

# Prospects for Consumption of Dairy Goat Milk Products

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## INTRODUCTION

Dairy goats were introduced to Korea in the early 1960s after the Korean War and goat milk is remembered by the elder people as a poor alternative to cow milk with an adversely strong goaty taste and flavour. However, in the early 1990s, the dairy goat was bred again and goat milk became known as a "well-being" food and became expensive to buy. A total of more than 7,000 dairy goats were reported to be used for breeding in 41 dairy goat farms for milk production in Korea. 370 dairy goats were recently imported by airplane from New Zealand. Goat milk powder has been imported for infant formula by major dairy companies over the past 5 years.

Table 1. is the world dairy goat industry overview. France consumes large amounts of goat milk and goat cheese (33,000 tonnes). The France dairy goat industry is a relatively significant industry and has been producing cheese that has been a part of French culture for generations. Goat cheese is also the main products in the USA and Australia, whereas whole goat milk production is the predominant product in New Zealand. New Zealand is the one key supplier to Asia where goat milk powder is regarded as medicinal food and is used for baby food. Ninety percent of powdered goat milk is exported abroad by New Zealand's Dairy Goat Co-operative(DGC).

There has been an increase in goat herds in the Netherlands because of no ties for the goat milk production quotas. Production of goat cheese from one company in the Netherlands reaches up to 400 tonnes per year. Greece contains 2.3 % of the world's goats and consumes 4.5% of the world's volume of goat milk.

Goat milk products became more popular in the USA when bovine growth hormones were approved for cows in 1994 attracting consumers who were after a more natural product. The market for goat milk products in the USA is estimated at between \$350 and \$500 million, and growing as the country becomes more ethnically diverse and Americans understand the nutritional value of

Table 1. World dairy goat industries overview

Country	Dairy goats	Milk production	Production/goat	Cheese production
France	900,000	430 M litres	480 litres	33,000 tonnrs
USA	1,000,000	500 M litres	500 litres	40,000 tonnes
Canada	182,000	-	-	-
New Zealand	12,000	6 M litres	500 litres	100 tonnes
Australia	5,000	2.5 M litres	500 litres	200 tonnes

Table 2. Import of some varieties of cheese in Canada

Cheese varieties	1995	2006	2006/1995
Goat cheese	11,174 kg	147,771 kg	130%
Feta cheese	756,340 kg	790,167 kg	5%
Ricotta cheese	12,564 kg	12,560 kg	0%
Romano cheese	514,735 kg	351,148 kg	-40%

Canadian Dairy Councils & Statistics Canada.

goat milk.

Canadian consumers drink goat milk for health reasons such as food allergies, natural image and reputation. Table 2. provides the dramatic increase in importation of a considerable amount of specialty cheese and goat cheese into Canada.

In Asia, the Japanese dairy goat milk industry is extremely small and goat milk is unavailable to the market. Consumers prefer cheese such as cow Feta, instead of goat Feta or sheep Feta owing to their preference to milder cheese. Consumption of the powdered form of goat milk is expanding as health/functional foods in Taiwan and Malaysia. Goat milk powder is well established in Taiwan. Over A\$19million worth of imported goat milk powder was aimed at children. Demand for goat milk products in Malaysia has remained low as consumers are not aware of the health benefits.

## COMPARISON OF GOAT'S MILK WITH COW'S MILK

Typical composition of cow's milk and goat's milk are not significantly differ in major nutritional constituents, even the proximate content of protein. However, physicochemical properties of the milks of two species are markedly discriminative in many aspects (Table 3). Goat's milk contains the 4 types of caseins present in cow milk (Boulanger, et. al., 1984) but in different portions. Indeed, the sum  $\alpha_{s1} + \alpha_{s2}$  represents on average 25% of the total caseins whereas this

Table 3. Typical composition of cow's milk and goat's milk

Milks	Fat (%)	Protein(%)			Lactose (%)	Ash (%)	Total solids (%)
		Total	Casein	Whey protein			
Cow's milk	3.9	3.2	2.49	0.54	4.6	0.72	12.6
Goat' milk	3.6	3.3	2.5	0.52	4.6	0.80	12.1

sum represents 50% of the caseins in cow milk. Adversely, the portions in  $\kappa$ -casein and mainly in  $\beta$ -casein are higher in caprine milk.

The primary structure of caprine milk, except for the caprine  $\beta$ -casein, has been elucidated (Fiat and Jolles, 1989) (Grosclaude, 1991). Of the ruminants, inter-species comparisons of the primary structures of similar caseins reveal a high degree of similarity, mainly between ovine and caprine casein (Fig. 1). And this similarity decreases in the order for  $\alpha_{s1}$ ,  $\alpha_{s2}$ ,  $\beta$ ,  $\kappa$ -casein; as for the  $\kappa$ -casein, but the polysaccharide chain structure is not known as precisely as that of the cow (Fiat and Jolles, 1989).

Of the micelle characteristics shown in Table 4, the more noticeable differences between milks of the bovine and caprine species concern the dimensions of the micelles. The average size of the caprine micelles is noticeably larger than that of the bovine micelles. These results were obtained using the same method based on the measure of an inelastic diffusion coefficients. This technique preserves the integrity of the micelle structure.

Despite the noticeable difference in casein composition, the structure of the caprine micelle is comparable to that of the bovine micelle. Ono et. al., (1989) relative portion of some casein associations;  $\alpha_{s1}$  -  $\kappa$ (F1),  $\alpha_{s2}$  -  $\beta$ -(F2),  $\beta$ - $\beta$ -casein(F3) are different between the species (Table 5). In goat milk,  $\beta$ - $\beta$  associations are in a higher proportion due to the richness in  $\beta$ -casein.

Cow/ Goat	1 ZEQNQEPIRCEKDERFFSDKIAKYIPIQYVLSRYPYGLNYYQKPVAL	10 C	20 D	30	40	50 R
Cow/ Goat	51 INNQFLPYPYAKPAAVRSPAQILQWQVLSNTVPAKSCQAQPTMARHPH	60 V	70 T	80 P	90 D	100 L
Cow/ Goat	101 PHLSFMAIPPKNQDKTEIPTINTIASGEPT--STPTTEAVESTVATLEDSpP	110	120 V A	130 A VH	140 IVN DNP	150 A S
Cow/ Goat	151 EVIESPPEINTVQVTSTAV	160 S A	169 A SpE			

Fig. 1. Amino acid sequence of bovine and caprine  $\kappa$ -casein.

Table 4. Structure and polymorphism of the casein

Caseins	Number of amino acid residues		Bovine/Caprine	
	Bovine	Caprine	No. of residues	Percentage
$\alpha_{s1}$ -casein	199	199	24	12.1%
$\alpha_{s2}$ -casein	207	208	27	13.0%
$\beta$ -casein	209	?	?	
$\kappa$ -casein	169	171	25	14.8%

Table 5. The hydration degree of the caprine micelles is lower than that of bovine micelles

	F2	F3	F4
Cow's milk	26.9	31.0	42.1
Goat's milk	11.0	25.9	63.1

This could be one of the reasons explaining the difference in size of the micelles, although other factors such as the primary structure of the casein or the proportion in  $\kappa$  -casein could also be involved.

Some differences concerning the mineral charge of the micelles have also been noticed: the quantity of calcium and inorganic phosphorus related to the casein rate are higher in the micelles of goat's milk (O'Connor and Fox, 1977). However, the ratio Ca/Pi in the micelle is very close for the two species, being between 2.0 and 2.10 (Richardson, et. al., 1974).

The acid and enzymatic coagulation mechanisms are common for bovine and caprine milks. Besides, the conservation from one species to another of the peptides link 105~106 of the  $\kappa$  -casein and its surroundings must be noticed in Fig. 1. However, in the case of goat's milk, a difference in behavior concerning rennet coagulation at around 2~4 °C should be noted. While the cow's milk blocks the aggregation process under the continuous process of cold-renneting, goat's milk coagulates within a few hours (Dunand, 1987), which particular behaviour reflects the lower stability of the caprine micelles.

## DAIRY GOAT INDUSTRY IN KOREA

### 1. Dairy Goat Farms

The dairy goat farms are mainly located in the middle, northern, and southern areas of the Korean peninsula as shown in Table 6. Data was tabled on the basis of the members of Korean Goat Milk Association established in 2005. A total of 41 members of the association is all around the country and most of goat farms are located in the middle area. Total production of raw goat milk seems

Table 6. Locations of dairy goat farms in Korea

Kangwon		Chungnam		Chungbuk		Kyunggi		Cheonam	
County	Goat farms	County	Goat farms	County	Goat farms	County	Goat farms	County	Goat farms
Hongcheon	5	Keumsan	3	Youngdong	3	Yangju	2	Youngam	5
Uljin	2	Asan	1	Okcheon	3	Pocheon	2	Hampyong	1
Chuncheon	1	Yesan	2	Jincheon	3			Kwangyang	2
Wonju	1			Boeun	1			Haenam	3
								Naju	1
Total	9	Total	6	Total	10	Total	4	Total	12

· Data from the Korean Goat farmer's Association and Park (2006).

to be less than 10 tonnes per day and this goat milk is collected by goat milk manufacturers or via the rural Dairy Farmer's Cooperation.

## 2. Consumers Trends for Dairy Goat Milk Products

Despite the fact that no goat milk products received Organic Permits from the Agricultural Ministry of Korea for the organic agricultural products, goat milk has been known as a so-called, a "well-being" product by consumers. Also, the price of raw goat milk is twice that of cow milk in Korea. This high price policy is driven from the value of goat breeding farms and from the minds of young mothers of high-income families who believe the nutritional composition of goat milk is similar to that of mother milk and that the medicinal benefits are superior to those of cow milk. The demand for goat milk is greater than the supply.

Korean consumers can purchase goat milk products directly from the manufacturers. Several Consumer's Cooperative Association use home delivery services and internet shopping as listed in Table 7.

A home delivery company, Mymorning Co., has an information that the market shares of fresh and fermented goat milk products are shown in Fig. 2. Types of goat milk products selling in Korea are simply fresh goat milk (78%) and yoghurt (22%), except for the imported infant goat milk formula. According to the market shares of goat milk in Fig. 3, The market is divided by four dairy goat companies including one home shopping company. Seventy six percent of goat's milk products are distributed mainly by the local distributors and organic stores of Consumer's Cooperative Associations (Fig. 4).

## 3. Productions of Dairy Goat Milk Products

Table 7. Web sites of manufacturers and distributors dealing with goat milk products

	Company	URL	Goat milk products
Manufacturer	Sangsaengwon	www.sansaengwon.co.kr	Domestic goat milk and yoghurt
	Natrue&Goat	www.goatsmilk.co.kr	Domestic goat milk and yoghurt
	Natureisdaphnis	www.daphnis.co.kr	Domestic goat milk and yoghurt
Distributors	Mymorning	www.mymorning.co.kr	Domestic goat milk and yoghurt
	Kangwonmart	www.gwmart.com	Domestic goat milk and yoghurt
	Nznara	www.nznara.co.kr	Imported infant Goat milk powder
	New Zealand Greencare	www.nzgreencare.com	Imported infant Goat milk powder (Nutricia) and goat milk powder (Healtheries)
	Auction	kd.auction.co.kr	Infant formulas of domestic 4 dairy companies made from imported goat milk powder
	Saenghyup	www.co-op.or.kr	Domestic goat milk and yoghurt
	Chorokmaeul	www.hanifood.co.kr	Domestic goat milk and yoghurt,
	Hansalim	www.hansalim.co.kr	Domestic goat milk and yoghurt

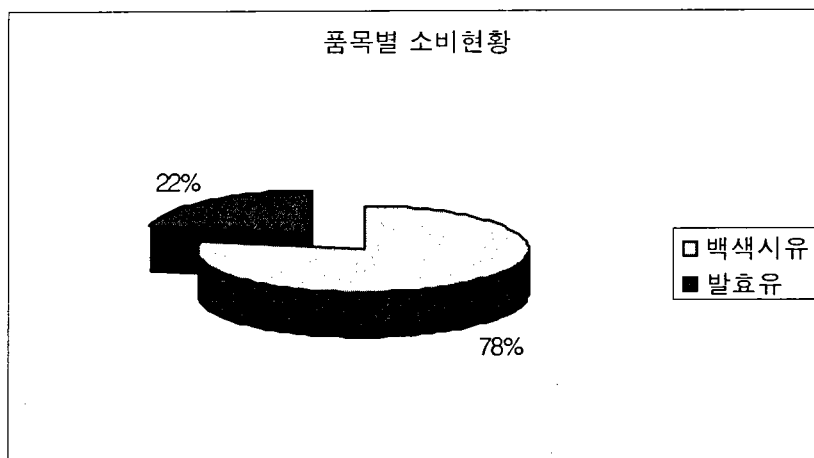


Fig. 2. Types of goat milk products consumed in Korea.

The major goat milk companies in Korea are “Sangsaengwon”, “Nature and Goat”, “Nature is Daphris”. Jeongwon Dairy Co. has been in recession from 2005. All dairy goat milk companies in 1998 have changed their company names owing to their small scale of capitals as summarized in Table 8.



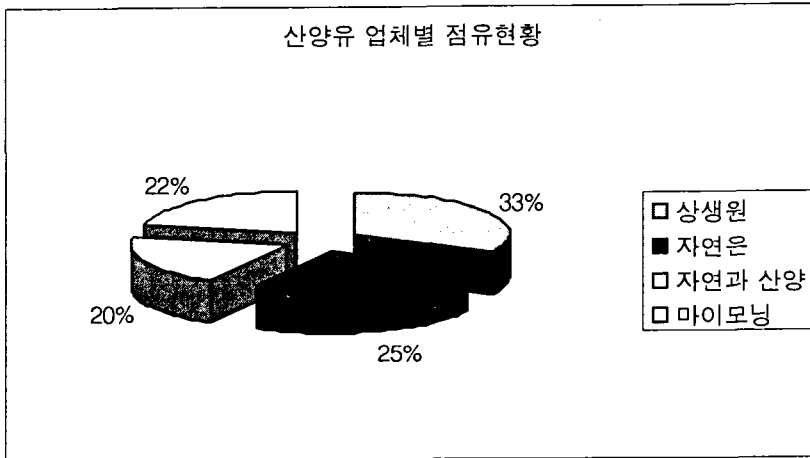


Fig. 3. Market shares of goat milk products by the company.

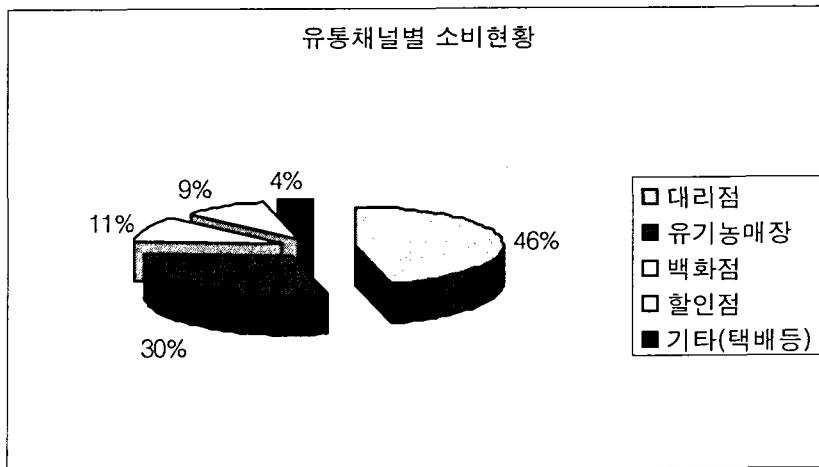


Fig. 4. Types of purchasing of goat milk products in Korea.

Table 8 shows the increment of goat milk production by comparing the changes of goat milk processors for 8 years from 1998 to 2006, obtained from two separate data. A total of 2,214 tonne of goat milk per year is expected to process by three goat milk companies. The number of dairy goat farms has also been increased almost twice more than 1998. Table 9 provides the details of goat milk products currently manufactured in Korea by the goat milk producers. Goat milk is mainly sold in the form of fresh liquid milk (200ml, 500ml, 1,000ml volume), and yoghurt (plain, apple, and strawberry). There are the only fermented goat milk products available on the Korean market. There is no imported fresh goat milk while infant goat milk powder is made from imported goat milk powder. Goat Feta cheese manufactured by a college company is recently launched to the market but the production scale is quite small. According to the study for this cheese, Goat Feta

Table 8. Korean goat milk production in 1998 and 2006

Company	1998*		2006**		Remarks
	Number of goats	Annual milk supply	Number of goats	Annual milk supply	
Jeongwon	300	-	-	-	
Korea Medi-R	1,500	432 tonnes	3,000	1,225 tonnes	Sansaengwon
Capro Biotech	400	180 tonnes	800	350 tonnes	NatureandGoat
Chowon	-	-	2,000	639 tonnes	NatureisDaphris
Total	3,100	1,152 tonnes	5,800	2,214 tonnes	

· Data of Kate, S. and J. Francis, (2001) and Park, S. Y., (2006).

Table 9. Products description of goat milk currently manufactured in Korea

Products	Brand name	Company	Products description	Heat treatment
Fresh goat milk	Jeongwon	Jeongwon*	Domestic farm goat milk	HTST
	Alpine	Hongcheon**	Domestic goat milk collected	HTST
	Milup	Nature and goat	Domestic goat milk collected	HTST
	Dew Goat milk	Sangsaengwon	Domestic goat milk collected	LTLT
	Cheonyeonmiso	Cheonan Yonam Milk	Domestic goat milk collected	HTST
Yoghurt	Goat yoghurt apple	Hong cheon**	Goat skim milk, skim goat milk powder or whole gat milk powder	
	Goat milk yoghurt strawberry	Sansaengwon	Domestic goat milk collected ***	
	Goat milk yoghurt strawberry	Cheonan Yonam Milk	Domestic goat milk collected	
Cheese	Goat Feta cheese	Cheonan Yonam Milk	Domestic goat milk collected	

\* Production had been in recession since 2005.

\*\* Production had been in recession since 2005.

\*\*\* Supplied by Asan dairy farmer's cooperative.

cheese is reported to have too strong, a goaty flavour for the Korean consumers (Kang & Park, 2006), but shows a potential market in that the distinct taste of goat cheese is considered as

something different from the cow cheese which they are used to eating.

#### 4. Consumers Response to New Goat Milk Products

A study regarding the goat milk products produced in Korea was performed by the speaker. In this study, consumer acceptance and organoleptic properties for the intensity and preference for Goat Feta cheese, manufactured occasionally at small scale dairy goat milk companies, were tested based on the taste (sweetness, acidity, saltiness, and bitterness), the flavour (milky, goaty, fermented) and the texture (mouthfeel and masticatory) using a 9 point method and 8 trained panels. As depicted in Fig. 5, overall results for the preferences and total sensory experience were satisfactory, and more than expected.

The preferences for sweetness and a, milky flavour in the taste as well as the texture and total sensory experience were evaluated and found to be superior to mozzarella cheese (used as control cheese made from cow's milk), but no significant differences were found between the two cheeses as shown in Fig. 5.

The intensities for the sensory evaluation on the smell and the saltiness of goat Feta cheese were higher ( $p < 0.05$  and  $p < 0.01$ , respectively) than those of the control cheese. The color, sweetness, bitterness, acidity and milky, goaty and fermented flavour were also higher than those of cow's cheese with no significant differences (Fig. 6).

Table 10 provides sensory resultst tested from consumers who tested goat Feta cheese. A total of 109 people tasted 2 week old Feta cheese. 62.80% of 43 men and 54.54% of 66 women responded with affirmative answers, but 42.20% of 109 people expressed negative answers. Distinct flavour originated from goat (9 answers) and sweet and clean taste (8 answers) and plain taste (2 answers) of goat Feta cheese were affirmative factors, while high-saltiness (10 answers) and strong goaty

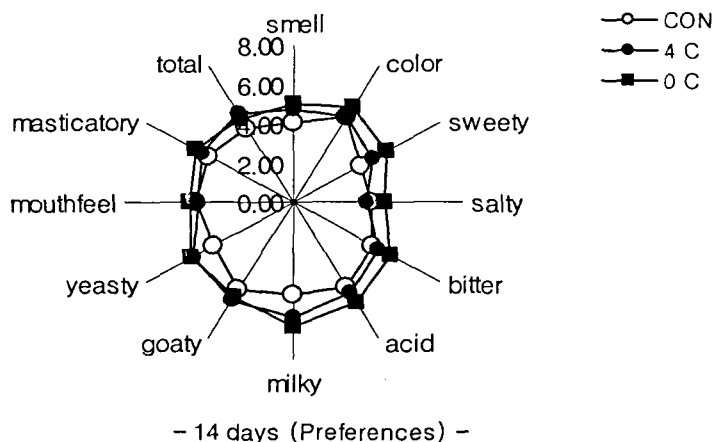


Fig. 5. Organoleptic preferences on goat Feta cheese.  
(Kang & Park, 2006).

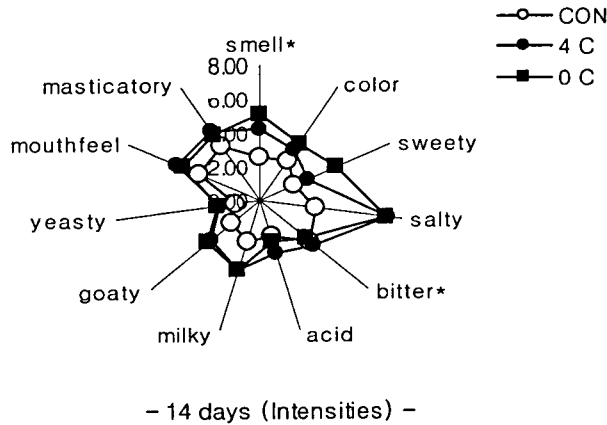


Fig. 6. Organoleptic intensities on goat Feta cheese.  
(Kang & Park 2006).

Table 10. Acceptances of Korean consumer for goat's Feta cheese

Gender	Number	Acceptances							
		Very Good		Good		Not Too Bad		Very Bad	
Men	43	9	(20.93%)	18	(41.87%)	8	(18.60%)	8	(18.60%)
Women	66	16	(24.24%)	20	(30.30%)	17	(25.76%)	13	(19.70%)
Total	109	25	(22.94%)	38	(34.86%)	25	(22.93%)	21	(19.27%)

(Kang & Park, 2006).

flavour (3 answers) of goat Feta cheese were adversary factors to the Korean consumers.

## CONCLUSION

### 1. Market Situations of Goat Milk Products

There has been a successful re-entry in the form of infant foods and as a product concept of "well-being" milk by feeding goat natural medicinal plants in high mountain lands and goats eating natural feeds. The potential market could be expected to expand by keeping its freshness and nutritional benefits. The supply of goat milk products all year around is also an important to the consumers. In order to increase its market scale of goat milk, product manufacturers need extensive advertising promotion.

### 2. Fresh and Fermented Goat Milk Manufactured in Korea

Domestically, goat milk is currently manufactured at small scale dairy goat milk companies and

consumed mainly in the form of fresh or fermented goat milk, while imported goat milk powder is used to produce infant goat milk formula by major dairy companies.

### **3. Collaborative Efforts for Expansion of Goat Milk Markets**

A regulation on the hygienic standard of goat milk is necessary for enhancing the quality and a collaborative effort would be expected among goat farmers, goat milk producers, scientists, and government officer related in this field. Decreasing the unpleasant goaty flavour for the Korean consumers would be essential for the researchers who work for dairy science and technology.

### **4. Prospect for New Goat Milk Products**

Goat cheese is likely to remain a niche product in the near future if health benefits can be adequately proven and information about cheese use and taste testing are provided. Sales by the home delivery company and by Consumer's Cooperative Association will continue to increase.

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