Impact of Different Levels of Energy on Performance and Haematological Blood Parameters in Black Does

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Abstract

Energy has been one of the key factors that influence the welfare and performance of an animal's farm. The whole study was performed at the Department of Animal Science, Animal Farm, College of Agricultural Engineering Sciences, Sulaimani University, Kurdistan Region-Iraq. Sixteen adult black does, 1.5-2 years old have been used and randomly divided into two classes (8 does + 8 does), and reared in single pens (1.20 x 1.10 cm). The groups were fed two levels, 300 g / day as low-level feed (0.9 Mcal ME) and 600 g / day (1.8 Mcal ME) as high-level feed for 8 weeks of mating season (4 weeks before matting and 4 weeks after matting). This study aimed to study the effect of two levels of energy on live body weight, body condition score, and some hematology parameters. The obtained results throughout all periods showed no significant variations in live body weight and body condition score of does fed either with low or high concentration levels. Moreover, in beginning the experiment HCT % and PLT were significantly increased ($p<0.05$) for T2 (high level) whereas an insignificant change in other parameters. After 4 weeks the white blood cell count (WBCs), L%, PLT, and PCT % were significantly increased ($p<0.05$), (WBCs) and L% for T1 (low level) and PLT, PCT % for T2 (high level). After 8 weeks, MO %, HCT %, and PLT were significant differences ($p<0.05$), MO % for T1 (low level) and HCT%, PLT for T2 (high level), while other parameters were not significant.

Key words: Doe, Live body weight, Body condition score, Energy and blood parameters.

Introduction:

In terms of livestock production, reproductive efficiency is one of the most important economic traits. Having good reproductive functions in the farm or flock is essential to the success of any system of livestock production. Success in goats and sheep production greatly depends on the optimal reproductive output of the herd or flock (Mohammed, 2016). Reproduction is the replication and continuation of a population by an occurrence series. This method includes the provision of hormones (i.e., oestrogen, testosterone) and the development of the reproductive system for the development of germ cells, fertilization, pregnancy, and ultimately parturition (Angela and Anderson, 2010). The reproductive efficiency of the doe is determined by various processes, such as the duration of the breeding season, cyclic operation, ovulation rate, age at puberty, age at first conception, birth weight of offspring, litter size, kidding time, fertilization rate, and postpartum anestrus period (Hasan *et al.*, 2014). Depending on the breed and diet, female goats (does) reach maturity at the age of seven to ten and should be 60 to 75 percent of their adult weight at breeding to avoid difficult kidding (Linda *et al.*, 2004). Noble (2004) reported that the Male goats could even weigh between 27 and 350 pounds anywhere, based on breed, health, and nutritional status. The earliest age the buck is being used to breed is 1 year old. The nutritional plane influences the metabolisms energy-sustaining (MEm) function of goats, as with other ruminant animal species. The NRC (2007) stated that changing metabolisms maintaining energy (MEm) for the nutritional plane is comparable to the NRC (2000) modification for beef cattle with energy intake levels lower than MEm. For goats with low BCS in pre-mating and mating cycles, nutritionally improved performance is expected because it must be as high as 1.5 as recorded (Meza-Herrera *et al.*, 2008). The body weight and body condition score had a major effect on pregnancy rates and indicated the need to use higher energy feeding in goats with lower body weights and BCS before breeding (IlkerSerin *et al.*, 2010). Dietary energy plays an important role in the absorption of nutrients and thus influences growth efficiency and meat development. Animals fed at different levels of energy in the diet have a significant impact on total feed intake, metabolizable energy, and average daily gain (Abbasi *et al.*, 2012). Blood is an effective and reliable tool for determining the individual animal's health status (Ramprabhu *et al.*, 2010). Deviations in animal blood parameters are due to various factors, such as altitude, level of feeding, age, sex, breed, diurnal and seasonal variation, animal temperature, and physiological status (Mbassa and Poulsen, 2003). However, the current study aimes to evaluate the impact of two energy levels before and after copulation in local black does on live body weight, weight gain, body condition ranking, and other haematological parameters.

Materials and methods:

This investigation was done out at the Animal Farm, Department of Animal Science, College of Agricultural Engineering Sciences, Sulaimani University/Kurdistan Region of Iraq. In this study, sixteen local adult black does (16 Does) aged 1.5-2 years and weighed 35 and 40 kg for does, were used; they have been split into two equals of does as shown in Table (1). Before beginning, the animals were developed for the feeding scheme for 15 days and steadily increased the amount of feed. In individual pens (1.10 or 1.20 cm) each animal was reared. Also, every does was tested using the Ultrasonic Diagnostic Instrument (image 1) to ensure that not all are pregnant.

Image 1. Ultrasonic Diagnostic (KX5000, SHINOVA Co., made in China)

After the 15-days adaptation period, does begin for 4 weeks before mating (pre-mating) at low and high energy levels and stayed for 4 weeks after mating. T1 (low energy level) contained 0.9 Mcal ME by feeding 300 g/d. T2 (high energy levels) contained 1.8 Mcal ME by feeding 600 g/d, the feed composition showed in (Table 2).

Table 1. Levels of energy and number of animals in each group which matted individually:

Treatments	Female (doe)
T1 (Low) (300 g/d; 0.9 Mcal ME)	8 Heads
T2 (High) (600 g/d; 1.8 Mcal ME)	8 Heads
Total	16 Heads

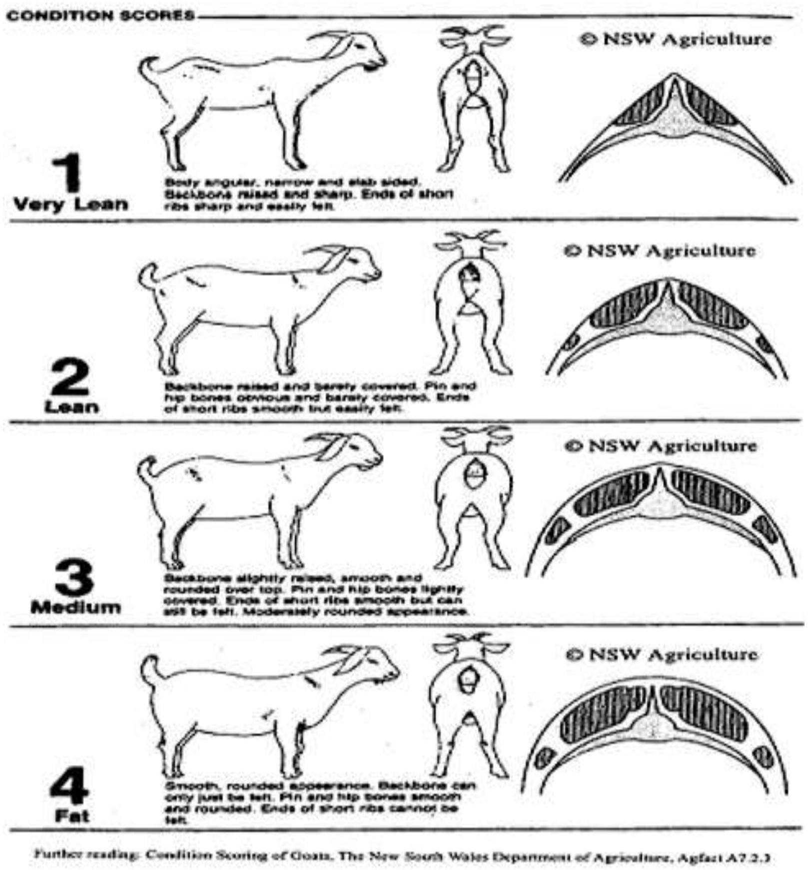
Table 2. Ingredient composition of the diet during the experiment:

Ingredient	**%**
Barley	45
Wheat grain	13
Corn grain	25
Soybean	15
Vitamin & minerals	1
Salt	1
Total	**100**
Crude protein (%)	15.7
* Metabolisable energy Kcal/kg	3.0184

***The nutritional requirement determined according to (NRC, 2007)**

Data collection:

1. **Characteristics:**
   - a- **Live body weight:** During the experiment (before, middle, and after matting) animals of does were weighed three times (Praveena *et al.*, 2014).
   - b- **Body Condition Score:** The BCS was evaluated by palpating the muscling fullness and fat cover over and around the outermost vertebrae, BSC of does were evaluated three times. (Melesse *et al.*, 2013).



Evaluate of BSC by palpating the muscling fullness and fat cover

2- Haematological Blood Parameters:

Blood samples were taken by vacuum puncture of the jugular vein. Tubes containing EDTA, 2ml, a haematological anticoagulant. Hämatological parameters including total number of white blood cells (WBC) count, haematocrit (HCT), haemoglobin (Hgb), number of red blood cells (RBC), Total concentration of corpuscular hemoglobin (MCHC), the total concentration of the corpuscular Measured volume (MCV) and mean cell hemoglobin (MCH). By Automated Analyzer for veterinary were calculated (Hemato Analyzer).

Statistical analysis:

In the current research, CRD has been used. Collected data were analyzed utilizing XLSTAT software (version-7.5, 2004) to assess the effect and difference of various treatments. Differences between means of care were tested using the Duncan Test (Duncan, 1955). The linear model of the analysis had been as follows:

$$\mathbf{Y_{ijk} = M + F_j + B(X_{ijk} - x^{-}) + e_{ijk}}$$

Where:

$\mathbf{Y_{ijk}}$ = observation j and k in group i (treatment i)

M = overall mean.

$\mathbf{F_j}$ = Effect of feed.

$\mathbf{B(X_{ijk}-x^{-})}$ = a continuous independent variable with mean M_x (Covariate).

$\mathbf{e_{ijk}}$ = Experimental error assumed to be NID (0, σ^2e).

Results and discussions:

1- Performance Parameters:

a- Live body weight (LBW):

Table (3) showed the impact of different levels of energy on live body weight in black does at beginning, after 4 weeks and after 8 weeks, In all periods, there were no major variations in LBW (P≤0.05) between low and high treatment, and LBW changed from beginning to end of ME low and high, from 37.36 to 40.85 kg for low and from 37.11 to 39.18 kg for high. Live body weight plays a major role in evaluating features of farm animals, especially those of economic significance. Even then, the bodyweight in the present study was no different from the findings by (Mohammed, 2016), who stated that there were no variations in body weight of doing augmented with either low or high concentration levels during the flushing time. Hafez *et al.*, (2011), mentioned that low- and high-energy supplementation was not identified on LBW at the start of the experiment. There were no major variations in live body weight complemented by low and high energy levels during the flushing process (Acero-camelo *et al.*, 2008).

Table 3. Impact of different levels of energy on live body weight in black does at the beginning, middle and End treatment (Mean ± S.E.):

Treatments	Beginning	After 4 weeks	After 8 weeks
T1 (Low) (300 g/d; 0.9 Mcal ME)	37.36 ± 0.82[a]	38.05 ± 0.85[a]	40.85 ± 0.43[a]
T2 (High) (600 g/d; 1.8 Mcal ME)	37.11 ± 1.45[a]	37.59 ± 1.53[a]	39.18 ± 1.45[a]

Means with different letters within each column have differed significantly (p<0.05)

b- Body Condition Score (BSC):

Table (4) show the impact of different levels of energy on body condition score in black does at the beginning, after 4 weeks and after 8 weeks, The BCS was not changed in low treatment over the period was (3.5), while the BCS increased from (3.0) to (3.5) in high treatment, in both treatments was not significant differences, these increase of BCS may be due to an increase in live body weight. BCS is used to assess existing and past feeding schemes and to determine the health condition of a given species. An effective tool for farm animals is body condition scoring managers or producers for the optimization of production (meat and milk), feeding, reproduction, and reproduction of the animal welfare (Ghosh *et al.*, 2019). Supplementary protein or energy-dependent feeding, typically increases at the time of mating reproductive output by expression of oestrus, pregnancy, fecundity, and goat twinning rate (Hafez *et al.*, 2011). Whenever they do with bad BCS, they seem to have low conception rates, low twinning levels, and low birth rate and weaning kid's waves (Urrutia-Morales *et al.*, 2012). Also, the body condition score is used to determine if energy and protein are useful for breeding or not. BCS 3.0 to 3.5 as optimum in mating season for goats (Villaquirán *et al.*, 2004).

Table 4. Impact of different levels of energy on body condition score in black does at the beginning, after 4 weeks and after 8 weeks (Mean ± S.E.):

Treatments	Beginning	After 4 weeks	After 8 weeks
T1 (Low) (300 g/d; 0.9 Mcal ME)	3.5 ± 0.2[a]	3.5 ± 0.13[a]	3.5 ± 0.11[a]
T2 (High) (600 g/d; 1.8 Mcal ME)	3.0 ± 0.21[a]	3.0 ± 0.14[a]	3.5 ± 0.10[a]

Means with different letters within each column have differed significantly (p<0.05)

2- Hematological parameters:

As shown-in Table (5), haematological parameters in black does at the beginning of the experiment, Hematological parameters revealed a significant decrease ($p<0.05$) of HCT% and PLT ($\times10^{12}/\mu L$) were changed from (27.52) % to (23.60) % and from (13.95) to (9.0) respectively while, other parameters has not significantly changed. WBC, RBC counts, and MCH, the low energy level (300 g/d; 0.9 Mcal ME) was more than the high energy level (300 g/d; 0.9 Mcal ME), but L%, Mo %, Hgb, MPV, and PCT%, the high energy level (300 g/d; 0.9 Mcal ME) was more than low energy level (300 g/d; 0.9 Mcal ME).

Table 5. Impact of different levels of energy on haematological parameters in black does at Beginning of experiment (Mean ± S.E.):

Parameters	Treatments		Range
	T1 (Low) (300 g/d; 0.9 Mcal ME)	T2 (High) (600 g/d; 1.8 Mcal ME)	
WBC ($\times10^9/\mu L$)	12.07 ± 0.22[a]	11.97 ± 0.28[a]	5.0-14.0
L %	38.85 ± 1.12[a]	38.88 ± 0.62[a]	55.8-90.6
MO %	04.23 ± 0.45[a]	05.49 ± 0.56[a]	1.8-6.0
GR %	09.58 ± 2.13[a]	13.29 ± 1.66[a]	8.6-17
RBC ($\times10^{12}/\mu L$)	11.03 ± 1.26[a]	10.71 ± 1.05[a]	8.30-17.90
Hgb (g/L)	09.78 ± 0.90[a]	10.80 ± 0.30[a]	8.0-11.5
HCT (%)	27.52 ± 0.54[a]	23.60 ± 1.23[b]	23.0-35.0
MCH (Pg)	07.96 ± 1.02[a]	07.82 ± 1.14[a]	5.2-8.0
PLT ($\times10^{12}/\mu L$)	13.95 ± 0.49[a]	09.00 ± 1.15[b]	4.50-15.90
MPV (fL)	04.63 ± 0.15[a]	04.72 ± 0.13[a]	3.8-6.0
PCT %	00.16 ± 0.01[a]	00.18 ± 0.02[a]	0.10-0.28

Means with different letters within each column are differed significantly ($p<0.05$)

Regarding the impact of different levels of energy on haematological parameters in black does after 4 weeks of the experiment mentioned in Table (6). In black does, influence of two levels of energy at the middle of the experiment were significant differences ($p<0.05$) in WBC count and L% for (T2) high level (600 g/d; 1.8 Mcal ME) were (11.80) (×109/μL) and (41.46) %, respectively. Also, PLT was significant differences ($p<0.05$) for (T1) low level (300 g/d; 0.9 Mcal ME) was (13.68) (×1012/μL). On the other hand, L%, GR%, HCT% and MCH (Pg) in (T1) low level (300 g/d; 0.9 Mcal ME) were largest than (T2) high level (600 g/d; 1.8 Mcal ME), whereas RBC count and Hgb (g/L) in (T2) high level (600 g/d; 1.8 Mcal ME) were biggest than (T1) low level (300 g/d; 0.9 Mcal ME).

Table 6. Impact of different levels of energy on haematological parameters in black does after 4 weeks of the experiment (Mean ± S.E.):

Parameters	Treatments		Range
	T1 (Low) (300 g/d; 0.9 Mcal ME)	T2 (High) (600 g/d; 1.8 Mcal ME)	
WBC (×109/μL)	11.22 ± 0.19[a]	11.80 ± 0.12[b]	5.0-14.0
L %	39.03 ± 1.96[a]	41.46 ± 0.93[b]	55.8-90.6
MO %	06.07 ± 0.56[a]	05.51 ± 0.45[a]	1.8-6.0
GR %	11.33 ± 1.38[a]	09.48 ± 1.37[a]	8.6-17
RBC (×1012/μL)	10.09 ± 0.01[a]	10.10 ± 0.01[a]	8.30-17.90
Hgb (g/L)	09.78 ± 0.42[a]	10.35 ± 0.29[a]	8.0-11.5
HCT (%)	28.42 ± 1.11[a]	25.08 ± 1.37[a]	23.0-35.0
MCH (Pg)	06.65 ± 1.29[a]	06.33 ± 1.30[a]	5.2-8.0
PLT (×1012/μL)	13.68 ± 0.80[a]	08.10 ± 1.70[b]	4.50-15.90
MPV (fL)	04.62 ± 0.26[a]	04.94 ± 0.29[a]	3.8-6.0
PCT %	00.30 ± 0.03[a]	00.20 ± 0.01[b]	0.10-0.28

Means with different letters within each column are differed significantly ($p<0.05$)

Table (7) shows the impact of different levels of energy on haematological parameters in black does after 8 weeks of the experiment. MO%, HCT% and PLT ($\times10^{12}/\mu L$) were significant differences ($p<0.05$) by different levels of energy, the highest percentage of MO was (06.52) % for (T2) high level (600 g/d; 1.8 Mcal ME), but the largest mean of HCT % and PLT ($\times10^{12}/\mu L$) for (T1) low level (300 g/d; 0.9 Mcal ME) were (28.26) % and (14.83) ($\times10^{12}/\mu L$) respectively. The effect of treatments on other parameters were not significant differences, L%, GR%, MCH (Pg) and PCT % the highest mean for (T1) low level (300 g/d; 0.9 Mcal ME), while WBC, RBC counts and Hgb (g/L) (T2) high level (600 g/d; 1.8 Mcal ME) were largest than (T1) low level (300 g/d; 0.9 Mcal ME).

Table 7. Impact of different levels of energy on haematological parameters in black does at after 8 weeks of experiment (Mean ± S.E.)

Parameters	Treatments		Range
	T1 (Low) (300 g/d; 0.9 Mcal ME)	T2 (High) (600 g/d; 1.8 Mcal ME)	
WBC ($\times10^9/\mu L$)	11.54 ± 0.29^a	11.84 ± 0.16^a	5.0-14.0
L %	30.13 ± 2.05^a	29.89 ± 2.64^a	55.8-90.6
MO %	05.08 ± 0.42^a	06.52 ± 0.29^b	1.8-6.0
GR %	14.92 ± 0.77^a	14.53 ± 0.64^a	8.6-17
RBC ($\times10^{12}/\mu L$)	10.41 ± 0.11^a	10.58 ± 0.13^a	8.30-17.90
Hgb (g/L)	09.06 ± 0.20^a	09.36 ± 0.59^a	8.0-11.5
HCT (%)	28.56 ± 0.78^a	25.43 ± 0.84^b	23.0-35.0
MCH (Pg)	06.64 ± 1.32^a	06.58 ± 0.86^a	5.2-8.0
PLT ($\times10^{12}/\mu L$)	14.83 ± 1.29^a	10.10 ± 1.09^b	4.50-15.90
MPV (fL)	05.42 ± 0.34^a	04.90 ± 0.24^a	3.8-6.0
PCT %	00.31 ± 0.06^a	00.25 ± 0.04^a	0.10-0.28

Means with different letters within each column are differed significantly ($p<0.05$)

Hematological parameters are strong indicators of physiological health status, and assessment is a significant factor when evaluating the response of animals under different adverse situations. The hematological blood parameters like RBC, WBC, and HGB can represent physiological phenomena in the body of an animal. Nutrition has an important role to play in animal growth and development. Malnutrition-related anaemia can lead to decreased metabolism of micro-molecules such as glucose, amino acids, fatty acids, and may result in a lower growth rate. Specifically, monocytes and lymphocytes are important component WBCs for the immune response. Monocytes are macrophage catalysts and lymphocytes are essential for humoral and cell-mediated response to immunity (Soul *et al.*, 2019). Standard MCHC indicates macrocytic in all the levels with increased MCV, Both the classes have normochromic anaemia (Abbasi *et al.*, 2012). The standard RBC values reported in this study show the absence of hemolytic anaemia and erythrogenic depression, Olafadehan (2011) reported similar concentrations of haemoglobin and indicate the lack of microcytic hypochromic anaemia associated with iron deficiency and excessive use during Hb formation. Haemoglobin is the iron-containing oxygen-carrying protein of vertebrate red blood cells. Haemoglobin deficiency in red blood cells reduces the oxygen-carrying ability of the blood contributing to animal symptoms (Kiran *et al.*, 2012). Even as adjustments in WBC were linked to understanding the way of protection due to animal immune variations (Piccione *et al.*, 2014; Arfuso *et al.*, 2016). MCV and MCHC in goats varied mainly according to RBC, HGB, and the HCT. It was in line with the Egbe-Nwiyi *et al.*, (2000) findings. Oddly, haemoglobin concentration (MCHC) did not increase proportionally with RBC size (MCV) rise.

These RBCs with a greater volume and a lower concentration of hemoglobin were presumably reticulocytes (i.e. RBC immature) (Andronicos *et al.*, 2014). Arfuso *et al.*, (2016) in a Messines review, goats found more RBC and a higher HGB content in real young goats compared to older goats, and similar difference in MCV and contrary pattern in MCHC blood of goats in Argentata dell'Etna. In specific, almost all of the hematological parameters found in our research were within the normal range recorded by other researchers for goats (Habibu *et al.*, 2017; Antunovic *et al.*, 2019).

Conclusion:

Through current research results, it can be assumed that the levels of energy do not significantly affect live body weight and body condition score. The results of does blood parameters in all periods PLT were significant differences and HCT % was improved by different energy from beginning to end of the experiment.

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تأثير مستويات الطاقة المختلفة على الأداء و الصفات الدموية لدم الماعز الأسود

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الملخص

الطاقة هي أحد العوامل الرئيسية التي تؤثر على رفاهية وأداء مزرعة الحيوانات. أجريت هذه الدراسة في حقل تربية الحيوان التابعة لقسم العلوم الحيوانية، كلية العلوم الهندسة الزراعية ، جامعة السليمانية، بإقليم كردستان العراق. استعملت (16) ستة عشر من المعزات السوداء البالغة، بعمر 1.5–2 سنة والتي وزعت عشوائياً الى مجموعتين متساويتين (8 أناث + 8 أناث)، وتم تربية كل حيوان في حظائر فردية ضمن قياس (1.10x1.20) سم. غذّيت هاتين المجموعتين على مستويين من التغذية، 300 غ/يوم (0.9 ميغاكالوري طاقة ممثلة) كمستوى منخفض من التغذية و600 غ/يوم (1.8 ميغاكالوري طاقة ممثلة) كمستوى مرتفع من التغذية، ولمدة ثمانية أسابيع (أربعة أسابيع قبل التزاوج وأربعة أسابيع بعد التزاوج) خلال موسم التناسل. هدف هذا البحث لدراسة تأثير مستويين من الطاقة على وزن الجسم الحي، ودرجة حالة الجسم، وبعض معايير الدم. أظهرت النتائج التي تم الحصول عليها طوال جميع الفترات عدم وجود اختلافات معنوية في وزن الجسم الحي، ودرجة حالة الجسم من المعزات التي غذّيت بمستويات تراكيز منخفضة أو عالية. علاوة على ذلك، في بداية التجربة، كان للمستوى العالي من التغذية تأثير معنوي ($p<0.05$) على HCT٪ وPLT، ولكن كان التأثير قليل في الصفات الأخرى. وفي وسط التجربة، كان المستوى المنخفض مختلف معنوياً ($p<0.05$) في عدد خلايا الدم البيضاء (WBCs) ونسبة L، أما المستوى المرتفع فقد اختلف معنوياً بالنسبة لكل من PLT، وPCT. وفي نهاية التجربة، اختلف المستوى المنخفض معنوياً ($p<0.05$) بالنسبة MO، واختلف المستوى العالي معنوياً ($p<0.05$) لكل من نسبة HCT وPLT، بينما لم يكن هناك أية اختلافات معنوية في القياسات الأخرى.

الكلمات المفتاحية: الماعز، وزن الجسم الحي، حالة الجسم، الطاقة و قياسات الدم.