International Conference on Biology Education, Natural Science, and Technology
Vol. 1 No. 1 (2023)

Plasma Protein of Obese White Rats Treated with of Glucomannan Porang Tubers and Moringa Extract.

Sabila Dina Ikhsani, Endang Setyaningsih*
Biology Education Department, Faculty of Teacher Training and Education, Universitas Muhammadiyah Surakarta. Jl. A. Yani Tromol Pos I, Pabelan, Kartasura, Surakarta 57162, Jawa Tengah, Indonesia
*Corresponding Author e-mail address: es211@ums.ac.id

KEYWORDS:
Glucomanan
Moringa
Plasma Proteins
Obesity
White

ABSTRACT

Living things have a fluid that flows throughout the body, namely blood. Blood contains blood cells as well as a fluid called blood plasma. Plasma is a mixture of blood with anticoagulants. Plasma protein levels are influenced by body weight, age, growth, etc. Weight in particular, is closely related to obesity. This study aimed to determine the blood plasma protein levels of obese white rats given a mixture of glucomannan porang tubers and moringa leaf extract. This research method uses true experimental which is prepared with a Complete Randomized Design (RAL) in the form of *posttest Only Control Design*. The data obtained were analyzed using One Way ANOVA SPSS version 20 followed by the Kruskal willis test. The results of this study showed plasma protein levels between groups, namely (P1) 1358.6; (P2) 1356.6; (P3)1356.6; (P4)1353.6; (P5)1356; (P6)1359; (P7)1357.6; (P8)1360 from the above results it can be concluded that the blood plasma protein levels of obese white rats treated with a mixture of glucomannan and Moringa leaf extract were the highest at 1360 g / dL and the lowest plasma protein levels of 1353.6 g / dL.

1. INTRODUCTION

Living beings have body fluids formed from living tissues and flow throughout the body through a network of vessels, the fluid is called blood. The total blood volume in the adult human body is about 3.6 L for women and 4.5 L for men. In the blood contains blood cells and a fluid called blood plasma which contains various nutrients and other substances about 55% of blood is a component of fluid or plasma, the remaining 45% is a component of blood cells; and the most blood cells are red blood cells or erythrocytes which account for 41% (Firani, 2018). Blood consists of two parts, namely blood plasma and blood cells. Blood cells are of three types, namely erythrocytes, leukocytes and platelets. The overall blood volume is one-twelfth of body weight or about five liters. About 55% is blood plasma, while the remaining 45% consists of blood cells (Fauzi et al ., 2019).

Plasma is a mixture of blood with anticoagulants. Anticoagulants are materials used to prevent blood clots. The most commonly used anticoagulants include EDTA, heparin, sodium citrate, ammonium oxalate, and calcium oxalate. Chemical tests, especially blood glucose tests, rarely even almost never use EDTA plasma specimens (Nur Ramadhani et al., 2019). Factors that affect blood plasma protein levels include weight, age, growth, hormonal, sex, pregnancy, lactation, nutrition, stress, and fluid loss. The biochemical concentration of blood plasma fluctuates with temperature and humidity fluctuations described in THI values. The decrease in triglyceride levels along with the increase in temperature and THI, indicates an increase in the catabolism of triglycerides into glycerol and fatty acids, so that these micronutires can be

involved in gluconeogenesis through the glyceraldehyde 3-phosphate pathway (Mushawwir et al., 2020).

Weight in particular, is closely related to obesity. Obesity and overweight are abnormal conditions of the body characterized by increasing excessive fat in the body. Excessive fat is generally stored in the subcutaneous tissue, around the organ, and sometimes infiltrated into the organ. Excessive accumulation of body fat results in various health problems. Low physical activity and consumption of foods high in simple sugars, fats, and proteins also have a role in the incidence of obesity (Suha & Rosyada, 2022). Excess body weight also affects differences in components in the body, there are significant differences in plasma chemerin levels in the obese group compared to non-obese. There was a significant difference in plasma chemerin levels in the group of obese with insulin resistance compared to non-insulin resistant obesity. There was a weak correlation of chemerin with HOMA-IR values in the obese group. There was a weak correlation of chemerin with HOMA-IR values in the insulin resistant obesity group (Dioni et al., 2020).

Obesity so far can be treated by improving a healthy diet by applying the principle of balanced nutrition to meet the Daily Value (RDA) both in meeting the needs of micronutrients and macronutrients and, doing physical activity, especially exercising is also one of the things that is often done to deal with obesity (Ardiani et al., 2021). But in addition to these two things, obesity can be treated with a diet using both generic and herbal drugs. Especially herbal medicines are often an option because they are considered more natural and safe for the body. One of the natural ingredients that can be used as an alternative to overcome obesity is porang tubers and moringa leaves.

Porang plant *(Amorphophallus muelleri Blume*) is one of the plants included in the family Araceae (taro-talasan) and belongs to the genus amorphophallus. The main content of porang plants is glucomannan found in tubers. Glucomannan is a hydrocolloid that has the ability to thicken and form gels so that it is widely used in various industries such as the food, chemical, biotechnology and pharmaceutical industries. The glucomannan content from the extraction contained in porang tubers is 38.5357±0.5014% (Wardani et al., 2021). Glucomannan can be used as a functional food provider of nutrients that provide satiety, because in it there is one of the active ingredients contained in porang and can be used by dissolving it in water. Glucomannan also has a role in decreasing and inhibiting blood lipids, inhibiting cancer, overcoming constipation, and reducing people with obesity (obesity) (Alamsyah, 2019).

While Moringa leaves (Moringa oleifera L), known to contain alkaloid compounds, saponins, phytosterols, tannins, polypheno, phenolics, and flavonoids that act as antioxidants. Moringa leaves are also known to contain Vitamin C 120 mg per 100gr. Moringa plant activity at a dose of 75 mg / kg is known to reduce total blood cholesterol levels of rats by 47.5%. The results of research that have been conducted can be concluded a significant decrease from the administration of Moringa leaf powder to blood glucose and cholesterol levels so as to improve lipid profiles by reducing cholesterol levels of obese individuals (Oktavisa et al., 2022). Based on research (Nahar et al., 2016) Moringa oleifera powder is useful as anti-obesity that can manage weight gain and administration of a single dose of Moringa leaf powder 50 mg / day / rat can reduce food intake and body mass index in obese control group rats, while the dose of 50 mg / day / rat for a day twice can result in a significant decrease in body mass index of obese control group rats.

Cholesterol testing at the laboratory level usually uses white rats (*Rattus norvegicus*). The white rat used in this study is a type of wistar strain with a characteristic wide head and ears, and a tail that is less than the length of its body (Wahyuni, 2022). White rats are test animals that are often used in obesity reduction research because white rats have more advantages compared to other test animals such as easy to handle, can be obtained in large quantities but the price is not too expensive, and has valid repeat results (Lahamendu et al., 2019). White rats

(Rattus norvegicus) are often used as food trials and food deficiencies in all types of animals including humans (Rejeki et al., 2018).

Porang has a relatively high glucomannan content of 50.84 – 70.70%, starch content 76.5%, protein 9.20%, fat 0.20%, fiber content 25 (Wigoeno et al., 2013). While according to (Nissa & Madjid, 2016) Giving a dose of 200 mg/kg body weight glucomannan in white rats induced with a high-fat diet was very effective in losing body weight and appetite of white rats. The yield of 70% ethanol extract of Moringa leaves is 357.85 g and the yield is 0.30% of the dry weight of simplisia 1180 g, while the yield of glucomannan porang tubers is 0.30% with purification results of 325.21 g from the dry weight of simplisia 2,500 g, flavonoid levels of ethanol extract 70% Moringa leaves maximum absorbance wave 420 nm, phenol content of ethanol extract 70% Moringa leaves maximum absorbance wave 730 nm, And the content in 100 g of glucomannan porang tubers has crude fiber 5.61%, soluble food fiber 10.32%, insoluble food fiber 9.53% and total dietary fiber 18.85% (Wati et al ., 2022).

2. MATERIALS AND METHODS

1.1. Place and time of study

This research will be carried out at the Biology Education Laboratory, Faculty of Teacher Training and Education, University of Muhammadiyah Surakarta, Jl. A.Yani Tromol Post 1 Pabelan Kartasura Sukoharjo from October 2022 to September 2023 from taking the title to drawing conclusions.

1.2. Research tools and materials

The tools used in this study include (1) scales, (2) porang cutting tools, (3) flour selep machines, (4) sieves (40, 60 and 100 mesh), (5) ovens, (6) baking sheets, (7) centrifugation, (8) blenders, (9) matching vessels, (10) filter paper, (11) rotary evaporators, (12)digital scales, (13) rat cages, (14) oral sondes, (15) spaits, (16) freeze dryers, (17) centrifuges, (18)refectometer, (19)pipt drop, and (20)purple microtube. While the materials used include (1) porang tubers, (2) moringa leaves, (3) 24 white rats, (4) dreagendroff reagents, (5) iron (III) Chloride 1%, (6) HCl, (7) Magnesium powder, (8) ethanol 70%, (9) ethanol 50%, (10) aquades, (11) salt, (12) Comfeed BR-1, (13) high fat diet feed (Comfeed BR-1 (70%), duck egg yolk (5%), Beef oil (20%)), and (14) white rat blood.

1.3. Research design

This study used a *true experimental method* prepared with a Complete Randomized Design (RAL) in the form of *Posttest only control design* using 8 treatment groups, namely:

Group 1: Control group with normal feed.

Group 2: Control group with high-fat diet feed

Group 3: Treatment group of high-fat diet feed + glucomannan and Moringa leaf extract 100 mg/kgBB (Nissa & Madjid, 2016) : 100 mg/kgBB.

Group 4: Treatment group of high-fat diet feed + glucomannan and Moringa leaf extract 120 mg / kg BB : 80 mg / KgBB.

Group 5: High fat diet feed treatment group + glucomannan and Moringa leaf extract, 80 mg/kgBB: 120 mg/kgBB.

Group 6: Treatment group of high-fat diet feed + glucomannan and Moringa leaf extract 50 mg/kgBB (Nugraheni et al., n.d.) : 50 mg/kgBB (Nahar, Faisal, Iqbal, et al., 2016)

Group 7: Treatment group of high-fat diet feed + glucomannan and Moringa leaf extract 60 mg / kg BB : 40 mg / kg BB.

Group 8: Treatment group of high-fat diet feed + glucomannan and Moringa leaf extract 40 mg/kgBB: 60 mg/kgBB.

1.4. Population and sample

The population of plasma level test animals used was 8 white rats of wistar *strain (Rattus norvegicus), while* the sample used white rats of wistar strain (Rattus norvegicus*) from the results of random sampling with criteria: male sex, age 2 months, weight 200 grams.*

1.5. Data analysis

The results of mouse blood plasma measurements were analyzed statistically using One Way Analysis of Variance (ANOVA) SPSS version 20 followed by the Willis crucial test.

3. RESULTS AND DISCUSSION

Normal standards of protein levels in rat blood serum according to (Sammad & Santoso, 2017) is 6-8 g/dl. Significant differences in plasma chemerin levels in the obese group compared to non-obese. There was a significant difference in plasma chemerin levels in the group of obese with insulin resistance compared to non-insulin resistant obesity. There was a weak correlation of chemerin with HOMA-IR values in the obese group. There was a weak correlation of chemerin with HOMA-IR values in the insulin resistant obesity group (Dioni et al., 2020). Based on the results of blood plasma protein levels in the treatment group can be seen in the following table:

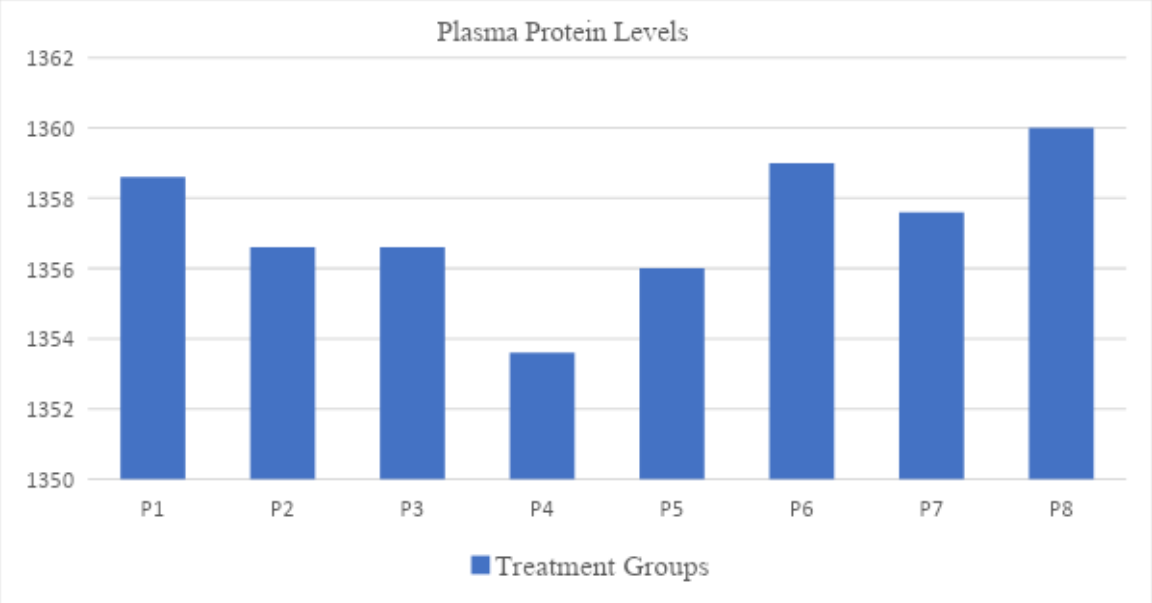

Figure 1. Results of plasma protein levels

Based on the results of the study, blood plasma protein levels of obese rats in the P1 treatment group of the control group with normal feed showed plasma protein levels of 1358.6 g / dL, in the P2 treatment group of the control group with high-fat diet feed showed plasma protein levels of 1356.6 g / dL, in the P3 treatment group of the control group with high-fat diet feed + glucomannan and Moringa leaf extract 100 mg / kg BB: 100 mg / kg BB showed

plasma protein levels of 1356.6 g / dL, in the control group P4 treatment group with high-fat diet feed + glucomannan and Moringa leaf extract 120 mg / kg BB: 80 mg / KgBB showed plasma protein levels of 1353.6 g /dL, in the control group P5 treatment group with high-fat diet feed + glucomannan and Moringa leaf extract, 80 mg/kgBB: 120 mg/kgBB showed plasma protein levels of 1356 g/dL, in the P6 treatment group control group with high-fat diet feed + glucomannan and moringa leaf extract 50 mg/kgBB: 50 mg/kgBB showed plasma protein levels of 1359 g/dL, in the P7 treatment group control group with high-fat diet feed + glucomannan and moringa leaf extract 60 mg/kgBB: 40 mg/kgBB showed plasma protein levels of 1357.6 g/dL, in the control group P8 treatment group with high-fat + glucomannan diet feed and moringa leaf extract 40 mg/kgBB: 60 mg/kgBB showed plasma protein levels of 1360 g/dL.

The highest plasma protein levels were found in the P8 treatment group, which was 1360 g / dL with a dose of Glucomannan 40: Moringa 60 (mg / kg BB) while the lowest plasma protein value was found in the P4 treatment group which was 1353.6 g / dL with a dose of Glucomannan 120: Moringa 80 (mg / kg BB), rat plasma protein levels that were close to normal levels at the lowest results or P4 treatment was due to normal standards of plasma protein levels of 6-8 g / dL. Obesity affects the increase in plasma protein levels in rats because there is a relationship between the incidence of obesity and protein consumption so that it will automatically affect plasma protein levels in the blood (Halim et al., 2022). The unnatural difference in normal plasma protein levels with the results in the treatment group was caused by several factors, one of which was when the blood serum separation process used centrifuges that were too long so as to make the serum too thin and increase the value on the refactometer. In addition, the increase in blood plasma protein levels is also caused by the use of EDTA plasma as in research (Munabari et al., 2022) regarding the effect of using serum specimens and EDTA plasma on total protein levels found that there is a marked difference in protein levels using EDTA plasma higher than serum.

Then, to determine the effect of a mixture of glucomannan porang tubers and Moringa leaf extract on blood plasma protein levels between the control and treatment groups, statistical tests were carried out which can be seen in the following table. Based on the results of the normality test, the significance value is 0.000 ($P < 0.05$), then the data is said to be abnormal and a follow-up test is carried out, namely the homogeneity test with the following results. The results obtained from the homogeneity test are 0.000 ($P < 0.05$), then the data is declared inhomogeneous. Because the data is not homogeneous, further tests are carried out using the crucial willis test with the results listed in the following table:

Table 2. Statistical test results of plasma protein levels (Tests of Normality and Homogeneity of Variance)

Treatments	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	f	Sig.
P1	.385	3	.	.750		.000
P2	.385	3	.	.750		.000
P3	.385	3	.	.750		.000
P4	.385	3	.	.750		.000
P5	.	3	.	.		.
P6	.	3	.	.		.
P7	.385	3	.	.750		.000
P8	.	3	.	.		.

Treatments	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	f	Sig.

		Levene Statistic		df1	df2	Sig.
	Based on Mean	10.286		7	16	.000
	Based on Median	.643		7	16	.715
	Based on Median and with adjusted df	.643		7	4.946	.713
	Based on trimmed mean	8.102			16	.000

Table 4. Test results of Kruskal-Wallis of plasma protein levels

Test Statistics[a,b]	
	plasma darah
Kruskal-Wallis H	14.612
df	7
Asymp. Sig.	.041

a. Kruskal Wallis Test
b. Grouping Variable: Kelompok Perlakuan

When viewed from the results of the Willis crucial test above, the significance value shows a number of 0.041 (P < 0.05) which means there is no difference between the treatment and control groups.

The statistical test carried out is a normality test with the aim of finding out whether the data is normally distributed or not. The results show a significance value of 0.000 (P < 0.05), then the data is said to be abnormal and a follow-up test is carried out, namely a homogeneity test with the aim of knowing that two or more groups of data samples are taken from populations that have the same variance. The homogeneity test results show a significance number of 0.000 (P < 0.05), so the data is declared inhomogeneous. Because the data is not homogeneous, further tests are carried out using the Willis crucial test. The results of the crucial willis test above, the significance value showed a number of 0.041 (P < 0.05) which means there is no difference between the treatment and control groups.

Porang flour can lose weight and reduce food intake in obese rats (Nissa & Madjid, 2016), So it is possible to reduce protein levels in the blood plasma of mice. The administration of bidara leaf extract was significantly different (P<0.05) on total plasma protein levels, but not significantly different (P>0.05) on albumin levels and Padjadjaran quail blood plasma globulin. Giving bidara leaf extract at a dose of 0.2% in the ration was able to increase the total blood plasma protein levels of Padjadjaran quail optimally within the normal range (Andini, 2022). However, based on statistical tests, the blood plasma protein levels of obese white rats with a significant value of 0.041 (P < 0.05) showed that the administration of a mixture of glucomannan in porang tubers and Moringa leaf extract did not have a real effect on the difference in plasma protein levels between the treatment and control groups seen from the measurement results (P1) 1358.6 g / dL; (P2) 1356.6 g/dL; (P3)1356.6 g/dL; (P4)1353.6 g/dL; (P5)1356 g/dL; (P6)1359 g/dL; (P7)1357.6 g/dL; (P8)1360 g/dL which did not undergo significant changes with different dose administrations.

The administration of a mixture of glucomannan porang tubers and Moringa leaf extract which had no effect on differences in blood plasma protein levels in obese white rats was in line with research (Sammad & Santoso, 2017) to determine the effect of giving methanolic extract of Scurrulla atropurpurea (Bl) Dans on total protein levels and serum albumin of female rats for 28 days. It was found that at doses of 250 mg / kg body weight (BB), 500 mg / kg body weight and 1000 mg / kg body weight had no effect on the levels of Total Protein and Albumin serum rats. Similar results were also found in the study (Afifah, I., & Sopiany, 2017) which was done to determine the toxicity effect of the presence of alginate extracted from brown seaweed Turbinaria sp. due to the content of blood protein, albumin, and globulin from the blood serum of wistar rats. The study was conducted with Complete Randomized Design (CRD) with alginate concentration treatment of 0.5%; 0.75%; 1%, and negative control. The results showed that treatment of up to 1% of the concentration of alginate did not exert a toxic effect on the liver. Both references support the results of this study that the mixture of glucomannan and Moringa leaf extract does not have a real effect or is not effective for reducing plasma protein levels.

4. CONCLUSIONS

Blood plasma protein levels of obese white rats treated with a mixture of glucomannan and Moringa leaf extract were the highest at 1360 g / dL and the lowest plasma protein levels at 1353.6 g / dL. A mixture of glucomannan and moringa daum extract had no significant effect on the difference in plasma protein levels between the treatment and control groups.

5. ACKNOWLEDGMENTS

Author would like to thank Miss Endang Setyaningsih S.Si.,M.Si as supervisor and University Muhammadiyah Surakarta as the location for this research.

6. REFERENCES

Afifah, I., & Sopiany, H. M. (2017). Efek Paparan Alginat Dalam Pangan Terhadap Kadar Protein Total, Albumin Dan Globulin Darah. Buana Sains, *87*(1,2), 149–200.

Alamsyah, M. (2019). *The effect of Glucomannan on reducing the risk of Ischemic Stroke Metode*. *Jurnal Ilmiah Kesehatan Sandi Husada*, *10*(2), 292–298. https://doi.org/10.35816/jiskh.v10i2.171

Andini, D. (2022). *Pengaruh Pemberian Ekstrak Daun Bidara (Ziziphus Spina- Christi L.) Dalam Ransum Terhadap Kadar Total Protein, Albumin, Dan Globulin Plasma Darah Puyuh Padjadjaran*. 156–166.

Ardiani, H. E., Permatasari, T. A. E., & Sugiatmi, S. (2021). Obesitas, Pola Diet, dan Aktifitas Fisik dalam Penanganan Diabetes Melitus pada Masa Pandemi Covid-19. *Muhammadiyah Journal of Nutrition and Food Science (MJNF)*, *2*(1), 1. https://doi.org/10.24853/mjnf.2.1.1-12

Dioni, S., Rini, E. A., & Yerizel, E. (2020). Hubungan Kadar Plasma Chemerin dengan Homeostasis Model Assessment Insulin Resistance pada Remaja Obesitas. *Sari Pediatri*, *22*(1), 24. https://doi.org/10.14238/sp22.1.2020.24-9

Fauzi, M., & Bahagia, S. N. (2019). Pengambilan Keputusan Komponen Darah Dalam Pengendalian Persediaan Dengan Menggunakan Metode Ahp Di Pmi Kota Bandung. *Jurnal Ilmiah Teknologi Infomasi Terapan*, *5*(2), 13–20. https://doi.org/10.33197/jitter.vol5.iss2.2019.276

Firani, novi khila. (2018). *mengenali sel-sel darah dan kelainan darah*. UBPRESS.

Halim, Ago; Bontong, Stella Irene; Rahfiludin, M. Z. (2022). *Relationship between Carbohydrate , Protein , and Fat Consumption with Obesity Incidence in 2014 UKI Faculty of Medicine Students*. *6*(4). https://doi.org/10.20473/amnt.v6i4.2022.385-391

Lahamendu, B., Bodhi, W., & Siampa, J. P. (2019). Uji Efek Analgetik Ekstrak Etanol Rimpang Jahe Putih (Zingiber Officinale Rosc.Var. Amarum) Pada Tikus Putih Jantan Galur Wistar (Rattus norvegicus). *Pharmacon*, *8*(4), 927. https://doi.org/10.35799/pha.8.2019.29372

Munabari, F., & Syahputra, A. (2022). Pengaruh Penggunaan Spesimen Serum Dan Plasma Edta Terhadap Kadar Total Protein. *Jurnal Pranata Biomedika*, *1*(2), 134–140. https://doi.org/10.24167/jpb.v1i2.5153

Mushawwir, A., Yulianti, A. A., Suwarno, N., Permana, R., Peternakan, F., & Padjadjaran, U. (2020). Profil Metabolit Plasma Darah dan Aktivitas Kreatin Kinase Sapi Perah Berdasarkan Fluktuasi Mikroklimat Lingkungan Kandangnya. *Jurnal Veteriner*, *21*(1), 24–30. https://doi.org/10.19087/jveteriner.2020.21.1.24

Nahar, S., Faisal, F. M., & Iqbal, J. (2016). *Antiobesity activity of Moringa oleifera leaves against high fat diet-induced obesity in rats IJBCP International Journal of Basic & Clinical Pharmacology Research Article Antiobesity activity of Moringa oleifera leaves against high fat diet-induced obesity in rats*. *August*. https://doi.org/10.18203/2319-2003.ijbcp20162427

Nahar, S., Faisal, F. M., Iqbal, J., Rahman, M., & Yusuf, A. (2016). *IJBCP International Journal of Basic & Clinical Pharmacology Research Article Antiobesity activity of Moringa oleifera leaves against high fat diet-induced obesity in rats*. *5*(4), 1263–1268.

Nissa, C., & Madjid, I. J. (2016). *Potensi glukomanan pada tepung porang sebagai agen anti-obesitas pada tikus dengan induksi diet tinggi lemak*. *13*(1), 1–6.

Nugraheni, B., Cahyani, I. M., & Herlyanti, K. (n.d.). *Efek Pemberian Glukomanan Umbi Porang (Amorphophallus oncophyllus Prain ex Hook . f .) Terhadap Kadar Kolesterol*. 32–36.

Nur Ramadhani, Q. A., Garini, A., Nurhayati, N., & Harianja, S. H. (2019). Perbedaan Kadar Glukosa Darah Sewaktu Menggunakan Serum Dan Plasma Edta. *JPP (Jurnal Kesehatan Poltekkes Palembang)*, *14*(2), 80–84. https://doi.org/10.36086/jpp.v14i2.407

Oktavisa, Anggeria; yuliana, Rahayu; fauziyah, E. (2022). *Serbuk Daun Kelor Efektif Menurunkan Kadar Glukosa Darah dan Kadar Kolesterol pada Individu Obese*. *12*(1), 10–16.

Rejeki, P. S., Putri, E. A. C., & Prasetya, R. E. (2018). Ovariektomi Pada Tikus Dan Mencit. In *Airlangga University Press*.

Sammad, F. H. A., & Santoso, H. (2017). *e − JBST 2017 e − JBST 2017 Material dan Metode*. *2*, 49–54.

Suha, G. R., & Rosyada, A. (2022). *Faktor-faktor yang berhubungan dengan kejadian obesitas pada remaja umur 13 – 15 tahun di Indonesia (analisis lanjut data Riskesdas 2018) Program Studi Ilmu Kesehatan Masyarakat , Fakultas Kesehatan Masyarakat , Universitas Sriwijaya*. *06*(01), 43–56.

Wahyuni, I. S. (2022). *Anti-Inflammatory Activity and Wound Healing Effect of Kaempferia galanga L . Rhizome on the Chemical-Induced Oral Mucosal Ulcer in Wistar Rats*. *April*, 2281–2294.

Wardani, N. E., Subaidah, W. A., & Muliasari, H. (2021). Ekstraksi dan Penetapan Kadar Glukomanan dari Umbi Porang (Amorphophallus muelleri Blume) Menggunakan Metode DNS. *Jurnal Sains Dan Kesehatan*, *3*(3), 383–391. https://doi.org/10.25026/jsk.v3i3.574

Wigoeno, Y. A., Azrianingsih, R., Roosdiana, A., Biologi, J., Kimia, J., & Timur, J. (1967). *Analisis kadar glukomanan pada umbi porang (*. *1*, 231–235.

Wati, D. P., & Setyaningsih, E. (2022). Efrektivitas Kombinasi Glukomanan Umbi Porang (*Amorphophallus muelleri Blume*) Dan Ekstrak Daun Kelor (*Moringa oleifera*) Terhadap Penurunan Obesitas. (Skripsi Sarjana, Universitas Muhammadiyah Surakarta)