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Beneficial influence of dietary spices on the ultrastructure and fluidity of the intestinal brush border in rats.

Prakash UN, Srinivasan K.

Department of Biochemistry and Nutrition, Central Food Technological Research Institute, CSIR, Mysore 570 020, India.

Abstract

The beneficial influence of three common spices was examined in experimental rats on: (i) the membrane fluidity of intestinal brush-border membranes (BBM), (ii) the activity of intestinal membrane-bound enzymes, and (iii) ultrastructural alterations in the intestinal epithelium. Groups of male Wistar rats were maintained on dietary black pepper (0.5 %), red pepper (3.0 %), ginger (0.05 %) and spice bioactive compounds piperine (0.02 %) and capsaicin (0.01 %) for 8 weeks. A membrane fluidity study using an apolar fluorescent probe showed increased BBM fluidity in all the spice-fed animals. This was corroborated by a decreased cholesterol:phospholipid ratio in the jejunal and ileal regions of the intestine. These dietary spices stimulated the activities of BBM enzymes (glycyl-glycine dipeptidase, leucine amino peptidase and gamma-glutamyl transpeptidase) in the jejunal mucosa, suggesting a modulation in membrane dynamics due to the apolar spice bioactive compounds interacting with surrounding lipids and hydrophobic portions in the protein vicinity, which may decrease the tendency of membrane lipids to act as steric constraints to enzyme proteins and thus modify enzyme conformation. Scanning electronic microscopy of the intestinal villi in these spice treatments revealed alterations in the ultrastructure, especially an increase in microvilli length and perimeter which would mean a beneficial increase in the absorptive surface of the small intestine, providing for an increased bioavailability of micronutrients. Thus, dietary spices (black pepper, red pepper and ginger) were evidenced to induce alterations in BBM fluidity and passive permeability property, associated with the induction of an increased microvilli length and perimeter, resulting in an increased absorptive surface of the small intestine.

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