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Moringa oleifera Leaf Extract and (*Amorphophallus muelleri* Blume.) Glucomannan Effects on Obese White Rat Feed Intake and Body Weight

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ABSTRACT

Obesity significantly raises the rates of illness and death in humans due to its association with several health conditions such as cardiovascular disease, hypertension, hypercholesterolemia, type 2 diabetes mellitus, osteoporosis, depression, breast cancer, and colon cancer. This study aims to determine the effect of *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.) on feed intake and body weight of obese white rats. This study used an experimental method with a pretest-posttest-only control grub design using 24 white male rats of the Wistar strain aged 8 weeks which were divided into 2 control groups, namely positive(K1) and negative(K2) and six treatment groups with extract doses *Moringa oleifera* leaves and glucomannan (*Amorphophallus muelleri* Blume.) 100mg/kgBW:100mg/kgBW(K3), 80mg/kgBW:120mg/kgBW(K4), 120mg/kgBW: 80mg/kgBW(K5), 50mg/kgBW:50mg/kgBW(K6), 40mg/kgBW:60mg/kgBW(K7), and 60mg/kgBW:40mg/kgBW(K8). Data analysis on body weight and feed intake used the SPSS ANOVA test and paired T-test. The results of the paired T-test ($p<0.05$) showed that *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.) significantly reduced body weight and feed intake. In conclusion, administration of *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.) in group K4 (80 mg/kgBW *Moringa oleifera* leaf extract: 120 mg/kgBW glucomannan *Amorphophallus muelleri* Blume) can reduce feed intake (4.29 g) and body weight (36.67 g) effectively.

Keyword: Obesity, *Amorphophallus muelleri* Blume, *Moringa oleifera*, Feed Intake, Body Weight

ABSTRAK

Obesitas secara signifikan meningkatkan angka kesakitan dan kematian pada manusia karena hubungannya dengan beberapa kondisi kesehatan seperti penyakit kardiovaskular, hipertensi, hiperkolesterolemia, diabetes melitus tipe 2, osteoporosis, depresi, kanker payudara, dan kanker usus besar. Penelitian ini bertujuan untuk mengetahui pengaruh pemberian ekstrak daun *Moringa oleifera* dan glukomanan (*Amorphophallus muelleri* Blume.) terhadap asupan pakan dan berat badan tikus putih obesitas. Penelitian ini menggunakan metode true experimental dengan pretest-postest only control grub design menggunakan 24 ekor tikus putih jantan strain wistar berusia 8 minggu yang dibagi menjadi 2 kelompok kontrol yaitu positif (K1) dan negatif (K2), serta enam kelompok perlakuan dengan pemberian dosis ekstrak daun *Moringa oleifera* dan glukomanan (*Amorphophallus muelleri* Blume.) 100mg/kgBB : 100mg/kgBB (K3), 80mg/kgBB : 120mg/kgBB (K4), 120mg/kgBB : 80mg/kgBB (K5), 50mg/kgBB : 50mg/kgBB (K6), 40mg/kgBB : 60mg/kgBB (K7), dan 60mg/kgBB : 40mg/kgBB (K8). Analisis data berat badan dan asupan pakan menggunakan uji ANOVA SPSS dan uji paired T-test. Hasil uji paired T-test ($p<0,05$) menujukan bahwa ekstrak daun *Moringa oleifera* dan glukomanan (*Amorphophallus muelleri* Blume.) dapat menurunkan berat badan dan asupan pakan secara signifikan. Kesimpulannya,

pemberian ekstrak daun *Moringa oleifera* dan glukomanan (*Amorphophallus muelleri* Blume.) pada kelompok K4 (80mg/kgBB ekstrak daun *Moringa oleifera* : 120mg/kgBB glukomanan *Amorphophallus muelleri* Blume.) dapat menurunkan asupan pakan (4,29 g) dan berat badan (36,67 g) secara efektif.
Keyword: Obesity, *Amorphophallus muelleri* Blume, *Moringa oleifera*, Feed Intake, Body Weight

1. Introduction

Obesity is a long-lasting syndrome caused by many metabolic problems. It occurs when there is an imbalance between the amount of energy consumed and the amount of energy expended. This imbalance leads to an excessive rise in body weight and fat mass, resulting in the accumulation of energy in the form of adipose tissue [1], [2]. Obesity increases the percentage of morbidity and mortality in humans because obesity is a factor in the emergence of cardiovascular disease, hypertension, type 2 diabetes mellitus, hypercholesterolemia, osteoporosis, depression, breast cancer, and colon cancer [3]. In addition, obesity can occur due to various factors, namely excessive food intake, lack of physical activity, technological advances to genetic factors. Based on national data which is conducted periodically every 5 years, obesity in Indonesia has increased from 2013 to 2018 where central obesity in people aged > 15 in 2018 reached 31.0% compared to 2013 which only amounted to 26.6%. Meanwhile, the national prevalence of obesity in adults aged > 18 years in 2018 was around 21.8%, a much increase compared to 2013 which was around 14.8% [4]. Based on the increasing percentage of obesity, this research has stimulated the search for solutions to reduce obesity in the population, one of which is the use of drugs from natural ingredients.

The utilization of plants as medicinal remedies has been practiced since ancient times, stemming from innate human instinct. Among the 944 varieties of medicine, 657 are from plants. Medicinal plants offer a wide range of sources for medicine, including flowers, fruits, leaves, roots, and bark [5]. For example, the *Moringa oleifera* plant is widely used for food, medicine, and commercial purposes. *Moringa oleifera* is sometimes referred to as "The Miracle Tree" due to its capacity to address nutritional issues and treat a range of illnesses. *Moringa oleifera* has a global historical presence, particularly in tropical nations. Virtually every component of *Moringa oleifera* have medicinal properties and can be utilized for traditional or commercial purposes, with diverse pharmacological uses. Multiple studies have demonstrated that the *Moringa oleifera* plant harbors a diverse array of chemicals, particularly in its leaves. These include flavonoids, tannins, phenolics (such as chlorogenic acid and caffeic acid), saponins, alkaloids, vitamins (A, B, B1, B2, B3, C, and E), isothiocyanates, and glucosinolates [6], [7]. Based on the research by [8]*Moringa oleifera* powder is useful as an anti-obesity that can manage weight gain, and giving a single dose of Moringa leaf powder 50 mg/day/rat can reduce food intake and body mass index in obese control group rats, whereas a dose of 50 mg/day/rat for twice a day can result in a significant decrease in the body mass index of the obese control group rats. In addition, *Moringa oleifera* leaves function as anti-obesity, anti-inflammatory, hypercholesterolemia, antibiotics, hypoglycemia activity, hypotension, antiulcer, antidiabetic, antiseptic, antiepileptic and anti-trypanosomal [9], [10].

Another plant that is useful for treating obesity is glucomannan from porang tubers (*Amorphophallus muelleri* Blume). The content of glucomannan compounds in *Amorphophallus muelleri* Blume is a hemicellulose polysaccharide compound composed of glucose and mannose monosaccharide units with varying ratios and can dissolve in water [11]. Glucomannan is a water-soluble food fiber that functions to reduce body weight with a mechanism that can provide a feeling of fullness and delay gastric emptying so that it can be an alternative in dealing with obesity [12]. Based on research by [13] administration of a dose of 200 mg/kg BW of glucomannan in white rats induced with a high-fat diet was very effective in reducing body weight and appetite in white rats. In addition, giving doses of 25 mg/kg BW, 50 mg/kg BW and 100 mg/kg BW. In addition, glucomannan has benefits as an alternative therapy such as anticancer, anti-inflammatory, antibacterial, antioxidant, immunomodulatory activity, anti-diabetes mellitus type 2, and hypoglycemic hypolipidemic effects [14], [15]. Referring to the description above, this study aims to determine the effect of *Moringa oleifera* leaf extract with glucomannan (*Amorphophallus muelleri* Blume.) on feed intake and body weight in obese white rats.

2. Material and Methods

2.1 Time and Place Research

This research was carried out for 7 months at the Biology Education Laboratory at Muhammadiyah University Surakarta and the Experimental Animals at Sebelas Maret University.

2.2 Ethical Clearance

The ethical clearance for this study was obtained from the ethical review committee of the Faculty of Medicine, Muhammadiyah University, Surakarta with No. 4139/A.1/KEPK-FKUMS/III/2022.

2.3 Tools and materials

The tools used in this study consisted of digital scales, porang cutters, ovens, pans, sieves (60 and 80 mesh), hot plate magnetic stirrers, blenders, maceration vessels, filter paper, rotary evaporators, water baths, rat cages, sondes. oral and syringe. The materials used in this study were glucomannan (*Amorphophallus muelleri* Blume.), 70% ethanol extract of *Moringa oleifera* eaves, Comfeed BR-1, high-fat diet feed for obesity induction consisting of butter and duck egg yolks.

2.4 Extract Manufacturing and Material Purification

Moringa oleifera leaf extraction was carried out by maceration method on *Moringa oleifera* leaf powder for 2 x 24 hours using 70% ethanol solvent with a ratio of 1: 10 and evaporation was carried out using a rotary evaporator and water bath [16]. Meanwhile, purification of glucomannan (*Amorphophallus muelleri* Blume.) was carried out by purifying porang flour from oxalate crystals in distilled water with a ratio of 1: 30 and washing using 50% ethanol and evaporating using an oven [17].

2.5 Design and Research Object

This research is a true experiment with a pretest-posttest-only control grub design. The research object used was 24 Wistar strain male white rats aged 8 weeks with an acclimatization time of 1 week and were divided into 8 treatments namely :

1) K1 (positive group) with normal feed treatment, namely comfeed BR-1
2) K2 (negative group) obesity with the high-fat diet
3) K3 (Obesity) with a dose of *Moringa oleifera* leaf extract 100 mg/KgBW + glucomannan *Amorphophallus muelleri* Blume 100 mg/ KgBW
4) K4 K3 (Obesity) with a dose of *Moringa oleifera* leaf extract 80 mg/kgBW + glucomannan *Amorphophallus muelleri* Blume 120 mg/KgBW
5) K5 (Obesity) with a dose of *Moringa oleifera* leaf extract 120 mg/ KgBW + glucomannan *Amorphophallus muelleri* Blume 80 mg/KgBW
6) K6 (Obesity) with a dose of *Moringa oleifera* leaf extract 50 mg/ KgBW + glucomannan *Amorphophallus muelleri* Blume 50 mg/ KgBW
7) K7 (Obesity) with a dose of *Moringa oleifera* leaf extract 40 mg/kgBW + glucomannan *Amorphophallus muelleri* Blume 60 mg/ KgBW
8) K8 (Obesity) with a dose of *Moringa oleifera* leaf extract 60 mg/kgBW + glucomannan *Amorphophallus muelleri* Blume 40 mg/kgBW

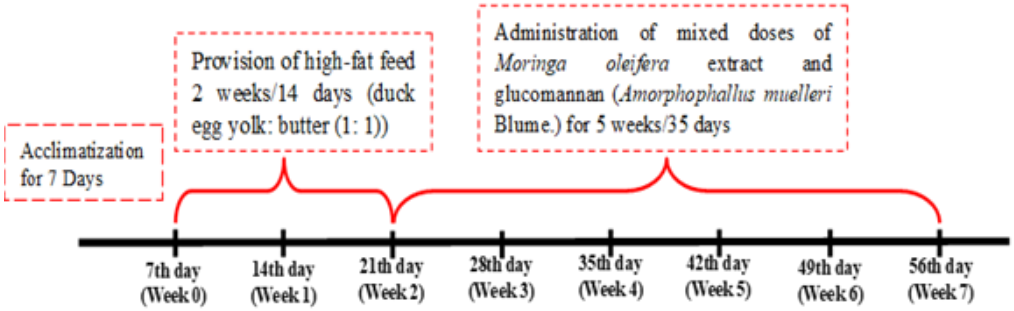


Figure 1. Treatment group flowchart

Experimental groups, K2, K3, K4, K5, K6, K7, and K8 rats were induced with high-fat feed in the form of duck egg yolks and butter in a ratio of 1:1 for 2 weeks (14 days) until they became obese with an increase in body weight 20% of body weight after the acclimatization process [18]. Giving high-fat feed and mixed doses of *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.) is done orally.

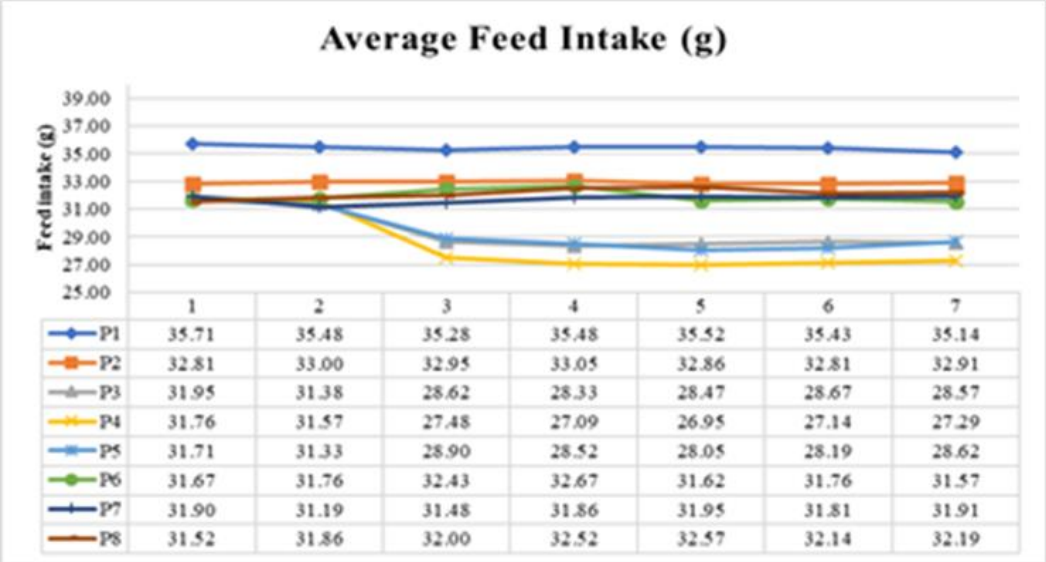
2.6 Data Analysis

The results of measuring the parameters of feed intake and body weight in this study were statistically analyzed using One Way Analysis of Variance (ANOVA) SPSS version 20 followed by a paired T-test.

3. Result and Discussion

Feed intake of white rats is one of the parameters in this study to determine the appetite of white rats after the high-fat feeding stage and doses of *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.) for 49 days (7 weeks) all treatment groups were given feed normal com feed-BR 1 as much as 40 g/head and weighed every day at 9 am. The average feed intake consumed by each treatment group for 7 weeks can be seen in Figure 2.

Based on the results of the paired T-test statistic related to the measurement of feed intake in the experimental group of white rats before and after administration of mixed doses of *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.) in table 1. Shows that in the K3 treatment group (100 mg/day) kgBB: 100mg/kgBB) and K4 (80mg/kgBB: 120mg/kgBB) there was a significant decrease in feed intake with a p-value <0.05. This can prove the dose of *Moringa oleifera* leaf extract and glucomannan *Amorphophallus muelleri* Blume. can affect the appetite of white rats by reducing feed intake by 2.81 g in the K3 treatment group (100mg/kgBW: 100mg/kgBW) and reducing feed intake by 4.29 g in the K4 treatment group (80mg/kgBW: 120mg/kgBW).



	1	2	3	4	5	6	7
P1	35.71	35.48	35.28	35.48	35.52	35.43	35.14
P2	32.81	33.00	32.95	33.05	32.86	32.81	32.91
P3	31.95	31.38	28.62	28.33	28.47	28.67	28.57
P4	31.76	31.57	27.48	27.09	26.95	27.14	27.29
P5	31.71	31.33	28.90	28.52	28.05	28.19	28.62
P6	31.67	31.76	32.43	32.67	31.62	31.76	31.57
P7	31.90	31.19	31.48	31.86	31.95	31.81	31.91
P8	31.52	31.86	32.00	32.52	32.57	32.14	32.19

Figure 2. The average feed intake of the white rat treatment group (week).

Table 1. Average feed intake before and after dosing of *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.).

Treatment (*Moringa oleifera* extract: glucomannan)	**mean ± SD**			**P**
	Pretest	***Postest***	Δ	
K1 (positive group)	35.71 ± 0.52	35.14 ± 0.38	-0.33 ± 0.43	0.314
K2 (Negative group)	32.81 ± 0.71	32.91 ± 0.36	-0.09 ± 0.93	0.878
K3 (100mg/kgBW : 100mg/kgBW)	31.95 ± 1.03	28.57 ± 0.94	-2.81 ± 0.95	0.036*
K4 (80mg/kgBW : 120mg/kgBW)	31.76 ± 0.43	27.29 ± 0.15	-4.29 ± 0.25	0.001*
K5 (120mg/kgBW : 80mg/kgBW)	31.71 ± 0.79	28.62 ± 1.38	-2.71 ± 1.62	0.101
K6 (50mg/kgBW : 50mg/kgBW)	31.67 ± 1.53	31.57 ± 1.31	-0.19 ± 2.51	0.908
K7 (40mg/kgBW : 60mg/kgBW)	31.90 ± 0.46	31.91 ± 0.36	0.72 ± 0.80	0.261
K8 (60mg/kgBW : 40mg/kgBW)	31.52 ± 0.44	32.19 ± 1.41	0.33 ± 1.23	0.685

description: *) there is a significant difference (p <0.05)

Δ posttest - pretest difference

Body weight parameters in male white rats of the Wistar strain as an experimental model of obesity were weighed every day for 56 days (8 weeks) consisting of 1 week of acclimatization stage, 2 weeks of high-fat feeding stage with the aim of the rats gaining weight 20% of body weight during the acclimatization period and the 5-week stage of giving doses of *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.).

The results of Figure 3 show the average body weight of the rats and the average change in body weight of the rats every week. In addition, from the figure, it can be seen that in the 2nd week, namely the final stage of high-fat feeding, the average body weight of rats increased by 22% so it can be said that the treatment group that was given high-fat feed was obese and this was following the standard obesity study conducted by [18] regarding the parameters of rats are said to be obese if the weight gain reaches 20% of the initial body weight.

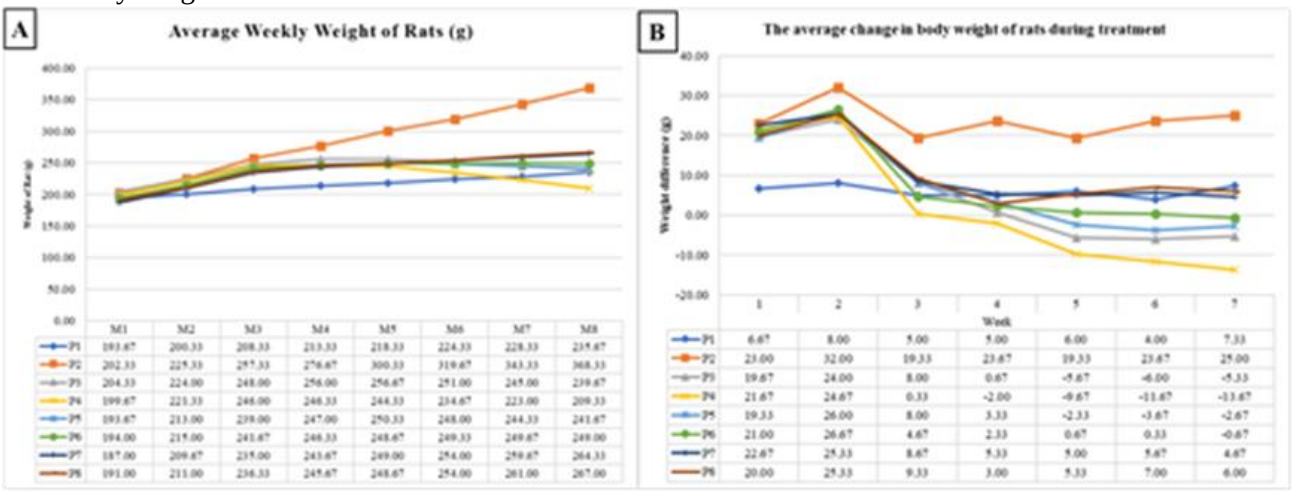


Figure 3. Average body weight and average change in body weight of rats during treatment. Figure A shows the average body weight of the rats per week, while figure B shows the average body weight change (the difference in body weight each week).

Table 2. The average change in body weight before and after administration of doses of *Moringa oleifera* leaf extract and glucomannan (*Amorphophallus muelleri* Blume.)

Treatment (*Moringa oleifera* extract: glucomannan)	**mean ± SD**			**P**
	Pretest	**Postest**	Δ	
K1 (positive group)	208.33 ± 6.43	235.67 ± 5.13	27.33 ± 1.53	0.001*
K2 (negative grup)	257.33 ± 14.01	368.33 ± 7.77	111.00 ± 20.42	0.011*
K3 (100mg/kgBW : 100mg/kgBW)	248.00 ± 2.65	239.67 ± 15.95	-8.33 ± 15.04	0.439
K4 (80mg/kgBW : 120mg/kgBW)	246.00 ± 5.57	209.33 ± 3.79	-36.67 ± 2.08	0.001*
K5 (120mg/kgBW : 80mg/kgBW)	239.00 ± 7.00	241.67 ± 1.53	2.67 ± 8.08	0.625
K6 (50mg/kgBW : 50mg/kgBW)	241.67 ± 13.05	249.00 ± 6.08	7.33 ± 9.45	0.311
K7 (40mg/kgBW : 60mg/kgBW)	235.00 ± 8.54	264.33 ± 20.50	29.33 ± 12.06	0.052
K8 (60mg/kgBW : 40mg/kgBW)	236.33 ± 5.86	267.00 ± 8.00	30.67 ± 13.65	0.060

description: *) there is a significant difference ($p < 0.05$)
Δ posttest - pretest difference

The normality test results for the average body weight and the mean change in body weight of obese rats during the high-fat feed treatment and the combination dose administration using the Shapiro-Wilk normality test showed that the data were normally distributed because $p > 0.05$.

The paired T-test in Table 2. related to the average pretest and post-test weight changes during the treatment, namely in the 2nd week and 7th week showed significantly different results with a p-value <0.05 in the K1 treatment group (control positive) and K2 (negative control) with the K3 treatment group given a mixed dose of *Moringa oleifera* added with *Amorphophallus muelleri* Blume glucomannan. in group K4 (80 mg/kgBB : 120 mg/kgBB).

However, the most effective in reducing the body weight of the rats was the control group K4 (80 mg/kgBW: 120 mg/kgBW) because it was able to lose weight up to -36.67 g compared to groups K1 (positive control) and K2 (negative control). who had a significant change in gaining weight instead of losing weigh.

Based on parameter data of average feed intake and mean change in body weight of white rats, it was shown that the K4 treatment group with a dose of *Moringa oleifera* leaf extract 80 mg/kgBW and glucomannan (*Amorphophallus muelleri* Blume.) 120 mg/kgBW was the most significant dose and had many reducing effects. body weight and feed intake the most compared to the other 7 treatment groups.

This is because glucomannan functions as a water-soluble dietary fiber and contains complex carbohydrates to replace white rice with the benefit of not being easily soluble in the digestive system so that it provides a longer feeling of fullness [12]. and this research is in line with research in line with a study by [19] investigated the effects of administering a feed combination containing 30% *Amorphophallus muelleri* Blume flour and 20% Moringa leaf powder on rats. The study found that this feed mixture led to reduced feed intake and lower body weight in the rats.

The addition of *Moringa oleifera* leaf extract in this study not only helps in losing weight in obese patients but also provides additional nutrients in the form of vitamins, proteins, flavonoids, tannins, phenolics (chlorogenic acid and caffeic acid), saponins, glucosinolates, isothiocyanates and alkaloids [6], [20].

4. Conclusion

The study concludes that the administration of *Moringa oleifera* leaf extract, together with glucomannan from *Amorphophallus muelleri* Blume, can decrease the amount of food consumed and the body weight of male Wistar strain obese white rats. The K4 treatment group, which received a combination of 80 mg/kgBW *Moringa oleifera* leaf extract and 120 mg/kgBW glucomannan (*Amorphophallus muelleri* Blume.), showed the most significant reduction in feed intake and body weight. Specifically, the rats in this group experienced a decrease of 4.29 g in feed intake and 36.67 g in body weight.

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