

THE EFFECT OF BODY CONDITION SCORE AND BODY WEIGHT OF SANJABI EWES ON IMMUNE SYSTEM, PRODUCTIVE AND REPRODUCTIVE PERFORMANCE

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The effect of body condition score and body weight of Sanjabi ewes on immune system, productive and reproductive performance

Total 80 Sanjabi ewes (2–5 years old and 50–85 weight domain) were selected in animal unit of Mehregan farm. The ewes were divided to 4 treatment groups according to body condition score of (2, 2.5, 3, 3.5 ≤). Blood samples were collected from non-pregnant ewes, then after mating, two weeks before expected lambing and at lambing day. Blood samples of newborn lambs were also taken from the jugular vein at birth and 7 days of age. The reproductive parameters such as number of lambs born per lambing, kg of lambs born per ewes mating, pregnancy period and lamb birth weight were determined. Some blood metabolites such as glucose, total protein, albumin and globulin were determined. The white blood cell and differential leukocyte counts were also measured. The result of this experiment indicated that BCS = 3 had a significant effect ($P < 0.05$) on the kg lambs born per ewes. Ewes with BCS = 3 had a better performance in the percentage of lambs born per ewes at mating, while the lambing rate reduced in ewes with BCS of 3.5 or more. Birth weight of lambs was significantly affected by BCS of their ewes ($P < 0.05$). There was a significant effect of BCS on plasma FSH concentration in ewes with BCS more than 3 but no significant difference was seen in blood metabolite in this study. Colostrum productions and the lamb birth weights were affected by body condition score of ewes. The white blood cell counts, neutrophils and lymphocytes counts did not change between ewes and lambs. It is concluded that BCS had a significant effect on kg lambs born per ewes, birth weight of lambs, lambs weaning weight and colostrum productions ($P < 0.05$) and the score of 3 at mating time could optimize profitability of Sanjabi ewes.

Key words: sheep / breeds / Sanjabi / weight / body condition score / production / reproductive performance / immune system

Vpliv ocene kondicije in telesne mase na imunski sistem ter proizvodne in reprodukcijske lastnosti ovac pasme sanjabi

V poskus je bilo vključenih 80 sanjabi ovac s farme Mehregan v starosti 2–5 let. Ovce smo razdelili v štiri skupine glede na oceno telesne kondicije (BCS 2, 2,5, 3, 3,5 ≤). Vzorce krvi smo jemali od nebrehjih ovac, takoj po paritvi, dva tedna pred pričakovano jagnitvijo in na dan jagnitve. Jancem smo jemali kri iz jugularne vene ob rojstvu in ko so bili stari 7 dni. Spremljali smo reprodukcijske parametre, kot so število jagnet na jagnitev, kg rojenih jagnet na paritev, dolžina brejosti in masa jagnet ob rojstvu. Določali smo nekatere parametre v krvi, kot npr. glukoza, skupne beljakovine, albumin in globulin. Prav tako smo spremljali število belih krvničk in diferencialno število levkocitov. Rezultati tega poskusa kažejo, da je ocena telesne kondicije (BCS = 3) značilno vplivala na k rojenih jagnet na ovco. Ovce z BCS = 3 so imele višji odstotek jagnet rojenih na paritev, medtem ko je bil delež jagnitev zmanjšan pri ovcah z BCS 3,5 ali več. BCS je statistično značilno vplival na maso jagnet ob rojstvu ($p < 0,05$). Prav tako je bil značilen vpliv BCS na koncentracijo FSH v plazmi pri ovcah z BCS višjim od 3, nismo ap zaznali razlik v koncentraciji metabolitov v krvi. BCS je vplival na proizvodnjo kolostruma in na maso jagnet ob rojstvu. Število belih krvničk, nevtrofilcev in limfocitov se med ovca-mi in jagneti ni razlikovalo. Ugotavljamo, da ima BCS značilen vpliv na kg rojenih jagnet na ovco, rojstno maso jagnet, maso jagnet ob odstavitvi in proizvodnjo kolostruma ($p < 0,05$). BCS 3 v času pripusta je optimalen za gospodarnost reje ovac pasme sanjabi.

Ključne besede: ovce / pasme / Sanjabi / teža / telesna kondicija / proizvodne lastnosti / reprodukcija / imunski sistem

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1 INTRODUCTION

Small ruminant production is a very significant component of livestock production throughout the world and more especially in the developing countries (Ketema, T.K., 2007; Thornton *et al.*, 2009). They were originally domesticated in southwest Asia, and Iran where today is the homeland of one of the first types of wild sheep (Dubeuf and Boyazoglu, 2009).

Body condition scoring has been widely adopted for managing the nutrition of flocks, especially when grazing, and for selecting lambs for purchase and slaughter. In Britain, and now increasingly in Europe, body scoring is based on a subjective assessment of the fat level and muscle thickness on the backbone behind the last rib (Treacher *et al.*, 2000).

The relationship between BCS at calving and BCS loss was used to study the effect of conditioning of cows at calving and the subsequent severity of negative energy balance (EB) (Dechow *et al.*, 2001). Body condition loss, as an indicator of EB, was used to study the impact of negative EB on stress symptoms, by correlating it to yield (Dechow *et al.*, 2001), days to first insemination, services per conception, conception rate, conception rate after first insemination (Loeffler *et al.*, 1999; Stevenson *et al.*, 1999; Butler, 2001; Gillund *et al.*, 2001) and oocyte development (Snijders *et al.*, 2000).

In cattle and sheep, dietary energy restriction suppresses episodic release of LH (Schillo, 1992). Also data on the effects of nutritional stimuli on follicle stimulating hormone (FSH) levels during the cycle are equivocal, with reports for (Rhind *et al.*, 1985, Rhind & McNeilly, 1986) and against (Findlay and Cumming, 1976; Rhind *et al.*, 1989; Xu *et al.*, 1989; Smith and Stewart, 1990) the induction of a change. When they used ultrasonography to study the static effect of nutrition on daily follicular development, they found that the increased ovulation rate in ewes with high body condition was associated with increased FSH and decreased oestradiol concentrations during the follicular phase (Vinoles *et al.*, 2002).

Gamez *et al.* (2008) demonstrated that BCS of goat passivity affected serum leptin concentration in a direct and proportional way, the better the BCS the greater serum leptin concentration during seasonal period. Zhang *et al.* (2005) showed that serum leptin concentration was positively correlated to BCS of sheep. Positive relationship have been shown between BCS and plasma leptin and FSH concentrations in Iranian fat tail ewes at mating time (Towhidi *et al.*, 2007). Vinales *et al.* (2005) indicated that Lower oestradiol production by the follicles is most probably associated with the higher leptin levels inhibiting steroidogenesis in ewes in high body condition. The lower oestradiol concentrations reduce nega-

tive feedback at the hypothalamus and pituitary gland, leading to higher circulating FSH concentrations.

Vinoles *et al.* (2005) found that ewes in high body condition score had a high ovulation rate, which is accompanied by high FSH and low oestradiol concentrations during the follicular phase, compared with ewes in low body condition. The pool of follicles available for the action of glucose and metabolic hormones may play a key role in stimulating an increase in ovulation rate. Ewes in high body condition had a higher number of gonadotrophin dependent follicles than did ewes in low body condition (Rhind and McNeilly, 1986, Rhind *et al.*, 1989, Xu *et al.*, 1989, Vinales *et al.*, 2005).

Ewes with very high level of body condition score show an increase in ova wastage and reduce in reproductive performance (Rhind *et al.*, 1985). Low body condition was related with prevention of estrus and fertility (Rhind *et al.*, 1985). Caldeira *et al.* (2007) reported on a variation in blood metabolic status at the different BCS. The metabolites could potentially be useful as indicators for predicting nutritional status. Blood metabolic profiles included different tests in accordance with each specific purpose have been proposed (Lee *et al.*, 1978; Kida, 2002) including the Compton Metabolic Profile Test (Rowlands, 1980; Payne and Payne, 1987).

Using metabolic profiles on farms has not been adopted extensively, as it is thought that blood parameters cannot predict the metabolic status of an animal without a characterization of its diet and level of production (Rowlands, 1980). The information gained from some strategic metabolic indicators and BCS can, however, possibly provide a more substantial basis regarding the knowledge of the metabolic status of the ewes and therefore, diets can be adjusted and metabolic disorders prevented together with improved production.

Branca and Casu (1989) showed that the animals experience nutritional imbalances can result in a marked decrease in milk yield, low milk fat and protein content and abrupt changes of body condition score. Wildman *et al.* (2010) reported that dairy cows of greatest efficiency of milk production showed no significant increase in body condition during lactation, had fewer days open, but had lower persistency of lactation. Dairy cows that increased significantly in body condition during lactation were less efficient producers, had a greater number of days open, and had high body condition scores at the end of lactation.

The selected reproduction criteria: fertility (percentage of kidding goats), prolificacy or litter size and fertilization date (deducted from kidding date) were affected by different BCS (Jalilian *et al.*, 2012). In addition, Jalilian *et al.* (2012) indicated that BCS had a significant effect on the kids born per goat at mating. In that study

Table 1: Components, ingredients and nutrient composition of diets
Preglednica 1: Sestava in hranilna vrednost obrokov

Ingredient	alfalfa	wheat	corn	soybean meal	barley	wheat bran	total
DM Feed (%)	55	15.3	12.6	8.1	5.4	3.6	100
ME(Mcal/Kg)	0.995	0.469	0.190	0.24	0.15	0.091	2.13
CP (% DM)	7.7	1.72	1.134	4.04	0.756	0.615	15.9
NDF (% DM)	31.9	1.48	3.52	1.20	1.51	1.83	41.44
ASH (% DM)	3.85	0.306	0.239	0.58	0.216	0.248	5.43
Se (mg/kg)	0.03	0.007	0.008	0.041	0.009	0.015	0.11
Cu (mg/kg)	7.535	1.193	1.00	1.81	0.46	0.50	12.49
Zn (mg/kg)	12.155	4.59	1.75	4.61	2.39	4.60	30.09
Fe (mg/kg)	93.5	6.12	11.42	14.98	4.86	4.60	135.48

goats with BCS 3 had more normal estrous, while goats with low BCS had shorter estrous period.

The present study was designed to investigate the effect of different BCS on blood metabolites, reproduction and production performance of Sanjabi ewes.

2 MATERIALS AND METHODS

This experiment was conducted in Mehregan farm located in Kermanshah province in the west of Iran. Total 80 Sanjabi ewes (2–5 years old and 50–85 weight domain) were selected in animal unit of Mehregan farm. The ewes were fed alfalfa hay and concentrate (corn, soybean meal, barley, wheat bran) according NRC 1985 (Table 1). The ewes were homogeneous for time of lambing and oestrus was synchronized with two intramuscular injections of prostaglandin given 9 days apart.

Estrous behavior was detected by testing the ewes every 12 h with vasectomized rams from the day of the second PG injection and from day 15 of the next estrous cycle. A week before the mating time ewes were weighed and scored according their body condition score (BCS). Classification of BCS considered the dorsal palpation technique using the technique of Santucci and Maestrini

(1985). The BCS measurement based on height, weight and age in addition to an interval rang of 0.5 point. Ewes were divided to 4 treatment groups according to the BCS (2, 2.5, 3, 3.5 ≤) (Table2). The body condition score (BCS) was determined by the joint agreement of four judges. Blood samples were taken a few days before mating. Also blood samples were collected from ewes three weeks before expected lambing and at lambing day. Immediately after parturition, newborn lambs were taken away from ewes.

Blood sample of lambs were drawn from the jugular vein at birth and 7 days of age. The lambs were housed in individual pens. For the first 48 hours of life, at 8–10 hour intervals, lambs of all groups were fed colostrum from their respective dams. Blood metabolic parameters (glucose, albumin and total protein) were determined by spectrophotometer using commercial kit (PERKIN-ELMER35-Pars Azmon). Serum globulin concentrations were determined using the difference between serum total protein and albumin concentrations.

Blood samples were taken by heparinized venipuncture on day1 (when ewes showed estrus sign) and at mating time (day2). Blood tubes were centrifuged (15 min at 4 °C and 3000×g) and plasma sample stored at –20 °C until FSH assay. FSH was measured by ELISA (Enzyme

Table 2: Body condition score, body weight and FSH concentration in Sanjabi ewes
Preglednica 2: Ocena telesne kondicije, masa telesa in koncentracija FSH pri ovcah pasme sanjabi

BCS	Ewes body weight at mating (kg)	Ewes body weight after kidding (kg)	FSH (ng/ml)	
			Day 1	Day 2
2.00	59.8 ± 6.9	60.5 ± 5.8	1.18 ± 0.09	2.50 ± 0.13 ^b
2.50	66.7 ± 8.8	67.2 ± 5.5	1.19 ± 0.11	2.65 ± 0.18 ^{ab}
3.00	73.9 ± 7.3	74.5 ± 6.1	1.25 ± 0.10	2.90 ± 0.16 ^a
≥3.5	81.7 ± 8.5	83.4 ± 6.8	1.20 ± 0.08	2.89 ± 0.13 ^a

(μ ± SE) Mean ± standard error; Means with different superscripts in the same row differ at P < 0.05

Table 3: Effect of body condition score on reproduction parameters
Preglednica 3: Vpliv telesne kondicije na reprodukcijske parametre

Parameters	BCS 2	BCS 2.5	BSC 3	BSC ≥3.5
Gestation length (days)	159 ± 3.45	160 ± 4.92	158 ± 3.34	157 ± 2.44
Lambs born / mated ewes (%)	133 ± 35 ^b	155 ± 40 ^{ab}	177 ± 45 ^a	130 ± 30 ^b
Lamb birth weight (kg)	3.9 ± 0.4 ^b	5.3 ± 0.21 ^a	5.55 ± 0.3 ^a	4.18 ± 0.5 ^b
Lamb weaning weight (kg)	20.9 ± 3.4 ^b	20.3 ± 3.21 ^b	24.21 ± 3.3 ^a	23 ± 3.5 ^a

(μ ± SE) Mean ± standard error; Means with different superscripts in the same row differ at P < 0.05

linked Immune Sorbans Assay) using a commercial kit (DRG diagnostics, EIA-1561, DRG instrument GmbH, Germany/2003).

Body condition score (BCS) as experimental treatment parity was considered as a block and weight was considered as a covariate. From birth to 4 weeks of age, the lambs were housed in individual pens. For the first 36 h of life, lambs of all groups were fed colostrum from their respective ewes. Colostrum production of ewes was recorded during the first 18 h lactation. White blood cells (WBC) counts were performed using the manual standard method (Dacie and Lewis, 1984). Differential leukocyte counts were performed on routinely prepared Giemsa-stained blood films using the cross-sectional technique (Jain, 1986).

The experimental design was randomized complete block with twenty replication and four treatments. Ewes were blocked by body condition score (BCS). Plasma samples were analyzed by use of a repeated measure procedure using GLM procedure (SAS Version 9.1, SAS Inst. Inc., Cary, NC SAS, 2003). The relationships between reproductive variables were determined and statistical model was:

$$Y_{ijkmn} = M + A_i + B_j + E_k + S_m + D_n(S_m) + E_{ijkmn}$$

where M is the overall mean, A = BCS of ewes, E = Age

of ewes B = Body weight, S = Ram effect D(S) = Ewes effect/ Ram effect and Eijkmn the experimental random error.

3 RESULTS AND DISCUSSION

The reproductive parameters are shown in Table 3. The result of this study showed that the kilograms kids born in mated ewes with body condition score of 2.5 and 3 significantly were more than other groups. In addition, the lamb birth weights were affected by the treatments. The lamb birth weight was higher in body condition score of 3 compared with other groups (Table 3).

The average gestation lengths do not differ among all experimental groups. However the pregnancy lengths are reduced by increasing body condition score (P > 0.05). Similarly, Jalilian *et al.* (2012) showed that the kilograms lamb born in mated Sanjabi ewes with body condition score of 3 were significantly more than in other groups. In the mentioned study the Sanjabi ewes with body condition score of 3 had a better performance in lambing rate and kg lambs born per ewes, while the lambing rate decreased in ewes with BCS 3.5 or more.

Rhind *et al.* (1985) reported that in ewes with high BCS (more than 4) the primary embryo wastage increased and reproductive performance decreased. Also

Table 4: Effect of Body condition score on blood metabolites in Sanjabi ewes

Preglednica 4: Vpliv telesne kondicije na metabolite v krvi pri ovcah pasme sanjabi

Parameters (mg/dL)	BCS 2	BCS 2.5	BSC 3	BSC ≥3.5
Glucose	51 ± 5.3	53 ± 5	59 ± 6.1	55 ± 5.9
Total protein	4.7 ± 0.8	4.5 ± 0.7	5.5 ± 0.9	4.9 ± 0.8
Insulin(ng/ml)	1.21 ± 0.08	1.17 ± 0.06	1.15 ± 0.07	1.20 ± 0.05
Albumin	3.81 ± 0.4	3.53 ± 0.6	4.00 ± 0.6	3.29 ± 0.5
Globulin	1.17 ± 0.11	1.15 ± 0.12	1.26 ± .14	1.1 ± 0.10
HDL	65.3 ± 8.2	67.7 ± 6.1	71.1 ± 8	66.3 ± 6.6
LDL	25.5 ± 6.3	21.0 ± 6	20.3 ± 6.1	23.5 ± 5.9
Total Cholesterol	99.2 ± 8.7	96.1 ± 6.9	93.6 ± 9.5	97.9 ± 7.7

(μ ± SE) Mean ± standard error

Vargas *et al.* (1999) suggested that body condition score had an impact on fertility rates in beef cattle. Rhind *et al.* (1985) showed that the body condition score more than 3 at mating caused low lamb production. The number of born lambs per ewe at mating was the highest in ewes with BCS of 2.75, which reduced this trait by increasing the body condition score in amount of 37 % (Rhind *et al.*, 1985). The results of this study were in accordance to those achieved in the present study.

The body condition score did not affect the lambs' weight at birth but increased numerically from 2 to 3 (Aliyari *et al.*, 2011). Jalilian *et al.* (2012) reported that the body condition score did not affect the kids' weight at birth. Body condition score had a significant effect on kilograms lambs born in ewes with BCS of 3 had a better reproductive performance.

The result of blood metabolites are indicated in Table 4. The blood glucose, total protein, albumin, globulin concentrations and some other blood metabolites such as insulin, HDL, LDL and total cholesterol did not differ among the groups. Thomas *et al.* (1987) reported that body condition score at the end of pregnancy significantly improved the blood, glucose, globulin and total protein concentrations but not blood albumin. The responses of plasma insulin and glucose to dietary protein were consistent with the results of Van de Ligt *et al.* (2002) who indicated that equal amounts of amino acids were used by peripheral tissue, and excellent glucogenic regulation was executed by pigs in a fasting state. This ability for glucogenic regulation ability may be similarly possessed by ruminants. Insulin action, glucose and cholesterol metabolism, and lipogenesis in both liver and adipose tissue correlated with dietary protein levels (Santos *et al.*, 2001; Sun *et al.*, 2007).

The mean of plasma FSH concentrations did not differ in experimental groups at day one. On the other

hand, the mean of plasma FSH concentrations in the ewes with BCS of 3 and 3.5 were significantly higher than in other experimental groups at day two (Table 2). This finding confirmed the Vinales *et al.* (2002) who expressed that the increased ovulation rate in ewes with high body condition was associated with increased FSH and decreased oestradiol concentrations during the follicular phase. Likewise, Garcia *et al.* (2002) showed that body size has an important participation in the onset of puberty and hormonal plasmatic levels were related to weight variation. Several studies have shown high correlation between FSH level and ovulation rate in ewes (Kosior, 2003; Korzecka and Bobwiec, 2003). Positive relationship have been shown between BCS and plasma leptin and FSH concentrations in Iranian fat tail ewes at mating time (Towhidi *et al.*, 2007).

They found also significant effect of FSH concentrations on ovulation rate in Chal ewes (Towhidi *et al.*, 2003) and reported that FSH concentrations were significantly different after maintaining on restricted diet. They recommended flushing of ewes with low BCS before mating. The nutritional state is closely regulated by neuroendocrine and hormonal cues and energy restriction produces harmful consequences in BCS. The relationship between feeding and FSH production is directly pertinent to the above issues.

The effects of body condition score on the white blood cell and different cell counts, neutrophils and lymphocytes of ewes and their lambs are shown in Table 5. The body condition score did not significantly affect the white blood cell, different cell counts, neutrophils and lymphocytes counts. In addition, the mean white blood cell, differential cell counts, neutrophils and lymphocyte of the treated ewes did not differ significantly ($P > 0.05$) after lambing. Similarly, BCS did not affect the hemato-

Table 5: Leukocyte counts in ewes at lambing, lambs at birth day and 7 days of age

Preglednica 5: Število levkocitov pri ovcah ob jagnitvi, masa jagnet ob rojstvu in na sedmi dan po rojstvu

	Item	BCS 2	BCS 2.5	BSC 3	BSC \geq 3.5
Ewes at lambing	WBC	9966 \pm 676	10098 \pm 541	10100 \pm 417	10000 \pm 640
	Neutrophils (%)	32.66 \pm 4.1	31.83 \pm 2.06	30.5 \pm 3.3	31.60 \pm 4.4
	Lymphocyte (%)	66.5 \pm 1.6	67.33 \pm 2	68.5 \pm 2.4	66 \pm 1.8
Lambs at birth	WBC	5060 \pm 437	5300 \pm 206	5500 \pm 394	5280 \pm 340
	Neutrophils (%)	58.25 \pm 3.7	54.75 \pm 4.8	56.8 \pm 2.3	58.2 \pm 3.9
	Lymphocyte (%)	40.25 \pm 3.2	44 \pm 4.1	44.2 \pm 3	41.23 \pm 3.6
Lambs at 7 days	WBC	7945 \pm 443	8000 \pm 533	8030 \pm 308	7980 \pm 323
	Neutrophils (%)	30 \pm 2.7	29.25 \pm 1.8	31.4 \pm 2	30 \pm 3.7
	Lymphocyte (%)	68.75 \pm 3.8	69.25 \pm 2	68.2 \pm 2.25	67.66 \pm 4.1

($\mu \pm$ SE) Mean \pm standard error

Table 6: Mean colostrum productions of ewes (ml)
Preglednica 6: Povprečna proizvodnja kolostruma pri ovcah (ml)

Time	BCS 2	BCS 2.5	BSC 3	BSC ≥ 3.5
1 hour postpartum	502.65 \pm 7.21	503.77 \pm 7.02	508.22 \pm 6.17	500 \pm 6.38
10 hours postpartum	589.77 \pm 7.28 ^b	600.11 \pm 6.98 ^b	649 \pm 6.73 ^a	598 \pm 5.45 ^b
18 hours postpartum	525.65 \pm 7.41 ^b	530 \pm 4.45 ^b	603 \pm 3.72 ^a	536 \pm 4.33 ^b

($\mu \pm$ SE) Mean \pm standard error; Means with different superscripts in the same row differ at $P < 0.05$

logical indicators of lambs at birth and 7 days of age (Table 5).

The mean colostrum production is shown in Table 6. The mean colostrum production at one hour postpartum did not differ between ewes but the colostrum production at 10 & 18 hours postpartum increased in ewes of BCS=3 ($P < 0.05$). Cabiddu *et al.* (1999) expressed that from day 120 of lactation there was a tendency towards a higher average milk yield in the herd with the highest BCS as shown by Branca and Casu (1989) and by Atti *et al.* (1995) in sheep. The slight negative correlation between mean BCS and the mean milk yield is in keeping with the finding of Morand-Fehr *et al.* (1989), this correlation is indeed much influenced by the inverse relationship during lactation between yield and BCS.

However, Cabiddu *et al.* (1999) expressed that at the beginning of lactation, milk yield and BCS were not correlated. Body condition score changed throughout the lactation, responding to changes in the energy balance (Coffey *et al.*, 2003). As milk yield peaks and demand for energy exceeds intake of energy, the cow mobilizes her lipid reserves and gets thinner, all by compromising her body condition.

This process is related to the daily milk yield curve, which is almost exactly opposite to the energy balance and BCS curves (Coffey *et al.*, 2002, 2003). Branca and Casu (1989) showed that the animals experience nutritional imbalances that can result in a marked decrease in milk yield, low milk fat and protein content and abrupt changes of body condition score. Wildman *et al.* (2010) reported that dairy cows of greatest efficiency of milk production showed no significant increase in body condition during lactation, had fewer days open, but had lower persistency of lactation.

The body condition scoring system is the means of accurately determining body condition of dairy cows, independent of body weight and frame size. Banos *et al.* (2004) expressed that a constant body condition score is associated with the ability of cow to produce milk while maintaining its energy balance. Studies relating BCS to milk production have provided inconsistent results with some (Pedron *et al.*, 1993; Ruegg and Milton, 1995; Domecq *et al.*, 1997) reporting no significant ef-

fect of BCS at calving on subsequent milk production while others reported the contrary (Waltner *et al.*, 1993; Markusfeld *et al.*, 1997; Roche *et al.*, 2007). Garnsworthy and Jones (1987) speculated that the quality of diet post-calving may influence the association between BCS at calving and milk production. Nonetheless, the impact of greater BCS loss on higher milk production is more consistent across studies (Roche *et al.*, 2007) with high milk production associated with greater BCS loss in early lactation. The positive effect of BCS at calving on overall milk production is at odds with some previous studies (Domecq *et al.*, 1997).

4 CONCLUSION

It is concluded that BCS had a significant effect on kilogram lambs born per ewes, birth weight of lambs and FSH concentration of ewes ($P < 0.05$) and the score of 3 at mating time could optimize profitability of Sanjabi ewes. Ewes with BCS 3 had normal estrous while ewes with lower BCS had shorter estrous period. In whole ewes with body condition score (BCS) of 3 had a better performance.

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