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EFFECT OF PROTECTED PROTEIN ON PERFORMANCE OF CROSSBRED EWES AND THEIR OFFSPRING

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ABSTRACT

Forty eight crossbred ewes at the last two months of pregnancy were divided into two similar groups (24 in each). Ewes in the first group were fed untreated concentrate feed mixture (UPP), while in the second group were fed concentrate feed mixture treated with formaldehyde (1% of CP) (PP). Wheat straw was offered *ad lib* for the two groups. Born lambs from both the two groups suckled their dams until weaning at 12 weeks of age.

Results obtained showed that the digestibility coefficients of all nutrients and nutritive values and the intake of DM, TDN and DCP by ewes were significantly higher ($P<0.05$) for PP than UPP ration. The yield of colostrums and milk and their contents of fat, protein, SNF and TS and the concentrations of immunoglobulin fractions (IgG, IgM and IgA) in colostrum were significantly higher ($P<0.05$) for PP than UPP. Moreover, milk yield for both groups increased with advancing lactation period up to 8 weeks and decreased afterwards, while the contents of all milk constituents showed opposite trend.

The number of weaned lambs per ewe was significantly higher ($P<0.05$) and the mortality rate was significantly lower ($P<0.05$) for PP than UPP, but it was nearly similar for male and female lambs. The birth and weaning weight, total and daily weight gain of lambs as well as total birth and weaned weight and weight gain of lambs per ewe were significantly higher ($P<0.05$) for PP compared with UPP as well as for male than female. Net revenue of lambs was significantly higher ($P<0.05$) for PP than UPP and for male than female.

The count of red and white blood cells and the concentrations of total protein, albumin, globulin, IgG, IgM and IgA in plasma were significantly higher ($P<0.05$) for PP compared with UPP and increased significantly ($P<0.05$) with the progresses of suckling period, but nearly similar for male and female. The incidence of diarrhea, respiratory, septicemia, navel and general weakness were significantly lower ($P<0.05$) for PP than UPP, decreased markedly with the progresses of suckling period and nearly similar for male and female lambs.

Keywords: Protected protein, ewes, digestibility, milk yield and composition, offspring growth, economic efficiency and immune response.

INTRODUCTION

Ruminant animals require two types of digestible protein, the first is a degradable protein in the rumen which is used by the micro-organisms to produce microbial protein, while the second is the by-pass protein which is digested in the small intestine and used by animals itself. Extensive degradation of valuable protein in the rumen by the micro-organisms results in some losses of nitrogen as urea in the urine. The reason behind the attempts to protect dietary protein is to avoid the degradation of high quality

proteins and to further reduce wasteful ammonia production in the rumen. To protect protein degradation in the rumen by micro-organisms several procedures such as heat treatment, chemical treatment/modification, inhibition of proteolytic activity and identification of naturally protected protein were widely used (Kamalak *et al.*, 2005).

The nutritional and economical point of treatment of concentrate feed mixture with 1% formaldehyde had beneficial effects on growth performance of Friesian calves in particular at the later stage of suckling period and early stage of weaning period (Abdelhamid *et al.*, 2003). Supplementation of 1.0 kg protected protein in the form of formaldehyde treated rapeseed meal in the ration of low yielding cows was found to be economical, compared to feeding similar quantity of untreated protein meal (Garg *et al.*, 2005). Feeding formaldehyde treated soybean meal improved colostrum and milk composition of ewes and growth performance, feed conversion, economic efficiency and reproductive performance of growing lambs (El-Reweny, 2006).

The objective of this study was to investigate the effect of feeding dietary protected protein on nutrients digestibility, nutritive values, milk yield and composition of ewes and growth performance, economic efficiency and immune response of their offspring.

MATERIALS AND METHODS

Forty eight crossbred ewes 1/2-Rahmmani X 1/2-Finnish Landrace at the last two months of pregnancy weighed 50-60 kg and aged 3-4 years were divided into two similar groups (24 in each). Ewes in the first group were fed untreated concentrate feed mixture (UPP), while those in the second group were fed formaldehyde treated concentrate feed mixture (PP) in two equal daily meals at 8 a.m. and 3 p.m. to cover their requirements of protein and energy according to NRC (1985). Wheat straw was offered *ad lib.* as a sole source of roughage for the two groups. The concentrate feed mixture of the treated group was sprayed with commercial formaldehyde solution (40%) at the rate of 1% of crude protein (160 ml / 100 kg diet). Total of 58 born lambs produced from both the two groups (29 in each) suckled their dams until weaning at 12 weeks of age (normal weaning).

Two digestibility trials were conducted using three ewes from each group to determine the digestion coefficients and nutritive values of the experimental rations. Tested rations were offered to cover the maintenance requirement according to NRC (1985) allowances for sheep. Animals were fed twice daily at 8 a.m. and 3 p.m. and refusals were recorded every day and daily feces was weighed. Samples of concentrate feed mixture, wheat straw and feces were chemically analysis according to AOAC (1995).

The yield of colostrum (1-3 days) and milk of ewes during the suckling period (12 weeks) was determined by the lamb suckling weight differential technique. Milk samples were taken from ewes at the first day after lambing to investigate the composition and immunoglobulin fractions of colostrum and weekly thereafter through the suckling period for all tested ewes to determine

milk composition using Milko-scan (133 BN, FOSS Electric). Also, blood samples were taken at the same times from the jugular vein of suckling lambs by clean sterile needle in clean dry plastic tubes using heparin as an anticoagulant and centrifuged at 4000 rpm for 15 minute to obtain blood plasma. Concentrations of total protein, albumin and globulin (by difference) were determined in plasma calorimetrically using commercial diagnostic kits (Test-combination, Pasteur lap.). Determination of immunoglobulin fractions (IgG, IgM and IgA) was done by Bovine Radial Immune Diffusion (BRID) kits according to the procedure outlined by manufacture (The Binding Site Ltd., Birmingham, UK).

Simple economical evaluation was calculated for the feed cost of ewes during suckling period and the price of total weight gain of suckling lambs and the revenue and its improvement due to feeding protected protein. The price of untreated concentrate feed mixture (UCFM) was 1600 L.E. / ton, treated concentrate feed mixture (TCFM) was 1650 L.E. / ton, wheat straw (WS) was 400 L.E. / ton and weight gain (WG) was 20 L.E. / kg according to the marketing prices of year 2007.

The data of the effect of treatment on digestibility coefficients, nutritive values, feed intake, colostrum yield and composition of ewes were statistically analyzed using T-test, while the effect of treatment, lactation period on milk yield and composition and treatment, sex and age of lambs on growth performance, economic efficiency, blood cells, plasma protein, immunoglobulin fractions and diseases incidence were statistically analyzed using factorial design procedure adapted by SPSS (2004). Duncan test within program SPSS was done to determine the degree of significance between the means.

RESULTS AND DISCUSSION

The chemical composition of tested feedstuffs and experimental rations are presented in Table (1). Chemical composition of treated (TCFM) and untreated concentrate feed mixture (UCFM) as well as unprotected protein ration (UPP) and protected protein ration (PP) were nearly similar. The UPP and PP rations contained were nearly isonitrogenous (12.14 vs. 12.38%) and isoenergetic (17.92 vs.17.96 MJ/kg DM). Similar results were obtained by Abu-El-Hamed (2003) and El-Reweny (2006).

Table (1): Chemical composition of feedstuffs and experimental rations used in feeding ewes.

Item	DM (%)	Composition of DM (%)						GE*
		OM	CP	CF	EE	NFE	Ash	
Feedstuffs								
UCFM	91.30	92.65	16.42	12.60	3.15	60.48	7.35	18.84
TCFM	91.08	92.88	16.77	12.30	3.20	60.61	7.12	18.91
Wheat straw	90.25	83.35	2.15	38.75	1.35	41.10	16.65	15.79
Experimental ration:								
UPP	90.99	89.86	12.14	20.45	2.61	54.66	10.14	17.92
PP	90.83	90.02	12.38	20.24	2.61	54.79	9.98	17.96

UPP = unprotected protein ration PP = protected protein ration

*** GE MJ / kg DM = (0.226 x CP + 0.177 x CF + 0.407 x EE + 0.192 x NFE) x 10 (MAFF, 1975).**

Results in Table (2) showed that the digestibility coefficients of DM, OM, CP, CF, EE and NFE and subsequently nutritive values as TDN and DCP were significantly (P<0.05) higher for PP than UPP ration. The nutritive values as TDN and DCP of PP ration increased by 2.80 and 0.66% compared with UPP ration, respectively. These results may be explained through the increase in the favorable nitrogen source for rumen microbes beside the higher available carbohydrates, which may lead to more microbial fermentation, so that it reduced the dietary energy sources escaping ruminal degradation. These results agreed with those obtained by Pani and Sivaiah (1999) and El-Reweny (2006), who found that digestibility coefficients and nutritive values were higher for sheep fed ration supplemented with protected protein than the control.

Table (2): Digestibility coefficients and nutritive values of experimental rations fed to ewes.

Item	Treatments		Significance (P-value)
	UPP	PP	
Nutrients digestibility (%)			
DM	63.45	66.70	0.016
OM	64.52	67.85	0.015
CP	65.30	69.35	0.020
CF	64.75	67.10	0.017
EE	70.23	73.25	0.021
NFE	68.60	71.40	0.027
Nutritive values (%)			
TDN	62.79	65.59	0.016
DCP	7.93	8.59	0.004

UPP = unprotected protein ration **PP = protected protein ration**

Average daily feed intake by ewes as presented in Table (3) revealed that the intake of UCFM, TCFM and wheat straw tended to increase in PP ration than UPP ration. While, the intake of DM, TDN and DCP was significantly (P<0.05) higher for PP ration compared with UPP ration. Similar results were obtained by Robinson *et al.* (1995) and El-Reweny (1999 and 2006).

Table (3): Average daily feed intake by ewes fed experimental rations.

Item	Treatments		Significance (P-value)
	UPP	PP	
No. of ewes	24	24	-
UCFM (kg)*	1.12	-	-
TCFM (kg)*	-	1.18	-
Wheat straw (kg)*	0.49	0.51	0.592
Total DM intake (kg)	1.46	1.54	0.065
TDN (kg)	0.92	1.01	0.036
DCP (g)	115.78	132.29	0.016

UPP = unprotected protein ration **PP = protected protein ration**

As fed.

The yield and composition of colostrum are shown in Table (4). The yield of colostrum was significantly (P<0.05) higher for ewes fed PP than those fed UPP ration (525 vs. 560 g/day). Also, the percentages of fat, protein, solids not fat (SNF) and total solids (TS) were significantly (P<0.05) higher in colostrum of ewes fed PP than those fed UPP ration. However, lactose and ash contents were nearly similar for both rations. Moreover, the concentration of immunoglobulin fractions (IgG, IgM and IgA) were significantly (P<0.05) higher in colostrum of ewes fed PP than those fed UPP ration. These results agreed with those obtained by El-Reweny (2006), who found higher constituents in colostrum of ewes fed PP ration compared with those fed control ration. In comparable with colostrum of goats, Rudovsky *et al.* (2008) reported that the fat concentration was 94.5 g/l, protein concentration was 148.4 g/l and total immunoglobulin was subdivided into subclasses: immunoglobulin G 49.1 g/l (90.3% of total), immunoglobulin M 3.19 g/l (6.0% of total) and immunoglobulin A 2.00 g/l (3.7% of total).

Table (4): Colostrum yield and composition of ewes fed experimental rations.

Item	Treatments		Significance (P-value)
	UPP	PP	
Yield (g/day)	525	560	0.038
Composition (%):			
Fat	7.82	7.95	0.025
Protein	6.25	7.04	0.12
Lactose	4.42	4.45	0.578
SNF	11.35	12.20	0.012
TS	19.17	20.15	0.024
Ash	0.69	0.71	0.288
Immunoglobulin fractions (mg/ ml):			
IgG	79.10	93.35	0.034
IgM	5.27	7.84	0.015
IgA	3.52	4.76	0.011

UPP = unprotected protein ration **PP = protected protein ration**

Data in Table (5) show the average daily milk yield of ewes was significantly (P<0.05) higher with feeding PP than UPP ration being 583 and 542 g / day, respectively. The trend of differences between both groups was observed at 4, 8 and 12 weeks of lactation period. Moreover, the percentages of fat, protein, SNF and TS were significantly (P<0.05) higher with feeding PP than UPP ration. All milk contents were higher in PP than in UPP group at 4, 8 and 12 weeks of lactation. The overall percentages of fat, protein, SNF and TS increased by 5.71, 5.21, 2.08 and 3.25% in PP group compared with UPP group, respectively. These results are in agreement with those obtained by Loerch *et al.* (1985), who reported that the slowly degradable protein sources improved milk production by ewes. Yadav and Chaudhary (2004) found that feeding of formaldehyde-treated (at 1% of CP) groundnut cake significantly increased the milk yield and fat corrected milk 4% (FCM) yield in medium-producing crossbred cows. Gargm *et al.* (2004) stated that the increase in milk yield and fat percentage were significantly (P<0.05) higher with supplementation of 1.0 kg protected protein in the ration of dairy cows. El-

Reweny (2006) showed that milk constituents were higher for ewes fed protected protein than control. However, Trinacty *et al.* (2006) found that average milk yield and protein increased significantly, while protein, fat and lactose contents were unaffected by protected protein supplementation to dairy cows.

Table (5): Average daily yield and composition of ewe's milk in experimental groups.

Item	Treatments		Lactation period (week)		
	UPP	PP	4	8	12
Milk yield (g/day)	542^{b}	583^{a}	560^{ab}	593^{a}	535^{b}
Composition (%):					
Fat	5.25^{b}	5.55^{a}	5.35^{ab}	5.29^{b}	5.57^{a}
Protein	4.80^{b}	5.05^{a}	4.85^{b}	4.76^{b}	5.17^{a}
Lactose	5.55	5.52	5.51^{b}	5.44^{b}	5.66^{a}
SNF	11.05^{b}	11.28^{a}	11.06^{b}	10.89^{b}	11.57^{a}
TS	16.30^{b}	16.83^{a}	16.41^{b}	16.18^{b}	17.14^{a}
Ash	0.70	0.71	0.70^{b}	0.69^{b}	0.74^{a}

a, b: Values in the same row for experimental groups and lactation period with different superscripts differ significantly (P<0.05).

UPP = unprotected protein ration PP = protected protein ration

Growth performance and economic efficiency of suckling lambs are shown in Table (6). The number of born lambs per ewe tended to be greater, while the number of weaned lambs per ewe was significantly (P<0.05) greater and the mortality rate during suckling period was significantly (P<0.05) lower in PP than UPP group. Average number of lambs at birth and weaning per ewe and mortality rate were nearly similar for males and females. The birth and weaning weight, total and daily weight gain of lambs as well as total weight of lambs at birth and weaning and weight gain of lambs per ewe were significantly (P<0.05) higher in PP than UPP group. Average daily weight gain of lambs in PP group increased by 12.64% compared with UPP group. Moreover, average weight at birth and weaning, total and daily weight gain as well as total weight at birth and weaning and weight gain per ewe were significantly (P<0.05) higher for male than female lambs. Average daily weight gain of male increased by 13.81% compared with female lambs. These results may be attributed to the increase of milk yield and constituents with feeding PP ration (Table 5).

The total feed cost of ewes, total revenue of lambs gain and net revenue were significantly (P<0.05) higher for PP compared with UPP group. The net revenue of PP group increased by 46.29% compared with UPP group. Moreover, the total feed cost, total revenue and net revenue were significantly (P<0.05) higher, but net revenue improvement due to treated CFM was significantly (P<0.05) lower for males than females. These results agreed with the findings of Encinias *et al.* (2004). In this respect, Loerch *et al.* (1985) reported that lambs nursing ewes fed protected protein gained faster than did lambs nursing ewes fed unprotected protein. Notter *et al.* (1991) found that male lambs grew 15% faster than females. El-Reweny (2006) stated that feeding PP ration resulted in higher body weight, total and daily weight gain of lambs.

Table (6): Growth performance and economic efficiency of suckling lambs.

Item	Treatments		Sex	
	UPP	PP	Male	Female
No. of born lambs	29	29	20	38
Suckling period (day)	84	84	84	84
No. of born lambs/ewe	1.17	1.25	1.25	1.18
No. of weaned lambs/ewe	1.07^{b}	1.14^{a}	1.15	1.08
Mortality rate (%)	12.50^{a}	8.33^{b}	10.00	10.71
Birth weight (kg / lamb)	3.39^{b}	3.68^{a}	3.64^{a}	3.49^{b}
weaning weight (kg / lamb)	15.04^{b}	16.80^{a}	17.10^{a}	15.31^{b}
Total weight gain (kg / lamb)	11.65^{b}	13.12^{a}	13.46^{a}	11.82^{b}
Average daily gain (g / lamb)	138.70^{b}	156.23^{a}	160.21^{a}	140.77^{b}
Total birth weight/ewe (kg)	3.97^{b}	4.60^{a}	4.55^{a}	4.12^{b}
Total weaned weight/ewe (kg)	16.09^{b}	19.15^{a}	19.67^{a}	16.53^{b}
Total weight gain/ewe (kg)	12.12^{b}	14.55^{a}	15.12^{a}	12.41^{b}
Total feed cost/ewe (L.E.)	166.99^{b}	180.68^{a}	179.39^{a}	171.06^{b}
Total revenue /ewe (L.E.)	242.40^{b}	291.00^{a}	302.40^{a}	248.20^{b}
Net revenue / ewe (L.E.)	75.41^{b}	110.32^{a}	123.01^{a}	77.14^{b}
Net revenue improvement (%)	100.00^{b}	146.29^{a}	120.03^{b}	124.79^{a}

a, b: Values in the same row for treatments and sex with different superscripts differ significantly (P<0.05).

UPP = unprotected protein ration **PP = protected protein ration**

Blood parameters in Table (7) revealed that the count of red (RBCs) and white blood cells (WBCs) in blood and the concentrations of total protein, albumin and globulin in plasma were significantly (P<0.05) higher for PP than in UPP group and tended to increase with the progresses of suckling period. However, there were no significant differences in all blood parameters between male and female lambs. Previous researches found that plasma constituents were higher with feeding PP ration in suckling Friesian calves (Abu El-Hamed, 2003) and lambs (El-Reweny, 2006).

The concentrations of immunoglobulin fractions in blood plasma of suckling lambs are shown in Table (7). The concentrations of IgG, IgM and IgA in blood plasma of lambs in PP group were significantly (P<0.05) higher than in UPP group. The concentrations of IgG, IgM and IgA in blood plasma post-colostral suckling times were significantly (P<0.05) higher than pre-colostral suckling time for both groups, being higher in PP than UPP group at all times. This displays the fact that immunoglobulins increased markedly as a result of ingestion colostrum. However, there were no significant differences in concentrations of immunoglobulin fractions between male and female lambs. These results are comparable to those of El-Gaafarawy *et al.* (2003) and Shitta (2005). It is of interest to note that the improvement in immunity of lambs in PP group was mainly associated with increasing concentration of immunoglobulin fractions in their colostrum as compared to the control group (Table 4).

The percentages of infection of suckling lambs with various diseases are presented in Table (8). The percentages of diarrhea, respiratory, septicemia, navel and general weakness diseases of lambs in PP group were significantly (P<0.05) lower than in UPP group. While, there were nearly

similarity in male and female lambs. Moreover, the percentages of various diseases were higher during the first 4 weeks of age and decreased markedly with age progress for both groups. These results might be due to the higher concentrations of immunoglobulins in plasma of lambs in PP group (Table 7). These findings are in accordance with those obtained by Heller and Duchman (2003) and Shitta (2005).

Table (7): Red and white blood cell counts and concentrations of plasma proteins and immunoglobulin fractions of suckling lambs.

Item	Treatments		Sex		Age (week)			
	UPP	PP	Male	Female	0	4	8	12
Blood cells:								
RBCs (x 10^6/mm^3)	10.07^b	11.09^a	10.55	10.61	10.05^b	10.49^{ab}	10.75^{ab}	11.05^a
WBCs (x 10^3/mm^3)	8.08^b	8.71^a	8.43	8.38	8.04^b	8.25^{ab}	8.49^{ab}	8.80^a
Plasma proteins (g/ 100 ml):								
Total protein	7.57^b	7.80^a	7.70	7.67	7.54^b	7.85^{ab}	7.74^{ab}	7.81^a
Albumin	3.40^b	3.54^a	3.45	3.48	3.40^b	3.46^{ab}	3.50^{ab}	3.53^a
Globulin	4.17^b	4.26^a	4.25	4.19	4.14^b	4.19^{ab}	4.24^{ab}	4.28^a
Immunoglobulin fractions (ng/ml):								
IgG (ng/ml)	34.44^b	42.01^a	38.25	38.22	8.28^c	44.54^b	47.88^{ab}	52.20^a
IgM (ng/ml)	4.22^b	4.61^a	4.39	4.43	2.80^c	4.69^b	4.95^{ab}	5.20^a
IgA (ng/ml)	2.81^b	3.14^a	2.95	2.98	1.73^c	3.23^b	3.39^{ab}	3.52^a

a, b: Values in the same row for treatments, sex and age with different superscripts differ significantly (P<0.05).

UPP = unprotected protein ration PP = protected protein ration

Table (8): The percentages of various diseases infection of suckling lambs.

Incidence (%)	Treatments		Sex		Age (week)		
	UPP	PP	Male	Female	1-4	5-8	9-12
Diarrhea	21.84^a	13.79^b	16.67	18.42	29.39^a	16.98^b	6.67^c
Respiratory	16.09^a	9.19^b	13.33	13.16	23.38^a	10.30^b	5.15^c
Septicemia	12.64^a	6.89^b	8.33	10.53	16.98^a	10.30^b	1.52^c
Navel	9.25^a	4.60^b	6.67	7.02	13.34^a	5.15^b	2.11^b
General weakness	8.05^a	3.45^b	5.00	6.14	10.31^a	5.15^b	1.52^c

a, b: Values in the same row for treatments, sex and age with different superscripts differ significantly (P<0.05).

UPP = unprotected protein ration PP = protected protein ration

From these results, it could be concluded that feeding ewes two months pre-partum and during the suckling period on protected protein ration improved nutrients digestibility, yield and composition of colostrum and milk of ewes and growth performance, economic efficiency and immune response of their offspring.

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تأثير البروتين المحمى على أداء النعاج الخليطة ونتاجها

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استخدم فى هذه الدراسة ٤٨ نعجة خليط (٢/١ رحمانى و ٢/١ فنلندى) فى الشهرين الأخيرين من الحمل وزنها قسمت إلى مجموعتين متماثلتين (٢٤ نعجة بكل منها)٠غذيت نعاج المجموعة الأولى على مخلوط علف مركز غير معامل، بينما غذيت نعاج المجموعة الثانية على مخلوط علف مركز معامل بالفورمالدهيد (١% من نسبة البروتين) وأعطى تبن القمح لحد الشبع لكلا المجموعتين٠ تم رضاعة الحملان المولودة لكلا المجموعتين لأمهاتها حتى الفطام فى عمر ١٢ أسبوع٠

توضح النتائج المتحصل عليها ارتفاع معاملات هضم كل العناصر الغذائية وبالتالى القيم الغذائية والمأكول من المادة الجافة والمركبات الغذائية المهضومة والبروتين المهضوم بواسطة النعاج معنويا (على مستوى ٠,٠٥) مع التغذية على البروتين المحمى عن غير المحمى٠ ارتفاع إنتاج السرسوب واللبن ومحتواهما من الدهن والبروتين والجوامد الصلبة اللادهنية والجوامد الصلبة الكلية وتركيز جلوبيولينات المناعة (IgG, IgM and IgA) فى السرسوب معنويا (على مستوى ٠,٠٥) مع التغذية على البروتين المحمى عن غير المحمى٠ أكثر من ذلك يزداد إنتاج اللبن لكلا المجموعتين مع تقدم فترة الحليب حتى ٨ أسابيع ثم يقل بعد ذلك، بينما أظهر محتوى مكونات اللبن اتجاه مضاد٠

ارتفاع عدد الحملان المفطومة لكل نعجة وانخفاض معدل النفوق معنويا (على مستوى ٠,٠٥) مع التغذية على البروتين المحمى عن غير المحمى، بينما كان القيم متماثلة تقريبا لذكور وإناث الحملان٠ ارتفاع وزن الميلاد والفطام والزيادة الكلية واليومية فى الوزن للحملان وكذلك وزن الميلاد والفطام والزيادة الكلية فى الوزن للحملان لكل نعجة معنويا (على مستوى ٠,٠٥) مع التغذية على البروتين المحمى عن غير المحمى وكذلك للذكور عن الاناث٠ ارتفاع تكلفة التغذية الكلية للنعاج والعائد الكلى والعائد الصافى للحملان معنويا (على مستوى ٠,٠٥) مع التغذية على البروتين المحمى عن غير المحمى وكذلك للذكور عن الاناث٠

ارتفاع عدد كرات الدم الحمراء والبيضاء وتركيز البروتين الكلى والألبيومين والجلوبيولين وتركيز جلوبيولينات المناعة (IgG, IgM and IgA) فى بلازما الدم معنويا (على مستوى ٠,٠٥) مع التغذية على البروتين المحمى عن غير المحمى وزادت معنويا (على مستوى ٠,٠٥) مع تقدم فترة الرضاعة، بينما لا توجد اختلافات معنوية بين الذكور والاناث٠ كذلك يرتفع فى البلازما معنويا (على مستوى ٠,٠٥) مع التغذية على البروتين المحمى عنه مع البروتين غير المحمى وتزداد بدرجة كبيرة مع تقدم فترة الرضاعة، بينما كانت متماثلة تقريبا لكل من الذكور والاناث٠ تقل نسبة الإصابة بأمراض الإسهال والالتهاب الرئوى وأمراض الدم والتهاب السرة والضعف العام معنويا (على مستوى ٠,٠٥) مع التغذية على البروتين المحمى عن غير المحمى وتقل بدرجة كبيرة مع تقدم فترة الرضاعة، بينما كانت متماثلة تقريبا للذكور والاناث٠

نستخلص من هذه النتائج أن تغذية النعاج خلال الشهرين الأخيرين من الحمل وأثناء فترة الرضاعة على البروتين المحمى أدى إلى تحسن هضم العناصر الغذائية وإنتاج وتركيب السرسوب واللبن وأداء النمو والكفاءة الاقتصادية والاستجابة المناعية لنتاجها من الحملان٠