



Performance of Growing Black Bengal Goats under Different Management Systems of Rearing

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ABSTRACT

Thirty female Black Bengal kids were selected randomly at the age of 2 months and divided equally into three groups with having ten kids in each group and maintained from 2 to 12 month of age under three different management systems, viz., extensive, semi-intensive and intensive systems in Tripura, a North Eastern state of India. Four phenotypic variables, hematology and biochemical profiles were done every month and data were analyzed by one way ANOVA followed by Duncan's test. There was a significant ($p < 0.01$) increase in mean (\pm SEM) body weight, height at withers, heart girth and body length of the goats maintained under different systems of management over the months. However, mean (\pm SEM) blood hemoglobin (Hb), glucose, albumin, globulin, cholesterol and alkaline phosphatase level in plasma of goats under different management systems varied significantly ($p < 0.05$) between age groups from 2nd months to 12th months of age. Except plasma glucose level, mean (\pm SEM) body weight, heart girth and body length of the goats under extensive system were significantly higher ($p < 0.05$) than those for goats maintained under semi-intensive and intensive system of management. Mean (\pm SEM) plasma cholesterol level in goats under extensive and semi-intensive system were more ($p < 0.05$) than that of the goats under intensive management system. Black Bengal goats reared under extensive management system showed a better performance in terms of body weight gain, body measurements and biochemical profiles as compared to the goats reared under semi-intensive and intensive management system.

Keywords: Goat, body weight, body measurement, hematology, biochemical profiles

Goat production, being the least cost input livestock enterprise, is a natural choice of livelihood option which is practiced by a large section of population in rural areas of India and in other developing countries like Bangladesh, Nepal and Pakistan. In India, goat rearing is mostly unorganized form. The natural ability of goat to eat a wide variety of vegetation and waste has been a big motivating

factor for small, marginal and landless labourers to rear small number of goats (2 to 5 goats per household) for subsidiary income purpose. Thus, goat farming has not been come up as an organized form. While dairy, piggery and poultry sectors become popularized for organized farming in medium and large scales, sufficient attention has not been paid to promote goat farming with a large number



in an organized way to utilize the huge scope of earning money from goat resource. However, the capacity of goats for adaptation to different agro- climatic environments indicates that goats may be the future animal for farming in the near future under global climate change scenario (Morand-Fehr *et al.*, 2004). Of particular interest is to how a large number of goats could be reared and managed in an organized way to exploit the market opportunities and meet the huge demand of goat meat in the country.

There are many goat management practices which are being followed in different regions/zones of the country. A large number of goats are reared in a migratory system of management in many places of our country. The goats are also maintained under either intensive or semi-intensive systems (Chowdhury *et al.*, 2002; Kumar, 2007). While goats and/ or sheep are very commonly reared in free range system on grazing fields in countries abroad, this system of management has hardly been adopted in our country where the major thrust focuses on agriculture food grain production. Thus, the specific information on best and appropriate goat management practice is lacking to rear and manage goats in an organized way. Hence, an attempt has been made to test the efficiency of three different rearing systems of goats viz., extensive, semi-intensive and intensive systems in Tripura, a North Eastern State of India. While animal genetic resource is poor in North Eastern region of India, the world famous meat-type only goat breed, known as Black Bengal goats are available in North Eastern region and the entire Eastern region of India. Black Bengal goats are popular for their best quality meat in terms of tenderness and taste. The aim of this study was to investigate growth, growth related parameters (body weight, height at wither, heart girth and body length), different blood haematology and plasma biochemical profiles in goats reared under different management systems.

MATERIALS AND METHODS

The experimental protocol and animal care were met in accordance with the National guidelines for care and use of Agricultural Animals in Agricultural Research and Teaching as approved by the Ethical Committee for Animal Experiments (ECAE) of ICAR Research Complex for NEH Region, Barapani, Meghalaya, India.

Experimental animals

A total of sixty Black Bengal female goats with their kids were selected randomly from the goat farm of ICAR Research Complex for NEH region, Lembucherra, West Tripura, India located 12.8m above mean sea level at 22° 56' and 24° 32' North and longitude 91° 10' and 92° 21' East. The kids were raised with their mothers until weaning at 8 weeks of age. After weaning, thirty female kids were further selected randomly and divided equally into three groups with having ten kids in each group. The animals were numbered with plastic ear tag for identification. The initial mean body weights of goats (2.46 ± 0.07 , 2.33 ± 0.02 , 2.33 ± 0.05 kg for extensive, semi-intensive and intensive system) at two months of age were non-significant ($p > 0.05$). The design of the experiment was a randomized complete block design (RCBD).

Farm management

Three experimental groups were maintained under three different management systems, viz., extensive, semi-intensive and intensive. Deworming and vaccination were done as per standard schedule. The goats under extensive system of management were allowed to free grazing for 8 h from 8.00 am to 4.00 pm. The animals were not supplemented with any sort of concentrate feeds or other fodders. The goats under semi-intensive system of management were allowed to let loose in the forenoon for 4 h from 8.00 am to 12.00 noon and thereafter they were provided one time with tree leaves, such as mulberry leaves, jackfruit leaves, signal grasses, local grasses, as and when available, in a sheltered paddock in the afternoon for 4 h from 12.00 noon to 4 pm. The goats under intensive system of management were provided two times in the forenoon at 8.00 am and again in the afternoon at 12.00 noon with mulberry leaves, jackfruit leaves, signal grasses, chopped maize fodder, banana leaves and local grasses, as and when available, at the indoor condition throughout the experimental period. The goats under semi-intensive and intensive system of management were supplemented with pelleted concentrate ration according to the recommendations of (NRC, 2007). Clean drinking water was made available *ad libitum* to all the kids. One buck was allowed to each group at the ratio of 10:1 (female: male) for natural breeding purpose. The experimental goats were provided with night shelter under natural environmental conditions.

Data collection

Four phenotypic variables were recorded every month on an individual data card in the morning before the animals were released for grazing. Body weight (kg) was taken using a spring balance. Three body measurements included height at wither (cm), heart girth (cm) and body length (cm) were taken using a measuring tape.

Blood sampling

A single blood sample was collected every month from each experimental goat started from 2 to 12 month of age under different management systems. Blood sampling was done before feeding between 08.00 am and 9.00 am by jugular venepuncture and collected into heparinised polypropylene tubes (20 IU heparin/ml of blood) taking due care. The blood samples were centrifuged at 2500×g for 10 min at 4°C and then the plasma samples were collected and stored at -20°C until biochemical analysis.

Estimation of blood haemoglobin and PCV

The blood Hb (g/dl) and PCV (%) were estimated from anti-coagulated blood samples following the standard laboratory methods.

Biochemical analysis

Plasma glucose (mg/dl), total protein (g/dl), albumin (g/dl), globulin (g/dl), cholesterol (mg/dl) and alkaline phosphatase (ALP KA units) were analyzed using commercially available kits.

Statistical analysis

The statistical analysis was done by using Statistical Package for the Social Sciences (SPSS 7.5, 1997). For the different age group, one way repeated measures ANOVA followed by Duncan's test ($p < 0.05$) was done for the monthly (a, b, c) means due to management system. General linear model was expected over month/age. Pooled means over month for management system were compared by Duncan's test ($p < 0.05$). The formula is as follows:

$$Y_{ij} = \mu + \alpha_i + e_{ij}(M2 - M12)$$

Where, α_i = month effect, e_{ij} = management system effect, μ = overall mean

RESULTS AND DISCUSSION

Body weight

Mean (\pm SEM) body weight (kg) of the goats maintained under different systems of management is presented in Fig. 1.

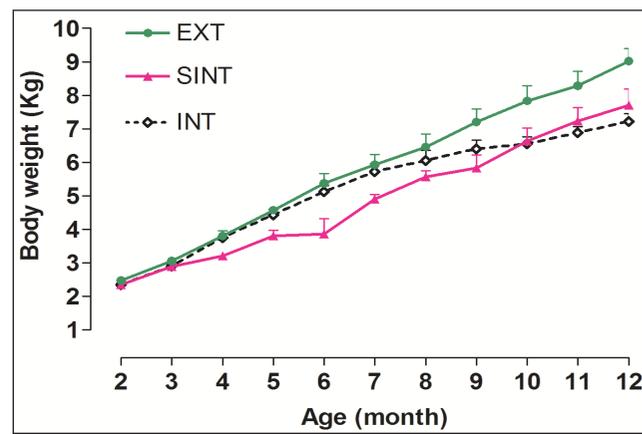


Fig. 1: Mean (\pm SEM) body weight (kg) of growing Black Bengal goats from 2nd months to 12th months of age under different management systems

There was no significant difference ($p > 0.05$) at 2nd and 3rd months of age, i.e., at the beginning of the experiment among different groups. A significant increase ($p < 0.05$) in mean (\pm SEM) body weight of the goats maintained under different systems of management was recorded from 2nd month upto 12th months of age. Mean (\pm SEM) body weight of the goats maintained under both extensive and intensive systems of management remained same between 4th and 8th month of age, but it was higher ($p < 0.01$) than the goats maintained under semi-intensive system of management between 4th and 7th months of age. Goats under extensive management system showed higher ($p < 0.05$) mean (\pm SEM) body weight as compared to the goats maintained under semi-intensive as well as intensive management system from 9th months up to 12th months of age. However, there was no difference ($p > 0.05$) in mean (\pm SEM) body weight between the goats maintained under semi-intensive and intensive management system from 9th to 12 months of age. Mean (\pm SEM) body weight of the

goats maintained under extensive system was better than the goats maintained under semi-intensive and intensive system. It could be explained as the optimum availability of the required nutrients essential for growth of the goats maintained under extensive system (Das *et al.*, 2008), as well as the free choice of feeds/ fodders and access to exercise (Yadav *et al.*, 2010). The lower mean (\pm SEM) body weight of goats under semi-intensive system might be due to either nutritional stress or managerial stress (Santra *et al.*, 2002; Karim *et al.*, 2007).

Body measurements

Mean (\pm SEM) height at withers (cm), heart girth (cm) and body length (cm) of the goats maintained under different systems of management are presented in Fig. 2- 4.

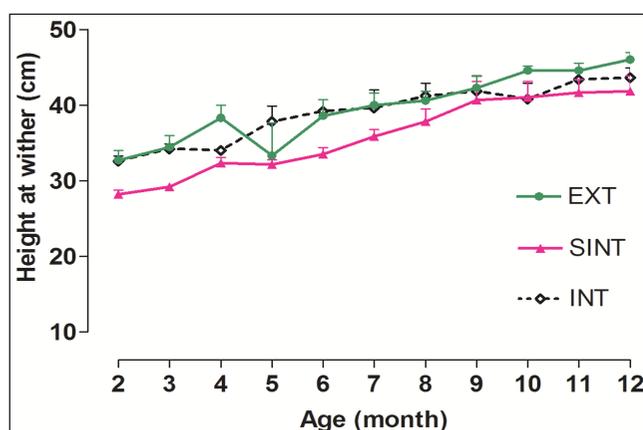


Fig. 2: Mean (\pm SEM) height at withers (cm) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

There was a significant ($p < 0.05$) increase in mean (\pm SEM) height at withers, heart girth and body length of the goats maintained under different systems of management over the months during the study period. Mean (\pm SEM) height at withers of the goats under extensive and intensive management system were significantly higher ($p < 0.05$) than the goats reared under semi-intensive management system. The mean (\pm SEM) heart girth as well as body length of the goats under extensive system were significantly higher ($p < 0.05$) than the mean (\pm SEM) heart girth and body length of the goats maintained under semi-intensive and intensive system of management over the age during the study period. The interaction between the

age of goat and management systems had a significant effect ($p < 0.05$) on heart girth as well as body length. Body weights of goats were found to be directly proportional to certain linear measurements (Adeyinka and Mohammed, 2006; Muhammad *et al.*, 2006). The increase in height at withers, heart girth and body length of the goats over the age could be explained by the increase in age and weight of animal (Slippers *et al.*, 2000; Tsegaye *et al.*, 2013).

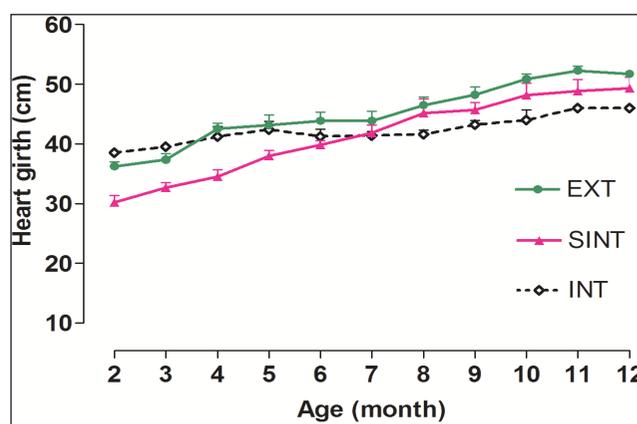


Fig. 3: Mean (\pm SEM) heart girth (cm) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

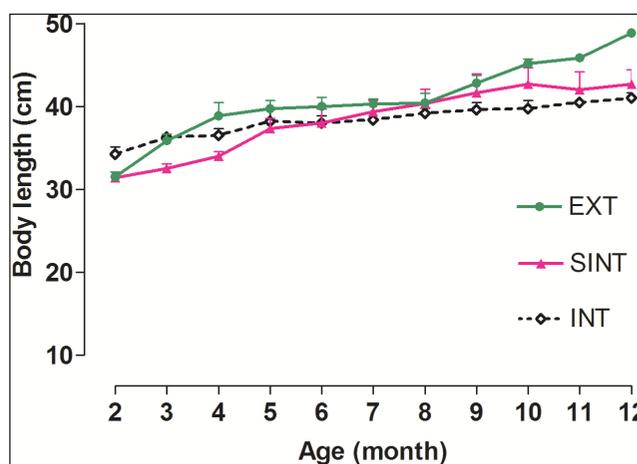


Fig. 4: Mean (\pm SEM) body length (cm) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

Blood hematology

Fig. 5 shows mean (\pm SEM) blood Hb level (g/dl) in goats under different management systems. Mean (\pm SEM)

blood Hb in the goats under different management systems varied significantly ($p < 0.05$) between age groups from 2nd months to 12th months of age.

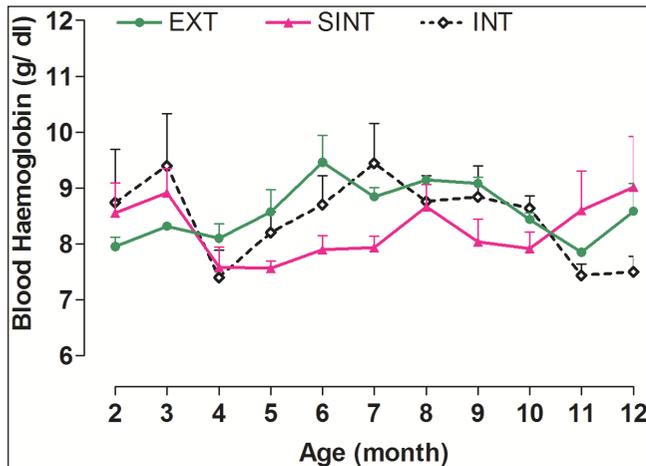


Fig. 5: Mean (\pm SEM) Hb (g/dl) level in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

The interaction between age and management system of goats had a significant effect ($p < 0.05$) on blood Hb level. The overall mean (\pm SEM) Hb level in goats under different management systems did not differ ($p > 0.05$) in the present study. Mean (\pm SEM) blood PCV (%) in goats under different management systems is depicted in Fig. 6.

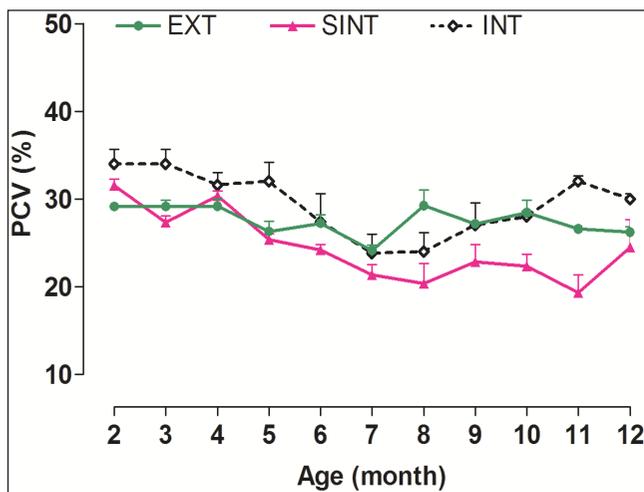


Fig. 6: Mean (\pm SEM) PCV (%) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

The mean (\pm SEM) PCV in goats under different management systems from 2 months to 12 months of age did not differ ($p > 0.05$) in the present study. The effect of age on blood Hb level in the goats was reported earlier (Egbe-Nwiyi *et al.*, 2000; Bhat *et al.*, 2014). Mean (\pm SEM) Hb levels in goats under different management systems remained within the normal range as reported previously (Kaneko, 1989). Thus, the general health of the goats under different management systems remained well. PCV was found to be influenced by diurnal and seasonal variations (Osaer *et al.*, 2000), management and age (Grunwaldt *et al.*, 2005). Mean PCV (%) in goats under extensive, semi-intensive and intensive system from 2nd months to 12th months of age varied from 24.00 to 29.20, 19.33 to 35.50 and 23.80 to 34.00, respectively. The present findings supported the earlier reports (Imasuen and Otoikhian, 2004; Tibbo *et al.*, 2004).

Plasma glucose

Mean (\pm SEM) plasma glucose level (mg/dl) in goats under different management systems is presented in Fig. 7. Mean glucose level in the goats under extensive, semi-intensive and intensive system from 2nd months to 12th months of age ranged from 26.97 to 59.69, 36.94 to 64.86 and 35.99 to 63.79 mg/dl, respectively.

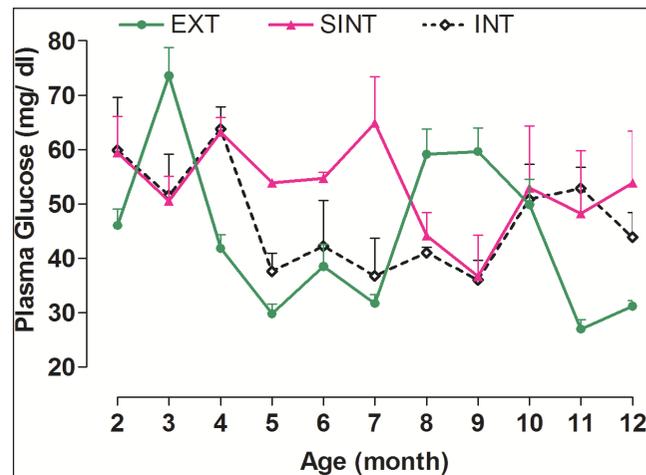


Fig. 7: Mean (\pm SEM) plasma glucose level (mg/dl) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

The overall mean (\pm SEM) plasma glucose level in the goats under semi-intensive and intensive system was

higher ($p < 0.05$) than that of the goats under extensive management system. Plasma glucose level recorded in the goats under different management systems was in close agreement with the previous report (Ramprabhu *et al.*, 2010). However, mean (\pm SEM) plasma glucose level in the goats under different management systems varied significantly ($p < 0.05$) between age groups from 2nd months to 12th months of age. It might be due to the levels of nutrition and the metabolic activity of individual animal (Devendran *et al.*, 2008). The physical and ranging activities could be the reason for lower plasma glucose level in the goats under extensive management system (Gbolabo *et al.*, 2015).

Plasma total protein and its fractions

Fig. 8 shows a significant difference ($p < 0.05$) of mean (\pm SEM) plasma total protein concentration (g/dl) over the age of goats under different management systems.

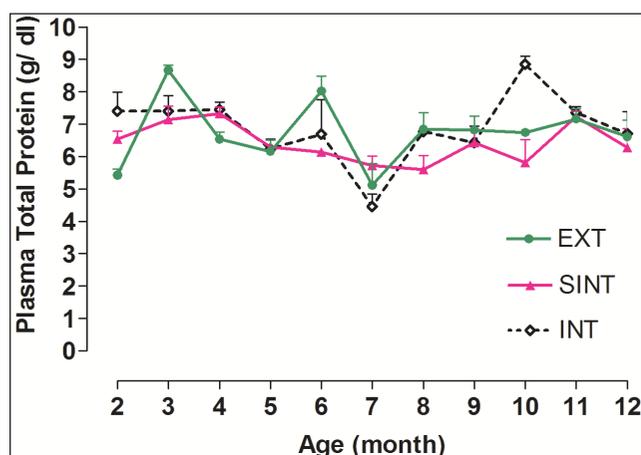


Fig. 8: Mean (\pm SEM) total protein concentration (g/dl) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

The overall mean (\pm SEM) plasma total protein concentration in the goats under extensive system and intensive system was higher ($p < 0.05$) than that the goats under semi-intensive management system. The interaction between the age of goat and management systems had a significant effect ($p < 0.05$) on plasma total protein concentration. Mean (\pm SEM) plasma albumin level (g/dl) as well as plasma globulin (g/dl) in goats under different management systems varied significantly ($p < 0.05$) between age groups from 2nd months to 12th months of age as shown in Fig. 9 and 10. However, no significant

difference ($p > 0.05$) in overall plasma albumin and globulin levels in the goats under different management systems was recorded. The interaction between the age of goat and management systems had a significant effect ($p < 0.05$) on plasma albumin as well as plasma globulin. The observed range of total protein concentration in the goats under extensive, semi-intensive and intensive system was within the normal range (Kaneko, 1989). Plasma albumin and globulin levels in the goats might be supported by the earlier findings (Teleb *et al.*, 2007; Matanovic *et al.*, 2007).

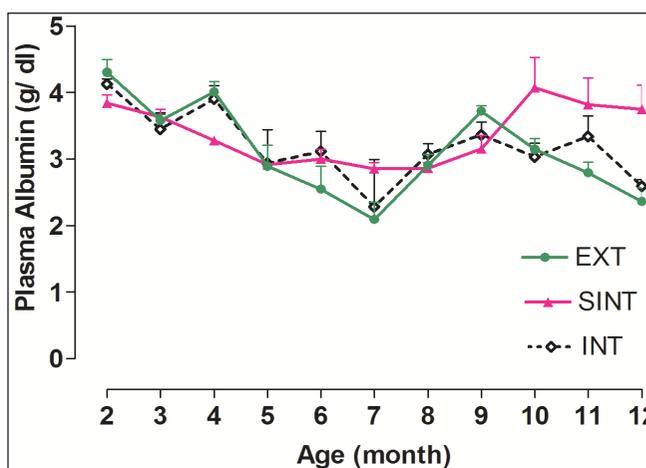


Fig. 9: Mean (\pm SEM) plasma albumin concentration (g/dl) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

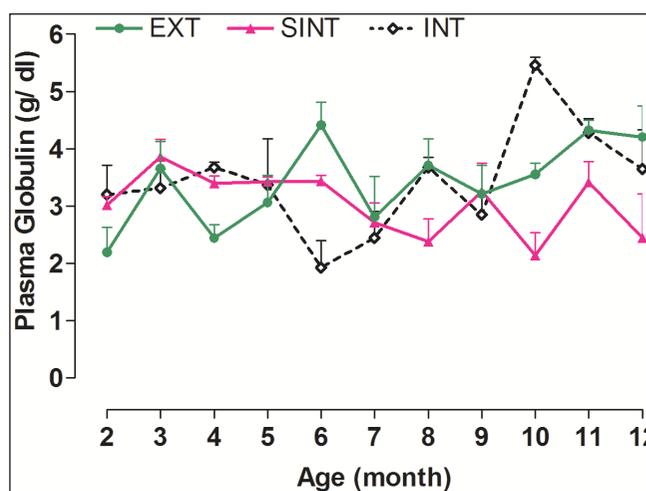


Fig. 10: Mean (\pm SEM) plasma globulin concentration (g/dl) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

Plasma cholesterol

Mean (\pm SEM) plasma cholesterol level (mg/dl) in goats under different management systems is presented in Fig. 11. Mean (\pm SEM) plasma cholesterol level in goats under different management systems varied significantly ($p < 0.05$) between age groups during the experimental period. The interaction between the age of goat and management systems had a significant effect ($p < 0.05$) on plasma cholesterol level. The overall mean cholesterol level in goats under extensive and semi-intensive system were higher ($p < 0.05$) than that of the goats under intensive management system. Mean (\pm SEM) plasma cholesterol level in goats under different management systems varied significantly ($p < 0.05$) between age groups. However, earlier report indicated that age did not affect serum cholesterol level in goats (Kiran *et al.*, 2012).

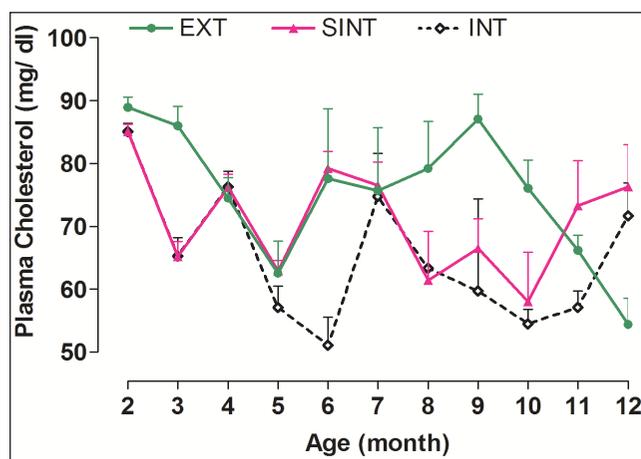


Fig. 11: Mean (\pm SEM) plasma cholesterol level (mg/dl) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

Plasma alkaline phosphatase

Mean (\pm SEM) plasma alkaline phosphatase level (ALP KA units) in goats under different management systems is shown in Fig. 12. Mean (\pm SEM) plasma alkaline phosphatase level in goats under different management systems changed significantly ($p < 0.05$) over the ages during the experimental period. There was no significant ($p > 0.05$) difference in overall mean plasma alkaline phosphatase level in the goats reared under different management systems. Plasma alkaline phosphatase level in the goats under different management systems was

within the normal range as reported by Kaneko (1989). Plasma alkaline phosphatase levels were higher in young goats as compared to older goats and this finding could be supported by the previous report (Antunovic *et al.*, 2004; Piccione *et al.*, 2010; Gwaze *et al.*, 2012), indicating the role of plasma alkaline phosphatase in bone growth at the young age.

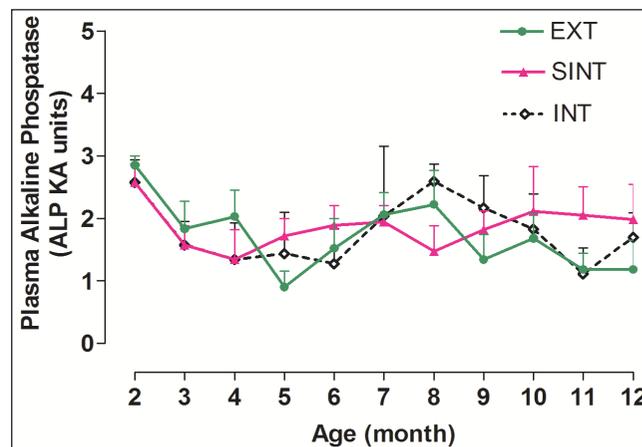


Fig. 12: Mean (\pm SEM) plasma alkaline phosphatase level (ALP KA units) in growing Black Bengal goats from 2nd months to 12th months of age under different management systems

CONCLUSION

Black Bengal goats reared under extensive management system showed a better performance in terms of body weight gain, body measurements and biochemical profiles as compared to the goats reared under semi-intensive and intensive management system. Blood hematological and plasma biochemical profiles in goats at different age groups under different management systems remained within the normal range. Hence, extensive management system could be recommended for better growth and overall performances of Black Bengal goats in Tripura, a state of North Eastern region of India.

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