CHAPTER 8: GOAT MILK PRODUCT DEVELOPMENT

8.1 Introduction

Although goat milk is currently produced on a limited scale in South Africa, interest in the milking of goats has increased considerably over the last three years. More and more farmers and small-stock owners are considering the milking of goats as a possible farming alternative. This chapter investigates the quality characteristics of goat milk available in South Africa and reports on the development of several milk products taking into consideration the consumer requirements and perceptions identified in Chapter 4.

8.2 Quality characteristics of goat milk

Goat milk is seen as a popular alternative for the nutrition of babies allergic to cow milk and for various therapeutic uses. Goat milk is also, of course, sought after for the production of up-market cheeses and powdered milk. There are several constraints to the increased consumption of goat milk. Generally they can be regarded as; an unfamiliarity to goat milk or its products, a poor public image of goat milk and goats in general and, a lack of public knowledge of, and appreciation for, the unique qualities of goat milk. Very few South Africans have ever tasted goat milk or its products. In part, this is due to the above-mentioned factors, but one should also keep in mind that goat milk and its products are not readily available to the consumer (Factors similar to those suggested for meat in Chapters 4 and 5).

Goat milk differs in various ways from cow and other milks as shown in Table 8.1. A comparison of goat milk and cow milk reveals the following differences in goat milk (ARC, 1999):

- More C6 to C10 fatty acids, especially caproic acid.
- More casein micelles and fat globules in a smaller range.

- Lack of an agglutinising agent to cause a "cream line".
- Differences in the binding of calcium.
- Lack of carotenoid pigments (the milk is white).
- It freezes and thaws with relatively little change because of the nature and dispersion of the fat globules.
- It has its own characteristic flavour. This should be less obvious in good-quality milk, but is more apparent when the milk if heated and made into cheese.
- It has a different curd form, which improves its digestibility.
- It makes cheese with many distinctive flavours and textures.
- Folic acid needs to be added when it is used for infant diets.

Goat milk has been shown to be deficient in folic acid when compared to human milk. This becomes important when babies are fed goat milk due to allergic responses to cow milk (Of course, it should be remembered that mother's milk should always be considered as the first option). Allergic reactions to cow milk and cow milk products by children and adults may be manifested in conditions such as skin rashes and eczema, runny noses, chest infections and asthma, and digestive upsets, such as colic and diarrhea. To overcome these problems, goat milk is often recommended. However, since the major allergic responses occur with infants, the nutritional value of goat milk is of the utmost importance. Folic acid is important in iron metabolism and the formation of red blood cells. Therefore, it is possible that an infant fed goat milk may develop anemia. As a general recommendation, a vitamin supplement of folic acid should be given to the child.

Table 8.1 Nutritional value of various types of milk

ITEM	GOAT	COW	SHEEP	HUMAN
	GRAMS PER 100 GRAMS			
Moisture	87.0	88.0	80.7	87.5
Protein	3.6	3.3	6.0	1.0
Fat	4.1	3.3	7.0	4.4
Carbohydrates	4.5	4.7	5.4	6.9
Isoleucine	1.207	0.199	0.338	0.056
Leucine	0.314	0.322	0.587	0.095
Lysine	0.290	0.261	0.513	0.068
Methionine	0.08	0.083	0.155	0.021
Threonine	0.163	0.149	0.268	0.046
Tryptophan	0.044	0.046	0.084	0.017
Valine	0.240	0.220	0.448	0.063
Argentine	0.119	0.119	0.198	0.043
Histidine	0.089	0.089	0.167	0.023
C_{10}	0.26	0.08	0.4	0.06
C_{12}	0.12	0.09	0.24	0.26
C_{11}	0.32	0.34	0.66	0.32
C_{16}	0.91	0.88	1.62	0.92
$C_{16:1}$	0.08	0.08	0.13	0.13
$C_{18:0}$	0.44	0.40	0.9	0.29
$C_{18:1}$	0.98	0.84	1.56	1.48
$C_{18:2}$	0.11	0.08	0.18	0.37
	Mg per 100 grams			
Cholesterol	11	14	11	14
Calcium	134	119	193	32
Magnesium	14	13	18	3
Phosphorus	111	93	158	14
Potassium	204	152	136	51
Sodium	50	49	44	17
Thiamin	0.05	0.04	0.07	0.01
Riboflavin	0.14	0.16	0.36	0.04
Vit B_6	0.046	0.042	0.09	0.011
Vit E	0.04	0.09	0.12	0.34
	Microgram per 100 gram			
Vit A	56	31	42	64

(Source: Langenhoven et al., 1991)

The allergic reaction to cow milk is quite different from that seen when there is lactose intolerance. Lactose intolerance is seldom seen in children, but may develop in adults when the ability to digest lactose is lost. In such a situation, the lactose passes undigested to the large intestine, where it is subject to bacterial action, leading to cramps, excessive gas production and even diarrhoea. A simple solution to the problem of lactose intolerance is to use fermented milk products (such as yoghurt or amasi), where "friendly" bacteria have been used to break down the lactose to lactic acid.

There is also great variation in the quality of milk produced by different breeds of goats (See Table 6.2). Several milk goat breeds are currently found in South Africa. The

most popular is the Saanen. However, small populations of Toggenburg and British Alpine are also found. The Indigenous South African goat has also been investigated for its milk quality and quantity.

The work of Donkin at MEDUNSA paved the way for further work on milking goats in the non-commercialised agricultural sector of South Africa. In a study by Donkin (1991), Saanen goats yielded 602 ± 139.2 kg over 279 ± 10 days. This milk analysed for 2.91 ± 0.43% milk fat and 2.64 ± 0.3% protein. In contrast, indigenous goats yielded 23 ± 12.8 kg over 94 ± 39.3 days. Indigenous milk analysed for 8.89 ± 2.22% milk fat and 5.36 ± 0.71% protein. Habteyohannes (2001) found a fat % of 4.96 ± 2.0 and a protein % of 4.2 ± 0.2 in indigenous goat milk and a fat % of 3.14 ± 0.1 and a protein % of 2.75 ± 0.01 in milk from Saanen goats. Interesting results were also obtained from crossbred (indigenous X Saanen) goats (Donkin, 1991). Milk from these does yielded ±5.44% fat and 3.73% protein. Yields from crossbred does were in the order of 1.6 to 2.5 kg daily as compared to the 2.4 to 3.3 kg per day for the Saanen does. These crossbred does also had lactation lengths in the same range as the Saanen goats.

The market survey discussed in Chapter 4 indicated an increasing potential for goat milk and goat milk products since respondents indicated an increased propensity to purchase the product after a goat cheese sample was tasted. Dairy results from a number of participating respondents showed that by comparing the general buying power of cow milk products to that of goat milk products, there was a general perception that consumers often buy items which are known to them (cheese, milk etc.) more than the so called "luxury/speciality" items. This shows that even products from goat milk should be offered or presented as similar to general daily purchases and not as luxury items. It was also shown that goat milk commodities among the targeted respondents were favoured by the educated, middle to upper income people from all groups. The general perception was that if these products have to be considered as a "luxury" they then have to be marketed to upper class consumers only, preferably those in high-income areas.

Table 8.2 Differences in composition of goat milk between different goat breeds (Mean ± SE)

BREED	MILK FAT, %	PROTEIN, %	LACTOSE, %
Saanen	3.43 ± .53	2.88 ± .34	4.49 ± .2
Indigenous	9.33 ± 1.84	5.04 ± .82	5.12 ± .56
Crossbred	5.47 ± .67	3.88 ± .29	4.81 ± .18
Three-quarter Saanen	5.1 ± .64	3.5 ± .41	4.73 ± .17

(Source: Donkin, 1991)

Goat milk research was conducted in collaboration with the University of Pretoria and the University of Orange Free State. Quality attributes of Feta cheese made from a mixture of goat and cow milk were studied. The results compared well with most literature studies and the cheese samples were well accepted (Pitso, 1999) by consumer panels. In the studies by Habteyohannes (2001), Gouda cheese was manufactured from goat milk only. Raw milk from this study showed that hand-milked goat milk was of good quality and had lower microbial counts than milk from Saanen goats that were machine-milked. This shows that if proper hygiene practices are applied it may be possible for non-commercialised farmers to produce dairy products of high standard if milking equipment is not available.

8.3 Review of existing goat milk products

The use of goat and or sheep milk is popular in the European Union (E.U.) especially in the eastern countries with the Mediterranean region dominating. The production of dairy products is often on a small scale and is regarded as traditional. Cheese-making in particular is localised or regionalized in a sense that each product is regarded as a "speciality" of that particular area. Greece, Italy and Cyprus are a few of those countries that produce almost 60% of traditional dairy products from goat milk. In the E.U. efforts are made to globalise these products to enhance the economy of the rural inhabitants involved in dairy making (Pirisi, Sanna and Caria, 2000). As stated by Sordo (2000), Europe produces 2245 tons of goat milk compared to 2599 tons produced in Africa.

Goat milk has been made into products for many centuries. Some uses of goat milk are: Cheeses: soft French style goat cheese, Camembert and Brie-type goat cheese, cottage cheese, Mozzarella, soft molded goat cheese, herbed soft molded goat cheese, chive-n-garlic slice goat milk cheese, mild and strong Feta cheese, Colby,

Cheddar, Monterey jack, Ricotta; Fermented milks: maas; Yoghurts: plain, flavoured yoghurt, frozen yoghurt; Dips; Ice-cream; Sorbets; Fudges; Puddings and pie fillings; Soap; and Paint (Whitewash) (Toth, undated).

Recipes for all these products are available to the public. Furthermore, courses in the making of these products are presented at the Animal Nutrition and Products Institute in Irene. Research into goat milk product development is continuing at the Animal Nutrition and Products Institute in Irene. Emphasis is being placed on the use of indigenous cultures, the combination of cow and goat milk in various products, and cheese-making with the inclusion of other traditional South African food items, such as crystallised fruit, marula fruit and others (these suggestions are also being implemented already by the Tantinki Goat Dairy Farm in Oudsthoorn). A further avenue of development is the provision of goat milk to the pedigree companion animal breeding fraternity as a milk replacer for orphaned pedigree puppies and kittens, and the possible use of goat milk as a breast-milk alternative to babies of mothers living with HIV/AIDS.

The producer price for goat milk varies between R3.00 and R4.00 per litre. Accordingly, goat milk prices are relatively high in comparison to cow milk producer prices, which average approximately R 1.80 per litre. If goat milk is positioned to compete for a market share in the fresh milk market it will need to be traded at competitive prices (Smuts, 1998a).

Retailers and producers only sell small quantities of goat yoghurt at approximately R5.25 per litre; sales are generally to consumers with allergic conditions. The retail price for powdered goat's milk is R 111 per kg and for canned goat milk is R 42 per litre. A spot price test at the Pick 'N Pay retail store at Fairy Glenn, Pretoria (28/02/98 – Smuts, 1998b) showed that goat cheese is relatively expensive in relation to the more well-known and popular cheese types (Table 8.3). Personal communications with goat cheese producers (Stillerust, Tantinki, Fairview, Middelpos) in 2004 found prices as high as R 120/kg for goat cheeses being obtained in the retail sector.

Table 8.3 Retail prices at Pick 'N Pay, Fairy Glenn, Pretoria, Cow and goat cheese.

PRODUCT	R PER KG
Cow cheese	
Cheddar	29.00
Gouda	27.95
Processed	27.99
Goat cheese	
Chevin	71.92
Rabiola	85.49

(Source: Independent spot price survey; Smuts, 1998b)

8.4 Conclusion

As shown in Appendix 1, several commercial goat dairies and goat product manufacturers exist in South Africa. Knowledge and information relating to this type of farming system is available, and the potential to develop new products for the South African consumer is large. However, access to this industry for the emerging entrepreneur is hampered by serious constraints in legislation, transportation, and information. The most important aspect of any successful and sustainable goat milk production and processing development will be to link farmers, researchers, the private sector, science and technology as well as professionals. All these aspects however, must operate based on legislation (institutions) set by the government (Vallerand, 2000). Current issues, which warrant attention include: The cheese making heritage of local populations; studies into traditional products or recipes; planning and co-ordination of the two dairy sectors (cow & goat); research information dissemination and the formation of farmer's groups; seeking governmental support for the development of an infrastructure that will deal with goat milk collection, transportation and the relevant equipment to be used.

Since milk is a highly perishable product innovative institutional arrangements to overcome this limitation need to be sought if the small-scale producer in South Africa is to become involved in this sector. Firstly, legislative matters may need to be addressed. In South Africa no additions to milk are allowed. This is different to some other developing countries where the addition of lactoperoxidase is allowed for by legislation. Lactoperoxidase is a naturally occurring preservative which lengthens the shelf-life of milk by several hours. If the addition of this preservative were allowed it may open up the possibility of satellite goat milk producers producing on contract to a

central processing facility (with the necessary refrigeration infrastructure). However, currently this is not possible. The suggestion of lactoperoxidase addition has been tabled with the necessary authorities (2001), with no outcome as yet.

Barring these institutional changes, the perishability of milk forces the production of goat milk and its products at a centrally managed infrastructure (as is found in all the commercial goat milk operations in existence in South Africa currently (Chapter 2)). Although many of the products investigated can be made at the kitchen level, penetration of retail markets require large volumes of product and consistency of supply and quality. Public health legislation would also inhibit the manufacture of products for sale from unregistered facilities. Goat milk is not yet recognized as "dairy" by the Milk Producer's Organisation of South Africa. Thus, the current institutional arrangements that exist for the collection, transportation and processing of milk in South Africa is not available for goat milk. The disadvantages of high costs of establishing new infrastructure for transport and processing thus lends itself more to a totally integrated company where the producers are also the processors (as found in all the commercial goat milk operations in existence in South Africa currently – Chapter 2 – with one exception: Fairview buys in milk on contract from Stillerust Dairy to augment its own supply).

Only one goat milk producer and cheese manufacturer currently has the capacity to supply in bulk to the large retailers (Pick 'n Pay) in South Africa (Fairview: Paarl: Chapter 2). TT Dairies (Pretoria) is however penetrating select stores of several retail chains and health food stores in the Pretoria vicinity, and Stillerust (Bonnievale) has recently received a national contract from Woolworths. Fairview and TT Dairies are totally integrated, both producing and processing the milk into value-added products. Stillerust however, has gone into a partnership with a cheese manufacturer based in Bonnievale, where the partnership will entail that Stillerust produces the milk, and the cheese manufacturer is responsible for producing the product. Stillerust receives the product back from the manufacturer and does the packaging and delivery, thus keeping the presentation of the product, the ultimate quality control and cold chain requirements in-house (demonstrating effective vertical co-ordination). Stillerust also delivers milk, on contract to Fairview. Thus, the institutional arrangements which may

allow non-commercialised farmers to penetrate this industry are different than for meat. These will be further addressed in Part 3 of this thesis.