ABSTRACT

Aseptic packaging is a method of packaging in which presterilized milk is packed and sealed in presterilized container under aseptic environment to keep for prolonged period at ambient conditions. Aseptically packaged sterilized milk offer better bacteriological and organoleptic qualities. The aseptic pouch form fill seal machine consists of film conveying rolls, hydrogen peroxide bath, UV tube, folding structure, vertical sealer, horizontal sealer, pedal, handle, rubber roll, gear, milk filling tube, air jacketed tube and funnel. Hydrogen peroxide was used for sterilization of packaging material. Bacteriological effectiveness of sterilization of packaging material was tested with *Bacillus subtilis* as target organism. Inoculated sample was exposed at concentration of 10-30 % v/v at temperature of 50-80 °C and at contact time of 30-90 second. The optimum values of concentration, time and temperature were found to be 10 % v/v, 50 °C and 90 second respectively. 7 log cycle reduction was obtained for sterilization of packaging material. Air sterilizer was designed for drying wet film and sterilizing contact surface and maintaining asepticity during milk filling. Estimated power requirement for heating air up to 140 °C from 20 °C was found to be nearly 1 kW. A barrel electric heater of wattage 1kW was selected and fitted inside the air heating pipe. It was observed that for the velocity range of 20 m/s to 40 m/s, temperature varied from 70 °C to 140 °C. Bacterial counts were found to be zero at and above 100 °C at all velocity. An aseptic pouch form fill seal machine was designed and fabricated for rural dairy cooperatives. The length of conveying roll selected was 0.37 m and diameter was 0.02 m. Designed length, width and height of hydrogen peroxide bath was found to be 0.38 m, 0.28 m and 0.34 m respectively. The length of folding structure was taken as 0.51 m while the width was 0.15 m which was bent from both sides. For aseptic pouch packaging, high density polythene (HDPE) film of thickness 80μm was taken. Power required for sealing time of 3 second was found to be 4.6 Watt. The current and voltage was found to be 0.4 Amp and 12 Volt respectively. Based on length of pouch, the designed diameters for roll and gears were found to be 0.047 m respectively. The length of both milk filling and air jacketed tubes were kept as 0.78 m as per design of machine

dimension and other constraints. The diameter of filling tube was taken as 0.025 m while diameter of jacketed tube was taken as 0.035 m. The upper diameter of funnel was taken as 0.20 m while bottom diameter was taken as 0.07 m. The time required for producing 500 ml milk pouch was found to be 15 second. So capacity of machine was found to be 120 litre/h. The optimisation of process variables were carried out for aseptic packaging. Response surface methodology was adopted to generate regression models in terms of process parameters for response i.e. survival count. The optimum results obtained for sterilization pressure of milk, sterilization time of milk, and concentration of hydrogen peroxide and temperature of solution were found to be 1.05 bar, 15.00 minutes, 10 % v/v and 49 °C respectively.

Sterilized milk was packaged under optimised process condition and stored at room temperature for storage study. Milk samples were analysed for survival bacterial count, colour change and viscosity change during storage. The bacterial counts were found to be zero up to 15 days of storage period. The Whiteness Index and the Yellowness Index of aseptically packed milk was measured in CIE Lab colour scale throughout the storage period up to 15 days. The decrease in Whiteness Index and increase in Yellowness Index of milk with storage period indicates the occurrence of amino-sugar browning or Maillard reaction. The viscosity of aseptically packed milk was measured by Brookfield Dial Viscometer during storage period up to 15 days. Since no appreciable rise in viscosity was found after 15 days of storage period, milk was free from gelation. Aseptically packed milk was completely stable at room temperature.

Keywords: aseptic packaging, pouch, packaging material, *B. subtilis*, hydrogen peroxide, sterilized milk, bacterial counts, colour, Whiteness Index, Yellowness Index, Maillard reaction, CIE Lab, gelation, viscosity.