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OriginalArticle

Effects of Supplementation with Ficus Sycomorus (Shola) on Performances of Washera Sheep Fed Natural Pasture Hay

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ABSTRACT

The experiment was conducted to evaluate the effect of supplementations with F. sycomorus leaf, fruit and their mixtures on digestibility of sheep fed basal diet hay, The experiment was carried out at Gish Abay in Sekela Woreda, West Gojjam Zone; using twenty intact male yearling Washera sheep with a mean (±SD) initial body weight of 17.5±0.39kg. The animals were vaccinated against anthrax and pasteurellosis, deformed and sprayed against internal and external parasites, respectively, before the start of the experiment. Experimental sheep were adapted for 15 days to the treatment feeds. The experiment consisted of digestibility trial of 10 days including harness training. The experiment was laid out in a randomized complete block design (RCBD) with five blocks consisting of four animals per block based on their initial body weight. Dietary treatments were randomly assigned to one of the four treatment diets within a block. Treatments comprised of feeding natural pasture hay *ad libitum* (un-supplemented: T_1) or natural hay supplementation with either *F. sycomorus* leaf (Treatment 2: T2), or *F. sycomorus* fruit (Treatment 4; T4), or mixture of *F. sycomorus* leaf and fruit in a ratio of 1:1(Treatment3; T3). The amount of supplements offered was 300 g/day on DM basis. Water and salt were available free choice. Natural pasture hay in the current study contained 8.0% crude protein (CP), 73.1% Neutral detergent fiber (NDF) and 43.6% acid detergent fiber (ADF). Sheep in the un-supplemented treatment consumed higher (p<0.001) basal dry matter intake ((581.6 g/day) as compared to supplemented group. However, total DM intake was higher for sheep in the supplemented group (T2-T4) compared to the un-supplemented (control).Supplementation significantly improved digestibility co-efficient of DM, organic matter (OM) (P<0.001) and CP (P<0.001). NDF and ADF digestibility were also improved (P<0.001) due to supplementation as compared to un-supplemented group. Thus, it can be concluded that supplementation in general improved animal performance. Among the supplements, however, T2 is biologically optimum.

Keywords: Digestibility, Feed Intake, andWashera Sheep.

LIST OF ABBREVIATIONS: **ADF**: Acid detergent fiber, **ADG**: Average daily gain, **ADL**: Acid detergent lignin, **CF**: Crude fiber, **CSA**: Central Statistic Authority, **DC**: Digestion Co-efficient, **DM**: Dry matter, **EARO**: Ethiopian Agricultural Research Organization, **FAO**: Food and Agricultural Organization of the United Nation, **FSF**: *Ficussycomorus* Fruit, **FSL**: *Ficussycomorus* Leaf, **ILCA**: International Livestock Center for Africa, **ILRI**: International Livestock Research Institute, **MOE:** Ministry of Education, **MPT**: Multipurpose Tree , **NDF**: Neutral detergent fiber, **OMD**: Organic matter digestibility

INTRODUCTION

Ethiopia is home for diverse indigenous sheep populations, which are estimated to be 26.1 million (CSA, 2009). There are about 14 traditional sheep populations in Ethiopia (Solomon *et al.*, 2007). Dangla (Washera) sheep is one of the traditional sheep found in West and East Gojjam Zone of the Amhara National Regional State extending to the south of Lake Tana. Washera sheep weigh about 2.8 and 13.8 kg at birth and weaning; respectively. The growth rate after weaning is comparable and even better than some other indigenous breeds. This indicates the potential of this breed for commercial mutton production for the local and export market (Kassahun and Solomon, 2008*).*

Despite the large population, productivity of Ethiopian livestock in general is not appreciable, mainly due to technical and non-technical constraints (EARO, 2001). Among the technical constraints, poor nutrition both in terms of quantity and quality, diseases and low genetic potential hinder animal productivity in the country.Feed shortage particularly during dry season; limit the animal output in most part of the country (Alemayehu, 2005).The available feed resources cannot meet the nutritional requirements of animals throughout the year in many parts of the country either due to inadequate supply or quality of the feed (Adugna, 2008). Livestock feed resources in Ethiopia are mainly natural grazing and crop residues, which are low in energy and protein leading to significant limitation in the productivity of sheep (CTA, 1991). Such feed deficiencies causes loses of weight gains made during more favorable periods, while fodder conservation to help eliminate seasonal feed supply fluctuations are rarely practiced (Alemayehu, 1995). As result, the annual off take of sheep is estimated to be 33% (EPA, 2002), with an average carcass weight of 10 kg, which is the second lowest among sub Saharan Africa countries (FAO, 2004).However, these trends of events can be changed if animals are strategically supplemented with available protein and energy sources such as agro industrial by products or multi-purpose trees (MPT). Nevertheless, the use of agro industrial by products is limited to the area where they are produced or economic factors limit their wider use.

This calls for searching for alternative feed resources which could be used as supplement to improve animal performance. Multi-purpose trees (MPT) are among the alternatives to be employed since it is abundant in different agro-ecological set up and contains higher nutrients. One potential source in the study area, in this regard, is the leaf and fruit of *F .sycomorus. F. sycomorus is* MPT and belongs to the family ofMoraceae whichis native to Ethiopia (Orwa *et al.,* 2009). It is available in Amhara National Regional State. *F. sycomorus* has been identified as feed of cattle, goat and sheep (Teferi *et al.*, 2008). *F. sycomorus* leaf are valuable fodder in overstocked semi-arid areas where the trees occur naturally and leaf are much-sought fodder with fairly high nutritive value of about 14-17.95% crude protein (CP) and 12 MJ/kg net energy on DM basis (Nkafamiya (2010; Devendra, 1990).

F. sycomorus leaf and petioles are well accepted by West African Dwarf lambs and led to higher levels of apparent digestibility than the other tree species (Anugwa and Okori, 1987). Feeding *Ficus* fodder to lambs is actively encouraged in Nigeria.Fruit of the plant are round from 2.8-5 cm in diameter conspicuous opening that may break at the one end and with various colours. Makishima (2005) found that *F. sycomorus* is the most abundant fruit supplier for frugivorous animals in the riverine forest in the semi arid northern Kenya. It is known that chimpanzees use *Ficus* species fallback sources of feed during the period of fruit scarcity (Fruichi *et al.,* 2001). *Ficus* fruit are available all the year round in Africa fruiting 3-5 times per year (Kinnaird, 1992).

In Sekela District, where this study was conducted, sheep feed on natural pasture, fallow land grazing and crop residues; where the nutrients supplied by these feed resources are insufficient to meet for maintenance, growth and production requirements of animals. Sometimes farmers in the area purchase protein supplements such as cotton seed meal and low quality roughage during dry season, but it is not effectively utilized. Moreover, the animals feed on fallen leaf and fruit of *F. sycomorus* since the tree grows around farm land residence and on the degrading area .In fact the leaf and fruit of tree are important sources of nutrient for small ruminants in the dry season. However, systematic evaluation of the value of *F. sycomorus* leaf and fruit for sheep has not been well researched in the study area.The current study was, therefore, designed to evaluate effects of supplementation with *F. sycomorus* leaf, fruit and their mixtures on intake, digestibility, and body weight gain and carcass parameters of Washera sheep fed natural pasture hay and To assess the economic benefit of the effect of supplementation with *F. sycomorus*.

MATERIALS AND METHODS

Study Site

This study was conducted in Sekela Woreda in West Gojjam Administrative Zone, North-Western Ethiopia. The site is located at 466 km North West of Addis Ababa and situated at an altitude ranging from 2013 and 3257 m.a.s.l. The average annual rainfall of the area was 1738 mm with a bi-modal distribution from February to April and from June to September. The average annual minimum and maximum temperature was 8 and 21˚C, respectively (Worldclim, 2009). Sekela has undulating landscape with degraded farmlands. Mixed crop-livestock production was the typical farming system in the Woreda with tree growing (Eucalyptus) as a common practice around farmlands and homesteads. Animal production in the Woreda is vital for the security and survival of large numbers of people. According to Sekela Agricultural and Rural Development Office (SARDO, 2009); the average land holding per household is 0.75 hectare.

Feed Preparation

Leaf of *F. sycomorus* was harvested by climbing the tree and pruning the branch of tree at the end of the rainy season from communal lands, local farmer's farm yard, and river banks around *Gish Abay*. The time of harvesting was determined based on the intensity of sunlight that facilitates drying and optimum growth of leaf with which biomass becomes higher. *F. sycomorus* fruit were also picked from the local tree fruit around Gish Abay. The Collection of fruits was done under the tree plant after the tree fruit ripened (red color). Fruit were fallen by the help of man. The leaf and fruit were air-dried under shade. *F. sycomorus* leaf's petiole was removed (twigs separating after lopping). The dried leaf was partially crushed and fruit were collected and put into sacks and stored in a well ventilated shade until used at room temperature. Adequate supplies of the experimental feeds were stored for use during the whole study period. The basal feed was natural pasture hay which was purchased from the surrounding farmers. After harvesting the hay was transported to the study sites, stored under shade to maintain its quality and used as a basal diet throughout the experimental period. Hay was manually chopped to the size of about 1-6 cm to minimize selective feeding by the sheep.

Animals and Management

Twenty yearling intact male Washera sheep were purchased from local market of Gish Abay. The animals were quarantined for a period of 15 days. During this period, all sheep were ear tagged for identification purpose, sprayed with acaricides (diazzinole) for external parasites and injections of Ivermectin solution for internal parasite and were vaccinated against common infectious diseases in the area such as pasteurellosis, anthrax and sheep pox based on the prescription of the veterinarian. Initial body weights of the animals was taken on two consecutive weighing after overnight fasting at the beginning of the acclimatization period(17.5+0.39; Mean+SD), and animals were grouped into five blocks of four animals each based on their initial BW. Sheep were adapted to the experimental feeds for additional two weeks before commencement of the actual experiment. Experimental sheep were penned individually; the pen equipped with bucket and feed bins which was made from bamboo. Cleaning of pens was done daily before offering the day's feed.

Measured quantities of natural pasture hay were offered for *ad libitum* consumption allowing 25% refusal. Adjustment of feed offer was made. Supplemented sheep were offered supplements twice a day at 08:00 h, and 16:00 h in equal portions. The animals had available free choices to salt block and water during the whole day**.** The leaf and fruit were offered with plastic sheet which was tied to a bamboo stick over the cage and above the feed bins to collect fruit and leaf that may have fallen down and hay were offered with locally available bamboo feed bins.

Experimental Design and Treatments

The Experimental Design used in this experiment was completely randomized block design. Initial weights of the animals were determined by taking the mean of two consecutive weighing after overnight fasting. Based on the design, sheep were blocked into five groups based on initial body weight and treatments were randomly assigned to five animals per treatment. Dietary treatments were randomly assigned to one of the four treatment diets within a block. Treatments were comprised of feeding natural pasture hay *ad libitum* (un-supplemented: T_1) or natural pasture hay supplementation with either *F. sycomorus* leaf (Treatment 2: T2), or *F. sycomorus* fruit (Treatment 4; T4), or mixture of *F. sycomorus* leaf and fruit in a ratio of 1:1(Treatment3; T3). The amount of supplements offered was 300 g/day on DM basis.

Digestion Trial

Digestion trial was conducted after two weeks of adaptation for the total of ten days. The feces collection was conducted after 3 days of adaptation for carrying fecal collection bags (harness) followed by seven days of feces collection. All the experimental animals were involved in the digestibility trial. The feces were collected and weighed every morning for each animal before offering the day's feed. The daily collected feces from each sheep were mixed thoroughly and 20% was sampled and kept in an air tight plastic container and stored frozen at -20 °C until end of the digestibility trial. At the end of the collection period, the daily samples of feces frozen were pooled per animal, thoroughly mixed and sub-sampled for analysis.

The fecal samples were transported to Bahir Dar University, Poly Food Science Laboratory, via as ice box, dried at 60˚C for 72 hrs to constant weight, and ground to pass through 1mm sieve. The ground samples were stored in an air tight container pending chemical analysis. The dried samples were transported to Haramaya University Nutritional Laboratory for analysis. The apparent digestibility co-efficient (DC) of nutrients were estimated following the equation suggested by Ranjhan (2001):

$$\textbf{DC=}\ \frac{\textbf{Total amount of nutrients in feed – nutrients in feces}}{\textbf{Total amount of nutrients in feed}}$$

A digestible organic matter content of treatment feeds was estimated by multiplying the OM Content of feed by its digestibility coefficient. However, the estimated metabolizable energy intake of sheep from treatment feeds was calculated using the equation of McDonald *et al.* (2002) as: ME ($MJ/_{Kg}DM$) = 0.016×DOMD, Where DOMD = is gram digestible organic matter per kilogram dry matter

Feeding intake

Feeding intake was measured. Daily feed offered to the experimental sheep and the corresponding refusals was recorded and measured during the experimentation period to determine daily feed intake. Representative samples of feed offer per batch, and refusal per animal were collected and stored based on type of feed, pooled over the experimental period and sub-sampled for chemical analysis. Daily feed intake of individual sheep was calculated as the difference between the amounts of feed offered and refused. Substitution rate was calculated as the difference between basal diet intake of the un-supplemented and supplemented treatments divided by the amount of supplement offered (Ponnampalam et al., 2004).

Chemical Analysis

Representative (composite) samples of feed offer, refusal, and fecal samples collected during the digestibility trial was milled to pass through a 1mm sieve screen size and analyzed for DM and ash following the procedure of AOAC (1990). Acid detergent fiber (ADF), NDF and ADL components of each ingredient were determined according to the procedures of Van Soest and Robertson (1985). The crude protein was estimated by multiplying N with a nitrogen factor of 6.25.

Statistical Analysis

Digestible feed intake and digestibility were subjected to analysis of variance (ANOVA) using the general linear model procedure in SAS soft ware (V9) (SAS, 2002). The association between nutrient intake and digestibility were tested using correlation analysis. Treatment means were separated using least significant difference (LSD). The model employed was:

$$\mathbf{Y_{ij} = \mu + t_i + b_j + e_{ij},}$$

Where; Y_{ij}= Response variable

μ = Overall mean

t_i = Treatment effect

b_j = Block effect (initial body weight)

e_{ij}= Random error

RESULTS

Chemical Composition of the Experimental Feeds

The chemical composition of feedstuff used in this study is given in Table 1 below. In the current experiment the CP content of *F. sycomorus* leaf was 17.9%. The NDF, ADF, ADL, DM and ash content of *F. sycomorus* leaf on DM basis in this study was 64.6%, 52.5%, 17.4%, 93.2% and 11.9%, respectively. On the other hand, the CP content of the *F. sycomorus* fruit in the current study was 11.8%. The hay offered to the experimental animals in the current study had CP content of 7.9% with higher NDF and ADF composition.

Table 1: Chemical composition of feed stuff

Feed offer							
Feed type	**%DM**						
	DM	**Ash**	**OM**	**CP**	**NDF**	**ADF**	**ADL**
Hay	93.2	8.4	92.6	8.0	73.1	54.6	16.3
FSL	93.2	11.9	88.2	17.9	64.6	52.5	17.4
FSF	92.3	5.7	94.3	11.8	35.2	32.7	14.4
1FSL:1FSF	92.7	8.8	91.3	14.9	49.9	42.6	15.9
Refusal							
Hay (T1)	93.4	10.8	89.2	3.8	80.0	59. 2	16.8
Hay (T2)	93.5	9.3	90.7	4.8	81.3	55.9	16.3
Hay (T3)	93.4	8.9	91.1	5.1	78.7	58.3	17.8
Hay (T4)	93.5	8.7	91.3	4.8	81.4	60.0	17.3

ADF = acid detergent fiber; ADL =acid-detergent lignin; CP =crude protein; DM = dry matter; FSL= *F. sycomorus* Leaf; NDF= neutral detergent fiber; OM =organic matter; FSF=F. sycomorus Fruit.

Feed Intake

The mean daily intakes of DM, OM, CP, NDF and ADF of Washera sheep fed a basal diet of natural pasture hay and supplemented with *F. sycomorus* leaf, fruit and their mixtures is presented in Table 2. The basal feed DM intake was higher (P>0.05) for sheep fed on T1 diet as compared to sheep in supplemented group (T2-T4). Among supplemented group, sheep in T2 had higher (p<0.05) dry matter intake from the basal diet followed by sheep in T3 and T4. In spite of the fact that supplemented group received equal quantity of the supplements (300 g/day), the lower basal DM intake recorded for sheep in T4 followed by T3 as compared to sheep in T2 might be explained by differences in nitrogen content of the different supplements. The total DM intake was higher (P<0.001) in the order T2>T3>T4 which could be attributed to differences in crude protein composition of the different types of supplements.

Table 2. Daily dry mater and nutrient intake of Washera sheep fed natural pasture hay alone and supplemented with *F. sycomorus* leaf, fruit and their mixtures.

Variables	Treatments				SEM
	T_1	T_2	T_3	T_4	
DM intake (g/day)					
• Basal	581.7[a]	429.9[b]	402.6[c]	375.4[d]	3.85
• Supplement	--	300.0	300.0	300.0	--
• Total DMI	581.7[d]	729.9 [a]	702.8[b]	675.4[c]	13.18
Substitution rate	--	0.51[c]	0.60[b]	0.69[a]	0.016
Digestible nutrient intake (g/day/head)					
DMI	332.8[d]	559.6[a]	528.3[b]	496.5[c]	8.04
OMI	305.2[c]	499.1[a]	480.6[ab]	465.3[b]	7.62
CPI	35.3[d]	80.6[a]	67.3[b]	58.4[c]	0.68
NDFI	237.6[c]	361.4[a]	299.2[b]	238.1[c]	5.53
ADFI	174.5[c]	273.1[a]	230.9[b]	185.6[c]	4.75

[a-d]means with different superscripts in row are significantly different; ADF=Acid detergent fiber; ADL= Acid detergent lignin; CP = crude protein; DM= dry matter; ME = metabolisable energy; FSL = *F. sycomorus* Leaf; NDF = neutral detergent fiber; OM = organic matter; SEM= standard error of mean; FSF = *F. sycomorus* Fruit ; T_1= natural pasture hay alone; T_2 = hay +300 g FSL DM; T_3 = hay +300 g 1FSL:1FSF DM mix; T_4 = hay +300 g FSF on DM basis.

The total average daily CP intake was significantly lower (P<0.001) in un-supplemented group than supplemented sheep. This could be attributed to the relatively low CP content of the basal feed. The CP, OM, NDF and ADF intakes in the current study were significantly higher (P<0.001) for sheep in the supplemented group (T_2-T_4) than in the un-supplemented (T_1). This could be due to improved rumen condition created by the supplementation that enhanced feed intake. There was also significantly higher (P<0.001) estimated metabolizable energy intake (EME**)** for supplemented group as compared to sheep in the un-supplemented. The total DM intake as a percent of body weight was also higher for sheep in supplemented group as compared to the un-supplemented. Among the supplements, sheep in T_2 had higher DMI expressed as percent of body weight followed by sheep in T_3 and T_4. The rate of substitution was higher in the present experiment and the difference among dietary treatments is significant (P<0.001).

Dry Matter and Nutrients Digestibility

The digestion coefficient of nutrient for sheep fed hay alone and supplemented with F. *sycomorus* leaf, fruit and their mixture is presented in Table 3 below.

The current supplementation strategy, in general, improved (P<0.05) feed DM, OM, CP, NDF and ADF digestibility compared to the un-supplemented. The lower digestion coefficients for animals in the un-supplemented could be due to the relatively low CP composition and higher fiber fraction contained in the basal feed. However, among supplemented group, the apparent digestibility coefficient of DM and OM were significantly higher (P<0.01) for T_2 compared to T_3 and T_4. The digestibility coefficient of CP was significantly higher (P < 0.001) for T_2 followed by T_3, T_4.

Table 3: Digestibility coefficients of nutrients in Washera sheep fed natural pasture hay alone and supplemented with *F. sycomorus* leaf, fruit and their mixtures.

Digestibility coefficients	T_1	T_2	T_3	T_4	SEM
DM	0.57^c	0.77^a	0.74^b	0.73^b	0.017
OM	0.57^c	0.75^a	0.74^{ab}	0.73^b	0.079
CP	0.63^d	0.87^a	0.83^b	0.78^c	0.021
NDF	0.56^d	0.70^a	0.67^b	0.62^c	0.013
ADF	0.55^c	0.70^a	0.66^b	0.61^b	0.052

$^{a-c}$Means with different superscripts in row are significantly different; ADF = acid detergent fiber ; CP = crude protein; DM = dry matter; FSL = *F. sycomorus* Leaf; NDF = neutral detergent fiber; OM= organic matter; SEM = standard error of mean; FSF = *F. sycomorus* Fruit ; T_1= natural pasture hay; T_2 = hay + 300g FSL DM;T_3 = hay + 300 g 1 FSL:1g FSF DM mix; T_4 = hay + 300 g FSF DM.

Correlation between Intake, Digestibility and Body Weight

The correlation coefficient between nutrient intake, digestibility, and body weight and carcass parameters is presented in Table 4below. Intake of total DM was positively correlated (P<0.001) with CP intake and DM, OM and CP digestibility. As the total DM intake increased, intake of all the other nutrients also increased. The reason could be that supplementation has an effect on fermentation activity of microorganisms that led to more DM intake.

Intake of total DM was positively correlated (P<0.001) with CP intake and DM, OM and CP digestibility. As the total DM intake increased, intake of all the other nutrients also increased. The reason could be that supplementation has an effect on fermentation activity of microorganisms that led to more DM intake.

Crude protein intake is also positively (P<0.001) related with digestibility of OM and CP. From this correlation, it can be observed that the increment in DM and CP intake was the major contributor of sheep.

Table 5: Correlations between feed intakes and digestibility of Washera sheep fed natural pasture hay alone and supplemented with *F. sycomorus* leaf, fruit and their mixtures

Variables	TDMI	TCPI	DMD	OMD	CPD
TDMI	1.0				
TCPI	0.99^{***}	1.0			
DMD	0.88^{***}	0.91^{***}	1.0		
OMD	0.88^{***}	0.92^{***}	0.98^{***}	1.0	
CPD	0.94^{***}	0.94^{***}	0.93^{***}	0.92^{***}	1.0

*= (P<0.05);** = (P<0.01);***= (P<0.001); CPD= crude protein digestibility; DMD= dry matter digestibility; TCPI= total crude protein intake; TDMI= total dry matter intake.

DISCUSSIONS

Chemical Composition of the Experimental Feeds

The chemical composition of feedstuff used in this study is given in Table 1 below. In the current experiment the CP content of *F. sycomorus* leaf was 17.9%. Similar result (17.95%) was also reported by Nkafamiya *et al*. (2010). On other hand, Njidda and Ikhimioya (2010) and Lorenzo (2002) reported 14.9 and 22.1% CP for *F. sycomorus* leaf, respectively. The NDF, ADF, ADL, DM and ash content of *F. sycomorus* leaf on DM basis in this study was 64.6%, 52.5%, 17.4%, 93.2% and 11.9%, respectively. The results for NDF and ADF composition were higher than 54.8% and 33.4% reported by Njidda and Ikhimioya (2010). However, literature is inconsistent with regard to the CP composition of *F. sycomorus* leaf. Nkafamiya *et al.*, (2010) reported 17.95%. The DM content of *F. sycomorus* leaf documented in this study was lower than 95.6% reported by Njidda and Ikhimioya (2010) but higher than 85.9% reported by Nkafamiya *et al*., (2010). The ash content of *F. sycomorus* leaf in the current study is higher than9.5% reported byNkafamiya et al. (2010) but lower than 18% reported by Njidda and Ikhimioya (2010). Moreover, the ash composition of the leaf of *F. sycomorus* was higher than fruit of the same plant and natural pasture hay.

On the other hand, the CP content of the *F. sycomorus* fruit in the current study was higher than 6.9-9.5% reported byMakishima (2005) and Lorenzo (2002).The difference in chemical constituents between the present findings and literature might be attributed to differences in harvesting season, stage of harvesting, growth pattern of the species within the genus, genetic potential, bioclimatic conditions and cropping systems as reported by Chanda and Bhaid (1987) and Divakaran *et al., (*1985).

The hay offered to the experimental animals in the current study had CP content of 7.9% with higher NDF and ADF composition. Even though the CP content of hay recorded in the present study was higher than 4.2% and 3.7% reported by Mulu *et al.* (2008) and Asnakew (2005), respectively; and lower than 10.9% reported by Yihalem (2004), it was expected to meet maintenance requirement of the animals. Therefore, the hay used in the current study was characterized as good quality hay in terms of CP content. It has been stated that CP value ranging from 7-7.5% is required to satisfy the maintenance need of ruminants (Van Soest, 1982).

Feed Intake

The basal feed DM intake was higher (P>0.05) for sheep fed on T_1 diet as compared to sheep in supplemented group (T_2-T_4). Among supplemented group, sheep in T_2 had higher (p<0.05) dry matter intake from the basal diet followed by sheep in T_3 and T_4. In spite of the fact that supplemented group received equal quantity of the supplements (300 g/day), the lower basal DM intake recorded for sheep in T_4 followed by T_3 as compared to sheep in T_2 might be explained by differences in nitrogen content of the different supplements. Consequently, this had negatively impacted total dry matter intake. Topps (1997) reported that supplementation level beyond 30-40% of the total DM offered reduces intake of the basal feed.

The total DM intake was higher (P<0.001) in the order T_2>T_3>T_4 which could be attributed to differences in crude protein composition of the different types of supplements. The supplemented sheep consumed higher total DM because supplementation might have created a favorable rumen environment resulting in enhanced fermentation of the basal roughage and thus increased microbial protein synthesis (Osuji *et al.*, 1995). The positive effects of supplementation on feed intake may have been a reflection of the increase in the intake of essential nutrients such as energy, vitamins and minerals and in particular nitrogen. Moreover, the high total DM intake in supplemented group could be due to lower gut fill of the supplements compared to natural pasture hay. The increase in total DM intake due to supplementation in the present study was in agreement with the result reported by Hirut (2008) and Wondwosen (2008).

The total average daily CP intake was significantly lower (P<0.001) in un-supplemented group than supplemented sheep. This could be attributed to the relatively low CP content of the basal feed. However, the CP content of the basal diet was slightly higher than maintenance requirement of small ruminants (Minson, 1990; Gatenby, 2002).

The CP, OM, NDF and ADF intakes in the current study were significantly higher (P<0.001) for sheep in the supplemented group (T_2-T_4) than in the un-supplemented (T_1). This could be due to improved rumen condition created by the supplementation that enhanced feed intake. Adugna and Sundstol (2000) also reported that the increased intake in the supplemented group could be due to increased availability of nitrogen to rumen microbes and enhanced rate of digestion. Among supplemented group, however, it was higher for sheep in T_2 followed by T_3 and T_4. The higher CP contained in *F. sycomorus* leaf (17.9%) as compared to *F. sycomorus* fruit (11.8%) might have rendered sheep in T_2 followed by T_3 to have higher intakes. According to Kempton *et al.*, (1979), dietary protein supplementation is known to improve intake by increasing the supply of N to the rumen microbes or can be increased by reducing poor quality feed retention time after supplementing concentrates to micro-organisms and stimulating their function in the rumen. There was also significantly higher (P<0.001) estimated metabolizable energy intake (EME**)** for supplemented group as compared to sheep in the un-supplemented. The intake of energy increased in the order of $T_2>T_3>T_4$ with increased level of *F. sycomorus* leaf as suggested previously (Montaldo, 1972).

The rate of substitution was higher in the present experiment and the difference among dietary treatments is significant (P<0.001). Substitution rates are often low when animals consume forage of low to medium digestibility. Doyle *et al.*, (1988) suggested that the rate at which basal hay intake reduce with increasing supplement intake (the substitution rate) reflects directly the effect of the supplement on the fractional rates of digestion and outflow from the rumen. Those supplement feeds with rapid fermentation rate replace the basal roughage to a lower extent than those that ferment slowly (Nsahalai and Ummuna, 1996).

Dry Matter and Nutrients Digestibility

The current supplementation strategy, in general, improved (P<0.05) feed DM, OM, CP, NDF and ADF digestibility compared to the un-supplemented. The lower digestion coefficients for animals in the un-supplemented could be due to the relatively low CP composition and higher fiber fraction contained in the basal feed. However, among supplemented group, the apparent digestibility coefficient of DM and OM were significantly higher (P<0.01) for T_2 compared to T_3 and T_4. The digestibility coefficient of CP was significantly higher (P < 0.001) for T_2 followed by T_3, T_4. The finding is in agreement with McDonald *et al., (*2002) who reported that higher CP intake is associated with better CP digestibility. There is no statistically significant difference (p<0.05) between, T_3 and T_4 in OM and NDF digestibility. The DM digestibility of the supplemented group in the present study is comparable with 75.8-80% reported by Tegbe *et al.*, (2005) in West African dwarf goats feeda basal diet of *Panicum maximum a*nd supplemented with *M. indica, F. thonningii, G. sepium* leaf and concentrate. Similarly, dry matter digestibility (DMD), which is related to nutrient composition, varied widely among tree and shrub species. Anugwa and Okori (1987) also reported that the fresh Ficus leaf and petioles were well accepted by West African dwarf lambs and led to higher levels of apparent digestibility than the other tree species, ranging from 70.1% for crude fibre (CF) to 81.8% for crude protein. Ahn *et al.,* (1989) have shown that drying of MPT leaf decreases tannin content which showed increase in digestibility of protein from 64-84%. The lower digestibility of DM and ADF observed in the un-supplemented than the supplemented sheep might be due to the lower supply of dietary CP and higher fiber fraction as compared to the other treatments. According to Bonsi *et al*. (1995) lower CP content of feed affect microbial growth and fermentation in the rumen. In agreement with the present study, Banamana *et al.*, (1990) reported that increasing CP in the diet increased the digestibility of OM, ADF and CP. Therefore, supplementation with *F. sycomorus* leaf, fruit and their mixture improves digestibility of low quality feeds.

Correlation between Intake, Digestibility, Body Weight and Carcass Parameters

Crude protein intake is also positively (P<0.001) related with digestibility of OM and CP. From this correlation, Solomon *et al.,* (2003) reported that increased CP intake resulted in increased CP digestibility which had a positive association with ADG.

The digestibility of OM was also positively correlated (P<0.001) with digestibility. From these correlation results, it could be concluded **t**hat intake of DM and CP can affect most of the parameters.

CONCLUSION

This experiment verified thatsupplementing intact male yearling Washera sheep with natural pasture hay alone (T_1) or natural pasture hay supplemented with either leaf (T_2), mixture of leaf and fruit (at a ratio of 1:1; T_3) or fruit (T_4) of *F .sycomorus* improved animal performances supplemented compared with un-supplemented (T1). In general, supplementation with 300g FSL, FSF and their mixture (FSL: FSL) improved the performance of sheep compared to the un-supplemented. Among the feeding strategy employed, supplementing sheep with T_2 becomes biologically optimum and economically important.

RECOMMENDATIONS

Due to shortage of pasture/grazing land, high cost of agro industrial by products and increasing competition with other livestock, it is economical and biologically advantageous to use *F. sycomorus* leaf and its fruits as supplement to improve productivity of sheep. Since supplementation with *F. sycomorus* leaf resulted in the highest performance parameters in sheep and returned the highest income, small holder farmers are advised to supplement sheep with leaf in order to exploit the genetic potential of the animals.

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List of Abbreviations

ADF: Acid detergent fiber
ADG: Average daily gain
ADL: Acid detergent lignin
CF: Crude fiber
CSA: Central Statistic Authority
DC: Digestion Co-efficient
DM: Dry matter
EARO: Ethiopian Agricultural Research Organization
FAO: Food and Agricultural Organization of the United Nation
FSF: *Ficussycomorus* Fruit
FSL: *Ficussycomorus* Leaf
ILCA: International Livestock Center for Africa
ILRI: International Livestock Research Institute
MOE: Ministry of Education
MPT: Multipurpose Tree
NDF: Neutral detergent fiber
OMD: Organic matter digestibility

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