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EFFECT OF DIFFERENT POST HARVEST TRAEATMENTS, PACKAGING AND STORAGE CONDITION ON FRENCH BEAN (*phaseolaus vulgaris* L.)

B.V.G. Prasad*, S. Chakravorty and P. Deb

Department of Crop Improvement, Horticulture and Agriculture Botany (CIHAB), Institute of Agriculture, Visva-Bharati, Sriniketan-731236, West Bengal, India.
**E-mail: prasadbvg@sify.com*

ABSTRACT : The present investigation was undertaken to study the effect of different post harvest treatments, packaging and storage condition on French bean. The experiment was conducted under the laboratory of Horticulture Department, Institute of Agriculture, Visva-Bharati University, Sriniketan, West Bengal (India) during the period of January to March 2013. The results from the investigation revealed minimum physiological loss in weight at 14th day (17.41 g/100g), the highest dry matter content (7.68%), total sugar content (3.53 g/100g) and crude protein content (1.33 g/100g) in $S_3P_2T_1$ (*i.e.,* Refrigerated storage, perforated polythene packing and $CaCl_2$ treatment) at the final stage of consumption.

Keywords: *French bean, Crude protein, physiological loss, refrigerated storage, total sugar.*

The French bean (*Phaseolaus vulgaris* L.) is a nutritionally significant (pods contain 1.7% protein, and dry seed contains 21.1% protein per 100 g of edible part) leguminous vegetable. It is grown for its tender green pods which are consumed either fresh or used for processing and dry seeds. One of the major problems in the French bean production is the high post harvest losses i.e., 5 to 25% in developed and 20 to 50% in developing countries (Khader *et al.,* 3) due to lack of organized market facilities such as transportation and temporary storage and the seasonality of the crop (Obera, 8). Like other horticultural commodities, French beans are highly perishable and rapidly deteriorate after harvest (Ryall and Lipton, 9). Hence, it is essential to take measures to improve the shelf life of French bean. Thus, the present research was formulated to study the effects of different post harvest treatments, packaging and storage condition on French bean.

MATERIALS AND METHODS

Fresh harvested pods were collected at edible maturity stage from well managed French bean field. After collection, pods were washed thoroughly to remove adherents and micro-organisms on the surface. In this experiment, fresh pods weighing 100g were used as basic material for each treatment, respectively. The detail of the treatments applied is given below.

Chemicals used for post harvest treatment : Calcium chloride @ 0.25% (T_1), Gibberellic acid @ 50ppm (T_2) and distilled water as control (T_3).

Packaging materials used for the experiment : Polythene pack (100 guage, P_1), perforated polythene pack (100 guage, having 0.1% perforation, P_2), news print (P_3) and treatment without packaging material (as control, P_4).

Storage condition : Ambient storage condition (S_1), storage under corrugated fibre box (CFB, S_2) and storage under refrigerated condition (S_3).

Chemical treatment: Treatment of fresh green pods with solution of $CaCl_2$ @ 0.25% and GA_3@ 50 ppm separately was done for different treatment combinations by dipping the pods in the freshly made solutions for 30 minutes.

Packaging : Open polythene pack, closed polythene pack (perforated) and news paper were used as packaging materials. After proper treatment as per the requirement of experiment 100g of French bean pods were packed in each packaging material in triplicate

Storage : There were three storage conditions under the present study like ambient, storage in corrugated fibre box (CFB) and storage in refrigerated condition (7°C and 85% relative humidity).

Observations were recorded for physiological losses in weight (PLW), dry matter content, total sugars and crude protein content in pods.

Design of experiment : Completely Randomized Design with 36 treatment combinations was used for experimentation (Table 1) and 3 replications were used and data obtained were statistically analyzed (Table 2).

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Table 1: Treatment details for the experiment.

Sl. No.	Treatment	Storage condition (S)	Packaging (P)	Chemical treatment(T)
1	$S_1P_1T_1$	Ambient	OP Pack	$CaCl_2$ @0.25%
2	$S_1P_1T_2$	,,	,,	GA_3 @50ppm
3	$S_1P_1T_3$	,,	,,	Control (DW)
4	$S_1P_2T_1$	,,	CP Pack	$CaCl_2$ @0.25%
5	$S_1P_2T_2$	,,	,,	GA_3 @50ppm
6	$S_1P_2T_3$	,,	,,	Control (DW)
7	$S_1P_3T_1$	,,	News Print	$CaCl_2$ @0.25%
8	$S_1P_3T_2$	,,	,,	GA_3 @50ppm
9	$S_1P_3T_3$	,,	,,	Control (DW)
10	$S_1P_4T_1$	,,	Open	$CaCl_2$ @0.25%
11	$S_1P_4T_2$	,,	,,	GA_3 @50ppm
12	$S_1P_4T_3$	,,	,,	Control (DW)
13	$S_2P_1T_1$	CFB	OP Pack	$CaCl_2$ @0.25%
14	$S_2P_1T_2$	,,	,,	GA_3 @50ppm
15	$S_2P_1T_3$	,,	,,	Control (DW)
16	$S_2P_2T_1$	,,	CP Pack	$CaCl_2$ @0.25%
17	$S_2P_2T_2$	,,	,,	GA_3 @50ppm
18	$S_2P_2T_3$	,,	,,	Control (DW)
19	$S_2P_3T_1$	,,	News Print	$CaCl_2$ @0.25%
20	$S_2P_3T_2$	,,	,,	GA_3 @50ppm
21	$S_2P_3T_3$	,,	,,	Control (DW)
22	$S_2P_4T_1$	,,	Open	$CaCl_2$ @0.25%
23	$S_2P_4T_2$	,,	,,	GA_3 @50ppm
24	$S_2P_4T_3$	,,	,,	Control (DW)
25	$S_3P_1T_1$	Refrigerated*	OP Pack	$CaCl_2$ @0.25%
26	$S_3P_1T_2$	,,	,,	GA_3 @50ppm
27	$S_3P_1T_3$	,,	,,	Control (DW)
28	$S_3P_2T_1$	,,	CP Pack	$CaCl_2$ @0.25%
29	$S_3P_2T_2$	,,	,,	GA_3 @50ppm
30	$S_3P_2T_3$	,,	,,	Control (DW)
31	$S_3P_3T_1$	,,	News Print	$CaCl_2$ @0.25%
32	$S_3P_3T_2$	,,	,,	GA_3 @50ppm
33	$S_3P_3T_3$	,,	,,	Control (DW)
34	$S_3P_4T_1$	,,	Open	$CaCl_2$ @0.25%
35	$S_3P_4T_2$	,,	,,	GA_3 @50ppm
36	$S_3P_4T_3$	,,	,,	Control (DW)

CFB= Corrugated Fibre Box; * = 7°C, 85% relative humidity; **OP Pack**= Open Polythene Pack; **CP Pack** = Closed Polythene Pack; **Open** = Without Packaging; **DW** = Distilled Water.

RESULTS AND DISCUSSION

The present results (Table 2) revealed that post-harvest packaging, chemical treatments and storage conditions significantly affected the physiological losses in weight (PLW), dry matter content, total sugars and crude protein content in pods. Minimum PLW (8.88 g and 17.41 g/100g) was observed in treatment combination $S_3P_2T_1$ (*i.e.,* refrigerated storage, perforated polythene packing and $CaCl_2$ treatment) at 7^{th} day and 14^{th} day post-harvest of pods, respectively whereas it was maximum at 7^{th} day (27.12 g/100g) and 14^{th} day (36.23 g/100g) under treatment $S_1P_4T_3$ (*i.e.,* ambient storage, without packing and no chemical treatment). In case of ambient storage the range of PLW was maximum (25.30 - 36.26 g/100g) and it was minimum under refrigerated storage (17.41 - 28.27 g/100g). Maximum PLW under $S_1P_4T_3$ may be due to lower relative humidity and high temperature in ambient storage than the refrigerated storage. Moreover, over respiration rate in ambient storage leads to exudation of water from the pods. The results are in consonance with Lal *et al.* (4) in tomato.

Influence of storage, packing and chemical treatments on initial dry matter content was statistically non-significant. The highest dry matter content at final stage (14^{th} day) was observed in $S_3P_2T_1$ (*i.e.,* refrigerated storage, perforated polythene packing and $CaCl_2$ treatment), whereas, the lowest response (5.83%) in this regard was recorded $S_1P_4T_3$ (*i.e.,* ambient storage, without packing and no chemical treatment). Moreover, the highest range (6.98 - 7.685%) was recorded under refrigerated condition and the lowest range (5.83 - 6.26%) in this regard was observed under ambient storage condition. Highest dry matter in $S_3P_2T_1$ may be due to slow rate of respiration and other metabolic processes (catabolic) under refrigerated condition. The results are in line with those of Badenoch *et al.* (1) and Jawandha *et. al.* (2).

Maximum total sugar content (3.53 g/100g) was observed at final consumption stage under $S_3P_2T_1$ (*i.e.,* refrigerated storage, perforated polythene packing and $CaCl_2$ treatment) and followed by $S_3P_3T_2$ (3.35 g/100g), $S_3P_3T_2$ (3.32 g/100g) and $S_3P_3T_1$ (3.30 g/100g). Later three treatments were statistically at par. Maximum range of total sugar (3.09 g - 3.53 g/100g) was observed under refrigerated storage condition whereas minimum range (2.08 g - 2.68 g/l00g) in this regard was recorded under ambient storage condition of pods. This is due to higher temperature under ambient condition and maximum utilization of sugars for respiration and less utilization of sugar at low

temperature under refrigerated condition. These results are in conformity with findings of Lal *et al.* (4) in tomato, and Neilson and Pub (6) in cucumber.

The initial crude protein content in French bean pods revealed that all the observation from different post-harvest treatment combination were statistically at par which closely ranged from 1.76 - 1.89 g/100g.

Table 2 : Effect of storage condition, packaging and chemical treatments on quality traits of French bean.

Sl. No.	Treatment	Physiological loss in weight (g/100g) ?		Dry matter content (g/100g)		Total sugar (g/100g)		Crude protein (g/100g)	
		7th day	14th day	Initial	Final	Initial	Final	Initial	Final
1	$S_1P_1T_1$	19.62	29.71	8.03	6.24	3.87	2.29	1.83	0.79
2	$S_1P_1T_2$	20.18	30.08	8.27	6.11	3.49	2.28	1.81	0.77
3	$S_1P_1T_3$	20.89	31.12	8.39	5.98	3.98	2.41	1.79	0.76
4	$S_1P_2T_1$	16.24	25.30	8.15	6.40	4.12	2.63	1.83	0.82
5	$S_1P_2T_2$	16.90	26.59	7.88	6.17	4.03	2.49	1.80	0.78
6	$S_1P_2T_3$	17.15	28.21	8.31	6.26	3.96	2.52	1.80	0.79
7	$S_1P_3T_1$	18.78	27.13	8.28	6.20	4.25	2.68	1.81	0.76
8	$S_1P_3T_2$	17.40	28.30	8.14	6.02	4.07	2.42	1.78	0.79
9	$S_1P_3T_3$	20.31	29.52	8.18	5.97	3.88	2.35	1.77	0.77
10	$S_1P_4T_1$	24.07	33.72	7.89	6.05	4.03	2.60	1.82	0.78
11	$S_1P_4T_2$	22.54	34.84	8.24	6.14	4.21	2.67	1.84	0.81
12	$S_1P_4T_3$	27.12	36.23	8.06	5.83	3.86	2.08	1.80	0.72
13	$S_2P_1T_1$	15.53	24.54	8.32	6.97	4.23	3.05	1.78	0.95
14	$S_2P_1T_2$	15.26	25.23	8.29	6.82	3.79	2.63	1.82	1.01
15	$S_2P_1T_3$	17.99	26.05	8.26	6.61	4.10	2.92	1.82	1.02
16	$S_2P_2T_1$	12.72	20.75	7.95	6.52	4.22	2.98	1.83	1.01
17	$S_2P_2T_2$	11.57	21.96	8.10	6.69	4.07	2.83	1.79	0.98
18	$S_2P_2T_3$	12.05	23.51	8.04	6.45	4.30	3.01	1.80	0.93
19	$S_2P_3T_1$	13.43	22.64	7.94	6.73	4.02	2.88	1.84	0.96
20	$S_2P_3T_2$	11.37	23.72	7.91	6.58	3.88	2.61	1.79	0.97
21	$S_2P_3T_3$	15.91	24.67	8.15	6.53	4.12	2.96	1.76	0.94
22	$S_2P_4T_1$	19.49	28.66	8.23	6.80	3.95	2.72	1.77	0.98
23	$S_2P_4T_2$	20.85	29.50	8.25	6.76	3.86	2.69	1.82	1.02
24	$S_2P_4T_3$	20.32	31.04	8.01	6.43	4.20	2.63	1.80	0.04
25	$S_3P_1T_1$	12.73	21.38	8.37	7.24	4.13	3.28	1.82	1.14
26	$S_3P_1T_2$	13.51	22.05	8.11	7.29	4.07	3.29	1.83	1.19
27	$S_3P_1T_3$	12.30	22.97	7.97	7.03	3.97	3.09	1.82	1.12
28	$S_3P_2T_1$	8.88	17.41	8.36	7.68	4.24	3.53	1.89	1.33
29	$S_3P_2T_2$	8.06	18.79	8.38	7.24	4.16	3.25	1.80	1.01
30	$S_3P_2T_3$	9.21	20.08	7.86	7.04	3.87	3.26	1.76	1.04
31	$S_3P_3T_1$	9.46	19.33	8.22	7.12	4.11	3.30	1.78	1.11
32	$S_3P_3T_2$	11.28	20.57	8.12	7.07	4.21	3.35	1.84	1.15
33	$S_3P_3T_3$	11.63	21.76	8.10	7.13	4.03	3.27	1.78	1.09
34	$S_3P_4T_1$	13.62	25.95	7.93	6.98	3.95	3.29	1.83	1.16
35	$S_3P_4T_2$	15.17	26.19	8.27	7.05	4.20	3.32	1.81	1.12
36	$S_3P_4T_3$	17.64	28.27	8.23	7.02	4.20	3.29	1.80	1.09
CD (P = 0.05)		1.05	1.21	NS	0.37	NS	0.15	NS	0.12

Which were decreased during the storage and influenced by different treatment combination. Maximum crude protein content (1.33 g/l00g) at final stage was recorded under $S_3P_2T_1$ (i.e. refrigerated storage, perforated polythene packing and $CaCl_2$ treatment). Maximum range of crude protein (1.01 g - 1.33 g/100g) was observed under refrigerated condition and minimum in ambient storage (0.72 g - 0.82 g/l00g). Higher temperature and lower relative humidity prevailed in ambient storage condition led to higher degradation of protein within the living tissues. In refrigerated condition the protein content was found to be maximum which might be due to prevalence of lower temperature. The results are in line with findings of Neota (7). In this study, maximum crude protein content of French bean was recorded under $CaCl_2$ treatment and low temperature in storage condition. The beneficial role of calcium to reduce the degradation of protein within living tissue of plant system was recorded by Lester and Grusak (5).

CONCLUSION

Among all the treatment combinations 'refrigerated storage, perforated polythene packing and $CaCl_2$ treatment' ($S_3P_2T_1$) as post harvest treatment, packaging and storage of French bean regarding the physiological loss in weight (PLW), dry matter content, total sugars and crude protein content in pods. So, the cheap and easy post harvest operation may be helpful for the French bean growers and traders.

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