ORGANOLEPTIC QUALITY EVALUATION OF WHOLE AND MP PRODUCTS OF FRUITS AND VEGETABLES BY ACTIVE PACKAGING

9.1 INTRODUCTION

Quality is a measure of the degree of excellence or degree of acceptability by the consumer. Sensory characteristics of quality include; appearance in terms of colour, texture, flavour. Colour increases the attractiveness of fruits and vegetables and in most cases; it is used as a maturity index. It is also associated with flavour, texture, nutritive value and wholesomeness. Surface colour is important for fresh market and internal colour for processing even. In this chapter organoleptic evaluation is discussed in terms of overall acceptability.

9.2 RESULTS AND DISCUSSION

9.2.1 Effect of active packaging concepts on the sensory evaluation of fruits and vegetables (MP and Whole)

9.2.1.1 Sensory evaluation (Overall acceptability)

The observations regarding the effect of active packaging on organoleptic quality in terms of overall acceptability of minimally processed (MP) as well as fresh (whole) fruits and vegetables during storage at refrigerated (RT) and ambient temperature (AT) are presented in Figs. 9.1(a,b,c) for apple, Figs. 9.2 (a,b,c) for banana, 9.3 (a,b,c) for orange, 9.4 (a,b,c) for tomato, 9.5 (a,b,c) for cauliflower and 9.6 (a,b,c) for spinach. The related results are presented in Table 9.1, 9.2, 9.3, 9.4, 9.5, and 9.6 as given in appendices. The organoleptic quality in terms of overall acceptability of the fruits at RT and AT storage conditions decreased in fruits and vegetables (MP and whole) with increase in storage duration.

For control samples, the overall acceptability (scores) was below acceptable limit (4.03) by 15th day of storage in MP apple. Chitosan coated samples and samples treated with ethylene scavenger had highest score value (5.67) and (5.6) with very little difference on 10th day, which was then decreased to (5.03) and (5.07) by 15th day in MP apple fruit respectively.
Among AP treatments, whole apple when treated with chitosan based coating and ethylene scavenger showed maximum and similar organoleptic scores (5.57) at RT on 50th day of storage whereas; at AT on 21st day of storage it exhibited highest scores (6.53) when treated with chitosan coating followed by ethylene scavenger (6.27) moisture scavenger (6.2) as presented in Table 9.1. Figs. 9.1 (b and c) present the observations regarding the effect of AP on overall acceptability of whole apple at RT and AT.

As given in Table 9.2, banana slices acquired highest scores (5.77) for samples treated with ethylene scavenger and moisture scavenger (5.73) followed by coated slices (5.6) on 10th day of storage. Observations regarding the overall acceptability of MP banana are presented in Fig. 9.2(a).
Figs. 9.2 (b and c) represent the observations regarding overall acceptability of AP treated whole banana at RT and AT. Whole banana coated with chitosan exhibited maximum scores (5.4) on 15th day of storage at RT whereas, other AP treatments showed scores below the acceptable limits. At ambient temperature chitosan coated whole banana recorded highest scores (5.93) followed by samples treated with ethylene scavenger (5.33) on 9th day of storage.

MP orange in Table 9.3 showed maximum (5.77) overall acceptability scores for the samples treated with ethylene scavenger, samples treated with moisture and O₂ scavenger recorded similar scores (5.53) followed by CO₂ scavenging treatment (5.47) whereas, chitosan coated samples exhibited lowest scores (5.17) among AP treatments on 15th day of storage. Observations regarding the effect of AP on overall acceptability of MP orange are presenting in Fig. 9.3(a).

On 25th day of refrigeration temperature whole orange fruit showed highest (5.67) scores and it was (5.73) on 15th day at ambient temperature when coated with chitosan.
followed by ethylene and moisture scavenger. Figs. 9.3 (b and c) presents the observations regarding overall acceptability of AP treated whole orange at RT and AT.

**Fig. 9.3(b): Effect of active packaging on overall acceptability (scores) of orange at RT**

![Graph](image)

**Fig. 9.3(c): Effect of active packaging on overall acceptability (scores) of orange at AT**

MP tomato slices had highest and identical organoleptic scores (5.7) when treated with ethylene scavenger and chitosan coating followed by moisture scavenger (5.53), O2 scavenger (5.2) and (5.13) for CO2 scavenger on the 15th day of storage whereas control had the minimum (4.7) which was below the acceptable limits (Table 9.4). Observations regarding the overall acceptability of MP tomato are presenting in Fig. 9.4(a).

**Fig. 9.4(a): Effect of active packaging on overall acceptability (scores) of MP tomato**

In case of whole tomato on 25th day at RT, chitosan coated samples, samples treated with ethylene and moisture scavengers showed the highest and similar scores (5.63) followed by samples treated with O2 scavenger (5.6). On the other hand tomato treated with CO2 scavenger showed less scores (4.83) than control samples (4.93) on 25th day whereas; during ambient storage chitosan treated tomatoes showed the highest scores (5.97) followed by ethylene scavenger (5.9) followed by moisture scavenger followed by O2 scavenger (5.37) and CO2 scavenger (5.33) and control showed the the least scores (5.1) on 12th day. Figs. 9.4
(b and c) presents the observations regarding overall acceptability of AP treated whole tomato at RT and AT.

Table 9.5 represent MP cauliflower on 15\textsuperscript{th} day of refrigerated storage showed maximum scores (6.27) for chitosan coating treatment followed by samples treated with ethylene and moisture scavengers exhibited identical scores (5.3) and O\textsubscript{2} and CO\textsubscript{2} scavengers also possessed similar scores (5.17). Observations regarding the overall acceptability of MP cauliflower are presenting in Fig. 9.5(a).

Chitosan coated whole cauliflower had highest scores (5.1) at RT while other AP treatments showed scores below the acceptable limits on 20\textsuperscript{th} day whereas, at AT chitosan coated cauliflower showed minimum (4.7) scores among AP treatments. Samples treated with ethylene scavenger exhibited (4.83 and 5.2) scores followed by moisture scavenging treatment (4.83 and 5.0), samples treated with O\textsubscript{2} scavenger recorded (4.6 and 5.0) scores, CO\textsubscript{2} scavenging treatment possessed (4.4 and 4.9) scores and control samples showed minimum scores (4.03 and 3.97) i.e. below the acceptable limits at final day of RT and AT.
Figs. 9.5 (b and c) represents the observations regarding overall acceptability of AP treated whole cauliflower at RT and AT.

Table 9.6 showed that MP Spinach scored highest (6.4) scores when treated with chitosan coating followed by oxygen scavenger (5.5), ethylene scavenger (5.37), moisture and CO₂ scavengers (5.27) and control samples exhibited minimum (5.17) scores at refrigeration storage on 15th day. Observations regarding the overall acceptability of MP spinach are presenting in Fig. 9.6(a).

From the same Table 9.6, it can be observed that whole spinach showed highest scores (6.17) when treated with chitosan based coating followed by ethylene and moisture scavengers (5.4), O₂ scavenger (5.23) whereas; control spinach samples and on treated with CO₂ scavenger similar scores (5.03) on 15th day at RT. On 6th day of storage at AT chitosan coated spinach showed the highest scores (7.4) followed by ethylene and moisture scavenger (5.5), O₂ scavenger (5.4) and CO₂ scavenger (5.17) and control samples showed the least scores (3.77). Figs. 9.6 (b and c) presents the observations regarding overall acceptability of AP treated whole spinach at RT and AT.
Fig. 9.6(b): Effect of active packaging on overall acceptability (scores) of spinach at RT

Fig. 9.6(c): Effect of active packaging on overall acceptability (scores) of spinach at AT

Among active packaging techniques chitosan coated and fruits treated with ethylene scavenger had highest mean score for overall acceptability followed by moisture scavenger whereas O2 and CO2 scavenger treated fruits had lower score and were unacceptable by the end of storage period but they were better than control. Organoleptic score of all packed fruits at later storage period remained low despite of the fact that there was delay in ripening, retention of green colour and flesh firmness, lower PLW and maintenance of sufficient TSS. Comparatively low sensory score for control and CO2 scavenger samples was observed and it was probably due to accelerated rate of bio-chemical changes. Chitosan coated and ethylene scavenger treated fruits remained acceptable at the end of storage may be due to optimum ripening and desirable texture. The hardening of fruits could be possible due to gelling behaviour of water soluble pectins, which reconstitute to form protopectin and lead to flesh hardening on prolonged storage. Mohamed et al. (1996) also reported highest mean score for all the attributes in cling wrapped guava in LDPE film stored at 10°C, followed by shrink wrapped. Similarly, peach fruit packed in HDPE with 1 and 1.5% opening level, stored in cold storage condition were also acceptable after 40 days of storage as reported by Singh et al. (2006).

Ishaq et al. (2009) observed the reduction in overall acceptability of apricot fruits during storage at room temperature may be due to metabolic changes occurring in structural polysaccharide and reduction of sugars, organic acids etc. that may reduced the taste of fruit with the advancement of storage.

Jiang and Li (2001) reported that chitosan treated longan fruit had good eating quality even after 30 days of storage at 2°C. Chitosan retained fruit quality and no off-flavour was developed. These results are in line with Munoz et al. (2006) who reported the influence of
the chitosan on strawberries stored at 20°C for 4 days showing better maintenance of eating quality. Doreyappa and Huddar (2001) also reported that flavour of mangoes after ripening showed significantly decreasing trend as the storage period proceeded when stored at 32 to 35°C. It might be due to fluctuations in acids, pH and sugar/acid ratio (Jitareerat et al., 2007). Abbasi et al. (2009) also studied the effect of irradiated crab chitosan on mango fruit and found that chitosan coating maintained the eating quality of mango fruit upto 4 weeks as compared to control.

9.3 CONCLUSION

On the basis of results obtained through organoleptic evaluation, it can be concluded that AP technology recorded better scores to judge the overall acceptability by hedonic rating scale in terms of shape, colour, flavour and texture for MP fruits and vegetables stored under refrigerated temperature. It can be stated that at 15th day MP apple treated with ethylene scavenger rated highest (5.07) followed by chitosan coating (5.03) and moisture scavenger (5.03) application. In case of MP banana, ethylene scavenger treated samples showed better results (5.77) followed by moisture scavenger treated (5.73) and chitosan coated samples (5.6) (value) at 10th day of storage, MP orange samples treated with ethylene scavenger showed better scores (5.77) followed by moisture scavenging treatment (5.7) at 15th day. Chitosan coated orange samples were rated lower (5.0) than other treatments of AP due to oozing out of juice from inner portion of the fruit probably due to acetic acid which used as an ingredient in the preparation of coating solution but it doesn’t affect the physico-chemical changes during storage. Chitosan coated tomato slices, cauliflower florets and spinach shreds were rated higher (5.7, 6.27, 6.40) followed by ethylene scavenging treatment (5.7, 5.3, 5.37) and moisture scavenger treated samples (5.53, 5.3, 5.27), respectively. However due to development of off-flavour and incipient taste in control samples at 15th day of storage, the same get completely spoiled and were rated low on the sensory scale. Whereas, in case of whole apple, banana, orange, tomato and spinach samples, chitosan coating followed by ethylene, moisture, O₂ and CO₂ scavenger application showed better results at refrigerated (5±1°C) and ambient temperature (30±2°C) on the 50th and 21st day of storage respectively whereas, in case of cauliflower at refrigeration temperature chitosan coating rated highest (5.1) followed by samples treated with ethylene scavenger (4.83), moisture scavenger (4.83), O₂ scavenger (4.6) and CO₂ scavenger (4.4), but at ambient temperature all the scavengers had better results compared with chitosan coating treatment at 6th day of storage. This shows that chitosan treatment is not suitable for cauliflower at ambient temperature. Among the AP treatments, chitosan coating was not found suitable for the preparation of minimally processed orange at refrigeration temperature whereas, it was also not observed suitable for whole cauliflower at ambient temperature.