

ABSTRACT

Fruit jam is an intermediate moisture food product consumed worldwide. However, deterioration of quality attributes occurs during conventional processing of jam. Therefore, an antioxidant-rich reduced-calorie jam was developed from Sapodilla (*Manilkara zapota* cv. Kalipatti) fruit using high pressure technology to maintain its nutritional value and the fruit freshness (sensory attributes). Also, sapodilla is rich in antioxidants, dietary fibers and total sugars, but underutilized due to the lack of suitable process technology. A reduced-sugar formulation containing sapodilla pulp as a base material, total soluble solids: 45%, pectin: 4.5% and citric acid: 0.5% was obtained for development of high pressure processed sapodilla jam based on textural, rheological, spectral and sensory properties. The effect of high pressure processing parameters within the domain of 300-600 MPa/25-65 °C/0-30 min was evaluated based on polyphenol oxidase (PPO) and peroxidase (POD) inactivation, total phenol content (TPC), antioxidant activity (AOA), browning index (BI), rheological parameters (gel strength: K' and frequency independency: n'), microbial flora and physicochemical properties of sapodilla jam. The enzyme inactivation during isobaric period followed the first-order kinetics, where the dependency of rate constant on temperature (activation energy) and pressure (activation volume) varied from 11 to 18 kJ·mol⁻¹ and -5.5 to -7.1 mL·mol⁻¹, respectively. The optimized conditions attained based on selected constraints were 600 MPa at 45 °C for 8 min, and the responses achieved at optimum process conditions were 0.01 for Δ BI, 29.2% for PPO inactivation, 24.2% for POD inactivation, 73.6 mg gallic acid equivalent·100 g⁻¹ for TPC, 33.2 mg gallic acid equivalent antioxidant activity·100 g⁻¹ for AOA, 1789 Pa for K' and 0.256 for n' .

The sapodilla jam formulation developed was supplemented with saffron (*Crocus sativus*) extract to improve its antioxidant activity. The extract rich in crocin, safranal and picrocrocin was obtained by high pressure technology using the optimized extraction conditions of 580 MPa at 50 °C for 5 min. The saffron extract was also evaluated for its anticancer activity, wherein an EC₅₀ value of 0.96 mg·mL⁻¹ was obtained for anti-proliferation of colon cancer cells with an incubation period of 72 h. The effect of saffron extract at different concentrations (1-10 mg·10 mL⁻¹) on sensory attributes of sapodilla jam was evaluated using Fuzzy Logic technique. The sample with saffron extract at a concentration of 7 mg·10 mL⁻¹ scored highest. The high pressure processed jam was compared with the thermal processed jam wherein a higher (69%) retention of antioxidant activity and minimum change ($\Delta E^* = 1.9$) in color was observed in high pressure processed sample compared to thermal processed jam with $\Delta E^* = 7.7$.

The change in quality attributes of high pressure processed (HPP) and thermal processed (TP) jam samples packed in ethylene vinyl alcohol (EVOH) pouches was evaluated during storage at 5, 25 and 45 °C. A decrease in PPO and POD activities was observed during storage following first order kinetics as observed for TPC and AOA as well. However, the change in color measured as total color difference followed the zero-order kinetics during storage. All the samples were microbiologically safe throughout the storage period. Therefore, the shelf-life estimated for both HPP and TP samples was > 180 days at 5 °C and ~100 days at 25 °C, whereas it was 49 days for TP sample and 70 days for HPP sample at 45 °C based on the microbiological stability (< 10 cfu·mL⁻¹), over all acceptability (> 5) and total color difference ($\Delta E^* < 12$).

Keywords: Anticancer activity, Antioxidant activity, Extraction, Fuzzy Logic, High pressure processed Jam, Enzyme kinetics, Optimization, Reduced-sugar, Rheology, Saffron, Sapodilla.
