

Review

The Potential of Goat Meat in the Red Meat Industry

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Abstract: Worldwide the consumption of chevon (goat meat) has increased largely due to its distinct nutritional attributes when compared to other red meats. In addition to being a good source of dietary protein for human beings, chevon comparatively has a lower total fat, saturated fatty acid and cholesterol content, which makes it a healthful product. Chevon's health promoting chemical composition fulfils the expectations of consumers' demand for healthful foods and thus explaining its growing popularity and increased demand. The increase in the popularity and demand of chevon is essential to contributing towards the increase in demand for animal-derived protein sources for human consumption, which is driven by an expansion in urban settlements, improving incomes, and the need for a better lifestyle. Despite chevon being established as lean red meat with low content of fat, cholesterol and saturated fatty acids, there are misconceptions regarding the perceived inferior quality of chevon compared to beef, pork or lamb among some consumers. This review seeks to provide evidence supporting the favorable nutritive characteristics of chevon and it being a healthful product that is poised to make a significant contribution to animal-derived foods for human consumption.

Keywords: chevon; consumer perspective; fatty acid profile; health impact; human population; meat; nutritional attributes

1. Introduction

Meat is an integral part of the human diet. It is one of the major sources of dietary protein, fat, vitamins and minerals for the human populace. Between 1961 and 2011, the global per capita meat (kg/person/year) consumption increased from 23.1 kg to 42.2 kg [1]. The demand for meat and animal products, globally, has been on the increase, although demand in the developing world has been occurring at a decreasing rate [2–4], while demand in developed countries has and continues to occur at an increasing rate [5]. In the developing world the expansion of urban settlements, an improvement in income and an increase in population are the major drivers. The observed demand in meat and animal products in the developing world over and above facilitating a food revolution has created tremendous opportunities for smallholder local producers as they tap into the ever increasing market [5,6].

Over and above being a concentrated source of energy, the fats in meat mediate the absorption of fat-soluble vitamins, thus helping prevent potential deficiency of fat-soluble vitamins. Despite its positive nutritional attributes (source of quality protein, energy dense, and vitamin and mineral content), red meat is also rich in saturated fat and cholesterol [7]. Due to its high saturated fat and cholesterol content, it has been confirmed that the excessive consumption of red meat and products

derived from it is associated with increased risk of developing metabolic derangements such as obesity, insulin resistance, and metabolic dysfunctions and their associated metabolic (type II diabetes, hypertension, atherosclerosis, metabolic syndrome, and cancer) diseases [8,9].

Globally consumers have become more health conscious and are now aware and more equipped with pertinent information regarding the effect of the food, including meat they consume. This increased consumer awareness has resulted in the emergence of a consumer category that demands healthful foods. Compared to other red meats such as beef and lamb, chevon has lower fat, saturated fat and cholesterol content [10,11] but a higher polyunsaturated fatty acid (PUFA) [12,13]. This chemical composition, in terms of the fat content and fatty acid profile, makes chevon a more healthful meat in comparison to other red meats. Thus, chevon has the potential to fill in a special market niche. As a direct consequence of its leanness and a health-beneficial fatty acid profile, the popularity of chevon on the global meat market is increasing as health-conscious consumers prefer leaner and healthier chevon [11,12].

The human population is expected to grow to nine billion by 2050 [14,15]. This huge increase in population is envisaged to further increase the already high demand for meat and other animal-derived products for human consumption [5,16–18]. In order to be able to meet the increased demand, there is the need for sustainable and efficient meat and animal product production. This population-mediated increase in the demand of animal-derived protein for human consumption creates a huge potential for goats, which are known to thrive in marginal areas, to play a significant role in the supply of meat and other protein products [19].

Compared to cattle, sheep and pigs, less scientific investment has been made towards improving the productivity of goats [20]. This “lag” in the investment towards improving the productive traits of goats, could have resulted from the relegation of goats to low economic value by the developed world, and a preference by consumers for other meats compared to chevon [21]. These two aspects have hugely contributed to the mismatch in developmental investment into goat productivity and the potential of goats to contribute to animal production for human consumption.

However, despite this slow investment into the development of goats targeting improved productivity, chevon, due to its healthful chemical nutrient profile is potentially going to be the next major contributor of animal-derived protein for human consumption in the not too distant future. It is against this background that this review seeks to create an awareness of the goat population, highlight the merits of goats over other small ruminants, and interrogate the capacity to produce chevon on a large scale and also to create an awareness of the health and nutritional benefits of chevon as a dietary protein source for human consumption.

2. Overview of the Goat Industry

2.1. Goat Populations

Currently the global goat population is one billion lower compared to cattle and sheep which are at 1.5 billion and 1.2 billion, respectively [22]. Africa and Asia’s goat populations contribute 38.7% and 55.4% of the global goat population, thus these areas are potentially major players in the goat industry value chain. Between the years 2006 and 2016, the world goat population increased by 19.3%, while cattle and sheep increased by 6.7 and 6.8%, respectively (Table 1). African and Asian countries constitute part of the developing countries and are characterized by huge rural areas that are dependent on subsistence farming. Due to goats being hardy, they are one of the most favoured and widely farmed small ruminants; hence their large numbers in African and Asian countries. These large numbers of goats in such resource poor communities present a tremendous opportunity for improved goat productivity and off-take.

Table 1. Percentage changes in goat, cattle and sheep populations (2006–2016) Source: [22].

	Goat Heads			Cattle Heads			Sheep Heads		
	2006	2016	Change% 2006–2016	2006	2016	Change% 2006–2016	2006	2016	Change% 2006–2016
Africa	281,690,042	387,667,193	37.6	255,302,101	324,844,768	27.2	280,667,155	351,579,045	25.3
America	38,039,407	37,866,521	−0.5	514,635,694	522,004,210	1.4	92,064,930	83,849,797	−8.9
Asia	498,978,363	556,019,726	11.4	445,448,690	470,224,322	5.6	458,176,129	511,711,463	11.7
Europe	17,915,841	16,965,650	−5.3	128,737,713	121,934,483	−5.3	136,628,505	131,059,072	−4.1
Oceania	3,747,638	4,291,278	14.5	38,711,880	35,879,934	−7.3	131,125,242	95,154,412	−27.4
World	840,371,292	1,002,810,368	19.3	1,382,836,078	1,474,887,717	6.7	1,098,661,961	1,173,353,790	6.8

In Asia, China, India, Pakistan and Bangladesh are home to large goat populations with Chinese goat populations constituting 14.85% of the global goat population [22]. Nigeria, Sudan and Ethiopia are the African countries with the most goats (Table 2) and their total goat population, 135,404,892 million, constitutes 13.5% of the global goat population [22].

Table 2. Top ten countries with the largest goat population in 2016 Source: [22].

Country	Goat Numbers	% of the Total
China	148,934,400	14.85
India	133,874,637	13.35
Nigeria	73,879,561	7.37
Pakistan	70,300,000	7.01
Bangladesh	56,083,240	5.59
Sudan	31,325,105	3.12
Ethiopia	30,200,226	3.01
Kenya	26,745,916	2.67
Mongolia	25,574,861	2.55
Mali	22,141,497	2.21

2.2. Goats: Adaptations and Economic Potential

Goats have inherent physiological adaptations that allow them to survive in marginal areas where crop and livestock production is not suited. They have a mobile upper lip which allows them to select nutrient-rich browse [23]. Additionally, because of their ability to secrete proline-rich proteins that complex with tannins, thereby reducing the detrimental effects [24], goats are able to consume and digest tannin-rich browse and effectively extract nutrients from it [25,26]. Goats are also known to be capable of enduring prolonged water deprivation and are better able to withstand heat stress compared to sheep and cattle [27]. Due to their adaptations, compared to other small livestock, goats are a low maintenance option and are the preferred small ruminant by farmers, particularly those residing in areas that are semi-arid and arid and thus characterized by marginal farming potential [28].

With climate change mediating a change of most natural grass rangelands into veld characterized by less grass, but more of browse trees and shrubs [29], goats are, the more suitable species to be reared in such marginal areas due to their adaptability to efficiently exploit such environs [30]. Goats are the most prolific domesticated ruminant, thus, from both a production point of view and with regard to their potential for genetic improvement, both can be attained in a relatively short time period [12,19]. The high prolificacy can be exploited to ensure adequate market supply of chevon, whose demand is on the increase.

2.3. Goat Breeds for Meat and Chevron Production Trends

Goats reared for chevon constitute a major part of the global goat population [31]. Several goat breeds are used for chevon production. In southern Africa, the major meat breed is the Boer goat of South Africa [31]. This breed is known to produce chevon of premium quality [32,33]. The low maintenance Kiko goat of New Zealand is known for its lean meat [31]. The Black Bengals of Bangladesh are known to be excellent in producing quality meat [34]. The Anglo-Nubian goat is used as a dual purpose breed for milk and meat production [31].

Despite the fact that over the last decade, among livestock, goats have had the largest numerical increase, the goat production industry is still characterized by a lack of organized selection programs in most areas particularly in the developing world [35]. In developing countries goats are mainly randomly bred with very limited if any dedicated selection programs. Due to the availability of a few well characterized breeds for meat production, there is a tremendous potential in these developing countries to select and exploit some of the untapped goat genetic potential. In addition to limited selection, goat production in these developing countries is mostly typified by an extensive production system and poor record keeping.

Despite the lack of well-organized selection programs, the global outlook of the chevon industry shows evidence of its tremendous potential to grow. The Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), [22] in 2016, indicated that the total world meat production grossed 329,890,425 tonnes, of which chevon contributed 5,621,333 tonnes, which constituted 2% of the total world meat production (Table 3). Of this contribution, Asia and Africa produced approximately 95% of the total world chevon (Table 4). This high production of chevon from these two continents points to both the importance and potential of chevon to be among the elements of household food security [20]. The global chevon production from 2006 to 2016 increased by 23.12% (Figure 1). In terms of regions the percent increase in chevon production was 12.68%, 29.35%, −19.57% and −1.66 % in Africa, Asia, Europe and the Americas, respectively [22].

Table 3. Global meat production in 2016 Source: [22].

Meat Type	Production (Tonnes)	% of the Total
Beef	65,973,820	20
Chevon	5,621,333	2
Chicken	107,143,008	32
Mutton	9,310,532	3
Pork	118,168,709	36
Other	23,673,023	7
Total	329,890,425	100

Table 4. Global chevon production in 2016 Source: [22].

Region	Chevon Production (Tonnes)	% of the Total
Africa	1,244,109	22
America	127,041	2
Asia	4,113,646	73
Europe	98,934	2
Oceania	37,603	1
World	5,621,333	100

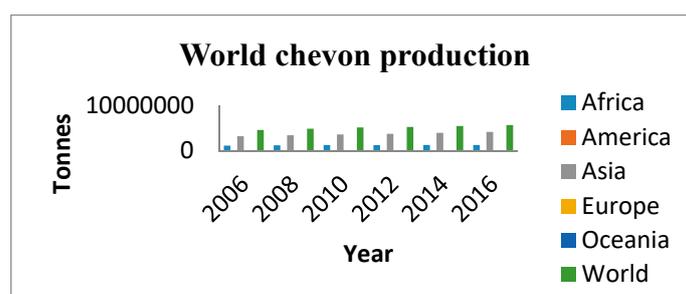


Figure 1. Global chevon production during the period 2006–2016 Source: [22].

2.4. Trade and Marketing of Goats and Chevon

Despite the economic importance of goats, particularly in the sustenance of household food security in rural areas of developing countries, marketing (of goats and chevon) is not as formalized as that of other livestock [36]. Other livestock production enterprises have functionally efficient production and marketing support structures which allow farmers to realize proper value from both the sale of live animals and or products derived from them. The inadequacy of pertinent literature regarding the marketing of goats and chevon also worsens the problems associated with a lack of formal goat and chevon marketing structures. Although this lack of an organized and streamlined marketing structure is largely true of the developing world, it is important to point out that even

in countries from the developed world, goat and chevon marketing structures are less developed compared to that of other livestock species and products.

In most areas, chevon is mainly consumed locally and most of it is sold at local “markets” that cater for domestic consumption [37]. This localization of the trade and marketing of chevon results from it (chevon) being not as yet considered a mainstream product in many regions of the world despite its potential and health beneficial chemical nutrient composition. As a result, in both developed and developing countries, a major portion of chevon produced is not traded as other meats: it is largely usually produced and consumed locally in the communities where production takes place.

The localized informal chevon markets are typified and driven by traders who link mostly butchers to producers. In addition to the unavailability of formalized marketing for goats and chevon, the lack of a product grading system, poor quality product, seasonality of demand, inconsistent product supply and negative consumer attitudes, and insufficient research to identify a new market and expand existing markets [38,39] compound the challenges faced by both goat producers and consumers of chevon.

In Africa and Asia, the demand for chevon is increasing despite the lack of a formalized marketing system. Besides being premised around social traditions and in some instances, ethnic demand, the demand for chevon is also influenced by religion as exemplified by the “Haji”, a religious festival, where Moslems slaughter approximately 34 million sheep and goats in about six hours. Such religiously premised and other localized slaughters are executed outside of the abattoirs and largely constitute traditional forms of chevon consumption. Development of a formalized marketing structure would exploit both the religious-social mediated and modern chevon consumption habits which would stimulate the growth of the chevon industry.

2.5. Chevon: Acceptability, Nutritional Value and Health Benefits

Although chevon popularity and marketing support is not as well developed as that of other animals-derived dietary protein and micronutrient sources, chevon is generally well accepted across religions. It has none of the taboos associated with any other meat products such as beef and pork have among the Hindu and Muslim faiths, respectively. This is due to its wide accepted acceptability coupled with the increased demand of animal products in sub-Saharan Africa, expansion of urban settlements and an improvement in incomes [5] as well as the growth in living standards in some parts of the world. Thus, chevon can potentially increase its market share.

Globally consumers have become more health conscious and now exert strong influence regarding the acceptability and or boycott of certain foods. Over and above considering the sensory attributes, nutritional value and convenience factors associated with meat. Currently consumers demand lean meat with less saturated fatty acids, which has been demonstrated to have less negative impacts on health [40–43] compared to fatty meat rich in saturated fatty acids [44]. Besides being a good source quality protein for human consumption, chevon has a low fat and cholesterol content [10,45,46], has a higher concentration of desirable and unsaturated fatty acids, which are known to have beneficial health effects in the human body [45,47].

Additionally, chevon which is leaner compared to other red meats, has favourable sensory and visual appeal [46]. Despite its favourable chemical nutrient composition and physical attributes, chevon is less recognized in the formal meat markets [48,49], is seen as a product for the poor and deemed an inferior product fit for the lower-income populace [50–52]. There is also a perception among consumers that chevon is stringy, tough and too strongly flavoured [21,46,53]. Despite some of these negative perceptions around chevon, its health benefiting fatty acid profiles and leanness clearly stand out and make it a potential significant contributor to the increased demand of animal products for human consumption.

Chevon is a low calorie, low fat and low cholesterol product [54] when compared to chicken, pork, beef and lamb (Table 5). Considering its high nutritional value and its greater unsaturated to saturated fatty acid ratio, chevon can potentially improve the health of human populations vulnerable

to malnutrition with a much reduced risk of causing obesity and its associated metabolic diseases such as insulin resistance, type II diabetes mellitus, cardiovascular diseases and metabolic syndrome [55,56].

Table 5. Chevon nutrient composition comparative chart Source: [54].

Per 85 g Cooked/Roasted	Calories	Fat (g)	Saturated Fat (g)	Cholesterol (mg)	Protein (g)	Iron (mg)
Chevon	122	2.8	0.79	63.8	23	3.2
Chicken	162	6.3	1.7	76.0	25	1.5
Beef	179	7.9	3.0	73.1	25	2.9
Pork	180	8.2	2.9	73.2	25	2.7
Lamb	175	8.1	2.9	78.2	24	1.4

Chevon is a major source of micronutrients particularly, iron and potassium as well as vitamin B₁₂. Iron deficiency results in anemia and this is a real threat to women of childbearing age, especially in rural areas [57,58]. The high concentration of iron (Fe) in chevon (Table 5) makes it potentially a source of iron for pregnant women in rural areas where iron supplements may be difficult to access while high concentrations of potassium are essential for the maintenance of electrolyte and osmotic balance. Vitamin B₁₂ is required for normal maturation of erythrocytes with its deficiency leading to megaloblastic anemia.

The protein quality of a food is determined by the composition and proportion of essential amino acids in the food [50]. Compared to beef, pork, and lamb, chevon is characterized by having comparable arginine, isoleucine, lysine, methionine, threonine and tryptophan concentration (Table 6).

Table 6. Amino acid profile of beef, chevon, lamb and pork Source: [59].

Amino Acid	Muscle Protein (mg Protein g)			
	Chevon	Beef	Pork	Lamb
Alanine	–	64	63	63
Arginine	75	66	64	69
Aspartic	–	88	89	85
Cysteine	–	14	13	13
Glutamic	–	144	145	144
Glycine	21	29	32	27
Histidine	21	29	32	27
Isoleucine	51	51	49	48
Leucine	84	84	75	74
Lysine	74	84	78	78
Methionine	27	23	25	23
Phenylalanine	35	40	41	39
Proline	–	54	46	48
Serine	–	38	40	39
Threonine	48	40	51	49
Tryptophan	15	11	13	13
Tyrosine	–	32	30	32
Valine	54	57	50	52

3. Potential for the Future

3.1. Research Promoting Goat Productivity

In the discourse above, it is very clear that most of the goats are found in the developing countries of Africa and Asia and are thus largely reared by rural small-scale farmers. Despite these countries having large goat populations, Morand-Fehr and Boyazoglu [60] contend research in small ruminant production has been low, particularly in Africa. Although Europe has only 2% of the global goat

population, it contributes 30% of the annual global scientific publications on small ruminants compared to Africa's 13.5% [60,61]. While there has been some research regarding goat production, most of it has tended to focus on on-station and or commercial goat enterprises with little done with respect to improving and increasing goat productivity in rural communities. There is therefore a dire need to dedicate resources for research on goat nutrition, management, breeding and health in rural areas with the objective of improving productivity and off take. In addition to the fundamental need to execute research that targets to improve goat productivity, there is a need to make the research outputs farmer-friendly such research outcomes can be practically translated and transformed into practical knowledge to support primary production, hygienic-slaughter and chevon storage, grading and marketing.

3.2. Chevon Market Development

In developing countries where goats are reared, they are mostly farmed under natural veld with very little, if any, use of pharmacological agents to improve health and productivity. Thus, these goats and chevon derived from them can be deemed "green produce." It is imperative that this "naturalness and greenness" of such goats and products derived from them be emphasized when marketing them at local, regional and international levels. A marketing cocktail that highlights the health beneficial fatty acid composition and "naturalness" of the chevon not only helps educate the consumers of the benefits of the product, but it also creates a special niche for the product which will translate to greater benefit by producers. A deliberate effort needs to be made to showcase chevon as a unique product and avoid the traditional approach of benchmarking it against lamb. It is fundamental that beside the traditional manner of packaging and consumption of chevon, that it be also processed into various types of snack foods, or other convenience products tailored for specific ethnic or cultural groups in developed countries [62]. Apart from the value addition generated by the processing into snack and convenience foods, the processing also helps create demand in such developed societies.

Therefore, the chevon industry can take advantage of the growing demand for organic food [63]. This demand for organic food is mainly motivated by the consumers' health concerns [64]. Organic food can be defined as natural food items that are free from synthetic chemicals such as antibiotics, fertilizers, herbicides, pesticides and genetically modified organisms [65]. Furthermore, goat production can provide food security to the increasing world population, while minimizing negative impacts to the environment and health since the development of organic food production is largely driven by the idea of sustainability and environmental concerns [63].

In order to increase the demand for chevon and simultaneously increase chevon sales, market participants are encouraged to avert misconceptions of goat meat being regarded as inferior meat through synchronization of market preferences with the supply of the product. This will ensure that producers are able to access markets. Facilitating the formation of smallholder goat producer enterprises that are linked to processing units may also be a useful tool. Furthermore, integrating producers with marketing organizations will assure a quality goat meat supply in the local formal markets and also the export market.

Therefore, quality assurance schemes could be put in place to ensure the quality of chevon by exposing producers to production practices such as herd health, nutrition, management, and proper care, record keeping, and biosecurity. This marketing tool guarantees consumers the wholesomeness of their chevon and products. Efforts to increase goat productivity through increased carcass size and production efficiency should be the aim of development projects. This will avert low productivity, especially in terms of edible carcass per animal, thereby fulfilling local chevon demand and ensuring that export standards are met.

Putting in place comprehensive and comparable national chevon classification systems will promote the selection of chevon based on quality. This will also motivate individual farmers to produce a product of good quality when incentives are provided. Chevon classification systems will also ensure a shift from benchmarking chevon against lamb or mutton. As a result, the chevon industry

development will be propped allowing chevon to be developed and marketed as a lean and healthy product. This will improve the recognition of chevon as an alternative source of good quality protein.

Therefore, windows of opportunity are open to establish marketing organizations that can capitalize on the growing demand for chevon. These organizations could add value to the products by undertaking to brand and ensuring the quality of the meat. Also, as production increases integrating smallholder producers into larger markets will allow access to buyers, processors, and suppliers of feeds and veterinary services. The aforementioned marketing tools are not only limited to countries in which there is a tradition of chevon consumption, but also European countries can apply them accordingly since the demand for healthy products of high nutritional value already exists.

3.3. *The Way Forward*

This overview of the situation of the world goat industry raises questions on the general opinion about goats as animals for poor people, on their potential for rural and local development, as well as for niche markets in urban communities. Furthermore, there is a projected twofold increase in the demand for safe, healthy, good quality meat and meat products by 2050 resulting from the dramatic growth in human population, improving lifestyles and urbanization [5,14,15,17]. Therefore, if goats contribute significantly to feeding rural populations, they certainly can also sufficiently supply meat in urban societies, provided an organized industry and marketing sector exist.

On the other hand, the world will be confronted with great water shortages, and a large demand by intensive water-using animal production systems can be questioned [5]. Goats can contribute to sustainable and productive use of water resources if their efficiency is improved by better adapted research and more efficient extension service. Therefore, the goat industry has great potential to grow in the global market.

4. Conclusions

Goats while known to play a significant role in human food security at household level, their contribution can be magnified by highlighting and creating awareness in the consuming public about the uniqueness of chevon, its being largely a natural product with a health beneficial fatty acid profile. Furthermore, an improvement in goat husbandry techniques, accurate record keeping and budgeting as well as the development of a formalized and well supported marketing structure is required in order for farmers to reap full benefits from goat farming and the sale of chevon. The creation of such awareness is bound to generate increased demand for the product which then avails more economic opportunities for goat farmers and the goat industry value chain. Therefore, opportunities exist for establishing marketing organizations at all levels from the village to national organizations that can take advantage of the growing demand for chevon.

This paper presents an interesting issue of chevon potential in the red meat industry, which might be particularly of importance to the meat producers, farmers in the developing African and Asian countries. This, therefore, calls for policy makers to create rapid and favourable policies, especially in the delivery of veterinary services and infrastructural development. Although demand for chevon is growing, it is not officially graded in most countries and this policy bottleneck limits the commercialization and marketing of chevon. Therefore, a chevon pricing and grading policy, if put in place, would promote the production of high-quality chevon thereby ensuring premiums for the producers and farmers. Ideally, this policy would also promote export earnings.

In conclusion, the adaptability and resilience of goats make them an indispensable resource to safeguard sustainable production and contribute to the increasing protein requirements of the growing human populace. This will call scientists in the near future to commence research on new technologies to improve the productivity and efficiency of goats.

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