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Processed Food Products and Nutrient Composition of Goat Milk

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Abstract: Goat milk is known to have better qualities such as digestibility and longer shelf life when processed than cow milk. Despite these qualities, goats are kept mainly for meat in many countries. The promotion of the full use of goat milk at household level to achieve cheap balanced diet and food/nutrition security is yet to be exploited. This paper discusses the possible differences between goats and cow milk, the importance and usefulness of processed goats milk and products for food/nutrition security in the household.

Key words: Goat milk, balanced diet, household level

Introduction

Most of the goats in the tropical countries are kept for meat production, and are rarely milked despite their greatest potential as producers of good quality milk. Though the amount is a lot less than that of the cows, a good pooling together system can enable the milk to be processed in a small plant which can be started for a better storage of the milk. Also hygienic goat milk products could be available all the year round in most communities. Thus, improving household food security and nutrition.

Sometime ago it was published in one of the local newspapers that:

'Food security depends on three factors:
- adequate food availability,
- adequate access to food, and
- full use of food through balanced diets, safe water, sanitation, education and health care. '(Mmegi/The Reporter, 1- 8 April, 1999). Anonymous (1998) explained that the contribution to food supplies in developing countries is increasing at a higher rate than that of cereals. Further, livestock are the mainstay of pastoral people and contribute to food security in harsh environments. There are further opportunities to increase food production and rural income through integrated production systems. Integrated production systems allow for intensified agriculture in an ecological friendly way by integrating crop growing, animal husbandry and forestry.

Goats are free roaming under extensive system in Botswana in the communal lands. However, to increase milk production of goats in Botswana an intensive system must be encouraged.

In many parts of Africa especially in the drier region (e.g. Mali), goat rearing is favoured because of the following reasons:

i several animals can be kept instead of one cow by subsistence farmers; and
ii milk can be produced all the year round by goats and/or mixed herds (goats and sheep).

Braun (1979) reported that immediately after a disaster (e.g. drought) goats ensured a family's livelihood and food security. Therefore, for the reasons afore-mentioned goat milk promotion is pertinent especially in the rural areas, and at household levels in particular.

Therefore, their promotion within an integrated agricultural system is overdue. Usually women and children are involved in the management of goats within the household. This fact makes the goat a rare benefit to household food/nutrition security. Goats milk can be processed into different milk products. These are: yoghurt, fermented milk (madila), cheese, butter (more difficult than that of the cow), and cream. Goats are adaptable to local conditions and feeds. But the appropriate breed for milk must be reared to achieve maximum success. Also, a system by which a community can pool milk into a common point can be developed for a small village level goat milk processing.

Milk composition: Goat milk, like any other milk from other animal sources, is a complex mixture. Also, the composition of goats milk compares very well with that of the cow (Table 1). All fresh normal milks are an emulsion of fat in a watery solution. However, the acidity of that of goat milk is slightly lower than that of the cow, i.e. pH 6.4 as compared to pH 6.7 (Gall, 1981).

Furthermore, the four major components of goat milk are lactose, fat, nitrogen compounds and minerals (Table 1). These components are also similar to that of cows milk. However, the goat milk contains more small fat globules, i.e. globules of less than 1.5 mm in size. If these small globules are compared to that of the cow the percentage is 28 and 10 respectively. Le Jaouen (1988) reported that the higher amount of these small fat globules in the goat milk is responsible for the better digestibility of goats milk. It is also known to possess peculiar (good) nutrition and medicinal qualities (Hasnain, 1985).

Table 1: Comparison of Goat Milk and Cows Milk*

	Goat	Cow
Yield(liters)	500 - 1000	3500 - 5000
Dry Matter (g)	115 - 130	115 - 130
Lactose %	40 - 50	45 - 50
Nitrogen %	28 - 35	30 - 35
Fat %	30 - 38	35 - 40
Mineral %	7 - 9	7 - 9

*Source: Gall, 1981

The nitrogen compounds form the major complex part of the milk and their difference with other milk sources stems from this constituent. The nitrogen compounds are divided into proteins and non-proteins. The proteins are the casein, i.e. casein a_s, casein ß and casein K. Casein K is susceptible to the enzyme action of rennet. The soluble non-coagulable proteins and proteoses-peptons occurs in small amounts. The coagulable part (casein) of goat milk differs from that of the cows. This peculiarity is used to detect the presence of cows milk in goats milk/products as a way of quality control (Table 2).

Table 2: Nitrogen Compound Content of Goat and Cows Milk*

	Goat Milk (%)	Cow milk (%)
Casein a_s	21.2	40.0
Casein $	67.4	43.3
Coagulable Nitrogen compounds	69.0	75.0
Diameter of micelle (mm)	50	75
Non - Protein Nitrogen content	9	5
Vitamin A content (1 u/ 100 ml)	191	159

*Source: Gall, 1981

Furthermore, goat milk does not contain carotene like that of cows milk and the absence of carotene in goats milk is the reason why it does not have a yellow colour both as milk and milk products.

Milk preservation: As afore-mentioned, it seems that goat milk can replace cows milk where lactose intolerance exists. Therefore, the consumption of goats milk should be encouraged and to find a way of increasing the shelf life of both milk and milk products through processing. Mol (1992) reviewed the methods of milk processing which are the same for goats milk. Mol highlighted some aspects of small-scale processing of milk which are ideal for processing of milk at household level. The general principle behind these methods are the reduction of pH or reducing water activity to improve the shelf life. These principles were used in the old days and are still being used, albeit with better hygiene practice. Goat milk can be pasteurized or sterilized to kill the bacteria and prolong the shelf life.

Pasteurization is the most effective and cheapest method for destroying the microorganisms without damaging the nutrients in the milk, especially the proteins. However, some bacteria will survive pasteurization, so cooling the milk is necessary afterwards.

Pasteurization can be effected in several ways:

1. The holding method - This method is carried out by heating the milk at a temperature below 100 ^{o}C and holding at this temperature for 30 minutes;
2. The high temperature and short time - method (HTST) or 72 ^{o}C for 15 seconds - method. The milk is heated at first to 72 ^{o}C and hold for 15 seconds, if possible and then pressure is applied to effect a temperature rise to 140 ^{o}C, for four seconds;
3. Ultra high temperature treatment - this is a heat treatment at very high temperature; e.g. 140 ^{o}C for four seconds

The method of sterilization involves the heating of milk at 110-120 ^{o}C and holding for 20-40 minutes. This method will kill all known organisms and the milk will keep for long periods without refrigeration.

General methods of milk processing: The methods of milk processing can be classified into three broad areas. These areas can overlap and a combination of two methods may be used to make a better preserved product.

1. Increasing the acidity (or lowering the milk pH). In this method, the growth of spoilage bacteria and the action of enzymes can be slowed down or destroyed. Acidity of milk can be increased by:

a) lactic acid fermentation. The beneficial micro-organisms ferment the milk sugar, i.e. lactose to lactic acid;
b) the addition of organic acids, i.e. addition of vinegar or lime juice.

2. Lowering the moisture content to a level which is sufficiently low to control the growth of micro-organisms and the action of enzymes. This reaction makes the product to become more stable. The moisture content can be lowered by:

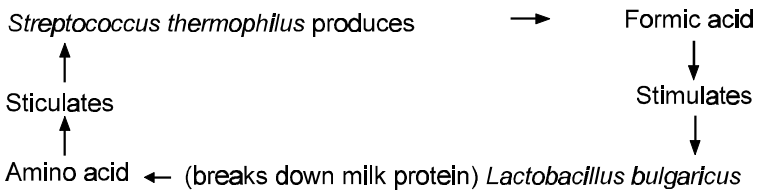
a) heating to evaporate the water e.g. pasteurization or sun-drying of cheese
b) curdling and removing the whey or watery part, e.g. as in cheese making
c) mechanical separation of the fat component, e.g. as in butter making
d) mechanical drying, e.g. roller and/or spray dried milk powders.

A range of products can be made with low amount of water. They keep better, transport well and are easier to preserve. These products can be grouped into:

I) Fermented milk products;
II) Products from coagulated milk;
III) Butter and ghee;
IV) Products from dehydrated milk.

Fermented milk products

Yoghurt: Yoghurt is made from pasteurized and cooled



Source: Production of Dutch Farm Cheese (Gouda type), Quark and Yoghurt, IPC, Livestock, 1989

Fig. 1: Reaction Pathway of the Culture in the Making of Yoghurt

milk for safety reasons. Yoghurt is obtained by souring milk with cultures consisting of exclusively *streptococcus thermophilus* and *lactobacillus bulgarus* (Fig. 1).

It is important to mention that to achieve uniformity in the product, a commercial starter should be used to initiate fermentation. University laboratories or Ministries can assist in obtaining the commercial starters. It is recommended that the culture should be allowed to grow in small amount of milk for 8 - 12 hours before being added to the main bulk of the milk.

Yoghurt can be made by:

1 Pasteurizing the milk and then cooking at 42 - 45 ^{o}C
2 Then addition of one percent starter and mixing very well
3 The mixture (2) is poured into plastic cups or containers
4 Allowing the mixture in the container to incubate until set (usually 3 to 6 hours) at 42 - 45 ^{o}C
5 Covering of the containers to mitigate against contamination.

In the households, traditional clay pots are used. There is nothing wrong with these, except that a high degree of sanitation must be adhered to.

Yoghurt and fermented milk products has their lactose partially degraded. In general, yoghurt and fermented milk are good food for children, because it is easier to digest (Den Hartog, 1992). This makes goats milk doubly good for processing into fermented milk which will also improve the shelf life of the milk.

Fermented milk (Madila): Madila (sour milk) is a popular food in Botswana produced through the process of fermentation (Ohiokpehai and Jagow, 1998). Fermentation is one of the oldest forms of food preservation in the world. Fermentation was reported to be linked to tradition and culture, in the rural household and at village level (Baltcock and Azam-Ali, 1998). They also said that fermentation improved food safety, nutritional quality through the biosynthesis of vitamins, essential amino acids and proteins. Also through fermentation the digestibility of proteins and carbohydrates is improved. Furthermore, harmful toxic substances are broken down and the bioavailability of minerals is improved. Ohiokpehai and Jagow (1998) reported an improved madila making from cows milk which can be used for goats milk as well. The final product tasted and looked like the original madila made according to the traditional method. Madila is acidified or soured milk produced by natural fermentation of lactose to lactic acid. Such products may be liquid or semi-solid and can be flavoured with artificial flavourings or fruit juices (e.g. morula).

Products from coagulated milk

Cheeses: Cheeses is a concentrated food containing all the solids in milk. The coagulation of milk, either by rennet (an enzyme) or acids (lime juice) results in a semi-solid component which can be stored for a few days. Goats milk is best for making 'feta' cheese. This is because of the higher amount of small fat globules as explained previously. Jenness (1980) stated that goat milk proteins formed a softer, friable curd on acidification. For this same reason goat milk could be better digested by infants and growing children when taken in adequate quantities (Aganga *et al*., 1997).

Butter: Butter is produced by mechanical agitation of the whole milk to separate the fat globules. The fat globules are made to join together to form a semi-solid mass with 80-85 percent fat and 15-20 percent water. Several types of butters can be made as with cows milk. However, goats milk lacks agglutinin which reduces its ability to form easy clusters when cooked, will act against its being used for good quality butter. Therefore, goats milk can be recommended for household level butter making only; where quality control is not stringent.

Future prospect: Finally, it can be suggested that an investigation can be conducted to institutionalize the acceptability and the nutritive value of the mixture of goat fermented milk (madila) and sorghum porridge (motogo). This is a traditional dish enjoyed in Botswana. Furthermore, be able to characterize the mixing ration that will give maximum nutritive value and other parameters as per the preferences of the consumers. Also, the possible effect of the mixing of 'madila' and sorghum porridge in the diet of growing children. Furthermore, develop the standards of the mixed ratios of the two ('madila' and sorghum porridge) by which a

consistent product can be produced for small business development for income generation from the urban areas. These suggestions are very important to be carried out in light of the HIV/AIDS scourge.

Conclusions:

1 Both men and women can rear goats and the promotion should be encouraged to improve the nutrition at the household level;
2 It has been shown that goat milk is better digested than cows milk. Therefore, consuming goat milk is very useful for both adult and growing children;
3 The above (No. 2) reason for the consumption of processed goat milk is good, particularly, for infants and growing children;
4 Processing of goat milk will preserve and improve the nutritive value of the milk;
5 Encouraging goat milk utilization will improve the consumption of cereals (sorghum in particular) to give the appropriate protein and energy composition of mixed foods which are traditional to Botswana.

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