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EFFECT OF UNRESTRICTED ENERGY ALLOWANCE DURING LATE GESTATION ON TWIN-BEARING EWES' PERFORMANCE, LAMBS VIABILITY AND THEIR GROWTH

By

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ABSTRACT

The present study was conducted to evaluate the effects of feeding rations with either restricted energy (E1) up to 100% or unrestricted energy (E2) up to 120% on Rahmani ewes' performance and their offspring lambs viability, behavior and growth. Twenty twin-bearing ewes were allocated to E1 and E2 dietary treatments (n=10 in each). Both E1 (included concentrate feed mixture (CFM) and roughage as berseem hay (BH) and rice straw (RS) and E2 received the same ration with the addition of daily 1% of PF Megalac® from dry matter intake / head). Both E1 and E2 groups were fed from day100 age of gestation up to weaning of lambs. All ewes in E1 and E2 treatments received adequate level of protein form day 100 up to weaning. As expected, increasing energy source has improved ($P < 0.05$) the ewe body weight (BW) and body condition score (BCS) prepartum. The E1 ewes lost more BCS in lactation compared with the E2 ewes. There was higher ($P<0.05$) effect of E2 nutrition on behavioral scores of the lambs as birth assistance, lamb vigour and suckling assistance and lamb birth weight than E1 ewes. Moreover, there was a considerable reduction of number of E1 lambs from birth to weaning, due to stillbirths, deaths, and life-support during this period. Early live weight gain and weaning weights of lambs increased nominally with increasing prepartum energy allowance of their respective ewes. However, only lambs in complete twin litters had significant increase in live weight gain until weaning ($P < 0.05$). The quantities of NEFA concentration in blood of E1 were higher ($P<0.05$) than E2 ewes. It could be concluded that it is possible for twin-bearing ewes to meet the increased nutritional demand via intake, and even gain BCS, in late gestation when feeding energy intake is high. The highest energy intake in ewes during late gestation increased energy mobilization during lactation that seemed to benefit lambs in twin litters with a growth advance until weaning.

Also, unrestricted energy ration can improve the income of farmers at time of sailing lambs after weaning with better growth rate.

Keywords:

***Ewes bearing twins, energy, nutrition and embryo losing*.**

INTRODUCTION

The effects of inadequate or excessive energy can have effects at multiple stages of the reproductive process. **Wiltbank *et al.* (2014)** confirmed that 1st stage during the early post-partum period have been postulated to alter the oocyte and subsequent embryo development after fertilization of the perturbed oocyte, the 2nd stage caused the changes in circulating factors such as insulin, glucose, urea and or amino acids during the final stages of oocyte development, prior to ovulation can profoundly impact fertilization or embryo development and the 3rd stage obvious target of nutrition on the embryo, is during the first week of embryo development when changes in oviduct and uterine environment could alter development of the embryo to the blastocyst stage. Finally, changes in circulating energy sources, such as glucose and propionate and building blocks for cells, such as amino acids, could alter the uterine lumen and subsequently alter embryo elongation **(Bender *et al.*, 2014)**.

Approximately 70% of the final birth weight of the fetus occurs in the trimester period **(Cal-Pereyra *et al.*, 2015)**. The plane of nutrition in late gestation may influence lamb birth weight, colostrum production, milk production and a potential subsequent effect on weaning rate and weight **(Campion *et al.*, 2016)**. Moreover, **Schmitt *et al*. (2018)** reported that nutrition during the last third of gestation not only improves body weight (BW) and body condition score (BCS) of ewes, but also minimize BW and BCS loss immediately post-parturition. An increasing of energy of rations during late gestation caused 80% of the fetal growth as well as growth of the ewes **(Pesántez-Pacheco *et al*., 2019)**.

Recently, **Mahdy *et al.* (2021)** concluded that feeding twin-bearing ewe on high energy from trimester to weaning has compromised reproductive, body weight, body condition score, lambs behavior and the goodness lactation to offspring growth performance.

Our research focused on improving twin-bearing ewe nutrition during late pregnancy would improve the performance of lambs reared as twin. Therefore, the objective of the present experiment was to study the effect of two different levels of energy (restricted and unrestricted) allocations during late gestation on twin-bearing, ewes' performance and their lambs' viability.

MATERIAL AND METHODS

Regulations controlling experiments with ewes by El-Serw Research Station belonging to Animal Production Research Institute (APRI), Agriculture Research Center, Ministry of Agriculture, Egypt. The experiment was carried out with Rahmani ewes in breeding season September 2020.

Animals, experimental design and dietary treatments:

One hundred-fifty shearing ewes were scanned by ultrasonography on day 60 of gestation. Only ewes carrying two fetuses were retained in the study. Twenty ewes were in their third to fourth parity, with on average body weight (BW) of 51.32±0.37 kg and 2.56±0.14 BCS (on a scale of 1 to 5). Ewes were placed in individual pens during the experiment. Until day 100 of gestation, the ewes were fed on maintenance level on an individual weight basis. At day 100 of gestation, the twenty ewes were distributed into two groups, each of ten, that were balanced according to expected lambing date, BW, body condition score (BCS). Thereafter, the two groups were randomly allocated to dietary energy treatments based on **NRC (2007)** requirements for sheep. Then, the restricted energy (E1) and unrestricted energy (E2) treatments were up to 100 and 120% of predicted energy requirement, respectively.

Feeds and feeding:

From one month prior to mating (as flushing period) and until ultrasound measurements (about gestation day 60), all ewes were offered concentrate mixture (CFM) + roughage consisted of berseem hay (BH) + rice straw (RS). Thereafter, up to 100 days of gestation the ewes in E1 and E2 groups were offered the previous ration and restricted fed. From day 100 of gestation to weaning, E1 ewes received CFM+ BH+ RS. However, E2 ewes received the same ration plus 1.0 % of protected fat (PF) Megalac® from any matter intake/ head/ day. This was done to ensure that all ewes received adequate level of protein form day 100 up to weaning. Daily rations from either E1 or E2 were divided into two portions, one being fed in the morning at 8.0 am and the other offered in the afternoon at 3.0 pm. Also, ewes had free access to fresh water and salt blocks with mineral and trace elements. The ingredients of CFM were 26 % under corticated seed cotton meal, 40 % yellow corn, 27 % wheat bran, 3.5 %

molasses,2% limestone,1% common isalt and 0.5 % minerals imixture.

The chemical composition of CFM, BH and RS according to **AOAC (2007)** is shown in (Table 1). Chemical analysis of PF *Megalac®* is illustrated in (Table 2). However, the chemical analysis of experimental rations (E1 and E2) is presented in Table (3).

Table (1): Chemical composition of CFM, BH and RS*

Items	Chemical composition (% on dry matter basis)							
	DM	OM	CP	EE	CF	NFE	Ash	*GE
CFM	89.91	87.77	14.40	7.09	2.41	63.87	12.23	1.791
BH	88.65	88.43	14.12	2.15	23.29	48.87	11.57	1.719
RS	92.83	80.23	3.08	1.49	36.88	38.78	19.77	1.525

*** Calculation of GE (MJ/100g / DM) = 0.0226× CP+ 0.0407×EE+0.0192×CF+0.0177×NFE according to MAFF (1975).**

Table (2): Chemical composition of protected fat (PF) *Megalac®* *.

Items %				Fatty acids profile%					
DM	Oil	Calcium	Moisture	C12 and C14	C16	C18. 0	C18. 1	C18. 2	GE
97.00	84.00	9.00	5.00	1.2	48.0	5.0	36.0	9.5	3.218

C12 Lauric acid, C:14 Myristic acid, C16 Palm tic acid, C18 Stearic acids, C18.1 Oleic acid and C18.2 Linoleic acid.

***The PF (Megalac®) consists of palm fats produced by reacting palm fatty acid distillate with calcium hydroxide to form calcium soap, volac Co.).**

Source: Richard Webster Nutrition L. td: Protected Fat and Omega-3 Fish Oil Supplements.

Table (3): Chemical analysis of basal E1and experiment rationseE2.

Item	Consumption energy	
	E1	E2
Dry matter (DM)	88.95	88.48
Organic matter (OM)	85.68	95.75
Crude protein (CP)	11.45	11.55
Ether extract (EE)	2.18	8.58
Crude fiber (CF)	21.33	20.45
Nitrogen free extract (NFE)	5 0.72	54.90
Ash	14.32	4.25
*GE (MJ /g/DM)	1.65	1.98

***Gross energy was calculated as MJ/100g DM according to MAFF (1975).**

Ewe measurements:

On days 100, 115, 130 and 145 of gestation the body weight (BW) and body condition scour (BCS) were recorded. Later, ewes were weighed and assessed for BCS at lambing and on 15, 30, and 45 days postpartum and at weaning. Body weight was recorded using an electronic balance (BioControl, Rakkestad, Norway). Body condition score assessment was recorded by a scale of 1 to 5 according to Table (4).

Table (4): Body condition scoring.

Scales	Thin			Ideal weight			Overweight		
From 1 to 5 points	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

Suckling milk quality and quantity:

Suckling milk quality and quantity were evaluated in E1 and E2 groups three times at 15, 30, 45 and 60 days post-lambing. To evaluate suckling milk quality, the oxytocin protocol of **Khalifa *et al.* (2013)** was used. To determine suckling milk quantity, milk samples (20 ml /ewe/group) were collected at early , middle, late stages in 15, 30 and 60 days in the morning pre-feeding, respectively. Immediately, collected milk samples were analyzed for fat% and protein% using digital Lactoscans, Milk analyzer, Wide LCD 8900 Nova Zagora, Bulgaria.

Then, Suckling milk energy was calculated using the following equation Suckling milk energy (kcal/kg) =203.8+ (8.36×fat %) + (6.29×protein %) according to **Khalifa *et al.* (2013)**.

Lambing behavior and lamb measurements:

The time of birth was recorded for every lamb. The lambs were assessed for a birth assistance, a lamb vigor and suckling assistance after birth as presented in (Table 5) according by **Pedernera *et al.*, (2017)**., Ewes and lambs remained in their individual pens until weaning then, body weight (BW) and body weight gain (BWG) at birth, 15, 30, 45 and 60 days were recorded.

Table (5): Definitions of birth assistance score, lamb vigour score and suckling assistance score.

Score	Description
(a) Birth assistance score	
0	**Unassisted or easy uncomplicated delivery of short duration < 30 min.**
1	**Unassisted or easy uncomplicated delivery of long duration <30 min.**
2	**Minor assistance required. Presentation corrected, little effort needed to deliver lamb.**
3	**Major assistance required. Difficult delivery needing effort to deliver lamb.**
4	**Veterinary assistance required**.
(b) Lamb vigour score	
0	**Extremely active and vigorous lamb has been standing on all four feet.**
1	**Very active and vigorous lamb, standing, on back legs and on knees.**
2	**Active and vigorous lamb, on chest and holding head up.**
3	**Weak lamb, lying flat, able to hold head up.**
4	**Very weak lamb, unable to lift head, little movement.**
(c) Sucking assistance score	
0	**Lamb sucking well without assistance within 1 h.**
1	**Lamb sucking well without assistance within 2 h.**
2	**Lamb given sucking assistance, fed by stomach tube once or twice in during the first 24 h after birth.**
3	**Lamb given sucking assistance, fed using a stomach tube more than twice, requiring help after 1 day of age, but able to suck by 3 days of age.**
4	**Lamb still requiring help to suck for more than 3 days of age**

Ewe blood sampling:

Blood samples were collected before morning-feeding on day 130 and 145 gestations and 1, 15 and 30 days of suckling, using 7 ewes /group. Samples were taken in clean tubes to collect serum blood. After collection, the samples were kept at room temperature for 20 min, and then centrifuged at 3,500 x g for 20 min. The serum samples were stored in eppendrof tubes at -20 ˚C until analyzed. The concentration of non-esterified fatty acids (NEFA) as an indicator of the energy status in serum was determined using NEFA ELISA Kit (Changhay Crystal Day Biotech Co., LTD., China) and ELISA Reader Sunrise (Tecan, Switzerland).

The economics of selling lambs after weaning:

Economics of feeding and performances of lambs recast of feeding ewes during suckling period and return on investment of marked weaning lambs were calculated.

Statistical Analysis:

Data were subjected to ANOVA using Duncan Multiple Range Test. Data were analyzed using SPSS software (**SPSS Statistics version 26, 2020**). If there was a difference, it was followed with less significance difference test at 95% level of significance. Also, Correlation between feeding and some productive items were calculated using the Pearson's coefficients of SPSS programmes.

RESULTS

Daily feed intake from E1 and E2 treatments:

The effect of treatment on intake from day 100 gestation through parturition and from parturition to weaning is shown in (Table 6). Ewes in E1 and E2 treatments were consumed all their offered dry mater from gestation day 100 up to parturition. Have, during the suckling periods ewes in the two treatments (E1 and E2) consumed high gross energy up to 53.65 and 64.72 MJ/g/DM of the offered rations, respectively. This is explained that, the E1 and E2 ewes were consumed higher energy in suckling period than energy through gestation from 100 to parturition that may be related to due to milk production.

Table (6): Daily feed intake as DM from E1 and E2 energy during gestation day 100 to parturition and from parturition to weaning.

Item	Treatment	
	E1	**E2**
During gestation from day 100 to parturition		
CFM /h/d	**1304.00**	**1304.00**
BH /h/d	**532.00**	**532.00**
RS /h/d	**278.00**	**278.00**
PF /h/d	**-**	**21.00**
Total DM intake /h/d	**2114.00**	**2135.00**
Total energy intake, MJ / h /d	**35.00**	**42.27**
Energy consumption, %	**100.00**	**120.00**
Concentrate: Roughage, C:R	**62:38**	**62:38**
From parturition to weaning (suckling period)		
CFM /h/d	**1079.00**	**1079.00**
BH /h/d	**709.00**	**753.00**
RS /h/d	**371.00**	**325.00**
PF /h/d	**-**	**21.00**
Total DM intake /h/d	**2159.00**	**2178.00**
Total energy intake, MJ / h /d	**36.00**	**43.16**
Energy consumption, %	**100.00**	**120.00**
Concentrate : Roughage, C:R	**50:50**	**50:50**

Effect of E1 and E2 treatments on BW and BCS of ewes:

The effect of E1and E2 treatments on changing of BW and BCS from day 100 to weaning are presented in (Table 7). The BW and BCS from gestation day 100 to 145 pre-lambing increased with increasing energy allowance then E2 had higher ($P<0.05$) BW and BCS than E1 treatment. Also at 145 days of gestation, the E2 ewes had a higher ($P<0.05$) BW (up to 3.15%) than E1ewes. The 120% (E2) ewes gained ($P<0.05$) BCS between gestation days 100 and 145, while the 100% (E1) ewes lost BCS during this period. The 100% (E1) ewes lost more BW and BCS in suckling period compared with the 120% (E2) ewes ($P < 0.05$).

Table (7): Effect of E1 and E2 feeding on BW and BCS of ewes.

Item	Treatment	
	E1	E2
BW from trimester (at 100 days) to 145 days of gestation /kg		
At 100 day	51.41±0.82[a]	51.22±0.57[a]
At 115 day	53.82±0.94[b]	56.15±0.55[a]
At 130 day	56.32±0.83[b]	59.86±0.41[a]
At 145 day	61.41±0.67[b]	63.66±0.44[a]
BCS from trimester (at 100 days) to 145 days of gestation		
At 100 day	2.56±0.05[a]	2.55±0.02[a]
At 115 day	2.68±0.07[b]	2.76±0.05[a]
At 130 day	2.79±0.09[b]	2.96±0.06[a]
At 145 day	2.86±0.11[b]	3.34±0.09[a]
BW from lambing to weaning /kg		
At lambing	49.66±0.55 [b]	51.88±0.39 [a]
At 15 days	48.85±0.51 [b]	51.49±0.46 [a]
At 30 days	48.48±0.44 [b]	50.72±0.33 [a]
At 45 days	47.87±0.46 [b]	49.87±0.37 [a]
At 60 days as the weaning time	46.99±0.44 [b]	49.88±0.53 [a]
BCS from lambing to weaning		
At lambing	2.55±0.08 [b]	2.88±0.09 [a]
At 15 days	2.37±0.08 [b]	2.81±0.07 [a]
At 30days	2.33±0.06 [b]	2.69±0.05 [a]
At 45 days	2.24±0.07 [b]	2.58±0.08 [a]
At 60 days as the weaning time	2.14±0.06 [b]	2.53±0.06 [a]

Values and mean ±SE with the different superscripts in the same row [a, b,] are significantly at $P<0.05$.

Suckling milk quality and quantity:

There was a difference (P<0.05) between E1 and E2 treatments in suckling milk quantity Fig. (1) and suckling milk quality (Table 8). The average of suckling milk post-partum in E2 ewes was 1490, 1240, 950 and 621 g, but it was 1040, 899, 740 and 534 g in E1 ewes through evaluation of suckling periods at 15, 30, 45 and 60 days, respectively. Then, E2 ewes have reduced more suckling milk by 43, 38, 28 and 16% through suckling stages at 15, 30, 45 and 60 days than E1 ewes, respectively. Thus, when ewes in E2 treatment consumed higher amounts of DM than E1 ewes this resulted more suckling milk production as shown in (Table 6). The highest milk production was probably due to the highest weight averages presented by E2 ewes and more energy in intake than E1 ewes. The average of milk production correlated positively with average body condition score variation as shown in (Table 7).

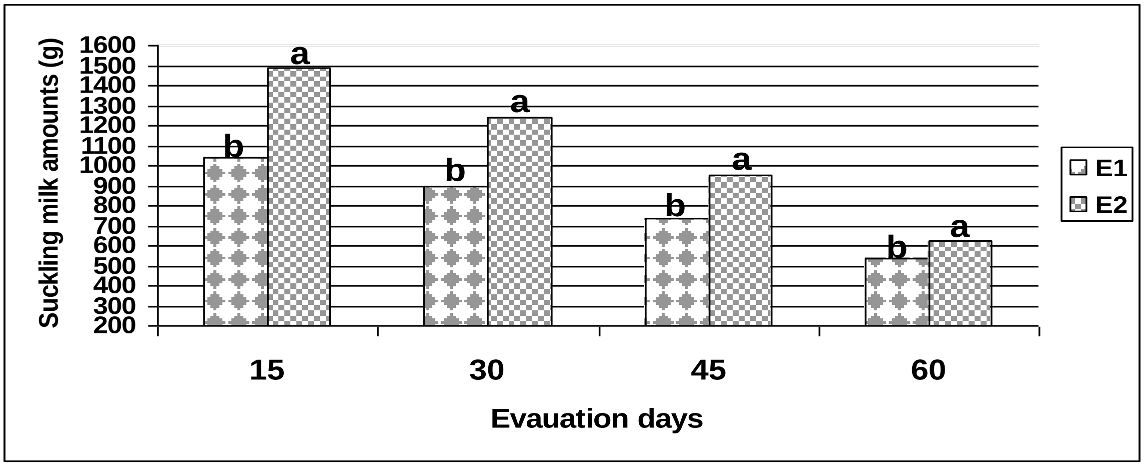

Fig. (1): Milk production of E1 and E2 ewes.

Table (8): Suckling milk composition of E1 and E2 ewes.

Items	Energy level	Stages of suckling milk		
		Early phase (15 days)	Middle phase (30 days)	Late phase (60 days)
Fat, %	E1	**6.24±0.11 [b]**	**6.61± 0.15 [b]**	**6.71±0.16 [b]**
	E2	**6.51±0.12 [a]**	**7.86±0.13 [a]**	**8.39±0.15 [a]**
Protein,%	E1	**4.20±0.08 [b]**	**4.20±0.14 [b]**	**4.13±0.14 [b]**
	E2	**4.50±0.07 [a]**	**4.60±0.13 [a]**	**5.46±0.18 [a]**
Suckling milk energy,	E1	**272.32±0.66[b]**	**265.30±18.46[b]**	**285.81±15.24[b]**

kcal/kg	E2	286.12±22.12[a]	298.43±21.19[a]	308.40±20.43[a]

Values and mean ±SE with the different superscripts in the same column [a, b,] are significantly at P<0.05.

Effect of E1 and E2 treatments on lambing behavior:

There was a significant (P<0.05) effect on lambing behavior (as birth assistance, lamb vigour and sucking assistance) between ewe in E1 and E2 as nutritional treatments Table (9). The best results obtained with E2 energy they may be related to the best suckling milk quality and quantity Fig. (1) and (Table 8) compared to E1 energy. Furthermore, 85% of E2 lambs and 70% of E1 lambs were active and vigorous, but almost half of E1 lambs needed assistance to suckling.

Table (9): Behavior scores of lambs in E1 and E2 ewes.

Item	Treatment energy	
	E1	E2
Birth assistance score, 0-4	1.35 ±0.01[b]	1.29±0.02[a]
Lamb vigour score, 0-4	1.85±0.03[b]	1.44 ±0.04[a]
Sucking assistance score, 0-4	1.56 ±0.03[b]	1.12 ±0.01[a]
Time to successful stand, seconds	1214.00 ±99.22[b]	886.00 ±87.44[a]

Values are mean ±SE with the different superscripts in the same row [a, b,] are significantly at P<0.05.

Lamb BW and BW gain with:

There was a significant (P<0.05) effect of ewe nutritional treatment on lamb body weight as shown in Fig. (2). after birth, lambs born to the 120% (E2) ewes were heavier (P>0.05) than lambs born to 100% (E1) ewes. At birth the average litter size was 2.0 and 2.0, but at weaning it was 1.6 and 1.8 for ewes in the E1 and E2 treatment, respectively. However, at weaning, the lambs born to the E2 ewes were heavier (P <0.05) than lambs born to the E1 ewes. There was a significant effect of ewe nutritional treatment on the BWG of the lambs Fig. (3). The BWG from birth to weaning was greater (P<0.05) for the lambs born to the E2 ewes than lambs born to the E1 ewes.

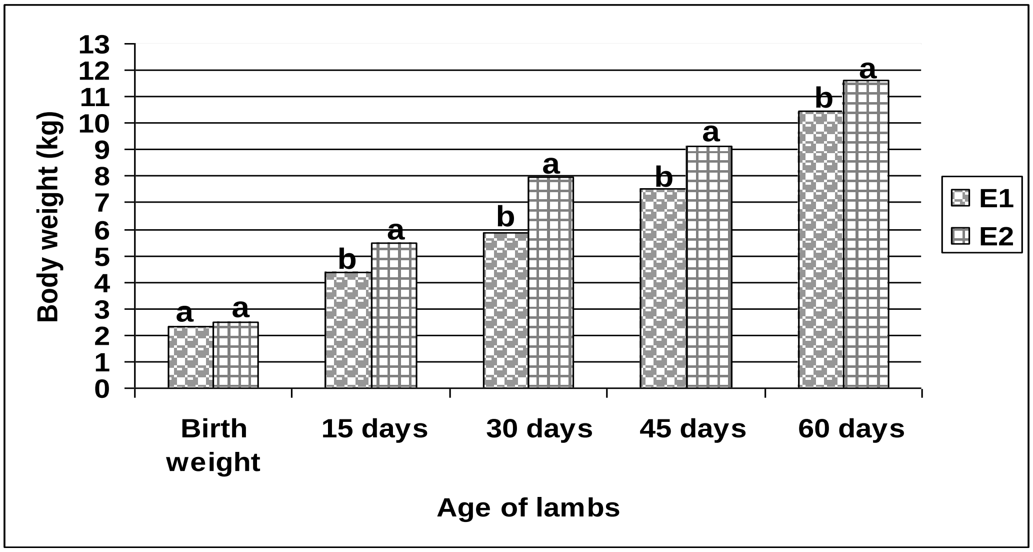

Fig. (2): Body weight of lambs as affected by E1 and E2 offered to their maternal ewes.

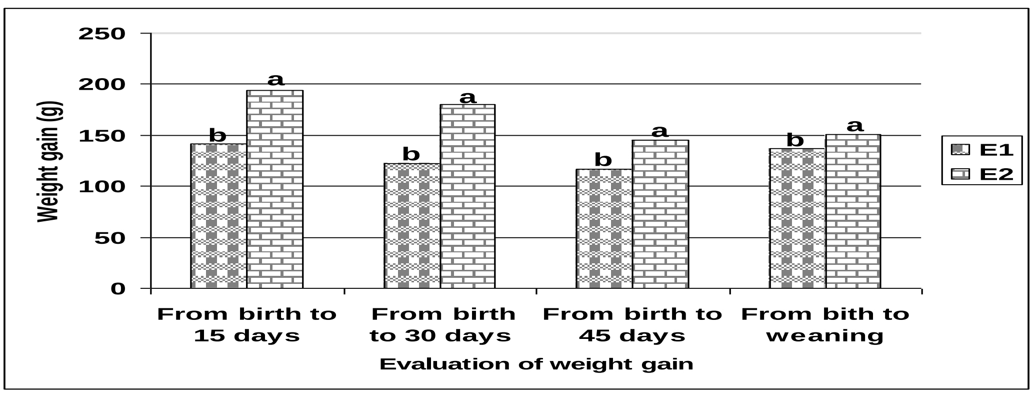

Fig. (3): Body weight gain of lambs as affected by E1 and E2 offered to their maternal ewes.

Ewes' blood NEFA concentration:

Blood serum NEFA concentration of the E1 and E2 was ranged within the reference values Fig. (4). at days 130 and 145 of gestation the NEFA concentration was higher ($P<0.05$) for the E1 ewes than the E2 ewes. The current results indicted that with advanced ewes' period of transition the NEFA concentration decreased. Thus, the E1 ewes had higher ($P<0.05$) NEFA concentration than E2 ewes at day 15 after lambing, and higher than the E2 ewes at day 30 after lambing ($P <0.05$).

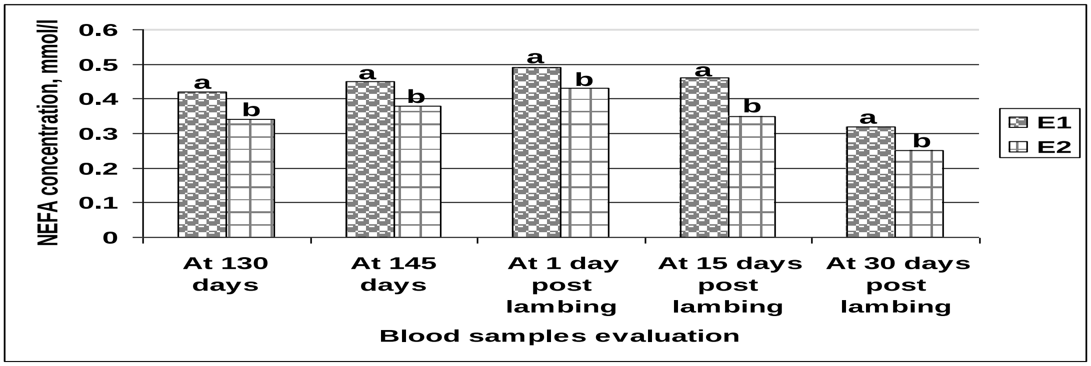

Fig. (4): NEFA concentration as affected by feeding E1 and E2 levels.

The economics of selling lambs after weaning:

Data in (Table 10) indicate that there was a considerable cost saving for lambs with E2 ewes compared to the control treatment (E1ewes). The differences in ewe BW of lambs during the suckling period showed that diet containing 120% of energy (E2) had the best values of body weight where they reached 207.00 kg (24.39%) for E2 as compared to E1 166.40 kg. This study was reflected that using 120% of energy in the diets of Rahmani ewes where this is due to the highest final body weight of weaning lambs of E2 treatment compared with E1 treatment lambs. So, using PF at 1% in twin-bearing ewes ration gave the lowest cost per one kg of weaning lambs production. This was refeled on increased economical return for sale lambs up to 5008 and 6318 Egyptian pounds and economical efficiency relative to control where, it was 100.00 % and 102.39% from weaning lambs in E1 and E2 ewes, respectively. These results encourage the use of PF as a safe energy source with daily ration to achieve the most performance in lambs.

Table (10): Economical efficiency of E1 and E2 energy levels to the sale of lambs weaning.

Items	Different energy levels	
	E1	E2
No. of lambs still alive up to weaning	16.00	18.00
Total final weight of lambs at weaning (kg)	166.40	207.00
Feed intake for ewes from lambing to weaning /60 days		
CFM, kg /day/ treatment	720.00	720.00
BH, kg /day/ treatment	480.00	480.00
RS, kg /day/ treatment	240.00	240.00
PF, kg /day/ treatment	-	120.00
Total feed intake during 60 days, kg	1440.00	1560.00
Cost of consumption ration and economic return		
Price of CFM, pounds	2880.00	2880.00
Price of BH, pounds	360.00	360.00
Price of RS, pounds	72.00	72.00
Price of PF, pounds	0.00	720.00
Total price of feed cost, pounds B	3312.00	4032.00
Price of sale lambs, Egyptian pounds A	8320.00	10350.00
*Economic return fro sale lambs, Egyptian pounds	5008.00	6318.00
Calculation of economical efficiency		
**Economical efficiency(EE) B ÷ A, %	2.51	2.57
***EE relative to control,%	100.00	102.39

Price of sale kg of lambs is 50 EGP. Price for CFM, BH, RS and PF = 4000, 750, 300 and 6000 EGP /ton, respectively.

***Economic return fro sale lambing= Price of sale lambing- price of feed cost.**

****Economic efficiency (%) = money out put (price of meat marking) ÷ money input (total price of feed consumed) ×100.**

***** EE (%) relative to control with E2= EE of E2 – EE of E1÷ EE of E1×100 +100 (consider EE of E1 100%).**

Correlation coefficients between feeding and total energy intake from lambing to weaning (TEI), weight of ewes at weaning (WEW), body condition scoring at weaning (BCSW), suckling milk yield (SMA), weight of weaning lambs (WWL), sale of weaning lambs (SWL), blood NEFA at 1day post-partum (BNPP1) and blood NEFA at 30 days post-partum (BNPP30).

Data in (Table 11) indicate that correlation coefficients between groups either E1 or E2 and some productive procedures. There were highly (P<0.01) significant correlations between energy feeding and TEI and BCSW, significant at (P<0.05) with WWL and SWL. The correlation coefficient between E1 or E2 and WEW, SMA, BNPP1and BNPP30 was positively. Also, highly (P<0.01) significant correlation between BCSW and WEW and, significant connection at (P<0.05) was observed between TEI and WWL and SWL. Moreover, significant (P<0.05) between WWL and WEW and BCSW.

Table (11): Correlation coefficient among feeding and some productive procedures.

Items	TEI	WEW	BCSW	SMA	WWL	SWL	BNPP1	BNPP30
Feeding	**1.00****	**0.995**	**1.00****	**0.996**	**0.998***	**0.999***	**0.964**	**0.934**
TEI		**0.995**	**1.00****	**0.996**	**0.998***	**0.999***	**0.964**	**0.934**
WEW			**0.996**	**0.981**	**0.999***	**0.989**	**0.987**	**0.966**
BCSW				**0.995**	**0.999***	**0.999***	**0.967**	**0.938**
SMA					**0.988**	**0.999***	**0.937**	**0.898**
WWL						**0.944**	**0.980**	**0.955**
SWL							**0.952**	**0.918**
BNPP1								**0.955**

*** (P<0.05).**

**** (P<0.01).**

DISCUSSION

The present study was focused on assessing the performance of twin-bearing ewes, which has been studied to a much lesser extent than single -bearing ewes. Previous studies have found that nutrition during late gestation may influence lamb birth weight, colostrum production and subsequent lamb growth rate and weaning weight **(Cal-Pereyra *et al*., 2015 and Mohammadi *et al*., 2016)**. This shows that controlling the plane of nutrition in late gestation may influence production **(Schmitt *et al*., 2018)**. The high energy allowance to the ewes in the 120% E2 treatment caused a high feed intake from day 100 and 5 weeks onwards, demonstrating that they were able to ingest feed above the requirements, as opposed to the consideration of **Pesántez-Pacheco *et al*., (2019)**. However, during the last two weeks before lambing they refused to feed rations probably reached the limit of their intake potential

(Cranston *et al*., 2017). Even, the physical fill effect probably regulated the intake together with the large uterine volume containing the two fetuses **(Díaz-Lópeza *et al*., 2017)**. These observations suggest that it would be advantageous to offer a higher concentrate ratio to the ewes the last weeks of gestation, as suggested by **Antunovic *et al*. (2017)**. Despite differences in energy intake between the E1 and E2 treatments during the late gestational period, there was no observed difference in lamb birth weight, but E2 lambs were heavier than E1 lambs. However, it seems to be only cases of severe under energy nutrition during late gestation reduce birth weight **(Cranston *et al*., 2017)**, who found that ewes under restricted energy had lower birth weight of lambs than unrestricted energy. For this reason, lamb birth weight is not suitable as a sole index of dietary energy in late gestation nutrition. This is also emphasized by **McGovern *et al.* (2015)** who noticed that altering the energy nutrition at 80, 100 or 120% ME requirements to twin ewes in late gestation did not affect birth weight or organ weight of newborn lambs. Ewes fed the highest energy level in late gestation had a higher BW, and also an increased BCS in the prepartum period, but an increased level of BCS loss in the postpartum period compared to the other treatment. This coincides with the study of **Mahdy *et al.* (2021)**, where twin-bearing ewes were fed different energy levels in late gestation and responded in the same pattern. This suggests that different levels of energy intake during late gestation can alter the body reserve mobilization pattern.

It is apparent that the 120% (E2) ewes had greater body fat stores and could mobilize fat in the early postpartum period to increase the milk yield, even though the mechanism behind is not fully clear. The same results were obtained by **(Gronqvist *et al*., 2018)**. **Campion *et al.* (2016)** found that, the ewes fed the highest energy level in late gestation maintained the highest milk yield through the first 6 weeks of lactation. **Dønnem *et al.* (2020)** found that increased ewe live weight gain during pregnancy increased lamb growth rate to weaning with using unrestricted of energy. The previous authors indicated that early live weight gain and weaning weights of lambs increased nominally with increasing prepartum energy allowance of their mother, but only for lambs in complete triplet litters the increase in live weight gain until weaning was significant. The present study suggests that the body reserves acquired by the E2 ewes pre-lambing to a greater extent were utilized to feed two lambs compared to fewer lambs to weaning. This is in line with **Mahdy *et al.* (2021),** where twin had the highest growth rate when their ewe had a high BCS from lambing to weaning. A low growth weight from birth to weaning of the twin-reared lambs in the E1 treatment may be due to the low the body reserve mobilization. Both ewes in late gestation and early lactation appeared to have compensated for the energy deficiency in late gestation **(Zhao *et al,* 2016)**; the energy reserves left at lambing was adequately utilized to feed their lambs. The highest body mass index attained through high prepartum energy feeding increased body mass mobilization postpartum and increased milk production **(Soares *et al.,* 2018)**. Lamb growth will also be affected by the different energy nutrition of the ewes during lactation. There was no difference in dry matter intake between the E1 and E2 from lambing until weaning. Then, **Mahdy (2021)** found that weaning lambs weight was 10.65 and 6.62 kg in ewes fed unrestricted and restricted energy, respectively. Milk production is sensitive to periods of under nutrition, with 70% of udder development taking place during the final 4 weeks of gestation **(Dønnem *et al.,* 2020**); energy supply in the final week of gestation is one of the primary drivers of colostrum yield. As the 100% (E1) and 120% (E2) ewes had difference energy intake the last two weeks of gestation, this could partly affect the lack of significant early live weight gain of the lambs between the treatments. During early lactation, ewe milk production significantly affects lamb growth rate. This is in agreement with **Kenyon *et al.* (2019)** who found milk yield to be significant after day 42 of lactation, indicating the lamb's decreasing dependence on milk as the main nutrient source. The quality of suckling milk could improve by energy source.Similarly,**Shereef (2020)** found that 331 calories were supplied to ewes' ration may improved milk ewes as total protein, linoleic acid, omega 3-FA and unsaturated fatty acids. Thus, greater milk production in early lactation has been previously shown to give lambs a weight advantage large that remained until weaning **(Gronqvist *et al.,* 2018**). In the present study, there is a low conformity between BC change and live weight change in ewes in the post-partum period. However, energy mobilization from body tissue in early lactation may greatly exceed apparent weight loss, suggesting that changes in the energy reserves of lactating animals may be more accurately assessed from their condition score rather than from measurements of live weight **(Dønnem *et al.,* 2020)**. In the present study we found effects of gestational nutrition on maternal and lamb neonatal behavior. **Dønnem *et al.* (2020)** found that the reduction in nutritional intake in pregnant ewes adversely affected lamb neonatal behavior. In addition, some of the lambs died due to weakness, or were taken from their mother on life support. In own study, the majority of the lamb loss was in E1 treatments was related to poor milk yield of the ewe, which in turn may be due to low energy allowance in late gestation and low fat mobilization after lambing. Generally, the development of the lamb's central nervous system, and therefore locomotor activity, might be affected by the ewe's nutrition energy during gestation **(Pedernera *et al.*, 2017)**. It has been shown that non- supplementing pregnant ewes with different sources of fatty acids could reduce the latency to suckle **(Rocha *et al.*, 2018)** moreover; a delay in consuming colostrum can increase the morbidity and mortality of lambs, especially in extensive systems where they cannot be assisted. The mobilization of body fat reserves is indicated through an elevation of NEFA concentration **(Schmitt *et al.*, 2018)**. The shift of NEFA concentration between few days before lambing; ewes fed the highest energy level shifted from the lowest to the highest NEFA concentration Fig. (4). Higher blood NEFA concentrations are reported in fasting sheep, sheep with twin reverse those with singleton pregnancy **(Marutsova and Marutsov, 2018)** the higher rate of NEFA was substantially higher and that could be converted in the liver. The increase of NEFA concentration in pre-partum as well as its peak at parturition is due to the high energy demand in the final third of gestation, rapid growth of fetuses and the mammary gland development **(Soares *et al.*, 2018)**. authors found that NEFA level declined at 10 day peri-partum, at parturition and post-partum at 10, 20 and 30 days, they were 0.3, 0.5, 0.3, 0.3 and 0.2 mmol/l, respectively. Also, the same authors defined that the magnitude of the metabolic challenge during the peri-partum period due to the higher energetic demand causes a greater release of NEFA into the bloodstream due to the lipolysis rate that overlaps with the lipogenesis. Part of this metabolite is used as a source of energy by peripheral tissues and another part is metabolized in the liver, being completely oxidized for energy production or partially oxidized to produce ketone bodies or esterified and stored as triglycerides.

The NEFA concentrations obtained during this study have not exceeded the normal values reported by other authors in clinically healthy ewes **Mohammadi *et al*. (2016)** who reported that normal concentration of NEFA<0.45 mmol/l. According to, **Benedet *et al.* (2020)** explained that the normal range for NEFA was from 0.01 to 1.32 mmol/l in healthy animals. Correlation coefficient was observed between feeding energy feeding and productive characteristics by **(Khalifa *et al.*, 2015)**. Also, **Ayele *et al.* (2017)** show and that unrestricted energy in concentrate supplement feeding could improve the rate of digestion, dry matter intake, efficient utilization of the feed, linear body measurements and daily gain. **Dønnem *et al.* (2020)** found that the highest energy intake in ewes during late gestation increased energy mobilization during lactation that seemed to benefit lambs with a growth advance until weaning.

CONCLUSION

The present study shows that it is possible for twin-bearing ewes to meet the increased nutritional demand in late gestation when feed quality is very poor. Thus, unrestricted energy intake during late gestation influenced the pattern of body reserve deposition or mobilization in ewes, simultaneously, as well as after parturition. For lambs reared in twin litters the unrestricted energy allocation seemed to give higher growth from birth until weaning than restricted energy. The study suggests that if a farmer wants to keep a minimized number of lambs to let the ewes to rear two lambs, the energy allowance should be increased above the current requirements.

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