Evaluation of the nutritional value of emping melinjo in rats, with special reference to nitrogen digestibility and mineral absorption

Sihombing, Geertruida, author

Abstrak

Gnetum gnemon LINN., also called tulip tree, is found throughout the islands of the Indonesian archipelago. Locally, this tree is known as melinjo tree, and its young stems and leaves, young and ripe fruits are used in a traditional dish. The seeds of the ripe fruits are eaten after roasting. The seeds may also be processed in household-food industries into flattened and dried flakes called "owing melinjo". Prior to consumption, emping melinjo is usually fried in coconut fat which renders it crispy with a specific bitter taste. Emping melinjo is also exported to Middle East countries and the Netherlands (Departemen Perindustrian, 1988).
The nutritional value of emping melinjo has not yet been studied in detail. A feeding trial using rats fed emping melinjo as the sole source of protein showed a low protein efficiency ratio when compared with skim milk (Oey, 1979). Budiarso and Sihombing (1989) reported that livers of rats fed diets containing melinjo seeds as major ingredient had perilobular necrosis. These studies suggest that emping melinjo has low nutritional value and may even contain toxic substances. However, the diets used consisted of emping melinjo as sole source of protein supplemented with vitamin and mineral mixtures. This is very different from the situation in Indonesians who consume emping melinjo as a snack, side dish or as a component of the rice menu. Thus, a study was performed with rats fed nutritionally adequate diets with varying levels of emping melinjo, either in dried/unfried or dried/fried form. The nutritional value of emping melinjo was assessed on the basis of growth performance, histology of selected organs, selected blood measures, nitrogen digestibility, and mineral absorption.
In the first experiment, purified diets were used containing either 0, 10, 20 or 40 % (w/w) of dried/unfried emping melinjo. The control diet (without emping melinjo) contained casein as sole source of protein and was formulated according to the recommendations of the National Research Council: it contained 5 % of fat. The four experimental diets were balanced for nitrogen, fat, calcium, magnesium and phosphorus. There were 8 male rats per dietary group; the experimental period lasted 14 days. The rats had free access to food and demineralized water.
Feed intake and weight gain were not significantly affected by emping melinjo in the diet. Cecum weight, including contents, was raised markedly after feeding emping melinjo. Feces production rose after consumption of emping in a dose-dependent fashion, but dry matter content fell. Histological examination showed that liver and jejunum were unaffected by the feeding of emping, but nephrocalcinosis was induced. The amount of emping melinjo in the diet did not affect hematocrit values and blood hemoglobin concentrations. Plasma triglyceride and cholesterol concentrations were significantly lowered by emping melinjo in a dose-dependent fashion. Apparent nitrogen digestibility was gradually decreased with increasing emping melinjo concentrations in the diet. The highest dietary concentration of emping used, i.e. 40 %, significantly reduced the apparent absorption of calcium, magnesium and phosphorus.
As a component of the human diet, melinjo is not consumed in its dry form but after frying in coconut fat. It could be suggested that dried/fried melinjo does not negatively affect mineral and nitrogen absorption

because eiher possible anti-nutritional factors are denaturated by frying or the nutrients in emping become more accessible to digestive processes. The second experiment was carried out to test this suggestion. In addition, the solubility of minerals in the ileal lumen was determined to obtain clues as to the mechanism underlying the inhibitory effectof emping on mineral absorption. Soluble minerals in the ileal lumen are considered to be available for absorption as opposed to insoluble minerals.

There were three experimental diets: a control diet, a diet containing 40 % dried/unfried emping and a diet containing 40 % dried/fried emping (corrected for the fat taken up while frying). The high-fat diets (15 % fat) were carefully balanced for nitrogen, fat, calcium, magnesium and phosphorus. There were 12 male rats per dietary group, which had free access to food and demineralized water; the experimental period lasted 14 days.

Feed intake did not differ significantly between the three experimental groups, but weight gain was some what depressed by both dried/unfried and dried/fried emping. The two emping preparations raised cecum weight and feces production, while the dry matter content of feces dropped.

As was observed in experiment 1, the feeding of dried/unfried emping at a level of 40 % of the diet significantly reduced the apparent absorption of nitrogen, calcium, magnesium and phosphorus. Frying of emping caused disappearance of the inhibitory effect on calcium and magnesium absorption whereas nitrogen and phosphorus absorption were still reduced, albeit to a lower extent.

Dried/unfried and dried/fried emping in the diet raised both the amount of solid and liquid phase in the ileum. The concentrations of soluble calcium and magnesium were decreased by dried/unfried as well as dried/fried emping. The concentration of phosphorus in the liquid phase of the ileal lumen was lowered by dried/unfried but not by dried/fried emping.

The addition of dried/unfried emping melinjo to the diet of rats at the expense of isonitrogenous amounts of nitrogen caused a lowering of the absorption of nitrogen, calcium, magnesium and phosphorus. This effect is either completely or partly abolished by frying of the emping melinjo Frying of dried/emping did not increase the concentrations of calcium and magnesium in the liquid phase of the ileum so that its stimulatory effect on calcium and magnesium absorption remains obscure. Frying of emping did raise the ileal solubility of phosphorus. Frying of emping did raise the ileal solubility of phosphorus.

The still some what reduced absorption of phosphorus as seen after the feeding of fried emping is probably the result of unavailable phosphorus as phytate in the emping. The reduced absorption of nitrogen in rats fed either dried/fried or fried emping could relate to the presence of poorly digestible material in the intestine as evidenced by the increased weight of solid phase in the ileal lumen. This undigestible material probably represents polysaccharides which raise microbial activity in the cecum leading to the formation of fatty acids and thereby elevating the water content of feces. The undigestible polysaccharides in emping melinjo, if and when present, could also be responsible for its cholesterol lowering activity.