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RESEARCH ARTICLE

Blanching effect on the quality and shelf life of pea

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ABSTRACT

The effects of blanching on the peas were investigated to determine the quality and shelf life of the pea during storage in deep freeze for six months. The experiment was carried out Completely Randomized Design and there were five treatments using four different blanching times as 1 min, 3min, 5 min, and 7 min with fixed temperature of 80^{0}C. The data were analyzed under computerized statistical methods of M-stat and Duncan's Multiple Range Test was used to compare the means. The chemical compositions were analyzed and the following results were investigated: the dry matter percentages were slightly decreased over storage duration. The acidity contents of blanching peas were slightly decreased and P^H contents slightly increased on storage. The Vitamin C and β-carotene contents were decreased after increasing the blanching time. Peroxidase and catalase inactivation time of enzyme for blanching of peas represents the most enzymes were inactivated rapidly as temperature rises to 80^{O}C with 7 minutes blanching. Therefore, the study results showed that the frozen peas were stored well in home deep freeze up to four months blanching at 80^{0}C for 7 minutes.

Keywords: Pea, blanching, quality, shelf life, dry matter, β- carotene, external color.

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INTRODUCTION

Pea (*Pisum sativum*) is a popular leguminous vegetable in Bangladesh. It is cultivated in area of 6500 ha and annual production in about 6153 metric tons (Anon, 2012). It is grown in Bangladesh mainly for green pods and immature seeds, which are consumed as vegetables. The matured seeds are used as pulse, chatpati, etc. The common pea is the garden or green pea. It has a tough pod that is discarded prior to eating (Basterrechea and Hicks, 1991; Snowdon, 1991).

Pea is largely confined to cooler temperate zone between the tropic of cancer and Mediterranean region. Being a cool season crop, it is extensively grown in the temperate region throughout the world. Most often peas are frozen or processed. Green peas are eaten cooked as a vegetable, and are marketed fresh, canned, or frozen while ripe dried peas are used as whole, split, or made into flour. Green peas are rich in vitamin and proteins. These are rich in health benefiting phyto-nutrients, minerals, vitamins and anti-oxidants. They are relatively low in calories when compared with beans, and cowpeas. Fresh pea pods are excellent source of folic acid; ascorbic acid (vitamin C) vitamin K. Pea contributes significant amounts of protein, carbohydrates, vitamins and minerals to the diet (Pallavi *et al.,* 2013).

Blanching is scalding the vegetables in water or in steam for a short time. It is a very important step in freezing vegetables because it slows or stops the action of enzymes. These enzymes are essential for growth and ripening. If the enzyme action is

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not stopped before freezing, the vegetables may continue maturing, develop off-flavors, discolor, or toughen so they may be unappetizing in a short time. Blanching times vary with the size and kind of vegetable. Under blanching can stimulate the activity of some enzymes and is worse than not blanching at all. Overbalancing results in loss of vitamins, minerals, flavor and color (Julie, 2003). Freezing is a quick, convenient, and popular way to preserve vegetables and it preserves more nutrients in the food if properly done. Frozen foods are easy to serve on short notice. Freezing retards the growth of bacteria, molds, and yeasts. Natural enzymes in foods cause changes in flavor, color, texture, and nutritive value. Freezing slows this activity but does not stop it. To prevent further enzyme activity, vegetables need to be blanched in boiling water or steamed before freezing. Constant storage temperature helps in retention of quality. Fluctuating temperature will damage the texture of frozen fruits and vegetables as the ice melts and then refreezes in the cells (Extension and Out research, 2011)

Vegetables are highly perishable foods subject to rapid deterioration by microorganisms, enzymes, or oxidation reactions. According to Delgado and Sun (2000), freezing technology combines the beneficial effects of low temperatures at which microorganisms cannot grow, chemical reactions are reduced, and cellular metabolic reactions are delayed; and is a process considered superior to canning or dehydration when the retention of sensory attributes and nutritional properties are considered (Fennema, 1982). The use of freezing technologies allows the retention of freshness qualities of vegetables for long periods, extending their availability well beyond the normal season of most horticultural crops (Arthey, 1993). Present studies were undertaken to establish the length of storage on various physic-chemical characteristics of frozen peas.

MATERIALS AND METHODS

The experiments were conducting in the Postharvest Technology Division of Bangladesh Agricultural Research Institute (BARI), Gazipur.

Sample collection and preparation for analysis

Pea (*Pisum sativum*) were collected from the local market of Gazipur and transported to the postharvest laboratory of BARI, Gazipur. Pea used in this experiment was greenish and firm and the physical appearance was better. Sound, mature and fresh pea which was free from diseases and visual defects were identified and discard .The peas were hand shelled. Water blanching was performed in hot water bath at 80^0C in different duration of 1, 3, 5, 7 minutes. Then, cool the product in distilled water and packed in high density polythene where vacuum packing was done. Finally, the product was storage at the laboratory deep freeze (-18^OC) available for homestead use. The experiment was started from the month of February in a year and the products were stored for the next 6 months and the shelf life studies were continued after 1 and 2 months of interval.

Treatments

T_1 = control

T_2= blanching at 80^0C for 1 min

T_3= blanching at 80^0C for 3 min

T_4= blanching at 80^0C for 5 min

T_5= blanching at 80^0C for 7 min

Measurement of ascorbic acid

For ascorbic acid measurement, 10g pulp tissue was homogenized in 50mL of 3% cold metaphosphoric acid (HPO_3) using a blender for 2 min and filtered through Whatman filter paper No. 2. The clear supernatant was collected for assaying ascorbic acid by 2, 6-dichlorophenolindophenol titration following the method of Ranganna (1994). Ten milliliters of aliquot was titrated with 0.1% 2, 6-dichlorophenolindophenol solution until the filtrate changed to pink colour persisted for at least 15 seconds and the titration volume of 2, 6-dichlorophenolindophenol was recorded. Prior to titration 2, 6-dichlorophenolindophenol solution was calibrated by ascorbic acid standard solution. Ascorbic acid content was calculated according to the titration volume of 2, 6-dichlorophenolindophenol and results were expressed as mg $100g^{-1}$ fresh weight.

Measurement of total soluble solid

Total soluble solid in the extracted juice of fruits was measured by a refractometer (ATAGO (Brix = 0 to 32%)) and the results were expressed as % Brix (Cheour *et al.,* 1991).

Measurement of p^H

Using a glass electrode p^H meter (Delta 320, Mettler, Shanghai) to measure p^H of the sample.

Measurement of Acidity

Titratable acidity expressed as citric acid (%) was determined by titration with 0.1 mol L^{-1} NaOH to p^H 8.1 according to the method by Ranganna (1986).

Measurement of β-carotene

The estimation of β-carotene was done by the extraction of 3g product sample with acetone (Fisher Scientific Ltd., Uk) and petroleum ether. It was further purified with acetone, metabolic KOH and distilled water. The resulting solution was filtered with anhydrous sodium sulphate and read on a spectrophotometer (T-80, PG Instrument Ltd., UK) at 451nm against petroleum ether as a blank. A standard graph was plotted using synthetic crystalline B-carotene (Fluka, Germany) dissolved in petroleum ether and its optical density measured at 451 nm (Alasalvar *et al.,* 2005).

Color assessment

Readings with colorimeter were randomly taken at three different locations on each pineapple fruit, using a digital Chroma Meter (Model CR-400, Minolta Corp., Japan). CIE *L*a*b** coordinates were recorded using D65 illuminants and a 10° Standard Observer as a reference system. *L** is lightness, *a** (-greenness to+redness) and *b** (-blueness to+yellowness) are the chromaticity coordinates. The* and *b** values were converted to chroma [$C = (a^{*2} + b^{*2})^{1/2}$] and hue angle [$h = \tan^{-1}(b^*/a^*)$].

Data analysis

The experiment was carried out Completely Randomized Design (CRD) and all five treatments were replicated three times. The data were analyzed for ANOVA in completely randomized design (CRD) under computerized statistical methods of MSTAT and Duncan's Multiple Range Test (DMRT) was used to compare the means.

RESULTS AND DISCUSSION

The process peas were stored in deep freeze for six months. The chemical compositions were done; experimental data were analyzed and presented in the following section.

Dry matter percentages, TSS, P^H, acidity, vitamin C, β- carotene were the quality parameters and external color that were typically assessed for fresh products, immediately after blanching and after a given storage period. Table 1 shows the dry matter percentages (DM %) and TSS contents of fresh and blanched pea at different treatments. The DM% of blanched peas was decreased when the blanching time and temperature were increased; the DM% rates were gradually decreased after storage time increases. But, the increase rates were investigated slower after four-month storage. In the fresh pea, the initial TSS contents were found 12.10 but it was decreased after prolonged storage as well as blanching with different time. The peas were blanched at 80^0C for 7 minutes up to two months' storage showed reasonable values of TSS.

Table 1. Changes of dry matter percentages and TSS of fresh and blanched pea

Treatments	Dry matter percentages					TSS (%)				
	Storage period, months									
	0	1	2	4	6	0	1	2	4	6
T_1= Control	30.53a	29.69a	29.60a	28.60a	27.69a	12.1a	9.1a	8.6a	5.2a	4.5a
T_2= 80^0C, 1 min	30.21b	28.31b	27.26c	27.14b	27.09b	11.4b	8.6b	7.8b	5.1a	4.4ab
T_3= 80^0C, 3 min	29.46c	27.87c	27.65b	26.76c	26.56c	10.8c	7.9c	7.4c	4.9b	4.3bc
T_4= 80^0C, 5 min	28.13d	26.37d	26.17d	25.47d	24.65d	10.2d	7.7d	7.3c	4.5c	4.2c
T_5= 80^0C, 7 min	26.81e	25.47e	25.22e	24.57e	24.13e	9.5e	7.5e	6.9d	4.3d	3.9d
C.V. (%)	0.34	1.91	0.37	0.38	0.38	0.93	1.23	1.32	2.08	2.35
LSD						0.182				

Means in the same column followed by different letters differs (P<0.05) according to the least significant difference multiple range test

The acidity contents of blanched peas were decreased and P^H contents were increased after increases the blanching time, these were continued at the same rate after storage time increased (Table 2). The products were blanched at 80^0C for 7 minutes up to four months' storage gives suitable values of acidity content.

Table 2. Changes of P^H and acidity of fresh and blanched pea.

Treatments	P^H					Acidity (%)				
	Storage period, months									
	0	1	2	4	6	0	1	2	4	6
T_1= Control	7.08b	7.13a	7.18	7.21	7.24	0.19a	0.18a	0.17a	0.16a	0.15a
T_2= 80^0C, 1 min	7.12ab	7.16	7.20	7.22	7.26	0.18a	0.17a	0.16a	0.15a	0.14a
T_3= 80^0C, 3 min	7.20ab	7.22	7.26	7.27	7.30	0.16b	0.15b	0.14b	0.13b	0.12b
T_4= 80^0C, 5 min	7.25ab	7.28	7.30	7.31	7.33	0.15b	0.14b	0.13bc	0.12bc	0.12b
T_5= 80^0C, 7 min	7.29a	7.31	7.33	7.34	7.36	0.13c	0.12c	0.12c	0.11c	0.11b
C.V. (%)	1.39	1.41	1.38	1.38	1.37	6.17	6.58	6.94	7.46	7.81
LSD					0.182					

Means in the same column followed by different letters differs (P<0.05) according to the least significant difference multiple range test

The vitamin C contents of fresh peas were found 40.10 mg/100g, but it was decreased after blanching with prolonged storage. The changes in vitamin C contents of processed peas were decreased after increased blanching time; and it was decreased at the same rates after storage period increased (Table 3). Whereas, initially the β- carotene contents of fresh peas were found 45.65 µg/100g but, it was decreased at blanched condition. At blanching, the changes of β- carotene contents were decreased after increased the blanching time; these were decreased at the same rate after storage at certain duration. Generally, blanching produces a decrease in the nutritional value of foods. Nutrients leach out from the product especially during water blanching. In addition, vitamins are degraded by heat. Vitamin C (ascorbic acid) is, by far, the most commonly assayed nutrient in blanching probably because its high solubility and heat susceptibility make it a conservative indicator of nutrient retention (Corcuera *et al.,* 2004).

Table 2. Changes of Vitamin C (mg/100g) and β- Carotene (µg/100g) contents of fresh and blanched pea

Treatments	**Vitamin C (mg/100g)**					**β- carotene (µg/100g)**				
	Storage period, months									
	0	**1**	**2**	**4**	**6**	**0**	**1**	**2**	**4**	**6**
T_1= Control	40.10a	30.75a	27.10a	22.75a	20.45a	45.65a	38.45a	34.15a	30.30a	27.25a
T_2= 80^0C, 1 min	34.40b	28.30b	25.20b	20.50b	17.20b	41.35b	36.40b	32.35b	29.30b	24.18b
T_3= 80^0C, 3 min	32.30c	26.20c	23.50c	19.80c	15.20c	38.10c	32.45c	28.40c	25.35c	21.15c
T_4= 80^0C, 5 min	29.30d	23.10d	20.80d	17.70d	14.50d	36.30d	28.48d	24.48d	21.42d	19.35d
T_5= 80^0C, 7 min	24.40e	19.25e	16.50e	14.30e	11.60e	34.24e	25.38e	22.58e	18.47e	16.34e
C.V. (%)	0.31	0.39	0.44	0.53	0.63	0.26	0.31	0.35	0.40	0.46
LSD	0.182									

Means in the same column followed by different letters differs (P<0.05) according to the least significant difference multiple range test

Color is an important factor in the perception of pea quality. The changes in the pea color were monitored by estimating lightness (L), chromaticity co-ordinates a^* and b^* during storage at deep freeze. The values are presented in the Table 4 and it represented that the intensity of light bluish color of the pea were gradually increased with extend the storage period and turned light green as evidence by increasing values of L and changing values of a^* and b^* accordingly. The processed pea under the control condition (T_1) to blanching at 80^0C for 7 minutes (T_5) represented a slower change in the pea color as indicated less gradually decreased in L and changing the values of a^* and b^* accordingly after four month of storage.

Blanching inactivates a portion of the enzymes and effects color and texture (Lee, 1958 and Purr, 1966). Blanching the vegetables before freezing impedes enzyme action during storage time in the freezer and this means that the deterioration of the vegetable was kept at a minimum and that vegetables will emerge from the freezer in the same condition as they entered. As such a sole method of preservation but as a pretreatment, this was normally carried out between the preparation of raw material and latter operations. There were different types of enzymes and their specific reactions that were responsible for flavor and color changes are not positively known (Joslyn, 1966). Most enzymes are inactivated rapidly as temperature rises to 80^OC with 7 mins. Catalase and peroxidase are two enzymes that resist heat inactivation (Zoueil and Esselen, 1959) and lose their reactivity in the range of importance for stabilizing frozen vegetables. These two enzymes have widely used to tell whether or not blanching has been adequate. Peroxidase was the more heat resistance of the two. As a result, the absence of residual peroxide activity would indicate that the other less heat resistant enzymes was also destroyed.

Table 4. Effect of blanching on the external color changes of fresh and blanched pea

Treatments	Storage period, months								
	0			1			2		
	Color co-ordinates								
	L	a*	b*	L	a*	b*	L	a*	b*
T_1= Control	53.10a	-71.74e	-5.96d	46.62a	-5.79b	7.69c	45.88a	-5.31c	26.68a
T_2= 80^{0}C, 1 min	47.98b	-67.62d	-5.08c	43.05b	-6.71d	7.56c	32.82d	-6.55e	22.18b
T_3= 80^{0}C, 3 min	42.77c	-58.67c	-4.56b	42.05c	-6.03c	9.27a	34.92b	-4.88b	18.92c
T_4= 80^{0}C, 5 min	40.69d	-57.74b	-4.52b	38.01d	-6.00c	8.44b	33.45c	-5.88d	15.89d
T_5= 80^{0}C, 7 min	38.11e	-56.02a	-4.32a	34.78e	-5.32a	8.36b	30.28e	-4.11a	12.93e
C.V. (%)	0.22	-0.16	-2.05	0.24	-1.68	-1.21	0.28	-1.87	1.61
LSD					0.182				

Treatments	Storage period, months					
	4			6		
	Color co-ordinates					
	L	a*	b*	L	a*	b*
T_1= Control	40.10a	-4.95c	27.01a	39.10a	1.79a	27.95e
T_2= 80^{0}C, 1 min	31.78b	-5.88d	23.23b	31.13b	1.13b	28.70d
T_3= 80^{0}C, 3 min	30.72c	-4.08a	19.36c	28.43c	0.56c	31.72a
T_4= 80^{0}C, 5 min	29.75d	-4.70b	18.11d	28.30c	0.53c	31.16b
T_5= 80^{0}C, 7 min	28.32e	-3.98a	16.50e	26.49d	0.32d	30.59c
C.V. (%)	0.31	-2.12	0.48	0.33	17.13	0.36
LSD			0.182			

Means in the same column followed by different letters differs ($P<0.05$) according to the least significant difference multiple range test

Peroxidase and catalase inactivation time of enzyme for steam blanching of peas are presented in Table 5. The blanching effect and quality parameters are tested, it would be concluded that the treatment T_5 (blanching at 80^{0}C for 7 minutes) with four months storage was found suitable. Therefore, peas can be stored at deep freeze using the above blanching condition for the four months.

Table 5. Inactivation time of enzyme for steam blanching of peas

Treatments	T_1	T_2	T_3	T_4	T_5
Peroxidase	+	+	+	-	-
Catalase	+	+	+	+	-

Note: T_1 = control; T_2= blanching at 80^{0}C 1 min; T_3= blanching at 80^{0}C 3 min; T_4= blanching at 80^{0}C 5 min; T_5= blanching at 80^{0}C 7 min

CONCLUSION

Peas are perishable vegetable subject to rapid deterioration by microorganisms, enzymes, or oxidation reactions. Blanching can stimulate the activity of some enzymes and is worse than not blanching at all. Early technological improvements focused on increasing product quality. From the investigations, it was found that the dry matter percentages, acidity, P^H, β- carotene, vitamin C and TSS contents of frozen peas were reduced during blanching with longer storage periods. The study results showed that the frozen peas were stored well in deep freeze up to four months with blanching at 80^0C for 7 minutes. At the same time, this research can give us efficient utilization of pea for long time consumption otherwise some of them are spoiled due to lack of proper processing during harvesting and handling practices by the farmers to the consumers.

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