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Effect of Blanching on Inactivation of Enzymes in Potato, Banana and Carrot

D Vijay Kumar, M Rajendra, Binay Kumar and D Bhaskara Rao
Dept. of Agril. Process and Food Engg., College of Agricultural Engineering, Bapatla 522 101

ABSTRACT

An experiment was conducted on the effect of blanching on inactivation of enzymes in potato, banana and carrot and on their quality at College of Agricultural Engineering, Bapatla. Three methods, namely low temperature long time (LTLT), LTLT followed by high temperature short time (HTST) and steaming followed by HTST were followed. The processed samples were stored at room temperature and refrigerator storage conditions and the quality was observed by color, taste and flavor up to 20 days time period. An organoleptic score of 1-9 is followed for quality analysis. It was concluded that, with increase of blanching temperature, the blanching time is significantly reduced and the time taken for inactivation of enzymes by mixed blanching methods is less over single stage blanching method. The potato sample blanched at 80 ^{0}c for 25 minutes under HTST method and stored at room temperature has scored highest 7.86 (like moderately). Under refrigerated storage, potato sample blanched at 60^{0}c for 30 minutes and then at 80^{0}c for 20 minutes under LTLT followed by HTST method scored highest i.e. 8.53 (like very much). For banana, the sample blanched at 70 ^{0}C for 4 min by HTST method scored highest i.e. 7.67 (like moderately) at both room and refrigerated storage conditions. Similarly for carrot, it was observed that, the sample blanched at live steam for 5 min and then at 70 ^{0}C for 0.5 min by Steaming followed by HTST method gave highest score of 7 (like moderately) at both room and refrigerated storage conditions. Un-blanched samples were spoiled within 5 days of storage period.

Key words : Blanching, Enzymes,Organoleptic score , Quality, Temperature-time combinations.

In vegetables, the presence of several enzymes such as polyphenoloxidase, peroxidase, phosphorylase etc lowers the quality during processing and storage unless they are inactivated. Many vegetables for e.g. potato, banana, carrot, brinjal, apple etc have a tendency to turn brown or rapid darkening when damaged or cut surfaces are exposed to air or oxygen. When the cut surface is exposed to air, phenoloxidase enzymes released at the surface and act on the polyphenols (tyrosine etc) present, thereby oxidizing them to orthoquinones and releases brown colored pigments. As a result, the quality of the final product decreases and hence the consumer acceptability decreases. Therefore, the enzymes present in vegetables are to be inactivated in order to get a good quality end product. The major factors useful in controlling the enzymes activity are temperature, water activity, P^H, chemicals which inhibit enzyme action and alteration of substrates. It is economical if heat the heat is given to vegetables to inactivate the enzymes, which is termed as blanching and then primarily focus in inactivating the enzymes that cause undesirable changes (color and flavor) during processing and storage. Optimum blanching under appropriate conditions of temperature and time improves the quality and minimizes disruptive changes.

An experiment was done to investigate the best blanching treatment i.e. temperature-time combinations for the vegetables potato, banana and carrot (these vegetables are selected since they are used for making some value added products like fried potato chips, banana chips, banana puree, carrot halva, salad etc) by following three methods namely low temperature long time (LTLT), LTLT followed by high temperature short time (HTST) and steaming followed by HTST. Their quality of end-product was also observed under room temperature and refrigerated temperature storage conditions.

MATERIAL AND METHODS

Various temperature levels followed for blanching of vegetables like potato, banana and carrot by three methods namely HTST, LTLT followed by HTST and Steaming followed by HTST are presented in Table 1

An identification code as shown in Table 2 was given to each temperature level in the blanching treatments for the selected vegetables.

The selected vegetables were cut into slices of thickness 1.5 to 2 mm and wrapped in a muslin cloth and then dipped in hot water bath in HTST and LTLT followed by HTST blanching methods. Where as in case of Steaming followed by HTST method, vegetable slices are initially subjected to live stem at 100 ^{0}C and then at selected temperature levels in hot water bath. The slices were removed at every ¼th minute and tested for activity of peroxidase and polyphenoloxidase enzymes. Two of the more heat resistant enzymes in vegetables are peroxidase and polyphenoloxidase. If these are destroyed then other significant enzymes in vegetables also will be inactivated. 1 % guaicol and 1 % hydrogen peroxide chemical solutions were used for performing the peroxidase test. The cut slices were wetted by the equal quantities of guaicol and hydrogen peroxide solutions. The appearance of a reddish brown color within 3 min was taken as parameter for indication incomplete blanching. If no color was observed after 3 min, the test for peroxidase was taken as negative which means the color causing enzymes were inactivated and blanching treatment was sufficient and time was noted. In this way, all cut slices of vegetables were tested for inactivity of enzymes at the selected temperature levels and time of blanching was noted.

After completion of blanching for all slices of vegetables, half of samples were initially dried in a greenhouse at the temperature of 46 ^{0}C and RH 25-30 % for 2 days (6 h/day) and then stored at room temperature. Remaining half of the samples were stored in a refrigerator at temperature of 5-8 ^{0}C. Some unblanched samples were also stored in above conditions for comparison with treated samples. The quality of the end product was observed daily up to 20 days time to recommend the best blanching method by following organoleptic test (Table 2) by observing color, taste and flavor.

RESULTS AND DISCUSSION

Time taken for blanching

The time taken (Table 4) for inactivation of enzymes i.e. blanching by HTST method (single stage blanching) for potato is 95 minutes at 70 ^{0}C, 25 minutes at 80 ^{0}C and 4 minutes at 90 ^{0}C. It is clear from the study that, with the increase of blanching temperature, the blanching time is significantly reduced. In case of LTLT followed by HTST method (double stage blanching), time taken for blanching is 80 minutes at 70 ^{0}C, 20 minutes at 80 ^{0}C and 3 minutes at 90 ^{0}C. Similarly under Steaming followed by HTST method (double stage blanching), 40 minutes at 70 ^{0}C, 15 minutes at 80 ^{0}C and 2 minutes at 90 ^{0}C. It was found that the time taken for inactivation of enzymes by mixed blanching methods is significantly less over the single stage blanching method. Similar results were observed in cases of banana and carrot also. For banana, the blanching temperature was less than 4 minutes at all temperature levels under single and double stage blanching methods. Where as in case of carrot, the blanching time was less than 12 minutes.

Quality evaluation

Table 5 shows the overall organoleptic score recorded for potato under single and double stage blanching methods, stored at room and refrigerated temperatures respectively. The sample P_{a2}, blanched at 80 ^{0}C for 25 min under HTST method and stored at room temperature has scored highest 7.86 (like moderately). Therefore, this sample was reported as superior in quality when compared to other methods. Other samples of potato undergone blanching treatments were also found at satisfactory condition even after 20 days of storage at room temperature. Control (unblanched) sample was totally spoiled within 5 days at room temperature storage. Under refrigerated storage, sample P_{b2} blanched at 60 ^{0}C for 30 min and then at 80 ^{0}C for 20 min by LTLT followed by HTST method scored highest i.e. 8.53 (like very much) and other samples of potato undergone blanching treatments were also found at satisfactory condition even after 20 days of storage at refrigerated temperature. Therefore, it was clear that, inactivation of enzymes in vegetables increased their storage life, improved quality and minimized the disruptive changes (color, taste and flavor). Similar results were found in cases of vegetables banana and carrot (Table 5). For banana, the sample B_{a1}, blanched at 70 ^{0}C for 4 min by HTST method scored highest i.e 7.67 (like moderately) at both room and refrigerated storage conditions. Similarly for carrot, it was observed that, the sample C_{c1}, blanched at live steam for 5 min and then at 70 ^{0}C for 0.5 min by Steaming followed by HTST method got highest score of 7 (like moderately) at both room and refrigerated storage conditions up to 20 days period of time. Unblanched samples were spoiled within 5 days of storage hence it was also proved that, there is a significant effect of blanching in vegetables banana and carrot on their storage life and quality.

Table 1 Temperature levels followed for blanching methods.

S.No.	Blanching method	Temperature levels
1.	HTST (single stage blanching)	For potato, banana and carrot i) 70 ^{0}c ii) 80 ^{0}c iii) 90 ^{0}c
2.	LTLT followed by HTST (two stage blanching)	For potato i)60 ^{0}c for 30 minutes followed by 70 ^{0}c ii)60 ^{0}c for 30 minutes followed by 80 ^{0}c iii)60 ^{0}c for 30 minutes followed by 90 ^{0}c For banana and carrot i)50 ^{0}c for 10 minutes followed by 70 ^{0}c ii)50 ^{0}c for 10 minutes followed by 80 ^{0}c iii)50 ^{0}c for 10 minutes followed by 90 ^{0}c
3.	Steaming followed by HTST (two stage blanching)	For potato, banana and carrot i)100 ^{0}c for 10 minutes followed by 70 ^{0}c ii)100 ^{0}c for 5 minutes followed by 80 ^{0}c iii)100 ^{0}c for 5 minutes followed by 90 ^{0}c

Table 2. Identification codes given to different temperature levels for blanching.

Vegetables	Temperature, ^{0}C	Type of blanching process			Unblanched sample
		HTST	LTLT followed by HTST	Steaming followed by HTST	
Potato	70	P_{a1}	P_{b1}	P_{c1}	P_u
	80	P_{a2}	P_{b2}	P_{c2}	
	90	P_{a3}	P_{b3}	P_{c3}	
Banana	70	B_{a1}	B_{b1}	B_{c1}	B_u
	80	B_{a2}	B_{b2}	B_{c2}	
	90	B_{a3}	B_{b3}	B_{c3}	
Carrot	70	C_{a1}	C_{b1}	C_{c1}	C_u
	80	C_{a2}	C_{b2}	C_{c2}	
	90	C_{a3}	C_{b3}	C_{c3}	

Note: In the above table

1. 'P', 'B' and 'C' represent potato, banana and carrot respectively.
2. 'a', 'b' and 'c' represent blanching methods HTST, LTLT followed by HTST and Steaming followed by HTST respectively.
3. '1', '2' and '3' represent three temperature levels i.e. 70, 80 and 90 ^{0}C respectively.
4. 'u' represents for unblanched or control sample.

Table 3. Organoleptic score card used for quality analysis.

Attribute	Score
Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Table 4. Time taken for blanching under single and double stage blanching methods.

S.No.	Type of vegetable	Blanching temperature in ^{0}C	Method of blanching (Time taken for blanching in minutes)		
			HTST	LTLT & HTST	Steaming & HTST
1.	Potato	70	95	80	40
		80	25	20	15
		90	4	3	2
2.	Banana	70	4	3	0.5
		80	2	2	0.4
		90	0.5	0.5	0.4
3.	Carrot	70	12	6	1
		80	6	2	0.5
		90	2	1	0.4

Table 5. Overall organoleptic score for vegetables.

S.No.	Type of vegetable	Storage condition	Overall organoleptic score									
1.	Potato		P_{a1}	P_{a2}	P_{a3}	P_{b1}	P_{b2}	P_{b3}	P_{c1}	P_{c2}	P_{c3}	P_u
		Room	7.53	**7.86**	6.47	7.53	7.67	6.09	7.27	6.07	5.47	2.86
		Refrigerator	7.47	7.80	8.20	7.93	**8.53**	8.47	7.80	8.07	7.93	4.67
2.	Banana		B_{a1}	B_{a2}	B_{a3}	B_{b1}	B_{b2}	B_{b3}	B_{c1}	B_{c2}	B_{c3}	B_u
		Room	**7.67**	6.07	6.07	7.10	6.33	5.80	6.67	5.73	5.14	3.60
		Refrigerator	**7.40**	6.67	6.27	6.53	6.33	6.13	6.33	5.60	5.53	3.40
3.	Carrot		C_{a1}	C_{a2}	C_{a3}	C_{b1}	C_{b2}	C_{b3}	C_{c1}	C_{c2}	C_{c3}	C_u
		Room	6.20	6.47	6.13	6.46	6.33	6.26	**7.46**	6.66	6.40	3.06
		Refrigerator	6.93	7.13	7.00	7.33	7.13	7.00	**7.93**	7.40	7.27	5.53

CONCLUSIONS

It was concluded from the study that, with increase of blanching temperature, the blanching time is significantly reduced and time taken for inactivation of enzymes by mixed blanching methods is less over the single stage blanching method. The potato sample blanched at 80 ^{0}C for 25 min under HTST method and stored at room temperature has scored highest 7.86 (like moderately). Under refrigerated storage, potato sample blanched at 60 ^{0}C for 30 min and then at 80 ^{0}C for 20 min under LTLT followed by HTST method scored highest i.e. 8.53 (like very much). For banana, the sample blanched at 70 ^{0}C for 4 min by HTST method scored highest i.e 7.67 (like moderately) at both room and refrigerated storage conditions. Similarly for carrot, it was observed that, the sample blanched at at live steam for 5 min and then at 70 ^{0}C for 0.5 min by Steaming followed by HTST method got highest score of 7 (like moderately) at both room and refrigerated storage conditions up to 20 days period of time. Unblanched samples were spoiled within 5 days of storage.

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