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IMPACT OF PARITY AND GESTATION ON BLOOD MINERAL PROFILE IN CORRIEDALE EWES

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The present study was conducted to investigate the effect of parity and gestation on different blood mineral parameters in corriedale sheep. The ewes were selected randomly from a flock of pregnant and non pregnant ewes and were divided into three groups based on parity with each containing eight non-pregnant and eight pregnant ewes. Blood samples were collected every month from pregnant ewes till lambing. The samples were also collected at the same intervals from the non pregnant ewes that acted as control. Pregnant ewes showed significantly ($P < 0.05$) lower values for calcium and phosphorous concentration from third month, magnesium concentration from first month, iron & zinc concentration from second month of gestation, but significantly higher values ($P < 0.05$) for copper concentration were reported as compared to non pregnant ewes from second month of pregnancy. Also at any stage of gestation, the concentration of a particular mineral did not vary between the pregnant ewes of different parities. In conclusion, proper mineral nutrition should be given without taking parity into consideration and also normal diet of pregnant ewes should be supplemented with micro-minerals and macro-minerals in order to have a healthy lamb at term and subsequently good reproductive performance and lactation.

Key words: Corriedale, ewe, gestation, parity, mineral

Corriedale sheep is a breed which is mostly raised for mutton. Nutrition of the pregnant ewe at all stages of gestation has been shown to influence lamb viability. Therefore the ewes should be in good health pre partum, pregnancy and post partum in order to have a normal healthy lamb and subsequently sufficient lactation yield (Balicki et al., 2007). Pregnancy and lactation are the physiological stages that impose a metabolic stress on the animal (Iriadam, 2007). Studying different metabolic parameters before and during different stages of pregnancy could be used as an aid to diagnose a metabolic disease in sheep (Balicki et al., 2007). However monitoring of mineral profile during different stages of pregnancy could signal about the need of the dam in terms of mineral nutrition for a normal healthy lamb to be born and also influence subsequent fertility of dam. The considerable evidence exists in literature on the role of specific nutrients that influence the health of dam in one or the other way. Calcium (Ca) is a structural component of the skeleton and essential for the activity of enzyme systems- including those necessary for the transmission of nerve impulses and for the contractile properties of muscles and blood coagulation (Mcdowel et al., 1993). Inorganic phosphorous (P) again is a component of the phospholipids which are important in lipid transport and cell membrane structure and functions in the energy metabolism and forms a constituent of several enzyme systems (Symondes and Forbes, 1993). Trace minerals are lost during gestation from the dam to the fetus where they are concentrated in the fetal liver to be used as a postnatal mineral reserve (Abdelrahman and Kincaid, 1993; Graham, 1994). Keeping in view the importance of different minerals especially during pregnancy, the present study was undertaken to assess the blood mineral profile during pregnancy and to find out the metabolic need of corriedale sheep during different months of pregnancy. To the best of our knowledge there is not even a single published report regarding the effect of parity on the different blood mineral parameters during different stages of gestation. Also at most of the sheep breeding farms pregnant ewes of higher parity are fed indiscriminately more minerals than primipara. This also forced us to undertake this study to find out the effect of parity on different mineral parameters at different stages of gestation.

MATERIALS AND METHODS

Study location

The present study was conducted on forty eight Corriedale ewes over a period of eight months from October, 2009 to May, 2010 at Mountain Research Centre for Sheep and Goat, SKUAST-K, Srinagar.

Experimental Animals

All animals were 3 to 4 years of age and recorded a mean body weight of 35.0 ± 7.0 kg. Body condition score of experimental animals was in the range of 3 to 4. All the animals were maintained in well-ventilated hygienic sheds under iso-managerial conditions and reared under semi-intensive and intensive housing system during September to October and November to March, respectively. Under semi-intensive conditions all the animals were allowed to graze on green pastures from 9:00 am to 4:00 pm and then dry chaffed oats and pellet feed (Agro Industries, India) @ 0.5 kg/ewe/day and 200 g/ewe/day was offered respectively. However under intensive conditions from November to December all the animals were given dry sorghum (0.5 kg/ewe/day), pellet feed (300 g/ewe/day) and turnip plus carrot (0.5 kg/ewe/day) and from January to march all the animals were stall fed with dry chaffed oats and dry sorghum at ad- libitum and pellet feed @ 700 g/ewe/day and turnip plus carrot (0.5 kg/ewe/day). The animals were regularly washed and had free access to clean drinking water. All animals were regularly vaccinated against important diseases. The animals were checked regularly for the presence of external parasites, if any, and were sprayed with deltamethrin as and when required. As a routine all animals were dewormed before the commencement of the study. All the ewes were selected randomly and were free from genital infections on gynaeco-clinical examination. The ewes were bred with healthy well maintained corriedale rams. The pregnancy was detected by real time B-mode ultrasound at 30 days post tupping. Twenty-four healthy ewes from pregnant flock were divided into three groups based on parity designated as G1, G2 and G3 corresponding to parity 1, 2 and 3 respectively while as eight non-pregnant animals of each parity acted as control (Table 1).

Blood sampling

The blood samples (10 ml) were collected aseptically in clean vials by jugular venipuncture of each animal using disposable syringes prior to feeding in the morning at monthly intervals till lambing. The blood samples were centrifuged at 855 g for 20 minutes. The serum samples so harvested were added with 0.01% thiomersol as preservative and stored at -20°C till analyzed. For mineral analysis the serum samples (0.5 ml each) were digested with 10 ml of nitric acid in Microwave Digestion Apparatus as per specification of the instrument manual. The digested samples

Table 1: Grouping of animals in to pregnant and non-pregnant on the basis of parity

Parity 1		**Parity 2**		**Parity 3**	
G1		**G2**		**G3**	
NP (n=8)	P (n=8)	NP (n=8)	P (n=8)	NP (n=8)	P (n=8)
NP= Non-pregnant, P= Pregnant, G=group					

Table 2: Effect of parity on blood mineral concentration at different stages of pregnancy in corriedale ewes (mean ±S.E.M)

Stage of gestation/ parity	Parameters					
	Calcium	**Phosphorous**	**Magnesium**	**Copper**	**Iron**	**Zinc**
First month						
G1	8.57±0.09	5.50±0.03	1.34±0.01	2.57±0.09	13.29±0.09	6.45±0.10
G2	8.57±0.09	5.55±0.05	1.34±0.01	2.59±0.10	13.22±0.11	6.45±0.10
G3	8.54±0.03	5.51±0.08	1.33±0.01	2.57±0.15	13.25±0.12	6.47±0.09
Second month						
G1	8.42±0.10	5.40±0.03	1.32±0.02	3.06±0.01	12.36±0.11	5.55±0.09
G2	8.45±0.10	5.41±0.06	1.32±0.02	3.04±0.02	12.34±0.13	5.55±0.09
G3	8.44±0.03	5.43±0.06	1.32±0.01	3.06±0.02	12.37±0.14	5.58±0.08
Third month						
G1	8.27±0.07	4.61±0.03	1.34±0.01	3.12±0.02	12.27±0.05	5.27±0.13
G2	8.26±0.07	4.65±0.05	1.35±0.02	3.10±0.02	12.29±0.05	5.27±0.13
G3	8.27±0.07	4.60±0.07	1.34±0.01	3.10±0.02	12.28±0.05	5.21±0.09
Fourth month						
G1	7.94±0.05	4.17±0.04	1.28±0.02	3.64±0.08	10.50±0.09	4.36±0.09
G2	7.90±0.04	4.13±0.04	1.29±0.01	3.61±0.09	10.41±0.16	4.36±0.09
G3	7.99±0.06	4.18±0.03	1.28±0.04	3.63±0.07	10.53±0.10	4.34±0.11
Fifth month						
G1	7.72±0.08	4.01±0.03	1.27±0.03	4.20±0.05	8.25±0.07	4.13±0.04
G2	7.73±0.08	4.03±0.04	1.27±0.03	4.24±0.05	8.21±0.07	4.13±0.04
G3	7.74±0.07	4.01±0.04	1.26±0.01	4.21±0.08	8.29±0.06	4.12±0.02

were diluted with distilled water up to 50 ml and diluted samples were analyzed in Atomic Absorption Spectrophotometer (Perkin Elmer, USA) as per specification of the instrument manual for estimation of serum concentration of calcium, phosphorus, magnesium, copper, iron and zinc.

Statistical analysis

The data generated was analyzed by adopting standard statistical procedure (SPSS, 1999). To evaluate the effect of parity at each stage of gestation for a particular parameter the date obtained were analyzed by one-way analysis of variance. No significant difference was observed between the parities and thus data were pooled and analyzed with the aid of a one-way ANOVA to determine the effect of gestation. The *T*-test was used to compare serum mineral levels between non-pregnant and pregnant ewes. The probability level for determining the significance was set at 5% level.

RESULTS

The results regarding effect of parity on mineral profile during different stages of gestation in pregnant sheep are set out in table 2. There was no significant difference ($P > 0.05$) in the concentration of different minerals at different stages of gestation between the ewes of parity 1, parity 2 and parity 3. The findings related to comparison between non-pregnant and pregnant animals at different stages of gestation and the trend with the advancement of pregnancy in a particular mineral parameter are presented in table 3. Calcium and Phosphorous concentration at different stages of gestation between pregnant and non-pregnant animals showed a significant ($P < 0.05$) decrease

Table 3: Blood mineral concentration at different stages of gestation in pregnant and corresponding stage in non-pregnant corriedale ewes (mean ± S.E.M)

Parameters	Stage of pregnancy				
	1st. month	**2nd. Month**	**3rd. month**	**4th. month**	**5th. month**
Calcium (mg/dl)					
Non pregnant	8.55± 0.09	8.52± 0.08	8.52^{a}± 0.08	8.51^{a}± 0.08	8.51^{a}± 0.08
Pregnant	8.56± 0.09	8.43± 0.10	8.26^{b}± 0.07	7.94^{c}± 0.04	7.73^{c}± 0.08
Phosphorous (mg/dl)					
Non pregnant	5.55± 0.05	5.56± 0.06	5.58^{a}± 0.05	5.58^{a}± 0.05	5.58^{a}± 0.05
Pregnant	5.52± 0.05	5.41± 0.06	4.62^{b}± 0.05	4.16^{bc}± 0.04	4.01^{c}± 0.04
Magnesium (mg/dl)					
Non pregnant	1.68^{a}± 0.01	1.68^{a}± 0.01	1.69^{a}± 0.01	1.69^{a}± 0.01	1.69^{a}± 0.01
Pregnant	1.33^{b}± 0.01	1.32^{b}± 0.02	1.34^{b}± 0.04	1.28^{c}± 0.01	1.26^{c}± 0.03
Copper (ppm)					
Non pregnant	2.61± 0.09	2.60^{a}± 0.08	2.57^{a}± 0.09	2.54^{a}± 0.09	2.61^{a}±0.09
Pregnant	2.57± 0.10	3.05^{b}± 0.02	3.10^{b}± 0.02	3.62^{c}± 0.09	4.21^{d}±0.05
Iron (ppm)					
Non pregnant	13.24± 0.05	13.25^{a}± 0.05	13.31^{a}± 0.05	13.31^{a}± 0.05	13.31^{a}± 0.05
Pregnant	13.25± 0.11	12.35^{b}± 0.13	12.28^{b}± 0.05	10.48^{c}± 0.16	8.25^{d}± 0.07
Zinc (ppm)					
Non pregnant	6.60± 0.06	6.60^{a}± 0.06	6.55^{a}± 0.07	6.59^{a}± 0.10	6.60^{a}± 0.08
Pregnant	6.45± 0.10	5.56^{b}± 0.09	5.25^{b}± 0.13	4.35^{c}± 0.09	4.12^{c}± 0.04

Means in the same column and within same variable with different superscripts (a, b, c, d) differ significantly (P < 0.05)

from third month and during pregnancy calcium decreased significantly from third month but phosphorous decreased significantly (P < 0.05) from second month to fifth month of gestation. However mean magnesium concentration decreased significantly (P < 0.05) from first month of gestation in pregnant as compared to non-pregnant ewes but in pregnant animals it started declining significantly (P < 0.05) from third month only. Iron and zinc concentration showed a significant (P < 0.05) decrease from second month between pregnant and non-pregnant and during pregnancy, the concentration of both minerals decrease significantly (P < 0.05) from third month of gestation. The serum copper levels increased significantly (P < 0.05) in pregnant in comparison to non-pregnant ewes from second month onwards but it increased significantly (P < 0.05) from third month of pregnancy.

DISCUSSION

All animals require minerals for growth, reproduction and lactation, and they serve as the structural part or components of enzymes and regulate many chemical reactions in the body (Ahmad, 2000). The effect of parity on mineral concentration at different stages of gestation was studied and no significant differences in values were found between the three parities. The authors could not come across any published report, thus could not compare the results due to paucity of literature on this aspect. It appears that our study happens to be the first report where blood concentration of various minerals of pregnant ewes were compared based on parity. The results of our study indicated gestation has an impact on mineral profile of ewes. The results of the present study indicate a significant decrease in the calcium level from third month of gestation. These findings are in agreement with those reported by Yildiz et al. (2004) in Akkaraman sheep, Iriadam et al. (2007) in female Kilis goats and Elnageeb and Adelatif (2010) in Desert Ewes. Contrary to our findings, Amer et al. (1999) reported no significant change during gestation in Ardy goats. The calcium (Ca) homeostasis in the body is well controlled by different hormones including hydroxylated metabolites of Vitamin D, parathormone and thyrocalcitonin (Swenson and Reece, 1993). The decrease in serum calcium level in the present study might be due to fetal skeletal formation in later half of pregnancy and an increase in the rate of movement of calcium out of the blood plasma which is not balanced by increase in the rate of absorption of calcium from the gut or bone (Sansom et al., 1982). The fetus takes out the calcium for ossification of its bones. Braithwaite (1982) indicated that the lowest concentration of calcium in late gestation is due to marked increase in the need of fetal skeleton for mineralization. The calcium supplementation should start from the first month itself even if it decreased significantly from third month of gestation. This is because the rate of calcium absorption is more in early than during late in pregnancy and also endogenous loss of calcium increases with the advancement of gestation (Braithwaite, 1982).

The mean serum phosphorous levels were significantly reduced from second to fifth month of pregnancy. The present findings simulate the findings of Yildiz et al. (2004) in Akkaraman sheep and Elnageeb and Adelatif (2010) in desert ewes. Decrease in serum phosphorous level during late pregnancy is attributed to a similar increase in the rate of movement of phosphorous out of the maternal circulation into the fetus which is not balanced by increase in the rate of absorption of phosphorous from the gut or from the bones of dam (Braithwaite, 1982).

The significantly lower serum magnesium levels at various stages of gestation in this study are in agreement with those reported by Yildiz et al. (2004) in Akkaraman sheep and Elnageeb and Adelatif (2010) in Desert Ewes respectively. Contrary to our findings Azab and Maksoud (1999) reported plasma magnesium concentration increased at three weeks pre-partum followed by a non-significant decrease in Baladi female goats. The serum magnesium level is influenced by the levels of protein (Hendricks et al., 1970) as well as calcium and phosphorous (Underwood and Suttle, 1999) in the diet. The decrease in magnesium concentration could be implicated to the factors influencing the absorption of magnesium from the gut, which include dietary protein and ammonia contents. Besides this, the decrease in serum magnesium level is presumably related to haemodilution which usually occurs during late pregnancy (Elnageeb and Adelatif, 2010).

The decreased iron concentration in our study is similar to the findings of Gurdogan et al. (2006). The decline in serum iron content during late pregnancy might be due to its demand by the fetus (Swenson and Reece, 1993) because the fetal liver concentrates iron continuously with the advancement of pregnancy and reaches high levels in the fifth month (Rallis and Papasteriadis, 1987). Also iron is utilized for formation of fetal and maternal hemoglobin, thus serum levels of iron decrease.

Reduction in zinc level here corroborates to the findings of Gurdogan et al. (2006) in Akkaraman sheep and Elnageeb and

Adelatif (2010) in desert sheep. The reason for low Zn level obtained in pregnant animals compared with non-pregnant ewes is the increase in the rate of accumulation of zinc by the developing fetus (Elnageeb and Adelatif, 2010). The fetus accumulates 1 to 2 mg of zinc per day and the demand becomes higher towards the end of pregnancy (Williams et al., 1972).

The mean serum copper concentration increased significantly in pregnant as compared to non-pregnant ewes from second month itself. These findings are in agreement with those reported by Elnageeb and Adelatif (2010), Gurdogan et al. (2006) and Yokus et al. (2006). Saxena and Gupta (1994) also recorded higher serum Cu concentration in different months of gestation than that in the lactation period. The reason being the increase in copper level in the form of ceruloplasmin in response to the high estrogen and progesterone levels (McArdle, 1995; Sato and Henkin, 1993). The increase could be related to the increased fetal demand and utilization of maternal copper for the development of the nervous system. Newborns are very dependent on copper acquired during the prenatal period since copper levels in milk are poor and proper copper nutrition in gestating females is critical to body stores in newborns.

CONCLUSION

Our study concluded that parity has no effect on blood mineral profile in pregnant ewes. Pregnant ewes showed significantly ($p<0.05$) lower values for calcium and phosphorous concentration from third month, magnesium concentration from first month, iron & zinc concentration from second month of gestation, but significantly higher values ($p<0.05$) for copper concentration were reported as compared to non pregnant ewes from second month of pregnancy. Therefore proper mineral supplementation should be provided without taking parity into consideration and normal diet of pregnant ewes should be supplemented with micro-minerals (Iron and zinc) and macro-minerals (Calcium, Phosphorous and Magnesium) from second month onwards so that health and subsequent reproductive activity of the dam are not affected.

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