ABSTRACT

The fruits apple (*cv. Royal Delicious*), guava (*cv. Baruipur*) and Litchi (*cv. Shahi*) were harvested from the orchard at their commercial maturity. The respiration rates of fruits were measured at 0 - 30 ºC in the step of 5ºC using an airtight respirometer. Headspace gas sample was analyzed quantitatively using gas chromatograph. The Michaelis-Menten type equation based on principle of enzyme kinetics with uncompetitive type of inhibition was fitted to the experimental respiration data. The temperature dependence of model parameters was estimated using Arrhenius relation. The developed models were found to be in close agreement with the experimentally estimated respiration rates. Polymeric films namely LDPE, BOPP, PVC, PVDC of different thickness were procured considering various film characteristics such as GTR, WVTR, clarity, strength, durability and cost effectiveness for MA packaging study. The GTR of films was determined employing equal pressure method. Arrhenius equation was used to develop models for predicting the GTR of polymeric films.

The whole aim of MAP design was to define conditions that would achieve the optimum atmosphere inside the package with minimum possible time for the extended storage of fruits. On the basis of preliminary investigations and the sub-optimal package air composition 3 %O_2 and 3% CO_2; 5 %O_2 and 4% CO_2; 5 %O_2 and 5% CO_2 in N_2, was found appropriate for designing the optimal MA packages for apple, guava and litchi, respectively. The MA package was finalized for medium size 1 kg±50g fill-weight of apple (06 nos.), guava (04 nos.) and litchi (52 nos). The GTR of any of the selected films could not match the gas transmission requirements of MAP. Thus judicious combinations of two different films were combined through the tailoring of film laminates to bring the gas transmission characteristics of the laminates close to the required values. A package size of 24 cm x 19 cm (A_p = 0.0912 m^2); 19 cm x 19 cm (A_p = 0.0722 m^2); and 28 cm x 22 cm (A_p = 0.1232m^2) were selected. The performance of various packages was evaluated. A mathematical model for MA packaging of fruits applying enzyme kinetics based respiration equation coupled with the Arrhenius model was developed. The model was solved numerically using MATLAB programme. The models efficiently predicted the time to reach to the equilibrium and level of O_2 and CO_2 at equilibrium. The E value of the Y_{O2}^{eq} and Z_{CO2}^{eq} as predicted by the developed model and that obtained through experiments were found to be in the range of 5.92-8.60 % and 7.14-9.35%, respectively for apple, guava and litchi fruits.

The different quality attributes such as PLW, volume reduction, firmness, TSS, TA, color parameters with related significant properties viz. chlorophyll content and solubilization of pectin of guava, and PPO, POD and anthocyanins content of litchi were determined at regular intervals. Various sensory attributes such as color, texture, taste and mouth feel of fruit samples were evaluated and Fuzzy logic model was developed for the sensory evaluation of stored fruits. The MA packaging system increased the shelf-life of apple, guava and litchi by 1.25-2.10, 1.12-1.86 and 1.00-1.50 times, respectively that of unpacked fruits at various storage temperatures with a quality comparable with the freshly harvested commodities. MA packaging of EDTA treated litchi fruits enabled the reduction of weight loss, prevention of browning, retention of good color and sweet taste during extended storage. The direct effect as well as two and three factor interaction effects of temperature, packaging system and storage periods found to have significant effect on quality parameters of fruits at 1% level of significance. The developed models using RSM yielded E value of less than 5 indicating the goodness for predicting the quality attributes of stored fruits.

Keywords*: Fruits, apple, guava, litchi, respiration rate, MA packaging, quality attributes*