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Development and evaluation of tea concentrate using natural extracts

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Abstract
The current study has proposed the development of nutraceutical herbal tea concentrate fortified with natural extracts from ginger and lemongrass by combining the functionalities of tea with natural herbal extracts. Four different formulations have been developed by using concentrations ranging between 0.05- 0.1% in tea concentrate along with a control sample and evaluated for physicochemical stability, sensory parameters and antioxidant activity. The study revealed that tea concentrate with lemongrass and ginger is better in terms of proximate composition (moisture 94.05%, ash 0.83%, protein 0.75%, fat 0.84%, carbohydrate 3.54%) and antioxidant activity (93.82%). The physicochemical parameters further confirm the stability with slightly acidic pH (5), acidity values as tannic acid equivalent between 1.29% and 1.38%, and TSS between 6.31 and 6.39 °Brix. Moreover, this formulation scored the highest for colour (8.5), flavour (8.0), taste (8.5), and mouthfeel (8.0).

Keywords: Tea, concentrate, lemongrass, ginger, antioxidant

Introduction

Tea, which is mostly made from the leaves of the Camellia sinensis plant, is one of the most popular drinks in the world after water (Das *et al*., 2022) [6]. Its origins can be traced back to ancient China, where it was first used for medicinal purposes before becoming a popular beverage (Wang *et al*., 2022) [10] Through trade routes, tea eventually made its way from Asia to Europe and other regions of the world (Han *et al*., 2022) [10] Tea is known to have immunomodulatory and anti-inflammatory properties since it promotes the growth of human peripheral blood mononuclear cells (Chattopadhyay *et al*., 2012) [5]. A tea is an evergreen shrub belonging to the *Theaceae,* family, and its leaves are processed into different types such as green, black, oolong, and white tea depending on oxidation and processing methods (Banerjee *et al*., 2022) [6]. These variations influence the colour, flavour, and chemical composition of tea. Tea is characterized by its distinct aroma, slightly bitter taste, and stimulating effect due to caffeine and other bioactive compounds. It contains important phytochemicals such as polyphenols, catechins, flavonoids, amino acids, and alkaloids. Among these, catechins like epigallocatechin gallate (EGCG) are key contributors to its biological activities (Brimson *et al*., 2023) [4]. Regular tea consumption has been linked to a lower risk of chronic diseases like diabetes, obesity, and cardiovascular disorders. Tea is well known for its antioxidant, anti-inflammatory, antimicrobial, and cardioprotective qualities. Frequent use has been linked to a lower risk of long-term conditions like diabetes, obesity, and cardiovascular disease (Brimson *et al*., 2023) [4].

The need for ready-to-use tea beverages, including flavoured and iced teas, has increased significantly due to convenience and changing consumer lifestyles. Instant tea products such as premixes and concentrates are also widely used for quick preparation. The present research work is undertaken with the intent to develop a nutraceutical tea concentrate formulation using herbal ingredients such as ginger and lemongrass to fill the existing research gap. A concentrate is a traditional technique that involves boiling plant materials in water for a specific duration, enabling a more efficient extraction of active compounds compared to standard infusion methods. This process facilitates the extraction of phytochemicals, essential oils, and bioactive substances found in herbal ingredients. The present tea concentrate combines the therapeutic qualities of ginger and lemongrass with the health advantages of tea. From a nutraceutical viewpoint, this herbal tea concentrate has the potential to function as a health-promoting beverage that supports overall well-being while relying on natural, plant-derived ingredients.

Methodology

Formulation of tea concentrate by incorporation of lemongrass and ginger extracts

The tea concentrate was prepared using a standardised extraction process. Tea extract was obtained by boiling tea powder in water and then filtered to obtain a clear tea concentrate. All prepared samples were evaluated based on sensory attributes (mouthfeel, colour, flavour and overall acceptability) of the product. The optimised formulation (TLG) was selected based on a uniform flavour profile, stable consistency, good colour retention, and high sensory acceptability. The final formulation was selected after comparative analysis of all trial batches on sensory analysis and physical parameters. Four samples were prepared *with* ginger, lemongrass, and combination along with control

Proximate analysis

The proximate analysis was estimated for four samples, i.e. control (T), tea and ginger extract (TG), tea and lemongrass extract (TL), tea, ginger and lemongrass extract (TLG). These readings were taken in triplicate, and mean values were recorded. The samples were evaluated for moisture content by the hot air oven method at 100°C till dryness (Vera Zambrano *et al*., 2019) [9]. The loss in weight was recorded for the determination of moisture. Determination of ash content was performed by the muffle furnace method. The pre-weighed crucible with concentrate was subjected to heat in the muffle furnace at 550-600°C till ash was formed. The ash residues were cooled, weighed and expressed in

percentage (Liu, 2019) [8]. The protein percentage was estimated by Kjeldahal method. The nitrogen level was calculated and converted into crude protein using a conversion of 6.25 (Kumar & Koirala, 2018) [7]. Quantification of fat content was done by the Soxhlet apparatus extraction method. Carbohydrate content was identified by the difference method (Bhattacharjee *et al*., 2019) [3].

Determination of physicochemical properties

The pH of the tea concentrate was measured by a digital pH meter. The equipment was regulated with a standard of pH (4.01 and 6.86), the readings were performed in triplicate for each sample. All the tea concentrate samples were prepared separately by diluting it with 10ml of water and adding 2-3 drops of phenolphthalein indicator, and then, quantitative estimation of tannin was carried out by titrating the samples against 0.1N NaOH solution. Evaluation of total soluble solids (TSS) content present in tea concentrate was measured by a digital refractometer.

Sensory Analysis

Sensory analysis was performed by 20 semi- trained panellists by maintain room temperature and lighting conditions. The experiment was conducted on a 9-point hedonic scale, in which 1 represents 'dislike extremely' and 9 represents 'like extremely'. The panellists examined the tea concentrate of four samples: the control sample (T), tea extract with ginger (TG), tea extract with lemongrass (TL), tea extract with ginger and lemongrass (TLG) in terms of its colour, flavour, consistency, taste and overall acceptability of the product.

Result & Discussion

Proximate analysis of herbal tea concentrate

The proximate composition of the concentrate samples is presented in Table 1. Tea concentrate sample with lemongrass extract had highest moisture content (94.66%), followed by control (94.28%), sample with ginger (94.25%), and sample with lemongrass and ginger extract (94.05%). The protein content of all samples and (0.75%) were found to be similar (0.73-075%). Low fat content was observed (0.79-0.83%). Carbohydrate content was found to be between 3.40 and 3.54 and ash between 0.73 to 0.83%.

Table 1: Proximate composition of tea concentrate

Parameters	S0	S1	S2	S3
Moisture (%)	94.28	94.25	94.66	94.05
Protein (g)	0.73	0.743	0.756	0.75
Fat (g)	0.80	0.81	0.74	0.84
Ash (g)	0.79	0.80	0.73	0.83
Carbohydrate (g)	3.40	3.41	3.12	3.54

Physicochemical Properties

The TSS value ranged between 6.31 to 6.39 °Brix, which indicated the presence of dissolved solids like sugars, organic acids and polyphenols. Similar findings were observed in studies conducted by Ezez & Tefera (2021) [1]

Among the tested samples, tea concentrate with lemon and ginger, tea concentrate with ginger and control sample had the highest pH (5.00). Tea concentrate with lemongrass extract had pH (4.99), indicating a slightly acidic nature.

The titratable acidity was significantly lower for the control sample (1.29 %). Among tea concentrate samples, tea concentrate with lemongrass extract had the highest acidity (1.38 %), followed by tea concentrate with lemongrass and ginger extract (1.36 %) and tea concentrate with ginger extract TG (1.34 %).

Table 2: Physicochemical properties of tea concentrate samples

Samples	TSS (°Brix)	pH	Titratable acidity (%)
S0	6.38	5.00	1.29
S1	6.34	5.01	1.34
S2	6.33	4.99	1.38
S3	6.32	5.00	1.36

Antioxidant activity

All tested samples (Fig.1) indicated high antioxidant activity (>80%). Among the samples, tea concentrate S2 showed the highest %DPPH scavenging activity (93.82%), followed by S3 (92.59%), S1 (88.65%), and control (87.71%).

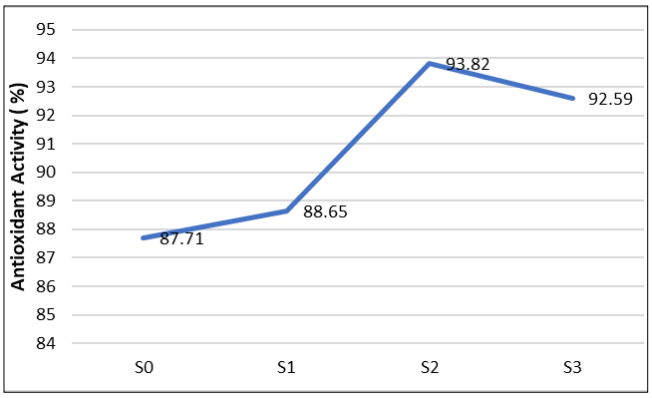

Fig 1: Antioxidant activity of tea concentrate

Sensory analysis

Tea concentrate sample S3 had the highest hedonic ratings with 8.43 color score, 8.6 taste, 8.5 aroma, 8.6 mouthfeel and 8.4 overall acceptability. S2 showed 7.71 color score, 8.3 taste, 8.49 aroma, 8.1 mouthfeel and 7.96 overall acceptability. S1 showed 8.0 color score, 8.1 taste, 7.9 aroma, 7.9 mouthfeel and 8.07 overall acceptability. While control showed 7.43 color score, 7.1 taste, 8.0 aroma, 7.4 mouthfeel and 7.39 overall acceptability.

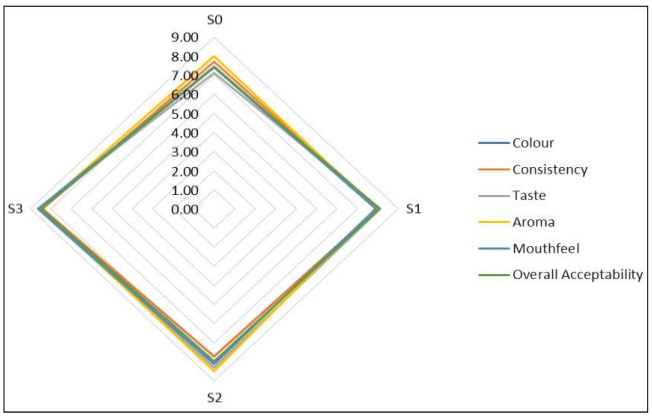

Fig. 2: Sensory profile of tea concentrate samples

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