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Kefir: A Probiotic Dairy-Composition, Nutritional and Therapeutic Aspects

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Abstract: Kefir is fermented milk only made from kefir grains and kefir cultures as no other milk culture forms. Kefir grains are the mixture of beneficial bacteria and yeast with a polysaccharide matrix. During fermentation lactic acid, CO_2, ethyl alcohol and aromatic compounds that make its unique organoleptic properties are occurred. Kefir is used for the treatment or control of several diseases for many years in Russia. It is begun to consume in some areas of the world, southwestern Asia, eastern and northern Europe, North America and Japan for its nutritional and therapeutic aspects. This paper attempts to review the consumption, process, chemical and nutritional composition and the health benefits of kefir.

Key words: Kefir, probiotic, fermented milk

Introduction

Kefir is a traditional popular Middle Eastern beverage. The world of kefir is said to have originated from the Turkish word 'Keyif' which means 'good feeling'. It is due to overall sense of health and well being when consumed (Chaitow and Trenev, 2002). It originates in the Caucasus Mountains in the former Soviet Union, in Central Asia and has been consumed for thousands of years. It is the product of fermentation of milk with kefir grains and mother cultures prepared from grains. Kefir grains look like pieces of coral or small clumps of cauliflower, which contain a complex mixture of both bacteria (including various species of lactobacilli, lactococci, leuconostocs and acetobacteria) and yeasts (both lactose-fermenting and non-lactose-fermenting) such that beneficial yeast as well as friendly probiotic bacteria found in yogurt. Kefir grains or mother cultures from grains (Libudzisz and Piatkiewicz, 1990) are added to different types of milk. It can be made from any type of milk; cow, goat or sheep, coconut, rice and soy but commonly cow milk is used. The grains cause its fermentation that results numerous components in the kefir including lactic acid, acetic acid, CO_2, alcohol (ethyl alcohol) and aromatic compounds. That provides kefir's unique organoleptic characteristics: fizzy, acid taste, tart and refreshing flavor (Anonymous, 1992). Kefir is made traditionally so that the grains and technology used can vary significantly and thus result in products with different compositions. Kefir contains vitamins, minerals and essential amino acids that help the body with healing and maintenance functions and also contains easily digestible complete proteins. The benefits of consuming kefir in the diet are numerous. Kefir has frequently been claimed to be effective against a variety of complaints and diseases (Hosono *et al*., 1990). Several studies have investigated the antitumor activity of kefir (Cevikbas *et al*., 1994; Furukawa *et al*., 1990; Furukawa *et al*., 1991) and of kefir grains (Murofushi *et al.,* 1983; Shiomi *et al*., 1982) and antimicrobial activity *in vitro* against a wide variety of gram-positive and gram-negative bacteria and against some fungi (Cevikbas *et al*., 1994; Zacconi *et al*., 1995).

An overview of the characteristics; including chemical and nutritional composition, production process and treatment of illnesses of kefir are being reviewed in this article.

Kefir as a probiotic: Kefir is a natural probiotic. Probiotics are foods that contain live bacteria, which are beneficial to health (Salminen *et al*., 1998). According to another definition, a probiotic is a live microbial food supplement that beneficially affects the host animal by improving the microbial balance and they are used in fermented dairy products (Gorbach, 1996). The term 'probiotic' dates back to 1965 when it referred to any substance or organism that contributes to intestinal microbial balance (Lilley and Stillwell, 1965), primarily of farm animals. At the beginning of this century, the basic probiotic concept was first conceived by Metchnikoff (1907) and he had long believed that the complex microbial population in the colon was having an adverse effect on the host through autointoxication. It was later revised to insist on the notion of a live microbial feed supplement, rather than any substances and became more relevant for humans (Fuller, 1989). Up until then, fermented milks had been a common source of food (Fuller, 1999). Most recently, probiotics is defined as 'living organisms, which upon ingestion in certain numbers, exert health benefits beyond inherent basic nutrition' (Schaafsma, 1996). This revision emphasizes the need for sufficient populations of live microorganisms and further indicates that benefits can include both improvement of microbial balance and other health effects. Kefir contains live active cultures of normal flora which is made of vary strong strains of microorganisms that help to over take pathogenic

organisms, repopulate the digestive tract and aid in digestion. The microorganisms predigest the protein that enchanting protein digest and absorption and also use the lactose thus many people whom have lactose intolerance problem can be consume kefir.

Consumption of kefir: Kefir has been consumed for thousands of years and originated in the Caucasus Mountains in the former Soviet Union. Although kefir is just being discovered in some areas of the world, it has been very popular in the former Soviet Union, Hungary and Poland for many years (Komai and Nanno, 1992). It is also well known in Sweden, Norway, Finland and Germany (Kroger, 1993), as well as in Greece, Austria, Brazil and Israel (Hallé *et al*., 1994). The popularity is growing in the United States and Japan.

In many countries, kefir-related products are also produced (Kurmann *et al.*, 1992). Some of them are:

Freeze-dried Kefir made from concentrated milk (360 g/kg total solids) and fermented using traditional grains, Buttermilk Kefir, a traditional product made from skimmed milk,

Cultured milk Kefir, produced from a special blend of baker's yeast together with a cream or yoghurt starter culture (none of which originated from Kefir grains), Kefir-like products, manufactured using blends of micro-organisms which result in a varying range of sensory properties, but lacking the typical characteristics of traditional Kefir; products with in these categories are known as Omaere (in South-West Africa), Rob or Roba (in some Arab countries), KjaKlder MjoKlk (in Norway), Kellermilch (in Germany), Tarag (in Mongolia) and Kefir (in Turkey),

Osobyi, a modified Kefir produced in Russia from bovine milk low in fat, but with enriched protein. Although bovine, caprine and ovine milk are widely used for the manufacture of many different types of fermented milk products, little information is available on the sensory quality of Kefir made with different mammalian milks.

Kefir grains: Kefir is made only made kefir grains or mother cultures which prepared from kefir grains (Picture 1). Kefir grains are prepared in a goat-hide bag filling with pasteurized milk inoculated with sheep intestinal flora, followed by culture of the surface layer in milk. Gradually a polysaccharide layer appears on the surface of the hide. The layer is removed from the hides and propagated in pasteurized milk. Kefir grains appear pieces of coral or small clumps of cauliflower florets or pop corn and range from 3 to 20 mm in diameter (Libudzisz and Piatkiewicz, 1990). The grains look like gelatinous white or yellow particles. These grains contain lactic acid bacteria (lactobacilli, lactococci, leoconostocs), acetic acid bacteria and yeast mixture clumped together with casein (milk proteins) and complex sugars by a matrix of polysaccharides. It is described as a symbiotic association. The overall organization of microorganisms of grains is not completely elucidated. The grain matrix is composed of a complex of 13% protein (by dry weight), 24% polysaccharide, plus cellular debris and unknown components (Hallé *et al*., 1994). The principal polysaccharide is a water-soluble substance known as kefiran. Several homofermentative Lactobacillus species including *L. kefiranofaciens* and *L. kefir* (Toba *et al*., 1987; Yokoi *et al*., 1991) produce this polysaccharide. The authors found that Kefiran producing, encapsulated *L. kefiranofaciens* that are located all over the grain and increased in the center, while *L. kefir* populated only a small region at the surface layer (Arihara *et al*., 1990).

Kefir process: There are several methods of producing kefir. Commonly traditional and industrial processes are used and also food scientists are currently studying modern techniques to produce a kefir with the same characteristics as those found in traditional kefir. Kefir can be made from any type of milk, cow, goat, sheep, coconut, rice or soy. There are many choices for milk; pasteurized, unpasteurized, whole fat, low fat, skim and no fat.

Traditional process: The traditional method of making kefir is occurred by directly adding kefir grains. The raw milk is boiled and cooled to 20-25 ^{o}C and inoculated with 2-10% (generally 5%) kefir grain. After a period of fermentation, 18-24 hours at 20-25 ^{o}C, the grains are separated from the milk by filtering with a sieve and can be dried at room temperature and kept at cold temperature for being used in the next inoculation. Kefir is stored at 4 ^{o}C for a time then is ready for consumption (Karagozlu and Kavas, 2000). The traditional process of kefir is shown in Fig. 1.

Industrial process: In industrial process of kefir, different methods can be used but basically up on the same principle. The first step is to homogenize the milk to 8% dry matter and held by heat treatment at 90-95 ^{o}C for 5-10 minutes. Then cooled at 18-24 ^{o}C and inoculated with 2-8% kefir cultures (bacterial starters) in tanks. Fermentation time is changed for 18 to 24 hours. The coagulum is separated by pomp and distributed in bottles. After maturing at 12-14 ^{o}C or 3-10 ^{o}C for 24 hours, kefir is stored at 4 ^{o}C (Koroleva, 1988). The industrial process of kefir is shown in Fig. 2.

Chemical and nutritional composition of kefir: The composition of kefir is variable and not well defined (Zubillaga *et al*., 2001). It depends on the source and the fat content of milk, the composition of the grains or cultures and the technological process of kefir. The chemical composition of kefir is shown in Table 1. The major products formed during fermentation are lactic

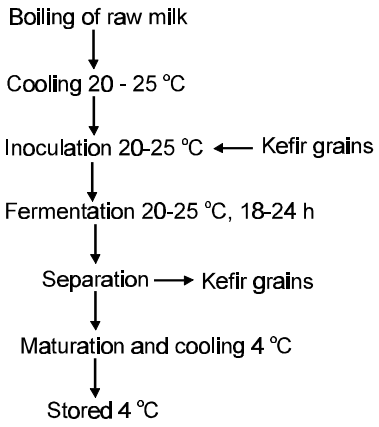

Fig. 1: The traditional process of kefir

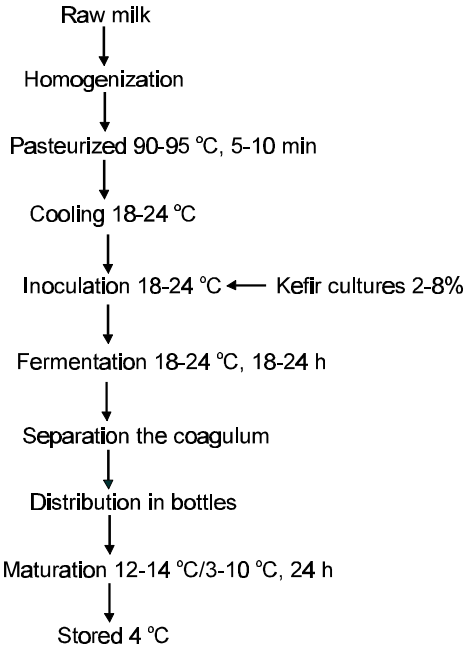

Fig. 2: The industrial process of kefir

acid, CO_2 and alcohol. Diacetyl and acetaldehyde, which are aromatic compounds, are present in kefir (Zourari and Anifantakis, 1988). Diacetyl is produced by Str. lactis subsp. diacetylactis and *Leuconostoc sp.* (Libudzisz and Piatkiewicz, 1990). The pH of kefir is 4.2 to 4.6 (Odet, 1995).

The chemical composition and nutritional values of kefir are shown in Table 1. In addition to beneficial bacteria and yeast, kefir contains vitamins, minerals and essential amino acids that help the body with healing and maintenance functions. Kefir is rich in Vitamin B_1, B_{12}, calcium, amino acids, folic acid and Vitamin K. It is a good source of biotin, a B vitamin that aids the body's assimilation of other B vitamins, such as folic acid, pantothenic acid and B_{12}. The numerous benefits of B

Picture 1: Kefir grains

vitamins are regulation of the kidneys, liver and nervous system to helping relieve skin disorders, boost energy and promote longevity. Kefir has the complete proteins that are partially digested and in this respect the body easily utilizes them. Tryptophan is one of the essential amino acids in kefir that is well known for relaxing effect on the nervous system and calcium and magnesium are abundant in kefir, which are important minerals for a healthy nervous system. Kefir is also a good source of phosphorus, which is the second most abundant mineral in our bodies, helps utilize carbohydrates, fats and proteins for cell growth, maintenance and energy (Saloff-Coste, 1996).

Kefir is a good diet for lactose intolerant individuals that have the inability to digest significant amounts of lactose that is the predominant sugar of milk. The lactose content is decreased in kefir and the $-galactosidase level is increased as a result of fermentation (Zourari and Anifantakis, 1988).

Health benefits of kefir: Many researchers have investigated the benefits of consuming kefir. More than a thousand years of consumption have demonstrated that the microorganisms in kefir are not pathogenic. Kefir is used in hospitals and sanatoria for a variety of conditions, including metabolic disorders, atherosclerosis and allergic disease in the former Soviet Union (Koroleva, 1988). It has even been used for the treatment of tuberculosis, cancer and gastrointestinal disorders when modern medical treatment was not available and has also been associated with longevity in Caucasus (Cevikbas *et al*., 1994; Zourari and Anifantakis, 1988). Regularly kefir consumption can be help to relieve all intestinal disorders, promote bowel movement, reduce flatulence and create a healthier digestive system. It cleans effectively the whole body that helps to establish a balanced inner ecosystem for optimum health and longevity and however easily

Table 1: The chemical composition and nutritional values of kefir (Renner and Renz-Schaven, 1986; Hallé *et al.*, 1994)

Components	100 g	Components	100 g
Energy	65 kcal	Mineral content (g)	
Fat (%)	3.5	Calcium	0.12
Protein (%)	3.3	Phosphor	0.10
Lactose (%)	4.0	Magnesium	12
Water (%)	87.5	Potassium	0.15
		Sodium	0.05
Milk acid (g)	0.8	Chloride	0.10
Ethyl alcohol (g)	0.9		
Lactic acid (g)	1	Trace elements	
Cholesterol (mg)	13	Iron (mg)	0.05
Phosphatateds (mg)	40	Copper (µg)	12
		Molybdenum (µg)	5.5
Essential amino acids (g)		Manganese (µg)	5
Tryptophan	0.05	Zinc (mg)	0.36
Phenylalanin+tyrosine	0.35		
Leucine	0.34		
Isoleucine	0.21	Aromatic compounds	
Threonine	0.17	Acetaldehyde	
Methionine+cystine	0.12	Diacetyl	
Lysine	0.27	Acetoin	
Valine	0.22		
Vitamins (mg)			
A	0.06	B_{12}	0.5
Carotene	0.02	Niacin	0.09
B_1	0.04	C	1
B_2	0.17	D	0.08
B_6	0.05	E	0.11

digested, provides beneficial bacteria and yeast, vitamins and minerals and complete proteins and is a nourishing food to contribute a healthy immune system and has been used to help patients suffering from AIDS, chronic fatigue syndrome, herpes and cancer.

The antibacterial (Zacconi *et al*., 1995), immunological (Furukawa *et al*., 1990), antitumoral (Furukawa *et al*., 1991) and hypocholesterolemic (Tamai *et al*., 1996) effects of kefir have investigated in recent studies.

Kefir (Zacconi *et al*., 1995) possesses antibacterial activity in vitro against a wide variety of gram-positive and gram-negative bacteria (Serot *et al*., 1990) and against some fungi (Cevikbas *et al.*, 1994). The antagonistic effects of kefir against *Salmonella kedougou* were attributed to the complexity and vitality of the kefir micro flora (Zacconi *et al.*, 1995). Various scientists have observed digestive benefits of kefir (Goncharova *et al*., 1979; Sukhov *et al*., 1986). The microorganisms of kefir are reduced the activity of the fecal enzymes in intestinal system. Several studies have investigated the antitumor activity of kefir and polysaccharides from kefir grain (Cevikbas *et al*., 1994; Driessen and Boer, 1989; Fernandes *et al*., 1987; Friend and Shahani, 1984; Furukawa *et al*., 1990; Furukawa *et al*., 1991; Gilland, 1989; Klupsch, 1985; Murofushi *et al*., 1983; Shiomi *et al*., 1982; Welch, 1987). The mechanism of antitumor activity was considered to be host mediated because of the lack of direct *in vitro* effect on tumor cells (Shiomi *et al*., 1982). Immune system stimulation with kefir (Furukawa *et al*., 1991) and with sphingomyelin isolated from the lipids of kefir (Osada *et al*., 1994) has been demonstrated in both *in vitro* and *in vivo* studies and improves the immune system. There is evidence to support the antitumour activity.

Kefir plays an important role of controlling high cholesterol levels in this way protecting from cardio vascular damage.

The lactase deficiency individuals has sickness such as nausea, cramps, bloating, gas and diarrhea but kefir's abundance of beneficial yeast and bacteria provide lactase, an enzyme which consumes most of the lactose left after the culturing process (Akalin and Ötles, 2002).

Conclusion: High nutritional values and health benefits of kefir are numerous; therefore it is recommended to consume for premature infants, young children, pregnant and nursing women, patient, old people and lactase deficiency individuals. Many researchers investigated many properties of kefir but mostly not well defined. Future observations will appear more clarification about kefir and its nutritional and therapeutic benefits.

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