PHYTONUTRIENT COMPOSITION, ANTIOXIDANT ACTIVITY AND VARIOUS PACKAGING OF DEVELOPED HERBAL TEA

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ABSTRACT

The study was aimed to develop herbal tea incorporating different herbs with best drying methods. Three variations of the tea were developed under two drying methods (shade drying and vacuum drying) and coded as SD_1, SD_2, SD_3, VD_1, VD_2, and VD_3 respectively. The variations were packed to find out the best packaging materials namely aluminium foil, tea bag, and airtight container and subjected to sensory evaluation consumer acceptability using 9 point hedonic scale. After assessing sensory evaluation and consumer acceptability ,VD3 variation was rated the best amongst the six variations. Further,phytonutrient and antioxidant activity (DPPH method) was carried out with aqueous extracts of the formulated herbal tea VD_3 of various packaging and standard tea for a comparison. Phytonutrients such as flavanoids, tannins, glycosides, cardiac glycosides, terpenoids, anthroquinones, and phlobatannins were present in variation VD_3 of all the packages whereas alkaloids, saponins, phlobatanins and anthroquinones are absent in the standard tea.The total flavanoids and total phenolic content of herbal tea VD_3 were 94±10 mg/ml and 96±15 mg/ml respectively. The developed herbal tea with different combination of herbs packed in airtight container VD_3 has high antioxidant activity compared to other packaging. Also in comparison to standard tea, antioxidant inhibition activity of formulated herbal tea VD_3 had a high radical scavenging activity of 99.6±0.1 than standard 89.3±0.2. Thus, it can be conclude that herbs have abundant phytochemical composition and antioxidant potential that could acts as an effective therapeutic agent or medicinal properties such as anti-inflammatory.

KEY WORDS: Herbal Tea, Phytonutrient, Antioxidant activity, Various Packaging

INTRODUCTION

Herbal tea is the form of an infusion of dried plant parts (leaves, flowers, seeds, roots and barks) (Eric *et al*., 2012). Other names for herb tea are 'herbal tea' or 'tisane' (Li Fu *et al*., 2011). Unlike most other forms of tea, herbal tea do not contain caffeine.Herbal teas are mostly popular because of their fragrance, antioxidant properties and therapeutic applications (Sanjuktha *et al*., 2014).

Herbal tea has been used for health care and diseases prevention for thousands of years in many countries (Dian *et al*., 2015). Indigenous herbs and spices have several health benefits as they are high in antioxidant and packed with phytonutrients. Herbal tea health benefits including good heart health, providing antioxidant to the body, boosting energy levels, aiding with stomach and digestive problems, detoxification properties, immune system enhancement, stimulating the internal organs, relieving stress and nourishing the nervous system (Ravikumar, 2014).

Thyme is a delicate herb which is both pungent and hot with penetrating fragnance. It is an excellent source of vitamin C, vitamin A (in the form of provitamin A, carotenoid, phytonutrients) and antioxidant as well as a good source of iron, copper, manganese and fiber. Thyme was determined to be the plant with the highest antioxidant level (Berkan Alpay *et al*., 2013).

Oregano is an important culinary and medicinal herb that has been used in, medicine and cooking for thousands of years. It contains very high concentrations of antioxidants, fiber, iron, manganese, vitamin E and K, calcium, omega fatty acids (Zanda *et al*., 2009).

Green tea contains polyphenols, which include flavanols, flavandiols, flavonoids, and phenolic acids; these compounds may account for up to 30percent of the dry weight. Most of the green tea polyphenols (GTPs) are flavonols, commonly known as catechins. There are four kinds of catechins mainly find in green tea: epicatechin, epigallocatechin, epicatechin-3-gallate, and

EGCG. Epigallocatechingallate is the most significant active component in green tea. The leaf bud and first leaves are richest in EGCG (Bellona *et al*., 2015).

Mint leaves are rich in many antioxidant vitamins, phytonutrients including vitamin A, beta carotene, vitamin C, K and E, folates, riboflavin and pyridoxine and minerals such as potassium, calcium, iron, manganese and magnesium (Straumite *et al*., 2015).

Holy basil (tulsi) is very important herb and has many medicinal applications. lt has antioxidant and antimicrobial activities due to its phenolic and aromatic compounds.the main phenolics reported in basil are phenolic acids and flavonol glycosides (Scagel, 2010). It has a good amount of antioxidants that helps to contend free radicals and also used for good vision, boosting immune system, stamina and maintains sugar level (Lakshmi, 2015).

Dried ginger has many medicinal properties. Studies have shown that, the long term dietary intake of ginger has hypoglycaemic and hypolipidaemic effect. It contains several active phytonutrients. Dried ginger has been used in traditional medicine to give relief from gastro intestinal distress and very powerful anti inflammatory properties which help in decreasing the level of pain of osteoarthritis, rheumatoid arthritis and also treats digestive disorders, prevent the growth and spread of colorectal cancer cells. (Raghavendra *et al*., 2013).

Cardamom is a herb, rich in various vitamins and micronutrients.Cardamom is used for digestion problems including heartburn, intestinal spasm and irritable bowel syndrome. It also helps to prevent colorectal cancer, cardiovascular health, stomach disorders, and inhibits the growth of microbes that cause food poisoning (Shrourou, 2013).

Ajwain seeds is an excellent source for various essential oils including thymol, cymene, pinene, terpinene and lionene. It is also rich in various vitamins, minerals, fibers and antioxidants (Dwivedi *et al*., 2012).

The above herbs and spices have abundant phytochemical composition and antioxidant potential that could acts as an effective therapeutic agent. Also addition of various herbs and spices enhances the taste, flavour and therapeutic properties. Thus, the study on “Phytonutrient Composition, Antioxidant Activity and Various Packaging on Developed Herbal Tea” was undertaken with the above facts in mind.

MATERIAL AND METHODS

Collection of the Ingredients

The herbs and spices ingredients namely, thyme, oregano, *camellia sinensis*, dry ginger, holy basil, mint leaves, cardamom, and ajwain seeds were selected for formulation of herbal tea. Fresh herbs and spices were collected from three different locations namely, Sirumalai hill,Kodaikanal hill and Madurai. Along with that, a tea which is commercially available were purchased from the local super market and considered as standard tea.

Drying Techniques for Preparation of the Herbal Tea

All the herbs and spices were dried using shade drying and vacuum drying methods and then powdered it slightly. Shade drying was carried out at 25 -30˚c for 10 days while vacuum drying was carried out at 60˚c with pressure of 27mm Hg for 5 hours.

Formulation of herbal tea

Herbs dried in two drying methods SD (shade drying) and VD (vacuum drying) were mixed in different proportions and three variations for each drying methods was coded as SD_1, SD_2, SD_3 for shade dried herbs and VD_1, VD_2 and VD_3 for Vacuum drying herbs. Boiling temperature and method of preparation are same for all variations.

The proportion used is presented in Table 1.

Table 1

Quantity of Ingredients used for Preparation of Herbal Tea

Ingredients	Amount of Various Quantities of Ingredients (Variations)		
	SD1 & VD_1	**SD_2 & VD_2**	**SD_3 & VD_3**
Thyme	2.5 g	2 g	1 g
Oregano	2.5 g	2 g	1 g
Camellia Sinensis	2.5 g	2 g	1 g
Mint Leaves	2.5 g	2 g	1 g
Holy Basil	2.5 g	2 g	1 g
Dry Ginger	1.5g	1 g	0.5 g
Cardamom	0.5 g	-	0.5 g
Ajwain	0.5 g	-	0.5 g
Water	200 ml	200 ml	200 ml
TOTAL	**15g**	**11g**	**7g**

Standardization of herbal tea

Standardization of a recipe is a formula specific of a quality of each ingredient required to produce a specific quality and quantity of a particular food (Khan, 1987). A standard tea and all variations of herbal tea were standardized for one serving and repeated. The developed herbal tea was then subjected to sensory evaluation. Five semi-trained experts evaluated the products using a 9 point hedonic scale taking into account of strength, pungency, flavour, colour of the preparation. Consumer acceptability of the products was also carried out. Fifty college going students were selected to assess the overall acceptability of the developed herbal tea. From the results of sensory evaluation and consumer acceptability of the developed herbal tea,amongst the six variations, VD_3 was accepted and taken for further study.

Extraction of herbal tea

A measured of 3.5g quantity of herbal tea powder was added to 100ml boiling water under cover for 10 min (herbal tea). The aqueous extract was obtained by filtering the mixture through filter paper. Then the extraction was used for determining the phytonutrient composition and antioxidant activity. The aqueous extract was kept at room temperature and allowed to cool for few minutes. Finally 1 ml of aqueous extract was further used for analysis of phytonutrient composition and determinaton of antioxidant activity.

Determination of Phytonutrient Composition of Standard and Developed Herbal Tea

The six hours of aqueous extracts of herbal tea and standard tea was subjected to preliminary screening of different phytonutrients such as tannin, flavonoid, saponin, anthroquinone, alkaloid, phlobatanins, terpenoids, cardiac glycosides, steroids, glycosides,cardiac glycosides using the procedures described by the Harbone (1973). Further the phytonutrients tannin (Schanderl, 1970), flavonoid (Bohm and Kocipai Abyazan 1994), saponin (Obdoni and Ochuko, 2001), alkaloid (Harbone, 1973), terpenoids (Ferguson, 1956), steroids (Mann et al., 2010) and total polyphenol and total flavonoids (Malik and Singh, 1980) were carried out.

Antioxidant Activity of the Standard and Developed Herbal Tea

The aqueous extracts of herbal tea and standard were investigated for the antioxidant activity using DPPH (2, 2- diphenyl -1- picrylhydrasyl) (Brand Williams *et al.,* (2001) method. Antioxidant activity of herbal tea was analysed before and after packaging.

Shelf life assessment of herbal tea

The formulated herbal tea packed in teabags,aluminium foil and air tight container was stored for 30 days . The sensory quality, consumer acceptability, phytonutrient and antioxidant activity was tested continuously on 7^{th} day, 15^{th} day, 21^{st} day and

finally 30th day. Variation VD_3 in air tight container packaging was considered the best rather than other packaging methods by the shelflife assessment of formulated herbal tea.

Data analysis

All the analysis were carried out in triplicate, and the results obtained were expressed as means ± standard deviation (n=3).

RESULTS AND DISCUSSION

The result of the sensory scores of standard and developed herbal tea is given in table 2.

Table 2

Mean Sensory Scores of Standard and Developed Herbal Tea

Attributes	SD_1	VD_1	SD_2	VD_2	SD_3	VD_3
Colour	3.346±0.47	3.384±0.48	3.461±0.63	3.461±0.49	3.500±0.69	**4.076±0.67**
Strength	3.307±0.46	3.384±0.48	3.423±0.63	3.461±0.49	3.500±0.69	**4.076±0.67**
Flavour	3.500±0.50	3.750±0.46	3.500±0.50	3.750±0.49	3.750±0.46	**4.500±0.72**
Appearance	3.884±0.31	3.807±0.39	3.846±0.36	3.961±0.91	3.884±0.31	**4.000±0.01**
Taste	3.538±0.49	3.346±0.47	3.384±0.48	3.269±0.44	3.423±0.49	**3.853±0.67**
Overall Acceptability	3.576±0.49	3.538±0.49	3.461±0.49	3.423±0.49	3.461±0.49	**4.084±0.68**

Table 2 shows the overall acceptability of herbal tea. It was noted that overall acceptability of the formulated herbal tea; SD_1, VD_1, SD_2, VD_2, SD_3, and VD_3 had 3.576±0.49, 3.538±0.49, 3.461±0.49, 3.423±0.49, 3.461±0.49 and 4.084±0.68 respectively.

It is evident from the results that VD_3 of the formulated herbal tea had the highest mean score and thus VD_3 variation is most accepted as the standard product. Vacuum drying results in better product quality with respect to characteristics such as flavour, fragrance, and rehydration (Drouzas and Schubert 1996). Vacuum drying also has advantages such as a reduction in processing temperature, improvement in the drying rate, and a reduction in shrivelling (Montgomery *et al*., 1997). The vacuum drying process has been successfully used for the drying of fruit, vegetables, and heat-sensitive products. A high quality product is obtained due to the retention of flavour and nutritive value in the structure of materials.

Consumer Acceptability of Standard and Developed Herbal Tea

The result for the consumer acceptability of developed herbal tea is given in table 3.

Table 3

Consumer Acceptability of Standard and Developed Herbal Tea

Attributes	SD_1	VD_1	SD_2	VD_2	SD_3	VD_3
Colour	3.444±0.43	3.412±0.47	3.325±0.61	3.450±0.46	3.510±0.62	**4.098±0.65**
Strength	3.330±0.41	3.386±0.46	3.456±0.60	3.451±0.43	3.578±0.67	**4.175±0.62**
Flavour	3.610±0.55	3.752±0.45	3.781±0.57	3.680±0.41	3.781±0.43	**4.512±0.79**
Appearance	3.781±0.39	3.812±0.32	3.632±0.35	3.999±0.98	3.898±0.30	**4.002±0.86**
Taste	3.652±0.40	3.435±0.43	3.349±0.43	3.563±0.49	3.406±0.41	**3.976±0.64**
Overall Acceptability	3.459±0.48	3.761±0.40	3.641±0.44	3.906±0.42	3.472±0.48	**4.085±0.51**

Table 3 shows the consumer acceptability of the formulated herbal tea SD_1, SD_2, SD_3 and VD_1, VD_2, VD_3 were 3.459±0.48, 3.761±0.40, 3.641±0.44 and 3.906±0.42, 3.472±0.48 respectively, **4.085±0.51**. Thus the result shows that VD_3 variation of herbal tea had the highest score. Thus,this variation was taken for further study.

Phytonutrient composition of standard and developed herbal tea

Qualitative of the variation VD_3 and the standard are presented below in Table 4.

Table 4

Qualitative Phytonutrient Composition of Standard and Developed Herbal Tea (VD_3)

Phytonutrients	Herbal Tea	
	Standard	VD_3
Flavanoids	+	+
Alkaloids	-	-
Steroids	+	-
Saponins	-	+
Tanins	+	+
Anthroquinones	-	+
Phlobatanins	-	+
Terpenoids	+	+
Glycosides	+	+
Cardiac Glycosides	+	+

(+) presence, (-) absence

It was found that phytonutrients such as flavanoids,alkaloids, steriods, tannins, glycosides, cardiac glycosides, terpenoids, anthroquinones, and phlobatanins are present in variation VD_3. The results of the table 4 reveals that alkaloids and steroids were absent in variation VD_3. Alkaloids, saponins, phlobatanins and anthroquinones are absent in the standard herbal tea.

Phenolic compounds including flavanoids are safe and non toxic antioxidants. High dietary intake of natural phenolics is strongly associated with longer life acceptancy, reduced risk of developing some chronic disease, various types of cancer, diabetes, obesity, improved endothelial function and reduced blood pressure. In the dried samples, due to the low water activity, destructive enzymes were inactivated and high levels of phenolic compounds remained in the extract (Hossain *et al*., 2010).

Maisuthi Sakul *et al.*, (2007) reported that phenolic compounds and its derivatives, such as phenolic acids and tannins, are strongly correlated with antioxidant activity.

Table 5

Quantitative Phytonutrient Composition of Standard and Developed Herbal Tea (VD_3)

Phytonutrient	**Herbal Tea**	
	Standard (mg/ ml)	**VD_3 (mg/ml)**
Total Flavanoid Content (TFC)	86±23	94±10
Total Phenolic Content (TPC)	73±30	96±15

It is clear from the results in Table 5 that total flavanoid content and total phenolic level of standard herbal tea was 86±23 mg/ml and 73±30 mg/ml. Results also reveals that total flavanoid content and total phenolic level of the formulated herbal tea VD_3 was 94±10 mg/ml and 96±15 mg/ml. The results shows that the formulated herbal tea has high total phenolic content and total flavanoid content than standard. Cai *et al*. (2004) studied 112 plant species used in Chinese medicine. They showed that plants with a higher content of total polyphenols had a higher antioxidant activity (expressed as TEAC). (Trolox Equivalent Antioxidant Capacity). (Anna Rusaczonek *et .,al.*2010) determined total polyphenol content in various herbal infusions and simultaneously studied their antioxidant activity. They showed that the highest antioxidant activity of lemon balm was connected with the highest content of total polyphenols (482 mg GAE/L), expressed as gallic acid (GAE).

Antioxidant activity of standard and developed herbal tea

The antiradical activities of the formulated herbal tea were assessed using DPPH (1,2 – diphenyl -2-picrylhydrazyl) radical scavenging assay. The result of the antioxidant activity of the formulated herbal tea extract is presented in Table 6.

Table 6

Antioxidant Activity of Standard and Developed Herbal Tea (VD_3)

Ingredients	**Antioxidant Inhibition activity (%)**
Standard	90.3±0.2
VD_3	99.6±0.1

Table 6 illustrates the antioxidant activity of standard and developed herbal tea, VD3 evaluated by the DPPH, activity of six of aqueous extracts showed antioxidant inhibition activity (%) of standard was 90.3±0.2 and VD_3 was 99.6±0.1.
Epidemiologic studies have shown close links between the consumption of food rich in antioxidants and the incidence of various diseases (Dhalla *et al.*, 2000; Harrison *et al.*, 1999; Pitchumoni & Doraiswamy, 1998). That is why special attention is paid to various raw materials, mainly of plant origin, which are their sources. Out of a number of substances known of their antioxidant activity special attention is paid to polyphenols occurring in various kinds of tea and herbal infusions (Majchrzak *et al.*, 2004).

Research found that herbal tea has highest antioxidant inhibition activity investigated that cold cocktail green tea has maximum percentage inhibition (84.4%±0.42) while minimum percentage inhibition (66.6%±0.3) was shown by hard infusion

method (In Cold cocktail, distilled water and ethanol was used with the ratio of 60 to 40%. Tea bags were infused in alcoholic solution for 15 minutes and then removed, after which the infusion was refrigerated for an hour and in Hard infusion, the tea bag was infused in distilled warm water having the temperature of 75-85 °C for 25 to 30 minutes) (Naila *et al.*, (2016).

Table 7

Sensory Evaluation of Herbal Tea with Aluminium Foil Packaging

Attributes	Sensory evaluation of herbal tea VD3 with Aluminium foil packaging for 7 days interval for one month				
	0th day	7th day	14th day	21st day	30th day
Colour	4.076±0.67	4.051±0.87	4.021±0.74	3.510±0.64	3.383±0.47
Strength	4.076±0.67	4.062±0.58	3.800±0.43	3.553±0.73	3.382±0.45
Flavour	4.500±0.72	4.493±0.68	3.951±0.57	3.823±0.87	3.751±0.44
Appearance	4.000±0	3.993±0.23	3.892±0.85	3.773±0.85	3.254±0.36
Taste	3.853±0.67	3.642±0.47	3.458±0.53	3.451±0.31	3.340±0.48
Overall Acceptability	4.084±0.67	3.625±0.81	3.507±0.43	3.376±0.37	3.107±0.50

Table 7 represents the overall acceptability of the formulated herbal tea with aluminium foil packaging method had gradual reduction from 0th day to 30th day such as 4.084±0.67 to 3.107±0.50 during time interval of 7 days for one month.

Table 8

Sensory Evaluation of Herbal Tea VD3 With Tea Bag Packaging

Attributes	Sensory evaluation of herbal tea VD3 with tea bag packaging for 7 days interval for one month				
	0th day	7th day	14th day	21st day	30th day
Colour	4.076±0.67	4.026±0.72	4.000±0	3.853±0.26	3.356±0.84
Strength	4.076±0.67	4.018±0.83	4.007±0.74	3.942±0.63	3.683±0.58
Flavour	4.500±0.72	4.453±0.72	4.453±0.72	4.206±0.58	3.554±0.65
Appearance	4.000±0	4.000±0	4.000±0	3.958±0.93	3.967±0.51
Taste	3.853±0.67	3.579±0.91	3.579±0.91	3.358±0.75	3.239±0.32
Overall Acceptability	4.084±0.67	3.539±0.73	3.539±0.73	3.239±0.65	3.106±0.47

Table 8 represents the overall acceptability of the formulated herbal tea with tea bag packaging had gradual reduction from 0th day to 30th day such as 4.084±0.67 to 3.107±0.47 during time interval of 7 days for one month.

Table 9

Sensory Evaluation of Herbal Tea VD3 with Packaging by AirTight Container

Attributes	Sensory evaluation of herbal tea VD3 with packaging by air tight container for 7 days interval for one month				
	0th day	7th day	14th day	21st day	30th day
Colour	4.076±0.67	4.059±0.85	4.023±0.67	4.001±0.47	3.986±0.95
Strength	4.076±0.67	4.057±0.38	4.000±0	3.974±0.36	3.835±0.95
Flavour	4.500±0.72	4.485±0.93	4.454±0.72	4.385±0.48	4.356±0.63
Appearance	4.000±0	4.000±0	4.000±0	4.000±0	4.0000±0
Taste	3.853±0.67	3.834±0.55	3.789±0.74	3.667±0.56	3.585±0.37
Overall Acceptability	4.084±0.67	4.065±0.96	4.064±0.64	4.053±0.31	4.021±0.47

The sensory evaluation of the formulated herbal tea with different packaging methods represented in table 9 shows that herbal tea VD3 with packaging by air tight container was highly acceptable with overall acceptability of 4.084±0.67 to 4.021±0.47 from 0th day to 30th day, than herbal tea with aluminium foil packaging and tea bag packaging, during time interval of 7 days for one month.

Table 10

Consumer Acceptability of Herbal Tea with Aluminium Foil Packaging

Attributes	Consumer acceptability of herbal tea VD3 with aluminium foil packaging for 7 days interval for one month				
	0th day	7th day	14th day	21st day	30th day
Colour	4.098±0.65	4.031±0.79	4.000±0	3.832±0.22	3.626±0.82
Strength	4.175±0.62	4.011±0.86	4.021±0.73	3.976±0.69	3.672±0.57
Flavour	4.512±0.79	4.462±0.71	4.476±0.68	4.202±0.57	3.982±0.61
Appearance	4.002±0.86	4.001±0.18	4.009±0.54	3.998±0.92	3.873±0.56
Taste	3.976±0.64	3.765±0.97	3.565±0.91	3.365±0.79	3.276±0.34
Overall Acceptability	4.085±0.51	3.760±0.70	3.521±0.73	3.221±0.61	3.124±0.42

Table 10 represents the overall acceptability of the formulated herbal tea with aluminium foil packaging method had gradual reduction from 0th day to 30th day such as 4.085±0.51 to 3.124±0.42 during time interval of 7 days for one month.

Table 11

Consumer Acceptability of Herbal Tea with Tea Bag Packaging

Attributes	Consumer acceptability of herbal tea VD3 with tea bag packaging for 7 days interval for one month				
	0th day	7th day	14th day	21st day	30th day
Colour	4.098±0.65	4.023±0.71	4.012±0.13	3.853±0.27	3.357±0.84
Strength	4.175±0.62	4.016±0.82	4.006±0.75	3.945±0.60	3.686±0.58
Flavour	4.512±0.79	4.457±0.78	4.458±0.71	4.207±0.52	3.559±0.65
Appearance	4.002±0.86	4.134±0.14	4.000±0	3.955±0.91	3.961±0.51
Taste	3.976±0.64	3.598±0.99	3.592±0.90	3.352±0.76	3.234±0.32
Overall Acceptability	4.085±0.51	3.565±0.73	3.532±0.75	3.239±0.68	3.210±0.45

Table 11 represents the overall acceptability of the formulated herbal tea with tea bag packaging had gradual reduction from 0th day to 30th day such as 4.085±0.51 to 3.210±0.45 during time interval of 7 days for one month.

Table 12

Consumer Acceptability of Herbal Tea VD3 with Packaging by AirTight Container

Attributes	Consumer acceptability of herbal tea VD3 with packaging by air tight container for 7 days interval for one month				
	0th day	7th day	14th day	21st day	30th day
Colour	4.098±0.65	4.023±0.79	4.011±0.36	3.992±0.25	3.988±0.91
Strength	4.175±0.62	4.011±0.82	4.007±0.75	3.941±0.61	3.830±0.93
Flavour	4.512±0.79	4.454±0.73	4.451±0.79	4.393±0.57	4.352±0.61
Appearance	4.002±0.86	4.001±0.67	4.000±0	3.959±0.94	3.956±0.94
Taste	3.976±0.64	3.583±0.96	3.571±0.91	3.359±0.70	3.357±0.31
Overall Acceptability	4.085±0.51	4.031±0.70	4.029±0.75	3.914±0.61	3.906±0.53

The consumer acceptability of the formulated herbal tea with different packaging methods represented in Table 12 shows that herbal tea VD3 with packaging by air tight container was highly acceptable with overall acceptability of 4.085±0.51 to 3.906±0.53 from 0th day to 30th day than herbal tea with aluminium foil packaging and tea bag packaging, during time interval of 7 days for one month.

Table 13

Qualitative Phytonutrient Composition of VD3 with Various Packaging Methods

Phytonutrients	Qualitative Phytonutrient Composition of herbal tea VD3 with 7 days intervals for one month														
	Aluminium foil packaging					Tea bag packaging					Packaging with air tight container				
	0th day	7th day	14th day	21st day	30th day	0th day	7th day	14th day	21st day	30th day	0th day	7th day	14th day	21st day	30th day
Flavanoids	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Alkaloids	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Steroids	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Saponins	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tanins	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Anthroquinones	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Phlobatanins	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Terpenoids	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Glycosides	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cardiac Glycosides	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

(+) presence, (-) absence

The results indicate the qualitative phytonutrient composition of the formulated herbal tea. VD3 with various packaging methods in 7 days of interval for 30 days and results shows that phytonutrients such as flavanoids, tannins, glycosides, cardiac glycosides, terpenoids, anthroquinones, and phlobatannins were present in all types of VD_3 packages whereas alkaloids,steroids and saponins were absent.

Table 14

Quantitative Phytonutrient Composition of Herbal Tea VD3 with Various Packaging Methods

Packaging methods	**Quantitative Phytonutrient Composition of herbal tea VD3 with 7 days intervals for one month**									
	Total Flavanoid Content (TFC) (mg/ml)					**Total Phenolic Content (TPC) (mg/ml)**				
	0^{th} day	**7^{th} day**	**14^{th} day**	**21^{st} day**	**30^{th} day**	**0^{th} day**	**7^{th} day**	**14^{th} day**	**21^{st} day**	**30^{th} day**
Aluminium foil packaging	94 ± 10	93 ± 12	91 ± 8	89 ± 12	89 ± 17	96 ± 15	95 ± 12	93 ± 10	92 ± 12	90 ± 16
Tea bag packaging	94 ± 10	93 ± 15	93 ± 11	92 ± 12	90 ± 12	96 ± 15	94 ± 18	94 ± 10	93 ± 11	93 ± 12

Packaging with air tight container	94 ± 10	94 ± 9	94 ± 11	94 ± 11	93 ± 10	96 ± 15	96 ± 12	96 ± 10	95 ± 8	95 ± 7

Quantitative phytonutrient composition of formulated herbal tea VD3 with aluminium foil packaging, tea bag packaging and packaging by air tight container for 7 days interval for one month has difference from 0th day to 30th day and found total phenolic content varies from 96±15 to 90±16, 96±15 to 93±12 and 96±15 to 95±7.

The Quantitative Phytonutrient Composition of the formulated herbal tea with different packaging methods shows that herbal tea with packaging by air tight container was higher total flavanoid content and total phenolic content than herbal tea with aluminium foil packaging and tea bag packaging, during time interval of 7 days for one month.

Plant based phenols, flavanoids, isoflavones, terpenes, glucosinolate and other compounds that are present in everyday diet are reported to have antioxidant and anticarcinogenic properties and a wide spectrum of tumour blocking activities (Pramila *et al.*, 2012). According to Toda (2011), the total phenolic content of herb tea-water extract of Arabian jasmine and guava, contains 90.2 mg/ml and 76.8 mg/ml.

Table 15

Antioxidant Activity of Herbal Tea VD3 with Various Packaging Methods

Packaging methods	**Antioxidant inhibition activity of herbal tea VD3 with 7 days intervals for one month**				
	0th day	7th day	14th day	21st day	30th day
Aluminium foil packaging	99.6±0.1	99.3±0.2	99.1±0.2	98.6±0.1	98.3±0.3
Tea bag packaging	99.6±0.1	99.6±0.1	99.5±0.1	99.5±0.4	99.5±0.6
Packaging with airtight container	99.6±0.1	99.6±0.3	99.6±0.6	99.6±0.4	99.5±0.5

Table 15 shows the Antioxidant inhibition activity of the formulated herbal tea VD3 with aluminium foil packaging, tea bag packaging and packaging by air tight container for 7 days interval for one month has difference from 0th day to 30th day and found as 99.6±0.1 to 98.3±0.3, 99.6±0.1 to 99.5±0.6 and 99.6±0.1 to 99.5±0.5. The results reveal that the antioxidant property was high in formulated herbal tea VD3 with packaging by air tight container in comparison to aluminium foil packaging and tea bag packaging.

Antioxidant compounds in food play an important role as a healthy protecting factor. Scientific evidence suggests that antioxidants reduce the risk for chronic diseases including cancer and heart disease (Shiv, 2011).

CONCLUSION

It can be concluded that formulated herbal tea has high Phytonutrients composition and Antioxidant activity. The overall acceptability of the formulated herbal tea was high for VD3 compared to other variations. Thus formulated herbal tea has the potential to be used for therapeutic purposes like anti-inflammatory properties and anti-bacterial properties.

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