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EFFECT OF DRYING METHODS ON NUTRITIONAL COMPOSITION OF DEHYDRATED BITTER GOURD (*MOMORDICA CHARANTIA* L.) RINGS

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ABSTRACT

Bitter gourd (*Momordica charantia* L.) cv. Pusa Hybrid-2 was dried using three different methods *viz.*, solar drying, low temperature drying and cabinet drying. The cabinet drying method was found to be the best method for drying of bitter gourd rings because of better retention of nutrients like ascorbic acid and total chlorophyll, total carotenoids and *β*-carotene. The moisture content and drying ratio was also found to be lower in cabinet dried rings compared to other methods of drying. Non-Enzymatic browning of the dehydrated fruits was also minimal in the case of cabinet dried bitter gourd rings.

Keywords:
Ascorbic acid, Bitter gourd, Nutritional composition

INTRODUCTION

Bitter gourd is an important vegetable of summer as well as rainy season. Immature fruit is a good source of Vitamin C, and also contains Vitamin A, phosphorus, and iron. The tender vine tips are an excellent source of Vitamin A, and a fair source of protein, thiamin, and Vitamin C. Bitter gourd is a blood purifier, activates spleen and liver and highly beneficial in diabetes. It is a purgative, appetizer, digestive, anti-inflammatory and has healing capacity. It is consumed through-out the Asian subcontinent for culinary and medicinal purposes. Though, due to bitter in taste, this vegetable is valued for its medicinal properties, particularly for the treatment of general fevers, malaria and diabetes (Kedar and Chakraborti, 1982). Bitter gourd is said to tone-up liver and spleen, useful for diabetic people, diuretic and vermicidal and improves digestion. It is also said to be a good vegetable for patient suffering from ascites, gout and pain in joints. Bitter gourd is also known for its anti-diabetic properties due to its potent oxygen free radical scavenging activity of the fruit juice (Sree Jayan and Rao 1991).

The fruits of bitter gourd are very much consumed as fresh and as dried vegetable for curries, bakery products, pickle or stuffed products of meat. It is also used for the preparation of several dishes. It can be fried, deep-fried, boiled, pickled, juiced, and dried to drink as tea (Myojin *et al*., 2008). The seeds of ripe fruits are used as condiment. The fruits are fairly good source of iron, vitamin A, vitamin B, vitamin C and an inexpensive source of protein and minerals (Kumar and Sagar, 2003). Vitamin C helped stave of blindness, kidney failure and the need for amputation among diabetics (Sagar *et al.*, 2008). Bitter gourd has good demand due to its special culinary taste and it is also considered to be a good source of dietary fibers (Gopalan *et al.*, 2000). Drying and canning are two common methods, which are employed to preserve it. Canning increases the cost of the product due to increasing the cost of canes. However dried product is preferred because of some advantages like it reduced mass (bulk) and lower the cost of packaging and storage requirement (Singh *et al*., 2006). Without proper pretreatment, bitter gourd develops rubbery texture and become brown and in addition to that it also loses some of its bitterness principles, ascorbic acid and chlorophyll during drying (Kumar *et al.*, 1991). Dehydrated products are hygroscopic in nature and exchange between food product and its surrounding atmosphere is a common problem. These changes can be controlled by providing adequate packaging material (Sagar, 2001).

MATERIALS AND METHODS

Bitter gourd fruits cv. '*Pusa Hybrid-2*' were obtained from experimental field, Division of Vegetable Science, Indian Agricultural Research Institute, New Delhi-110012. All the fruits were washed with running water under tap to remove adhering dust and reduce the surface micro-flora. The bitter gourd fruits were cut into 1.5 cm thick rings with the help of a sharp stainless steel knife. The prepared rings of bitter gourd were blanched in boiling water for 3 minutes and soaked in 0.2% potassium metabisulphite solution for 15 minutes to inactivate the peroxidase enzymes. The pre-treated bitter gourd rings were spread on an aluminium tray (1.05 × 0.45 m) @ 1.5 kg/sq.m for cabinet drier and solar drier and in stainless steel tray (50 × 40 cm) @ 1.0 kg/sq.m for low temperature drier then

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drying was carried out with the cross flow of hot air flow rate of 1.20-1.80m/sec, at a temperature of 58-60^{0}C in cabinet drier (Kilburn make, Model-0248) and solar drier (40-50^{0}C, 60-80% RH) and low temperature drier (40 ± 2^{0}C and 25-40% RH) to a moisture content of 4-5 % in the finished product. Drying rate was computed by recording the loss in weight at half an hour interval and it was expressed as the rate of residual water to dry matter (Kg of water per kg of dry matter). Fresh fruits as well as dehydrated bitter gourd rings were analyzed for different quality parameters. The moisture content was determined by drying a known weight of the sample in a hot air oven at 60±5^{0}C to a constant weight and expressed as per cent. Total chlorophyll, Total carotenoids, β-carotene, ascorbic acid and non enzymatic browning were determined according to the method of Ranganna (1986). Drying ratio was calculated as net dry weight obtained from fresh weight of the material (Ranganna, 1986).

$$\text{Drying ratio} = \frac{\text{Fresh weight of the material}}{\text{Net dry weight obtained}}$$

Five gram of the dehydrated sample was taken into a beaker and 50 ml of warm (60^{0}C) water was added into it. After one and half hours, the drained weight of the rehydrated material was taken. Rehydration ratio was calculated as:

$$\text{Rehydration ratio} = \frac{\text{Drained weight of rehydrated sample (g)}}{\text{Weight of dehydrated sample (g)}}$$

Overall acceptability, colour, texture and flavour were evaluated by a panel of 7 semi trained members. The samples were presented after rehydration in tap water. Attributes were scored on five point hedonic scale of excellent, 1; good, 2; fair, 3; poor, 4 and very poor, 5 (Okoli *et al.,* 1988). To obtain the loss % in ascorbic acid the data for fresh as well as dehydrated material were expressed as dry weight basis. The data obtained in the present study were subjected to Factorial Completely Randomized Design with 3 replications for statistical analysis as suggested by Gomez and Gomez (1984). The critical difference CD (P=0.05) value at 0.05% level of probability was compared for making the comparison among different treatments.

RESULTS AND DISCUSSION

The physical and chemical constituents of fresh bitter gourd fruits (PH-2) used in the experiment are given in Table1. The peeling/Scrapping loss was 4.60 %. Yield of ready-to-cook bitter gourd rings was 95.40%. The bitter gourd rings took 3 minutes for peroxidase enzyme inactivation time. The drying rate was faster in cabinet drier followed by low temperature drier and solar drier for better drying of bitter gourd rings (Fig - 1). Among the three different types of drier, cabinet drier took 7 hour for drying to reach the constant weight and low temperature driers took 9 hour followed by solar drier, which took 11 hour. Data pertaining to rehydration ratio (Table 2) clearly indicate that, among the driers, cabinet drier was found better for obtaining better dehydration ratio. The better result of cabinet drier was due to high temperature, low RH and fast removal of water. The present study was similar to Jayaraman *et al*. (1991) who revealed the same result on drying ratio of green leafy vegetables. The rehydration ratio was higher in the product dehydrated in cabinet drier and it was comparatively poor in the dehydrated material of solar drier. This was due to faster removal of water during drying, lesser disturbances to anatomical structure of the fruits and better integration of components of dried materials in case of cabinet drier. While, rehydration ratio was comparatively poor in low temperature drier and solar drier due to longer time for drying, poor RH maintenance and fluctuation in air flow and loss of texture which were the main reason for the poor rehydration ratio in case of low temperature and solar drier.Among the driers, cabinet drier was found to be superior for dehydration of bitter gourd as it reduces maximum moisture (4.94 %) after dehydration. The superiority of cabinet drier might be due to the presence of high temperature, low RH and constant airflow. Similar significance influence on moisture content of solar drier has also been reported by Pande *et al.* (2000). Ascorbic acid (57.34 mg/100 g) and total chlorophyll content were higher (11.78 mg/100 g).

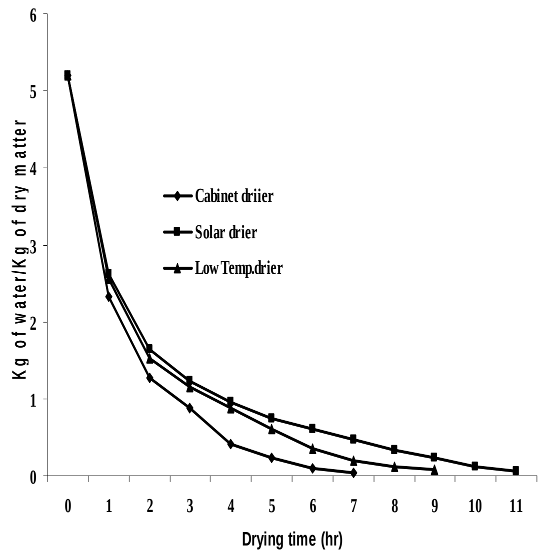

Fig. 1: Drying rate of bitter gourd rings

Table 1: Physical and Chemical parameters of fresh bitter gourd (Wet weight basis)

Parameters	**Pusa Hybrid-2**
Peeling/Scrapping loss (%)	4.60
Yield of bitter gourd rings (%)	95.40
Time taken for inactivation of enzyme (min)	3.00
Moisture (%)	88.64
Ascorbic acid (mg/100g)	77.56
Total carotenoids (mg/100g)	2.16
β-carotene (mg/100g)	1.19
Total chlorophyll (mg/100g)	11.23

Table 2: Effect of drying condition on physic-chemical composition of dehydrated bitter gourd rings (Dry weight basis)

Parameters	**Driers**			**SE(±)**	**CD (*P*=0.05)**
	CD	**SD**	**LTD**		
Drying ratio	10.05:1	11.23:1	10.92:1	0.03	0.10
Rehydration ratio	1:5.51	1:4.91	1:5.12	0.03	0.11
Moisture (%)	4.94	5.16	5.02	0.18	0.64
Ascorbic acid (mg/100g)	57.34	45.74	51.40	0.46	1.59
Total chlorophyll (mg/100g	11.78	10.36	11.56	0.24	0.85
Total carotenoids (mg/100g)	2.11	1.72	2.03	0.14	0.48
β-carotene (mg/100g)	0.86	0.59	0.82	0.05	0.17
NEB (OD at 420nm)	0.51	0.60	0.56	0.01	0.04

The loss of ascorbic acid was higher in the solar drier as compared to cabinet drier and low temperature drier. This might be due to exposing the samples for longer period in the solar drier as compared to cabinet drier. However, the other reason may be due to the proportional of moisture content and dry matter in the finished product, which might have affected the ascorbic acid in different drying conditions. The loss of ascorbic acid in cabinet drier and low temperature drier was at par which might be due to high temperature and less time required for drying in case of cabinet drier and low temperature and more exposure time for drying in case of low temperature drier. Lower chlorophyll content of cabinet drier was due to an inactivation of chlorophyllase enzyme which may be responsible for degradation of chlorophyll. *Jayaraman et al, (*1991) reported that drying by direct exposure to sun resulted in significant loss of pigments due to long time taken for drying, leading to more oxidation of carotene. Negi and Roy (2001) reported that sun, solar, shade or cabinet drying decreased β-carotene of amaranth, and fenugreek significantly. Non-Enzymatic-Browning (NEB) was also lower in cabinet dried materials. This was due to arrest of reaction between amino acid and sugars by cabinet drier as these two components were mainly involved in maillard reaction.The score for sensory evaluation was excellent under cabinet drier (Fig. 2). The dehydrated bitter gourd rings was excellent in colour, flavour and good in texture. The best colour might have due to SO_2 treatment with faster drying of material under cabinet drier. The overall high score was obtained by cabinet drier while solar drier was poor in sensory characteristics due to its slower drying rate.

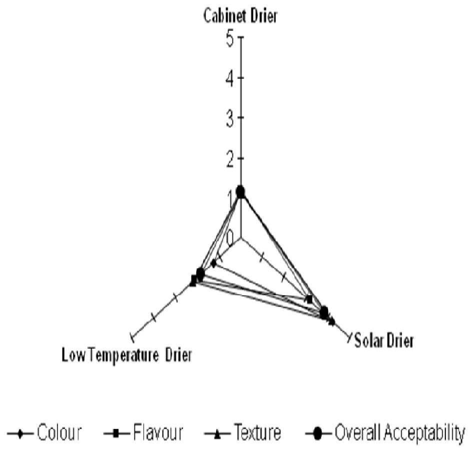

Fig. 2: Sensory Score of dehydrated bitter gourd rings

CONCLUSION

Dehydrated bitter gourd rings have the potential to become an important value added product because of relatively inexpensive, easily and quickly cookable and rich in several nutrients, which are essential for human health. Three different driers namely cabinet drier, low temperature drier and solar drier tried to find out best method of drying, cabinet dryer gave better result as compared to low temperature dryer and solar drier for retaining high content of ascorbic acid, total chlorophyll, β-carotene and total carotenoids, better drying and rehydration ratio and less moisture and NEB in the dehydrated product. Cabinet drier had some additional advantages also as it retained comparatively less moisture in the product, higher retention of nutritional quality parameters in the dehydrated bitter gourd rings and took less time for drying the product in bulk at a time.

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