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Effect of Canning Variables on Physical Biochemical and Microbial Parameters of Peas

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ABSTRACT

The freshly harvested green peas (cv., Goldy) were used for the experimental work. The experiment was conducted at department of processing and food engineering, Junagadh agricultural university during 2016-17. The canning of fresh green peas was carried out at different levels of preservatives (0.05 % citric acid, 0.05 % citric acid + 0.05 % ascorbic acid, 0.5 % citric acid + 0.10 % ascorbic acid and no preservatives) and brine solution (1 % and 2 %), whereas sample to solution ratio of 65:35 (w/w) and head space of 10 mm were kept constant throughout the experiment.The physical parameters of fresh peas, viz., weight (100 peas), firmness, maximum & minimum diameter, biochemical parameters, viz., moisture content, protein content, total carbohydrate content, pH, ascorbic acid, crude fiber and fat content as well as microbial parameters, viz., E. coli, Salmonella and Total Plate Count of canned peas were determined as per the standard analytical methods and the observations were carried out at an interval of 45 days (i.e., 0, 45 and 90 days of storage). The physical, biochemical and microbial analysis of canned peas at 90th day of storage, the treatment T_6 (P_3B_2) (0.5 % citric acid + 0.10 % ascorbic acid + 2 % brine solution) was found to be the best among all the treatments.

Key words: *Vegetables, Ascorbic acid, E. coli, Fiber, Fat*

INTRODUCTION

Vegetables are important food and highly beneficial for the maintenance of health and prevention of diseases. They are valued for their high carbohydrate, vitamin, mineral and fibre contents. Pea's production in India during 2015-16 was 4811 million tonnes from area of 498 ha[2]. Pea as a vegetable is an annual plant, with a life cycle of one year. It is a cool-season crop grown in many parts of the world; planting can take place from winter to early summer depending on location. Green peas are a very good source of protein, dietary fibre, vitamin K, vitamin B_1, vitamin C, vitamin B_2, vitamin folate, manganese, phosphorus, copper, niacin, molybdenum, zinc, magnesium, iron and potassium. Even though green peas are an extremely low-fat food and including sizable amounts of beta-carotene and small but valuable amounts of vitamin E[1].The consumption of peas is increases day by day due its health benefits.

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The post-harvest losses in peas occur due to lack of proper packaging materials, improper handling during long distance transport, microbial spoilage and storage facilities in the consuming centres, all contribute to the degree of loss reported.

The preservation of peas is carried out by several methods, viz., drying, freezing, etc., but among these freezing is very costly method. Several researchers were also reported that storage of dried peas could be carried out for 8 to10 months at about 3 to 4% (db) moisture content. But, hot air drying of fresh green peas leads the loss of vitamins, minerals, antioxidants, carbohydrates, fat, protein, etc. Previous findings indicated that canning of vegetables is a better alternative solution for preservation of vegetables for long storage period (more than 12 months).Canning preserves most of the nutrients in foods. Proteins, carbohydrates and fats are unaffected, as are vitamins A, C, D and B_2. The retention of vitamin B_1 depends on the amount of heat used during canning. Some vitamins and minerals may dissolve into the brine or syrup in a can during processing, but they retain their nutritive value, if those liquids are consumed.

Peas are low acid vegetables, preservation of low acid food for long term storage at ambient condition, needs high thermal processing temperature more than 121°C is required[12]. In addition to this, final canned product could retain its quality in terms of physical, functional, biochemical and organoleptic parameters as compared to drying of vegetables. Anti- nutritional factors also destroyed by canning. Peas are most commonly used in all Indian dishes, viz., Gujarati, Punjabi, South Indian, Italian, etc. Most of the Indian dishes need fresh green peas instead of dried one. As far as Indian recipes are considered green peas are supplemented in almost all kinds of Sabjis. Furthermore, fresh green peas are the source of boosting energy to human being in different forms. But, the availability of fresh green peas are limited to its peak season only. So, there is a need to preserve fresh green peas throughout the year as per the food habits of consumers.

Our objective was to examine the effects of canning on peas at different process variables, viz., preservatives and concentrations of brine solution. These canning process variables was optimized to identify the best treatment combination producing canned peas on the basis of physical, biochemical and microbial parameters at the end of storage period.

MATERIAL AND METHODS

Raw material

Commercial fresh green peas (*pisum sativum*) were canned in small-scale food processing equipment of the Processing and Food Engineering Department of the Junagadh Agriculture University. The green peas were bought in the market on the same day that they were processed.

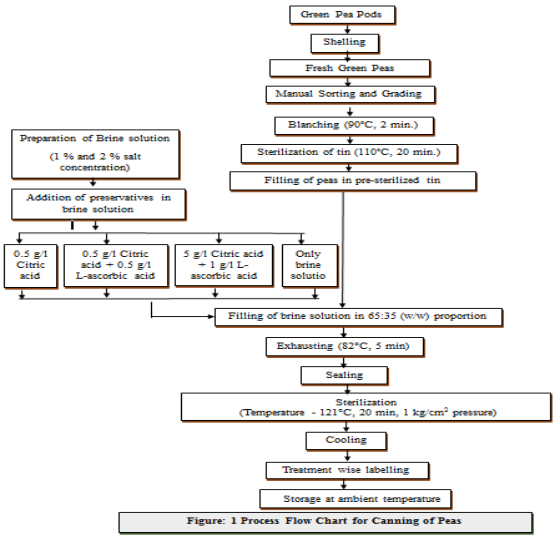

Figure: 1 Process Flow Chart for Canning of Peas

Canning process

Fig. 1 shows the canning process applied in this study. After selecting and washing (by tap water), peas were blanched by blanching water (90°C, 2 min.) and cooled by continuously at room temperature. In present investigation, two levels (i.e., 1 % and 2 %) of brine solution were used for experiment. Proportion of citric acid and L-ascorbic acid were added in different container as per their treatment order (i.e., T_1 to T_8) in following manner.

- The citric acid in the proportion of 0.05 % was added in 1 % and 2 % brine solutions (Treatment T_1 and T_2).

- The citric acid and L-ascorbic acid in the proportion of 0.05 % and 0.05 %, respectively were added in 1 % and 2 % brine solutions (Treatment T_3 and T_4).
- The citric acid and L-ascorbic acid in the proportion of 0.50 % and 0.10 %, respectively were added in 1 % and 2 % brine solutions (Treatment T_5 and T_6).
- The brine solutions of 1 % and 2 % concentration without any preservatives (Treatment T_7 and T_8).

Eight different brine solutions with and without preservatives were prepared as per following treatments.

Table 1: Treatment combination for peas

Sr. No.	Treatments	Combinations
1	$T_1(P_1B_1)$	0.05 % (C) + 1 % (B)
2	$T_2(P_1B_2)$	0.05 % (C) + 2 % (B)
3	$T_3((P_2B_1)$	0.05 % (C) + 0.05 % (A) + 1 % (B)
4	$T_4(P_2B_2)$	0.05 % (C) + 0.05 % (A) + 2 % (B)
5	$T_5(P_3B_1)$	0.5 % (C) + 0.1 % (A) + 1 % (B)
6	$T_6((P_3B_2)$	0.5 % (C) + 0.1 % (A) + 2 % (B)
7	$T_7(P_4B_1)$	1 % (B)
8	$T_8((P_4B_2)$	2%(B)

Then after filling the brine solution in can and then exhausting, sealing, sterilization, cooling, labelling and storage at room temperature.

Statistical analysis

The observations taken for various treatment combinations for canned peas were subjected to analysis of variance technique considering two factors Completely Randomized Design with four replications at 5 per cent level of significance as suggested by Panse and Sukhatme[8].

RESULTS AND DISCUSSION

Quality evaluation of fresh green peas

The quality of fresh green peas (Cv. *Goldy*) was determined on the basis of physical parameters, i.e., weight (100 peas), firmness and maximum and minimum diameter of peas. The Weight, firmness and maximum and minimum diameter were measured by digital weight balance, texture analyser and digital Vernier callipers respectively.

Table 2: Physical parameters of fresh green peas

Sr. No	Parameter	Mean	SD
1	Weight (100 peas) (g)	48.57	5.52
2	Firmness (kgf)	0.26	0.02
3	Maximum diameter (mm)	8.58	0.65
4	Minimum diameter (mm	6.76	0.51

The quality of fresh green peas (Cv. *Goldy*) was determined on the basis of biochemical parameters, viz., moisture content, protein content, total carbohydrate, oil content, pH, ascorbic acid and crude fiber. The moisture content, protein content, total carbohydrate content and ascorbic acid, fat content, crude fiber and pH of peas were measured by Ranganna[9], Lowry *et al.*[7], Sadasivam and Manickam[10], Soxhlet extraction, AOAC[3] fibretherm and Digital pH meter respectively.

Table 3: Biochemical parameters of fresh green peas

Sr. No.	Parameter	Mean	SD
1	Moisture content (%(wb))	77.61	0.27
2	Protein content (%)	5.41	0.16
3	Total Carbohydrate content (%)	14.55	0.27
4	pH	6.96	0.04
5	Ascorbic acid (mg/100g)	42.00	2.39
6	Crude fiber (%)	5.58	0.03
7	Fat content (%)	0.42	0.03

Quality evaluation of canned peas

The quality evaluation of canned peas was carried out on the basis of various physical parameters, *viz.*, firmness as well as biochemical parameters, *viz.*, moisture content, protein content, total carbohydrate content, pH, ascorbic acid, crude fiber and fat content at an interval of 45 days (i.e., 0, 45 and 90 days). The mean values of physical and biochemical parameters are reported in Appendix A and Appendix B.

Firmness

Highest Firmness of canned peas at (0, 45 and 90 days) storage were found (0.235, 0.198 and 0.160 kgf) respectively in treatment T_6 ((P_3B_2)) (Appendix A).While, lowest firmness of canned peas at (0, 45 and 90 days) storage were found (0.190, 0.150 and 0.113 kgf)

respectively in treatment T_7 (P_4B_1) (Appendix A). Statistically individual effect of preservatives (P) and brine solution (B) were found significant whereas, interaction between P x B was found non-significant at (0, 45 and 90 days) of storage (Table 4). The results are in agreement with the results reported by Sejani[11] for canning of bottle gourd cubes.

Moisture content

Highest moisture content of canned peas at (0, 45 and 90 days) storage were found (75.94, 77 and 77.63 % (wb)) respectively in treatment T_5 (P_3B_1) (Appendix A).While, lowest moisture content of canned peas at (0, 45 and 90 days) storage were found (75.15, 75.63 and 76.43 % (wb)) respectively in treatment T_8 ((P_4B_2) (Appendix A). Statistically individual effect of preservatives (P) was found non-significant at (0, 45 and 90 days) of storage and effect of brine solution (B) was found significant at 0 day storage and non-significant at 45 and 90 days of storage whereas, interaction between P x B was found non-significant at (0, 45 and 90 days) of storage (Table 4). The results are in agreement with the results reported by Sejani[11] for canning of bottle gourd cubes.

Protein content

Highest protein content of canned peas at (0, 45 and 90 days) storage were found (5.413, 5.363 and 5.338 %) respectively in treatment T_6 ((P_3B_2) (Appendix A).While, lowest protein content of canned peas at (0, 45 and 90 days) storage were found (5.390, 5.335 and 5.295 %) respectively in treatment T_7 ((P_4B_1) (Appendix A). Statistically effect of preservatives (P), brine solution (B) and interaction between P x B were found non-significant at (0, 45 and 90 days) of storage (Table 4). The results are in agreement with the results reported by Sejani[11] for canning of bottle gourd cubes.

Carbohydrate content

Highest Carbohydrate content of canned peas at (0, 45 and 90 days) storage were found (14.113, 14.073 and 14.050 %) respectively in treatment T_6 ((P_3B_2) (Appendix A).While, lowest carbohydrate content of canned peas at (0, 45 and 90 days) storage were found (14.083, 14.045 and 13.993 %) respectively in treatment T_7 ((P_4B_1) (Appendix A). Statistically effect of preservatives (P), brine solution (B) and interaction between P x B were found non-significant at (0, 45 and 90 days) of storage (Table 4). The results are in agreement with the results reported by Belloso and Barriobero[4] for canning of asparagus, whole peeled tomatoes, mushrooms and lentils.

pH

Highest pH of canned peas at (0, 45 and 90 days) storage were found (6.62, 5.82 and 4.76) respectively in treatment T_8 ((P_4B_2) (Appendix B).While, lowest pH of canned peas at (0, 45 and 90 days) storage were found (6.32, 5.41 and 4.44) respectively in treatment T_5 (P_3B_1) (Appendix B). Statistically individual effect of preservatives (P) and brine solution (B) were found significant whereas, interaction between P x B was found non-significant at (0, 45 and 90 days) of storage (Table 4). The results are in agreement with the results reported by Sejani[11] for canning of bottle gourd cubes.

Ascorbic acid

Highest ascorbic acid of canned peas at (0, 45 and 90 days) storage were found (35.93, 34.63 and 34.19 mg/100g) respectively in treatment T_6 ((P_3B_2) (Appendix A).While, lowest ascorbic acid of canned peas at (0, 45 and 90 days) storage were found (32.50, 31.64 and 30.75 mg/100g) respectively in treatment T_7 ((P_4B_1) (Appendix B). Statistically effect of preservatives (P) was found significant and effect of brine solution (B) was found non-significant whereas, interaction between P x B were found non-significant at (0, 45 and 90 days) of storage (Table 4). The results are in agreement with the results reported by Belloso and Barriobero[4] for canning of asparagus, whole peeled tomatoes, mushrooms and lentils.

Crude fiber

Highest crude fiber of canned peas at (0, 45 and 90 days) storage were found (5.62, 5.57 and 5.50 %) respectively in treatment T_6 ((P_3B_2) (Appendix B).While, lowest crude fiber content of canned peas at (0, 45 and 90 days) storage were found (5.45, 5.38 and 5.30 %) respectively in treatment T_7 ((P_4B_1) (Appendix B). Statistically effect of

preservatives (P) and brine solution (B) was found significant whereas, interaction between P x B were found non-significant at (0, 45 and 90 days) of storage (Table 4). The results are in agreement with the results reported by Belloso and Barriobero[4] for canning of asparagus, whole peeled tomatoes, mushrooms and lentils.

Fat content

Highest fat content of canned peas at (0, 45 and 90 days) storage were found (0.40, 0.37 and 0.35 %) respectively in treatment T_6 ((P_3B_2) (Appendix B).While, lowest fat content of canned peas at (0, 45 and 90 days) storage were found (0.38, 0.36 and 0.33 %) respectively in treatment T_7 ((P_4B_1) (Appendix B). Statistically effect of preservatives (P), brine solution (B) and interaction between P x B were found non-significant at (0, 45 and 90 days) of storage (Table 4). The results are in agreement with the results reported by Sejani[11] for canning of bottle gourd cubes.

Microbial parameters

The microbial analysis for *E. coli*, *salmonella* and total plate count (TPC) of canned peas was carried out at intervals of 0, 45 & 90 days during storage. The standard Procedure suggested by Downes and Ito[5] was used for microbial analysis for stored peas.

E. coli

No *E. coli* was found in canned peas in all the treatments at an interval of 0, 45 and 90 days of storage period.

Salmonella

No *salmonella* was found in canned peas in all the treatments at an interval of 0, 45 and 90 days of storage period.

Total plate count (TPC)

No total plate count (TPC) was found in canned peas in all the treatments at an interval of 0, 45 and 90 days of storage period.

Table 4: Effect of preservatives and brine solution on firmness, moisture content and protein content of peas during storage (statistically analyzed data)

Treatment	Firmness (kgf) at different storage period			Moisture content (%(wb)) at different storage period			Protein content (%) at different storage period		
	0 day	45 days	90 days	0 day	45 days	90 days	0 day	45 days	90 days
Preservatives (P)				**Preservatives (P)**			**Preservatives (P)**		
P_1 = 0.05 % (C)	0.206	0.165	0.124	75.305	76.198	76.948	5.396	5.346	5.308
P_2 = 0.05 % (C) + 0.05 % (A)	0.219	0.180	0.139	75.625	76.378	77.238	5.403	5.354	5.315
P_3 = 0.5 % (C) + 0.1 % (A)	0.231	0.193	0.154	75.724	76.769	77.229	5.410	5.360	5.331
P_4 = NP	0.196	0.156	0.118	75.218	76.069	76.729	5.391	5.338	5.299
S.Em.±	0.003	0.003	0.002	0.157	0.179	0.250	0.005	0.007	0.008
C.D. at 5%	0.008	0.008	0.005	NS	NS	NS	NS	NS	NS
Brine Solution (B)				**Brine Solution (B)**			**Brine Solution (B)**		
B_1 = 1% brine solution	0.209	0.169	0.129	75.558	76.774	77.334	5.398	5.35	5.309
B_2 = 2% brine solution	0.217	0.178	0.138	75.378	75.933	76.738	5.402	5.35	5.317
S.Em.±	0.002	0.002	0.001	0.111	0.127	0.176	0.004	0.005	0.006
C.D. at 5%	0.006	0.005	0.004	NS	0.370	0.515	NS	NS	NS
P x B				**P x B**			**P x B**		
S.Em.±	0.004	0.004	0.003	0.222	0.253	0.353	0.007	0.009	0.011
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V.%	3.831	4.284	3.974	0.588	0.664	0.916	0.265	0.354	0.428

Cont……

Table 4: Effect of preservatives and brine solution on carbohydrate, pH and ascorbic acid of peas during storage (statistically analyzed data)

Treatment	Carbohydrate (%) at different storage period			pH at different storage period			Ascorbic acid (mg/100g) at different storage period		
	0 day	45 days	90 days	0 day	45 days	90 days	0 day	45 days	90 days
Preservatives (P)				**Preservatives (P)**			**Preservatives (P)**		
P_1 = 0.05 % (C)	14.098	14.059	14.019	6.59	5.70	4.70	33.47	32.71	31.30
P_2 = 0.05 % (C) + 0.05 % (A)	14.106	14.066	14.031	6.46	5.59	4.61	34.45	33.59	32.65
P_3 = 0.5 % (C) + 0.1 % (A)	14.111	14.071	14.040	6.37	5.46	4.52	35.50	34.49	33.73
P_4 = NP	14.089	14.050	14.004	6.57	5.79	4.69	32.69	31.84	30.86
S.Em.±	0.006	0.005	0.009	0.04	0.01	0.06	0.32	0.44	0.34
C.D. at 5%	NS	NS	NS	0.11	0.04	0.05	0.94	1.28	0.99
Brine Solution (B)				**Brine Solution (B)**			**Brine Solution (B)**		
B_1 = 1% brine solution	14.098	14.059	14.016	6.45	5.61	4.56	33.76	32.78	31.83
B_2 = 2% brine solution	14.104	14.064	14.031	6.54	5.66	4.70	34.30	33.53	32.44
S.Em.±	0.004	0.004	0.006	0.03	0.01	0.04	0.23	0.31	0.24
C.D. at 5%	NS	NS	NS	0.08	0.03	0.12	NS	NS	NS
P x B				**P x B**			**P x B**		
S.Em.±	0.008	0.008	0.012	0.06	0.02	0.08	0.46	0.62	0.48
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V.%	0.120	0.108	0.173	1.71	0.65	3.58	2.68	3.74	2.98

Cont….

Table 4: Effect of preservatives and brine solution on crude fiber and fat content of peas during storage (statistically analyzed data)

Treatment	Crude fiber (%) at different storage period			Fat (%) at different storage period		
	0 day	45 days	90 days	0 day	45 days	90 days
Preservatives (P)				**Preservatives (P)**		
P_1 = 0.05 % (C)	5.56	5.49	5.42	0.389	0.364	0.339
P_2 = 0.05 % (C) + 0.05 % (A)	5.59	5.52	5.45	0.394	0.370	0.343
P_3 = 0.5 % (C) + 0.1 % (A)	5.61	5.55	5.48	0.399	0.376	0.350
P_4 = NP	5.48	5.41	5.34	0.384	0.361	0.334
S.Em.±	0.010	0.008	0.008	0.004	0.004	0.004
C.D. at 5%	0.03	0.02	0.02	NS	NS	NS
Brine Solution (B)				**Brine Solution (B)**		
B_1 = 1% brine solution	5.54	5.47	5.40	0.390	0.366	0.339
B_2 = 2% brine solution	5.57	5.51	5.44	0.393	0.369	0.343
S.Em.±	0.007	0.006	0.006	0.003	0.003	0.003
C.D. at 5%	0.02	0.01	0.01	NS	NS	NS
P x B				**P x B**		
S.Em.±	0.015	0.011	0.012	0.006	0.006	0.006
C.D. at 5%	NS	NS	NS	NS	NS	NS
C.V.%	0.53	0.41	0.43	2.901	3.127	3.330

Appendix A

Mean values of firmness, moisture content, protein content and carbohydrate content of canned peas during storage

Treatment	Firmness, (kgf)			Moisture content, (% (wb))			Protein content, (%)			Total Carbohydrate, (%)		
	Storage period			Storage period			Storage period			Storage period		
	0	45	90	0	45	90	0	45	90	0	45	90
$T_1(P_1B_1)$	0.203	0.163	0.120	75.32	76.65	77.25	5.395	5.345	5.305	14.095	14.058	14.015
$T_2(P_1B_2)$	0.210	0.168	0.128	75.29	75.75	76.65	5.398	5.348	5.310	14.100	14.060	14.023
$T_3((P_2B_1)$	0.218	0.178	0.135	75.69	76.94	77.44	5.400	5.353	5.313	14.105	14.065	14.025
$T_4(P_2B_2)$	0.220	0.183	0.143	75.56	75.82	77.04	5.405	5.355	5.318	14.108	14.068	14.038
$T_5(P_3B_1)$	0.228	0.188	0.148	75.94	77.00	77.63	5.408	5.358	5.325	14.110	14.070	14.030
$T_6((P_3B_2)$	0.235	0.198	0.160	75.51	76.54	76.83	5.413	5.363	5.338	14.113	14.073	14.050
T_7 (P_4B_1)	0.190	0.150	0.113	75.29	76.51	77.03	5.390	5.335	5.295	14.083	14.045	13.993
$T_8((P_4B_2)$	0.203	0.163	0.123	75.15	75.63	76.43	5.393	5.340	5.303	14.095	14.055	14.015

Appendix B

Mean values of pH, ascorbic acid, crude fibre and fat content of canned peas during storage

Treatment	pH			Ascorbic acid, (mg/100g)			Crude fibre, (%)			Fat content, (%)		
	Storage period			Storage period			Storage period			Storage period		
	0	45	90	0	45	90	0	45	90	0	45	90
$T_1(P_1B_1)$	6.57	5.68	4.65	33.38	32.05	31.03	5.56	5.48	5.40	0.388	0.363	0.338
$T_2(P_1B_2)$	6.62	5.72	4.75	33.56	33.36	31.56	5.57	5.50	5.43	0.390	0.365	0.340
$T_3((P_2B_1)$	6.41	5.57	4.53	34.09	33.11	32.25	5.59	5.51	5.44	0.393	0.368	0.340
$T_4(P_2B_2)$	6.50	5.60	4.69	34.81	34.08	33.05	5.59	5.52	5.45	0.395	0.373	0.345
$T_5(P_3B_1)$	6.32	5.41	4.44	35.08	34.34	33.28	5.60	5.53	5.46	0.398	0.375	0.348
$T_6((P_3B_2)$	6.42	5.51	4.61	35.93	34.63	34.19	5.62	5.57	5.50	0.400	0.378	0.353
T_7 (P_4B_1)	6.51	5.76	4.64	32.50	31.64	30.75	5.45	5.38	5.30	0.383	0.360	0.333
$T_8((P_4B_2)$	6.62	5.82	4.76	32.89	32.05	30.98	5.50	5.44	5.37	0.385	0.363	0.335

CONCLUSION

Physical parameter, *viz.*, Firmness of fresh green peas was decreased after canning that might be attributed to osmosis process between peas and brine solution resulted into reduction of firmness. Biochemical parameters, *viz*. moisture content, protein content, carbohydrate content, pH, ascorbic acid, crude fiber and fat content were also decreased after canning of peas. This might be attributed to thermal processes, *viz.*, blanching, exhausting and sterilization of fresh green peas carried out during canning process resulted into thermal degradation of biochemical constituents as well as leaching of organic compounds into the brine solution. Microbial analysis of canned peas were considered, *E. coli*, s*almonella* and total plate count (TPC),

there was no any microbial contamination or growth was observed in any treatment at 90thday of storage. Finally, optimizing the physical, biochemical and microbial analysis of canned peas at 90th day of storage, the treatment T_6 (P_3B_2) (0.5 % citric acid + 0.10 % ascorbic acid + 2 % brine solution) was found to be the best among all the treatments.

REFERENCES

1. Anonymous. Best Health Benefits of Peas. Available at 20 September, 2012 (2012).
2. Anonymous. Indian Horticulture database. National Horticulture Board, Ministry of Agriculture, Department of Agriculture and Cooperation. Available at http://www.nhb.gov.in accessed 25 January, 2017(2016).
3. AOAC. Official methods of analysis. 18th edition. Association of Analytic Chemist. Washington DC (2005).
4. Belloso, O. M. and Barriobero, E. L. Proximate composition, minerals and vitamins in selected canned vegetables. *Eur Food Res Technol*. **212:** 182–187 (2001).
5. Downes, F. P. and Ito, K. Compendium of methods of the microbiological examination of food. 4th Edition. American Public Health Association, Washington. (2001).
6. Compendium of methods of the microbiological examination of food. 4th Edition. American Public Health Association, Washington. Francis, F. J. (edition), Wiley Encyclopaedia of Food Science and Technology 2nd Edition. *John Wiley & Sons Inc*. New York. 493 (1999).
7. Lowry, O. H.; Rosebrough, N. J.; Farr, A. L. and Randall, R. J. Protein measurement with the folin phenol reagent. *Journal of Biological Chemistry*. **193(1):** 265-275 (1951).
8. Panse, V.G. and Sukhatme, P.V. Statistical methods for agricultural workers. *Indian Council of Agricultural Research,* New Delhi (1967).
9. Ranganna, S. Handbook of analysis and quality control for fruits and vegetable products. *Tata McGraw Hill Publishing* Co. Ltd., New Delhi (2000).
10. Sadasivam, S. and Manickam, A. Biochemical Methods for Agriculture Sciences, Willey Eastern Limited, New Delhi (1996).
11. Sejani, V. M. Studies on canning of bottle gourd pulp and cubes. M. Tech. (Agril. Engg.) Thesis (Unpublished). Junagadh Agriculture University, Junagadh (2016).
12. Wu, J. S. B. and Shen, S. C. Processing of vegetable juice and blends, In: Handbook of Vegetables and Vegetable Processing, *Blackwell Publishing Limited,* USA. 335-350 (2011).