Happy Days Dairies, Ltd. Article Series

Article #1 - Goat Milk – From Perception to Perfection
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Goat milk – revered since the ancient times of the Pharaohs who supposedly offered the milk and cheese as gifts in burial tombs, goat dairy remains a staple in the diets of the majority of the world's populations today. The global popularity of goats is as much based on its near-perfect nutritional content as their ability to thrive in diverse climates ranging from Africa to Asia to Europe to North and South America. Being a main supplier of dairy and meat products for many of the world's rural populations, goat milk has traditionally maintained the unwarranted reputation as the "poor man's cow". However, the "superfood" nutritional status of goat dairy compared to other dairy products gives it flavor, texture and health characteristics that transcend this archaic perception, placing goat dairy in a highly desirable league of its own that has pushed global production and consumer interest to new heights. For foodie connoisseurs and health enthusiasts alike, goat dairy is rapidly staking its claim at the top of the list. This article explores the nutritional aspects of goat milk that are perpetuating this phenomenon and advancing goat dairy products into the captivating realm of functional foods that dominate global food trends.

Macronutrient Nutritional Composition of Goat Milk
In this section, we break down the three major nutritional components (carbohydrates, proteins and fats) to elucidate the science behind the health claims. From this macronutrient perspective, goat milk is already full strides ahead in achieving its place in the functional food world. Its striking similarities to human milk make goat milk an ideal match for human consumption compared to other dairy products such as cow and sheep. The average basic nutrient composition of goat milk compared to sheep, cow and human is demonstrated in Table 1 below.

Table 1: Average composition of basic nutrients in goat, sheep, cow and human milk

Composition	Goat	Sheep[a]	Cow	Human
Fat (%)	3.8	7.9	3.6	4.0
Solids-not-fat (%)	8.9	12.0	9.0	8.9
Lactose (%)	4.1	4.9	4.7	6.9
Protein (%)	3.4	6.2	3.2	1.2
Casein (%)	2.4	4.2	2.6	0.4
Albumin, globulin (%)	0.6	1.0	0.6	0.7
Non-protein N (%)	0.4	0.8	0.2	0.5
Ash (%)	0.8	0.9	0.7	0.3
Calories/100 ml	70	105	69	68

(Park et al. 2007)

CARBOHYDRATES
Although we generally consider lactose to be the dominant carbohydrate in milk products, the carbohydrate content of goat milk is differentiated by its high oligosaccharide content compared to other dairy. Oligosaccharides are functional food components that have prebiotic properties resulting in the wide scope of health benefits discussed below.

Lactose

The major carbohydrate in domesticated animal milk is lactose, a disaccharide made up of glucose and galactose sugars. Although a valuable nutrient due to its role in the intestinal absorption of minerals such as calcium, magnesium and phosphorus and in the utilization of vitamin D (Park et al. 2007), many people lack the enzyme to digest lactose in the body (lactase) and are thus lactose-intolerant. Goat milk contains less lactose than cow milk (4.1% versus 4.7%) (Raynal-Ljutovac et al. 2008; Park et al. 2007), which contributes to its higher digestibility and appeal to lactose-intolerant populations.

Oligosaccharides

The lactose content of goat milk is by no means its primary distinguishing factor. Of greater significance in its potential as a functional food is its oligosaccharide content. Unlike disaccharides comprised of two monosaccharide carbohydrates (such as lactose), oligosaccharides are made up of 3-10 monosaccharides and are actually considered to be a soluble fibre. The amount and diversity of oligosaccharides in goat milk differentiates it from other dairy products (Urashima and Taufik 2010; Park et al. 2007). Goat milk's oligosaccharide content is typically about 4-5 times higher than cow milk and 10 times higher than sheep milk, ranging from 0.25-0.39 g/L in goat milk compared with 0.03-0.06 g/L in bovine and 0.002-0.004 g/L in ovine milk (Urashima and Taufik 2010; Silantkove et al. 2010).

Among the wide variety of oligosaccharides present in goat milk are 6'-SL, 3'-SL, disialyllactose, Nglycolylneuraminyllactose, 3'-galactosyllactose, N-acetyl glucosaminyllactose, LNH and additional high molecular oligosaccharides (Urashima and Taufik 2010). The complex oligosaccharide profile in goat milk is most similar to human milk, in comparison to sheep and cow milk (Silanikove et al. 2010). In addition, goat milk contains 4 times the amount of sialic acid (N-acetylneuraminic acid) as cow milk (approximately 230 mg/kg in goat milk compared to 60 mg/kg in cow milk) (Reynal-Ljutovac et al. 2008). Sialic acids present in oligosaccharides play a variety of essential roles in biological processes involving recognition of carbohydrate groups and mediate interactions with bacterial toxins, plant and animal lectins, interferon, and certain tumor-specific and blood group antibodies (Higa and Paulson 1985).

Goat milk oligosaccharides possess "prebiotic" properties, meaning they promote the growth of beneficial bacteria *Bifidobacteria* in the intestine (Raynal-Ljutovac et al. 2008). The benefits of *Bifidobacteria* used to be primarily attributed to their role in promoting neonate immunity and protection against intestinal pathogens as well as brain development (Raynal-Ljutovac et al. 2008). However, several strains of *Bifidobacteria* are now widely used as functional foods for their wide-scope of beneficial effects on health including immune stimulation, protection against infectious pathogens, anti-carcinogenic and cholesterol-lowering properties (Russell et al 2011). Interestingly, *Bifidobacteria* also helps to alleviate lactose maldigestion (Russell et al. 2011) which adds to goat milk's benefits for people suffering from lactose intolerance. Thus the prebiotic properties due to the oligosaccharide content of goat milk are a significant contributor to its wide scope of health benefits and its deserving classification as a functional food.

Other carbohydrates

Besides lactose and oligosaccharides, other carbohydrates in goat milk include glycopeptides, glycoproteins and nucleotide sugars (Park et al. 2007). Goat milk has a remarkably high nucleotide content compared to other milks, containing approximately 154 μmol/100 mL compared to 93 μmol/100 mL in sheep milk and 68 μmol/100 mL in cow milk (Park et al. 2007). Nucleotide sugars are of particular interest due to their roles as precursors for glycoproteins, glycolipids and oligosaccharides in the biosynthesis of milk (Park et al. 2007).

FATS

Although there is no significant difference in the average fat content between goat and cow milk, two much overlooked defining characteristics of goat milk fats are its high proportion of medium chain fatty acids (MCFA) and smaller fat globules. Additional benefits to goat milk are imparted by its higher concentrations of monounsaturated (MUFA) and polyunsaturated (PUFA), conjugated linolenic acid (CLA) and branched-chain fatty acids,

Medium Chain Fatty Acids

One of the most distinguishing characteristics of goat milk is its high content of short and medium chain fatty acids (MCFA). Goat milk fat contains at least twice as many C6-C10 fatty acids as cow milk fat, at approximately 16% of total fat in goat milk compared with 8% in cow milk (and 12% in sheep milk) (Park et al. 2007). Specifically, goat milk is much higher in butyric (C4:0), caproic (C6:0), caprylic (C8:0), capric (C10:0), lauric (C12:0), myristic (C14:0), palmitic (C16:0) and the essential omega-3 linolenic (C18:2), which being lower in the longer chain fatty acids stearic (C18:0) and oleic acid (C18:1) (Haenlein et al. 2004). These fatty acids are associated with the characteristic flavor of cheeses (Park et al. 2007); in fact, 3 of the fatty acids were named after goats because of their predominance in goat milk (caproic, caprylic and capric) (Haenlein et al. 2004).

These fatty acids have different metabolism than long chain fatty acids that lend to significant health benefits including amelioration of fat malabsorption, cholesterol-lowering activity (in particular LDL cholesterol) and possible weight loss benefits in overweight individuals (Raynal-Ljutovac et al. 2008). In addition, the unique metabolic ability of capric and caprylic acids and MCFA to provide direct energy instead of being deposited in adipose tissues has led to their use in a wide array of clinical disorders including hyperlipoproteinemia, infant malnutrition, intestinal resection, epilepsy, cystic fibrosis, coronary bypass and gallstones (Haenlein et al. 2004). Table 2 below outlines the average fatty acid composition of goat milk compared to cow milk.

Table 2: Average fatty acid composition (g/100 g milk) in lipids of goat and cow milk

	Goat milk	Cow milk	Difference (%) for goat milk
C4:0 butyric	0.13	0.11	
C6:0 caproic	0.09	0.06	
C8:0 caprylic	0.10	0.04	
C10:0 capric	0.26	0.08	
C12:0 lauric	0.12	0.09	
C14:0 myristic	0.32	0.34	
C16:0 palmitic	0.91	0.88	
C18:0 stearic	0.44	0.40	
C6-14 total MCT	**0.89**	**0.61**	**+46**
C4-18 total SAFA	**2.67**	**2.08**	**+28**
C16:1 palmitoleic	0.08	0.08	
C18:1 oleic	0.98	0.84	
C16:1-22:1 total MUFA	**1.11**	**0.96**	**+16**
C18:2 linoleic	0.11	0.08	
C18:3 linolenic	0.04	0.05	
C18:2-18:3 total PUFA	**0.15**	**0.12**	**+25**

[a] MCT: medium chain triglycerides; SAFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids.

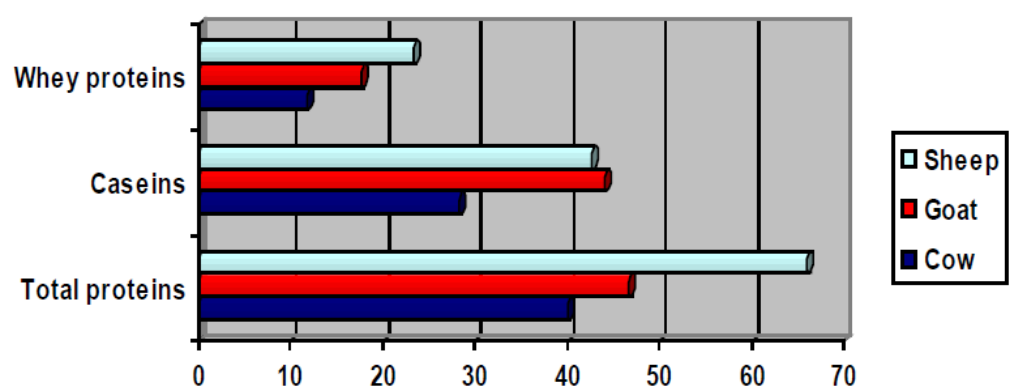
(Haenlein et al. 2004)

Fat Globule Size
The size of the fat globules in goat milk is another defining characteristic resulting in its functional health properties. Goat milk has a higher proportion of small fat globules compared to cow milk, further improving the digestibility of goat milk (Mehaia 1995). Approximately 80% of the fat globules in goat milk are smaller than 5µm, compared to 60% in cow milk (Silanikove et al. 2010). The smaller fat globule size in goat milk has been attributed to the caprine αs1- casein genotype (Neveu et al. 2002). The difference in fat globule size results in the softer texture of goat milk products such as goat cheese (Silankove et al. 2010). The combined action of the smaller fat globules and high MCFA content has shown beneficial effects on fat assimilation and energy in animal (rats and pigs) and human studies (in malnourished children), as well as a lowering effect on triglycerides and cholesterol in pigs (Raynal-Ljutovac et al. 2008).

Other Fatty Acids – MUFA, PUFA, CLA and BCFA
In addition to their high MCFA content, goat milk also contains significantly higher concentrations of polyunsaturated- (PUFA), monounsaturated- (MUFA) and branched-chain fatty acids (BCFA) as well as conjugated linolenic acid (CLA) than cow milk (Haenlein et al. 2004). Goat milk's favorable fatty acid composition is attributed to their specific food selection habits, particularly the high proportion of leuminous forage in their diet (Shingfield et al. 2008). MCFA, PUFA and CLA are well known for their cardiovascular health benefits (Haenlein et al. 2004; Silanikove et al. 2010). CLA in particular has been shown to reduce oxidative stress, atherosclerosis, improve blood lipid profiles and protect against cancer (Silanikove et al. 2010).

PROTEINS
As shown in table 1, the percentage of protein in goat milk is virtually identical to cow milk. The protein in goat milk is differentiated by the makeup of its proteins, high levels of casein and structure of the casein micelle, the wide array of bioactive peptides within these fractions as well as minor proteins and non-protein fraction which includes amino acids, nucleotides and nucleosides. These protein characteristics of goat milk dictate many of its physical properties and health benefits. Table 3 shows a comparison of the protein profile in goat, sheep and cow milk.

Table 3: The profile of proteins in cow, goat and sheep milk



(Cozma et al. 2011)

Casein

Milk protein is comprised of about 80% caseins and 20% whey proteins. Principal caseins (CN) in goat, sheep and cow milk are αs1- CN, αs2- CN, β- CN and k- CN. The main forms of caprine and ovine caseinomacropeptides are the soluble C-terminal derivatives from the action of chimosin on k-casein during the milk clotting process of cheesemaking. These forms of casein are an excellent source of antithrombotic peptides (Atanasova and Ivanova 2010). Two of the primary distinguishing features of goat milk are the size of the casein micelle and the low level of αs1-casein. Casein micelles in goat milk are larger than those in cow milk, ranging from 100 to 200 nm compared with 60-80 nm (Silanikove et al. 2010). The lower levels of αs1-casein in goat milk is thought to be directly related to the lower allergenicity of goat milk compared to cow milk, which is a key benefit to both infants using goat milk as their main source of nutrients and individuals with existing cow milk allergies (Silanikove et al. 2008). Casein micelles in goat milk are also markedly different in their sedimentation rate, β-casein solubilisation, heat stability, and calcium and phosphorus content than cow milk (Haenlein et al. 2004). The low αs1-casein content of goat milk is favorable for making soft cheeses, as it results in a faster coagulation time and softer curds (Ambrosoli et al. 1988).

Minor Proteins

Along with casein, goat milk contains a number of important minor proteins in the whey protein components including β-lactoglobulin, α-lactalbumin, immunoglobulins, glycomacropeptides, folate-binding protein, prolactin, bovine serum albumin and minor proteins such as lactoperoxidase, lysozyme and lactoferrin (Atanasova and Ivanova 2010; Park et al. 2007). The high levels of folate-binding protein in goat milk compared to cow milk (about 12 µg/mL in goat milk) result in lower folate levels in goat milk, thus additional folate supplementation is required in infants given goat milk (Park et al. 2007). Goat milk has similar ranges of immunoglobulins such as Igg, IgA and IgM to those of cow and sheep milk and colostrum (Park et al. 2007). Table 5 below identifies some minor protein contents in goat, cow and human milk.

Table 5: Minor protein constituents in goat, cow and human milk

Proteins	Goat	Cow	Human
Lactoferrin (µg/ml)	20–200	20–200	<2000
Transferrin (µg/ml)	20–200	20–200	<50
Prolactin (µg/ml)	44	50	40–160
Folate-binding protein (µg/ml)	12	8	–
Immunoglobulin			
IgA (milk: µg/ml)	30–80	140	1000
IgA (colostrum: mg/ml)	0.9–2.4	3.9	17.35
IgM (milk: µg/ml)	10–40	50	100
IgM (colostrum: mg/ml)	1.6–5.2	4.2	1.59
IgG (milk: µg/ml)	100–400	590	40
IgG (colostrum: mg/ml)	50–60	47.6	0.43
Non-protein N (%)	0.4	0.2	0.5

(Park et al. 2007)

Bioactive Peptides

Both casein and whey proteins in are important sources of bioactive peptides that confer a wide range of health benefits including ACE inhibitory, antihypertensive, antimicrobial, antithrombotic, immunomodulating, mineral binding and antioxidant effects (Atanasova and Ivanova 2010; Park et al. 2007). Enzymatic hydrolysis of milk proteins during gastrointestinal digestion, food processing and during fermentation releases these peptides, biologically activating their health promoting properties (Park et al. 2007; Atansova and Ivanova 2010). Table 6 below categorizes several bioactive peptides in goat and sheep milk according to their biological properties.

Table 6: Bioactive Peptides from ovine and caprine milk proteins

Peptide fragment	Sequence	Biological activity
Ovine α_{s1}-CN *f*(86–92)	VPSERYL	ACE-inhibitory
Ovine α_{s1}-CN *f*(102–109)	KKYNVPQL	ACE-inhibitory
Caprineα_{s1}-CN *f*(143–146)	AYFY	ACE-inhibitory
Ovine α_{s2}-CN *f*(165–170)	LKKISQ	Antibacterial
Ovine α_{s2}-CN *f*(165–181)	LKKISQYYQKFAWPQYL	Antibacterial
Caprine α_{s2}-CN *f*(174–179)	KFAWPQ	ACE-inhibitory
Ovine α_{s2}-CN *f*(184–208)	VDQHQAMKPWTQPKTKAIPYVRYL	Antibacterial
Ovine α_{s2}-CN *f*(202–204)	IPY	ACE-inhibitory
Ovine and caprine α_{s2}-CN *f*(203–208)	PYVRYL	Antibacterial ACE-inhibitory Antihypertensive
Ovine α_{s2}-CN *f*(205–208)	VRYL	ACE-inhibitory
Ovine and caprine β-CN *f*(47–51)	DKIHP	ACE-inhibitory
Ovine β-CN *f*(58–68)	LVYPFTGPIPN	ACE-inhibitory
Caprine κ-CN *f*(59–61)	PYY	ACE-inhibitory
Ovine and caprine κ-CN *f*(106–111)	MAIPPK	ACE-inhibitory
Ovine and caprine κ-CN *f*(106–112)	MAIPPKK	ACE-inhibitory
Ovine κ-CN *f*(112–116)	KDQDK	Antithrombotic
Caprine β-Lg *f*(46–53)	LKPTPEGD	ACE-inhibitory
Caprine β-Lg *f*(58–61)	LQKW	ACE-inhibitory
Caprine β-Lg *f*(103–105)	LLF	ACE-inhibitory
Caprine β-Lg *f*(122–125)	LVRT	ACE-inhibitory
Ovine and caprine LF *f*(17–41)	ATKCFQWQRNMRKVRGPPVSCIKRD	Antibacterial
Ovine and caprine LF *f*(14–42)	QPEATKCFQWQRNMRKVRGPPVSCIKRDS	Antibacterial

(Park et al. 2007)

Non-Protein Fraction

Goat milk has a very different profile of the non-protein nitrogen fraction to cow milk, with several constituents such as nucleotides at concentrations approaching those in human breast milk (Prosser et al. 2008). The non-protein nitrogen fraction of goat milk consists of nucleosides and nucleotides, along with urea, creatinine, polyamines and free amino acids (further described in the section below), which accounts for 8-10% of total nitrogen (Prosser et al. 2008). The main component of the non-protein fraction in goat milk is urea, making up 30% compared to 18% in cow milk (Prosser et al. 2008).

The primary nucleotide and nucleosides in goat milk (as well as cow and sheep milk) are UMP, AMP and CMP; however goat milk also contains UDP (Raynal-Ljutovac et al. 2008). Nucleotides and nucleosides are major components of nucleic acids RNA and DNA and participate in energy metabolism, signal transduction and general regulation of cell growth. Due to their role in immune maturation, nucleotides are often added to infant formulas (Silanikove et al. 2010; Raynal-Ljutovac et al. 2008). Additional biological roles for nucleotides include lipoprotein metabolism, enhanced high-density lipoprotein (HDL) plasma concentration, as well as enhanced synthesis of apolipoprotein (Apo) A1 and Apo A1V in pre-term infants, and in upregulation of long-chain polyunsaturated fatty acid synthesis in human neonates (Silanikove et al. 2010).

Goat milk contains the highest levels of polyamines compared to all other mammalian milks including human milk (Silanikove et al. 2008). Polyamines are shown to be important for optimal growth, gastro intestinal tract cell function, maturation of gastrointestinal enzymes and reduce the incidence of food allergy in infants (Silanikove et al. 2008). Table 7 provides a comparison of the non-protein nitrogen fraction of whole milk powders and infant formulae made from goat and cow milk.

Table 7: Comparison of the non-protein nitrogen fraction of whole milk powders and infant formulae made from goat or cow milk

	Goat			Cow		
	Whole milk powder	Infant formula	Follow-on formula	Whole milk powder	Infant formula	Follow-on formula
Total nucleotide monophosphates[a]	10.1	4.0	5.7	ND	ND	ND
Polyamines	0.06	0.016	0.037	0.041	0.012	0.016
Free amino acids	21.3	9.7	12.4	5.9	9.2	9.9
Urea	28	11	14	22	7	14
Creatinine	1.4	1.0	1.0	1.8	1.0	1.0
Carnitine	2.1	1.6	1.6	2.1	1.7[b]	1.8[b]
Sialic acid	10.5	4.8	5.0	19.9	6.8	11.1

The concentrations of individual components were determined in reconstituted powders and their nitrogen content calculated. All concentrations are in mg/100 ml reconstituted powder or formulae. ND, not determined. [a]The nucleosides were converted to monophosphate equivalents and summed with the nucleotide monophosphates to obtain total nucleotide monophosphate levels. [b]Contains added carnitine.

(Prosser et al. 2008)

Amino Acids

Amino acids also belong to the non-protein fraction. Goat milk contains a similar amino acid profile to cow and human milk, with the exception of a lower concentration of cysteine than human milk (Silanikove et al. 2010). The major free fatty acids in goat milk taurine, glycine and glutamic acid, taurine being particularly high at 20-40 times the levels in cow milk (Silanikove et al. 2010). Taurine is a conditionally essential amino acid that can be synthesized in the body from cysteine and methionine (Raynal-Ljutovac et al. 2008). Supplemental taurine is sometimes required in infants lacking the enzyme to convert cystathionine to cysteine, and is thus added to infant formulas for this reason (Silanikove et al. 2010). Taurine is also beneficial for adults due to its cardiovascular benefits such as blood pressure regulation, as well as in vision, cerebral functions, detoxification and fatty acid assimilation (Silanikove et al. 2010; Raynal-Ljutovac et al. 2008). Recent findings in animal studies suggest that taurine may also be useful in alleviating muscle fatigue and raising exercise capacity during workouts (Silanikove et al. 2010). Table 8 outlines the amino acid composition (g/100 g milk) of goat and cow milk.

Table 8: Average amino acid composition in proteins of goat and cow milk

	Goat milk	Cow milk	Difference (%) for goat milk
Essential amino acids			
Tryptophan	0.044	0.046	
Threonine	**0.163**	**0.149**	+9
Isoleucine	**0.207**	**0.199**	+4
Leucine	0.314	0.322	
Lysine	**0.290**	**0.261**	+11
Methionine	0.080	0.083	
Cystine	**0.046**	**0.030**	+53
Phenylalanine	0.155	0.159	
Tyrosine	**0.179**	**0.159**	+13
Valine	**0.240**	**0.220**	+9
Non-essential amino acids			
Arginine	0.119	0.119	
Histidine	0.089	0.089	
Alanine	0.118	0.113	
Aspartic acid	0.210	0.250	
Glutamic acid	0.626	0.689	
Glycine	0.050	0.070	
Proline	0.368	0.319	
Serine	0.181	0.179	

(Haenlein et al. 2004)

Micronutrient Composition of Goat Milk

In this section, we examine the micronutrient properties of goat milk which include its vitamin and mineral components and provide comparisons with other milks.

MINERALS

The mineral content of goat milk is higher than human or cow milk, ranging from 0.70 to 0.85% (Park et al. 2007; Silanikove et al. 2008). Goat milk contains particularly high levels of calcium and phosphorus compared to human milk, in addition to higher levels of potassium, magnesium and chloride than cow milk (Park et al. 2007). With regard to trace minerals, goat milk contains more zinc and iodine and less iron than human milk (Park et al. 2007); however, iron bioavailability of goat milk is higher than cow milk due to the higher nucleotide content contributing to better absorption in the gut (Raynal-Ljutovac et al. 2008). Selenium content of human and goat milk is higher than cow milk (Park et al. 2007) and is more bioavailable, which is attributed to the high MCFA content or soluble protein ratio in goat milk (Raynal-Ljutovac et al. 2008). The salt balance in goat milk is a determining factor in the retention of minerals in the curd during cheese making; for example, goat cheese retains most of its zinc and manganese as it exists in the micellar fraction, whereas varying levels of calcium, magnesium and phosphorus are found in the soluble phase (33%, 66% and 39%, respectively) and thus not retained in the curd (Park et al. 2007). The mineral concentrations in goat milk do not fluctuate much but vary slightly depending on the breed, diet, individual animal and stage of lactation (Park et al. 2007).

VITAMINS

Goat milk contains particularly high levels of B vitamins and vitamin A, but lacks β-carotene entirely, due to its conversion into retinol in goat milk (Raynal-Ljutovac et al. 2008; Park et al. 2007). The conversion of β-carotene into retinol accounts for the whiter color of goat milk compared to cow milk (Park et al. 2007). Compared to cow milk, goat milk is also lower in vitamin E as well as folic acid, vitamin B12, which can result in “goat milk anemia” if additional quantities of these minerals are not present in the diet (Park et al. 2007). Goat milk contains excessive levels of the B vitamins thiamine, riboflavin and pantothenate for a human infant, thus infants fed solely on goat milk are oversupplied with these minerals as well as protein, calcium and phosphorus (Park et al. 2007). Table 9 shows the vitamin and mineral composition of goat milk compared to cow, sheep and human milk.

Table 9: Mineral and vitamin contents (per 100 g) of goat, sheep, cow and human milk

Constituents	Goat	Sheep	Cow	Human
Mineral				
Ca (mg)	134	193	122	33
P (mg)	121	158	119	43
Mg (mg)	16	18	12	4
K (mg)	181	136	152	55
Na (mg)	41	44	58	15
Cl (mg)	150	160	100	60
S (mg)	28	29	32	14
Fe (mg)	0.07	0.08	0.08	0.20
Cu (mg)	0.05	0.04	0.06	0.06
Mn (mg)	0.032	0.007	0.02	0.07
Zn (mg)	0.56	0.57	0.53	0.38
I (mg)	0.022	0.020	0.021	0.007
Se (μg)	1.33	1.00	0.96	1.52
Al (mg)	n.a.	0.05–0.18	n.a.	0.06
Vitamin				
Vitamin A (IU)	185	146	126	190
Vitamin D (IU)	2.3	0.18 μg	2.0	1.4
Thiamine (mg)	0.068	0.08	0.045	0.017
Riboflavin (mg)	0.21	0.376	0.16	0.02
Niacin (mg)	0.27	0.416	0.08	0.17
Pantothenic acid (mg)	0.31	0.408	0.32	0.20
Vitamin B_6 (mg)	0.046	0.08	0.042	0.011
Folic acid (μg)	1.0	5.0	5.0	5.5
Biotin (μg)	1.5	0.93	2.0	0.4
Vitamin B_{12} (μg)	0.065	0.712	0.357	0.03
Vitamin C (mg)	1.29	4.16	0.94	5.00

(Park et al. 2007)

Goat Milk – Natural Nutrition Perfection

With goat milk’s synergistic nutrient profile – from its prebiotics and bioactive peptides to its healthy fat and unique flavor characteristics – there is no denying that it is bursting with potential to top both functional food and foodie charts. Its extensive health benefits, ranging from reduced allergies and immune modulation to improved nutrient digestion and nutrient absorption to cardiovascular benefits including antithrombotic, antihypertensive and cholesterol-lowering effects and beyond, make goat milk a highly desirable alternative for health conscious consumers with a connoisseur flare.

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