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Micro-mineral and biochemical profile of Marwari goats

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ABSTRACT

Healthy, pluriparous, cyclic Marwari does (6) were used to investigate the changes in Zn, Cu and certain biochemical parameters during different physiological stages. Blood samples were collected during oestrous cycle, on the day of mating, gestation period (fortnightly up to fourth month, weekly during last month), day of kidding and up to 1 month of lactation period. In this study, glucose and protein profile did not change significantly between different phases of oestrus cycle, the activity of transaminases was significantly high during the follicular phase of oestrus cycle. Glucose concentration was significantly high during early and late gestation and attained significantly lowest level on the day of kidding. The activity of transaminases remained significantly low up to third month of gestation while on day of kidding, the activity increased significantly. Total protein level decreased progressively during fifth month of gestation period. However, it increased significantly at the beginning of the lactation. Up to 105 days of gestation period, albumin concentration decreased while globulin concentration increased. Albumin concentration tended to increase and attained normal value at term. However, the globulin decreased to term and lactation period. Zinc concentration remained low up to third month of gestation. At fourth month of gestation it increased significantly and remained high up to first week of post-partum period. Copper concentration showed increasing trend from third month of gestation and attained significantly higher level in the mid of fifth month of gestation. Thereafter it decreased and remained low up to first week of lactation.

Key words: Copper, Glucose, Marwari, Protein, Transaminases, Zinc

Goats should be in good health during and after pregnancy so as to produce viable kids. As pregnancy progresses, there is a difference in serum glucose, cholesterol and total protein concentrations as the need of the dam changes (Bal1kcy *et al.* 2007, Nazifi *et al*. 2002, El-Sherif and Assad 2001). Kaneko and Cornelius (1980) reported that the total serum protein progressively decreases throughout gestation. In domestic ruminants, blood total protein and albumin concentration is used to assess nutritional status and low levels of these are taken as measures of protein deficiency and under-nutrition (Kaneko 1989). Stress, irrespective of the cause, predisposes to gluconeogenesis, with an associated rise in circulatory transaminases (Kaushik and Bugalia 1999). Reproductive failure may be induced by deficiencies or imbalances of trace elements and concomitant infertility in animals may be associated with enzyme dysfunctions resulting from these deficiencies. Thus, the present study was initiated to study changes in Zn, Cu and certain biochemical parameters for different reproductive physiological phases in Marwari does.

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MATERIALS AND METHODS

Pluriparous, cyclic Marwari does (6), 2 to 4 years old, weighing 25.5 to 40 kg maintained under semi-intensive system of management with 4 to 6 h daily grazing were used for this study. Pelleted concentrate mixture with 13 and 69% digestible crude protein (DCP) and total digestible nutrients (TDN) respectively, was offered @ 300 g/animal/day during advanced pregnancy and 400 g/kg of milk during lactation. Heat detection was done by observing behavioural manifestation of estrus and with vasectomised buck twice daily. Receptive goats were mated with fertile bucks.

Blood was collected in nitric acid washed heparinized vials from jugular vein at day 0 i.e. day of estrus, 5th, 9th, 13th, 17th, 20th day of oestrous cycle, on the day of mating, gestation period fortnightly up to fourth month, weekly during last month of gestation period, day of kidding and 7 th, 14 th, 21 st, 30 th day of lactation period. Glucose, total protein and total albumin, and activity of SGPT and SGOT were estimated in blood plasma using Span diagnostics kits, India. Total globulin was calculated by taking difference of total protein and total albumin. For estimation of Zn and Cu, 5 ml. blood samples were digested as per the method prescribed by AOAC (1984). In digested samples, Zn and Cu was estimated using flame atomic absorption spectrophotometer (Naresh 1997).

Data were analyzed statistically by applying analysis of variance (ANOVA) in the program CRD and tested at 5 and 1% level of significance (Snedecor and Cochran 1994).

RESULTS AND DISCUSSION

In present study, glucose level did not change significantly between different phases of oestrus cycle. It was non-significantly high (49.37±5.75 mg/dl) (Table 1) on the day of estrus. Glucose level was significantly (P<0.01) high during early and late gestation and remained significantly (P<0.01) low during mid gestation. During pregnancy, the requirement for glucose increases considerably as in the pregnant animal, the foetus and uterus utilize glucose as a major energy source (Chaiyabutr *et al*. 1982). On the day of kidding, it attained the significantly (P<0.01) lowest level (39.33±2.60 mg/dl). Due to the stress of kidding, there is sharp decline in the concentration of blood glucose on the day of kidding which results in decreased food intake by the goats because, in ruminants, glucose comes mainly from gluconeogenesis. Khan and Ludri (2002), Mohy El-Deen *et al*. (1985) and Bal1kcy *et al.* (2007) also observed the similar pattern of glucose concentration in Alpine × Beetal, Beladi ×Angora goats and Akkaraman ewes respectively. In this study, after kidding glucose concentration increased significantly and attained the normal level during lactation. However, Vernon *et al.* (1981) and Fýrat and Ozpýnar (2002) did not record significant changes in serum glucose levels during pregnancy and lactation in ewes.

The activity of transaminases was significantly (P<0.01) high during the follicular phase of oestrus cycle. On day of estrus SGPT attained significantly (P<0.01) low (2.91±0.61 Units/ml) value. While, SGOT attained significantly (P<0.01) high value on day of estrus which was in agreement with Mathai and Nirmalan (1992) in goats. Higher values of SGOT observed on day of estrus probably indicated the increased rate of metabolic activity during the follicular phase. During pregnancy, the uterine and hormonal changes affect metabolism, which also alters transaminases activity. The activity of transaminases remained significantly (P<0.01) low up to third month of gestation. Significant elevated SGPT and SGOT activity during the 4th month of gestation could be attributed to occurrence of gluconeogenesis induced by pregnancy stress (Kaushik and Bugalia 1999). On day of kidding, there was significant rise in transaminases activity (Table 2). Singh *et al.* (1992) and Ingole *et al.* (1999) also observed rise in SGOT activity during parturition in cows. Vihan and Rai (1987) and Visha *et al.* (2003) also recorded the similar pattern in goats and sheep respectively. This rise may be due to muscular damage which is in accordance with West (1989). Similarly, decreased activity with advancing stage of lactation was observed by Murtuza *et al.* (1980) and Ingole *et al.* (1999) in cows.

Protein profile concentrations were not significantly different between different phases of the oestrous cycle while their concentrations were significantly (P<0.01) different between different phases of gestation and lactation period. Total protein was nonsignificantly high during the follicular phase of the oestrous cycle. There was significant (P<0.01) fall in plasma total protein at fourth month of gestation period (Table 2) appear to be due to utilization of immunoglobulins for cholesterol synthesis. After that it increased significantly (P<0.01) for a week and then decreased progressively throughout the remaining gestation period suggesting that the immunoglobulins rapidly leave the plasma during the last month of the pregnancy, when colostrum is being formed in the mammary gland (Amer *et al.* 1999). Total protein concentration was significantly high (P<0.01) at the beginning of the lactation. Similarly, Khaled *et al.* (1998) observed that the highest concentrations of total plasma protein were at the beginning of lactation in dairy goats.

Total albumin concentration increased significantly (P<0.01) up to 105 days of gestation. From 4th month of gestation, it decreased significantly (P<0.01) and remained low up to 135 days of gestation. Thereafter it tended to increase and attained normal value (3.39±0.25 g/100 ml) at term. There was slight decrease (3.37±0.10 g/100 ml) during

Table 1. Mean±SE of biochemical profile of Marwari goats during oestrous cycle

Parameters	Days of oestrous cycle						
	Day of estrus (0)	Day 5	Day 9	Day 13	Day 17	Day 20	Day of mating
Glucose (mg/dl)	48.69±2.52	38.29±2.46	41.48±2.05	41.44±4.88	39.33±4.73	47.70±4.58	49.37±5.75
GPT (units/ ml)	2.91±0.61 [a]	17.16±1.76 [b]	19.52±0.80 [b]	13.43±3.44 [bc]	3.45±0.00 [a]	4.36±1.39 [a]	3.18±0.56 [a]
GOT (units/ ml)	55.19±1.8[a]	48.95±3.28[a]	46.39±3.28 [b]	39.03±1.92 [bc]	44.29±1.99 [b]	43.27±1.59 [b]	53.06±2.31 [a]
Total protein (g/100 ml)	6.12±0.27	6.19±0.09	6.88±0.47	6.18±0.23	6.43±0.11	6.11±0.18	6.13±0.29
Total albumin (g/100 ml)	3.49±0.04	3.52±0.13	3.25±0.14	3.19±0.11	3.28±0.46	3.46±0.20	3.39±0.13
Total globulin (g/100 ml)	2.63±0.29	2.67±0.21	3.63±0.55	2.98±0.30	3.14±0.40	2.65±0.22	2.74±0.35

a,b,c, denotes dissimilar mean.

Table 2. Mean±S E for biochemical profile of Marwari goats during gestation and lactation period

	Days	Glucose (mg/dl)	GPT (units/ml)	GOT (units/ml)	Total protein (g/100 ml)	Total albumin (g/100 ml)	Total globulin (g/100 ml)
Day of mating		49.37±5.7^{bc}	3.18±0.56^{cd}	53.06±2.31^{a}	6.13±0.29^{ab}	3.39±0.13^{ab}	2.74±0.35^{ab}
Gestation	15	60.83±3.41^{af}	2.63±0.40^{c}	39.27±3.6^{def}	6.02±0.09^{a}	3.22±0.26^{a}	2.80±0.24^{ab}
	30	43.00±3.63^{be}	2.90±0.38^{cd}	40.59±17.35^{df}	6.69±0.08^{c}	3.39±0.09^{ab}	3.30±0.16^{ad}
	45	57.14±8.94^{ac}	2.90±0.38^{cd}	33.14±1.03^{dgh}	6.84±0.17^{c}	3.76±0.16^{b}	3.08±0.23^{abd}
	60	52.22±4.04^{ac}	5.46±0.76^{be}	28.71±2.18^{egh}	6.69±0.08^{c}	3.98±0.05^{c}	2.70±0.05^{b}
	75	40.00±5.96^{bd}	2.90±0.38^{cd}	34.88±0.94^{dg}	6.80±0.39^{c}	3.79±0.31^{bc}	3.01±0.23^{a}
	90	47.78±7.79^{bc}	3.18±0.56^{cd}	31.50±1.69^{dgh}	6.94±0.11^{c}	3.88±0.04^{bc}	3.06±0.12^{abd}
	105	57.96±3.90^{af}	6.61±0.32^{b}	46.61±10.72^{af}	6.69±0.11^{c}	3.41±0.27^{a}	3.28±0.27$^{a\ bd}$
	120	48.33±2.58^{bc}	7.22±0.78^{b}	47.07±8.83^{af}	6.07±0.19	2.07±0.18^{d}	4.00±0.08^{c}
	128	41.67±3.91^{bd}	4.02±0.39^{cdf}	23.23±0.96^{bh}	6.87±0.21^{ce}	2.75±0.30^{e}	4.12±0.11^{c}
	135	53.33±2.74^{ac}	4.88±0.58^{ef}	25.86±1.30^{bg}	6.80±0.17^{ce}	2.69±0.19^{e}	4.11±0.08^{c}
	142	56.25±2.76^{ac}	6.62±0.60^{b}	28.57±3.39^{egh}	6.59±0.08^{be}	2.95±0.10^{a}	3.64±0.11^{d}
Day of kidding		39.33±2.60^{b}	15.15±1.74^{a}	96.19±6.04^{c}	6.67±0.16^{ce}	3.39±0.25^{ab}	3.28±0.25^{ab}
Lactation	7	46.55±2.19^{bc}	5.74±0.63^{be}	91.78±2.92^{c}	7.21±0.15^{d}	3.35±0.05^{ab}	3.86±0.18^{c}
	14	53.18±3.06^{ac}	4.31±0.64^{de}	67.53±4.43^{i}	7.10±0.13^{d}	3.38±0.08^{ab}	3.72±0.16^{c}
	21	53.60±3.68^{ace}	3.73±0.31^{cdf}	41.15±5.71^{df}	6.63±0.24^{ce}	3.39±0.18^{ab}	3.24±0.29^{ab}
	30	51.20±3.08^{acd}	2.90±0.38^{cd}	38.26±3.22^{def}	6.86±0.16^{cde}	3.37±0.42^{ab}	3.48±0.54^{c}

a,b,c,d,e,f,g,h denotes dissimilar mean;means with at least one common superscript within same column don’t differ significantly.

post-partum period. On citing literature, in ewes, albumin decreases to a minimum at mid gestation and return to near normal at term (Kaneko *et al*. 1997). The globulin value remained significantly low up to 105 days of gestation thereafter it increased progressively up to 135 days of gestation and then again decreased near term which shows that during the last month of gestation, when colostrum is being formed in the mammary glands, the immunoglobulins rapidly leave the plasma (Amer *et al.* 1999).

There was a significant difference in zinc and copper concentration between different phases of gestation and lactation period. Zinc level was significantly higher ($P<0.01$) on day of mating. It decreased during 1st month of gestation period and remained low up to third month of gestation period (Table 3). Again, it increased significantly ($P<0.01$) during 4th month of gestation period and remained high up to first week of post-partum period which is indicative of the increased metabolic demand for this element. Zinc affects growth and development, bone and blood formation and metabolism of nucleic acids and carbohydrates (Vergnes *et al*. 1990 and Kadzere *et al*. 1996). Zinc concentration decreased and attained significantly ($P<0.01$) low level after 1 month of lactation. However, Groppel and Henning (1971) reported that lactating does required more than 6–7 ppm Zn per day and amount less than this led to loss of appetite and subsequent loss of body condition. Zinc plasma level increased throughout pregnancy and lactation which would reflect on the effect of Zn on foetal development, involution of the uterus and following parturition (Ahmed *et al*. 2001).

Copper level started increasing from third month of gestation and attained significantly ($P<0.01$) higher level in the mid of 5th month of gestation (Table 3). Copper levels obtained in pregnant animals could be related to elevated Cu in the form of ceruloplasmin enzyme apparently in response to elevated blood oestrogen (NRC 1980). Radostits *et al.* (2000) also reported that during gestation, the copper concentration increases progressively in the ovine and bovine fetal liver and decreases in the maternal liver. Thereafter, copper concentration decreased and remained low up to first week of lactation. After that it attained significantly ($P<0.01$) higher level during second week of lactation and remained high up to one month of lactation. Similarly, higher plasma Cu levels in lactating as compared to non lactating animals were observed by Ahmed *et al*. (2001) and Ben-Ghedalia *et al*. (1994).

Table 3.Mean±S E for mineral profile of Marwari goats during gestation and lactation period

	Days	Zn (ppm)	Cu (ppm)
Day of mating		2.58±0.12	3.28±0.17
Gestation	30	2.13±0.11	3.20±0.16
	60	2.39±0.12	3.04±0.16
	90	2.22±0.12	3.43±0.11
	120	2.47±0.09	3.63±0.15
	128	2.62±0.08	3.76±0.06
	135	2.52±0.03	3.92±0.07
	142	2.69±0.08	3.77±0.15
Day of kidding		2.64±0.02	3.70±0.24
Lactation	7	2.60±0.06	3.59±0.25
	14	2.18±0.12	4.15±0.17
	21	2.09±0.1	4.13±0.12
	30	1.84±0.12	4.03±0.26

These observations suggest that different physiological stage variations have to be taken into consideration for the correct interpretation of serum chemistry and elements status in goats. However, quantification of the actual dietary supplements and their utilization by the animal in the various physiological states needs to be established to avoid a decline in their performance which would represent the consequent economic loss.

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REFERENCES

Ahmed M M M, Hamed T F M and Barri M E S. 2001. Variation of zinc and copper concentrations in the plasma of Nubian goats according to physiological state. *Small Ruminant Research* **39**: 189–93.

Amer H A, Salem H A H and Al-Hozab A A. 1999. Biochemical changes in serum and milk constituents during postpartum period in Saudi Ardy goats. *Small Ruminant Research* **34**: 167–73.

AOAC.1984. *Association of Official Analytical Chemists*. pp. 444–76.Virginia.

Balýkcý E, Yýldýz A and G¨urdogan F. 2007. Blood metabolite concentrations during pregnancy and postpartum in Akkaraman ewes. *Small Ruminant Research* **67**: 247–51.

Ben-Ghedalia D, Miron J and Yousef E. 1994. Apparent digestibility of minerals by lactating cows from a total mixed ration supplemented with poultry litter. *Journal of Dairy Science* **97**: 454–58.

Chaiyabutr N, Faulkner A and Peaker M.1982. Glucose metabolism in vivo in fed and 48 h starved goats during pregnancy and lactation. *British Journal of Nutrition* **47**: 87–94.

El-Sherif M M A and Assad F. 2001. Changes in some blood constituents of Barki ewes during pregnancy and lactation under semi arid conditions. *Small Ruminant Research* **40**: 269–77.

Firat A and Ozpinar A. 2002. Metabolic profile of pre pregnancy, pregnancy and early lactation in multiple lambing Sakiz ewes. 1. Changes in plasma glucose, 3–hydroxybutyrate and cortisol levels. *Annals Nutrition Metabolism* 46: 57–61.

Groppel B and Henning A. 1971. Zn deficiency in ruminants. *Archives of Experimental Veterinary Medicine* **25**: 817–29.

Ingole S D, Talvelkar B A, Deshmukh B T and Nagvekar A S. 1999. Serum enzyme profile during gestation and early lactation in Gir and crossbred cows. *Indian Journal of Animal Science* **69**: 479–81.

Kadzere C T, Liewelyn C A and Chivandi E. 1996. Plasma progesterone, calcium, magnesium and zinc concentrations from oestrous synchronization to weaning in indigenous goats in Zimbabwe. *Small Ruminant Research* **24**: 21–26.

Kaneko J J and Cornelius C E. 1980. *Clinical Biochemistry of Domestic Animal* 3rd edn. pp 41–376. Academic Press, New York.

Kaneko J J, Harvey J W and Bruss M L. 1997. *Clinical Biochemistry of Domestic Animal*. 5th edn. pp 129–130. Academic Press, New York.

Kaneko J J. 1989. *Clinical Biochemistry of Domestic Animal*. 4th edn. Academic Press, New York.

Kaushik H K and Bugalia N S. 1999. Plasma total protein, cholesterol, minerals and transaminases during pregnancy in goats. *Indian Veterinary Journal* **76**: 603–06.

Khaled N F, Illeb J, Filipek J and Sedlakova D. 1998. Changes in milk and blood composition in dairy goats during lactation. *Proceedings of the Sixth International Symposium on the Milking of Small Ruminants*. 26 September- 1 October, Athens, Greece.

Khan J R and Ludri R S. 2002. Changes in blood glucose, plasma non-esterified fatty acids and insulin in pregnant and non-pregnant goats. *Tropical Animal Health and Production* **34**: 81–90.

Mathai E and Nirmalan G. 1992. Enzyme profile during growth and oestrous cycle in goats. *Proceedings of 5th International Conference on Goats: Recent Advances in Goat Production*. pp 1341–47. New Delhi.

Mohy El-Deen, Hassan A M, Samk M, Zahraa R and Abolezz E. 1985. Changes in milk yield and certain blood components of crossbred goats and their correlation associated with lactation, pregnancy and dry season. *World Review of Animal Production* **21**:36–40.

Murtuza M D, Pandey M D and Rawat J S. 1980. Studies on certain clinically important serum enzymes and serum protein fraction in Haryana cattle under various physiological states. *Indian Journal of Animal Health* **19**: 131–41.

Naresh R. 1997. 'Studies on profile of trace and toxic heavy metals in mastitis and ameliorative effects of ascorbic acid therapy.' M.V.Sc. Thesis, IVRI, Izatnagar.

Nazifi S, Saeb M, Ghavami S M. 2002. Serum lipid profile in Iranian fat-tailed sheep in late pregnancy, at parturition and during the post-parturition period. *Journal of Veterinary Medicine* Series- A. **49**: 9–12.

NRC. 1980. *Mineral Tolerances of Domestic Animals*. pp 85. Academic Press, Washington, D C.

Radostits O M, Gay C C, Blood D C, Hinchcliff K W. 2000. *Veterinary Medicine* A *Textbook of the diseases of Cattle, Sheep, Pigs, Goats and Horses*.8th edn. pp. 1488– 1553. Baillier Tindal.

Singh R, Setia M S, Singha S P S. 1992. Plasma enzyme levels during pregnancy in buffaloes. *Buffalo Journal* **2**: 287–91.

Snedecor G W and Cochran W G. 1994. *Statistical Methods*. 8th edn. Iowa State University Press, Ames, Iowa.

Vergnes H A, Courdouhji M K, Guelfi J F, Grozdea J G and Lamand M. 1999. Effect of Zn deficiency in lambs on plasma and neutrophil alkaline phosphatase. *Small Ruminant Research* **3**: 167–77.

Vernon R G, Clegg R A and Flint D J. 1981. Metabolism of sheep adipose tissue during pregnancy and lactation. *Biochemistry Journal* **200**: 307–14.

Vihan V S, Rai P. 1987. Certain hematological biochemical attributes during pregnancy, parturition and post-parturition periods in sheep and goats. *Indian Journal of Animal Sciences* **57** (11): 1200–04.

Visha P, Leela V and Viswanathan S. 2003. Serum transferases during pregnancy and parturition in Madras red sheep. *Indian Journal of Animal Reproduction* **24**: 60–61.

West H J. 1989. Liver function of dairy cows in late pregnancy and early lactation. *Research of Veterinary Science* **46**: 231–37.