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Review on: Role of Legume Forage Meal Supplementation on Feed Intake, Weight Gain, Digestibility and Carcass Characteristics of Ruminant Livestock

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Abstract- This paper recapitulates the role of legume forage meal supplementation on feed intake, weight gain, and digestibility and carcass characteristics of ruminant livestock. The different research works that had been carried out on ruminant livestock that fed on a basal diet of roughage based diets and supplemented with leaf meal(hay) of forage legumes demonstrated that supplementation of legume forages stimulated microorganism function in the rumen, reduced retention time and thus increased the intake of the feeds. Furthermore, different research output demonstrated the advantages of forage legume supplementation in process of digestibility which had depicted that supplementation of legume forages such as Lablab purpureus, Cowpea, pigeon pea, alfalfa and Sesbania sesba, Tagasaste, L. pallida, Desmodium leaf meal (hay) had played significant role in improvements in digestibility of DM, OM, CP, NDF and ADF.

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Review on: Role of Legume Forage Meal Supplementation on Feed Intake, Weight Gain, Digestibility and Carcass Characteristics of Ruminant Livestock

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Abstract- This paper recapitulates the role of legume forage meal supplementation on feed intake, weight gain, and digestibility and carcass characteristics of ruminant livestock. The different research works that had been carried out on ruminant livestock that fed on a basal diet of roughage based diets and supplemented with leaf meal(hay) of forage legumes demonstrated that supplementation of legume forages stimulated microorganism function in the rumen, reduced retention time and thus increased the intake of the feeds. Furthermore, different research output demonstrated the advantages of forage legume supplementation in process of digestibility which had depicted that supplementation of legume forages such as Lablab purpureus, Cowpea, pigeon pea, alfalfa and Sesbania sesba, Tagasaste, L. pallida, Desmodium leaf meal (hay) had played significant role in improvements in digestibility of DM, OM, CP, NDF and ADF. Moreover, this review paper also had been demonstrated the positive effect of supplementation of legume forages leaf meals on weight gain and carcass characteristics in ruminant livestock as did concentrate supplements. Therefore, it is advisable to livestock producers to use legume forage leaf as protein supplements in order to improve the livestock production and boost the economic advantages. Despite the many research output on effect of supplementation on ruminant livestock, the availability of information to the livestock producers is very low. Future research be aimed to demonstrate many of research output on supplementation effect of legume forages wider scale in order to benefits the communities. This review paper also not reported supplementation effect of forage legumes on carcass quality characteristics such as carcass compositions and chilling losses which should be reviewed in the future in order to fill the gap.

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I. INTRODUCTION

The ruminant livestock production especially in developing country has been used as a pillar for food security, human nutrition and economic growth of the county (Shapiro *et al.*, 2015). However, despite of the huge potential in terms of ruminant livestock population and presence of diverse agro-

ecologies suitable for their production, the productivity obtained from the ruminant livestock is very low due to poor nutrition impediments (Berhanu *et al.*, 2007; FAO, 2010). In most developing countries the ruminant livestock production has depended on natural pastures and crop residues feed base (Adugna, 2007). It is apparent that feed resource base from the natural pasture and crop residues is insufficient to provide the minimum crude protein requirements to rumen microorganism and their host animal. Consequently, the digestibility and intake of these feeds are low which results in poor growth and reproductive performance in ruminant livestock (McDonald *et al.*, 2010; Adugna, 2008; Tessema and Ameha, 2003

Aregheore, 2001). The supplementing ruminant livestock with feed that affluent in protein and energy improves intake, digestibility and growth performance of ruminants that fed on low quality forages base diets. Among the supplements has been used as protein supplements in ruminant nutrition is the legume forages which has been used as protein supplements for ruminant livestock to improved sustainability of production (Savon, 2005). However, many of research works had demonstrated the importance of legume forages as supplements to the ruminant livestock. On the other hand, the availability of information on legume forages as supplementation for the readers and ruminant livestock producers are still limited. Therefore, review of the baseline information on research output available on the issue is so important to readers or livestock producers in order attain goals of high animal production (Crowder and Chheda, 1982) because the attainment of production goals depends upon the feeding value of feed resource (Humphreys, 1991). Therefore, the objective of this paper was reviewed role of forage legume meal supplementation on feed intake, weight gain, and digestibility and carcass characteristics of ruminant livestock.

II. EFFECT OF FORAGE LEGUME SUPPLEMENTATION ON FEED INTAKE

Feed intake is the weight of feed eaten by an animal or group of animals in a given period of time

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during which they have free access to feed (Forbes, 2007). Feed intake is one of the most important factors that influence the performance of animal (Huhtanen *et al.*, 2011). If the feed intake is too low, the performance will be depressed (Forbes, 1995). The feed intake is affected by many factors like the density of energy in the diet, digestibility, succulence and amount of crude fiber and the physical nature of the feed (Rehrahie *et al.*, 2003). Conversely, the McDonald *et al.* (2002) report demonstrated that feed intake in ruminants consuming fibrous forages is primarily determined by the level of rumen fill, which in turn is directly related to the rate of digestion and passage of fibrous particles from the rumen. Furthermore, Adugna *et al.* (2002) reported that feed bases that have low in protein content and high in fiber constituents has been resulted in low voluntary feed intake in animal. Different research output demonstrated that supplementation of legume forages to poor quality roughages stimulated microorganism function in the rumen, reduced retention time and thus increased the intake of poor quality feeds. Hunegnaw and Berhan (2016) reported that the higher improvement in total DM intake in Wollo Lambs supplemented with Pigeon pea, Cowpea and Lablab hay meals over those Wollo sheep supplemented with wheat bran and fed natural grass hay as basal diet. The higher nutrient intakes particularly higher CP intakes helped the Lambs to acquire protein required for growth faster than the Lambs supplemented with wheat bran only which is indicating the advantages of legume forages as supplements to roughage feed has improved feed intake by the animals (Abraha, 2013). Likewise, the study made by Abule *et al.* (2004) reports demonstrated that cross bred calves fed on a basal diet of *Teff* straw which supplemented with *Lablab purpureus* and Cow pea hay meal had shown higher improvement in dry matter intake of *Teff* straw than none supplemented groups. Sultan Singh *et al.* (2010) found out that growing Bundel khandi kids which supplemented with 50% and 100% *Lablab purpureus* meal had exhibited higher daily roughage intake over none supplemented group of goats. Furthermore, the study made from Ethiopia highland area by the Dana *et al.* (2000) demonstrated that sheep Supplemented with graded levels of *Leucaena* leaf meal to a basal diet of chickpea haulm had resulted in increased DM intake of the basal feed with concomitant increase in total DM and CP intake. Similarly, Adugna and Sundstøl, (2000) observed the higher feed intake in Ethiopia highland sheep when sheep supplemented with graded levels of *Desmodium intortum* hay meal than sheep fed on basal diet of Maize Stover. According to Abule (1994) supplementation of graded level of cow pea and *Lablab meal* indicated that there was significantly increased microbial nitrogen supply in calves. Conversely, Bonsi *et al.* (1995) observed that sheep fed a basal diet of *Teff* straw and supplemented with 0, 175, 245 or 315 g of *Sesbania*

shown that the dry matter degradation and liquid passage rates increased with increasing level of *Sesbania* up to 245.

III. EFFECT OF FORAGE LEGUME SUPPLEMENTATION ON NUTRIENT DIGESTIBILITY

The digestibility of a feed is defined as the proportion that is not excreted in the feces and it is assumed to be absorbed by the animal body. On the other hand, it is simply a measure of the availability of nutrients to the animal. It is commonly expressed in terms of DM as a coefficient or percentages base. Supplementation of legume forages to the animal that fed on poor quality feed has been improved the digestibility of feed by the ruminant animals in large. Different research output demonstrated the advantages of legume forage supplementation in process of digestibility improvements. Mekonnen *et al.* (2016) report demonstrated that Horro sheep supplemented with *Lablab purpureus* leaf had 63% and 68% of DM and CP digestibility respectively than 58% and 56% of DM and CP respectively for Horro sheep supplemented with concentrate. Devendra (1982) and McDonald *et al.* (2002) had stated that supplementation with forage legumes increased the digestibility of poor-quality roughages by promote high microbial population in the rumen through facilitate rumen fermentation process. Moreover, Meron (2016) and Tolera and Sundstøl (2000) reports were demonstrated that there was a linear increase in CP digestibility with increasing levels of legume forages (*Tagasaste* and *Desmodium*) leaf meal supplementation in sheep fed a basal diet of Barley straw and Maize stover. Similarly, Adugna (2007) findings demonstrated that the digestibility of the DM, CP and NDF was improved when sheep fed on basal diet of *Napie* grass hay supplemented with *Sesbania sesba* and *Desmodium* or *Lucerne*. Conversely also, Bonsi and Osuji (1997) reported that supplementation of *Sesbania* or *Leucaena* leaf meal to *Teff* straw improved the digestibility of DM, OM and N. Furthermore, Belete *et al.* (2013) noted significantly higher DM and CP digestibility for Arsi Bale kids supplemented with air dried pigeon pea hay than kids supplemented with concentrate. Moreover, similarity in DM and OM digestibility has been reported by Ajebu *et al.* (2013) for Arsi Bale goats supplemented with pigeon pea leaves that fed as a supplement to replace the commercial concentrate which indicated that pigeon pea leaf had potential to replace commercial concentrate. Improvement in DM and OM digestibility noted in ruminant animal which supplemented with legume forage leaf meal to poor quality forage is due to increase the availability of nitrogen in the rumen, thereby improving the rate of degradation of the feed (Yohannes, 2011; Gebreslassie, 2012; Hagos 2014).

Abraham (2015) reported that similarity in DM and OM digestibility for Begait sheep fed pasture hay as basal diet and supplemented with Tsar and Pigeon pea leaves compared to the concentrate mixture. Moreover, Kaitho *et al.* (1998) showed that DM, digestible organic matter (OM) and nitrogen (N) intakes as well as the digestibility of DM, OM and N were increased with increasing level of forage legume supplementation to a basal diet of tef straw fed to Ethiopian highland sheep. Similarly, Adu *et al.* (1990) also reported that lablab supplementation to sorghum stover significantly improved CP digestibility and generally improved rumen fermentation of the test diets and improved live weight gains of sheep. However, Solomon (2004) also reported that lablab had better digestibility of N, ADF and ADL than graded levels of *L. pallida*, while, it had lower digestibility of DM, OM and NDF than graded levels of *L. pallida*.

IV. EFFECT OF LEGUME FORAGE SUPPLEMENTATION ON WEIGHT GAIN

Generally supplementation of poor quality diets with good quality feed or leguminous sources can improve intake, digestibility and thereby weight gain. Different research output had been demonstrated the positive effect of supplementation of legume forages leaf meals on weight gain performance in ruminant livestock as concentrate supplements. Hunegnaw and Berehan (2016) reported higher ADG for Wollo sheep fed on basal diet of grass hay supplemented with *Lablab purpureus* meal than those Wollo sheep supplemented with wheat bran. Conversely, Denbela (2017) also had observed higher ADG performance for Woyto-Guji goats fed on basal diet of haricot bean haulms and supplemented with *Lablab purpureus* meal than those Woyto-Guji goats that supplemented with concentrate meal which had comprised wheat bran and noug cake. The reason why higher in ADG for goats supplemented with *Lablab purpureus* meal than goats supplemented with concentrate reported by Denbela (2017) is due to higher total DM intake and digestibility which made them efficiently converted feed in to flesh. Furthermore, Nsahlai and Umunna (1996) and Adu *et al.* (1990) reports also demonstrated that the nitrogen in *Lablab purpureus* leaf is rapidly degradable in the rumen which is useful to meet the requirements of rumen microorganisms for efficient degradation of low quality roughages. Moreover, Denbela (2017) also observed similarity in ADG between goats supplemented with pigeon pea leaf and Concentrate meal which had showed that pigeon pea leaf had potential to replace the commercial concentrate in goat feeding as CP supplements in area where commercial concentrate are not available. The ADG of the Spanish goat kids and Boer and Boer cross weathers fed on grass hay supplemented with Alfalfa hay meal were showed higher

daily body weight gain than those fed only grass-hay (Wildeus *et al.*, 2007). Turner *et al.* (2005) also reported that the average daily weight gain of goats supplemented with alfalfa-hay-fed were 80 % higher than those goats fed only on *Sericea lespedeza* hay. Similar investigation made by Wuliji *et al.* (2003) for Spanish goat kids fed a basal diet of prairie-grass hay and supplemented with alfalfa pellets which had 17.9 % CP demonstrated that there was notable improvement in average daily weight gain (82g/day vs. 0g/day). Manaye *et al.* (2009) and Gebregiorgis *et al.* (2012) reports also demonstrated that there was significance improvement in body weight changes of sheep supplemented with *Moringa stenopetala* leaf meals than non supplemented sheep. Dana *et al.* (2000) report also showed that supplementation of graded levels of *Leucaena leucocephala* leaf hay up to 300 g/head/day to Ethiopian highland sheep fed a basal diet of chickpea haulm improved body weight gain performance of sheep than the sheep supplemented with concentrate. Similarly, Adugna and Sundstøl (2000) and Adugna (2007) reports also demonstrated that sheep fed a sole diet of maize stover lost body weight while supplementation with different levels of *Desmodium intortum* and *Macrotyloma axillare* hays resulted in body weight gain. In addition, Miller *et al.* (2005) reported for the weaned goats that fed Pangola grass hay as a basal diet and supplemented with dried mulberry leaves had achieved similar ADG's (g/day) as compared to the commercial grain concentrate. The other study made by Singh *et al.* (2003) demonstrated that the higher weight gain performance was observed in rams supplemented with the cowpea haulms of variety IT90K-277-2 compared to concentrate meal.

V. EFFECT OF FORAGE LEGUME SUPPLEMENTATION ON CARCASS CHARACTERISTICS

A carcass is composed of muscle, bone, fat and its' compositions which influenced by the slaughter weight, age at slaughter, sex, breed and nutrition (Amha, 2008). A lot of studies reported the positive effect of supplementation of animal with forage legumes with great improvements on the carcass performance (Hirut, 2008; Gebretnsae, 2011; Gebreslassie, 2012). Hunegnaw and Brehan (2016) report demonstrated that the significantly higher carcass characteristics merits such as hot carcass weight (HCW), empty body weight (EBW), slaughter weight (SW), dressing percentage (DP) and rib eye muscle area (REMA) had obtained when the lambs fed grass hay as basal diet and supplemented with legume forage leaf meal as compared to lambs that supplemented with concentrate. Moreover, Meron (2016) and Kumer *et al.* (1991) reports showed that the weights of total non-carcass of the rams supplemented with Tagasaste leaf was significantly ($p < 0.01$) higher

than rams kept only on barley straw. Conversely, Wildeus *et al.* (2007) and Wuliji *et al.* (2003) findings also showed that Spanish kids and Boer-cross goats supplemented with Alfalfa hay had higher hot carcass weight (HCW) and dressing percentage (DP) compared to those group of goats fed on only grass hay. Shahjalal *et al.* (1992) observed that increasing CP concentrations of diets resulted in increments in DP in wether goats. Similarly, also Mahgoub *et al.* (2005) and Solomon *et al.* (2008) showed an increased slaughter weight, carcass weight, empty body weight and DP with increasing level of metabolisable energy intake in the diets of Omani and Sidama goats. Furthermore, Denbela (2017) reported that DP values for yearling male Woyto-Guji goats supplemented with legume forages (*Lablab purpureus* and pigeon pea) leaf meal were higher than those Woyto-Guji goats supplemented with concentrate-based diets. Similarly, also Denbela (2017) supplementation of goats with *Lablab purpureus* and pigeon pea leaf meals had been resulted in better improvement in total edible components than goats supplemented with concentrate meal. The higher in carcass characteristics such as HCW, EBW, DP total edible offal and total none edible offal for the ruminant animal supplemented with forage legumes than animals supplemented with concentrate based diets is due to fact that higher intake of total DM and digestibility of nutrients. According to Pralomokarn *et al.* (1995) carcass characteristics of animals increased as total DM and nutrient intake increased.

VI. SUMMARY

In most developing countries the ruminant livestock production has been depended on natural pastures which are insufficient to provide the minimum crude protein requirements to rumen microorganism and their host animal. Consequently, the digestibility and intake of these feeds are low which results in poor growth and reproductive performances. The supplementing ruminant livestock with feed that affluent in protein and energy is one of appealing strategies that has been carried out in developing country in order to improve production performance and boost economic benefits of livestock producers. Legume forages has a significant role in improving ruminant nutrition due to legume forages are rapidly degradable in the rumen which is useful to meet the requirements of rumen microorganisms for efficient degradation of low quality roughages. The feed intake, digestibility of nutrients, growth performances and carcass characteristics of ruminants' livestock that fed on low quality forages base diets and supplemented with legume forages had been improved. It was apparent that this indicated that the legume forages be used as protein supplements for ruminant livestock to improved sustainability of production in area where commercial concentrate is not available due to its high cost and distance.

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