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Influences of Edible Coating on the Quality and Sensory Attributes of *Elaeagnus umbellate* Berry Fruits

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Present research was done to study the effect of coating on the chemical and sensory properties of *Elaeagnus umbellate* berry fruits produced in area of Poonch, Pakistan. Different concentrations (0.5, 1.0, 1.5 and 2.0 %) of chitosan coating were made. Fruits were dipped, dry and stored at 27 °C, at intervals of 3 days for 18 days. During examination, physio-chemical and sensory parameters such as colour, flavour, taste, texture and overall acceptability (scores) were evaluated during storage. A decreasing trend in total soluble solids and pH values were witnessed during storage. However, higher concentrations of chitosan coating retain total soluble solids and pH values. Titratable acidity decreased initially in all treatments with a rapid decline in control followed by lower concentrations of chitosan. Whereas, higher sensorial scores were achieved at higher concentrations of chitosan. This study revealed that 2 % concentration of chitosan was effective in retaining keeping quality of berry fruits significantly up to 13 days at ambient storage.

Keywords: Chitosan coating, Physico-chemical, Sensory properties.

INTRODUCTION

Elaeagnus umbellate is a part of family Elaeagnacea and a species of *Elaeagnus* inherent to eastern Asia commencing the Himalayas east towards Japan. It is also known as their other names like autumn olive, Japanese silverberry and cardinal oliveus [1]. It produces in large quantity in mountainous area of Jammu and Kashmir. It is very nutritional but excessive amount of fruits are loss due to handling of people. In order to preserve the quality characteristic of fruits edible coating such as chitosan is used. Chitosan is mostly applied as a preservative and as a component of packaging material, not only to retard microbial growth in food, but also to improve the quality and shelf life of food [2]. The advantages of chitosan also include the relative low cost and that its use as a food additive has been approved by the United States Food and Drug Administration (USFDA) [3]. Chitosan is solvable type of acids inorganic and organic containing acetic, formic, glutamic acids lactic and HCl however inexplicable on unbiased and alkaline pH. Chitosan shows a variety of biological and physico-chemical properties and therefore can be used in various fields such as the edible film industry, as flavourings agent to improve nutritious value of foodstuffs, for recovery of dense things in food treating wastes and in the purification of water [4]. It is used in preservation of food and increase the quality of foods in storage [5]. Chitosan can be used as coatings to extend the storage life of fruit, vegetables, seafood or meat products by modified internal atmosphere, thereby decreasing transpiration and delaying ripening, preventing dehydration, oxidative rancidity and surface browning [6]. Coating with chitosan has been established to remain active in increasing postharvest life of a variety of foods, such as mangoes, strawberries [7,8]. Chitosan have also been used on various foods such as tomatoes, herring and Atlantic cod [6,9]. The quality of food declined due to microbiological, biochemical and bodily changes. Changes occurred in foodstuff due to the microbiology are directly linked to food safety, while physical and chemical changes are generally related with loss of sensory quality (*e.g.*, loss of crispiness, colour changes, rancidity). In order to control these processes, packing skill is very significant. So, water vapour and oxygen are the critical compounds that can decline food quality can be controlled by using packaging materials. In particular, utilization of packaging materials controls loss of moisture, reduce the beginning of produce spoilage and reduces the quantity of sensual value retardation by disturbing the amount of moisture vapour and gases [10]. The packaging of food endures to be an innovative areas and significant in new products processes and development. To provide the necessitating beautiful esthetical look, defense, definite physico-chemical possessions and progressive food packing resources serve as a protection arrangement [11].

EXPERIMENTAL

Collection and preparation of sample: Fully matured, green and firm fruits and leaves were directly harvested from Poonch, Pakistan were immediately transferred to Food Technology laboratory in Faculty of Agriculture, Rawalakot, Pakistan. Sample was rinsed with tap water and surface-sterilized by dipping in 2 % sodium hypochlorite for 2 min and allowed to dry at room temperature.

Preparation and application of coating: Different concentrations (0.5, 1.0, 1.5 and 2.0 %) of edible chitosan coating was prepared by mixing it in 0.5 % glacial acetic acid 0.18 % glycerol and applied on samples, dried and packed in low density polyethylene bags. These samples were analyzed at 25-27 °C + RH 55-60 %, 3 days (1, 3, 6, 9, 12, 15, 18) intervals for 18 days from 3rd to 20th August, 2012 for following parameters.

Total soluble solids (%): Total soluble solid was estimated as described by the method of Association of Analytical Chemists by using hand Refractometer model (RX-7000CX) [12]. For this process, took a drop of juice from sample and put on the prism and closed the lid. Then, note the reading.

Titratable acidity (%): The method of Association of Analytical Chemists was applied to evaluate the percentage of titratable acidity [12]. Freshly prepared juice about 10 mL was added through pipette into 250 mL beaker. 100 mL distilled water was added to dilution purpose and few drops of phenolphthalein. The NaOH (0.1 N) was used for titration until pink colour appear.

pH Value: The pH meter was used to determine pH according to method of Association of Analytical Chemists [12]. An appropriate quantity of extract was taken in 50 mL beaker and electrode was put into it in order to record pH.

Sensory evaluation: The treated samples were evaluated for quality characteristics such as colour, taste, flavour, texture and overall acceptability by a panel of five judges selected from the department. A nine point hedonic scale was used for sensory evaluation as described by Larmond [13].

Statistical analysis: The obtained data was statistically analyzed using analysis of variance and difference among the treatment means were compared by using Duncan's multiple range test (DMRT) at 5 % probability level [14].

RESULTS AND DISCUSSION

Total soluble solids (%): Results indicated that total soluble solids percentages of the fresh autumn olive fruit was 13.96 (%) that was increased up to 22.30 (%) at 18th day of storage (Fig. 1a). In general, there was slow rise in total soluble solids were noted with the advancement of period in all treatments. The rate of increase in total soluble solid content was greater in 0.5 and 1 % chitosan treatment. During postharvest period, hydrolytic changes in the concentrations of starch was observed that can be indirectly related to fluctuation in total soluble solids [15]. It has been recognized that rise in concentrations of soluble solids in storing periods is directly correlated to the conversion of insoluble starch to soluble solids which is agreement with Winsor *et al.* [16]. Data showed that maximum total soluble solid contents were noted in control (22.84 %) followed by 0.5 % chitosan showed the quantity of total soluble solids (20.35 %), 1 % chitosan (18.09 %), 1.5 % chitosan (17.55 %), while 2 % chitosan (14.30 %) showed the lower concentration of total soluble solids percentages during storage. Higher concentrations of coating depicted maximum retention of total soluble solids percentages contents in storage may be due to decrease of respiration rate or other metabolic processes and modified atmosphere lowered the level of ethylene which can reduced the ripening process. The retaining of total soluble solids percentages was due to the reduced change in structure of cell wall and conversion into simple sugars [17]. These results are in line with Hernández-Muñoz *et al.* [18]. They described the soluble solid contents of those fruit which are kept as a control increased with passage of time as compared to that strawberry fruits treated with chitosan coating showed slight changes during storage.

Titratable acidity (%): The titratable acidity was higher (0.94 %) in freshly harvested fruits but decreased to 0.101 % with the passage of time (Fig. 1b). During storage, acidity was decreased may be due to the alteration of several biological or metabolic processes of fruits or utilization of organic acid in development of respiration that is agreements with those of Echerverria and Valich [19]. The retention of titratable acidity was higher in the treated fruit having higher concentration of 2 % chitosan coating might be due to reduction in metabolic changes of organic acid into CO_2 and H_2O. These results are an agreement with those of Dong *et al.* [20] who have used the chitosan coating shows higher retention of acidity in peeled litchi fruits during storage. Whereas the same results were observed by Abbasi *et al.* [21] in mango fruit stored in low density polyethylene bags with chitosan coating showed higher retention of acidity.

pH Value: It was increased from 3.22 to 5.90 up to 18th day of storage (Fig. 1c). This increase in pH mean value may be due to use of organic acid in metabolic process which causes the reduction of acids that indirectly related with pH. As pH is an important factor it is negative log of hydrogen ion concentration. To control the microbial growth the pH should be maintained. It also has effect on the processing and safety concerns. This is an agreement with those of Echerverria and Valich [19]. Similarly increase of pH value was noted by Hayat *et al.* [22] during storage. The maximum pH was examined in T_1 (5.92) followed by T_2 (5.57), T_3 (4.86) and T_4 (4.51), as compared to T_5 having lower pH (3.62). These results are in agreement with the Abbasi *et al.* [21]. The coatings slowed the changes on pH and effectively delaying senescence of mango fruit.

Colour (Scores): It was increased up to 5.87 at 6th day and then reduced to 3.66 at 18th day of storage (Fig. 2a). The increase in colour score for the duration of storage might be due to the conversion of the green colour of fruits due to the presence of chlorophyll into carotenoid pigments by biological responses. Present results are in corresponding by study of Wills *et al.* [23] stated main factors which are responsible to the reduction of green colour are fluctuations in pH, oxidation process and chlorophyllases enzyme. However the highest colour score was depicted in T_5 (6.66) followed by T_4 (5.58), T_3 (5.06), T_2 (4.37), as compared to control T_1 (3.80) having minimum colour retention during storage. The retention of colour in treated fruits may be due to the leisurelier conversion of chlorophyll into carotenoids in the presence of edible coating with sealed polyethylene bags. The present investigation are similar with the observation of Hernández-Muñoz *et al.* [18]. They described that chitosan coating have similar properties as based on other naturally occurring biopolymers edible coatings having ability to retention of postponing exterior colour variations in strawberries. Use of chitosan coating was delayed the decline in sensory quality of peeled litchi fruits and extend the shelf life [20].

Taste (Scores): Taste score (6.01) was observed at first day, maximum score 6.46 was noted at 6th day and then decreased 4.39 at end of storage period (Fig. 2b). These conclusions are reckoning with Abbasi *et al*. [21] they described the increase and decrease of taste scores in mango fruit were observed with the advancement of time and this fluctuation of taste scores may be due to coating with chitosan, which preserved perception and reserved the value of berry till 3 weeks of storage the deterioration happening. It also might be due to variations in pH, acids and sugar/acid ratio [24]. Maximum taste scores was observed in T_5 (7.12) followed by T_4 (6.18), T_3 (5.60), T_2 (5.24) whereas the minimum taste scores was noted in T_1 (4.13) having similar taste score in storage and several preserved berries were impotent to consume due to unpleasant taste. The consequences of this investigation are in closely related by previous scientist Munoz *et al*. [18] who described the effect of the coating of chitosan on strawberries keep the eating quality at 20 °C for 4 days. Similar results were reported by Jiang and Li [25] told that use of chitosan on longan fruit had better eating value at 2 °C after 30 days of storage. Our investigations are also in agreement with Pen and Jiang [26] reported that the favourable influence of chitosan coating on the peeled litchi fruit must be mostly recognized to the protecting effects stopping from superficial browning, leaking of juice while it also increase the storage life of fresh-cut Chinese water chestnut by maintaining their quality through decreasing respiration and preventing actions of PPO and POD.

Flavour (Scores): The flavour score 5.76 at the 9th day of storage was observed high and then reduced to 4.11 at the 18th day of storage (Fig. 2c). The increase in flavour scores of fruits during storage might be due to the formation of organic acids, alcohols, soluble sugars and other volatile essential compounds *etc*. attributes to increase in flavour of fruit during storage and the further degradation of all these compounds into ethylene, water, CO_2 and other phenolic compounds may cause a reduction in flavour at later stage of storage [26]. The maximum flavour score was assessed in T_5 (6.37) and followed by T_4 (5.38), T_3 (5.14), as compared to control T_1 (3.10) or other treatment and T_2 (3.95) having minimum flavour score during storage. The highest scores of flavour observed in T_8 and T_9 might be due to the higher retention of volatile compounds, slower chemical reactions and other soluble sweeteners that maintained the flavour for a longer period of time in a modified environment created in sealed polyethylene bags having (2 % chitosan). Same findings are detected by Abbasi *et al*. [21] described that mango fruits showed better flavour.

Texture (Scores): In the fresh fruit at 1st day of storage maximum texture score (8.73) was detected and then declined to 5.34 at 12th day of storage and further reduction was noted to a score 4.49 at the end of storage (Fig. 2d). The postharvest quality of fruits depends on its firmness and loss of texture is one of the main aspects controlling quality and shelf life of fruit and vegetables. Analysis of starch and cell wall to form sugar and soluble pectic substances was depicted. Firmness of fruits is maintained due to the pectic substances (structural polysaccharides). During ripening unstiffening of fruit happens due to polymers of pectin become less tightly bound in the cell walls and these are two enzymatic processes which reduce firmness of fruits [27]. The maximum retention in texture score was observed in T_5 (7.72) followed by T_4 (6.91), T_3 (6.57) and T_2 (5.40) as compared to control having lower texture score (4.69) during storage. The maximum retention of texture score might be due to the presence of modified atmosphere with chitosan has excellent barrier properties towards O_2 (non-polar molecules) and as a physical barrier decreases respiration rate of fruits [28]. These results coincide with the finding of Jafarizadeh *et al*. [29] who described that increasing the chitosan concentration, permeability of edible coating based on chitosan decreased towards O_2 of storage atmosphere and respiration rate of coated banana decreased. The reduction in respiration rate, reduced the activities of hydrolysis enzymes and retarded the softening of banana.

Overall acceptability (Scores): Results relating to overall acceptability increase and decrease with the advancement of storage periods. At the first day of storage overall acceptability scores (6.51), it was increase 5.58 score at the 9th day and then decrease 4.12 score was noted at the end of storage (Fig. 2e). The highest scores for overall acceptability was observed in T_5 (6.91) followed by T_4 (6.19), T_3 (5.46) and T_2 (5.05) whereas, control having minimum overall acceptability score 4.33 at the end of storage. These scores are important as they consistent

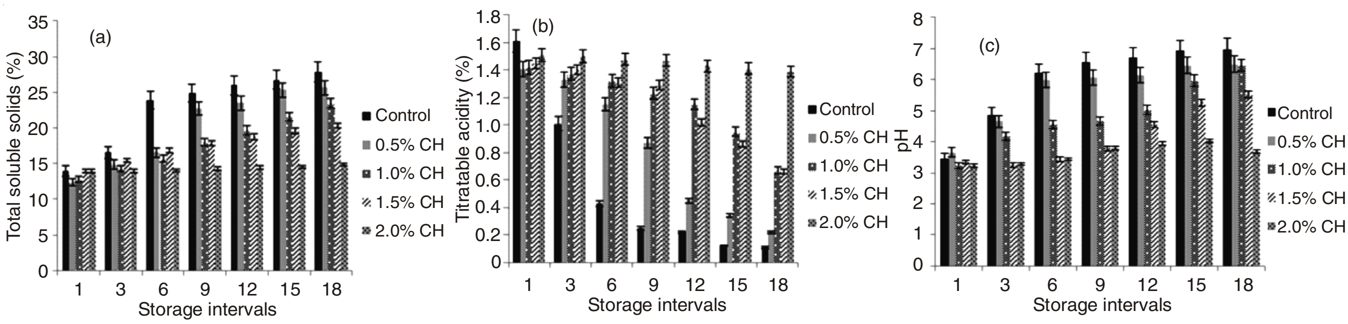

Fig. 1. (a,b,c) Effect of coating on total soluble solids (%), titratable acidity and pH value of *Elaeagnus umbellate* berry fruits shown variation after treatment of chitosan coating with different concentrations during storage. Bar graphs exhibited thestandard deviation ± means

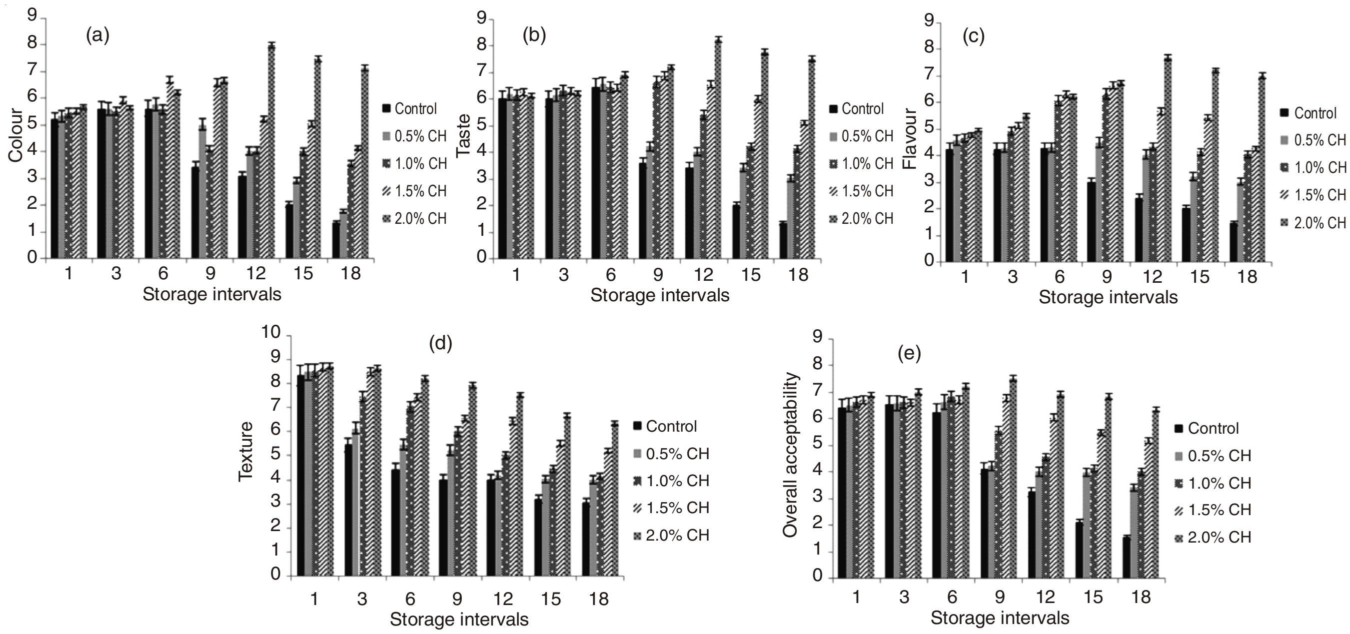

Fig. 2. (a,b,c,d,e) During storage, effect of chitosan coating on concentration of sensory parameters such as colour, flavour, taste, texture and overall acceptability (scores) of *Elaeagnus umbellate* berry fruits were observed. Bars presented the standard deviation ± means

of colour, taste, flavour and texture use to judge the responses of consumer towards particular food. The increase and decrease in overall acceptability of autumn olive fruit might be due to the metabolic changes occur in structural polysaccharide and reduction of sugars, organic acids *etc*. during storage. These results are in agreement with the Abbasi *et al*. [21] they coatings slowed the changes on pH and effectively delaying senescence of mango fruit.

Conclusion

Elaeagnus umbellate berries have important part in regions of Jammu and Kashmir. These fruits were produced in large quantity that was loss due to the lack of knowledge of local inhabitant related to postharvest. Recent investigation used the cheap source to preserve these valuable berry fruits by using chitosan coating. Coating was proved to retain its chemical and sensory properties and also increase its storage life about 13 days that was only 4 days without treatments. Hence, it was concluded that 2 % chitosan application may improve fresh market traits of berry fruits during ambient storage and may help to increase marketing options of fruits.

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