Development of dehydrated avocado powder using different drying techniques and evaluation of their quality

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1. Introduction

In Sri Lanka, due to climatic and seasonal variations, postharvest losses in fruits and vegetables are estimated to be 30-40%. Avocado (*Persea americana*) is a climacteric fruit that belongs to the *Lauraceae* family. It is a well-known subtropical fruit with a high commercial worth. The fruit is particularly prone to postharvest losses in terms of both quality and quantity. Postharvest losses are mainly due to lack of correct maturity indices, uneven ripening, improper handling, lack of infrastructure, lack of transportation facilities and lack of attention to product development. It fulfils the requirement for monounsaturated fats, fibre, vitamins and minerals. The production of value-added food items utilizing the surplus of fruits will help to reduce the loss and improve customer demand. Due to its popularity as a food crop and the developing trend of commercial avocado farming in Sri Lanka, avocado production will be strong shortly. The drying technique used is determined by a number of criteria, including the kind of product, the availability of drying equipment, the cost of dehydration, energy efficiency and the ultimate product quality (Wijewardana et al., 2016). Freeze drying is one of the greatest drying processes since it preserves natural colour, maximal nutrients, original flavour, and fragrance (Marques et al., 2007). Fruits dried using conventional air dryer have poor product quality (Jain et al., 2011). Latest technological improvements are based on heat pump technology, which allows for high energy efficiency (Singh et al., 2020). The qualitatively impacts of drying methods were investigated in this study using eight treatments for conventional air dryer, heat pump dryer, and freeze dryer. This study was conducted to develop a dehydrated avocado powder and to optimize the pre-treatment for dehydration of avocado, to identify the proper drying method qualitatively and economically for avocado powder processing and to evaluate the physiochemical properties of dehydrated avocado powder.

2. Materials and Methods

The experiment was conducted in the laboratory of the National Institute of Post-Harvest Management, Anuradhapura. The "Pollock" avocado cultivar was harvested at the correct maturity stage. Fruits free from any visible defects were selected. Fresh fruits were cut into slices (5 – 8 mm thickness). Table 1 shows the different drying methods and treatments.

Table 01. Avocado powder processing

Dryer type	Temperature (°C)	Time (Hours)	Pre-treatment type	
			With blanching	Without blanching
Conventional air dryer	55	4	Citric acid 1.5 g/ L	Citric acid 1.5 g/ L
			Ascorbic acid 1.5 g/ L	Ascorbic acid 1.5 g/ L
			Citric acid + Ascorbic acid	Citric acid + Ascorbic acid

			(7.5 g/ L from each)	(7.5 g/ L from each)
			Control	Control
Heat pump dryer	40	2.30	Citric acid 1.5 g/ L	Citric acid 1.5 g/ L
			Ascorbic acid 1.5 g/ L	Ascorbic acid 1.5 g/ L
			Citric acid + Ascorbic acid (7.5 g/ L by each)	Citric acid + Ascorbic acid (7.5 g/ L by each)
			Control	Control
Freeze dryer	(-55)	15	Citric acid 1.5 g/ L	Citric acid 1.5 g/ L
			Ascorbic acid 1.5 g/ L	Ascorbic acid 1.5 g/ L
			Citric acid + Ascorbic acid (7.5 g /L by each)	Citric acid + Ascorbic acid (7.5 g/ L by each)
			Control	Control

Colour values were measured using Hunter lab colour difference meter (CR 400, Konica Minolta), the values of L*, a* and b* were recorded (McGuire, 1992). From above combinations, two treatments were selected from each drying method based on L* value. Then, Browning index was calculated based on the formula used by Maskan (2001); Saricoban and Yilmaz (2010); Kasim and Kasim (2015) to identify the better performing one treatment from selected two treatments from each dryer type. Used formula was,

$$BI = \frac{[100(X-0.31)]}{0.17} \quad Where,\ X = \frac{a+1.7L}{5.645L+a-3.012b}$$

L* - darkness or lightness of color and ranges from black (0) to white (100). Negative a* values indicate the greenness whereas positive values indicate redness. Negative b* values indicate the blueness and positive values indicate the yellowness (McGuire, 1992)

Quality evaluation for dehydrated avocado powder samples were analysed using Yield percentage, proximate analysis and physicochemical properties {titratable acidity (TA), ascorbic acid, total soluble solids (TSS), and calorimetric measurements} for two months of period.

3. Results and Discussion

According to the findings, in terms of Browning Index eight different treatments in Air dryer and Heat pump dryer were significantly different ($P = 0.000$) ≤ ($\alpha = 0.05$). Treatments without blanching ascorbic and blanching citric acid had the highest estimated median in both AD (56.45±5.17), (52.18±6.37) and HP (63.05±2.66), (63.61±3.92); the colour of browning in the freeze dryer was not substantially different across the eight different treatments ($P = 0.998$) ≤ ($\alpha = 0.05$). However, the treatment without blanching ascorbic and the treatment without blanching control had the highest estimated medians of (61.11±9.00) and (61.12±7.01) respectively. The treatment with the lowest browning index was selected as the best performing treatment according to the dryer type. Blanching followed citric acid (38.30±18.10), ascorbic

acid (56.03±3.28), and control (33.91±10.68) were the best performing treatments for AD, HP, and Freeze dryer respectively.

Yield percentages for AD, HP, and FD were 7.23%, 7.62%, 8.19% respectively. Proximate composition were analysed. The low moisture (6.57±0.00%) and highest ash (3.86±0.00%) was obtained by HP method, while the highest crude protein (14.84±0.00%) from FD method and the highest crude fat (20.31±0.00%) from AD method. A significant difference ($P \leq 0.05$) was observed in all physicochemical properties according to the completely randomized design. The lowest water activity (0.42±0.01%) and disperse of powder in the water (1.56±0.11%) was obtained with HP method.

During the two-months of storage period, physicochemical properties were observed according to the dryer types. TA in AD, HP and FD ranged as 0.75 ± 0.08 to 0.17 ± 0.08, 1.12 ± 0.28 to 0.65 ± 0.08, and 0.75 ± 0.08 to 0.54 ± 0.41) respectively. Acids may have lost during storage because they involved chemical interactions with sugars to inverse non-reducing sugars to reducing sugars (Rk et al., 2019). Ascorbic acid in AD, HP, and FD ranged as 161.20 ± 0.61 to 94.55 ± 0.57, 155.79 ± 0.50 to 88.28 ± 1.00 and 159.70 ± 0.49 to 96.93 ± 0.52 respectively. The ascorbic acid contents in fruits may degrade due to heat, preserving duration, pH value, moisture content, direct exposure to sunlight and amount of oxygen (Ali et al., 2016). TSS in AD, HP, and FD ranged as 1.43 ± 0.05 to 1.83 ± 0.05, 1.53 ± 0.05 to 2.13 ± 0.05 and 1.43 ± 0.05 to 1.93 ± 0.05 respectively. The inversion of non-reducing sugars and other polysaccharides into reducing sugars is responsible for the modest rise in reducing sugars in dried fruit after storage (Rk et al., 2019). As the colorimetric measures got using Chroma meter, L* value ranged as 56.79 ± 0.59 to 51.55 ± 0.92, 61.57 ± 0.10 to 55.58 ± 0.54 and 67.74 ± 0.13 to 58.91 ± 0.62 respectively. The L* coordinate denotes colour darkness or brightness and runs from black (0) to white (100) (McGuire, 1992).

4. Conclusions

From the present study, it can be concluded that the dehydrated avocado powder successfully developed according to the physicochemical properties. Pre-treatments for dehydration of avocado was optimized; AD – Citric acid followed by blanching; HP – Ascorbic acid; FD – control (without using any pre-treatment). Optimum drying time and temperature to achieve less than 8% of moisture in avocado powder; AD - 55℃ for 4 hours; HP – 40℃ for 2.30 hours; FD – (-55℃) for 15 hours. Heat pump drying method was identified as the proper drying method according to the physicochemical analysis, colorimetric values, and proximate analysis for avocado powder processing. During the two-month storage period, physicochemical properties were conserved in dehydrated avocado powder.

5. References

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