Encapsulation of Yeast Enzymes for Improved Fruit Juice Tolerance in Congenital Sucrase-Isomaltase Deficiency

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Dear Editor,

Congenital sucrase-isomaltase deficiency (CSID) is a rare autosomal recessive disorder that impairs the digestion of certain carbohydrates, particularly sucrose and isomaltose[1]. It typically manifests as chronic diarrhea, abdominal discomfort, bloating, and failure to thrive in affected individuals. Clinically, CSID can closely resemble irritable bowel syndrome (IBS), which often leads to misdiagnosis[2]. The estimated prevalence of CSID is 31.4 per million births (95% CI: 28.3–34.8)[3], but underdiagnosis remains a significant concern, particularly in regions such as Turkey[4].

Dietary management of CSID poses ongoing challenges. Even minimal consumption of sucrose-rich foods, including fruits and fruit juices, can provoke symptoms[5]. As an alternative to strict dietary exclusion, we investigated the potential of enzyme supplementation through yeast encapsulation. This method involves enclosing biologically active yeast—containing native sucrase and isomaltase—within sodium alginate, a safe, biocompatible polymer that preserves enzyme function while protecting against environmental degradation.

In our preliminary experiments, yeast was encapsulated in sodium alginate beads and introduced into sucrose-containing fruit juices. The metabolic activity of the encapsulated yeast facilitated the hydrolysis of sucrose and isomaltose into simpler sugars, notably glucose and fructose. Post-treatment, the encapsulated beads were removed from the juice and reused in subsequent cycles. Enzymatic activity was assessed using Benedict's test. Initially, the untreated juice tested negative for reducing sugars. Following treatment, however, the juice yielded a distinct orangish-yellow precipitate upon heating with Benedict's solution, confirming the presence of glucose.

The encapsulated yeast enzymes demonstrated functional stability over a temperature range of 0°C to 37°C and maintained efficacy for up to two weeks under refrigeration. This reusability suggests economic and practical advantages for routine use.

This simple, low-cost approach presents a novel and promising dietary adjunct for individuals with CSID, potentially reducing the need for complete avoidance of common dietary sugars. Moreover, the encapsulation strategy may be adapted to other enzyme-deficiency disorders, such as lactose intolerance, by encapsulating lactase to hydrolyze lactose in dairy products. Further clinical studies are warranted to evaluate the long-term safety, efficacy, and scalability of this intervention.

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