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Strictly as per the compliance and regulations of:

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Keywords: Nutrition, Bonga Sheep, Carcass, Brugmansia Suaveolens, Economic Feasibility.

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I. Introduction

The sheep and goats population of Ethiopia, including expert estimates of the pastoral areas, is about 55 million heads of which about 27 million are sheep (CSA,2014) and diverse genotype of sheep populations (Gizaw et al., 2007) maintained in different agro-ecological zones and ethnic groups. Most of the sheep (about 70%) are found in the highlands of the country maintained in the traditional husbandry system (Mengistu, 2006).They provide about 46% of the national meat consumption and 58% of the value of hide and skin production (Awgiww et al. 1991).

Fattening has been defined as intensive feeding of highly nutritious feed to promote fast growth and fat deposition to achieve desired carcass growth and quality (Alemu, 2007).Sheep fattening in Ethiopia has been recognized as a potential profitable activity that enhances the income of smallholder farmers (Shapiro et al., 1993; Pasha, 2006).Fattening is practice by 89.5% of the farmers in Adiyo Kaka district of kafa zone. Castration practice by 98.2% of the farmers,average age of castration is 10.8 ± 2.53 months, 63.3% primarily practice Castration to improve the fattening potential and is the means of getting higher sale prices in local markets in Ethiopia(Edea Z.*et al*., 2012).

Kafa Zone pouplation of Bonga sheep is 437,879(CSA,2014).Bonga sheep found at the Ecology of Humid mid-highland area(1200–2500).Distinguishing physical features of bonga sheep is long fat tail with straight tapering end (98.4%) (Abegaz (2004) ;Gizaw et al. (2007); Gizaw et al. (2008), Zewdu (2008); Dejen (2010); Amelmal (2011)) .Average weight of fattened bonga sheep is 50-65 kg,farmers at cooperative in kafaenter sheep for fattening at the age of 4-6 months others can enter fattening at 3 to 4.5 months of age immediately after weaning.There is no standard weight and age at which the sheep begin fatteningbut Most respondents gave preference to one year old sheep for sheep fattening (Animut, G. and J. Wamatu. 2014).

Brugmansia suaveolens, a member of solanaceae family, native to tropical South America (i.e.

Brazil, Bolivia and Peru).It is also naturalised on other parts of the world including Ethiopia at eastern Africa. It is trees or bushes(Correa 1984,Zayed and Wink,2004).It is growing to about 3 m tall but occasionally reaching up to 4.5 m in height. The large leaves (10-30 cm long and 5-12 cm wide) are alternately arranged along the stems with entire margins and pointed tips.

It is multipourpose tree used for fence,animals feed,honey bee flora,poupulary known at study area as"*yemogn abeba*".Grows at areas with high humidity and heavy rainfall.Farmers based on their indigenous knowledge use different fattening ration practices for bonga sheep fattening regardless lack of comprehensive information and literature on sheep fattening in study area in addition to lack of appropriate feed packages to make sheep fattening an economically viable system.There is also no study on market oriented fattening from locally available B.suaveolensleaf improvingnutrient availabilityfor effective and efficiently utilization for sustainableusing experiment result at the end.

The pourpose of this present work is to investigateby roasting technique nutritional value improved brugmansia suaveolens brows leaf supplementation on performance of nutrient intake, weight change, feed conversion, carcass of yearling bonga sheep and its economic feasibility to develop sustainable fattening protocol under smallholder situations.

II. Materials and Methods

a) *Experimental Site*

Table 1: Description of the study area

Altitude	1,809 m.a.s.l
Latitude (NS):	07^{o} 11.513
Longitude (EW):	036^{o} 18.052

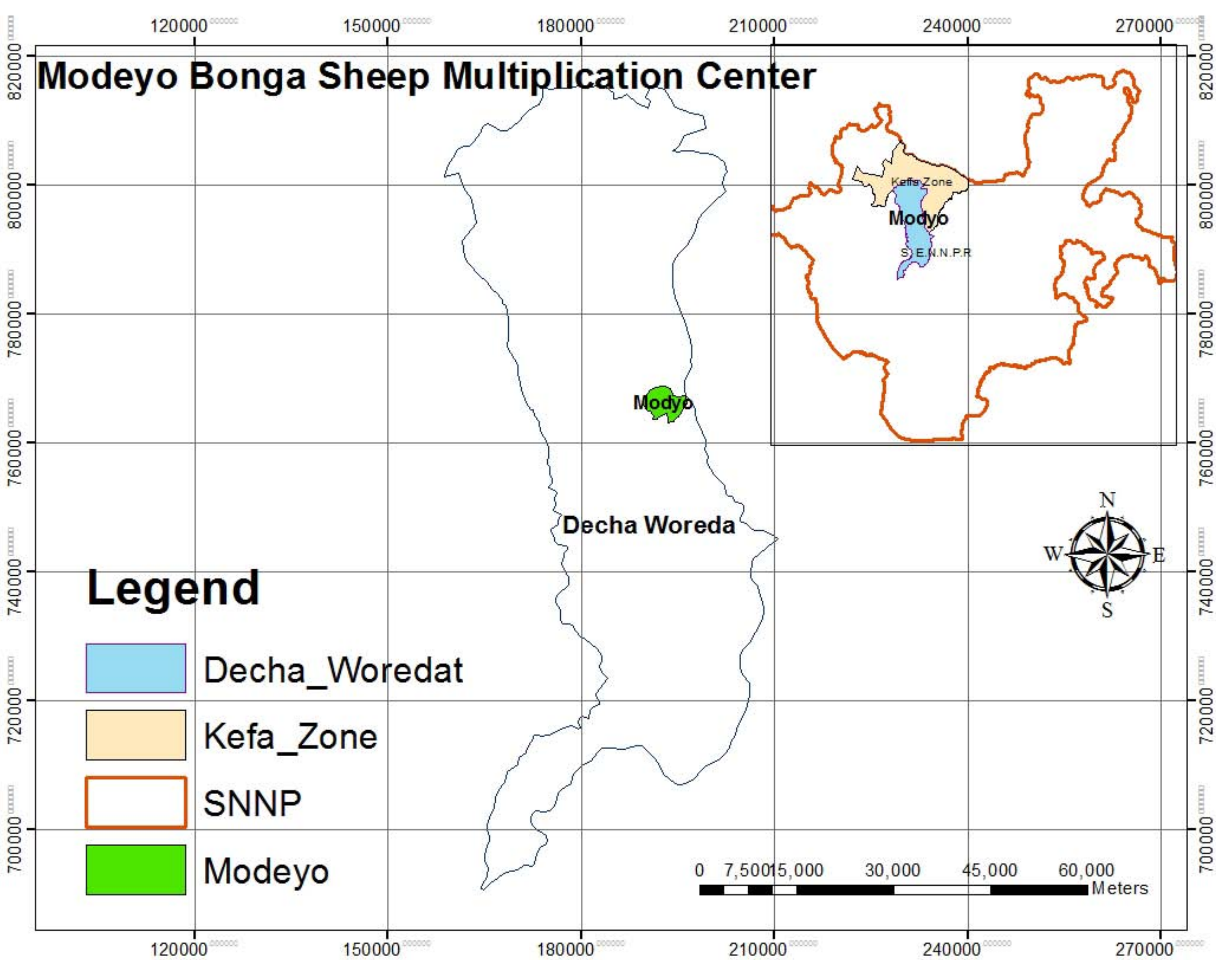

Fig. 1: Map of bonga sheep multiplication center(fig credit to:Desta y.wodebo)

b) Sample collection and Experimental feed Preparation

Leaves of B. Suaveolenswere collected from moist ecology of 1,809 m.a.s.l from farmers around modeyo Bonga sheep multiplication center (N 07^{o}11.513,E 036^{o}18.052).Fresh green leaves were collected everyday throught the experiment for daily ration earlymoring at 21:00, starting from 11 september 2015 to 5 January 2016 G.C at the bases of 50 g DM/kg live weight for each sheep in adition to 15 % to be leftover.Th fresh leaf decorticate blade from petiole with excusive of midrib from base and roasted for 5 minute only stiring by droping a water in to casserole(pan) used for rosting.

A⇨ B⇨ C⇨ D⇨

Fig. 2: Brugmansia suaveolens leaf preparation procedures

c) Animals and Feed Management

Twenty eight castrated male Bonga sheep 12 months of age(31.67±1.59 kg) were used in the experiment.The sheep were from modeyo bonga sheep multiplication center where they had ear tagged and good record on their birth history to determine their age.Prior to experiment; the animals were dewarmed and vaccinated (drenched) against common diseases of small ruminants especially against gastro-intestinal parasites in the experimental cite.Pens were installed in a well ventilated shed with one side open to natural light and roofing to protect animals against sun and rain. They were randomly housed in individual holding pens (1.5 x 2.5 m^2) with concrete floors on an open-air platform. They were penned individually in a well-ventilated shed with cemented floor. During the feeding trial, animals were fed their experimental allowances according to the experimental scheme.

Pasture grazing (30%), and test diet (70%) all together estimated to 50 g DM/kg live weight feed daily in adition to 15% to be leftover (Osuji et al., 1993). Test feed was provided once daily at 8:00AM prior to the provision of basal diet up to 10:00 AM in a separate trough in an individual opened pen. The animals were free access to clean drinking water throughout the experiment. The offered and refused amounts of feeds were recorded to estimate the actual voluntary feed intake for each treatment.

In the beginning ,every two week and last day of each of the experimental period, all animals were weighed individually following overnight fasting to avoid gut content variation and data for the next period were recalculated.Body weight was measured using steelyard spring balance manual weighing which was calibrated manually. Weight of animals was taken after the balance is set correctly and once the animals stand calmly on it. In general, the daily diet (basal + supplement) were balanced to provide 8.36 MJ/kg Metabolisable energy and 70 g/kg crude protein in dry matter basis (NRC, 2007).

The total amount of feed offered and refused daily collected to determine the quality of feed the sheep consumed throughout the experimental period. Every morning the refusal collected, weighed on individual bases, and bulked for laboratory analysis. All sheep weighted fortnightly on suspended weight balance of 100gm precision.

Table 2: List of treatment combinations used in the experiment

Treatment	Composition
T1	Tethered Grazing
T2	Roasted Brugmansia S.Leaf
T3	Concentrate
T4	Roasted B.S Leaf

Control feed(T1) is composed of 57% Poaceae, 27.7% Asteraceae, 15% Fabaceae, 0.3% Cyperaceae and Juncaceae, from test diet:T2=5 minute rosted brugmansia suaveolens leafe with salt (5.33gm), T3=Concentrate composed of: Wheat(354gm), fabeaben(77gm),barley(102gm), salt(5.33gm),T4=rosted brugmansia suaveolens and concentrate at 1:1 ratio

The experimental animals DM intake (percent body weight) was estimated from= (DM intake/Body weight)*100.Metabolisable energy (ME) contents were predicted from the equations of Abate and Meyer (1997). Feed conversion efficiency (FCE) was measured as proportion of average daily BW gain to daily DM intake (Ball and Pethick, 2006). The daily BW gain was calculated as the difference between the final and initial BW divided by the number of feeding days

d) Chemical Analysis of Feed

Samples of feedstuffs were analyzed for dry matter (DM), crude protein (CP), crude ash (CA), crude fiber (CF) and ether extract (EE) according to AOAC (2005) and for neutral detergent fiber (NDF), Acid detergent fiber (ADF) according to Van Soest et al. (1991).Total digestible nutrients were calculated from the proximate, detergent composition and nutrient digestion data following McDonald et al. (2010)

e) Lamb slaughter and carcass data collection

Lambs were slaughtered at 465 day of age. Lambs were transported 10 km to the Bonga agricalteral reaserch center were sloughtering and carcass data taken . Feed and water were withheld from lambs for approximately 12 h before slaughter.slaughter and carcass data collection of the experiment is according to USDA(1992).

Empty body weight was calculated as the difference between slaughter and gut contents. Percentage of total edible offal components (TEOC) was calculated as the sum total of blood, lung + trachea, heart, liver empty gut and kidney. The percentage of total non-edible offal components (TNEOC) was considered as the sum of head, skin with feet, penis + testicle, omental fat from kidney and abdomen, spleen, gall bladder, and gut content. Both TEOC and TNEOC percents were calculated based on SBW. The dressing percentage was calculated on the hot carcass as proportion of the slaughter weight as well as empty body weight

All the offal's and the carcass including the cuts were weighed on a digital balance with an error margin of 1 gram.Thestored sides(both quarters) were thawed at room temperature,reweighed,deboned and miced (excluding the bone).duplicate samples of the thoroughly mixed mince were taken to determine moisture by freeze-drying and the freeze-dried samples were analyzed for fat(soxhlet) and protein(kjeldhal).

f) Data Collection, Experimental Design and Statistical analyses

Initial,every two week and final body weight of the animal and their costs (feed cost,cost of sheep at the start and at the end of experiment , medicament cost, fire wood cost) were collected.Daily feed offered and refused was collected and recorded for each animal throughout the experimental period. Body weight was taken at every fifteen days interval after overnight fasting using suspended weighing scale. At the end of the experiment, all the experimental sheep were fasted for 12 hours, weighed and slaughtered. The animals were slaughtered following the standard slaughtering procedures for sheep.

Experimental sheep were adapted for 15 days to the treatment feeds. The experiment consisted of digestibility trial of 7 days and feeding trial of 90 days. The experiment was laid out in a randomized complete block design (RCBD) with four blocks consisting of seven animals per block based on their initial body weight. Dietary treatments were randomly assigned to one of the four treatment diets within a block.

Feed intake , body weight gain and carcass parameters were subjected to analysis of variance(ANOVA) using the general linear model procedure in SAS 2013 SAS software version 9.4.Treatment means were separated using least significant difference(LSD). When the results were significant, mean comparisons were made using Tukey multiple range test procedure of the SAS package.All data were analyzed as a randomized complete block design(RCBD).

The model employed was:

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

Where; Y_{ij} = Response variable
μ = Overall mean
t_i = Treatment effect
b_j = Block effect (initial body weight)
e_{ij} = Random error

g) Economic Analysis

Partial budget analysis was performed by considering variable costs (sheep cost at the start of experiment and at the end of experiment cost, feed cost) and total revenue (income) from sales of sheep. Net income obtained from the experiment was calculated as the difference of total revenue (total returns) and total variable costs according to the formula developed by Upton, 1979

Where,

$NI = TR - TVC$
$\Delta NI = \Delta GR - \Delta TVC$
$MRR = \Delta NI/\Delta TVC$

Where, NI = net income, TR = Total return, TVC = Total variable cost, ΔNI = change in net income, ΔGR = change in gross return, ΔTVC = change in total variable cost, MRR = marginal rate of return.

Marginal rate of return (MRR) is another way of taking the cost factor into account. It measures the ΔNI which is generated by each additional unit of expenditure (ΔVC).

III. Results

The chemical composition of feeds used for experiment is shown in Table 3.Crude protein containt of Roasted B. Suaveolens is 547% higher than control feed of grazing pasture grass hey and 290 % higher than concentrate feed used at the experiment.

Table 3: Chemical Composition of Experimental Feedstuffs

	Nutrient (%)							
Diet	DM%	OM%	Ash%	CP%	CF%	NDF	ADF	ADL
Grazing natural pasture grass	91.1	88.3	11.7	6.3	3.9	65	51.1	12.9
Roasted B. Suaveolens	90.57	88.82	11.18	34.51	5.93	36.33	18.97	5.21
Concentrate	91.58	96.2	2.42	11.7	1.54	18.21	3.27	1.15
Roasted B. Suaveolens and Concentrate	92.37	91.59	5.37	13	3.4	21.67	7.32	3.25

DM dry matter,OM organic matter, CP crude protein ,CF crude fatt,ND Fneutral detergent fiber, ADF acid detergent fiber, ADL acid detergent lignin,

Table 4: Feed intake, daily weight gain,feed conversion ratio of yearling bonga sheep suplemented rosted *brugmansia suaveolens* leafe, concentrate mix and their mixture

DM Intake, g/day	T1	T2	T3	T4	SEM	P
Rosted brugmansia s. leafe	-	838	-	569		
Concentrate mix	-	-	600	181		
Grazingnatural pasture	adlibly	adlibly	adlibly	adlibly		
Total	100^{d}	938^{a}	700^{c}	850^{b}	0.57	***
Initial	30.56	31.88	31.08	31.15	0.19	NS
Final	37.67^{d}	41.07^{a}	38.64^{c}	40.07^{b}	1.03	***
AverageDaily gain, g	79^{d}	91^{a}	84^{c}	88^{b}	2.1	***

^{abc} *Means in the same row with different superscript letter are significant different; NS, non significant (P>0.05);*significant at P<0.05; **significant at P<0.01,T treatment, DM dry matter, FCR feed conversion ratio*

Table 5: Carcass parameters, edible and non-edible carcass offal of yearling bonga sheep suplemented rosted *brugmansia suaveolens leafe*, concentrate mix and their mixture

	Mean, Treatments					
Traits	T1	T2	T3	T4	SE	P
(a)Edible carcasses						
liver(g)	347^{d}	456^{a}	388^{c}	450^{b}	0.39	**
heart(g)	114.67^{c}	151^{a}	115.33^{c}	138.67^{b}	1.20	**
Empty gut(kg)	1.5	2.52	2.17	2.2	0.52	NS
Kidney without fat(g)	74	86.3	79.5	81.83	2.06	NS
Heart without fat(g)	45.7^{d}	109^{a}	52^{c}	59^{b}	0.75	**
Tail fat(g)	236^{d}	395^{a}	244^{c}	267^{b}	3.16	***
Kidney fat(g)	16.7^{d}	56^{a}	28.8^{c}	39^{b}	1.02	**
Intestinal fat(g)	112	174.21^{a}	129.08^{b}	169.18^{a}	4.34	***
(b) Non-edible traits						
skin(kg)	2.8	2.8	2.9	2.7	0.04	NS
Spleen(g)	60.67^{d}	83.5^{a}	65.33^{c}	80.33^{b}	0.67	***
Testis(g)	152.67^{d}	195.67^{a}	146^{c}	187.67^{b}	5.83	***
Head(kg)	2.87^{d}	2.9^{a}	2.7^{c}	2.8^{b}	0.07	*
Blood weight(gm)	904.7	1043	1022	1041	0.03	NS
lung with trachea(g)	313	369.7	321.3	351.3	11.12	NS
Gall bladder(g)	11^{d}	39^{a}	19.17^{c}	20.3^{b}	0.32	**
Pancreas(g)	27^{d}	58^{a}	31^{c}	51^{b}	0.43	**
Four legs with hooves(kg)	1.33	1.6	1.3	1.5	0.11	NS

^{abc} *Means in the same row with different superscript letter are significant different NS, non significant (P>0.05);*significant at P<0.05; **significant at P<0.01*

Table 6: LS Mean and SEM of carcass charechteristics of yearling Bonga sheep suplemented rosted *brugmansia suaveolens* leafe, concentrate mix and their mixture

Variable	Overall mean	Cv%	Sign.level	Feeding Regime T1	T2	T3	T4	SEM
SWT(kg)	39.36±0.43	6.87	*	37.67^d	41.07^a	38.64^c	40.07^b	1.03
HCW(kg)	17.01±0.21	7.04	**	14.33^d	20.35^a	15.26^c	18.06^b	0.45
EBW(kg)	31.18±0.99	6.07	**	28.66^d	34.49^a	29.35^c	32.25^b	0.97
DPSBW(%)	42.87±0.38	4.53	***	37.33^d	49.56^a	39.49^c	45.08^b	1.34
DPEBW(%)	54.25±0.21	6.22	***	50^d	59^a	52^c	56^b	1.88

*[abc] Means in the same row with different superscript letter are significant different; ns, non significant (P>0.05);*significant at P<0.05; **significant at P<0.01; T, treatment; LSMean, least squire mean; SEM, standard error of mean; SWT, slaughter weight; HCW, hot carcass weight; DPSW, dressing percentage on slaughter body weight base; DPEBW, dressing percentage on empty body weight base.*

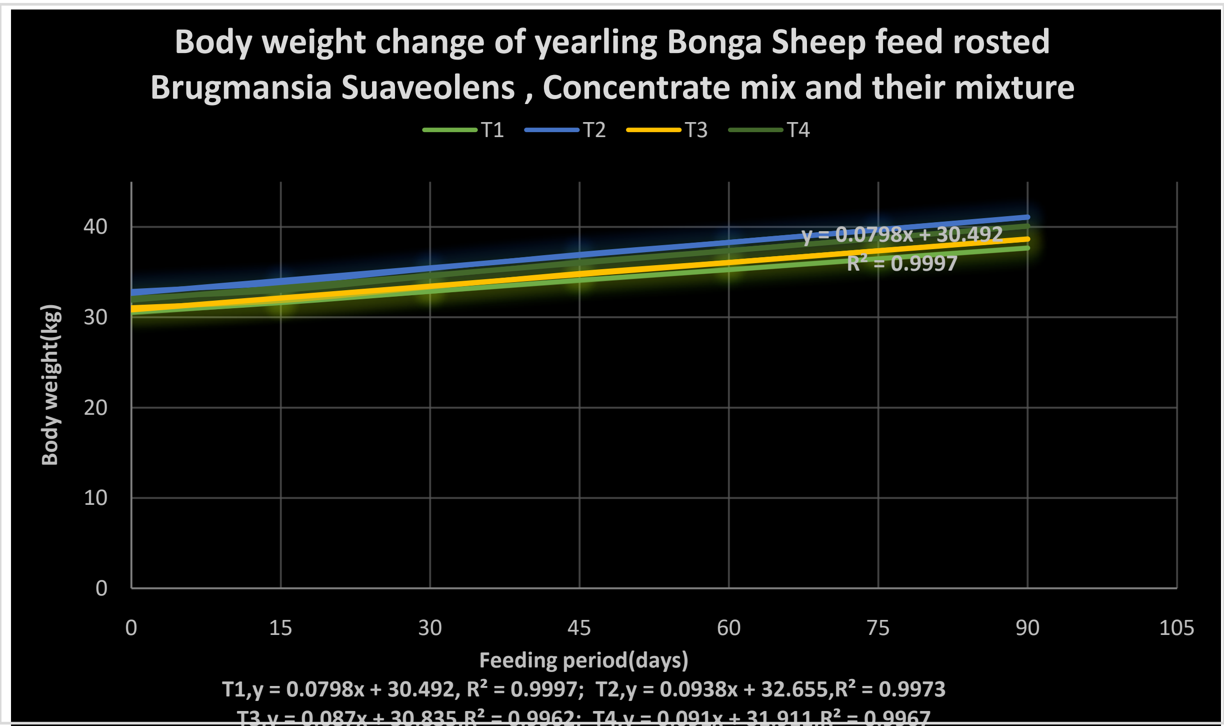

Fig. 3: Body weight change of yearling bonga sheep feed rosted *brugmansia suaveolens,* concentrate mix and their mixture

Table 7: Partial budget analysisof yearling bonga sheep feed rosted *brugmansia suaveolens,* concentrate mix and their mixture

Parameter	Experimental diet T1	T2	T3	T4
Sheep initial price (EB/head)	605.7	632.8	607.2	678.6
Total feed cost (EB)		7.47	202.5	302.5
Total non-feed cost (EB)	202.5	226.5	202.5	202.5
Total variable cost(EB)	808.2	856.8	1012.2	1183.6
GR, selling price (EB/head)	1477.4	1590	1684	2086
NR (EB/head)	669.2	733.2	501.8	693.4
NROC (EB/head)		248	67.1	97.9
MRR		1.3168	0.0127	0.6212
MRR (%)		131.68	1.274	62.12

EB ethiopian birr,GR gross return,NR net return, NROC net return over control,MRR marginal rate of return

IV. Discussion

Mean daily diets intake of rosted*brugmansia suaveolens*leafe (T2) was significantly ($P<0.001$) higher than the rest three treatment and given in (Table 4).Despite the differences in the magnitude of nutrient consumption, the superior nutrient intake, daily weight gain and feed conversion ratio in yearling Bonga sheep feed T2 can be a good scientific evidence for improvement of sheep nutrition under small holder farming settings where *brugmansia suaveolens browse plant dominantly growing* agroecology. This might be associated with the 5 minute rosting makes strong bond between nutrients and antinational elements to be broken and nutrients in the leaf available to be easily absorbed by small intestine

The mean values of edible and non-edible carcass characteristics of slaughtered yearling bonga sheep suplemented five minute rosted *brugmansia suaveolens leafe*, concentrate mix and their mixture are presented in Table 5. The values of the most edible carcass components such as liver, heart, heart without fat, tail fat, kidney fat, intestinal fat were increased in animals supplemented with five minute rosted *brugmansia suaveolens leafe* (T3) as compared to the rest three diet($p<0.05$). Similarly, most non-edible carcass traits such as head, testis, spleen and pancreas weights were increased in lambs supplemented with either concentratemix, mixture of five minute rosted *brugmansia suaveolens leafe* with concentratemix and grazing natural pasture grass.

Kuwet fat tailed Naeemi breed (a local strain of the Awassi breed) feed 70% concentrate and 30%lucern hay at 5 month age had carcasses dressed according to the normal commercial procedure in Kuwait, which includes removal of tail, liver, heart and kidneys was $40.7\pm0.68\%$ and dresed hot carcass weight was 15.9 ± 0.28kg, Kideny fat 0.231 ± 0.040kg.

carcass charechteristics of yearling Bonga sheep suplemented rosted *brugmansia suaveolens* leafe, concentrate mix and their mixture are presented in Table 6.Relatively the highest dressing percentage values in T2 over T1, T3 and T4 in the present study can indicate that T3 positively improves the growth performance and weight addition of sheep. On the other hand the higher dressing percentage values in T2 over T1, T3 and T4 implies that supplementation of a sheep with 5 minute rosted *brugmansia suaveolens* leafe has a potential to improve edible carcass parameters through improved feed intake of the diet. The differences might be related to the energy protein ratio of diets supplied to animals, which might have constrained the growth of some these organs.

The results observed in this study agree to Gebremeskel and Kefelegn, (2011) who reported nutritionally poor and dried roughage feeding lambs supplemented with a protein source had significantly higher hot carcass weight, and dressing percentage than the non-supplemented lambs. Moreover, by increasing the nutritional densities of the diet, it is possible to obtain heavy and fleshy carcasses (Alexandre *et al.,* 2010). The dressing percentage values calculated from the empty body weight basis were higher than on live weight at slaughter basis, implying the influence of digesta (gut fill) on dressing percentage. Expression of dressing percentage based on empty weight basis rather than live body weight at slaughter basis can be a less exaggerated and realistic. Pralomkarn *et al.,* (1995) also indicated that dressing percentage increased as feed intake increased. Gibbs and Ivings (1993) and El-Khidir *et al.,* (1998) reported that gut content constitutes a large portion of the body weight and contribute 4 - 14% of fasted live weight in sheep.

Kirton *et al.,* (1972) reported that proportion of carcass offal can be affected by the nutritional status and BW of animals, and therefore, the differences observed between the control and supplemented treatments in proportion of carcass offal could be traced to dietary origins. Wester *et al.,* (1995) also reported the effect of protein and energy nutrition in visceral organ mass in lambs. Low-energy diets (such as those provided by forage-based feeding), might lower growth of liver and kidneys compared with high-energy diets (such as those supplied by concentrate-based feeding) (A´ lvarez-Rodrı´ guez *et al.,* 2009). Because it is well documented that testis weight is correlated to spermatozoa production (Mahouachi, 1985).

The economic analysis of the experiment was computed and described for each treatment (Table 7).Selling price estimated by six different merchants at the end of the experiment but manure that can use as fertilizer was not included in total revenue calculation because sheep manure selling is not common in the study area. Fixed costs such as feeding pen were constructed previously by the southern agricultural research institute Modeyo Bonga sheep multiplication center for on-station experiment and its cost were not included in calculation. Communal grazing land was free of charge and common for all experimental sheep and was not considered for partial budget analysis.

The major cost that determined the profitability of using rosted *brugmansia suaveolens,* concentrate mix and their mixture to the non-feed cost. Solomon et al. (1991) reported that feed input is the major component of sheep production costs in agreements with the high feed costs of the current finding. Similar to the current study Aganga et al. (2005) reported that under intensive and semi-intensive livestock production a large proportion of costs are feed costs. For each Ethiopian birr invested on treatment farmers can obtain additional 1.3168, 0.0127 and 0.6212 Ethiopian birr from T2, T3 and T4, respectively.

V. Conclusion

At this finding yearling bonga sheep Feed Rosted for five minute Brugmansia Suaveolens Brecht (*yemogn abeba*) daily at 50 g DM/kg live weight perform better ADG of 91 g/day very significantly. This particular treatment (T2) economically feasible and marginal rate of return (MRR) is higher than the rest group that within 1 birr investment there will be 1.32 birr profit .It can be concluded that five minute rosted for Brugmansia Suaveolens with crude protein (CP=34.51%)could be recommended as a supplement for fatting of yearling bonga sheep in south and south west Ethiopia.

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Conflict of Interest

All authors declare that there are no potential or actual conflicts of interest related to the research presented in this paper

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