



EFFECTIVENESS OF MANGO LEAF EXTRACT SUPPLEMENTATION (MANGIFERA INDICA L.) ON METABOLIC DISEASE PANEL OF WISTAR RATS (RATTUS NORVEGICUS) INDUCED BY HIGH-FAT DIET

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Abstract

High-calorie foods can cause obesity if consumed in excess. Obesity occurs due to excessive fat accumulation in the body. Excess weight is a major risk factor for secondary disorders in pets, such as diabetes mellitus. Diabetes mellitus occurs due to high blood glucose levels. Mango leaf extract contains bioactive compounds that can lower and normalise blood glucose levels and can be used as a supplement. This study aims to determine the effectiveness of mango leaf extract supplementation induced by a high-fat diet on blood glucose levels. This study used arumanis and golek mango leaf. The methods used were extraction and in vivo testing. Extraction was performed on mango leaf, and the extraction results were administered to test animals in vivo. The phytochemical results showed that arumanis and golek mango leaf contain flavonoids, tannins, alkaloids, and saponins. The results showed that arumanis mango leaf extract was more effective in lowering blood glucose levels than golek mango leaf extract. These findings are expected to contribute to the development of knowledge about supplements and drug substitutes, as well as to identify more practical methods for drug therapy for diabetes mellitus in pets.

Keywords: Diabetes, Glucosa, Mango Leaf, Supplement

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Introduction

In line with the times, animals that initially played a role as tools in work now have a role as pets. In Indonesia, the most common types of pets among the community are cats, dogs, birds, snakes, rabbits, and fish (Nugroho et al., 2022). Pet food is generally produced commercially, although some pet owners choose to prepare their own pet food using ingredients sourced from animals and plants (Li and Wu., 2023).

One of the four pillars of health that is important for pet care is preventive measures or disease prevention. These measures are better than disease treatment (curative), because disease treatment

requires greater costs, and the condition of sick animals will become more severe. The problem faced by pet owners in caring for their cats is a lack of knowledge and awareness about how to care for cats, so that their cats are easily infected with diseases (Siagian et al., 2023). One of the diseases that can be a factor in the occurrence of diabetes mellitus is obesity.

Obesity occurs due to abnormal or excessive fat accumulation in the body. Excess weight is a major risk factor for secondary disorders in cats, such as diabetes mellitus. Excess weight caused by excessive body fat content leads to reduced insulin sensitivity and can subsequently cause hyperglycemia (Keller et al., 2017).

The management of diabetes mellitus generally includes pharmacological therapy, such as insulin and oral antidiabetic drugs. Although this therapy has been proven effective in controlling blood glucose levels, long-term use has the potential to cause various side effects, including hypoglycaemia, gastrointestinal disorders, and an increased risk of certain complications. In addition, the relatively high cost of treatment is also a challenge for some patients (Irfan et al., 2026).

Indonesia is known as a country with a high level of biodiversity and has a long history of using medicinal plants as part of its traditional medicine system. Various types of herbal plants have been used empirically to help control blood glucose levels in people with diabetes mellitus. With the advancement of science, the use of medicinal plants has developed towards phytotherapy, which is the use of herbal-based preparations that have undergone a standardisation process and are supported by scientific evidence regarding their safety and effectiveness (Irfan et al., 2026).

A number of studies have reported that medicinal plants contain various bioactive compounds, such as flavonoids, phenolic compounds, alkaloids, saponins, and tannins, which contribute to antidiabetic activity. The mango plant is one plant that has potential as a medicinal plant. Mango plants have this potential because they contain secondary metabolites. In addition to flavonoids, mango plants also contain saponins, gallic tannins, catechin tannins, quinones, and steroids (Ningsih et al., 2017). One of the compounds found in mango leaf is flavonoids, which can inhibit the HMG-CoA reductase enzyme, thereby lowering blood cholesterol and acting as an antioxidant that can stimulate the recovery of damaged pancreatic β cells. With this regeneration, insulin secretion will increase so that the glucose in the blood will enter the cells. Saponins work by inhibiting cholesterol absorption in the intestines through a process of forming insoluble complexes with cholesterol. They can also lower blood glucose levels by inhibiting sugar transport in the digestive tract and stimulating insulin secretion. Astringents can constrict the small intestinal epithelial membrane, thereby reducing nutrient absorption and ultimately lowering blood glucose levels. Tannins inhibit fat absorption in the intestines by causing a reaction in the mucosal proteins and epithelial cells, and play a role in increasing glycogenesis activity, which is the metabolic pathway that converts glucose into glycogen for storage in the liver. This leads to a decrease in blood glucose levels and can constrict the small intestinal epithelial membrane, thereby reducing nutrient absorption and ultimately preventing a sharp rise in blood glucose levels (Sulaeman et al., 2022).

The findings regarding the effectiveness of mango leaf extract (*Mangifera indica* L.) supplementation in improving metabolic disease parameters in Wistar rats induced by a high-fat diet have potential implications in the field of clinical veterinary medicine. Metabolic disorders such as obesity and hyperglycaemia are also increasingly reported in companion animals, particularly dogs and cats, due to changes in feeding patterns, lack of physical activity, and increased life expectancy of animals. These conditions contribute to the emergence of chronic diseases such as diabetes mellitus.

Bioactive compounds in mango leaf, such as flavonoids and polyphenols, which are known to have antioxidant, antihyperglycaemic, and hypolipidaemic activities, have the potential to support complementary therapy in animals with metabolic disorders. In veterinary practice, this approach has the potential to be developed as part of an integrated management strategy, alongside dietary regulation, weight control, and conventional pharmacological therapy. However, clinical application in dogs and cats still requires further study, particularly regarding safe dosage, bioavailability, interactions with other veterinary drugs, and species-specific toxicity testing. Therefore, the results of research on mouse models can serve as promising preliminary scientific evidence (preclinical evidence) for the development of veterinary phytopharmaceuticals in the management of metabolic diseases in companion animals.

A high-fat diet is used as one method to increase body fat. Therefore, we conducted a study entitled “*Effectiveness of Mango Leaf Extract Supplementation (Mangifera Indica L.) on Metabolic Disease Panel of Wistar Rats (Rattus Norvegicus) Induced by High-Fat Diet*”. The results of this study are expected to provide information and references related to the treatment of metabolic diseases in pets, which are increasing every year in line with the growing public interest in pet care.

Materials and Methods

Research Animals

The study used male Wistar strain white rats (*Rattus norvegicus*) as test animals. The rats used weighed 190-200 grams and were obtained from breeders in Maros Regency. They were then acclimatised and treated at the Animal Lab of the Hasanuddin University Veterinary Teaching Hospital. The rat cages were first sterilised by drying them in the sun, then lined with husks. Once the cages were sterile, the rats were immediately placed in them and given pellet feed and water ad libitum. The cages were also covered with wire mesh, and the rats were acclimatised for 7 days. The cages were cleaned and the husks replaced every 3 days. All research procedures have undergone ethical review and obtained approval from the Animal Ethics and Research Commission of Hasanuddin University Animal Hospital, Makassar, with letter number: 002/UN4.1.RSHUH/B/PP36/2025.

Orientation and Preparation of Mango Leaf Extract

The equipment used in the extraction process includes glass jars, 1000 mL Erlenmeyer flasks (Pyrex®), glass funnels (Pyrex®), stirring rods, a rotary vacuum evaporator, digital scales, porcelain dishes, 100 mL measuring cups (Pyrex®), 500 mL and 250 mL chemical beakers (Pyrex®), dropper pipettes, filter paper, and an oven. The materials used were young sweet mango leaf, young golek mango leaf, and 70% ethanol.

The sweet-smelling mango leaf and golek mango leaf were dried in an oven until dry, then macerated, 70% ethanol solvent was added until submerged, and the solution was then left for 3 days while being stirred occasionally. The macerate was then separated from the residue, and all the macerate obtained was evaporated using a rotary evaporator at a temperature of ± 40 degrees Celsius until a thick extract was obtained (Hanifah et al., 2022).

Phytochemical Screening

1. Identification of flavonoid compounds

Several samples of mango leaf extract in test tubes were added with 0.1 grams of magnesium powder, 0.4 mL of amyl alcohol (a mixture of 37% hydrochloric acid and 95% ethanol in equal volumes) and 4 mL of alcohol, then shaken. The presence of flavonoid compounds is indicated by a colour change to red, yellow or orange in the amyl alcohol layer (Yuliawati et al., 2022).

2. Identification of tannin compounds

Several samples of mango leaf extract in test tubes were added with 10 mL of 1% FeCl₃ (III) distilled water. The presence of tannin compounds is indicated by the formation of a blue or dark green colour (Yuliawati et al., 2022).

3. Identification of saponin compounds

Several mango leaf extract samples in test tubes were added with 10 mL of hot distilled water, cooled, and then shaken vigorously for 30 seconds. Then, 2N HCl was added dropwise into the tube and the changes observed. Foam that did not disappear for 10 minutes, reaching a height of 1-10 cm, indicated the presence of saponin compounds (Yuliawati et al., 2022).

Preparation of High-Fat Diet Feed

The feed formulation to be given to each treatment group was prepared by combining several ingredients containing fat. The ingredients used to make the high-fat feed formulation consisted of a mixture of butter, coconut oil, and duck egg yolks. The ratio of the three fat-containing ingredients was 1:1:1 (grams). The butter and coconut oil were first heated and then mixed with duck egg yolks. This feed mixture was given to the rats at a rate of 2% of their total body weight.

High-Fat Feed and Mango Leaf Ethanol Extract

The rats were first acclimatised for 7 days to adjust to the new environment. The test animals were divided into 4 groups, namely 2 control groups (K- and K+) and 2 treatment groups (KP1 and KP2).

K- : The negative control group was given standard feed for 30 days

K+ : The positive control group was given a high-fat diet for 30 days

KP1: Group given a high-fat diet and feed formulated with 150 mg/kg BW of sweet mango leaf ethanol extract for 30 days

KP2: Group given a high-fat diet and feed formulated with 150 mg/kg BW of golek mango leaf ethanol extract for 30 days

Fasting Blood Glucose Test

The fasting blood glucose test was performed by placing a blood sample into a Nesco Multicheck 3 in 1 GCU. After 10 seconds, the glucose level contained therein was observed.

Results and Discussion

Qualitative Phytochemical Test

Table 1. Qualitative Phytochemical Test Results (TLC Method)

NO	Type Of Test	Reagent	Test Results		Description
			Golek Mango	Arumanis Mango	
1	Flavonoid	Citroborate	+	+	Colour change to greenish yellow
2	Tannins	FeCl ₃	+	+	Colour change to dark blue to black
3	Alkaloids	Dragendorff	+	+	Colour change to reddish orange
4	Saponins		+	+	There is static foam in the reaction tube

The results of the Qualitative Phytochemical Test on golek mango leaf and arumanis mango leaves showed the presence of flavonoids, tannins, alkaloids, and saponins. This is in line with the theory of Sari and Sujarwati (2023), that ethanol extracts of arumanis mango seeds show the presence of phenolic compounds, flavonoids, and terpenoids. Another study by Laoi et al. (2020) also mentioned that ethanol extracts of sweet mango seeds contain secondary metabolites in the form

of flavonoids, tannins, terpenoids, and saponins.

Fasting Blood Glucose Test

Twenty-four male Wistar rats were kept in individual cages. Table 1 shows that group K- had an average FBG level of 80.67 mg/dL, which is within the normal range of 50–135 mg/dL, while groups K+ and KP2 had FBG levels of 127.83 mg/dL and 124.17 mg/dL, which are normal but ineffective in lowering FBG.

Table 2. Fasting Blood Glucose Results (One-Way ANOVA Test)

Treatment Group	GDP (mg/dL)	ANOVA sig.
K-	80,67 ± 27,03 ^a	.004
K+	127,83 ± 15,28 ^b	
KP1	86,50 ± 23,24 ^a	
KP2	124,17 ± 29,43 ^b	

The K+ treatment group remained within the normal range but showed an increase in GDP. Meanwhile, KP1 and K- reduced GDP again. KP2 had no effect because the GDP of K+ remained the same. Based on Duncan's post-hoc test, there is a significant difference between K- and K+, indicating a significant increase in GDP in Wistar rats fed HFD and the formulation. There is no difference in GDP between K- and KP1, meaning that the administration of sweet mango leaf extract is effective in reducing GDP in Wistar rats. There is a significant difference in GDP between K- and KP2, meaning that the administration of golek mango leaf extract is not effective in reducing GDP. Based on the ANOVA test results, a significance value of 0.004 was obtained, meaning that GDP in mice that have been treated has a significant effect.

Body Weight Examination

Each group had significant differences in body weight based on the One Way Anova test. The average body weights of the K-, K+, KP1 and KP2 groups were 144.17 g, 241.17 g, 145.33 g and 231.17 g, respectively.

Table 3. Body Weight Results of Wistar Rats (One-Way ANOVA Test)

Treatment Group	Weight (g)	ANOVA sig.
K-	144.17 ± 5.71 ^a	.000
K+	241.17 ± 12.38 ^b	
KP1	145.33 ± 9.89 ^a	
KP2	231.17 ± 3.76 ^b	

Based on Duncan's post hoc test, there was a significant difference between K- and K+, indicating a significant increase in body weight in Wistar rats fed HFD and the formulation. There was no difference in body weight between K- and Kp1, meaning that the administration of sweet mango leaf extract was effective in reducing body weight in Wistar rats. There was a significant difference in body weight between K- and Kp2, meaning that the administration of golek mango leaf extract was not effective in reducing body weight. Based on the results of the ANOVA test, a significance value of 0.000 was obtained, meaning that the body weight of Wistar rats that had been given the treatment was significantly affected.

The Effect of Mango Leaf Extract on Blood Glucose

Based on the average GDP levels of Wistar rats (*Rattus Norvegicus*), it can be seen that the K-

control group showed the lowest average GDP compared to the treatment groups. This was because the control group was not given additional HFD feed and formulation. HFD feed and formulation play a role in causing obesity through the accumulation of gut microbiota, leading to increased intestinal permeability or absorption capacity. This obesity is caused by the accumulation or accumulation of high levels of fat in body tissues (Enggarwati and Qomariyah, 2023).

The addition of mango leaf extract affected the GDP levels of Wistar rats (*Rattus Novergicus*). A decrease in GDP levels occurred in the KP1 treatment group with sweet mango leaf extract, when compared to the KP2 treatment group with golek mango leaf extract. This is because the content (phenols, flavonoids, polyphenols, tannins, and saponins) of sweet mango leaf is higher than that of golek mangoes (Aji et al., 2024). Mango leaf ethanol extract has the effect of reducing blood cholesterol levels (Destiana et al., 2022). It reduces glucose absorption, regulates the activity of enzymes involved in carbohydrate metabolism, and inhibits the breakdown of polysaccharides into monosaccharides (Anwar et al., 2017).

Conclusion

This study shows that supplementation with mango leaf extract (*Mangifera indica* L.) has the potential to mitigate metabolic disorders induced by a high-fat diet in Wistar rats (*Rattus norvegicus*). Through the method of extract administration and analysis of blood glucose parameters, this study successfully identified the positive effects of mango leaf extract on controlling metabolic damage. From the data obtained, mango leaf extract contains active compounds such as flavonoids, saponins, tannins, and alkaloids. The results showed that sweet mango leaf extract was more effective in lowering blood glucose than golek mango leaves. This study successfully provided important preliminary data to support further development in the use of mango leaf extract as a therapeutic agent for the prevention and management of metabolic diseases in pets. This is a promising first step for implementation in the fields of veterinary medicine and animal pharmacology.

Conflict of Interest

We declare that there is no conflict of interest with any financial, personal, or other relationships with persons or organisations related to the subject matter discussed in this manuscript.

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