



Plant Archives

Journal homepage: <http://www.plantarchives.org>

DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-2.380>

ECO-FRIENDLY FORMULATION AND ANTI-OBESITY ACTIVITY OF LEMONGRASS (*Cymbopogon citratus*) AND STEVIA (*Stevia rebaudiana*) HERBAL DIP TEA

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(Date of Receiving : 03-05-2026; Date of Revision : 26-06-2026; Date of Acceptance : 15-07-2026)

ABSTRACT

A study was carried out to formulated different herbal dip Tea sachets and anti-obesity activity. Different types of herbals (lemongrass, Tanner's cassia, Mulberry, Rose and Betel-vine), different natural dyes (Turmeric, Beetroot, Hibiscus, Butterfly pea and Tanner's cassia) and Stevia (natural sweetener) were used to formulated and evaluate the anti-obesity activity. This research produced twenty-four herbal Tea dip sachets involving five base herbal components and five natural dyes with some ingredients (Mint for blood circulation, Ginger for blood sugar level and Cardamom for heart health). Novel herbal dip Tea product was formulated to low-calorie, efficient beverage for anti-obesity activity. A pilot study was conducted among 25 members from Athimugam village near Adhiyamaan college of Agriculture and research. Participants consumed the herbal dip Tea (1 gram in 100 ml hot water) twice daily for one 30 days (1 month) while maintaining their original diet and daily activity, with reduce intake of sugar rich food, fatty food and non-vegetarian food. Body weight was noted the before the start of the study and again after one month. The initial and final weight were compared to determine weight loss. The preliminary results indicated potential anti-obesity effects of the herbal dip tea and reported the Tanner's cassia was most effective, compare to others because significantly rich in antioxidant properties and phytochemical properties.

Keywords : Lemongrass, Stevia (Natural sweetener), Natural dyes and Anti-obesity activity.

Introduction

Human obesity has a critical global health challenge due to rapid lifestyle shifts, poor dietary habits, and reduced physical activity (James, 2018). The increasing adiposity is largely attributed to inactive lifestyles, excess caloric intake, and diets rich in table sugars and saturated fats (Blucher, 2019). Consequently, carrying excess body weight is linked with several chronic disorders such as diabetes, cardiovascular diseases, hypertension, and metabolic syndrome (Grundy, 2004). To address this rising number of obesity cases, direct the development of natural, safe, and efficient functional foods and drinks to help manage weight (Stabnikova *et al.*, 2024). Due to their therapeutic efficacy and lower risk than synthetic pharmaceutical products, herbal products with high bioactive compound content have gained

widespread attention (Harikrishnan *et al.*, 2020). Herbal teas are globally used beverages prepared from herbal plants and are known for their antioxidant, detoxifying, and metabolism-enhancing properties (Chintada *et al.*, 2025). Among various herbal ingredients, Lemongrass (*Cymbopogon citratus*) is an aromatic medicinal plant widely used in traditional medicine due to its antimicrobial, antioxidant, anti-inflammatory, and digestive properties (Kiani, 2022). *Cymbopogon citratus* tea stimulates the immune system and detoxifies the body when ingested daily. Lemongrass contains important phytochemicals such as citral, flavonoids, phenolic compounds, and terpenoids, which contribute to its health-encouraging effects (Nambiar *et al.*, 2012). It is also described to support fat metabolism, improve digestion, and aid in detoxification, making it a promising ingredient for weight management formulations (Gaba *et al.*, 2020).

Stevia (Stevia rebaudiana) is a natural, non-caloric sweetener broadly used as an alternative to sugar (Ahmed *et al.*, 2017). The leaves of stevia contain steviol glycosides, which deliver sweetness without cumulative calorie intake or blood glucose levels (Al-Hamdani, 2019). In addition to its sweetening property, stevia possesses antioxidant, anti-diabetic, and anti-obesity activities (Peteliuk *et al.*, 2021). The amalgamation of stevia into herbal beverages helps improve deliciousness while reducing the ingestion of refined sugar, thereby supporting healthy body weight maintenance (Mehta *et al.*, 2025). The combination of lemongrass and stevia in herbal dip tea formulation may provide coactive health benefits due to the presence of various bioactive compounds (Mehta *et al.*, 2025). Herbal dip tea products are appropriate, easy to prepare, and progressively popular among health-conscious consumers seeking natural wellness brews (Huda *et al.*, 2024). The formulation of a low-calorie herbal tea enhanced with antioxidant and anti-obesity properties could serve as a healthier substitute to sugar-sweetened beverages and commercial weight-loss supplements (Mehta *et al.*, 2025). Molecular docking and silico examinations have become valuable tools for assessing interactions among phytoconstituents and obesity-related molecular targets of compounds with potential anti-obesity activity (Pinzi and Rastelli, 2019). Merging phytochemical characterization with molecular investigations affords a scientific basis for evolving functional herbal formulations with enhanced effectiveness. In this context, the present study intended to formulate a novel herbal dip tea based on lemongrass (*Cymbopogon citratus*), Tanner’s cassia (*Senna auriculata*), Mulberry (*Morus alba*), Rose

(*Rosa damsacena*), Betel-vine (*Piper betel*), Turmeric (*Curcuma longa*), Beetroot (*Beta vulgaris*), Hibiscus (*Hibiscus rosa-sinensis*), Butterfly pea (*Clitoria ternatea*) and stevia (*Stevia rebaudiana*) enhanced with antioxidant and anti-obesity properties. The study focused on assessing its phytochemical composition, mechanisms of bioactive compounds, antioxidant potential, sensory attributes, and anti-obesity efficacy. The outcomes are expected to contribute to the development of an experimentally verified herbal beverage that may aid as a natural dietary supplement for obesity management and metabolic health improvement.

Materials and Methods

Materials

Fresh Lemongrass leaves, mint leaves, ginger, cardamom, and Stevia leaves were collected from the Adhiyamaan college of Agriculture and search (ACAR) farm, Krishnagiri, TN. The collected plant materials thoroughly wash with distilled water and Tea sachets, sealing materials, weighing balance, hot air oven, grinder used for formulation and analytical studies.

Formation of Herbal Dip Tea

Wash the mentioned herbal and natural dye material, then cut into small pieces and dried in the absence of sunlight for 1 week. Grind the dried herbals like lemon grass, mint leaves, stevia, ginger, cardamom and natural dye materials were stored in airtight container with suitable label for further usage Table 1. Twenty-four (24) different tea sachets formulated for 1-gram tea sachets. One Tea bags capacity was dipped in 100 ml of hot water.



Table 1: Formulation of Herbal Tea Bags

Ingredients	Quantity to be taken (%) (Percentage)	Quantity to be taken (1 gram)
Lemon grass powder	40 %	0.4 gram
Stevia leaf powder	57 %	0.57 gram
Mint leaf powder	01 %	0.1 gram
Dried ginger powder	01 %	0.1 gram
Cardamom powder	01 %	0.1 gram

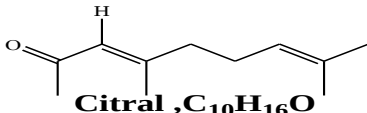
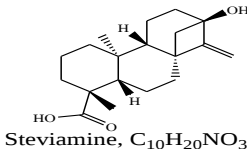
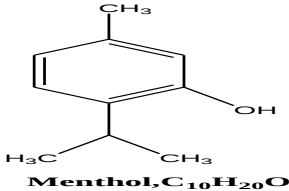
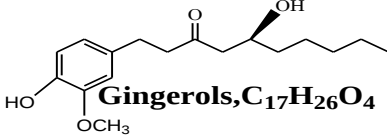
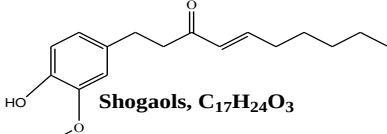
Results and Discussion

Formulation of Herbal Dip Tea

The 24 herbal dip tea prepared by 5 base herbals like Lemongrass contains Citral ($C_{10}H_{16}O$) responsible for lemon aroma (Table.2) with strong anti-oxidant due to its keto group ($C=O$) present in the molecules, Tanners cassia leaves also used for herbal tea because it possess rich content of (flavonoids, Phenolic and tannins) biomolecules with mild floral flavour to support blood sugar regulation, Mulberry plant leaves were used in herbal tea because it possess anti-oxidant properties (polyphenol, flavonoids and 1-deoxynojirimycin), Rose petals used in the herbal tea because (polyphenol, flavonoids and 1-deoxynojirimycin) it possess anti-oxidant properties with vitamin C and Betel-vine leaves also used for herbal tea because it possess (hydroxychavicol, eugenol and flavonoids) anti-oxidant, anti-microbial and anti-inflammatory properties. Stevia leaves were

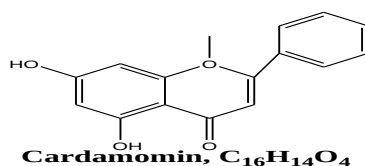
used in this herbal Dip tea products because it possesses sweet taste with zero calories due to present in sativoside and rebaudioside A molecules. Among the verified formulations, the blend containing 40% (five) base materials and 60% stevia showed better sensory acceptance due to its balanced flavour, refreshing aroma, and mild sweetness without the addition of refined sucrose. Additionally, added like dried mint leaves for enhance the sensory quality due to present in menthol ($C_{10}H_{20}O$) and methone ($C_{10}H_{18}O$) molecules, Ginger containing gingerol ($C_{17}H_{24}O_4$) and shogaol ($C_{17}H_{26}O_3$) molecule to digestive properties and enhance the flavour, aroma and immunity and cardamom contains (cineole, triphenyl acetate and cardamomin ($C_{16}H_{14}O_4$)) important anti-oxidant molecule possess pleasant aroma and taste. Finally, Tanner's Cassia Herbal Dip Tea were given best result compare to others because it acts as base material and self-food colour.

Table 2: Biomolecules present in the Herbals

Components	Biological source	Structure and Molecular formula	Images
Lemon grass <i>Cymbopogon citratus</i>	Dried leaves	 Citral, $C_{10}H_{16}O$	
Stevia leaves <i>Stevia rebaudiana</i>	Dried leaves	 Steviolbioside, $C_{40}H_{64}O_{18}$	
Mint leaves <i>Mentha piperita</i> L.	Dried leaves (Peppermint)	 Menthol, $C_{10}H_{20}O$	
Ginger <i>Zingiber officinale</i>	Dried plant	 Gingerol, $C_{15}H_{26}O_4$  Shogaol, $C_{15}H_{24}O_3$	

Cardamom
*Elettaria
cardamomum*

Dried seed



Biomolecules responsible food colour in Herbal Dip Tea products

These natural food colour used for formulated herbal dip Tea products due to no chemical hazardous, pollution free and contribute to antioxidant activity with enhance the functional and nutraceutical values of

the beverages like Turmeric contains vitamin-C, beetroot contains (folate) biomolecules possess vitamin-9, Hibiscus rich in vitamin-C, Butterfly Pea possess vitamin -A, vitamin -C and vitamin-E, Tanner's Cassia rich in vitamin -C & A (Table 3).

Table 3: Biomolecules present in the Natural dyes

Natural dyes	Biomolecule Structure and Molecular formula	Colour	Images
Turmeric <i>Curcuma longa</i>	Curcumin, C₂₁H₂₀O₆	Yellow	
Beetroot <i>Beta vulgaris</i> L.	Betalains, C₂₄H₂₆N₂O₁₃	Pinkish Red	
Hibiscus <i>Hibiscus rosa-sinensis</i>	Anthocyanins, C₁₅H₁₁O₆	Red	
Butterfly Pea <i>Clitoria ternatea</i>	Anthocyanins (Ternatins), Complex	Blue	
Tanner's Cassia <i>Senna auriculata</i>	Quercetin, C₁₅H₁₀O₇	Yellow	

Anti-Obesity Activity

A study was conducted with 25 volunteers from Athimugam village near Adhiyamaan college of Agriculture and research, Krishnagiri, T.N, involving 10 female homemakers, 10 male farmers and five male college students. The volunteers were taken 1 g of Dip Tea two times daily with 100 ml boiled water (100 °C) for one month. In this herbal Tea Dip practice reduce

per day 2 tablespoon equal to 8-gram sucrose ($C_{12}H_{22}O_{11}$) and reduce 32 K.cal. After 30 days total calorie reduction for each volunteers were 960 K.cal. Initial and final body weight was noted and a gradual body weight reduction was absorbed after 30 days suggesting that replacing sucrose with stevia-based food products may help reduced calories intake and support obesity management (Table 4 & Fig1).

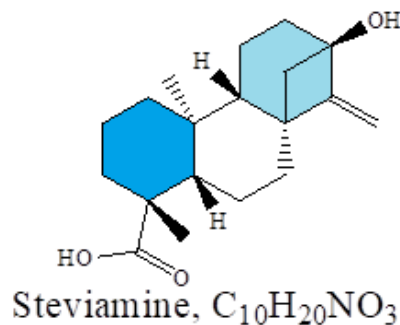
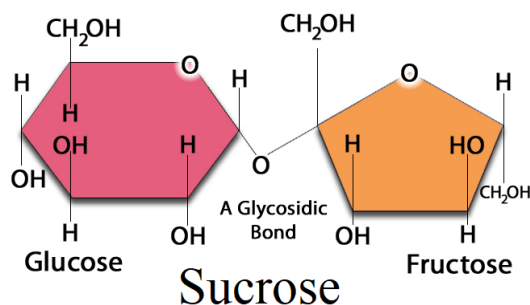


Table 4: Anti-obesity analysis from samples (1 month).

Sample	Initial wait.	Sucrose ($C_{12}H_{22}O_{11}$) reduction FN & AN		One day K.cal reduction (Sucrose 4g =16 K.cal X 2=32 K.cal)	Reduction of sugar for 30 days	Reduction of -K.cal for 30 days	Final wait
Sample 1 Housewife	50	4g	4g	32 kcal	240g	960	49.5
Sample 2 Housewife	58	4g	4g	32 kcal	240g	960	57.5
Sample 3 Housewife	52	4g	4g	32 kcal	240g	960	51
Sample 4 Housewife	49	4g	4g	32 kcal	240g	960	48.2
Sample 5 Housewife	60	4g	4g	32 kcal	240g	960	59.5
Sample 6 Housewife	75	4g	4g	32 kcal	240g	960	74
Sample 7 Housewife	57	4g	4g	32 kcal	240g	960	55.5
Sample 8 Housewife	55	4g	4g	32 kcal	240g	960	54.2
Sample 9 Housewife	85	4g	4g	32 kcal	240g	960	83
Sample 10 Housewife	65	4g	4g	32 kcal	240g	960	64
Sample 11 Farmer	79	4g	4g	32 kcal	240g	960	78.2
Sample 12 Farmer	59.5	4g	4g	32 kcal	240g	960	58
Sample 13 Farmer	65.2	4g	4g	32 kcal	240g	960	64
Sample 14 Farmer	75.4	4g	4g	32 kcal	240g	960	73.9
Sample 15 Farmer	58.2	4g	4g	32 kcal	240g	960	57.2
Sample 16 Farmer	49.5	4g	4g	32 kcal	240g	960	48
Sample 17 Farmer	59	4g	4g	32 kcal	240g	960	57.5
Sample 18 Farmer	90	4g	4g	32 kcal	240g	960	89.5
Sample 19 Farmer	95	4g	4g	32 kcal	240g	960	94
Sample 20 Farmer	65.5	4g	4g	32 kcal	240g	960	64.5
Sample 21 Student	57.5	4g	4g	8 kcal	240g	960	55
Sample 22 Student	58.8	4g	4g	32 kcal	240g	960	57.5
Sample 23 Student	78.8	4g	4g	32 kcal	240g	960	77.5
Sample 24 Student	65.2	4g	4g	32 kcal	240g	960	64
Sample 25 Student	85.5	4g	4g	32 kcal	240g	960	83.5

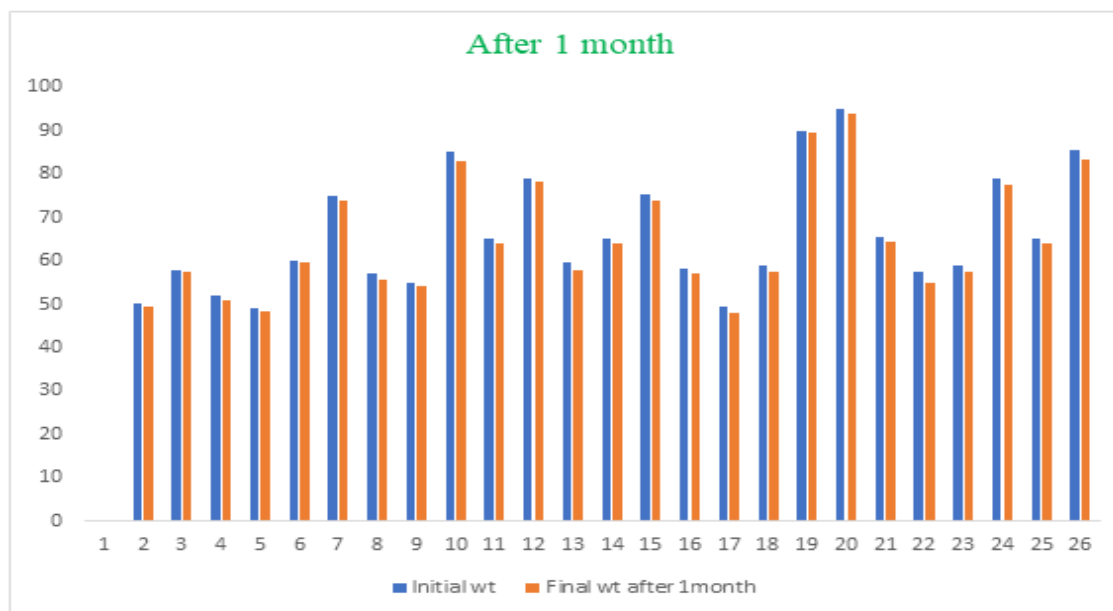


Fig. 1 : Anti-obesity analysis from samples

Conclusion

The current study effectively formulated and reported 24 different herbal tea sachets product (1g) possess anti-obesity properties. Overall, the formulated herbal Tea dip can be measured as promising natural functional beverage for weight reduction and health promotion. The integration of stevia as a natural low-calorie sweetener improved the palatability of the beverage without increasing caloric intake, making the product beneficial for calorie-conscious and diabetic individuals. Among the 24 Tea sachets products, Tanner's cassia with four different natural dyes may help advance metabolism, digestion, and lipid regulation, especially tanner's cassia has antidiabetic properties (Blood sugar regulation) thereby contributing to obesity prevention and overall wellness compared to others. The established formulation showed good sensory acceptability with a very good aroma, natural sweetness, radiant colour and refreshing taste, making it suitable for even ingestion as a useful beverage. The herbal Tea verified significant antioxidant activity (based on the biomolecules) and notable pancreatic lipase inhibitory effects, signifying its potential role in reducing oxidative stress and supporting body weight management.

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