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Effect of Different Blanching Methods and Period of Frozen Storage on Enzyme Activities and Some Quality Criterias of Hot and Sweet Red Peppers (*Capsicum annuum* L.)

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Abstract: In this research, sweet Keşan peppers and hot Urfa peppers were blanched in different conditions which were used microwave and water. This application was carried out at different temperatures and time intervals. The samples were frozen at -40°C and then stored at -20±2°C for 10 months. During this period, storage stability of red peppers with no enzyme activity and different levels of enzyme activity were investigated. Therefore, the aim of this study was to discuss which pre-treatment gives the best result for high quality, usefulness of blanching and differences between varieties. It was found that sweet peppers had a higher peroxidase and lipoxygenase activity than hot peppers. In Urfa peppers which contain a high level of capsaicin having an antioxidant effect, losses of colour compounds for both varieties were found to be lower then that of the sweet peppers. The losses of capsantin in the treatments decreased by decreasing lipoxygenase enzyme activity. Before storage of sweet peppers, vitamin C content (170.20 mg/100 g) decreased to 79.05 mg/100 g (53.52%) in the tenth month. This reduction in Urfa peppers was from 201.62 mg/100 g to 111.75 mg/100 g, which is 44.78%. In samples of non-blanched Urfa peppers, capsaicin content was found to be 56.34 mg/100 g. Before the storage loss of capsaicin was up to 16.08% with blanching at 85°C for 4 min. At the end of the storage period, capsaicin content of non-blanched peppers was lower then that of microwave and water-blanched peppers. Higher temperatures and longer time lengths will cause a decreasing in capsantin and vitamin C content, It could be concluded that using lipoxygenase enzyme as an indicator instead of peroxidase enzyme used in 5 min blanching at 85°C as a commercial application would help to decrease losses in quality are related compounds in some red peppers.

Key words: Sweet red pepper (*Capsicum annuum* L.), hot red pepper, lipoxygenase, peroxidase, capsantin, capsaicin, ascorbic acid

INTRODUCTION

Blanching is not only an important factor in the successful production of high quality frozen vegetables but it is also one of the most controversial steps of the vegetable freezing process. It was known that quality changes of unblanched frozen vegetables survival of enzyme activation may cause even at low temperature[1]. Vegetables are blanched to peroxidase (POD) inactivation level because of POD is heat resistant enzyme[2-5]. It was known that the applied high temperature in use of POD enzyme as a adequate blanching indicator cause the loss of quality of frozen vegetables. However, it has been suggested that complete inactivation of POD is not necessary for quality preservation during frozen storage of vegetables[6]. According to Ganthavorn and Powers[7], blanching to completely inactivate POD was probably unnecessary of frozen asparagus. Halpin[8] reported that, blanching to the point of POD inactivation does not appear to be necessary to retain quality during frozen storage green peas. The enzymes considered to be important for blanching and it is researchers on as indicators of effectiveness of the blanching treatment are peroxidase, catalase and more recently lipoxygenase (LOX)[4,9-11]. Some researchers [12]reported that LOX enzyme was more suitable as a blanching index than POD for freezing soybeans. Güneş and Bayındırlı[13] found that in water or microwave blanching in which LOX was chosen as an indicator enzyme the retention of ascorbic acid would be higher when compared to POD inactivation. Many studies have indicated that residual LOX activity which was closely related to off-flavour of vegetables[3,14-17]. In contrast, others investigations reported that residual POD activity had little effect on quality of frozen vegetables[4,6,17]. Adams[18] showed that, the best quality samples of green beans were obtained when LOX and pectin-methylesterase had been almost inactivated completely and as blanching test of one of these enzymes rather than peroxidase would be more appropriate. Dietrich *et al.*[19] was reported that

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inactivation of LOX was reached even in a short period blanching.

Red peppers are good source of vitamins A and C, which are most important dietary antioxidant. Vitamin C, reportedly reduces the risk of arteriosclerosis, cardiovascular diseases and some forms of cancer[20-22]. Lee *et al.*[1] found an important correlation (r^2=0.86) between phenolic compounds and antioxidant activity for different peppers varieties. They reported that capsaicin had more antioxidant effective than quercetin. According to Fujimoto *et al.*[23], stability of carotenoid originated from phenolic compounds such as capsaicin and alpha tokoferol in red peppers. The concentration of phenols in vegetables appeared to have a high correlation with the inhibitory effect on carotene bleaching by Oszmianski and Lee[24]. Certain phenolic compounds are known to prevent LOX activity[25-27]. Lee and Smith[28] reported that the LOX activity and phenolic content varied greatly among vegetables and carotene bleaching was affected. On the other hand some researchers were determined a remarkable LOX activity in red peppers varieties[29-32]. According to previous researchers[33-35] carotene oxidised by LOX indirectly. Bernal *et al.*[36] and Bernal *et al.* [37] found that, capsaicin was oxidised by pepper peroxidase isoenzyme B6 and capsaicin, caffeic acid and ferulic acid are good substrates for hot pepper POD.

The aim of this study was to determine the effects the changes POD and LOX activity in pepper varieties that was subjected to different blanching conditions. Another purpose of the study was estimate relationship between capsantin, ascorbic acid, capsaicin and enzyme activity of peppers during frozen storage.

MATERIALS AND METHODS

Raw material: Sweet and hot red pepper varieties (*Capsicum annuum* L.) were used as experimental material in this research which were grown in Keşan and Urfa, respectively. They are very popular products in Turkey. Experimental material were harvested the end of September. The length of sweet pepper was 15-17 cm, hot pepper was 10-12 cm Each as washed, sorted to approximately 5x10 mm length. The products were divided in to 3 lots. One lot was the unblanched. The second lot was used for microwave blanching for 30, 60, 90, 120 and 180 sec in microwave oven at high setting (Beko, model no BKMD1550, 2450 MHZ, 1130 W). The other last one was blanched for 120 and 240 sec in water at 65,75 and 85°C at multipurpose heat vessel (Armfield, 25 lt capacity) During the blanching, temperature was followed by a recording thermocouple of vessel and the other thermocouple (Portec type K thermometer, P.I.8013). After blanching, samples were cooled immediately in cold water for 2-3 min and holded in refrigerator at +2°C (COF Lucco, Italy) until freezing. Pepper lots were frozen in blast freezer (Armfield-Blast and Fluid Bed Freezer) at -40°C. Later on, they were packed into small plastic refrigerator bags containing 250-300 g of pepper and stored at 20±2°C in freezer (Williams HS 1 BCBF). Sampling of experiments was done with the intervals of 2 months during the frozen storage. Each specified time, two bags from each treatments were removed for examination.

Enzyme assay: Pepper pulp (40 g) was homogenised in an ice cooled blender (Waring 32BL 79) for 3 min of mixing with cold (80 mL) 0.2 M potassium phosphate buffer (pH 7.0) for extraction enzyme. Homogenates were filtered through cheese-cloth and centrifuged for 15 min at 3000 rpm (IEC HN-SII Centrifuge). Resulting supernatants were retained in freezer (Marvel CFC -11) until assayed for enzyme activity[38]. POD activity was measured as the change in absorbance at 470 nm using guaiacol and H_2O_2 as substrate according to Thomas *et al.*[39]. The substrate solution of 0.5% guaiacol (Sigma, Chem. Co.) in 0.1 M K_2HPO_4 (pH 6.0) was stirred for 30 min; 0.008, 35% H_2O_2 was added immediately before use. Prepared enzyme extract (50 μL) was added to 2.5 mL substrate in a cuvette and absorbance recorded (Hitachi spectrophotometer, Model 121-002). One unit of activity was expressed as a change of 0.1 per min per mg protein.

For determination LIP activity, firstly the substrate solution was prepared by the method of Chen and Whitaker[16]. The substrate solution was prepared by mixing 157.2 μL linoleic acid (99% pure, Sigma Chemical Co.), 157.2 μL Tween 20 (Sigma Chemical Co.) and 10 mL distilled water, clarified by adding 1 mL of 1.0 N NaOH and diluted with distilled water to 100 mL to give a linoleate concentration of 0.01 M. Before assay, the stock solution was diluted to $2x10^{-3}$ M linoleate concentration with 4 volumes of 0.2 M phosphate buffer, pH 7. The substrate buffer solution was flushed with air for 10 min before use. Chen and Whitaker[16], Halpin and Lee[8] reported that substrate solution (pH 7) before adding enzyme and extract was waited at 25°C 10 min and activation determined at 234 nm. absorbance was continuously decreased in this method. In pepper, Minguez[29] determined that max LOX activity was pH 7, reaction pH was 6.5 during ripening period. According to this results reaction pH was arranged to 6.5. Determination of LOX activity was assayed by the method of Bonnet and Crouzet[40]. This method modified from the method of Chang *et al.*[41]. According to this method 2.7 mL of phosphate buffer (0.2 M, pH 6.5), 0.3 mL substrate and 50 μL enzyme was prepared in a tube, after incubation (10 min at 37°C) the reaction was started by addition of enzyme and the increased in absorbance at 234 nm was followed with a spectrophotometer. The specific activity is the number of units per mg of proteins.

Other methods: The content of dry matter was determined using gravimetric method[42]. Protein was assayed according to the method of Lowry *et al.*[43] using Folin Ciocalteus Fenol reactive and BSA as a standard. Determination was done with spectrophotometer at 500 nm. The indication principle of ascorbic acid value is based on 2,6-diklorofenol indofenol reaction which was determined by using (Hitachi UV/Vis) spectrophotometer at 520 nm[44]. Pepper samples were extracted with benzol and extracts were assayed in spectrophotometer at 496 nm for determination capsantin[45]. While pepper samples were extracted with acetone and petroleum ether for obtaining of capsaicin value. Extracts were reacted with ammoniumvanadate, HCl was than filtrated. Filtrates absorbance value was read at 496 nm. Spectrophotometer[46].

Statistic analysis methods: Statistic analysis were done using MSTAT packaged program and performed two replications and two parallel for randomised complete block factorial test design[47].

RESULTS AND DISCUSSION

POD activity of sweet pepper was found to be higher than that of the hot pepper (Table 1). According to our results POD enzyme inactivation of pepper needs more period more than blanched with water 240 sec and microwave 180 sec. Earlier researchers[2-4,48] reported that POD was the most resist enzyme and protected their effectiveness even during a long period blanching. If based on 100 of starting enzyme activation of pepper, enzyme inactivation rate were found to be 98.45% of sweet pepper, 99.22% of hot pepper at blanching of 85°C for 240 sec. Previous investigators showed that enzyme activity decreased to 97% for 60 sec blanched in carrot[49], 98.2% in green bean at 96°C 2.5 min[50], 94% 60°C 6 min with blanched in pea[8]. Ganthavorn *et al.*[51] found 47% residual activity of asparagus 70°C for 10 min Ramansway *et al.*[52], 8.9% steam of cauliflower blanced 3 min in boiled water. It seems that present findings for red pepper are similar to those observed previously. Müftügil[53], explained that most speed enzyme inactivation of green bean were obtained from microwave blanching. In present research residual activity had obtained at 180 sec in red peppers. Some investigators[13] have reported that residual activity of some different vegetable species were found to be average 5% at 180 sec in microwave blanching. It can be concluded that differences in results originated from different enzyme system. In addition, Dietrich *et al.*[54] observed that microwave blanching prevented enzyme activation in brussels support, which supported present findings.

Significant LOX inactivation was obtained by process of pepper varieties. Enzyme inactivation level of 64.85 and 92.71% were obtained from 120 and 180 sec microwave heating in sweet pepper, respectively, according to average of storage. Even though LOX activity was reduced to 88.09% with 120 sec heating and LOX was inactivated by 180 sec heating in hot pepper. Whole inactivation in both varieties were provided by 120 and 240 sec water blanching at 85°C (Table 1). Earlier researchers result LOX inactivation was 99% at 100°C 60 sec blanching in asparagus[51] and 68% at 60°C water blanching in green bean were decreased[8]. In addition total inactivation of peas was obtained from 180 sec microwave blanching, on the other hand 9% residual activity was determined in bean at the same application[13]. Previous studies[55] also showed that similar results. In our study LOX activity of hot pepper was determined lower than sweet pepper (Table 1). According to some researchers, LOX activity prevented by some phenolic compounds[25-27]. Furthermore it may assumed that hot pepper which have capsaicin had been inhibitor effect on LOX activity.

Ascorbic acid content of sweet pepper was 178.25 mg/100 g at the beginning of storage. Where as after storage it was 44.67 mg/100 g. In addition 210.20 and 85.15 mg/100 g values were determined in hot pepper, respectively (Table 2). Ascorbic acid content of peppers were found to be higher than Vanderslice *et al.*[56], (155 mg/100 g) and Lee *et al.* [1] (between 48.9-68.40 mg/100 g) findings. The light of the results stability of ascorbic acid content of pepper in microwave blanching were found to be increased. However ascorbic acid content of dry matter was found decreasing depends on increasing dry matter. Other investigations showed that microwave blanched vegetables had a higher vitamin C content than steam and water blanched vegetables[57-60] and similar with the present study. The loss of ascorbic acid increased in water blanching application, related to heating temperature and period. According to our treatments this values were determined as 8.26, 9.11, 8.84, 9.87, 11.36 and 14.41% in sweet pepper before frozen, while this values were obtained 0.51, 1.01, 8.74, 12.70, 14.02 and 15.08% in hot pepper, respectively (Table 2). Lisiewska *et al.*[61] explained that ascorbic acid content of pepper reduced 18% during blanching period. It was seen that ascorbic acid content of water blanching was higher than that of unblanched pepper end of storage (Table 2). It is shown that ascorbic acid lost of pepper which is reduced enzyme activity more than unreduced enzyme activities. It was not

determined activity of ascorbic acid oxidase in our study, however it known that firstly inactivated of ascorbic acid oxidase and then the other enzymes inactivated during blanching[48]. Lee *at al.*[1] reported that ascorbic acid loses of unblanched frozen vegetables survival of enzyme activation may cause even at low temperature. Ascorbic acid reduction were found to be of blanching pepper was 38% and unblanched frozen pepper was 57% during frozen storage Müftügil[49], Kmiecik and Lisiewska[62], found that ascorbic acid content of blanched chive was higher than that of unblanched chive end of frozen storage period. In addition present findings are in agreement with those of Ganthaworn and Powers[7], Güneş and Bayındırlı[13].

Changes of capsantin value in varieties were found to be significantly important during storage period. In addition capsantin value of sweet pepper were determined to be higher than that of hot pepper. It can be assumed that increasing of capsantin value depends on increasing dry matter in microwave blanching (Fig. 1). Regarding to statistical results maximum and minimum capsantin value were found in 180 sec microwave blanched and water blanching at 85°C for 240 sec, respectively during 10 months storage period (Table 2) . It can be said, decline in residue LOX enzyme activity reduced decreasing capsantin value. Müftügil[49], Walsh and Hauge[33], Oszmianski and Lee[24], Cabibel and Nicolas[35], Kim and Cheing[34] explained that caroten oxidation occurred by LOX activity.

Capsaicin value of hot peppers was increased by increasing of microwave blanching time. However apposite trend in capsaicin value were obtained in water blanched pepper (Table 2). In samples of non-blanched Urfa peppers, capsaicin content was found to be 56.34 mg/100 g. The highest value (58.50 mg/100 g) was obtained from 180 sec microwave-blanching whereas the lowest value (47.40 mg/100 g) was obtained from 4 min water-blanching at 85°C. Before the storage loss of capsaicin was up to 16.08% with blanching at 85°C for 4 min. At the end of the storage period, capsaicin content of non-blanched peppers was lower than microwave and water-blanched peppers (Table 2). Bernal *et al.*[36,37,63], reported that the capsaicin has remarkable importance substrate for POD. Also, in our research when decreasing of POD activity, lost of capsaicin value was decreased.

According to Table 3 data LOX activity was found non significant during the storage period. Meanwhile slightly increasing of POD activity was found to be similar with the other findings related to regeneration of POD activity[2,4]. Before storage of Keşan peppers, vitamin C content (170.20 mg/100 g) decreased to 79.05 mg/100 g (53.52%) in the tenth month. This reduction in Urfa peppers was from 201.62 to 111.75 mg/100 g, which is 44.78%. In this case decreasing of capsantin value of hot and sweet pepper were found to be significant to the end of the storage period. While at the beginning of storage capsantin value was 134.63 mg/100 g of sweet pepper, it decreased to 126.60 mg/100 g (5.96%), meanwhile hot pepper values slightly changed from 109.00 to 105.54 mg/100 g (3.67%) during storage, respectively. Some researchers[23] reported that antioxidant effects of capsaicin content of hot pepper and fenolic compounds of vegetables were prevented to bleach of carotenoid. Present findings were found to be similar with the results.

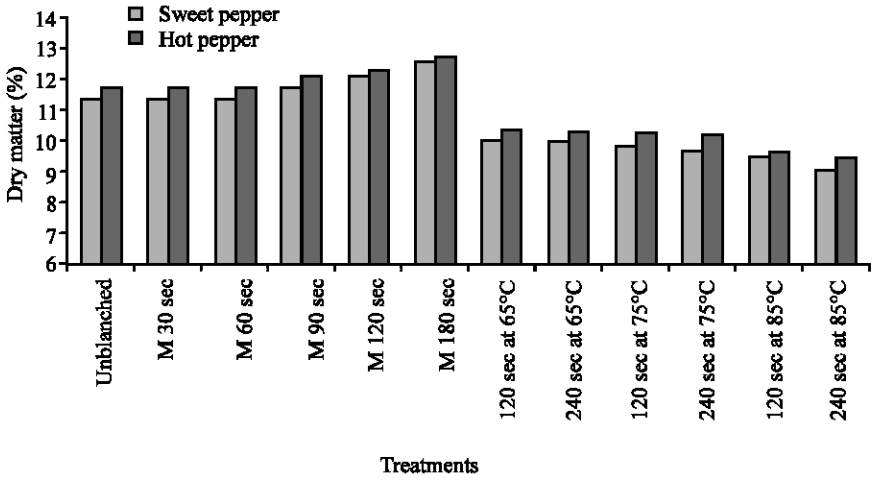

Fig. 1: Dry matter value (%) of pepper varieties during different treatment

Table 1: Average values of peroxidase (U/mg protein/mL) and lipoxigenase activity (U/mg protein/mL) of pepper varieties

	Peroxidase activity (U/mg protein/mL)				Lipoxigenase activity (U/mg protein/mL)			
	Pepper varieties				Pepper varieties			
	B.F.*		A.S.*		B.F.*		A.S.*	
Treatments	sweet	Hot	sweet	Hot	sweet	Hot	sweet	Hot
Unblanched	0.572a	0.500a	0.579a	0.507a	0.086a	0.069a	0.096a	0.084a
Microwave								
30 sec	0.566a	0.488a	0.569b	0.496b	0.075ab	0.064a	0.077b	0.064b
60 sec	0.554a	0.360b	0.557c	0.362c	0.069ab	0.049abc	0.070bc	0.051c
90 sec	0.459b	0.328c	0.459d	0.334d	0.049cd	0.036cd	0.047e	0.036d
120 sec	0.403d	0.268d	0.406g	0.272e	0.033b	0.011ef	0.034f	0.00f
180 sec	0.300f	0.155e	0.307i	0.157h	0.005e	0.00f	0.007g	0.00g
120 sec at 65°C	0.439bc	0.336c	0.433f	0.340d	0.063bc	0.047bcd	0.062cd	0.049c
240 sec at 65°C	0.430c	0.255d	0.425e	0.258f	0.033d	0.039cd	0.056b	0.039f
120 sec at 75°C	0.338e	0.162e	0.341h	0.166g	0.005b	0.026de	0.034f	0.026e
240 sec at 75°C	0.257g	0.083f	0.259j	0.087i	0.0e	0.003ef	0.005g	0.003g
120 sec at 85°C	0.067h	0.025g	0.067k	0.029j	0.0e	0.0f	0.0g	0.0g
240 sec at 85°C	0.009l	0.003h	0.009l	0.004k	0.0e	0.0f	0.0g	0.0g
A.V.*	0.366	0.247	0.368	0.251	0.039	0.029	0.041	0.030
LSD5%	2.201 E-02		8.140 E-03		2.201 E-02		8.140 E-03	

B.F.*: Before freezing, A:S.*: After storage, LSD: Least significant degree

Table 2: Average values of ascorbic acid, capsantin and capsaicin content of pepper varieties

	Ascorbic acid (mg/100 g)				Capsantin value (mg/100 g)					
	Pepper varieties				Pepper varieties				Capsaicin (mgkg^{-1})	
	B.F.*		A.S.*		B.F.*		A.S.*		Hot pepper	
Treatments	Sweet	Hot	Sweet	Hot	Sweet	Hot	Sweet	Hot	B.F.*	A.S.*
Unblanched	178.3c	210.2bc	116.9ý	142.6f	138.2d	113.2e	132.4de	110.9d	56.3g	48.3h
Microwave										
30 sec	178.2c	209.4bc	119.8h	144.4e	138.9d	113.1e	134.2bcd	111.7cd	56.4f	51.2e
60 sec	179.6bc	210.4bc	126.5fg	151.8d	138.4d	113.6d	135.3bcd	112.8cd	57.0d	52.9d
90 sec	180.4bc	210.6bc	133.3cd	158.7c	140.9c	114.5c	138.0abc	114.0bc	58.4c	56.2c
120 sec	181.4b	212.6ab	135.3b	173.0b	141.3b	115.1b	139.0ab	115.9b	59.4b	57.2b
180 sec	183.5a	214.3a	140.9a	178.3a	142.0a	116.6a	141.4a	119.7a	61.1a	58.5a
120 sec at 65°C	163.5d	209.1bc	133.9bc	152.3d	137.8e	111.1f	133.2cd	107.8e	54.4e	51.6fg
240 sec at 65°C	162.0de	208.1c	128.3e	151.6d	131.8f	107.3g	127.9ef	105.5ef	52.8h	50.6ef
120 sec at 75°C	162.5de	192.9d	132.4d	148.6f	131.2g	105.2h	124.8ef	103.7f	50.9ý	49.5g
240 sec at 75°C	160.7ef	183.5e	127.4ef	142.6f	130.0h	101.5ý	124.3fg	101.0g	50.5ý	49.2g
120 sec at 85°C	158.0f	180.7e	127.1efg	139.9g	125.5ý	100.7j	121.5gh	100.3gh	48.3j	47.4h
240 sec at 85°C	152.6g	176.6f	125.8g	137.5h	119.6j	98.6k	119.0h	98.7h	47.3k	46.4ý
A.V.*	170.1	201.5	128.9	152.0	134.6	109.1	131.2	108.48	54.4	47.6
LSD5%	3.101	3.101	1.406	1.112	3.803	3.803	50.961	24.827	0.276	0.899

B.F.*: Before freezing, A:S.*: After storage, LSD: Least significant degree

Table 3: Average value of ascorbic acid, capsantin and capsaicin content of pepper varieties

	POD U/mg protein/mL		LOXU/mgprotein/mL		Vit.C mg/100 g		Capsantinmg/100 g		Capsaicin mgkg^{-1}
	Pepper varieties		Pepper varieties		Pepper varieties		Pepper varieties		Pepper varieties
Storage period	Sweet	Hot	Sweet	Hot	Sweet	Hot	Sweet	Hot	Hot
Before Freezing*	0.366b	0.247c	0.040a	0.030a	170.2a	201.6a	134.6a	109.0ab	54.4a
2nd month	0.366b	0.246c	0.039a	0.030a	153.3b	183.2b	133.8ab	110.3a	53.8b
4th month	0.358c	0.248b	0.040a	0.031a	137.1c	152.6c	132.3abc	109.5ab	52.8c
6th month	0.367b	0.251b	0.040a	0.031a	128.1d	134.3d	130.7bc	108.7ab	51.4d
8th month	0.370b	0.254a	0.042a	0.032a	106.1e	123.8e	128.9cd	107.8b	50.1e
10th month	0.379a	0.259a	0.044a	0.034a	79.1f	111.3f	126.6d	105.5c	47.4f
A.V.*	0.367	0.250	0.041	0.031	128.97	151.2	131.1	105.5	51.7
LSD5%	5.756 E-03		5.756 E-03		0.994	0.793	36.035	17.555	1.009

LOX and POD activity correlation were found to be significant (0.01) (r^2=0.908**, r^2=0.894**) in sweet and hot pepper, respectively (Table 4). Similar result were obtained from LOX-capsantin correlation in both variety (r^2=0.216**, r^2=0.301**). This explanations showed that capsantin was important substrat for LOX. Negative

Table 4: Corralation of some important characteries of pepper varieties

	Pepper varieties						
	Sweet pepper			Hot pepper			
Characteries	POD	LOX	ascorbic acid	POD	LOX	ascorbic acid	Capsantin
Peroxidase	0			0			
Lipoxigenase	0.903**	0		0.894***	0		
Ascorbic acid	0.019	- 0.140	0	- 0.069	- 0.155*	0	
Capsantin	0.525**	0.216***	0.429***	0.520**	0.301**	0.377***	0
Capsaicin	-	-	-	0.265**	- 0.014	0.587***	0.731

*)0.05 significant level, **)0.01 significant level

correlation were found between ascorbic acid and POD (r^2= –0.069); ascorbic acid and LOX (r^2=-0.155) in hot pepper. In addition ascorbic acid correlated with LOX(r^2= -0.140), POD r^2=0.019 in sweet pepper. Negative correlation between ascorbic acid and enzyme activity can be explanation inhibitor effect of ascorbic acid. Prestomo and Manzano[64] determined an inhibitory effect of ascorbic acid on peroxidase activity in tomato. Capsaicin–POD activity was determined r^2=0.265** significant at 0.01 confidence level. This findings explained that capsaicin was important substrat for POD. On the other hand negative correlation was obtained from relationship of capsaicin and LOX activity (r^2=-0.014). It can be say capsaicin had inhibitor effect on LOX activity in hot pepper. Also Lee *et al.*[1] reported that capsaicin had high antioxidant activity in pepper varieties.

From the results, in both red pepper varieties blanching treatment should be applied to both red pepper variety prior to freezing. Capsantin, one of the important criteria which are oxidized by lipoxygenase enzyme activity, which causes a colour bleaching problem. From this research, it could be suggested that 180 sec microwave-blanching would be adequate when losses of capsantin contents decreased by decreasing of lipoxygenase enzyme activity. In water blanching treatments, 4 min blanching at 75°C or a longer treatment time length, or 2 min blanching at 85°C would be sufficient. Higher temperatures and longer time lengths will cause decrease in capsantin, ascorbic acid, water soluble compounds. It could be concluded that using lipoxygenase enzyme as an indicator instead of peroxidase enzyme used in 5 min blanching at 85°C as a commercial application would help to decrease losses in quality related compounds in some red peppers.

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