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EFFECTS OF WEANING AGE AND SOME OTHER FACTORS ON GROWTH PERFORMANCE OF OSSIMI LAMBS

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ABSTRACT

This study was conducted to evaluate the effects of weaning age (early, traditional and late weaning), parity number (first, second and third or more), birth type (single and twins) and sex of lamb (male and female) on growth performance of Ossimi lambs during post-weaning period. One hundred and five Ossimi lambs distributed into 3 groups based on their weaning age. Lambs of early weaning group weaned at 56 days age, while, the second and third groups of lambs were remained with their mothers until 84 days (for traditional) and 112 days (for late weaning). The study performed at the experimental farm belongs to Faculty of Agriculture at Moshtohor, Benha University, Egypt, and lasted 240 days. Monthly live body weight (LBW) was recorded individually, while average daily gain (ADG) and total weight gain (TWG) were calculated as growth indices. Both total and daily feed intake (TFI and DFI) of dry matter were determined, then feed conversion ratio (FCR) and economical feed efficiency (EFE) were calculated. Regarding the effect of weaning age, results indicated that early weaned lambs showed a significant ($P<0.05$) heavier LBW, while traditional and late weaned lambs had the lowest LBW from post-weaning until yearling weight. TWG and ADG of the early weaned lambs were greater than those weaned at the traditional and late ages ($P<0.001$). Obtained results indicated that parity number had a significant ($P<0.05$) effect on LBW, while it did not affected TWG and ADG of lambs. Concerning the effects of birth type and sex of lamb, results indicated that single born ram-lambs had heavier LBW and higher ADG than twin born ewe-lambs. TFI, DFI, FCR and EFE in early weaned lambs were greater ($P<0.001$) than those weaned at the other ages. In conclusion, early weaning at 56 days of age, compared with weaning at 84 and 112 days, had positive effects on LBW, TWG and ADG of lambs. Thus, Ossimi sheep producers should wean their lambs at 56 days of age to earn heavier LBW and higher TWG and ADG.

Key words: Ossimi lambs, weaning age, growth performance.

INTRODUCTION

Early-weaning of lambs has become a key process for improving efficiency and profitability of intensive sheep production system. Weaning age is crucial for the success of early-weaning of lambs **(Chai *et al.*, 2015**). Early weaning is also very useful to avoid starvation and lamb mortality from birth to weaning, in case of mothers have low milk production. Moreover, early weaning helps when sheep milk used for cheese industry. Regarding the option of meat production, early weaning allows ewes to return rapidly to estrous, which lead to a short breeding season, that essential for accelerated lambing programs (**Abdel-Fattah *et al.*, 2013**). In the breeds started reducing milk production after sixteen days of lactation, lambs are forced to compete dams for available forage. In addition, the poor milk production means that lamb has to consume other feedstuffs within a few weeks after birth. It can also provide a solution to the problems of raising orphan lambs in the flock. Early weaning allow ewes to have better body condition, therefore the ewe would be able to conceive earlier. However, health and normal growth of lambs must not be compromised (**Abbas *et al.*, 2010**). Factors like parity, birth type and sex of lamb influence the

growth, which is highly essential for distinguishing the characteristic of any sheep flock (**Ramakrishanappa *et al.*, 2015)**. Ossimi ewes of those breeds have low milk production, which is not sufficient for suckling lambs. Therefore, Ossimi lambs are oriented to consume available forge and feed starter at early ages. The objective of this study was to investigate the effects of weaning age, parity number, birth type and sex of lamb on post-weaning growth performance of Ossimi lambs.

MATERIALS AND METHODS

This study was carried out on 105 Ossimi lambs belonging to the Experimental Sheep Farm, Faculty of Agriculture at Moshtohor, Benha University, Egypt during February 2014 to September 2014.

Management of experimental lambs:

Lambs were allowed to feed Egyptian clover (*Trifolium alexandriunm*) during winter and spring months. In summer months, lambs were allowed to feed clover hay, available green grasses which could substitute with green corn plants (Darawa) and wheat straw. Pelleted concentrate mixture (cotton seed cakes 35%, wheat bran 33%, yellow corn 22%, rice bran 4%, molasses 3%, calcium carbonate 2% and sodium chloride 1%) was offered to all lambs. The amount of concentrate mixture started with 0.5 kg per head per day, and gradually reached one kg per head per day, according to **NRC (2007)** allowances. The nutritive values of the pelleted concentrate mixture were determined and approved by the Animal Production Research Institute **(APRI)** at Dokki, Cairo, Agriculture Research Center, Ministry of Agriculture and Land Reclamation, Egypt. These nutritive values were: 78.20% total digestible nutrients (TDN), 21.53% crude protein (CP), 17.81% crude fiber (CF), 3.48% fat (ether extract, EE) and 2872.5 kcal metabolizable energy (ME). Mineral salts blocks and clean water were available to lambs all time. Lambs were subjected to the routine vaccination program against infectious diseases and also were injected or drenched against internal parasites. Lambs were also sprayed by the necessary pesticides when needed.

Treatments of the experiment

For each ewe the parity number (i.e. first, second and third or more), birth type (single and twin) and sex of lamb (male and female) were recorded. After lambing, lambs were left with their dams for suckling and weaned at three different ages: (1) early (56 days), (2) traditional (84 days) and (3) late (112 days). The number of lambs was 35, 32 and 38 in the three groups, respectively.

Post-weaning growth performance of lambs

All lambs were monthly weighed individually using the Salter scale (50 kg capacity with 200 grams precision) in the morning before feeding and drinking from four months up to yearling age. For each lamb, the total weight gain (TWG) and the average daily gain (ADG) were calculated between 4 to 12 months of age. Diet was weighed and offered twice daily to lambs at 8:00 am and 4:00 pm with abundance for 15% refusal to different weaning groups. Both of the consumed diets and refusals, if any, were recorded daily. Clean and fresh water with salt blocks were offered *ad libitum*. Total and daily dry matter feed intake (TFI and DFI), feed conversion ratio (FCR) and economical feed efficiency (EFE) were calculated.

FCR was recorded by this equation = TFI (kg) / TWG (kg).

EFE* was recorded by this equation = benefit of TWG (LE) /cost of TFI (LE).

*Based on price of the ingredients in the market during the experimental period. The prices were: TFI 3 LE/kg and TWG 45 LE /kg.

Statistical analysis:

Statistical analysis was carried out by using the least squares procedure for analyzing

data with unequal subclass number as described by **SAS (2004).** The statistical model used is:

$$Y_{ijklm}=\mu+W_i+P_j+T_k+S_l+(WP)_{ij}+(WT)_{ik}+(WS)_{il}+(PT)_{jk}+(PS)_{jl}+(TS)_{kl}+(WPT)_{ijk}+(WPS)_{ijl}+(PTS)_{jkl}+e_{ijklm}$$

Where: Y_{ijklm}= the observation of m lamb post-weaning growth performance; μ= the overall mean of all observations; W_i= the fixed effect of i^{th} weaning age, (i= 1, 2, 3, where 1=early, 2= traditional and 3= late weaning age); P_j= the fixed effect of j^{th} ewe parity number, (j= 1, 2, 3, where 1= 1^{st}, 2= 2^{nd} and 3= 3^{rd} or more parity number); T_k= the fixed effect of k^{th} birth type, (k= 1, 2, where 1= single and 2= twin); S_l= the fixed effect of l^{th} sex of lamb, (l= 1, 2, where 1= male and 2= female); $(WP)_{ij}$ = the fixed effect of the interaction between weaning age and parity number; $(WT)_{ik}$ = the fixed effect of the interaction between weaning age and birth type; $(WS)_{il}$ = the fixed effect of the interaction between weaning age and sex of lamb; $(PT)_{jk}$ = the fixed effect of the interaction between parity number and birth type; $(PS)_{jl}$ = the fixed effect of the interaction between parity number and sex of lamb; $(TS)_{kl}$ = the fixed effect of the interaction between birth type and sex of lamb; $(WPT)_{ijk}$ = the fixed effect of the interaction among weaning age, parity number and birth type; $(WPS)_{ijl}$ = the fixed effect of the interaction among weaning age, parity number and sex of lamb; $(PTS)_{jkl}$ = the fixed effect of the interaction among parity number, birth type and sex of lamb; e_{ijklm}= random error associated with the individual observation and assumed to be (N,IND) and (0, σ^2_e). Tests of significance for differences between means were carried out according to **Duncan (1955).**

RESULTS AND DISCUSSION

Lambs body weight:

As presented in Table1, weaning age significantly (P<0.05) affected body weight of lambs from 6 months up to yearling age, while at age four and five months minor changes noticed in lambs weights. Lambs weaned at the early age had the heaviest body weight compared with those weaned at the traditional and late ages. The superiority of early weaned lambs in post-weaning body weight could be due to faster rumen development which reflected on better rumen capacity and increasing solid feed consumption compared with traditional weaned lambs **(Abbas *et al.*, 2010).** Thus, early weaned lambs showed a faster recoverability to grow. It was speculated that the earlier weaning of lambs accompanied with a smaller psychological stress due to the separation from dams **(Simitzis *et al.*, 2012)** and an ability to consume more creep feed **(Alvarez-Rodríguez *et al.*, 2010).** These findings are in agreement with **Boas *et al.* (2003)** who reported that Hampshire down lambs weaned at 34 days of age showed higher weight gain than those weaned at 68 days of age (P<0.05). **Villarroel *et al.* (2008)** used Morada lambs weaned at 60, 75 and 90 days of age; found that weaning age had a significant (P<0.05) effect on lambs' weight. **Abbas *et al.* (2010)** found that weaning Rahmani and Chios lambs at 8, 12 and 16 weeks of age affected significantly (P<0.01) body weights of lambs at 3 and 4 months, while no significant changes noticed after four months of age. Results obtained by **Abdel-Fattah *et al.* (2013)** indicated significant (P<0.05) effect of weaning age on Barki lambs growth**,** and that early weaned lambs (60 days) had heavier body weight gain at 8 months of age than those late weaned (120 days).

During the period from post-weaning until yearling age, parity number had a significant (P<0.05) effect on live body weight of lambs. The present results are in agreement with **Thiruvenkadan *et al.* (2009)** who mentioned that parity had a significant (P<0.05) effect on six, nine and 12 months live body weights of Mecheri lambs, as well as they indicated that body weight at different ages increased with the increase in parity. These results may attributed to the strong influence of mothering ability of the dams on offspring before weaning, as they greatly depend on their dams milk yield **(Abbas *et al.*, 2010)**.

Parity increases mothering ability and milk production, therefore kids born from first parity goats have lower weight than those born from later parities **(Deribe and Taye, 2013)**.

From post-weaning until yearling weight, birth type (single and twins) significantly (P<0.01 and P<0.001) affected body weights of lambs. Single lambs had heavier post-weaning weights than twin lambs. Single born lambs maintained their weight superiority up to weaning and beyond. The current results agree with **Yilmaz *et al.* (2007)** who found that single born lambs were heavier (P<0.01) than twins born lambs at 6 months of age by 2.3 kg in Norduz sheep. **Abbas *et al.* (2010)** reported that single lambs of Rahmani and Chios sheep were significantly (P<0.01) heavier than twins at 6, 9 and 12 months of age by 1.28, 1.30 and 1.37 kg, respectively. **Deribe and Taye (2013)** found that single born kids were heavier (P<0.001) than twin kids post-weaning at six months and yearling weight and they noticed that single kids had an advantage over twins because twins had to compete for milk of their dam.

Sex of lambs significantly (P<0.05) affected live body weights of lambs from 7 to 12 months of their age while minor differences noticed at four, fifth and sixth months of age (Table1). Male lambs were heavier than females; difference due to sex could explain by the influence of sexual hormones on animal development that affects body dimensions and fat deposits, as well as, muscle and bone tissues. These results are similar to those obtained by **Yilmaz *et al.* (2007)** who found that ram-lambs were heavier (P<0.01) than ewe-lambs at 6 months of age by 2.3 kg in Norduz sheep. **Villarroel *et al.* (2008)** concluded that ram-lambs of Morada sheep had significantly (P<0.05) heavier body weights than ewe-lambs (20.7 kg versus 17.6 kg) at 6 months of age. **Thiruvenkadan *et al.* (2009)** reported that sex of lamb had a significant (P<0.01) effect on body weight, while male lambs were heavier than females at all ages and that difference in body weight between males and females increased from 0.14 kg at birth to 2.64 kg at 12 months of age. **Abbas *et al.* (2010)** found that ram-lambs of Rahmani and Chios sheep breeds were significantly (P<0.01) heavier than the ewe-lambs from 6 months up to yearling weight. **Abdel-Fattah *et al.* (2013)** reported that sex had a significant (P<0.01) effect on Barki lambs live body weight at 8 months of age either for early weaned (60 days) or late weaned (120 days) lambs.

Lambs total and daily gains:

Weaning age, birth type and sex of lamb significantly (P<0.001) affect TWG and ADG of lambs between 4 and 12 months of age as shown in Table 2. The TWG and ADG of early weaned lambs were higher (23.17 kg and 96.54 grams) than those weaned at the traditional age (21.28 kg and 88.69 grams) and late age (21.66 kg and 90.29 grams). Growth response of early-weaned lambs (males and females) compared with late-weaned lambs indicated their efficient utilization of feed nutrients for body tissue accretion. Results of **Schichowski *et al*. (2007)** showed that Merino landschaf lambs weaned at 8 weeks had greater (P = 0.004) ADG compared with lambs weaned at 16 weeks of age. **Abbas *et al.* (2010)** noted that ADG of early weaned Rahmani and Chios lambs was significantly (P<0.01) higher than late weaned lambs. **Chai *et al.* (2015)** compared among four weaning groups (ewe reared, weaned at 10, 20 and 30 days of age) and found that the ADG of lambs was significantly (P<0.01) increased with increasing of age. **Ekiz *et al.* (2016)** reported that ADG of Kivircik lambs weaned at 45, 75 and 120 days were significantly (P<0.05) different.

Parity number had no significant effect on TWG and ADG of lambs. **Alvarez-Rodríguez *et al.* (2010)** noted that dam parity number did not affect post-weaning ADG of lambs. **Deribe and Taye (2013)** found that post-weaning ADG did not effect by parity number of Abergele goats.

Results of **Yilmaz *et al.* (2007)** showed that single born lambs recorded a higher (P<0.05) post-weaning ADG than twin born lambs by 16 grams/day. **Alvarez-Rodríguez *et al.* (2010)**

recorded that single born ram-lambs had a higher ADG than twin born ewe-lambs. **Abdel-Fattah *et al.* (2013)** found that early weaned male Barki lambs had significantly (P<0.05) higher TWG and ADG than late weaned female lambs from 4 to 8 months of age. All these findings are in agreement with the present findings (Table2).

Lambs dry matter intake (DMI), feed conversion ratio (FCR) and economical feed efficiency (EFE):

Lambs weaned at the early age had higher TFI, DFI and EFE, while lower FCR (better) compared with those weaned at the other ages (P<0.001). TFI and DFI significantly differed due to parity number (P<0.05) and birth type (P<0.01), while other changes due to effects of parity number, birth type and sex of lamb on TFI, DFI, FCR and EFE were not significant, as presented in Table 3. Further evidence could conclude from observation of **Bhatt *et al*. (2009)**, where early introduction of lambs to *ad libitum* creep feeding on mixture resulted in increased ciliate protozoa population in rumen, improved nutrient digestibility and caused better growth performance.

From these findings, it implies that the important component in successful lamb rearing program ought to the early transition from dependency on milk to solid nutrient, by early weaning of lambs, thus improved FCR and growth in terms of higher TWG. In accordance, **Abdel-Fattah *et al.* (2013)** found that DMI was higher for early weaned male lambs than late weaned female lambs, and FCR was better (lower) with early weaned male lambs than late weaned female lambs.

The interaction between weaning age and all other factors was not significant. This is the same for the interactions among other traits.

CONCLUSION

Early weaned lambs had better post-weaning growth performance compared with the traditional and late weaned lambs. Therefore, Ossimi lambs could weaned at age 56 days, without any negative results. Early weaning of lambs accomplish the best post-weaning growth while reduce prolonged and lactation stress on dams.

REFERENCES

Abbas, S. F.; M. Abdallah; F. M. Allam and A. A. Aboulella (2010). Growth performance of Rahmani and Chios lambs weaned at different ages. Australian Journal of Basic and Applied Sciences, 4 (7): 1583-1589.

Abdel-Fattah, M. S.; A. L. S. Hashem; Y. M. Shaker; Ashgan M. Ellamie and Hanan Z. Amer (2013). Effect of weaning age on productive performance and some plasma biochemical parameters of Barki lambs in Siwa oasis, Egypt. Global Veterinaria, 10 (2):189-202.

Alvarez-Rodríguez, J; A. Sanz; R. Ripoll-Bosch and M. Joy (2010). Do alfalfa grazing and lactation length affect the digestive tract fill of light lambs? Small Ruminant Research, 94:109-116.

Bhatt, R. S.; M. K. Tripathi; D. L. Verma and S. A. Karim (2009). Effect of different feeding regimes on pre-weaning growth rumen fermentation and its influence on post-weaning performance of lambs. Journal of Animal Physiology and Animal Nutrition, 93:568-576.

Boas, A. S. V.; M. D. B. Arrigoni; A. C. Silveira; C. Costa and L. A. L. Chardulo (2003). Effects of age at weaning and feed management on the production of super-young lambs. R. Bras. Zootec., 32 (6): 1969-1980.

Chai, J.; Q. Diao; H. Wang; Y. Tu; X. Tao and N. Zhang (2015). Effects of weaning age on growth, nutrient digestibility and metabolism, and serum parameters in Hu lambs. Animal Nutrition, 1(4): 344-348.

Deribe, B. and M. Taye (2013). Evaluation of growth performance of Abergele goats under traditional management system in Sekota district, Ethiopia. Pakistan Journal of Biological Sciences, 16(14):692-696.

Duncan, D.B. (1955). Multiple ranges and multiple F-test. Biometrics, 11: 1-42.

Ekiz, B.; O. Kocak; H. Yalcintan and A. Yilmaz (2016). Effects of suckling duration on growth, slaughtering and carcass quality characteristics of Kivircik lambs. Trop. Anim. Health Prod., 48: 395–401.

NRC (National Research Council) (2007). Nutrient requirements of small ruminant. National Academy Press, Washington, DC.

SAS (2004). SAS Procedure Guide" version 9 Ed". SAS Institute Inc., Cary, NS, USA.

Schichowski, C.; E. Moors and M. Gauly (2007). Effects of weaning lambs in two stages or by abrupt separation on their behavior and growth rate. Journal of Animal Science, 86: 220–225.

Simitzis, P.; M. Petrou; N. Demiris and S. Deligeorgis (2012). Effect of pre-weaning temporary isolation within different age periods on the early post-weaning behaviour of juvenile lambs. Appl. Anim. Behav. Sci., 141:43-48.

Ramakrishanappa, N.; R. M. Sreesujatha; S. N. Kumar; G. U. Manju and Y. S. R. Devi (2015). Growth perforamance of Mandya lambs under farm management. Indian vet. J., 92(10): 30-32.

Thiruvenkadan, A. K.; K. Karunanithi; M. Murugan; K. Arunachalam and R. N. Babu (2009). A comparative study on growth performance of crossbred and purebred Mecheri sheep raised under dry land farming conditions. South African Journal of Animal Sciences, 39(1):121-125.

Villarroel, A. B. S.; M. B. Maciel and N. M. Oliveira (2008). Effects of weaning age and weight on lamb growth rate of Morada Nova breed raised in a tropical extensive production system. Ciência Rural, 38(3): 784-78.

Yilmaz, O.; H. Denk and D. Bayram (2007). Effects of lambing season, sex and birth type on growth performance in Norduz lambs. Small Ruminant Research, 68:336-339.

الملخص العربى

تأثير عمر الفطام وبعض العوامل الأخرى على أداء النمو فى الحملان الاوسيمى

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تم دراسة تأثير عمر الفطام (مبكر- تقليدى- متأخر) وترتيب الولادة (الاولى- الثانية - الثالثة او اكثر) ونوع الولادة (فردية - توأمية) وجنس الحملان (ذكر– أنثى) على أداء النمو بعد الفطام لعدد 105 حمل أوسيمى. تم أجراء الفطام المبكر عند 56 يوم من العمر على المجموعة الأولى من الحملان بعدد 35 حمل بينما المجموعة الثانية والثالثة من الحملان ظلت مع أمهاتها حتى الفطام التقليدى والمتأخر عند 84 و112 يوم من العمر لعدد 38 و 32 حمل على الترتيب.

أظهرت الحملان المفطومة مبكرا (56 يوم من العمر) زيادة فى وزن الجسم (عند مستوى معنوية 0.05) بالمقارنة بالحملان المفطومة عند العمر التقليدى والمتأخر (84 و 112 يوم) وذلك للوزنات من عمر 7 أشهر وحتى عمر سنه. الزيادة الكلية فى وزن الجسم ومعدل النمو اليومى للحملان المفطومة مبكرا كانت أفضل بالمقارنة بالحملان المفطومة بالعمر التقليدى أوالمتأخر (عند مستوى معنوية 0.001) من وزن 4 أشهر وحتى وزن سنه. ترتيب الولادة للأم لم يكن له تأثير معنوى على وزن الجسم أو الزيادة الكلية أو معدل النمو اليومى فى وزن الجسم بينما كانت الحملان الذكور المولودة بصورة فردية أو توأمية أثقل فى الوزن وأعلى فى معدل النمو اليومى عن الحملان الاناث المولودة بصورة فردية أو توأمية. أعطت الحملان المفطومة مبكرا نتائج أفضل فى كمية المأكول الكلى واليومى ومعامل التحويل الغذائى وكذلك الكفاءة الأقتصادية للغذاء عن أعمار الفطام الأخرى.

الفطام المبكر بعمر 56 يوم كان له تأثير أيجابى على وزن الجسم والزيادة الكلية ومعدل النمو اليومى فى وزن الجسم بالمقارنة بباقى الأعمار ولذلك نوصى منتجى الأغنام الأوسيمى ان تقوم بفطام حملانها عند عمر 56 يوم من العمر للحصول على وزن أثقل وأعلى معدل نمو يومى.

Table1. Least-squares means (±SE) of post-weaning live body weight (kg) of Ossimi lambs.

Items	N	Age (month)								
		Four	Five	Six	Seven	Eight	Nine	Ten	Eleven	Twelve
Weaning age:										
Early	35	19.55±0.29	22.46±0.29	25.38^{a}±0.29	28.30^{a}±0.29	31.16^{a}±0.29	34.03^{d}±0.29	36.99^{g}±0.29	39.86^{g}±0.29	42.72^{g}±0.29
Traditional	38	18.92±0.23	21.55±0.23	24.19^{b}±0.23	26.82^{b}±0.23	29.51^{b}±0.23	32.20^{e}±0.23	34.83^{i}±0.23	38.34^{h}±0.23	40.20^{i}±0.23
Late	32	19.38±0.24	22.05±0.24	24.71^{b}±0.24	27.33^{ab}±0.24	30.08^{ab}±0.24	32.85^{de}±0.24	35.62^{h}±0.24	37.52^{i}±0.24	41.05^{h}±0.24
Parity number:										
First	21	18.23^{b}±0.30	21.97^{b}±0.30	24.70^{b}±0.30	26.42^{b}±0.30	29.17^{b}±0.30	32.94^{b}±0.30	35.71^{b}±0.30	37.46^{a}±0.30	40.21^{b}±0.30
Second	41	18.87^{b}±0.21	21.54^{b}±0.21	24.22^{b}±0.21	26.87^{b}±0.21	29.59^{b}±0.21	32.31^{b}±0.21	35.04^{b}±0.21	37.74^{b}±0.21	40.44^{b}±0.21
Third & more	43	19.80^{a}±0.25	22.50^{a}±0.25	25.20^{a}±0.25	27.89^{a}±0.25	30.62^{a}±0.25	33.36^{a}±0.25	36.11^{a}±0.25	38.83^{a}±0.25	41.54^{a}±0.25
Birth type:										
Single	65	19.57^{d}±0.17	22.31^{g}±0.17	25.06^{g}±0.17	27.79^{g}±0.17	30.55^{g}±0.17	33.32^{g}±0.17	36.11^{g}±0.17	38.87^{g}±0.17	41.62^{g}±0.17
Twin	40	18.65^{e}±0.27	21.26^{h}±0.27	23.86^{h}±0.27	26.45^{h}±0.27	29.12^{h}±0.26	31.80^{h}±0.26	34.46^{h}±0.26	37.11^{h}±0.26	39.75^{h}±0.26
Sex of lamb:										
Male	51	19.46±0.20	22.20±0.20	24.93±0.20	27.65^{a}±0.20	30.41^{a}±0.20	33.17^{a}±0.20	35.95^{d}±0.20	38.70^{d}±0.20	41.44^{g}±0.20
Female	54	19.05±0.22	21.71±0.22	24.38±0.22	27.02^{b}±0.22	29.72^{b}±0.22	32.44^{b}±0.21	35.15^{e}±0.21	37.85^{e}±0.21	40.53^{h}±0.21

^{a,b,c} are superscripts within a column for means significantly differed at P≤0.05, while ^{d,e,f} are superscripts within a column for means significantly differed at P<0.01 and ^{g,h,i} are superscripts within a column for means significantly differed at P<0.001. Otherwise, they are not differed significantly.

Table2. Least-squares means (±SE) for post-weaning total weight gain and average daily gain of Ossimi lambs.

Items	N	Total weight gain (kg)	Average daily gain (grams/day)					
			ADG1	ADG2	ADG3	ADG4	ADG5	ADG6
Weaning age:								
Early	35	23.17^{g}±0.48	97.16^{g}±6.2	95.50^{g}±9.4	95.51^{g}±8.2	96.75^{g}±8.5	96.33^{g}±7.0	96.54^{g}±7.1
Traditional	38	21.28^{i}±0.66	87.86^{i}±5.1	89.53^{i}±7.9	89.53^{i}±6.0	88.28^{i}±6.4	89.11^{i}±5.1	88.69^{i}±5.5
Late	32	21.66^{h}±0.49	88.98^{h}±5.7	91.92^{h}±8.6	90.43^{h}±6.9	89.20^{h}±6.9	91.37^{h}±5.6	90.29^{h}±5.8
Parity number:								
First	21	21.98±0.55	91.17±5.4	91.86±8.5	91.66±6.2	91.20±8.2	91.98±7.2	91.89±7.9
Second	41	21.57±0.45	89.19±4.1	90.60±7.9	89.97±5.9	89.33±5.1	90.41±5.8	89.87±5.4
Third or more	43	21.73±0.47	89.99±5.8	91.19±8.2	90.59±6.0	90.13±6.9	91.01±6.0	90.57±6.8
Birth type:								
Single	65	22.05^{g}±0.31	91.51^{g}±3.7	92.10^{g}±5.3	91.89^{g}±4.4	91.50^{g}±4.4	92.27^{g}±4.2	91.89^{g}±4.1
Twin	40	21.10^{h}±0.47	86.95^{h}±6.3	89.20^{h}±8.2	88.11^{h}±7.1	87.30^{h}±7.9	88.56^{h}±6.3	87.93^{h}±6.0
Sex of lamb:								
Male	51	21.97^{g}±0.35	91.11^{g}±4.1	91.97^{g}±6.1	91.56^{g}±5.4	91.17^{g}±5.7	91.98^{g}±4.4	91.57^{g}±4.5
Female	54	21.48^{h}±0.44	88.82^{h}±5.6	90.27^{h}±7.3	89.65^{h}±6.9	88.98^{h}±5.9	90.04^{h}±5.1	89.51^{h}±5.3

^{a,b,c} are superscripts within a column for means significantly differed at P≤0.05, while ^{d,e,f} are superscripts within a column for means significantly differed at P<0.01 and ^{g,h,i} are superscripts within a column for means significantly differed at P<0.001. Otherwise, they are not differed significantly.

Total weight gain (kg) = (yearling weight – 4 months weight); ADG1 = (6 months weight – 4 months weight/60) ×1000;

ADG2 = (9 months weight – 7 months weight/60) ×1000; ADG3= (yearling weight –10 months weight/60) ×1000;

ADG4= (8 months weight – 4 months weight/120) ×1000; ADG5= (yearling weight – 8 months weight/120) ×1000;

ADG6 = (yearling weight – 4 months weight/240) ×1000.

Table3. Least-squares means (±SE) for post-weaning dry matter intake, feed conversion ratio and economical feed efficiency of Ossimi lambs.

Item		Total DMI (kg/lamb)	Daily DMI (grams / lamb/ day)	Feed conversion ratio	Economical feed efficiency
Weaning age:					
Early	35	191.05^{g}±0.41	796^{g}±19	8.24^{i}±0.15	1.81^{g}±0.06
Traditional	38	183.77^{h}±0.45	765^{h}±13	8.63^{g}±0.10	1.73^{i}±0.04
Late	32	181.75^{i}±0.56	757^{i}±20	8.39^{h}±0.12	1.78^{h}±0.05
Parity number:					
First	21	184.00^{c}±0.43	766^{c}±22	8.37±0.17	1.79±0.05
Second	41	186.11^{b}±0.45	775^{b}±13	8.62±0.12	1.73±0.03
Third or more	43	188.61^{a}±0.64	785^{a}±15	8.67±0.15	1.72±0.04
Birth type:					
Single	65	188.53^{d}±0.71	785^{d}±11	8.55±0.10	1.75±0.07
Twin	40	183.37^{e}±0.49	764^{e}±14	8.69±0.14	1.72±0.05
Sex of lamb:					
Male	51	187.77±0.52	782±19	8.66±0.11	1.75±0.05
Female	54	183.16±0.82	763±13	8.52±0.12	1.73±0.08

^{a,b,c} are superscripts within a column for means significantly differed at P≤0.05, while ^{d,e,f} are superscripts within a column for means significantly differed at P<0.01 and ^{g,h,i} are superscripts within a column for means significantly differed at P<0.001. Otherwise, they are not differed significantly.