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Changes of phytochemical, antioxidant characteristics of *Polyscias Fruticosa* rhizomes during convective and freeze drying

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Polyscias fruticosa rhizomes have various target specific biological activities. There has been an increase of awareness and interest in this valuable medicinal plant in recent times. However changes of phytochemical, antioxidant characteristics of *Polyscias fruticosa* rhizomes during drying have not been well understood. This research evaluated the drying methods affecting the phytochemical and antioxidant characteristics of *Polyscias fruticosa* rhizomes. Convective drying and freeze drying were compared the total polyphenol and flavonoid contents, the antioxidant activity characteristics of *Polyscias fruticosa* rhizomes. It has been concluded to use freeze drying (50ºC) rather than convective drying to minimize the loss of total polyphenol, total flavonoid contents; maintain the most antioxidant activity.

Keywords: Polyscias fruticosa, rhizomes, convective drying, freeze drying, of total polyphenol, total flavonoid, antioxidant.

INTRODUCTION

Polyscias fruticosa belongs to Araliaceae family and distributes widely in Vietnam. The leaves are used as atonic, antiinflammatory, antitoxin, and antibacterial (M.B. Bensita et al., 1999). Rhizome is used as a diuretic, febrifuge, antidysentery, and for treatment of neuralgia, rheumatic pain, asthma (R. Varadharajan and D. Rajalingam, 2011; George Asumeng Koffuor et al., 2014; Nguyen Thi Thu Tram et al., 2017; Alex Boye et al., 2018). There was not many researches mentioned to drying of *Polyscias fruticosa.* The effect of blanching time and temperature, $CaCl_2$ concentration in blanching; *Polyscias fruticosa* leaf size and temperature in drying; and storage condition to saponin (µg/g) content in the herbal tea was demonstrated (Nguyen Phuoc Minh et al., 2019). Therefore, objective of this our study focused on the effectiveness of convective drying and freeze drying methods affecting the phytochemical and antioxidant characteristics of *Polyscias fruticosa* rhizomes.

MATERIALS AND METHODS

2.1 Material

Polyscias fruticosa rhizomes were harvested from Soc Trang province, Vietnam. After collecting, they must be washed under tap water and conveyed to laboratory for experiments as soon as possible. Chemical substances such as Folin-Ciocalteu reageant, Na_2CO_3, Gallic acid, $NaNO_2$, $AlCl_3 \cdot 6H_2O$, NaoH, catechin, ethanol, methanol, potassium persulfate, phosphate buffer, potassium hexacyanoferrate, trichloroacetic acid solution, ferric chloride, ascorbic acid, ferrous sulfate, FRAP reagent, acetate buffer were all supplied from Van Dai Phat Co. Ltd.

2.2 Researching procedure

Raw samples (500g per samples) of *Polyscias fruticosa* rhizomes were dried by convective drying (50^{o}C, 55^{o}C, 60^{o}C) and freeze drying (50^{o}C, 55^{o}C, 60^{o}C). Thereafter, they were cooled by air at ambient temperature. All treated samples were then stored in dry cool place before analysis.

2.3 Physico-chemical, sensory and statistical analysis

Total phenolic (mg GAE/ 100g) was estimated spectrophotometrically using Folin-Ciocalteu reagent (Singleton V. L. et al., 1999). Total flavonoid (mg GE/ 100g) was estimated spectrophotometrically (Dewanto et al., 2002). DPPH (%) and ABTS (%) radical-scavenging activity were determined using reducing power assays (Thi and Hwang, 2014). The FRAP of *Polyscias fruticosa* rhizomes extract was determined as described by Chung H et al. (1999). The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

RESULTS AND DISCUSSION

3.1 Total polyphenol and flavonoid contents

The total polyphenol and flavonoid contents in *Polyscias fruticosa* rhizomes subjected to different drying treatment methods are presented in table 1. Raw samples showed the highest total polyphenol content of 31.29 mg GAE/100g dry weight. Convective dried samples at 60^{o}C exhibited the lowest total polyphenol content of only 12.41 mg GAE/100g dry weight. Raw samples contained higher total flavonoid contents both convective and freeze dried samples. The highest total flavonoid contents of samples after being dried by convective (at 50^{o}C) and freeze (at 50^{o}C) drying method were 6.19 and 7.23 mg GE/100g dry weight, respectively, both lower than that of raw samples.). Based on these results, it may be desirable to use freeze drying rather than convective drying to minimize the loss of total polyphenol and total flavonoid contents.

3.2 Antioxidant activity

The antioxidant capacity of *Polyscias fruticosa* rhizomes was compared among the drying conditions: convective drying (50^{o}C, 55^{o}C, 60^{o}C) and freeze drying (50^{o}C, 55^{o}C, 60^{o}C). The highest inhibition of DPPH radical formation in raw sample was 29.42% compared with 21.37% and 24.52% in convective (50^{o}C) and freeze drying (50^{o}C), respectively. Raw, convective (50^{o}C) and freeze (50^{o}C) dried samples showed highest ABTS radical-scavenging activities at 28.23%, 20.28%, and 22.76%, respectively. Raw, convective (50^{o}C) and freeze (50^{o}C) dried samples showed highest FRAP at 0.35%, 0.22%, and 0.26%, respectively (see table 2)

Table 1: Total polyphenol and total flavonoid contents in raw, convective and freeze drying of *Polyscias fruticosa* rhizomes

Drying treatment	**Total polyphenols (mg GAE/100g)**	**Total flavonoids (mg GE/100g)**
Raw	31.29 ± 0.26^{a}	9.45 ± 0.14^{a}
Convective drying (50^{o}C)	21.43 ± 0.13^{cd}	6.19 ± 0.08^{bc}
Convective drying (55^{o}C)	18.34 ± 0.24^{d}	4.83 ± 0.16^{cd}
Convective drying (60^{o}C)	12.41 ± 0.19^{e}	2.44 ± 0.12^{e}
Freeze drying (50^{o}C)	28.35 ± 0.33^{b}	7.23 ± 0.04^{b}
Freeze drying (55^{o}C)	22.17 ± 0.28^{c}	5.28 ± 0.09^{c}
Freeze drying (60^{o}C)	18.32 ± 0.11^{d}	3.74 ± 0.13^{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%).

Table 2: Antioxidant activity in raw, convective and freeze drying of *Polyscias fruticosa* rhizomes

Drying treatment	**DPPH (%)**	**ABTS (%)**	**FRAP (mm Fe_2^+/L, %)**
Raw	29.42 ± 0.31^{a}	28.23 ± 0.19^{a}	0.35 ± 0.01^{a}
Convective drying (50^{o}C)	21.37 ± 0.27^{d}	20.28 ± 0.07^{d}	0.22 ± 0.00^{c}
Convective drying (55^{o}C)	20.88 ± 0.15^{de}	19.81 ± 0.11^{de}	0.19 ± 0.03^{d}
Convective drying (60^{o}C)	20.36 ± 0.34^{e}	19.32 ± 0.06^{e}	0.15 ± 0.02^{e}
Freeze drying (50^{o}C)	24.52 ± 0.26^{b}	22.76 ± 0.08^{b}	0.26 ± 0.00^{b}
Freeze drying (55^{o}C)	23.78 ± 0.19^{bc}	22.01 ± 0.12^{bc}	0.21 ± 0.02^{cd}
Freeze drying (60^{o}C)	23.05 ± 0.22^{c}	21.45 ± 0.10^{c}	0.18 ± 0.01^{de}

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%).

Based on these results, it may be desirable to use freeze drying rather than convective drying to minimize the loss of antioxidant activity.

DPPH was a stable free radical, which accepts an electron or hydrogen radical to become a stable diamagnetic molecule. It was usually used as a substrate to evaluate antioxidative activity of antioxidants (Kulisic T et al., 2004). There was positive correlation between the quantity of phenolic compounds and the DPPH free radical scavenging effect (Piluzza G, Bullitta S, 2011; Sun L et al., 2011). ABTS was a protonated radical. It decreased with the scavenging of the proton radicals (Mathew S, Abraham TE, 2006).

The quality of aromatic *Pandanus* leaves dried at low temperature (35 °C) and low RH (27%) in a heat pump dryer was evaluated and compared with those obtained from hot air drying at 45 °C. The effect of temperature was prominent in the later part of drying, which acted as a driving force for moisture diffusion and hence the total drying time was reduced (Kalpana Rayaguru and Winny Routray, 2010). In another one report, hot air drying at 60ºC or lower resulted in doenjang powder with similar sensory and nutritional qualities to that of freeze-drying (Seung Min Park et al., 2018).

CONCLUSION

Polyscias fruticosa rhizomes are used widely as functional food with different pharmacological characteristics. Through this research, changes of phytochemical, antioxidant characteristics of *Polyscias fruticosa* rhizomes during drying have been well understood. This will help manufacturers having appropriate strategy to maitain their valuable components during processing and preservation.

CONFLICT OF INTEREST

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

AUTHOR CONTRIBUTIONS

Paper is based on single author study

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