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Effect of pre- and post-partum dietary crude protein level on the performance of ewes and their lambs

M.H. Ahmed[a], A.Z.M. Salem[b,*], O.A. Olafadehan[c], A.E. Kholif[d], N. Rivero[e], M.A. Mariezcurrena[b], L.M. Camacho[f], M.M.Y. Elghandour[b], M.U. Alonso[b], A.H.A. Almaz[a]

[a] Animal and Fish Production Department, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt
[b] Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, Estado de México, Mexico
[c] Department of Animal Science, University of Abuja, Abuja, Nigeria
[d] Dairy Science Department, National Research Centre, 33 Bohouth St. Dokki, Giza, Egypt
[e] Universidad Autónoma del Estado de Hidalgo, Instituto de Ciencias Agropecuarias, Área Académica de Medicina Veterinaria y Zootecnia, Mexico
[f] Unidad Académica de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Guerrero, Altamirano P.O. 40660, Mexico

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ABSTRACT

In a block randomized design, fifty-one Barki ewes weighing 38.0 kg in average and 2–4 years old, were used to study the effect of pre- and post-lambing dietary crude protein level (CP) of concentrates on the milk yield, milk composition and weight of ewes, and performance of their lambs. The treatments comprised supplementary concentrate containing (g/kg dry matter (DM)): (1) 110 CP (low), (2) 130 CP (medium) and (3) 150 CP (high), while Egyptian berseem hay (*Trifiolium alexandrinum*) was the basal diet. Ewes were weighed individually biweekly, and the number of lambs dropped and nursed by ewes was recorded within 24 h after birth and biweekly subsequently. New-born lambs were left to suckle their dams freely, except for the period when milk yield was recorded by weighing lambs before and after suckling. Milk yield was estimated once a week. Ewes were fed the experimental diets during the last two months of pregnancy and throughout the lactation period. Ewes fed 110 g CP/kg DM attained peak of milk yield earlier than those fed 130 and 150 g CP/kg DM. Total milk yield, milk fat and milk total solids, and weaning weight, average daily gain and relative growth rate of lambs were higher ($P < 0.05$) for ewes fed medium and high protein levels compared to those fed low protein level. Suckled milk was affected by protein level ($P < 0.05$); the rank order was: 110 CP < 130 CP < 150 CP. Milk protein and extractable milk were higher ($P < 0.05$) for high protein level compared to low protein level but solids-not-fat (SNF) and lamb birth weight were not affected ($P > 0.05$) by protein level. Lamb sex, and parity and weight at lambing of ewes had no effect ($P > 0.05$) on suckled milk, extractable milk and milk yield. Whereas lamb sex and parity of ewe had no effect ($P > 0.05$) on milk composition, ewe lambing weight affected ($P < 0.05$) milk fat and SNF but not milk protein and total solids ($P > 0.05$). Weights of ewes during gestation, after lambing (post-partum weight loss) and during lactation were not affected ($P > 0.05$) by protein level, except at the 3rd month of lactation. Lamb sex, parity and lambing weight had pronounced ($P < 0.05$) effects on lamb birth weight and weaning weight. It is concluded that 150 g CP/kg DM level pre- and post-partum could be used for improved performance of ewes and their lambs while parity and weight of ewe at lambing should also be given consideration.

1. Introduction

The nutritional plane of an animal during gestation and in the ensuing lactation has a pronounced effect on its performance and that of its offspring. Nutrition in the final stages of pregnancy for sheep is one of the very important factors, and depends upon many qualities after birth. During the last two months of pregnancy (the late gestation), eighty percent of the foetal growth occurs, leading to a significant increase in nutrient requirements of the ewe (Bell, 1995). Protein requirements are also increased for foetal growth and for the development of the mammary gland for colostrum production (NRC, 1985). Level of feeding in the last two month of pregnancy and after lambing affects the milk production of the

* Corresponding author. Fax: +20 521 722 180 61 94.
E-mail addresses: asalem70@yahoo.com, asalem70@hotmail.com (A.Z.M. Salem).

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ewe during lactation period and also growth performance of lambs (Owen, 1981). The nutrition of ewes in the pre-partum period not only affects the growth of the developing foetus, but also the ability of the ewe to supply the lamb with adequate amount of colostrum and milk post-partum (Treacher, 1983). Ocak et al. (2005) investigated the effect of feeding high dietary protein levels during late gestation of ewes on colostrum yield and lamb survival rate, and concluded that an excess of crude protein (CP) in the diet caused a decrease in colostrum yield and lamb survival. This was due to an increased lamb birth weight resulting in a higher number of lamb dystocia. Consequently, the protein level of diets fed to the pregnant ewes during this critical period of gestation and ensuing lactation has been of concern to livestock scientists. Hatfield et al. (1995) reported that birth weights of lambs were higher when the ewes were fed higher levels of protein compared to when they were fed low levels (149 vs. 113 g CP/kg dry matter (DM)) during late gestation and early lactation. It therefore becomes important to determine the pre- and post-partum dietary protein level that can maximize the production potential of ewes and the performance of their lambs. We hypothesized that increasing dietary CP of ewes during gestation and lactation could improve their body weight, lactation performance, and birth weight and growth of their lambs. The study aimed to investigate the effects of pre- and post-partum dietary protein level from concentrates on milk yield, milk composition and body weight changes of the experimental Barki ewes and the performance of their lambs.

2. Materials and methods

Ewes and lambs were cared and handled in accordance with the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 2010). The experimental area conditions was a temperate-tropic humid climate with winter rains and an annual average rainfall of 22 mm and means annual temperature between 14 and 32 °C.

2.1. Animals, diets and experimental design

Fifty-one 2–4 years old gestating Barki ewes were divided into three groups according to age and body weight (BW), and were randomly assigned to one of three isocaloric supplementary diets containing different CP levels (g/kg DM), 110 CP (low), 130 CP (medium) and 150 CP (high), during the last two months of pregnancy and throughout four months of lactation. Earlier before the experiment, ewes were divided into three groups of similar average initial body weight (38.0 kg average BW) and were mated to Barki rams (1 ram to 17 ewes sex ratio). The rams were allowed to run with the ewes for two months during the breeding season (October–November). Composition of the supplementary concentrate and the experimental diets is shown in Table 1. Diets were served at the ewe's 2% BW twice daily at 08:00 and 16:00 h. The roughage portion of the diet (Egyptian berseem hay; *Trifolium alexandrinum*) was offered first followed by concentrates. Berseem hay contained (g/kg DM): organic matter 902.0, CP 167.0, CF 200.0, ether extract 20.1, and nitrogen free extract 532.9. Water and mineral blocks (contain per kg: vitamin A 55,000 IU, vitamin D3 27,500 IU, vitamin E 300 IU, Ca 30,000 mg, Mg 5,000 mg, Mn 2,500 mg, Fe 1,800 mg, Zn 1,500 mg, Co 50 mg, I 35 mg, Se 10 mg) were provided free choice. The amount of supplementary concentrate fed was adjusted monthly according to ewes BW changes. Ewes were weighed individually biweekly with digital multi-purpose platform scale during the period of steaming and throughout lactation period. Number of lambs dropped and nursed by ewes was recorded, and lambs were weighed within 24 h after birth and biweekly thereafter until weaning. Each group of ewes and their lambs were housed in a partly enclosed yard. New-born lambs were left to suckle their dams freely for the first three days and were kept with their dams till weaning at 16 weeks of age, except for the period when milk yield was recorded. Throughout the experimental period, six ewes were excluded due to pathogenic infection and death; 2 ewes from the low level of protein, 1 ewe from the medium level of protein, and 3 ewes from the high level of protein.

Table 1
Composition of the supplementary concentrate.

	Dietary protein level (g/kg DM)		
	110 (Low)	130 (Medium)	150 (High)
Ingredients (g/kg DM)			
Soybean meal	10.0	50.0	105.0
Maize	vahbox820.0	570.0	600.0
Barley	140.0	350.0	265.0
Limestone	20.0	20.0	20.0
Mineral mixture[a]	10.0	10.0	10.0
Chemical composition (g/kg DM)			
Dry matter (g/kg wet material)	875.0	874.1	860.3
Organic matter	962.9	948.9	947.0
Crude protein	110.3	131.1	151.1
Ether extract	29.0	20.9	26.7
Crude fibre	30.0	39.0	35.7
Nitrogen free extract[b]	793.5	754.9	734.4
Digestible energy (Mcal/kg)[c]	3.66	3.60	3.62

[a] Contained: $Ca_3(PO_4)$ 150 g, NaCl 100 g, MgO 4 g, ZnO 2 g, $MnSO_4$ 2 g, $Fe_2(SO_4)_3$ 3 g, $CuSO_4$ 1 g, CaI 100 mg, and $CoSO_4$ 20 mg.
[b] Nitrogen free extract calculated by difference [1000 g/kg – (1000 g/kg crude fibre + 1000 g/kg crude protein + 1000 g/kg ether extract + 1000 g/kg ash)].
[c] Calculated according to NRC (2001).

2.2. Determination of milk yield

Lambs were separated from their dams at 19:00 h a day prior to the week of milk yield estimation and were weighed at 07:00 h the following morning before suckling for 15 min. Lambs were weighed again after suckling and separated from their dams. The same procedures were repeated in the afternoon after which both lambs and their dams were housed overnight. Surplus milk (hand-milked or extractable milk) was hand milked both in the morning and afternoon. Milk consumed by lambs was taken as the difference between the lamb weight before suckling and after suckling, while daily milk yield was estimated by summing the lamb milk consumption and surplus milk in the morning and afternoon for the day. Milk yield was estimated once a week until weaning at 16th week of age.

2.3. Chemical analysis and calculation

Diets were analysed for their DM (#930.15), ash (#942.05), nitrogen (#954.01), ether extract (#920.39), and crude fibre (#950.02) according to AOAC (1997) official methods. Milk samples were analysed for total solids, fat, and protein using infrared spectrophotometry (Foss 120Milko-Scan, Foss Electric, Hillerød, Denmark). Nitrogen free extract and organic matter of feeds were calculated. Relative growth rate was calculated using the equation of Brody (1945):

$$\text{Relative growth rate} = \frac{W_2 - W_1}{\frac{1}{2}(W_2 + W_1)} \times 100$$

where W_1 = weight at the beginning; W_2 = weight at the end of the period which growth rate was calculated.

2.4. Statistical analysis

In a block randomized design, data were analysed using the General Linear Model (GLM) of SAS (2000). Data of dead sheep were