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Enhancing the Therapeutic Potential of Purslane Leaf Extract (Portulaca oleracea) for Cholesterol Management

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ABSTRACT Cardiovascular diseases remain the leading cause of mortality globally, with dyslipidemia being a major contributing factor due to elevated low-density lipoprotein (LDL) and triglyceride levels. Although statin therapy has proven effective, its long-term use is associated with side effects and poor adherence, prompting the search for safer, natural alternatives. Purslane (Portulaca oleracea) is a medicinal plant rich in omega-3 fatty acids, antioxidants, flavonoids, and phytosterols compounds known to offer lipid-lowering and cardiovascular benefits. This study aimed to develop a functional herbal tea formulation using purslane leaf extract as a potential cholesterol-controlling beverage. Purslane leaves were collected, dried, powdered, and extracted using food-grade 96% ethanol via maceration and distillation. The resulting crude extract was combined with green tea (Camellia sinensis Linn.) in a 1:2 ratio (1 g extract to 200 mL green tea) to produce the formulation. A proximate analysis was conducted to determine the nutritional content, while a sensory evaluation was performed with 11 panelists to assess acceptability based on color, aroma, and taste. Results from proximate testing indicated that the formulation is low in calories (1.64–1.68 kcal/100g), low in fat (0.04%), and high in water content (99.6%), supporting its role as a health beverage. Sensory testing showed moderate acceptance, with potential improvements needed in color and aroma. Although the bioactive compounds such as polyphenols and flavonoids were not quantified, their presence is supported by prior research. In conclusion, the herbal tea formulation incorporating purslane extract shows promise as a functional beverage for cholesterol management. Future studies should focus on quantifying active compounds and validating its lipid-lowering effects through clinical trials.

INDEX TERMS Purslane leaf extract, cholesterol management, herbal tea formulation, proximate analysis, sensory evaluation

I. INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of mortality worldwide, accounting for approximately 17.9 million deaths annually, or about 32% of total global deaths [1], [2]. In Indonesia, CVDs contribute significantly to the national mortality burden, with prevalence rates reaching 1.5% and accounting for approximately 35% of all deaths [3]. One of the primary risk factors for CVD is dyslipidemia characterized by elevated levels of low-density lipoprotein (LDL), triglycerides, and reduced high-density lipoprotein (HDL) [4], [5]. Management of cholesterol levels is therefore vital in reducing the risk of atherosclerosis, hypertension, stroke, and coronary artery disease [6]. Currently, statins remain the gold standard for managing high cholesterol levels due to their proven efficacy in lowering LDL cholesterol. Statins inhibit the enzyme HMG-CoA reductase, thereby reducing endogenous cholesterol synthesis [7], [8]. Despite their effectiveness, long-term use of statins can result in adverse effects such as myopathy, liver dysfunction, and increased risk of type 2 diabetes [9]–[11]. Moreover, medication adherence is a significant issue, with non-compliance rates ranging from 40% to 75% within the first six months of therapy [12], [13]. This has led to growing interest in exploring plant-based alternatives that are safer, more accessible, and culturally acceptable.

One such alternative is *Portulaca oleracea* L. (purslane), a plant known for its abundant bioactive compounds including omega-3 fatty acids, flavonoids, phenolics, saponins, phytosterols, and essential minerals [14]–[17]. Purslane contains approximately 523 mg/100 g of α-linolenic acid (ALA), one of the highest omega-3 concentrations found in terrestrial plants [18]. Flavonoids such as quercetin, kaempferol, and luteolin, along with phytosterols and saponins, have been shown to contribute to lipid-lowering, anti-inflammatory, and antioxidant effects [19]–[22]. These compounds act synergistically to inhibit cholesterol synthesis, enhance bile acid excretion, and block intestinal absorption of dietary cholesterol [23]–[25].

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Although multiple studies have highlighted the pharmacological potential of purslane, few have explored its application in functional beverages, particularly as an ingredient in herbal tea blends for cholesterol management. Most studies have focused on its use as encapsulated supplements or extracts without integrating consumer-oriented formulations [26], [27]. This represents a key research gap, especially given the increasing demand for natural, easy-to-consume therapeutic products.

Therefore, the present study aims to develop and evaluate a purslane-based herbal tea formulation by combining purslane leaf extract with green tea (*Camellia sinensis* L.). The proximate composition and organoleptic properties of the formulation were assessed to determine its potential as a functional beverage for cholesterol control. The key contributions of this study are as follows:

1. It introduces a novel, plant-based herbal tea formulation combining purslane extract and green tea as a potential lipid-lowering beverage.
2. It presents proximate nutritional analysis and sensory evaluation to assess the formulation's acceptability and nutritional profile.
3. It highlights the need for further exploration of bioactive compound quantification and therapeutic validation in future research.

II. METHOD

This study was conducted using a quantitative experimental approach to evaluate the formulation of herbal tea using purslane (*Portulaca oleracea*) extract for cholesterol control. The study focused on the preparation of herbal tea and laboratory analysis to assess nutritional composition and sensory characteristics.

A. PLANT COLLECTION AND IDENTIFICATION

Fresh samples of *Portulaca oleracea* were collected on August 23, 2024, from rice field areas in Kediri, East Java. Plant identification was based on morphological features, including reddish stems and small green leaves. The selected plant material was then brought to the Analytical Chemistry Laboratory, Poltekkes Kemenkes Surabaya, for further processing.

B. PREPARATION OF PLANT MATERIALS

Collected purslane leaves were washed under running water to remove impurities, separated from other plant parts, and subjected to a two-stage drying process: sun-drying for three to four days, followed by oven drying at 40–50°C for 1–2 hours. The dried leaves were then pulverized into a fine powder using a blender and stored in a sealed container at room temperature until extraction.

C. EXTRACTION PROCESS

Extraction was performed using the maceration method with 96% food-grade ethanol. A sample of 50 grams of powdered leaves was immersed in 350 mL of solvent (1:7 ratio) in a dark-colored container wrapped in aluminum foil to prevent light exposure. The extraction was carried out over 48 hours in two 24-hour cycles, with stirring every 8 hours. The extract was then filtered and concentrated using a rotary evaporator over six days to obtain a thick, crude extract. Prolonged exposure to oxygen during extraction was avoided to prevent degradation of bioactive compounds such as flavonoids and polyphenols [31], [32].

D. FORMULA OF HERBAL TEA

The final herbal tea formulation was prepared by mixing 0.5–1 g of crude purslane extract with 200 mL of green tea (*Camellia sinensis Linn.*) infusion. Green tea was selected for its strong antioxidant properties, which may enhance the functional benefits of the formulation [33], [34]. The mixture was filtered using Whatman paper to remove extract clumps and obtain a clear beverage. The formulation ratio was standardized at 1:2 (extract to green tea).

E. PROXIMATE ANALYSIS

Proximate analysis was conducted at SIG Laboratory Surabaya using standard Indonesian National Standards (SNI) protocols and other validated methods. The following parameters were measured: total calories, calorie from fat, ash content, moisture content, carbohydrate content (by difference), total fat, and protein content. Each test was performed in duplicate to ensure reliability and precision. Proximate testing helps evaluate whether the product qualifies as a low-calorie, low-fat functional beverage suitable for cardiovascular health management [35], [36].

F. SENSORY EVALUATION

A sensory test was performed at the Nutrition Laboratory, Poltekkes Kemenkes Surabaya, with 11 moderately trained panelists. Each panelist evaluated two formulations: pure green tea (T1) and green tea with purslane extract (T2). Evaluation criteria included color, aroma, and taste, scored on a 5-point hedonic scale (1 = strongly dislike, 5 = very like). Average scores for each indicator were calculated and compared to assess overall acceptance and identify areas for improvement [37].

G. DATA ANALYSIS AND ETHICAL CONSIDERATIONS

Data from proximate and sensory tests were tabulated and analyzed descriptively using Microsoft Excel. Mean values were used to summarize proximate results, while sensory results were expressed as mean hedonic scores. Comparative analysis between T1 and T2 formulations was conducted to assess differences in panelist preferences. This research did not involve human subjects in medical procedures or interventions. Therefore, ethical approval was not required. However, all procedures followed institutional guidelines for research involving food product development and laboratory safety.

III. RESULT

A. PROXIMATE TEST

The purpose of this proximate test is to obtain accurate data on the nutritional content contained in the tea formulation with a mixture of purslane extract. The test was conducted using nationally and internationally recognized methods, in accordance with the Indonesian National Standard (SNI) and other relevant methods, such as manual calculation (MU) and titrimetry. Tests were carried out in two repetitions which is simplo (single repetition) and duplo (double repetition) to ensure the validity of the results. The

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following are the results of the proximate test on tea formulations with a mixture of purslane extract:

TABLE 1
The Result Of Proximate Test

No	Parameter	Unit	Simplo	Duplo	Limit of Detection	Method
1.	Total Calories	Kcal/ 100 g	1.64	1.68	-	11-3-3/MU (Calculation)
2.	Calorie From Fat	Kcal/ 100 g	0.36	0.36	-	11-3-3/MU (Calculation)
3.	Ash Content	%	0.03	0.03	-	SNI 01-2891-1992 point 6.1
4.	Moisture Content	%	99.61	99.60	-	SNI 01-2891-1992 point 5.1
5.	Carbohydrate (By Difference)	%	0.32	0.33	-	11-3-3/MU (Calculation)
6.	Total Fat	%	0.04	0.04	-	11-3-2/MU (Weibull)
7.	Protein Content	%	<0.04	<0.04	-	11-3-1/MU (Titrimetry)

B. SENSORY TEST

Sensory tests were conducted by 11 moderately trained panelists using several indicators such as color, aroma, and taste.

TABLE 2
The result of panelist and predetermined indicators

Panelists	Color		Taste		Aroma	
	T1	T2	T1	T2	T1	T2
1	4	5	5	3	4	3
2	3	4	4	3	3	4
3	3	3	3	4	3	2
4	3	3	3	4	4	3
5	3	3	3	4	3	4
6	4	4	4	3	5	3
7	3	3	3	4	3	4
8	4	3	4	4	4	3
9	3	3	3	4	3	2
10	5	5	4	3	4	4
11	3	2	3	3	3	3
Total	38	33	39	39	39	35
Average	3,45	3	3,54	3,54	3,54	3,18

Panelists were given 2 different formulations which is green tea formulation with purslane extract and pure green tea. Panelists will be asked to taste samples of each formulation as well as rate the tea with predetermined indicators. The results of the 11 panelists can be seen in the following TABLE 2. With the average value of the assessment between pure green tea (T1) and green tea with a purslane extract (T2), which can be seen in the following table:

TABLE 3
Average of the result by the panelist

No	Indicators	Pure Green Tea (T1)	Herbal Tea Formulation with Purslane Leaf Extract Blend (T2)
1	Color	3,4	3
2	Aroma	3,5	3,2
3	Taste	3,5	3,5
	Average	3,5	3,3

Rating Score Description: 1= Strongly dislike, 2 = Dislike, 3 = Neutral, 4 = Like, 5 = Very Like

Purslane (*Portulaca oleracea*) as a tea mixture has been widely reported to have many health benefits. Purslane (*Portulaca oleracea L.*) has attracted the attention of researchers as a potential ingredient to control cholesterol. A recent study, showed that purslane leaf extract has potential as a natural hypolipidemic agent [31]. This study explores the possibility of using purslane leaf extract as a mixture in herbal tea to serve as a cholesterol-controlling herbal drink. Tea formulation with a mixture of purslane extract is done by extracting purslane using 96% food grade ethanol, which is then evaporated using a distillator to obtain concentrated extracts in the form of crude extracts. The purpose of evaporation is to separate the solvent from the active compounds in purslane leaves (*Portulaca oleracea*). The purslane extract obtained from the evaporation results is then formulated by mixing the crude extract with pure green tea brew. The ratio of purslane leaf extract (*Portulaca oleracea*) and green tea (*Camellia sinensis Linn.*) is 1:2 with 1 gram of extract and 200 mL of green tea. Analysis of the tea formulation with a mixture of purslane extract was carried out with proximate tests to determine the content of the formulation, and sensory tests were also carried out to assess the quality and develop products through consumer preferences.

Based on TABLE 1 the results of laboratory testing with proximate tests, it was found that the tea formulation with purslane leaf extract mixture has a nutritional profile that is low in calories, low in fat, and high in water content [29,36]. These characteristics support its use as a functional beverage for cholesterol control. However, the content of bioactive compounds such as polyphenols and flavonoids, which may play a role in the cholesterol-lowering effect, was not measured in this proximate analysis and requires further testing. Research on this formulation should also be further developed to meet other technical requirements as a cholesterol-controlling herbal drink.

Based on TABLE 2 the result of sensory test, the two formulations between T1 and T2 in the sensory test that has been carried out can be known the results of general panelist preferences based on color, aroma, and taste. From the table, it can be seen that the pure green tea steeping formulation (T1) is the most preferred by panelists. This is evidenced by the assessment score of 3.5 and this value is the largest compared to the tea formulation with a mixture of purslane leaf extract (T2) with a ratio of 2: 1 between purslane extract and green tea in 200 ml of water.

Based on TABLE 3 the results of the sensory test on color indicators, the pure green tea steeping formulation (T1) received a higher average value of 3.4 compared to the

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formulation between tea and purslane leaf extract mixture (T2) with an average value of 3 in the color indicator sensory test. The results of the sensory test on the color indicator indicate that the color results obtained from the formulation of tea with a mixture of purslane leaf extract may be a factor that needs to be improved to increase consumer appeal.

Based on the aroma indicator in the formulation between pure green tea brew (T1) and also the formulation between tea and purslane leaf extract mixture (T2). The results of the aroma indicator sensory test showed that panelists were more likely to like the pure green tea steeping formulation (T1) with a higher average value of 3.5. The tea formulation with a mixture of purslane leaf extract (T2) received a lower average value of 3.2 and was categorized as below the T1 formula. The results of the sensory test on the aroma indicator show that the aroma of the tea formulation with a mixture of purslane leaf extract may also be a factor that needs attention for researchers. Tea formulations with a mixture of purslane leaf extract can be combined with other additives as an innovation that can increase consumer appeal.

Based on the taste indicator in the formulation between pure green tea brew (T1) and also tea formulation with a mixture of purslane leaf extract (T2) shows the same average value with a score of 3.5. The results of this sensory test indicate that there is no significant difference in taste between the formulation of tea with purslane leaf extract mixture (T1) and also the pure green tea steeping formulation (T2). The results of the sensory test on the taste indicator are things that can be developed again while maintaining the content of purslane leaf extract and green tea itself so that it can be consumed by consumers according to its function and purpose.

IV. DISCUSSION

A. INTERPRETATION OF FINDINGS

The present study evaluated the potential of purslane (*Portulaca oleracea*) leaf extract as a functional ingredient in herbal tea for cholesterol management. The proximate test revealed that the formulation is low in calories (1.64–1.68 kcal/100g), low in fat (0.04%), and high in water content (99.6%). These nutritional characteristics support the formulation's suitability as a health-oriented beverage targeting individuals with hypercholesterolemia [41]. Furthermore, sensory evaluation showed that the formulation was generally acceptable, although improvements in color and aroma are needed to enhance consumer appeal. Taste scores between the pure green tea (T1) and the purslane blend (T2) were equivalent (3.5), suggesting that the inclusion of purslane extract did not compromise palatability. However, lower scores in color and aroma for T2 highlight areas for further development in formulation aesthetics and olfactory balance.

The combination of purslane extract and green tea may provide synergistic health effects. Green tea is known for its catechin content, particularly epigallocatechin gallate (EGCG), which supports lipid metabolism and exhibits antioxidant activity [42]. When blended with purslane which contains omega-3 fatty acids, flavonoids, saponins, phytosterols, and phenolics the formulation becomes a multifunctional beverage potentially capable of reducing cholesterol synthesis, enhancing bile excretion, and preventing lipid peroxidation [43].

B. COMPARISON WITH PREVIOUS STUDIES

The findings of this study are consistent with a growing body of research supporting the lipid-lowering and antioxidant properties of Portulaca oleracea. Previous studies have demonstrated the ability of purslane extract to reduce serum LDL cholesterol and triglycerides while increasing HDL cholesterol [44], [45]. For instance, Karimi et al. conducted a double-blind randomized controlled trial and reported significant reductions in inflammatory markers and lipid levels in patients with rheumatoid arthritis after purslane supplementation [46]. In another investigation, Rahman et al. confirmed the presence of high levels of alpha-linolenic acid (ALA), phytosterols, and flavonoids in purslane, all of which are associated with improved lipid profiles [47]. Similarly, studies by Petropoulos et al. and Liu et al. found that purslane's diverse phytoconstituents such as quercetin, kaempferol, and oleracein compounds exhibit cardioprotective activities through the inhibition of HMG-CoA reductase the same enzyme targeted by statins [48], [49].

Compared to pharmacological agents such as statins, purslane offers a natural, low-side-effect alternative. While statins are clinically proven to reduce LDL cholesterol levels by over 30%, they are also associated with side effects such as myopathy, elevated liver enzymes, and increased risk of diabetes mellitus [50]. Purslane, on the other hand, has a gentler lipid-lowering effect, making it a suitable adjunct or preventive option in populations with mild to moderate dyslipidemia [51]. Additionally, Brimson et al. highlighted the regulatory roles of herbal teas in cellular homeostasis and metabolic health, further validating the rationale for formulating functional beverages using botanicals like purslane [52]. However, many prior studies employed encapsulated forms or crude extracts of purslane in animal or clinical trials, whereas this study uniquely focused on integrating the extract into a palatable, drinkable format an area with limited research coverage.

C. STUDY LIMITATIONS AND IMPLICATIONS

Despite encouraging results, several limitations must be acknowledged. First, this study did not quantify specific bioactive compounds such as polyphenols, flavonoids, and saponins, which are believed to play a major role in the hypolipidemic effects of purslane. Without such data, it is difficult to correlate proximate composition with expected pharmacological outcomes. Future studies should incorporate phytochemical analysis and chromatographic profiling to measure compound concentration and stability post-formulation [53]. Second, the sensory test involved only 11 panelists, which limits the generalizability of the findings. Although the participants were moderately trained, a larger, more diverse group including target consumers would provide more reliable data on acceptability and preferences. Third, the current study does not assess the actual cholesterol-lowering effect of the formulation in vivo. While proximate and sensory analyses are critical for

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product development, clinical validation through human trials remains essential to confirm the efficacy of this herbal tea in managing lipid profiles [54].

Moreover, the formulation contains oxalates naturally occurring compounds in purslane that, if consumed in excess, may contribute to kidney stone formation or interfere with calcium absorption. This is particularly relevant for individuals with a history of nephrolithiasis or renal impairment. Some studies suggest that consuming purslane with probiotic sources like yogurt may mitigate this effect [55]. In terms of practical implications, this research highlights the feasibility of converting underutilized edible plants like purslane into high-value health beverages. The formulation could serve as a preventive nutritional strategy for communities at risk of cardiovascular disease, especially in regions where access to pharmaceutical interventions is limited. Given the increasing global demand for plant-based and sustainable health solutions, the commercialization of purslane-based tea could generate economic benefits while improving dietary quality.

Additionally, the low calorie and low fat content of the tea suggest it may also contribute to weight management, which is often associated with better cardiovascular outcomes. However, this hypothesis needs to be supported by further studies assessing body weight, waist circumference, and body mass index after regular consumption of the formulation [56]. This study also opens avenues for improving formulation design by experimenting with other synergistic herbs, natural flavor enhancers, or encapsulation techniques to enhance bioavailability and stability. Integrating modern food technology with ethnobotanical knowledge can create hybrid health solutions that are both evidence-based and culturally acceptable.

V. CONCLUSION

This study aimed to formulate a functional herbal tea by combining *Portulaca oleracea* (purslane) leaf extract with green tea (*Camellia sinensis*) and to evaluate its nutritional composition and sensory acceptability as a potential cholesterol-controlling beverage. The proximate analysis showed that the formulation had desirable nutritional attributes: low calories (1.64–1.68 kcal/100 g), minimal fat content (0.04%), and high moisture content (99.6%), indicating its suitability as a low-fat, hydrating health beverage. Sensory evaluation results revealed moderate acceptability across three key indicators: color (2.73), aroma (3.23), and taste (3.50), suggesting that the formulation can be consumed comfortably, although there is room for improvement in visual and aromatic properties. The integration of purslane and green tea leverages the lipid-lowering, antioxidant, and anti-inflammatory bioactive compounds such as omega-3 fatty acids, flavonoids, and catechins making the formulation both functional and natural. While the current study provides foundational insight into the development of plant-based therapeutic drinks, several limitations were identified, including the lack of bioactive compound quantification and clinical efficacy testing. Therefore, future studies should focus on advanced phytochemical profiling (e.g., HPLC or GC-MS) and clinical trials to determine the cholesterol-lowering potential and safety of regular consumption. Additionally, efforts should be made to enhance sensory appeal by experimenting with flavor-masking agents or botanical blends and to evaluate consumer preferences on a larger, more diverse scale. In conclusion, the developed herbal tea formulation presents a promising, sustainable solution for functional food innovation and preventive health nutrition, particularly in populations seeking natural alternatives to pharmaceutical lipid-lowering agents.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

Hafizatul Ilmi initiated the research concept, prepared the formulation, and led the manuscript writing. Devita N. Sholikhah contributed to proximate analysis and conducted the sensory evaluation. Yuyun Yuniastri was responsible for phytochemical discussions and literature synthesis. Lia Novita provided critical revisions, organized the research timeline, and finalized the manuscript. All authors reviewed and approved the final version of the article.

DECLARATIONS

ETHICAL APPROVAL

This study did not involve human or animal subjects in medical or clinical procedures. Ethical approval was not required.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants

COMPETING INTERESTS

The authors declare no competing interests.

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