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Impact of Hydrogel-Encapsulated Sugar on Dental Caries Incidence in Rats

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Objectives Formulations of sports energy gel should not only focus on optimizing carbohydrate oxidation for ergogenic purposes, but also on mitigating the risk of dental caries. To achieve this goal, hydrogel-encapsulated fructose-glucose (FRU-GLU) has been developed. The present study aimed to assess the incidence of dental caries in rats subjected to daily administration of hydrogel-encapsulated FRU-GLU.

Methods Hydrogel-encapsulated FRU-GLU, a test sugar, was prepared in two forms: spherical-shaped beads (Beads) and gel form (Gel; Gel 100, Maurten, Gothenburg, Sweden). A control sugar (Ctrl) was also prepared by simply blending alginate gel with FRU-GLU to attain a texture similar to that of Gel. All three formulations contained 27% FRU and 33% GLU. The protocol for the animal study was approved by the Institutional Animal Experiment Committee of Tohoku University (approval number: 2018DnA-053). Twenty-four male Wistar rats (3-week-old) were allocated to Beads, Gel, and Ctrl groups (n = 8) on Day 0. Between Day 6 and Day 10, cariogenic bacteria (*Streptococcus mutans*) were inoculated into the oral cavity of all animals. Additionally, oral administration of the sugars (approximately 1 g) using a syringe commenced on Day 6 and was repeated daily throughout the 12-week study period. After euthanasia, the maxillary and mandibular molars underwent micro-CT analysis.

Results Analysis of 288 molars revealed a significantly lower incidence of distinct dental caries in the Beads (17.7%) and Gel (21.9%) groups compared to the Ctrl group (39.6%). When suspected cases of caries were included, the incidence rates were 54.2% for Beads, 66.7% for Gel, and 76.9% for Ctrl.

Conclusions Hydrogel-encapsulated sugars (Beads and Gel) exhibited reduced dental caries compared to the control sugar (Ctrl), despite that both types contained identical amount of FRU and GLU. Therefore, utilization of hydrogel-encapsulated FRU-GLU as a sports fuel may alleviate concerns regarding the development of dental caries.