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EFFECT OF ROUGHAGE SOURCES IN STARTER ON PERFORMANCE OF EARLY WEANED LAMBS

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ABSTRACT

Forty Ossimi male lambs with an average live body weight 3.85 ± 0.25 kg and 7 days age were randomly assigned to four feeding groups, each of 10 animals to be weaned early at 8 weeks of age. The different experimental groups were supported by a creep feeding ration from the second week of age until being weaned, besides dam's milk. After weaning, lambs were depended completely on the starter ration for another four weeks (12 weeks old).

Rations were characterized by no fiber source (control) or inclusion of 5 % different dietary fiber sources, i.e. bean straw (Bs), wheat straw (Ws) and peanut hulls (PnH) which resulted in four isonitrogenous and caloric rations.

Data indicated insignificant intake differences among the different tested groups in both milk and solid diets in the first 8 weeks of age. Also, data pointed out both R3 and R4 showed significantly heavier *($p < 0.05$)* final live body weight, higher total and daily body weight gain compared with R2 but without significant differences with R1 (nil roughage source).

From 9-12 weeks of age lambs in R1 recorded higher creep feeding intake without significant differences with R3 and R4 while R2 recorded the lowest feed intake value. Lambs in R3 recorded heavier *($P < 0.05$)* final live body weight, total body and daily weight gain in comparison with the different feeding groups.

Results of digestibility trials which carried out after 12 weeks of lambs age for the tested rations pointed out to higher digestibility coefficients and nutritive values in different terms in favor of R1 (starter without roughages) followed by R3 (Ws), R2 (BS) and later was the (Pn H) ration (R4), respectively. This matter might suggest that (Pn H) roughage source was not a suitable roughage source to be incorporated in ruminant rations, particularly creep feeding rations.

INTRODUCTION

Proper development of the rumen is an important task that can be controlled to benefit both the ruminant newborn animal and the producer. The rumen of a newborn ruminant animal is a small, nonfunctional sac, accounting for less than 30% of the total stomach mass and displaying rudimentary papillary development (Church, 1969), but the rumen of a mature sheep accounts for up to 80% of the stomach mass and possesses numerous long papillae. The process of rumen development does not occur "magically", and with the right management the cost of raising calves and lambs can be decreased (Quigley, 1996). The mechanisms that are responsible for rumen development have not been completely characterized; however, solid feed consumption stimulates rumen morphological development *(*Warner *et al,* 1956*).* The success of early weaning must depend partly upon the speed with which the rumen develop, which affect by starter composition and partly upon the level of milk production of the dams (Wardrop, 1961), also has shown that rumen function develops rapidly after birth until, at about 8 weeks of age, the grazing lambs can digest herbage with the efficiency of an adult. Bonsma & Engela (1941) and Bosman & Bonsma (1944) found that lambs weaned at 8 weeks of age had the same growth rate as unweaned controls. Wardrop I.D and Coomb, J.B. (1960) demonstrated that the type of nutrition was more important than the plane of nutrition, in determining the growth rates of the fore-stomachs of the lamb, and that plant food was necessary for the normal development of these organs. Brownlee (1956) reported that plant food appears to be necessary for the full development of the anatomical and histological structure of the ruminant stomach, however different plant – feed sources can alter the appearance of the rumen mucosal surface. Landsverk (1978) and Dirksen (1983) said that structure and morphology of the rumen of sheep and cattle has been shown to be influenced by type of feed. Sideny and Lyford (1988) reported that, in young ruminants; muscular was increased with the ingestion of solid feedstuffs, in particular coarse fibrous forages.

Niwi *et al.,* (2005) found that the type of liquid feed has no effect on the size of ruminal papillae, but may stimulate the direction of rumen fermentation.

Balwant and Chaudhary (2002) found that feeding good quality concentrates and roughage together with milk is required as early as 2 weeks of age and onwards in order to stimulate early rumen development. In view of these findings, it appears on theoretical grounds that lambs can be successfully weaned at any time after about 8 weeks of age; it is depending on starter consumption. This theoretical prediction has been experimentally verified by several authors. It is well known that local sheep breeds are characterized by their lower milk yield, which in turn would be reflected on the growth rate of their offspring. Hence, the aim of the present study was to justify the effect of pre-weaning diet at weaning on the efficiency of production from the early weaned lambs. The presence of feed bulk is necessary for rumen growth and its muscle development, though the introduction of different sources of fibrous feedstuffs were incorporated in the starter ration (at 5%) to examine its impact on rumen development and in turn on lamb's performance.

MATERIALS AND METHODS

Forty Ossimi male lambs with an average live body weight 3.85 $\pm$ 0.25 kg and 7 days age were randomly assigned to four feeding groups, 10 animals each, to be weaned early at 8 weeks of age. Different experimental groups were supported by a creep feeding ration (Table I) from the second week of age until being weaned, besides dam's milk. After weaning, lambs were depended completely on the starter diet for another four weeks (12 weeks old).

Starter rations were characterized by no inclusion fiber (control) or 5% different fiber sources, i.e. bean straw (Bs), wheat straw (Ws) and peanut hulls (PnH). The four experimental rations were formulated to be isonitrogenous and caloric and calculated according to NRC recommendations (1985) and offered to lambs *ad libitum*. Residuals were daily collected, while composite samples were taken and dried for further proximate analysis. Lambs were kept in semi-opened pens, while water and salt blocks were freely available. Animals were fasted and weighed at biweekly intervals, while daily feed intake, changes in live body weight, average daily gain (ADG), feed conversion (kg DMI/kg. gain) and feed costs (LE/kg. gain) were estimated.

Milk determination:

Average daily milk intake by lambs was determined once weekly during the rearing period, by milk difference technique according to Louca *et al* 1974).

Digestibility trails and N balance:

A metabolic trail and N balance was conducted to evaluate the digestibility, feeding values and N retention of the experimental rations.

Table (I): Composition of experimental rations offered to early weaned lambs from (2-12 weeks old) on (DM basis %).

% rations composition	R1 Conc	R2 Bs	R3 Ws	R4 PnH
Yellow Corn	50	50	50	50
Soybean meal	30	30	30	30
Wheat bran	12	7	7	7
Bean straw (Bs)	-	5	-	-
Wheat straw (Ws)	-	-	5	-
Peanut hulls (PnH)	-	-	-	5
Molasses	5	5	5	5
Lime stone	1.5	1.5	1.5	1.5
Sodium Chloride	1.0	1.0	1.0	1.0
Mineral mix. And Vit. (Premix)*	0.5	0.5	0.5	0.5

*** Primex, contained/kg Mn. 33 mg, Zn 25 mg, Fe 20 mg, Cu 6 mg, I 800 mg, Sel 66 mg, and Co 160 mg.**

Simultaneously, by the end of the study (12 weeks), four representative lambs per each dietary treatment were randomly chosen and used in a digestibility trail. Lambs were placed in metabolic cages, weighed at the start and the end of the trail. The duration period of the trail, consisted of 7 days as an adaptation and preliminary period, followed by another 7 days as a collection one. Through the collection period, daily amounts of feed consumed and residuals were accurately weighed and recorded, meanwhile, faeces and urine were quantitatively collected once daily at 8 a.m.

Faeces collection:

The daily samples (10%) of faeces were immediately frozen at $^{-}$20ºC. At the end of the collection period, a composite sample for each lamb was prepared and dried in a drying oven at 65ºC for 24 hours and then grinding and stored in suitable jars for proximate analysis. Also a composite sample of experimental rations was prepared by drying, grinding and stored in tight jars for further chemical analysis.

Urine sampling:

Five m1 of diluted sulphuric acid (1:1) were added in the urine collecting bottles to avoid ammonia losses. The urine output was measured daily along the collection period for each animal and representative samples (10%) were collected daily from each animal, and a composite sample was then stored at -20ºC for nitrogen determination

Chemical analysis:

Proximate analysis of feeds, residuals, faeces and nitrogen in urine were analyzed according to A.O.A.C (1990) procedures.

Statistical analysis:

Data were analyzed using the general linear models procedure adopted by SAS (1996). Differences between means were tested for significances using the L.S.D test according to Duncan (1955). One way analysis of variance was adopted using the following equation:

$Yij = u + Ti + Eij$

Where:-

Yij = The observations of the parameter measured.

U = Overal means

Ti = The effect of replication

Eij = The random error term.

RESULTS AND DISCUSSION

Chemical composition of experimental rations:

Data presented in (Table II) showed similar DM content for different tested rations; somewhat higher OM for R1, and R2. Similar CP content was shown for different tested rations, nearly 18.5%. On the other hand, R1 indicated higher EE and NFE contents in comparison with rations 2,3 and 4, but lower CF and ash contents for the same ration. As for fibrous experimental rations, R2, 3 and 4 showed in general higher CF contents (ranged between 6.2 to 6.8%) and higher ash content (6.3 to 8.6%), which may be attributed to the inclusion of 5%, fibrous feedstuffs to the standard ration (R_1).

Table (II): Chemical composition of experimental rations (DM basis %).

Items	Experimental rations			
	R1	R2	R3	R4
DM	91.7	92.2	91.9	92.0
OM	94.6	93.7	91.8	91.4
CP	18.6	18.7	18.3	18.5
CF	5.2	6.8	6.2	6.5
EE	4.7	3.9	3.9	3.8
NFE	66.1	64.3	63.4	62.6
Ash	5.4	6.3	8.2	8.6

Effect of dietary roughage sources on the performance of early weaned lambs (2 – 8 weeks of age):

Data presented in (Table III) indicated insignificant intake differences among the different tested groups in both milk and solid diets intakes. However, it was noticeable in general lower milk yield by different feed groups; the matter which favored the early weaning practice as a good managerial process to be applied for the native breeds which are genetically considered as a lower milky yield breeds.

Data presented in (Table III) pointed out to similar initial live body weight, but significant final live body weight and body weight gains in different feed groups. However, both treatments R3 and R4 showed significantly heavier *($p < 0.05$)* final live body weight, higher total and daily body weight gain and without significant differences with R1 (nil roughage source). This result might suggest that rations of early weaned lambs might involve lower percentages of fibrous materials to enhance rumen development, mastication and rumination. According to Stock *et al*. (1990) and Jung and Allen (1995), roughages are necessary for normal rumen fermentation, reduce acidosis, improve intake, stimulate chewing and may increase rate of passage of concentrates. In addition, such fibrous materials must be also characterized by its higher palatability and digestibility which might in turn to lead to higher growth performance. Similar results were reviewed by Brandt *et al* (1987) who reported that cattle can be finished on all concentrate diets, however gains and feed efficiency usually have been improved by including small amounts of roughage, also, Stock *et al*, (1987) pointed out to the importance of including 5 to 15% roughages in ruminants rations to reduce the incidence and severity of digestive problems.

Table (III): Effect of dietary roughage source on live body weight gain, feed efficiency and feed cost/kg gain for Ossimi male lambs from 2-8 weeks of age .

Item	R_1 (Conc)	R_2 (Bs)	R_3 (Ws)	R_4 (PnH)
Mean feed intake				
Milk (ml/h/d)(1)	347 ±27	338±35	304±24	319± 29
Starter (g/h/d) (2)	198 ±12	177 ±11	196 ±13	190 ±15
DMI (g/h/d)	225 ± 20	205 ± 23	218 ± 19	215 ±22
Body weight gain				
Av. Initial B.W (kg) (2)	3.8± 0.20	3.90 ± 0..26	3.90 ± 0.27	3.8± 0.25
Av. Final B.W (kg) (4)	10.5 ± 0.75ab	9.5 ± 0.75^{b}	11.6 ± 0.78^{a}	11.3 ± 0.75^{a}
Total B.W. gain (kg)	6. 7 ± 0.56^{ab}	5.6 ± 0.66^{b}	7.7 ± 0.69^{a}	7.5 ± 0.59^{a}
Av. Daily gain (g)	137 ± 20^{ab}	114± 16^{b}	157± 17^{a}	153± 19^{a}
Feed efficiency and feed cost (pt.)/kg gain				
Kg DMI/kg gain	1.64 ± 0.10^{ab}	1.80 ± 0.18^{a}	1.39 ± 0.08^{b}	1.41± 1.05^{b}
Feed cost (LE.) kg gain	8.76 ±0.05^{a}	10.09± 0.07^{a}	6.88± 0.10^{b}	7.32± 0.08^{b}

a, b and c different letters indicate significant difference ($P \leq 0.05$)
(1) Current price of 1kg ewes milk = 2.6 L.E
(2) Current price of 1kg starter = 1.5 L.E
(3) Av. Initial B.W = 2 weeks old
(4) Final B.W = 8 weeks old

Boraei (2003) referred the significant increase in feed intake and feed conversion of buffalo calves to the dietary NDF and roughages source as the main effective factors in improving both criteria. On the other hand, it was shown lower *($P < 0.05$)* final live body weight, total and daily weight gains for (R2) *i.e* bean straw fibrous source. This matter led to suggest that bean straw as a fibrous feedstuff was of lower digestibility and palatability which might lead to decrease lambs gain.

Feed efficiency results and feed costs for different tested rations during early life of newborn lambs pointed out both of R3 and R4 had higher *($P < 0.05$)* feed efficiency and lower *($P < 0.05$)* feed costs/ kg gain. This might be related to the higher ADG for the two groups.

Effect of dietary roughage sources on the performance of male lambs (9 -12 weeks of age):

Data presented in Table IV showed significant feed intakes *($p < 0.05$)* among the different tested rations, however R1 recorded higher creep feeding intake without significant differences with R3 and R4 while R2 recorded the lowest feed intake value. These matters coincide with the marked variations in the daily feed intake g/ h/ day.

Results showed also significant differences among the tested groups in final live body weight due to the significant variations in daily body weight gain. However, R3 recorded heavier *($P < 0.05$)* final live body weight, total body and daily weight gain in comparison with the different feed groups. Similar results were obtained in the earlier age for such ration (Table III); which might suggest the relatively higher nutritive value of (WS) roughage source in comparison with both (BS) and (PnH) roughage sources. On the other hand, relatively higher daily gains were detected for both (BS) and (PnH) groups in comparison with the previous earlier gains (Table III) which might be considered as a compensatory growth phenomena for both the two feeding groups.

Table (IV): Effect of dietary roughage source on the performance of Ossimi male lambs from 9-12 weeks of age.

Item	R_1	R_2	R_3	R_4
Mean feed intake				
DMI (g/h/d)) (1)	522 ± 0.2^{a}	449 ± 0.3^{b}	499 ± 0.1^{ab}	487 ± 0.5^{ab}
Body weight gain				
Av. Initial B.W (kg) (2)	10.5 ± 0.75^{ab}	9.5 ± 0.75^{b}	11.6 ± 0.78^{a}	11.3 ± 0.75^{ab}
Av. Final B.W (kg) (3)	15.6 ± 1.05^{b}	15.3 ± 1.05^{b}	18.4 ± 1.09^{a}	16.6 ± 1.05^{ab}
Total B.W. gain (kg)	5.1 ± 0.61^{b}	5.8 ± 0.61^{b}	6.80 ± 0.64^{a}	5.3 ± 0.61^{b}
Av. Daily gain (g)	182 ± 12^{b}	207 ± 15^{ab}	243 ± 13^{a}	189 ± 11^{b}
Feed efficiency and feed cost (pt.)/kg gain				
Kg DMI/kg gain	2.9 ± 0.23^{a}	2.2 ± 0.23^{b}	2.1 ± 0.23^{b}	2.6 ± 0.23^{ab}
Feed cost (L.E) kg gain	4.3 ± 15^{a}	3.3 ± 13^{b}	3.1 ± 16^{b}	$3.9 \pm 17^{a\,b}$

a and b different letters indicate significant difference ($P \leq 0.05$).
(1) Current price of 1kg starter = 1.5 L.E
(2) Av. Initial B.W = 9 weeks old.
(3) final B.W = 12 weeks old.

Results of growth performance were in general in reverse directions with both of the digestibility coefficient results (Table V) and growth performance data during the rearing period (Table IV). Feed efficiency results (Table IV) showed higher efficient values for both (BS) and (WS) rations in comparison with both of (PnH) and nil roughage rations (R4 & R1) respectively. As a result to feed efficiency data, the more efficient group of lamb's *i.e* R2 and R3 showed lower *($p < 0.05$)* feed costs/ kg gain. *i.e* 3.3 L.E and 3.1 L.E/ kg gain *vs* 3.9 and 4.3 L.E/ kg gain for R4 and R1 respectively.

In the light of the present results, it could be concluded, that roughage source might be considered in formulating rations of newborn lambs, besides the source of the fibrous feedstuffs, which might be of good digestibility and palatability to obtain more efficient gains and more economic production values

Effect of dietary roughage sources on digestion coefficients and nutritive values of the experimental rations:

Data presented in (Table V) showed higher *(p < 0.05)* DMI for both R1 and R2, compared with R3 and R4. This result might suggest that roughage source, being an effective factor on voluntary DMI, particularly NDF contents of the fibrous feedstuffs. According to El-Ayek *et al*, (2001) and Boraei (2003) roughage source was the more pronounced factor affecting intake for both sheep and buffalo claves, while Waldo and Jorgensen (1981) and West *et al*, (1998) pointed out to a positive correlation between DMI and digestibility of the ration.

Results of (Table V) pointed out to higher digestibility coefficients in different terms in favor of R1 (starter without roughages). This matter might suggest that the inclusion of dietary roughage sources led to lower *(P < 0.05)* digestibility of the tested roughage rations.

This finding was not in contrast with the statement of stock (1987) and (1990) or Jung and Allen (1995), since their statement was concerned, may be with ruminants, but older ages rather than the new born lambs. It was also noticeable significant differences within the tested roughage rations, which might suggest the importance of type of roughage included on ruminants intake and digestibility; as previously reported by El–Ayek *et al,* (2001) and Boraei (2003). However, digestibility coefficient values showed higher superiority for R1, followed by R3 (Ws), R2 (BS) and later was the (pn H) ration (R4), respectively.

Table (V): Effect of dietary roughage source on digestion coefficients and nutritive values of experimental rations at 12 weeks of age.

Items	Treatments			
	R1 (St)	**R2 (Bs)**	**R3 (Ws)**	**R4 (PnH)**
DM intake g/h/d	750^{a} ±25	787^{a} ±30	661^{b} ±22	645^{b} ±18
Digestibility coeff %				
DM	88.5^{a}±1.9	78.0^{b} ±1.7	86.0^{a} ±2.0	77.2^{b} ±1.4
OM	89.7^{a}±2.1	79.7^{b} ±1.3	87.2^{a} ±1.8	79.3^{b} ±1.6
CP	85.5^{a}±1.8	75.9^{b}±1.8	85.0^{a}±1.9	73.5^{b}±1.7
CF	95.6^{a}±1.7	91.0^{b} ±2.2	94.0^{a} ±2.7	85.1^{b} ±2.1
EE	88.2^{a}±1.9	64.1^{d}±1.2	76.2^{b}±2.6	67.6^{c}±1.5
NFE	90.5^{a}±2.5	80.5^{c}±1.4	87.1^{b}±2.2	81.2^{c}±2.4
Nutritive values %				
TDN	90.0^{a}±2.6	77.8^{c}±1.9	83.3^{b}±2.3	75.7^{d}±2.2
DCP	15.9^{a}±0.8	14.2^{b} ±0.9	15.6^{a} ±1.1	13.6^{b} ±1.0
Utilization of dietary N (g/h/d)				
NI	22.3^{a} ±1.8	23.5^{a} ±1.0	19.4^{b}±1.9	19.1^{b} ±2.1
FN	3.2^{b}±0.5	5.7^{a}±0.7	2.9^{b} ±0.4	5.1^{a} ±0.8
UN	13.3^{a} ±0.5	11.2^{b}±0.5	8.7^{c}±0.6	8.0^{c} ±0.9
NB	5.8$±^{c}$0.1	6.6^{b}±0.2	7.8^{a}±0.2	6.0^{bc}±0.1

a, b , and c different letters indicate significant difference (P ≤ 0.05)

Results also, pointed out also to significant differences *(P < 0.05)* among different experimental rations in their nutritive values in a matter coincide parallel with rations digestibility values. The higher nutritive values were detected for R1 (90.0% TDN and 15.9 % DCP) followed by R3 (WS) then R2 (Bs) and later was the (PnH) ration (R4).

This might suggest that (Pn H) roughage source was not a suitable roughage source to be incorporated in ruminant rations, particularly creep feeding rations. Similar results were reported by Hill (2000) and Boraei (2003) concerning the lower digestibility and nutritive value of (PnH) roughage source as a more lignified feedstuff and higher tannin contents.

Utilization of dietary N (Table V) showed higher *(p < 0.05)* NI for both R1 and R2, which might be referred to its higher DMI. In contrast, lower *(P < 0.05)* NI was detected for both (WS) and (PnH) in the same order. Different significant *(P < 0.05)* urinary and faecal excreted N values were detected in different feed groups, which led in turn to significant differences among the tested rations in DN and nitrogen retention (g / h / day). Lambs in R3 retained more N (*P< 0.05)* with significant differences among the other tested groups, while R1 recorded lowest NB without significant difference with T4.

Peanut hull ration recorded the lowest *(P < 0.05)* DN and retained, the matter which confirmed the previous lower *(P < 0.05)* digestibility and nutritive values data concerned with (PnH) roughage source as a non suitable feedstuff to be incorporated in rations of newborn lambs.

In the light of the present results, it could be concluded that the appropriate creep feeding ration must be formulated on grain-fed basis and that roughages is not of great necessity at such age. In addition, roughage source, digestibility, palatably if there is a necessity and its level must be taken in consideration in formulating the creep feeding rations to maintain higher growth performance at such age.

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تأثير إستخدام مصادر مختلفة من الألياف فى البادئ على آداء الحملان المفطومة مبكرا

جمال أبو ورد- محمد عبداللطيف طويلة – سوسن محمد جاد – عبد المجيد أحمد عبيدو و سعاد إبراهيم النجار
المركز القومى لبحوث – شارع البحوث – الدقى – القاهره.

أجريت هذه التجربة على ٤٠ حولى أوسيمى بمتوسط وزن ٣,٨٥ ± ٠,٢٥ كجم و عمر ٧ أيام تم تقسيمها عشوائيا إلى أربع مجاميع غذائية (١٠ حولى / مجموعة) و لقد تم فطامها عند عمر ٨ أسابيع. تم تدعيم كل المجاميع بعليقة بادئ بداية من الأسبوع الثانى حتى الفطام و ذلك بجانب لبن الأمهات و لقد إستمرت الحيوانات بعد الفطام على عليقة البادئ حتى الأسبوع الثانى عشر. و كانت العليقة الأولى (المقارنة) بدون أى مصدر للألياف بينما العليقة الثانية و الثالثة و الرابعة تحتوى على ٥ % تبن فول وتبن القمح و قشر الفول السودانى على التوالى. و كانت العلائق الأربعة متساوية فى محتواها من الطاقة و البروتين.

و لقد دلت النتائج على تساوى المأكول من المادة الجافة للعلائق المختلفة سواء من اللبن أو البادئ فى الأسابيع الثمانية الأولى من عمر الحوالى. كما أظهرت النتائج تفوق حملان العليقة الثالثة و الرابعة معنويا فى الوزن النهائى و معدل الزيادة اليومية بعد مرور ٨ أسابيع مقارنة بالمعاملة الثانية بينما لم تكن هناك إختلافات معنوية مع عليقة المقارنة.

أما فى المرحلة العمرية من ٩-١٢ أسبوع سجلت العليقة الأولى أعلى مأكول دون إختلافات معنوية مع العليقة الثالثة و الرابعة بينما سجلت العليقة الثانية أقل مأكول. و لقد حققت الحوالى فى المعاملة الثالثة أعلى معدل نمو و كذلك أعلى قيم غذائية مقارنة بباقى المعاملات. أما بالنسبة لمعملات الهضم فقد سجلت مجموعة المقارنة أعلى قيم هضمية يليها المعاملة الثالثة ثم الثانية بينما أظهرت المعاملة الرابعة أقل معاملات هضم.

مما سبق يتضح من هذة الدراسة أن قشر الفول السودانى ليس مصدر الألياف المناسب فى علائق البادئ و الحملان الرضيعة.