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A Review Sheep Production System, Yield, Quality and Preservation Methods in Ethiopia

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ABSTRACT

The review assesses Sheep Production System, Yield of Sheep Meat, Chemical Composition, Preservation of Meat and its quality in Ethiopia. In Ethiopia, Sheep production provides food, cash income and manure to the smallholder farmers. Major feed resources in Ethiopia for sheep production are natural pasture, crop residues, Aftermath, browse species and agro-industrial byproducts and to a lesser extent improved pasture and forage crops. In the country, the different types of sheep production system practiced accordingly are: Highland sheep-barley system, mixed crop-livestock system, pastoral and agro-pastoral production system, ranching, and Urban and peri-urban (UPU) sheep production system. Ethiopia has a diverse indigenous sheep population numbering 28.89 million Sheep, excluding nomadic areas. Meat production is depends up on different factors feed is one protein and energy are limiting factors, so that supplementation of nutrient has shown dramatic change on meat yield of the sheep in Ethiopia.

1. INTRODUCTION

1.1 Background

Ethiopia has a diverse indigenous sheep population numbering 28.89 million Sheep, excluding nomadic areas (CSA, 2015/16). Sheep contribute significantly to farm livelihoods, particularly where crop production is unreliable and where livestock is the mainstay of livelihoods (i.e., pastoral areas). In Ethiopia, Sheep production provides food, cash income and manure to the smallholder farmers. Major feed resources in Ethiopia for sheep production are natural pasture, crop residues, thereafter, browse species and agro-industrial byproducts, and to a lesser extent improved pasture and forage crops (Yohannes, 2011). The feeding systems include communal or private natural grazing and browsing, cut- and carry feeding, hay and crop residues (Amare, 2012). Therefore, the feeding recommendations for farm animals in tropical and swarm regions are still largely based on standards established in temperate regions (Agricultural Research Council (ARC), 1984; National Research Council (NRC), 2007). The adaptation to diet and climatic condition affects nutrients partition, animal growth, body composition and, consequently, energy and protein requirements (Berg and Butterfield, 1976). Smallholder farmers rear sheep mainly for two purposes: for cash income and slaughter for home consumption during festivals. Small ruminants provide about 48% of the cash income generated by livestock production (Kassahun *et al.,* 1991) and local per capita consumption of mutton meat is estimated to be 2.8 kg (Belachew and Jemberu, 2003). Meat is one of the most nutritious foods that humans can consume, particularly in terms of supplying high-quality protein (essential amino acids), minerals (especially iron) and essential vitamins. Meat is defined as all animal tissues suitable as food for human consumption. The quality is determined by its tenderness, juiciness, flavor, palatability, color, and neatness (Beriain *et al.,* 2001). However, the best method of determining meat quality are assessing pH, water holding capacity, chemical composition of meat (Fakolade and Omojola, 2008; Abd El-aal and Suliman, 2007; Gustavson *et al.,* 2011). Meat pH level value, in normal circumstances, decreases during post-mortem due to formation of lactic acid from glycogen. The low pH-value is favorable for keeping quality and flavor FAO (2004). Determining of meat water-holding capacity is important because it can affect both the yield and the quality of meat, and is often described as drip loss. This parameter can also indicate the whole performance condition of the live animal at the time of harvest, or the entire system of live animal production and handling history (Andrzej, 2010). Many scientific studies also indicate that the most valuable components of meat from the nutritional and processing point of view are water , fat , protein and minerals (FAO , 2004; Adam *et al.,* 2010). To sustain the quality of the meat preservation is a key, the aim of preservation is to delay adverse chemical, physical and microbial changes so as to extend the storage life of food (Yanjun, 2010).

2. REVIEW

2.1 Sheep Type of Ethiopia

According to the report of ESGPIP (2009) there are about 14 traditionally recognized sheep populations in Ethiopia. These populations are called sheep types in some literatures. They are also designated as breeds according to some definitions of ‘breed’. The sheep types are named after their geographic location and/or the ethnic communities keeping them. The sheep types in Ethiopia are classified into four major groups based on their physical characteristics: short fat-tailed, long fat-tailed, thin-tailed and fat-rumped sheep (Solomon, 2008).

Table 1: Major groups and sheep types in Ethiopia

Major group	Sheep types	Tail type/shape	Fiber type
Short-fat-tailed	Simien	Fatty and short	Wool/fleece
	Sekota, Farta, Tikur, Wollo, Menz	Fatty and short	Wool/fleece
	Washera	Fatty and short	Short hair
Long-fat-tailed	Horro	Fatty and long	Short hair
	Arsi-Bale, Adilo	Fatty and long	Short hair
	Bonga	Fatty and long	Short hair
Fat-rumped sheep	Afar	Fat rump with fat tail	Short hair
	Black head Somali	Fat rump/tiny tail	Short hair
Thin-tailed sheep	Gumz	Thin and long	Short hair

ESGPIP (2009)

2.2 Sheep Production System in Ethiopia

In Ethiopia, various sheep production system categories are practiced, namely highland sheep-barley system, mixed crop-livestock system, pastoral and agro-pastoral production system, ranching, and Urban and peri-urban (UPU) sheep production system (Solomon *et al.,* 2008). The mixed crop-livestock production system is based on limited communal and/or private grazing areas and the use of crop residue and stubble. The pastoral production system is based on extensive communal grazing whereas agro-pastoralists are characterized by a combination of both pastoral and mixed crop-livestock production (Asfaw *et al.,* 2011). While contributing significantly to meat production in Ethiopia, present production levels of sheep from such subsistent type of production systems is far below their potential. As a result, meat production is estimated at about 3.5 kg per sheep per year in the population and 10 kg per sheep slaughtered. Both values are very low when compared with those in neighboring countries that have small ruminant population's 50–75% less than Ethiopia (Amha, 2008).

2.3 Feed Resource for Sheep in Ethiopia

According to the report of (Adugna *et al.,* 2012), feed resources can be classified as natural pasture, crop residue, improved pasture and forage and agro industrial by-products namely, (noug seed cake , soybean meal, wheat bran, etc,) of which the first two contribute the largest share. The fibrous agricultural residues contributes a major part of livestock feed especially in densely populated areas where land is prioritized for crop cultivation. The same authors reported that crop residues contribute about 50% of the total feed supply in Ethiopia. Similarly, the naturally occurring grasses, legumes, herbs, shrubs and tree foliage are used as animal feed (Adugna, 2008). The availability of feed resources in the highlands of Ethiopia depends on the mode and intensity of crop production as well as population Pressure (Seyoum *et al.,* 2001). Crop residues represent a large proportion of feed resources in mixed crop-livestock systems (Malede and Takele, 2014). Reliance on crop residues for animal feed is increasing from time to time as more land is cropped to feed the fast growing human population. Feed is the single largest cost associated with raising small ruminants, typically accounting for 60-65% of the total production cost of sheep (Lemus and Brown, 2008). In most production system of Ethiopia, extensive free grazing in communal lands and stubble grazing are the most common practices of sheep feeding (Solomon *et al.,* 2010), whereas limited grazing areas and cultivation of pasture lands causes loss of palatable forage species due to high grazing pressure. Agro-industrial by-products are also other potential feed resources that can be used as supplements to crop residues and poor quality natural pasture based diets. These include the by-products from flour milling, oil processing, sugar and brewery factories Alemayehu (2006). Supplementation with agro-industrial by-products has been used in many developed countries for improving locally available nutrients of feed resources. Since feed cost accounts more to total cost in any livestock production, it is of paramount importance to incorporate locally available byproducts and raw materials into the feed of ruminant animals.

2.4 Nutrient Requirement of Sheep

Nutrition plays a major role in the overall productivity, health, and well-being of the sheep flock (Umberger,

2009). Nutritive value is a function of feed intake and the efficiency of nutrient extraction from the feed during digestion (Norton, 1998). The partition of nutrient is an exceptionally complex process controlled by the animal's genotype, stage of development, quantity and quality of feed and environmental factors (Reddy, 2006). The nutritive value of feeds should be ranked on: voluntary consumption, digestibility and ability to support high rates of fermentative digestion, microbial protein synthesis in the rumen, and ability to provide bypass nutrients for absorption from the small intestine (Norton, 1998). Feeds contain five main types of nutrients, namely: protein, energy, vitamins, minerals and water. But, protein and energy are the most factors affecting sheep productivity (Umberger, 2009). Therefore, Proteins are the principal constituents of the animal body and continuously needed in the feed for growth and cell repair (Ensminger, 2002). According to the report of Cheeke (1999) Protein is a critical nutrient, particularly for young rapidly growing animals and for maturing, lactating animals. The CP requirements for growing and fattening lambs with 20 and 10 kg BW are 85 and 127 g, respectively and moderately growing early-weaned lambs with 10 and 20 kg BW have CP requirements of 26.2 and 16.9%, respectively (Cheeke, 1991). So the protein requirement of the growing sheep is affected by growth, weight, age, body condition, rate of gain and protein to energy ratio (Ensminger, 2002). To achieve fast growth, adequate amount of protein should be supplied. Therefore, Animals require considerable amount of protein because their bodies and products (milk, meat) are composed of high level of protein. Most common feeds are low in protein, and supplying protein to livestock is a major challenge (ESGPIP, 2008). Many different proteins supplements have been used successfully in lambs fattening rations. The oils seed meals are used most commonly as protein supplement in the ration ruminants. Depending on the amount and quality of the forage, supplemental feed may be used to maintain a higher rate of growth or in order to get lambs to a market finish at faster rate (Church, 1986). Generally, in most instances, the amount of protein is more critical than quality, i.e., microbial protein is often adequate. Bypass protein might be beneficial in some instances, and can use non protein nitrogen or NPN in some instances (Chiba, 2014).

Table 2: Protein Requirements of Sheep for Growth

Nutrient		Gain (g/day)			Calculated requirement per BW 0.75	
Protein (g/day)	Live weight (kg)	0	50	100	Maintenance	For gram gain
	20	30	40	60	3.17	0.30
	30	45	55	65	4.76	0.20
	40	45	70	85	2.83	0.40

Source: ARC 1980

2.4.1. Energy

Energy is a limiting factor for exploiting the maximum genetic potentials for growth and Carcass yield. The growth rate of a young sheep depends on the energy density of the diet (Pond et al., 1995).The major sources of energy for sheep are from pasture, hays, silage, by-product feeds, and grains. Energy deficiencies result in reduced growth or weight loss, reduced reproductive efficiency, reduced milk, reduction in resistance to infectious disease and parasites and increased mortality (Pond et al., 1995). Bigger sheep need a larger intake of energy than small or average sized sheep. According to NRC (1981), a daily energy requirement for 20 kg sheep for maintenance is 1.17 Mcal DE. For growing (yearling) and fattening animals the requirement relatively increases as compared for adult animal. Sheep in dry lot or in small pastures need less energy than sheep grazing over large range or pasture areas. In winter, sheep with short fleece need more energy than those with a full fleece. Moreover, the energy status of sheep is dependent on their feed intake, energy content and digestibility of the feeds (Mike, 2007).

Table 3: Energy Requirements of Sheep for Growth

Nutrient		Gain (g/day)			Calculated requirement per BW 0.75	
Energy (g/day)	Live weight (kg)	0	50	100	Maintenance	For gram gain
	20	4.1	5.1	6.2	0.43	0.02
	30	5.6	7.0	8.5	0.44	0.03
	40	7.0	8.7	10.7	0.44	0.04

Source: ARC 1980 MJ =Mega joule ME=metabolisable energy

For the red meat production from sheep, the following ingredients are used to formulate from locally available feed ingredients and can be used as fattening. Generally, the nutrient requirement for sheep is 2.5% (DM basis) of their body weight for fattening.

Table 4: Feed Formulation for Sheep Fattening

Ingredient	Percentage
Maize grain	10
Wheat bran	70
Wheat middling	11.6
Noug cake	8
Salt	0.4
Total	**100**

Source: Haramaya University

2.4.2. Minerals

Minerals are divided into two groups, macro-minerals, those required at 0.1% or more in the diet, and micro-minerals, those required at very small amounts (part per million (ppm)) levels. There are seven major minerals Calcium (Ca,), phosphorus (P), magnesium (Mg), potassium (K), sodium (Na), and sulfur (S). Each of these minerals has been found to be deficient for grazing livestock under specific conditions, with the exception of Cl (McDonald *et al.,* 2010). Calcium is the most abundant mineral in the body, ninety-eight percent of Ca is found in the bones and teeth (Rick, 2007). Small amount of Ca may be absorbed from the rumen but the major absorptive site is the small intestine (Yano et al., 1991). The control of absorption is achieved by two hormones, parathyroid hormone (PTH) and physiologically active form of vitamin D3 (Brown, 1991). The basic function of Ca is therefore to provide a strong frame work for supporting and protecting delicate organs, jointed to allow movement and malleable to allow growth (Underwood, 1981). Some of the non-skeletal functions of Ca are blood clotting, membrane permeability, muscle contraction, nerve functions, and cardiac regulation and enzyme activations (Rick, 2007). Mineral deficiencies can lead to decreased growth and reproduction. There are some areas of Ethiopia deficient in one or more minerals, e.g., copper in the Rift Valley region (Alemu, 2008). In practice, the true "dietary" requirements vary considerably, depending on the amount and nature of minerals (& also their associated minerals). Most requirements can be met with normal grazing and their feeding habits, but a trace mineral salt containing Cl, I, Co, Fe, Mn, and Zn is usually fed free-choice (Chiba, 2014).

Cu requirements for sheep have been established between 7 to 11 mg per kg of DM intake (NRC, 1985). Sheep are highly sensitive to Cu intoxication, in comparison; goats are more tolerant to such toxicity (Meschy, 2000). Likewise, the need for Zn by most animals is based on its influence on enzymes and proteins and their activities, that are linked to vitamin A synthesis, carbon dioxide (CO2) transport, collagen fiber degradation, free radical destruction, membrane stability of red blood cells, metabolism of essential fatty acids, carbohydrate metabolism, protein synthesis, metabolism of nucleic acids, among others (Powell, 2000; McCall *et al.,* 2000; Stefanidou et al., 2006; Rubio *et al.,* 2007,). Thus, the presence of Zn at the cellular level is essential, for instance, in the gonads, where cell growth and division occurs continuously (MacDonald, 2000).

2.4.3. Vitamin

Vitamins stimulate the body's function or metabolism (Alemu, 2008). Sheep need all the fat-soluble vitamins, normally; the forage & feed supply all the vitamins in adequate amounts. But, vitamin A (e.g., grazing on dry or winter pasture for an extended period time) and vitamin D is important mainly for maintenance of healthy bones. (e.g., under confinement) may be deficient under certain circumstances. The B vitamins are synthesized in the rumen, thus usually there is no need for supplementation (Chiba, 2014).

2.5. Yield of Sheep Meat in Ethiopia

Different authors reported that supplementation of nutrient has shown dramatic change on meat yield of the sheep. According to the Asefu (2012) increased proportion of concentrate from 30 to 50% improved hot carcass weight (HCW) from 7.5 to 9.0 kg and 7.7 to 8.6 kg in Washera and Horro lambs, respectively. So the result of supplementation of different types of sheep in Ethiopia have been reported as follows

Table 5: Slaughter and carcass weight (kg) and dressing percentage (%) of indigenous sheep in Ethiopia

Sheep type	SW	HCW	DP	Source
Washera	21.3	9.3	43.4	Yilkal et al. (2014)
Washera	22.2	9.9	47.2	Abebe et al. (2011)
Arsi-	21.1	9.7	46.0	Girma et al. (2014)
Arsi-	27.8	10.0	36.1	Wondwosen et al. (2013)
Farta	22.5	9.6	42.8	Aschalew and Getachew (2013)
Afar	20.9	8.8	44	Awet and Solomon (2009)
Horro	29.3	12.1	41.4	Gemeda et al., 2007
BHO	20.6	8.5	41.5	Birhanu et al., 2013
Menz	28.9	14.2	49.1	Kassahun, 2000

2.5.1. Chemical Composition of Meat

Carcass and meat quality are dependent on many factors and one of the most important environmental factors amongst these is the feeding system. Previous studies that predominantly compared pasture vs. grain feeding indicated that growth performance and carcass characteristics (Carrasco *et al.,* 2009; Ripoll *et al.,* 2008), meat quality traits, such as color (Priolo *et al.,* 2001; Ripoll *et al.,* 2008), water-holding capacity (WHC) always linked to sensory and technological properties of meat such as tenderness, juiciness and cooking yield (Pena *et al.,* 2009). (Santos-Silva *et al.,* 2002), sensory characteristics (Duckett *et al.,* 2013; Fisher *et al.,* 2000), fatty acid (FA) profile (Karaca and Kor, 2015; Nuernberg *et al.,* 2008), and oxidative stability (Popova, 2007), can also be affected by feeding systems. In general, meat is composed of water, fat, protein, minerals and a small proportion of carbohydrate FAO (2007).

As the report of FAO, 2007 the chemical composition of sheep fried meat contains 60.9%, 28.5%, and 9.5% of water, protein, and fat respectively. And 207 of Calories / 100g.

Table 6: Chemical Composition of Sheep Meat

No	Parameters	Raw meat
1	PH Level	5.5
2	WHC (%)	32
3	Moisture (%)	19
4	Protein (%DM)	72
5	Fat, (%DM)	6.4
6	Ash , (%DM)	1.1

Table 6: Composition of Mammalian Muscle

Component	% of Muscle Weight
Water	75% (65 – 80%)
Protein	18.5% (16 – 22%)
Lipid	3% (1 – 13%)
Carbohydrate	Carbohydrate 1% (0.5 – 1.5%)
Non - Protein Nitrogenous Substances	1.7% (1-2%)
Other Non - Protein Substances (minerals, vitamins, etc.)	0.85% (0.5=1%)
Source, (U.S. Department of Agriculture, 2008)	

2.6. Preservation of Sheep Meat

Meat is a highly perishable products and soon becomes unfit to eat and possibly dangerous to health through microbial growth, chemical change and breakdown by endogenous enzymes. These processes can be curtailed by reducing the temperature sufficiently to slow down or inhibit the growth of micro-organisms, by heating to destroy organisms and enzymes (cooking, canning), or by removal of water by drying or osmotic control (binding the water with salt or other substances so that it becomes unavailable to the organisms). The traditional methods that have been used for thousands of years involve drying in wind and sun, salting and smoking. Because it is high in protein and moisture, meat is potentially an ideal medium for bacterial growth. Many techniques have been evolved to reduce or eliminate this growth and so preserve the meat longer (Gray and Crackel, 1992). The most dominant of these techniques are better known by the common names drying, smoking, chilling, freezing and curing. Food drying reduces water activity of food to prevent microbial growth (Rahman and Perera 2007). Smoking does not majorly reduce food moisture content; rather it generates compounds with an ability to prevent growth of microorganisms and lipid oxidation of foods (Cohen and Yang 1995). Wood smoking produces a family of phenolic compounds which effectively inhibit the growth of bacteria. (The composition of phenols from smoking depends on the nature of wood) (Rahman and Perera 2007). These chemicals in wood smoke also add flavour and colour to the food. Salt is also usually applied to muscle foods prior to smoking (Rahman and Perera 2007) and this serves to lower water activity (Huang and Nip 2001) and inhibit some classes of microorganism. Likewise, Chilling simply involves lowering the temperature as close to the freezing point of wet foods as possible (-1.5℃ for raw meat), but due to costs of refrigeration and its control, this ideal is not often achieved, particularly in domestic situations. The growth rate of microflora on food is generally slowed by chilling (Herbert 1989; Russell 1990), and this is probably due to lower rates of reaction. Freezing of food involves storage below about -1.5℃ and is accompanied by development of ice crystals and a simultaneous increase in the concentration of dissolved solutes in liquid water (Fennema 1975). The lower the temperature the more storage-stable the food becomes (Fennema 1996), but as with chilling of foods, low temperature storage is constrained by cost of refrigeration. The growth rate of microflora on food is generally slowed by chilling (Herbert 1989; Russell 1990), and this is probably due to lower rates of reaction. The slower growth rate effect extends the time required for multiplying microorganisms to reach a hazardous concentration for human consumption. Generally, at freezing temperatures the metabolism of microorganisms is inhibited strongly or prevented entirely. However, deterioration of foods by endogenous biochemical changes is slowed down, but not stopped. Moreover, the development of growing ice crystals, which occupy a volume about 9% more than water, leads to cell membrane damage, resulting in enzymatic and nonenzymatic damage leading to “freezer burn“ (Franks 1985). Another method is called Canning is a commercial sterilization preservative method , employing metal and glass containers, and more recently retortable plastic pouches. It destroys microorganisms and spores to keep the foods safe at ambient temperature until consumption. Canning involves so-called retort temperatures to destroy microorganisms (Yanjun, 2010). Similarly, curing historically, curing means preserving food through variations and combinations of drying, salting and smoking. Nowadays, the term curing has come to mean a preservation method using the combined effect of nitrate/nitrite and salt, to extend food storage-life and improve food flavour (Hutton 2004).Now cured meat is defined as the addition of purified salt plus nitrite/nitrate with the purpose of meat preservation, which is associated with specified colour and flavour (Martin 2001). The salt concentration in meat products is between 2 and 4% of the total product weight. Too much salt will result in very salty tasting products and too little salt adversely affects meat protein gelation and preservation. Recently, reduction of salt use in food has drawn a lot of attention. High salt food is a risk for hypertension. Sodium chloride use is associated with hypertension, and its substitute potassium chloride has

been partially successful in the development of low salt foods. A 60% sodium chloride and 40% potassium chloride mixed salt was found to be the most favoured combination by consumers for reduced sodium foods (Pearson and Gillett 1996). And the last but is not the list techniques of preservation is Fermented foods still play an important role in the human diet, because fermented foods are shelf stable, have low energy consumption, are easily digested, have unique sensory properties and nutritional benefits. Actually, the market demand for fermented foods has increased recently, as consumers regard fermented foods as natural and beneficial for health (Granato and others 2010).

2.7. Meat Quality

Meat quality includes many factors including palatability, water-holding capacity, colour, and Nutritional value (Hopkins and Geesink 2009). In the literature, meat quality both refers to meat eating quality traits or palatability which can be tested by sensory evaluation and traits which are measured instrumentally. Lambe *et al.* (2008) declares meat quality traits other than meat eating quality traits as chemical composition, mechanical properties and bacteriological stability. Therefore, The quality of lamb and sheep meat is defined by tissue composition, physical and chemical properties, chemical composition, nutritive value and sensory characteristics (Lambe *et al.,* 2009; Kaić *et al.,* 2012; Krvavica, 2012). From the viewpoint of consumers, the color of meat is the most important factor in quality. Equally important is the smell of meat. Consumers also attach great attention to the texture and tenderness of the meat (Purchas, 1990; Martinez-Cerezo, 2005).Tenderness is the primary determinant of eating quality and acceptability of meat (Voges *et al.,* 2007; Destefanis *et al.,* 2008). In most studies, meat tenderness has been evaluated instrumentally using the Warner-Bratzler shear method, which gives the best correlation with sensory panel scores for tenderness within muscles (Destefanis *et al.,* 2008; Schönfeldt and Strydom, 2011). Perry *et al.* (2001) reported that a shear force below 4 kg (40 N) is what equates to meat with an acceptable level of tenderness in Australian markets. Hopkins et al. (2006) and Shorthose *et al.* (1986) concluded that sheep meat with shear force values less than 49 N is considered and acknowledged as tender.Low pH and high carcass temperature can enhance the disruption of the lysosomal membrane to release cathepsins, which will then have access to myofibril proteins resulting in meat tenderness (O'Halloran *et al.,* 1997; Hopkins and Taylor, 2002).Compared to goat, sheep meat tends to be higher tender, with low shear force values and collagen content (McMillin and Brock, 2005; Webb *et al.,* 2005). Carcass composition is another important aspect of meat quality and is normally assessed by amount of physical dissected tissues (muscle, fat and bones) or chemical analysed constituents i.e. protein, fat, water and ash (Moran and Wood, 1986).

3. CONCLUSION

In Ethiopia Sheep production provides food, cash income and manure to the smallholder farmers. Smallholder farmers rear sheep mainly for two purposes: for cash income and slaughter for home consumption during festivals. Local per capita consumption of mutton meat is estimated to be 2.8 kg in the country there are about 14 traditionally recognized sheep populations in Ethiopia. The sheep types in Ethiopia are classified into four major groups based on their physical characteristics: short fattailed, long fat-tailed, thin-tailed and fat-rumped sheep. In the country they are different types of sheep production system are practiced accordingly, Highland sheep-barley system, mixed crop-livestock system, pastoral and agro-pastoral production system, ranching, and Urban and peri-urban (UPU) sheep production system. The feed resource for the sheep are come from different sources, namely, Feed resources can be classified as natural pasture, crop residue, improved pasture and forage and agro industrial by-products and The nutritive value of feeds should be ranked on: voluntary consumption, digestibility and ability to support high rates of fermentative digestion, microbial protein synthesis in the rumen, and ability to provide bypass nutrients for absorption from the small intestine. Feeds contain five main types of nutrients. Namely protein, energy, vitamins, minerals and water But, protein and energy are the most factors affecting sheep productivity. Therefore, Proteins are the principal constituents of the animal body and continuously needed in the Feed for growth and cell repair. Likewise, Energy is a limiting factor for exploiting the maximum genetic potentials for growth and Carcass yield. The growth rate of a young sheep depends on the energy density of the diet. The major sources of energy for sheep are from pasture, hays, silage, by-product feeds, and grains. Minerals are divided into two groups, macro-minerals, those required at 0.1% or more in the diet, and micro-minerals, those required at very small amounts (part per million (ppm)) levels. There are seven major minerals Calcium (Ca,), phosphorus (P), magnesium (Mg), potassium (K), sodium (Na), and sulfur (S). Most requirements can be met with normal grazing and their feeding habits, but a trace mineral salt containing Cl, I, Co, Fe, Mn, and Zn is usually fed free-choice. Sheep need all the fat-soluble vitamins, normally; the forage & feed supply all the vitamins in adequate amounts. In general, meat is composed of water, fat, protein, minerals and a small proportion of carbohydrate. Meat is one of the most nutritious foods that humans can consume, particularly in terms of supplying high-quality protein (essential amino acids), minerals (especially iron) and essential vitamins. Thus, Tenderness juiciness, flavor, palatability, color, and neatness are the most important characteristic used to determine the quality of the meat via organoleptic. The best methods of determining of meat quality are assessing pH, water

holding capacity, chemical composition of meat. Meat is a highly perishable products and soon becomes unfit to eat and possibly dangerous to health through microbial growth, chemical change and breakdown by endogenous enzymes. The most dominant of these techniques are better known by the common names drying, smoking, chilling, freezing and curing. Therefore, the quality of lamb and sheep meat is defined by tissue composition, physical and chemical properties, chemical composition, nutritive value and sensory characteristics. From the viewpoint of consumers, the color of meat is the most important factor in quality. Equally important is the smell of meat. Consumers also attach great attention to the texture and tenderness of the meat. Carcass composition is another important aspect of meat quality and is normally assessed by amount of physical dissected tissues (muscle, fat and bones) or chemical analysed constituents i.e. protein, fat, water and ash.

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4. RECOMMENDATIONS

- ✓ Supplementation is necessary to increase the production of meat from the sheep.
- ✓ Identifying of the energy density of the diet should be necessary in order to have good growth rate of a young sheep.
- ✓ Provision of protein should be continuously needed in the Feed for growth and cell repair of the sheep.
- ✓ Sheep should need all the fat-soluble vitamins, for their growth.
- ✓ Provision of macro minerals should be necessary to produce ample amount of meat from sheep.
- ✓ Meat should be preserved soon based on the different techniques to keep their quality.
- ✓ Meat should be free from spoilage and keep hygiene.

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