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EFFECT OF FEEDING SESBAN AND ITS MIXTURES WITH SOME SUMMER FORAGE CROPS ON PRODUCTIVE PERFORMANCE OF OSSIMI SHEEP

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ABSTRACT

This study was carried out to evaluate four different rations formulated as dry matter basis. The first ration (R1, control) consisted of 50% concentrate feed mixture and 50% rice straw. In the second ration (R2), the rice straw percentage (50%) was replaced by *Sesbania sesban* (SESB). In the third (R3) and fourth (R4) rations, half of the rice straw percentage (25%) was replaced by SESB, and the other half (25%) was replaced by *Echinochloa crusgalli* (ECH) or *Sudanese-grass* (SUD), respectively. After weaning, forty Ossimi male lambs (10 per each) three months old of similar birth type and averaged body weight of 20.17±0.43 kg were selected to study the effect of feeding the same transaction on the productive performance of growing male lambs. All lambs were weighed biweekly and kept under the same environmental conditions in a semi-open shaded yard during the experimental period. Results showed that the chemical composition of SESB contains higher levels of crude protein (CP), ether extract, and lower crude fiber content than ECH and SUD. CP content in SESB is almost six times as much as its content in RS and nearly double in ECH and SUD. Similarly, the CP content of experimental rations that involved sesban (R2, R3, and R4) was higher than R1. the nutritional values and nutrient digestibilities of animals fed experimental rations were significantly lower ($P < 0.001$) than rams fed the SESB pure (R2), SESB-ECH mixture (R3) and SESB-SUD mixture (R4) diets. Treated groups (R2, R3 & R4) exhibited better total digestible nutrients (TDN), and digestible crude protein (DCP), and digestible energy (DE) values than the control group. All ruminal parameters were improved in treated groups compared to the control. intakes of total dry matter (DM), TDN, and DCP, kg/head/day for R1 were lower ($P < 0.05$ & 0.001) than for R2, R3, and

R4. The differences between SESB-ECH and SESB-SUD mixtures were not significant (P > 0.05). Animals that fed on green forages (R2, R3, & R4) had the greatest (P < 0.001) total body gain (TBG) and average daily gain (ADG) values . Total body gain and ADG in lambs fed the mixture forage diets (R3 & R4) were better than that fed the control diet (R1). There was no significant (P > 0.05) increase in growth rate among R3, R4 *vs.* R1, while R2 showed a significant increase compared to the other groups (percentage change= 29.71, 4.27, & 9.36 in R2, R3 & R4, respectively). Economic efficiency was noticeably higher (1.18, 1.01, & 1.06 *vs*. 0.82%) in treated groups (R2, R3, & R4 *vs*. R1, respectively) than the control. All blood serum metabolites were improved in treated groups compared to the control. Thyroid hormones concentrations increased significantly (P < 0.001) in blood serum by feeding SESB-supplemented rations for ram-lambs. It could be concluded that the SESB with or without ECH mixture or SUD mixture could be utilized for feeding the growing lambs without any adverse effect.

Key words: Sesban, *Echinochloa*, Sudan-grass, Productive, Sheep.

INTRODUCTION

The animals suffer from the shortage of feed, especially during summer season in Egypt. Most animal feeding in this period depends on concentrate feed mixtures and agricultural residues. The high price of energy sources such as grains or protein sources such as soybean meal and cotton seed meal tend to increase feed cost for animals. Green forage is cheap for ruminant feeding, improving animal health and reducing health expenses. The greenest forages in summer season in Egypt are grasses as Sorghum, Sesbania sesban, Echinochloa crusgalli, Sudan-grass, Millet, Teosinte and Napier are grasses ; Generally, grasses have a higher yield than legumes, but they are considered poor in quality due to low protein content and essential amino acids, therefore, sowing legumes in mixtures with grasses improve the quality of forage by increasing protein and reducing crude fiber contents. Moreover, the combination improves the yield of green forage. High-yielding and high-quality legume-grass mixtures play an important part in forage-animal production system (**Mooso and Wedin, 1990**). Some practical studies were carried out to evaluate some mixtures of legumes and grasses in ruminant feeding in summer season such as cowpea with sorghum **(Gabra et al., 1991),** cowpea with millet (**Fathia et al., 2008; Abd El-Hamid et al., 2008),** Sesbania with Teosinte **(Soliman et al., 1997 and Soliman and Haggag, 2002a),** and Sesbania with Sudan grass **(Fathia et al., 2008b; Abd El-Hamid et al., 2008**). Some studies were carried out for cultivation of Sesbania sesban as a new legume crop in clay soils pure or its mixtures with some grasses in Egypt **(Soliman et al. 1997; Haggag et al., 2000a; Fathia et al., 2008a; Abd El-Hamid et al., 2008)**. The study aimed to evaluate the effects of feeding Sesbania sesban (SESB) and/or mixed with Echinochloa crusgalli (ECH) or Sudan-grass (SUD) as a replacement with rice straw in experimental rations on digestibility coefficients, feeding values, ruminal parameters, and performance of growing Ossimi lambs. Finally, a simple economic evaluation was considered.

MATERIALS AND METHODS

The present study was carried out at Sids Experimental Station, Animal Production Research Institute (APRI), with partnership of Faculty of Agriculture, Minia University, Egypt, from January 2020 until March 2021. This study was carried out to evaluate four different rations formulated as dry matter basis as follow: Ration 1 (R1, control): 50% concentrate feed mixture (CFM) + 50% rice straw (RS) as requirements of CP according to **NRC (2007)**. Ration 2 (R2): 50% CFM + 50 % Sesbania (SESB). Ration 3 (R3): 50% CFM + 25 % SESB + 25%(ECH). Ration 4 (R4): 50% CFM +25 % SESB + 25% Sudan grass (SUD).

After weaning, forty Ossimi male lambs (10 per each) three months old of similar birth type and averaged body weight of 20.17±0.43 kg were selected to study the effect of feeding the same transaction on the productive performance of male lambs. All lambs were weighed biweekly and kept under the same environmental conditions in a semi-open shaded yard during the experimental period.

Diets are offered at two times; 9 am and 4 pm daily. Composite of feedstuff samples analyzed according to the methods of **AOAC (2003).** Gross energy (GE) calculated after **Nehring and Haenlein (1973)** as follows, GE, Mcal/kg DM = (5.72 CP +9.5 EE +4.79 CF + 4.03 NFE) / 1000 (where the values of CP, EE, CF, NFE, are in g/kg DM). Fresh water and blocks of mineral salts were available at all times of the experiment.

A digestibility experiment was carried out to determine the digestibility coefficients, feeding values, and ruminal parameters of the tested rations (R1, R2, R3, & R4). The preliminary period was extended for 14 days, and a collection period was 5 days followed by 3 days of ruminal studies. Three healthy adult Ossimi rams averaged 50.25±0.33 kg were used in each feeding treatment. Rams were fed according to the **NRC (2007)** allowances. Animals were adapted to stand in metabolic cages. Feed intake and feces outputs were obtained and recorded daily.

The chemical composition of representative samples of CFM, RS, forages, refusals, and feces were determined according to **AOAC (1985)** procedures.

Rumen fluid samples were taken from 12 rams (3 in each group) using a stomach tube at zero time (before feeding), 3 hours and 6 hours post-feeding. These samples were filtered through three layers of surgical gauze without squeezing. Ruminal pH was immediately estimated by a digital pH meter. Rumen ammonia-N was determined according to **Conway (1958).** Total volatile fatty acids (TVFAs) were measured by the steam distillation method described by **Warner (1964).** Total number of protozoa was counted by using the Fuchs Rosenthal chamber. Microbial protein was determined by sodium tungstate method, according to **Schultz and Schultz (1970).**

Blood samples were collected biweekly in the morning before feeding *via* the jugular vein from ewes or growing lambs using sterile vacutainer tubes without an anticoagulant. The clear non-haemolysed supernatant serum was quickly removed for analysis of biochemical parameters. The obtained samples were kept at -20 °C till used. Serum total protein (TP), albumin (ALB), alanine aminotransferase (ALT), and aspartate aminotransferase (AST), urea, and glucose contents were assayed according to **Young (2000)** method using biosystems automated reagent kits obtained from Costa Brava 30, Chemical Company, Barcelona (Spain). Globulin (GLB) content was calculated by calculating the differences between TP and ALB. Lipid metabolites were determined using an enzymatic colorimetric method using commercial kits (Vitro Scient, Germany) according to the manufacturer's instructions. Levels of total cholesterol (TC) and triglyceride (TG) were quantified after enzymatic hydrolysis and oxidation of the sample. The high-density lipoprotein cholesterol (HDLc) assay was determined using cholesterol E-Test Kit (Wako, Osaka, Japan) according to **Lopes-Virella *et al.* (1977).** The amount of low-density lipoprotein cholesterol (LDLc) level was calculated by using the Friedewald equation: LDLc = TC - HDLc - (TG/5), where (TG/5) = very low-density lipoprotein cholesterol (VLDLc).

Radiommunoassay procedures determined Triiodothyronine (T3) and Thyroxin (T4) according to **Chopra et al. (1971),** and **Irvin and Standeven (1968),** respectively, kits purchased from Diagnostic products corporation, United States.

Economic efficiency was calculated based on daily feed cost and price of daily body weight gain. The return was estimated using the following equations: Return = output - input. Output = current prices in Egyptian pound (LE.) of body weight gain. However, Input = cost of consumed feeds. Feed cost (FC) = CFM + RS in ration 1 (control). While, FC = CFM + Green forage in rations 2, 3 and 4. Total revenue/ewe (LE) = Total body gain × 50, assuming that the selling price of each Kg gain was LE (50). Net revenue /rabbit (LE) = Total revenue / head -Total feed cost / head. Economic efficiency = Net revenue / head (LE)/ Total feed cost/ head (LE).

Data were statistically analyzed using the general linear model procedure **(SAS, 2002).** The differences among means were tested using Duncan's Multiple-rang test **(Duncan, 1955).** The model used in statistical analysis was:

$$Y_{ij} = \mu + R_i + e_{ij}$$

Where:

Y_{ij} = an observation

μ = overall means

R_i = effect of treatment (i = R1, R2, R3, & R4)

e_{ij} = random error.

REULTS AND DISCUSSION

Nutritional evaluation

1. Chemical Composition

The proportions of all components of the formed diets and the proximal composition of the experimental diets, which were formulated to replace rice straw (RS) as poor protein roughage using *Sesbania sesban* (SESB) and/or mixed with *Echinochloa crusgalli* (ECH) or *Sudan-grass* (SUD), are presented in Table (1).

Table (1) showed that the chemical composition of SESB contains higher levels of crude protein (CP), ether extract (EE), and lower crude fiber (CF) content compared to ECH and SUD. CP content in SESB is almost six times as much as its content in RS and nearly double in ECH and SUD. Similarly, the CP content of experimental rations that involved sesban (R2, R3, and R4) was higher than R1, which made sesban forage has nutritional and economic importance value compared to RS. However, nitrogen-free extract (NFE) content decreased either in sesban or rations that included sesban (R2, R3, and R4) compared to RS. CF content in SESB was lower than in RS. While its content in ECH and SUD was higher than RS. Therefore, SESB can be considered a source of protein and energy to supplement the deficiency in sheep rations **(Sabra et al., 2010)**. **Mahgoub et al. (2022)** reported that the chemical composition of SESB had a significant effect on the higher ratios of CP, EE, NDF, and ADF of the experimental supplemented with sesban hay (R_2, R_3, and R_4) compared to control, in contrast with CF content, these results in harmony with those obtained by **Tekliye et al. (2018)**.

Chemical composition values of SESB obtained in this study within the chemical composition data obtained by **El-Nahrawy and Soliman (1998), Haggag et al. (2000), Soliman and Haggag (2002), Zaki (2015), and Mahgoub et al. (2022).** Also, chemical composition values of ECH and SUD grasses were within the range reported by **Abd El-Hamid et al. (2008), Fathia et al. (2008), Ahmed et al. (2009)**, **and Serag et al. (2014)**.

Calculated chemical composition of the experimental rations on DM basis explained that the ration contained SESB pure had higher level of CP (17.87%), EE (2.63%) and NFE (56.36%) than rations contained SESB-ECH and SESB-SUD mixtures (15.31% & 16.04% CP, 2.32% & 2.34% EE, and 52.55% & 52.93% NFE, respectively). However, CF content in the R2 ration (15.07%) was lower than in other rations. A similar trend was reported by **Soliman and Haggag (2002)**. Who found that different levels of SESB-Teosinte mixture had 15.85-18.04% CP, 50.68-53.34% NFE, and 19.43-20.25% CF. Generally, the calculated chemical composition differs with different green forage intakes. Several workers showed that green forages differ to a large extent in their chemical composition mainly due to species, maturity, cuts, season, soil, and mixtures of different forages **(Abd El-Baki et al., 1996; Geweifel, 1997; Soliman and Haggag, 2002; Zaki, 2015, Mahgoub et al., 2022)**.

2. Apparent nutrient digestibility

Table (2) summarize the nutritional values and nutrient digestibilities of animals fed experimental rations. The dry matter (DM), organic matter (OM), CP, EE, CF, and NFE digestibility of rams fed the control diet (R1) were significantly lower ($P < 0.001$) than rams fed the SESB pure (R2), SESB-ECH mixture (R3) and SESB-SUD mixture (R4) diets. Furthermore, in animals fed R2 and R4 diets, the digestibility of CP (73.02% & 67.00%, respectively), EE (78.34% & 67.78%, respectively) and NFE (64.47% & 54.58%, respectively) were significantly ($P < 0.001$) greater than in rams fed R1 diet (58.91% CP, 47.90 EE, 46.41 CF & 46.83 NFE) and R3 diet (63.78% CP, 63.23% EE, 54.32% CF & 51.34% NFE). Hardly, CF digestibility in R2, R3 and R4 was significantly (P < 0.05) better than in the control group (R1) (56.71%, 54.32 & 54.34% *vs*. 46.41%, respectively). It could be noted that,, the treated groups (R2, R3 & R4) exhibited better TDN, DCP, and DE values than the control group. TDN, DCP, and DE values of the ration containing the SESB pure (R2) followed by R4, then R3 were significantly (P < 0.001) higher than the control (R1). The SESB group (R2) was given preference over the other groups regarding nutritional values, which could be due to a higher level of CP digestibility coefficient.

The digestibility coefficient values obtained in the present study agreed with those obtained by **Rekib and Shukla (1995), Soliman and Haggag (2002), Zaki (2015),** and **Mahgoub et al. (2022).** However, the current digestibility values were higher than those obtained by **Rekib and Shukla (1995)** with SESB pure fed by calves and lower than that obtained by **Soliman et al. (1997)** and **El-Nahrawy and Soliman (1998)**.

The digestibility coefficient of CP was in agreement with those obtained by **Fathia et al. (2008)** and **Ahmed et al. (2009)** with ration contained SESB-SUD grass, but it was higher than that obtained by **Soliman et al. (1997)**, **El-Nahrawy and Soliman (1998),** and **Soliman and Haggag (2002).** The digestibility coefficient of CF was nearly similar to values reported by **Soliman and Haggag (2002),** and it was lower than the values shown by **Soliman et al. (1997), Ahmed et al. (2009),** and **Fathia (2008)**. Generally, digestion parameters are influenced by many factors, such as animal species, rumen microbe activities, feed ingredients, and their associated effects. **Usman et al. (2013)** reported that leaves and tender branches of SESB are rich in protein (20-25% CP) and have high digestibility when consumed by ruminants.

The highest value of DCP in rations containing SESB may be due to the high digestibility of CP. This result is consistent with **Solomon et al. (1997)** obtained with goats fed pure SESB. However, the TDN and DCP% of the SUSB-SUD mixture were nearly similar to those obtained by **Fathia et al. (2008)** with goats fed SUSB-SUD mixture and **Soliman and Haggag (2002)** with SESB+Teosinte. **El-Nahrawy and Soliman (1998)** found that sheep fed on Sesbania plants obtained 69.90% TDN and 14.30% DCP. In general, TDN values vary with chemical composition and nutrient digestibility; also, the DCP value depends on rations CP and its digestion coefficients. The higher CP and lower fiber content of the supplements might have enhanced the supply of nutrients to ruminal microbes and microbial proliferation with resultant improvement in total digestibility of dietary DM and nutrients **(Wallie et al., 2012).**

3. Ruminal parameters

Results of ruminal parameters are presented in **Table (3).** Results showed that maximum pH values were recorded at zero hour with all experimental rations without significant (P > 0.05) differences, then diminished significantly

(P < 0.001) after 3 hours post feeding, then it is not significant again after 6 hours of feeding. The pH value of the R2 group had the highest values, followed by R4, then R3 compared to R1. Ruminal pH is influenced by many factors like drinking water, ruminal ammonia-nitrogen (NH_3-N), and total volatile fatty acids (TVFA's). A similar trend was observed by **Soliman et al. (1997), Gabr et al. (1999), Haggag et al. (2000), Fathia et al. (2008), Zaki (2015),** and **Mahgoub et al. (2022).** However, the pH values measured post-feeding range from 6.33 to 7.25. These findings are within the standard ranges for rumen functions (5.5 to 7.3), according to **Hungate (1966)**.

Post feeding, NH_3-N concentrations were substantially (P < 0.001) higher than before (Table 3). The same trend was shown by **Soliman et al. (1997), Haggag et al. (2000)**, **Fathia et al. (2008), Zaki (2015), and Mahgoub et al. (2022)**. The differences among treatments at 2 hours after feeding were not significant. The NH_3-N of the R1 group was significantly (P < 0.001) higher than other groups post-feeding. While the R2 group had the lowest values significantly, followed by R4 and then R3 compared to R1 at all times. Almost the same values of NH3-N of SESB-Tosinte mixture, SUSB-SUD mixture with goats, and SUSB hay with sheep were obtained by **Soliman et al. (1997), Fathia et al. (2008)** and **Mahgoub et al. (2022),** respectively. NH3-N concentrations are affected mainly by the rations' CP percentage and the rumen's CP degradability.

TVFA's concentrations in the rumen fluid of sheep fed on experimental diets increased significantly with advanced time (0, 3, & 6 hours post-feeding). The differences among the experimental groups at 0, 3, and 6 hours post-feeding were significant in favor of the R2 group, which obtained the highest values, followed by the R4 and then the R3 compared to the R1, which obtained the lowest values at all times after feeding. These TVFA’s values are in agreement with those reported by **Soliman et al. (1997), Haggag et al. (2000), Fathia et al. (2008),** and **Mahgoub et al. (2022)**, while they are lower than that reported by **Zaki (2015)**

The results of the total number of protozoa (10^6/ml rumen liquor) tended to be with the same trend TVFA's and the opposite trend with NH3-N (Table 3). Before feeding at zero hour, the results showed that all groups got the minimum number of protozoa. And it began to gradually (P < 0.001) increase with the progression of time until it reached its maximum after 6 hours post feeding. Moreover, protozoa numbers of treated rations (R2, R3, & R4) contained SESB with or without ECH or SUD grasses were significantly (P < 0.001) higher than the control ration (R1). The protozoa number in all groups was quite high, suggesting that all diets were well-balanced, as reported by **Hungate (1966),** who showed that the number of protozoa was higher with well-balanced rations than with inadequate rations. These results are in agreement with those reported by **Zaki (2015)**.

Microbial protein (g /100 ml rumen liquor) of sheep fed on tested diets is presented in Table (3). The findings showed a significant (P < 0.001) increase in the microbial protein of R2 and R4 rations compared with R1 and R3 rations. Similar values of R1 and R3 rations' microbial protein with no significant differences and the same result was obtained between R2 and R4 rations. Similar findings have been reported by **Soliman et al. (1997), Fathia et al. (2008),** and **Zaki (2015)**.

In general, ruminal parameters presented in Table (3) indicated that ruminal TVFA, the total number of protozoa and microbial protein of diets containing SESB forage were found to be significant (P < 0.001) higher. However, NH_3-N concentration was lower (P < 0.001), and the ruminal pH value was not significant (P > 0.05) change compared to the control diet. These values are within normal values in healthy sheep **(Hungate, 1966; Zaki, 2015**). This finding could be due to the fact that the control ration fed rice straw has higher fiber content (20.07 %) than the other three rations (15.07, 19.81 & 19.12 %, respectively), in which the TVFA level is influenced by the rations' CF content **(Garcia et al., 2002; Mahgoub et al., 2022).** The rise in the overall TVFA concentrations could be due to microbial population regulation caused by the SESB-based diet **(Zaki, 2015).** Both the degree and pattern of ruminal fermentation are determined by the ruminal content of pH and TVFA levels and serve as an indirect marker of ruminal microbial activity **(Polansky et al. 2016).**

Effect of the experimental rations on growing lambs from weaning to puberty

1. Feed intake

Mean values for feed intake by different groups are shown in Table (4). Comparisons among groups indicated that intakes of total DM, TDN, and DCP, kg/head/day for R1 were lower (P < 0.05 & 0.001) than for R2, R3, and R4. The SESB group had the highest values, but the control group had the lowest. The differences between SESB-ECH and SESB-SUD mixtures were not significant (P > 0.05). However, SESB consumption was higher than mixtures of SESB with ECH or SUD. The previous result was in agreement with **Haggag et al. (2000)** in bucks, **Nahrawy and Soliman (1998), Bekele et al. (2013),** and **Mahgoub et al. (2022)** in sheep**.** However**, Zaki (2015)** reported that total DM intake was the lowest when Farafra lambs were fed SESB pure with CFM compared to lambs fed rice straw (control ration). Lower intakes of DM, OM, and N in the R1 group fed rice straw than those provided SESB with or without ECH and SUD forage mainly reflected the higher CF contents in this ration. The high fiber content of rice straw compared to Sesbania forage may have caused lower digestibility of basal and total feeds DM, OM, and N, which subsequently may have decreased energy availability and N to the rumen microbes **(Mekoya et al., 2009c)**.

The feed unit's intake such as TDN and DCP intakes, were highly significant (P < 0.001) higher in treated groups, which fed green forages than the control group fed rice straw. These results could be attributed to the increased DM intake. It is known that intakes of TDN and DCP are influenced by several factors such as feed consumption, the chemical composition of feedstuff, and nutrient digestibility coefficients. The low intake in control may be due to the higher fiber fraction in the basal diet, lower dietary

CP intake, and the concomitant lower digestibility of nutrients. According to **Cheeke (1999),** the fiber constituent of the feed is the major component limiting rumen fill and, thereby intake. Higher intake of DM, OM, CP, and ME for the supplemented group than in the control suggests the potential of the supplements **(Mullu et al., 2008; Melaku and Betsha, 2008; Abebe et al., 2011).**

2. Growth performance

Table (4) showed that the experimental lambs were uniformly distributed among the three groups at the start of the growth trial, with no notable weight disparities. The final body weight (FBW) in all groups had more than doubled by the end of the study. Animals that fed on green forages (R2, R3, & R4) had the greatest FBW, TBG, and ADG values ($P < 0.001$) at the end of the growth period. TBD and ADG in lambs fed the mixture forage (R3 & R4) diets were better than that fed RS diet (R1). There was no significant ($P > 0.05$) increase in growth rate (GR) among R3 and R4 *vs.* R1, while lambs in R2 showed a significant increase compared to the other groups (percentage change= 29.71, 4.27, & 9.36 in R2, R3 & R4, respectively).

These results could be due to the higher nutrient contents of the treatments, thus increasing the animal's nutrient supply. Lambs fed the treated rations (green forages) obtained large total body gain, revealing that the nutrients provided by the treated rations are more than sufficient for maintenance. This data was likely because of the relatively high and good crud protein content of the forages used in the current study. This result was in agreement with **Bekele et al. (2013)** and **Mahgoub et al. (2022)** in sheep. However**, Zaki (2015)** studied four experimental diets (CFM+RS, CFM+SESB, CFM+SESB+ Sorghum, and CFM+SESB+Milt) and reported that FBW and ADG of all experimental groups were nearly similar in the differences among groups were not significant. Similar results were reported by **Abd El-Hamid et al. (2008)** and **Ahmed et al. (2009)** of lambs fed SESB-SUD mixture that it was greater than **Fathia et al. (2012)**. Also, the same results were gained by growing kids fed SESB-Teosinte mixture and SESB pure with CFM **(Soliman et al., 1997),** who showed no significant disparity between these treatments. But, **Fathia et al. (2012)** found that ADG of growing lambs fed SESB-Millet silage was significantly greater than that fed SESB pure silage.

Mekoya et al. (2009c) reported that the differences in daily live weight gain among experemintal groups fed similar levels of Sesbania supplementation more or less reflected the differences in daily DM, OM, and N intake and digestibility of DM, OM, N, and fiber. The linear increase in daily body weight gain with increasing levels of Sesbania is probably the result of increased OM and N intake and/or efficient use of basal feed.

3. Feed conversion efficiency

The treatments improved ($P < 0.001$) feed conversion (FC) efficiency of lambs compared to control (Table 4). The present data indicated that feed conversion of DM in the R2 group had the lowest values ($P < 0.001$) compared to other groups, which did not differ. Moreover, feed conversion of TDN and DCP were significant ($P < 0.001$) increased by green forage treatments compared to control. **Zaki (2015)** obtained a similar trend, who reported that the best FC of DM was recorded with the SESB-Milt diet, and the worst was with control. These results are in agreement with that reported by **Soliman et al. (1997), Abd El-Hamid et al. (2008), Fathia et al. (2012),** and **Mahgoub et al. (2022)**

4. Economic efficiency

Economic efficiency (EE) was noticeably higher (1.18, 1.01, & 1.06 *vs*. 0.82%) in treated groups (R2, R3, & R4 *vs*. R1, respectively) compared to control. These differences in this feature were statistically significant (P < 0.001). Thus, replacing rice straw in growing lambs' diets with the SESB or mixture of SESB with ECH or SUD forage increased the economic benefit by 44.00, 24.26, and 29.66%, respectively, compared to the control group. The positive effect of SESB forage on EE was observed by **El-Kholany et al. (2013 & 2016)**. Eather extract is enhanced by using 10, 20, and 30% sesban seeds in the Zaraibi goat's ration. The same trend with results obtained by **Tekliye et al.** (**2018**) suggested that sheep diets enriched with the highest level of SESB leaves were most beneficial given the net return and marginal rate of return. **Mahgoub et al. (2022)** reported that EE was significantly higher with elevating sesban levels in sheep’s diets; also, relative EE was gradually increased at a rate ranging from 10.77 to 33.08.

Effect of the experimental rations on blood constituents (biochemistry, lipid profile, and thyroid hormones)

Data of some biochemical blood profiles of experimental pubertal ram-lambs are presented in Table (5). Blood metabolites are usually used to assess animals' general health and vitality. All blood serum metabolites were within the normal physiological ranges **(Boyd, 2011; Shaarawy et al., 2022)** for healthy goats and sheep, respectively. Therefore, they are considered an important indicator of normal liver functions. This indicates the absence of pathological lesions in the liver (**Pettersson et al. 2008**). The findings reported that serum protein profile (TP, ALB, & GLB), glucose, and urea-N concentration were increased significantly (P < 0.001) with treated rations that included SESB (R2, R3, & R4) compared to the control group (R1) in growing ram-lambs. While no significant (P > 0.05) differences in liver enzymes (ALT & AST) among experimental groups. Similar results have been obtained in sheep (**Sabra et al., 2010; Shaarawy et al., 2022; Mahgoub et al., 2022**; **Farghaly et al., 2022)** and goats **(El-Moghazy et al., 2017; Ahmed et al., 2017)**. Animals given SESB may create more nitrogen due to increased protein and amino acid catabolism, leading to higher serum blood urea-N concentration. **Ponnampalam et al. (2005)** suggested that rising protein consumption boosts urea-N levels in the blood. Moreover, rising serum urea-N levels in SESB diets could be related to increasing rumen NH3-N levels **(Mahgoub et al., 2022)**. Regarding the glucose concentration, it could be noticed that ewes fed R2 and R4 recorded significantly (P < 0.001) the highest values compared to R1 and R3. Glycaemia plays a vital role in regulating ovarian follicle responsiveness to gonadotropins (**Selvaraju et al., 2003**).

The enhancements in the general health status of the sheep fed SESB with or without ECH and SUD forages could be due to the increase in digestion and absorption of feeds, as well as to the ameliorative of amino acid and fatty acid profile. The nutritive value of Sesbania is reflected positively on blood metabolites of total protein, albumin, globulins, and urea **(Farghaly et al., 2022). Usman et al. (2013)** reported that the Sesbania plant has good medicinal importance. Flowers contain cyanidin and delphinidin glucosides, Pollen and pollen tubes contain alpha-ketoglutaric, oxaloacetic and pyruvic acids in the leaves of Sesbania Sesban evaluated the topical anti-inflammatory activity, antidiabetic and CNS stimulant effect, in thyroid disorders, dysuria. The leaf of Sesbania Sesban has traditionally been used as purgative, demulcent, maturant, Anthelmintic, and for all pains and inflammation. The renal protective effect of the aqueous extract of Sesbania Sesban leaves.

The effect of feeding SESB with or without ECH and SUD forages on lipid profile is shown in Table (5). All serum lipid profile parameters were within the normal physiological ranges. Serum total cholesterol (TC) was significant ($P < 0.05$) increased with treated groups compared to the control group in growing ram-lambs. However, triglyceride and VLDL levels decreased significantly ($P < 0.05$) in treated groups, whereas HDL was non-significantly ($P > 0.05$) reduced in these groups compared to the control group. Furthermore, the SESB group (R2) results had the best values in TC, TG, and VLDLc compared to other groups. High TC level was correlated to greater estrogen level in SESB-supplemented groups because estrogen boosts TC production (**Kaushik and Bugalia, 1999**). The increase in cellular cholesterol synthesis is related to lowering LDL receptor function **(Ness et al., 1996)** and total lipid increase **(Bhandari et al., 2005).** Similar results have been obtained in sheep (**Shaarawy et al., 2022; Mahgoub et al., 2022; Farghaly et al., 2022)**. Contrary, **Pandhare et al. (2011)** reported that the lipid profile of animals treated with aqueous extract of SESB leaves (250 & 500 mg/kg) showed significant reductions in TC, LDL, and VLDL and an increase in HDL compared to control. Serum cholesterol value was higher in treated groups than in control, either ewes or ram-lambs. These results may be attributed to increased voluntary feed intake, roughage intake (Table 4), rumen fermentation (Table, 3), enzymes activities, and high thyroid gland secretion (Table 5).

Thyroid hormones [Triiodothyronine (T3) and Thyroxin (T4)] concentrations of pubertal ram-lambs increased significantly ($P < 0.001$) in blood serum by feeding of SESB supplemented rations. The present results are in agreement with those reported by **Mahgoub et al. (2022),** who indicated that stimulation of the metabolic processes in the SESB- supplemented sheep and the marked increase in serum T3 in these sheep. T3 and T4 values in pubertal ram-lambs were 61.59, 36.59, & 29.27% in T3; and 14.66, 4.78, & 8.88 in T4 higher in R2, R3, & R4 groups, respectively, compared to the control group.

Table (1). Proximate analysis of feedstuff and experimental rations fed to Ossimi ewes on a DM basis (%).

Items	Chemical composition (%), DM basis							GE Mcal. /kg DM
	DM	OM	CP	EE	CF	NFE	Ash	
Feedstuff								
CFM	92.04	91.15	16.55	2.99	12.01	59.60	8.85	4.21
RS	87.15	89.83	3.84	1.18	28.13	56.68	10.17	3.96
SESB	20.12	92.68	19.19	2.26	18.12	53.11	7.32	4.32
ECH	75.66	84.97	8.95	1.04	37.11	37.87	15.03	3.91
SUD	80.73	86.69	11.86	1.11	34.33	39.39	13.31	4.02
Experimental rations								
R1	89.60	90.49	10.20	2.09	20.07	58.14	9.51	4.09
R2	56.08	91.92	17.87	2.63	15.07	56.36	8.09	4.26
R3	69.97	89.99	15.31	2.32	19.81	52.55	10.01	4.16
R4	71.23	90.42	16.04	2.34	19.12	52.93	9.58	4.19

GE calculated after Nehring and Haenlein (1973). GE, Mcal/kg DM = (5.72 CP +9.5 EE +4.79 CF + 4.03 NFE) / 1000 (where the values of CP, EE, CF, NFE, are in g/kg DM).

Concentrate feed mixture used in formulating the experimental rations contained 24 % Cotton seed meal, 40% Wheat bran, 30% Yellow Corn, 1.5% Lime stone, 1 % Sodium chloride, 0.5% vitamins and mineral mixture, and 3% Molasses**.**

Table (2). Digestibility coefficient and nutrient values of Ossimi rams fed experimental rations.

Items	Experimental rations				±SE	P. value
	R1	**R2**	**R3**	**R4**		
***Digestibility coefficient**, %*						
DM	58.55^{d}	64.43^{a}	61.27^{c}	62.70^{b}	0.41	0.0001
OM	55.26^{c}	60.90^{a}	58.82^{b}	59.07^{b}	0.36	0.0001
CP	58.91^{d}	73.02^{a}	63.78^{c}	67.00^{b}	0.55	0.0001
EE	47.90^{d}	78.34^{a}	63.23^{c}	67.78^{b}	0.60	0.0001
CF	46.41^{c}	56.71^{a}	54.32^{b}	54.34^{b}	0.30	0.0001
NFE	46.83^{d}	64.47^{a}	51.34^{c}	54.58^{b}	0.44	0.0001
***Nutrient values**, %*						
TDN	51.05^{d}	76.29^{a}	61.18^{c}	65.04^{b}	0.27	0.0001
DCP	6.01^{d}	13.05^{a}	9.76^{c}	10.75^{b}	0.06	0.0001
DE	1.98^{d}	2.82^{a}	2.30^{c}	2.43^{b}	0.01	0.0001

a, b, and c. Mean within each row with different superscripts are significantly different (P<0.05).

Table (3). Ruminal parameters of Ossimi rams fed experimental rations.

Rumen liquid parameters	Time of samples	Experimental rations				±SE	P. value
		R1	R2	R3	R4		
pH	Zero time	7.16	7.25	7.25	7.22	0.04	0.3477
	After 3hr	6.33^{c}	6.71^{a}	6.54^{b}	6.68^{ab}	0.05	0.0004
	After 6hr	6.43	6.62	6.43	6.46	0.12	0.6202
	Overall mean	6.64	6.86	6.74	6.79	0.13	0.6880
NH3-N (mg / 100 ml)	Zero time	16.06^{a}	11.03^{c}	15.34^{a}	11.89^{b}	0.26	<0.0001
	After 3hr	39.87^{a}	22.85^{d}	32.44^{b}	25.20^{c}	0.68	<0.0001
	After 6hr	37.66^{a}	21.69^{d}	29.73^{b}	23.62^{c}	0.40	<0.0001
	Overall mean	31.20^{a}	18.52^{b}	25.84^{ab}	20.24^{b}	2.73	0.0103
Total volatile fatty acids (ml Eq. / 100 ml)	Zero time	4.75^{c}	5.74^{a}	4.94^{c}	5.31^{b}	0.11	0..0002
	After 3hr	5.10^{d}	6.37^{a}	5.70^{c}	6.03^{b}	0.05	<0.0001
	After 6hr	5.58^{d}	6.75^{a}	6.09^{c}	6.38^{b}	0.08	<0.0001
	Overall mean	5.14^{c}	6.29^{a}	5.58^{bc}	5.91^{ab}	0.16	0.0002
Total number of protozoa (10^{6} /ml rumen fluid)	Zero time	0.51^{b}	0.75^{a}	0.52^{b}	0.69^{a}	0.02	<0.0001
	After 3hr	1.25^{b}	1.85^{a}	1.01^{c}	1.32^{b}	0.05	<0.0001
	After 6hr	1.64^{b}	2.13^{a}	1.36^{c}	1.72^{b}	0.04	<0.0001
	Overall mean	1.13^{ab}	1.58^{a}	0.96^{b}	1.24^{ab}	0.17	0.0478
Microbial protein (g/100ml rumen fluid)	After 6hr	0.50^{b}	0.62^{a}	0.52^{b}	0.60^{a}	0.01	<0.0001

Table (4). Growth performance, feed efficiency, and economic efficiency of Ossimi growing lambs fed experimental rations.

Items	Experimental rations				±SE	P. value
	R1	R2	R3	R4		
Daily DM intake (Kg)						
CFM (Kg/h/d)	0.65	0.75	0.68	0.70	0.006	
RS (Kg/h/d)	0.55	0.00	0.00	0.00	0.002	
SESB (Kg/h/d)	0.00	0.63	0.30	0.34	0.003	
ECH (Kg/h/d)	0.00	0.00	0.26	0.00	0.001	
SUD (Kg/h/d)	0.00	0.00	0.00	0.24	0.001	
Total DM intake (Kg/h/d)	1.20^{c}	1.38^{a}	1.24^{bc}	1.28^{b}	0.011	0.0366
TDN intake (Kg/h/d)	0.61^{d}	1.05^{a}	0.76^{c}	0.83^{b}	0.005	0.0001
DCP intake (Kg/h/d)	0.07^{d}	0.18^{a}	0.12^{c}	0.14^{b}	0.001	0.0001
Growth performance						
Initial weight, kg	20.17^{a}	20.17^{a}	20.17^{a}	20.17^{a}	0.43	1.000
Final weight, kg	39.83^{c}	45.67^{a}	40.67^{bc}	41.67^{b}	0.37	0.0001
Total body gain, kg	19.66^{c}	25.50^{a}	20.50^{bc}	21.50^{b}	0.49	0.0001

Avg. body gain, g/day[3]	163.83[c]	212.50[a]	170.83[bc]	179.17[b]	4.06	0.0001
Growth rate (%)	97.47[b]	126.43[a]	101.64[b]	106.59[b]	4.53	0.0010
% Change	0.00	29.71	4.27	9.36		
Survival rate (%)	100	100	100	100		
Feed conversion (FC)						
FC (TDMI/ kg gain)[1]	7.32[a]	6.49[b]	7.26[a]	7.14[a]	0.13	0.0010
FC (TDN/ kg gain)	3.74[c]	4.95[a]	4.44[b]	4.65[b]	0.07	0.008
FC (DCP/ kg gain)	0.44[d]	0.85[a]	0.71[c]	0.77[b]	0.01	0.0011
Economic efficiency (EE)						
Price / kg diet (LE)	3.76	3.54	3.42	3.40		
Total Feed cost / h / 120d, LE	541.44[d]	586.22[a]	508.90[c]	522.24[b]	4.32	0.0001
Total revenue / h, LE[2]	983.00[c]	1275.00[a]	1025.00[bc]	1075.00[b]	24.35	0.0001
Net return / h, LE[3]	441.56[d]	688.78[a]	516.10[c]	552.76[b]	22.38	0.0001
Economic efficiency[4]	0.816[c]	1.175[a]	1.014[b]	1.058[b]	0.04	0.0001
Relative EE%	100.00	144.00	124.26	129.66		

a, b, and c. Mean within each row with different superscripts are significantly different (P<0.05).
TDMI= Total dry matter intake; CFM= concentrate feed mixture; RS= rice straw; SESB= Sesban.
Based on prices in the Egyptian market during the experimental period (2020).
1 Feed conversion = Total DM intake / kg gain
2 Total revenue/ewe (LE) = Total body gain × 50, assuming that the selling price of each Kg gain was LE (50).
3 Net revenue /rabbit (LE) = Total revenue/h -Total feed cost/h.
4 Economic efficiency = Net revenue /h (LE) ÷ Total feed cost/ h (LE).

Table (5). Serum biochemistry markers, lipid profile and thyroid hormones levels of pubertal ram-lambs fed experimental rations.

Items	Experimental rations				±SE	P. value
	R1	R2	R3	R4		
Total protein (g/dl)	6.23[c]	7.51[a]	7.22[ab]	6.92[b]	0.130	0.0007
Albumin (g/dl)	4.12	4.32	4.14	4.09	0.138	0.6554
Globulin (g/dl)	2.11[b]	3.19[a]	3.08[a]	2.83[a]	0.218	0.0312
Albumin / Globulin ratio	1.95[a]	1.35[b]	1.34[b]	1.45[ab]	0.161	0.0488
Glucose (g/dl)	70.44[c]	76.52[a]	73.66[b]	76.11[a]	0.513	0.0001
AST (U/L)	40.37	38.36	40.18	39.96	0.770	0.3028
ALT (U/L)	27.92[a]	29.52[a]	29.18[a]	29.45[a]	0.821	0.5164
Urea (mg/dl)	33.59[b]	40.74[a]	34.62[b]	41.14[a]	0.754	0.0001
Total cholesterol (mg/dl)	165.08[b]	169.96[a]	165.59[b]	166.66[ab]	1.063	0.0447
Triglyceride (mg/dl)	62.33[a]	55.50[c]	59.67[ab]	56.33[bc]	1.216	0.0142
HDL (mg/dl)	52.50	49.78	50.25	51.50	1.263	0.4601
LDL[1] (mg/dl)	100.11[c]	109.08[a]	103.41[bc]	103.89[b]	1.011	0.0017

VLDL (mg/dl)	12.47[a]	11.10[c]	11.93[ab]	11.27[bc]	0.243	0.0142
T3 (nmol/L)	1.64[c]	2.65[a]	2.24[b]	2.12[b]	0.050	0.0001
T4 (nmol/L)	30.96[c]	35.50[a]	32.44[bc]	33.71[b]	0.523	0.0017

a, b and c . Means within each row with different superscripts are significantly
a-c means in the row followed by the same letter are not significantly different (P>0.05).
1 LDL-cholesterol level was calculated by using the formula:
LDL= Total cholesterol -HDLc - (Triglyceride/5), where (Triglyceride/5) = VLDL

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الملخص العربي

تأثير تغذية السيسبان وبعض مخاليطه من المحاصيل الصيفية على الأداء الإنتاجي للأغنام الأوسيمي

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أجريت هذه الدراسة لتقييم أربع معاملات مختلفة تم تركيبها على أساس المادة الجافة. تتكون العليقه الأولى (R1 ،الكنترول) من 50٪ خليط علف مركز و 50٪ قش أرز. تم استبدال العليقه الثانية (R2) ، نسبة قش الأرز (50٪)السيسبان SESB)) ، والثالثة (R3) والرابعة (R4) ، تم استبدال نصف نسبة قش الأرز (25٪). تم استبدال SESB والنصف الآخر (25 ٪) بـ الدنيبه ECH) crusgalli) أو العشب السوداني (SUD). بعد الفطام تم اختيار أربعين من ذكور الحملان الأوسيمي (10 لكل منهما) بعمر ثلاثة أشهر من نفس نوع الولادة ومتوسط وزن الجسم 20.17 ± 0.43 كجم لدراسة تأثير تغذية نفس المعاملة على الأداء الإنتاجي لنمو ذكور الحملان. تم وزن جميع الحملان مرتين شهريًا وتحت نفس الظروف البيئية في ساحة مظللة شبه مفتوحة خلال فترة التجربة. أظهرت النتائج أن

التركيب الكيميائي لـ SESB يحتوي على مستويات أعلى من البروتين الخام ومستخلص الأثير ومحتوى أقل من الألياف الخام مقارنةً بـ ECH و SUD. محتوى CP في SESB هو ما يقرب من ستة أضعاف محتواه في RS وتقريباً ضعف في ECH و SUD. وبالمثل ، كان محتوى CP للمعاملات التجريبية التي اشتملت على سيسبان (R2 و R3 و R4) أعلى من R1. كانت القيم الغذائية وهضم المغذيات للحيوانات التي تغذت على المعاملات التجريبية أقل بكثير (P <0.001) من الكباش التي تغذت على علف SESB النقي (R2) ومزيج SESB-ECH (R3) ومزيج SESB-SUD (R4). أظهرت المجموعات المعالجة (R2 و R3 و R4) قيم TDN و DCP و DE أفضل من مجموعة التحكم. تم تحسين جميع معاملات الكرش في المجموعات المعالجة مقارنة مع مجموعة التحكم. كانت مآخذ المادة الجافة الكلية (DM) ، وإجمالي المغذيات القابلة للهضم (TDN) ، والبروتين الخام القابل للهضم (DCP) ، كجم / رأس / يوم لـ R1 أقل (P 0.001 & 0.05>) من R2 و R3 و R4. حصلت مجموعة SESB على أعلى القيم ، لكن المجموعة الضابطة كانت الأقل. لم تكن الفروق بين خلائط SESB-ECH و SESB-SUD كبيرة (P> 0.05). الحيوانات التي تتغذى على الأعلاف الخضراء (R2، R3، R4) كان لها أكبر اكتساب إجمالي للجسم (TBG) ، ومتوسط الكسب اليومي (ADG) قيم (P <0.001) في نهاية فترة النمو. كان TBD و ADG في الحملان المغذاة على العلف المخلوط (R3 & R4) أفضل من علف الضبط (R1). لم تكن هناك زيادة معنوية (P> 0.05) في معدل النمو بين R3 و R4 مقابل R1 ، بينما أظهر R2 زيادة معنوية مقارنة بالمجموعات الأخرى (النسبة المئوية للتغير = 29.71 و 4.27 و 9.36 في R2 و R3 و R4 على التوالي.). كانت الكفاءة الاقتصادية (EE) أعلى بشكل ملحوظ (1.18 ، 1.01 ، 1.06 مقابل 0.82٪) في المجموعات المعالجة (R2، R3، R4 مقابل R1 ، على التوالي) مقارنة بمجموعة التحكم .تم تحسين جميع مستقلبات مصل الدم في المجموعات المعالجة مقارنة مع مجموعة التحكم. زادت تراكيز هرمونات الغدة الدرقية بشكل معنوي (P <0.001) في مصل الدم عن طريق التغذية بالحصص الغذائية التكميلية SESB للحملان. يمكن الاستنتاج أن SESB مع أو بدون خليط ECH أو خليط SUD يمكن الاستفادة منه لتغذية الحملان النامية دون أي تأثير ضار.

الكلمات المفتاحية: سيسبان ، الدنيبه ، حشيشه السودان ، الإنتاج ، الأغنام.