

**Physicochemical analysis of Bell Pepper dried using conventional and microwave technique**Deepshikha<sup>1\*</sup>, Sankalp<sup>2</sup>, Sonia<sup>3</sup>, Rohit Biswas<sup>4</sup>, Rama Nath Shukla<sup>5</sup><sup>1,3,4</sup> *Department of Food Technology and Nutrition, School of Agriculture, Lovely Professional University, Phagwara (Punjab), India*<sup>2,5</sup> *Department of food process engineering, VIAET, SHUATS, Allahabad, U.P-211007**\*E-mail: bansaldeepshikha789@gmail.com**Department of Food Science & Nutrition, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India**Tel. no. +91-8872223134***Abstract**

*Bell pepper is initial nutrition daily basis at home Capsicum annum, belongs to Solanaceae family a tropical climate environment and in among important crop in Brazilian market. In natural form pepper (chilly) (Capsicum spp) is considered as spice in most case. In this project the drying method of capsicum has been introduced, that is microwave drying and tray drying method. The experiment had been conducted for 15 days with 16 samples of bell pepper. During the experiment several test of bell pepper had been taken like moisture content, vitamin C, ash content, microbial count per centimeter square and last one was sensory by different peoples. This was founded that the drying rate of bell pepper was 11.68 to 12.44%, moisture content on hot air oven was varying from 11.68 g to 22.12 g and on microwave dryer was varying from 11.75 g to 20.22 g. Where was the ash content of sample varying from 1.96 g to 1.14g.*

**Introduction:**

Pepper (chilli) is widely used as spice, vegetable and fruit in some ethnic diets mostly preferred in African and Asian provinces. Over 19 million tons are harvested from 1.5 million hectares of Nigeria land making it highest producer. Bell pepper is available in a wide variety of color, shape, size ranging mainly in term color as green, yellow and red.

Pepper is consumed worldwide and presence of high level of Ascorbic Acid, calcium and Carotene tend to be characterized as such. Dried bell pepper is a potential spice product with wide use as flavoring and coloring agents. Traditionally sun drying plays vital role in drying of spices, but it limits the quality of final dried product obtained as it takes almost 5 days to dry completely relying on weather condition to finally reach 4-11 % d.b.

Conventional drying tends to longer drying time and also partial isolation from surrounding depending on drying equipment's, also various undesirable changes such as wilting, color change lead to lower economical value (Santos and Silva 2008). As to avoid this problem, as by reducing drying time and exposure to external environment lead to higher quality of final product, thus Microwave drying poses potential in this regard of overcoming the time constrain thus increasing the final quality of products. The need to preserve the fruits and vegetable either in fresh form or in dried form with the quality comparable to that of freshly grown fruit enact with natural vitamins and mineral. This could be achieved with that of cold storage but there are certain fruits and vegetable which couldn't be stored well in lower temperatures so drying is second most suitable form of preservation, but for fruits and vegetable with heat sensitive vitamins drying is also a concern. So, the need to optimize the temperature with the maximum retention of vitamins. This could be achieved with that drying in lower temperature for a longer time, but the best time must be correlated with that of temperature so as to achieve maximum quality and rehydration property.

**Material and methods:****Preparation and Drying of Raw bell pepper:**

Raw sample has been bought from local market and cut into two different shapes i.e. slice and cube shape. Then measured amount of sample has been dried using hot air oven as well as

microwave oven. In hot air oven the four samples have been placed at a temperature of 70°C for 6-7hrs. For microwave sample has been placed at 200 W for 10-12 minutes and dried.

**Determination of moisture content:**

The moisture content of raw and dried bell pepper sample has been determined by using hot air oven method as described by AOAC methods. The measured amount of sample raw as well as dried by using both methods of bell pepper was dried using pre-weighed glassware and dried in heated hot air oven at 105±1°C until constant reading of sample has been achieved. The sample has been weighed after cooling in desiccator and % percentage moisture content has been calculated.

$$\text{Moisture Content} = \frac{\text{initial weight of sample} - \text{final weight of sample}}{\text{initial weight of sample}} \times 100$$

**Estimation of Ash content:**

5g of sample (sliced and cube shape) kept in pre-weighed and dried crucible dish. The sample has been subjected to charring on low flame followed by heating in muffle furnace at 550± 50°C for 3-4 hours. Then sample has been taken out and kept in desiccator for cooling and weighed. The ash percentage has been calculated by given formula.

$$\text{ash \%} = \frac{\text{weight of ash}}{\text{weight of sample}} \times 100$$

**Determination of Ascorbic acid:**

**Iodine solution:** The solution was prepared from 1.3g of iodine crystals and 2g of potassium iodide and mixed with little amount of water until it gets dissolved. Then make up volume upto 1L of distilled water and kept it for 12-13 hrs.

**Starch Solution (0.5%):**0.25 g of soluble starch was added to 50 ml of distilled near boiling water in conical flask. Mixed well by stirring and cooled completely before usage.

**Nutrient Agar solution:** Solution of nutrient agar has been prepared using standard calculation to determine the growth of microorganism. As it contains all essential nutrients which facilitates the growth of variety of microorganisms.

**Sample preparation:** Juice from raw and dried sample has been extracted and strained using cheesecloth to remove any seeds or any other solid material that may interfere during analysis. For the extraction of juice pre-weighed amount of 10g sample has been taken and grind by using pestle and mortar with the addition of small amount of distilled water for several times for ease of juice extraction. Alternatively, food processor can be used to blend sample and strain the pulp through cheesecloth by washing it with 10 ml portions several times to extract juice and make up volume up to 100 ml.

**Titration:**

A 20 ml sample juice has been mixed with 150 ml of distilled water and 1 ml of starch indicator solution into 250 ml of conical flask. Iodine solution prepared was used for titration of sample to obtain ascorbic acid. Permanent trace of dark blue-black colour obtained identified as the end point of titration due to starch-iodine complex.

**Rehydration ratio:** The rehydration ratio of sample has been determined during storage studies of 15 days' interval. The sample has been tested after every 5 days by putting the weighed sample into water at a temperature of 80°C to check the rehydration property of sample during the period of storage.

$$\text{Rehydration ratio} = \text{Wr/Wd} \times 100$$

**Microbial growth:** Nutrient agar for microbial analysis has been prepared by using 7g in 200ml of distilled water. The prepared sample sterilize by autoclaving at 15psi and 121°C for 15-20 minutes to remove any type of contamination. Sample for the analysis was prepared by using 10g of crushed capsicum with addition of 50ml of distilled water, strained and 10 ml of juice has been pipetted, added to one test tube. Then prepared solution was used to prepare serial dilutions for every sample and analyzed for microbial growth by transferring into petri plate and mix with nutrient agar media.

**Sensory analysis:** Sensory analysis including color, texture, appearance and overall acceptability was determined. Hedonic rating was performed for the conduct of sensory evaluation. It was done for obtaining the acceptability at consumer level. Consumer survey was performed at various age group so to obtain overall acceptability of product at various age group. The consumer were required to rate the product on the basis of 9-point hedonic scale.

### **Results and discussions**

**Drying and effect on moisture content of bel pepper:** Bel pepper sample has been dried using hot air oven and microwave method. The results were analyzed on comparison basis with both the methods for different samples. Sample has been dried into two different shapes and in four different samples for each method. Results revealed that the moisture left in dried sample was more in cube shaped sample than in sliced sample i.e. 12.44% to 11.75% in microwave and for hot air oven the change in moisture content was 12.54% to 11.68% on average basis. On comparison between both methods, microwave drying results in higher level of drying in cube shaped sample as compare with hot air oven method. The results have been in accordance with previous studies that drying rate of any fruit and vegetable sample remains higher in microwave drying as compared to conventional drying as in former method energy is absorbed in water

dipoles which allows it to remove moisture by creating pressure at the center of the dried sample (Tang et al., 2005).

Table 1 : Moisture content of dried sample

Method of drying	Sample Pattern		Moisture Content of dried bell pepper				Average% of dried bell pepper
			R1	R2	R3	R4	
Microwave drying	Cube	T1	12.26	12.98	12.32	12.22	12.44
	Slice	T2	11.75	11.61	12.11	11.55	11.75
Hot air oven drying	Cube	T3	12.38	12.65	13.02	12.11	12.54
	Slice	T4	11.68	11.14	12.55	11.37	11.68

On further proceeding for analysis of effect of storage studies on moisture content during 15 days by using LDPE as packaging material it was found that with increasing the days of storage moisture content of sample was progressively increased for both methods but increase in moisture content was higher in conventional drying (12.44% to 20.22%) as compared to microwave treated sample (12.54% to 22.12%).

Table 2 : Moisture content of sample at different storage time intervals

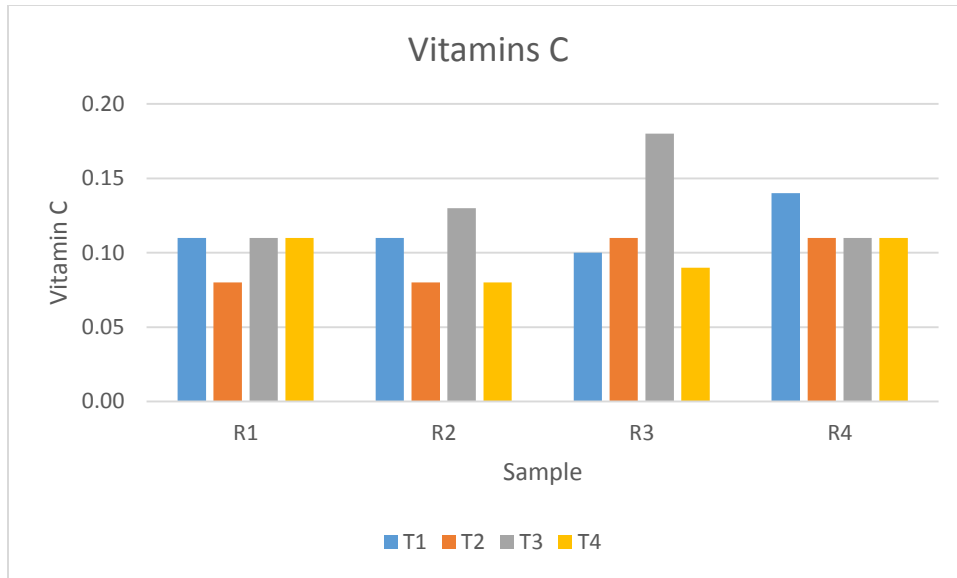
Method	Sample	R1	R2	R3	R4
Microwave drying	T <sub>1</sub>	12.44	14.74	17.88	20.22
	T <sub>2</sub>	11.75	13.50	18.22	21.23
Hot air oven drying	T <sub>3</sub>	12.54	14.52	17.35	22.12
	T <sub>4</sub>	11.68	13.45	18.25	21.85

**Effect of drying on ash content:**the amount of inorganic material was also examined for the sixteen samples of bel pepper treated with both methods having cube and slice shape. As ash content falls under proximate analysis of a material so, in this process the organic material is completely charred to left out only with inorganic material so no significant difference was observed among the samples.

Table 3 : Ash content observed in 15 days with four samples dried by different method.

Method	Sample	R1	R2	R3	R4
<b>Microwave Drying</b>	T <sub>1</sub>	1.14	1.44	1.96	1.52
	T <sub>2</sub>	1.36	1.18	1.42	1.76
<b>Tray Drying</b>	T <sub>3</sub>	1.28	1.28	1.22	1.96
	T <sub>4</sub>	1.18	1.42	1.62	1.00

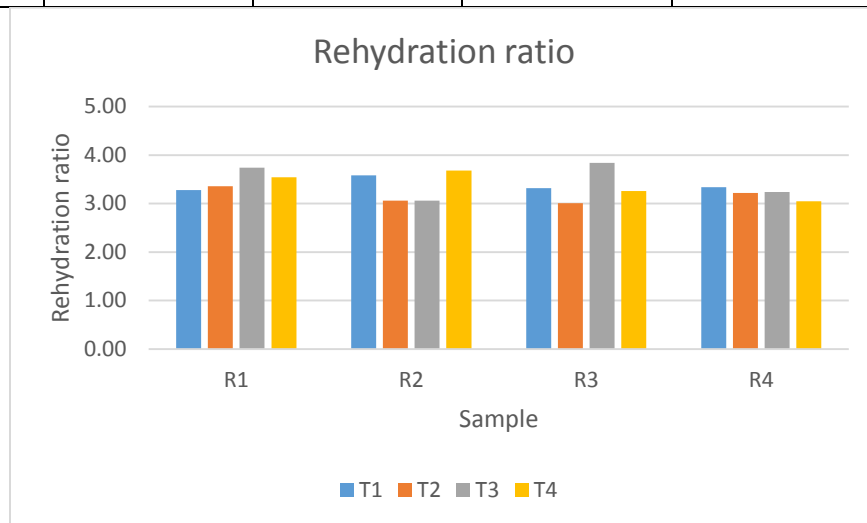
**Effect of drying methods on Ascorbic acid:** Raw bel pepper sample has been considered as good source of vitamin C as this is having good antioxidant properties. So effect of drying was examined on vitamin C content of dried bel pepper sample to evaluate at what conditions it could retain more value. So the study shown that there was decrease in vitamin C content but there was little retention in cube shape sample even during the storage cycle of 15 days. The degrading value of ascorbic acid content could be due to various factors as this content is heat sensitive and sliced shape sample have more exposure towards environmental conditions during drying in both machines so unable to retain its property during storage intervals. Similar type of results were also found with other studies for different fruits by Qing-guo et al (2006), Al-Zubaidy and Khalil(2007) and Goula and Adamopoulos (2006). The decrease in ascorbic acid content was obvious as vitamin C content is heat sensitive. So, the results were in accordance with previous studies Ahmat kaya et al., (2010).



**Effect on drying on rehydration ratio:** The effect of drying methods with varying conditions on content of Rehydration ratio are shown in Fig. The results had revealed that for all the samples with both shapes there was decrease in rehydration ratio content with varying days of storage from 0 to 15 days except for cube shape microwave treated sample. While considering both methods microwave dried bel pepper have good rehydration property than hot air oven i.e. 3.28% to 3.34% for cube shape in comparison to sliced sample treated by same method 3.36% to 3.22%. For conventional drying methods the results were in degrading manner as per concern for both of methods and storage studies. The increase in rehydration ratio in cube shape sample could be due to evenly drying and having more retention property due to less damage to cellular structure while comparing to sliced shape sample the value was decreasing that could be due to exposed surface of sample was more and comparatively thin and effect of temperature and microwave may lead to decrease this value. The results for current study was found similar to previous studies Singh & Pandey, 2011; Souzaa et al., 2011; Seremet et al., 2016).

Method	Days	Sample	Initial Weight	Rehydrated Weight	Rehydration Ratio
	0	T <sub>1</sub>	5	16.4	3.28

Microwave Drying		T <sub>2</sub>	5	16.8	3.36
	5	T <sub>1</sub>	5	17.9	3.58
		T <sub>2</sub>	5	15.3	3.06
	10	T <sub>1</sub>	5	16.6	3.32
		T <sub>2</sub>	5	15.5	3.01
	15	T <sub>1</sub>	5	16.7	3.34
Hot air oven drying		T <sub>3</sub>	5	18.7	3.74
		T <sub>4</sub>	5	17.7	3.54
	5	T <sub>3</sub>	5	15.3	3.06
		T <sub>4</sub>	5	18.4	3.68
	10	T <sub>3</sub>	5	19.2	3.84
		T <sub>4</sub>	5	16.3	3.26
	15	T <sub>3</sub>	5	16.2	3.24
		T <sub>4</sub>	5	17.5	3.05



**Microbial analysis of dried sample:**The shelf life of the dried sample has been analyzed on microbial basis. Microbial colony count was performed so as to obtain microbial activity on the dried product for the respective days. At 0 days the microbial load was found almost nil as due to drying, while it increased exponentially on 5<sup>th</sup> day due non-vacuum condition, and the microbial

load consistently increased for the consecutive days, till the 15<sup>th</sup> day the microbial load of dried capsicum rendered it unacceptable.

Method	Sample	0 Day	5 Day	10 Day	15 Day
Microwave Drying	T <sub>1</sub>	0	0.4487	0.5151	0.6027
	T <sub>2</sub>	0	0.5600	0.3478	0.2333
Hot air oven drying	T <sub>3</sub>	0	0.4583	0.5166	0.4705
	T <sub>4</sub>	0	0.5166	0.4888	0.4375

**Sensory Evaluation**

Sensory evaluation was carried out for dried sample at defined interval of timeso as to summaries the human acceptability for dried product at various shelf life condition. The dried product suitability was found in T4 sample at 5 days, which was due to partial moisture gain, thus improving it appearance and overall aroma of dried product. Whereas sample after 15 days was found with lowest acceptability in terms of appearance due to microbial spoilage.

Days	Product	Colour	Texture	Appearance	Overall Acceptability
0	T <sub>1</sub>	6.5	6.0	7.1	6.8
	T <sub>2</sub>	6.3	6.8	7.0	6.5
	T <sub>3</sub>	6.4	6.2	6.9	6.5
	T <sub>4</sub>	6.6	6.3	7.0	6.7
5	T <sub>1</sub>	6.5	6.0	5.6	6.6
	T <sub>2</sub>	6.0	6.1	6.3	6.8
	T <sub>3</sub>	6.0	6.2	6.0	6.6
	T <sub>4</sub>	6.3	6.5	6.2	7.0
10	T <sub>1</sub>	6.3	6.3	6.8	6.6
	T <sub>2</sub>	6.0	5.6	6.3	6.6
	T <sub>3</sub>	6.4	6.2	6.7	6.8
	T <sub>4</sub>	6.2	5.9	6.5	6.8
15	T <sub>1</sub>	6.1	6.3	7.0	6.6
	T <sub>2</sub>	5.8	6.0	6.8	6.6
	T <sub>3</sub>	6.6	6.1	6.6	6.6
	T <sub>4</sub>	6.5	6.6	5.0	6.0

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