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RESEARCH PAPER

Studies on drying and dehydration of bitter gourd slices

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SUMMARY : An experiment was carried out to evaluate the drying and dehydration behaviour of bitter gourd slices. The bitter gourd slices were dried by cabinet and sun drying using different pre-treatments. Out of these different pre-treatments and drying methods blanched bitter gourd slices treated with KMS 0.2 per cent and Salt 2 per cent soaking for 10 min. in solution and dried by cabinet drying showed better retention of chlorophyll content, ascorbic acid, higher rehydration ratio with less moisture, less titrable acidity and less non-enzymatic browning as compared to sun drying.

Key Words : Bitter gourd, Cabinet drying, Sun drying, Pre-treatments

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An increasing trend of improving the dietary standards among the people has been observed in recent years. Vegetables are having importance, mainly because of vitamins, minerals and dietry fibre. Preservation of these vegetables can prevent wastage as well as make them available in lean season.Different methods and equipments are available for drying and dehydration of various vegetables. Pre-treatments are the necessary pre-requisites for successful dehydration process. Pre-treatments check the undesirable physico-chemical and other qualitative changes that may occur during drying process and subsequent storage and there by help to extend keeping quality of dried products. Various pre-treatments employed are sulphuring blanching in hot water, brining, steeping in solutions of certain chemicals like salt, potassium metabisulphite and acetic acid for specific period.The post-harvest losses of bitter gourd are about 25 per cent. Main reason for this much of loss is due to ripening and mechanical damage during transport. Bitter gourd fruits are used as vegetables in many ways and are quite commonly used in cooked, stuffed, fried forms and the fruits are also pickled, canned and dehydrated (Anonymous, 2010). The preservation methods such as dehydration, steeping (salt solution) and pickling can be successfully adapted to preserve bitter gourd for off-season. The suitability of a particular drying methods and pre-treatment needs to be worked out for specific vegetables and their a varieties in order to get product of high quality with consumer acceptability.

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EXPERIMENTAL METHODS

The study was conducted in Post Harvest technology Laboratory at University Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2010-2011. After the cutting the tips and stem portions, the bitter gourds fruits were cut into 0.5 cm thick slices by knife and then slices were allowed for further pre-treatments of control, blanching for 3 min, blanching for 3 min in soaking in 2 per cent salt and blanching for 3 min. and soaking in solution of 0.2 per cent KMS and 2 per cent salt for 10, 20, 30 min, respectively and 1 per cent and 0.5 per cent solution of acetic acid for 20 min and allowed to dry in cabinet dryer (D_1) for 3 hrs at 60°C and in open sun drying (D_2) (Siva Kumar *et al.* 1991 and Singh *et. al.*, 2008). After drying, the dried slices were allowed for

chemical analysis at 20 days interval upto 80 days of storage (Shah, 2007). Dried slices were cooled and packed in 250 guage polyethylene bags sealed and stored in dry and cool place. (Manimegalai and Ramah, 1999 and Shams-Ud-Din and Shraji, 2008). The physical and chemical parameters like dehydration ratio, rehydration ratio, moisture, titrable acidity, ascorbic acid, chlorophyll and non-enzymatic browning of dried bitter gourd slices were determined according to methods of (Ranganna, 1979).

EXPERIMENTAL FINDINGS AND ANALYSIS

An investigation was carried out to find out suitable drying methods for drying of bitter gourd slices. General physical and chemical properties of dried bitter gourd slices are presented in Table 1 Table 2. The time taken for drying was influenced not only by the drying methods, but also by the pre-treatments, while minimum time for drying was taken by the control (T_1), where as in other pre-treatments additional time was required. It might be due to presoaking of slices in different solutions. However, the drying methods did show distinct effect regarding the number of hours for drying. Cabinet drying could reduce the drying time as compared to sun drying. Lesser number of hours taken for drying in cabinet drier might be due to higher and constant drying temperature of 60°C as compared to a temperature of 25 to 28° C maintained in surrounding atmosphere (Hiremath *et al.,* 2009). Similarly the dehydration ratio of bitter gourd slices was highest in control (T_1) while lowest in 0.2 per cent KMS and 2 per cent salt solution soaked for 10 min. (T_4) The maximum ascorbic acid, chlorophyll and rehydration ratio were recorded in the dehydrated slices treated with KMS *i.e.* T_4 (2 % salt + 0.2 % KMS for 10 minutes + cabinet drying) and minimum in control (T_1) treatment dried under sun from first day of drying to 80 days. However, maximum moisture, dehydration ratio and non-enzymatic browning and titrable acidity were registered in control (T_1) treatment dried under sun while minimum in T_4 (2 % salt + 0.2 % KMS for 10 minutes + cabinet drying) pre-treatment dried in cabinet drier with the advancement of storage period.

The progressive decrease in rehydration ratio and increase in moisture were notified in all the samples dried by cabinet and sun drying method. It might be possibly due to hygroscopic nature of the slices, which absorbed the atmospheric moisture during storage. The gain of moisture was highest and lowest rehydration ratio observed in control as compared to pre-treated slices with 2 per cent salt + 0.2 per cent KMS for 10 minutes. (Shams-Ud-Din and Shirazi, 2008). Loss of ascorbic acid and chlorophyll content primarily due to its oxidation during dehydration. Sulphur dioxide inhibited the oxidative changes of ascorbic acid and hence, ascorbic acid retention was better in KMS treated samples. Some of antioxidants are reducing agents and essential equipment for higher retention of ascorbic acid and chlorophyll content during dehydration and subsequent storage and thereby help to extent the keeping quality of dried product. The decreased trend of ascorbic acid and chlorophyll content were found mostly due to its oxidation and as substrate in non-enzymatic browning during the storage period and also ascorbic acid is very sensitive to heat. It might be lost due to application of heat during drying. An antioxidant that might have reduced the discoloration of the dried bitter gourd slices (Sivakumar *et al*., 1991)

Increase in acidity percentage might be due to conversion of some amount of sugars into acids. Increasing the titrable acidity is not only due to pre-treatments but also drying methods. Sun drying showed maximum percentage of titrable acidity as compared to in cabinet drying. During storage, the

Table 1 : Effect of pre-treatments and drying methods on drying time (hrs.) and dehydration ratio of dried bitter gourd slices

Drying time (hrs.)				Dehydration ratio			
Treatments	D_1	D_2	Mean	Treatments	D_1	D_2	Mean
T_1	3.40	16.30	9.85	T_1	9.11	11.16	10.14
T_2	4.09	18.87	11.48	T_2	8.72	9.82	9.27
T_3	3.45	18.83	11.14	T_3	8.50	9.43	8.99
T_4	3.50	18.20	10.86	T_4	7.52	8.13	7.83
T_5	3.55	18.35	10.95	T_5	7.56	8.15	7.86
T_6	4.05	18.57	11.31	T_6	7.91	8.61	8.26
T_7	4.11	19.65	11.88	T_7	8.31	8.89	8.60
T_8	4.15	19.75	11.95	T_8	8.37	8.94	8.66
Mean	3.80	18.50		Mean	8.26	9.14	
	T	D	T x D		T	D	T x D
'F' test	Sig.	Sig.	Sig.	'F' test	Sig.	Sig.	Sig.
S.E. (m)±	0.04	0.08	0.12	S.E. (m)±	0.07	0.01	0.02
C.D. (P=0.05)	0.12	0.24	0.36	C.D. (P=0.05)	0.21	0.04	0.09

Sig. = Significant

Table 2 : Effect of pre-treatments and drying methods on physical and chemical parameters of dried bitter gourd slices

Treatments	Physical and chemical parameters											
	Moisture (%)		Rehydation ratio		Ascorbic acid (mg/100g)		Titrable acidity (%)		Non-enzymatic browning (OD at 440 nm)		Chlorophyll (mg/100g)	
	0 days	80 days	0 days	80 days	0 days	80 days	0 days	80 days	0 days	80 days	0 days	80 days
Pre-treatments												
T_1	7.13	13.27	5.57	5.57	29.47	25.09	0.95	1.24	0.47	0.64	17.53	16.56
T_2	6.61	12.98	5.95	5.95	32.18	27.00	0.80	1.05	0.42	0.58	18.33	17.52
T_3	6.36	12.63	6.15	6.15	34.23	28.77	0.73	0.86	0.41	0.54	18.76	17.87
T_4	5.65	10.91	6.67	6.67	55.69	50.62	0.38	0.56	0.25	0.36	24.56	24.10
T_5	5.69	11.23	6.56	6.56	54.60	49.06	0.45	0.64	0.27	0.41	23.27	22.34
T_6	5.89	11.54	6.51	6.51	41.13	35.09	0.50	0.62	0.30	0.44	22.67	22.19
T_7	6.05	11.90	6.28	6.28	38.88	34.02	0.53	0.71	0.32	0.48	20.30	19.75
T_8	6.11	12.17	6.25	6.25	38.74	33.79	0.62	0.81	0.33	0.51	20.17	19.67
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S.E. (m)±	0.02	0.01	0.05	0.05	0.02	0.02	0.001	0.002	0.0001	0.0001	0.05	0.03
C.D. (P=0.05)	0.06	0.03	0.15	0.15	0.08	0.07	0.003	0.007	0.0003	0.0004	0.16	0.09
Drying methods												
D_1	5.74	12.09	6.54	6.54	48.08	42.37	0.49	0.70	0.30	0.45	21.52	21.05
D_2	6.63	12.48	5.94	5.94	33.17	28.44	0.75	0.91	0.39	0.54	19.87	19.09
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S.E. (m)±	0.04	0.01	0.10	0.10	0.05	0.04	0.002	0.005	0.0002	0.0003	0.11	0.06
C.D. (P=0.05)	0.13	0.03	0.30	0.30	0.15	0.12	0.006	0.015	0.0007	0.0009	0.34	0.19

Sig. = Significant

physico-chemical parameters like moisture, titrable acidity and non-enzymatic browning showed the increasing trend while, rehydration ratio, ascorbic acid and chlorophyll content noticed the decreasing trend with the advancement of storage period and drying methods *i.e.* qualitative product were obtained in cabinet drying as compared to sun drying. The merits of any product depend upon the consumer acceptability, organoleptic evaluation is an important tool to know the consumer acceptability. Good quality of dehydrated bitter gourd slices with respect to physico-chemical and organoleptic characters can be obtained by treatment with 2 per cent salt + 0.2 per cent KMS for 10 minutes and dried in cabinet dryer it is found to be best at it gives a dark green product of soft texture although reduced bitterness and imparted salty taste (Kulkarni *et al*., 2005)

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