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Impact of boiling and roasting on antinutritional and antioxidant attributes of Jackfruit seeds

Minh Phuoc Nguyen

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

***Correspondence:** minh.np@ou.edu.vn **Received 04-03-2020, Revised: 17-05-2020, Accepted: 20-05-2020 e-Published: 07-06-2020**

Recently jackfruit (*Artocarpusheterophyllus*) seed has been utilized as a value-added by-product in many processing factories. Beside phytochemical micronutrients like phenolics and flavonoids, jackfruit seeds also included anti-nutrients like phytate, tannin. Our research investigated the impact of thermal treatments to the anti-nutritional factors as well as antioxidant property in jackfruit seed. The jackfruit seed was boiled at 100^{o}C in different duration (10, 15, 20, 25, 30 minutes) or roasting at 130^{o}C in different durations (10, 15, 20, 25, 30 minutes). Our results revealed that thermal treatments had negative impact to antioxidant capacity. Boiling caused a significant reduction of phytate and tannin, while roasting increased these variables. Boiling would be the first choice in jackfruit seed processing to convert a discarded by-product into a simple metabolite applied in various functional applications.

Keywords: Jackfruit seed, anti-nutrient, reduction, phytate, tannin, antioxidant, boiling, roasting

INTRODUCTION

Jackfruit (*Artocarpusheterophyllus*) seed contains various phytochemicals such as phenolic compounds, flavonones (AkhilHari, 2014). However, it is normally discarded as waste in processing factories. It's generally utilised as feed for animals. It has nutritional and anti-nutritional contents inside. Anti-nutritional factors are components interfering with the metabolism of nutrients. Popular anti-nutrients are listed as saponins, tannins, trypsin inhibitor, cyanogenic glycosides, phytic acid, oxalates, amylase inhibitors (Akande KE, 2010). Phytate is a polydentate ligand which can chelate metal ions at physiological pH reducing the bioavailability of essential dietary nutrients such as minerals, proteins (Dahiya, 2006; Keerthana Sivakumaran and SukithaKothalawala, 2018). Tannins are astringent, bitter polyphenolic compounds (Makkar HPS, 2003; Nwogu LA et al., 2008). There are two groups of tannins: condensed (flavonoid monomers) and hydrolysable (gallicacid). Tannins play a key role in protection from predation and plant growth regulation. Thermal treatments like boiling, cooking, roasting had significantly affected to the sensitive constituents like antioxidants. Thermal treatments were also recorded to cause a great reduction of anti-nutritional factors (Adeyemo and Onilude, 2013, Cheriff et al., 2016). Objective of our study examined the possiblity of boiling and roasting to the anti-nutrients as well as antioxidants of jackfruit seed.

MATERIALS AND METHODS

Material

Jackfruit seeds were utilized from processing factories. After collecting, they must be kept in dry cool box and quickly conveyed to laboratory for experiments. They were subjected to washing in peracetic acid 25 ppm for sanitization. Besides jackfruit seeds, other chemical and reagents were analytical grade purchased from Rainbow Trading Co. Ltd. Lab utensils and equipments included

HPLC, spectrophotometer, boiling and roasting oven.

Researching method

Jackfruit seeds were boiled in hot water at 100^{o}C for different durations (10, 15, 20, 25, 30 minutes) or roasted at 130^{o}C in different duration (10, 15, 20, 25, 30 minutes) to demonstrate the impact of thermal treatment to phytate (mg/kg), tannin (mg/kg), antioxidant activity (%) inside jackfruit seeds.

Chemical and statistical analysis

Phytate (mg/kg) was determined according to the HPLC method described by Kwanyuen and Burton (2005). Tannin (mg/kg) was measured by the Folin-Denis spectrophotometry method described by Chinelo A. Ezeabara et al., (2014). Antioxidant activity (%) was evaluated by the ability of the extract of the samples to inhibit stable diphenylpicrylhydrazyl radical. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

RESULTSAND DISCUSSION

Effect of boiling duration to antinutritional and antioxidant properties of jackfruit seed

Anti-nutritional constituents are proven to limit the bioavailability of nutrients in human metabolism; phytate chelates minerals and makes them metabolically unavailable while tannin creates insoluble complexes with protein thereby decreasing protein bioavailability (C. Nduagu et al., 2008). According to Amadi et al. (2018), jackfruit seeds contained phytic acid 8.11±0.06 mg/100g, tannin 0.06±0.01 mg/100g, flavonoid 2.03±0.06 mg/100g. In our research, we noticed that the longer the boiling duration was, the more phytate, tannin levels and antioxidant capacity reduced. There was non- significant difference of data between 25 and 30 minutes (table 1). Their reduction could be explained by dissolving into the aqueous medium, thermal degradation, and formation of insoluble complexes between phytate and other elements like protein and minerals (P. Siddhuraju and K. Becker, 2001). Our results were similar to other findings. S. Olanrewaju Arinola and KunleAdesina (2014) proved that boiling decreased phytate, tannin levels and antioxidant capacity of wallnut. Udensi et al., (2007) showed a similar result of loss of phytate and tannin contents of vegetable cowpea (*Sesquipedalis*) seeds during boiling. Boiling led to reduction in phytate, tannin of jackfruit seed flour *(*RN Attaugwu et al., 2016*).*

Effect of roasting duration to antinutritional and antioxidant properties of jackfruit seed

Roasting has been demonstrated to cause a greatest reduction of anti-nutritional factors as compared to other thermal treatments like boiling, cooking, non-thermal like fermentation (Adeyemo and Onilude, 2013). Roasting the *Moringa oleifera* leaves at a high temperature led to a significant reduction in the levels of the anti-nutrients (Cheriff et al., 2016). Roasting led to reduction in phytate, tannin of jackfruit seed flour *(*RN Attaugwu et al., 2016*).* In contrary, our research found that roasting significantly increased in both the content of these antinutritional components but dramatially decreased antioxidant capacity in jackfruit seeds (table 2). In comparision between boiling (table 1) and roasting (table 2), we concluded that roasting created the detrimental effect to healthy components while accumulating much more antinutritional elements like phytate and tannin. Our results were parallel to other literatures. Enujiugba (2003) demonstrated that roasting created an increase of anti-nutritional components and a decrease of antioxidant capacity in conophor nut. Roasting increased phytate and tannin levels, while decreased antioxidant capacity of wallnut (Olanrewaju and Kunle, 2014; Ekwe and Ihemeje, 2013). Lima et al., (2009) demonstrated that both boiling and roasting caused a dramatic deduction of antioxidant activity in vegetable. Abiola et al.. (2018) proved that the roasted jackfruit seeds had the highest percentage reduction in the anti-nutrients as compared to the fermented sample.

Table 1: Effect of boiling duration (minutes) to antinutritional and antioxidant properties of jackfruit seed

Boiling duratio(min)	Control	10	15	20	25	30
Phytate (mg/kg)	17.82±0.02^{a}	9.24±0.00^{b}	8.03±0.02^{c}	7.11±0.01^{d}	6.32±0.00^{de}	6.04±0.01^{e}
Tannin (mg/kg)	6.59±0.01^{a}	3.84±0.03^{b}	3.41±0.01^{bc}	3.12±0.02^{c}	2.01±0.03^{d}	2.00±0.00^{d}
Antioxidant activity (%)	19.26±0.00^{a}	16.53±0.01^{b}	12.28±0.03^{c}	10.04±0.01^{d}	6.35±0.02^{e}	6.32±0.03^{e}

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: Effect of roasting duration (minutes) to anti-nutritional and antioxidant properties of jackfruit seed

Roasting duration (min)	Control	10	15	20	25	30
Phytate (mg/kg)	17.82±0.02^{c}	18.11±0.02^{bc}	18.64±0.03^{b}	18.94±0.02^{ab}	19.23±0.02^{a}	19.25±0.00^{a}
Tannin (mg/kg)	6.59±0.01^{c}	6.92±0.01^{bc}	7.31±0.00^{b}	7.75±0.01^{ab}	7.98±0.01^{a}	8.00±0.01^{a}
Antioxidant activity (%)	19.26±0.00^{a}	13.51±0.00^{b}	11.42±0.01^{c}	9.56±0.00^{d}	5.17±0.03^{e}	5.15±0.02^{e}

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

Phytate and tannin are anti-nutritional factors impairing mineral absorption and protein digestion. Phenolic substances act as antioxidant contributing great health benefit to human body. In this research, we have successfully demonstrated that boiling significantly reduced these anti-nutritional factors as well as antioxidant property. Meanwhile, roasting caused a backward effect to anti-nutritional factors by increasing their contents. Jackfruit seeds should be heated by boiling at least 25 minutes to eliminate phytate and tannin to safe edible level.

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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