ABSTRACT

This research explores the nutraceutical potential of *Asparagus racemosus* (Shatavari), a medicinal plant indigenous to tropical and subtropical regions of India, emphasizing its application as a functional food and nutraceutical ingredient. The study utilized dried Shatavari roots sourced from the Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow, which underwent comprehensive physicochemical and biochemical evaluations. The analysis revealed a moisture content of 9.82% (w/w), ash content of 7.06% (w/w), saponin content of 2.82% (w/w), and total starch content of 56.85% (w/w), highlighting the plant's nutritional and functional attributes.

Antioxidant activities were assessed using DPPH, ABTS, and FRAP assays for both methanol and aqueous extracts. Aqueous extracts consistently exhibited superior antioxidant potential. Quantification of total phenolic and flavonoid contents demonstrated that methanol extracts contained higher phenolic content (13.50 mg of GAE/g) compared to aqueous extracts (0.80 mg of GAE/g). High-performance liquid chromatography (HPLC) was employed to identify and quantify bioactive compounds, revealing significant levels of quercetin, rutin, ferulic acid, and gallic acid. These findings underscore Shatavari's rich phytochemical profile and its potential for health applications.

The study also involved the development of a Shatavari-based low-alcohol nutraceutical beverage (SLANB) through the fermentation of Shatavari root juice using *Saccharomyces cerevisiae* NCIM 2428. Process optimization was achieved through advanced methodologies, including artificial neural networks (ANN) and response surface methodology (RSM). Optimal fermentation conditions—temperature at 32°C, pH at 4.0, and inoculum concentration of 10% (v/v)—were established, significantly influencing the beverage's pH, total soluble solids, yeast count, and ethanol yield. The fermentation process resulted in an ethanol concentration of 3.21 g/L and an antioxidant activity of 421.47 μg/L. Sensory evaluation using a 9-point hedonic scale indicated high consumer acceptability, with sample 3 achieving the highest preference due to its balanced flavor, aroma, and overall appeal.

Toxicological evaluations were conducted to ensure the safety of SLANB. Acute and subacute toxicity studies on mice, administered doses of up to 1.5 mL/100g body weight over 28 days, revealed no adverse effects on body weight, organ weight, food consumption, haematological parameters, or mortality. These findings confirmed the beverage's safety for consumption.

In conclusion, this study demonstrates the feasibility of incorporating Shatavari into nutraceutical applications through innovative biotechnological approaches. The research highlights the plant’s rich bioactive compound profile, optimized fermentation methodologies, and its safety and acceptability as a functional beverage. These findings pave the way for further exploration and commercialization of Shatavari-based products in health-focused food and beverage sectors.

Keywords: *Shatavari; Starch; Bioreactor; Saccharomyces cerevisiae; Modelling; Product validation; Characterization; Sensory attributes; Toxicity*