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Abstract

This investigation was carried out during two consecutive seasons on "Alphonse" and "Badami" (*Mangifera indica* L.), grown at Daraneet orchard, Beheira- Governorate to evaluate the effect of some preharvest natural treatments on store fruit. The results showed that, in both experimental seasons in "Alphonse" and "Badami" cultivars, weight loss percentage, T.S.S., reducing sugars, total sugars, peroxidase and polyphenoloxidase increased progressively through the storage period, whereas, fruit firmness, ascorbic acid and total phenols decreased in both cultivars. During storage period, fruit of both "Alphonse" and "Badami" mangoes treated with Cacl2 at 0.5, 1.0 and 1.5 % decreased fruit weight loss, firmness, peroxidase and polyphenoloxidase activities, while T.S.S, ascorbic acid and total phenols content increased as compared to control. However, reducing sugars and total sugars were not greatly affected during storage time. Also, results revealed that, during storage period, fruit of both "Alphonse" and "Badami" mangoes treated with ascorbic acid or citric acid at 200, 300 and 400 ppm, in addition active dry yeast treatment (3g/l) decreased fruit weight loss, firmness loss and peroxidase and polyphenoloxidase activities compared to control. In contrast, T.S.S, ascorbic acid, reducing sugars and total soluble sugars increased compared to control.

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Introduction

The mango (*Mangifera indica* L.) is one of the members of family Anacardiaceae. Calcium widely used in several studies to control many of physiological and chemical changes affecting quality characteristics of fruits during the storage. One of calcium sources is Cacl2, naturally occurring, inexpensive, edible and has been approved by the U.S. Food and Drug Administration for postharvest use (Yuen, 1994 and Saftner *et al*., 1999). Ascorbic acid and citric acid are two natural and organic antioxidants have auxinic action (Elad, 1992).

However, the various positive effects of applying active dry yeast as a newly used biofertilizer, high percentage of proteins, large amount of vitamin B and the natural plant growth hormone namely cytokinins (Abd- Elmotty and Fawzy, 2005). Temperature management is the major method of controlling respiration rate and extending the storage life of fruits, El- Oraby *et al*. (2004).

This investigation was carried out during the 2003 and 2004 in order to study the effect of foliar preharvest Cacl2, ascorbic acid, citric acid and active dry yeast treatments on physio-chemical changes of mango fruits during storage in cold conditions.

Materials and Methods

This investigation was carried out (2003 and 2004) on two mango cultivars; i.e., Alphonse and Badami grown at Daraneet orchard, Behera Governorate.

Thirty-three trees, as uniform as possible, The eleven treatments were as follows:Control, Cacl2 (0.5, 1.0 and 1.5%), Ascorbic acid (200, 300 and 400 ppm),Citric acid (200, 300 and 400 ppm), Active dry yeast (3 g/L) (450 g + sugar 250 g were dissolved in 5 litres warm water (38^{o}C) and allowed to stand for two hours, then completing the volume to 150 litres of water). The first application was at full bloom and at fruit set and three weeks before harvest.

All boxes stored at 10^{o}C + 85-90% R.H for 30 days. Fruits were taken from each replicate at 0, 6, 12, 18, 24 and 30 days from storage. In each fruit sample, fruit firmness, T.S.S, acidity, ascorbic acid, reducing sugars, total sugars, total phenols, PPO and PO activity, and physiological fruit weight loss were determined.

Fruit firmness was determined by Magness and Taylor (1925). T.S.S (%) was determined in fruit juice by a hand refractometer. Vitamin C content was determined in fruit juice using 2, 6-dichlorophenol-indo-phenol blue dye as mg ascorbic acid per 100 ml juice (A.O.A.C., 1980).

The total sugars were determined colorimetrically using phenol and sulphuric acid according to Malik and Singh (1980). The reducing sugars were determined by the Nelson arsenate-molybdate colorimetric method (Dubois *et al*., 1956). Total phenolic compounds were determined according to the method of Swain and Hillis (1959).

Peroxidase activity was spectrophotometrically determined according to

Chance and Maehly (1955).Polyphenol oxidase activity was measured by (Chance and Maehly, 1955). Polyphenol oxidase activity by (Matta and Dimond, 1963).

The percentage of physiological fruit weight loss calculated according to the following equation:

$$\text{Weight loss (\%)} = \frac{\text{Average loss in fruit weight}}{\text{Average initial fruit weight}} \times 100$$

The experimental design was randomized complete block design, and statistically analyzed by the analysis of variance as described by Steel and Torrie (1980).

Results and Discussion

1. *Physical Properties*

a) *Weight loss*

Statistical analysis of the present data revealed that (1.0 and 1.5% $Cacl_2$) significantly decreased fruit weight loss as compared with control Tables 1and2, except for 1.0% treatment, in the first season for "Badami" cultivar. Significant difference was also found between 1.5 and 0.5%, respectively, in 2004 season for "Alphonse" cultivar. Such results due to the effect of calcium on inhibiting the activities of respiratory enzymes such as pyruvate kinase and the activity of pectolytic enzymes and cellulose (Nijjar, 1985).

Both antioxidants and active dry yeast treatments, generally, reduced fruit weight loss compared with control. This might be due to the action of free radical scavengers (antioxidants) in inhibiting senescence by reducing respiration or preventing a respiratory rise (Elad, 1992). In the meantime, these results are in line with those obtained by Ahmed (2001) on spraying Anna apple with active dry yeast.

b) *Fruit firmness*

In Tables 1 and 2 as for "Alphonse" cultivar, (1.0 and 1.5% $Cacl_2$) treatments resulted in a statistically significant increase in fruit firmness compared with (0.5%) and control. In both experimental seasons, pulp firmness of "Badami" cultivar was significantly increased with the three Cacl2 treatments as compared with control. Significant differences were also found among the treatments, except between (1.0 and 1.5%), in the first season only.

Mkrtchyan et al.(1989) reported that calcium appears to delay softening and this could be explained by delaying degradation of cell wall polymers.

In "Alphonse" mango, (400 ppm A.A.) and active dry yeast treatments resulted in a statistically significant increase in fruit firmness compared with (200 (ppm A.A. and C.A.) and control. Significant differences were also found between the active dry yeast (3 g/l) treatment compared with (300 ppm A.A.

and (300 and 400 ppm C.A.), in the second season. However, significant difference was only found between active dry yeast compared with the control in the first season.

In "Badami" cultivar, (300 and 400 ppm A.A) and active dry yeast (3 g/l) treatment significantly increased fruit firmness compared with (200 ppm A.A), all citric acid treatments (200, 300 and 400 ppm) and the control, except between the (300 ppm A.A) and (400 ppm C.A.), in the second season. Significant differences were also found between active dry yeast and the two higher concentrations of ascorbic acid, in both experimental seasons for "Badami". In accordance with these results, are those previously reported by Ahmed (2001). She found that active dry yeast caused significantly higher firmness compared with control in Anna apple fruits. Yeast contains cytokinins thus delays the aging of tissue (Abo-Taleb et al., 1999).In the meantime antioxidants are potent compounds for delaying the loss of membrane integrity and ethylene production (Elad, 1992).

c) *Total soluble solids*

Statistical analysis Tables 1 and 2 revealed that (1.5% $Cacl_2$) treatment significantly increased fruit T.S.S content compared with control, in both experimental seasons for the two cultivars, except in the second season for "Alphonse" cultivar. In the first season of "Badami" cultivar only, In agreement with El-Shobaky and Mohamed (2000), Abd El-Rahman et al.(2001) and Brakat and Mohsen (2005a) on different orange varieties. This increment may be due to calcium may regulate respiration and perhaps other metabolic processes in the maturing fruits (El-Naggar et al., 2005).

Data in Tables 1 and 2 also showed that in the first season of "Alphonse" cultivar, fruit T.S.S content was significantly increased with (300 and 400 ppm A.A.), 300 ppm C.A. and active dry yeast treatments as compared with the lowest concentration of both ascorbic acid and citric acid (200 ppm) treatments and control. The second season of "Alphonse", all ascorbic acid treatments (200, 300 and 400 ppm), (400 ppm citric acid) and active dry yeast treatment resulted in a statistically significant increase in T.S.S content compared with the control. Significant differences were also found between 400 ppm ascorbic acid and 200 ppm citric acid treatments.

It is evident that, in the first season for "Badami" cultivar 300 and 400 ppm ascorbic acid, 400 ppm citric acid and active dry yeast (3 g/l) treatments caused a significant increase in fruit T.S.S content compared with control. Significant differences were also found between (300 and 400 ppm ascorbic acid) and 200 ppm ascorbic acid. The second season of "Badami" cultivar indicated that 300 and 400 ppm ascorbic acid, 400 ppm citric acid and active dry yeast treatments significantly increased fruit T.S.S content compared with the lowest concentration of the two antioxidants (200 ppm).

The important role of yeast in increasing the release of carbon dioxide through fermentation process effectively activates the photosynthesis and accelerates the biosynthesis of carbohydrates (Subbo Rao, 1984). In the meantime, Hegab (2000) spraying Balady mandarin with citric and ascorbic acids and found an

increase in T.S.S content compared with control, since the antioxidants have synergistic effects on quality of fruits and enhancing photosynthesis as noted in sugars (Zhang and Klessing, 1997).

2. Chemical Analysis

d) *Vitamin C*

The present results (Tables 1 and 2) indicated that, Cacl2 (1.0 and 1.5%) treatments caused significant increase in fruit ascorbic acid content compared with control for the two cultivars. Significant differences were also found between the two higher concentrations of $Cacl_2$ (1.0 and 1.5%) and the lowest concentration (0.5%), in the second season of "Alphonse" cultivar. It was concluded that calcium retarded the conversion of L-ascorbic acid into dihydro-ascorbic acid as a senescence process (Amen, 1987).In the meantime, both the two antioxidants and active dry yeast treatments caused a general increase in fruit ascorbic acid content, in two seasons for "Alphonse" and "Badami" cultivars Tables (1 and 2). In both experimental seasons of "Alphonse", significant differences were found between the highest concentration of ascorbic acid (400 ppm) compared to control. In the meantime, control trees produced fruits with significantly lower ascorbic acid content compared to the intermediate treatment of ascorbic acid (300 ppm), in the first season, and to the highest concentration of citric acid and active dry yeast treatments, in the second season.

In "Badami" cultivar, significant differences were found between both the two highest concentrations of the two antioxidants (400 ppm) and active dry yeast treatments compared to control, in 2003 and 2004 seasons, and to the two lowest concentrations of both antioxidants (200 ppm), in 2003 season, except between the highest and lowest concentration of citric acid treatments, in 2004 season.

These results are in agreement with those obtained by Hegab (2000) spraying citric acid and ascorbic acid on Balady mandarin, this may be due to that antioxidants have beneficial effect on delaying the senescences by scavenging the free radicals or active oxygen species that are produced during respiration process . In the meantime, the improvement of vitamin C (ascorbic acid) by yeast might be due to stimulating depletion of D-glucose (a direct precursor of vitamin C) into ascorbic acid biosynthesis (Isherwood and Mapson, 1962).

e) *Reducing sugars*

In both experimental seasons, the three concentrations of Cacl2 treatments caused a slight decrease in reducing sugars content as compared with the control. The present results indicated that, in both seasons, the differences among tested treatments were not big enough to be statistically significant. These results seemed to be in line with those obtained by Zambrano and Manzano (1995), working on mango fruits. They noticed that, generally, calcium application slightly delayed the ripening process when treated fruits

are compared with the control.As for the effect of different applications of the two antioxidants and active dry yeast treatments, results (Tables 1 and 2) showed an improvement in fruit reducing sugars content. In both experimental seasons of the two cultivars, the highest concentration of ascorbic acid (400 ppm) and active dry yeast (3 g/l) treatments caused a significant increase in fruit reducing sugars content as compared with control, except between the active dry yeast treatment and control, in the first season for "Badami" cultivar.

These results confirmed those reported by Hegab (2000) spraying Balady mandarin with citric acid and ascorbic acid .There was an obvious promotion on fruit chemical quality in terms of increasing fruit reducing sugars content by antioxidants, were responsible for accelerating the biosynthesis of various pigments (Elad, 1992 and Farag, 1996). In the meantime, Haggag et al.(1995) on guava and Hegab et al.(1997) on Valencia orange found that dry yeast improved reducing sugars content.

3. Total sugars

The present results Tables 1 and 2 indicated that, in both seasons, fruit total sugars content was slightly affected by the different Cacl2 treatments and the differences among tested treatments were not big enough to be significant. In accordance with these results are those previously reported by Awad (2000) working on mango. She noticed that calcium treatments had insignificant effect on fruit total sugars content. Abdel-Hamid (2000) reported that calcium application delayed maturation via ethylene blocked action which resulted in preservation of membrane from deterioration, so that Ca^{+2} effect on delaying maturation.

It is evident from data that, in "Alphonse" mango cultivar, (300 and 400 ppm) and active dry yeast treatments caused a significantly higher fruit total sugars content compared with control, in the first season, and with control and (200 ppm A.A and C.A.) in the second season. Significant differences were also found between 400 ppm A.A. and 300 ppm C.A., in the second season for "Alphonse" cultivar only.

As for the effect of both the two antioxidants and active dry yeast treatments of "Badami" cultivar, results showed that, in the first season, fruit total sugars content was significantly increased with (300 and 400 ppm A.A and C.A) and active dry yeast (3 g/l) treatments as compared with (200 ppm C.A) and control, except between 200 and 300 ppm citric acid treatments. Active dry yeast treatment, 300 ppm A.A and 400 ppm citric acid resulted in a statistically significant increase in total sugars content compared with the lowest concentration of (200 ppm A.A). The second season of "Badami" cultivar had the same trend but the significant results were in the two higher concentrations of ascorbic acid (300 and 400 ppm), the highest concentration of citric acid (400 ppm) and active dry yeast (3 g/l) treatments as compared with control. Significant differences were found between (400 ppm A.A) compared to (200 ppm) and the two lower concentrations of C.A. (200 and 300 ppm). Later, the active dry yeast treatment produced higher total sugars content compared with 200 ppm) (Tables 1 and 2).

These results agreed with those obtained by Abou-Rawash et al.(1998) on Taimour mango sprayed with ascorbic acid, Hegab (2000) on "Balady" mandarin sprayed with C.A. and A.A.. Abou El-Komsan et al.(2003) on "Balady" orange sprayed with citric acid. The great role of antioxidants in stimulation the biosynthesis and movement of carbohydrates effectively improved fruit quality (Hegab, 2000). These results were also in agreement with those obtained by Abd-Elmotty and Fawzy (2005). They sprayed "Zebda" and "Langra" mango with dry yeast and reported the beneficial effect of yeast in improving fruit quality by enhancing the biosynthesis and translocation of sugars.

4. *Total phenols*

Cacl2 treatments Tables 1 and 2, caused a significant increase in total phenols by (1.5%) compared to control, except in 2003 season for "Alphonse". Significant difference was also found between 1% compared to control, in 2004 season for "Badami" only. It was noticed that calcium treatments decreased the activity of polyphenoloxidase due to its effects on delaying the senescence processes (Lang and Volz, 1993).

With a closer view, results showed that significant increase was found between the two higher concentrations of citric acid (300 and 400 ppm) and the highest concentration of ascorbic acid (400 ppm) compared to control, in 2004 season for "Badami" cultivar only. This might be due to the role of both the antioxidants and active dry yeast in retarding respiration process (antioxidants) (Elad, 1992) and retarding tissue aging (active dry yeast) as discussed in polyphenol oxidase.

5. *Peroxidase activity (PO)*

The data in Tables 1 and 2. revealed that the various treatments, generally, reduced PO activity.

Statistical analysis of data indicated that the two higher concentrations (0.1 and 1.5%) of Cacl2 significantly inhibited fruit peroxidase enzyme activity as compared with control, except for 0.1% treatment, in the second season for "Alphonse" and the first season for "Badami", significant difference was also found between the two higher concentrations, only in 2004 season for "Alphonse".

Calcium, in inhibiting senescence, can reduce peroxide accumulation and involve some protection of membranes from free radical or peroxidative attack when susceptible membranes have a large amount of calcium binding (Ferguson, 1984).

In the meantime, the treatments of the two antioxidants and active dry yeast slightly decreased peroxidase activity in fruit pulp extract. Significant differences were found between the highest concentration of ascorbic acid (400 ppm) compared to control, in 2003 and 2004 seasons for the two cultivars, except in the first season for "Badami" cultivar. Significant differences were also found between 300 ppm ascorbic acid treatment compared with control, in the second season for "Alphonse" cultivar only (Tables 1 and 2).

Antioxidants maintaining the potential for conversion of 1-amino cyclopropane-1-carboxylic acid (ACC) to ethylene (Ferguson, 1984). Active yeast was attributed to its own from the natural growth hormone namely cytokinins and protects membranes from peroxidative attack (Leshem et al., 1981 and Ferguson, 1984).

6. *Polyphenoloxidase activity (PPO)*

In Tables 1 and 2.Statistical analysis of data indicated that the two higher concentrations of Cacl2 (1.0 and 1.5%) significantly inhibited PPO enzyme activity as compared with control, in 2003 and 2004 seasons for two cultivars, except between 1.0% and control, in 2004 season for "Alphonse" and 2003 season for "Badami" fruits. Significant differences were also found between the highest concentration (1.5%) and lowest one (0.5%), in 2003 for "Alphonse" only.

It was noticed that calcium treatments decreased the activity of PPO due to its effects on delaying the senescence processes (Bramlage et al., 1974 and Lang and Volz, 1993) and enhances membrane stability, would probably keep the normal spatial separation between PPO and its substrate (Hall et al., 1982).

In the same trend, the two antioxidants (ascorbic acid and citric acid) and active dry yeast treatments inhibited the pulp PPO enzyme activity compared with control. Statistical analysis revealed that the highest concentration for the two antioxidants (400 ppm A.A and C.A) and active dry yeast (3 g/l) treatments significantly decreased pulp PPO activity compared to control, in both seasons for two cultivars, except for active dry yeast treatment, in 2004 season for "Alphonse" cultivar and 400 ppm citric acid treatment, in 2004 season for "Badami" cultivar. Significant differences were also found between the highest concentration of ascorbic acid treatment compared to the lowest citric acid concentration (200 ppm), in the first season for "Alphonse". Later, the intermediate concentration of citric acid treatment (300 ppm) significantly decreased pulp PPO content compared to control, in the second season for the two cultivars. These results may be due to the role played by antioxidants in maintaining membrane integrity and retard respiration process (Elad, 1992). Similar action is that of active dry yeast, since containing of cytokinin which retards tissue aging. Moreover, the relatively high ascorbic acid content in antioxidants and active dry yeast treated fruits (Tables 1 and 2) might also account for the low browning potentiality of such fruits. Augustin et al.(1985), working on guava PPO enzyme, stated that ascorbic acid acts by reducing the quinines formed by PPO action back into colourless compounds.

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Table (1): Effect of some natural preharvest treatments on means of physical and chemical parameters during cold storage at 10°C of "Alphonse" and "Badami" mango cultivars in first season.

Parameters	Treatments											L.S.D$_{0.05}$
	Control	Cacl2 (%)			Ascorbic acid (ppm)			Citric acid (ppm)			Active dry yeast (3 g/l)	
		0.5	1.0	1.5	200	300	400	200	300	400		
"Alphonse"												
Weight loss(%)	6.879	6.427	6.172	5.965	6.878	6.590	6.543	6.887	6.833	6.647	6.697	0.557
Firmness(lb/in^2)	7.40	7.64	8.86	8.91	7.44	7.59	7.74	7.32	7.54	7.70	8.24	0.57
T.S.S(%)	10.38	10.44	10.55	10.63	10.35	10.69	10.75	10.39	10.78	10.56	10.87	0.23
V. C (mg/100 ml)	35.18	36.39	38.13	38.60	36.86	37.65	38.14	36.15	36.58	37.56	37.28	2.40
Reducing sugars(%)	2.441	2.438	2.436	2.432	2.457	2.472	2.478	2.447	2.463	2.464	2.480	0.031
Total sugars(%)	8.46	8.47	8.49	8.46	8.58	8.71	8.81	8.52	8.60	8.68	8.87	0.25
Total phenols (mg/100 g)	8.00	8.05	8.07	8.10	8.02	8.03	8.04	8.01	8.02	8.02	8.02	0.11
Peroxidase(O.D/g/min)	0.249	0.240	0.234	0.234	0.244	0.240	0.237	0.244	0.244	0.241	0.245	0.011
Polyphenoloxidase (O.D/g/min)	0.333	0.327	0.320	0.315	0.331	0.323	0.320	0.332	0.328	0.321	0.321	0.012
"Badami"												
Weight loss(%)	8.625	8.471	8.288	8.137	8.629	8.533	8.458	8.612	8.533	8.533	8.459	0.471
Firmness(lb/in^2)	8.90	10.03	11.02	11.49	8.79	9.80	9.60	8.68	9.02	8.96	10.67	0.53
T.S.S(%)	9.18	9.27	9.40	9.57	9.29	9.71	9.89	9.31	9.38	9.49	9.56	0.21
V. C (mg/100 ml)	47.94	48.61	49.82	51.50	47.99	48.27	50.18	47.51	48.67	49.28	49.32	1.32
Reducing sugars(%)	1.366	1.361	1.358	1.361	1.383	1.409	1.430	1.378	1.391	1.397	1.407	0.052
Total sugars(%)	6.90	6.90	6.93	6.86	7.05	7.36	7.30	6.98	7.16	7.31	7.33	0.26
Total phenols (mg/100 g)	8.69	8.75	8.77	8.78	8.74	8.75	8.76	8.73	8.76	8.76	8.76	0.09
Peroxidase(O.D/g/min)	0.221	0.215	0.210	0.208	0.220	0.213	0.213	0.220	0.216	0.214	0.214	0.011
Polyphenoloxidase(O.D/g/min)	0.304	0.299	0.295	0.293	0.300	0.297	0.294	0.301	0.299	0.294	0.294	0.010

Table (2): Effect of some natural preharvest treatments on means of physical and chemical parameters during cold storage at 10°C of "Alphonse" and "Badami" mango cultivars in second season.

	Treatments											L.S.D 0.05
		Cacl2 (%)			Ascorbic acid (ppm)			Citric acid (ppm)			Active dry yeast (3 g/l)	
	Control	0.5	1.0	1.5	200	300	400	200	300	400		
"Alphonse"												
Weight loss(%)	6.542	6.261	5.650	5.515	6.543	6.429	6.379	6.552	6.499	6.413	6.430	0.622
Firmness(lb/in^2)	7.69	8.01	9.05	9.05	7.65	7.82	8.00	7.68	7.85	7.93	8.29	0.31
T.S.S(%)	10.89	10.94	11.20	10.95	11.33	11.33	11.40	11.04	11.17	11.28	11.34	0.35
V. C (mg/100 ml)	35.61	36.44	39.35	40.97	36.84	37.47	38.05	36.11	36.65	37.64	37.74	2.01
Reducing sugars(%)	2.731	2.732	2.729	2.727	2.742	2.758	2.768	2.742	2.760	2.785	2.765	0.034
Total sugars(%)	8.94	8.94	8.96	8.97	8.95	9.28	9.39	8.90	9.08	9.16	9.32	0.28
Total phenols (mg/100 g)	7.95	7.99	8.05	8.07	7.98	8.00	8.01	7.98	8.02	8.02	8.00	0.12
Peroxidase(O.D/g/min)	0.244	0.238	0.236	0.224	0.238	0.232	0.229	0.242	0.237	0.233	0.236	0.012
Polyphenoloxidase(O.D/g/min)	0.334	0.330	0.325	0.324	0.333	0.330	0.324	0.332	0.324	0.324	0.329	0.010
"Badami"												
Weight loss(%)	8.492	8.272	8.116	7.942	8.495	8.408	8.387	8.436	8.336	8.304	8.291	0.350
Firmness(lb/in^2)	9.27	10.14	11.31	12.22	9.38	9.76	9.86	9.25	9.34	9.50	10.98	0.35
T.S.S(%)	9.44	9.49	9.64	9.84	9.60	9.92	10.23	9.52	9.79	9.95	9.93	0.23
V. C (mg/100 ml)	48.10	50.07	51.06	52.09	48.70	50.34	51.52	48.57	49.26	49.80	49.83	1.70
Reducing sugars(%)	1.644	1.640	1.641	1.642	1.659	1.674	1.685	1.659	1.672	1.678	1.695	0.037
Total sugars(%)	7.03	7.00	7.02	7.04	7.18	7.37	7.64	7.07	7.20	7.36	7.39	0.30
Total phenols (mg/100 g)	8.91	8.96	9.00	9.02	8.96	8.99	9.01	8.96	9.00	9.01	8.99	0.09
Peroxidase(O.D/g/min)	0.214	0.210	0.203	0.200	0.212	0.207	0.203	0.212	0.208	0.206	0.206	0.009
Polyphenoloxidase(O.D/g/min)	0.295	0.290	0.284	0.281	0.290	0.287	0.284	0.290	0.284	0.285	0.284	0.011