min-max	Mean
Age (yo)	28 - 59	39	25-60	42
WC (cm)	80.3-110.0	92.7	83.0-104.5	92.7
BMI (kg/m^2)	27.3-43.6	32.02	27.0-37.0	30.6
PBF (%)	34.2-46.64	39.96	33.2-45.5	39.3

Comparison of Energy, Protein, Fat, Carbohydrate, and Fiber Intake Before and After the Intervention of Black Glutinous Rice Oat Tape Cookies and the Control Group

Table 3. Comparison of Energy, Protein, Fat, Carbohydrate, and Fiber Intake Before and After the Intervention of OFBG Cookies and the Control Group

Variable	Intervention		p value*)	control		p value*)
	pre	post		pre	post	
Energi (kkal)	1561,1 (511,7)	1311,1,3 (492,3)	0,090	1456,2 (519,9)	1409,3 (516,7)	0,722
Protein (g)	55,2 (22,4)	49,1 (22,6)	0,336	43,6 (13,9)	47,9 (14,4)	0,365
Fat (g)	61,3 (23,4)	45,9 (21,1)	0,023	48,7 (24,1)	43,4 (19,8)	0,467
Carbohydrate (g)	193,0 (21,1)	184,3 (72,9)	0,711	227,1 (109,4)	211,7 (78,1)	0,486
Dietary fiber (g)	7,5 (4,8)	10,1 (7,4)	0,227	6,1 (4,1)	6,5 (5,1)	0,822

*) *Dependent T Test*

The results of the statistical test using the Dependent Test at a 95% confidence interval showed no significant difference between energy intake before and after in the group given black glutinous rice oat tape cookies (p-value = 0.090 (p>0.05), and no significant difference between energy intake before and after in the control group (p-value = 0.722 (p>0.05). Table 3 shows no significant difference between protein intake before and after in the group given black glutinous rice oat tape cookies (p-value = 0.336 (p>0.05). There was no significant difference between protein intake before and after in the control group (p-value = 0.365 (p>0.05). It shows a significant difference between fat intake before and after in the group given black glutinous rice oat tape cookies (p-value = 0.023 (p≤0.05), but no significant difference between fat intake before and after in the control group (p-value = 0.467 (p>0.05). Table 3 shows no significant difference between carbohydrate intake before and after in the group receiving black glutinous rice oat tape cookies (p-value = 0.711 (p>0.05). There was no significant difference between carbohydrate intake before and after in the control group (p-value = 0.486 (p>0.05). Table 3 shows no significant difference between fiber intake before and after in the group receiving black glutinous rice oat tape cookies (p-value = 0.227 (p>0.05). There was no significant difference between fiber intake before and after in the control group (p-value = 0.822 (p>0.05).

Comparison of BW, BMI, WC, and PBF before and after the intervention in the intervention and the control groups

Table 4. Comparison of BW, WC, BMI, and PBF before and after the intervention of OFBGR cookies in the intervention and the control groups

Variable	Intervention		p value*)	control		p
value*)	pre	post		pre	post	
BW (kg)	69,3 (11,9)	67,8 (11,8)	<0,001	69,4 (7,3)	69,5 (7,3)	0,547
BMI (kg/m^2)	31,3 (4 ,1)	30,5 (4,5)	<0,001	30,2 (2,4)	30,3 (2,6)	0,793
WC (cm)	91,5 (9,2)	89,6 (9,8)	<0,001	85,5 (6,9)	87,2 (6,2)	<0,001
PBF (%)	41,6 (4,1)	39,9 (4,9)	0,018	39,9 (3,6)	39,8 (3,3)	0,519

*) *Dependent T Test*

All anthropometry data (BW, BMI, WC, PBF) in the intervention group declined after 30 days of cookie administration in the intervention group. But in the control group, their WC rose almost 2 cm. The results of the statistical test using the Dependent Test at a 95% confidence interval showed a significant difference between pre-post in the intervention group (p<0.05).

Effectiveness of OFBG Cookies on Energy, Protein, Fat, Carbohydrate, and Fiber Intake in Obese Women.

Table 5. Effectiveness of OFBGR Cookies on Energy, Protein, Fat, Carbohydrate, and Fiber Intake in Obese Women

Variable	Intervention		control		p value*)
	Mean (SD)	Md (Min-Max)	Mean (SD)	Md (Min-Max)	
Energy (kcal)	-249,9 (607,0)	-230,4 (-1338-814,8)	-46,8 (565,5)	-151,1 (-1017,1-827,2)	0,300
Protein (g)	-6,10 (26,89)	-5,2 (-47,5-47,1)	23,8 (86,8)	-0,8 (-22,8-372,8)	0,157
Fat (g)	-15,4 (26,9)	-9,6 (-61,0-33,6)	-5,3 (31,2)	-3,6 (-57,4-57,8)	0,300
Carbohydrate (g)	-8,67 (100,2)	-1,60 (-161,3-262,0)	-15,4 (94,3)	-28,8 (-173,1-153,5)	0,988
Dietary Fiber (g)	2,56 (8,9)	2,1 (-7,0-30,47)	6,84 (20,2)	0,56 (-10,99-61,3)	0,942

*) *Mann-Whitney test*

Table 5 shows that the statistical test results using the Mann-Whitney test at a 95% confidence interval indicate that administering OFBGR cookies effectively reduced energy intake in obese women, but not significantly, with a p-value of 0.300 (p>0.05). Table 5 shows that administering OFBG cookies effectively reduced protein intake in obese adults, but not significantly with a p-value of 0.157 (p>0.05); effectively reduced fat intake in obese adults, but not statistically significantly with a p-value of 0.300 (p>0.05); effectively reduced carbohydrate intake in obese adults, but not statistically significantly with a p-value of 0.988 (p>0.05); and effectively increased fiber intake in obese adults, but not statistically significantly with a p-value of 0.942 (p>0.05).

Effectiveness of OFBG Cookies on BW, BMI, VW, and PBF in Obese Women

Table 6. Effectiveness of OFBG Cookies on BW, BMI, WC, and PBF in Obese Women

Reduction	Intervention		control		p value*)
	Mean (SD)	Md (Min-Max)	Mean (SD)	Md (Min-Max)	
BW (kg)	-1,5 (0,7)	-1,2 (-3,3-(-0,6)	0,1 (0,9)	-0,2 (-1,3-1,8)	<0,001
BMI (kg/m^2)	-0,8 (0,7)	-0,5 (-3,5-(-0,2)	0,04(0,7)	-0,02 (-1,9-1,30)	<0,001
WC (cm)	-1,9 (1,8)	-1,9 (-4,8-1,00)	1,7 (1,7)	2,0 (-3,0-3,7)	<0,001
PBF (%)	-1,5 (2,66)	-0,7 (-10,2-0,0)	-0,2 (1,0)	-0,1 (-1,8-2,2)	0,039

*) *Mann-Whitney test*

Table 6 shows that the results of statistical tests using the Mann-Whitney test at a 95% confidence level indicate that administering OFBG cookies is effective in significantly reducing body weight in obese adults with a p-value of <0.001 (p≤0.05). Table 5 shows that statistically, administering OFBG cookies is effective in significantly reducing BMI in obese adults with a p-value of <0.001 (p≤0.05); WC in obese adults with a p-value of

<0.001 (p≤0.05); PBF in obese women with a p-value of <0.001 (p≤0.05). Therefore Mann-Whitney test at a 95% confidence level indicates that administering OFBG cookies is effective in significantly reducing BW, BMI, WC, and PBF in obese adults with a p-value of <0.001 (p≤0.05).

It has been found to be involved in many complex metabolic interactions in human metabolism. Anthocyanins are generally effective in inhibiting α-glucosidase, lipase, and α-amylase enzymes, lowering glucose levels, regulating insulin secretion, and preventing insulin resistance. They possess anticancer, anti-tumoral, anti-atherosclerotic, anti-inflammatory, anti-microbial, and anti-obesity effects on human health and are the chemical compounds that prevent neuronal and cardiovascular diseases (5). Supplementation with QGPJ significantly reduces body weight and BMI ($p < 0.05$), with the average decrease of 0.6 kg in body weight and 0.2 units in BMI over the period of 4 weeks (6). Overwhelming evidence exists supporting the use of dietary fiber as a public health tool with which to prevent obesity and its metabolic consequences. There is also a large body of evidence supporting the use of fiber intake as adjunctive therapy for patients with hypertension, dyslipidaemia, and T2DM, and patients with these conditions should be encouraged to consume increased amounts of a variety of high fiber foods, including fruits, vegetables, grains, nuts and seeds, and legumes, as well as specific fiber supplements (7). Heterogeneity exists between fibres in terms of their chemical and physical structures, which determines the effects of fibre on the gastrointestinal tract, the gut microbiota, and energy homeostasis. Increased consumption of dietary fibre has the potential to induce structural, physicochemical, and gastrointestinal site-specific benefits that are relevant for the treatment of obesity and metabolic syndrome (8)

CONCLUSION

1. Administering black glutinous rice oat tape cookies significantly reduced body weight in obese women with a p-value of <0.001 (p≤0.05).
2. Administering black glutinous rice oat tape cookies significantly reduced body mass index in obese women with a p-value of <0.001 (p≤0.05).
3. Administering black glutinous rice oat tape cookies significantly reduced waist circumference in obese women with a p-value of <0.001 (p≤0.05).
4. Administering black glutinous rice oat tape cookies significantly reduced body fat percentage in obese women with a p-value of 0.039 (p≤0.05).

Further research is needed to be conducted.

COMPETING INTERESTS

All authors had none to declare

AUTHOR'S CONTRIBUTION

Yenny Moviana conceived of the presented idea, data analysis, and writing manuscript; Rr. Nur Fauziyah was in charge of data collection and analysis, and drafting the manuscript. All authors contributed to the final manuscript.

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