# ABSTRACT

Fresh Sugarcane (*Saccharum officinarum*) juice is a popular beverage in South Asian countries. It is obtained by crushing of sugarcane stems or stalks using juice extractor. It has many therapeutical and nutritional properties. It is a rich source of vitamins, minerals, phenolic compounds and many health promoting compounds. However, the shelf-life of sugarcane juice is limited due to high incidences of microbial contamination and enzymatic browning which takes place immediately after extraction of juice. The seasonal availability and short shelf-life is limiting the market availability of sugarcane juice in packaged form. Conventional thermal processing of sugarcane imparts jaggery flavour with loss of bioactive components and was not acceptable to the consumers.

Among different sugarcane juice extractors under study, the three roller power operated sugarcane juice extractor recorded highest juice extraction of 81% followed by diesel operated (75%) and hand operated (73%). Hence, for hygienic production of sugarcane juice, power operated three roller juice extractor was recommended for small juice processing units. In the present scenario, to meet the consumers demand for "fresh like" products free from chemicals, non-thermal processing such as high pressure processing (HPP) need to be explored. The major advantage with HPP is retention of nutritional qualities while maintaining the microbial stability of the product. Hence, HPP of sugarcane juice was attempted and its effect on physico-chemical, nutritional, enzymatic and microbial qualities of juice was studied within the range of pressure 300–600 MPa, temperature 30-60 °C and dwell time 10-25 min. Pressurization at higher temperatures resulted in color change of sugarcane juice within "well visible" range ($3.0<\Delta E^*< 6.0$). Total phenols and antioxidant activity in HPP treated sugarcane juice were well retained up to 50 °C within the pressure domain of 300–600 MPa. A maximum loss of 25% ascorbic acid was recorded under HPP treatment at 600 MPa/60 °C /25 min.

The highest inactivation of Polyphenol oxidase (PPO) (98%) was attained at 600 MPa/60 °C/25 min while for Peroxidase (POD), it was 92%. PPO, the major enzyme causing enzymatic browning in sugarcane was found to be sensitive to temperature and pressure. During HPP, among the microorganisms studied, aerobic mesophiles were found to be baro-resistant and above 50 °C, all the microorganisms were eliminated below detection limits. Both enzyme inactivation and microbial destruction followed first order kinetics in HPP sugarcane juice within the experimental domain (300-600 MPa; 30–60 °C, 10-25 min).

The process conditions were then optimized within experimental domain using Design Expert software. The optimum condition for HPP treatment of sugarcane juice was 523 MPa/50 °C/11 min with a desirability value of 0.647. Under optimized condition, the sugarcane juice sample resulted in 62% PPO inactivation, 69% POD inactivation, 95% antioxidant capacity, microbial safety (> 5 $\log_{10}$ reduction) with $\Delta E^*$ value < 3.0. The shelf-life studies were carried out for optimized HPP sample (523 MPa/50 °C/11 min), thermal processed sugarcane sample (90 °C/5 min) and untreated sample, packed in two different packaging materials ethyl vinyl alcohol (EVOH) and multilayered polyethylene terephthalate (ML-PET) under two different storage temperatures of 4 and 25 °C upto 120 days. The quality analysis together with sensory evaluation was carried out at regular intervals for shelf-life estimation. Based on quality parameters, the shelf-life of HPP treated sugarcane juice samples was extended upto 100 and 25 days under storage temperatures of 4 and 25 °C, respectively.



**Keywords:** Sugarcane juice; High pressure processing; Enzyme inactivation; First order kinetics; Microbial destruction; Optimization; Shelf-life.