

LACTATION PERFORMANCE OF SOHAGI SHEEP AS AFFECTED BY FEEDING CANOLA PROTECTED PROTEIN

A. Y. Kassab¹; A. A. Abdel-Ghani²; G. M. Solouma¹; E. B. Soliman² and A. K. Abd El moty².

¹Department of Animal Production, Faculty of Agriculture, Sohag University.
Egypt

² Department of animal production, Faculty of Agriculture, Minia University.
Egypt

ABSTRACT

Twenty four healthy Sohagi ewes averaged 46.40 ± 1.40 Kg body weight were used in a comparative feeding trial to investigate the effect of feeding protein protected canola meal on milk yield and composition and the suckling lambs' performance during lactation period (8 weeks). The canola meal was replaced 25% of the concentrate mixture (on DM basis). The animals were divided randomly into three equal groups as: control (untreated canola meal, CM), heated CM (T1) or sodium hydroxide treated CM (T2). Wheat straw was offered for all ewes as a bulky ingredient with concentrates. Three digestibility trials were carried out to determine the digestibility and feeds nutritive values of the experimental rations.

Results indicated that digestibility of DM, OM and all nutrients, except CF, were significantly higher with tested rations than the control one and that heat treatment was superior. Similar trends among treatments were occurred with feeding values (TDN & DCP). The ewes reached their maximum milk yield at the second week of lactation, and then gradually decreased till the end of lactation. Milk yield of T1 and T2 increased ($P < 0.01$) by 17.5 and 6.85 %, respectively, compared with control group. Milk fat percentage gradually increased with advancing stage of lactation where it averaged 5.46, 5.72 and 5.59 % for control, T1 and T2, respectively with significant differences among them. The values of milk protein content and daily protein yield were significantly ($P < 0.01$) superior for T1 followed by T2 then control. Milk energy content in T1 and T2 were significant ($P < 0.01$) higher than that of control. The highest ($P < 0.01$) weaning weight and daily gain for lambs were recorded with T1, followed by T2 then control.

It could conclude that protein protection of canola meal had beneficial effect on ewes and their suckling lambs. **Meanwhile**, heat treatment is more efficient than sodium hydroxide.

Key words: Sheep, milk, growth, performance, protected protein

INTRODUCTION

The protein content in diets of ruminant animals is essential for growth and production requirements. Possibility that reasonable portions of high quality protein of feedstuffs may be degraded in the rumen is occurred which negatively affect animal utilization of the feed. In this context there are several methods for protection of dietary protein from degradation in the rumen. The impact of protected protein on milk production of sheep or goats was studied by Bacar-Huskic *et al.* (1998), Aly (2005) and El-Shabrawy (2006).

The main objective of this study was to investigate the influence of feeding protected protein of canola meal on milk production, composition and suckling performance of Sohagi ewes and their lambs.

MATERIALS AND METHODS

The present study was carried out at the Experimental Farm of Animal Production Department, Faculty of Agriculture, Sohag University in cooperation with Animal Production Department, Faculty of Agriculture, Minia University.

1- Experimental design:

Treated or untreated (control) of canola meal, which represent 25% in concentrate feed mixture, were tested in three experimental rations. The formulation of the concentrate mixtures in the present experiments are presented in Table (1).

A total number of 24 healthy Sohagi ewes average 46.40 ± 1.40 Kg body weight (BW), where all gave birth of single lambs were used in this study. The ewes were divided into three equal (n=8) groups as control fed unprotected canola meal, heat protected canola meal (T1) according to **Stern *et al.* (1985)** and canola meal protected with sodium hydroxide solution (T2) according to **Mir *et al.* (1984)**. Ewes were offered their requirements of concentrate diets and wheat straw according to **NRC (1985)** allowances. Wheat straw was offered for all ewes as a bulky ingredient mixed with concentrates.

Milk yield (MY) of ewes during the suckling period was estimated through the weight of suckled lambs according to **Economides (1986)**. Lambs were separated daily from their dams at 5:00 pm on the evening and in the following morning day at 07:00 am. Lambs were weighed and allowed to suckle their dams for 15 minutes. Their BW was then recorded and lambs separated again til the next day at 5:00 pm. This procedure was repeated weekly during the whole suckling period. Milk samples were taken weekly throughout the suckling period from all experimental ewes. Equal samples were taken in the morning and afternoon and then both samples were mixed together in a composite sample for chemical analysis. Milk samples (50 ml) was collected by hand milking from both sides of the udder per ewe. Fat % of milk samples were assayed immediately. Then samples were stored at -20 °C. Before chemical analyses samples were thawed at room temperature and agitated for homogenization. Milk samples were analyzed for protein (N X 6.38) as described by **Ling (1963)**. Milk energy values were calculated using the following equation as proposed by **Economides (1986)**.

$$\text{Calorific value (MJ/kg)} = 1.94 + 0.43 \times \text{fat\%}$$

Weekly suckling lambs' weight and their average daily gain (ADG) in each treatment were determined.

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Table (1): Formulation of the experimental concentrate mixtures.

Items	Treatments		
	Control	T1	T2
Canola meal (C.M.) %			
C. M. Untreated (Control)	25	-----	
C. M. Treated by heat (T1)	-----	25	-----
C. M. Treated by Sodium hydroxide (T2)	-----		25
Maize grain %	42	42	42
Wheat bran %	30	30	30
Premix %	0.5	0.5	0.5
Sodium chloride %	0.5	0.5	0.5
Limestone %	2.0	2.0	2.0

* Premix contents per 3 kg are of vit. A. 12000000 IU; vit. D3, 2200000 IU; vit. E, 10 gm; vit. K3, 2 gm; copper, 10 gm; zinc, 50 gm; Manganese, 55 gm; Iodine, 1 gm; Selenium, 0.1 gm; Carrier (CaCo3), up to 3000 gm.

2- Evaluation of the experimental rations:

To evaluate the effect of feeding protected protein on digestibility coefficients of nutrients and nutritive values of different tested rations, total number of 12 healthy male Sohagi lambs averaged 35.8±1.29 kg body weight were used in digestion trials. The animals were divided randomly into three equal (n=4) groups and kept separately in pens to be fed individually on concentrate diet (80%) and wheat straw (20%) for 3 weeks. Fresh water was available all the day . Feedstuffs were analyzed according to **A.O. A. C (1980)**

Digestibility coefficients of DM, OM, CP, CF, EE and NFE were determined using acid insoluble ash (AIA %) as natural marker according to **Van keulen and Young (1977)**. The nutritive values (TDN and DCP %) of the experimental rations were calculated.

Dry matter digestibility (DMD) was calculated according to the following equation:

$$\text{DMD}\% = 100 - \frac{\text{con. AIA of feed DM}}{\text{con. AIA of feces DM}} \times 100$$

Nutrient digestibility was calculated by the following equation:-

$$Y = 100 - \frac{N}{M} (100 - \text{DMD})$$

Where, Y= Digestibility of nutrient. N= % nutrient in feces.

M=% nutrient in feed. DMD=Dry matter digestibility

3- Statistical analysis:

The results were statistically analyzed using the General Linear Model (**SAS, 1998**) for complete randomized design. Productive parameters were performed by

methods of analysis of variance. All statements of significant difference are based on the 0.05 or 0.01 probability levels. Significant differences among treatments, within the experiment, were analyzed using **Duncan (1955)**.

RESULTS AND DISCUSSION

1- Nutritive values of experimental rations:

Digestibility coefficients of the experimental rations and their contents are presented in Table (2). Heat and sodium hydroxide treatments recorded higher ($p < 0.05$) values of DMD than control one. While T1 was significantly higher in DMD than T2. Similar trend was noticed on digestibilities of OM, CP, EE and NFE. The CF digestibility did not, significantly, influenced by the two methods of protecting protein. The nutritive values expressed as TDN and DCP were also significantly higher for treated rations than control one. Improvement in DMD for heat or sodium hydroxide treatments compared with control may be due to the positive effect of protein protection on maintaining diet in the rumen which reflected on increasing digestibility of most nutrients especially CP, EE, and NFE. Similar trend for digestibility coefficients of OM, CP, EE, and NFE was observed.

The present results are in agreement with those reported by **Atwal et al. (1995)**; **El- Shabrawy (1996)**; **El-Ayek et al. (1999)** and **El- Reweny (1999 & 2006)** whom indicated that protein protection of different forms of animal rations improved the digestibility coefficient of different nutrients and elevate the nutritive values of the ruminant rations.

2- Milk yield (MY):

Data of daily milk yield (DMY) and total milk yield (TMY) during lactation

Table (2): The effect of treatments on digestibility coefficients of feed contents and nutritive value of the experimental rations.

Treatments	Digestibility coefficients (LSM) •							
	DM	OM	CP	EE	CF	NFE	TDN	DCP
Control	66.03 ^c	68.04 ^c	67.84 ^c	67.69 ^c	61.23	69.39 ^c	65.27 ^c	9.96 ^c
T1	69.77 ^a	71.42 ^a	71.87 ^a	71.30 ^a	61.11	72.51 ^a	68.01 ^a	10.62 ^a
T2	67.79 ^b	69.76 ^b	70.31 ^b	69.69 ^b	61.76	71.21 ^b	66.98 ^b	10.46 ^a
±SE	1.44	1.57	1.19	1.38	1.05	1.00	1.32	0.36

Values are least square means (LSM) ± standard error.

a, b, c, values with the same letters in the same column are not significantly different, ($P < 0.05$).

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periods are presented in Table (3). The present results indicated that T1 and T2 increased TMY by 17.05 % and 6.85%, respectively, compared with control. The differences were significant ($P < 0.01$) among treatments, being the highest with T1 and the lowest with control. Over the 8 wks, the DMY and TMY significantly showed the highest estimates with T1, followed by T2 then control (Table 3). These results may be due to the increase in rumen undegradable protein that subsequently escaped to reach the lower gut (small intersected portion) for highly efficient enzymatic digestion. Ration containing protected protein, either achieved by using heat or sodium hydroxide, probably led to higher flow of N and essential amino acids to the small intestine which support milk production than that of untreated ration (Cunningham *et al.*, 1996). The present results are in agreement with those of Bacar-Huskic *et al.* (1998), who reported that supplementation with protected methionine increased milk yield in goats. Also, El-Shabrawy (2006) indicated significant increase ($P < 0.05$) in milk yield (13.9% and 12.9%) for goats fed formaldehyde or heat treated soybean meal compared to goats fed untreated soybean meal.

Results in Table (3) show that lactation reached the peak at the second week of lactation, then decreased gradually till the end of lactation. This result is in agreement with Maharem (1996) on Barki ewes. Also, similar results were obtained by Mousa *et al.* (1997); Hayder (2004) Hamdon (2005) and El-Medany (2005).

Table (3): Effect of protected protein methods on average daily milk yield (DMY) and total milk yield (TMY) of ewes during the lactation period.

Items	Treatments (LSM) •			±SE
	Control	T1	T2	
<i>DMY (g/d)</i>				
Week1	765.6 ^c	900.0 ^a	831.2 ^b	6.75
Week2	1118.7 ^c	1321.8 ^a	1215.6 ^b	14.87
Week3	981.2 ^c	1203.1 ^a	1071.8 ^b	17.09
Week4	871.8 ^c	1028.1 ^a	943.7 ^b	14.49
Week5	756.2 ^c	871.9 ^a	787.5 ^b	7.72
Week6	678.1 ^c	765.6 ^a	703.1 ^b	8.03
Week7	606.2 ^b	678.1 ^a	621.8 ^b	9.78
Week8	512.5 ^c	593.7 ^a	546.8 ^b	6.18
<i>TMY (kg)</i>	44.03 ^c	51.54 ^a	47.05 ^b	0.83

• Values are least square means (LSM) ± standard error.
a, b and c means with the same letters in the same row are not significantly different ($P < 0.01$).

3 - Milk Composition:

3.1- Milk fat

Data in Table 4 show the effect of the two protein protection methods during the successive 8 wks – suckling period on milk fat level and yield. Milk fat percentages and yield were significantly the highest with T1 and the lowest with control ration during the whole lactation period. By calculation T1 and T2 increased daily fat yield by 21.5% and 8.6% respectively compared to control group. This increase may be due to the increased digestibility of most nutrients and TDN as a result of protein protection. These results are in agreement with those of **El-Ayek *et al.* (1999)**; **El-Shabrawy (2000)** and **Ismail and El-Shabrawy (2002)** who reported that milk fat yield increased when lactating animals fed protected protein. In sheep, **Khattab *et al.* (2004)** found that ewes received corn gluten ration (natural protected protein) had significantly ($P < 0.05$) more fat yield than those received linseed cake (less natural protected protein). Also, these results are in accordance with those of **Sevi *et al.* (1998)** and **Roeder *et al.* (2000)** who found that milk fat content increased ($P < 0.05$) as the level of protected protein increased in the ration.

Table (4) show that fat percentage increased gradually with advancing stage of lactation until the end of the lactation period while fat yield increased up to the third week, then decreased gradually. These results are in agreement with those of **Mousa *et al.* (1997)**.

3.2 -Milk protein:

Milk protein percentage increased gradually with advance of lactation until the end of the lactation, while the daily protein production decreased after a peak at the second week of lactation (Table, 5). Similarly, **Hamdon (2005)** found that protein% in milk of Chios and Farafra ewes increased gradually with advancing stage of lactation.

There is evident improvement in protein percentages in T1 and T2 compared to control. This result may be due to the increased digestibility coefficient of crude protein as a result of protein protection and subsequently the potential supply of amino acids that generated from the enzymatic digestion of the escaped protein portion to the small intestine. These results are in agreement with those of **Cunningham *et al.* (1996)** who reported that improving milk composition probably due to the higher flow of N and essential amino acids to the small intestine. The positive effect of protected protein in the diets on milk protein production was studied by **El-Shabrawy (2006)** where he found that protein percentage in goat milk was greater ($P < 0.05$) with formaldehyde treated soybean meal and heat treated soybean seed than that of untreated soybean meal one.

Generally, the average milk fat and protein percentages were increased gradually from the third week of lactation to reach its maximum level at the last week (8 weeks). These results illustrate that there is a negative correlation between milk composition (fat and protein) and milk yield. Similar results were indicated by

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Hamdon (2005) who found that with advancing stage of lactation milk production decreased and at the same time percentage of fat and protein increased in ewes.

Table (4): Effect of protected protein methods on milk fat levels.

Items	Treatments (LSM) •			±SE
	Control	T1	T2	
<i>Daily Fat %</i>				
Week1	4.35 ^c	4.39 ^a	4.38 ^b	0.01
Week2	4.40 ^C	4.64 ^A	4.49 ^B	0.02
Week3	5.10 ^C	5.21 ^A	5.17 ^B	0.02
Week4	5.55 ^C	5.62 ^A	5.60 ^B	0.01
Week5	5.60 ^c	5.83 ^a	5.66 ^b	0.03
Week6	5.95 ^C	6.35 ^A	6.19 ^B	0.03
Week7	6.29 ^C	6.71 ^A	6.55 ^B	0.03
Week8	6.37 ^C	6.98 ^A	6.70 ^B	0.01
Overall mean of treatment	5.46 ^c	5.72 ^A	5.59 ^B	0.01
<i>Daily fat production(g/d)</i>				
Week1	33.25 ^C	39.59 ^A	36.43 ^B	0.78
Week2	50.17 ^C	61.36 ^A	54.56 ^B	1.09
Week3	50.08 ^C	62.65 ^A	54.99 ^B	1.06
Week4	48.37 ^C	57.78 ^A	52.85 ^B	1.07
Week5	41.44 ^C	50.86 ^A	44.63 ^B	0.93
Week6	40.37 ^C	48.62 ^A	43.54 ^B	0.82
Week7	38.15 ^C	45.48 ^A	40.72 ^B	0.68
Week8	32.64 ^C	41.48 ^A	36.63 ^B	0.93
Overall mean of treatment	41.93 ^C	50.97 ^A	45.54 ^B	0.79

•Values are least square means (LSM) ± standard error.

a, b and c means with the same letters in same row are not significantly different (P< 0.05).

A, B and C Means with same letters in the same row are not significantly different (P< 0.01).

Table (5): Effect of protected protein methods on milk protein level and yield of ewes during successive weeks of lactation period.

Items	Treatments (LSM) •			±SE
	Control	T1	T2	
<i>Daily protein %</i>				
Week1	4.07 ^c	4.35 ^a	4.22 ^b	0.04
Week2	4.55 ^c	4.90 ^A	4.73 ^B	0.02
Week3	5.02 ^c	5.23 ^A	5.09 ^B	0.02
Week4	5.15 ^c	5.29 ^A	5.30 ^B	0.02
Week5	5.27 ^c	5.77 ^A	5.38 ^B	0.01
Week6	5.49 ^c	5.86 ^A	5.60 ^B	0.02
Week7	5.71 ^c	6.17 ^A	5.93 ^B	0.02
Week8	5.69 ^c	6.37 ^A	6.21 ^B	0.01
Overall mean of treatment**	5.11 ^c	5.49 ^A	5.32 ^B	0.02
<i>Daily protein production (g/d)</i>				
Week1	30.95 ^c	39.12 ^A	35.89 ^B	1.45
Week2	50.93 ^c	64.81 ^A	57.46 ^B	1.17
Week3	49.29 ^c	62.89 ^A	54.68 ^B	1.47
Week4	44.86 ^c	54.35 ^A	50.03 ^B	1.28
Week5	39.06 ^c	50.29 ^A	42.38 ^B	0.96
Week6	37.28 ^c	44.87 ^A	39.38 ^B	0.69
Week7	34.60 ^c	41.81 ^A	36.86 ^B	0.69
Week8	29.17 ^c	37.83 ^A	33.93 ^B	1.02
Overall mean of treatment**	39.62 ^c	49.50 ^A	43.83 ^B	0.81

•Values are least square means (LSM) ± standard error.

a, b and c means with the same letters in same row are not significantly different (P< 0.05).

A, B and C Means with same letters in the same row are not significantly different (P< 0.01).

4- Milk energy:

The effects of the two protected protein treatments on milk energy content during the whole lactation period are presented in Table (6). Heat treatment (T1) showed the highest energy content, followed by sodium hydroxide treatment (T2) then the control. Energy content increased by advance of lactation in all groups. The

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increased of milk energy (MJ/Kg) in T1 and T2 may be due to their higher fat percentage (Table 4) compared to the control. Similar results were obtained by Hamdon (2005) who found that energy content was increased gradually with increasing fat percentage along the progressive stage of lactation in ewes.

Table (6): Effect of protected protein methods on milk energy of ewes during successive weeks of the lactation periods.

Items	Treatments (LSM) •			±SE
	Control	T1	T2	
<i>Daily Energy(MJ/kg)</i>				
Week1	3.81 ^b	3.83 ^a	3.82 ^{ba}	0.01
Week2	3.83 ^c	3.94 ^a	3.87 ^b	0.01
Week3	4.13 ^c	4.18 ^a	4.16 ^b	0.01
Week4	4.32 ^c	4.36 ^a	4.35 ^b	0.01
Week5	4.35 ^c	4.45 ^a	4.37 ^b	0.01
Week6	4.49 ^c	4.67 ^a	4.60 ^b	0.01
Week7	4.65 ^c	4.82 ^a	4.76 ^b	0.01
Week8	4.68 ^c	4.94 ^a	4.82 ^b	0.01
Overall mean of treatment**	4.29 ^C	4.40 ^A	4.34 ^B	0.01

•Values are least square means (LSM) ± standard error.

a, b and c means with the same letters in same row are not significantly different (P< 0.05).

A, B and C Means with same letters in the same row are not significantly different (P< 0.01).

5-Body weight and daily gain of suckling lambs:

Body weight and daily gain of suckling lambs during lactation period are presented in Table (7). The highest weaning weight and average daily gain were found in T1 , followed by T2 then control with significant differences among them. These increases being 15.69 % for T1 and 9.81 % for T2 compared with the control group. The increased body weight and daily gain of lambs during suckling period in T1 and T2 may be due to the positive effect and more efficient of dietary protein utilization of these tested rations compared with control one. These results are in agreement with Ahamed (1999), Dean *et al.* (1999) and Hegarty *et al.* (1999) who reported that high level of nutrition during early lactation period had a positive effect (P<0.01) on milk production, growth rates, weaning weight, total body weight and daily body weight gain

for Zaraibi kids. Also, *Khattab et al. (2004)* found that plan of nutrition for dams had positive effect on milk production, suckling and weaning weight of lambs.

Table (7): Effect of protected protein methods on body weight and daily gain of suckling lambs during successive weeks of lactation.

Items	Treatments (LSM)			±SE
	Control	T1	T2	
<i>Lamb weight (kg)</i>				
Week1	3.61 ^b	3.83 ^a	3.68 ^b	0.01
Week2	4.68 ^C	5.27 ^A	5.01 ^B	0.01
Week3	5.68 ^C	6.71 ^A	6.43 ^B	0.04
Week4	6.73 ^C	8.08 ^A	7.59 ^B	0.05
Week5	8.16 ^C	9.85 ^A	9.64 ^B	0.05
Week6	10.43 ^C	11.61 ^A	11.18 ^B	0.05
Week7	11.63 ^C	13.49 ^A	12.62 ^B	0.05
Week8	13.03 ^C	14.72 ^A	14.02 ^B	0.01
Daily gain (g/d) **	168.13 ^C	194.51 ^A	184.63 ^B	1.00

•Values are least square means (LSM) ± standard error.

a, b and c means with the same letters in same row are not significantly different (P< 0.05).

A, B and C overall mean with same letters in the same row are not significantly different (P< 0.01).

The present results help to conclude that there is a certain beneficial effect due to heat treatment of canola meal on milk yield and contents and consequently lambs performance during suckling. Sodium hydroxide treatment also has significant effects but less than that achieved by heating. So, unless it is cost wise treatment heating is more recommended.

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" بسم الله الرحمن الرحيم "
الملخص العربي

كفاءة إنتاج اللبن في الأغنام السوهاجي المغذاة على بروتين الكانولا المحمي

أيمن يوسف كساب 1 و- عادل عبدا لله عبد الغني 2 وجمال محمود سلومه 1 و- عصام بسيوني سليمان 2
و- عبد المعطي خيرى إبراهيم 2
1 قسم الإنتاج الحيواني والدواجن - كلية الزراعة - جامعة سوهاج - مصر 2 قسم الإنتاج الحيواني - كلية
الزراعة - جامعة المنيا - مصر

الملخص:

أجريت هذه التجربة على نعاج أثناء إنتاجها اللبن (8 أسابيع من الولادة) وذلك لدراسة تأثير البروتين المحمي على إنتاج اللبن وتركيبه وكذلك على أداء الحملان النامية أثناء فترة الرضاعة. استخدم في هذه الدراسة عدد 24 نعجة سوهاجي ذات ولادات فردية وكان وزن الجسم الحي لهذه النعاج 46.4 ± 1.4 كجم. تم تقسيم الحيوانات إلى ثلاثة مجاميع متساوية (8 نعاج في كل مجموعة) والمعاملات هي مجموعة الكنترول، مجموعة كسب الكانولا المعامل بالحرارة ومجموعة كسب الكانولا المعامل بهيدروكسيد الصوديوم ويمثل كسب الكانولا 25% من مخلوط العلف المركز. تم تقدير محصول إنتاج اللبن من النعاج أثناء الرضاعة بواسطة طريقة وزن الحملان قبل وبعد الرضاعة. تم أخذ عينات اللبن أسبوعيا من جميع النعاج التي ترضع خلال فترة التجربة. وتم خلط عينات الصباح والمساء معا وأخذت منهم عينات للتحليل الكيميائي وذلك لتقدير نسبة الدهن والبروتين كما تم تقدير كمية الطاقة بطريقة حسابية. تم تقدير وزن الجسم في الحملان التي ترضع في جميع المعاملات ومنها تم حساب معدل النمو في الحملان الرضية. ويمكن تلخيص أهم نتائج الدراسة فيمايلي.

أظهرت النعاج أعلى مستوى من إنتاج اللبن في الأسبوع الثاني من فترة إنتاج اللبن ثم بعد ذلك تناقص إنتاج اللبن تدريجيا حتى نهاية فترة الحليب. كان تأثير معاملة كسب الكانولا سواء بالحرارة أو هيدروكسيد الصوديوم عالي المعنوية ($P < 0.01$) وكانت الزيادة 17.05% ، 6.85% في كلتا المعاملتين على التوالي بالمقارنة بمجموعة الكنترول. وقد وجد أن نسبة الدهن تزيد زيادة قليلة مع تقدم منحنى الحليب نحو النهاية وقد سجلت نسبة الدهن في المعاملات بـ 5.46% ، 5.72% ، 5.59% لكل من الكنترول ، المعاملة بالحرارة وبالصوديوم على التوالي وكانت النسبة المنوية لزيادة نسبة الدهن في المعاملات عن مجموعة الكنترول 4.76% ، 2.38% لكل من معاملة الحرارة و معاملة هيدروكسيد الصوديوم على التوالي.

سجلت نسبة البروتين (جرام / يوم) زيادة عالية المعنوية ($P < 0.01$) في أثناء فترة إنتاج اللبن وقد سجلت نسبة البروتين زيادة قليلة مع التقدم في مرحلة الحليب حتى نهايته. وقد سجلت متوسطات نسبة البروتين 5.11 ، 5.49 ، 5.32 لكل من الكنترول و المعاملة بالحرارة ومعاملة هيدروكسيد الصوديوم على التوالي. وجد أن قيمة الطاقة (ميغا كالورى / كجم لبن) هي 4.29 ، 4.4 ، 4.32 لكل من الكنترول و المعاملة بالحرارة ومعاملات هيدروكسيد الصوديوم على التوالي. وجد أن معاملة الحرارة قد سجلت قيم عالية المعنوية لوزن الفطام ومتوسط معدل النمو اليومي عن معاملة هيدروكسيد الصوديوم والكنترول.

ويستخلص من هذه الدراسة أن التغذية على بروتين الكانولا المحمي لها فوائد عديدة منها تحسين محصول إنتاج اللبن وتحسين مكونات اللبن وكذلك تحسين معدل نمو الحملان للنعاج التي تغذت على بروتين محمي وتوصى الدراسة بحماية كسب الكانولا بالحرارة حيث سجلت مجموعة حماية الكسب الحرارة أفضل النتائج تليها مجموعة حماية الكسب بهيدروكسيد الصوديوم.