WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 5.990
Volume 4, Issue 6, 1042-1048. Research Article ISSN 2277– 7105

PHYSICO-CHEMICAL PROPERTIES OF CHAKIYA VARIETY OF AMLA (*EMBLICA OFFICINALIS*) AND EFFECT OF DIFFERENT DEHYDRATION METHODS ON QUALITY OF POWDER

Abhinav Tyagi[1*] and Dr Anju Pal[2]

[1]Research Scholar, Dept of Biotechnology, Shri Venkateshwara University Gajurala, U.P.

[2]Scientist, Dept of Horticulture, GP Pant University of Agriculture and Science, Uttaranchal.

Article Received on
22 March 2015,

Revised on 13 April 2015,
Accepted on 08 May 2015

***Correspondence for Author**
Abhinav Tyagi
Research Scholar, Dept of Biotechnology, Shri Venkateshwara University Gajurala, U.P.

ABSTRACT

In present study a comparative study of wild variety and cultivated variety of *Amla* were carried out simultaneously, effect of different drying techniques on physicochemical properties of *Amla* powder were also studied. The fruits of wild variety were found smaller than the cultivated variety. In case of wild variety, the total phenolic contents were found to be 34.34 g/100 g of gallic acid equivalent (dwb), whereas Chakiya variety had 25.60 g/100 g of gallic acid equivalent (dwb). The fruits of Chakiya variety were used to prepare the powder by different techniques like freeze drying, sun drying, spray drying, hot air drying and vacuum drying. Powder yield varied with type of drying method as sun drying (11.12%), tunnel drying (9.88%) and vacuum drying (13.58%), spray drying (5.80%) and freeze drying (3.33%). Significant differences ($p<0.05$) in chemical composition of *Amla* powder were observed when prepared by different techniques. The freeze dried powder had the highest ascorbic acid content followed by spray dried powder. The lowest concentration of ascorbic acid was found in sun dried powder. Freeze dried samples showed maximum mineral contents in terms of calcium (89.7 mg/100 g), phosphorus (13.48 mg/100 g) and iron (98.05 mg/100 g).

KEYWORDS: Amla, dehydration methods, quality, polyphenols.

INTRODUCTION

Amla (*Emblica officinalis*, family Euphorbiacea) is a native of India, Ceylon, Malaya and China. The fruit is used as a major constituent in several Ayurvedic preparations such as *Chyavanprash* and *Rasayana* which promotes health and longevity (Rajkumar *et al.*, 2001).

Amla is one of the richest sources of Vitamin C known. In addition to this, potent antioxidant, several active tannoid principles (Emblicannin A, Emblicannin B, Punigluconin and Pedunculagin) have been identified which appear to account for its health benefits (Rastogi 1993; Rao *et al.*,1985). Amla has been reported to posses expectorant, purgative, spasmolytic, antibacterial, hypoglycemic (Jamwal *et al.*, 1959; Jayshri and Jolly, 1993), heaptoprotective and hypolipidemic (Thakur and Mandal, 2004) activity. The aqueous extract has been reported to have anti-pyretic laxative and tonic properties and also showed antibacterial activity (Vinaygamoothy,1982). The ascorbic acid content of fresh *Amla* fruit can range up to 950/100gm which is said to highest among all fruits next only to Barbados cherry (Shankar, 1969). Several value added products have been reported from Amla. Amla was used to prepare ready-to-serve beverage (Deka *et al.*, 2001), candy powder (Tripathi *et al.*, 1988), sauce (Chauhan *et al.*, 2005) etc. The quality of final product depends on the nature of the raw material used for its preparation. There are several varieties of Amla grown throughout different parts of India. However, these varieties are yet to be researched in terms of physico-chemical properties for value addition (Kalra, 1988). In addition, storage conditions also play important role in postharvest quality of Amla fruits. Chakiya is an important variety of Amla which is grown in the Eastern regions of India (Kumar and Khurdiya, 2002). However, little work has been carried out with respect to physicochemical characterization of this variety and powder preparation from the fruits of this particular variety. Therefore, present work was undertaken to study the physicochemical attributes of the fruits of Chakiya varieties as well as a wild variety and preparation of powder. Effect of different drying methods such as sun drying, tunnel drying, spray drying, freeze drying and vacuum drying were also studied with respect to the quality of Amla powder.

MATERIALS AND METHODS

Raw material and preparation of Amla powder

Amla of Chakiya variety (cultivated) was procured from local market while wild variety of Amla was obtained from forest of Saharanpur (Uttar Pradesh, India). The Amla fruits were cleaned and cut into pieces and immediately pressed to obtain juice using a small laboratory manual press. For the preparation of spray dried powder, juice was evaporated up to 50% using rotary evaporator. Maltodextrin (5%, w/v of initial juice) was added to the concentrated juice and stirred for 5 min using mechanical stirrer followed by spray drying (Model LU 228 advance, Labultima, Mumbai, India) at 200°C inlet and 150°C outlet temperature and 40% aspiration speed to dry the sample. For freeze drying 200 ml of juice was subjected to

freezing at -35°C for 3 h followed by freeze dehydration in a freeze dryer (Model Alpha 1-4, Martin Christ, Germany) at 60°C for 16 h. Sun dried powder was prepared from grated Amla dried under sun followed by grinding in a mixer grinder and filtration using muslin cloth. The powder was also prepared by drying the grated Amla in a vacuum oven (KC Instruments, Lucknow, India) at 50°C and in a tunnel drier (B. Sen Berry and Co. India) at 70°C followed by grinding and filtration as described earlier.

ANALYTICAL METHODS

Physical properties

Average fruit weight, length, diameter and number of segments per fruit were measured taking 15 samples of both the varieties. The juice yield was calculated by pressing the fruit segments after removal of seeds and the data were converted on percentage basis.

Moisture, crude fat and mineral content

The moisture and crude fat content of the samples were determined as per AOAC (1997) procedures, whereas minerals (Ca, P and Fe) were estimated as per the AOAC (1990) procedures.

Total phenolic content

Total polyphenols were estimated as per procedure described by Jayprakash *et al.*, (2001) where 250 mg sample was taken in 10 ml of methanol and water (70:30 v/v) solution in a graduated test tube and heated on water bath at 70^{o}C for 10 min. The sample was brought to room temperature, centrifuged at 3500 rpm for 10 min. The supernatant (0.2 ml) was made up to 10 ml with distilled water. This solution was diluted 10 fold. Sample solution (5 ml) was mixed with saturated sodium carbonate (0.5 ml) and Folin-Ciocalteaue reagent (0.2 ml) and made up to 10 ml with distilled water. The absorbance was read at 765 nm after 60 min by UV visible double beam spectrophotometer (Model Evolution 600, Thermo Electron, US).

Ascorbic acid

Sample solution equivalent to 0.2 mg ascorbic acid/ml was prepared in water containing 3% (w/v) metaphosphoric acid. It was titrated against standard 2, 6 dichlorophenol indophenol (2,6 DCIP) solution of 0.5 mg/ml concentration until the pink colour developed completely. The operation was repeated with a blank (Indian Pharmocopia).

Tristimulus colour

Tristimulus colour in terms of Hunter L, a, b values was measured using X-Rite spectrophotometer (USA) using D-65 illuminant and 10^0 C observer. 'L' value represents lightness, 'a' value shows redness-greenness and 'b' value indicates blueness-yellowness of the samples.

Statistical analysis

The data obtained were analyzed statistically for analysis of variance (ANOVA) using completely randomized design with least significant difference (LSD) at $p<0.05$ using Co.Stat 6.303, CoHort software (USA).

RESULTS AND DISCUSSION

Physical properties of wild and cultivated Chakiya variety of Amla fruits is given in Table 1. The fruits of wild variety were found smaller than the cultivated variety. There was significant difference ($p < 0.05$) in weight of the fruits of both the varieties. An average weight of the fruits of the wild variety of Amla was 17.66 g, whereas cultivated variety showed an average weight of 28.88 g. The fruits of both the varieties have six segments. Juice yield was found to be significantly ($p<0.05$) higher in wild variety (48.3%) as compared to Chakiya variety (41.9%). In case of wild variety, the total phenolic contents were found to be 32.32 g/100 g of gallic acid equivalent (dwb) Table 2. The total phenolic contents were also found high in the juice and residue (left after extraction of juice) of wild variety of Amla than the Chakiya variety. The juices had total phenolic concentrations in the range of 174.0 and 176.6 mg/100 g of juice (fwb) in Chakiya and wild variety, respectively. The phenolic contents in juices are low compared to fruits due to loss of phenolics during squeezing process. Another reason may be that polyphenols are involved in specific physicochemical interactions with the solid part of the fruits, especially the cell wall material (Ranaurd *et al.*, 2001). This was reconfirmed by the polyphenolic estimation of residue of juice. Ascorbic acid content was also found to be high in wild variety of *Amla* compared to the cultivated variety Table 2. Kaur and Kapoor (2002) reported more than 70% antioxidant activities as percentage inhibition of oxidation in *Amla* fruits which was correlated positively with total phenols. The total soluble solids in juice prepared from cultivated variety (9.3oBrix) of Amla were also lower than that of wild variety (13.1oBrix).

Effect of drying methods on the quality of powder

The fruits of Chakiya variety were used to prepare the powder. Powder yield varied with type of drying method as sun drying (10.11%), tunnel drying (8.78%) and vacuum drying (12.48%), spray drying (4.90%) and freeze drying (2.23%). Significant differences ($p<0.05$) in chemical composition of Amla powder were observed when prepared by different techniques. The total ascorbic acid content ranged from 3.00 to 5.43 g/100 g of powder. The freeze dried powder had the highest ascorbic acid content followed by spray dried powder. The lowest concentration of ascorbic acid was found in sun dried powder Table 3. When Amla fruits were cut and dried the oxidation process already took place and this may be the reason of low ascorbic acid content in sun dried powder. The rate of oxidation was high during sun drying, hence the sun dried sample showed lowest amount of ascorbic acid than other samples. Moisture content varied from 5.05 to 6.78% whereas fat content varied from 0.23 to 0.59% in the powder prepared by using different dehydration methods. Freeze dried samples showed maximum mineral contents in terms of calcium (79.6 mg/100 g), phosphorus (12.38 mg/100 g) and iron (88.03 mg/100 g). Tristimulus colour values of the powder on Hunter scale in terms of L, a, b values are given in Table 4. Significant differences ($p < 0.05$) were observed in L, a, b values of the samples. Freeze dried sample was found lighter in colour as compared to other powder samples, whereas the sun dried sample was found to be darkest in colour which can be observed by higher L value in freeze dried (61.64) and lower L value in sun dried (45.78) samples. Higher redness was observed in sun dried sample followed by tunnel, vacuum, freeze and spray dried samples. Where as, b value was maximum in tunnel dried sample and minimum in spray dried sample. On the basis of L, a, b colour values, the freeze dried sample was considered better in terms of colour values followed by spray dried one.

Table 1: Physical properties of fruits of wild and Chakiya variety of Amla (n=15)

Particular	Chakiya Variety	Wild Variety
Average Length (cm)	4.0^{a}	3.72^{b}
Average Diameter (cm)	4.8^{a}	4.0^{b}
Average Weight (g)	29.99^{a}	18.77^{b}
No of segments per fruit	7^{a}	7^{a}
Juice yield %	42.9^{b}	49.4^{a}

Values in same row with different superscripts differ significantly ($p<0.05$

Table 2: Chemical properties of fruits of wild and Chakiya variety of *Amla* (n=3)

Particular	Chakiya Variety	Wild Variety
Ascorbic acid (g/100g)	573 + 7.94[b]	670.0 + 10.53[a]
TSS(0Brix)	10.4 + 0.34[b]	14.2 + 0.216[a]
Total phenols in residue (g/100g, dwb)	5.0 + 0.34[b]	13.2 + 0.46[a]
Total phenols in juice (mg/100gm, fwb)	185.0 + 5.8[a]	187.7 + 7.29[a]
Total phenols in fresh Amla (g/100g,	35.6 + 2.22[b]	43.4 + 2.46[a]

Table 3: Mineral content and some chemical properties of *Amla* powder (n=3)

Drying Method	Ca	P	Fe (mg/100g)	Ascorbic acid	Moisture %	Fat
Freeze Dried	80.7 + 0.83[a]	8.00 + 0.35[c]	99.04 + 0.860[a]	6543.86 + 27.22[a]	6.80 + 0.03[a]	0.35 + 0.005[d]
Sun Dried	80.4 + 0.83[b]	8.00 + 0.35[c]	65.30 + 0.83[b]	4006.00 + 15.50[e]	6.87 + 0.20[c]	0.40 + 0.009[c]
Vaccum Dried	75.0 + 0.38[c]	9.27 + 0.94[b]	64.98 + 0.77[b]	3340.88 + 16.25[d]	6.64 + 0.12[b]	0.53 + 0.097[b]
Spray Dried	66.0 + 0.96[d]	6.20 + 0.36[d]	50.37 + 0.92[c]	4060.55 + 11.32[b]	5.08 + 0.91[e]	0.33 + 0.021[e]
Tunnel Dried	60.1 + 2.32[e]	8.96 + 0.54[c]	64.78 + 0.98[b]	3411.00 + 13.31[c]	5.60 + 0.17[d]	0.60 + 0.089[a]

Values in same row with different superscripts differ significantly ($p < 0.05$)

Table 4. Tristimulus colour profile of *Amla* powder (n=3)

Drying Method	L	a	b
Freeze Dried	61.64[a]	-0.16[d]	15.02[b]
Sun Dried	45.78[e]	2.49[a]	14.37[c]
Vaccum Dried	46.18[d]	1.58[c]	12.77[d]
Spray Dried	53.84[c]	-0.30[e]	7.88[e]
Tunnel Dried	59.17[b]	1.67[b]	15.15[a]

Values in same column with different superscripts differ significantly ($p < 0.05$)

CONCLUSION

Amla (var. Chakiya) can be used for development of value added products. This variety had a lower content of phenol, total soluble solids and ascorbic acid as compared to wild variety. However, in terms of average weight, length and diameter the fruit of this variety was found better than wild variety. The powder developed from this variety showed better retention of nutrients and colour in the case of freeze dried samples followed by spray dried ones.

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