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Efficacy of different pretreatments on physical properties of Oyster Mushroom (*Pleurotus florida*)

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Abstract
Mushrooms are nutritionally regarded as a very good vegetarian source of high quality protein. In terms of the amount of crude protein, they rank below animal meat but well above most other foods including milk. It contains all essential amino acids and is a low calorie food with very low fat without any cholesterol. Mushrooms require the highest level of postharvest care both for fresh market and for processing since they are highly perishable due to their higher moisture content. The development of proper packaging, storage and processing techniques will help in reduction of post harvest losses, seasonal gluts, distress sales and other problems in mushroom industry. Among the different mushrooms, Oyster mushroom is one of the most cultivated species due to its medicinal values and its ability to grow on a variety of agricultural residues. The present study was carried to test the efficacy of different pretreatments on physical properties of Oyster Mushroom. Among the different preatments tested, calcium chloride (0.5%) treated oyster mushroom samples exhibited lower physiological loss in weight than control and other treatments. This treatment was also the most effective in delaying the deterioration of mushroom colour and texture in comparison to all other treatments. Similarly, calcium chloride treated mushrooms recorded lower total soluble solid values when compared to control. The study revealed that calcium chloride pretreatment was the best one among all in improving the quality and various parameters in oyster mushrooms.

Keywords: Oyster mushroom, pretreatments, calcium chloride, citric acid, ozonated water

Introduction
Mushroom is defined as a macro fungus with a unique fruiting body that can be either epigeous or hypogenous. Mushrooms grow naturally in practically all soil types, on decaying organic waste, wooden stumps, meadows, open fields, marsh borders, gardens, lawns, and hardwood forests under shade (Mehta *et al*. 2011) [9]. Mushroom is considered to be a complete and safest food and suitable for all age groups, children to aged people. It is one of the good sources of protein, which contains less of carbohydrate and fat. Protein content of cultivated species ranges from 1.8 to 5.9% of their fresh weight and on dry weight basis they contain about 19 to 35% protein. They are rich in vitamins (especially B vitamin) and potassium. It contains all essential amino acids and is a low calorie food with very low fat without any Cholesterol.
Around 20 different types of mushrooms are currently grown worldwide for commercial purposes. Among them the production of Button mushroom (*Agaricus bisporus*), Shiitake mushroom (*Lentinula edodes*), Oyster mushroom (*Pleurotus* spp.), Black ear mushroom (*Auricularia polytricha*), and Paddy straw mushroom (*Volvariella volvacea)* are most significant. Among these different types of mushrooms, oyster mushroom which belongs to the class Basidiomycetes and family Agaricaceae is also one of the most cultivated species because of its medicinal values and its ability to grow on different agriculture-based residues and also can adapt to a wide range of temperatures. Therefore, oyster mushroom production has increased all over the world because of its eco-friendly nature as it brings no harm to the environment in comparison to other crop cultivation. There are about half a dozen Oyster Mushroom species namely *Pleurotus ostreatus*, *P. florida*, *P. flabellatus*, *P. citrinopileatus*, *P. sajor-caju*, *P. djamor* etc. being artificially cultivated throughout the world. In addition to button mushrooms, oyster mushrooms and paddy straw mushrooms are also produced in small but considerable

amounts, particularly in the tropical regions of India (Rai and Arumuganathan, 2008) [13].

As mushrooms are highly perishable in nature because of their higher moisture content, mushrooms require the highest level of postharvest care both for the fresh market and for processing. In the mushroom marketing industry, gluts and distress sales are typical, especially during the peak months when seasonal harvest is greatly reduced. The adoption of appropriate packaging, storage, and processing technologies can help in dealing with marketing problems like seasonal gluts and distress sales. Information about proper postharvest care and processing of such a perishable commodity is essential for keeping the wheels of this industry turning at the right pace (Rai and Arumuganathan, 2008) [13]. Adopting adequate post-harvest practices for storage and processing may help to overcome the challenges of mushroom marketing to some extent during the peak seasons. Mushrooms are highly perishable because of high moisture content metabolism and susceptibility to enzymatic browning. These factors contribute to mushrooms having a shelf life of 1 to 3 days at room temperature. Therefore, it is necessary to make an attempt to extend the shelf life of mushrooms for at least a short period of time. Some of the crucial standardized processes for short-term mushroom storage are washing or pretreatment, packing, shipping, and marketing. Taking all these things into consideration, the present study was carried to assess the efficacy of different pretreatments on physical properties of Oyster Mushroom.

Materials and Methods

Raw material collection and sample preparation

Fresh Oyster (*Pleurotus florida*) mushrooms were collected in the morning from Pragathi farm, Turuvekere, Karnataka and transported to the laboratory in one hour. These mushrooms were then washed and sorted. Healthy mushrooms which were disease free, damaged, non uniform and which were not spoilt or changed in color were selected for the experiment. The mushrooms stalks were then trimmed into uniform length. All treatment samples were kept ready before mushrooms were brought to the laboratory.

Treatment details

This particular study contained 4 treatments which were replicated five times. The four different treatments were T1: Distilled water (Control), T2: Calcium chloride (0.5%), T3: Citric acid (0.5%) and T4: Ozonated water (1 ppm). The experimental design used was Completely Randomized Design. The statistical analysis of the data collected for the physical parameters of Oyster Mushroom in this study was done as described by Panse and Sukhatme (1985) [12].

Preparation of solution and treatment imposition of Mushroom

Each solution containing of 1000 ml of water along with 0.5% Calcium chloride, 0.5% citric acid were prepared separately. One ppm of Ozonated water and 1000 ml of distilled water were also used for the pretreatment of mushrooms.

The mushrooms were treated with 0.5% calcium chloride, 0.5% citric acid, 1 ppm ozonated water and distilled water (control). The treatment was applied by dipping oyster mushrooms separately for 3 to 4 minutes in each solution, followed by placement on absorbent paper for 15 minutes under a fan to remove excess surface liquid (Brennan *et al*. 2000; Olotu, *et al*. 2015) [3,11]. After completion of treatment process, 100 g of mushrooms were placed in a polypropylene bag with a 51-micron thickness and heat-sealed using a plastic film sealer. The packages were then labelled and placed in the refrigerator.

Observations recorded

The observations related to physical properties of Oyster mushroom like physiological loss in weight, color, texture, moisture content, pH, total soluble solids, respiration rate, decay percentage and browning index were recorded in this trial.

Physiological loss in weight

The weight loss in mushrooms packaged in polypropylene packing materials and with moisture absorbers was measured by subtracting the weight of the mushroom after storage from the original weight of the mushroom, i.e., before storage. Percent loss of weight in mushroom was used to express the results.

$$\text{PLW (\%)} = \frac{\text{(Initial weight of the sample} - \text{Final weight of the sample)}}{\text{(Initial weight of the sample)}} \times 100$$

Color

The color was evaluated by measuring L*, a*, b* parameters by means of Hunter lab colorimeter. The instrument was standardized against white tile before the measurements. Colour was expressed in CIE-Lab parameters as L* (whiteness darkness), a* (redness / greenness), and b* (yellowness/blueness) (Byrnes and O Beirne, 2008) [5]. Three measurements were performed at random locations of mushrooms and the average of three measurements was taken.

The browning index (BI) which shows the purity of brown color was calculated, according to the equation

$$BI = 100 \times (x - 0.31)/0.172$$

Where $x = (a^* + 1.75\,L^*)/(5.65\,L^* + a^* - 3.012b^*)$

Texture

The Stable Microsystems Texture Analyzer was used to analyse the texture with the appropriate parameters (probe: P/2N, puncture rate: 2.0 mm/s). The degree of hardness of the mushrooms was represented by the break-away maximum force Fmax. The outcomes of each decision were averaged after being repeated a total of three times. The measured value of force was given in Newtons.

Moisture content

A Sartorius MA-35 infrared moisture analyzer was used to calculate the moisture content of a known quantity of sample and expressed in percentage (Thejas *et al*., 2021) [18].

pH

pH was determined using a digital pH meter. The sample of mushroom was crushed with an equal quantity of distilled water and the pH was determined using digital pH meter after calibration with standard buffers of 4, 7 and 9.

Total Soluble Solids

A hand refractometer with a range of 0 to 32°B (Model ERMA) was used to measure the total soluble solids (TSS). The raw material was crushed in a pestle and mortar, and an extract was extracted for analysis. One to two drops of extract were placed in the prism of a hand refractometer to measure the TSS. The data were then presented as °Brix.

Respiration rate

The respiration rate was measured by analysing gas for O_2 and CO_2 in samples. A gas analyser was used to determine the samples' gas composition. A needle was used to measure the air composition in the samples of mushrooms via the septum, making sure that the hole is kept closed. The gas content was recorded as a percentage.

Decay percentage

Decay was determined according to 5-point scale, where 0 = no decay, 1 = very slight decay, 2 = slight decay, 3 = moderate decay, and 4 = severe decay.

The decay index was calculated using the formula

$$\text{Disease Index (\%)} = \frac{(1\times N1 + 2 \times N2 + 3 \times N3 + 4 \times N4)}{4 \times N} \times 100$$

Browning Index

The purity of the brown colour is represented by the browning index (BI). According to Srivatsava *et al*. (2020) [17], the browning index is considered as an important indicator in the context of product browning. The browning index can be determined using the formula given below

$$\text{Browning Index (B.I)} = \frac{[100\ (x-0.31)]}{0.17}$$

Where,

$$x = \frac{(a^* + 1.75\ L^*)}{(5.645\ L^* + a^* - 3.012\ b^*)}$$

Results and Discussion

Physiological loss in weight in oyster mushroom

Irrespective of the treatment combinations used in the experiment, significant difference was observed between the pre-treatments with regard to physiological loss in weight in oyster mushroom at different days of storage period (3,5,7 and 9 days). T1 (control) had 3.03% weight loss on the third day of storage while T4 (1ppm ozonated water) samples were statistically on par with control samples having physiological loss in weight of 3.3% (Fig 1). After 9 days, a significant weight loss of 7.16% was observed for T1 samples of oyster mushroom which were treated with distilled water, and the lowest weight loss of 3.11% was recorded for T2 samples, which were treated with 0.5% $CaCl_2$ (Fig 1).

The moisture content was less reduced in mushroom samples treated with 0.5% calcium chloride on the 9th day of storage. The physiological weight loss increased during storage. This might be due to transpiration that led to loss of moisture and respiration that led to loss in dry matter. Since 90% of mushrooms are comprised of water, one of the main issues with postharvest mushroom is dehydration and quick moisture loss, which will cause an excessive weight loss. The two processes that lead to horticultural commodities losing weight are transpiration and respiration. Respiration results in the loss of dry product matter, while transpiration causes the loss of water (Wei *et al*. 2017) [20]. In the current study mushroom samples treated with 0.5% calcium chloride showed less weight loss compared to mushrooms treated with distilled water. Varoquaux *et al*. (1999) [19] found that a significant decrease in weight was caused by the surface losing moisture due to increased respiration and transpiration losses after harvest. Mushrooms tissue fluid exudation that accumulated in poly bags was the primary cause of the observed weight loss. In contrast, no fluid exudation was seen in the calcium chloride treated samples. This could be due to the fact that use of calcium chloride which leads to formation of calcium pectate within the tissue which helps to hold the water within the tissue (Guillamon *et al.* 2010) [7].

L, a* and b* value of oyster mushroom

The data presented in Table 1 shows that there was significant difference between all treatments at different storage periods with regard to L value of oyster mushroom. The highest L value at 9 days after during storage was recorded in the oyster mushrooms treated with 0.5% $CaCl_2$ (71.20), followed by mushrooms washed with 0.5% citric acid (67.60) and ozonated water (1 ppm) (65.80) (Table 1). In contrast, oyster mushrooms treated with distilled water recorded the lowest L value at 9 days after storage (63.47)

Highest amount of a* value was recorded in oyster mushroom samples treated with distilled water at 3, 5, 7 and 9 days of storage period (Table 2). Minimum a* value of 1.08 was recorded in oyster mushroom samples treated with 0.5% calcium chloride, while maximum a* value of 1.76 was were recorded in oyster mushroom samples treated with distilled water at 3 days after storage (Table 2). After 5, 7 and 9 days of storage similar trends were observed with regard to a* value. Maximum a* value of 2.90 was recorded for T1 treatment at 12 days after storage while 0.5% calcium chloride treated samples recorded the lowest a* value of 2.27. Oyster mushroom samples treated with 0.5% citric acid and ozonated water (1 ppm) recorded a* value of 2.50 and 2.70, respectively at 12 days after storage.

Highest amount of b* value was recorded in oyster mushroom samples treated with distilled water at 3, 5, 7 and 9 days of storage period (Table 3). Maximum b* value of 8.36 was recorded in oyster mushroom samples treated with distilled water at 3 days after storage. The b* value recorded by distilled water treated oyster mushrooms were significantly different from oyster mushroom samples treated with Ozonated water (1 ppm), 0.5% citric acid and 0.5% calcium chloride at 3 days after storage. Almost all the treatments differed significantly from one another with regard to b* value of oyster mushrooms at 5, 7 and 9 days after storage (Table 3). However, no significant difference was observed between T3 (0.5% citric acid; 14.2) and T4 (1ppm ozonated water; 14.70) musroom samples with regard to b* value.

One of the initial steps taken in the basic processing of mushrooms is washing them. The main indicator for assessing washing treatments was considered to be the change in colour after washing. The thin cell membrane that separates the enzyme polyphenol oxidase from the substrate is damaged, which results in browning and darkening of pilei (Burton and Noble, 1993) [4]. This injury is the cause of the browning. Calcium chloride treated oyster mushroom samples had lower a* and b* values and higher L* value, indicating that the calcium chloride inhibited the senescence of the mushrooms, preventing them from turning yellow. Comparing the mushroom samples with Ca Cl2 dipping, the mushrooms which were not dipped in Ca Cl2 showed improvement in colour of mushrooms on 9th day of storage which may be due to the potential of calcium in imparting stability to vacuole membrane and further slowing the enzymatic browning (Roy *et al.* 1996) [14]. Washing of mushroom decreases the activity of polyphenol oxidase (PPO) due to the leaching of free phenols (Czapski and Szudyga, 2000) [6].

Texture

One of the primary causes of mushroom deterioration is a change in texture (Ares *et al.*, 2006) [2]. In the current study, the hardness of all oyster mushroom samples decreased with the advancement of the storage. Highest texture value was recorded in oyster mushrooms treated with 0.5% Ca Cl2 at 3, 5, 7 and 9 days after storage (Table 4). This particular treatment differed significantly from all other treatments at all days of storage with regard to texture of mushrooms. The lowest values of mushroom texture were recorded in oyster mushroom samples treated with distilled water at 3, 5, 7 and 9 days after storage and this particular treatment differed significantly from rest of the treatments with regard to mushroom texture at different days of storage. After 9 days T2 treatment (3.89 kg.f) recorded maximum texture value while minimum texture value was recorded in T1 treatment (2.14 kg.f).

The main cause of oyster mushroom degradation is textural abnormalities. All textural parameters deteriorated with storage (Jafri *et al*. 2013) [8]. In this study, the hardness of oyster mushrooms reduced with the storage time. The calcium chloride treatment had a significant effect on the hardness of the mushroom. The primary causes for mushroom softening are vacuole disruption, polysaccharide breakdown, and protein denaturation (Oliviera *et al*. 2012) [10]. The control samples lost a more significant level of hardness compared to the samples that underwent calcium chloride treatment. The samples treated with calcium chloride exhibited the highest levels of hardness in oyster mushrooms on 9th day of storage. The tissue of both mushrooms softened and lost its rigidity, causing an abrupt decrease in quality. A very useful technique for preserving the firmness of edible mushrooms is by using calcium chloride as a firming agent (Antmann *et al*. 2008) [1].

Moisture content

All mushroom samples had an initial moisture content of 93.66%, with no significant variations between the treatments. Moisture content of oyster mushroom in all treatments decreased significantly ($p< 0.01$) over the storage time (Table 5). The moisture loss was found to be highest in distilled water treated samples (T1) (90.85%) and lowest in T2 (0.5% CaCl2 treated; 92.98) after 3 days. The same trend was followed for 5, 7 and 9 days of storage. T2 treatment recorded highest moisture content of 92.72% by the course of the 9 day storage period under cold storage conditions. T2 had significantly higher moisture content values than control, T3 (0.5% citric acid treated) (91.29%) and T4 (1ppm ozonated water treated; 89.89%) samples, while T1 (control) had a minimum moisture content of 89.02% at 9 days after treatment application (Table 5).

pH

In general it was noticed in the present study that there was drop in pH as the storage period got extended. At 3 days after storage, highest pH value was recorded in T2 treatment (5.54) while the lowest pH was recorded in T3 treatment (5.08) (Table 6). The pH value was also highest in T2 treatment at 5, 7 and 9 days after storage and these values differed significantly from rest of the treatments at these storage periods. At 9 days of storage, T2 treatment recorded significantly higher pH values than other treatments (4.82) while lower pH was observed in control samples and ozonated water treated mushroom samples (4.72).

The acidic action of citric acid and calcium chloride was mostly responsible for the lower pH of oyster mushrooms after chemical treatment. These chemicals might have adsorbed on the surface of chemically treated mushrooms and had been accumulated in supernatant after centrifugation of grinded mushroom samples. Different bacterial growth was found with storage duration, and the subsequent generation of organic acid may have been the cause for decrease in pH (Singh *et al*., 2018) [16]. Chemically treated samples (CaCl2 0.5%) sustained pH much better than control samples in these oyster mushrooms. Calcium chloride treated samples produced the greatest results with a pH of 2.67 in oyster mushrooms that were close to the initial pH on the 9th day of storage indicating that the microbial load was low in those samples.

Total Soluble Solids

Highest TSS values were recorded in oyster mushroom samples treated with distilled water followed by the ozonated water (1 ppm) treatment at different days of storage period. These two treatments differed significantly from the other two treatments namely 0.5% citric acid and 0.5% calcium chloride treatment with regard to TSS values at 3, 5, 7 and 9 days after storage (Table 7). The TSS values recorded by different treatments like distilled water, 0.5% calcium chloride, 0.5% citric acid and ozonated water (1 ppm) at 9 days after storage were 5.88, 5.36, 5.51 and 5.53 respectively (Table 7).

Total soluble solids were found to increase with storage time, indicating increased respiration rates and quicker ripening. The changes were faster in chemically untreated samples (distilled and ozonated water treated). On the ninth day of storage, the TSS of oyster mushrooms treated with Ca Cl2 was low. Calcium chloride also maintained a lower pH in mushrooms while the control had significantly higher pH. This clearly shows that calcium chloride reduced the rate of senescence of oyster mushrooms while retaining their firmness and these results correlate with the studies which were conducted earlier (Srivastava *et al*., 2020) [17].

Respiration rate (% O2)

Data pertaining to the effect of pretreatment on respiration rate of oyster mushroom stored at cold storage (5±2°C) condition is presented in Fig. 2. A review of the data reveals a drop in O2 content from 14.00 to 1.00 percent during the third to ninth day of storage in control mushrooms. When compared to mushroom treated with distilled water (control), there was little change in the respiration rate in mushroom treated with 0.5% Ca Cl2, i.e., a reduction in O2 level from 16.00 to 3.5% was observed.

On the ninth day of storage, there was an increase in the rate of O2 consumption and CO2 evolution. Mushroom treated with 0.5% Ca Cl2 showed gradual decrease in O2 level, whereas the CO2 level was observed to increase at 9th day of storage, when compared with other treated mushrooms stored at refrigerated condition. Calcium chloride treated mushrooms recorded maximum O_2 concentration which clearly indicates that calcium chloride reduced the rate of respiration and increased the quality of mushrooms (Srivastava *et al*., 2020) [17].

Decay percentage (%) and browning index

The data pertaining to influence of pretreatments on decay percentage of oyster mushroom during storage period is presented in Fig 3. A significant increase in decay% was recorded during storage of oyster mushrooms irrespective of the pretreatment combinations which were applied in the current study. Lowest decay percentage of 30 was recorded in mushrooms treated with 0.5% calcium chloride followed by mushrooms treated with 0.5% citric acid (46%) and distilled water (69%) at 9 days after storage (Fig 3).

In the current study browning index values of oyster mushroom samples got increased in all the treatments at 3, 5 and 7 days after storage (Table 8). After 9 days of storage browning index

values differed significantly among all the treatments irrespective of the pretreatment combinations used. However, minimum browning index was recorded in T2 treatment: 0.5% calcium chloride (15.43), and maximum browning recorded in T1 treatment: distilled water treatment (20.49). T2 treatment (0.5% calcium chloride treated mushroom samples) had significantly lower values of browning index values than all other treatments 9 days after storage period.

Ca Cl2 samples showed the lowest deterioration percentage in oyster mushrooms. On the other hand, control mushrooms recorded higher decay percentages in oyster mushrooms. The protective effects of Ca Cl2 treatment in preventing mushroom deterioration during storage can be correlated to the maintenance of membrane integrity, the activation of antioxidant systems, and the inhibition of PAL (Phenyl alanine lyase) and CHT enzyme activity. Mushroom softening is another measure of the quality of mushrooms during transportation and storage. This experiment is in line with earlier findings that fruits treated with Ca Cl2 exhibited increased firmness as a result of the calcium-suppressed breakdown of hemicellulose and pectin (Shao *et al*., 2019) [15]. It was demonstrated that the application of Ca Cl2 either alone or in conjunction with SA significantly prevented the mushrooms from softening or kept them firm for the duration of storage.

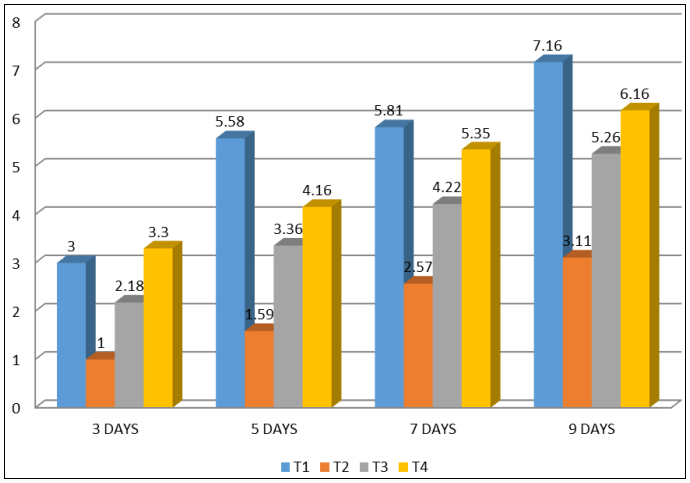

Fig 1: Effect of pretreatments on PLW (%) of oyster mushroom

Table 1: Effect of pretreatments on L value of oyster mushroom

Treatment details	Number of days				
	0	3	5	7	9
T_1	79.10±0.22^a	77.73±0.41^c	73.89±0.44^c	67.36±0.48^d	63.47±0.48^d
T_2	79.10±0.22^a	79.73±0.41^a	77.68±0.38^a	74.54±0.30^a	71.20±0.44^a
T_3	79.10±0.22^a	78.56±0.31^b	76.14±0.44^b	72.39±0.38^b	67.60±0.48^b
T_4	79.10±0.22^a	78.40±0.22^b	75.70±0.39^b	70.07±0.37^c	65.80±0.48^c
S.Em ±	0.10	0.15	0.18	0.17	0.26
CV	0.28	0.44	0.55	0.55	0.89
CD@1%	0.41	0.65	0.77	0.72	1.10

Table 2: Effect of pretreatments on a* value of oyster mushroom

Treatment details	Number of days				
	0	3	6	9	12
T_1	0.68±0.01^a	1.76±0.44^b	2.12±0.49^b	2.50±0.58^d	2.90±0.58^d
T_2	0.68±0.01^a	1.08±0.44^a	1.50±0.44^a	1.78±0.49^a	2.27±0.49^a
T_3	0.68±0.01^a	1.55±0.44^{ab}	1.82±0.44^{ab}	2.00±0.44^b	2.50±0.44^b
T_4	0.68±0.01^a	1.39±0.44^{ab}	1.90±0.45^{ab}	2.16±0.44^c	2.70±0.44^c
S.Em ±	0.004	0.18	0.19	0.19	0.20
CV	1.30	27.96	24.16	20.25	16.87
CD@1%	0.02	0.74	0.81	0.78	0.80

Table 3: Effect of pretreatments on b* value of oyster mushroom

Treatment details	Number of days				
	0	3	5	7	9
T_1	6.98±0.01^a	8.36±0.44^c	11.92±0.40^c	13.36±0.35^c	15.90±0.44^c
T_2	6.978±0.01^a	6.28±0.44^a	9.20±0.40^a	11.20±0.44^a	13.40±0.44^a
T_3	6.98±0.01^a	7.70±0.45^b	10.80±0.50^b	12.70±0.44^b	14.20±0.44^b
T_4	6.98±0.01^a	8.00±0.45^{ab}	11.00±0.50^b	13.10±0.45^{ab}	14.70±0.44^b
S.Em ±	0.006	0.18	0.17	0.19	0.20
CV	0.19	5.47	3.61	3.38	3.07
CD@1%	0.02	0.76	0.71	0.78	0.82

Table 4: Effect of pretreatments on texture of oyster mushroom

Treatment details	Number of days				
	0	3	5	7	9
T_1	5.35±0.02^a	4.56±0.04^d	3.88±0.04^c	3.03±0.04^d	2.14±0.04^d
T_2	5.35±0.02^a	5.15±0.08^a	4.80±0.04^a	4.05±0.02^a	3.89±0.16^a
T_3	5.35±0.02^a	4.76±0.02^b	3.96±0.04^b	3.58±0.04^b	2.70±0.04^b
T_4	5.35±0.02^a	4.60±0.04^c	3.93±0.04^{bc}	3.52±0.06^c	2.39±0.10^c
S.Em ±	0.01	0.02	0.02	0.05	0.04
CV	0.50	1.13	1.07	3.04	3.80
CD@1%	0.05	0.10	0.08	0.20	0.19

Table 5: Effect of pretreatments on moisture content of oyster mushroom

Treatment details	Number of days				
	0	3	5	7	9
T_1	93.66±0.40^a	90.85±0.47^c	87.78±0.43^d	85.37±0.20^d	89.02±0.44^d
T_2	93.66±0.40^a	92.98±0.44^a	91.72±0.40^a	90.73±0.29^a	92.72±0.40^a
T_3	93.66±0.40^a	92.69±0.38^a	89.64±0.35^b	88.72±0.40^b	91.29±0.16^b
T_4	93.66±0.40^a	91.98±0.44^b	88.64±0.35^c	87.24±0.35^c	89.89±0.44^c
S.Em ±	0.2	0.19	0.17	0.14	0.17
CV	0.47	0.48	0.43	0.36	0.42
CD@1%	0.82	0.81	0.72	0.59	0.70

Table 6: Effect of pretreatments on pH value of oyster mushroom

Treatment details	Number of days				
	0	3	5	7	9
T_1	5.73±0.04^a	5.32±0.04^d	4.96±0.08^{bc}	4.72±0.04^c	4.72±0.04^b
T_2	5.73±0.04^a	5.54±0.08^a	5.24±0.08^a	5.04±0.08^a	4.82±0.04^a
T_3	5.73±0.03^a	5.08±0.04^c	4.84±0.01^c	4.64±0.08^b	4.54±0.08^c
T_4	5.73±0.04^a	5.24±0.13^{bc}	5.08±0.04^c	4.84±0.08^c	4.72±0.04^b
S.Em ±	0.06	0.03	0.04	0.03	0.02
CV	2.57	1.63	1.88	1.67	1.25
CD@1%	0.27	0.16	0.17	0.15	0.10

Table 7: Effect of pretreatments on TSS of oyster mushroom

Treatment details	Number of days				
	0	3	5	7	9
T_1	4.06±0.03^a	3.95±0.04^c	3.84±0.02^d	5.73±0.04^d	5.88±0.04^c
T_2	4.06±0.03^a	3.66±0.03^a	3.53±0.01^a	5.24±0.08^a	5.36±0.02^a
T_3	4.06±0.03^a	3.74±0.04^b	3.65±0.02^b	5.40±0.05^b	5.51±0.06^b
T_4	4.06±0.03^a	3.94±0.02^c	3.72±0.03^c	5.52±0.04^c	5.53±0.08^b
S.Em ±	0.01	0.01	0.01	0.02	0.05
CV	0.88	0.99	0.68	1.07	2.06
CD@1%	0.06	0.07	0.04	0.10	0.2

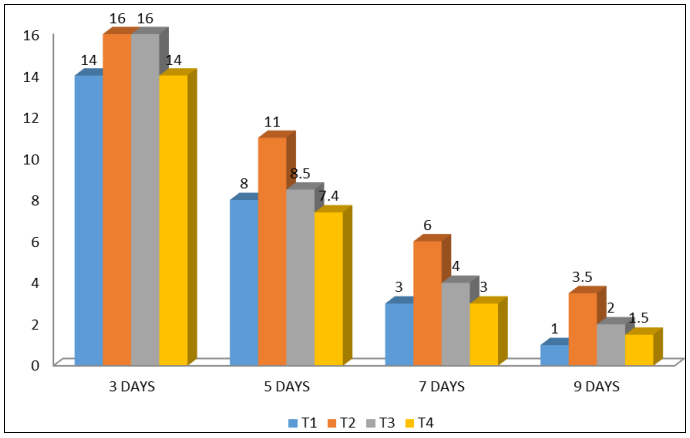

Fig 2: Effect of pretreatments on respiration rate of oyster mushroom

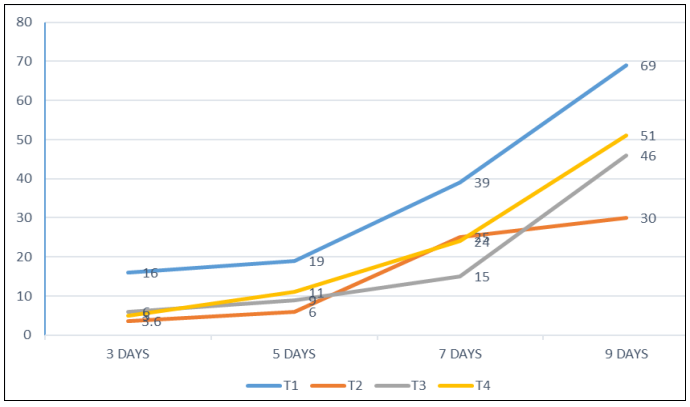

Fig 3: Effect of pretreatments on decay percentage of oyster mushroom

Table 8: Effect of pretreatments on browning index (BI) value of oyster mushroom

Treatment details	Number of days			
	3	5	7	9
T_1	11.44±0.31^b	14.00±0.55^b	17.43±0.31^b	20.49±0.28^d
T_2	9.06±0.13^b	11.37±0.76^b	13.62±0.21^b	15.43±0.31^a
T_3	10.24±0.03^b	12.18±0.09^b	15.24±0.42^b	18.37±0.35^b
T_4	10.91±0.10^b	13.32±0.55^b	16.68±0.17^b	19.87±0.07^c
S.Em ±	0.07	0.24	0.13	0.12
CV	1.71	4.32	1.89	1.50
CD@1%	0.23	1.01	0.55	0.51

Conclusion

The current study was initiated to test the efficacy of various pretreatments like distilled water, calcium chloride (0.5%), citric acid (0.5%) and ozonated water on physical properties of oyster mushroom. The study revealed that treating the oyster mushrooms with calcium chloride (0.5%) improved the quality of the packaged mushroom and maintained physical parameters such as physiological loss in weight, moisture content, pH, respiration rate, texture, color, TSS, browning index and decay percentage.

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