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Blanching and drying effects on dried herbal tea production from Peppermint (*Mentha piperita* L.)

Minh Phuoc Nguyen

Faculty of Biotechnology, Ho Chi Minh City Open University, Ho Chi Minh City, **Vietnam**

***Correspondence:** minh.np@ou.edu.vn **Received 23-03-2020, Revised: 17-05-2020, Accepted: 20-05-2020 e-Published: 08-06-2020**

Peppermint (*Menthapiperita* L.) plant has great beneficial and economical role for human in different therapeutic applications. It is most frequently utilized as essential oil. Purpose of this research penetrated on the effectiveness of blanching temperature and duration; drying temperature and storage condition to shelf-life of the dried *Menthapiperita L.* herbal tea. Results showed that *Menthapiperita L.* should be blanched in hot water 95^{o}C at 4 seconds in the present of citric acid 0.5% and then being dried by heat pump dryer at 40^{o}C until 12% moisture content. The final herbal tea should be preserved in PA bag at ambient temperature to maintain total phenolic, flavonoid and DPPH radical scavenging assay for 12 months. Drying converted peppermint into light weight, easily transportable and storable product.

Keywords: *Menthapiperita* L., herbal tea, blanching, drying, total phenolic, flavonoid, DPPH, shelf-life

INTRODUCTION

Peppermint (*Menthapiperita* L.) is a perennial aromatic herb belonging to the Lamiaceae family. The leaves and stems are usually slightly fuzzy (Azhari et al., 2018). It's a fast-growing plant; once it sprouts, and it spreads very quickly (Zaidy and Dahiya, 2015). It's between medicinal and aromatic plants (Mekonnen, 2011). It's a medicinal plant that has received more attention from both food and pharmaceutical industries because of its health benefits for human (Loolaie et al., 2017). It was cultivated all over the world for its use in flavor, fragrance, medicinal, and pharmaceutical applications (Iscan et al., 2002; Dorman et al., 2003). It's widely utilized as traditional medicine for treatment of digestive disorders and nervous system (Keifer et al., 2008; Saeidnia et al., 2005). It's known for refreshing, antiseptic, anti-asthmatic, simulative, diaphoretic, stomachic, and antispasmodic features (Dattatreya et al., 2011). It can be used to add a minty flavor to drinks, add mint flavor to food such as chocolates and icing and used in a number of natural applications from deterring ants to clearing up chest congestion (Azhari et al., 2018). It is cultivated mainly for its essential oil through distillation (Cosentino et al., 2009; Riachi, De, 2015). Oil was extracted from flowers, leaves, stems, roots, seeds, barks, resins, or fruit rinds (Yen et al., 2008). The most abundant chemical compounds that isolated form peppermint are largely classified into monoterpenes (Gershenzon et al., 2000). It is an excellent source of antioxidants, fibers, minerals (Azhari et al., 2018).

Peppermint (*Menthapiperita* L.) is propagated using the underground stolons produced by existing plants. Stolons can't be stored for more than a few days since they deteriorate rapidly due to dehydration (Douhan et al., 2001). Drying is one of the most methods to maintain quality of aromatic and medicinal plants. It consists of water removal from the raw material up to a level at which microbial spoilage and deterioration reactions are highly minimized (Rocha et al.,

2011). Experimental determination of the sorption isotherms of peppermint was mentioned (Kouhila et al., 2001). One study estimated the effects of different drying methods on appropriate drying time, essential oil yield, total phenol content and antioxidant capacity of peppermint (Hossein et al., 2014). Peppermint leaves were dried using active ventilation, convection, infrared, vacuum, microwave, and sublimation methods (Marina et al., 2015). Peppermint leaves were dehydrated by hot air, shade as well as microwave drying (Sathiya et al., 2015). The drying method affected strongly the essential oil composition of dry peppermint (Tuncay et al., 2017). Thin layer drying experiments of the leaves were performed in shade, hot air dryer and microwave oven (Mohsen et al., 2018). One study was to develop the herbal blended beverage from mint and basil leaves (Sorraya et al., 2018). The objective of our research was to verify the effectiveness of blanching and drying to herb tea production from *Menthapiperita*L.

MATERIALS AND METHODS

Material

We collected *Menthapiperita L.* from HauGiang province, Vietnam. After collecting, they were stored at a temperature of 20˚C and conveyed to laboratory as soon as possible for experiments. They were washed thoroughly under tap water to remove foreign matters. Apart from *Menthapiperita L.* leaves we also used other materials such as citric acid, FolinCiocalteu reagent, aluminum chloride. Lab utensils and equipment included digital weight balance, cooker, hot air dryer.

Researching method

Effectiveness of blanching temperature and duration to the total phenolic (mg/kg), flavonoid (mg/kgg) and DPPH (mg/ml) in the dried herbal tea from Mentha piperita L.

Raw *Menthapiperita L.* leaves were blanched in hot water with 1.5% citric acid at different temperature and time (100^{o}C, 5 second; 95^{o}C, 10 seconds; 90^{o}C, 15 seconds; 85^{o}C, 20 seconds). Then they were dried by hot air dryer at 60^{o}C until 9.5% moisture. All samples were analyzed the total phenolic (mg/kg), flavonoid (mg/kg) and DPPH (mg/ml)to verify the optimal blanching condition.

Effectiveness of drying temperature to the total phenolic (mg/kg), flavonoid (mg/kg) and DPPH (mg/ml) in the dried herbal tea from Mentha piperita L.

Raw *Menthapiperita L.* leaves were blanched in water solution with 1.5% citric acid at 95^{o}C in 10 seconds. Then these samples would be dried under hot air dryer at different temperature (40^{o}C, 45^{o}C, 50^{o}C, 55^{o}C, 60^{o}C) until 9.5% moisture. All samples were analyzed the total phenolic (mg/g), flavonoid (mg/kg) and DPPH (mg/ml)to verify the optimal drying temperature.

Stability of dried Mentha piperita L. herbal tea under preservation

At the end of drying treatment, the dried *Menthapiperita L.* herbal tea was subjected to preservation. They were stored in PA (vaccum) bag at ambient temperature. The total phenolic (mg/kg), flavonoid (mg/kg) and DPPH (mg/ml)will be analyzed in 3 month-interval for 12 months.

Chemical evaluation and statistical analysis

Total polyphenol content (mg/kg) was determined by FolinCiocalteu reagent method (Hossain et al., 2013). Aluminum chloride colorimetric method was used for flavonoids (mg/100 g) determination (Eswari et al., 2013; Mandal et al., 2013). DPPH (IC_{50}, mg/ml) radical scavenging assay of peppermint oil was conducted using a method described by Bradly (1992). The Methods were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

RESULTSAND DISCUSSION

Effectiveness of blanching temperature and duration to the total phenolic, flavonoid and DPPH in the dried herbal tea from *Mentha piperita L.*

Phenolic compounds are responsible for the antioxidant activity of plant materials and they are highly effective radical scavengers (Pan et al., 2008). The phenol moiety helps them to work as reducing agents, hydrogen donors, and singlet oxygen quenchers (Chua et al., 2008). DPPH assay is based on the reduction of DPPH radical in the presence of a hydrogen donating antioxidant, and it has been extensively used for screening antioxidant activity of natural compounds (Chua et al., 2008). Blanching inactivated the enzyme actions which can cause loss of flavor, color and texture. It also removed dirt on the surface, organisms, brightened the

color, helped retard loss of vitamins. The blanching treatment interacted to the proteins in cell walls and made the porosity of membranes. The higher porosity increased permeability of cell walls and improved solvent diffusivity, resulting in an increase of yield extractability (Stamatopoulos et al., 2016; Deylami et al., 2016).

In our research, raw *Menthapiperita L.* leaves were blanched in water solution with 1.5% citric acid at different temperature and time (100^{o}C, 5 second; 95^{o}C, 10 seconds; 90^{o}C, 15 seconds; 85^{o}C, 20 seconds). Then they were dried by hot air dryer at 60^{o}C until 9.5% moisture. Results were mentioned in table 1. From table 1, the *Menthapiperita L.* leaves should be blanched at 95^{o}C in 10 seconds to preserve the most total phenolic (mg/kg), flavonoid (mg/kg) and DPPH (mg/ml)in the dried *Menthapiperita L.* herbal tea. Zaidy and Dahiya, (2015) indicated that TPC of other kind of *Menthapiperita* had the highest contents of total phenolic (12.63± 0.878). Retention of chlorophyll could be improved by blanching as reported in rosemary and marjoram (Meenakshi et al., 1996). Blanching prior to drying improved nutrient retention and sensory attributes of mint leaves (Khule et al., 2019).

Effectiveness of drying temperature to the total phenolic, flavonoid and DPPH in the dried herbal tea from *Mentha piperita L.*

Drying method had a significant effect on oil content and composition of aromatic plants (Stanisavljevic et al., 2012). Tea processing by using specific drying temperature greatly affects the chemical components contained in tea products produced (Sahadi et al., 2017). Drying process should be undertaken in closed equipment to improve the quality of the product (Ertekin and Yaldiz, 2004). Industrial dryers are rapid and provide uniform and hygienic dried product (Doymaz and Pala, 2002). In tea processing, drying temperature ranges between 50^{o}C-85^{o}C with 80-90 minutes drying time. Drying temperature could effect on the chemical components of tea are produced. Higher drying temperature chemical constituents contained in the tea leaves will diminish and disappear as the content of antioxidants and others. The active component in tea that has the most effective antioxidant capabilities are polyphenols. However, the polyphenol components are easily damaged by heat. Therefore, in the process of drying the tea leaves should be noted that the drying temperature is used, it aims to maintain the active components contained in tea leaves is maintained (Minh et al., 2019). Antioxidant properties are easily damaged by light and high temperature. The higher the temperature and duration of drying the antioxidant activity produced higher until a certain time limit, then decreased (Tan and Thuy, 2017).

In our research, raw *Menthapiperita L.* leaves were blanched in hot water with 1.5% citric acid at 95^{o}C in 10 seconds. Then these samples would be dried under hot air dryer at different temperature (40^{o}C, 45^{o}C, 50^{o}C, 55^{o}C, 60^{o}C) until 9.5% moisture. Results were mentioned in table 2. From table 2, the *Menthapiperita L.* leaves should be dried at 50^{o}C to maintain the most total phenolic (mg/kg), flavonoid (mg/kg) and DPPH (mg/ml)in the dried *Menthapiperita L.* herbal tea. According to Azhari et al., (2018), the total phenolic of fresh and dry samples were 14.00±0.12 and 8.80±0.09 mg /kg, respectively. Total flavonoid of the mint essential oil were 8.1±0.09 and 5.0±0.07mg/kg, for fresh and dry sample, respectively. DPPH inhibition percentages were recorded and inhibition concentrations at 50% activity (IC50) were 0.651±0.09, 0.683±0.6 mg/ml for wet, dry samples respectively. In another report, peppermin was convectively dried by thin layer under different drying behaviours at 45, 50, 55, 60 and 65°C. It took 240 min at 65°C whereas it took 390 min at 45°C (Dattatreya et al., 2011). Temperatures below 50°C were the best to retain volatile compounds (Rocha et al., 2011). In hot air drying the loss of phenolic compounds and antioxidant activity reached up to 60% compared to freeze drying (Marina et al., 2015). In another report, pepperming leaves were dried by hot air dryer at temperatures of 50°C, 60°C, and 70°C. Major compound of the oil, were found in hot air-dried leaves at temperature of 50°C (Mohsen et al., 2018). Higher drying temperature (60^{o}C or 80^{o}C) sharply decreased the essential oil yield of dried peppermint leaves (Blanco et al., 2000). Tray drying method was used for drying mint leaves at two different temperatures 50^{o}C and 55^{o}C. Drying mint leaves at 55^{o}C was better than drying at 50^{o}C (Sorraya et al., 2018).

Stability of dried *Mentha piperita L.* herbal tea under storage

At the end of drying treatment, the dried *Menthapiperita L.* herbal tea was subjected to preservation. They were stored in PA (vaccum) bag at ambient temperature. From table 3, we could see that dried *Menthapiperita L.* herbal tea was stable for 12 months under ambient

temperature. A previous study by Hussain et al., (2011) indicated that the radical scavenging activity of the essential oil from *Menthapiperita* was the highest (81.09±1.21%) at concentration of 150µg/mL. According to Padmini et al., (2010), the mint and its tea extract are rich in the essential minerals. In one report, dehydrated mint sample were packed in different packaging material such as LDPE, HDPE and Aluminum foil. Aluminum foil packaging material is the best packaging material for long time preservation (Khule et al., 2019).

Table 1: Effectiveness of blanching temperature and duration to the total phenolic (mg/kg), flavonoid (mg/kg) and DPPH (mg/ml)in the dried *Menthapiperita L.* herbal tea

Blanching	Total phenolic (mg/kg)	Flavonoid (mg/kg)	DPPH (mg/ml)
100°C, 5 seconds	7.94±0.03^{ab}	3.45±0.01^{ab}	0.91±0.01^{bc}
95°C, 10 seconds	8.05±0.02^{a}	3.78±0.02^{a}	0.87±0.00^{c}
90°C, 15 seconds	7.83±0.01^{b}	3.19±0.03^{b}	0.98±0.03^{b}
85°C, 20 seconds	7.11±0.00^{c}	2.64±0.02^{c}	1.25±0.00^{a}

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%).

Table 2: Effectiveness of drying temperature to the total phenolic (mg/kg), flavonoid (mg/kg) and DPPH (mg/ml)in the dried *Menthapiperita L.* herbal tea

Drying temperature (°C)	Total phenolic (mg/kg)	Flavonoid (mg/kg)	DPPH (mg/ml)
40	8.73±0.02^{b}	4.06±0.01^{b}	0.74±0.03^{b}
45	8.96±0.01^{ab}	4.25±0.00^{ab}	0.69±0.02^{bc}
50	9.05±0.03^{a}	4.69±0.02^{a}	0.63±0.01^{c}
55	8.24±0.00^{bc}	3.97±0.01^{bc}	0.81±0.03^{ab}
60	8.05±0.02^{c}	3.78±0.02^{c}	0.87±0.00^{a}

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%).

Table 3: Stability of dried *Menthapiperita L.* herbal tea under preservation

Storage (months)	Total phenolic (mg/kg)	Flavonoid (mg/kg)	DPPH (mg/ml)
0	9.05±0.03^{a}	4.69±0.02^{a}	0.63±0.01^{c}
3	9.01±0.01^{ab}	4.60±0.01^{ab}	0.68±0.02^{bc}
6	8.97±0.02^{b}	4.51±0.03^{b}	0.72±0.00^{b}
9	8.94±0.03^{bc}	4.46±0.00^{bc}	0.75±0.01^{ab}
12	8.88±0.00^{c}	4.42±0.01^{c}	0.79±0.03^{a}

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%).

CONCLUSION

Peppermint (*Menthapiperita* L.) is considered as a valuable target for both food and pharmaceutical applications as it contains various active constituents with numerous biological activities. In the dried *Menthapiperita L.* leaf production, the blanching and drying has been clearly affected to product quality. Fresh leaves of *Menthapiperita L.* can be blanched, dried to safe moisture level, and preserved within 12 months as dried herbal healthy tea. Peppermint essential oil can be used as a potential source of natural antimicrobial compound to promote healthy diet.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Minh Phuoc Nguyen arranged the experiments and also wrote the manuscript.

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