ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at: www.jgpt.co.in

RESEARCH ARTICLE

Effectiveness of Drying Methods to *Callisia Fragrans* Tea Production

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Abstract

Herbal tea is a polyherbal formulation of different medicinal plants that is a rich source of antioxidant. Tea manufacturing processes can greatly affect the oxidation of tea polyphenols**.** *Callisia fragrans* is an herbaceous plant with small white fragrant flowers and waxy leaves. Its leaves are used for treatment of different skin diseases, burns and join disorders owing to its biologically active flavonoids, neutral glycol and phospholipids and fatty-acid. In order to better utilization of *Callisia fragrans* was functional herbal tea, the effect of different drying methods such as sun drying, microwave drying and oven drying to the total phenolic, total flavonoid and antioxidant capacity was investigated. Results revealed that microwave drying was the best option to stabilize the valuable components in this plant during drying.

Keywords: *Callisia fragrans, Total phenolic, Total flavonoid, Antioxidant, Drying, Herbal.*

Introduction

Herbs are highly valued for its specific flavor, taste, functional physiological effect and phytochemical properties which appeal to sense of taste, smell, and appearance. Herbal products often consumed in the form of tea, where boiling water are added to steep infusion of dried plant parts [1]. Tea consumption depends primarily on the type and mode of preparations [2]. Sterilisation, pasteurisation, dehydration and prolonged storage are roots of antioxidant decomposition [3]. Storage environment is vital to preserve antioxidant capacity of herbal tea [4].

Callisia fragrans is a perennial, succulent plant of the Commelinaceae family [5].It is quite a big plant with two type's sprouts: vertical and horizontal, which are made up of joints. It mostly propagates with cuttings. The flowers are small, gathered in the glow inflorescences with hyacinth odor. Due to biologically active substances it also has antioxidant, anti-hypoxic, antimutagenic and other healing properties.

It is widely used in folk medicine for treating a number of diseases such as cancer, joints and spinal diseases (rheumatism, arthritis, arthrosis, radiculitis, osteochondrosis), liver and pancreas, gastrointestinal tract, skin diseases, bronchial asthma [5].

C. fragrans leaves contain biologically active flavonoids, neutral glycol-and phospholipids and their fatty-acid compositions [6]. The *C. fragrans* ethanol extract effectively inhibited the infection of Vero cells by HSV-1, HSV-2 *in vitro*, while its aquatic extract inhibited only VZV [7].The changes in appearance and aroma are caused by losses in volatiles or the formation of new volatiles as a result of oxidation or esterification reactions [8].

The drying of herbs is often accompanied with the loss of bioactive compounds, which may possess antioxidant activity and other health-promoting properties [9]. Several researches mentioned to the effectiveness of drying methods to the phytochemical elements in herbal tea. Chan et al [10].

Studied the effects of five different drying methods (microwave, oven, and sun drying) on antioxidant properties of *Alpinia zerumbet*, *Etlinger aelatior*, *Curcuma longa* and *Kaempferia galangal* .The changes in total phenolics, hydroxycinammic acid derivatives, and antioxidant properties of spearmint after five drying treatments (convection oven drying, freeze-drying,

microwave drying, and air drying with the sun exposure and without the sun exposure) were investigated [8].

A study was conducted to determine the effect of air (AD), oven (OD) and freeze drying (FD) on the free radical scavenging activity and total phenolic content (TPC) of *Cosmos caudatus* [11]. A study was to evaluate the effects of different drying methods (hot-air drying, microwave drying and freeze-drying) on the color, phytochemicals content and antioxidant capacity of purslane leaves [12]. Effect of drying methods on the chemical composition and colour of peppermint (*Mentha* × *piperita* L.) leaves was done [13].

The effect of seven drying treatments (sun, shade, oven 60 °C, oven 80 °C, oven 100 °C, microwave and freeze-drying) were evaluated with respect total flavonoid (TFC), phenolic (TPC), antioxidant activity, vitamin C and color characteristics of green tea [14]. *Callisia fragrans* is an excellent source of phytochemical components with potential antioxidative effects. The present study focused on the effect of different drying methods such as sun drying, microwave drying and oven drying to the total phenolic, total flavonoid and antioxidant capacity of dried herbal tea from *Callisia fragrans*.

Materials and Method

Material

Callisia fragrans leaves were naturally collected from Soc Trang province, Vietnam. Only young, mature and good shape leaves were used for the processing of tea. They were then washed under tap water for cleaning. These samples were then dripped before experiments. The tea preparation consisted of three parts: blanching, drying and storage.

Drying treatments were performed triplicate. All tea leaves used for drying were from the same batch. Lab utensils were used including oven dryer, microwave dryer, UV-Vis spectrophotometer, centrifugator, incubator shaker, digital balance, glassware. Chemical substances were also used such as gallic acid; Folin-Ciocalteu's reagent; sodium carbonate; 1, 1-diphenyl-2-picrylhydrazyl; $NaNO_2$-Al $(NO_3)_3$, $NaNO_2$, $AlCl_3$.

Figure 1: ***Callisia fragrans***

Researching Procedure

Effect of Sun Drying to Total Phenolic Content (TPC, mg/g), Total Flavonoid Content (TF, mg/g) and the Antioxidant Properties (DPPH, mg/mL) of Dried Tea

Fresh *Callisia fragrans* leaves were subjected to sun drying at average temperature 35°C on 4 consecutive days. Taking 5g of dried herb to analyze the total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL).Based on the analyzing results, the optimal drying variable could be identified.

Effect of Microwave Drying to Total Phenolic Content (tpc, mg/g), Total Flavonoid Content (tf, mg/g) and the Antioxidant Properties (DPPH, mg/mL) of Dried Tea

Fresh *Callisia fragrans* leaves were subjected to microwave drying at different power and time settings (180 w in 8 minutes; 360 w in 6 minutes; 600 w in 4 minutes, and 800 w in 2 minutes). Taking 5g of dried herb to analyze the total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL).Based

on the analyzing results, the optimal drying variable could be identified.

Effect of Oven Drying to Total Phenolic Content (TPC, mg/g), Total Flavonoid Content (TF, mg/g) and the Antioxidant Properties (DPPH, mg/mL) of Dried Tea

Fresh *Callisia fragrans* was subjected by oven drying at different temperature and time settings (45°C in 18 hours; 50°C in 16 hours; 55oC in 14 hours, and 60°C in 12 hours).

Taking 5g of dried herb to analyze the total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL).Based on the analyzing results, the optimal drying variable could be identified.

Physico-chemical and Biological Analysis

The total phenolic content (TPC, mg/g) was determined using the Folin-Ciocalteu assay [15]. Total flavonoid content (TF, mg/g) was determined according to the $NaNO_2$-Al $(NO_3)_3$ method [16]. Radical-scavenging capacity (DPPH, mg/mL) was determined according to the method described by Chan et al [10].

Statistical Analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT). Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Effect of Sun Drying to Total Phenolic Content (TPC, mg/g), Total Flavonoid Content (TF, mg/g) and the Antioxidant Properties (DPPH, mg/mL) of Dried Tea

To produce green tea, freshly harvested leaves are immediately blanched to destroy the enzymes responsible for breaking down the color pigments in the leaves and to allow the tea to maintain its green color during drying. These processes preserve natural polyphenols with respect to their health-promoting properties [17, 19].

Natural drying (sun drying) is still the most widely used method because of its lower cost. Fresh *Callisia fragrans* leaves were subjected to sun drying at average temperature 35°C on 4 consecutive days. Taking 5g of dried herb to analyze the total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL).Results revealed in Table 1.

Table 1: Effect of sun drying to total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL) of dried tea

Sun drying (days)	TPC (mg/g)	TF (mg/g)	DPPH (mg/mL)
1	67.42±0.17^{a}	44.53±0.05^{a}	484.23±1.19^{a}
2	64.59±0.06^{ab}	42.64±0.03^{ab}	469.85±0.86^{ab}
3	62.31±0.07^{ab}	41.17±0.04^{ab}	453.77±0.74^{ab}
4	59.87±0.12^{b}	40.06±0.08^{b}	446.35±0.92^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Composition of the phenolic compounds from C. fragrans juice was investigated. The $CHCl_3$ extract gave aloe-emodin, umbelliferone, and scopoletin; ethylacetate, quercetin, gallic, caffeic, and chicoric acids [20]. The contents of ascorbic acid and organic acids and chlorophyll and carotinoid pigments in various plant organs were established [6]. The effect of seven drying treatments (sun, shade, oven 60 °C, oven 80 °C, oven 100 °C, microwave and freeze-drying) were evaluated with respect total flavonoid (TFC), phenolic (TPC), antioxidant activity, vitamin C and color characteristics of green tea. The highest TPC (209.17 mg Gallic acid/gdw) and TFC (38.18 mg Quercitin/gdw) were obtained in oven drying at 60 and 100 °C, respectively. Among methods, oven drying at 60 °C revealed the highest radical scavenging activity (IC_{50} = 167.166 µg/ml), while microwave showed the lowest one (IC_{50} = 505.5 µg/ml) [14].

Effect of Microwave Drying to Total Phenolic Content (TPC, mg/g), Total Flavonoid Content (TF, mg/g) and the Antioxidant Properties (DPPH, mg/mL) of Dried Tea

In comparison to hot air drying, microwave drying techniques can greatly reduce the drying time of biological materials without

quality degradation [14]. Microwave drying has gained popularity as an alternative drying method for a variety of food products such as fruits, vegetables, snack foods and dairy products [21]. Fresh *Callisia fragrans* leaves were subjected to microwave drying at different power and time settings (180 w in 8 minutes; 360 w in 6 minutes; 600 w in 4 minutes, and 800 w in 2 minutes).Taking 5g of dried herb to analyze the total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL). Results were noted in Table 2.

Table 2: Effect of microwave drying to total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL) of dried tea

Microwave drying	TPC (mg/g)	TF (mg/g)	DPPH (mg/mL)
180 w, 8 minutes	74.94±0.24^{c}	49.82±0.12^{c}	576.53±1.04^{c}
360w, 6 minutes	76.13±0.19^{b}	52.18±0.08^{b}	594.38±2.19b
600w, 4 minutes	79.84±0.37^{a}	56.85±0.04^{a}	633.71±4.52^{a}
800w, 2 minutes	75.61±0.09^{bc}	51.47±0.06^{bc}	586.47±2.48^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Rabeta, M. S. and Vithyia M [1].Examined the effects of different thermal drying methods (sun drying, microwave drying and hot air oven drying) on the total phenolic content (TPC), total anthocyanin content and the antioxidant properties of *Vitex negundo* (VN) tea. Microwave drying has been found to be a good method for maintain the TPC, anthocyanin content and AEAC in dried sample of VN tea.

Effect of Oven Drying to Total Phenolic Content (TPC, mg/g), Total Flavonoid Content (TF, mg/g) and the Antioxidant Properties (DPPH, mg/mL) of Dried Tea

Conventional air drying is one of the most frequently used operations for food dehydration. Total products show low porosity and high apparent density. Significant color changes occur during air drying and the final product has low sorption capacity [21]. Oven drying presents some benefits such as low energy efficiency and lengthy drying time during the last stage of drying. The antioxidants in herbs have been confirmed to combat cancer, diabetes and cardiovascular diseases [10]. The tea flavonoids have also been found to prevent lipid peroxidation, a major problem in food industry, which can cause unfavorable rancidity and potentially toxic reaction in products [22]. The antioxidant contents of fresh plant materials were higher than those of dried plant materials due to their degradation during drying, while some recent studies have shown that dried plant materials contain higher antioxidants such as polyphenolics, and antioxidant activity as compared to fresh plant materials [23].

Fresh *Callisia fragrans* was subjected by oven drying at different temperature and time settings (45^{o}C in 18 hours; 50^{o}C in 16 hours; 55oC in 14 hours, and 60^{o}C in 12 hours).Taking 5g of dried herb to analyze the total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL). Results were noted in Table 3.

Table 3: Effect of oven drying to total phenolic content (TPC, mg/g), total flavonoid content (TF, mg/g) and the antioxidant properties (DPPH, mg/mL) of dried tea

Oven drying	TPC (mg/g)	TF (mg/g)	DPPH (mg/mL)
45^{o}C, 18 hours	69.54±0.11^{c}	45.76±0.03^{c}	489.75±1.3^{c}
50^{o}C, 16 hours	71.29±0.12^{b}	47.93±0.04^{b}	514.40±2.16^{b}
55^{o}C, 14 hours	74.35±0.03^{a}	48.62±0.05^{a}	528.17±3.04^{a}
60^{o}C, 12 hours	70.18±0.08^{bc}	46.25±0.07^{bc}	497.55±1.08^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Previous researches showed that the radical scavenging activity was elevated at higher drying temperatures using oven drying treatments [24, 25]. It is believed that the high total phenolic content might contribute to the high antioxidant activity by high temperature drying [26]. Drying process can break down the cellular constituents leading to accelerate in releasing phenolic compounds from the food matrix [27].

Conclusion

Drying is considered as a critical factor for the postharvest management and the merchantability of herbs. The drying of herbs inhibits microbial growth and forestalls biochemical changes but, at the same time, it can give rise to other changes that affect the herb quality. *Callisia fragrans* is an excellent source of phytochemicals with potential antioxidative effects. Drying is a very useful technique to extend the shelf-life of *Callisia fragrans* and to produce dried *Callisia fragrans* with a high phenolic content and a potent antioxidant activity. Significant effects of drying methods on phenolic composition and antioxidant properties of the dried material were found. Among the drying methods tested, the microwave drying was demonstrated the ideal one for treatment of *Callisia fragrans.*

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