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Breadfruit Leaf Extract (Artocarpus altilis) and Its Effect on Triglyceride Levels in Obese Adults

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Abstract. *Obesity is a major global health problem closely associated with metabolic dysfunction, including dyslipidemia and elevated triglyceride levels, which increase cardiovascular risk. Breadfruit (Artocarpus altilis) leaf extract has been traditionally used for metabolic disorders and contains bioactive compounds such as flavonoids and phenolics with antioxidant and lipid-regulating properties, but clinical evidence on its triglyceride-lowering effect in obese adults remains limited. This study aimed to evaluate the effect of Artocarpus altilis leaf extract supplementation on triglyceride levels among obese adults. A quasi-experimental study with a pretest–posttest control group design was conducted at Puskesmas Makkasau, Makassar, Indonesia. Eighty-two obese adults (BMI ≥25 kg/m^2, aged 30–60 years) were allocated into an intervention group (n = 41, breadfruit leaf extract) and a control group (n = 41, placebo/standard care). Serum triglyceride levels were measured at baseline and after 8 weeks. Baseline characteristics were comparable between groups ($p > 0.05$). After 8 weeks, the intervention group showed a significantly greater triglyceride reduction (−46.9 ± 28.4 mg/dL) than the control group (−7.9 ± 20.5 mg/dL), with a between-group difference of −39.0 mg/dL ($p < 0.001$).*

Keywords: *Artocarpus Altilis, Breadfruit Leaf Extract, Obesity, Triglyceride, Dyslipidemia*

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INTRODUCTION

Obesity has become one of the most challenging global public health problems of the twenty-first century. The prevalence of obesity has increased substantially over the past decades and has affected populations across developed and developing countries (Chooi et al., 2019; Ng et al., 2014; Koliaki et al., 2023; Blüher, 2019). The World Health Organization (WHO) recognizes obesity as a chronic disease characterized by excessive accumulation of body fat that impairs health and increases the risk of multiple metabolic disorders, including cardiovascular disease, type 2 diabetes mellitus, hypertension, dyslipidemia, and premature mortality.

The global increase in obesity is driven by complex interactions between genetic susceptibility, unhealthy dietary patterns, sedentary lifestyles, environmental factors, and socioeconomic determinants. Consequently, obesity has become a major contributor to the increasing burden of non-communicable diseases worldwide and requires effective preventive and therapeutic strategies (Blüher, 2019; Chooi et al., 2019).

Beyond excessive fat accumulation, obesity represents a state of metabolic dysfunction involving chronic inflammation, oxidative stress, and impaired lipid metabolism. Adipose tissue is now recognized as an active endocrine organ capable of secreting adipokines, cytokines, and inflammatory mediators that regulate systemic metabolism. In individuals with obesity, excessive expansion of adipose tissue promotes macrophage infiltration and increases the production of

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pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), and C-reactive protein (CRP).

These inflammatory processes contribute to insulin resistance, abnormal lipid metabolism, and increased cardiovascular risk. Therefore, obesity-associated metabolic disturbances represent a complex pathological condition requiring interventions beyond weight reduction alone (Unamuno et al., 2018; Ellulu et al., 2017; Rohm et al., 2022). One of the most common metabolic abnormalities observed in obese individuals is dyslipidemia, particularly elevated triglyceride concentrations. Hypertriglyceridemia develops as a consequence of increased free fatty acid mobilization from dysfunctional adipose tissue, enhanced hepatic triglyceride synthesis, and increased production of very-low-density lipoprotein (VLDL).

Elevated triglyceride levels contribute to the formation of atherogenic remnant particles, endothelial dysfunction, and accelerated atherosclerotic processes. Furthermore, hypertriglyceridemia is frequently associated with reduced high-density lipoprotein cholesterol (HDL-C) and increased small dense low-density lipoprotein (LDL), creating an unfavorable lipid profile that significantly increases cardiovascular disease risk. Therefore, controlling triglyceride levels represents an important therapeutic target in reducing obesity-related cardiometabolic complications (Nordestgaard, 2016; Virani et al., 2021).

Current approaches for managing obesity-related dyslipidemia include lifestyle modification, dietary intervention, increased physical activity, and pharmacological therapy. Although lipid-lowering medications such as statins, fibrates, and omega-3 fatty acids have demonstrated effectiveness in improving lipid profiles, several limitations remain, including adverse effects, treatment costs, drug interactions, and limited long-term adherence among patients. These challenges have encouraged increasing interest in natural products and medicinal plants as complementary interventions for metabolic disorders. Bioactive compounds derived from plants, particularly flavonoids, phenolic compounds, and terpenoids, have demonstrated antioxidant, anti-inflammatory, insulin-sensitizing, and lipid-regulating properties, suggesting their potential role in improving obesity-associated metabolic abnormalities (Ganesan & Xu, 2017).

Breadfruit (*Artocarpus altilis*) is a tropical plant belonging to the Moraceae family that has been traditionally utilized as a source of food and medicine in many tropical regions, including Southeast Asia and the Pacific Islands. In traditional medicine, breadfruit leaves have been used for managing several health conditions, including hypertension, diabetes mellitus, inflammation, and metabolic disorders (Raihandhany, 2022; Ulandari et al., 2023; Asni & Rahayu, 2025; Mehta et al., 2023). Increasing scientific interest in *Artocarpus altilis* has emerged due to its rich phytochemical composition and potential pharmacological activities. Phytochemical investigations have identified various bioactive constituents in breadfruit leaves, including flavonoids, phenolic compounds, tannins, saponins, terpenoids, and prenylated flavonoids. These compounds possess strong antioxidant and anti-inflammatory properties, which may contribute to the regulation of metabolic pathways involved in obesity and dyslipidemia (Jagtap & Bapat, 2010).

The metabolic benefits of *Artocarpus altilis* leaf extract are primarily attributed to its bioactive compounds that influence several mechanisms associated with lipid metabolism. Flavonoids and phenolic compounds have been reported to reduce oxidative stress by scavenging reactive oxygen species (ROS) and enhancing endogenous antioxidant defense systems. Oxidative stress plays a crucial role in obesity-induced metabolic dysfunction by promoting inflammation, insulin resistance, and abnormal lipid accumulation.

Furthermore, flavonoids may regulate lipid metabolism through inhibition of hepatic fatty acid synthesis, suppression of sterol regulatory element-binding protein-1c (SREBP-1c), activation of AMP-activated protein kinase (AMPK), and enhancement of fatty acid oxidation pathways. These mechanisms provide a biological rationale for the potential triglyceride-lowering effect of breadfruit leaf extract in individuals with obesity-associated metabolic disorders (Panche et al., 2016; Ganesan & Xu, 2017).

Several experimental studies have demonstrated the beneficial effects of *Artocarpus altilis* on metabolic parameters. Animal studies have reported that breadfruit leaf extract administration may improve glucose regulation, reduce oxidative stress markers, and enhance lipid profile parameters in experimental models of metabolic disorders. The presence of flavonoids and phenolic compounds in breadfruit leaves has been associated with improvements in total cholesterol, triglyceride, and low-density lipoprotein cholesterol (LDL-C) levels. These findings suggest that breadfruit leaf extract may have potential as a natural hypolipidemic agent. However, most available evidence has been derived from preclinical models, and translation of these findings into clinical practice requires further investigation through human studies (Sikarwar et al., 2014; Omoruyi et al., 2015).

Recent clinical investigations have begun to provide evidence regarding the metabolic effects of breadfruit leaf extract in humans. A clinical trial conducted among obese adults in Makassar, Indonesia, reported that supplementation with *Artocarpus altilis* leaf extract produced improvements in cardiovascular parameters, particularly blood pressure, suggesting its potential role in reducing obesity-related cardiovascular risk. Furthermore, another clinical study investigating breadfruit leaf extract among patients with metabolic disorders demonstrated improvements in metabolic parameters, including lipid-related outcomes. These findings indicate that breadfruit leaf extract may have clinically relevant biological activity; however, evidence regarding its specific effect on triglyceride reduction remains limited and requires further confirmation (Jariah et al., 2024; Nurhaedar & Kurniati, 2024).

Despite promising experimental and preliminary clinical findings, several important research gaps remain. First, most previous studies examining *Artocarpus altilis* have focused on animal models, diabetes-related conditions, or general metabolic outcomes rather than specifically evaluating triglyceride reduction in obese adults. Second, limited clinical evidence exists regarding the effectiveness of standardized breadfruit leaf extract as an intervention for obesity-associated hypertriglyceridemia. Third, variations in extraction methods, dosage, intervention duration, and participant characteristics make it difficult to establish consistent conclusions regarding its therapeutic effectiveness. Therefore, well-designed clinical studies are needed to determine whether breadfruit leaf extract can significantly improve triglyceride levels among obese adults.

The investigation of breadfruit leaf extract as a potential intervention for obesity-related hypertriglyceridemia is particularly relevant in Indonesia, where breadfruit plants are widely available and traditionally recognized for their medicinal properties. Developing evidence-based interventions using locally available medicinal plants may provide an affordable and culturally acceptable complementary strategy for managing metabolic disorders. Furthermore, the identification of natural compounds capable of improving lipid metabolism may contribute to the development of functional foods and nutraceutical approaches for preventing cardiovascular complications associated with obesity. Therefore, this study aims to evaluate the effect of breadfruit leaf extract (*Artocarpus altilis*) on triglyceride levels among obese adults. This research is expected to provide new clinical evidence regarding the hypolipidemic potential of *Artocarpus altilis* and contribute to the development of complementary therapeutic strategies for obesity-associated dyslipidemia.

METHODS

Study Design and Setting

This study employed a quasi-experimental study design with a pretest–posttest control group approach to evaluate the effect of breadfruit leaf extract (*Artocarpus altilis*) supplementation on triglyceride levels among obese adults. The study was conducted at Makkasau Primary Health Care Center (Puskesmas Makkasau), Makassar, Indonesia, a community-based healthcare facility providing preventive and promotive health services for individuals with metabolic risk factors. The study was designed to determine whether administration of standardized breadfruit leaf extract could improve lipid metabolism, particularly serum triglyceride levels, among adults with obesity. Participants were assessed at baseline before intervention and reassessed after completion of the intervention period. The study protocol was developed according to the principles of clinical intervention research and reported following relevant guidelines for observational and experimental health research.

Participants and Recruitment

Participants were recruited from adults receiving health services at Puskesmas Makkasau, Makassar. Eligible participants were adults diagnosed with obesity based on Asian-Pacific criteria, which define obesity as a body mass index (BMI) ≥25 kg/m^2. The inclusion criteria were: Adults aged 30–60 years; BMI ≥25 kg/m^2; Willing to participate and sign written informed consent; Having stable dietary and physical activity patterns during the study period; and Having triglyceride measurements available before and after intervention. Participants were excluded if they met one or more of the following criteria: Diagnosed cardiovascular disease; Diabetes mellitus requiring insulin therapy; Chronic-kidney disease or liver disease; Current use of lipid-lowering medication; Pregnancy or breastfeeding; History of allergy to herbal products; Failure to complete the intervention protocol.

Sample Size Determination

The sample size was calculated based on the comparison of mean differences in triglyceride levels between the intervention and control groups. The calculation used a significance level of 5% (α = 0.05), statistical power of 80% (β = 0.20), an estimated standard deviation of triglyceride changes of 45 mg/dL, and a minimum expected mean difference of 30 mg/dL between groups. Using the formula for comparing two independent means, the minimum required sample size was calculated as 36 participants per group. Considering a potential dropout rate of approximately 15% during the intervention period, the final sample size was increased to 41 participants per group. Therefore, the total sample size required for this study was 82 obese adults, consisting of 41 participants in the breadfruit leaf extract intervention group and 41 participants in the control group.

Participants

A total of 82 obese adults were recruited from Puskesmas Makkasau, Makassar, Indonesia. Participants were randomly allocated into two groups: the intervention group receiving *Artocarpus altilis* leaf extract (n = 41) and the control group receiving placebo/standard care (n = 41). The inclusion criteria were adults aged 30–60 years, body mass index (BMI) ≥25 kg/m^2 based on Asian-Pacific obesity criteria, willingness to participate in the study, and availability for triglyceride assessment before and after intervention. Participants were excluded if they had cardiovascular disease, uncontrolled diabetes mellitus, chronic kidney or liver disease, were using lipid-lowering medication, were pregnant or breastfeeding, or had a history of allergy to herbal products.

RESULT AND DISCUSSION

Table1. Participant Flow and Baseline Characteristics

Stage	Number
Participants assessed for eligibility	120
Excluded	38
Included and randomized	82
Intervention group	41
Control group	41
Completed follow-up	78
Lost to follow-up	4

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Table 2. Baseline Characteristics of Participants

Variable	Intervention (n=41)	Control (n=41)	p-value
Age (years)	45.6 ± 7.8	46.1 ± 8.2	0.781
Male (%)	43.9	41.5	0.823
Female (%)	56.1	58.5	
BMI (kg/m^2)	30.2 ± 3.1	30.5 ± 3.4	0.694
Waist circumference (cm)	102.4 ± 8.6	103.1 ± 9.1	0.721
Systolic BP (mmHg)	137.5 ± 15.2	138.1 ± 14.8	0.861
Triglyceride (mg/dL)	198.6 ± 42.5	195.8 ± 40.7	0.756
Total cholesterol (mg/dL)	218.4 ± 35.6	215.7 ± 37.1	0.743
LDL-C (mg/dL)	142.6 ± 31.4	140.9 ± 30.7	0.802
HDL-C (mg/dL)	42.8 ± 6.7	43.2 ± 7.1	0.781

Table 3. Changes in Lipid Profile After 8 Weeks

Parameter	Intervention	Control	Between-group Difference	p-value
TG baseline	198.6 ±42.5	195.8±40.7	2.8	0.756
TG week 8	151.7±35.8	187.9±39.2	-36.2	<0.001
ΔTG	−46.9±28.4	−7.9±20.5	-39.0	<0.001

Table 4. Intervention Group Paired Analysis

Outcome	Baseline	Week 8	Mean Change	p
Triglyceride	198.6	151.7	-46.9	<0.001

The intervention group showed a significant reduction in triglyceride levels after 8 weeks of breadfruit leaf extract supplementation ($p < 0.001$).

Table 5. Control Group

Outcome	Baseline	Week 8	Mean Change	p
Triglyceride	195.8	187.9	-7.9	0.061

This study investigated the effect of breadfruit leaf extract (*Artocarpus altilis*) supplementation on triglyceride levels among obese adults. The findings indicate that breadfruit leaf extract has potential lipid-lowering activity, as participants receiving the intervention demonstrated greater improvements in triglyceride levels compared with the control group. These findings suggest that *Artocarpus altilis* may represent a promising complementary intervention for managing obesity-associated dyslipidemia. The reduction in triglyceride levels observed following breadfruit leaf extract supplementation may be attributed to the presence of bioactive compounds, particularly flavonoids, phenolic compounds, and quercetin derivatives. Previous phytochemical studies have demonstrated that breadfruit leaves contain various secondary metabolites with antioxidant and metabolic regulatory activities. These compounds can reduce oxidative stress, inhibit inflammatory responses, and improve lipid metabolism, which are key mechanisms involved in the development of obesity-related dyslipidemia (Jagtap & Bapat, 2010).

Obesity is characterized by excessive adipose tissue accumulation, which promotes increased lipolysis and elevated circulating free fatty acids. The increased availability of free fatty acids stimulates hepatic triglyceride synthesis and enhances very-low-density lipoprotein (VLDL) production, resulting in elevated serum triglyceride concentrations. Bioactive compounds in breadfruit leaf extract may counteract these metabolic disturbances by improving insulin sensitivity, reducing hepatic lipid synthesis, and promoting fatty acid oxidation. Flavonoids have been reported to activate AMP-activated protein kinase (AMPK), a key regulator of energy metabolism that suppresses lipogenesis and enhances lipid utilization (Panche et al., 2016; Ganesan & Xu, 2017).

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The antioxidant activity of *Artocarpus altilis* leaf extract may also contribute to improvements in lipid metabolism (Adaramoye & Akanni, 2014). Chronic oxidative stress is an important mechanism linking obesity with metabolic disorders. Excessive production of reactive oxygen species (ROS) can impair insulin signaling, increase inflammation, and promote abnormal lipid accumulation. Phenolic compounds present in breadfruit leaves may neutralize ROS and enhance endogenous antioxidant defense mechanisms, thereby improving metabolic homeostasis (Salehi et al., 2020). The findings of this study are consistent with previous experimental investigations demonstrating the metabolic benefits of breadfruit leaf extract. Studies using animal models have reported that *Artocarpus altilis* extract may improve glucose regulation, reduce oxidative stress markers, and enhance lipid profiles. These effects have been associated with the presence of flavonoids and phenolic compounds that regulate pathways involved in glucose and lipid metabolism (Omoruyi et al., 2015).

Furthermore, emerging clinical evidence supports the potential therapeutic role of breadfruit leaf extract in humans. A clinical study conducted among obese adults in Makassar, Indonesia, reported that breadfruit leaf extract supplementation improved cardiovascular parameters, indicating its potential role in reducing obesity-related metabolic risk. Another clinical investigation involving individuals with metabolic disorders demonstrated improvements in metabolic parameters following breadfruit leaf extract intervention. However, previous studies have not specifically focused on triglyceride reduction as the primary outcome among obese adults, making the present study important in expanding current clinical evidence (Jariah et al., 2024; Kurniati, 2024).

The clinical relevance of these findings is significant because hypertriglyceridemia represents an important modifiable risk factor for cardiovascular disease among obese populations. Although pharmacological therapies such as fibrates and statins remain effective, complementary interventions based on locally available medicinal plants may provide additional benefits, particularly in communities where access to long-term pharmacological treatment is limited. Breadfruit is widely cultivated in tropical regions, including Indonesia, making its utilization as a functional herbal intervention potentially feasible and sustainable.

Despite these promising findings, several limitations should be acknowledged. First, the intervention period was relatively short; therefore, longer-term studies are required to determine whether the triglyceride-lowering effect of breadfruit leaf extract can be maintained over time. Second, this study focused primarily on triglyceride levels, while other metabolic biomarkers such as inflammatory markers, insulin resistance indicators, and oxidative stress parameters were not evaluated. Future studies should incorporate these biomarkers to provide a more comprehensive understanding of the mechanisms underlying the metabolic effects of *Artocarpus altilis*. Overall, this study provides evidence that breadfruit leaf extract may have beneficial effects on triglyceride regulation among obese adults. The findings support further investigation of *Artocarpus altilis* as a potential complementary intervention for obesity-associated dyslipidemia and cardiovascular risk reduction.

CONCLUSION

This study provides evidence that breadfruit leaf extract (*Artocarpus altilis*) has potential beneficial effects on lipid metabolism among obese adults. Supplementation with breadfruit leaf extract was associated with improvements in serum triglyceride levels, suggesting its potential role as a complementary intervention for managing obesity-related dyslipidemia. The triglyceride-lowering effect of *Artocarpus altilis* may be attributed to its bioactive compounds, particularly flavonoids, phenolic compounds, and other phytochemicals that contribute to antioxidant activity, reduction of oxidative stress, regulation of inflammatory pathways, and improvement of lipid metabolism. These mechanisms may collectively contribute to the prevention of metabolic disturbances associated with obesity. The findings of this study highlight the potential of breadfruit leaf extract as a locally available, affordable, and culturally acceptable complementary approach for improving cardiometabolic health among obese populations.

However, further studies with larger sample sizes, longer intervention periods, and more comprehensive metabolic assessments are required to confirm its clinical effectiveness and establish standardized therapeutic recommendations.

SUGGESTION

Based on the findings of this study, several recommendations are proposed for future research and clinical practice. First, future clinical trials should involve larger sample sizes and longer follow-up periods to evaluate the sustainability of triglyceride reduction and determine the long-term safety profile of breadfruit leaf extract supplementation. Second, future studies should investigate the optimal dosage, extraction methods, and standardization of bioactive compounds in *Artocarpus altilis* leaf extract. Identification and quantification of key compounds, such as flavonoids, phenolic acids, and quercetin derivatives, are important to ensure consistency and reproducibility across clinical applications. Third, subsequent research should evaluate additional metabolic biomarkers, including insulin resistance parameters (such as fasting insulin and HOMA-IR), inflammatory markers (CRP, IL-6, TNF-α), oxidative stress indicators, and other lipid parameters (LDL-C, HDL-C, and total cholesterol) to provide a more comprehensive understanding of the mechanisms underlying the metabolic effects of breadfruit leaf extract. Fourth, healthcare providers and public health practitioners may consider the potential integration of evidence-based herbal interventions as complementary strategies for obesity management, particularly in communities where medicinal plants are widely available. However, such applications should be accompanied by appropriate clinical monitoring and lifestyle modification programs, including dietary improvement and increased physical activity. Finally, future investigations should explore the cost-effectiveness, acceptability, and feasibility of implementing breadfruit leaf extract-based interventions within primary healthcare settings, particularly in regions with abundant breadfruit resources such as Indonesia.

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