Degradation of Phytochemical and Antioxidant Capacity of Noni (*Morinda Citrifolia* L.) Pulp Tea during Drying and Roasting Treatment

Abstract. Noni *(Morinda citrifolia L.)* fruit is highly evaluated as an important herb with a good source of natural antioxidant against various ailments as well as maintain overall good health. It's normally disposed due to unpleasant aroma from the ripened fruit. There is limited literature mentioned to the decomposition of this valuable fruit during thermal processing. Hence this reseach aimed to evaluate the possible degradation of total phenolic (mg GAE/100 g), total flavonoid (mg QE/100 g), DPPH radical-scavenging ability (mM TE/100 g), FRAP ferric reducing antioxidant power assay (mM TE/100 g) in raw, dried and roasted noni pulp tea. The highest contents of functional constituents and antioxidant capacity were noticed in the raw sample; meanwhile decreased dramatically in the roasted one. However, degradation of noni flavonol glycosides during roasting could produce aglycone metabolites, which in turn, may lead to increased bioavailability. Owing to degradation of phytochemical and antioxidant ability by harsh thermal treatment, it's necessary to be careful in drying and roasting to limit detrimental effect in herbal noni tea production.
Keywords: *Noni, pulp, degradation, phytochemical, antioxidant, phenolic, tea*

1. INTRODUCTION

Noni (*Morinda citrifolia* L.) is a popular plant in Southeast Asia. Its fruit has a yellowish-white ovoid lumpy body. The unripe fruit has dark green color and the ripe fruit releases a strong butyric acid as decayed smell (Yanine *et al.* 2006). The unpleasant odor of noni extract was accounted by medium chain fatty acids such as capric, caproic and caprylic acids (Norma *et al.* 2004). Its pulp is juicy and bitter, light dull yellowish white, gelatinous when the fruit is ripped. Octanoic acid and hexanoic acid are the major volatile acids, while malic acid, malonic acid and fumaric acid are the main non-volatile acids (Jorge *et al.* 2009). The major phytochemical components in noni (*Morinda citrifolia* L.) are phenolic acid, organic acid, glycosides, polysaccharides, iridoids, alkaloids, lignans, trisaccharide fatty acid esters, anthraquinones, scopoletin, morindin, vitamins, minerals and alkaloids (Wang, Su, 2001; Sang *et al.* 2003; Su *et al.* 2005). It's normally consumed in the form of juice, capsule, powder, concentrate, tea, wine (Adriana *et al.* 2010; Yashaswini *et al.* 2014; Mohammad *et al.* 2016; Robledo-Pe *et al.* 2017; Hardeep *et al.* 2018). It's considered as a natural antioxidant beneficial in daily consumption to exploit therapeutic functions against various ailments like skin diseases, respiratory infections, gastritis, menstrual, diabetes, venereal, burns, headaches, arthritis, wounds, nausea and vomiting (Hirazumi *et al.* 1996; Silva *et al.* 2013; Ulloa *et al.* 2014; Hardeep *et al.* 2018). Noni is an underutilized fruit crop with limited literature mentioned to the degradation of phytochemical and antioxidant ability in its pulp through thermal processing.

Although thermal treatment including drying and roasting decreased the chemical, enzymatic and microbiological reactions to extend product shelf-life, it also created undesirable effects on product quality such as overall appearance and degradation of bioactive constituents leading to low commercial acceptance (Larrosa *et al.* 2015). It's totally depended on the severity of drying and roasting conditions (Rodríguez *et al.* 2013). The effect of thin-layer drying temperature on color, phenolic content and antioxidant capacity of noni slices was investigated (Ana *et al.* 2016). Thermal degradation of flavonol glycosides in noni leaves during roasting was investigated (Shixin *et al.* 2011). Purpose of our research aimed to survey the decomposition of total phenolic, total flavonoid, DPPH radical-scavenging ability, FRAP ferric reducing antioxidant power assay in raw, dried and roasted noni pulp tea.

2. MATERIAL AND METHOD

2.1 Material

Raw noni fruits were naturally collected from Can Tho city, Vietnam. After harvesting, they must be conveyed to laboratory as soon as possible for experiments. All standards and reagents such as Folin-Ciocalteu reagent, Na_2CO_3, gallic acid, $Al(NO_3)_3$, potassium acetate, DPPH, methanol, ethanol, acetate

buffer, 2,4,6- tripyridyl-s-triazine, HCl , $FeCl_3.6H_2O$ were analytical grade and purchased from Sigma-Aldrich. Lab utensils and equipments included weight balance, hot air dryer, roasting oven, spectrophotometer.

2.2 Research method

Noni pulp was chopped into small pieces, dried at 45^{o}C for 8 hours to 8.5% moisture content, roasted at 170^{o}C for 20 minutes. The raw, dried, roasted samples were all analyzed the total phenolic (mg GAE/100 g), total flavonoid (mg QE/100 g), DPPH radical-scavenging ability (mM TE/100 g), FRAP ferric reducing antioxidant power assay (mM TE/100 g) to demonstrate the reduction of phytochemical and antioxidant capacity through thermal treatment. Total phenolic content (mg GAE/g) was evaluated using Folin–Ciocalteu assay (Nizar *et al.* 2014). Total flavonoid content (mg QE/g) was avaluated by the aluminium calorimetric method (Formagio *et al.* 2015). DPPH (mM TE/g) assay and FRAP (mM TE/g) were performed according to Ivanov *et al.* (2014). All analyses were performed in triplicates. Data were statistically summarized by Statgraphics Centurion XVI.

3. RESULT & DISCUSSION

Phenolic constituents which are related to the flavor, color, shelflife of herbal products, strongly correlated with the antioxidant capacity (Correia *et al.* 2011). Nascimento *et al.* (2018) evaluated the chemical composition, nutritional properties and antioxidant capacity of noni's pulp and seeds. The total phenolic, DPPH, FRAP were 79.57 mg GAE/ 100g, 348.47 µM TE/g, 38.07 µM TE/g respectively. Palioto *et al.* (2015) found higher total phenolic, ranging from 820.8 to 1143.5 mg GAE/100 for noni's pulp. In our research, noni pulp was chopped into small pieces, dried at 45^{o}C for 8 hours to 8.5% moisture content, roasted at 170^{o}C for 20 minutes. Results were clearly presented in table 1. The decrease of the total phenolic, flavonoid components and the antioxidant activity was observed after drying and roasting. It could be explained as a result of thermal effect which was detrimental of sensitive constituents. Krishnaiah *et al.* (2013) proved that dehydrated noni's pulp had total phenolic 431.8 mg GAE/100 g. Roasting process for the noni leaf tea could induce the degradation of flavonol glycosides. It may lead to increased bioavailability (Shixin *et al.* 2011). Ana *et al.* (2016) demonstrated that convective drying caused a degradation of total phenolic (20-28%), the antioxidant capacity (82-93% DPPH inhibition) of dried noni.

Table 1. Total polyphenolic, flavonoid and antioxidant activities of raw, dried and roasted noni tea

Sample	Total phenolic (mg GAE/100 g)	Total flavonoid (mg QE/100 g)	DPPH (mM TE/100 g)	FRAP (mM TE/100 g)
Raw	639.83±0.02^a	111.72±0.00^a	24.63±0.02^a	57.34±0.01^a
Dried	324.36±0.03^b	80.88±0.01^{ab}	16.35±0.03^b	36.89±0.02^b
Roasted	115.97±0.01^c	58.45±0.03^b	10.84±0.00^c	19.53±0.01^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%).

4. CONCLUSION

Thermal treatment is one of the most important processing and preserving technologies in the food industry. It help decreasing the chemical, enzymatic and microbiological reactions to extend product shelf-life. *Morinda citrifolia* (Noni) has pharmacologically active antioxidant activities and healthy benefits. Noni tea prepared from its pulp via drying and roasting process has attract much more consumer's attention owing to its potential health benefits in daily consumption. Degradation of metabolites during thermal treatment is crucial to evaluate its therapeutic attributes. We have demonstrated drying and roasting had significant effect to the degradation of phytochemical and antioxidant capacity of dry-roasted noni tea.

REFERENCE

1. Adriana Bramorski, Adriana da Rosa Cherem, Chaiana Paula Marmentini, Joseane Torresani, Tatiana Mezadri, Andréa de Almeida Silva Costa (2010). Total polyphenol content and antioxidant activity of

commercial noni (*Morinda citrifolia* L.) juice and its components. *Brazilian Journal of Pharmaceutical Sciences* 46: 651-656.
2. Ana Isabel Mireles-Arriaga, Irving Israel Ruiz-López, Pedro Abel Hernández-García, Enrique Espinosa-Ayala, Leticia Xóchitl López-Martínez, Ofelia Márquez-Molina (2016). The impact of convective drying on the color, phenolic content and antioxidant capacity of noni (*Morinda citrifolia* L.). *Food Sci. Technol, Campinas* 36: 583-590.
3. Correia, A.A da S., Gonzaga, M.L.C., Aquino, A.D., Souza, P.H.M. de, Figueiredo, R.W. de and Maia, G.A. (2011). Chemical and physical-chemical pulp noni (*Morinda citrifolia*) grown in the state of CearáO. *Alimentos e Nutrição, Araraquara* 22: 606-615.
4. Formagio, ASN., Ramos, DD., Vieira, MC., Ramalho, SR., Silva, MM., Zárate, NAH., Foglio, MA. and Carvalho, JE. (2015). Phenolic compounds of *Hibiscus sabdariffa* and influence of organic residues on its antioxidant and antitumoral properties. *Braz. J. Biol.* 75: 69-76.
5. Hardeep kaur, Nisha Gurjar and Ruth Gill (2018). The noni fruit (*Morinda citrifolia* L.): A systematic review on anticancer potential and other health beneficial pharmacological activities. *Journal of Medicinal Plants Studies* 6(2): 86-93.
6. Ivanov, I. G., Vrancheva, R. Z., Marchev, A. S., Petkova, N. T., Aneva, I. Y., Denev, P. P., and Pavlov, A. I. (2014). Antioxidant activities and phenolic compounds in Bulgarian Fumaria species. *International Journal of Current Microbiology and Applied Sciences* 3: 296-306.
7. Jorge A Pino, Eliosbel Márquez, Déborah Castr (2009). Volatile and non-volatile acids of noni (*Morinda citrifolia* L.) fruit. *Journal of the Science of Food and Agriculture* 89: 1247-1249.
8. Krishnaiah, D., Bono, A., Sarbatly, R. and Anissuzzaman, S. M. (2013). Antioxidant activity and total phenolic content of an isolated *Morinda citrifolia* L. methanolic extract from Poly-ethersulphone (PES) membrane separator. *Journal of King Saud UniversityEngineering Sciences* 27: 63-67.
9. Larrosa, A. P. Q., Cadaval, T. R. S. Jr, & Pinto, L. A. A. (2015). Influence of drying methods on the characteristics of a vegetable paste formulated by linear programming maximized antioxidant activity. *LWT Food Science and Technology* 60: 178-185.
10. Mohammad Ali, Mruthunjaya Kenganora, Santhepete Nanjundaiah Manjula (2016). Health benefits of *Morinda citrifolia* (noni): A review. *Pharmacognosy Journal* 8(4): 321-334.
11. Nascimento, L.C.S., Rodrigues, N. da R., Alves, M.P.C., Sabaa Srur, A.U.O., Barbosa Junior, J.L. and Barbosa, M.I.M.J. (2018). Chemical characterization, nutritional aspects and antioxidant capacity of noni (*Morinda citrifolia* L) produced in Northeastern Brazil. *International Food Research Journal* 25: 870-875.
12. Nizar Sirag, Elhadi MM, Algaili M Algaili, Hozeifa Mohamed Hassan and Mohamed Ohaj (2014). Determination of total phenolic content and antioxidant activity of roselle (*Hibiscus sabdariffa* L.) calyx ethanolic extract. *Standard Research Journal of Pharmacy and Pharmacology* 1: 034-039.
13. Norma, H., Normah, A., Ahmad, A.W., Rohani, M.Y., Muhammad Gawas, M. and Sharizan, A. (2004). Reducing the smelly compounds (caproic, caprylic and capric acids) in noni by treating the juice with activated charcoal powder. *Proceeding of the National Food Technology Seminar* p. 125-129.
14. Palioto, G.F., Silva, C.F.G., Mendes, M.P., Almeida, V.V., Rocha, C.L.M. and Tonin, L.T. (2015). Proximate composition, bioactive compounds and antioxidant activity of fruits of *Morinda citrifolia* L. (noni) cultivated in Paraná, Brazil. *Revista Brasileira de Plantas Medicinais* 17: 59-66..
15. Robledo-Pe, Karla & Buenano Sc, Jimena & Maurtua Mo, Stefania & Ramos-Escudero, Fernando. (2017). Behavior of polyphenol content and antioxidant activity of noni wine (*Morinda citrifolia* L.) during alcoholic fermentation. *American Journal of Food Technology* 12: 144-151.
16. Rodríguez, J., Melo, E. C., Mulet, A., & Bon, J. (2013). Optimization of the antioxidant capacity of thyme (Thymus vulgaris L.) extracts: management of the convective drying process assisted by power ultrasound. *Journal of Food Engineering* 119: 793-799.
17. Sang, S., Liu, G., He, K., Zhu, N., Dong, Z., Zheng, Q., (2003). New unusual iridoids from the leaves of Noni (*Morinda citrifolia* L.) show inhibitory effect on ultraviolet B-induced transcriptional activator protein-1 (AP-1) activity. *Bioorganic and Medicinal Chemistry* 11: 2499–2502.

18. Shixin Deng, Brett J. West and C. Jarakae Jensen (2011). Thermal degradation of flavonol glycosides in noni leaves during roasting. *Advance Journal of Food Science and Technology* 3: 155-159.
19. Su, B. N., Pawlus, A. D., Jung, H. A., Keller, W. J., McLaughlin, J. L., & Kinghorn, A. D. (2005). Chemical constituents of the fruits of *Morinda citrifolia* (noni) and their antioxidant activity. *Journal of Natural Products* 68: 592–595.
20. Wang MY, Su C (2001). Cancer preventive effect of *Morinda citrifolia* (Noni). *Annals of the New York Academy of Sciences* 952: 161-168.
21. YanineChan-Blanco, FabriceVaillant, AnaMercedes Perez, MaxReynes, Jean-MarcBrillouet, PierreBrat (2006). The noni fruit (*Morinda citrifolia* L.): A review of agricultural research, nutritional and therapeutic properties. *Journal of Food Composition and Analysis* 19: 645-654.
22. Yashaswini, S., Venugopal, C. K., Hegde, R. V. and Mokashi, A. N. (2014). Noni: A new medicinal plant for the tropics. *African Journal of Plant Science, Lagos* 8: 243-247.