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STUDIES ON SOME ASPECTS OF DEHYDRATION OF BITTER GOURD (KRELA)

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Abstract. Results of the effects of different pretreatments on the quality of dried bitter gourd (krela) have been presented. Blanching in alkaline medium was found to preserve the colour and ascorbic acid. Salting improved the taste by removing most of the bitterness, but affected the rehydration properties adversely. Drying without any pretreatment produced products of poor quality.

Bitter gourd is a popular vegetable of the Indo-Pakistan subcontinent known also for its medicinal value. It is abundantly grown in Pakistan and is in great demand both inside and outside country all the year round.

In villages the housewives preserve it by sun-drying but the quality of this dried product is quite poor. There is no reported study in literature dealing with the conditions to produce dehydrated 'krelas' having good culinary, organoleptic and nutritive properties. The present investgation was carried out to find out effects of certain treatments on the rehydration and organoleptic characteristics and loss of ascorbic acid of dehydrated bitter gourd.

Materials and Methods

Procurement and Preparation. Fresh bitter gourd (referred to as 'vegetable' in the text) was purchased from a grocer who brought it daily from the same farm. The vegetable was then washed, peeled, sliced into rings of ½ in thickness and deseeded. Full batch of prepared vegetable weighing 35 lb was subdivided into seven equal portions which were given different pretreatments (Table 1). Sample 7 was treated according to the method of Blair and Ayers as described by Cruess.[1] The sample was soaked at room temperature (25°C) for 30 min in 2% Na_2CO_3 solution and then blanched for 4 min in a simmering 0.037% $Ca(OH)_2$ solution. Excess alkali was removed by rinsing the sample in 5 litres dilute brine solution (0.1%) containing 0.1% $Mg(OH)_2$ in suspension prior to drying.

Salting, Blanching, and Sulphiting. The vegetable pieces were mixed with commercial salt @10% of the materials and allowed to stand for 3 hr with occasional mixing. The sample was then slightly hand-pressed and washed in tap-water for 1 min to remove the salt. The sample was then drained free of water.

Blanching time for the vegetable was determined as described by Cruess.[2] The samples unless mentioned otherwise were blanched for 5 min in simmering water (100°C).

The vegetable was uniformly sprayed with a 1% solution of sodium metabisulphite so that total sulphite used was 0.04% of the fresh vegetable.

Drying. The treated samples were dried in an electric cabinet-drier (model Mitchell No. 6298/59 Manchester) working on forced air draft system. The samples were spread evenly over the trays @1⅛ lb/ft.^{2} Drying was carried out at a dry-bulb temperature of 180°F. All the samples were dried to approximately 5% moisture content. Moisture was determined according to A.O.A.C.[3] using hot air oven at 105°C. Weights of dehydrated and fresh samples gave the dehydration ratio (D.R.). The experiment was carried out four times on different days (4 replicates). After drying and subsequent cooling to room temperature the samples were packed in polyethylene bags.

Rehydration. Samples were reconstituted as follows: About 5.0 g sample was weighed and transferred to a 250-ml beaker. The sample was then soaked in 200 ml tap-water at 33°C. After 4 hr the water was drained away and any superfluous moisture was removed by rolling reconstituted pieces gently over a filter paper without subjecting them to any external pressure. The samples were then weighed within 15 min of above operation. The weights of rehydrated and dehydrated samples gave the rehydration ratio (R.R.). Reconstituted samples were also evaluated for appearance and texture, by a panel of 10 judges. The data was analysed statistically according to Snedecor and Cochran[4] using randomised block or 'among and within groups' design.

Ascorbic Acid. For fresh vegetable 10 g sample was blended with 41 ml water (presuming 9 ml already in the sample) and 50 ml 20% trichloroacetic acid (TCA) solution for 3 min. The blended sample was allowed to stand for 30 min in a beaker and then

TABLE 1. VARIOUS PRETREATMENTS AND DRYING CONDITIONS OF BITTER GOURD.

Sample	Salting	Blanching	Sulphiting	Drying
1	No	No	No	Sun
2	No	No	No	Cabinet*
3	No	Yes	No	,,
4	Yes	No	No	,,
5	Yes	Yes	No	,,
6	Yes	Yes	Yes	,,
7	Yes	Yes	Special treatment	,,

*Cabinet drying temperature 180°F

filtered through a muslin cloth. An aliquot of the filtrate was taken and ascorbic acid determined according to the method of Barakat *et al.*[5]

Dehydrated sample was first ground to a 20-mesh powder in a small Wiley mill and 1-g sample was blended with 50 ml water and 50 ml 20% TCA and the rest of the procedure was same as for the fresh sample.

Organoleptic Evaluation. Properly cooked samples of dehydrated vegetable were presented to a panel of 10 trained judges for evaluating them with respect to colour, texture and taste. The scoring was done according to 10-point hedonic scale, i.e. 1–2 unacceptable; 3–4 poor; 5–6 satisfactory; 7–8 good and 9–10 excellent. Judges were also asked to give some remarks whether samples were too bitter; bitter but acceptable; less bitter (O.K.). Not more than three samples were given at one time. A fresh sample was always used for comparison.

Cooking. The ingredients used in cooking were: (a) bitter gourd, 15 g dehydrated/150 g fresh; (b) chopped onion, 150 g; (c) tomato (sliced), 90 g; (d) fat, 50 g; (e) tumeric, ¼ teaspoonful (tsf); (f) corriander, ½ tsf;(g) chillies, ½ tsf; and (h) salt 1 tsf.

Dehydrated sample was soaked in luke-warm water for 2 hr and boiled for about 5 min. Chopped onions were fried in the fat and were then taken out and a paste made of ingredients (e–h) was seasoned in the same fat. After few minutes when the paste turned brown, pieces of reconstituted/fresh vegetable were added and roasted for sometime adding small increments of water. Fried onion and tomatoes were now added and cooking was continued for 15 min in a covered pan on a low fire. The vegetable was ready to serve.

Results and Discussion

Preliminary tests showed that unpeeled dehydrated samples were quite bitter and had low organoleptic characteristics. Blanching of the peeled vegetable in acid medium (0.1% solution of citric or tartaric acid) had no effect on the bitterness of the vegetable. It rather impaired the green colour of the vegetable. A temperature of 180°F was found suitable for cabinet drying of bitter gourd. Average drying ratio was 1:11; the average moisture-content of the prepared vegetable being 92.0%.

Blanching Time. Table 2 gives the inactivation of peroxidase in boiling water. The enzyme is completely inactivated in ordinary tap-water (pH 6.8) in 5 min and in alkaline solution (pH 7.5) in 4 min. This probably is due to the fact that boiling in alkaline solution brings about faster hydrolysis of tissue components resulting in enhanced penetration of heat.

Rehydration. Figure 1 shows the effect of time on the rehydration ratios (R.R.s) of dehydrated vegetable samples having different pretreatment. It is clear from the curves that rehydration is adversely affected due to salting and/or blanching. However, blanching after salting slightly improved the R.R. Most of rehydration took place in 2 hr beyond which the rate declined sharply in all cases. It is also apparent from the curves that relative rates of rehydration of the different samples are independent of the rehydration time.

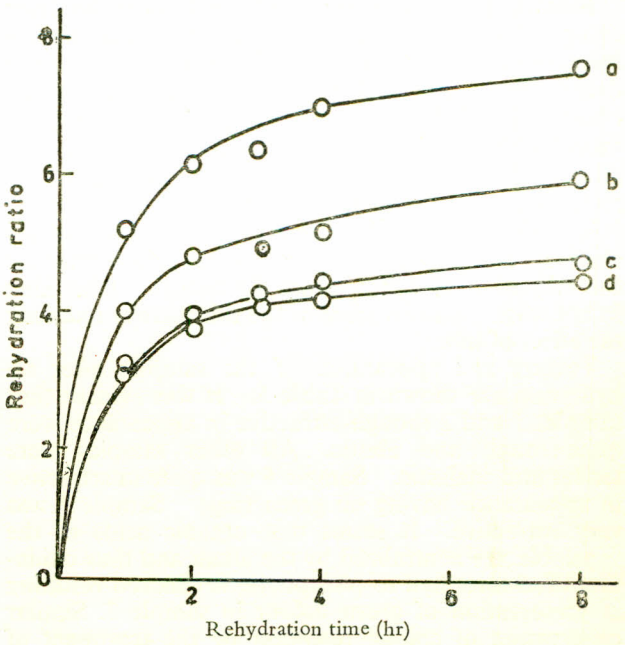

Fig. 1. Rehydration ratio of dried bitter gourd (krela) sample as affected by rehydration time. a, unsalted, unblanched; b, unsalted; blanched; c, salted, blanched; d, salted, unblanched.

TABLE 2. EFFECT OF BLANCHING* TIME ON THE INACTIVATION OF PEROXIDASE IN FRESH BITTER GOURD SAMPLES.

Blanching time (min)	Enzyme test	
	pH 6.8	pH 7.5
1	Highly+ve	Highly+ve
2	+ve	+ve
3	+ve	+ve
4	Slightly+ve	—ve
5	—ve	—ve

Blanching medium, simmering water (100°C)

TABLE 3. ANALYSIS OF VARIANCE FOR THE DATA IN TABLE 4.

Source of variation	D.F.	S.S.	M.S.	F
Between treatments	6	40.63	6.77	45.1*
Within treatments	21	3.12	0.15	

*Highly significant $P < \cdot 001$

Statistical analysis of data in Table 4 revealed that differences in the R.R.s were highly significant (Table 3). Comparison of R.R.s would reveal that samples 1 and 2 have significantly higher values than all other samples (Table 4). It was also apparent that blanching (sample 3) and salting (sample 4) decreased R.R. On comparing samples 4 and 5 it was found that blanching after salting improved R.R. Low R.R. in case of sampler 7 was due to over tenderization of the vegetable prior to drying.

Blanching is known to cause hydrolysis of the tissue components of the vegetable.[6] It seems that hydrolysed material loses some of its water affinity after dehydration. Also there is cell damage during blanching. These factors result in low rehydration ratio on blanching. Two reasons can be given for the adverse effect of salting. Firstly, it leaches some of the compounds so vital for rehydration. Secondly, it brings about, during the course of dehydration, certain chemical and physical changes that act as a barrier for the migration of water across the tissue. Blanching in hot water removes some of the salt thereby reducing the effect of salt.

Texture and appearance of the samples after rehydration are shown in Table 5. It was evident that samples 1 and 2 though attractive in appearance were quite tough and elastic. All other samples were tender and inelastic. Sample 6 was quite unattractive in appearance having no green tinge. Sample 7 was very attractive. It seems that organic acids of the vegetable are neutralized by the alkali and thus oxidation of chlorophyll to pheophytin is checked resulting in preservation of green colour in sample 7. Similar observation of colour retention by the treatment of sodium bicarbonate have been made in spinach and other vegetables.[7] However, it is difficult to offer any suitable explanation at this stage for the undersirable effect of sulphiting on the colour of the dried vegetable.

Ascorbic Acid. Per cent ascorbic acid losses are shown in Table 6. It is evident that maximum losses occured in sample 1 (91.3%) and sample 4 (88.9%). In case of sample 3 loss was less as compared to sample 2. This indicated that blanching has protective action on the retention of ascorbic acid. Similar effect of blanching is revealed in sample 4 and 5. The loss of ascorbic acid was minimum (71%) in case of sample 7, which was dried after blanching in alkaline medium. The protective action of blanching in alkaline medium is interesting and worth further investigation. Malakar and Banerjee showed that blanching of bitter gourd in acidic medium causes less loss of ascorbic acid.[8] It is possible that loss of ascorbic acid is lesser on blanching both in acidic and alkaline medium.

Organoleptic Evaluation. The results of organoleptic tests showed that colour of all samples was comparable to fresh except sample 6 (Table 7). The colour of this sample was also quite unattractive after rehydration (Table 5). Texture scores indicated that samples 1 and 2 were inferior to all other samples. This was expected because after rehydration these samples were tough and elastic. They were also found to be bitter and average taste scores were below 5, i.e. poor. The samples 3, 4, 5 and 7 were found to be almost comparable to fresh sample with regard to colour, texture and taste.

Conclusion

Reviewing the data in different Tables it is found that samples 1 and 2 though best with regard to rehydration were tough and elastic in texture both after rehydration and cooking. Besides, ascorbic acid losses were very high in these cases. Sulphiting brought

TABLE 4. REHYDRATION RATIOS OF VARIOUS DEHYDRATED BITTER GOURD SAMPLES (LSD 5% =0.55).

Sample	Replicates				Mean
	I	II	III	IV	
1	6.3	6.0	5.6	6.8	6.4
2	6.6	7.0	6.9	6.3	6.7
3	5.2	5.1	5.6	5.0	5.2
4	4.0	3.6	3.5	4.1	3.8
5	4.5	4.0	4.6	4.9	4.5
6	4.8	3.9	4.8	4.7	4.5
7	2.5	2.8	3.7	3.6	3.2

TABLE 5. OBSERVATIONS ON COLOUR TEXTURE OF REHYDRATED BITTER GOURD SAMPLES.

Sample	Appearance	Texture
1	Attractive	Tough elastic
2	,,	,,
3	,,	Tender, inelastic
4	Unattractive	,,
5	,,	,,
6	Very unattractive	,,
7	Very attractive	,,

TABLE 6. EFFECT OF VARIOUS PRETREATMENTS ON THE ASCORBIC ACID LOSS OF DEHYDRATED BITTER GOURD.*

Sample	% Loss of ascorbic acid (replicates)				Mean value
	I	II	III	IV	
1	92.2	91.6	90.2	91.3	91.3
2	84.2	82.9	82.9	84.1	83.6
3	73.6	74.1	74.1	74.5	74.1
4	89.5	88.7	88.7	89.0	88.9
5	85.3	84.9	84.6	84.9	84.7
6	80.6	81.9	81.1	81.6	81.3
7	72.0	71.3	71.1	71.6	71.5

Original ascorbic acid 96 mg/100 g fresh (peeled and deseeded) or 1143 mg/100 g dehydrated sample (5% moisture basis).

TABLE 7. ORGANOLEPTIC EVALUATION OF DIFFERENT DEHYDRATED BITTER GOURD SAMPLES AFTER REHYDRATION AND COOKING TRADITIONALLY. (Scores are average of 10 judgements).

	Average scores			
	Colour	Texture	Taste	Remarks
Control (fresh)	7.8	8.2	7.4	O.K.
1	7.7	5.0	4.5	Bitter
2	7.0	5.3	4.3	Bitter
3	7.8	6.5	7.0	Acceptable
4	7.0	6.5	7.1	O.K.
5	6.6	6.0	6.6	O.K.
6	5.0	6.0	6.0	O.K.
7	7.8	7.7	6.6	O.K.

about certain colour changes and this made sample unattractive both after rehydration and cooking. Sample 3 was tender on rehydration, had good organoleptic qualities and rehydrated well. Sample 7 was best in respect of retention of green colour and ascorbic acid and had good organoleptic scores. However, it had a very low rehydration ratio. From the overall considerations following conclusions could be drawn to get a good quality dehydrated bitter gourd: (1) partial peeling is necessary; (2) blanching in alkaline medium helps to preserve both green colour and ascorbic acid; (3) blanching and/or salting treatments prior to drying yield tender quick-cooking product. Salting also removes much of bitter substances; and (4) sulphiting is undesirable and should be avoided.

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