

1 Review Article

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3 **Milk, milk products and disease free health: an updated**  
4 **overview**

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22 **ABSTRACT**

23 The cow and its milk have been held sacred in India since the dawn of human  
24 civilization. Indian ancient Vedic texts also describe the virtues of milk and dairy  
25 products, as is authenticated by modern scientific principles and proofs. Therefore, milk  
26 has been considered as one of the most natural and highly nutritive part of a daily  
27 balanced diet. Currently, the integration of advanced scientific knowledge with  
28 traditional information is gaining incredible momentum towards developing concept of  
29 potential therapeutic foods. Furthermore, new advances towards understanding the  
30 therapeutic roles of milk and milk products has also given a new impetus for unraveling  
31 the old- age secrets of milk. At present, the best-known examples of therapeutic foods  
32 are fermented milk products containing health promoting probiotic bacteria. In present  
33 article, we have tried to review the various aspects of the therapeutic nature of milk and  
34 fermented dairy products in a highly up-dated manner, and offer an in-depth insight  
35 into the development of targeted therapeutic future foods; as per the admirable  
36 requirements of consumers.

37 **Key words:** Milk, dairy products, synbiotics, functional foods, therapeutic foods.

## 38 INTRODUCTION

39 Milk, our very first food, is surrounded with emotional, cultural and religious  
40 importance. We are habituated since childhood to think of milk as “nature’s most  
41 perfect food”. Milk and dairy products have long been acknowledged as an important  
42 constituent of a balanced diet. In addition, evidence of health benefits of milk products  
43 allied with the presence of specific components or bacteria are progressively gaining  
44 established scientific credibility. It is, therefore, logical that among the best-known  
45 examples of functional foods are fermented milks and yogurts containing probiotic  
46 bacteria (Weaver, 2003; Kurien et al, 2005). These days, the boundary line between  
47 food and medicine is also becoming diffused with the enhanced understanding of food  
48 science and technology. Among the various food products, milk has primarily been  
49 identified to have a high potential for health improvements for human beings. It is an  
50 optimally rich source of vital nutrients such as proteins, fat, lactose, vitamins, minerals,  
51 enzymes, hormones, immunoglobulins and cells. Dairy products are consumed not only  
52 for meeting the nutritional requirements of the consumers, but also for their role in  
53 preventing various disorders such as obesity, osteoporosis, dental caries, poor  
54 gastrointestinal health, cardiovascular diseases, hypertension, colorectal cancer, bone  
55 ailments, eye diseases, ageing etc. (Sharma and Rajput, 2006). Hence, we have made an  
56 attempt to highlight the various therapeutic aspects of milk and milk-based foods with  
57 special reference to their role in combating several life-style diseases and disorders,  
58 aside from some of the basic knowledge pertaining to this category of foods.

## 59 HISTORICAL PERSPECTIVE

60 Ancient Indian literature (Upnishads, Purans and Vedas) is full of evidences of the  
61 beneficial and therapeutic properties of milk and milk products. The Rigveda describes  
62 a cow as Amrutasya nabhih and compares ghee to nectar. Sadhays and Vasus, who  
63 tasted cow milk, became immortal, as is said in the Atharva Veda. The milk of Surabhi,  
64 which is considered the celestial cow and supreme among all bovines, is useful to  
65 humans, as mentioned in the Mahabharata. Milk, according to Bhava Prakasha, is a  
66 remedy for the patients of chronic diseases such as epilepsy, jaundice, heart ailments,  
67 suppression of stool and urine, spleen enlargement and piles. Bhava Prakasha states that  
68 Dadhi acts as an appetizer, tones up a weak person, and also work as an anti-tode  
69 against chronic diseases of kidney. Ayurveda emphasizes on the ability of milk to  
70 revitalize the energy system of the body. Buttermilk warmed with curry and/ or

71 coriander leaves, turmeric, ginger and salt is relished in Kerala (India), which, as per  
72 the ancient science, is the reason for least cases of obesity and indigestion being  
73 reported in that state (Sabikhi and Mathur, 2004). Milk, according to Ayurveda, is a  
74 laxative whereas dahi has the opposite effect of curing diarrhea.

75 Cow's milk was first used as human food in the Middle East. Goats and sheep were also  
76 domesticated in the Middle East between 9000 and 8000 BC. Around 7000 BC, cattle  
77 were being herded in parts of Turkey. There is evidence of milk consumption in the  
78 British Isles during the Neolithic period, and the use of cheese and butter spread in  
79 Europe, and parts of Asia and Africa. Domestic cows, which previously existed  
80 throughout much of Eurasia, were then introduced to the colonies of Europe during the  
81 'Age of Exploration'. Russian Scientist Elie Metchnikoff was the first person to notice  
82 the beneficial effect of fermented milk products as probiotics (Greek; pro = for, bios =  
83 life) or therapeutics in his publication on 'Prolongation of Life, 1908'. He found that  
84 the colon housed the friendly bacteria similar those good bugs found naturally in  
85 fermented milk such as curd, yogurt, acidophilus milk, cultured buttermilk etc. called  
86 *Lactobacillus*.

## 87 **MILK AND WELL BEING**

88 The three most important factors that primarily contribute to health are diet, exercise  
89 and genetic factors. Milk is not only nature's food for a new born infant, but also a  
90 source for a whole range of dairy products consumed by mankind. Milk contains about  
91 87% water and 13% solids. The fat portion of the milk contains fat-soluble vitamins.  
92 The solids (other than fat) include proteins, carbohydrate, water-soluble vitamins, and  
93 minerals. Milk products contain high quality proteins. The whey proteins constitute  
94 about 18% of the protein content of the milk. Casein, a protein found only in milk,  
95 contains all of the essential amino acids and accounts for 82 % of the total proteins in  
96 milk. Milk also contains calcium, phosphorus, magnesium, and potassium. The calcium  
97 found in milk is readily absorbed by the body; Vitamin D plays a role in promoting the  
98 calcium absorption and its utilization. Milk is also a significant source of riboflavin  
99 (vitamin B2), which helps promote healthy skin and eyes (Dairy Facts, 2003). Dairy  
100 products such as yogurts, cheeses and ice creams contain nutrients such as proteins,  
101 vitamins and minerals. Consumption of dairy products has been associated with  
102 decreased risk of osteoporosis, hypertension, colon cancer, obesity and insulin

103 resistance syndrome. The main dietary source of calcium and vitamin D are dairy  
104 products (Weaver, 2003).

105 Milk can be converted into a number of dairy products, and most of these products have  
106 already achieved a reputed health-oriented image in consumer's mind, and have proved  
107 to be an excellent solution for formulating superior nutrition (Table 1). Overall, dairy  
108 foods can be divided into three groups:

- 109 • Basic products i.e. milk, fermented milks, cheeses, ice-cream, etc.
- 110 • Value-added products, in which the milk composition has been changed, e.g. low-  
111 lactose or lactose-free products, hypoallergenic formulae with hydrolyzed protein  
112 for milk-hypersensitive infants, milk products enriched with Ca, vitamins, etc.
- 113 • Functional/ therapeutic dairy products, primarily those containing probiotic  
114 bacteria, and quite frequently enriched with prebiotic carbohydrates.

115 Since, many chronic diseases such as cancer, osteoporosis, coronary heart disease and  
116 hypertension are connected to an unbalanced diet; consumers have now started  
117 accepting that diet has a great influence on health and well-being. As a result of this,  
118 the food industry has taken benefit of new avenues for producing health oriented milk  
119 products. Food processing and biotechnology has enabled the food industry to make  
120 food with special characteristics. In addition to disease prevention, the role of food as  
121 an agent for improving health has been projected. Probiotics, prebiotics, synbiotics and  
122 functional foods have been created to describe food products with special  
123 characteristics. Developing functional value in dairy-based products simply means  
124 enriching the healthy nature of the original base. Functional foods are generally  
125 described as foods that promote health beyond providing basic nutrition. A food can be  
126 regarded as 'functional' if it satisfactorily demonstrates to affect beneficially one or  
127 more target functions in the body, beyond adequate nutritional effects in a way that is  
128 relevant to improved health or reduced risk of disease. These foods are eye-catching to  
129 modern men and women who wish to reach old age in a healthy form. The best known  
130 examples of functional food are fermented milks and yogurts containing probiotic  
131 bacteria (Nagpal *et al.*, 2007a).

132 Milk, our very first food, is surrounded with emotional and cultural importance. We  
133 have been habituated since childhood to think of milk as "nature's most perfect food.  
134 Now, we (almost all of us, infants, the young, adolescents, adults and even the aged)

135 are a nation of milk drinkers. We drink several hundred gallons of milk a year and add  
136 to that many pounds of dairy products such as cheese, butter and yogurt. Milk and dairy  
137 products have long been acknowledged as an important constituent of a balanced diet.  
138 These products provide a wide range of important nutrients. In addition, evidence of  
139 health benefits of milk allied with the presence of specific components or bacteria is  
140 progressively gaining established scientific credibility. It is therefore logical that among  
141 the best known examples of functional foods are fermented milks and yogurts  
142 containing probiotic bacteria. Milk itself is much more than the sum of its nutrients. It  
143 is a natural source of a jumble of beneficial nutrients and biologically-active  
144 compounds with a potential impact on human health. Further, probiotic microorganisms  
145 present in milk or fermented milk products, such as dahi, cheese etc., beneficially affect  
146 the host improving the properties of intestinal microbial balance. These probiotic  
147 effects include alleviation of intestinal disorders such as lactose intolerance, acute  
148 gastroenteritis due to enteric pathogens, constipation, inflammatory bowel disease, and  
149 food allergy. Three most important factors contributing to health are diet, exercise and  
150 genetic factors. There are only a few people who are familiar with terms like probiotics  
151 and functional food. The determinants of healthful effects of dairy product are multi-  
152 factorial, for example, live bacteria and other components of fermented milk such as  
153 highly absorbable calcium, conjugated products of linoleic acid (CLA) and bioactive  
154 peptides (Nagpal *et al.*, 2007b).

155 Coronary heart disease, the most common and severe form of cardiovascular disease, is  
156 the foremost cause of death in developed countries. Milk and dairy products contain  
157 components with at least a protective, if not hypocholesterolemic, effect such as  
158 calcium, linoleic acid, conjugated linoleic acid, antioxidants and lactic acid bacteria or  
159 probiotic bacteria. Calcium plays an important role in mediating vascular contraction  
160 and vasodilatation, muscle contraction, nerve transmission and glandular secretion.  
161 Linoleic acid is also favorable in reducing coronary heart disease risks in human  
162 subjects. Probiotics, in the form of fermented milk products, have the reputation of  
163 cholesterol-lowering properties in humans (Yadav *et al.*, 2006a, b; 2007a, b,c).

164 Hypertension is another modern day problem and again both genetic and environmental  
165 factors influence blood pressure. People with high blood pressure are at increased risk  
166 of coronary heart disease, stroke, and kidney failure. It is not only an excess of one  
167 electrolyte (sodium) in our diets but rather inadequate levels of several others that

168 produce hypertension. An adequate intake of calcium, potassium, and magnesium has  
169 now been documented to reduce blood pressure. It has already been proved that effect  
170 of milk on blood pressure is greater and more rapid than that of calcium alone. Milk  
171 and dairy products are meaningful sources of all three nutrients along with certain  
172 bioactive peptides with a potential to reduce blood pressure due to their ability to  
173 inhibit the formation of some potent vasoconstrictors (Ashar and Chand, 2004a).

174 Colorectal cancer is one of the leading causes of cancer morbidity and mortality in the  
175 Western countries and it is thought to be caused by an interaction between dietary  
176 factors and genetic predisposition. The components in dairy foods which may protect  
177 against colon cancer are above all calcium, vitamin D, probiotic lactic acid bacteria, a  
178 class of fatty acids known as conjugated derivatives of linoleic acid (LCA) and  
179 bioactive peptides derived from milk proteins. The high amounts of colloidal calcium  
180 phosphate in milk products cause intestinal formation of insoluble, amorphous calcium  
181 phosphate, which precipitates bile acids, fatty acids, and other unknown cytotoxic  
182 factors and thus inhibits colonic epithelial proliferation. The human colon is intensively  
183 colonized with bacteria and as such an extremely complex microbial ecosystem. The  
184 majority of these residents is in fact benign and may even offer some health-promoting  
185 effect. The lactic acid bacteria termed probiotics are the most prominent representatives  
186 of health promoting colon-residents. Oral administration of certain probiotic bacteria is  
187 associated with a number of anti-carcinogenic actions, including reduction of colonic  
188 pH, immuno-stimulation, anti-mutagenicity and reduction in the activity of enzymes  
189 responsible for the conversion of procarcinogens to carcinogens. Fermented milk  
190 products, specially those containing probiotic bacteria, may help reduce the risk of  
191 cancer at a number of sites. Milk proteins are most likely another milk component with  
192 anti-carcinogenic properties, and may therefore retard the development of colon tumors  
193 and tumor precursors. Besides, milk whey also contains different high-affinity binding  
194 proteins that bind iron, folic acid, vitamin B12, riboflavin, retinol and vitamin D. Their  
195 bioactivity is very important for keeping an organism in a healthy condition.  
196 Lactoferrin binds iron which is potentially pro-carcinogen and thus prevents intestinal  
197 damage, whereas the vitamin binding proteins protect vitamins from intestinal  
198 microflora (Daniel et al., 1990; Rokka et al., 1997).

199 Moreover, with an already healthy image, dairy is an excellent solution for formulating  
200 flavorful and nutritious functional beverages such as sport drinks, energy drinks and

201 smoothies. Dairy-based beverages provide superior nutrition, as dairy is a source of  
202 high quality proteins, calcium, potassium and other nutrients. Such protein-rich  
203 beverages provide not only with a source of high-quality protein, but also may add a  
204 variety of health benefits that make dairy proteins ideal for a variety of functional  
205 beverages. The fat in milk can also be a natural source of conjugated linoleic acid,  
206 which may offer health benefits. Dairy also provides an excellent vehicle for delivering  
207 probiotics, which play an important role in intestinal health, immunity and other health  
208 issues. In addition, ultra-filtered (UF) milk provides the opportunity to create unique  
209 dairy-based beverages, such as low-carb/ high-protein drinks. Dairy proteins, such as  
210 casein and whey, offer all of the essential amino acids the body requires. Higher daily  
211 intake of proteins and their components, especially the high amount of leucine found in  
212 dairy proteins, may help people lose fat while preserving lean muscle.

213 Dairy proteins contain several components that may help the human body protect itself  
214 against toxins, bacteria and viruses. For example, lactoferrin, an iron-binding whey  
215 protein, may increase iron absorption and transport, enhance immunity and stimulate  
216 growth of beneficial bacteria in the intestinal tract. Probiotics are a perfect fit for these  
217 dairy-based beverages, as dairy is an excellent vehicle to deliver beneficial bacteria  
218 such as *Bifidobacterium* and *Lactobacillus* species. Consumption of probiotics with  
219 dairy foods such as milk, yogurt and cheese buffers the stomach acid and increases the  
220 chance that the bacteria will survive into the intestine. The healthful properties of  
221 probiotics also work well with the healthful properties of dairy beverages. Probiotic  
222 cultures have been shown in a variety of test systems to stimulate certain cellular and  
223 antibody functions of the immune system. Lactic acid bacteria also enhance the levels  
224 of certain immuno-reactive cells (e.g. macrophages and lymphocytes) or factors  
225 (cytokines, immunoglobulins and interferon). Exposure to probiotics early in life may  
226 decrease the risk of allergy. Dairy products are the major natural sources of CLA which  
227 is naturally present in cow's milk, holds anti-cancer properties, and have a positive  
228 impact on cardiovascular health (Nagpal *et al.*, 2007b). Calcium is not only essential  
229 for bone health; it has also been linked to the maintenance of healthy blood pressure  
230 and reduction of dental cavities. The resulting ultra-filtered (UF) milk, in both fluid and  
231 powdered forms, offers opportunities for lower-carb beverages. From proteins and  
232 probiotics to nine essential vitamins and minerals, dairy-based beverages have much to  
233 offer today's health-conscious consumer.

## 234 **HEALTH PROMOTING MILK FOODS**

235 There is a growing trend of health awareness all over the world, wherein consumers  
236 and health professionals alike are increasingly adopting a preventive approach rather  
237 than a curative one to diseases. While antibiotic therapy is currently the most  
238 commonly used approach to treat bacterial infections, it is essentially curative and is  
239 associated with unpleasant side effects. Probiotics, on the other hand, score over  
240 antibiotics by being preventive, non-invasive and free from any undesirable effects.

241 Consequently, the awareness and popularity of probiotics among the global population  
242 is increasing rapidly (Sanders, 1998). Several health benefits have been attributed to the  
243 ingestion of probiotic bacteria such as *Lactobacillus* spp and *Bifidobacterium* spp.  
244 These bacteria enhance the population of beneficial bacteria in the human gut, suppress  
245 pathogens and build up resistance against intestinal diseases. Ingestion of these bacteria  
246 is considered to be very effective in preventing diarrhea in children and in alleviating  
247 symptoms of lactose intolerance in adults (Salminen *et al.*, 1999; Goyal and Gandhi,  
248 2006). Probiotic food products have also been called nutraceuticals, pharma-foods,  
249 designer foods, nutritional foods, medical foods or super foods (Childs and Poryzees,  
250 1998).

### 251 **Functional milk foods: foods with therapeutic values**

252 Probiotic bacteria are live microbial strains that, when applied in adequate doses,  
253 beneficially affect the host by improving its intestinal microbial balance. Probiotic  
254 foods are products that contain a living ingredient in sufficient concentration, so that  
255 after their ingestion, the postulated effect is obtained (deVrese and Schrezenmeir,  
256 2001). A good probiotic microorganism should meet the following criterion:

- 257 • Be easily produced at lab or home.
- 258 • Non-toxic and non-pathogenic to the host.
- 259 • Better adherence to the host intestine for positive and lasting results.
- 260 • Withstand at high acid in host's stomach.
- 261 • Remain viable for a longer period of time.

262 Common probiotics include 1) lactobacilli such as *L. acidophilus*, *L. johnsonii*, *L. casei*,  
263 *L. delbrueckii ssp. bulgaricus*, *L. reuteri*, *L. brevis*, *L. cellobiosus*, *L. curvatus*, *L.*  
264 *fermentum*, *L. plantarum*; 2) gram positive cocci such as *Lactococcus lactis ssp.*

265 *cremoris*, *Streptococcus salivarius ssp. thermophilus*, *Enterococcus faecium*, *S.*  
266 *diacetylactis*, *S. intermedius*; and 3) bifidobacteria such as *B. bifidum*, *B. adolescentis*,  
267 *B. animalis*, *B. infantis*, *B. longum* (Mercenier et al., 2002). Also other microbial  
268 species, besides lactic acid bacteria (LAB) like *Bacillus subtilis*, *Propionibacterium*  
269 spp. and yeasts (*Saccharomyces boulardii*) have been accepted and used as probiotics  
270 (Jan et al., 2001).

271 The second generation of probiotics is genetically modified microorganisms (GMO)  
272 providing the host with some necessary components e.g. production of immuno-  
273 modulators (e.g. interleukins). Probiotic products may be conventional foods (yogurt,  
274 cheese, milk) consumed for nutritional purposes, but also for the probiotic effect; food  
275 supplement/ fermented milks or medicinal foods; dietary supplements: capsules,  
276 tablets, liquids, powder (Ross, 2000; Temmerman et al., 2002). Probiotic preparations  
277 used as food supplement can consists of one single strain (e.g. yakult, Japan – *L. casei*  
278 Sirota) or there are mixed cultures of two (e.g. Bacilac, Belgium – *L. acidophilus* plus  
279 *L. rhamnosus*) or even more (e.g. food supplement VSL-3, Italy, contains 8 LAB  
280 species) strains.

281 Historically, humans were exposed to probiotics through fermented foods. The modern  
282 diet however contains dramatically decreased numbers of fermented foods. Moreover,  
283 the increased hygiene measures in food manufacturing plants and restaurants have  
284 resulted in human beings exposed to as few as one millionth of the probiotic organisms  
285 to which their ancestors were exposed (Markowitz and Bengmark, 2002). Ageing,  
286 increased stress and a hectic lifestyle have further contributed to the declining  
287 populations of probiotic organisms in the human gut (Lourens-Hattingh and Viljoen,  
288 2001).

289 In the current situation, it becomes critical to supplement human diet with adequate  
290 doses of probiotic microorganisms to re-establish the intestinal microflora balance and  
291 help maintain good health. Consequently, in recent times, probiotics have been  
292 marketed as dietary supplements in the form of tablets, capsules and freeze-dried  
293 preparations (Shah, 2000). Probiotic cultures can be more effective, when ingested in a  
294 food medium. An empty stomach has a low pH that destroys most bacteria. When food  
295 is ingested, the pH in the stomach quickly rises and probiotic bacteria can easily pass  
296 unharmed to the small intestine where they are most effective (German et al., 1999).

297 In addition to directly introducing live probiotics to the colon through dietary  
298 supplementation, another approach to increase the numbers of beneficial bacteria in the  
299 intestine is using prebiotics (Kurien et al, 2005; Mandal et al, 2006). Prebiotics are  
300 defined as non-digestible food ingredients that beneficially affect the host by  
301 selectively stimulating the growth of beneficial bacteria in the colon, and thus improve  
302 host health (Gibson and Roberfroid, 1995). The prebiotics identified are non-digestible  
303 carbohydrates that supply a source of fermentable sugar for beneficial bacteria only in  
304 the colon (Crittenden, 1999).

305 An approach that combines both probiotics and prebiotics is called *synbiotics* (Ligi et  
306 al, 2006). Synbiotics is defined as a mixture of probiotics and prebiotics that  
307 beneficially affects the host by improving the survival and implantation of live  
308 microbial dietary supplements in the gastrointestinal tract, by selectively stimulating  
309 the growth of a limited number of health-promoting bacteria, and thus improving host  
310 welfare (Gibson and Roberfroid, 1995). In contrast to probiotics, which introduce  
311 exogenous bacteria into the human intestine, prebiotics stimulate the preferential  
312 growth of a limited number of bacteria already existing in a healthy, indigenous  
313 microbiota. The main dairy products enriched with prebiotics are yoghurts and yoghurt  
314 drinks, but spreads, fresh cheeses and milks are also on the market.

315 Conventionally, food healthiness has been associated with nutritional factors such as  
316 fat, fibre, salt and vitamin content. In addition to this traditional healthiness, food may  
317 contain single components that may have a positive impact on our well-being. Products  
318 that are claimed to have special beneficial physiological effects in the body have been  
319 called nutraceuticals, pharma foods, designer foods, nutritional foods, medical foods,  
320 therapeutic foods or super foods (Childs and Poryzees, 1998). More usually they are  
321 termed *functional foods*. The first functional food products were launched in Japan  
322 where a food category called FOSHU (Foods for Specific Health Use) was established  
323 in 1991 to reduce the increasing health-care costs. The first functional probiotic  
324 fermented milk drink 'Yakult' has been available in Japan already since 1935 (Karimi  
325 and Pena, 2003).

326 According to a concerted action project FUFUSE (Functional Food Science in Europe)  
327 coordinated by ILSI (International Life Sciences Institute), "a food can be regarded as  
328 functional if it has been satisfactorily demonstrated to affect beneficially one or more  
329 target functions in the body beyond adequate nutritional effects in a way that is relevant

330 to either an improved state of health and well-being and/or a reduction of risk of  
331 disease” (ILSI Europe, 2002). Besides providing scientifically proven health effects,  
332 functional foods have to maintain a food-like nature and they have to be easily  
333 incorporated into the daily diet. A functional food must remain food and it must  
334 demonstrate its effects in amounts that can normally be expected to be consumed in the  
335 diet: it is not a pill or a capsule, but it is a part of the normal food pattern” (Diplock et  
336 al., 1999).

337 It is now well established that there is a clear relation between diet and health. More  
338 recent discoveries support the hypothesis that, beyond nutrition, diet may modulate  
339 various functions in the body. Functional foods are gaining more widespread popularity  
340 and acceptance throughout the developed world and are already well accepted in  
341 countries like Japan and the United States. Functional foods can include probiotics,  
342 prebiotics and synbiotics (DiRienzo, 2000). The concept of probiotics evolved from a  
343 theory first proposed by Nobel Prize winning Russian scientist, Elie Metchnikoff who  
344 suggested that the long life of Bulgarian peasants resulted from their consumption of  
345 fermented milk products. Probiotic bacteria can be found worldwide in a variety of  
346 products, including conventional food products, dietary supplements and medical  
347 foods. The main outlets for probiotic bacteria are dairy foods and dietary supplements  
348 and medical foods. Dairy foods containing probiotic bacteria include most major brands  
349 of yogurt, culture containing fluid milks, such as sweet acidophilus milk and a few  
350 brands of cottage cheese. Dairy foods seem to fit naturally with probiotics because of  
351 the traditional association of beneficial fermentation bacteria and fermented dairy  
352 product. Consumers naturally associate fermented dairy products with live cultures and  
353 perceive a benefit in the presence of these cultures (Sanders, 2000).

354 The concept of functional foods seems to be attractive and consumers have accepted  
355 such health-tailored food products. For instance, in 1998, Childs and Poryzees (1998)  
356 reported that 42% of Americans were interested in regularly buying foods that could  
357 help prevent disease. Functional food is intended for a population generally in normal  
358 health and must demonstrate beneficial effects in amounts that are usually consumed in  
359 the diet. Functional food is a natural food, to which a component has been added/  
360 removed or a food in which the bioavailability of the components has been modified by  
361 technological or biotechnological means (Korhonen, 2002). Functional foods can be  
362 classified into different groups according to their effects: probiotics, prebiotics and

363 dietary fibers, antioxidants, vitamins, polyphenols, plant sterols, poly-unsaturated fatty  
364 acids and minerals. The most promising targets for functional foods are the GI  
365 functions and particularly control of nutrient bioavailability (Roberfroid, 2000).  
366 However, functional foods can affect different systems in the body, e.g. balanced  
367 colonic microflora, control of transit time and mucosal motility, bowel habits;  
368 modulation of epithelial cell proliferation, balance of redox and antioxidant systems,  
369 metabolism of macronutrients, esp. amino acids, carbohydrates and fatty acids.

### 370 **Functional symbiotic foods**

371 Historically, humans were exposed to probiotics through fermented foods. The modern  
372 diet however contains dramatically decreased numbers of fermented foods. Moreover  
373 the increased hygiene measures in food manufacturing plants and restaurants have  
374 resulted in humans being exposed to as few as one millionth of the probiotic organisms  
375 to which their ancestors were exposed (Markowitz and Bengmark, 2002). Ageing,  
376 increased stress and a hectic lifestyle have further contributed to the declining  
377 populations of probiotic organisms such as lactobacilli and bifidobacteria in the human  
378 gut (Lourens-Hattingh and Viljoen, 2001). In the current situation, it becomes critical to  
379 supplement human diet with adequate doses of probiotic microorganisms to re-establish  
380 the intestinal microflora balance and help maintain good health. Consequently, in  
381 recent times, probiotics have been marketed as dietary supplements in the form of  
382 tablets, capsules and freeze-dried preparations (Shah, 2000). Some of the commercial  
383 probiotic products available in the market are shown in Table 1.

384 Probiotic cultures can be more effective however, when ingested in a food medium. An  
385 empty stomach has a low pH that destroys most bacteria, except those lactic acid  
386 bacteria that adhere to the stomach mucosa. When food is ingested, the pH in the  
387 stomach quickly rises and probiotic bacteria can easily pass mostly unharmed to the  
388 small intestine where they are most effective. Such foods incorporated with probiotic  
389 cultures fall under the category of functional foods which are broadly defined as ‘foods  
390 similar in appearance to conventional foods that are consumed as part of a normal diet  
391 and have demonstrated physiological benefits and/or reduce the risk of chronic disease  
392 beyond basic nutritional functions’ (German et al., 1999). In addition to directly  
393 introducing live bacteria to the colon through dietary supplementation, another  
394 approach to increase the numbers of beneficial bacteria such as bifidobacteria in the  
395 intestinal microbiota is using prebiotics, in the form of synbiotic foods.

396 **MAJOR THERAPEUTIC ATTRIBUTES OF MILK FOODS**

397 In this section, we have described various health benefiting roles of functional dairy  
398 foods:

399 **Lactose intolerance**

400 Lactose, a type of sugar that naturally occurs in milk is hydrolyzed by lactase enzyme  
401 developed in the small intestine. Some people are not able to produce enough lactase so  
402 undigested lactose is broken up by the bacteria in the large intestine causing gas,  
403 bloating, pain and diarrhea. This condition is called ‘lactose intolerance’ and is quite  
404 common in most parts of the world. One can be born lactose intolerant or develop it  
405 later in life (Heyman, 2006).

406 There is convincing evidence from several studies that symptoms of lactose-intolerance  
407 are reduced with the consumption of probiotic dairy products (Fonden et al, 2000;  
408 Salminen and Gueimonde, 2004). The mechanism of action of probiotic bacteria and  
409 fermented products includes lowering of lactose concentration in the product that could  
410 result in high lactase activity and thereby increasing the active lactase enzyme entering  
411 the small intestine. The bacterial enzyme, beta-galactosidase found in the ileum after  
412 consumption of fermented milk products with viable probiotic bacteria is the major  
413 factor that improves digestibility by lactose hydrolysis (de Vrese et al., 2001; Saltzman  
414 et al., 1999; Vesa et al., 2000; Vinderola and Reinheimer, 2003). This is true for all  
415 fermented dairy products, especially yoghurt/ dahi, owing to the enzyme activity of the  
416 culture and the higher consistency of fermented milks compared with ordinary milk.  
417 Milk and milk products are highly nutritious, so people who suffer from lactose  
418 intolerance should not give them up entirely. One can still consume milk in moderate  
419 quantities i.e. half a cup of milk, three quarters of a cup of ice-cream or yoghurt etc.  
420 Milk foods that contain lactose are better tolerated, if eaten with other foods containing  
421 probiotic bacteria or spread out over the day, rather than being eaten in large amounts at  
422 once (Talhok et al, 1996; Salminen et al, 1999).

423 **Hypertension**

424 According to the Vedic literature, milk also helps in relieving mental tension. Milk also  
425 suppresses pain during abortion, childbirth and at times of extreme fatigue.  
426 Hypertension, a modern day’s problem is influenced by genetic and environmental  
427 factors. People with high blood pressure are at increased risk of cardiovascular disease

428 and stroke. It is not only an excess of one electrolyte (sodium) in our diets but also  
429 rather inadequate levels of several others that produce hypertension. An adequate intake  
430 of calcium, potassium, and magnesium has now been documented to reduce blood  
431 pressure. It has already been proved that effect of milk on blood pressure is greater and  
432 more rapid than that of calcium alone. Milk and dairy products are meaningful sources  
433 of all three nutrients along with certain bioactive peptides with a potential to reduce  
434 blood pressure. Main components of milk products with anti-hypertensive activity  
435 include: calcium, peptides derived from whey proteins, casein phosphopeptides,  
436 fermented dairy products (Patel and Renz-Schanen, 1998; Marshall, 2004; Ashar and  
437 Chand, 2004a, b).

#### 438 **Heart diseases**

439 According to the Puran, consumption of milk with Nagara roots, Suvarcala salt and  
440 Sivagharta was a remedy for all heart ailments. It was also reported that milk cooked  
441 with dried pippali and consumed with honey, sugar and ghee cured cough and chronic  
442 heart diseases. Milk and dairy products contain components with at least a protective, if  
443 not hypocholesterolemic, effect such as calcium, conjugated linoleic acid, antioxidants  
444 and probiotic bacteria. Linoleic acid is also favorable in reducing coronary heart  
445 disease risks in humans. Probiotics, in the form of fermented milk products, have the  
446 reputation of cholesterol-lowering properties in humans. Some bacteria harbor enzymes  
447 that are capable of utilizing cholesterol (Gilliland et al., 1984; James et al., 1999; Xiao  
448 et al., 2003).

#### 449 **Overweight**

450 Due to lack of knowledge, a lot of people, who are trying to lose weight, avoid milk  
451 and other dairy foods. However, it is well known that dairy foods in a low-calorie diet  
452 may actually help with managing the body weight. A number of studies have shown  
453 that a low-calorie diet, rich in dairy nutrients, may actually change the way fat cells  
454 work, reducing the amount of body fat stored, particularly from around the abdominal  
455 (waist) region. Weight loss from around the abdomen is beneficial for reducing the risk  
456 of heart disease and type-2 diabetes. Maintaining a healthy body weight means burning  
457 off at least as many calories as you eat. If you need to watch your weight, then choose  
458 reduced fat and low fat dairy products for fewer calories (Zemel, 2005).

459

## 460 **Dentist milk foods**

461 Teeth and bones are very alike. So the calcium, phosphorus and protein found naturally  
462 in dairy foods are just as important for building and maintaining strong healthy, teeth as  
463 they are for your bones (Patel and Renz-Schanen, 1998; Bowen, 2002; Johansson,  
464 2002). Dairy foods are beneficial for your teeth in a number of ways:

- 465 • Calcium, phosphorus and protein can help build and maintain strong, healthy teeth.
- 466 • Milk is a tooth friendly drink, safe for in between meals, as it does not promote  
467 dental caries.
- 468 • The nutrients in milk and dairy can reduce the build up of acid on your teeth which  
469 occurs after eating sugary foods
- 470 • The combination of casein, phosphorus and calcium in cheese may actually help  
471 remineralize teeth and help reduce your risk of tooth caries.
- 472 • Stimulated saliva flow that is beneficial in a number of ways
- 473 • The dentists' recommends eating a small amount of cheese after meals as it may  
474 reduce your risk of dental caries.

## 475 **Diabetes management**

476 People, who have a high low-fat milk food intake, have a lower risk of type-2 diabetes  
477 mellitus; hence, diet and lifestyle modifications can substantially reduce the risk of  
478 type-2 diabetes. While a strong inverse association has been reported between milk  
479 food consumption and the insulin resistance syndrome among young obese adults, the  
480 relation between milk food intake and type-2 diabetes is yet to be completely  
481 understood. Dairy products i.e. dahi may produce an anorexic or insulinotropic effect  
482 and hence, reduces the risk of diabetes (Hyon et al, 2005; Yadav et al, 2006b).

## 483 **Disease resistance**

484 Some of the probiotic dairy products have been shown to enhance immune functions  
485 and thus to reduce the risk of infection in consumers. Milk and colostrums contains  
486 some natural immunoglobulins which reduce the risk of many infections in the host by  
487 preventing the occurrence of infections by microbes (Haque and Chand, 2006).

488

489

490 **Sleeping sickness**

491 Melatonin is a hormone that controls the body's day and night rhythm. The secretion of  
492 melatonin is high in early childhood and decreases rapidly with ageing. Stress  
493 conditions and age causes lowering of the level of melatonin. It is secreted at nights in  
494 both humans and bovines. The concentration of melatonin in cows' milk at night is  
495 about four times higher than in milk collected during the day. The level of melatonin in  
496 the milk complements that of the human body, and hence, the drink helps in having a  
497 relaxed sleep if taken at night or late in the evening, without causing any drowsiness the  
498 following morning (Irina et al, 1999; Valtonen et al, 2005).

499 **Against bad bugs**

500 Acute diarrhea is a serious cause of infant death. Bhava Prakash commends the  
501 antimicrobial properties of milk and its usefulness in controlling gastrointestinal  
502 disorders such as diarrhea and dysentery. The factors responsible for antimicrobial  
503 properties of milk are:

- 504 • Immunoglobulins: are present in high levels in colostrums. These can detoxify  
505 toxins, fight viruses, inhibit entero-pathogenic adherence to intestinal wall, prevent  
506 the absorption of food antigens, suppresses the growth of pathogens and aid in  
507 phagocytosis (Walzem, 2001).
- 508 • Lactoferrin: a whey protein present in bovine milk, strongly bind to iron, making it  
509 unavailable to entero-phathogenic bacteria (Reiter, 1985; Marshall, 2004)
- 510 • Lysozyme: present in bovine milk, degrades the bacterial cell wall of invading  
511 pathogens.
- 512 • Lactoperoxidase: interact with hydrogen peroxide produced by microbial growth,  
513 producing certain intermediary compounds that eventually lyse the pathogenic  
514 bacterial cell wall (Ballongue, 1998).

515 **Cancer**

516 Epidemiological studies indicate that humans who consume milk are less likely to  
517 develop cancer of the colon and the rectum. Conjugated linoleic acid is a natural  
518 component in milk fat and it may reduce the risk of certain diseases, such as breast  
519 cancer. The amount of conjugated linoleic acid in milk is higher in whole milk than in  
520 reduced or low fat milk. Yogurt consumption has been associated with a reduced  
521 incidence of colon cancer in some population groups, which was associated with  
522 peptides formed during fermentation (Ganjam et al, 1997).

523 Colorectal cancer is one of the leading causes of cancer morbidity and mortality and it  
524 is thought to be caused by an interaction between dietary factors and genetic  
525 predisposition. The components in dairy foods, which may protect against colon cancer,  
526 are above all calcium, vitamin D, probiotic lactic acid bacteria, a class of fatty acids  
527 known as conjugated derivatives of linoleic acid and bioactive peptides derived from  
528 milk proteins (Marshall, 2004; Rehmeyer, 2006).

### 529 **Bone ailments**

530 Calcium is widely recognized as very important ingredient for proper bone health. The  
531 consumption of milk and dairy products has been recommended since ancient times for  
532 strong bones. In addition to being a rich source of calcium, whey protein contains an  
533 active fraction that stimulates the proliferation of bone forming cells (Patel and Renz-  
534 Schanen, 1998; Whiting and Lemke 1999; Heaney, 2000). Dairy foods, which are rich  
535 in biologically available calcium, have long been shown to retard and minimize  
536 osteoporosis. We need calcium everyday because bones are continually being repaired  
537 and renewed (that's how broken bones mend!).

### 538 **Youthful foods**

539 Vasistha the ancient saint, retained perpetual youth for over thousand years by  
540 consuming milk and milk products obtained from divine cow Nandini, as mentioned in  
541 the Mahabharata. Milk products contain adequate amounts of essential nutrients that  
542 help in maintaining normalcy in health and general well being. Halawa prepared from  
543 whole- wheat flour and ghee is fed postpartum to ladies to overcome weight loss, to  
544 prepare the body for the additional requirement of feeding the child and tone-up the  
545 internal organs affected by pregnancy and childbirth (Grover and Dalal, 1993).

### 546 **Eye-ailments**

547 Milk incorporated with small amount of triphala paste acts as an excellent cure for  
548 several eye diseases if applied regularly into the eyes. Bhava Prakash states that freshly  
549 churned Makkhan is an excellent lubricant for eyes. Regular application of a few drops  
550 of fresh cow ghee in eyes is useful in preventing eye ailments according to the  
551 Ayurveda and also for exercising the eye muscles, as is practiced in traditional dance  
552 form Kathakali. Bovine milk particularly colostrums has high levels of vitamin A  
553 activity that initiates vision from light energy, and is essential for growth and in  
554 maintaining the epithelial tissue of eye. Cataract is a major cause of blindness in the

555 elderly. Recent epidemiological evidences suggest that eating of yogurt leads to dose-  
556 related protective effects against cataract (Salmon, 1994).

### 557 **Suppress appetite**

558 The soluble fraction remaining in whey after rennet coagulation of milk can suppress  
559 appetite by stimulation of the pancreatic hormones, which stimulates the gall bladder  
560 contraction and bowel mobility and regulates gastric emptying optimally (Walzem,  
561 2001). Hence, this can avoid excessive and frequent dietary intake that ultimately leads  
562 to several complicated disorders.

### 563 **Delaying of AIDS**

564 During the past several years there have been several reports that whey proteins can be  
565 beneficial to patients with HIV infections. Supplementation with whey proteins  
566 increases plasma glutathione in advanced HIV infections that lead to better tolerance of  
567 the treatment. During a two weeks trial, the commercial source of protein did influence  
568 the extent of increase in plasma glutathione levels (Micke et al., 2001, 2002). Whey  
569 protein also has been shown to improve muscle strength in women with HIV (Agin, et  
570 al., 2001). Lactoferrin has also been shown to be inhibitory to HIV virus (Berkhout, et  
571 al., 2003). Ng et al. (2001) evaluated a number of bovine milk proteins for activity  
572 against HIV-1 enzymes which are considered to be important for the life cycles of the  
573 HIV virus.

### 574 **Rotavirus diarrhea**

575 Several studies have shown selected probiotics such as *L. reuteri*, *L. casei* Shirota, *B.*  
576 *lactis* Bb12 and *L. delbrueckii* ssp. *bulgaricus* can shorten the duration of rotavirus  
577 diarrhea by approximately one day (Boudra et al., 2001; Chandra, 2002; Kaila et al.,  
578 1992; Saavedra et al., 1994; Shornikovacasas et al., 1997; Sugita and Togawa, 1994).  
579 Shortening of the duration of rotavirus diarrhea using the probiotic strain *L. rhamnosus*  
580 GG is perhaps the best documented probiotic effect. It has been well documented in  
581 several studies around the world and in a recent multicenter study in Europe  
582 (Guandalini et al., 2000). *L. acidophilus*, has also been documented to shorten the  
583 duration of rotavirus diarrhea (Simakachorn et al., 2000). The mechanism behind this  
584 favourable outcome is associated with enhancement of IgA to rotavirus and serum IgA  
585 antibody level at convalescence. It is therefore suggested that certain strains of  
586 probiotic bacteria promote systematic and local immune response to rotavirus, which

587 may be of importance for protective immunity against re-infections (DeRoos and  
588 Katan, 2000; Fonden et al., 2000; McFarland, 2000).

#### 589 **Antibiotic-associated diarrhea**

590 *L. rhamnosus* GG, *L. acidophilus*, *B. longum* and *B. animalis* have been reported to  
591 prevent antibiotic-associated diarrhea when consumed either in yogurt form or as a  
592 freeze-dried product (Arvola et al., 1999; Colombel et al., 1987; McFarland, 1998,  
593 2000; Siitonen et al., 1990; Thomas et al., 2001; Vanderhoof et al., 1999; Witsell et al.,  
594 1995). These effects are mainly documented in infants; however, in case of adults, the  
595 data is not yet clear (Salminen and Gueimonde, 2004).

#### 596 **Allergy prevention and alleviation**

597 The prevalence of allergic diseases has been on rise in the past few decades and is  
598 likely to continue to do so. It has been found that differences in intestinal microbiota  
599 composition precede the development of some allergic diseases (Bjorksten et al., 2001;  
600 Kalliomaki et al., 2001). This therefore indicates potential application of probiotic  
601 bacteria in this area. Administration of *L. rhamnosus* GG and *B. lactis* Bb12 prenatally  
602 to mother and during the first few months to infants with high risk of atopic disease  
603 reduced the prevalence of atopic eczema (HelinHaatela et al., 2002; Kalliomaki et al.,  
604 2003; Majama and Isolauri, 1997). Additionally, supplementation of extensively  
605 hydrolyzed whey with *L. rhamnosus* GG or *B. lactis* Bb12, has been found to be more  
606 effective than unsupplemented formula on eczema alleviation in infants with atopic  
607 eczema (Isolauri et al., 2000).

#### 608 **BIOACTIVE PEPTIDES FROM MILK**

609 Milk is well known to contain an array of bioactivities, which extends the range of  
610 influence of mother over young beyond nutrition alone. Most of the bioactivities of  
611 milk are attributable to the proteins and peptides secreted into milk by mammary gland.  
612 Many milk borne bioactivities are latent and require proteolytic release of bioactive  
613 peptides from inactive native milk proteins. However, some are natural and do not  
614 require digestion which otherwise destroy their bioactivities. Bioactive peptides have  
615 been identified as decomposition products of several food proteins (Brantl et al., 1979;  
616 Zioudrou et al., 1979; Loukas et al., 1983). Milk proteins are the most important  
617 sources of bioactive peptides. These have been shown to have various activities  
618 including opiate, antithrombotic or antihypertensive activity, immunomodulating or

619 mineral utilization properties. Some of them have been known to influence in insulin  
620 secretion or the motility and secretion of the intestine (Daniel et al., 1990). Bioactive  
621 peptides may be generated from milk protein *in-vivo* through gastrointestinal processes.  
622 Often, this liberation serves to influence numerous physiological responses as a result  
623 of their hormone like properties. These peptides encoded within the sequences of native  
624 protein precursors may also be generated *in-vitro* by enzymatic hydrolysis, such  
625 peptides from protein hydrolysates could be purified by various separation techniques.  
626 The physiologically active peptides have been chemically synthesized to confirm the  
627 biological properties associated with a specific amino acid sequence. There is  
628 considerable evidence that many bioactive peptides serve in multifunctional capacities  
629 and influence numerous biological processes evoking behavioral, gastro intestinal,  
630 hormonal, immunological, neurological and nutritional responses. The specific bio-  
631 reactions associated with each physiological class have been well characterized.

632 The major bioactivities of milk are summarized into four categories (based on their  
633 biological roles) as shown below:

634 a) Having gastrointestinal developmental activity and function:

635 i) Break down product of casein – casomorphins, casokinnins (ACE-I)

636 ii) Lactoferrin

637 iii) Growth factors IGE<sub>1</sub>, TGF, EGF etc.

638 b) Having role in infant development:

639 i) Milk peptides

640 ii) Prolactin

641 iii) Growth factors

642 iv) Prosuposin

643 c) Having immunological functions:

644 i) Immunoglobulin IgG and IgA

645 ii) Cytokinins

646 iii) Prolactin

647 iv) Lactoferrin

- 648 v) Caseins – casomorphs and casokinins
- 649 d) Having microbiotic activity:
- 650 i) Antibiotic: Immunoglobulins, Lactoferrin, Glycolipids and
- 651 Oligosaccharides
- 652 ii) Probiotic: Lactoferrin, k-casein glycomacropeptide and oligosaccharides

653 Depending upon their physiological functions, the bioactive peptides have been

654 categorized as below:

- 655 • Antihypertensive
- 656 • Antimicrobial
- 657 • Antithrombic
- 658 • Mineral Binding
- 659 • Opioid

660

661 Although bioactive peptides do exist in a number of processed and fermented foods,

662 their true physiological functions in humans are unknown. In healthy individuals

663 eating a varied diet, the presence of bioactive peptides may help in keeping the

664 nervous, immune and digestive systems in a well-maintained state. The future

665 potential value of bioactive peptides in the diet may be their ability to affect certain

666 pathological conditions, although this has yet to be proven. Casein derived peptides

667 have already found interesting applications as dietary supplements (phosphopeptides)

668 and as pharmaceutical preparations (phosphopeptides, casomorphins) (Brule et al.,

669 1982, Reynolds, 1994). The efficacy and safe conditions of use of these peptides in

670 animals and in humans remain to be proven. At present, ACE-inhibitory peptides

671 and phosphopeptides are an important area in which bioactive peptides may be found

672 to be useful ingredients for dietary applications. Peptides have also been shown to

673 exert beneficial physiological effects (Table 2). These milk peptides may be

674 considered as food additives and perhaps as starting components for development of

675 some drugs. Casein derived peptides have already found interesting applications as

676 dietary supplements and pharmaceutical preparations. Today, some of the biologically

677 active peptides are known to be released during the *in-vivo* digestion, however, their

678 physiological function are not clearly understood, and hence, more research is needed  
679 to fully understand the functional significance of these substances.

## 680 **FUTURE PROSPECTS AND CONCLUSIONS**

681 The three most important factors contributing to health are diet, exercise and genetic  
682 factors. People conventionally think that food is food and medicine is medicine with no  
683 overlap between the two. At the end of the 1980s and particularly during the 1990s,  
684 interest in the area of relation between milk, milk products and health was generated  
685 and has increased significantly. Nowadays, such products are termed functional, i.e.  
686 foods that have an effect on health beyond their nutritional value. Their development  
687 has aroused immense interest and today, there are hundreds of foods in the market that,  
688 in addition to nutrition, also have health-maintaining or even therapeutic effects. The  
689 efficacy of the active ingredient used in a functional food or of a product that contains it  
690 has to be demonstrated in humans. There has to be a sufficient quantity of the active  
691 ingredient in the food. However, only a small fragment of global population is familiar  
692 with terms like probiotics and functional food. Probiotics are perfect fit for these dairy-  
693 based beverages, as dairy is an excellent vehicle to deliver beneficial bacteria such as  
694 *Bifidobacterium* and *Lactobacillus* species. Consumption of probiotics with dairy foods  
695 such as milk, yogurt and cheese buffers the stomach acid and increases the chance that  
696 the bacteria will survive into the intestine. The healthful properties of probiotics also  
697 work well with the healthful properties of dairy beverages. Probiotic cultures have been  
698 shown in a variety of test systems to stimulate certain cellular and antibody functions of  
699 the immune system. Exposure to probiotics early in life may decrease the risk of  
700 allergy. However, more rigorous research is required before such claims gain improved  
701 scientific credibility.

702 Milk is a rich source of nutritive compounds that can be enriched and/or further  
703 modified to give the best benefit to the consumers. However, in developing therapeutic  
704 dairy products, various groups of medical experts, nutritionists and microbiologists are  
705 considered important for their association. Food technologists are looked-for product  
706 development technologists and biotechnologists for processing the compounds,  
707 chemists to analyze these and, finally, the experts for marketing the products. It is  
708 important to remember that therapeutic dairy products are mainly for supplying  
709 nutritive foods for everyday consumption. Hence, nutria-marketing is also preferred to

710 explain research results to healthcare professionals and consumers so as to convince  
711 them of the benefits of therapeutic milk foods.

712

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- 922

923 **Table 1. Some commercial health-promoting probiotic products (Nagpal et al.,**  
 924 **2007a)**

<b>Product</b>	<b>Probiotic</b>
Muller Vitality Probiotic Yoghurt, UK.	<i>L. acidophilus</i> and <i>Bifidobacterium</i> sp.
Crunch n Yogurt™, General Mills, USA	<i>L. acidophilus</i> , <i>L. bulgaricus</i> and <i>Streptococcus thermophilus</i>
Classic flavor, France	<i>L. acidophilus</i>
Lactinex powder, Hyson, Westcott and Dunning	<i>L. acidophilus</i> and <i>L. bulgaricus</i>
LGG capsules, Japan	<i>L. rhamnosus</i> GG
LGG Milk, Japan	<i>L. rhamnosus</i> GG
LGG+, Iceland and Greenland	<i>L. rhamnosus</i> GG
Dukat BioAktiv Dairy Product, Slovenia	<i>L. rhamnosus</i> GG
Tnuva LGG1, Israel	<i>L. rhamnosus</i> GG
Beautiful Day LGG, Taiwan	<i>L. rhamnosus</i> GG
Culturelle capsules, USA	<i>L. rhamnosus</i> GG
Yakult, Japan	<i>L. casei</i>
Bacilac, Belgium	<i>L. acidophilus</i> plus <i>L. rhamnosus</i>
VSL-3, Italy	8 LAB species
Vitacel® prolac, Rosenberg	<i>Lactobacillus reuteri</i>
Amul Prolife probiotic ice-cream, India	<i>L. cremoris</i> , <i>L. lactis</i> , <i>L. bulgaricus</i> and <i>L. acidophilus</i>
Probiotic Dahi (yoghurt), NDRI, Karnal, India	<i>L. acidophilus</i> and <i>L. casei</i>
Symbalance yogurt, Switzerland	<i>L. reuterii</i> , <i>L. acidophilus</i> and <i>L. casei</i>

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927 **Table 2. Bioactive peptides identified in various fermented milk products.**

<b>Product</b>	<b>Bioactivity</b>	<b>Reference</b>
<b><i>Fermented milks</i></b>		
Sour milk	Phosphopeptides	Kahala et al., 1993
Sour milk	ACE-inhibitory	Nakamura et al., 1995
Sour milk	$\beta$ -casomorphin-4	Matar et al., 1996; 2003
Fermented milk (Treated with pepsin and trypsin)	ACE-inhibitory Immunomodulatory Opioid	Rokka et al., 1997
Yoghurt	ACE-inhibitory (weak), Immunomodulatory, Antihypertensive, Antiamnesic, Microbicidal, Antithrombotic	Meisel et al., 1997
<b><i>Cheeses</i></b>		
Parmesan and Reggiano	$\beta$ -casomorphin precursors	Addeo et al., 1992
Cheddar	Phosphopeptides	Singh et al., 1997
Edam, Emmental, Gouda	ACE-inhibitory	Meisel et al., 1997
Mozzerella, Italico, Crescenza	ACE-inhibitory	Smacchi and Gobbetti, 1998
Edam, Emmental, Turunmaa	ACE-inhibitory	Ryhanen et al, 2001
Cheddar, Edam, Swiss, Feta	Antihypertensive Anti amnesic Opioid	Dionysius et al., 2000

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