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Biochemical and nutritional variations in lettuce, cabbage, tomato and turnip

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Abstract : Ascorbic acid and phenol content in four vegetables namely lettuce *(Lactuca sativa*), cabbage (*Brassica oleracea*), tomato (*Solanum lycopersicum*) and turnip (*Brassica rapa*) were determined for five days continuously at room temperature. Highest level of ascorbic acid was found in lettuce (44.44 mg/100g fresh weight) followed by cabbage (35.50 mg/100g fresh weight), tomato (19.80 mg/100g fresh weight) and turnip (9.67 mg/100g fresh weight). Ascorbic acid oxidase (AAO) activity in all four vegetables were determined. It was highest in lettuce and lowest in tomato. Phenol content was obtained highest in tomato (0.54 mg/100g fresh weight), followed by cabbage (0.47 mg/100g fresh weight), lettuce (0.34 mg/100g fresh weight), and turnip (0.30 mg/100g fresh weight). Polyphenol oxidase (PPO) activity in all four vegetables were also analysed and obtained highest in cabbage and lowest in turnip. F-Test applied for ascorbic acid and phenol content for four vegetables, during five days of storage period at room temperature were found significance. During self life of four vegetables ascorbic acid decreases up to 85.86 percent in lettuce, 89.57 percent in cabbage, 83.18 percent in tomato and 51.08 percent in turnip, while phenol content reduced to 67.64 percent in lettuce, 59.57 percent in cabbage, 82.45 percent in tomato and 33.33 percent in turnip.

Key Words : Ascorbic acid oxidase, Polyphenol oxidase, Ascorbic acid

Introduction

Vegetables are good resource of vitamins and minerals and also provide enzymes required for human health. Generally vegetable are harvested at tender stage but they are transported to for a distance in the country and abroad. There are certain vegetables which are harvested and kept in the consumers house to use them on another days. Effort has been done in the present study to assess nutrient losses and variation in keeping quality for a period of 1 to 5 days. There are many parameters which variate due to variation in the storage time.

In the present study efforts have been made to find out the variation of ascorbic acid, ascorbic acid oxidase, phenol and phenol oxidase. Commonly vegetables contain more than 90 percent water that is very important for digestion. Hence, the content of moisture per day was also determined.

Enzymes mostly located in the soluble parts of cytoplasm in the water available in the vegetables. Deficiency of Vitamin ascorbic acid which results scurvy disease in human body and it is lost gradually when exposed to atmosphere (Ahmad *et. al.,* 1935).

Therefore present study, have been planned to study the quality losses and variation in some important vegetables. Since, browing reduces nutritional and sensory qualities, several techniques and mechanisms have been developed to control polyphenol oxidase (PPO) activity. These mechanisms act on one or more of the essential components necessary for the reaction to occur: oxygen, enzyme, copper or substrate. Four vegetables namely lettuce *(Lactuca sativa),* cabbage *(Brassica oleracea)*, tomato *(Solanum lycopersicum)*, turnip *(Brassica rapa)* were selected for the studies.

Materials and methods

Freshly harvested lettuce, cabbage, and turnip vegetables were sampled from the local market for the analysis. Periodical studies were conducted from one to five days. These vegetables were kept at the room temperature for the important biochemical studies. The vegetables were washed throughly before the estimations.

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Ascorbic acid estimation done by using Harris and Ray, (1935). Total phenol oxidase was analyzed by the method of Bray and Thorpe, (1954), Liu *et al.,* (2005) respectively. Ascorbic acid oxidase estimation was done by using by the method of Oberbacher and Vines, (1963). Protein content was estimated by the method of Lowry, (1951). Statistical analysis was done by using the method given by Fisher and Yates (1938).

Result and Discussion

Ascorbic acid (Vitamin C)

The results of Ascorbic acid content preserved quantitatively for a period of 5 days, procured from local market are presented in Table 1. Ascorbic acid content was found highest in salad leaves (44.44mg/100g) and then followed by cabbage (35.50mg/100g), tomato (19.80), and least in turnip (9.67mg/100g) on first day. The ascorbic acid content of freshly harvested vegetables continuously decreases day by day at room atmosphere linearly in lettuce, cabbage and tomato. However, there was slight variation in decrease in turnip as depicted in the figure 3.1 At last day during ascorbic content found to be least in tomato (3.33mg/100g) followed by cabbage (3.70mg/100g) then turnip (4.73mg/100g) and lettuce (6.28mg/100g). The percentage decrease in four vegetables during five days of preservation was in order cabbage (89 percent), lettuce (85.86 percent), tomato (83.18) and turnip (51.08 percent).

Lee *et al*., (2000) reported that Vitamin C losses are enhanced by extending storage period, higher temperatures, low relative humidity, physical damage and chilling injuries. Maturity at harvest and harvesting method also affect the vitamin C content in fruit and vegetables. In general, freshly harvested fruits and vegetables contained more vitamin C than those held in storage and they show a gradual decrease in ascorbic acid content as the storage temperature or duration increases, thus our results are in concordance with Lee *et. al.,* (2000) and Howard *et. al.*, (1999).

The AAO activity was found highest in cabbage and followed by turnip, lettuce and least in tomato, on the first day. The AAO activity however, increased periodically but there were some variations among the values. Shimada *et al*. (2008) observed ascorbic acid, dehydroascorbic acid and total ascorbic acid in fruits and vegetables and amount remaining after 24 hours were measured and determined activity of ascorbic acid oxidase in nine kinds of vegetables. The relationship between the activity of ascorbic acid oxidase and the amount of ascorbic acid, dehydroascorbic acid and total ascorbic acid were discussed. The residual ratio of dehydroascorbic acid increased and the total amount of ascorbic acid decreased in vegetables with high enzymatic activity and our results are in agreement with Shimada *et. al.,* (2008).

Table 1. Asccorbic acid content preserved quantitavely for period of 5 days

DAYS	Ascorbic Acid mg/100g fresh weight			
	Lettuce	Cabbage	Tomato	Turnip
1	44.44	35.50	19.80	9.67
2	33.33	20.60	7.01	5.80
3	28.57	13.90	6.34	5.80
4	15.18	10.40	5.55	4.90
5	6.28	3.70	3.33	4.73
Per cent decrease	85.86	89.57	83.18	51.08
F test	S	S	S	S
S.Ed	1.459	0.076	0.553	0.115
C.D	3.571	0.187	1.354	0.281

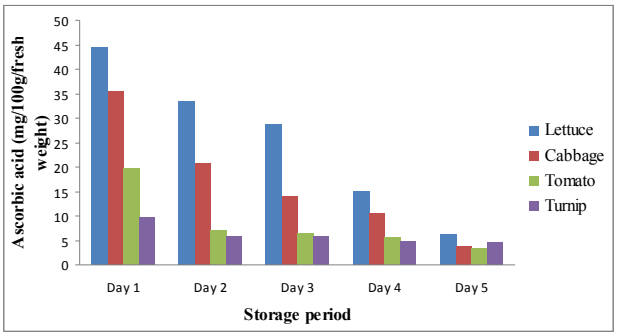

Fig. 1. Ascorbic acid content on periodically preserved lettuce, cabbage, tomato, and turnip

Phenol content found to be highest in tomato (0.54 mg/100g) followed by cabbage (0.47 mg/100g), lettuce (0.76mg/100g) and minimum in turnip (0.30 mg/100g) on first day. Phenol content did not show any particular pattern of increase or decrease, however, in first few days, there was an increase in concentration and then reduction in values were recorded. At last day it was recorded lowest in tomato (0.10mg/100g) and for turnip,

Table 2. Ascorbic acid oxidase activity for period of 5 days

Days	Ascorbic acid oxidase activity unit/min/mg protein fresh weight			
	Lettuce	Cabbage	Tomato	Turnip
1	0.013	0.017	0.010	0.015
2	0.018	0.019	0.011	0.023
3	0.021	0.023	0.014	0.023
4	0.024	0.029	0.016	0.028
5	0.024	0.026	0.016	0.027

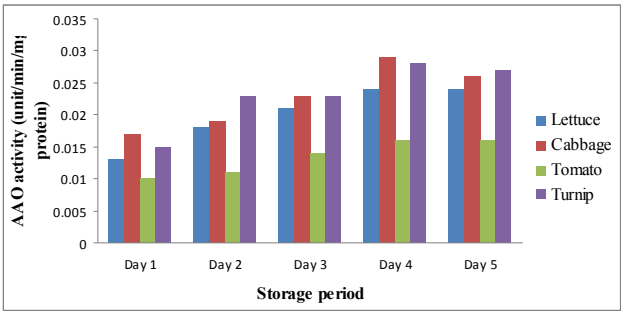

Fig. 2. Periodical activity of Ascorbic acid oxidase on lettuce, cabbage, tomato and turnip

lettuce and cabbage it was 0.20mg/100g, 0.11mg/100g, 0.19mg/100g respectively. Percentage decrease in phenol content during five days of preservation was in order tomato (82.45 percentage), lettuce (67.64 percentage), cabbage (59.57 percentage), turnip (33.33 percentage).

Chutichudet *et al*., (2011) reported that increasing content of polyphenols stored under different atmospheric condition from the first day of harvest at low temperature, is an indication of further biosynthesis of polyphenol in plant for protection against microbes and pathogens presumably triggered as a reaction to

Table 3. Total phenol content preserved quantitavely for period of 5 days

Days	Total Phenol mg/100g fresh weight			
	Lettuce	Cabbage	Tomato	Turnip
1	0.34	0.47	0.54	0.30
2	0.39	0.51	0.52	0.30
3	0.28	0.32	0.43	0.24
4	0.19	0.28	0.29	0.24
5	0.11	0.19	0.10	0.20
Per cent decrease	67.64	59.57	82.45	33.33
F test	S	S	S	S
S.Ed	0.013	0.015	0.013	0.013
C.D	0.032	0.037	0.031	0.033

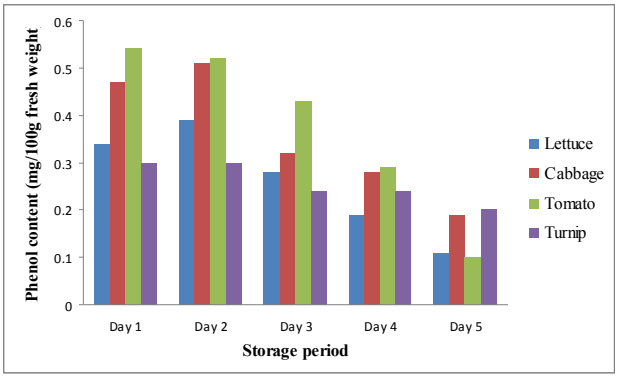

Fig 3: Phenol content on periodically storage lettuce, cabbage, tomato and turnip

stress in plants. Furthermore, it has been reported that longer storage time resulted in decreased phenol content. Jiang *et al.,* (2004) presumed that this disorder is mainly associated with the enzymatic browning caused from the oxidation of phenol compound by the enzyme PPO to produce quinone that polymerizes and form brown pigment in lettuce. Our results are in conformity with Chutichudet *et al.* (2011) and Jiang *et al.* (2004).

Polyphenol oxidase activity: (EC. 1.14.18.1)

Polyphenol oxidase activity determined in all four vegetables was noticed to increase slowly firstly then its activity increased rapidly. However, it was found minimum in tomato (0.001 unit/min/mg protein) and highest in lettuce (0.004 unit/min/mg/protein). PPO activity was obtained in increasing regular pattern in Lettuce and Cabbage and tomato. However in turnip somewhat constant firstly and then increased suddenly.

Table 4. Polyphenol oxidase activity for period of 5 days

Days	Polyphenol oxidase activity in unit/min/mg protein			
	Lettuce	Cabbage	Tomato	Turnip
1	0.006	0.002	0.001	0.003
2	0.007	0.003	0.005	0.003
3	0.015	0.006	0.007	0.003
4	0.019	0.015	0.012	0.009
5	0.022	0.023	0.019	0.013

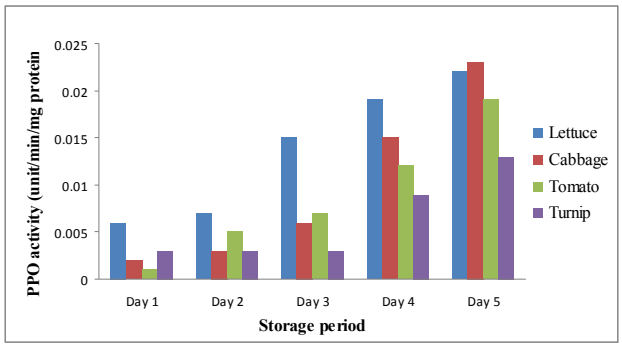

Fig 4. Polyphenol oxidase activity on periodically preserved lettuce, cabbage, tomato and turnip

Khumjing *et al*. (2011) reported that phenol compound can be oxidized by enzyme PPO to form quinone that spontaneously polymerizes leading to formation of brown pigment melanin responsible for tissue browning. Huang *et al.* (2005) reported that stress or mechanical damage affects the degradation of plant membrane and enhances the PPO leakage which contact with the phenolic substrate present in plant tissue and oxidizes it and causes browning. Our results were in agreement with Khumjing *et al*. (2011) and Huang *et al.* (2005).

सारांश

चार सब्जियाँ अर्थात सलाद पत्ता (*लैक्टुका सटाइवा*), बंद गोभी (*ब्रासिका ओलेरेसिया*), टमाटर (*सोलेनम लाइकोपरसीकम*), शलजम (*ब्रेसिका रेपा*) को कमरे के तापमान पर रखकर 5 दिन तक लगातार एस्कार्बिक एसिड (विटामिन–सी) और फिनॉल की मात्रा को निर्धारित किया गया। एस्कार्बिक एसिड की अधिकतम मात्रा सलाद पत्ते (44. 44 मिग्रा/100 ग्राम ताजा भार) और उसके बाद क्रमशः बंद गोभी (35.50 मिग्रा/100 ग्राम ताजा भार), टमाटर (19.80 मिग्रा/100 ग्राम ताजा भार) और शलजम (9.67 मिग्रा/100 ग्राम ताजा भार) में पायी गई। एस्कार्बिक एसिड अक्सिडेज (एएओ) की गतिविधि सभी चार सब्जियों में निर्धारित की गई। इसकी सबसे अधिक मात्रा सलाद पत्ता में और सबसे कम मात्रा टमाटर में थी। फिनॉल की मात्रा सबसे ज्यादा टमाटर (0.54 मिग्रा/100 ग्राम ताजा भार) में और उसके बाद क्रमशः बंद गोभी (0.47 मिग्रा/100 ग्राम ताजा भार) सलाद पत्ता (0. 34 मिग्रा/100 ग्राम ताजा भार) और शलजम (0.30 मिग्रा/100 ग्राम ताजा भार) में प्राप्त की गई। पोलीफिनॉल आक्सिडेज (पीपीओ) की गतिविधि भी सभी चार सब्जियों में विश्लेषित की गई। और बंद गोभी में सबसे ज्यादा और शलजम में सबसे कम प्राप्त की गई। एस्कार्बिक एसिड और और फिनॉल की मात्रा इन चार सब्जियों के कमरे के तापमान पर 5 दिनों के भण्डारण अवधि के दौरान एफ–टेस्ट प्रयुक्त करके महत्वपूर्ण पायी गई। इस भण्डारण के दौरान एस्कार्बिक एसिड सलाद पत्ता में 85.86%, बंद गोभी में 89.57%, टमाटर में 83.18% और शलजम में 58.08% कम हुआ जबकि फिनॉल की मात्रा सलाद पत्ता में 67.64%, बंद गोभी में 59.57%, टमाटर में 82.45% और शलजम में 33.3% कम हुयी।

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