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ANGORA GOATS AND MOHAIR PRODUCTION IN SOUTH AFRICA: A REVIEW

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REVIEW

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ABSTRACT: This review summarises the properties, nutritional requirements, and production of a natural fibre called mohairs produced by Angora goats. One of the most valuable natural fibres is mohair, produced by Angora goats. Angora goats, also known as Ankara, have their origin in Asia Minor, but today, South Africa is home to over 23% of the global population of Angora goats, where it produces over 60% of the world's mohair, generating about 4 million kilograms annually. Eastern parts of South Africa account for over 72% of the total Angora goats in the country, hence producing the highest number of mohair. The physical properties of Angora mohair, such as lustre, non-inflammable, breathable, durability, elasticity, and resistance to soiling, make it unique and different from other natural fibres of other animal sources. These properties are affected by age, nutrition, and management. The role of nutrition is particularly crucial, as Angora goats require 3-4% of their body weight DM, whilst meat goats and lactating dairy goats require 3-5% and 4-6% of their body weight DM. When Angora goats were fed diets with 18% crude protein, mohair growth increased by about 33% annually compared to diets containing 12-15% CP, while feed intakes were the same. Also, copper, sulphur, molybdenum, and water intake affect the quality of mohairs. In conclusion, inadequate nutrition significantly impedes productivity and sustains financial losses. Hence, promoting sustainable farming practices is vital, investing in research to develop resilient grazing systems and drought-tolerant feed crops, and building capacity for small-scale farmers to improve mohar production and quality in South Africa.

Keywords: Angora goats, Mohair, Nutrition, Physical Properties, Processing.

INTRODUCTION

The global goat population is around 1.2 billion, with Southern Africa having an estimated 35 million goats (Monau et al., 2020; Mthi et al. 2024). According to Mthi et al. (2024), South Africa is home to approximately 5.2 million goats, where they were domesticated. National Institute of Food and Agriculture (2022) stated that different goat breed types include Kalahari Red, Savanna, Nguni, Xhosa Lob-ear, Northern Cape Speckled, Kaokoland, Boer, Skilder goat, Saanen, British Alpine, Toggenburg, Non-descript, and Angora goats are found in South Africa. Nguluma et al. (2018) and Mataveia et al. (2021) reported that angora goats account for approximately 23% of the goat population in South Africa. Additionally, Turkey, Iran, China, the United States, and Australia are home to large populations of Angora goats.

Capra hircus ancryrensis, also known as Angora goats, originated from the district of Angora in Asia Minor and became established in Turkey, where they were called Ankara (Zehra and Çek, 2021). It produces the lustrous fibre known as mohair. It is widespread in many world countries, and many breeds have derived from it, including the Indian Mohair and the Soviet Mohair (Porter et al., 2016). In South Africa, Angora goats thrive in Eastern Cape Province and Karoo regions (Mpyana, 2019), which has become a significant economic contributor to goat production through mohair (Mataveia et al., 2021). Angora goat is a unique breed farmed for mohair, meat, milk, leather, and other social needs. Daskiran et al. (2018) reported that Angora goats are dual-purpose animals with small body frames and adapt quickly to poor environmental conditions compared to other breeds of goats.

Mpyana (2019) and Marius et al. (2021) asserted that South Africa produces approximately 60% of the world's mohair, generating about 4 million kilograms annually. Mohair is a gleaming fibre that is white, extraordinarily soft, and silky, possessing a natural brightness and shine. It is a breathable, moisture-wicking, strong, durable natural fibre resistant to soiling and wrinkling (Abdollahzadeh and Yousefi, 2014; Gericke et al., 2022). Mohair is flame and static-resistant; it does not encourage the growth of bacteria, making it an excellent choice for allergy sufferers compared to other fibres such as cotton and wool (Gericke et al., 2022; Shashikant and Singh, 2024). Gericke et al. (2022) stated that Mohair is smoother, shinier, more durable, and wrinkling-resistant than wool. Due to its characteristics, mohair is suitable for use in the textile sector, especially for making clothes, sweaters, drapes, socks, scarves, and other items.

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Angora breed of goats has different nutritional requirements in different physiological stages (Zehra and Çek, 2021). About 14 to 16% of crude protein content in the Angora goat diet is essential for growth and mohair production. Froghi and Hosaini (2012) and Zehra and Çek (2021) reported that inadequate protein results in coarse and brittle Angora fleece, which can lead to a lower quality. Similarly, when Angora goats do not receive enough energy from their diet, they might experience poor growth performance, and fleece may be affected. Insufficient calcium and phosphorus minerals in their diets lead to skeletal problems and reduced fertility (Froghi and Hosaini, 2012; Kumar, 2023).

MOHAIR PRODUCTION

Although South Africa is the largest producer of mohair globally, the country witnessed a decline in the Angora goat population between 2003 and 2015 (Mpyana, 2019), leading to a drop in mohair production from 12.2 to 2.23 million kilograms annually. This decline may be due to decreased profits from fluctuating costs of feed ingredients. Additional obstacles could involve a lack of functional local markets, insufficient financial support from the government, and inadequate infrastructure within the market (Mpyana, 2019; Marius et al., 2021). However, because of the recent increase in the demand for mohair in the global market, there has been an increase in the population of Angora goats in South Africa, leading to a 25% increase in mohair production (Gericke et al., 2022). Figure 1 shows the global mohair production by countries as reported by the South Africa Mohair Growers Association in September 2022 cited from Mohair South Affrica (2022).

Mohair quality

The age of Angora goats affects the quality of Mohair produced (Zehra and Cek, 2021), while Mpyana (2019) observed that as the Angora advanced in age, the quality of mohair produced declined, especially the fibre thickness, hardness, and lustiness. According to Zehra and Çek (2021), goats aged 3 to 5 years produce more low-quality mohair, whereas goats aged 1 to 2 years produce less low-quality Mohair. Zehra and Çek (2021) and Gericke et al. (2022) also reported that males produce more mohair than females. Mohair yields and quality depend largely on genetics composition, goat management, and, most importantly, nutritional factors (Zehra and Çek, 2021). Good management practice and balanced nutrition are essential for mohair growth and high-quality yields.

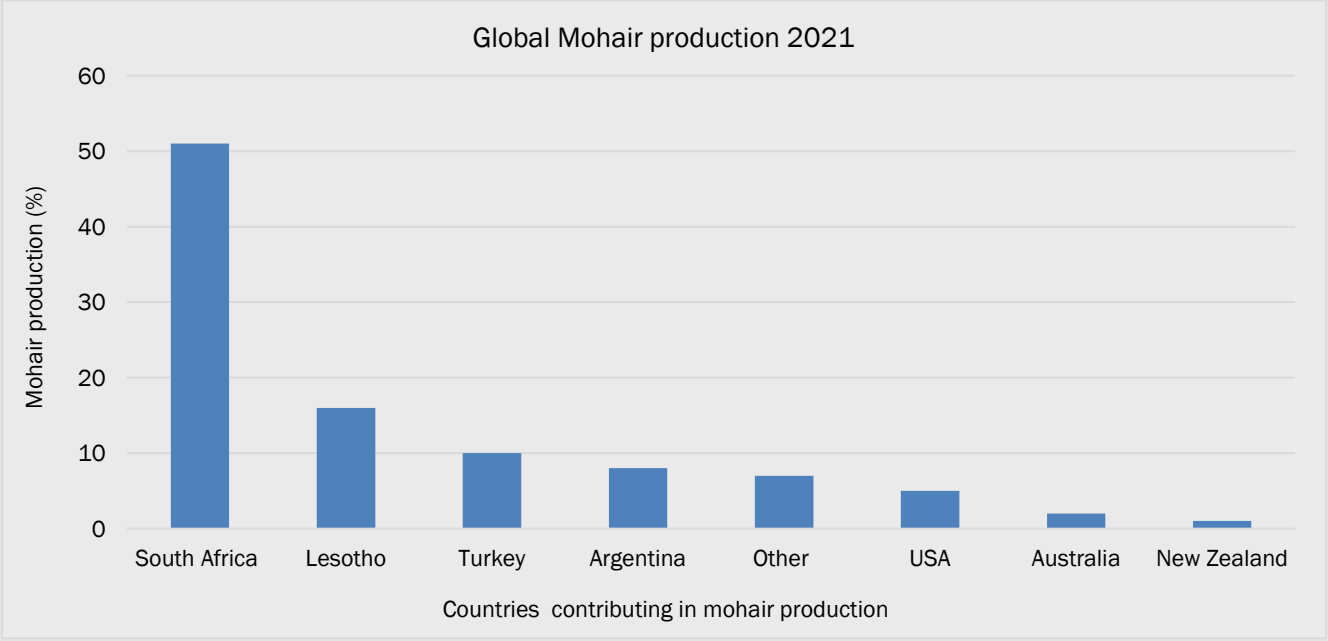

Figure 1. A bar graph showing global mohair production in 2021

Impact of mohair production on rural economy in South Africa

Mohair production in South Africa significantly contributes to rural income, particularly in the Eastern Cape Province, which is the heart of the global mohair industry (Mpyana, 2019). Over 800 farmers (communal and commercial) and their dependents, numbering around 30,000 people, benefit directly or indirectly from the mohair value chain (SA Farmers' Magazine, 2022). Hence, support rural livelihoods through farming, processing, and export-related activities.

Efforts to enhance income and participation among rural farmers include initiatives like the Mohair Empowerment Trust (MET), which collaborates with government entities to support emerging black farmers (SA Farmers' Magazine, 2023). This Trust allocated funds for farm infrastructure, Angora goats, and shearing equipment to improve productivity and market access for

these rural farmers. Thereby integrating historically disadvantaged individuals into the commercial sector and promoting sustainable income generation (Marius et al., 2021). Similarly, in 2023, the Eastern Cape Development Corporation (ECDC) provided over R1 million to support emerging mohair farmers, which highlights the financial backing given to rural initiatives to uplift income levels. This funding helps farmers adopt best practices in animal care and fibre production, which, in turn, increases the marketability and profitability of their mohair (SA Farmers' Magazine, 2023)

Nutrition and feeding requirements of Angora goats

According to Froghi and Hosaini (2012), goats differ in breeds, which necessitates diverse dietary needs. Angora type of goats requires specific quantities of protein, energy, vitamins, and mineral elements to satisfy their nutritional requirements. These depend on the age, sex, breeding condition, and wellness state of the goat (Zehra and Çek, 2021). Illustratively, Mcgregor (2018) communicated that young goats in the growth phase demand additional protein compared to those matured ones; furthermore, pregnant or lactating goats require more energy and calcium. Hay or pasture is the most important source of nutrition for mohair goats (Zehra and Çek, 2021). In South Africa, most Angora strives better with Leucine hay than other types of hay (Mpyana, 2019; Nipane et al., 2023). Mamoon (2008) and Kumar (2023) reported that providing Angora goats with dry matter (DM) ranging from 3-4% of their body weight through pasture or hay is beneficial to their growth and overall productivity. It is suggested that the hay is of the highest quality as it should be free from contaminations such as moulds and dust and offer the right proportion of protein, energy, and fibre. Hay such as Alfafa, grass hay, oats hay, leucine and legume hay are good for mohair production (Mamoon, 2008; Nipane et al., 2023). The literature asserts that small ruminants may be best offered twice daily, once in the morning and another in the afternoon (Ikusika et al., 2019; Khaskheli et al., 2020). Inadequate nutrition is a crucial factor impeding productivity and sustaining financial losses most of the time. Nipane et al. (2023) delineated five critical elements in goat nutrition: water, proteins, minerals, vitamins, and energy (obtainable from fats and carbohydrates).

Dry matter

Dry matter is that part of a feed that does not contain liquid form or moisture (Cériac et al., 2019). More than that, the whole feed solids are composed of fibre, protein, and minerals. Rahman et al. (2020) noted that the dry matter content of feeds may be determined by subtracting the moisture value from the total weight of feed offered. DMI is measured by the portion of dry matter consumed by goats in a day (Rahman et al., 2020). Important determinants of a goat's dry matter requirements include age, weight, breed, and production environment. Nipane et al. (2023) noted that young and lactating goats have significantly higher DMI than other goats. Inadequate dry matter intake leads to poor performance and productivity (Zhang et al., 2011; Cériac et al., 2019). Inadequate Dry matter Intake may result in goats consuming fewer nutrients, negatively impacting mohair growth.

Angora goats require 3-4% of their body weight DM, whilst meat goats and lactating dairy goats require 3-5% and 4-6% of their body weight DM (Mamoon, 2008; Nipane et al., 2023). Too much dry matter, Copper, and Molybedum may result in poor mohair production and digestibility difficulties in goats (Zhang et al., 2011). Goats are estimated to consume DM ranging from 12-35% in forages and 86-92% in hay (Mamoon, 2008). Dry matter is directly proportional to protein and inversely proportional to the energy in a diet, which means that energy, milk yield, and body weight gains may estimate the DMI of goats (Nipane et al., 2023).

Energy

Meeting the energy needs of angora goats is essential as goats that are not adequately nourished show reduced growth and mohair output. Weather, activity level, pregnancy, and disease impact Angora goats' energy requirements (Hart, 2004; Froghi and Hosaini, 2012). According to Atiba et al. (2020), goats and sheep have nutritional needs distinct from those of larger animals such as cows and horses. Small ruminant animals are hindgut fermenters, indicating that they break down food in the cecum, a sizable pouch close to the start of the large intestine. A high-fiber diet with moderate levels of protein and fat is essential for small livestock (Nipane et al., 2023). A higher-quality diet is required for fat deposition because Angora stores a small amount of body fat (Froghi and Hosaini, 2012). Energy supplements may contain oats and barley. However, Mcgregor (2018) concluded that Angora goats fed hay, corn, and barley have a significant body weight gain but little change in mohair production. Australian results anticipated that when an Angora goat is fed energy and protein from 5 months old, it tends to gain about 3.6kg body weight, increased mohair production by about 20%, and mohair diameter by <1um (McGregor, 1998). Kids produced the most valuable and quality fibre. However, mohair diameter increases as the goat ages (McGregor, 1998).

Angora goats have higher energy requirements than other goat breeds (Mcgregor, 2018). This is because they grow more quickly than other breeds and produce mohair. Weight, age, and reproductive status influence the goat's required energy range. McGregor (2020) claimed that the energy requirements of young goats that are still growing and gaining weight are different from the needs of adult goats who are neither lactating nor about to give birth. Milking goats, the highest stage in the list, require more energy than any other stage to help maintain body condition and milk production.

When lactating, goats need approximately 30% more energy than non-lactating goats (Oliveira et al., 2021; Nipane et al., 2023). According to Gelayenew et al. (2016), angora goats are more vulnerable to nutritional stress because they store less body fat.

Protein

Angora goats with high mohair yields have higher protein requirements than other goat breeds (Froghi and Hosaini, 2012). Protein is necessary in the Angora goat's diet for mohair's growth, maintenance, and production (Nipane et al., 2023). If goats do not have sufficient protein, they can become weak and ill, and in extreme situations, they may die. Angora goats need between 14 and 16% protein in their dry matter consumption (Emeruwa, 2016). Environmental conditions, activity level, pregnancy, and disease impact Angora goats' protein requirements.

Protein is typically obtained from the hay or forage that the goats consume. Hay, legumes, alfalfa, barley, corn, oats, soya meal, peas, canola, and cottonseed meal are typical protein supplements that fulfil goats' protein needs (Mamoon, 2008; Chisoro et al., 2023; Nipane et al., 2023). According to Huston et al. (1971), cited from McGregor (1998) findings, when Angora goats were fed diets with 18% crude protein, mohair growth increased by about 33% annually compared to when fed diets containing 12-15% CP while feed intakes were the same. However, in other countries such as Australia, it is allowed only to feed Angora goats wheat with 12 to 14% CP (McGregor et al., 2012).

Determining protein quality relies on its amino acid profile and is crucial for achieving optimal productivity (Nipane et al., 2023). According to Froghi and Hosaini (2012) and Nipane et al. (2023), proteins' prime building block units generally comprise amino acids crucial for hair growth and protein synthesis. In an article published in 2018, the researcher Hobson (2018) highlighted how essential amino acids such as methionine and lysine are vital for goats' well-being. The potential for increasing mohair production by up to 20% exists through utilising rumen bypass proteins (Froghi and Hosaini, 2012). The diet needs to have a balance of protein and energy levels. The protein-to-energy ratio in goats is influenced by the type of hay, quantity of protein supplement, and level of exercise. Overall, if goats obtain enough amino acids, they can digest protein properly, leading to better productivity.

Vitamins

There is a lack of literature regarding this element related to Angora goats; however, like any other livestock, the well-being of the Angora goat influences mohair growth. Each vitamin plays a unique role in goats' performance and mohair production. Four vitamins are known as fat-soluble vitamins, i.e., A, D, E, and K, and water-soluble vitamins such as C and B complex are incredibly beneficial to health and fibre production (Froghi and Hosaini, 2012). Angora goats require vitamins for various purposes; all vitamins, with their unique purposes, contribute to quality mohair yields.

Skin, eye health, reproduction, and the coat of goats seem to benefit immensely from the favourable role that Vitamin A and Vitamin D play in research by Nipane et al. (2023). Also, conditions favourable for bone growth and mineral absorption are brought about by vitamin D supplementation. Vitamins can assist in ensuring that the goat is healthy, which might translate into better fiber production, especially mohair (Nipane et al., 2023; Ma et al., 2024). Table 1 below shows the estimated fat-soluble vitamin-required levels for goats.

Table 1 - Fat-soluble vitamin requirements levels of goats

Vitamin	Level
A	11.000 IU/Kg of feed
D	4,400 IU/Kg of feed
E	176 IU/Kg of feed
K	A well-functioning rumen cans synthesis sufficient levels.

Source: (Nipane et al., 2023)

Minerals

There are two main categories of essential minerals: macronutrients and micronutrients (Mamoon, 2008; Atiba et al., 2020). Froghi and Hosaini (2012) and Nipane et al. (2023) stated that macronutrients are needed in large quantities, while micronutrients are needed in small amounts in diets. The Angora goats require the intake of calcium, phosphorus, magnesium, copper, zinc, manganese, and selenium to stay healthy and give high-quality mohair. According to Hobson (2018) and Nipane et al. (2023), copper is one of the most essential minerals in mohair production. They both reported that including copper in the diets of Angora goats resulted in mohair and keratin production growth. In contrast, copper deficiency may make mohair weak, thin, or discoloured. Copper and Mo are reported to be essential minerals for mohair quality. However, a recommended percentage must be fed. Zhang et al. (2011) reported that feeding goats a feed containing 19 mg Cu per kg Dry matter in an experimental diet with 4, 75 mg/kg Cu, 0.16 mg of Mo, and Sulfur equal to 0.2 % can potentially revamp growth performance, fibre digestion, and mohair growth.

Zehra and Çek (2021) concluded that mohair quality is affected by Calcium, Magnesium, Sulfur, Iron, and Nitrogen content. Zinc and selenium are essential minerals that impact mohair quality by supporting hair and bones and enforcing muscles. Most of the time, there is a need to supply phosphorus supplements since phosphorus acts in cahoots with calcium to speed up the process of bone and enamel strengthening. Sodium resides in a water arrangement where the body is mainly in homeostasis. Each mineral uniquely impacts mohair production, and ensuring that Angora goats receive the correct proportion of minerals is crucial because an excess could be harmful (Froghi and Hosaini, 2012; Hobson, 2018). Table 2 below shows goat diets' estimated recommended micro and macro minerals quantities.

Table 1 - Estimated micro and macronutrient quantities in goat diets.

Micronutrients	Quantity (%)	Micronutrients	Quantity (ppm)
Calcium (Ca)	0.3-0.8	Iron (Fe)	50-1000
Phosphorus (P)	0.25-0.4	Selenium (Se)	0.1-3
Sodium (Na)	0.2	Manganese (Mn)	0.1-3
Potassium (K)	0.8-2.0	Iodine (I)	0.5-50
Chloride (Cl)	0.2	Molybdenum (Mo)	0.1-3
Sulfur (S)	0.2-0.32	Copper (Cu)	10-80
Magnesium (Mg)	0.18-0.4	Zinc (Zn)	40-500
		Cobalt (Co)	0.1-10

Source: Cited from Nipane et al. (2023)

Water

Sufficient water consumption is crucial for proper bodily functions like digestion, waste elimination, temperature control, and overall well-being (Nipane et al., 2023). Mpendulo et al. (2020) argue that water is essential for the digestion of feed and absorption of nutrients. Lower-quality diets increase water intake because goats must drink more to stay hydrated. Water is crucial for Angora goats as it is one of their most essential nutrients. Insufficient water can lead to dehydration in Angora goats, resulting in various health problems such as decreased food consumption and mohair production, and potentially leading to their demise (Michael, 2021).

Angora goats' water requirements vary according to their age, activity level, diet, and environmental conditions (Nipane et al., 2023). Water consumption increases in hot weather and when the goat's diet contains more dry matter (Michael, 2021). Goats weighing about 20 kg require about 700ml of water daily; however the abovementioned factors might influence the water intake (Nipane et al., 2023). Nipane et al. (2023) claim that goats consume about 3.5 litres of water for each litre of milk produced. Daramola and Adeloye (2009) and Nipane et al. (2023) reported that sufficient water intake is essential for healthy mohair growth; if an Angora goat does not get adequate water, it is likely to experience poor mohair growth, and its mohair tends to be dry and brittle. Excessive water intake may negatively impact mohair production by leading to soggy mohair, which is less desirable for processing and spinning (Schoeman and Visser, 1995). Despite all the factors affecting water intake, a goat must always have free-choice access to water. Table 3 below shows the estimated water consumption at different stages of goats per day; however, these can be affected by factors like temperatures, the water content in the feed, etc.

Table 2 - Estimated water consumption on different life stages of goat daily.

Different goat stages	Water consumption per day
Weaners	4-6 liters
Adult dry goat	5-7 liters
Doe with kid	5-10 liters

Source: (Nipane et al., 2023)

Physical properties of Mohair

Luster

Luster is the most noticeable feature, referring to a mohair's natural shine (Muthu and Gardetti, 2016; Mazinani and Rude, 2020). Luster is a characteristic that explains how light bounces off a fibre's exterior. Mohair is famous for its shiny, metallic look due to its high lustre. Mohair fibres are comparatively straight and flat, enabling uniform light reflection on

the surface (Singh and Gaikwad, 2020). Mohair is also famous for its soft texture and resistance to pilling (Gericke et al., 2022). This characteristic is why mohair is often chosen for luxury clothing and fabrics.

Non-flammable

Shashikant and Singh (2024) claims that the slivers of mohair fibre turn into little ash beads if placed straight in the fire. In contrast, the combustion process will discontinue as soon as it is removed from the toxicity of fire. Whilst ignition temperature is the attribute that distinguishes mohair fibres from the wool of other animals, it is also known as the ultimate point at which the fibres start to burn. Mohair is more challenging to ignite and better than most synthetic materials when it tumbles because its flame spreads slowly and burns more excellently. However, fibres such as mohair need a higher temperature to ignite than other natural fibres such as cotton and wool above the ignition temperature (Gericke et al., 2022; Shashikant and Singh, 2024). Early teddy bears were crafted from mohair to prevent injuries due to their properties; mohair is also less likely to cause allergic reactions than other wool types (Shashikant and Singh, 2024). Mohair's elevated ignition point makes it an excellent option for clothing in dangerous settings like the military or fire department.

Style and character

Gericke et al. (2022) indicate that mohair is well renowned among fashion people for its rich and trendy appearance. Fibres are luxuriously smooth and very delicate, thus making mohair yarn classified as silk. Since the mohair comes in multiple colours, patterns, and textures, finding a style that matches one's preference is easy (McGregor, 2020; Shashikant and Singh, 2024). The mohair is all the more remarkable due to its halo or fuzzy outline, which makes it stand out from the rest with its unique look and texture. The fluffy look of the fabric is due to the twisted pattern of mohair fibres, which creates a halo effect by trapping air (Shashikant and Singh, 2024). Mohair is usually deemed a halo or bloom, the importance of which is a light and fluffy sensation. The fabric is very soft, and it has a halo or bloom. The crafting style has a significant impact on how the fibres are spun. This yarn creation's shape results from the fibre twist and air pockets formed (Gericke et al., 2022). This makes the mohair garments look elegant and incredible; therefore, the mohair materials are considered excellent for sweaters, scarves and other garments.

Breathable

The airflow permeability, the level that makes the clothes breathable, is an insightful aspect that helps prevent moisture accumulation. Cotton and mohair are two distinct fibres; however, like cotton, mohair is an incredibly breathable material that can absorb moisture and support airflow (Shashikant and Singh, 2024). Availing of these unique qualities of mohair, it is undoubtedly that they are perfect for producing healthy, relaxing wear and cooling materials such as summer wear and sportswear. The breathability of mohair prevents mildew and bacterial growth and aids in regulating body temperature, according to Gericke et al. (2022), Shashikant and Singh (2024). This is why mohair fibres can retain body heat in chilly temperatures and release moisture in hot weather, keeping you cosy at all times.

Durable

The mohair quality is the most prominent feature of this great material. It offers high strength and relatively durable quality. Mohair was pointed out by Shashikant and Singh (2024) as a fabric that is mainly well known for its superb resistance to wear and tear and for surviving multiple cycles through washing. This is attributed to the nature of the fibre, which consists of long, strong fibres entangled with each other. Due to its durability, mohair garments and fabrics can be expected to stay with proper care for longer. Mohair garments from certain textile manufacturers are also known to be long-lasting (Gericke et al., 2022; McGregor, 2020). Mohair's composition enables it to flex and turn without harm, affirming claims that it is the most rigid fibre compared to other animal fibres.

Elastic

Zehra and Çek (2021) highlighted that the elasticity of mohair is influenced by nutrition, and poor nutrition leads to decreased elasticity. Gericke et al. (2022) indicated that the spindle fibres of mohair are expected to stretch by an increment of 30 % along its length with a standard shape after that. As per Shashikant and Singh (2024), being elastic denotes the ability of a fibre to stretch itself and regain its normal state automatically. Mohair tends to possess a relatively high degree of elasticity, enabling it to stretch and regain its initial shape and form without decreasing either strength or appearance. This characteristic makes mohair an excellent option for clothing and textiles needing to preserve their shape long-term. This is a critical factor in why mohair is frequently utilised in knitwear, as it can regain its shape after being stretched while being knitted. Mohair apparel maintains its shape when worn (McGregor, 2020). According to Zehra and Çek (2021) results, mohair elasticity values peak when a goat is six months old and decrease as it grows.

Resistance to soiling

Mohair is recognised for its ability to resist getting dirty, making it less prone to staining than other materials (Shashikant and Singh, 2024). The mohair fibres have a smooth and tightly bound surface, hindering dirt and grime from sticking to the material (McGregor, 2020; Shashikant and Singh, 2024). This property means that mohair is easy to clean and maintain. Dust can be easily removed by brushing and shaking the fabrics.

Mohair Steps/stages in Mohair production

Mohair undergoes processing to guarantee top quality and the lack of impurities (Ghiţuleasa et al., 2013). The processed mohair can be twisted into thread and utilised to create various items. The Australian Mohair Marketing Organisation Ltd. (2020) stated that processing mohair is essential to ensure the end product's uniform texture and quality. In general, the processing of mohair allows for the production of unique and top-notch items that can be sold at a higher price. According to Frank et al. (2012), shearing is the initial stage in mohair processing, where the mohair is taken off the Angora goat. The following stages are sorting, carding, combing, and spinning. During shearing, a shearing comb is used to cut the mohair into long strips (McGregor, 2020). The cut mohair is gathered in big bags and categorised by colour and quality.

Classing/ Grading

Classing or grading refers to sorting mohair by quality and character in the industry. This process ensures that mohair of similar quality is spun together, producing a consistent yarn (Muthu and Gardetti, 2016). The classification process includes various steps such as visual examination, measuring fibre length and diameter, and analysing the characteristics of the fibre (Almeida et al., 2016). The mohair is segmented into various groups depending on its grade. Top-grade Mohair is commonly employed in upscale goods, whereas inferior mohair is frequently used for practical items. The price of mohair is affected by the grade it receives (AMMO Ltd, 2020). Grading is essential so buyers know what they're buying and can make informed decisions on the mohair's quality.

Scouring

Scouring mohair involves cleansing the fibre to eliminate natural oils and dirt (Almeida et al., 2016; AgriSETA, 2018). This method also assists in the softening of the mohair and simplifying its manipulation. Scouring mohair is comparable to wool processing, with some distinct variations noted (Almeida et al., 2016). Mohair is more prone to damage from heat and alkali, which is why it is usually scoured using gentler solutions and at a lower temperature. Another difference is that mohair is often scoured with a detergent called Lanasol, which is designed explicitly for delicate fibres like mohair (Morris, 2017). Zehra and Çek (2021) concluded that Angora goats aged six months have the highest clean mohair percentage compared to 2.5 years; this might be because six months kids have less environmental exposure, such as dust, plant material and other animals, etc.

Carding

Carding straightens the fibres and removes impurities (Muthu and Gardetti, 2016). It involves combing the mohair with a machine known as a carder. The carder divides and arranges mohair fibres in a uniform direction. Almeida et al. (2016) stated that this procedure eliminates any impurities in the mohair, such as plant material, dirt, and fragments. Carding helps smooth the mohair and even while preparing the fibres for the next stage (Almeida et al., 2016).

Combing

Both combing and carding are processes that prepare mohair for spinning, but they serve different purposes. Carding straightens the fibres and removes any debris or impurities while combing straightens them even more and removes all shorter, weaker fibres (Almeida et al., 2016). Combing produces a smoother, more uniform yarn than carding. Frank et al. (2012) highlighted that combing yields higher-quality yarn, but it takes longer and costs more money. Combing is a process that occurs after carding but before spinning (Muthu and Gardetti, 2016). Mohair is separated into individual fibres during combing, with the shorter fibres removed (Almeida et al., 2016). This procedure results in a yarn that is smoother and more consistent. Once the mohair has been combed, it is prepared for spinning by twisting it into yarn.

Spinning

According to Almeida et al. (2016) the thickness of the yarn is determined by the spinning process, which can vary from extremely fine to extremely thick and is carried out manually or using a spinning frame machine. Kosmovis et al. (2013), cited from Zehra and Çek (2021), stated that fibre thickness in male Angora goats between old one-year-old, six months, two years old, and 3 to 5 old, is 27.3, 2,4, 31,3, and 34,6 um, respectively. Hand-spun mohair tends to be pricier yet boasts a unique look and feel. The spinning frame twists carded mohair fibres to create a continuous yarn strand (Almeida et al. 2016). Different types of spinning exist, such as worsted spinning, as Frank et al. (2012) mentioned. This method of spinning yields a smooth, strong yarn suitable for a wide range of applications (Muthu and Gardetti, 2016). Another type of spinning is known as woollen spinning. This method produces a loftier, fuzzier yarn commonly used to knit sweaters and other garments (Almeida et al., 2016). Additionally, there are various spinning methods, such as ring spinning, which involves a ring-shaped device for twisting fibres, and air-jet spinning, which utilizes fast air jets. Once the yarn has been spun, it is then wound onto spools, where it is prepared for weaving or knitting various products.

Techniques used to make fabric for end products

Weaving

After being produced, mohair yarn can create different fabrics through weaving. The process of interlacing yarns to create fabric is known as weaving (Almeida et al., 2016). There are various classifications of weaving, such as plain weave, twill weave, and satin weave. The type of weave can impact how the fabric looks and feels, as well as its resilience and robustness (Ghiţuleasa et al., 2013). After being woven, the fabric can be utilized to create various items, such as garments, interior decorations, and industrial supplies (Gericke et al., 2022). One way to create a fluffy texture is by brushing the fabric, while another method to make it wrinkle-resistant is heat-setting. It is also possible to dye or print it to create patterns or designs (Almeida et al., 2016). Certain textiles may also undergo treatment using chemicals or other substances to become resistant to water and flames. Mohair fabric can be completed in various ways, depending on its intended use.

Knitting

Yarn can be machine-knitted into garment panels, whereas hand knitting comes in solid balls or skeins in various colours, textures, and blends (Almeida et al., 2016). Knitting involves creating a textile using mohair yarn by intertwining loops with knitting needles or a machine (Mazinani and Rude, 2020). There are two types of knitting: warp knitting and weft knitting. The most prevalent form of knitting is weft knitting, which creates fabrics like jersey, ribbing, and double knitting (Omer et al., 2024). Warp knitting is less prevalent, yet it produces textiles like tricot, milanese, and raschel. Both knitting methods can create a range of mohair clothing and accessories, according to Gericke et al. (2022). Knitting involves different stitches, such as garter stitch, stockinette stitch, and seed stitch. Certain stitches are more appropriate for creating specific types of clothing or desired outcomes. All of these elements contribute to the versatility of mohair for knitting.

Global future and prospects of Mohair

In March 2020, the Textile Exchange and the South African Mohair Industry established the Reandair Standard (RMS) to increase mohair (Elizabeth, 2023). South Africa's mohair demand in the past five years has grown (Saez, 2013). Angora goat population is reported to be increasing by Saez (2013) and Mataveia et al. (2021), which means mohair production is expected to grow in the coming years. Gericke et al. (2022) highlighted that mohair is highly resistant to abrasion. It can withstand enormous wear and tear without losing strength or shape, making mohair ideal for high-traffic areas like rugs and carpets. This might be why China is the largest market for South Africa's Mohair, as reported by Mohair South Africa (2022). Elizabeth (2023) reported that the South African mohair industry is working on the adverse effects of climate change and supports the idea of decreasing carbon emissions by at least 45% at the end of 2030, which will have a positive impact on land and have the potential to increase mohair production. Mohair is a renewable resource, making it a valuable fabric in growing demand.

CONCLUSION

South Africa is the world's leading mohair producer, contributing around 60% of global output. The country has earned a reputation for producing high-quality mohair due to its ideal climatic conditions, predominantly in the Karoo region, which provides the necessary arid environment for raising Angora goats. The industry supports thousands of farmers and workers, contributing significantly to the rural economy. However, inadequate nutrition is a significant factor that could impede the quantity and quality of mohair. This is because the Angora type of goats requires specific quantities of protein, energy, vitamins, and mineral elements to satisfy their nutritional requirements and to produce quality mohair. Therefore, promoting sustainable farming practices, investing in research to develop resilient grazing systems and drought-tolerant feed crops, building capacity for small-scale farmers, and developing innovative uses for mohair beyond traditional markets are some of the ways South Africa can maintain mohair global leadership.

DECLARATIONS

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Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

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Consent to publish

Not applicable.

Competing interests

The authors declare no competing interests in this research and publication.

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