ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at: www.jgpt.co.in

RESEARCH ARTICLE

Investigation of Steam Blanching and Infrared Drying in Processing of *Chrysanthemum indicum* L. Flower Herbal Tea

Nguyen Phuoc Minh

Faculty of Natural Sciences, Thu Dau Mot University, Binh Duong Province, Vietnam.

Abstract

In Vietnam, *Chrysanthemum indicum* has been used as an herb. Its flower has a strong aroma. *Chrysanthemum indicum* L. flower has a bright yellow color and various functional active compounds. However it's easily perishable in blooming season, it's necessary to to dry fresh *Chrysanthemum indicum* L. flower to extend its shelf-life for long-term use. Objective of this study penetrated on the effectiveness of various processing variables such as blanching by steaming; infrared drying power, temperature and time on total phenolic, flavonoid, carotenoid and sensory score of dried herbal tea from *Chrysanthemum indicum* flowers by the infrared irradiation. Our results showed that these flowers should be blanched by steaming within 60s and then being dried at power 200 W, temperature 60°C with air velocity 1.5 m/s in the infrared dryer. From this approach, major phytochemical components such as total phenolic, flavonoid, carotenoid in the dried *Chrysanthemum indicum* flower could be maintained. Owing to the benefits of the infrared irradiation, it would be an innovative solution for blanching and drying to preserve utmost valuable elements inside as well as good appearance outside of dried *Chrysanthemum indicum* L. flower.

Keywords: *Chrysanthemum indicum, Steaming, Drying, Infrared irradiation, Phenolic, flavonoid, Carotenoid.*

Introduction

Chrysanthemum is a short day plant because of its habit of flowering only under short day conditions [1]. The yield of *Chrysanthemum indicum* L. flower oil was 2.0% (w/w) and the color was light golden yellow [2]. *Chrysanthemum indicum* flower has strong aroma by its essential oil [3]. Soluble solids concentration of *Chrysanthemum indicum* flower was 39.41±0.99 mg/g, which was 30% higher than that of black [4].*Chrysanthemum indicum* flower is a good source of natural quercitrin and myricetin [3].

Chrysanthemum indicum L. flowers may be a potentially effective therapeutic agent for hypertension, obesity, anti-oxidant, anti-nociceptive, anti-bacterial, anti-viral, anti-inflammatory, osteoporosis, stomatitis and fever [5, 12].During drying, the moisture content is reduced to a certain level where microbiological growth will not occur while maintaining high nutrient value. Medicinal and aromatic plants are mainly preserved by air drying. Dried products can be stored for a long time and can be easily blended, powdered or packed for direct use or for further processing in the food or pharmaceutical industry [13]. Infrared drying shows many benefits compared to conventional drying. Infrared heating is faster than convection [14]. Infrared energy is moved from the heating element to the sample, heating the material more rapidly and uniformly. Much more vapor emits from the irradiated surface and drying duration is shortened [15].

The flower drying technique involves reducing moisture content of flowers to a point at which bio- chemical changes are minimized while maintaining cell structure, pigment level and flower shape [16].There were several studies mentioned to drying of *Chrysanthemum* species. An investigation was conducted for evaluation of different methods for drying of chrysanthemum (Dendranthema grandiflorum Tzevlev) flowers.

Solar drier was rated to be better as compared to other methods of drying [17]. Drying with silica gel embedding also

obtained maximum point scale on visual basis of colour, texture and appearance in dried flowers of annual chrysanthemum [18]. Sun drying is a method suitable for *Chrysanthemum*[19].The purple chrysanthemum tea contained anthocyanins and linarin, while the yellow chrysanthemum tea had higher luteolin-7-*O*-ß-glucoside, 3,5-dicaffeoylquinic acid, apigenin-7-*O*-ß-glucoside, and apigenin contents in comparison with the purple chrysanthemum tea [20].

However there was not any research mentioned to the drying of *Chrysanthemum indicum* flowers into dried herbal tea. Therefore, objective of this our study penetrated on the effectiveness of processing variables such as blanching by steaming; infrared drying power, temperature and time on total phenolic, flavonoid, carotenoid and sensory score of dried herbal tea from *Chrysanthemum indicum* flowers by the infrared irradiation

Materials and Method

Material

Chrysanthemum indicum flowers were collected from Soc Trang province, Vietnam. After collecting, they must be kept in cool and dry cotton box, conveyed to laboratory for experiments. They were subjected to the steaming and infrared drying under different conditions.

Researching Procedure

Effect of Steaming Time in Blanching to the Total Phenolic, Flavonoid, Carotenoid and Sensory Score of Chrysanthemum Indicum Flower

Raw *Chrysanthemum indicum* flowers were blanched by vapor in different duration (30s, 45s, 60s, 75s, 90s). After being blanching, these steamed flowers would be analyzed the total phenolic (mg GAE/100 g), flavonoid (mg QE/100 g), carotenoid (µg/g) and sensory score.

Effect of Infrared drying Power (W) to the Quality of Dried Chrysanthemum Indicum Flower

By selecting the optimal steaming time, these blanched flowers would be dried by infrared dryer under different power (100, 150, 200, 250, 300 W) at temperature 45°C with air velocity 0.5 m/s. After this experiment, the dried flowers would be analyzed the total phenolic (mg GAE/100 g), flavonoid (mg QE/100 g), carotenoid (µg/g) and sensory score.

Effect of Infrared drying Temperature (°C) the Quality of Dried Chrysanthemum Indicum Flower

By selecting the optimal steaming time and drying power, these blanched flowers would be dried by infrared dryer under power 200 W at different temperature (45°C, 50°C, 55°C, 60°C, 65°C) with air velocity 0.5 m/s. After this experiment, the dried flowers would be analyzed the total phenolic (mg GAE/100 g), flavonoid (mg QE/100 g), carotenoid (µg/g) and sensory score.

Effect of Infrared drying Air Velocity (m/s) the Quality of Dried Chrysanthemum Indicum Flower

By selecting the optimal steaming time, drying power and drying temperature, these blanched flowers would be dried by infrared dryer under power 200 W at temperature 60°C with different air velocity values (0.5, 1.0, 1.5, 2.0, 2.5 m/s). After this experiment, the dried flowers would be analyzed the total phenolic (mg GAE/100 g), flavonoid (mg QE/100 g), carotenoid (µg/g) and sensory score.

Physico-chemical, Sensory and Statistical Analysis

Total phenolic content (mg GAE/100g) was determined through the HPLC method [21]. Aluminum chloride colorimetric method was used for flavonoids (mg QE/100 g) determination [22].Carotenoid content (µg/g) was analyzed by HPLC [23]. Sensory score was evaluated by a group of panelist using 9 point-Hedonic scale. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Effect of Steaming Time in Blanching to the Total Phenolic, Flavonoid, Carotenoid and Sensory Score of *Chrysanthemum Indicum* Flower

Raw *Chrysanthemum indicum* flowers were blanched by vapor in different duration (30s, 45s, 60s, 75s, 90s). Our results were elaborated in Table 1.

It's obviously seen that 60s in vapour steaming as blanching was adequate to preserve the highest amount of total phenolic, flavonoid, carotenoid as well as good appearance. So this value was selected for further experiments.

Table 1: Effect of vapour steaming time (s) to the quality of steamed *Chrysanthemum indicum* flower

Steaming time (s)	30	45	60	75	90
Total phenolic (mg GAE/100g)	57.42±0.00^{c}	61.19±0.03^{b}	63.47±0.01^{a}	58.23±0.00^{bc}	56.05±0.02^{d}
Total flavonoid (mg QE/100g)	33.51±0.03^{cd}	35.18±0.03^{b}	37.24±0.02^{a}	34.39±0.00^{c}	32.80±0.01^{d}
Carotenoid (µg/g)	77.18±0.05^{d}	79.42±0.02^{bc}	83.04±0.03^{a}	81.55±0.01^{b}	78.69±0.03^{c}
Sensory score	5.68±0.03^{c}	6.12±0.02^{b}	6.59±0.04^{a}	6.44±0.00^{ab}	6.05±0.02^{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%)

A method of combined infrared and steam blanching was applied in blanching to inactivate enzymes that cause brown discoloration and loss of bioactive components inside *Chrysanthemum indicum* L. flower [24].

Effect of Infrared drying Power (W) to the Quality of Dried *Chrysanthemum indicum* Flower

By selecting the optimal steaming time, these blanched flowers would be dried by infrared dryer under different power (100, 150, 200, 250, 300 W) at temperature 45^{o}C with air velocity 0.5 m/s. Our results showed in Table 2. It's clearly noted that the optimal infrared drying power should be 200 W to preserve the best quality of dried *Chrysanthemum indicum* flower. So this value was selected for further experiments.

Table 2: Effect of infrared drying power (W) to the quality of dried *Chrysanthemum indicum* flower

Drying power (W)	100	150	200	250	300
Total phenolic (mg GAE/100g)	63.47±0.01^{a}	63.39±0.01^{a}	63.31±0.00^{a}	61.13±0.02^{b}	58.41±0.02^{c}
Total flavonoid (mg QE/100g)	37.24±0.02^{a}	37.19±0.02^{ab}	37.05±0.04^{b}	34.29±0.00^{c}	31.13±0.01^{d}
Carotenoid (µg/g)	83.04±0.03^{a}	82.84±0.01^{ab}	82.60±0.05^{b}	78.13±0.06^{c}	74.30±0.03^{d}
Sensory score	6.59±0.04^{cd}	7.35±0.00^{b}	7.84±0.03^{a}	7.05±0.05^{c}	6.42±0.03^{d}

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%)

Effect of Infrared Drying Temperature (^{o}C) the Quality of Dried *Chrysanthemum Indicum* Flower

By selecting the optimal steaming time and drying power, these blanched flowers would be dried by infrared dryer under power 200 W at different temperature (45^{o}C, 50^{o}C, 55^{o}C, 60^{o}C, 65^{o}C) with air velocity 0.5 m/s. Our results were noted in Table 3. The optimal drying temperature was recorded at 60^{o}C so we choose this value for further experiments.

Table 3: Effect of infrared drying temperature (^{o}C) to the quality of dried *Chrysanthemum indicum* flower

Drying temperature (^{o}C)	45	50	55	60	65
Total phenolic (mg GAE/100g)	63.31±0.00^{a}	63.24±0.00^{ab}	63.17±0.01^{ab}	63.08±0.02^{b}	60.26±0.01^{c}
Total flavonoid (mg QE/100g)	37.05±0.04^{a}	37.00±0.02^{ab}	36.89±0.03^{ab}	36.85±0.00^{b}	32.11±0.02^{c}
Carotenoid (µg/g)	82.60±0.05^{a}	82.41±0.00^{ab}	82.15±0.02^{ab}	82.04±0.01^{b}	79.15±0.03^{c}
Sensory score	7.84±0.03^{c}	8.04±0.01^{bc}	8.09±0.03^{b}	8.34±0.05^{a}	8.21±0.00^{ab}

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%)

Studies were conducted to standardize drying techniques for chrysanthemum flowers for better display quality of dry flowers. Among different methods of drying microwave oven drying with silica gel as medium recorded maximum score of 4.06 and 4.02 in terms of texture and shape, respectively. However colour and over all acceptability was maximum in oven drying with white sand as embedding medium (4.05 and 4.04 respectively). Best results in terms of display quality were obtained when flowers were dried at 80 percent micro power level for 120 seconds [25].

Effect of Infrared drying Air Velocity (m/s) the Quality of Dried *Chrysanthemum indicum* Flower

By selecting the optimal steaming time, drying power and drying temperature, these blanched flowers would be dried by infrared

dryer under power 200 W at temperature 60°C with different air velocity values (0.5, 1.0, 1.5, 2.0, 2.5 m/s). Our results were noted in Table 4. The optimal air velocity was recorded at 1.5 m/s so we choose this value for application.

Table 4: Effect of air velocity to the quality of dried *Chrysanthemum indicum* flower

Drying air velocity (m/s)	0.5	1.0	1.5	2.0	2.5
Total phenolic (mg GAE/100g)	63.08±0.02^{c}	64.11±0.02^{b}	64.75±0.00^{a}	64.38±0.05^{ab}	63.82±0.01^{bc}
Total flavonoid (mg QE/100g)	36.85±0.00^{c}	36.95±0.00^{bc}	37.29±0.03^{a}	37.11±0.02^{ab}	37.02±0.04^{b}
Carotenoid (µg/g)	82.04±0.01^{bc}	82.19±0.04^{ab}	82.35±0.02^{a}	82.17±0.05^{b}	81.94±0.03^{c}
Sensory score	8.34±0.05^{c}	8.49±0.00^{b}	8.73±0.01^{a}	8.58±0.02^{ab}	8.42±0.03^{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%)

The effects of different drying conditions, such as infrared power, drying air temperature and velocity, on quality of strawberry were evaluated. Drying time decreased with increased infrared power, air temperature and velocity. An increase in power from 100 W to 300 W, temperature from 60 to 80°C and velocity from 1.0 $m.s^{-1}$ to 2.0 $m.s^{-1}$ decreased fruit color quality index. For total phenol and anthocyanin content, 300 W, 60 °C, and 1.0 $m.s^{-1}$ were superior to the other experimental conditions [26].

Conclusion

Blanching is an important step before drying of herbal materials to inactivate enzymes that cause brown discoloration and loss of bioactive components. Infrared irradiation has potential for drying herbs because it is gentle and shortens the processing duration. The flower drying is an important post-harvest strategy for improving product quality as well as providing added value. We have successfully examined different technical variables influencing to the drying process of *Chrysanthemum indicum* flower.

Due to low moisture content, these dried flowers can be kept in ambient environment for longer periods without losing their appearance and pharmaceutical value. Dried chrysanthemum flowers are in considerable demand in the global market.

References

1. Kandil M, Mahros El-Saady, M Badawy, Mona H, Mahgoub; Afaf, M Habib andIman, M El-Sayed (2011) Effect of putrescine and uniconazole treatments on flower characters and photosynthetic pigments of Chrysanthemum indicum L. plant. Journal of American Science, 7(3): 399-408.
2. Kyung-Mi Chang, Gun-Hee Kim (2008) Volatile aroma composition of Chrysanthemum indicum L. flower oil. Journal of Food Science and Nutrition, 13(2): 122-127.
3. Liang-Yu Wu, Hong-Zhou Gao, Xun-Lei Wang, Jian-Hui Ye, Jian-Liang Lu, Yue-Rong Liang (2010) Analysis of chemical composition of Chrysanthemum indicum flowers by GC/MS and HPLC. Journal of Medicinal Plants Research, 4(5): 421-426.
4. Liang YR, Xu YR (2003) Effect of extraction temperature on cream and extractability of black tea [Camellia sinensis (L.) O. Kuntze]. Intl. J. Food Sci. Technol., 38: 37-45.
5. Kong LD, Cai Y, Huang WW, Cheng CH, Tan RX (2000) Inhibition of xanthine oxidase by some Chinese medicinal plants used to treat gout. J. Ethnopharmacol., 73: 199-207.
6. Cheng W, Li J, You T, Hu C (2005) Anti-inflammatory and immunomodulatory activities of the extracts from the inflorescence of Chrysanthemum indicum Linne. J. Ethnopharmacol., 101: 334-337.
7. Shunying Z, Yang Y, Huaidong Y, Yue Y, Guolin Z (2005) Chemical composition and antimicrobial activity of the essential oils of Chrysanthemum indicum. J. Ethnopharmacol., 96: 151-158.
8. Kyung-Mi Chang, Eun-Mi Choi, Gun-Hee Kim (2010) Chemical constituents of Chrysanthemum indicum L. flower oil and effect on osteoblastic MC3T3-E1 cells. Food Science and Biotechnology, 19(3): 815-819.
9. Shi GB, Zhao MH, Zhao QC, Huang Y, Chen YF (2011) Mechanisms involved in the antinociception of petroleum ether fraction from the EtOH extract of Chrysanthemum indicum in mice. Phytomedicien., 7: 609-616.
10. Sunmin Park, Jung Bok Lee, Suna Kang (2012) Topical application of Chrysanthemum indicum L. attenuates the development of atopic dermatitis-like skin lesions by suppressing serum IgE Levels,

IFN-γ, and IL-4 in Nc/Nga Mice. Evidence-Based Complementary and Alternative Medicine, article ID 821967, 8.

11. Jiao He, Xiaoxue Wu, Yali Kuang, Tianyang Wang, Kaishun Bi, Qing Li (2016) Quality assessment of Chrysanthemum indicum flower by simultaneous quantification of six major ingredients using a single reference standard combined with HPLC fingerprint analysis. Asian Journal of Pharmaceutical Sciences, 11(2): 265-272.
12. Ji-Yun Cha, Sarmila Nepali, Hoon-Yeon Lee, Sung-Woo Hwang, Sang-Yong Choi, Jeong-Mo Yeon, Bong-Joon Song, Dae-Ki Kim, and Young-Mi Lee (2018) Chrysanthemum indicum L. ethanol extract reduces high-fat diet-induced obesity in mice. Exp. Ther. Med., 15(6): 5070-5076.
13. Albert GW Heindl, Joachim Müller (2007) Microwave drying of medicinal and aromatic plants. Stewart Postharvest Review, 4(5): 1-6.
14. Nowak D, Lewicki PP (2005) Quality of infrared dried apple slices. Drying Technology, 23: 831-846.
15. Nowak D, Lewicki PP (2004) Infrared drying of apple slices. Innovative Food Science & Emerging Technologies, 5: 353-360.
16. Singh Alka, Dhaduk BK (2005) Effect of dehydration techniques in some selected flowers. J. Orna. Hort., 8(2): 155-156.
17. Deenawilson BL Attri, Satish K Sharma (2013) Evaluation of different methods for drying of chrysanthemum flowers. The Asian Journal of Horticulture, 8(2): 743-745.
18. Khyati M Patel, RB Patel, SL Chawla, Swati Parmar, Unnati R Patel (2017) Standardization of drying method for winter annual flowers. International Journal of Chemical Studies, 5(5): 557-559.
19. Kamal Kant (2018) Drying techniques for preservation of ornamental parts of plant. International Journal of Science, Environment and Technology, 7(5): 1650-1654.
20. Ah-Reum Han, Bomi Nam, Bo-Ram Kim, Ki-Chang Lee, Beom-Seok Song, Sang Hoon Kim, Jin-Baek Kim, Chang Hyun Jin (2019) Phytochemical composition and antioxidant activities of two different color Chrysanthemum flower teas. Molecules, 24(2): 329.
21. Cristina C Mircea, Oana Cioancă, Lucia Draghia, Monica Hăncianu (2015) Morphological characteristics, phenolic and terpenoid profiles in garden Chrysanthemum grown in different nutritional conditions. Not. Bot. Horti. Agrobo., 43(2): 371-379.
22. Mandal S, Patra A, Samanta A, Roy S, Mandal A, Mahapatra TD, Pradhan S, Das K, Nandi DK (2013) Analysis of phytochemical profile of Terminalia arjuna bark extract with antioxidative and antimicrobial properties. Asian Pacific Journal of Tropical Biomedicine, 3(12): 960-966.
23. Chang Ha Park, Soo Cheon Chae, Soo-Yun Park, Jae Kwang Kim, Yong Joo Kim, Sun Ok Chung, Mariadhas Valan Arasu, Naif Abdullah Al-Dhabi, Sang Un Park (2015) Anthocyanin and carotenoid contents in different cultivars of Chrysanthemum (Dendranthema grandiflorum Ramat.) flower. Molecules, 20: 11090-11102.
24. Yuan-Hui Li, Zhen-Feng Wu, Xue-Cheng Wang, Fen Yu, Ming Yang (2019) Effects of combined infrared and steam blanching on enzyme inactivation and product quality of Chrysanthemum indicum L. flower. Journal of Food Processing and Preservation, 43(10): e14119.
25. Aravinda K, Jayanthi R (2004) Standardization of drying techniques for chrysanthemum (Dendranthema grandiflora Tzvelev cv. Button type Local) flowers. Journal of Ornamental Horticulture, 7(3): 370-375.
26. Nafiye Adak, Nursel Heybeli, Can Ertekin (2017) Infrared drying of strawberry. Food Chemistry, 219: 109-116.

