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Effect of Boiling and Roasting to Nutrients and Anti-nutritients of Lotus (*Nelumbo nucifera*) Seed

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Lotus (*Nelumbo nucifera*) seeds are edible, medicinally versatile. However they are relatively perishable due to high moisture. They are normally sold in the shelled and dried form. Thermal treatment could create positive and negative interaction to phytochemical components inside of lotus seeds. This research, the effects of boiling (100^{o}C) and roasting (140^{o}C) for 15 min on the total polyphenol and flavonoid contents, the antioxidant activity, oxalate and phytate contents of lotus seed extract were evaluated. It may be desirable to use boiling rather than roasting to minimize the loss of total polyphenol, total flavonoid contents and antioxidant activities. This thermal treatment was more efficient in reducing the anti-nutrient contents such as oxalate and phytate inside lotus seed.

Keywords: Lotus seed, boiling, roasting, total polyphenol, total flavonoid, antioxidant, oxalate, phytate

INTRODUCTION

Nelumbo nucifera Gaertn. (Nymphaeaceae) is a potential aquatic crop widely grown in Mekong Delta, Vietnam. It is is a large aquatic rhizomatous herb consisting of slender, elongated, creeping stem with nodal roots. The bioactive constituents of lotus are mainly alkaloids, flavonoids, asteroidal triterpenoids. Lotus contains several biological active compounds such as polyphenolic compounds (kaempferol, quercetin, and isoquercetin) and oligomeric procyanidines (Nguyen Phuoc Minh, 2019a). It also contained abundant dietary fiber (Moro et al., 2013; Zhao et al., 2014). It has been extensively used as a traditional herb medicine in the treatment of various ailments such as antidiabetic, diarrhea, emollient, diuretic, tissue inflammation, diarrhea, cholera, fever, hyperdipsia, homeostasis, cancer, nervous disorders, insomnia, and cardiovascular disease (Huang et al., 2011; Jung et al., 2011). Embryo of lotus seeds is used to overcome nervous disorders, insomnia, and cardiovascular diseases (Keshav Raj Paudel and Nisha Panth, 2015).

There was not many research mentioned to the effectiveness of thermal treatment to antioxidant activity inside lotus seed. The effects of heat treatment during drying on the total polyphenol content and sensory characteristics of lotus seed were investigated. A high retention of polyphenols was recorded at drying temperature of 65°C in 14 h (Nguyen Phuoc Minh, 2019b). Therefore, objective of this our study focused on the effects of boiling and roasting on the total polyphenol and flavonoid contents, the antioxidant activity, oxalate and phytate contents of lotus seed.

MATERIALS AND METHODS

Material

Lotus seeds were collected from Dong Thap province, Vietnam. After collecting, they must be conveyed to laboratory for experiments. They were selected in uniformity. Chemical substances such as Folin-Ciocalteu reagent, 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 were all supplied from Van Dai Phat Co. Ltd.

Researching procedure

Raw lotus seeds were boiled in oven at 100°C or roasted at 140°C in 15 minutes. Thereafter, they were cooled by air at ambient temperature. All treated samples were then stored in dry cool place before analysis.

Physico-chemical, sensory and statistical analysis

Total phenolic (mg GAE/ 100g) was estimated spectro photometrically 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). Oxalate and phytate were determined using the method of AOAC (2005). The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

RESULTS AND DISCUSSION

Total polyphenol and flavonoid contents

The total polyphenol and flavonoid contents in lotus seed subjected to different thermal treatment methods are presented in table 1. Raw samples showed the highest total polyphenol content of 26.34 mg GAE/100g dry weight. Roasted samples exhibited the lowest total polyphenol content of only 19.05 mg GAE/100g dry weight. Raw lotus seed contained higher total flavonoid contents both boiled and roasted samples. The total flavonoid contents of lotus seed after boiling and roasting were 5.16 and 3.03 mg CE/100g dry weight, respectively, both lower than that of raw samples. These results were similar to finding by Anna Ngozi Agiriga and Muthulisi Siwela (2018) while verifying the cooking methods on antioxidant content in *Monodora myristica* seed. Similar results were observed by Otles and Selek (2012) for chestnuts. Thermal treatments significantly destroyed the phenolic contents of faba beans (Khalil AH, Mansour EH., 1995). Reduction in total flavonoid was also noticed on green bean while processing at 121°C in 10 minutes (Jiratanan T, Liu RH, 2004). Based on these results, it may be desirable to use boiling rather than roasting to minimize the loss of total polyphenol and total flavonoid contents.

Table 1: Total polyphenol and total flavonoid contents in raw, boiled, and roasted lotus seed

Thermal treatment	Total polyphenols (mg GAE/100g)	Total flavonoids (mgCE/100g)
Raw	26.34±0.75a	7.24±0.24[a]
Boiled	23.19±0.36[b]	5.16±0.13[b]
Roasted	19.05±.52[c]	3.03±0.19[c]

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%).

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 average inhibition of DPPH radical formation in raw lotus seed was 34.26% compared with 30.01% and 26.73% in boiled and roasted lotus seed, respectively. Raw, boiled, roasted lotus seed showed ABTS radical-scavenging activities at 42.14%, 36.74%, and 31.35%, respectively (see table 2). These results were contrary to finding by Anna Ngozi Agiriga and Muthulisi Siwela (2018) while verifying the cooking methods on antioxidant content in *Monodora myristica* seed. Boiling and steaming created a higher reduction in the antioxidant capacity of red pepper than stir-frying and roasting (Hwang IG et al., 2012). Based on these results, it may be desirable to use boiling rather than roasting to minimize the loss of antioxidant activity.

Table 2: Antioxidant activity in raw, boiled, and roasted lotus seed

Thermal treatment	DPPH (%)	ABTS (%)
Raw	34.26±0.34[a]	42.14±0.17[a]
Boiled	30.01±0.19[b]	36.74±0.08[b]
Roasted	26.73±0.22[c]	31.35±0.11[c]

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%).

3.3 Oxalate and phytate contents

Anti-nutrient components such as oxalate and phytate hinder the efficient utilization, absorption, or digestion of good nutrients and thus limits their bioavailability and nutritional quality (Anna Ngozi Agiriga and Muthulisi Siwela, 2018). Phytates could reduce bioavailability of minerals, impair protein digestibility caused by formation of phytic protein complexes, and hinder absorption of nutrients due to damage to the pyloric caeca region of the intestine (Francis G et al., 2001). Oxalate created kidney stones and a decrease in calcium absorption (Oyedeji OA et al., 2017).

Table 3: Oxalate and phytate contents in raw, boiled, and roasted lotus seed

Thermal treatment	Oxalate (mg/100g)	Phytate (mg/100g)
Raw	1.13±0.02^{a}	4.35±0.01^{a}
Boiled	0.22±0.01^{c}	1.13±0.00^{c}
Roasted	0.74±0.03^{b}	2.48±0.03^{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%).

Boiling was more effective in the reduction of anti-nutritional factors than roasting (see table 3). This result was similar to finding by Anna Ngozi Agiriga and Muthulisi Siwela (2018). Boiling could breakdown the plant cell wall permiting the emission of anti-nutrients into water while roasting create mild moisture evaporation (Ehirim Fidelis N et al., 2017; Inyang UE et al., 2015; Ogbadoyi EO et al., 2006). Roasting retained more of the nutrients than boiling in safflower seeds (Abdalbasit Adam Mariod et al., 2012). High acceptability for chips produced from lotus rhizome by frying at 200°C (Wipawee Yodkraisri and Rajeev Bhat, 2012).

CONCLUSION

Lotus seed (*Nelumbo nucifera*) was regarded as a potential nutraceutical source. The bioactive constituents of lotus are mainly alkaloids and flavonoids. It may be desirable to use boiling rather than roasting to minimize the loss of total polyphenol, total flavonoid contents and antioxidant activities. Boiling was more efficient in reducing the anti-nutrient content inside lotus seed. From this finding, manufacturers would have more basic foundation in processing lotus seed remaining high nutrient but low anti-nutrient.

CONFLICT OF INTEREST

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

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