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Deterioration of Therapeutically Important Phytoconstituents and Nutrients of Amla (*Phyllanthus emblica*) due to Temperature

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ABSTRACT: Indian gooseberry or amla is a very rich source of ascorbic acid. Its ascorbic acid content lost during the process of drying. Therefore, effect of 4 different temperatures on the nutritional aspects of amla were observed. At the start of experiment dried powder from fresh amla was prepared at room temperature. This powder was subjected to different temperatures ranging from 0 to 90 ^{0}C. From the results it was observed that higher temperatures deteriorate the phytoconstituents and nutritional value of amla powder like ascorbic acid, total sugars, proteins and total phenolics. It is recommended here that amla should be dried at room temperature using standard procedures will maintain the quality of amla best, as evidenced by the results.

I. INTRODUCTION

Phyllanthus emblica (amla) is native of tropical India and Southeast Asia, commonly named as 'Indian gooseberry' (Barthakar and Arnold, 1991). Amla or Indian gooseberry is one of the most important traditional and underutilized fruits of Indian origin, having immense potential for cultivation on marginal or waste lands. It belongs to the family Euphorbiaceae and sub-family Phyllanthoidae. Amla fruits are fleshy, yellowish green in colour having six vague perpendicular furrows enclosing seeds. Nutritional, commercial and medicinal significance of amla fruit makes it popular all over the world (Goyal et al., 2007). Amla is an excellent source of ascorbic acid, amino acid and minerals along with phytochemicals such as polyphenols, tannins, emblicol, linoleic acid, corilagin, phyllemblin and rutin (Ghorai and Sethi, 1996; Jain and Khurdiya, 2004; Murthy and Joshi, 2007; Baliga and Dsouza, 2011). Amla is also a source of carbohydrates, carotene, thiamine, riboflavin, and minerals like iron, calcium and phosphorus (Pareek and Kitinoja 2011) .

The fresh amla fruits are not popular as a table fruit due to their high astringency and its storability after harvesting is also limited (Pareek, 2009). As it is usually used as powder as constituents of herbal drugs. Temperatures deteriorate the plant constituents due to either increasing the enzymatic activity or disrupting the structure and thereby degrades the quality of amla. The present primary study is aimed toward this direction to evaluate the affect of different temperatures on the phytoconstituents and nutritional value of the amla powder.

II. MATERIAL AND METHODS

Fresh amla were harvested from the plants. These were then air dried at room temperature in sunshade. The amla fruits were then grinded in to fine powder. After this the powder were subjected to four different temperatures at 0, 30, 60 and 90 0C for 15 days. 0 ^{0}C was maintained in deep freeze refrigerator and 30, 60, and 90 were maintained in hot air oven. After 15 days interval these samples were subjected to biochemical estimation using the standard methods. Therapeutically important phytoconstituents (total phenolics and ascorbic acid) along with some nutritional components (total sugar and protein) were analyzed during the study. The active constituents were selected on the basis of their therapeutic values whereas the nutrients were selected due to their potential for growth and metabolism. Analysis of total phenolics was carried out in accordance with the Makkar et al. [1993] whereas ascorbic acid was estimated by a titrimetric method as suggested by Roe [1954]. Total sugar was estimated by the standard method as proposed by Dubois et al. [1951] and Lowery et al. [1951] respectively. All the experiments were performed in triplicates.

III. RESULTS

A. Effect on ascorbic acid concentration

The data revealed that *Phyllanthus emblica* powder is rich source of vitamin C. During present investigation initial concentration of ascorbic acid in amla powder was recorded as 4.62±0.32 $mg.g^{-1}$ dry weight. A minor difference was observed in the values of ascorbic acid concentration at 0 and 30 °C temperatures (4.62±0.32and 4.32±0.20) in amla powder samples. However, after increasing the temperature further, there is more deterioration of active principle of amla powder. At 90 °C there is a abrupt deterioration of ascorbic acid After 15 days interval at 90 °C there was quite high difference in comparison at 00C and 90 ^{0}C temperature clearly indicating the role of temperature in degradation of ascorbic acid (Table 1; Fig. 1)

B. Effect on total soluble sugar concentration

During this study a small decrease in total soluble sugar concentration was observed during 0 and 30 and 30 and 60 ^{0}C temperatures. Results showed decreased concentration of total sugar after 15 days of storage at different temperatures and showed at low temperatures sugars are less affected as compared to high temperatures (Table 1 and Fig. 1).

Table 1: Evaluation of phytoconstituents and nutrients of Amla powder samples at various temperatures after storage of 15 days.

Phytoconstituents and nutrients $mg.g^{-1}$ dry weight	Temperature °C			
	0	30	60	90
Ascorbic acid	4.62±0.14	4.32±0.28	3.24±0.22	0.34±0.01
Total Sugar	86.24±0.34	82.46±0.64	74.32±0.54	18.48±0.13
Protein	128.24±0.98	114.32±0.84	98.46±0.64	22.48±0.14
Total Phenolics	264.64±1.24	254.46±1.86	215.62±1.58	102.42±0.86

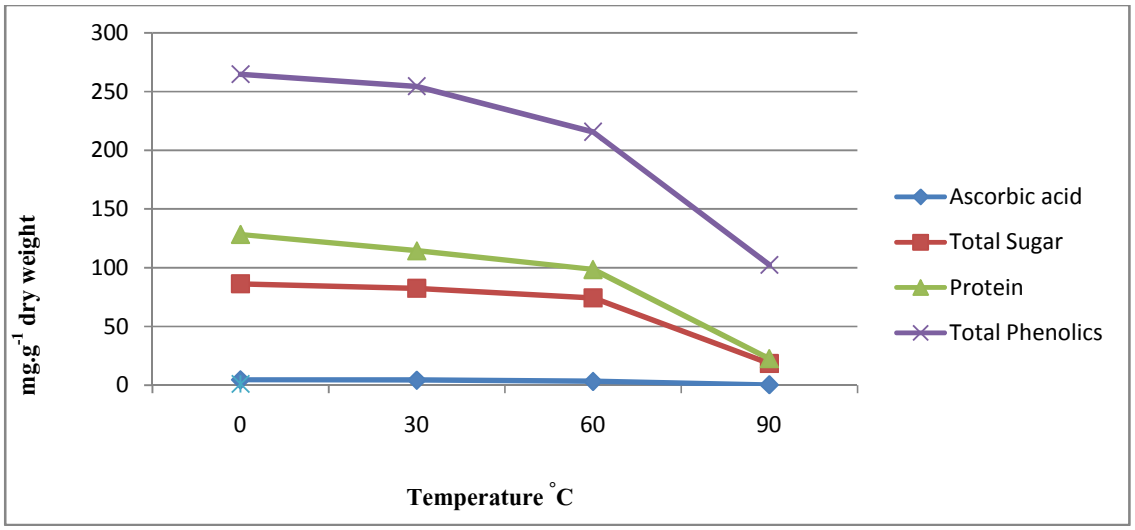

Fig. 1. Changes in phytoconstituents and nutrients of amla powder at different temperatures of 15 days storage.

C. Effect on protein concentration

Results of present investigation showed a significant decrease in protein content during 15 days storage at different temperatures. Initial protein concentration was 128.24±0.96 later on it was recorded as low as 22.48±0.12 at 90 °C after 15 days. Although there was Significant difference in protein concentration at 0, 30, 60 90 °C temperature after 15 days storage.

D. Effect on total phenolics concentration

As depicted in Table 1 and Figure 1, in comparison to the initial concentration of total phenolics (264.64 ±1.20 $mg.g^{-1}$ dry weight) a gradual decrease was observed in concentration of total phenolics of amla powder samples at different temperatures. A significant difference in total phenolic concentration was observed between 30 and 60 and 60 and 90°C temperatures after 15 days storage. Findings revealed that the decrease in total phenolics concentration was comparatively high at 90 °C than 60 and 30°C temperatures. (Table 1 and Fig. 1).

IV. DISCUSSION

Amla is the important constituent of herbal drugs. Generally amla powder is mixed with other ingredients for making different types of herbal drugs. As usually amla powder is used in preparation of these herbal drugs. We have analysed in present study, at which temperatures drying should be done. As higher temperatures deteriorates the phytoconstituents of amla, if it is not properly dried using standard procedures. Just after powder formation at room temperature, we have subjected this powder to different temperatures for 15 days continuously in an oven. The highest ascorbic acid was found in dry powder at 0 ^{0}C followed by 30, 60 and 90 °C. After 30 °C temperature affect ascorbic acid content significantly after 15 days storage (Fig. 1). Tripathi *et al.* (1988) reported that the ascorbic acid content of amla fruit dried by fuidized bed drying has also been reported to be significantly higher than hot air tray drying and sun drying. The reduction in ascorbic acid content might be due to oxidation during storage at high ambient temperature.

Total sugar content was decreased with increase in temperature at 15 days period. The total sugar content of amla was maximum just after drying whereas it was minimum at the 90 °C temperature after 15 days storage. Tripathi *et al.* (1988) reported that a steady decline in total sugar content in direct solar dried Banarasi aonla at 90 days of storage. The decrease in total sugars might be due to the non-specific hydrolysis of macromolecules, interconversion of sugars and aggregation of monomers during storage (Patter 1985). Protein content in the amla start decreases abruptly at higher temperatures. As it is already know that higher temperature disrupt protein structure and denature proteins. Same has been also reported by Akkerman (2014) on the effect of heating processes on milk whey protein denaturation. Phenolics too are affected by the higher temperatures. As because of high temperatures, it seems that conformation disruption may have occurred and that reduces the phenolic content drastically.

V. CONCLUSIONS

This study showed that drying amla fruits at a temperature of 0-30 °C found the best temperature of amla fruits. After further increase in temperatures decreases the nutritional and medicinal value of this wonder fruit.

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