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DEVELOPMENT AND QUALITY EVALUATION OF GINGKO BILOBA AND GOTU KOLA HERBAL TEA

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ABSTRACT

The development and quality assessment of a functional herbal tea made from Gotu kola and Ginkgo biloba are the main objectives of this study. Ginkgo biloba is an ancient plant with a unique composition that is high in terpenoids, terpene lactones, ginkgolides, bilobalide and flavonoids. The herbal medicinal plant known as Gotu kola (*Centella asiatica*) is highly valued for its therapeutic qualities due to the presence of asiaticoside, asiatic acid, madecassoside and madecassic acid. The phytochemical screening was done qualitatively. Superoxide dismutase (SOD) and malondialdehyde (MDA), two indicators of oxidative stress, were used in an *in vivo* investigation to assess the effectiveness of antioxidants. Strong antioxidant potential was shown by the results, which revealed a considerable drop in MDA levels and an increase in SOD activity. After screening phytochemical potential and oxidative stress marker these plants were utilized for the preparation of tea bags. The tea bags was be prepared by the blend of Ginkgo biloba and Gotu kola dried leaves and was undergo for their proximate composition during storage. The obtained data from all evaluations was subjected to statistical analysis in order to check the level of significance. Its nutritional value and shelf stability were supported by compositional analysis, which showed acceptable amounts of moisture, ash, crude fiber and fat. In terms of taste, aroma, color, and flavor, trained panel's sensory evaluation utilizing a 9-point hedonic scale revealed healthy herbal tea for future.

Keywords: Ginkgo biloba; Gotu kola; MDA; SOD; Phytochemical screening

INTRODUCTION

Ginkgo biloba has been used in medicine for over 2,000 years, especially in traditional Chinese medicine, where it has been valued for its therapeutic properties (More *et al.*, 2021). The herb Centella asiatica, commonly known as Gotu kola or tiger grass, can grow up to 15cm in height. It has leaves that resemble tiny fans and flowers that range in color from white to purple (Kwaśniewska and

Kiewlicz, 2021). Numerous chemicals with distinctive structures found in Ginkgo biloba have contributed to the expansion of the chemical variety of herbal medicine. Antioxidative and neuroprotective qualities of Ginkgo biloba may help reduce oxidative stress and brain damage, owing to its neurological conditions (Essawy *et al.*, 2022). According to research, Gotu kola and Ginkgo biloba extract may both promote neurochemical equilibrium, raising neurotransmitter levels and shielding the brain from oxidative damage brought on by epileptic episodes. This suggests that both herbs have therapeutic promise for the treatment of epilepsy (Essawy *et al.*, 2022). The possible interactions of two plants, Ginkgo biloba and Gotu kola, with antiepileptic medications, especially phenytoin, have been well investigated. Known for its capacity to improve cognition, Ginkgo biloba has been demonstrated to decrease the bioavailability of phenytoin, possibly resulting in sub-therapeutic levels. Likewise, Gotu kola, which is used to enhance circulate on and cognition, interacts with phenytoin to change its pharmacokinetics. These interactions highlight how crucial it is to keep an eye on and comprehend how these herbs are used in conjunction with antiepileptic drugs to guarantee both patient safety and therapeutic efficacy (Taleb, 2023). The present study was designed for the assessment of the Ginkgo biloba and Gotu kola extract and their use in development of herbal tea.

Material and Methods

The proposed study was conducted in the Department of Food Science and Technology laboratories at the Government College Women University, Faisalabad, Pakistan. The raw materials used and methods followed in this study are described below.

Procurement of raw materials

The raw materials were taken from the local market of Faisalabad. Gotu kola *(Centella asiatica)* plant leaves were purchased from Best Garden Nursery Farm, Faisalabad and Ginkgo biloba leaves from Green Pakistan Nursery Farm, Islamabad. The chemicals and standards were purchased from Merk (KGaA Merk Darmstadt, Germany).

Sample preparation

The sample was prepared by adopting the method of Fang *et al.* (2020); (Abdulqahar and Alhadithi, 2023) with slight modifications.

Drying and grinding of plant materials

Ginkgo biloba and Gotu kola leaves were cleaned, dried at 50–65°C and ground into a fine powder to obtain extracts (Zha *et al.*, 2017).

Preparation of extracts

The aqueous extract of Ginkgo biloba and Gotu kola was prepared by adopting the method of (Noaman *et al.*, 2022; Ibraheem *et al.*, 2023), respectively.

Aqueous Extract

Leaf extracts from Gotu kola and Ginkgo biloba were extracted in the way described below: One litre of distilled water was combined with 100g of dried Ginkgo biloba and Gotu kola leaves, powdered and the mixture was heated to 95°C for one hour. After letting both mixtures drop to ambient temperature, they were filtered through fresh cheese cloth and the extracts were kept at -18°C. The Soxhlet apparatus was used to extract the materials in a different technique in which a dried plant sample of 20g was refluxed for ten to twelve hours in 300mL of deionized water. Applying boiling water to the Soxhlet Apparatus, extracts were filtered and concentrated until they were dry using a rotary evaporator and then stored in a dark space.

Phytochemical screening of bioactive components

The bioactive components in the Ginkgo biloba and Gotu kola extract were evaluated by high-performance liquid chromatography (Yang *et al.*, 2016; Wang *et al.*, 2019), respectively.

***In Vivo* Rat Study (Oxidative Stress Biomarkers)**

Experimental Animals

The NIH, animal house provided the male Sprague-Dawley rats, which weighed between 150 and 200g. Through the investigation, the rats were kept in a controlled environment at a temperature of 25°C in the departmental animal facility, with a 12-hour light/12-hour dark cycle. A typical pellet diet and water were given to them.

Experimental Protocol

Five groups of rats were created, with six rats in each group at random are presented in Table 1. The first group did not get any treatment and was used as the control. For the second group, α-tocopherol was given as an antioxidant. The remaining three groups were administered herbal extracts. Ginkgo biloba was given to the third group, Gotu kola extract was given to the fourth group, and a combination of Gotu kola and Ginkgo biloba extracts was given to the fifth group. This experimental setup was used to assess the effects of these therapies, both separately and in combination, on oxidative stress and antioxidant activity. Key Biomarkers for Oxidative Stress & Antioxidant Activity Malondialdehyde (MDA) Measures lipid peroxidation (oxidative damage indicator) and Superoxide Dismutase (SOD), Key antioxidant enzyme protecting against oxidative stress.

Treatment Protocol

The rats were divided into five experimental groups as follows:

I. Group (Control): No treatment was be administered.
II. Group (Antioxidant): Rats was receive α-Tocopherol as an antioxidant.
III. Group (Ginkgo biloba): Rats was be administered Ginkgo biloba extract.
IV. Group (Gotu Kola): Rats was receive *Centella asiatica* (Gotu Kola) extract.
V. Group (Combination Treatment): Rats was be treated with a combination of *Ginkgo biloba* and Centella asiatica extracts.

Group	Treatment
Group I	Control: Vehicle (distilled water) + saline-injected rats.
Group II	Rats was receive α-Tocopherol as an antioxidant.
Group III	250mg/kg Ginkgo biloba extract orally for 4 weeks
Group IV	250mg/kg Gotu kola extract orally for 4 weeks
Group V	125mg/kg *Ginkgo biloba* +125 Gotu kola extract orally for 4 weeks

Table 1: Efficacy of the Exract

Development of Ginkgo biloba and Gotu kola Tea bags

The tea bags were prepared by utilizing the medicinal herbal plant leaves (Ginkgo biloba+Gotu kola) according to the procedure described by (Suseno *et al.*, 2022; Li *et al.*, 2023). Fresh ginkgo biloba and gotu kola leaves were dried at a temperature of 50°C until a constant weight was achieved. The dried leaves were then crushed and sieved using an 18-mesh sieve to obtain a uniform particle size. The sieved powders of ginkgo biloba and gotu kola leaves were mixed in according to the ratios mentioned in Table 2. The ingredients were blended in a closed container to ensure uniform mixing. After blending, 2g of the mixed herbal tea was weighed and packed into pre-cut tea filter paper to prepare individual tea bags. The filter paper was sealed using a heat sealer to ensure proper closure and avoid leakage of the tea material during brewing. The prepared tea bags were stored in airtight containers to preserve freshness and prevent contamination. For brewing, each tea bag containing 2g of the herbal mixture was steeped in hot water at 100°C for 5 minutes. After steeping, the tea bag was removed and the tea was analyzed for sensory, chemical, or other quality parameters as required.

Table 2: Treatment plan for the Development of Tea bags

Sr. No.	Ingredients %	T0	T_1	T_2	T_3	T_4	T_5
1	Ginkgo biloba	-	100	-	75	50	25
2	Gotu kola	-	-	100	25	50	75
3	Lemon grass	100	-	-	-	-	-

Analysis of Tea Bags

The prepared tea bags were evaluated at specific storage intervals.

Compositional analysis on developed tea bags

The proximate composition such as moisture, protein, fat, fibre, ash and nitrogen-free extract was evaluated as stated by the standard method of the American Association of Analytical Chemists as stated in the standard protocol of the AOAC (2016).

Moisture content

The moisture percentage of tea bags was estimated by dehydrating them in a hot air oven. Take 5g samples of each treatment in Petri dishes, was placed for 24 hours in a hot air oven at 105±5°C. After that the samples were placed in a desiccator to cool down without absorbing moisture from the environment. The dried samples were weighed again and repeated till the constant weight was attained as mentioned in AOAC (2016). The obtained moisture contents were calculated by the given below formula;

$$\% \, Moisture = \frac{Weight \, of \, sample \, before \, drying \, (g) - Weight \, of \, sample \, after \, drying \, (g)}{Weight \, of \, original \, sample \, (g)} \times 100$$

Fat content

The moisture-free sample of 5g from each variety of tea bags was placed in a soxhlet apparatus to estimate the fat content. After that, the 50mL of hexane solvent was introduced to a cup connected to the extraction unit set the temperature at 40 to 60°C. The wrapped samples were defatted thrice and the fat content was calculated by the utilization of hexane, which acts as a solvent in the Soxhlet apparatus with continuous reflux as described in AOAC (2016). The fat percentage was calculated by using the below formula;

$$\% \; fat = \frac{Weight \, of \, fat \, (g)}{Weight \, of \, original \, sample \, (g)} \times 100$$

Fibre content

Take 5g of defatted samples and place in 200mL of 1.25% H_2SO_4 solution for 30 minutes for boiling purposes. After filtration, collect the filtrate and place it in an already prepared base solution of 1.25% NaOH solution and boil for 30 minutes. The resultant filtrate was carefully dried in an air-dried oven at ±105°C, the sample was cooled in a desiccator. The dried and cooled filtrate was burnt at 600°C and reweighed after cooling that sample. The fibre content was estimated by taking fat-free samples as termed in AOAC (2016). The loss in weight after drying was calculated as the fibre content.

$$\% \, Fiber = \frac{Weight \, of \, dried \, residue \, (g) - weight \, of \, ash \, (g)}{weight \, of \, original \, sample \, (g)} \times 100$$

Ash content

Take 5g sample in a crucible was sited in a muffle furnace for 3-5 hours at 550±50°C and cooled in a desiccator. This process was repeated till the weight became constant and residues of greyish-white color were obtained as a final product. The ash content was estimated through the following procedure as a reference in AOAC (2016). The ash content was quantified by using the prescribed below formulas

$$\%\ Ash = \frac{Weight\ of\ ash(g)}{Weight\ of\ original\ sample(g)} \times 100$$

Sensory evaluation

Sensory evaluation was determined by a 9-point Hedonic scale defined by (Meilgaard *et al.*, 2016). After the preparation of beverages, the quality attributes of the prepared juice were evaluated by the trained judges. The beverages were calculated for taste, color, flavour, consistency, aftertaste and overall acceptability using the 9-point hedonic scale conferring to the strategies of Meilgaard.

Statistical analysis

The data obtained after performing analysis was statistically analyzed by using statistix 8.1 Software according to the procedure described by (Montgomery, 2017). The resulting facts and figures for every parameter were examined through Tukey's HSD by using Statistical Software 8.1. As for as, the level of significance was also examined through the analysis of variance (ANOVA) technique according to the principles defined by (Montgomery, 2017).

Results and discussion

Phytochemical screening of Ginkgo biloba and Gotu kola

The qualitative phytochemical screening to analyze the presence of phytochemicals in the extracts was conducted using the method (Bankole *et al.*, 2016; Veer *et al.*, 2019; Shaikh and Patil, 2020). Plants produce a wide range of natural chemicals as secondary metabolic products, many of which have antibacterial properties. These consist of alkaloids, steroids, glycosides, flavonoids, tannins, terpenoids, and saponins (Shakeri *et al.*, 2012; El-Beltagi and Badawi, 2013). The phytochemical analysis of Ginkgo biloba in this study was prersentedin Table 3, the extract showed the absence of anthraquinones but the presence of alkaloids, flavonoids, tannins, saponins, triterpenes, steroids, and glycosides. Ginkgo biloba leaf extract was described as a complex product with several active components that was utilized as a phytomedicine (Jain *et al.*, 2011). Additionally, this aligns with the findings of (DeFeudis and Drieu, 2000) and (Goh and Barlow, 2002).Gotu kola analysis regarding bioactive components found in extract include terpenoid, alkaloid, flavonoid, tanin, and saponin. According to a prior study, the majority of the bioactive components found in Gotu kola are triterpene compounds, including asiatic acid, madecassic acid, asiaticoside, and madecassoside (Shukla *et al.*, 1999). Plants naturally produce flavonoids, which are antioxidants. It has been stated that the hydroxyls in flavonoids are what give them their ability to scavenge radicals (Hanasaki *et al.*, 1994). Superoxides and peroxynitrite can both be scavenged by some flavonoids. According to (De Groot, 1994), peroxynitrite is a highly reactive radical generated from oxygen. According to the earlier study, the most effective flavonoids against ROS are flavones and cathechins (Cui *et al.*, 2006).

Table 3: Phytochemical screening of Ginkgo biloba and Gotu kola

Ginkgo biloba	Presence	Gotu Kola	Presence
Glycosides	+	Flavonoids	+
Saponins	+	Glycosides	+
Steroids	+	Phenolic compounds	+
Triterpenes	+	Alkaloids	-
Anthraquinones	-	Saponins	+
Tannins	+	Steroids	+
Flavonoids	+	Tannins	+
Alkaloids	+	Terpenoids	+

In Vivo Rat Study (Oxidative Stress Biomarkers)

The effect of Ginkgo biloba, Gotu kola, and their combination on antioxidant indicators - Malondialdehyde (MDA) and Superoxide Dismutase (SOD) was evaluated in vivo using Sprague Dawley rats. The findings are presented as mean ± SD, and ANOVA is used to determine statistical significance among treatments are depicted in Table 4. The effect of Ginkgo biloba, Gotu kola, and

their combination on antioxidant indicators - Malondialdehyde (MDA) and Superoxide Dismutase (SOD) was evaluated in vivo using Sprague Dawley rats. The findings are presented as mean ± SD, and ANOVA is used to determine statistical significance among treatments. The highest MDA level was observed in the control group (6.22 ± 0.35 nmol/mL), indicating high lipid peroxidation and oxidative stress. Treatment with α-Tocopherol significantly reduced MDA (4.12 ± 0.28 nmol/mL), serving as the positive control. Herbal treatments, especially the combination group (3.82 ± 0.26 nmol/mL), also showed a marked reduction in MDA levels, suggesting potent antioxidant effects of the herbal extracts.

Group	**MDA (nmol/mL)**	**SOD (U/mL)**
Control	6.22 ± 0.35	16.12 ± 1.12
α-Tocopherol	4.12 ± 0.28	29.32 ± 1.54
Ginkgo Biloba	4.52 ± 0.29	25.92 ± 1.41
Gotu Kola	5.02 ± 0.31	23.62 ± 1.37
Combination	3.82 ± 0.26	31.22 ± 1.66

Table 4: ***In Vivo Rat Study (Oxidative Stress Biomarkers)***

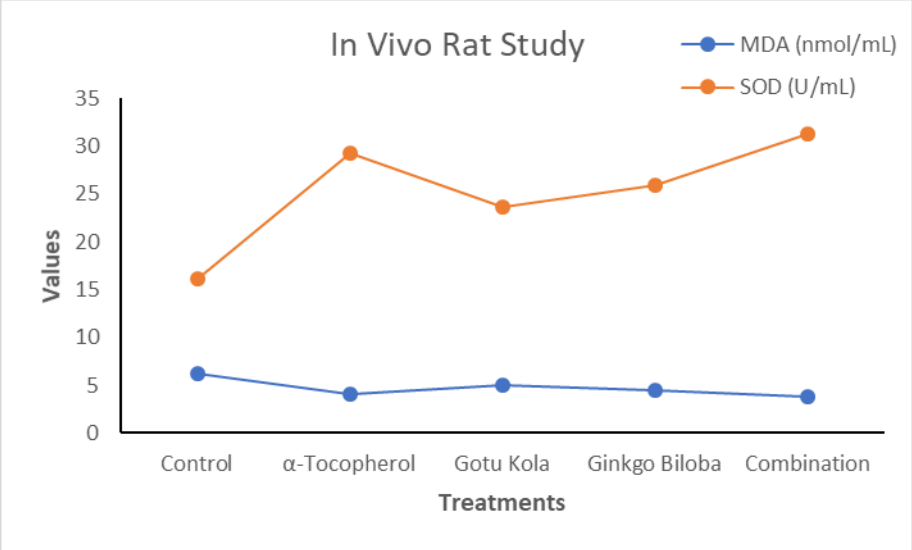

Figure 1: ***In Vivo*** **Rat Study (Oxidative Stress Biomarkers)**

Compositional analysis of tea bags

The study examined composition of tea bag treatments across four storage periods of 0, 60, 120, and 180 days are presented in Table 5. Treatments were created utilizing varying doses of Ginkgo biloba and Gotu kola aqeous extracts, which are renowned for their functional qualities. Moisture, fat, fiber, ash, and protein content were all measured throughout the investigation. The results revealed substantial heterogeneity across treatments as well as noticeable deterioration patterns during storage durations. The moisture content at day 0 was between 3.71 ± 0.2 (T2) to 4.36 ± 0.15 (T_0). T_0 had the most moisture due to the lack of moisture-binding phytochemicals. As predicted, all treatments demonstrated a steady decrease in moisture content over time. By day 180, moisture readings had declined across the board, with most samples showing a 0.2-0.3% decrease. This decrease might be ascribed to gradual evaporation during storage and the partial permeability of packing materials. According to (Adnan *et al.*, 2013) similar decreases in tea products occur over time owing to moisture migration and environmental exposure, even under controlled settings. The initial reduced moisture in T_1 and T_2 can also be explained by the presence of phenolic-rich extracts like Ginkgo biloba, which tend to reduce water activity (Sati et al., 2018). Fat content also followed a decreasing trend over time. Starting from a range of 0.48 ± 0.32 to 0.71 ± 0.2 on day 0, fat levels slightly dropped by day

180 in all samples. This reduction is likely due to oxidative degradation of lipids during storage. As confirmed by (Ezembu *et al.*, 2020) the breakdown of unsaturated fats is a common consequence of exposure to oxygen, light and temperature fluctuations in herbal formulations. Furthermore, phenolic compounds present in Ginkgo biloba and Gotu kola may have promoted oxidation at early stages, causing further fat depletion (Okoro, 2023). Fiber content was highest in T_2 6.58 ± 0.25 at day 0 due to the high proportion of Gotu kola, an herb rich in dietary fiber. While fiber remained relatively stable compared to other components, a slight reduction was seen over time, especially after 120 days. This degradation may result from enzymatic breakdown or solubilization of fiber during storage, as supported by Sadowska et al. (2023), who reported minor changes in fiber structure in dry herbal samples under long-term storage.

Ash content, which reflects total mineral content, showed a consistent but mild decrease throughout the storage period. Initially highest in T_2 3.38 ± 0.25, ash content reduced slightly by day 180, which may result from mineral leaching, chemical interactions within the matrix, or packaging-related shifts. (Awad *et al.*, 2025) documented similar findings in herbal tea powders where mineral loss was linked to storage duration and herbal formulation composition. The most significant observation across all components is that after 60 days, nearly every proximate value moisture, fat, fiber, ash, and protein showed a measurable decline. This is due to natural chemical and physical degradation processes, including evaporation, oxidation, enzymatic reactions, and nutrient loss due to storage temperature and humidity. As (Liu *et al.*, 2023) noted, even well-packaged functional beverages and herbal infusions experience compositional changes when stored over extended periods. In terms of differences among treatments (T_0–T_5), the initial values were directly influenced by the type and amount of extract used. For instance, T_2 consistently showed higher protein, ash, and fiber content due to its 10% Gotu kola extract, known for its rich nutritional profile (Sati et al., 2018; (Awad *et al.*, 2025)). Meanwhile, T_5 had the highest fat due to increased Gotu kola levels, which contribute minor lipid fractions.

Table 5: Proximate composition of Ginkgo biloba and Gotu kola tea bags

Treatment	Day	Moisture (%)***	Fat (%)*	Fiber (%)***	Ash (%)**
T_0	0	4.36 ± 0.15^{A}	0.68 ± 0.15^{A}	5.98 ± 0.15^{ABC}	3.08 ± 0.15^{A}
T_1	0	3.71 ± 0.2^{AB}	0.51 ± 0.2^{A}	6.31 ± 0.2^{ABC}	3.31 ± 0.2^{A}
T_2	0	3.58 ± 0.25^{B}	0.38 ± 0.25^{A}	6.58 ± 0.25^{ABC}	3.38 ± 0.25^{A}
T_3	0	3.78 ± 0.32^{AB}	0.48 ± 0.32^{A}	6.48 ± 0.32^{ABC}	3.18 ± 0.32^{A}
T_4	0	4.08 ± 0.15^{AB}	0.68 ± 0.15^{A}	6.28 ± 0.15^{ABC}	3.18 ± 0.15^{A}
T_5	0	4.11 ± 0.2^{AB}	0.71 ± 0.2^{A}	6.11 ± 0.2^{ABC}	3.01 ± 0.2^{A}
T_0	60	4.18 ± 0.25^{AB}	0.56 ± 0.25^{A}	5.87 ± 0.25^{BC}	2.97 ± 0.25^{A}
T_1	60	3.63 ± 0.32^{AB}	0.46 ± 0.32^{A}	6.26 ± 0.32^{ABC}	3.25 ± 0.32^{A}
T_2	60	3.64 ± 0.15^{AB}	0.46 ± 0.15^{A}	6.65 ± 0.15^{A}	3.46 ± 0.15^{A}
T_3	60	3.77 ± 0.2^{AB}	0.49 ± 0.2^{A}	6.48 ± 0.2^{ABC}	3.18 ± 0.2^{A}
T_4	60	3.94 ± 0.25^{AB}	0.56 ± 0.25^{A}	6.16 ± 0.25^{ABC}	3.05 ± 0.25^{A}
T_5	60	4.02 ± 0.32^{AB}	0.65 ± 0.32^{A}	6.06 ± 0.32^{ABC}	2.96 ± 0.32^{A}
T_0	120	4.23 ± 0.15^{AB}	0.64 ± 0.15^{A}	5.95 ± 0.15^{ABC}	3.05 ± 0.15^{A}
T_1	120	3.6 ± 0.2^{B}	0.46 ± 0.2^{A}	6.26 ± 0.2^{ABC}	3.25 ± 0.2^{A}
T_2	120	3.5 ± 0.25^{B}	0.34 ± 0.25^{A}	6.52 ± 0.25^{ABC}	3.33 ± 0.25^{A}
T_3	120	3.7 ± 0.32^{AB}	0.44 ± 0.32^{A}	6.41 ± 0.32^{ABC}	3.13 ± 0.32^{A}
T_4	120	3.99 ± 0.15^{AB}	0.63 ± 0.15^{A}	6.23 ± 0.15^{ABC}	3.12 ± 0.15^{A}
T_5	120	4 ± 0.2^{AB}	0.65 ± 0.2^{A}	6.06 ± 0.2^{ABC}	2.96 ± 0.2^{A}
T_0	180	4.07 ± 0.25^{AB}	0.51 ± 0.25^{A}	5.83 ± 0.25^{C}	2.92 ± 0.25^{A}
T_1	180	3.53 ± 0.32^{B}	0.41 ± 0.32^{A}	6.21 ± 0.32^{ABC}	3.19 ± 0.32^{A}
T_2	180	3.56 ± 0.15^{B}	0.42 ± 0.15^{A}	6.59 ± 0.15^{AB}	3.4 ± 0.15^{A}
T_3	180	$3.68 \pm 0.2A^{B}$	0.45 ± 0.2^{A}	6.4 ± 0.2^{ABC}	3.13 ± 0.2^{A}
T_4	180	3.85 ± 0.25^{AB}	0.51 ± 0.25^{A}	6.1 ± 0.25^{ABC}	2.98 ± 0.25^{A}
T_5	180	3.91 ± 0.32^{AB}	0.59 ± 0.32^{A}	6 ± 0.32^{ABC}	2.9 ± 0.32^{A}

T0= 100% Lemongrass T_3= 75% Ginkgo biloba and 25% Gotu kola

T_1= 100% Ginkgo biloba
T_2= 100% Gotu kola
T_4= 50% Ginkgo biloba and 50% Gotu Kola
T_5= 75% Gotu kola and 25% Ginkgo biloba
**=Highly significant (P≤ 0.01)
*=Significant (P=0.01-0.05)
NS=Non-Significant (P≥0.05)

Sensory evaluation of Ginkgo biloba and Gotu kola tea

The trained judges assessed the produced herbal tea qualitative features in accordance with Meilgaard's approach, the tea were evaluated for taste, color, flavor and aroma using a 9-point hedonic scale and their scores are mentioned in Table 6. The highest score was observed in T_4 8.44 ± 0.62while the lowest in T_1 8.00± 0.76 at 0 day. The lowest score was awarded at the end of the storage day in T_3 at 180 is 6.25 ± 0.71. The highest score for aroma observed in T0 8.63 ± 0.52 at 1st day of storage and the lowest in t_1 and T_2 6.25 ± 0.71 at 180th day of storage. The highest score for flavor observed in T0 8.75 ± 0.46 at 1st day of storage and the lowest in T_1 6.75 ± 0.71at 180th day of storage. The highest score for taste observed in T_4 8.19 ± 0.7 5at 1st day of storage and the lowest in T_1 5.63 ± 0.52 at 180th day of storage.

Table 6: Sensory evaluation of Ginkgo biloba and Gotu kola tea

Treatment	Day	Color	Aroma	Flavor	Taste
T_0	0	8.38 ± 0.52	8.63 ± 0.52	8.75 ± 0.46	7.88 ± 0.35
T_1	0	8.00± 0.76	7.75 ± 0.89	8.00 ± 0.76	7.63 ± 0.52
T_2	0	8.25 ± 0.46	8.13 ± 0.35	8.25 ± 0.46	8.00 ± 0.53
T_3	0	8.13 ± 0.64	7.88 ± 0.35	8.00 ± 0.53	7.75 ± 0.71
T_4	0	8.44 ± 0.62	8.31 ± 0.59	8.56 ± 0.62	8.19 ± 0.75
T_5	0	8.38 ± 0.52	8.25 ± 0.46	8.38 ± 0.52	7.88 ± 0.83
T_0	90	7.63 ± 0.52	8.00± 0.76	8.50 ± 0.53	6.88 ± 0.35
T_1	90	7.13 ± 0.83	7.00 ± 0.53	7.75 ± 0.71	6.63 ± 0.52
T_2	90	7.25 ± 0.46	7.63 ± 0.52	8.00 ± 0.53	7.00 ± 0.53
T_3	90	7.13 ± 0.64	7.00 ± 0.01	7.88 ± 0.35	6.75 ± 0.71
T_4	90	7.75 ± 0.46	7.94 ± 0.18	8.31 ± 0.59	7.25 ± 0.71
T_5	90	8.00 ± 0.53	7.88 ± 0.35	8.13 ± 0.35	6.88 ± 0.83
T_0	180	6.63 ± 0.52	6.63 ± 0.52	7.50 ± 0.53	5.88 ± 0.35
T_1	180	6.25 ± 0.71	6.25 ± 0.71	6.75 ± 0.71	5.63 ± 0.52
T_2	180	6.38 ± 0.52	6.38 ± 0.52	7.00 ± 0.53	6.00 ± 0.53
T_3	180	6.25 ± 0.71	6.25 ± 0.71	6.88 ± 0.35	5.75 ± 0.71
T_4	180	7.00 ± 0.53	7.00 ± 0.53	7.50 ± 0.53	6.25 ± 0.71
T_5	180	6.88 ± 0.35	6.88 ± 0.35	7.38 ± 0.52	5.88 ± 0.83

T0= 100% Lemongrass
T_1= 100% Ginkgo biloba
T_2= 100% Gotu kola
T_3= 75% Ginkgo biloba and 25% Gotu kola
T_4= 50% Ginkgo biloba and 50% Gotu Kola
T_5= 75% Gotu kola and 25% Ginkgo biloba
**=Highly significant (P≤ 0.01)
*=Significant (P=0.01-0.05)
NS=Non-Significant (P≥0.05)

Conclusion

The created herbal tea showed promising functional qualities and consumer-friendly qualities, indicating that it could be a beverage that promotes health. According to the study's findings, gotu kola and ginkgo biloba tea can be used as a natural, potent antioxidant-rich beverage for functional food applications. The presence of important bioactive substances such flavonoids, tannins, saponins, alkaloids, and phenolics—all of which support the tea's potential to promote health.

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