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Consequence of extreme warm environment on hepatic and serum vitamin A and enzymes in Marwari goats

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ABSTRACT

A study was conducted to investigate liver and serum carotene, vitamin A and enzymes i.e. aspartate amino transferase (AST) and alanine amino transferase (ALT) during winter and summer in 300 Marwari goats. In each climatic condition 150 animals were taken. They were categorized into males (70 of 0–1 year, and 30 of above 1 year) and females (30 of 0–1 year, and 20 of above 1 year). Liver carotene (µg/g), vitamin A (µg/g), AST (IU/L) and ALT (IU/L) ranged from 3.25 to 11.36, 156.56 to 290.25, 210.56 to 610.10 and from 170.11 to 562.70, respectively. Serum carotene (µg/dl), vitamin A (µg/dl), AST (IU/L) and ALT (IU/L) ranged from 36.24 to 78.65, 22.45 to 62.55, 56.70 to 215.00 and from 20.15 to 85.77 (average 57.54±1.24), respectively. Season had significant effect on liver and serum carotene, vitamin A and ALT. Liver carotene**,** vitamin A and ALT showed significant effect on sex in both climatic conditions and age group in winter. Higher values were observed in all the liver parameters in males than females in both climatic conditions. Higher values of all liver parameters were observed in 0–1 year age group animals than above 1 year age group in both climatic conditions except in summer values of ALT were was higher in above 1 year age group animals.

Serum AST showed significant effect of sex in both climatic conditions while, serum vitamin A and ALT showed significant effect on age group in summer only. Higher values of serum carotene and AST were observed in male while serum vitamin A and ALT values were higher in female of both climatic conditions.

Key words: Alanine amino transferase (ALT), Aspartate amino transferase (AST), Carotene, Liver, Serum, Summer, Winter, Vitamin A

High environmental temperature is one of the major factors affecting the efficiency of goat production in western Rajasthan and higher humidity adds complexity to the situation (Manish Kumar *et al.* 2010). The degree of animal resistance to rise in ambient temperature varies with animal species because of difference in their heat regulating mechanisms (Beatty *et al*. 2006). Liver serves as a main storehouse of vitamin A which plays central role in growth, production and reproduction. Plasma retinol is not a reliable index of vitamin A reserves and only analysis of biopsy samples of liver provides a useful index of vitamin A reserves (Rucker and Morris 1999).This clearly needs for simultaneous estimation of vitamin A in serum and liver tissue. Aspartate amino transferase (AST) and alanine amino transferase (ALT) are present in hepatic cells and their levels in serum increases during diseases (Gahlot 1988). Marwari is an important-medium size goat breed found predominantly in Marwar region of Rajasthan. This goat is primarily of meat type and also suitable for milk production. The information on this aspect is meager in goats particularly in Marwari breed. Combination of determination of carotene, vitamin A, AST and ALT simultaneously in liver tissue and serum is helpful in bringing out the commendable diagnosis for the welfare of animals particularly goats. It becomes very essential to monitor their health as it is related with the economy as well as health of human population. Therefore to parry the extrapolation of scientific know how to other species and breeds to Marwari goats, the present investigation was planned to study the liver and serum carotene, vitamin A, AST and ALT during summer climatic condition in Marwari goats.

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MATERIALS AND METHODS

Goats (300) of both the sex ageing 0 to 3 years belongings to farmer's stock of adjoining area of Bikaner district were used in the present investigation. Semi-intensive feeding management was followed and animals were fed *Ziziphus*

Table 1. Mean±SE values of temperature and relative humidity during experimental period

Season Summer	Temperature (°C)		Relative humidity (%)	
	Minimum (°C)	Maximum (°C)	8: 30 AM	5: 30 PM
	27.54±1.01	42.25±1.22	30.28±2.20	14.40±2.10
Winter	22.18±0.58	34.42±0.22	60.44±2.25	32.24±1.25

numularia leaves and loopings of *Prosopis cineraria* trees. Blood samples were collected from jugular vein by using clot activator vials and serum was processed on same day. Liver tissues were collected from the animals immediately after slaughter. All the analyses were carried out at the same day of collection on fresh samples. Modified method of Carr and Price (Varley 1988) was used to determine the liver and serum carotene and vitamin A. Modified method of Cornelius *et al.* (1959) was used to determine the liver enzymes. Serum enzymes, viz. AST and ALT were determined by using Reitman and Frankel's (1957) method of kit.

RESULTS AND DISCUSSION

Overall mean values of liver carotene, vitamin A, AST and ALT were 7.44±0.25 µg/g, 215.42±12.79 µg/g, 579.65±11.33 IU/L and 402.09±21.34 IU/L, respectively (Table 2). The overall mean values of liver vitamin A obtained were in partial agreement with those reported by Molokwu (1978) in goats. The overall mean values of liver AST and ALT obtained in our study were more or less similar to those obtained by Fakhruddin (2003) in goats. Tissue vitamin A concentration provides a useful index of reserves. As per Kaneko *et al.*(1999) liver concentration of 100 µg/g retinol in plasma is well maintained until liver reserves are grossly depleted. Therefore, the concentration can be considered as adequate. This was also proved by the serum vitamin A and carotene levels as determined in present study. However, liver carotene (0.22 to 3.6 µg/g) reported by them was lower than that observed in present investigation. Church *et al.* (1954) also reported lower hepatic concentration of carotene in sheep.

AST and ALT are useful indicators to show the integrity of hepatocytes (Tennants 1999). As per Coles (1986) liver biopsy can provide valuable information to a clinician along with serum determination. ALT is much more abundant in liver than other tissues (Oser 1976). As per Ghoshal and Kataria (1995) the GPT rises sooner, faster and higher than GOT. During summer mean values of carotene and vitamin A decreased while values of ALT increased significantly ($P<0.05$). Per cent decrement of carotene, vitamin A, AST were 19.75, 18.62, 3.25 and increment of ALT was 35.31, respectively.

Liver vitamin A and carotene levels decreased during extreme hot in present study. Molokwu (1978) reported that liver vitamin A and carotene levels decreased slowly until the end of summer. The decrease in liver vitamin A and carotene in present study might be due to unavailability of good quality of fodder. Wharton's (1966) also found the low liver vitamin A reserve through the dry season. The literature showing seasonal effect on liver carotene and vitamin A is meager. The effect of climate was observed only on liver ALT values. The values were higher in summer. Similar trends were observed for serum transaminases.

Mean values of liver carotene, vitamin A and AST were lower, while ALT values were higher in both sexes during summer season compared to winter. We observed that mean liver carotene, vitamin A, AST and ALT were low in female goats than males in both the climatic conditions. However, the differences were significant ($P<0.05$) only for vitamin A and ALT. Mean values of liver carotene, vitamin A, AST and ALT were low in the animals of above 1 year age groups than 0–1 year in both the climatic conditions except for ALT mean value which was higher above 1 year age group during summer. However, the differences were significant ($P<0.05$) only for liver vitamin A and ALT during winter.

Mean±SE values of serum carotene, vitamin A, enzymes, viz. AST and ALT during season, sex and age groups in

Table 2. Mean±SE values of liver vitamin A and enzymes during season, sex and age groups in Marwari goats

Parameter	Overall (300)	Season		Sex				Age			
		Summer (150)	Winter (150)	Summer		Winter		Summer		Winter	
				♂ (100)	♀(50)	♂ (100)	♀(50)	<1 (100)	>1 (50)	<1 (100)	>1(50)
Carotene(µg/g)	7.44 ±0.25	6.23 ±0.27^{b}	8.66 ±0.40^{a}	6.75 ±0.70^{a}	5.85 ±0.50^{a}	8.49 ±0.74^{a}	8.24 ±0.89^{a}	6.38 ±0.50^{a}	6.22 ±0.70^{a}	8.87 ±0.71^{a}	7.86 ±0.91^{a}
Vitamin A(µg/g)	215.42 ±12.79	154.43 ±12.96^{b}	276.42 ±20.94^{a}	190.10 ±25.45^{a}	136.10 ±7.75^{b}	289.63 ±31.65^{a}	193.48 ±14.28^{b}	174.90 ±12.55^{a}	151.27 ±15.35^{a}	278.18 ±27.16^{a}	205.30 ±18.80^{b}
AST(IU/L)	579.65 ±11.33	579.33 ±11.57^{a}	579.98 ±19.54^{a}	579.33 ±11.57^{a}	565.30 ±22.75^{a}	602.16 ±47.27^{a}	584.07 ±32.04^{a}	584.75 ±21.41^{a}	555.60 ±37.15^{a}	631.15 ±41.00^{a}	570.00 ±27.45^{a}
ALT(IU/L)	402 ±0.09	441.31 ±30.18^{b}	362.88 ±30.18^{a}	511.36 ±35.87^{a}	371.25 ±27.85^{b}	380.31 ±47.86^{a}	345.48 ±35.87^{b}	439.15 ±35.87^{a}	443.47 ±47.85^{a}	412.54 ±35.87^{a}	313.22 ±47.85^{b}

The means with different superscript in cell differ significantly ($P<0.05$) from each other.

Table 3. Mean±SE values of serum vitamin A and enzymes during season, sex and age groups in Marwari goats

Parameter	Overall (300)	Season		Sex				Age			
		Summer (150)	Winter (150)	Summer		Winter		Summer		Winter	
				♂ (100)	♀(50)	♂ (100)	♀(50)	<1 (100)	>1 (50)	<1 (100)	>1(50)
Carotene(µg/g)	56.60 ±1.08	50.40 ±1.06[b]	62.80 ±1.73[a]	52.15 ±2.20[a]	50.30 ±1.68[a]	67.92 ±4.41[a]	64.58 ±2.42[a]	48.82 ±1.80[a]	53.62 ±2.07[a]	65.07 ±2.75[a]	67.43 ±4.24[a]
Vitamin A(µg/g)	38.83 ±0.55	34.85 ±0.70[b]	42.83 ±0.72[a]	35.48 ±1.35[a]	32.82 ±1.03[a]	42.30 ±1.22[a]	43.60 ±1.20[a]	35.81 ±1.06[a]	32.48 ±1.30[b]	43.66 ±1.01[a]	42.22 ±1.40[a]
AST(IU/L)	186.76 ±7.87	183.68 ±14.47[a]	189.85 ±6.27[a]	256.16 ±11.52[a]	154.10 ±4.30[b]	235.16 ±14.88[a]	180.36 ±7.07[b]	170.70 ±8.22[a]	164.46 ±9.25[a]	225.40 ±15.47[a]	190.15 ±9.48[b]
ALT(IU/L)	57.54 ±1.24	77.68 ±1.75[b]	57.41 ±1.75[a]	55.80 ±1.50[a]	59.28 ±2.00[a]	54.92 ±1.50[a]	60.17 ±2.00[a]	73.15 ±2.07[a]	82.21 ±2.77[b]	56.68 ±2.07[a]	58.13 ±2.77[a]

The means with different superscript in cell differ significantly (P<0.05) from each other.

Marwari goats are presented in Table 3. Overall mean values of serum carotene, vitamin A, AST and ALT were 56.60±1.08 µg/dl, 38.83±0.55 µg/dl, 186.76±7.87 IU/l and 57.54±1.24 IU/l, respectively (Table 3). The overall mean values of liver vitamin A obtained in this study were in partial agreement with those obtained by Molokwu (1978) in goats.

Mean values of serum carotene and vitamin A were low while ALT was high significantly (P<0.05) during summer than the winter. Percent decrement in serum carotene and vitamin A and AST were 19.75, 18.63 and 3.25, respectively and the increment in ALT was 35.31. Higher carotene levels obtained in this present study could also be due to higher values of liver carotene observed in the present study as serum values are reflection of hepatic stores. Serum carotene and vitamin A levels decreased in the present study during summer hot condition. However, Molokwu (1978) found vitamin A levels in plasma were consistent in goats. They observed no more variation due to season.

In the present investigation ALT activity was predominated over the AST activity during summer condition probably due to stress. Smith and Hoijer (1962) also reported similar findings in goats and the increment in ALT was 35.31. However, Kataria *et al.* (1993) reported higher activity of AST during summer in goats. In present study serum ALT was significantly (P<0.05) higher during summer condition. Highman and Atland (1960) theorized that stress predisposed to gluconeogenesis with associated rise in circulatory transaminases. Latif *et al.* (1997) reported seasonal variation in transaminases activities of sheep. Baumgartner and Pernthaner (1994) recorded the effect of season and age on transaminases activities in sheep. This could be a probable cause of changes in transaminases activities due to temperature variation.

Mean values of serum carotene and vitamin A were higher in both sexes. The mean values of serum AST and ALT were higher in male than in female while mean values of serum carotene, vitamin A and AST were lower and ALT higher in both age groups in summer climatic condition than winter.

Mean values of serum AST were significantly (P<0.05) lower and the ALT higher (P<0.05) significantly in females than males in winter. Mean values of serum AST were significantly (P<0.05) lower and serum ALT (P<0.05) higher in female goats than male in extreme climatic condition. In present study, the sex effect was significant (P< 0.05) only for ALT. The changes in serum transaminases due to sex are probably because of sex hormones (Chatterjee *et al.* 1979).

Mean value of serum vitamin A and AST were lower in the animals of above 1 year age group, than zero to 1 year age group in extreme climatic condition except serum ALT means value that was higher in above 1 year age group. However, the differences were significant (P<0.05) for serum vitamin A and ALT.

Season had significant effect on liver and serum carotene, vitamin A and ALT. Liver carotene**,** vitamin A and ALT showed significant effect on sex in both climatic conditions and age group in winter. Higher values were observed in all the liver parameters in males in comparison to females in both climatic conditions. Higher values of all liver parameters were observed in 0–1 year age group animals than above 1 year age group in both climatic conditions except in summer climatic condition values of ALT observed higher in above 1 year age group animals.

Serum AST showed significant effect of sex in both climatic conditions but serum vitamin A and ALT showed significant effect on age group in summer climatic condition only. Higher values of serum carotene and AST were observed in male while serum vitamin A and ALT values were higher in female of both climatic conditions.

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