ABSTRACT

Grapes are non-climacteric fruits. The shelf life of grapes is only 5-8 days. Increasing the storage life of grapes is beneficial for farmers in order to store the grapes for long time. Modified atmospheric packaging is a suitable method for extending the shelf life by controlling the respiration rate. Respiration rate is the indication of senescence of fruits. Decrease in respiration rate during storage is beneficial to maintain quality. There are various technologies available to enhance the shelf life of fresh grapes and among them modified atmospheric packaging gains more attention due to its simplicity and performance.

The principle behind modified atmosphere packaging is reduction of respiration rates of fresh grapes by reducing the available oxygen within the packaging material by flushing a desirable gas composition into the storage.

The measurement of respiration is very important because it provides a window through which we can determine the metabolic activity of plant tissues. This study deals with the shelf life of grapes by using 27 different combinations of modified atmospheric gases. A closed system was developed to measure O\textsubscript{2} and CO\textsubscript{2}, resulting from respiration of grapes (Vitis vinifera l). Respiration rate was measured in terms of production of CO\textsubscript{2} and uptake of O\textsubscript{2} contents which were measured by using gas meter Checkmate II, PBI Dansensor. Oxygen and carbon dioxide levels were measured over time and the respiratory quotient (RQ) of grapes was estimated as 1.90 ml/kg h and 1.60 ml/kg h for black grapes and white
grapes respectively. The study was carried out at different temperatures (5, 10, 15, and 28 °C) and quality analysis of grapes viz. Total soluble solid, acidity, pH, anthocyanin content for 96 h was carried out in a static system.

Effect of different packaging material was studied by testing the Water Vapour Permeability and Oxygen Permeability. Three different packaging materials (viz. LDPE, HDPE and PP) were taken and tested at three different temperatures (Room temperature, Refrigeration temperature and 28°C) by two methods (Wet Cup Method and Water Vapor Permeability Tester). Instrument used for testing is PBI Dansensor for oxygen permeability test. To conclude, LDPE were found be more suitable packaging material with less water vapour and oxygen permeability.

The physical properties of grapes such as mass, volume, density, geometric mean diameter, specific gravity, projected area, surface area, moisture content, roundness and sphericity were measured.

The impact of different four temperatures (5, 10, 15, and 28 °C) and storage period of 4 days on the respiration reaction rate (RO₂ and RCO₂) of fresh grape variety (‘Bangalore Blue syn or Isabella’ ‘Bhokri’) were studied. It was found that the parameters such as time and temperature are very important factors on the respiration rate of grapes and critical in the development of correct modified atmosphere packaging parameters. It needs a known previously studied model for other fruits or vegetable to predict the respiration of grapes also depends on time of storage and temperature. RO₂ and RCO₂ were found to be in range of 0.33 to 17.22
0.2 ml/kg h for black grapes and 1.62 to 16.09 O₂ ml/kg h, for white grapes, and 3.25 to 26.97 CO₂ ml/kg h for black grapes and 0.32 to 23.07 CO₂ ml/kg h for white grapes, respectively for both varieties. RO₂ and RCO₂ were found to be increased with increase in temperature from 5°C to Room temperature. Decreasing storage temperature of grapes from Room temperature (28°C to 5°C decreased RO₂ and RCO₂, respectively. The results give an idea that respiration rate of grape will be defined in well descriptive manner that environmental factor, temperature and time with a combination of calculating the activation energy produced at time of RO₂ and RCO₂ of fresh grapes. The activation energy of black grapes were found E₀₂ 43.47 kJ.mol⁻¹ and E₀₂ 64.05 kJ.mol⁻¹ and white grape was found E₀₂ 66.54 kJ.mol⁻¹ and E₀₂ 40.11 kJ.mol⁻¹. In this study, it was found that the grapes respire an-aerobically after few hours. It was well explained by the modeling (Michaelis-Menten type equations). The Arrhenius equation was used in combination with Michaelis-Menten type equations, to describe the respiration rate properly and calculate the Ea Activation energy. Arrhenius-type equation which describes temperature as a function of RR for both RO₂ and RCO₂ was applied in model fitting.

For the better understanding of the system, Response surface methodology was used to determine the effects of different combinations of modified atmospheric gases such as oxygen, carbon dioxide and the packaging material on the quality of grapes in one month study. Modified atmosphere condition optimized O₂ 5%+CO₂ 10%+N₂ 85% and physiochemical parameters analyzed. TSS, Acidity and pH of the grapes were not significant decline as per storage
periods increases. The physiological loss in weight observed was low under refrigerated condition than in ambient condition for black and white grapes. The anthocyanin in black grapes and beta carotene content for white grapes were not altered significantly up to 21st days. The microbial population or fungal growth for black and white grapes was not within permissible level after 21st days. It means grapes were spoiled.

The aim of this study was to design large scale cold storage facility in order to find its temperature and velocity distribution using transient heat analysis for different inlet velocity and temperature by CFD simulation using ANSYS CFX. Transient simulations were solved by computing a solution for many discrete points in time and iterating at each point to get solution. The simulation was run for a time period of 360 s. It was observed that there was proper distribution of cool air inside the storage as well for the grapes if kept in the boxes. The results demonstrated the use of CFD to study the variations of velocity and temperature in order to design and optimize the storage facility.