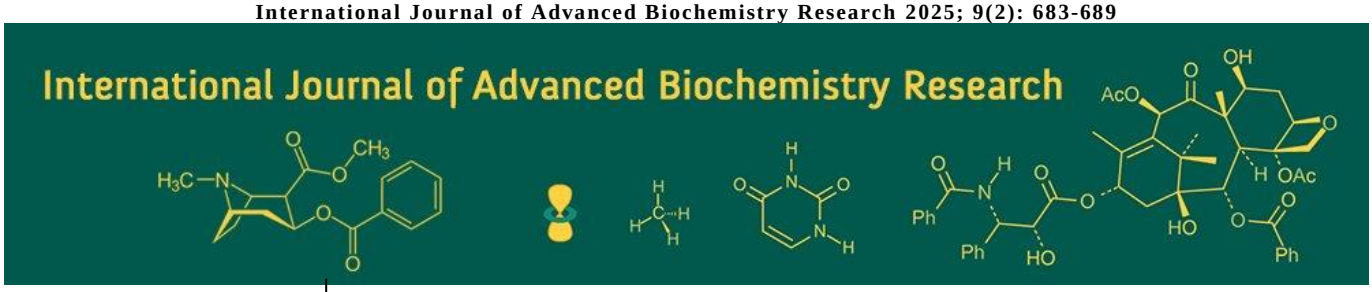

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Standardization of different drying methods of bitter gourd

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Abstract
The present study entitled Standardization of different drying methods of bitter gourd was conducted in the laboratory of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.) during 2023-24. In this experiment the effect of different drying methods for different parameters of bitter gourd were analysed periodically at every 15 days interval up to 60 days of storage period under ambient condition. The physico-chemical analysis of dehydrated bitter gourd revealed an increasing trend in titratable acidity (0.51-0.64%) and decreasing trend in rehydration ratio (5.62 to 5.32), TSS (6.43-6.13%), total chlorophyll (12.93-12.69 mg 100g-1) and beta carotene content ((0.92-0.76 mg $100g^{-1}$). At the end of the experiment, it is revealed that treatment T_7 having tray drying of bitter gourd rings at 50°C is most effective for retaining the quality parameters up to 60 days of storage.

Keywords: Drying methods, physio-chemical, TSS, storage & bitter gourd

1. Introduction
Bitter gourd (*Momordica charantia* L.) is a member of the Cucurbitaceae family and known as Karela commonly in India. Bitter gourd is probably native to India, with a secondary centre in China (Grubben, 1977) [5]. In India, it is cultivated over an area of 110,000 hectares with an annual production of 1,369 tonnes (NHB, 2021-22).

It ranks first among the Cucurbitaceae in terms of nutritional value, especially vitamin C and iron. It is also used as a dietary supplement for vitamins, minerals, bioactive chemicals and antioxidants. It also contains α-momorcarine, β-momorcarine and glycoproteins, making it a good source of nutrition. Though bitter in taste, this vegetable is highly valued for its medicinal properties, especially for treating common fever, malaria, and diabetes (Kedar and Chakraborti, 1982) [10].

India produced around 971,000 tonnes of bitter gourd in the major states of Andhra Pradesh, Odisha, Bihar, and Chhattisgarh (Ministry of Agriculture, 2014). Despite high production, the average annual post-harvest loss of bitter gourd is around 21.88% of the total production (Kalpana *et al.*, 2023) [9]. Main reason for these much loss is due to ripening and mechanical damage during transport. The shelf life of this vegetable is short (3-4 days) at room temperature. This is due to its high moisture content and fast ethylene production. To extend the shelf life of bitter gourd and make it available throughout the year, proper preservation methods are required.

Drying is one of the most important and appropriate methods of moisture reduction and food preservation because it converts agricultural commodities into light weight and volume, easily transportable and storable products thereby minimising packaging, storage and transportation costs. Tray drying of vegetables is a traditional and effective method that involves spreading the samples on trays and exposing them to controlled heat and airflow. Sun drying of vegetables is one of the oldest and simplest methods of food preservation, leveraging natural sunlight and airflow to remove moisture. This method is energy-efficient and cost-effective, making it accessible for small-scale and home operations, particularly in regions with warm, dry climates (Joshi *et. al*, 2011) [7].

2. Materials and Methods

The experiment was designed in Completely Randomized Design (CRD) with 7 treatments and 3 replications. The treatment combinations of present investigation are given below in Table 1.

Table 1: Treatment Details of the Experiment

Treatments	Treatments Details
T_1	Natural drying (Sun drying) of bitter gourd (Control)
T_2	Natural drying (Shade drying) of bitter gourd
T_3	Hot air oven drying of bitter gourd at 50 °C
T_4	Hot air oven drying of bitter gourd at 60 °C
T_5	Air frying of bitter gourd rings at 80 °C
T_6	Air frying of bitter gourd rings at 100 °C
T_7	Tray drying of bitter gourd rings at 50 °C
T_8	Tray drying of bitter gourd rings at 60 °C

2.1 Raw Material

Fresh healthy and unripe bitter gourd vegetables were procured from the local market and are washed thoroughly with clean water to remove dirt adhering. Bitter gourd vegetables were cut into uniform thickness of 5 mm slices.

2.2 Experimental Procedure

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 slices were subjected to various treatment as given in treatment details. After drying the physical and chemical properties of dried bitter gourd slices were determined.

2.3 Observations recorded

2.3.1 Rehydration ratio

To calculate rehydration ratio, 5 g of dehydrated sample was taken into a beaker and 50 ml of Luke warm water was added to it. After one hour, the drained weight of rehydrated sample was taken. Rehydration ratio was calculated by using following formula (Singh and Sagar, 2013) [5].

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

2.3.2 Total soluble solids (TSS) %

TSS content of a product was determined by the index of refraction. It is measured by using hand refractometer, and also referred as degrees Brix. A few drops of sample were placed on hand refractometer and total soluble solids were recorded on the scale of the instrument and it is expressed in percent (%).

2.3.3 Acidity (%)

5 ml sample was taken and dissolved in 50 ml of distilled water and from this 20 ml aliquot was taken out and titrated with 0.1 N NaOH using few drops of phenolphthalein as indicator. End point was judged by the appearance of pink colour. The acidity of the juice is expressed in terms of percent acidity.

$$\text{Acidity (\%)} = \frac{\text{Titre value} \times \text{Normality} \times \text{Eq.wt of acidity} \times \text{volume made up} \times 100}{\text{Weight of sample taken} \times \text{sample taken for estimation} \times 1000}$$

2.3.4 Total chlorophyll (mg 100g^{-1})

Take 1 g of fresh sample, cut into small pieces, add about 5ml of water and homogenize in blender. Make up homogenate to 10 ml with water and centrifuge solution. Take 0.5 ml aliquot and add 4.5 ml of 80% acetone to it to extract pigments. Centrifuge, remove the supernatant and record its optical density (O.D.) at 480, 645 and 663 nm, using 80% acetone as a blank.

Total chlorophyll (mg 100g^{-1}) = (0.0202) (O.D. at 645) + (0.00802) (O.D. AT 663)

2.3.5 Beta-carotene (mg 100g^{-1})

Take 5 g of fresh sample and crush in 10-15 ml acetone, adding a few crystals of anhydrous sodium sulphate, with the help of pestle and mortar. Decant the supernatant into a beaker. Repeat the process twice and transfer the combined supernatant to a separatory funnel, add 10-15 ml petroleum ether and mix thoroughly. Two layers will separate out on standing. Discard the lower layer and collect upper layers will separate out on standing. Discard the lower layer and collect upper layer in a 100 ml volumetric flask, make up the volume to 100 ml with petroleum ether and record optical density at 452 nm using petroleum ether as blank.

$$\text{Beta- carotene (mg 100g}^{-1}) = \frac{\text{O.D.} \times 13.9 \times 10^4 \times 100}{\text{Wt.of sample} \times 560 \times 1000}$$

3. Results and Discussion

3.1 Rehydration ratio

The findings (Table 4.2) of the data showed that the effect of drying methods on rehydration ratio of dehydrated bitter gourd during storage period was found significant on all day of storage period.

On the 1st day of storage, significantly maximum rehydration ratio was recorded in T_7 having (5.62) followed by T_3 and T_2 having rehydration ratio (5.14) and (4.98) respectively. While significantly minimum rehydration ratio of (3.23) was noted in T_6 followed by T_5 (4.20) and T_1 (4.55).

On the 15th day of storage, significantly maximum rehydration ratio was recorded in T_7 having (5.54) followed by T_3 and T_2 having rehydration ratio (5.05) and (4.91) respectively. While significantly minimum rehydration ratio of (3.15) was noted in T_6 followed by T5 (4.11) and T_1 (4.48).

On the 30th day of storage, significantly maximum rehydration ratio was recorded in T_7 having (5.47) followed by T_3 and T_2 having rehydration ratio (4.96) and (4.84) respectively. While significantly minimum rehydration ratio of (3.08) was noted in T_6 followed by T_5 (4.04) and T_1 (4.39).

On the 45th day of storage, significantly maximum rehydration ratio was recorded in T_7 having (5.39) followed by T_3 and T_2 having rehydration ratio (4.89) and (4.76) respectively. While significantly minimum rehydration ratio of (3.00) was noted in T_6 followed by T_5 (3.97) and T_1 (4.31).

On the 60th day of storage, significantly maximum rehydration ratio was recorded in T_7 having (5.32) followed by T_3 and T_2 having rehydration ratio (4.82) and (4.69) respectively. While significantly minimum rehydration ratio of (2.94) was noted in T_6 followed by T_5 (3.90) and T_1 (4.24).

Rehydration ratio indicates the capacity of dehydrated bitter gourd to absorb the moisture, the larger value of rehydration

ratio is the desirable characteristic of the dehydrated bitter gourd. Maximum rehydration was found in tray drying at 50 ℃ whereas minimum in air frying at 120 ℃ during entire storage period. This might be due to lesser disturbances to anatomical structure of the fruits and better integration of components of dried materials in case of tray dryer. The results were matched with Abasi *et al.* (2009) [1]. They stated that cellular tissue becomes more porous at higher temperature for absorbing maximum water. It was observed from the data that, rehydration ratio of bitter gourd slices decreases with advancement of storage up to 180 days. The decreasing trend might be due to gain of moisture by dried slices from atmosphere. These results are in close confirmation with the findings of Shams-Ud-Din and Shirazi (2008) [14] in dehydrated bitter gourd slices.

Table 2: Rehydration ratio of bitter gourd slices influenced by different drying methods

Treatment	Rehydration ratio				
	Storage period (in days)				
	1st day	15th day	30th day	45th day	60th day
T_1 (Sun drying (Control))	4.55	4.48	4.39	4.31	4.24
T_2 (Shade drying)	4.98	4.91	4.84	4.76	4.69
T_3 (Hot air oven drying at 50 °C)	5.14	5.05	4.96	4.89	4.82
T_4 (Hot air oven drying at 60 °C)	4.80	4.71	4.63	4.56	4.47
T_5 (Air frying at 100 °C)	4.20	4.11	4.04	3.97	3.90
T_6 (Air frying at 120 °C)	3.23	3.15	3.08	3.00	2.94
T_7 (Tray drying at 50 °C)	5.62	5.54	5.47	5.39	5.32
T_8 (Tray drying at 60 °C)	4.96	4.87	4.80	4.72	4.64
Mean	4.68	4.60	4.53	4.45	4.38
SE(m)±	0.01424	0.01577	0.01318	0.01242	0.01612
CD at 5%	0.02014	0.04727	0.0395	0.03722	0.04832
CV (%)	0.52660	0.59321	0.50421	0.48328	0.63645

3.2 Total soluble solids (TSS %)

The analysis of TSS

content from dehydrated bitter gourd is reported in (Table 4). It was found that TSS content of dehydrated bitter gourd slices during storage period was significant on all day of storage period.

On the 1st day of storage, significantly maximum TSS content was recorded in T_8 having (6.43%) followed by T_4 and T_7 having moisture (6.30%) and (6.26%) respectively. While significantly minimum of (5.59%) was noted in T_2 followed by T_1 (5.87%) and T_6 (5.92%).

On the 15th day of storage, significantly maximum TSS content was recorded in T_8 having (6.36%) followed by T_4 and T_7 having moisture (6.23%) and (6.18%) respectively. While significantly minimum of (5.51%) was noted in T_2 followed by T_1 (5.80%) and T_6 (5.86%).

On the 30th day of storage, significantly maximum TSS content was recorded in T_8 having (6.27%) followed by T_4 and T_7 having moisture (6.15%) and (6.09%) respectively. While significantly minimum of (5.43%) was noted in T_2 followed by T_1 (5.72%) and T_6 (5.78%).

On the 45th day of storage, significantly maximum TSS content was recorded in T_8 having (6.20%) followed by T_4 and T_7 having moisture (6.09%) and (5.99%) respectively. While significantly minimum of (5.38%) was noted in T_2 followed by T_1 (5.64%) and T_6 (5.69%).

On the 60th day of storage, significantly maximum TSS content was recorded in T_8 having (6.13%) followed by T_4 and T_7 having moisture (6.01%) and (5.92%) respectively. While significantly minimum of (5.31%) was noted in T_2 followed by T_1 (5.58%) and T_6 (5.63%).

The better retention of TSS was observed significantly higher in dehydrated bitter gourd slices dried by tray dryer at 60℃ followed by hot air oven dryer at 60℃. The loss of TSS higher in shade drying. It was observed from the data that, total soluble solids content of dehydrated bitter gourd slices decreases with advancement of storage up to 60 days. The decreasing trend was might be due to chemical reactions such as maillard browning and caramelization and also due to moisture absorption by the dehydrated bitter gourd slices during storage leads to microbial activity, which can further break down sugars and other soluble solids. These results are in good agreement with the result reported by (Dhotre *et al*. 2012) [4] and (Singh and Sagar, 2013) [5].

Table 3: TSS content (%) of bitter gourd slices influenced by different drying methods

Treatment	TSS (%)				
	Storage period (in days)				
	1st day	15th day	30th day	45th day	60th day
T_1 (Sun drying (Control))	5.87	5.80	5.72	5.64	5.58
T_2 (Shade drying)	5.59	5.51	5.43	5.38	5.31
T_3 (Hot air oven drying at 50°C)	6.21	6.12	6.04	5.95	5.88
T_4 (Hot air oven drying at 60°C)	6.30	6.23	6.15	6.09	6.01
T_5 (Air frying at 100°C)	5.96	5.89	5.83	5.75	5.69
T_6 (Air frying at 120°C)	5.92	5.86	5.78	5.69	5.63
T_7 (Tray drying at 50°C)	6.26	6.18	6.09	5.99	5.92
T_8 (Tray drying at 60°C)	6.43	6.36	6.27	6.20	6.13
Mean	6.07	5.99	5.91	5.84	5.77
SE(m)±	0.01328	0.01424	0.01349	0.01359	0.01491
CD at 5%	0.03982	0.04269	0.04044	0.04075	0.04469
CV (%)	0.37918	0.41153	0.39509	0.40333	0.44761

3.3 Titratable acidity (%)

The data presented in Table 4 revealed that influence of different drying methods on titratable acidity content of bitter gourd slices is depicted in Fig. 4.6. The analysis of the data revealed that every day of the storage period, it was determined that different drying methods had a significant effect on the acidity content of dehydrated bitter gourd slices.

On the 1st day of storage, significantly maximum acidity content was recorded in T_7 having (0.51%) followed by T_3 and T_8 having acidity (0.48%) and (0.44%) respectively. While significantly minimum of (0.29%) was noted in T_6 followed by T_5 (0.31%) and T_1 (0.33%).

On the 15th day of storage, significantly maximum acidity content was recorded in T_7 having (0.55%) followed by T_3 and T_8 having acidity (0.52%) and (0.47%) respectively. While significantly minimum of (0.33%) was noted in T_6 followed by T_5 (0.35%) and T_1 (0.37%).

On the 30th day of storage, significantly maximum acidity content was recorded in T_7 having (0.58%) followed by T_3 and T_8 having acidity (0.56%) and (0.51%) respectively. While significantly minimum of (0.36%) was noted in T_6 followed by T_5 (0.38%) and T_1 (0.41%).

On the 45th day of storage, significantly maximum acidity content was recorded in T_7 having (0.6%) followed by T_3 and T_8 having acidity (0.59%) and (0.52%) respectively. While significantly minimum of (0.38%) was noted in T_6 followed by T_5 (0.4%) and T_1 (0.44%).

On the 60th day of storage, significantly maximum acidity content was recorded in T_7 having (0.64%) followed by T_3 and T_8 having acidity (0.61%) and (0.55%) respectively. While significantly minimum of (0.40%) was noted in T_6 followed by T_5 (0.43%) and T_1 (0.47%).

It was observed from the data that, titratable acidity of bitter gourd slices increases with advancement of storage up to 60 days. The increasing trend might be due to conversion of some amount of sugars into acid. T_6 had the lowest acidity, which increased from the 1st to 60th day that is 0.29% to 0.40% whereas T_7's acidity content remained at its greatest point during the storage days and increased from the 1st to 60th day that is 0.51% to 0.64%. Increase in acidity is due to drying methods.

Table 4: Titratable acidity (%) content of bitter gourd slices influenced by different drying methods

Treatment	Titratable acidity (%)				
	Storage period (in days)				
	1st day	15th day	30th day	45th day	60th day
T_1 (Sun drying (Control))	0.33	0.37	0.41	0.44	0.47
T_2 (Shade drying)	0.35	0.39	0.44	0.46	0.49
T_3 (Hot air oven drying at 50°C)	0.48	0.52	0.56	0.59	0.61
T_4 (Hot air oven drying at 60°C)	0.40	0.43	0.48	0.51	0.53
T_5 (Air frying at 100°C)	0.31	0.35	0.38	0.40	0.43
T_6 (Air frying at 120°C)	0.29	0.33	0.36	0.38	0.40
T_7 (Tray drying at 50°C)	0.51	0.55	0.58	0.60	0.64
T_8 (Tray drying at 60°C)	0.44	0.47	0.51	0.52	0.55
Mean	0.39	0.43	0.46	0.49	0.51
SE(m)±	0.01074	0.00858	0.00852	0.0065	0.0071
CD at 5%	0.03219	0.02572	0.02554	0.0194	0.0212
CV (%)	4.77857	3.48292	3.17508	2.2914	2.3839

The results are in agreement with the findings of Dhotre *et al*. (2012) [4] in dehydration of bitter gourd slices. The increase in acidity may be attributed to the increased microbial growth in dehydrated products, producing organic acids during storage irrespective of pretreatments under study. The results of a present investigation are in conformity with the results reported by Chitarra and Chitarra (2005) [3] who observed that, the titratable acidity in vegetables might be due to organic acids which are dissolved in the vacuoles of the cells either free from, as combined with salts, esters, glycosides. Reduction in titratable acid content was also reported by Muzzaffar *et al.* (2016) [12] and Santos *et al*. (2016) [13].

3.4 Total chlorophyll (mg $100g^{-1}$)

The of total chlorophyll content of dehydrated bitter gourd has been presented in (Table 4) and graphically depicted in (Figure 1). The critical evaluation of the data showed that the effect of drying methods was found significant on all day of storage period.

On the 1st day of storage, significantly maximum total chlorophyll content was recorded in T_7 having (12.93 mg $100g^{-1}$) followed by T_3 and T_8 having chlorophyll (12.78 mg $100g^{-1}$) and (12.56 mg $100g^{-1}$) respectively. While significantly minimum of (11.29 mg $100g^{-1}$) was noted in T_6 followed by T_5 (11.53 mg $100g^{-1}$) and T_1 (11.87 mg $100g^{-1}$).

On the 15th day of storage, significantly maximum total chlorophyll content was recorded in T_7 having (12.87 mg $100g^{-1}$) followed by T_3 and T_8 having chlorophyll (12.70 mg $100g^{-1}$) and (12.48 mg 100g-1) respectively. While significantly minimum of (11.22 mg $100g^{-1}$) was noted in T_6 followed by T_5 (11.46 mg $100g^{-1}$) and T_1 (11.81 mg $100g^{-1}$).

On the 30th day of storage, significantly maximum total chlorophyll content was recorded in T_7 having (12.81 mg $100g^{-1}$) followed by T_3 and T_8 having chlorophyll (12.63 mg $100g^{-1}$) and (12.41 mg $100g^{-1}$) respectively. While significantly minimum of (11.15 mg $100g^{-1}$) was noted in T_6 followed by T_5 (11.39 mg $100g^{-1}$) and T_1 (11.75 mg $100g^{-1}$).

On the 45th day of storage, significantly maximum total chlorophyll content was recorded in T_7 having (12.75 mg $100g^{-1}$) followed by T_3 and T_8 having chlorophyll (12.57 mg $100g^{-}$) and (12.34 mg $100g^{-1}$) respectively. While significantly minimum of (11.08 mg $100g^{-1}$) was noted in T_6 followed by T_5 (11.33 mg $100g^{-1}$) and T_1 (11.68 mg $100g^{-1}$).

On the 60th day of storage, significantly maximum total chlorophyll content was recorded in T_7 having (12.69 mg $100g^{-1}$) followed by T_3 and T_8 having chlorophyll (12.50 mg $100g^{-1}$) and (12.27 mg $100g^{-1}$) respectively. While significantly minimum of (11.01 mg $100g^{-1}$) was noted in T_6 followed by T_5 (11.28 mg $100g^{-1}$) and T_1 (11.62 mg $100g^{-1}$).

Total chlorophyll is the main chemical component responsible for the green colour of the vegetables; it was

determined in the dehydrated bitter gourd slices at different stages of storage up to 60 days. In the present study, total chlorophyll content was significantly affected not only drying methods, but also by the storage periods, there was gradual decrease in the chlorophyll content in drying methods during storage. It was observed that significantly lowest in samples dried in air frier at 120 ℃ and highest chlorophyll content was recorded in bitter gourd slices dried by tray dryer at 50 ℃, it might be due the lower drying temperatures are more effective in preserving chlorophyll, which degraded at higher temperatures.

Results of reduction of chlorophyll content during storage have also been reported by Kalaskar *et al*. (2012) [4] in dried fenugreek leaves, Manimegalai *et al*. (1999) [11] in bitter gourd and Singh *et al*. (2006) [16] in green leafy vegetables.

Table 5: Total chlorophyll (mg $100g^{-1}$) Content of bitter gourd slices influenced by different drying methods

Treatment	Total chlorophyll (mg $100g^{-1}$) Storage period (in days)				
	1st day	15th day	30th day	45th day	60th day
T_1 (Sun drying (Control))	11.87	11.81	11.75	11.68	11.62
T_2 (Shade drying)	12.02	11.96	11.88	11.81	11.75
T_3 (Hot air oven drying at 50 °C)	12.78	12.70	12.63	12.57	12.5
T_4 (Hot air oven drying at 60 °C)	12.17	12.11	12.04	11.97	11.9
T_5 (Air frying at 100 °C)	11.53	11.46	11.39	11.33	11.28
T_6 (Air frying at 120 °C)	11.29	11.22	11.15	11.08	11.01
T_7 (Tray drying at 50 °C)	12.93	12.87	12.81	12.75	12.69
T_8 (Tray drying at 60 °C)	12.56	12.48	12.41	12.34	12.27
Mean	12.15	12.08	12.01	11.94	11.88
SE(m)±	0.01555	0.01654	0.01514	0.01491	0.01349
CD at 5%	0.04661	0.04959	0.04538	0.04469	0.04044
CV (%)	0.2217	0.23725	0.21837	0.21622	0.19669

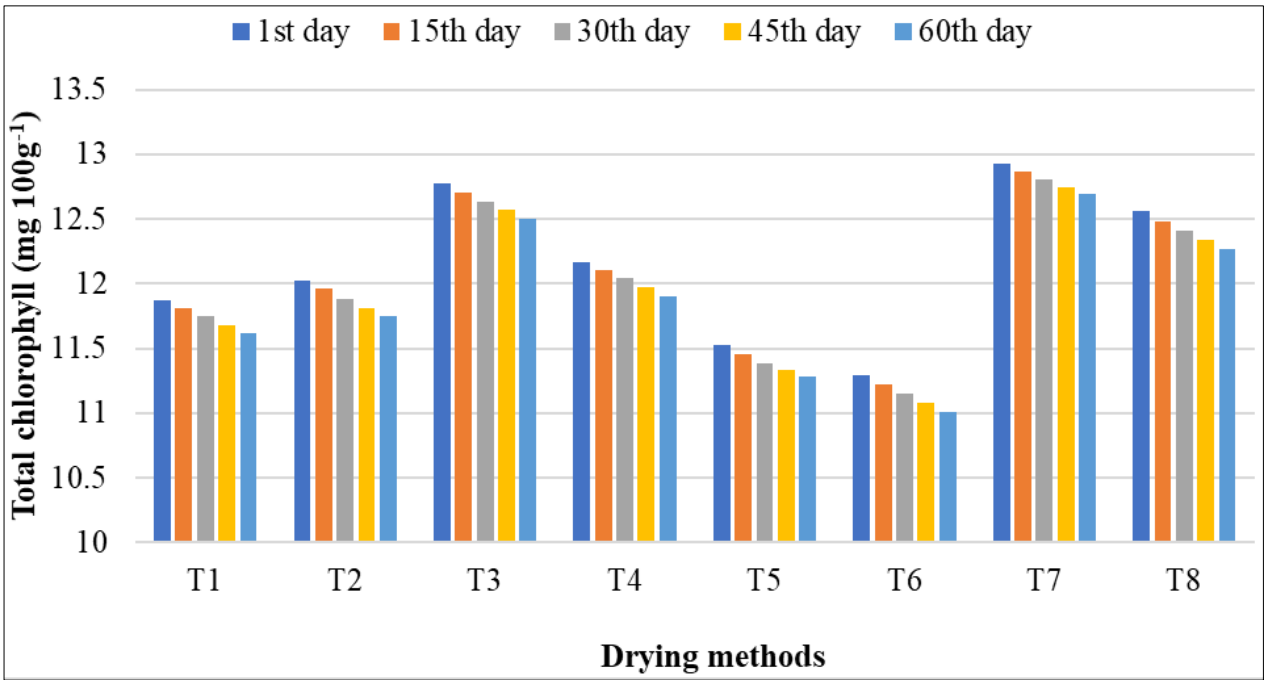

Fig 1: Total chlorophyll (mg $100g^{-1}$) Content of bitter gourd slices influenced by different drying methods

3.5 Beta-carotene (mg $100g^{-1}$)

The beta-carotene content of dehydrated bitter gourd has been presented in (Table 5) and graphically depicted in (Figure 1). The critical evaluation of the data showed that the effect of drying methods was found significant on all day of storage period.

On the 1st day of storage, significantly maximum beta-carotene content was recorded in T_7 having (0.92 mg $100g^{-1}$) followed by T_3 and T_8 having beta-carotene (0.87 mg $100g^{-1}$) and (0.8 mg $100g^{-1}$) respectively. While significantly minimum of (0.41 mg $100g^{-1}$) was noted in T_6 followed by T_5 (0.5 mg $100g^{-1}$) and T_1 (0.59 mg $100g^{-1}$).

On the 15th day of storage, significantly maximum beta-carotene content was recorded in T_7 having (0.87 mg $100g^{-1}$) followed by T_3 and T_8 having beta-carotene (0.83 mg $100g^{-1}$) and (0.79 mg $100g^{-1}$) respectively. While significantly minimum of (0.37 mg $100g^{-1}$) was noted in T_6 followed by T_5 (0.46 mg $100g^{-1}$) and T_1 (0.55 mg $100g^{-1}$).

On the 30th day of storage, significantly maximum beta-carotene content was recorded in T_7 having (0.84 mg $100g^{-1}$) followed by T_3 and T_8 having beta-carotene (0.79 mg $100g^{-1}$) and (0.75 mg $100g^{-1}$) respectively. While significantly minimum of (0.33 mg $100g^{-1}$) was noted in T_6 followed by T_5 (0.42 mg $100g^{-1}$) and T_1 (0.51 mg $100g^{-1}$).

On the 45th day of storage, significantly maximum beta-carotene content was recorded in T_7 having (0.80 mg $100g^{-1}$) followed by T_3 and T_8 having beta-carotene (0.76 mg $100g^{-1}$) and (0.71 mg $100g^{-1}$) respectively. While significantly

minimum of (0.29 mg 100g^{-1}) was noted in T_6 followed by T_5 (0.37 mg 100g^{-1}) and T_1 (0.48 mg 100g^{-1}).

On the 60th day of storage, significantly maximum beta-carotene content was recorded in T_7 having (0.76 mg 100g^{-1}) followed by T_3 and T_8 having beta-carotene (0.72 mg 100g^{-1}) and (0.68 mg 100g^{-1}) respectively. While significantly minimum of (0.25 mg 100g^{-1}) was noted in T_6 followed by T_5 (0.34 mg 100g^{-1}) and T_1 (0.43 mg 100g^{-1}).

It is revealed from the data that beta-carotene content of dried bitter gourd slices was significantly varied due to different drying methods and storage. Further, decreasing trend of beta-carotene content was observed during the storage among all the drying methods. However, the β-carotene content was significantly higher when the samples are dried in tray drying at 50 ℃ compared to other method of drying. Lower amount of beta-carotene content fount in the samples dried by air fryer at 120 ℃. Beta-carotene is a fat soluble and sensitive to heat and light therefore the more beta-carotene retention in tray drying. Similar result found by Joshi and Mehta (2010) [6] and Ahmed *et al.* (2012) [2]. Closer results were recorded by Singh and Sagar (2013) [5] in dehydrated bitter gourd rings.

Table 6: Beta-carotene (mg 100g^{-1}) Content of bitter gourd slices influenced by different drying methods

Treatment	Beta-carotene (mg 100g^{-1}) Storage period (in days)				
	1st day	15th day	30th day	45th day	60th day
T_1 (Sun drying (Control))	0.59	0.55	0.51	0.48	0.43
T_2 (Shade drying)	0.68	0.63	0.59	0.55	0.51
T_3 (Hot air oven drying at 50 °C)	0.87	0.83	0.79	0.76	0.72
T_4 (Hot air oven drying at 60 °C)	0.73	0.69	0.65	0.61	0.58
T_5 (Air frying at 100 °C)	0.50	0.46	0.42	0.37	0.34
T_6 (Air frying at 120 °C)	0.41	0.37	0.33	0.29	0.25
T_7 (Tray drying at 50 °C)	0.92	0.87	0.84	0.80	0.76
T_8 (Tray drying at 60 °C)	0.8	0.79	0.75	0.71	0.68
Mean	0.69	0.65	0.61	0.57	0.53
SE(m)±	0.01027	0.01027	0.01034	0.01061	0.01093
CD at 5%	0.03080	0.03080	0.03100	0.03180	0.03277
CV (%)	2.59152	2.74299	2.93636	3.22301	3.55209

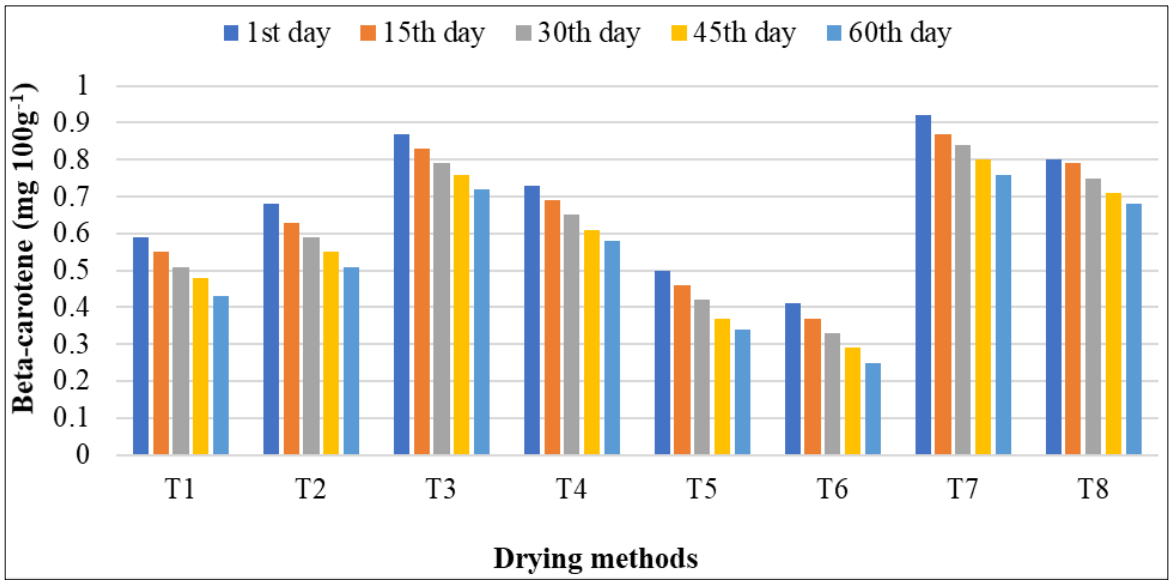

Fig 2: Beta-carotene (mg 100g^{-1}) content of bitter gourd slices influenced by different drying methods

4. Conclusion

This research emphasizes to study effect of drying methods on physico-chemical properties of dehydrated bitter gourd during storage. Throughout the storage period it was observed T_7: Tray drying of bitter gourd at 50 °C was found significantly superior in maintaining maximum rehydration ratio, acidity, total chlorophyll and beta-carotene. Hence the treatment T_7: Tray drying of bitter gourd at 50 °C can be considered as the most effective for retaining the quality parameters. T_8: Tray drying of bitter gourd at 60 °C has recorded maximum TSS content during the storage period up to 60 days. Chemical compounds like acidity increased, while rehydration ratio, total chlorophyll and beta-carotene content decreased with advancement of storage period.

5. References

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