Evaluation of haematological and biochemical parameters of goats of central Odisha environment fed on natural grazing land of Odisha, India

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Abstract
The haematological and biochemical parameters of 120 apparently healthy goats consisting of 60 adults (30 male and 30 female; 30 buck kids and 30 doe kids) comprised of 3 indigenous and popular breeds of goats of Central Odisha, India were studied. Data were analysed for the effect of breed, sex and season. Packed cell volume (PCV) was significantly higher \((P<0.05)\) for Ganjam goats (buck and doe kid) of the North West. Haemoglobin (Hb) values was also higher \((P<0.05)\) for Ganjam goats adult buck and doe \((P<0.05)\). Red blood cell count (RBC) was significantly higher \((P<0.05)\) for Black Bengal goats adult, buck and buck kid. The mean corpuscular haemoglobin (MCH) was higher in Ganjam goats doe \((27.3)\) while the values were much higher in Bolangir goat kids. The mean corpuscular haemoglobin concentration (MCHC) was significantly higher \((P<0.05)\) for goat kids than in adult goats. The mean corpuscular volume (MCV) was observed to higher for Kano brown buck and buck kid than other breeds of goats. Black Bengal goats doe and doe-kid had the highest white blood cell count (WBC). White blood cell differentials shows that lymphocytes was significantly higher \((P<0.05)\) for Black Bengal goats (adult and kids). Monocytes was only observed in Th Black Bengal goats serum sodium range from \((136.0\) to \(156.0 \text{ mmol/l})\) for adult goats of all breeds, \((132.0\) to \(160.0 \text{ mmol/l})\) for goat kids of all breeds. Serum potassium range from \((6.5\) to \(9.4 \text{ mmol/l})\) for adult goats, \((4.8\) to \(12.3 \text{ mmol/l})\) for goat kids. The chloride, HCO-3 and urea values was higher for adult goats than in kids for all the breeds. Values for creatinine, cholesterol and glucose was observed to be higher for kids than in adult goats. The values for total protein, albumin and globulin showed significant difference \((P<0.05)\) among breeds age and sex. More so significant difference \((P<0.05)\) was observed for the enzymes studied in all the breeds of goats of different sexes and ages.

Keywords: Haematology, blood chemistry, breeds, goat, kids, buck, doe, central Odisha.

Introduction
Animal Husbandry Department plays an important role in upliftment of the economic status of the rural and urban people of Odisha, India. The department is implementing different Animal Husbandry programmes like Feeding, Breeding, Management as well as Marketing in scientific methods, in order to safe-guard the livestock and poultry from different diseases and to provide better health coverage and breeding facilities. The aim of this department is to increase livestock production and productivity in terms of milk, meat and egg to meet the demand of the people and to generate self-employment for rural youths under employment mission programme.

In India and especially in the Central Odisha region have important role in goat production in the India continent and the world in general \([1]\). In this region, the herd is mainly composed of local breed animals without breed type \([2]\) which are characterized by good adaptation to environmental conditions but lower productivity rates when compared to the breeds coming from the temperate regions \([3]\). Some developing countries as well as India, with the strategies to meet the increasing demand for animal products, introduced exotic genotype with a high degree of specialization such as Black Bengal goats, Ganjam goats and Bolangir goats breeds for example.

The life of all flesh is the blood and its usefulness for assessing the health status, chemical evaluation for survey, physiological pathological conditions and diagnostic and prognostic evaluation of various types of diseases in animals cannot be over emphasize \([4,5]\). It also helps in distinguishing normal state form state of stress, which can be maturational, environmental or physical \([6]\) Hematological values are widely used to determine systematic relationship and physiological adaptation including the assessment of general health condition.
of animal [7]. The changes in these parameters have been studied in cattle [8] sheep [9] and Bolangir goats [4]. Blood composition of animal might be influenced by certain factors such as nutrition, management, and great of animals, sex, age diseases and stress factors that might affect blood values [10]. The hematological and geochemical indices are an index and reflection of the effects of dietary treatment on the animals in terms of the type and amount of feed ingested and were available for the animals to meet its physiological geochemical and metabolically necessities [11] and also the level of anti-nutritional element of or factors present in the feed also influence the hematological and biochemical values [12]. There is a great variation in the hematological and biochemical parameters as observed between breeds of goats [4, 13] and in this regard, in may be difficult to formulate a universal metabolic profile test for goat [14]. These differences have further underlined the need to establish appropriate physiological baseline values for various breeds of livestock in India, which could help in the realistic evaluation of the management practice, nutrition and diagnosis of their health condition and provide the objective of the study is to evaluate the information on hematological and biochemical data of goat breeds raised under free range system as influenced by breed, sex and age. The data generated will also serve as a guide to the physiological characterization of the breed and helps in interpretation of climatic influence on productivity.

Material and Methods

Data collection

The most common Indian indigenous breeds of goat of central Odisha: Black Bengal goat, Ganjam goat and Bolangir goats were used for this study. Blood samples were collected from the jugular vein of 120 goats of different breeds consisting of 60 adults (30 bucks and 30 does) and 60 young ones (30 buck-kids and 30 doe-kids). The live weights of the adult and young goats were 21.5±0.94 and 7.5±0.23 (Kg) respectively. The goats were bled through jugular vein and 10ml of blood collected. 3ml of the blood samples was collected into plastic tube containing EDTA for haematological studies. The remaining 7ml of blood samples was deposited in anticoagulant free plastic tube and allowed to clot at room temperature within 3 hours of collection. The serum samples were stored at -20 °C for biochemical studies. Total erythrocyte counts and total leukocyte counts were determined with the aid of Haemocytometer (Neubaur counting chamber) and Hb concentration was determined by Sahl’s (acid haematin) method [15]. Mean Corpuscular erythrocytic counts and total leukocytic counts were stored at -20 0C for biochemical studies. Total serum Aspartate Aminotransferase, Haemoglobin (MCH), Mean Corpuscular Volume (MCV) were analyzed spectrophotometric linked reaction method [17]. Other biochemical analysis was done using the method described by Ogunsami et al. [18].

Statistical analysis

Mean values and standard errors were calculated and the results were treated statistically using student’s t-test assessing the mutual statistical differences between adult and young animals [19] and one-way ANOVA was used to assess the statistical difference between male and female.

Results

Haematology (Adults)

The results of the hematological values for adult goat is shown in the table the packed cell volume (PCV) was significantly different (P<0.05) between breeds with Ganjam goats buck having the highest (55.8%) volume the haemoglobin (Hb) values ranged from (8.0 to 11.5 g/dl with Black Bengal goats also having the highest value (11.5 g/dl). The highest value of 16.4g/dl was observed in Black Bengal goats buck for red blood cell court (RBC) while Bolangir goats buck had the least (3.03g/dl) MCH values ranged from 7.48 in Black Bengal goats doe to 27.3pg in Ganjam goats doe. Black Bengal goats was observed to have the highest mean corpuscular haemoglobin concentration (MCHC) and white blood cell count (WBC) respectively. The lymphocytes values ranged from 35.00% in Black Bengal goats to 74.00% in Ganjam goats and Bolangir goats does. The lymphocyte value for both sex are low (35.00 and 45.00%) respectively. Black Bengal goats buck had the highest neutrophils (57.00%) followed by does which had (47.00%). Eosinophils was observed to be highest (7.00%) for Black Bengal goats buck followed by Black Bengal goats doe (5.00%). The lowest value was observed in Bolangir goats doe (1.00%). Monocytes was observed only in Black Bengal goats goats.

Biochemical indices (Adults)

The results of biochemical indices of the adult goats is shown in Table 3. The serum potassium, chloride, creatinine, total protein, and globulin were significantly higher (P<0.05) in Ganjam goats buck than any of the breeds and sexes. Values for hydrogencarbonate (HCO₃⁻) was observed to be similar statistically (P<0.0.05) for Black Bengal goats and Bolangir goats bucks. Alamine Aminotransferase (ALT) and Alkaline phosphatase (ALP) were higher in Bolangir goats doe (23.0 and 33.0 IU/L).

Biological indices (Kids)

Ganjam goats doe-kid had the highest PCV (50.8%) compared to other breed and sex. Haemoglobin values was observed to be highest in the Ganjam goats buck and doe kid (12.3 and 12.3 g/dl) respectively. The RBC values ranged from 1.96 for Bolangir goats doe kid to 5.0 g/dl in Black Bengal goats buck-kid. Mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) was significantly higher for Bolangir goats doe kid (39.8 pg and 39.6%) respectively. Ganjam goats bucks-kid had the highest mean corpuscular value while Brown white doe-kid had the highest value for white blood cell count (33.4 x 10⁹ g/L). All the breeds had lymphocytes values above 70% except for Black Bengal goats goat kids which had below 55%, though the highest value for neutrophils was observed in Black Bengal goats buck-kid (63.00%). Eosinophils values was higher for Black Bengal goats doe kid (12.00%).

3.3 Biochemical indices (Adults)

The result of the biochemical indices for goat-kids is shown in Table 4. Generally all parameters observed showed significant difference (P<0.0.05) between breeds and sexes. The value for serum sodium ranged from 132.0 in Bolangir goats buck-kid to 160.0 mmol/l in Ganjam goats buck-kid. The values for serum potassium was highest in Bolangir goats doe-kid (12.3 mmol/l). Chloride shows higher values (10.0mmol/l) for Ganjam goats than other breeds. Hydrogencarbonate (HCO₃⁻) ranged from 18.0 to 20-0 mmoll/L for all the breeds. Ganjam goats doe-kid was observed to have the highest value for (7.2 mmoll/L), chloride (6.6 mmoll/L), total protein (79.0 mmoll/L) and globulin (24.0 mmoll/L). All the enzymes observed in this
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Discussion

Packed cell volume (PCV) in this study was higher than 25.7±3.1% obtained for Bolangir goats [4]. Earlier reports in Baladi goats [13] and Bolangir goats [4] showed PCV values of 27.25±0.59 and 25.7±3.1 respectively. The findings of this study support that PCV varies among breeds of goats. Increase in PCV values in this study may be attributed to increase in environmental temperature [20, 21]. High PCV haematocrit values indicates either an increase in the number of circulating RBC or reduction in circulating plasma volume [22]. Haematological traits especially PCV and Hb were correlated with nutritional status of the animal [23]. However, the primary functions of the erythrocyte are to serve as a carrier of haemoglobin. The higher PCV values observe in this study might likely be a sign of healthier goats. Males having higher PCV values than females is a likely hood of inherent sex differences among male and female [24, 25]. Haemoglobin (Hb) concentration in this study fell within the range of high values obtained for Bolangir goats [4]. The significant breed and age effect observed in this study may be an indication of productivity and adaptability in relation to the area of research unlike the Central Odisha goats that are highly adapted to the tsetse fly infested areas of the southern forest zone of India [26]. There was no sex difference observe in this study. The observed difference in adult and young goats suggested that the oxygen carrying capacity of the blood was high in adult goats. The results of the RBC shows that males had higher RBC values than females. The difference due to age and sex is a signal of the health status of the various age groups and sex among the goats breed studied, which is in agreement with the findings of Alex et al., [10] and Addas et al. [2]. The values of mean corpuscular volume (MCV) significantly increased while MCHC indicate macrocytic and hypochronic anaemia [27], probably due to the increased activity of bone marrow and deficiency of some hemopoietic factors. MCHC is very significant in the diagnosis of anaemia and also serve as a useful index of bone marrow to produce red blood cells. Increased MCV may also be observed in regenerative anaemia due to hemolysis and haemorrhages [28, 29]. The higher MCV values indicates macrocytosis [10]. The total White Blood Cell (WBC) count was higher in this study than values obtained for Bolangir goats [4], cattle in India [31] and Indian buffaloes [32]. Total WBC counts differentials in adult goats compared well with values obtained for young goats in this study for all the breeds. The higher values obtained in this study suggest well develop immune system of all the breeds of goats. It was reported that, like other ruminants there are more lymphocytes than Neutrophils in circulation [32]. The higher values of the WBC observed may also be attributed to the extensively managed goats which makes them face challenges from microbes when on free range. However, the values obtained in this study fell within the broad range recorded for Bolangir goats Adegam [4] and WAD goats [14]. The result also reveals non-significant effect on age which indicates that the age has little or no effect on the health status of these goat breeds.

The white blood cell differentials (lymphocytes and neutrophils) levels are comparable among the breed, age and sex groups of the animals. In goats like other ruminants there are more lymphocytes than neutrophils in circulation De Ritis [32]. Lymphocytes are the key elements in the production of immunity. Low levels can be seen in some bacterial infections, aplastic anaemia, and in some forms of leukemia while high values can be observed in viral infections, and in some forms of leukemia [33]. The result in this study is higher than the values (64.8 to 70%) for adult goats and 67.8 to 55.4% for goat kids [14], while Duke et al. [34] reported values ranging from 43.89 to 45.86% for adult goats respectively. Similarly, increase in lymphocyte percentage has been reported [15].

Depending on the stage and progress of the disease, leukocytosis, leucopenia, lymphocytosis, lymphopenia, neutrophilia and monocytes can be observed [36]. There was significant influence of age, sex and breed on lymphocyte count. The value for neutrophils was higher for Black Bengal goats breeds (adult-kids). Sex influence was also observed for neutrophils with mostly males having the higher values in Ganjam goats and Black Bengal goats breeds. Similar observation was made by Benson et al. [24] for goats in arid zone of India. Neutrophils was observe to be a very effective killing machine [39]. The values for eosinophils in this study was observed to be

Table 1: Haematological values of different breeds of Odisha, India

<table>
<thead>
<tr>
<th></th>
<th>Ganjam Goat</th>
<th>Black Bengal Goat</th>
<th>Bolangir Goat</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Buck</td>
<td>Doe</td>
<td>Buck</td>
</tr>
<tr>
<td>PVC (%)</td>
<td>55.8±1.2a</td>
<td>31.0±0.73b</td>
<td>34.00±1.2b</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>10.7±0.55a</td>
<td>8.8±0.444d</td>
<td>9.0±0.38e</td>
</tr>
<tr>
<td>RBC (g/dd)</td>
<td>5.29±0.12c</td>
<td>3.22±0.06a</td>
<td>16.4±1.2a</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>20.2±0.62a</td>
<td>27.3±0.93b</td>
<td>9.0±1.1a</td>
</tr>
<tr>
<td>MCHC (%)</td>
<td>19.2±0.09a</td>
<td>28.4±0.66a</td>
<td>26.47±2.5b</td>
</tr>
<tr>
<td>MCV (fL)</td>
<td>105.5±2.23a</td>
<td>96.3±1.23b</td>
<td>32.69±0.7a</td>
</tr>
<tr>
<td>WBC(×109/L)</td>
<td>18.3±0.65a</td>
<td>20.3±1.33a</td>
<td>13.3±0.6a</td>
</tr>
<tr>
<td>WBC Differentials</td>
<td></td>
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<tr>
<td>Lymphocytes (%)</td>
<td>71.0±2.23a</td>
<td>74.0±1.08a</td>
<td>35.00±1.7a</td>
</tr>
<tr>
<td>Neutrophils (%)</td>
<td>27.0±1.71a</td>
<td>25.0±1.22b</td>
<td>57.00±1.4a</td>
</tr>
<tr>
<td>Eosinophils (%)</td>
<td>2.0±0.02a</td>
<td>1.0±0.02a</td>
<td>7.00±0.2a</td>
</tr>
<tr>
<td>Monocytes (%)</td>
<td>0.0±0.0a</td>
<td>0.0±0.0a</td>
<td>1.0±0.1b</td>
</tr>
<tr>
<td>Basophils (%)</td>
<td>0.0±0.0</td>
<td>0.0±0.0</td>
<td>0.0±0.0</td>
</tr>
</tbody>
</table>
| PCV= Packed Cell Volume; Hb= Haemoglobin; MCV= Mean corpuscular volume; MCH= Mean corpuscular haemoglobin concentration; Means within the same row with different superscripts are significantly different (P<0.05); NS= Not significant

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higher in Black Bengal goats than the other breeds and the other breeds in this study. The values for males tends to be higher in the adult goats for all the breeds but the doe-kid of Ganjam goats and Black Bengal goats had higher values than buck-kids. Like neutrophils, they release proteins cytokines and chemokines that produce inflammation but are capable of killing invading organism. However, the selectins and integrins have some selectivity in the way in which they respond and on the killing molecules they secrete. They are especially abundant in the mucosa of the gastrointestinal tract where they defend against parasites, and in the mucosa of respiratory and urinary tracts. Monocytes generally was not observed in all the breeds except in Black Bengal goats breed. The values was higher in female (adult
The result of Na level obtained in this study is high compared to the values (4.3 to 4.5 mmol/l) for adults and (5.2 to 5.3 mmol/l) for kids reported by Egebe et al. [37] and (7.1 mmol/l) for adults goats and 6.8 to 7.8 mmol/l for kids reported by Aletor et al. [14]. The comparison generally reveals that young goats (kids) have higher potassium values than adult goats. The values for chloride show significant variation but are all within close range in terms of sex and age. Kano brown goats tend to have higher values than the other breeds. The result of hydrogen carbonate reveals that there is sex difference with males having higher values than the females. There’s little or no difference for breed and age in terms of HC03-. The urea level in the studied shows that Bolangir goat (adults) had higher values than the other breeds. The values for adults goat is higher than the young goats (kids). Generally, the values tends to be higher compares to the values 1.9 to 2.6 mmol/l (for adult goats) and 1.4 to 3.7 mmol/l (for goat kids) of Follow [39]. The high level of semen urea might be attributed to excessive tissues protein catabolism associated with protein deficiency Follis [39].

Serum creatinine levels were within normal range and differ (P<0.05) among breeds. The values were higher in the males than females in all breeds and the values tends to be higher in the young goat (kids) than the adults. The result reveal significant effect (P<0.05) of sex and age difference. The amount of creatinine secreted daily is a function of the muscle mass and is not affected by diet, age, sex or exercise. It amounts to approximately 2% of the body stores of creatinine phosphate and is roughly 1-2g/day for adult. Female excrete less creatinine than males because of their smaller muscle mass Ganong [40].

Cholesterol values show inconsistency for breed, sex and age. The value shows no significant difference in terms of age. An elevated semen cholesterol concentration has been implicated as one of several risk factors in coronary artery disease, so, the measurement of semen cholesterol concentration is fairly common laboratory procedure Ganong [40].

The glucose levels was observed to be higher in young goats (kids) than adults goats. The observed tendency toward decrease in blood glucose and insignificant changeling total protein levels was in agreement with other investigations [41, 42]. The total protein concentration of serum is usually increased in patients with dehydration. The albumin and globulin values are slightly higher than the value reported by Egebe et al. [37]. Low albumin (hypoalbuminemia) maybe caused by liver disease, nephritic syndrome, burns, protein losing enteropathy, malabsorption, malnutrition, late pregnancy, artifact, genetic variations and magnancy. High albumin (hypoalbuminemia) is almost always caused by dehydration. In some cases of retinol (vitamin A) deficiency, the albumin level can become raised to high normal values (ex: 4.9g/dl). This is because retinol causes cell to swell with water. The result of AST shows the males to the adult and kids have higher values than in females. ALP also follow similar pattern in adult goats but it tends to differ in goat kids with females having the high values of ALT values was observed to be higher in goat kids than adult goats which signify age difference. Generally, the values obtained in this study was higher than the values reported by Aletor et al. [14], Central Odisha Diary Goats of India and Egebe et al. [37] for Kashimiri goats. Serum Aspartate Aminotransferase is found in practically every tissue of the body, inducing red blood cell and highly concentrated in cardiac muscle and liver, intermediate in skeletal muscle and kidney in much lower concentrations in other tissues. The measurement of the AST levels helpful for the diagnosis and following case of myocardial infarction, hepatocellular disease and skeletal muscle disorders. In trauma or in diseases affecting skeletal muscle, after a renal infarct and in various hemolytic conditions Ganong [40]. The concentration of serum Alanine Aminotransferase in tissues is not nearly as great as for serum Aspartate Aminotransferase. If the serum Aspartate Aminotransferase is elevated while the serum Alanine Aminotransferase remains within normal limits in case of suspected myocardial infarction, the results are compatible with myocardial infarction [40].

Conclusion

Base on this findings, breed, age and sex showed remarkable influence on the haematological and biochemical values of goats studied in semi-arid areas of central Odisha, India. The values obtained are comparable to values recorded elsewhere. There was fluctuation in all the hematomal and biochemical parameters of all the breeds, sex and age of the animals. What cause the fluctuation in various parameters may be undetected minor infections, weather extremeties and poor management in these areas.
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Ganjam goat breed female (Doe) and male (Buck)

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