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Effect of breed, production system and fecundity on serum alkaline phosphatase of goats from Andaman and Nicobar Islands

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This study evaluated the effect of breed, production system, fecundity, and parity on serum alkaline phosphatase (ALP) activity in goats from the Andaman and Nicobar Islands (ANI). A total of 83 healthy multiparous does, including Andaman local goats and crossbreds, were sampled from farm and farmers' flocks. ALP activity was measured using a colorimetric assay, and data were analyzed using a univariate model to assess variations across the study parameters. The results showed that ALP levels ranged from 0.05 to 1.91 U/mL (mean 0.63 ± 0.04 U/mL) but revealed no significant differences based on breed, production system, fecundity, or parity. Compared to other indigenous breeds, ANI goats exhibited, relatively higher ALP levels, possibly due to the unique ecological and nutritional conditions of the islands. The findings align with previous research indicating that non-gravid status, parity, and rearing conditions do not significantly influence ALP activity. This study provides critical baseline data on ALP activity in goats from ANI, highlighting the role of ecological factors in shaping physiological traits.

Goats are highly beneficial farm animals due to their unique intrinsic characteristics such as shorter growth periods, multiparous capability, easy maintenance, and less space requirement (Nawito *et al.* 2016). The Andaman and Nicobar Islands (ANI), an archipelago with a hot and humid climate, have a significant goat population comprising about 42.1% of the livestock population, primarily reared for meat production. The goats in ANI include four major types: Andaman local goats, Teressa goats, Malabari goats, and their crossbreeds (Alyethodi *et al.* 2020).

Alkaline phosphatase (ALP; EC 3.1.3.1) is a metalloenzyme having nonspecific phosphomonoesterase activity (Millán 2006, Kothekar *et al.* 2014). It is ubiquitous across organisms and is present in various tissues and cells, such as bone, liver, kidneys, prostate, spleen, duodenum, and granulocytes (Fernandez and Kidney 2007, Djuricic *et al*. 2011). ALP is released during physiological processes such as bone growth, tissue injury, and pregnancy (Liesegang *et al*. 2006, Cepeda-Palacios *et al*. 2018). ALP exists in two main forms: tissue-nonspecific and tissue-specific. The tissue-nonspecific form is primarily associated with the liver, while the tissue-specific form is linked to placental and intestinal tissues (Yang *et al.* 2012). ALP plays a critical role in bone mineralization, and elevated serum ALP activity is often indicative of conditions such as liver disease, osteitis, or osteomalacia (Djuricic *et al.* 2011).

In ruminants, ALP activity is commonly assessed to diagnose conditions that lead to production losses, including those affecting fur, wool, and milk yield (Ismail and Amireh, 2008). Furthermore, environmental and management factors such as housing and nutrition can influence the biochemical profiles of animals (Mohammed *et al.* 2016). The physiological status of individual breeds can be monitored by analyzing their biochemical parameters (Tibbo *et al*. 2008).

To the best of our knowledge, no studies have been conducted on serum ALP activity in goats from ANI. This study aimed to evaluate the effect of breed (Andaman Local goats vs. crossbreeds), production system (farmers' flocks vs. farm flocks), fecundity (high vs. low), and parity (1–3 vs. more than 3) on serum ALP activity in goats from ANI.

The study was approved by the IAEC under CPCSEA guidelines and conducted at the ICAR-Central Island Agricultural Research Institute (Sri Vijaya Puram) and unorganized farmer fields in Andaman and Nicobar Islands (latitude: 6º45′–13°41′ N; longitude: 92°12′–93°57′ E).

The study included 83 healthy multiparous does (body weight: 21–32 kg) assessed via visual observation and FAMACHA (Sunder *et al*. 2019). Andaman local goats (n=53) and crossbreds (n=30) were sampled from farmer flocks (n=73) and Institute farm (n=10). The goats were grouped by fecundity (single: n=35; multiple: n=48) and parity (1–3: n=49; >3: n=34). Farm goats were grazed in the morning hours, fed 250–300 g/day of commercially available concentrate pellets mixed with the mineral supplement AGRIMIN® (Virbac, India), and provided

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with locally available jackfruit and breadfruit leaves. In contrast, goats in farmers' flocks were grazed freely for 6–7 hours and hand-fed with coconut, jackfruit, and breadfruit leaves, without balanced concentrate feeding or mineral supplementation.

Blood samples were aseptically collected from the jugular vein into clot activator tubes, stored at 4°C, and centrifuged at 1200 × g for 30 minutes to separate serum. Serum samples were stored at -80°C until analysis. ALP activity was estimated using the EZAssay™ Alkaline Phosphatase Activity Estimation Kit (Himedia, India) according to the manufacturer's instructions. Absorbance was measured at 405 nm, and enzyme levels were expressed in Units/ml.

Data were analyzed after removing outliers using the box-whisker plot method. Normality and homoscedasticity of variances were confirmed using the Kolmogorov-Smirnov normality test and Levene's test, respectively, with the null hypothesis accepted. The effects of breed (Andaman local Goat vs. crossbred), rearing condition (farmers' flock vs. farm flock), fecundity (high vs. low), and parity (1–3 vs. above) on ALP levels were analyzed using a univariate model in PROC GLM (SAS, 2002). Results were expressed as mean ± SE, with significance at $p \leq 0.05$. The following model was used for analysis.

$$Y_{ijkl} = \mu + A_i + P_j + M_k + K_l + e_{ijkl}$$

Where, Y_{ijk} was the ALP estimate, μ is overall mean, A_i was the fixed effect of i^{th}breed admixture group; P_j was the fixed effect of j^{th} fecundity group, M_k was the effect k^{th} rearing system group, K_l was the effect of the l^{th} parity record; e_{ijkl} is the error fraction.

The ALP values in ANI goats ranged from 0.05 to 1.91 U/mL, with a mean of 0.63 ± 0.04 U/mL (equivalent to 50–1910 U/L, mean 630 U/L). No significant differences were observed across variables such as breed (Andaman local goat vs. crossbred), rearing condition (farm vs. farmers' flock), fecundity (single vs. multiple), and parity (1–3 vs. >3).

Profiling serum biochemicals like ALP is widely used to assess animal health, the effects of nutrition, and disease diagnosis (Ismail and Amireh 2008, Ihejirika *et al*. 2017). The findings are consistent with studies reporting no significant differences in ALP levels based on nutrition, parity, or rearing conditions in goats (Ikhimioya and Imasuen 2007, Soul *et al*. 2019). However, ANI goats showed higher ALP levels compared to other breeds, such as Black Bengal (94.59 U/L; Samaddar *et al*. 2021) and Barbari (44.62 ± 1.30 KA units; Bhooshan *et al*., 2010), likely due to unique ecological and nutritional conditions.

Studies on gestating goats highlight elevated ALP during pregnancy, associated with fetal growth and milk production (Liesegang *et al*. 2006, Härter *et al*. 2015). In goats, ALP increases significantly from early to advanced gestation (Kumar *et al*. 2017), and gravid uteri tissue had reported heightened activity during later stages (Cepeda-Palacios *et al*. 2018). However, the current study on non-gravid animals found no significant differences in ALP across fecundity groups, aligning with the findings in crossbred goats (Cepeda-Palacios *et al*. 2018), where authors reported no difference in the ALP levels with singleton and multiple foetuses.

Parity showed no influence on ALP levels in the present study, consistent with findings in goats (Belić *et al*. 2017) and sheep (Beigh *et al*. 2018). In contrast, studies in dairy cows indicate decreasing ALP levels with increasing parity (Mohebbi *et al*. 2010). Similarly, no significant differences in ALP were found in goats based on parity or nutritional treatments, supporting the lack of effect observed in the current study (Ikhimioya and Imasuen 2007, Yu *et al*. 2011). Recent research has also evaluated ALP as a predictor of passive transfer status in neonatal goat kids and concluded it is not a reliable marker for this purpose (Roccaro *et al*. 2023). The unique ecological conditions of the Andaman and Nicobar Islands might have contributed to the observed variation in ALP levels. Further research could explore the physiological and environmental factors influencing enzyme activity in this indigenous breed.

The study highlighted ALP as a valuable biochemical marker for assessing animal health, nutrition, and disease diagnosis. ANI goats exhibited higher ALP levels compared to other indigenous breeds, likely influenced by the unique ecological and nutritional conditions of the islands. The findings also aligned with the previous studies showing no significant effects of parity or fecundity on ALP levels in non-gravid animals.

This research provides critical baseline data on ALP activity in ANI goats, emphasizing the importance of ecological factors in shaping the physiological traits. These insights can aid in formulating targeted strategies for managing goat health and production under similar tropical conditions.

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REFERENCES

Alyethodi R R, Karthik S, Sunder J, Ravi S K, Perumal P, Bala P A and Mayuri S C. 2020. Comparative White and Red Blood Cell Profiles of Multiparous Andaman Local Goats under Field and Farm Conditions. *Journal of the Andaman Science Association* **25**(2): 151–55.

Al-Bulushi S, Shawaf T and Al-Hasani A. 2017. Some hematological and biochemical parameters of different goat breeds in Sultanate of Oman: A preliminary study. *Veterinary World* **10**(4):461.

Beigh Y A, Ganai A M, Ahmad H A, Mir D M, Bhat M A and Muzamil S. 2018. Blood metabolic profile of lambs fed complete diet supplemented with exogenous fibrolytic enzymes cocktail. *Journal of Animal Health and Production*

6: 96–102.

Belić M, Ljubičić S, Robić M, Kušec V, Grizelj J, Vrbanac Z, Benić M and Turk R. 2017. The influence of parity on bone alkaline phosphatase during the transition period in Saanen goats. *Veterinarski Arhiv* **87**: 35–42.

Bhooshan N, Kumar P and Yadav M C. 2010. Effect of age and reproductive state on phosphatase enzymes and steroid hormones profile in Indian goats. *Indian Journal of Animal Sciences* **80**: 321–25.

Cepeda-Palacios R, Fuente-Gómez M G, García-Álvarez A and Llinas-Cervantes X. 2018. Effects of pregnancy and post-kidding stages on haematochemical parameters in cross-bred goats. *Journal of Applied Animal Research* **46**(1):269–73.

Djuricic D, Dobranic T, Grizelj J, Gracner D, Harapin I, Stanin D, Folnozic I, Getz I, Cvitkovic D and Samardzija M. 2011. Concentrations of total proteins and albumins, and AST, AP, CK, and GGT activities in the blood serum Boer and Saanen goats during puerperium. *Reproduction in Domestic Animals* **46**: 674–77.

El-Itok B. 2012. Reference values for hematological and biochemical parameters in Saanen goats breeding in Afyonkarahisar province. *Kocatepe Veterinary Journal* **5**, 2012517117–2012517121.

Fernandez N J and Kidney B A. 2007. Alkaline phosphatase: Beyond the liver. *Veterinary Clinical Pathology* **36**: 223–33.

Gwaze F R, Chimonyo M, and Dzama K. 2012. Effect of season and age on blood minerals, liver enzyme levels, and faecal egg counts in Nguni goats of South Africa. *Czech Journal of Animal Science* **57**: 443–53.

Härter C J, Castagnino D S, Rivera A R, Lima L D, Silva H G O, Mendonça A N and Bonfim G F. 2015. Mineral metabolism in singleton and twin-pregnant dairy goats. *Asian-Australasian Journal of Animal Sciences* **28**(1):37.

Ihejirika U G D, Adenekan O O, Jimoh O A, Jack A A and Uwaeziozi U C. 2017. Serum biochemistry and oxidative stress indicators in West African dwarf goats under semi-intensive management system. *Nigerian Journal of Animal Production* **44**:110–17.

Ikhimioya I, and Imasuen J A. 2007. Blood profile of West African dwarf goats fed Panicum maximum supplemented with Afzelia africana and Newbouldia laevis. *Pakistan Journal of Nutrition* **6**(1):79–84.

Ismail Z A B and Amireh F. 2008. Metabolic profiles in goat does in late pregnancy with and without subclinical pregnancy toxemia. *Veterinary Clinical Pathology* **37**(4): 434–37.

Kothekar D, Bandivdekar A and Dasgupta D. 2014. Increased activity of goat liver plasma membrane alkaline phosphatase upon release by phosphatidylinositol-specific phospholipase C. *Indian Journal of Biochemistry and Biophysics* **51**:263–70.

Kumar V, Singh S, Farooqui M, Gangwar C, Kumar P and Prakash A. 2017. Acid and alkaline phosphatase activity in uterus of goat in different stage of pregnancy. *International Journal of Livestock Research* **1**: 1–8.

Liesegang A, Risteli J and Wanner M. 2006. The effects of first gestation and lactation on bone metabolism in dairy goats and milk sheep. *Bone* **38**: 794–802.

Millán J L. 2006. Alkaline phosphatases. *Purinergic Signaling* **2**: 335–41.

Mohammed S A, Razzaque M A, Omar A E and Al-Gallaf W M. 2016. Biochemical and hematological profile of different breeds of goat maintained under intensive production system. *African Journal of Biotechnology* **15**: 1253–57.

Mohebbi A, Khaghani A and Mohammadnia A. 2010. Bone-specific alkaline phosphatase activity in dairy cows. *Comparative Clinical Pathology* **19**: 33–36.

Nawito M F, Abd, A R, Hameed E, Sosa A S A and Mahmoud K G M. 2016. Impact of pregnancy and nutrition on oxidant/antioxidant balance in sheep and goats reared in South Sinai, Egypt. *Veterinary World* **9**: 801–5.

Njidda A A, Hassan I T and Olatunji E A. 2013. Haematological and biochemical parameters of goats of semi-arid environment fed on natural grazing rangeland of Northern Nigeria. *Journal of Agriculture and Environment for International Development* **3**:1–8.

Opara M N, Udevi N and Okoli I C. 2010. Haematological parameters and blood chemistry of apparently healthy West African Dwarf goats in Owerri, South Eastern Nigeria. *New York Science Journal* **3**: 68–72.

Roccaro M, Bolcato M, Ferrari M G, Dondi F, Gentile A and Peli A. 2023. Associations between serum gamma-globulin concentration, enzyme activities, growth, and survival in preweaning Alpine goat kids. *Small Ruminant Research* **227**: 107064.

Samaddar K, Rahman M M and Haque Z. 2021. Biochemical and haematological profiles of black Bengal goat in Mymensingh Sadar of Bangladesh. *Research in Agriculture, Livestock and Fisheries* **8**: 329–37.

Soul W, Mupangwa J, Muchenje V and Mpendulo T C. 2019. Biochemical indices and hematological parameters of goats fed Lablab purpureus and Vigna unguiculata as supplements to a Chloris gayana basal diet. *Veterinary and Animal Science* **8**: 100073.

Sunder J, Bhattacharya D, Sujatha T. De A K, Chakraborty G and Mayuri S C. 2019. Use of FAMACHA to detect anaemia and control of gastrointestinal parasite in goats of A and N Islands, India. *Indian Journal of Animal Research* **1**: 6.

Tibbo M, Jibril Y, Woldemeskel M, Dawo F, Aragaw K and Rege J E O. 2008. Serum enzymes levels and influencing factors in three indigenous Ethiopian goat breeds. *Tropical Animal Health and Production* **40**: 657–66.

Yáñez-Ruiz D R and Molina-Alcaide E. 2008. A comparative study of nutrients utilization, alkaline phosphatase activity and creatinine concentration in the serum of sheep and goats fed diets based on olive leaves. *Journal of Animal Physiology and Animal Nutrition* **92**: 141–48.

Yang Y, Wandler A M, Postlethwait J H and Guillemin K. 2012. Dynamic evolution of the LPS-detoxifying enzyme intestinal alkaline phosphatase in zebrafish and other vertebrates. *Frontiers in Immunology* **3**: 1–15.

Yu C, Chou S, Wu J, Lin K, Chan K, Su Y, Wu C and Lai J. 2011. The relationship of alkaline phosphatase and the reproductive performance of animals. *Veterinary Journal* **37**: 152–58.