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Slice thickness and vaccum drying temperature affects on phytochemical constituents of the dehydrated eggplant (*Solanum melongena)*

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Eggplant (*Solanummelongena*) a rich source of anthocyanins, phenolics, flavonoids, antioxidants, vitamins, dietary fibers. It has got a great interest as functional food due to its excellent antioxidant property. It provides significant therapeutic benefits thanks to its abundance of pharmaceutical attributes. Eggplant has a short shelf life due to its perishable behavior. Drying is one of the most traditional process utilized to keeping eggplant for a long stability. In our research, we examined the effect of slice thickness (1.0, 1.5, 2.0, 2.5, 3.0 cm) and vacuum drying temperature (35, 40, 45, 50, 55^{o}C) to total phenolic (mg GAE/100g), flavonoid (mg QE/100g), DPPH (mM TE/100g) assay and FRAP (mM TE/100g) of the dried eggplant pieces. Our results revealed that the most valuable phytochemical constituents would be maintained effectively by vacuum drying temperature 40^{o}C in 2.0 thickness. Our data revealed that slice thickness and vacuum drying temperature had positive influence to phytochemical retention in the dehydrated eggplant.

Keywords: ***Eggplant, thickness, vaccum drying temperature, phenolic, flavonoid, DPPH, FRAP, phytochemical***

INTRODUCTION

Eggplant (*Solanummelongena*) is an important vegetable crop in Vietnam. Eggplant has classified among top ten vegetables with excellent antioxidant capacity due to its high content of phytochemical components like phenolics, flavonoids, saponins especially anthocyanin, chlorogenic acid contributing to health benefits (Cao et al., 1996; Noda et al., 2000; Ajay et al., 2009; Niño-Medina et al., 2017; Nergiz et al., 2018). It has various shapes, sizes and colors (Mishra et al., 2013; Uthumporn et al., 2015; San et al., 2013). The purple eggplant is attracted in a great preference owing to its abundant anthocyanin. Eggplant has huge therapeutic potentials for treatments of different ailments such as diabete, hyperlipidemia, atherogenic cardiovascular, hyperlipidemia, hypercholesterolemia (Sudheesh et al., 1997; Guimaraẽs et al., 2000; Kwon et al., 2008; Basuny et al., 2012; Mauara et al., 2017). Due to the relatively short postharvest life in fresh status, it should be converted into shelf stable form. Eggplant can be blanched and fermented to convert into pickle product (Nguyen et al., 2019). Dehydration is considered an important process to preserve and enhance food quality as well as hygienic condition (Mohamed et al., 2015).

Several notable literatures mentioned to the drying of eggplant. Long et al. (2012) investigated the effects of drying pressure and temperature on the drying rate and drying shrinkage of the eggplant samples. Gozde et al. (2015) verified drying characteristics and quality properties of eggplant dried by sun drying, hot air convective drying and infrared assisted convective drying. Mohamed et al. (2015) studied experimentally the drying kinetics of eggplant in a laboratory-scale fluidized bed dryer. Luis et al. (2018) evaluated the mass transfer and oil uptake variables during vacuum frying of eggplant slices. Objective of our study focused on the influence of slice thickness (1.0, 1.5, 2.0, 2.5, 3.0 cm) and vacuum drying temperature (35, 40, 45, 50, 55ºC) to total phenolic (mg GAE/100g), flavonoid (mg QE/100g), DPPH (mM TE/100g) assay and FRAP (mM TE/100g) of the dried eggplant slices.

MATERIALS AND METHODS

2.1 Material

Eggplantswere bought in local market from SocTrang province, Vietnam. After collecting, they must be kept in dry cool box and quickly conveyed to laboratory for experiments. They were subjected to primary washing and treatments. 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, blender, vacuum dryer, spectrophotometer.

2.2 Researching method

Eggplants were cut in slices with different thickness (1.0, 1.5, 2.0, 2.5, 3.0 cm), blanched for 45 seconds in hot water (100 °C), cooled toambient temperature, soaked in $CaCl_2$ solution (0.5 w/v %) for 20 min, dried at different vacuum drying temperature (35, 40, 45, 50, 55ºC) at constant pressure 12.5 kPa for 12 hours to final moisture content below 10%. The dried samples were then analyzed the total phenolic content (mg GAE/100g), flavonoid (mg QE/100g), DPPH (mM TE/100g) assay and FRAP (mM TE/100g) to verify the optimal vacuum drying temperature and slice thickness.

2.3 Phytochemical analysis

Total phenolic content (mg GAE/100g) was evaluated using Folin–Ciocalteu assay (NizarSirag et al., 2014). Total flavonoid content (mg QE/100g) was avaluated by the aluminium calorimetric method (Formagio et al., 2015).DPPH (mM TE/100g) assay and FRAP (mM TE/100g) were performed according to Ivanov et al. (2014).

2.4 Statistical analysis

The experiments were run in triplicate with three different lots of samples. Probability value of less than 0.05 was considered statistically significant Statistical analysis was performed by the Statgraphics Centurion XVI

RESULTS AND DISCUSSION

3.1Effect of vacuum drying temperature to phytochemical retention in dehydrated eggplant slice

Drying can lead to considerable loss of the available bioactive components due to thermal degradation depending on the drying method and temperature conditions (Naomi et al., 2018). In our experiment, we examined different vacuum drying temperature (35, 40, 45, 50, 55ºC) at constant pressure 12.5 kPa on the total phenolic (mg GAE/100g), flavonoid (mg QE/100g), DPPH (mM TE/100 g), FRAP (mM TE/100 g). Our results revealed that there was not significant difference in phytochemical constituents at temperature 35ºC or 40ºC. While increasing the vacuum drying temperature, there was potential reduction of functional antioxidant capacity. Therefore 40ºC was appropriate for next experiment. In other report, Long et al. (2012) found that increasing drying temperature accelerated the vacuum drying process, while drying chamber pressure did not show significant effect on the drying process within the temperature range investigated. Gozde et al. (2015) realized that the increasing of temperatures during the drying of eggplant led to a significant reduction of the drying time. Loss of nutrition was observed in eggplant samples dried at higher temperature. Naomi et al. (2018) proved that total phenolic content, antioxidant capacity were significantly affected by drying method and drying temperature. Freeze-drying was the most effective in preserving the highest bioactive elements in eggplant. Pham and Ung (2019) proved that the highest anthocyanin content in purple sweet potato was achieved by slice thickness of 3 cm and drying temperature of 55ºC for 48 h.

3.2 Effect of slice thickness to phytochemical retention in dehydrated eggplant slice

In our experiment, eggplants were cut in slices with different thickness (1.0, 1.5, 2.0, 2.5, 3.0 cm), blanched for 45 seconds in hot water (100 °C), cooled to ambient temperature, soaked in $CaCl_2$ solution (0.5 w/v %) for 20 min, dried vacuum drying temperature 40ºC at constant pressure 12.5 kPa for 12 hours to final moisture content below 10%.

Table 1: Effect of vacuum drying temperature (ºC) at constant vacuum presure 12.5 kPa on the phytochemical retention

Vacuum drying temperature (ºC)	35	40	45	50	55
Total phenolic (mg GAE/100 g)	465.29±0.01^{a}	460.74±0.01^{a}	413.57±0.03^{ab}	386.12±0.02^{b}	298.56±0.00^{c}
Total flavonoid (mg QE/100 g)	116.32±0.00^{a}	113.41±0.03^{a}	95.26±0.00^{ab}	93.42±0.01^{ab}	80.37±0.01^{b}
DPPH (mM TE/100 g)	17.65±0.03^{a}	17.19±0.02^{ab}	16.83±0.01^{b}	16.47±0.00^{bc}	16.02±0.02^{c}
FRAP (mM TE/100 g)	23.09±0.02^{a}	23.01±0.00^{a}	22.74±0.02^{ab}	22.63±0.01^{ab}	22.26±0.00^{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%).

Table 2: Effect of slice thicnkness (cm) at constant vacuum drying temperature 40ºC, presure 12.5 kPa on the phytochemical retention of the dried eggplant slice

Slice thickness (cm)	1.0	1.5	2.0	2.5	3.0
Total phenolic (mg GAE/100 g)	460.74±0.01^{c}	511.03±0.02^{b}	586.45±0.02^{a}	537.52±0.03^{ab}	489.15±0.02^{bc}
Total flavonoid (mg QE/100 g)	113.41±0.03^{c}	159.34±0.01^{b}	204.17±0.03^{a}	184.53±0.02^{ab}	131.42±0.00^{bc}
DPPH (mM TE/100 g)	17.19±0.02^{c}	17.87±0.03^{b}	18.95±0.00^{a}	18.43±0.01^{ab}	17.42±0.02^{bc}
FRAP (mM TE/100 g)	23.01±0.00^{c}	23.76±0.01^{b}	24.65±0.00^{a}	24.03±0.00^{ab}	23.40±0.01^{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%).

Our results showed that at 2.0 cm of thickness, the most phytochemical constituents in the dried eggplant slices would be preserved effectively. In a similar report, the influence of temperature and slice thickness on the drying attributes of pumpkin were examined in a lab-scale tray dryer, using hot air temperatures of 55, 60, 65 °C and 2, 3, 4 mm slice thickness at a constant air velocity of 1.5 m/s. The drying duration decreased with increasing drying temperature, but it increased with increasing slice thickness of the pumpkin (Kongdej, 2011).

CONCLUSION

Eggplant (*Solanummelongena*) is a great good source of phytochemical constituents such as total phenolics, flavonoids, dietary fibers, minerals, vitamins etc with numberous health benefits. The health and nutritional values of eggplant have led to its increased demand and production. Increased production is accompanied by its short shelf life after harvesting limits its commercial value in marketing. In this research, we have successfully investigated the influence of slice thickness and vacuum drying temperature to total phenolic, flavonoid, DPPH assay and FRAP of the dried eggplant slices. By vacuum drying, raw eggplant could be converted to value-added product with prolonged stability.

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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