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Bamboo, new raw material for phytosterols

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Fermented succulent shoots of bamboo (*Bambusa tulda* and *Dendrocalamus giganteus*) are an enriched source of phytosterols. The concentration of phytosterols ranges from 1.6 to 2.8% on dry-weight basis. Fermented bamboo shoots can therefore be used as starting material in the production of steroidal drugs.

OCCURRENCE of various ingredients of nutritional significance in succulent bamboo shoots has been described by many workers[1–5]. Its medicinal importance has also been studied[6–8]. The waste material of sugar industries, press mud, has already been explored as a non-conventional source of sterol to be used for steroidal drugs after its microbial conversion[9–11]. Extensive study on metabolic changes during fermentation of edible bamboo shoots has been made[12, 13], including estimation of a number of metabolites (sugars, organic acids, alcohols, nitrogenous compounds, vitamins, etc.) during fermentation.

The increasing demand for steroidal drugs has resulted in the depletion of various natural resources such as *Dioscoria* and *Solanum*. Hence, an alternative source for a starting material is imperative. In this context phytosterols, which are also used for the production of steroidal drugs, are of some importance. In the present paper, succulent bamboo shoots are proposed as an alternative source of phytosterols.

Bamboo cultivation is practised in many tropical countries. In India, bamboo is grown as a cash crop in the north-eastern part. In Manipur, an area of about 3268 km^2 is covered by bamboo forests[13]. The fermented preparation of bamboo shoot slices, locally called 'soibum', is a highly prized vegetable item (Figure 1). The soibum is manufactured by thin slices of fresh succulent and soft bamboo shoots in specialized containers/chambers for 2–3 months. The fermentation chambers are made up either of bamboo planks or of roasted earthen pots. The inner surface of bamboo chambers are lined with musa leaves and a thin polythene sheet.

The phytosterol was extracted from fresh succulent shoots and also from the fermented product (soibum) obtained from market. The sterol was isolated from oven-dried (60°C) fresh and fermented material. Dry matter was 10–15% of the fresh material. One gram of each sample (fresh and fermented) was crushed with 10 ml alcohol-acetone solution (1 : 1) and centrifuged, the supernatant dried and to the dry residue 10 ml chloroform was added to dissolve phytosterols. The concentration of total phytosterols was determined colorimetrically using the Lieberman–Burchard reaction[14]. Two ml of acetic anhydride-sulphuric acid mixture (30 : 1) was added to 1 ml of phytosterol extract in chloroform; this produces a blue-green colour (λ_{max} 680 nm). Cholesterol was used as standard.

The concentration of total phytosterols was 1.6–2.8% in the dried fermented bamboo shoot samples obtained from different manufacturers. However, its concentration in the dried unfermented (fresh) samples was 0.21–0.39%. The increase in the level of phytosterols in the fermented samples is due to anaerobic digestion by microorganisms that cause degradation of the organic

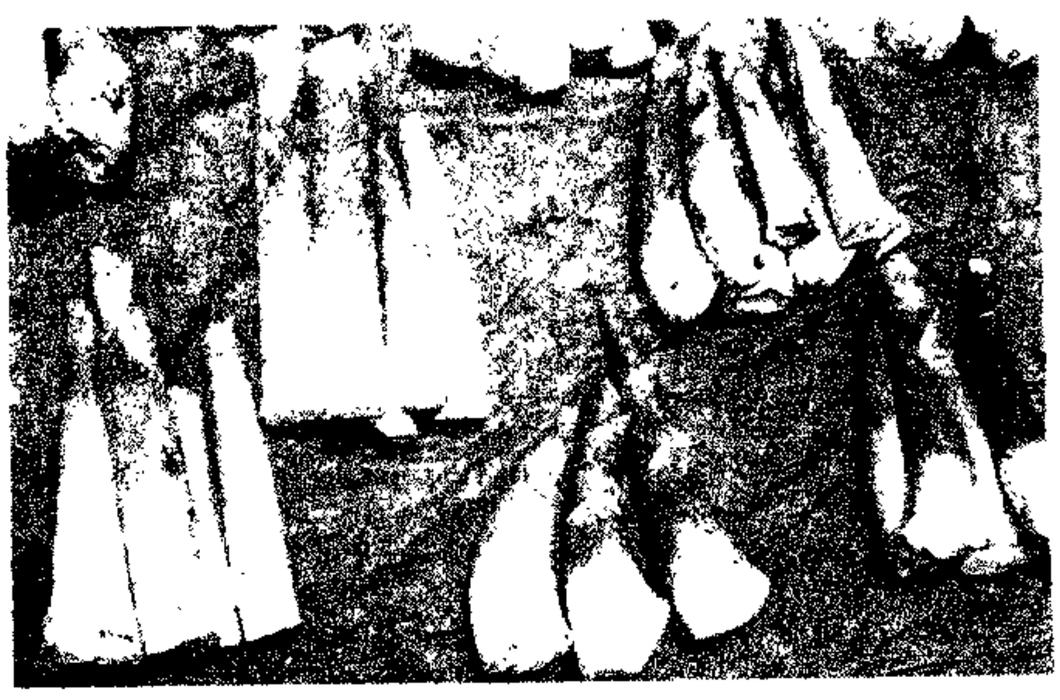

Figure 1. Fresh bamboo shoot (succulent).

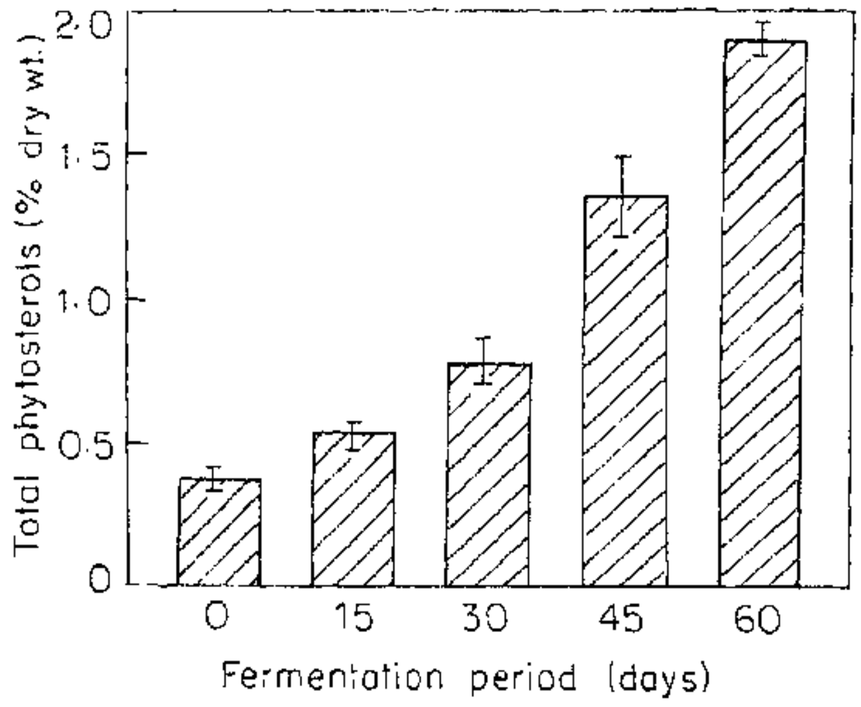

Figure 2. Enrichment of phytosterols during fermentation.

matter and resulted in enrichment of phytosterols (Figure 2).

These observations show that bamboo shoots (succulent ones) are a good source of phytosterols. The phytosterols so obtained can be used for the manufacture of steroidal drugs after microbial conversion into 1,4-androstadiene-3,17-dione using *Arthrobacter oxidans* as was done earlier[9,10]. Thus the fermented succulent bamboo shoots can replace diosgenin from *Dioscoria* and solasodine from *Solanum* as the starting material in the production of steroidal drugs from plant steroids.

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Cadmium-induced cancer in the gills of the crab *Scylla serrata* (Forskal)

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The commercially important edible estuarine portunid crab *Scylla serrata* was exposed to three sublethal concentrations of cadmium (1/10, 1/7 and 1/4 of the LC_{50} value of 8 ppm) for 30 days. After exposure, the histological changes effected by cadmium were observed. The changes noticed were: thickening of gill lamellae, increase and accumulation of haemocytes, and infiltration of cells into the haemocoelic space of the gill. Among the infiltrated cells there were present proliferated cancerous cells. The observations are discussed.

METAL ions are serious pollutants in the marine environment as they are concentrated by the marine organisms[1-3]. The accumulation of cadmium in different tissues of marine crustaceans has been studied, and gills have been shown to be the organs of accumulation, both under natural and experimental conditions[4-6]. Gills are the primary sites of respiration and of transport system involved in osmoregulation and it has been confirmed that accumulation of metal ions within them may have an adverse effect on these functions[7-9]. Ultra-structural changes related to bronchial cells in crustaceans have been reported by various authors[10,11]. Some studies have emphasized that histological changes occur within the gills, when aquatic animals are subjected to different concentrations of metal ions[12,13]. It is of interest to note that no spontaneous or idiopathic neoplasms have been reported for crustaceans even though thousands of crabs, shrimps and other crustaceans have been examined histologically in a variety of toxicological and pathological studies[14]. Here we report our observation of cancerous cells induced by cadmium toxicity in the edible crab *Scylla serrata*, which has good market potential. In all probability, this is the first report of metal-induced carcinoma in a crustacean, particularly edible crabs.

Healthy specimens of *S. serrata* were collected from the Pitchavaram mangrove (Lat. 11°29'N, Long. 79°47'E) and kept alive in estuarine water of salinity $27 \pm 1‰$ for a week. After acclimation, based on the LC_{50} value (8 ppm of cadmium) 30 crabs (ten in each concentration) were exposed to three sublethal concentrations (0.8, 1.1 and 2.0 ppm) representing 1/10, 1/7 and 1/4 of the LC_{50} value for 30 days. A control group (10 crabs) was also maintained. During the experimental period, the crabs were fed with chopped clam meat. After the exposure period, the gills of the control and experimental animals were dissected out and fixed in