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Effect of Long-term Betaine Supplementation on Performance of Growing Saidi Lambs

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Abstract

The current study was carried out to investigate the effect of Long-term betaine supplementation on performance of Saidi lambs during growing period. Twenty-four local Egyptian lambs (Saidi) with 7 months of age and average body weight of 25 ±1.36 kg were used. Lambs were allocated to one of the three experimental treatments of eight replicates (control group, low betaine supplementation (LBS); supplemented with 1500 mg betaine /kg concentrate mixture or high betaine supplementation (HBS); supplemented with 2500 mg betaine /kg concentrate mixture) at RCBD design. Concentrate mixture was fed to cover 80% of the daily requirements while the other 20% was supplied by offering wheat straw *ad libtum*. Daily feed intake was recorded for each group every 24 hrs. at 8:00 am during the experimental period. In addition, lambs were weighed every two weeks during the experimental period. Also, the daily gain and feed conversion ratio were calculated for all lambs. Blood samples were collected at 7:00 am after 8 hours of fasting. Blood samples were collected from each lamb monthly and complete CBC were performed. The results showed that both levels of betaine supplementation improved feed intake ($P<0.01$), final body weight ($P<0.05$), average daily gain ($P<0.05$) and feed conversion ratio ($P<0.01$). In addition, the CBC results showed that betaine supplementation improved lambs health and decreased the harmful response to low temperature effects during winter months. The current study concludes that, using betaine supplementation either in low (1500 mg betaine /kg concentrate mixture) or in high level (2500 mg betaine /kg concentrate mixture) improves growing lambs health and ameliorates the low temperatureeffects during winter. Subsequently, those responses improved lambs performance and growth. Moreover, using high level of betaine supplementation is more effective than low level.

Keywords: *Betaine, complete blood count test, performance, lambs, daily gain.*

Introduction

Betaine was first discovered in the juice of sugar beets (*Beta vulgaris*) in the nineteenth century (Craig, 2004; Eklund *et al.*, 2006). In addition, betaine (trimethylglycine, glycine betaine) is a nontoxic amino acid derivative of the amino acid glycine which is distributed widely in nature(Yancey *et al.*, 1982). Moreover, Betaine is a zwitterionic quaternary ammonium compound and has been known as a methylamine compound due to its three chemically reactive methyl groups connected to the nitrogen atom of a glycine molecule. Consequently, betaine plays as a methyl donor and also as an osmolyte, which is necessary for the nervous, immune, renal and cardiovascu-

lar systems(Feng, 1996; Kidd *et al*., 1997). Moreover, betaine enhances the animals' growth and metabolism during its exposure to various physiological stresses such as drought or high salinity(Virtanen, 1995; Huang *et al*., 2009). As a methyl donor, betaine provides its labile methyl groups which can use in transmethylation reactions of homocysteine to methionine (McKeever *et al*., 1991; Lothong *et al*., 2016). Consequently, betaine can be used for the synthesis of several metabolically active substances such as creatine, carnitine, phosphatidylcholine as well as methylated amino acids*(Eklund et al.*, 2006). As a methyl donor, betaine is involved in protein and energy metabolism (Eklund *et al.*, 2005). Thus, betaine increases the levels of the methionine and cysteine which are necessary for a protein synthesis (McDevitt *et al.*, 2000). In addition, betaine stimulates the synthesis of carnitine for the transport of long-chain fatty acids to mitochondria, where they are oxidized(Zabaras-Krick, 1997). The current experiment aimed to study the long duration (120 days) of betaine supplementation on growing lambs' performance and their complete blood count during low temperature season (winter) in upper Egypt.

Materials and Methods

1. Location and experimental period.

A 120-day long experiment was carried out from January 17th, 2017, to May 17th, 2017, at a private sheep farm, in Petroleum Road, Jahdam, Assiut. Egypt (71111).

2. Animals and experimental design.

A total number of twenty-four local Egyptian lambs (Saidi) with 7 months of age and average body weight of 22±1.18 kg were bought from the local markets near Assiut governorate. Lambs were kept for28 days as adaptation period before starting the experiment tell their average body weight reached 25±1.36 kg. Upon the arrival, all lambs were subjected to a clinical examination. Additionally, the lambs were given preventive antimicrobial treatment against any internal and external parasites. At the end of adaptation period, all lambs were weighed, blocked in descending order according to their initial body weight. Lambs were allocated to one of the three treatment groups of eight replicates (control group, LBS; supplemented with 1500 mg betaine /kg concentrate mixture or HBS; supplemented with 2500 mg betaine /kg concentrate mixture) at random within each block. Therefore, each treatment contained lambs that covered the full range of weights available.

3. Animal housing.

Animals were housed in opened shaded grouped pens; the animals were kept under the same managerial conditions. The pen space was 24 m^2 (4×6), surrounded by 3 m concrete wall, and covered by a roof of metal sheet at 4 m height. Ambient temperature and relative humidity were recorded daily during the experimental period inside each pen at 8:00 am and 2:00 pm which were similar in the three pens.

4. Animal feeding.

Lambs were fed once a day at 8:00 am. Lambs were fed concentrate

mixture to cover 80% of their daily requirements while the other 20% was supplied by offering wheat straw *ad libtum*. Concentrate mixture composition are shown in Table (1). The concentrate mixture was kindly donated by El-Safa Factory for commercial livestock concentrate mixture, Assiut, Egypt. The samples from concentrate mixture were collected regularly every two weeks and at the end of the experiment all samples were mixed in one sample used for chemical analysis Table (2).

Table 1. Composition of concentrate mixture (%).

Composition	Percentage
Corn	42%
Wheat bran	30 %
Decorticated cotton meal	25%
Sodium chloride (table salt)	1.5%
Mineral and vitamin premix	1.5 %

Table 2. Chemical composition (% on DM basis) of concentrate mixture and wheat straw

Items	Concentrate mixture	Wheat straw
CP	13.66	3.72
CF	13.85	39.52
EE	3.58	1.69
NFE	54.68	42.28
Ash	9.74	12.79

5. Performance Measurements:

Daily feed intake was recorded every 24 hrs. for each group at 8:00 am during the experimental period. Lambs were weighed at the beginning of the experiment and then weighed every two weeks during the experimental period. The daily gain and feed conversion ratio were calculated for all lambs.

6. Blood sampling and complete blood cells count (CBC)

Blood samples were collected from each lamb monthly at 7 am before feeding. Blood samples were drawn from the jugular vein, approximately 5 ml was collected into a capped test tube containing ethylenediaminetetraacetic acid (EDTA). There after, the tube was directly used for the determination of complete blood count (CBC). Complete blood count test was performed in the hematology laboratory, Assiut University, Faculty of Veterinary Medicine, Assiut, Egypt. Complete blood cell count including hemoglobin (g/dL) (Hb) concentration, Red Blood Cell count (million cells/µL) (RBCs), Hematocrit (%) (HCT), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (Pg) (MCH), Mean corpuscular hemoglobin concentration (g/dl) (MCHC), platelet count (1000 cells/µL) (PLTs) and white blood cell count (1000 cells/µl) (WBCs) were measured in fresh whole blood using a biochemical blood analyzer (Emperor model EMP-168). White blood cell count differentials including neutrophils, band cell, segmentation, eosinophils, basophils, monocytes, and lymphocytes were manually determined by

optical microscopy (model XSZ-107BN).

7. Statistical analysis.

Data were analyzed using the Statistical Analyses System (SAS, 2013), and tested for normality prior to analysis by examination of normal distribution plots, all the experimental data were normally distributed, and no data transformation was done. The effect of treatments on animals' performance and blood parameters were analyzed using the analysis of variance with time (month or week) as repeated measure. The experimental traits were analyzed using an analysis of variance, with treatment and time as fixed effect and residual as random effect. The comparisons between different treatments and different time were done using Duncan multiple range test (Duncan, 1955). While, the interactions were tested using LS-means with PDIFF procedure.

Results and Discussions

1- Effect of betaine on animals' performance

1.1- Feed intake

Results of feed intake are shown in Table (3). Betaine did not affect dry matters consumption during the first five weeks. However, the significant differences were first appeared in week six and continued to the end of the experimental period. The overall mean of dry matter intake (the mean of the dry matter intake during all experiment period) showed that lams in HBS consume higher ($P<0.01$) dry matter by 5.69% and 6.56% than both lambs in LBS and control groups, respectively. Additionally, no differences were notice between lambs in LBS and control group.

Betaine may enhance feed consumption by reducing the energy requirement for ion pumping in the intestinal tissue which saves more energy for intestinal cell proliferation (Siljander-Rasi *et al.*, 2003). Consequently, this could provide a sufficient gut surface for nutrient absorption and enhances feed intake. Another reason is due to betaine's osmolytic properties, it improves the secretion of digestive enzymes through the maintaining of water balance and intestinal cell volume which in turn stimulates feed consumption (Eklund *et al.* 2005). Similar to the current results in grazing steers, Bock *et al.* (2004) concluded that 20 gram of betaine per head per day increased ($P<0.05$) feed intake compared with the control group. In addition, in weaned piglets, Xu *et al.* (1999a) demonstrated that dietary betaine (600 or 800 mg/kg of diet) increased feed intake ($P<0.05$) by 9.39% and 8.71%, respectively, in respect to the control group.

1.2- Body weight and daily gain

The results of body weight (BW), total gain (TG) and daily gain (DG)are shown in Table (3). It was found that during the first six weeks there were no significant differences between the three experimental groups in their BW. However, betaine supplementation improved BW in week 8 and to the end of experiment. The final weight results in Table (3) showed that lambs in HBS had 11.16% and 4.84 % higher ($P<0.5$) final weight than those in both control and LBS groups, respectively. In addition, lambs in LBS had 6% higher ($P<0.5$) final weight than those in control group. Similarly, betaine

supplementation improved both TG and DG as in Table 3. Lambs in HBS had higher (P<0.05) DG and TG than those in LBS or control group. Additionally, lambs in LBS had higher (P<0.05) DG than those in control group.

The effect on BW first appeared at week eight and continued to the rest of experimental period. On the other hand, DG response to betaine supplementation began from week two and continued to the end of the experimental period. A reason of high BW and DG of betaine supplementation might be due to the increase of feed intake of supplemented groups (Table 3) and the improvement of nutrients digestibility (Eklund *et al.*, 2006). In addition, betaine as a methyl donor (Xu *et al*., 1999a; Xu *et al*., 1999b; Eklund *et al.*, 2005), is involved in the transmethylation reactions for the conversion of homocysteine to methionine which is involved in synthesis of several metabolically active substances such as creatine, carnitine, and phosphatidylcholine ((McDevitt *et al*., 2000; Huang *et al.*, 2006; Huang *et al*., 2009). Thus, betaine is involved in protein and energy metabolism which have an important effect on animals' growth. Moreover, dietary betaine decreased the maintenance requirement for energy which causes increased BW and DG (Wang *et al*., 1998; Schrama *et al.*, 2003). Moreover, Esteve-Garcia and S. Mack (2000a) showed that betaine could increase BW and carcass weight by increasing the water retention of the muscle's tissues. Moreover, Hussein and Abdelsattar (2019) stated that lambs supplemented with 1500mg betaine/KG concentrate mixture had significant (P<0.05) higher final BW and average daily gain than those in control Group.

1.3- Feed conversion ratio (DM g /g gain)

Results of feed conversion ratio (FCR) are shown in Table (3). Both lambs supplemented with 1500 mg betaine/kg concentrate mixture and 2500 mg betaine/kg concentrate mixture had significant lower (P<0.05) feed to gain ration than those in the control group. However, no significant difference was obtained between lambs in HBS and those in LBS groups in their FCR.

In the current study, betaine supplementation significantly improved feed conversion ratio (Tables 3). The effect may be due to the increased DG associated with betaine supplementation. Similarly, several studies confirmed that betaine improved feed efficiency of pigs, Xu *et al.* (1999a) found that feed to gain ratio improved (P<0.05) by 2.19% and by 2.79% in weaned piglets fed diets with 600 and 800 mg/kg betaine, respectively. In addition, Xu *et al.* (1999b) indicated that feed to gain ratio improved (P<0.01) in pigs fed betaine (1000 mg/kg of diets) compared with un-supplemented pigs.

4.2. Complete blood cells count (CBC)

Data of CBS are presented in Table (4). Betaine supplementation did not affect Hb, MCV, MCH, MCHC, PLTs, WBCs, segmented, Basophils, Monocytes or Lymphocytes (data not shown). On the other hand, betaine supplementation had a significant (P<0.05) effect on RBCs count. In addition, at the end of January, two weeks from the experiment

beginning, lambs in control group had significant lower RBCs count than those in HBS, lambs in LBS had intermediate non-significant RBCs count. At the end of second month (February), lambs in LBS had significant ($P<0.05$) higher RBCs than those both in control and HBS. The Effect was changed by the end of March RBCs count was significant higher in lambs in HBS compared with those in LBS and control. Moreover, lambs in control and LBS had similar RBCs count. Similarly, by the end of April, lambs in HBS had significant ($P<0.05$) higher RBCs than those both in control and LBS treatment group. Additionally, lambs in LBS had higher ($P<0.05$) RBCs than those in control group in the same period. At the end of the experiment, lambs in both HBS and LBS had higher ($P<0.05$) RBCs than those in control group. The overall mean of RBCs showed a significant increase in RBCs count for lambs in HBS compared with those in control group. While lambs in LBS had a non-significant intermediate RBCs count compared with control and HBS.

Hematocrit results had similar response pattern to betaine supplementation as RBCs count which leaded to the same overall mean response. Lambs supplemented with 2500 mg betaine /kg concentrate mixture (HBS) had significant ($P<0.05$) higher hematocrit than those in control group. In contrast, no difference was obtained between lambs supplemented with 1500 mg betaine /kg concentrate mixture (LBS) and those in control group.

Effect of betaine supplementations on neutrophils are showed in Table (4). Lambs in control group had significant ($P<0.05$) higher neutrophils than those in both LBS and HBS during all experimental months except the last month (May). On the other hand, no significant differences were found between lambs in LBS and those in HBS in all experimental periods. All neutrophils count values in the three groups were within the normal range for sheep values.

Effect of betaine supplementations on Band cell is showed in Table (4). During all experimental periods lambs in control group had significant higher Band cell than those in HBS, while lambs in LBS had a non-significant intermediate values of Band cell. Similarly, Eosinophils was affected by betaine supplementation and also its response was stable during all experimental periods. Lambs in control group had significant higher Eosinophils than those in both LBS and HBS. In contrast, no differences were obtained between lambs in LBS and those in HBS. All values of WBCs count, and their differential cells were within the normal range for all lambs although there were significant differences between different groups.

Betaine supplementation increased both RBCs count and Hematocrit. This finding is similar to Ezzat *et al.* (2011)who found that betaine increased ($P<0.05$) blood RBCs in hens. In addition, El-Badry *et al.* (2015) found that dietary betaine (1.5 g/kg of diet) increased ($P\leq0.05$) RBCs count and Hb concentration in ducks. Moreover, Abdelsattar *et al.* (2020) stated that lambs supplemented with 1500 mg betaine/kg concentrate mixture had improved

hematological parameters compared with control. The high concentration of some hematological parameters might be due to the better nutrient utilization (Table 3) especially of iron and consequently, high Hb concentration, RBC count and HCT value. The improvement of the hematological picture after betaine supplement indicated the improvement of health status of lambs that might be responsible for the significant increase of the BW of betaine supplemented groups than control (Table 3).

In contrast, betaine supplementation decreased Neutrophils, Band and Eosinophils compared with control group. The increase in the production of immature neutrophils in the blood circulation (band cell) is called the left shift or blood shift which indicates stress exposure responses (Hassan *et al.*, 2011; Kumar *et al.*, 2014). The stress may be caused in control group by the cold during winter season, betaine supplementation improved animals' response to low temperature during winter. Then, low blood eosinophil and band neutrophils percentages in supplemented groups indicated the healthy status of lambs fed dietary betaine especially when WBC count was in normal level.

Conclusions

The current study reveals that using betaine supplementation either in low (1500 mg betaine/kg concentrate mixture) or in high level (2500 mg betaine/kg concentrate mixture) improves growing lambs health and ameliorates the low temperature effects during winter. Subsequently, those responses improved lambs' performance and growth. Moreover, the results showed that, using high level of betaine supplementation has more positive effects than low level in lambs' health and growth. Subsequently, the current study strongly recommends using high level of betaine supplementation (2500 mg betaine /kg concentrate mixture or more)to improve lambs health and growth performance during growing period.

Table 3. Effect of betaine supplementation on lambs' performance

Performance	Significance	Treatments		
		Control	LBS	HBS
Dry matter intake (kg/day)	**	$1.22^{B} \pm 0.02$	$1.23^{B} \pm 0.02$	$1.30^{A} \pm 0.03$
Initial weight (kg)	NS	25.23±1.41	25.43±1.30	25.96±1.37
Final weight (kg)	*	$44.63^{C} \pm 0.90$	$47.32^{B} \pm 1.28$	$49.61^{A} \pm 1.62$
Total gain (kg)	*	$19.40^{C} \pm 1.2$	$21.89^{B} \pm 1.02$	$23.65^{A} \pm 1.08$
Daily gain (g/day)	*	$161.77^{C} \pm 6.52$	$182.42^{B} \pm 8.33$	$197.08^{A} \pm 6.45$
FCR (DM / DG)	*	$7.54^{A} \pm 1.01$	$6.74^{B} \pm 0.92$	$6.60^{B} \pm 0.56$

^{A}, ^{B} and ^{C} means within the same row are significantly different; * Significant (P<0.05); ** Highly significant(P<0.01). Treatments are; supplemented betaine with 0 mg/kg concentrate mixture(control); supplemented with 1500 mg betaine / kg concentrate mixture (LBS) and supplemented with 2500 mg betaine / kg concentrate mixture (HBS). FCR; feed conversion ratio.

Table 4. Effect of betaine supplementation on complete blood account (CBC).

		Significance	Control	LBS	HBS
Red blood cells million cells / µL	January	*	3.11^{B}±0.05	3.32^{AB}±0.10	3.40^{A}±0.22
	February	*	2.95^{B}±0.24	3.01^{A}±0.25	2.56^{B}±0.26
	March	*	3.21^{B}±0.16	3.20^{B}±0.21	3.66^{A}±0.30
	April	*	3.06^{C}±0.18	3.53^{B}±0.29	3.81^{A}±0.31
	May	*	3.07^{B}±0.07	3.52^{A}±0.04	3.56^{A}±0.10
	Overall	*	3.08^{B}±0.07	3.32^{AB}±0.09	3.40^{A}±0.14
Hematocrit %	January	*	27.89^{B}±0.39	29.70^{AB}±0.81	30.68^{A}±2.00
	February	*	26.63^{A}±2.12	27.14^{A}±2.22	23.04^{B}±2.35
	March	*	28.70^{B}±1.39	28.93^{B}±1.95	33.12^{A}±2.65
	April	*	27.55^{C}±1.66	31.77^{B}±2.58	34.28^{A}±2.78
	May	*	27.73^{B}±0.57	30.98^{A}±0.82	32.28^{A} ±0.91
	Overall	*	27.70^{B}±0.58	29.70^{AB}±0.82	30.68^{A}±1.23
Neutrophils %	January	*	44.50^{A}±0.18	42.70^{B}±0.57	42.80^{B}±0.73
	February	*	45.20^{A}±0.86	41.00^{B}±1.38	43.20^{B}±1.80
	March	*	44.20^{A} ±1.32	42.00^{B}±2.30	41.80^{B}±0.58
	April	*	44.40^{A}±0.81	43.60^{B} ±0.98	43.00^{B} ±1.10
	May	NS	45.60±2.54	44.20±1.77	44.20±.62
	Overall	*	44.78^{A}±0.58	42.70^{B}±0.66	43.00^{B}±0.70
Band cell%	January	*	3.70^{A}±0.15	3.10^{AB}±0.29	2.85^{B}±0.38
	February	*	3.20^{A}±0.20	3.00^{AB}±0.24	2.60^{B}±0.51
	March	*	4.00^{A}±0.45	3.00^{AB}±0.32	2.80^{B}±0.20
	April	*	3.60^{A}±0.51	3.00^{AB}±0.24	3.00^{B}±0.00
	May	*	3.00^{B}±0.45	3.40^{AB}±0.51	3.00^{A}±0.45
	Overall	*	3.50^{A}±0.17	3.10^{AB}±0.18	2.85^{B}±0.21
Eosinophils %	January	*	1.85^{A}±0.74	0.90^{B}±0.41	0.80^{B}±0.37
	February	**	4.80^{A}±0.73	2.30^{B}±0.40	2.10^{B}±0.37
	March	*	1.20^{A}±0.20	0.80^{B}±0.37	0.60^{B}±0.24
	April	*	0.60^{A}±0.24	0.40^{B}±0.24	0.20^{B}±0.20
	May	*	1.81^{A}±0.24	1.00^{B}±0.18	0.90^{B}±0.30
	Overall	*	1.71^{A}±4.40	0.90^{B}±0.21	0.80^{B}±0.19

^{A}, ^{B} and ^{C} means within the same row are significantly different; * Significant (P<0.05); ** Highly significant(P<0.01). Treatments are supplemented betaine with 0 mg/kg concentrate mixture(control); supplemented with 1500 mg betaine/kg concentrate mixture (LBS) and supplemented with 2500 mg betaine/kg concentrate mixture (HBS).

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تأثير اضافة البيتاين لفترات طويله على اداء الحملان الصعيدي خلال فترة النمو

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قسم الانتاج الحيواني – كلية الزراعة – جامعة أسيوط – أسيوط ٧١٥٢٦ – مصر

الملخص

اجريت الدراسة الحالية خلال فصلي الشتاء والربيع لعام ٢٠١٧ وامتدت لفترة ١٢٠ يوم بمزرعه خاصه على طريق البترول، جحدم، أسيوط. حيث اجريت الدراسة الحالية على عدد ٢٤ من حملان الاغنام الصعيدي والتي يبلغ متوسط اعمارها ٧ شهور بمتوسط وزن ٢٥ كجم بغرض دراسة اثر اضافة البيتايين على اداء الحملان الصعيدي خلال فترة النمو. تم تقسيم الحملان الى ثلاث مجاميع متساويه في الوزن عوملت باحد معاملات التجربه كالتالي المعامله الضابطه لم تتلقي اي اضافات من البيتايين، مجموعه البيتايين المنخفضه وتم تغذيتها على مخلوط مركز يحتوي على ١٥٠٠ مجم بيتايين / كجم من المخلوط المركز، مجموعه البيتايين المرتفعه وتم تغذيتها على مخلوط مركز يحتوي على ٢٥٠٠ مجم بيتايين / كجم من المخلوط المركز. تم تغذية الحيوانات على المخلوط المركز بحيث يغطي ٨٠% من احتياجات الحملان كما تم تقديم تبن القمح كمادة مالئة حتى الشبع. تم قياس كمية الغذاء المأكول يوميا خلال فترة التجربه، كما تم وزن الحيوانات كل اسبوعين، بالاضافه الى حساب معدل الزيادة اليومية وكفاءة تحويل الغذاء. كما تم سحب عينات الدم من كل حملان التجربه شهريا من خلال استنزاف الوريد الودجي وعمل صورة دم كامله للحيوانات وتم الحصول على النتائج التالية:

- أدت المعاملة بالبيتايين سواء بمستوي منخفض او مرتفع لفترات طويله الى تحسين كمية المادة الجافه الماكوله عند مستوي معنويه ($P<0.05$) خلال فترة التجربه كما اسفرت النتائج عن زيادة كمية المادة الجافه الماكوله بواسطة الحملان التي عوملت بمستوى مرتفع من البيتايين عن مثيلاتها التي عوملت بمستوى منخفض وكانت هذه الفروق معنويه عند مستوى ($P<0.05$).
- كان لاضافة البيتايين الى علائق الحيوانات تأثير ملحوظ على وزن الجسم النهائي للحيوانات، حيث أدت المعاملة بالبيتايين بكلا مستوييه المرتفع والمنخفض الى زيادة وزن الحملان في نهاية التجربه بشكل معنوي ($P<0.05$) مقارنة بالحملان الغير معامله (المجموعة الضابطة)، علاوة على ذلك فان الوزن النهائي للحيوانات المعاملة بمستوى مرتفع من مكمل البيتايين كانت اعلى من مثيلاتها المعاملة بمستوي منخفض من البيتايين بصوره معنويه ($P<0.05$).
- اظهرت صفتي معدل الزيادة اليومية وكفاءة التحويل الغذائي نفس استجابة وزن الجسم النهائي للمعاملة بالبتايين حيث ان كلا الصفتين يعتمد على وزن الجسم في حسابهما.
- اظهرت النتائج المتحصل عليها من عمل صورة دم للحملان شهريا بان استخدام البيتايين كمكمل غذائي ادى الى تحسن الحالة الصحية للحملان وعدم تأثرها بانخفاض درجات الحرارة خلال فصل الشتاء مما انعكس على نموها وتحسن كفاءة التحويل الغذائي لها، بالاضافة الى أن المستوى المرتفع من البيتايين كان ذو تأثير افضل على صحة الحيوان وصفات صورة الدم مقارنة بالمستوى المنخفض.
- وتوصي الدراسة الحالية باستخدام البيتايين كمكمل غذائي لحملان الصعيدي خلال فترات النمو حيث انه يحسن من صحة الحيوانات ويجعلها قادرة على التاقلم ضد اي اجهاد تتعرض له خلال فترة نموها مما ينعكس على تحسن اداء هذه الحيوانات.