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Studies on Canning of Bottle Gourd Pulp

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ABSTRACT

Bottle gourd pulp in its pure form is very difficult to preserve because of lower acidity (about 0.17 %). A possible alternative solution to this problem is to develop a comprehensive process technology of canning of bottle gourd pulp that can be able to store the product for a longer period without any microbial or quality deterioration at room temperature.The freshly harvested bottle gourd fruits of Pusa Naveen variety were used for the experimental work. The physical parameters and biochemical parameters of bottle gourd fruits were determined as per the standard methods. The canning of bottle gourd pulp was carried out at different levels of sodium benzoate (0, 0.05 and 0.10 %) and different head space (10, 20 and 30 mm), The results of canned bottle gourd pulp were statistically analyzed by two factors Completely Randomized Design with four replications at 5 per cent level of significance. The quality evaluation of canned bottle gourd pulp was carried out on the basis of biochemical parameters and microbial analysis at an interval of 45 days (i.e., 0, 45 and 90 days) during the entire storage period. The initial mean values of various quality parameters of bottle gourd pulp, viz., moisture content, protein content, pH, ascorbic acid, and crude fiber were decreased after canning of bottle gourd pulp, whereas only titratable acidity of bottle gourd pulp after canning was increased. During the storage studies of canned bottle gourd pulp, highest retention of ascorbic acid (6.50mg/100 g), protein content (0.629 %), crude fiber (0.229 %), and lowest value of titratable acidity (0.163 %) were obtained in treatment $P_7(S_3H_1)$ (0.10% sodium benzoate +10 mm head space) among all the treatments at 90th day of storage among all the treatments. In addition to this, there was no any microbial contamination or growth was observed in any treatment at 90th day of storage.

Key words*: *Bottle gourd pulp, Bottle gourd juice, Canning, Canned vegetables, Storage.

INTRODUCTION

Bottle gourd or *Lagenaria siceraria* originated in tropical Africa, the crop is domesticated in Asia, Africa and New World. It is extensively grown in India and fruits are available throughout the year. Bottle gourd is a minor vegetable crop. Bottle guard production in India during 2013-14 was 1818.86 thousand tonnes from area of 103230 hectares[1].

Bottle gourd contains about 92 to 93 % (wb) water and the remaining is easily digestible fiber.

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So it is the easily digestible food. The glucose and sugar related compounds are nearly nil in the bottle gourd. So, it is one of the best food options for the diabetic patients. The bottle gourd is the one of the body heat control food and it keeps your body temperature at normal level. Bottle gourd juice is widely used for weight loss therapy. It also helps to reduce the inflammations in the liver and kidneys. The bottle gourd juice is also helpful in treating the diarrhoea. Better food for the persons those who are suffering with the constipation. Hair oil prepared from bottle gourd with sesame oil helps for the good sleep. It is one of the remedy for the insomnia. Bottle gourd helps to treat the urinary tract infection[2].

There has been a great deal of research on the impact of canning on the nutritional value of fruits and vegetables; however, determining the impact is not an exact science. Factors that impede precise measurements and valuations of the effect of canning fruits and vegetables on nutrient value include: the type of fruit and vegetables, differences in research methodologies & practices and real world food storage & preparation. For example, fresh produce loses its nutrient value faster than canned produce[9].

Basically, India produces most of the vegetables due to tropical weather zone. As far as, post-harvest management is considered, there are about 25 to 40 % post-harvest losses occurs in different post-harvest operations, viz., cleaning, grading, transportation, drying, storage, packaging, etc. Bottle gourd is one the important minor vegetable crop having enormous uses and health benefits. Bottle gourd is underutilized fruit in spite of being one of the cheapest source of nutrients and potential source of natural antioxidants. The consumption of bottle guard juice/pulp is increasing day by day due to its health benefits. The post-harvest losses in bottle gourd occur due to lack of proper packaging materials, improper handling during long distance transport and microbial spoilage. Bottle gourd fruit has higher edible index and lower waste index, which proves its importance of processing. It is necessary to conserve bottle gourd juice/pulp for long time storage at normal ambient conditions (room temperature).

Bottle gourd juice in its pure form is very difficult to preserve because of lower acidity (about 0.17 %). Preservation of low acid juice/pulp for long term storage at ambient condition, needs high thermal processing temperature about 121°C or even more temperature is required[10].

A possible alternative solution to this problem is the canning and storage of bottle guard juice / pulp. Canning of bottle gourd is a very interesting alternative to preserve the bottle gourd with practically all the natural properties of the product. Preservation of vegetables by different canning process variables, *viz.*, head space, and sodium benzoate is the novel concept as the final product is likely to get optimum benefits of these variables.

Looking into the above demand, a canning process is standardized by optimizing the two canning process variables, *viz.*, levels of preservative and different head space. The quality evaluation of canned bottle gourd pulp was carried out on the basis of biochemical and microbial analysis at an interval of 45 days. The best treatment among all the treatment could be able to withstand to preserve bottle gourd pulp with highest retention of nutrients during the entire period of storage without any microbial deterioration.

METHODS AND MATERIALS

Pusa Naveen variety of bottle gourd was selected as locally produced; the fruits of bottle gourd were long, cylindrical, nearly straight, firm, uniform, greenish in appearance

and tender. The fresh bottle gourd fruits of *Pusa Naveen* variety were procured from marketing yard of Junagadh for the experimental work. All the experiments were carried out in the JAU Mango Canning Plant, Department of Processing and Food Engineering, College of Agricultural Engineering & Technology, Junagadh Agricultural University, Junagadh.

Physical and biochemical parameters of fresh bottle gourd fruits

The physical parameters of fresh bottle gourd fruit, *viz.*, fruit weight, fruit firmness, pulp to peel ratio and maximum and minimum diameter of whole fruit were measured using appropriate instruments. Five respective samples of well graded and matured bottle gourd fruits (*Pusa Naveen*) were selected for experimental work. Whereas, the biochemical parameters, *viz.*, moisture content, protein content, titratable acidity, pH, ascorbic acid and crude fiber of fresh bottle gourd fruits were determined by standard analytical methods. The moisture content of fresh bottle gourd was determined by hot air oven method as suggested by Ranganna[7], protein content by the method as suggested by Lowry *et al.*[5], titratable acidity by the method as suggested by Ranganna[7], pH of bottle gourd pulp was measured by using digital pH meter (model : Eutech 700, Eutech Instruments), ascorbic acid was determined by using 2-6 dichlorophenol indophenol methodas described by Sadasivam and Manickam (1996) and fiber content is measured by fibertherm.

Canning process for bottle gourd pulp

The canning of bottle gourd pulp was carried out after determination of different physical and biochemical parameters of fresh bottle gourd pulp. Different operations carried out for canning of bottle gourd pulp are shown in Fig 1 and described in following sub sections.

Procurement of bottle gourd fruits

Fresh bottle gourd fruits of *Pusha Naveen* variety were procured from Marketing Yard, Junagadh. The following operations were carried out for preparation of bottle gourd pulp for canning.

Manual grading

Well graded and matured bottle gourd fruits of uniform sized were selected for experimental work. The grading of fruits was carried out by visual observations. The unnecessary portion of fruits was removed.

Washing

After grading, fruits were washed out thoroughly in fresh tap water to remove the unwanted material adhered to the outer surface.

Peeling

After washing, the bottle gourd fruits were peeled manually by using a stainless steel knife in such a way that minimum loss of edible portion of the fruits during peeling operation.

Cutting of bottle gourd in small pieces

Then cutting of bottle gourd fruit into small pieces was carried out by stainless steel knife to permit easier crushing of bottle gourd during crushing operation.

Blanching

The bottle gourd pieces were placed in clean cotton cloth. The blanching was carried out by dipping the cotton cloth containing bottle gourd pieces in hot boiling water having temperature of 90°C for 2 minutes. The blanched pieces were removed from the cotton cloth and transferred to open stainless steel vessel.

Crushing (Pulping)

The hot blanched bottle gourd pieces were kept under fan for cooling. After cooling of bottle gourd pieces, crushing (pulping) was carried out using commercial fruit and vegetable crusher (SHE Model: GM-2). Large size uncrushed bottle gourd pieces were recycled till the homogenized pulp obtained.

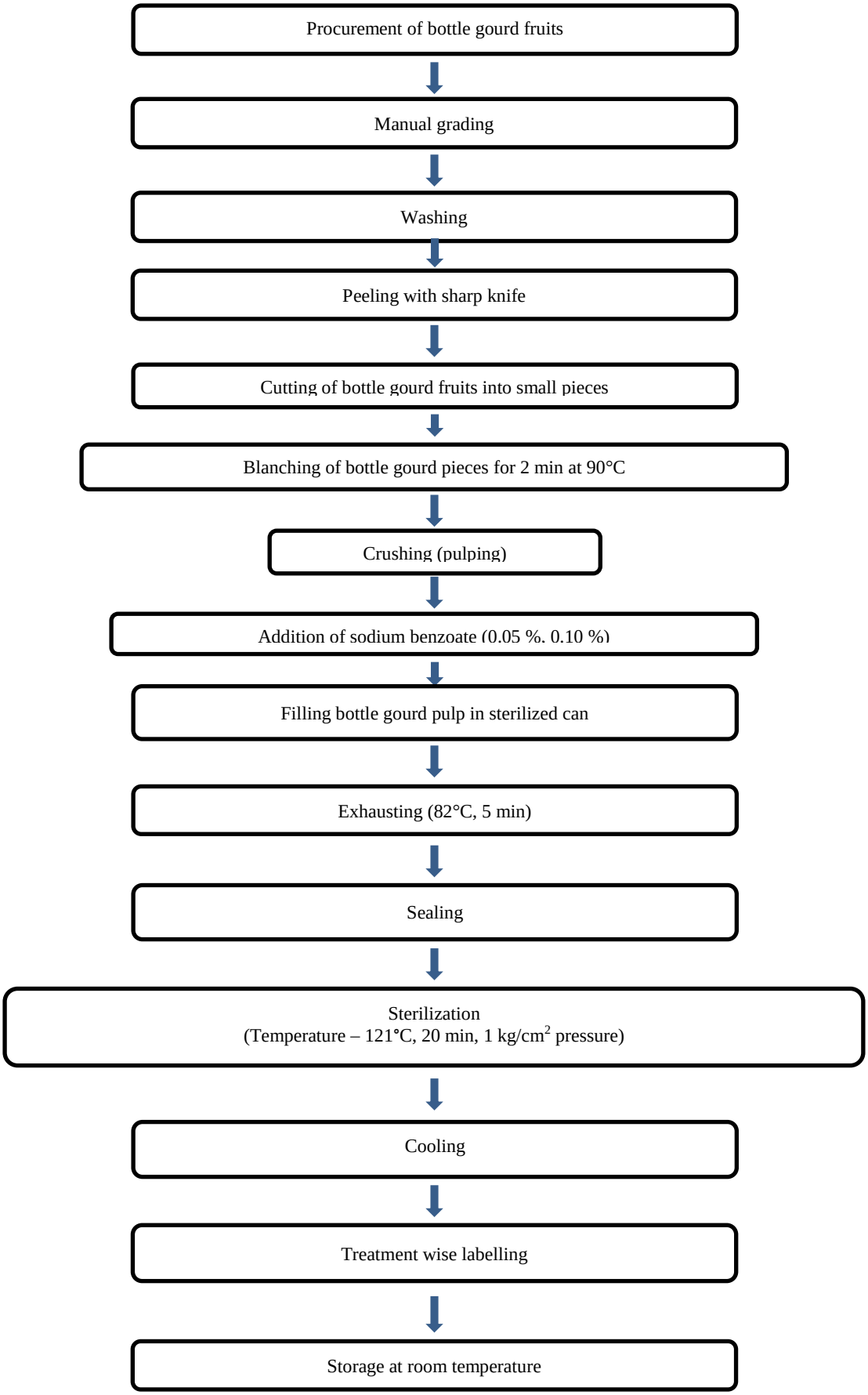

Fig 1: Process flow chart for preparation of bottle gourd pulp

Addition of sodium benzoate

The sodium benzoate in the proportion of 0.05% and 0.10% was added in the bottle gourd pulp. 0.5 g and 1.0 g sodium benzoate weighed and dissolved in luke warm water (20 ml) in a glass beaker. Then, glass beaker containing water and sodium benzoate stirred continuously till traces of sodium benzoate dissolved completely. Then, prepared 0.05% and 0.1% sodium benzoate solutions were added into bottle gourd pulp kept in different containers (stainless steel vessels) as per their treatment order. Now, bottle gourd pulp was ready to fill in the tins of different treatments.

Filling

Prepared bottle gourd pulp was placed in pre-sterilized metal cans (at 110°C) keeping the head space of 10, 20 and 30 mm as per its treatment order and weigh using digital electronic balance (Sartorius, Model: BP 3100 S). The quantity of bottle gourd pulp was required 800 g, 745 g, and 700 g for maintaining 10, 20 and 30 mm headspaces, respectively.

Exhausting

The exhausting of 36 tins (with lid) of a first lot of treatments was carried in exhaust box for removal of remaining air from container. Exhausting of tins of different treatments was carried out at 82˚C for 5 minutes. After exhausting of bottle gourd pulp tins of different treatments were transferred to sealing operation using heat resistance hand gloves.

Sealing

The hot tins containing bottle gourd pulp were sealed hermetically by using a double seaming machine (BHARTIA Seaming Machine, Model; AMLE 40). The precautions were taken that no leakage and damage occurred during the sealing process.

Sterilization

The sealed bottle gourd pulp tins were put in auto clave (EQUITRON Autoclave, Model: Vertical-FA) for sterilization. The temperature of sterilization was kept 121°C for 20 minutes time at 1 kg/cm^2 pressure (Cruess (1948)). After 20 minutes, the hot tins of bottle gourd pulp were removed from auto clave with the help of heat resistant hand gloves.

Cooling

The cooling process of hot tins of bottle gourd pulp was carried out by immersing the hot tins in the tank of cold water. The canned bottle gourd tins were allowed to cool for 30 minutes and then removed using heat resistant hand gloves.

Treatment wise labelling

After cooling process, tins of different treatments were labelled as per its treatment order. Total 36 numbers of tins obtained by 9 treatments x 4 replications were labelled separately. The details of sodium benzoate levels, head spaces, and date of production were mentioned on the labels.

Storage

Finally, these labeled tins of different treatments were stored at room temperature for storage. The quality evaluation of these tins was carried out on the basis of biochemical and microbial parameters at 0, 45 and 90 days of storage.

Treatment details

The canning of bottle gourd pulp was carried out at different levels of head space (i.e., 10, 20 and 30 mm) and different levels of sodium benzoate (0, 0.05 and 0.10 %), whereas sterilization temperature of 121 ºC was kept constant for all the treatments. So, total 9 treatments replicated 4 times were statistically analyzed under 2– factor Completely Randomized Design at 5 per cent level of significance as suggested by Panse and Sukhatme (1985). Different combinations of all of these treatments are mentioned in Table 1.

Table 1 Treatment combinations for bottle gourd pulp

Sr. No.	Treatments	Combinations
1	$P_1(S_1H_1)$	0 % (S) + 10 mm (H)
2	$P_2(S_1H_2)$	0 % (S) + 20 mm (H)
3	$P_3(S_1H_3)$	0 % (S) + 30 mm (H)
4	$P_4(S_2H_1)$	0.05 % (S) + 10 mm (H)
5	$P_5(S_2H_2)$	0.05 % (S) + 20 mm (H)
6	$P_6(S_2H_3)$	0.05 % (S) + 30 mm (H)
7	$P_7(S_3H_1)$	0.10 % (S) + 10 mm (H)
8	$P_8(S_3H_2)$	0.10 % (S) + 20 mm (H)
9	$P_9(S_3H_3)$	0.10 % (S) + 30 mm (H)

Note: H – Head Space; S – Sodium Benzoate

Observations recorded:

a) Fresh bottle gourd fruit

i. ***Physical parameter :*** Fruit weight, fruit firmness, pulp to peel ratio and maximum & minimum diameter

ii. ***Biochemical parameter :*** Moisture content, protein content, acidity, pH, ascorbic acid and crude fiber content

b) Canned bottle gourd pulp (At an interval of 45 days)

i. ***Biochemical parameter :*** Moisture content, protein content, acidity, pH, ascorbic acid, crude fiber content and total soluble solids

ii. ***Microbial parameter :*** *E. coli, salmonella and total plate count*

Storage studies of canned bottle gourd pulp

The quality evaluation of canned bottle gourd pulp was carried out on the basis of biochemical parameters (i.e., moisture content, protein content, titratable acidity, pH, ascorbic acid, crude fiber and total soluble solids) at an interval of 45 days (i.e., 0, 45 and 90 days) during the storage. The microbial analysis (i.e., *E. coli*, *salmonella* and total plate count (TPC)) of canned bottle gourd pulp was also carried out at an interval of 45 days (i.e., 0, 45 and 90 days) during the storage at room temperature.

Quality evaluation of canned bottle gourd pulp during storage

The quality evaluation of canned bottle gourd pulp obtained by 9 different treatments (i.e., total 36 tins) was carried out on the basis of biochemical and microbial parameters as per the standard analytical methods and appropriate instruments.

RESULTS AND DISCUSSION

Quality evaluation of fresh bottle gourd fruits

The quality of fresh bottle gourd fruits (Cv. *Pusa Naveen*) was determined on the basis of physical parameters, *viz.*, fruit weight, fruit firmness, pulp to peel ratio and maximum and minimum diameter of whole fruit as well as biochemical parameters, *viz.*, moisture content, protein content, titratable acidity, pH, ascorbic acid and crude fiber.

Five representative samples of bottle gourd were randomly selected from the lot of freshly harvested bottle gourd fruits used for canning process. The various physical and biochemical parameters were determined as per the standard methods. The data of various physical and biochemical parameters of fresh bottle gourd fruit are reported in Table 2 and Table 3, respectively.

Table 2: Physical parameters of fresh bottle gourd fruits

Sr. No.	Fruit weight (g)	Firmness (kgf)	Pulp to peel ratio	Maximum diameter (mm)	Minimum diameter (mm)
1	768.11	6.90	10.55	67.25	57.74
2	698.27	5.40	9.95	69.95	56.78
3	501.93	7.10	7.79	62.05	46.18
4	643.77	6.00	9.06	58.94	52.30
5	726.6	7.80	9.03	56.78	47.65
Mean	**667.74**	**6.64**	**9.28**	**62.99**	**52.13**
SD	**103.12**	**0.94**	**1.05**	**5.53**	**5.21**

Table 3: Biochemical parameters of fresh bottle gourd fruits

Sr. No.	Moisture content (%(wb))	Protein content (%)	Titratable acidity (%)	pH	Ascorbic acid (%)	Crude fiber (%)
1	93.64	0.750	0.104	6.90	0.014	1.37
2	93.94	0.697	0.112	7.00	0.010	1.29
3	93.73	0.594	0.131	7.00	0.011	1.56
4	93.20	0.687	0.109	6.95	0.013	1.85
5	93.55	0.618	0.123	7.05	0.016	1.70
Mean	**93.61**	**0.669**	**0.116**	**6.98**	**0.013**	**1.55**
SD	**0.27**	**0.06**	**0.011**	**0.06**	**0.002**	**0.23**

The mean values of physical parameters of fresh bottle gourd fruit, *viz.*, fruit weight, firmness, pulp to peel ratio, maximum and minimum diameter with their standard deviation were found 667.74 ± 103.12 g, 6.64 ± 0.94 kgf, 9.28 ± 1.05, 62.99 ± 5.53 mm and 52.13 ± 5.21 mm, respectively. However, the mean values of biochemical parameters of fresh bottle gourd fruit, *viz.*, moisture content, protein content, titratable acidity, pH, ascorbic acid, and crude fiber with their standard deviation were found 93.61 ± 0.27 % (wb), 0.669 ± 0.06 %, 0.116 ± 0.011 %, 6.98 ± 0.06, 0.013 ± 0.002 % and 1.55 ± 0.23 %, respectively.

Canning of bottle gourd pulp

Quality evaluation of bottle gourd pulp

The quality evaluation of canned bottle gourd pulp was carried out on the basis of various biochemical parameters, *viz*., moisture content, protein content, titratable acidity, pH, ascorbic acid, crude fiber, and total soluble solids (TSS) at an interval of 45 days (i.e., 0, 45 and 90 days). The mean values of various biochemical parameters are reported in Table 4 and 5.

Table 4: Mean values of moisture content, protein content, titratable acidity and pH of canned bottle gourd pulp during storage

Treatment	Moisture content, (%(wb))			Protein content, (%)			Titratable acidity, (%)			pH		
	Storage period			Storage period			Storage period			Storage period		
	0	45	90	0	45	90	0	45	90	0	45	90
$P_1(S_1H_1)$	93.56	93.46	93.35	0.628	0.619	0.618	0.128	0.156	0.192	5.18	4.96	4.62
$P_2(S_1H_2)$	93.56	93.43	93.34	0.625	0.616	0.615	0.128	0.151	0.187	5.19	4.97	4.63
$P_3(S_1H_3)$	93.56	93.41	93.31	0.622	0.619	0.616	0.128	0.146	0.182	5.20	4.98	4.64
$P_4(S_2H_1)$	93.41	93.33	93.24	0.631	0.629	0.629	0.123	0.137	0.172	5.52	5.30	4.96
$P_5(S_2H_2)$	93.41	93.31	93.23	0.628	0.625	0.622	0.123	0.133	0.170	5.57	5.35	5.01
$P_6(S_2H_3)$	93.41	93.29	93.2	0.627	0.626	0.622	0.123	0.131	0.169	5.59	5.37	5.03
$P_7(S_3H_1)$	93.35	93.18	93.06	0.632	0.630	0.629	0.120	0.128	0.163	6.10	5.88	5.54
$P_8(S_3H_2)$	93.35	93.17	93.05	0.627	0.625	0.625	0.120	0.122	0.156	6.11	5.89	5.55
$P_9(S_3H_3)$	93.35	93.18	93.02	0.628	0.627	0.625	0.120	0.120	0.156	6.14	5.92	5.58

Table 5: Mean values of ascorbic acid, crude fiber and total soluble solids of canned bottle gourd pulp during storage

	Ascorbic acid, (%)			Crude fiber, (%)			Total soluble solids, (°B)		
	Storage period			Storage period			Storage period		
	0	45	90	0	45	90	0	45	90
$P_1(S_1H_1)$	0.0067	0.0061	0.0058	0.205	0.202	0.191	3.10	3.30	3.80
$P_2(S_1H_2)$	0.0065	0.0060	0.0058	0.195	0.189	0.176	3.00	3.50	4.00
$P_3(S_1H_3)$	0.0064	0.0059	0.0056	0.178	0.176	0.161	3.20	3.60	4.20
$P_4(S_2H_1)$	0.0067	0.0065	0.0062	0.225	0.217	0.212	3.80	3.80	4.60
$P_5(S_2H_2)$	0.0066	0.0064	0.0062	0.218	0.209	0.204	3.70	4.30	4.60
$P_6(S_2H_3)$	0.0064	0.0063	0.0061	0.205	0.199	0.193	3.80	4.50	4.80
$P_7(S_3H_1)$	0.0068	0.0066	0.0065	0.235	0.232	0.229	4.10	4.80	5.10
$P_8(S_3H_2)$	0.0066	0.0065	0.0064	0.226	0.222	0.218	4.00	4.80	5.00
$P_9(S_3H_3)$	0.0065	0.0064	0.0064	0.210	0.209	0.206	4.00	4.60	5.00

Losses of nutrients during canning of bottle gourd pulp

It was noticed that the initial mean values of various quality parameters of bottle gourd pulp, *viz.*, moisture content, protein content, pH, ascorbic acid, and crude fiber were decreased after canning of bottle gourd pulp (Table 4 and 5), whereas only titratable acidity of bottle gourd pulp after canning was increased. It might be due to addition of sodium benzoate in bottle gourd pulp before canning results in increase of acidity of bottle gourd pulp. Similar kind of nutritional loss of vegetables was reported by Belloso and Barriobero (2001) during canning of vegetables.

Fresh bottle gourd fruits (*Pusa Naveen*)

Preparation of bottle gourd pulp

Sealing of bottle gourd pulp tins

Storage of canned bottle gourd pulp tins

Plate 1: Canning of bottle gourd pulp

Effect of sodium benzoate (S) and head space (H) on canned bottle gourd pulp during storage

It was found that the bottle gourd pulp could be successfully stored up to 90 days of storage period at without preservative and with preservative (0.05 % and 0.10 % sodium benzoate) and different levels of head space (10 mm, 20 mm and 30 mm) for all the 9 treatments. In addition to this, there was no any microbial contamination or growth, *viz.*, *E. coli*, s*almonella* and total plate count (TPC) was observed in any of 9 treatments up to 90th day of storage period.

As far as individual effect was concerned, the effect of sodium benzoate (S) was found little more significant on few quality parameters of bottle gourd pulp as compared to head space (H) during the 90th day of storage.

So, as far as biochemical parameters of canned bottle gourd pulp were considered, highest retention of protein content (0.629 %), ascorbic acid (0.0065 %, i.e., 6.50 mg/100 g), crude fiber (0.229 %), and lowest value of titratable acidity (0.163 %) were obtained in treatment $P_7(S_3H_1)$ (0.10 % sodium benzoate + 10 mm head space) among all the treatments at 90th day of storage.

So, it could be concluded that on the basis of biochemical and microbial analysis of canned bottle gourd pulp at 90^{th} day of storage, the treatment $P_7(S_3H_1)$ (0.10 % sodium benzoate + 10 mm head space) was found to be the best among all the treatments.

CONCLUSIONS

1) The bottle gourd pulp could be successfully stored up to 90 days of storage period without preservative & with preservative (0.05 % and 0.10 % sodium benzoate) and different head space (10, 20, and 30 mm).
2) The initial mean values of various quality parameters of canned bottle gourd pulp, viz., moisture content, protein content, pH, ascorbic acid and crude fiber were decreased after canning of bottle gourd pulp, whereas only titratable acidity of bottle gourd pulp after canning increased.
3) On the basis of biochemical parameters of canned bottle gourd pulp, highest retention of ascorbic acid (0.0065 %, i.e., 6.50 mg/100 g), protein content (0.629 %), crude fiber (0.229 %), and lowest value of titratable acidity (0.163 %) were obtained in treatment $P_7(S_3H_1)$ (0.10 % sodium benzoate + 10 mm head space) among all the treatments at 90^{th} day of storage.
4) On the basis of microbial analysis of bottle gourd pulp on the basis of *E. coli*, s*almonella* and total plate count (TPC), there was no any microbial contamination or growth was observed in any treatment at 90^{th} day of storage.
5) On the basis of biochemical and microbial analysis of canned bottle gourd pulp at 90^{th} day of storage, the treatment $P_7(S_3H_1)$ (0.10 % sodium benzoate + 10 mm head space) was found to be the best among all the treatments.

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