

Preservation of Fresh Green Pepper by Canning, Bottling and Other Methods

J. S. PRUTHI, A. V. BHAT, SATYAVATI K. KUTTY, A. GEORGE VARKEY & M. GOPALAKRISHNAN

Central Food Technological Research Institute

G. S. I. R. Complex, Trivandrum-19.

Black Pepper (*Piper nigrum* L.) is the most important national spice of India fetching valuable foreign exchange to the tune of 300 to 390 million rupees annually. Due to the cut-throat competition in the world market for black pepper, it is necessary to diversify our exports of pepper in other forms like processed green pepper, etc. Of recent, there has been a growing demand from 12 European countries, Japan and U. S. A. for canned or bottled tender green Pepper. Besides, there is also a demand from the local industry to develop the proper scientific techniques as well as quality standards therefore. A survey of literature revealed little published information on the subject. Hence studies were undertaken to (1) standardise the conditions of processing of tender green pepper vis. (a) canning and (b) bottling, etc., (2) determine the optimum stage of harvesting of green pepper for canning and bottling, etc., (3) formulate quality standards for (a) canned green pepper (b) bottled green pepper in brine/vinegar/oil with special reference to green colour, texture, drained weight, etc. only a summary of the important findings is presented in this paper as under:

1. Canning of Tender Green Pepper:

(a) Detn. of Processing time and temperature:

Studies on process evaluation of canned tender green pepper as berries and as spikes in 2% brine and in plain water have shown that the marginal atmospheric thermal processes for pepper spikes packed in different sizes of cans were 15, 20, 25 and 25 minutes for 202 x 214, 301 x 309, 401 x 300 and 401 x 411 cans respectively. The marginal thermal processes for pressure processing (10 lbs steam pressure) were found to be 10, 15, 20 and 20 minutes for 202 x 214 and 301 x 309, 401 x 300 and 401 x 411 cans for

pepper spikes and 10 and 15 minutes for 202 x 214 and 301 x 309 cans for pepper berries respectively. These results were further confirmed in the subsequent season.

Out of the 13 treatments tried for standardization of condition for canning green pepper in 2% brine, plain water or distilled or deionised water with or without additives like EDTA, Citric acid, etc., addition of citric acid @ 0.15% to 0.20% level prevented the bluish grey discoloration found in the covering liquid and also gave a good clear covering liquid in both Panniyur and Karimunda varieties of green pepper irrespective of the location of plantation. There was neither gelation nor rupturing of berries nor cloudiness of brine in any of the lots. Based on these studies, the following method may be recommended for canning of tender green pepper.

The pepper berries after removal from spikes, are thoroughly cleaned of foreign matter, pin-heads, etc. washed thoroughly in running water and then steeped in chlorinated water containing 20 ppm. of chlorine for about one hr. They are then packed in plain 301 x 309 cans, covered with hot 2% brine containing 0.2% citric acid exhausted to 80°C, sealed promptly and processed in boiling water for 30 minutes immediately whereafter they are cooled in running cold water. (Pruthi et al, 1975).

(b) Determination of the optimum stage of maturity for canning and bottling of green pepper:

Studies were conducted to determine the optimum stage of maturity for canning and bottling of green pepper of Panniyur and Karimunda. Spikes of either variety were harvested regular

interval of 10-12 days during October 1974 to February 1975 and analysed for a study of the changes in physical characteristics (Table I A & B) and chemical quality characteristics Table II A & B). The Results have shown that both the varieties were good for canning up to about the end of December. Panniyur variety was good for bottling upto the end of December and Karimunda upto the middle of December. There was no gelation, cloudiness or residue in green pepper canned during this optimum period. This was a critical stage with respect to chemical composition where there was sudden increase in starch content, a decrease in volatile oil and an increase in piperine content (Table II A&B) which made them too pungent. More dramatic changes were observed after the end of December in both the varieties of pepper, notably in respect of starch and sugars: During development and maturation, in general there was a slight increase in recovery of berries and in length and weight of spikes in both the varieties (Table I A & B).

2. Bottling of green pepper in Vineger/Acetic acid/Brine:

Studies undertaken to find out the optimum concentrations of common salt, acetic acid, citric acid etc. for the preservation of bottled green Pepper (as spikes or berries) have shown that berries and spikes packed in 2% brine and 2-4% acetic acid could be preserved. Air-tight capping of bottles is essential to prevent mould attack. Further studies showed that berries and whole spikes could be preserved in 16% brine containing 1-2% acetic acid. Berries or spikes could also be preserved without any difficulty in 2-4% acetic acid solution alone without the use of common salt.

Out of the 20 different treatments tried for bottling of green pepper of Panniyur and Karimunda varieties in 20% brine with the addition of different concentrations of citric acid, EDTA, SO_2 , etc., addition of 100 ppm. SO_2 + 0.2% citric and in 20% brine is recommended as the best technique of bottling of green pepper berries in brine. However, the salt content in the final brine must be raised to 16% after 2-3 days of packing as the salt concentration goes down to 12-13% due to osmosis, etc. (Pruthi et al, 1975)

(a) Storage studies on bottled pepper:

Acetic acid was found to be a better preservative than citric acid from preservation angle, but colour retention was better with citric acid. Berries preserved in only 2% brine and 2% acetic acid had better colour than blanched berries packed similarly. Light has a positive role in the darkening of green pepper berries during storage. This has to be taken care of by packing green pepper in brine/negar in PVC containers instead of glass containers as indicated in our studies.

(b) Other bottled products:

Different types of mixed pickles (using green pepper as one of the components) prepared in brine, vinegar and oil remained in good condition for nearly 6 months. Green pepper could advantageously be incorporated in the place of black pepper in the preparation of rasam, soups, etc. Canned pepper rasam remained in good condition for 6 months. Based on the analysis of several market samples and lab. samples of canned and bottled green pepper, quality standards have been proposed therefor.

3. Physical and chemical changes during maturation and ripening of green pepper:

The changes in physico-chemical characteristics of green pepper during development and maturation of Panniyur and Karimunda varieties were recorded during October '74 to February '75 at intervals of 10-12 days. The chemical composition of pepper at green, yellow and red ripe stage is summarised in Table III.

Studies were also conducted on the effect of storage of spikes for 1-4 days on per cent recovery of berries, wastage, time of separation of berries from spike, moisture, volatile oil and non-volatile ether extract (Table IV) etc. Time taken for the separation berries was reduced when the green pepper with spikes were kept 2-3 days. The recovery of volatile oil was higher when the green pepper was distilled at the fresh stage and the recovery of non-volatile ether extract slightly increased during 2-4 days storags (Table IV.) However, there was some deleterious effect on the quality of volatile oil with respect to colour and aroma after 3-4 days keeping. Blanching reduced the recovery of volatile and non-

volatile ether extract. Studies were made on the determination of the optimum time of distillation for maximum recovery of volatile oil from green pepper. 90% of the volatile oil was removed by distillation just in about 35–40 minutes. As a safety measure, green pepper, yellow berries and red berries of Panniyur variety of pepper as conducted.

4. Bulk Packaging:

Studies on bulk packaging of whole spikes in PVC containers (10 L, 20 & 35 ltr capacity PVC jerry cans) in 10% brine containing 1–1.5% acetic acid have given encouraging results. Alternatively use of 16% brine, containing 0.25% citric acid and 100 ppm. SO₂ helps in better retention of colour of green pepper. Thorough washing of pepper spikes, berries in running water, followed by steeping in fresh water containing 8–10 ppm. of chlorine prior to bulk preservation is absolutely essential to avoid the onslaught of mould attack. During prolonged storage, of green pepper in Winchester bottles containing brine acidified with acetic acid, the covering liquid turns more brown more rapidly than with citric acid.

5. Impact on Industry and Agriculture:

The results of these investigations have boosted up the exports of canned, bulk-packed and bottled green pepper. There have been numerous enquiries from the industries for taking up this improved process. As a result thereof, export of canned and bottled green pepper to about 6 European Countries, Japan and U. S. A. has increased from Rs. 2 lakhs to about Rs. 12 lakhs (Table V). This study has also highlighted the urgent need for development of early season, mid-season and late season varieties of pepper, so as to extend the season of availability of green pepper for processing purposes to about 5–6 months or more, if possible.

6. Economic aspects & Future Scope:

The canned, bottled and bulk packaged green pepper in 35 litre PVC Jerry cans fetch about 6–10 times the price of normal black pepper and hence there appears to be quite bright future for it as a relatively new venture in Spice Technology. Thus, processing of tender green pepper is quite a promising line in Spice Technology. Its prospects can further improve, if the season of availability of green pepper

could be got extended to 4–6 months by developing suitable early, mid and late season varieties of pepper low in piperine and starch content.

7. Development of quality standards for canned and bottled pepper

Based on the systematic analysis of a large number of commercial as well as laboratory samples, the following tentative quality standards for canned pepper in brine are suggested.

“The product shall be prepared from fresh, healthy green berries of *Piper nigrum* of optimum maturity free from insect and microbial contamination. It shall be free from any foreign or extraneous matter. The only additives permissible are common salt, citric acid, ascorbic acid and potable water. The minimum drained weight shall be 55% w/w. The canned product shall not show any sign of positive pressure. The other general conditions of incubation etc shall be the same as those prescribed for canned vegetables under the F. P. O”.

The bottled green pepper shall contain at least 16% brine, which shall not exceed 40% of the total volume of the container (as against 33% prescribed for pickled vegetables/fruits in brine.) It may contain 0.5% citric acid and 100 p.p.m. of SO₂. The product shall not show any insect and microbial contamination and shall be free from any foreign or extraneous matter.

The bottled green pepper in vinegar shall contain at least 12% brine and 1.00% acetic acid. The volume of the covering liquid shall not exceed 40% of the total volume. No preservative shall be added.

In bulk packaging of green pepper in PVC jerry containers, cans, the ratio of berries/spikes to the covering brine/vinegar will depend upon the shape and size of the container. Generally the volume of the covering liquid should not exceed 55% of the total volume of the container. However, more data would be required on different sizes of bulk packages of green pepper for the formulation of quality standard therefor.

SUMMARY

Studies on standardization of the conditions of canning and bottling of tender green pepper (*Piper nigrum* L.) have been reported. In the absence of any published information on the subject, marginal thermal processes for green pepper in brine and water packed in different sizes of cans (202 × 214, 301 × 309, 401 × 300 and 401 × 411) have been determined. Several treatments have been tried. The addition of EDTA was not much useful. However, addition of citric acid @ 0.15% to 0.20% level to 2% brine prevented bluish grey discolouration found in the covering liquid in both Panniyur and Karimunda varieties of green pepper irrespective of the location of plantation. There was neither gelation nor rupturing of berries nor cloudiness of brine in any of the lots as observed or experienced earlier by some canning industries.

The optimum stage of maturity for harvesting of Panniyur Variety was found to be from mid October to end of December and that for the local commercial variety Karimunda, it was from mid October to mid December, as judged by the changes in starch, volatile oil, piperine and moisture content, etc. under Trichur conditions. Green pepper harvested in January and February was over mature. The biochemical changes in the above two varieties of green pepper berries during maturation and ripening have been graphically presented and discussed.

Bottled green berries of these varieties could be preserved without spoilage in 20% brine containing 100 ppm. of SO_2 and 0.2% citric acid. Berries could also be preserved in 2% Brine and 2% acetic acid or even 2-4% acetic acid alone without common salt. Better retention of colour was however, observed in

berries packed in brine and citric acid and without blanching than in those blanched before bottling. Use of PVC containers appeared to be better for the prevention of darkening in green berries than bottled during storage,

Recovery of oil from green berries was maximum when distilled immediately after harvest. The quality of volatile oil was affected by keeping green berries for 3-4 days in shade before distillation. However keeping the spikes for 3 days in shade significantly reduced the time of removal of berries from spikes. About 90% of the oil could be distilled in about 35-40 minutes but to ensure maximum recovery of oil, the time of distillation recommended is 1 hour.

ACKNOWLEDGEMENT

The authors record their grateful thanks to Dr. B. L. Amla, Director and Sri C. P. Natarajan, Dy. Director, C.F.T.R.I. Mysore, for the keen interest and encouragement during the course of these investigations. The authors also cordially thank the authorities of District Agricultural farm, Mannuty for the fine co-operation in supply and in allowing the harvest of green pepper of different varieties at regular intervals as per our programme.

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TABLE — IA : Changes in Physical Characteristics of Panniyur Variety of Green Pepper during development and maturation

Date of Harvest	Range of Variation	P1		P2		P3		Overall Av.		P1		P2		P3		Mean Value		
		L. cm.	Wt. g.	L. cm.	Wt. g.	L. cm.	Wt. g.	L. cm.	Wt. g.	Berries Stalk %	Berries Stalk %	Berries Stalk %	Berries Stalk %	Berries Stalk %	Berries Stalk %	Berries Stalk %	Berries Stalk %	
9-10-74 (D1)	Minimum	13.5	6.0	13.0	7.0	13.0	5.0	13.0	6.0									
	Maximum	17.5	11.0	19.5	12.0	18.0	10.0	19.5	12.0									
	Average	15.6	9.3	16.1	8.8	15.1	7.4	15.6	8.5	88.2	11.8	88.8	11.2	86.7	13.3	87.9	12.1	
16-10-74 (D2)	Minimum	12.5	7.0	10.0	7.0	12.0	7.0											
	Maximum	16.0	12.0	18.5	10.0	16.0	10.0											
	Average	14.2	9.2	13.9	8.4	13.3	7.7	13.8	8.4	88.9	11.1	88.8	11.2	89.3	10.9	89.0	11.0	
29-10-74 (D3)	Minimum	12.5	8.0	11.0	6.0	10.5	6.0											
	Maximum	18.0	11.0	18.5	10.0	13.5	10.0											
	Average	14.7	9.3	14.3	8.2	14.0	8.0	14.3	8.5	88.9	11.1	88.6	11.4	89.0	11.0	88.9	11.0	
12-11-74 (D4)	Minimum	11.0	6.0	11.0	5.0	11.0	5.0											
	Maximum	20.0	13.0	18.0	10.0	16.0	11.0											
	Average	15.4	9.7	14.9	8.6	14.7	8.6	15.4	9.0	89.8	10.2	89.9	10.1	87.9	12.1	89.2	10.8	
21-11-74 (D5)	Minimum	10.0	6.0	10.0	7.0	11.5	6.0											
	Maximum	17.0	15.0	18.0	11.0	17.0	12.0											
	Average	13.6	9.8	14.6	9.6	13.8	8.7	14.0	9.4	91.7	8.3	91.9	8.1	90.6	9.4	91.4	8.6	
4-12-74 (D6)	Minimum	10.5	8.0	11.0	7.0	11.5	7.0											
	Maximum	17.5	12.0	17.5	15.0	17.0	12.0											
	Average	15.2	10.9	13.9	10.2	14.3	9.3	14.8	10.2	92.0	8.0	91.2	8.8	90.7	9.3	91.3	8.7	
16-12-74 (D7)	Minimum	11.0	10.0	13.0	9.0	13.0	8.0											
	Maximum	19.0	16.0	21.0	17.0	18.5	12.0											
	Average	15.1	12.3	15.8	12.0	15.5	10.4	15.4	11.6	91.8	8.2	90.5	9.5	90.2	9.8	90.9	9.1	
30-12-74 (D8)	Minimum	10.5	8.0	12.0	10.0	12.5	10.0											
	Maximum	19.5	17.0	19.0	15.0	18.0	15.0											
	Average	15.0	13.1	15.3	11.5	15.8	11.8	15.4	12.1	93.4	6.6	92.2	7.6	90.3	9.7	92.0	8.0	
8-1-75 (D9)	Minimum	8.0	8.0	9.5	8.0	11.0	9.0											
	Maximum	17.5	15.0	10.0	13.0	18.0	16.0											
	Average	15.2	12.7	15.7	11.1	11.5	11.3	15.5	11.7	91.6	8.4	90.0	10.0	91.9	8.1	91.2	8.8	
21-1-75 (D10)	Minimum	9.5	10.0	11.5	8.0	11.5	10.0											
	Maximum	19.0	18.0	18.0	17.0	18.5	17.4											
	Average	15.5	13.6	15.7	12.6	15.1	12.0	15.4	12.7	90.8	9.2	91.2	8.8	92.0	8.0	91.3	8.7	
31-1-75 (D11)	Minimum	12.0	9.0	11.0	9.0	11.0	11.0											
	Maximum	18.0	20.0	18.0	18.0	18.5	18.0											
	Average	15.4	13.9	15.9	12.8	15.4	12.8	15.6	13.2	91.9	8.1	93.0	7.0	92.1	7.9	92.3	7.7	
12-2-75 (D12)	Minimum	12.0	10.0	11.0	10.0	12.0	10.0											
	Maximum	18.0	18.0	19.0	18.0	19.0	18.0											
	Average	15.4	14.0	15.8	13.2	15.6	13.8	15.6	13.6	93.2	6.8	92.8	7.2	92.7	7.3	92.9	7.1	

Each figure is the mean of 20 independent observations from each of the 3 vines and the overall average is of 60 observations.

L — Length
W — Weight

TABLE—IB : Changes in Physical Characteristics of Karimunda Variety of Green Pepper during development and maturation

Date of Harvest	Range of Variation	K1		K2		K3		Mean Value.		K1		K2		K3		Mean Value			
		L. cm.	Wt. g.	L. cm.	Wt. g.	L. cm.	Wt. g.	L. cm.	Wt. g.	L. cm.	Wt. g.	L. cm.	Wt. g.	L. cm.	Wt. g.	L. cm.	Wt. g.	Berries %	Stalk %
9-10-74 (D1)	Minimum	5.0	3.0	5.0	4.0	6.0	4.0	6.6	5.2	90.9	9.1	89.7	10.3	88.3	11.7	89.7	9.3		
	Maximum	7.0	6.0	7.5	6.0	8.0	8.0												
	Average	6.0	4.9	6.5	4.7	7.2	5.9												
16-10-74 (D2)	Minimum	3.0	3.0	5.5	4.0	4.0	4.0	6.1	5.1	93.3	6.7	90.0	10.0	92.2	7.8	91.8	8.2		
	Maximum	8.0	7.0	8.0	7.0	8.0	7.0												
	Average	5.6	4.7	6.7	5.1	6.0	5.4												
29-10-74 (D3)	Minimum	4.0	3.0	3.5	3.0	3.5	3.0	5.8	4.8	89.9	10.1	90.9	9.1	92.7	7.3	91.2	8.8		
	Maximum	7.0	6.0	8.0	6.0	8.0	8.0												
	Average	5.6	4.5	5.7	4.3	6.0	5.5												
12-11-74 (D4)	Minimum	4.5	4.0	3.0	3.0	3.5	3.0	5.7	5.3	93.3	6.7	94.0	6.0	93.7	6.3	93.6	6.4		
	Maximum	7.5	7.0	7.5	7.0	8.0	8.0												
	Average	5.9	5.4	6.5	5.1	5.8	5.4												
21-11-74 (D5)	Minimum	4.0	4.0	4.0	4.0	5.0	4.0	5.7	5.6	93.3	6.7	93.2	6.8	93.1	6.9	93.2	6.8		
	Maximum	8.0	8.0	7.5	8.0	9.0	10.0												
	Average	6.0	5.7	5.4	5.5	5.9	5.6												
4-12-74 (D6)	Minimum	4.0	3.0	3.0	3.0	3.5	4.0	5.4	4.5	94.1	5.9	92.6	7.4	94.0	6.0	93.6	6.4		
	Maximum	8.5	10.0	7.5	6.0	7.5	6.0												
	Average	5.7	4.3	5.0	4.3	5.0	5.0												
16-12-74 (D7)	Minimum	4.0	4.0	2.5	2.0	4.0	4.0	5.1	4.9	92.1	7.9	91.8	8.2	93.8	6.2	92.6	7.4		
	Maximum	7.0	7.0	7.0	7.0	7.0	7.0												
	Average	5.3	5.0	4.4	4.0	5.6	5.5												
30-12-74 (D8)	Minimum	3.5	3.0	2.5	2.0	3.5	4.0	5.0	4.9	93.8	6.2	94.4	5.6	93.8	6.2	94.0	6.0		
	Maximum	7.5	8.0	6.5	7.0	7.0	7.0												
	Average	5.0	5.3	4.5	4.2	5.4	5.1												
8-1-75 (D9)	Minimum	2.5	3.5	3.0	4.0	3.5	6.0	5.1	5.2	93.0	7.0	93.7	6.3	93.3	6.3	93.5	6.5		
	Maximum	6.5	7.5	7.0	7.5	6.5	5.0												
	Average	4.9	5.4	5.1	5.3	5.3	5.5												
21-1-75 (D10)	Minimum	4.5	4.0	3.5	4.0	3.0	3.0	5.4	5.7	94.6	6.0	92.3	7.7	92.2	7.8	92.7	7.3		
	Maximum	8.5	8.0	8.5	8.0	7.0	8.0												
	Average	5.9	6.0	5.6	5.6	5.4	5.6												
31-1-75 (D11)	Minimum	3.0	3.0	4.0	3.0	4.0	4.0	5.7	5.7	93.9	6.1	92.3	7.7	91.8	8.2	92.7	7.3		
	Maximum	7.0	7.0	7.0	7.0	7.0	7.0												
	Average	5.8	6.0	5.5	5.5	5.7	5.6												

Each figure is the mean of 20 independent observations from each of the 3 vines and the overall average is of 60 observations. K1—K3: Karimunda vines L — Length Wt — Weight

TABLE — IIA : Chemical changes in Panniyur Variety of Green Pepper (*P. nigrum*) at different stages of maturity (Locality : Mannuthy)

Physio-Chemical Characteristics	Dates of Harvesting											
	D1 9-10-74	D2 16-10-74	D3 29-10-74	D4 12-11-74	D5 21-11-74	D6 4-12-74	D7 16-12-74	D8 30-12-74	D9 8-1-75	D10 21-1-75	D11 31-1-75	D12 12-2-75
Moisture	84.54	84.40	33.37	31.55	80.33	79.39	76.41	73.28	72.81	70.63	68.01	64.03
Volatile oil:												
FWB %	1.0	1.0	1.4	1.5	1.5	1.5	1.5	1.2	1.0	0.8	0.7	0.9
DWB %	6.4	6.4	3.4	3.1	7.6	7.2	6.3	4.5	3.6	2.8	2.2	2.0
Non-volatile ether extract:												
FWB %	1.40	1.46	1.50	1.63	1.75	1.82	2.06	2.31	2.21	2.37	2.59	2.77
DWB %	8.7	9.3	9.3	8.9	8.8	8.8	8.7	8.5	8.2	8.1	8.1	7.8
Nitrogen %	0.35	0.38	0.40	0.46	0.48	0.50	0.58	0.58	0.59	0.64	0.72	0.5
Piperine:												
FWB %	0.30	0.31	0.36	0.41	0.52	0.54	0.64	0.73	0.75	0.91	1.06	1.26
DWB %	1.9	2.0	2.1	2.1	2.6	2.6	2.7	2.7	2.8	3.1	3.3	3.5
Sugars :												
Fructose %	ND	ND	ND	ND	0.106	0.117	0.136	0.206	0.183	0.148	0.113	0.107
Glucose %	ND	ND	ND	ND	0.083	0.120	0.118	0.193	0.153	0.107	0.110	0.113
Sucrose %	ND	ND	ND	ND	0.141	0.150	0.175	0.237	0.276	0.290	0.399	0.456
Total sugars	ND	ND	ND	ND	0.390	0.377	0.429	0.636	0.612	0.545	0.622	0.676
Protein (N × 62.5)	2.187	2.375	2.500	2.875	3.000	3.125	3.640	3.640	3.687	4.000	4.490	4.690
Starch %	2.54	2.67	2.73	3.64	3.73	4.50	5.13	5.95	8.68	10.17	13.3	16.8
Crude fibre %	4.0	4.0	4.1	4.1	4.1	4.1	4.3	4.3	4.3	4.4	4.5	4.6
Ascorbic acid mg/100g	3.6	3.6	3.6	3.6	3.7	3.6	3.3	3.1	3.2	3.1	3.1	3.2
Total ash %	1.05	1.03	1.15	1.33	1.36	1.37	1.46	1.44	1.51	1.53	1.76	1.81
Acid insoluble % in HCl	0.49	0.49	0.52	0.54	0.58	0.60	0.61	0.67	0.71	0.72	0.81	0.85
Ca mg/100 g	90	90	92	108	116	136	150	148	178	180	224	229
P mg/100 g	42.8	42.8	46.4	50.6	54.2	56.0	51.8	58	68.6	68.6	73.4	76.3
Fe mg/100 g	1.00	1.00	1.00	1.00	1.00	1.12	1.12	1.20	1.20	1.20	1.20	1.20

ND = Not Done.

D1—D12=Dates of harvesting.

FWB=Fresh Weight Basis.

DWB=Dry Weight Basis.

Unless specified to the contrary, results are on F. W. Basis.

TABLE— IIB : Chemical changes in Panniyur Variety of Green Pepper (*P. nigrum*) at different stages of maturity (Locality : Mannuthy)

Physio-Chemical Characteristics	Dates of Harvesting										
	D 1	D 2	D 3	D 4	D 5	D 6	D 7	D 8	D 9	D 10	D 11
	9-10-74	16-10-74	29-10-74	12-11-74	21-11-74	4-12-74	16-12-74	30-12-74	8-1-75	21-1-75	31-1-75
Moisture	82.35	83.96	80.42	78.9	76.90	75.83	72.34	68.56	66.23	63.78	61.13
Volatile oil:											
FWB %	1.2	1.4	2.0	2.4	2.4	2.5	2.2	1.8	1.7	1.6	1.4
DWB %	6.8	8.8	10.2	10.3	10.4	10.4	8.2	5.8	5.0	4.4	3.6
Non-volatile ether extract:											
FWB %	1.82	1.86	2.10	2.26	2.34	1.82	2.37	2.48	2.53	2.64	2.87
DWB %	10.3	10.4	10.7	10.7	9.7	8.8	8.6	7.8	7.6	7.5	7.4
Nitrogen %	0.45	0.45	0.46	0.48	0.80	0.50	0.57	0.61	0.61	0.69	0.69
Piperine:											
FWB %	0.34	0.33	0.40	0.44	0.57	0.54	0.62	0.84	0.94	1.12	1.21
DWB %	1.9	2.0	2.0	2.1	2.4	2.6	2.4	2.6	2.8	3.1	3.1
Sugars :											
Fructose %	ND	ND	ND	ND	0.161	0.117	0.195	0.254	0.159	0.123	0.112
Glucose %	ND	ND	ND	ND	0.101	0.120	0.120	0.139	0.181	0.117	0.116
Sucrose %	ND	ND	ND	ND	0.159	0.150	0.171	0.227	0.212	0.258	0.420
Total sugars	ND	ND	ND	ND	0.451	0.377	0.486	0.448	0.552	0.468	0.728
Protein (N x 6.25)	2.892	2.812	2.875	3.000	3.125	3.125	3.662	3.812	3.812	4.012	4.012
Starch %	2.56	2.80	3.25	3.88	4.90	4.50	6.18	10.10	14.80	15.30	15.30
Crude fibre %	4.0	4.1	4.0	4.0	4.1	4.1	4.2	4.2	4.3	4.5	4.6
Ascorbic acid mg/100g	4.7	4.6	4.5	4.4	4.2	3.6	4.1	3.9	3.9	3.8	3.7
Total ash %	0.91	1.01	1.11	1.32	1.40	1.37	1.49	1.58	1.61	1.54	1.83
Acid insoluble % in HCl	0.49	0.54	0.57	0.60	0.63	0.60	0.64	0.75	0.74	0.75	0.86
Ca mg/100 g	110.0	122.0	126.0	130.0	148.0	136	152.0	196.0	194.0	198.0	241.0
P mg/100 g	44.0	44.0	46.4	50.0	56.0	56.0	58.00	76.0	76.6	79.2	82.4
Fe mg/100 g	1.00	1.00	1.00	1.00	1.20	1.12	1.20	1.20	1.20	1.20	1.20

ND = Not Done.

D1—D12=Dates of harvesting.

FWB= Fresh Weight Basis.

DWB= Dry Weight Basis.

Unless specified to the contrary, results are on F. W. Basis.

TABLE—III

Variation in chemical composition of green, yellow and red berries of Panniyur variety pepper (January 1975)

Particulars	Pale greenish	Yellow berries	Red berries
1. Moisture %	68.01	59.20	58.98
2. Volatile oil FWB	0.70	0.70	0.70
MFB	2.10	1.70	1.70
3. Non-volatile ether Extract : FWB	2.59	2.96	2.88
MFB	8.10	7.20	7.00
4. Sugars:			
(a) Glucose %	0.11	0.83	0.78
(b) Fructose %	0.11	0.63	0.70
(c) Sucrose %	0.40	1.34	2.56
(d) Total sugars %	0.62	2.82	4.04
5. Starch %	13.30	18.70	20.40
6. Crude fibre % (FWB)	4.50	5.80	5.80
7. Acidity %	0.09	0.19	0.29
8. Ascorbic acid mg/100g	3.20	3.60	3.70

FWB = Fresh Weight Basis. MFW = Moisture Free Basis. Unless specified to the contrary the results are on fresh weight basis.

TABLE—IV

Effect of keeping Green Pepper with spikes (Var. Panniyur) in shade on moisture, volatile oil content and non-volatile ether extract:

Date	Storage period (Days)	Moisture %	Volatile oil % v/w F W B	Volatile oil % v/w M F B	Non-volatile ether extract % w/w F W B	Non-volatile ether extract M F B % w/w
16-12-74	0	76.41	1.5	6.3	2.06	8.7
17-12-74 (Blanched)	1	76.20	1.3	5.6	1.94	8.2
17-12-74	1	75.23	1.4	5.7	2.16	8.9
18-12-74	2	74.91	1.3	5.2	2.36	9.4
19-12-74	3	74.47	1.2	4.7	2.61	10.2
20-12-74	4	72.60	1.2	4.4	2.91	10.6

Conclusions: (1) Recovery of volatile oil content is more in fresh berries
 (2) Non-volatile oil content increased
 (3) No change in clarity of volatile oil
 (4) Blanching slightly effected the recovery of volatile and non-volatile ether extract.

TABLE—V

Export Trends of CANNED GREEN PEPPER from India*

Country	1970-'71		1971-'72		1972-'73	
	Quantity (Kg)	Value (Rs)	Quantity (Kg)	Value (Rs)	Quantity (Kg)	Value (Rs)
Belgium	528	11,760	180	4,590	2,830	58,240
Danmark	...	...	...	...	397	8,472
France	...	...	2,705	54,000	...	...
Germany F. R.	9,645	2,05,455	29,235	5,12,865	58,971	10,23,744
Holland	...	...	...	...	921	19,887
Japan	528	11,905	...	...	...	...
Switzerland	...	...	2,120	53,820	690	10,333
U. K.	...	...	...	...	61	1,131
United States	...	...	...	...	255	6,189
Total	10,701	2,29,120	34,240	6,25,275	64,125	11,97,996

*Export Statistics (1974) Processed Foods Export Promotion Council, New Delhi.