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Storage Stability of Spray-Dried Papaya (*Carica Papaya* L.) Leaf Powder Packaged in Aluminium Laminated Polyethylene

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ABSTRACT

Physiochemical characteristics of spray-dried papaya leaf powder packed in aluminium laminated polyethylene (ALP) and stored at room temperature for 45 days were evaluated. Moisture content of ALP packaged powder was 6.35% (d.b) by the end of 45 days storage period. Water activity of the spray-dried papaya leaf powder had not exceeded 0.6 in packaging material, which showed that the powder was self-stable. pH of papaya leaf powder was slightly decreased during storage period. There was no loss of total flavonoid content of spray dried papaya leaf powder during storage period. The results indicated that the powder packaged in ALP was best with acceptable qualities and stability. Thus, ALP packaging with storage condition at room temperature was better for keeping spray-dried papaya leaf powder.

Keywords: *Papaya leaf powder, Storage stability, Spray drying, Aluminium laminated polyethylene.*

Papaya leaves contain antioxidant compounds such as flavonoids. Flavonoid have shown to play an important role in prevention of many ill health conditions. Fresh, green papaya leaf is an antiseptic, while the brown, dried papaya leaf is the best as a tonic and blood purifier and carica papaya leaves extracts used to treat dengue fever in patients (Ahmad *et al.,* 2011). Recent reports have claimed possible beneficial effects of papaya leaf juice in treating patients with dengue viral infections (Yunita *et al.,* 2012). In some parts of Asia, the young leaves of the papaya are steamed and eaten like spinach. The extracts of both the leaves and fruit are known to contain several proteins and alkaloids with important pharmaceutical, medical and industrial applications. Interestingly, papaya fruit juice and leaf extract have demonstrated anti-cancer properties. In a recent study it is found that, the powder from papaya leaves is responsible for the release and production of thrombocytes/platelets (Patil *et al.,* 2013).

The dehydration technique is a good choice for leaf preservation as it reduces moisture in leaves, which inhibits the growth of microorganism and enzymatic activity (Mishra *et al*., 2014). Spray drying is one of the techniques used extensively for the production of heat-sensitive fruits and vegetables (Wong and Chong, 2015). Fruit juice powders have many benefits and economic potentials over the liquid counterparts such as reduced weight or volume, reduced packaging, easier handling, transportation and much longer shelf life (Fazaeli *et al*., 2012).

Aluminium laminated polyethylene (ALP) is considered as laminates and metallized films. The lamination of aluminium films binds aluminium foil together with paper or plastic such as polyethylene or polypropylene to improve its barrier properties (Marsh and Bugusu, 2007). Lamination of aluminium to plastic enables heat sealibility of the packaging material. It also provides excellent barrier to light and reduce the permeability of oxygen (Abdel-Bary, 2003).

In this study, papaya leaf powder was produced by adding maltodextrin concentrations of 8%, 10% and 12% to the aqueous papaya leaf extract. The concentrated papaya leaf juice was fed into the drying chamber with feed flow rates of 350 mL/h, 475 mL/h, 600 mL/h and inlet air temperatures were maintained at 130 ^{o}C, 140 ^{o}C and 150 ^{o}C. Obtained powder was stored for 45 days in aluminium laminated polyethylene covers under ambient conditions.

MATERIAL AND METHODS

Preparation of papaya leaf juice

Green papaya leaves of same maturity level were collected from local field, leaves were washed and sliced. The sliced leaves were again washed with mineral water. From papaya leaf slices, juice was extracted by using INTEX mixer grinder. For each experimental run, the papaya leaves (1 kg) was blended in distilled water (250 mL), in the ratio of 1-0.25. The juice was separated from papaya leaf waste through filtering.

Preparation of spray dried papaya leaf powder

The resulting papaya leaf juice was twice filtered using a muslin cloth to avoid blocking of the atomizer of the spray dryer. The carrier agent

maltodextrin of 8%, 10% and 12% w/v was added to the papaya leaf juice to increase concentration and to reduce hygroscopicity of the dried powder. Initially papaya leaf juice has 5 °Brix after addition of maltodextrin concentrations 8%, 10% and 12% w/v, the °Brix was increased to 13%, 15% and 17% °B, respectively. Then the concentrated papaya leaf juice was fed in to the drying chamber with feed flow rates of 350 mL/h, 475 mL/h, 600 mL/h and inlet air temperatures were maintained at130 °C, 140 °C and 150 °C temperatures. Obtained powder was stored in aluminium laminated polyethylene covers under ambient conditions.

Assessment of stability of spray-dried papaya leaf powder

The papaya leaf powders were stored in aluminium laminated polyethylene covers under ambient temperature and their physical and chemical characteristics were analyzed for every 15 days interval. The shelf life of papaya leaf powder was based on the physical and chemical characteristics of powder.

Moisture Content

The moisture content was determined in accordance to moisture measurement method of AOAC (2000).

Water Activity

The water activity (A_w) of the samples was measured by using a water activity meter (Hygro Lab C1 bench-top meter) at 25 ± 1 °C (Quek *et al*., 2007).

pH

The pH of papaya leaf powders were measured using a pH meter (Systronics micro pH system-362, Ahmadabad, India).

Total flavonoid content

The method used for determination of total flavonoid content was adapted from Kamtekar *et al.* (2014). Quarcetin solution (100 mg/ml) was used to construct the standard curve. Total flavonoid content of the spray-dried papaya leaf powder was spectrophotometrically determined at 510 nm and the data of total flavonoids of papaya leaf powders were expressed as mg of quercetin equivalents/100 g of dry mass.

RESULTS AND DISCUSSION

During storage period, the moisture content of all papaya leaf powders gradually increased due to absorption of moisture. Moisture content had increased from 4.14 to 6.35% during the storage period from 0 to 45 days. Moisture content of all samples were observed to below 10% up to 45 days of storage, moisture content below 10% is adequate to ensure that the powder produced is microbiologically safe (Ng *et al.,* 2012). Moisture absorption over storage period also resulted in increase in moisture content of sample. The changes in moisture content of the powders as shown in Fig. 1.

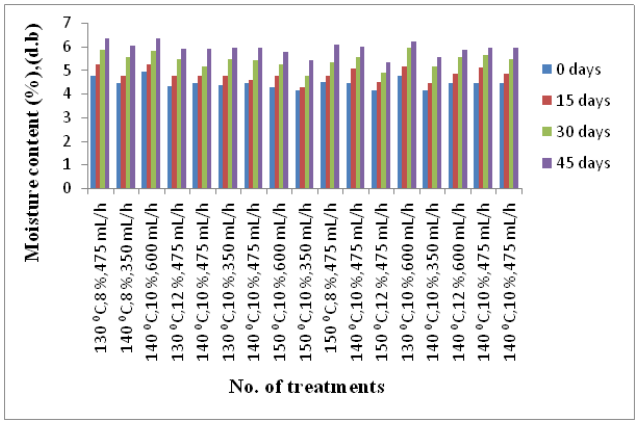

Fig. 2 Changes in water activity of spray dried powders during storage period

pH

The decrease in pH of spray dried papaya leaf powders were observed over a storage period. At 45th day of storage, the pH of powders slightly decreased from 6.52 to 6.35. The changes in pH of the powders as shown in Fig.3.

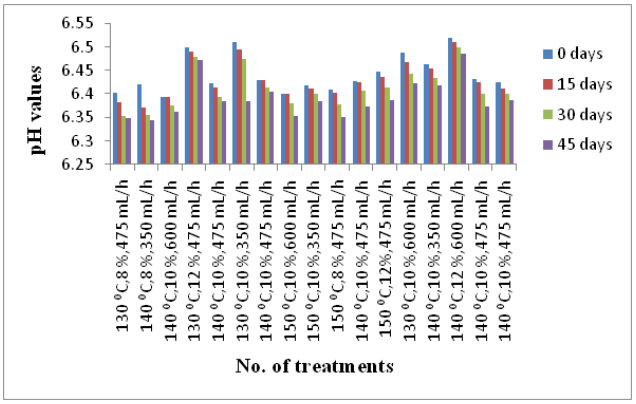

Fig. 3 Changes in pH values of spray dried powders during storage period

Total Flavonoid Content

During the storage period, there was loss during the storage period studied here at room temperature. On the basis of these findings, it can be concluded that the process did not affect the conservation of the material up to 45 days. The present findings were in agreement with the results obtained for spray dried propolis by Silva *et al.* (2011). The changes in total flavonoid content of the powders as shown in Fig. 4.

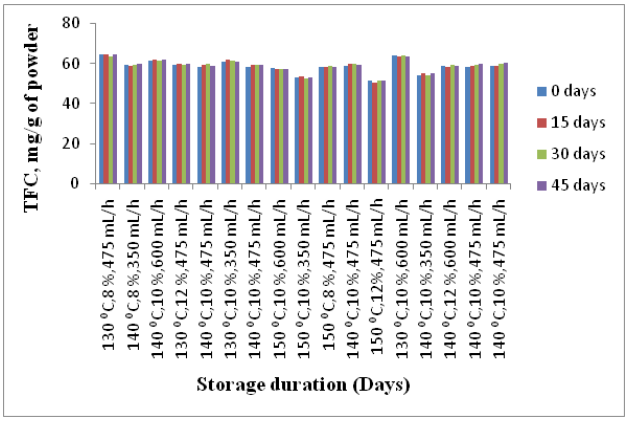

Fig. 4 Changes in total flavonoid content values of spray dried papaya leaf powders during storage period

CONCLUSION

Choosing a suitable packaging material can ensure a longer shelf life of food product. Aluminium laminated polyethylene packaging material influenced spray-dried papaya leaf powder's moisture content, water activity, pH and total flavonoid content. This study suggested that ALP pouch was better to maintain stable physico-chemical properties for spray-dried leaf powders.

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