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Formulation And Evaluation Of Herbal Tea Granules

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Abstract:

The growing interest in natural remedies and wellness products has led to the development of convenient and health promoting formulations such asherbal tea granules. The demand for natural, health promoting beverages has led to growing interest in the herbal teas that offer therapeutic benefits beyond basic nutrition.This study supports the development of herbal tea granules as a convenient, shelf-stable alternative to traditional herbal infusions.

This study involves the formulation and evaluation of herbal tea granules composed of *clitoria ternatea*, *Cymbopogon citratus* (Lemongrass),*Ocimum sanctum* (Tulsi), *Elettaria cardamomum* (Cardamom),and *Piper nigrum* (Black Pepper). These herbs were selected for their scientifically supported antioxidant, anti-inflammatory, digestive and immune boosting properties. The powder of clitoria ternatea extracted with hydroalcoholic solvent by maceration extraction method. The filtrate was concentrated and stored properly. The granules were prepared using wet granulation technique and evaluated for organoleptic properties, physicochemical properties including flowability, pH, ash value, water soluble ash value, and in vitro antioxidant and anti-inflammatory activity were also assessed. The optimized formulation exhibited good granule characteristics, acceptable taste and significant antioxidant and anti-inflammatory potential indicating its suitability as a functional herbal beverage. Herbal Tea has a mild, slightly sweet-bitter taste. The mild flavor makes it a good base for tea blends, allowing other flavors to shine through commonly mixed with natural sweetener as jaggery.

This research highlights the potential of herbal tea granules as a convenient, caffeine-free, and functional beverage that can contribute to a healthy lifestyle

***Index Terms*:** Herbal tea granules, Antioxidant activity, Anti-inflammatory activity, Wet granulation, Functional beverage

1. INTRODUCTION:

The global focus on health and wellness has led to a growing interest in natural remedies and supplements that can enhance the body's immune response. Among these, herbal teas have gained significant popularity due to their potential health benefits, including boosting immunity. One such promising intervention is the development of an herbal tea granule formulated with a blend of herbs and natural ingredients known for their antioxidant and anti-inflammatory properties.[19]

The project titled Preparation and Evaluation of Herbal tea granules aims to explore the preparation of a specially designed tea that combines various medicinal herbs traditionally used to promote immune health. Ingredients such as butterfly pea flower, lemongrass, holy basil, and others are considered for their antioxidant, anti-inflammatory properties, which may contribute to improving the body's resistance to infections and diseases.

Herbal teas are regarded as a popular beverage globally. Many different herbs are combined to make herbal tea, also referred to as "tisanes." The dried leaves, seeds, nuts, barks, fruits, flowers, or other botanical components of herbal teas are combined to create tisanes.[1]

Herbal teas have been consumed for centuries in many cultures worldwide, both for their soothing qualities and for their potential medicinal properties. Many herbal teas are valued for their ability to promote relaxation, aid digestion, or support immune health.[20]

table 1: comparison between herbal tea, green tea, and black tea.[2]

Herbal Tea	Green Tea	Black Tea
Herbal tea is achieving more calm and relaxed state of mind	Allergic reaction is shown due to consumption.	Black tea is a source of caffeine.
Herbal tea is caffeine free.	Consumption of green tea for longer period has also proven to relate to esophageal cancer.	Caffeine causes insomnia in adults, children, and infants.
They trigger immune system.	They trigger central nervous system.	They trigger central nervous system.
Herbal tea boosts energy levels and relieves stress.	Green tea is known to cause other less serious side effects such as heartburn, stomach upset, loss of appetite, diarrhea, etc	Black tea is known to cause erosion of dental enamel if taken continuously
They do not go under oxidation process during production	They help in weight loss by increasing the metabolism. They also do not undergo oxidation process during production.	They may have a carcinogenic effect. They undergo oxidation process during production.
Water temp 80·c	Water temp 80·c	Water temp 100·c
Time 2 min	Time 2-3 min	Time 3-5 min

Natural herbs and their profile:

- ***Clitoria ternatea:***

Clitoria ternatea is a perennial climber (2–3 m in height) and is known by its common name as butterfly pea or blue pea flower. *Clitoria ternatea* is recognized as a nootropic herb in Ayurvedic medicine. This plant exhibits several variations with different flower colors, including light blue, dark blue, white, and mauve, each of them measuring 4-5 cm in length.[3]

fig no.1

The taxonomical classification of *Clitoria ternatea* species:

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Rosids
Order: Fabales
Family: Fabaceae
Subfamily: Papilionoidea
Genus: *Clitoria*
Species: *ternatea* (Linnaeus)

Chemical constituents: The preliminary phytochemical screening showed that the plant contained tannins, phlobatannin, carbohydrates, saponins, triterpenoids, phenols, flavonoids, flavanol glycosides, proteins, alkaloids, anthraquinone, anthocyanins, cardiac glycosides, Stigmast-4-ene-3,6-dione, volatile oils and steroids.[16]

Role:

i. Anti-inflammatory effect: inhibiting inflammatory mediators.
ii. Antidiabetic effect
iii. Antioxidant effect
iv. Neuroprotective effect

- **Holy basil (Tulsi):**

Fig no.2

- Synonyms: Holy basil
- Biological name: Ocimumtenuiflorum
- Biological source: Tulsi is an aromatic perennial plant of Ocimum Sanctum in the family.
- Geographical location: India, Southeast asia, Nepal, Himachal.
- Family: Lamiaceae

Chemical constituents: The plant Ocimum sanctum contains a wide range of chemicals, including carvacrol, β-element, β-caryophyllene, ursolic acid, Rosmarinus acid, eugenol, and germacrene. Ocimum holy is thought to possess booster and diuretic effects.[4]

Role:

i. Adaptogenic and anti-stress effect: regulating cortisol level, activating stress related pathway.
ii. Anti-inflammatory and Antioxidant effect: Inhibiting inflammatory mediators, Scavenging free radical.
iii. Immunomodulatory effects: enhancing the immune function.[9]

➢ **Lemmon grass:**

Fig no.3

- Synonyme: Citronella grass, Fever grass
- Biological name: Cymbopogoncitratus
- Biological source: The leaves and stems of the lemongrass plant are used.
- Geographical location: south east asia, India, Sri Lanka, Burma and Thailand.
- Family: Poaceae

Chemical constituents: Lemongrass primarily composed of terpenes, contains significant amounts of citral (a mixture of geranial and neral), geraniol, and other compounds like limonene and myrcene, which contribute to its characteristic aroma and potential health benefit.[10]

Role:

i. Anti-inflammatory effect
ii. Anti-oxidant effect
iii. Antipyretic effect
iv. Gastroprotective & Digestive Aid
v. Sedative and Anxiolytic (Calming) Effects

➢ **Cardamom:**

fig no. 4

- Synonyms: Green cardamom
- Biological name: Elettaria cardmomum.
- Biological source: Cardamom comes from the seeds.
- Geographical location: It is native to tropical forests of India and Southeast Asia.
- Family: Zingiberaceae

Chemical constituents: It contains volatile compounds (terpenes, esters, aldehydes) nonvolatile compound (flavonoids, saponins) vitamins, minerals.[21]

Role:

i. Anti-inflammatory
ii. Digestive aid
iii. Antioxidant
iv. Flavour and aroma

➢ **Black pepper:**

fig no. 6

- Synonyms: Kali mirch
- Biological name: Piper nigrum
- Geographical location: native to India and Southeast Asia
- Biological source: Black pepper comes from the dried, unripe berries of piper nigrum.
- Family: Piperaceae

.

Chemical constituents: It contains volatile oils, including limonene and pinene. also contain flavonoids, alkaloids.[22]

Role:

i. Anti-inflammatory
ii. Digestive aid
iii. Antioxidant

2. MATERIAL AND METHOD:

2.1 Collection of material:

All natural materials used in present study i.e. cardamom powder, tulsi powder, black pepper powder, jaggery were purchased from local market (Bagwan ayurvedic medical guruvar peth, karad) in the form of dried powder. The drying of lemongrass is done in oven at temperature 45°C for 5hours. The butterfly pea powder is purchase from amazon manufactured by saara herbal products, tamilnadu.

Chemicals required for preparation and evalution include starch, magnesium sterrate, hydrogen peroxide, albumin, ascorbic acid, sodium chloride, potassium chloride, sodium phosphate dibasic, potassium phosphate monobasic are issued from college store.

Equipment: UV Spectrophotometer, Colorimetry.

2.2 Method of preparation of extract:

20 gram of butterfly pea powder.

↓

Soaking in hydro alcoholic solvent, Occasional stirring for proper extraction.

↓

Maceration period (24 hours/depend upon extraction need). (fig no.7)

↓

Filtration (Separation of Liquid Extract from Plant Residue). (fig no.8)

↓

With help of evaporator, extract should be collected. (fig no.9)

fig no. 7: extraction

fig no. 8: filtration

fig no. 9: evaporation

2.3 Formulation Table:

table no.2: composition of herbal tea granule

Sr.no	Ingredients	Quantity (for 25 gm)
1	Clitoria ternatea	2.18
2	Tulsi	3.75
3	Lemon grass	2.18
4	Black pepper	0.25
5	Starch	2
6	Cardamom	1.32
7	Magnesium sterrate	0.31
8	jaggery	12.5
9	water	q. s

2.4 Preparation of herbal tea granules:

i. Weigh accurate amount of all ingredients mentioned in formulation table.
ii. Mixed all dry ingredients include lemongrass, black pepper, cardamom, tulsi powder, magnesium sterrate, butterfly pea powder extract with help mortar and pestle. ensure they are uniformly distributed.
iii. Then melt the jaggery using double boil method, maintain the temperature of water bath at 90°C. add starch and stir it continuously avoid lumps formation.
iv. Add the melted jaggery and starch paste to the herbal powder mixture until it reaches a dough like consistency. If required add water (q.s).
v. The obtained dough mass was passed through #16 sieve.
vi. Dry the granules in a drying oven to remove excess moisture.
vii. Packed the granules in air tight container such as sachets or amber color container to preserve their potency and flavour.

fig no. 10: herbal tea granules

3. Evaluation:

3.1 Organoleptic evaluation:

Organoleptic study is basic study to identify and evaluate the quality of the product. In the organoleptic test color, odor, taste, and texture were evaluated by visual inspection of the product.

3.2 Phytochemical evaluation:

table no.3 phytochemical evaluation

Sr. No	Test	Procedure	Observation
1	Mayer's test	2 mL extract+1 mL of Meyer's reagent	Precipitates are observed
2	Dragendroff test	1 mL Dragendroff reagent+2 mL extract	Reddish brown precipitate appears
3	Wagner's test	2 ml of extract+ 2ml of Wagner's reagent	Brown color appears
4	Salkowski test	Extract 5 mL+2 mL chloroform+3 mL concentrated sulfuric acid	Reddish brown color appears
5	Lead acetate test	1 mL filtrate+3 drop of lead acetate solution.	A creamy white precipitate is observed
6	Ferric chloride test	Ferric chloride solution+ extract	Red color appears
7	Fehling's test	1 mL Fehling A solution+1 mL Fehling B solution, boil it for 5–6 min+2 mL of extract, and heat it in water bath.	Brick red color appears

3.3 Physical evaluation:

1. Bulk density and tap density: Bulk density can be identified as the volume occupied by the solid plus the volume of voids when divided into powder. Whereas, tap density is a different type of bulk density obtained by tapping or vibrating the container in a particular method to achieve more effective particle parking and therefore, it is usually higher than bulk density.[12]

   Bulk density: mass/volume

   Tap density: mass/tapped volume

fig no. 11: density

2. Carr index and Hausner ratio: They are used in describing the flowability of powder. Carr's index can be determined as the ratio of the difference of the tapped and the bulk densities to the tapped density. According to Carr (1965), who introduced the flowability index, an excellent flowability is between the Carr index of 5–15% while Carr index of above 25% normally shows poor flowability.

   Carr's index = (Tapped density-bulk density/ bulk density) × 100

   Hausner's ratio = Tapped density/Bulk density

3. Angle of repose: angle of repose is defined as the maximum angle possible between the surface of pile of sample and the horizontal plane. It was determined using funnel method. In a funnel, the accurately weighed powder was taken. The funnel height was arranged in a manner that the funnel tip just touches the apex of the heap or head of blend. Through the funnel the drug excipient blend was allowed to flow freely on to the surface.[12]

   Angle of repose (θ) = $\tan^{-1}$ (h/r)

   Where, h= height of pile

   r=average radius

4. Flow rate: mass of powder/time required for flow (g/sec) [12]

5. Ash value: Ash value is helpful in determining the quality and purity of crude drug, especially in powder form. The objective of ash vegetable drugs is to remove all traces of organic matter, which may otherwise interfere in an analytical determination.[11]

   Total ash value: Weight accurately about 2 g of powdered drug in a tarred silica crucible. heat with a burner, using a flame about 2cm high and supporting the dish about 7cm above the flame, heat till vapors almost cease to be evolved; then lower the dish and heat more strongly until all the carbon is burnt off.

   Total ash value of sample (%): 100(z-x)/y

   Where, x=weight of empty dish

   y=weight of the drug taken

   z=weight of dish + ash (after complete incineration)

fig no.12: total ash value

6. Water-soluble ash value: The ash boiled with 25 mL of water, filtered, and collected the insoluble matter on an ash less filter paper, washed with hot water, and ignited in a tarred crucible at temperature not exceeding 450°C. weighted, and subtracted weight off insoluble matter from the total weight of ash.[11]

Water-soluble ash value (%) = (wt. of total ash − wt. of water-insoluble ash/wt. of crude drug) ×100

fig no. 13: water soluble ash value

3.4 Chemical evaluation:

1.Determination of pH: The pH of herbal tea granule solution in distilled water was determined at room temperature by using pH paper.

Fig no. 14: pH determination

2.Anti-inflammatory activity:

The in vitro assessment of anti-inflammatory activity for unknown crude extracts can be performed by evaluating their ability to inhibit the denaturation of egg albumin (a protein).
Preparation of 1% of egg albumin solution: Carefully separate the egg white from the yolk or egg albumin powder and mix it with distilled water in a 1:100 ratio (1 ml egg white per 100ml of w/v distilled water) Stir the mixture well to dissolve the egg white, ensuring it's thoroughly combined with the water.

To prepare the reaction mixture, 0.2ml of 1% egg albumin solution, 2ml of test extract at various concentration and 2.8 ml of phosphate buffered saline (PBS, pH 7.4) were combined, resulting in a total volume of 5ml.
The control sample was prepared by mixing 2ml of distilled water, 0.2 ml of 1% egg albumin solution, and 2.8 ml pf PBS, also totaling 5ml.

All reaction mixture were incubated at room temperature of 37±2°C for 30 min, followed by heating in a water bath at 70±2°C for 15 minutes.

After allowing the mixture to cool to room temperature, absorbance was recorded at 660 nm using a UV spectrophotometer, with distilled water serving as the blank reference.[14] [15]

The percentage inhibition of protein denaturation was determined by using following equation,

% inhibition = [(absorbance of control-absorbance of test sample) / absorbance of Control] × 100

Fig no. 15: UV Spectrophotometer

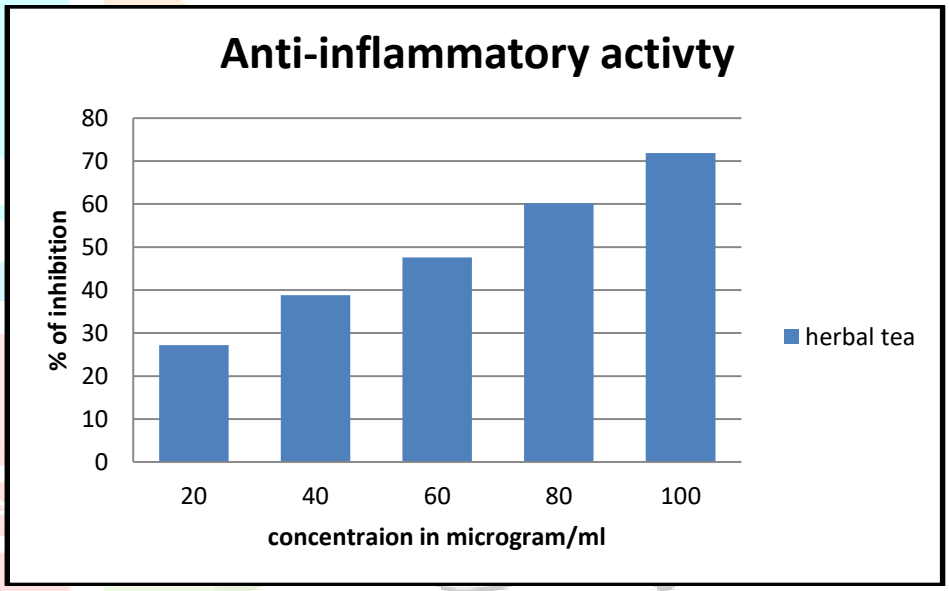

fig no. 16: anti-inflammatory activity of herbal formulation

3.Antioxidant activity:

Antioxidant activity of test compounds was estimated for their free radical scavenging activity by using DPPH (1, 1-Diphenyl-2, Picryl-Hydrazyl) free radicals.

1ml of different concentrations (20, 40, 60, 80, 100µg/ml) were taken in a test tubes. 1.5ml of 0.1% methanolic DPPH was added over the samples and incubated for 30 minutes in dark condition.

The samples were then observed for discoloration; from purple to yellow and read the absorbance on colorimeter at 510 nm [13]

Radical scavenging activity was calculated by the following equation:

DPPH radical scavenging activity (%) = [(Absorbance of control - Absorbance of test sample)

Test sample) / (Absorbance of control)] x 10

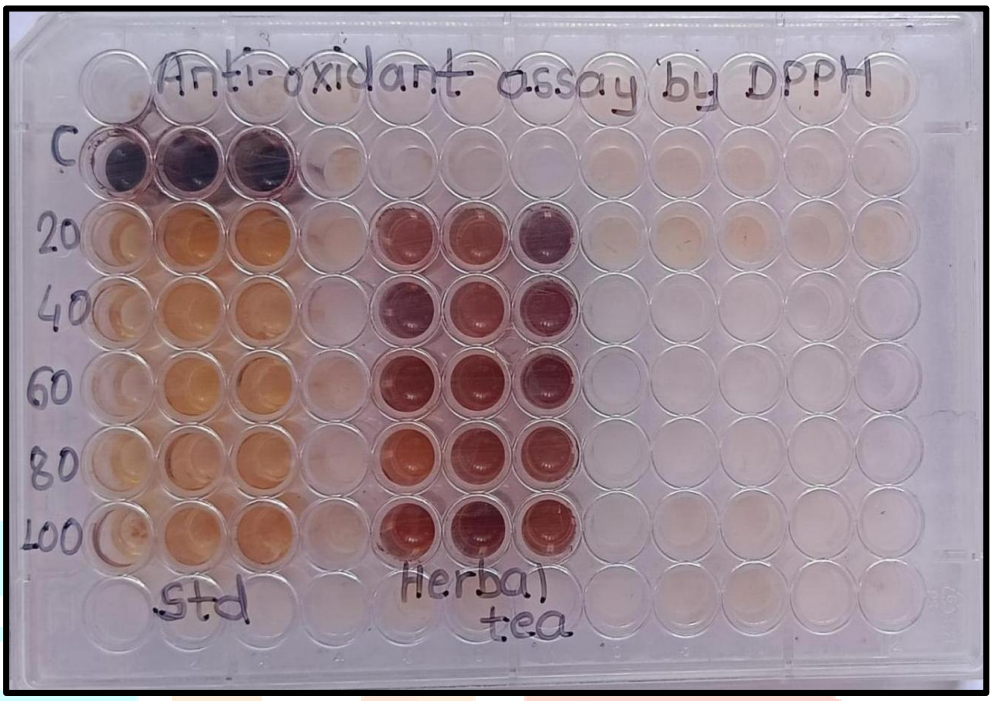

fig no. 17: antioxidant assay by dpph

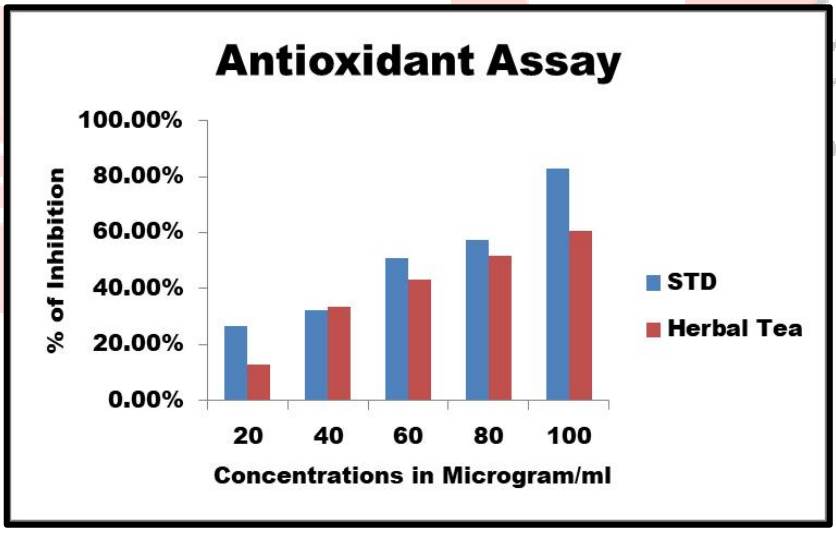

fig no. 18: the scavenging ability of sample and standard on dpph

4. RESULT AND DISCUSSION:

4.1 Organoleptic test:

Prepared herbal tea granules have reported the following parameters.
Color: grey
Odor: pleasant smell
Taste: sweet-bitter type
Texture: gritty texture

4.2 Phytochemical test:

Phytochemical constituents such as tannin, steroids, flavonoids, alkaloids, carbohydrates, and terpenoids were present in the prepared herbal tea granule formulations. For the phytochemical constituent screening, following test was performed.

Phytochemical test	Name of test	observation	inference	Figure
Alkaloids	Mayer's test	Precipitates are observed	Alkaloid is present	
	Dragendroff test	Reddish brown precipitate appears	Alkaloid is present	
	Wagner's test	Brown color appears	Alkaloid is present	
Steroids	Salkowski test	Reddish brown color appears	Steroid is present	
Tannins	Lead acetate test	A creamy white precipitate is observed	Tannin is present	

Flavonoids	Ferric chloride test	Red color appears	Flavonoids are present	
Carbohydrates	Fehling's test	Brick red color appears	Carbohydrates are present	

4.3 Physical test:

Sr no.	Parameters	Results
1	Bulk density	0.33g/ml
2	Tap density	0.38g/ml
3	Carr's index	13.15
4	Hausner ratio	1.15
5	Angle of repose	30.83°
6	Flow rate	0.70g/sec
7	Ash value	8%
8	Water soluble ash value	3.12%

4.4 Chemical test:

9	Ph	6-7

10. Anti-inflammatory activity:

Sr.no	Sample code	Concentration	Absorbance	% of inhibition
1	control	-	1.03	-
2	Herbal tea	20	0.75	27.18
		40	0.63	38.83
		60	0.54	47.57
		80	0.41	60.19
		100	0.29	71.84

11.Antioxidant activity:

Sr.no	Sample code	Concentration	Absorbance at 510nm				% inhibition
			Test 1	Test 2	Test 3	Mean	
1	Control	-	1.93	1.93	1.93	1.93	_
2	Standard (ascorbic acid)	20	1.45	1.42	1.40	1.42	26.42%
		40	1.31	1.29	1.33	1.31	32.12%
		60	0.95	0.97	0.93	0.95	50.77%
		80	0.82	0.85	0.79	0.82	57.51%
		100	0.35	0.32	0.32	0.33	82.90%
3	Herbal tea	20	1.70	1.66	1.68	1.68	12.95%
		40	1.29	1.25	1.31	1.28	33.67%
		60	1.09	1.11	1.12	1.10	43.00%
		80	0.93	0.95	0.92	0.93	51.81%
		100	0.77	0.77	0.74	0.76	60.62%

5. CONCLUSION:

The present study successfully demonstrated the preparation and evaluation of herbal tea granules formulated using selected medicinal plants known for their antioxidant and anti-inflammatory properties. The granules were developed through standard granulation techniques, ensuring desirable physical characteristics such as ash value, good flowability also done stability study through pH detection by pH paper.

Phytochemical screening confirmed the presence of key bioactive compound such as flavonoids, tannis, alkaloids, steroids, and carbohydrates which are responsible for observed biological activities.

The antioxidant and inflammatory profile of herbal tea granules was evaluated by measuring the percent of inhibition against DPPH scavenging reagent and protein (egg albumin) denaturation assay respectively. The anti-inflammatory property increases as increase in concentration of compound and however the concentration increases also the antioxidant activity of the compound increases as compares to the standard ascorbic acid.

Overall, the formulation herbal tea granules offer a convenient, effective, and natural alternative for managing oxidative stress and inflammation. These finding support the potential of herbal tea granules as a functional health supplement.

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