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The function of lactobacilli as dietary adjuncts

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Lactic acid bacteria are important microorganisms in the production of many types of fermented foods (Smith and Palumbo, 1981). Formation of lactic acid and some other metabolites contribute to the preservation of these products. Apart from this, these bacteria affect the flavour of the end-product. Presence of viable bacteria is not deliberate here, as in the production of some – more recently developed – dietary milk-products. These milk-products – for instance Yakult, Biogurt and Biogarde – owe their value to the presence of viable lactic acid bacteria, added to stabilize an eubiotic bowel flora or to improve dysbiotic (disturbed) floras. Since Metchnikoff (1907) many studies concerning this aspect have been made, however with contradictory results partly because of the use of strains which differed in certain qualities necessary to be active in the large intestine. Besides the necessity to be resistant to gastric and bile acids, also their capacity to adhere to human intestinal cells is an important criterion in choosing a lactic acid bacterium as dietary adjunct (Sandine, 1979; Kilara, 1982; Klaenhammer, 1982). Passage of lactobacilli through stomach and duodenum – though doubted by many authors – was clearly demonstrated by Bernhardt and Knoke (1978). However, in spite of many indications, actual colonization in the large intestine has not yet been confirmed; stabilization of high levels of lactobacilli after discontinuing their consumption has seldom been ascertained (Gilliland et al., 1978).

More conformity is observed in the interesting results of investigations regarding the influence of consumption of lactobacilli on the metabolic activity of the bowel flora. Addition of *Lactobacillus acidophilus* to the meat ration of rats actually resulted in lower levels of β-glucuronidase, nitroreductase and azoreductase (Goldin and Gorbach, 1977). These enzymes are possibly related with conversion of procarcinogenic into carcinogenic compounds. Studies with humans showed similar tendencies (Ayebo et al., 1980). However, little is known as yet concerning the mechanism behind these alterations in enzymic activities after consumption of lactobacilli. Possibly, higher levels of lactic acid or of other even more specific antimicrobial compounds are mainly responsible. In this connection it is worth mentioning that Vincent et al. (1959), Reddy and Shahani (1971), Hamdan and Mikolajcik (1974) and Shahani et al. (1977) isolated compounds named lactocidin, bulgarican, acidolin, and acidophilin, respectively. Some of these products which are different from lactic acid or hydrogen peroxide possess highly active antimicrobial qualities. Our investigations also showed the presence of antimicrobial substances besides lactic acid and hydrogen peroxide (see Table 1). Addition of lactic acid to skim-milk to pH values similar to those of fermented skim-milks yielded only minor inhibition zones as compared with those for the fermented milks. Addition of 6% $CaCO_3$ to skim-milk before fermentation resulted in a disproportionate reduction of the inhibition zones, indicating an acid nature of the antimicrobial compound(s).

More directly, lactic acid bacteria seem to influence carcinogenesis through antitumour compounds in the cell wall. Consumption of yogurt resulted in inhibition of outgrowth of intraperitoneally injected Ehrlich ascites tumour cells in mice (Friend et al., 1982; Shahani et al., 1983). Rats were cured of subcutaneously implanted tumours (Sarcoma 180) by intravenous injection of cell

Table 1. Inhibition of bacterial growth by skim-milk fermented by *Lactobacillus acidophilus* and *Lactobacillus casei*

Test organisms	Diameter of inhibition zones (mm)[1]					
	L. acidophilus			*L. casei*		
	A[2]	B	C	A	B	C
Bacillus subtilis	12	7	6	14	6.5	6.5
Proteus vulgaris	9	7	6	7	6.5	6
Sarcina lutea	13	6.5	6	16	6	6
Staphylococcus aureus	6	6	6	8	6.5	6

[1] Diameter of disc 6 mm.
[2] A. fermented skim-milk; B. fermented skim-milk + 6% $CaCO_3$; C. non-fermented skim-milk; pH as of A. by addition of lactic acid.
Note. In no instance, addition of catalase reduced the diameter of the inhibition zone.

extracts of *L. acidophilus*, *L. bulgaricus*, *L. casei*, and *L. helveticus* (Aksakov, 1966). The active compounds were resistant to proteolytic enzymes like pepsine and trypsine. Thus there may be possibilities to influence large bowel carcinogenesis by means of consumption of (fermented) milk-products. This aspect is currently being studied at our institute.

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