Comparison of Hematological and Biochemical Parameters of Clinically Healthy Buck Kid of Saanen, Sapera, and Ettawa Crossbred in Indonesia

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Abstract. The Saanen goat has adaptation abilities and is used for genetic improvement through crossbreeding programs with Ettawa breeding to produce Sapera goats in Indonesia. The development requires support for data to determine health and metabolic status. Sixteen juvenile buck goats aged 4–6 months, comprising five Saanen, seven Sapera, and four Ettawa crossbred goats, were used in this study. Blood was collected aseptically through the jugular vein for hematological and biochemical analyses. There were no statistically significant variations in most hematological and biochemical variables, except MCH, MCHC, and P-LCR. MCH in juvenile bucks of both Saanen (40.26 ± 6.94 pg) and Sapera goats (37.96 ± 6.24 pg) were lower than that in juvenile bucks of the Ettawa crossbred goats (61.63 ± 19.74 pg). MCHC in juvenile bucks of both Saanen (40.96 ± 6.82 g/dL) and Sapera goats (37.01 ± 6.72 g/dL) was lower than that in juvenile bucks of Ettawa crossbred goats (61.18 ± 23.15 g/dL). P-LCR in juvenile bucks of Ettawa crossbred goats (41.30% ± 10.95%) was significantly lower than that in juvenile bucks of both Saanen (63.48 ± 8.98%) and Sapera goats (69.00 ± 12.00%). Besides, no statistically significant variations were observed in enzyme, iron, lipid, and electrolyte activity in all three breeds.

1. Introduction
Goats (Capra aegagrus hircus) are the predominant farm animals in Indonesia [1]. The population of Indonesian goats has reached 18.6 million [2]. There are three dominant dairy goats among this population of goats, namely Ettawa crossbred, Saanen, and Sapera goats [3]. Saanen goats that were indigenous to the Saanen valley, Switzerland, are known as the largest dairy goats [4]. These goats were intentionally bred to establish a new goat breed that possessed higher milk productivity and had good adaptive abilities to environmental circumstances in Indonesia [5]. Pregnant Saanen goats have started to be imported from Australia since 2015. In contrast, the Ettawa crossbred [6] is a local goat breed that is bred as dairy goats in Indonesia [7]. The crossbreed between Kacang goats, Indonesian indigenous goats, and Ettawa goats from Jamnapari, India, resulted in the Ettawa crossbred goat [6]. The Ettawa crossbreed is classified as a dual-purpose goat, i.e., for producing meat and milk [1], and was an upgrade to Kacang goats [1,7]. Ettawa crossbred goats have been capable of adapting to tropical circumstances.
and increasing milk productivity with an average goat milk production of 1,340.00 ± 76.38 mL/head/day in Indonesia [3]. Besides, Ettawa crossbred goats are better than Kacang goats concerning goat's productivity. The local goats’ productivity is increased by altering meat-type goats to dual purpose-type goats [1]. Saanen goat breeding in Indonesia has generated crossbred goats, such as the Sapera goat, which is a crossbreed between female Ettawa crossbred goats and Saanen bucks [3,5]. Milk productivity of Sapera goats is 1,674.00 ± 122.77 mL/head/day [3].

Indonesia’s government has distributed juvenile Sapera goats to breeders to accelerate the genetic improvement of goats through this crossbreeding program. This program needs hematological and biochemical reference data of juvenile buck goats produced by crossbreeding. Hematological reference data plays an important role in a realistic evaluation of diagnosis and management practices [8], health status [9,10], and nutritional status [11] to prevent diseases and mortality of juvenile goats, which in turn can preclude suppression of the economy and goat productivity [4].

The previous study conducted in 3-month-old Saanen goats in Iran revealed that serum biochemical parameters generated reference values that were closely related to specific ages [4]. The ability of metabolic adaptation of juvenile Saanen, Sapera, and Ettawa crossbred goats, produced by crossbreeding in Indonesia’s tropical climate, in terms of hematology and biochemistry, has not been documented. Variations in hematological and biochemical parameters occur from one species to another and from one breed to another within the same species [12]. Besides being influenced by seasons, the hematological and biochemical status of the blood is also affected by breed [13,14], sex [15], age [4,9,14], productivity, environment, and management [13], and physiological status [16]. Since there has been little data on Saanen, Sapera, and Ettawa crossbred goats, the purpose of this study was to compare hematological and biochemical parameters, such as minerals, iron, enzyme, and lipid activity in juvenile Saanen, Sapera, and Ettawa crossbred goats to bridge this knowledge (research data) gap.

2. Materials and Methods

2.1. Ethical Approval
All methodology used in this research was approved in number 00026/04/LPPT/IV/2018 by the Ethics Committee of Ethical Clearance for Pre-Clinical Research, Integrated Research, and Testing Laboratory, Universitas Gadjah Mada, Yogyakarta.

2.2. Place and Animal Research
Animal research was conducted at Sukoharjo Regency, Central Java, Indonesia. Sixteen male goats aged 4–6 months (juvenile bucks) were selected from among the three breeds of goats, namely, five Saanen goats, seven Sapera goats, and four Ettawa crossbred goats. All of the kid’s health clinically were fed as shown in Table 1.

Table 1. Composition of feed.

| Feed composition consists of: |
|------------------------------|
| Concentrate                  |
| Complete silage consists of: |
| Cane of green corn           |
| The rind of bean skin        |
| Indigofera                   |
| Concentrate                  |
| Kefir goat milk              |
| Chemical composition:        |
| Dry material (%)             | 96.13 |
| Total dry matter (%) consists of: | 43.77 |
Levels (% dry matter)

|       |       |
|-------|-------|
| Ash   | 8.73  |
| CP    | 12.47 |
| EE    | 2.22  |
| CF    | 23.28 |
| NFE   | 53.30 |

CP: crude protein, EE: extract ether, CF: crude fiber, NFE=Nitrogen-free extract

2.3. Blood Sampling

Blood samples (as much as 10 ml each) were from the jugular veins 5 ml to a vacuum tube containing EDTA and 5 ml to a tube containing no anticoagulants.

2.4. Hematology

Hematology analysis was conducted using a Hematology Analyzer Sysmex KX-21 to determine red blood cell (RBC), the mean of corpuscular volume (MCV), levels of hematocrit (HCT) and hemoglobin (HGB), the mean of corpuscular hemoglobin (MCH), the mean of corpuscular hemoglobin concentration (MCHC), white blood cell (WBC), lymphocytes (L), neutrophils (N), platelet (PLT) count, the mean of platelet volume (MPV), platelet distribution width (PDW), and platelet larger cell ratio (P-LCR).

2.5. Serum Biochemistry

The analysis was conducted using a technical kit supplied from Roche Diagnostics in Roche/Hitachi Cobas c systems Cobas c 502 analyzer (Japan). The analysis included the determination of enzyme activities for, namely, alkaline phosphatase (ALP), alanine aminotransferase (ALT), and aspartate aminotransferase (AST). Mineral analysis and electrolysis included the determination of sodium (Na), potassium (K), chloride (Cl), calcium (Ca), magnesium (Mg), and phosphorus (P) levels. The analysis also included the determination of serum iron levels and unsaturated iron-binding capacity (UIBC). The transferrin-iron saturation percentage (TS%) was calculated according to the following formula: TS% = serum iron/TIBC × 100 and TIBC = Iron + UIBC [17]. Analysis of serum proteins and other metabolites included determination of albumin (A), total protein (TP), globulin (G), albumin/globulin ratio (A/G ratio), blood urea nitrogen (BUN), creatinine (CRE), and glucose (GLU). Globulin levels were calculated by subtracting albumin levels from the TP level [18]. The A/G ratio was determined by the Sorathiya and Pulsoundar method [19] and the method used by Goklaney et al. [20]. Serum lipid analysis included determination of cholesterol (CHO), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglyceride (TG) levels.

2.6. Statistical Analysis

Hematological and biochemical analyses of blood from the three goat breeds were performed using general linear models 17th version of Statistical Package for Social Science (SPSS, USA) then ANOVA and Duncan’s multiple range tests. The result was then presented as reference data. Data were presented as mean and standard deviation, the range of maximum and minimum intervals, and 95% confidence intervals for mean in the lower and upper bounds. Hematological and biochemical data among animals were different at $p < 0.05$.

3. Results

All animals were in good physical shape and optimal health, and no animals had any apparent abnormalities. The hematology and biochemistry of the three breeds of goats indicated that they were physiologically normal. The results and descriptive statistics of hematological and biochemical parameters analyzed in this report are presented in Tables 2–7.
| Parameters      | Breed            | N  | Mean ± SD | Range Interval | 95% Confidence Interval for Mean |
|-----------------|------------------|----|-----------|----------------|--------------------------------|
|                 |                  |    |           | Minimum        | Maximum                    | Lower Bound | Upper Bound |
| RBC \(10^6/\mu L\) | Sapera           | 7  | 2.54 ± 0.92  | 1.71           | 3.72                       | 1.40  | 3.69  |
|                 | Ettawa crossbreed| 4  | 2.46 ± 0.73  | 1.80           | 3.79                       | 1.79  | 3.13  |
|                 | Ettawa crossbreed| 4  | 1.30 ± 0.66  | 0.33           | 1.82                       | 0.25  | 2.36  |
| MCV (fL)        | Saanen           | 5  | 98.48 ± 7.15 | 87.20          | 105.80                     | 89.60  | 107.36 |
|                 | Sapera           | 7  | 103.16 ± 7.95 | 88.50          | 110.70                     | 95.80  | 110.51 |
|                 | Ettawa crossbreed| 4  | 103.30 ± 16.82 | 86.30         | 126.10                     | 76.54  | 130.06 |
| HCT (%)         | Saanen           | 5  | 24.92 ± 8.85 | 17.60          | 36.00                      | 13.94  | 35.90  |
|                 | Sapera           | 7  | 84.43 ± 34.32 | 43.00          | 149.00                     | 18.07  | 32.76  |
|                 | Ettawa crossbreed| 4  | 80.50 ± 17.21 | 56.00          | 93.00                      | 1.71   | 25.59  |
| HGB (g/dL)      | Saanen           | 5  | 9.78 ± 2.05  | 7.50           | 12.70                      | 7.23   | 12.33  |
|                 | Sapera           | 7  | 8.96 ± 0.91  | 7.70           | 10.20                      | 8.11   | 9.80   |
|                 | Ettawa crossbreed| 4  | 7.05 ± 2.71  | 3.00           | 8.70                       | 2.74   | 11.36  |
| MCH (pg)        | Saanen           | 5  | 40.26 ± 6.94 | 49.70          | 49.70                      | 31.63  | 48.88  |
|                 | Sapera           | 7  | 37.96 ± 6.24 | 26.90          | 26.90                      | 32.19  | 43.72  |
|                 | Ettawa crossbreed| 4  | 61.63 ± 19.74| 47.80          | 90.90                      | 30.21  | 93.04  |
| MCHC (g/dL)     | Saanen           | 5  | 40.96 ± 6.82 | 33.00          | 48.30                      | 32.49  | 49.42  |
|                 | Sapera           | 7  | 37.01 ± 6.72 | 6.73           | 44.30                      | 30.79  | 43.24  |
|                 | Ettawa crossbreed| 4  | 61.18 ± 23.15 | 43.50         | 93.80                      | 24.34  | 98.00  |
| WBC \(10^3/\mu L\) | Saanen           | 5  | 15.00 ± 3.83 | 9.30           | 20.10                      | 10.25  | 19.75  |
|                 | Sapera           | 7  | 18.17 ± 6.08 | 11.40          | 28.40                      | 12.55  | 23.79  |
|                 | Ettawa crossbreed| 4  | 20.50 ± 2.52 | 17.20          | 23.00                      | 16.49  | 24.51  |
| L (%)           | Saanen           | 5  | 65.30 ± 65.30 | 59.60         | 59.60                      | 57.25  | 73.35  |
|                 | Sapera           | 7  | 48.83 ± 24.37 | 0.00           | 74.80                      | 26.29  | 71.37  |
|                 | Ettawa crossbreed| 4  | 44.25 ± 29.78 | 0.00           | 64.00                      | -3.13  | 91.63  |
| N (%)           | Saanen           | 5  | 34.70 ± 6.48 | 23.70          | 40.40                      | 26.65  | 42.75  |
|                 | Sapera           | 7  | 51.17 ± 24.37 | 25.20         | 100.00                     | 28.63  | 73.71  |
|                 | Ettawa crossbreed| 4  | 55.75 ± 29.77 | 36.00         | 100.00                     | 8.37   | 103.13 |
| PLT \(10^4/\mu L\) | Saanen           | 5  | 1.89 ± 24.36 | 156.00        | 214.00                     | 159.15 | 219.65 |
|                 | Sapera           | 7  | 1.74 ± 29.36 | 146.00        | 236.80                     | 146.46 | 200.77 |
|                 | Ettawa crossbreed| 4  | 1.59 ± 58.89 | 81.70         | 224.40                     | 65.46  | 252.89 |
| MPV (fL)        | Saanen           | 5  | 14.46 ± 0.89 | 13.60          | 15.70                      | 13.60  | 15.57  |
|                 | Sapera           | 7  | 14.80 ± 1.05 | 13.60          | 16.50                      | 13.83  | 15.77  |
|                 | Ettawa crossbreed| 4  | 12.37 ± 1.09 | 11.10         | 13.70                      | 10.63  | 14.12  |
Table 3. Comparison of enzyme activity in three breeds of juvenile bucks kids.

| Parameters | Breed       | n    | Mean ± SD | Range Interval | 95% Confidence Interval for Mean |
|------------|-------------|------|-----------|----------------|---------------------------------|
|            |             |      |           | Minimum        | Maximum                         |
| ALP (U/L)  | Saanen      | 5    | 172.20 ± 166.34 a | 40.00 - 455.00 | -34.34 378.74                   |
|            | Sapera      | 7    | 295.57 ± 242.29 a | 54.00 - 702.00 | 71.48 519.66                   |
|            | Ettawa crossbreed | 4 | 149.25 ± 94.69 a | 29.00 - 260.00 | -1.42 299.92                   |
| ALT (U/L)  | Saanen      | 5    | 17.40 ± 2.96 a | 14.00 - 22.00 | 13.72 21.08                   |
|            | Sapera      | 7    | 19.28 ± 10.86 a | 6.00 - 39.00 | 9.24 29.33                   |
|            | Ettawa crossbreed | 4 | 18.75 ± 5.44 a | 11.00 - 23.00 | 10.09 27.40                   |
| AST (U/L)  | Saanen      | 5    | 76.00 ± 11.04 a | 63.00 - 86.00 | 62.28 89.71                   |
|            | Sapera      | 7    | 84.43 ± 34.32 a | 43.00 - 149.00 | 52.69 116.16                   |
|            | Ettawa crossbreed | 4 | 80.50 ± 17.21 a | 56.00 - 93.00 | 53.11 107.89                   |

ab Different superscripts within the same column are significantly different (p < 0.05).

Table 4. Comparison of serum mineral and electrolyte parameters in three breeds of juvenile bucks kids.

| Parameters | Breed       | N    | Mean ± SD | Range Interval | 95% Confidence Interval for Mean |
|------------|-------------|------|-----------|----------------|---------------------------------|
|            |             |      |           | Minimum        | Maximum                         |
| Na (mmol/L)| Saanen      | 5    | 148.40 ± 2.07 a | 145.00 - 150.00 | 145.83 150.97                 |
|            | Sapera      | 7    | 149.43 ± 4.50 a | 140.00 - 153.00 | 145.26 153.59                 |
|            | Ettawa crossbreed | 4 | 151.00 ± 3.56 a | 148.00 - 155.00 | 145.34 156.66                 |
| K (mmol/L) | Saanen      | 5    | 5.73 ± 0.42 a | 5.07 - 6.19 | 5.21 6.26                   |
|            | Sapera      | 7    | 5.85 ± 0.79 a | 4.71 - 7.25 | 5.12 6.59                   |
|            | Ettawa crossbreed | 4 | 6.00 ± 0.18 a | 5.86 - 6.26 | 5.72 6.29                   |
| Cl (mmol/L)| Saanen      | 5    | 106.68 ± 2.04 a | 104.40 - 109.60 | 104.15 109.21                 |
|            | Sapera      | 7    | 109.29 ± 3.56 a | 102.80 - 113.40 | 105.99 112.58                 |
|            | Ettawa crossbreed | 4 | 108.95 ± 3.28 a | 106.50 - 113.60 | 103.73 114.17                 |
| Ca (mmol/L)| Saanen      | 5    | 2.35 ± 0.11 a | 2.22 - 2.48 | 2.21 2.49                   |
|            | Sapera      | 7    | 2.33 ± 0.16 a | 2.10 - 2.58 | 2.18 2.48                   |
|            | Ettawa crossbreed | 4 | 2.26 ± 0.22 a | 2.03 - 2.52 | 1.91 2.60                   |
| Mg (mg/dL) | Saanen      | 5    | 2.59 ± 0.19 a | 2.35 - 2.79 | 2.36 2.83                   |
Table 5. Comparison of iron parameters in three breeds of juvenile bucks kids.

| Parameters | Breed          | n   | Mean ± SD     | Range Interval       | 95% Confidence Interval for Mean |
|------------|----------------|-----|---------------|----------------------|--------------------------------|
|            |                |     |               | Minimum | Maximum | Lower Bound | Upper Bound |
| Iron (µg/ dL) | Saanen        | 5   | 105.20 ± 14.65 a | 85.00  | 122.00  | 87.00  | 123.39 |
|            | Sapera         | 7   | 107.43 ± 37.53 a | 47.00  | 154.00  | 72.71  | 142.14 |
|            | Ettawa crossbreed | 4  | 162.75 ± 68.69 a | 106.00 | 262.00  | 53.4   | 272.05 |
| TIBC (µg/ dL) | Saanen       | 5   | 216.00 ± 13.47 a | 197.00 | 230.00  | 199.27 | 232.72 |
|            | Sapera         | 7   | 226.43 ± 20.92 a | 194.00 | 261.00  | 207.07 | 245.78 |
|            | Ettawa crossbreed | 4  | 256.00 ± 43.30 a | 210.00 | 303.00  | 187.09 | 210.00 |
| UIB (µg/dL) | Saanen        | 5   | 110.80 ± 25.01 a | 91.00  | 145.00  | 79.74  | 141.86 |
|            | Sapera         | 7   | 119.00 ± 29.39 a | 69.00  | 166.00  | 91.8   | 146.18 |
|            | Ettawa crossbreed | 4  | 93.25 ± 57.30 a  | 41.00  | 175.00  | 2.08   | 184.42 |
| TS (%)     | Saanen        | 5   | 49.00 ± 8.60 a  | 37.00  | 57.00   | 38.32  | 59.68  |
|            | Sapera         | 7   | 46.86 ± 14.55 a | 22.00  | 69.00   | 33.40  | 60.32  |
|            | Ettawa crossbreed | 4  | 63.25 ± 19.69 a | 38.00  | 86.00   | 31.92  | 94.58  |

aa Same superscripts within the same column are not significantly different (p > .05).

Table 6. Comparison of serum proteins and other metabolites in three breeds of juvenile bucks kids.

| Parameters | Breed       | n   | Mean ± SD     | Range Interval       | 95% Confidence Interval for Mean |
|------------|-------------|-----|---------------|----------------------|--------------------------------|
|            |             |     |               | Minimum | Maximum | Lower Bound | Upper Bound |
| A (g/dL)   | Saanen      | 5   | 2.81 ± 0.17 a | 2.64  | 3.05   | 2.59  | 3.02 |
|            | Sapera      | 7   | 2.64 ± 0.40 a | 2.07  | 3.15   | 2.27  | 3.01 |
|            | Ettawa crossbreed | 4  | 2.95 ± 0.35 a | 2.74  | 3.48   | 2.39  | 3.51 |
| TP (g/dL)  | Saanen      | 5   | 6.39 ± 0.84 a | 5.70  | 7.68   | 5.35  | 7.44 |
|            | Sapera      | 7   | 6.23 ± 0.57 a | 5.25  | 6.76   | 5.71  | 6.75 |
|            | Ettawa crossbreed | 4  | 6.52 ± 0.49 a | 5.89  | 6.99   | 5.75  | 7.30 |
| G (g/dL)   | Saanen      | 5   | 3.59 ± 0.73 a | 2.99  | 4.63   | 2.68  | 4.49 |
|            | Sapera      | 7   | 3.58 ± 0.45 a | 2.84  | 4.36   | 3.17  | 3.99 |
Table 7. Comparison of serum lipid parameters in three breeds of juvenile bucks kids.

| Parameters | Breed       | n | Mean ± SD | Range interval | 95% Confidence Interval for Mean |
|------------|-------------|---|-----------|----------------|---------------------------------|
|            |             |   |           | Minimum        | Maximum                        | Lower Bound | Upper Bound |
| CHOL (mg/dL)| Saanen      | 5 | 71.00 ± 12.71 a | 36.00          | 62.00                          | 57.00       | 88.00       |
|            | Sapera      | 7 | 65.00 ± 12.26 ab | 44.00          | 78.00                          | 47.00       | 81.00       |
|            | Ettawa crossbreed | 4 | 104.25 ± 41.07 b | 68.00          | 162.00                         | 38.89       | 169.60      |
| HDL (mg/dL)| Saanen      | 5 | 53.00 ± 18.43 a | 29.00          | 74.00                          | 30.12       | 75.88       |
|            | Sapera      | 7 | 41.43 ± 28.16 a | 6.00           | 74.00                          | 15.39       | 67.47       |
|            | Ettawa crossbreed | 4 | 104.25 ± 41.07 a | 37.00          | 117.00                         | 17.11       | 123.89      |
| LDL (mg/dL)| Saanen      | 5 | 37.00 ± 17.15 a | 17.00          | 59.00                          | 15.71       | 58.29       |
|            | Sapera      | 7 | 32.57 ± 96.80 a | 6.00           | 74.00                          | 23.45       | 41.69       |
|            | Ettawa crossbreed | 4 | 71.75 ± 64.91 a | 21.00          | 167.00                         | 31.53       | 175.03      |
| TG (mg/dL) | Saanen      | 5 | 36.80 ± 13.95 a | 20.00          | 54.00                          | 19.47       | 54.13       |
|            | Sapera      | 7 | 67.14 ± 48.62 a | 12.00          | 144.00                         | 22.18       | 112.10      |
|            | Ettawa crossbreed | 4 | 47.25 ± 22.29 a | 31.00          | 80.00                          | 11.78       | 82.72       |

ab Different superscripts within the same column are significantly different (p < 0.05).

4. Discussion

4.1. Erythrocyte Indices

Table 2 shows that breed influenced only MCH and MCHC among the erythrocyte indices (p < 0.05). MCH levels of juvenile bucks of both Saanen (40.26 ± 6.94 pg) and Sapera (37.96 ± 6.24 pg) goats were
lower than those of juvenile bucks of Ettawa crossbred goats (61.63 ± 19.74 ρg). MCHC of juvenile bucks of both Saanen (40.96 ± 6.82 g/dL) and Sapera goats (37.01 ± 6.72 g/dL) was lower than that of juvenile bucks of Ettawa crossbred goats (61.18 ± 23.15 g/dL). However, there was no significant difference in MCHC between juvenile bucks of Saanen and Ettawa crossbred goats (p > 0.05). MPV indices are employed to assess erythrocytes' functional activity [21] and HGB, PCV, MCV, MCH, and MCHC [22]. Breed did not affect PCV as found in local Bundelkandhi goats [23]. The highest value of MCH and MCHC were recorded in juvenile bucks of Ettawa crossbred goats compared with those in juvenile bucks of Saanen and Sapera goats (p < 0.05). MCH in juvenile bucks of Saanen goats in this study was higher than that in young bucks of Saanen goats [24]. MCH and MCHC in juvenile bucks of Saanen, Sapera, and Ettawa crossbred goats were higher than those in young Saanen goats; kids of red Sokoto and Sahel goats [25]; and young bucks of Ganjam goats, Black Bengal goats, and Bolangir goats [26]. MCH and MCHC are very significant for diagnosing and characterizing anemia [9] and indices RBCs production [11]. Therefore, they showed that in three breeds of juvenile bucks kids not anemic.

HGB levels, HCT, and MCV also demonstrated that there was no anemia in the three breeds. It was found that the breed did not affect HGB levels in local Bundelkandhi goats [23]. RBC levels obtained in this study were lower than those obtained in kids of Saanen goats [24]; neonatal, nursing, and juveniles of Saanen goats [25]; kids of red Sokoto and Sahel goats [26]; kids of Jabal al Akhdar goats, Batina goats, and Dhofari goats at 3 and 8 weeks old [28]. The primary function of the erythrocyte is to serve as a carrier of hemoglobin [27]. The results of HGB levels in three breeds of juvenile bucks kids were lower than that in buck kids of Saanen [24], kid Sakoto red [25], buck kids of Ganjam goat, Black Bengal goats, and Bolangir goats [26], buck kid of Kano Brown, Borno white, and Sakoto red goats [27]. Higher the HGB recorded this research than in juvenile Black Bengal and Jamnapari goats of Chittagong, Bangladesh [14]. No HGB level variations observed in this study showed that there was no difference in the nutritional status [26, 28] of the three breeds. In this study, the value of HCT also showed that the nutritional status of the juvenile bucks of Saanen, Sapera, and Ettawa crossbred goats was not different (p > 0.05). The values of HCT in juvenile bucks of Saanen and Sapera goats were higher than those of HCT in buck kids of Saanen [24], Black Bengal, and Jamnapari goats [14] and lower than those in buck kids of red Sokoto and Sahel goats during the col-dry, hot-dry, and rainy seasons [25]; Ganjam, Black Bengal, and Bolangir goats [26]; and Kano Brown, Borno white, and Sakoto red goats [27]. The values of HCT in Ettawa crossbred juvenile bucks kids were lower than those of HCT in buck kids of the Saanen [24], juveniles of Black Bengal, and Jamnapari goats [14], and goats of the Arid Zone of Rajasthan and Iran [19]. The values of MCV in buck juveniles of Saanen goats in this study were higher than those of MCV in buck kids of Saanen goats [24]. The values of MCV in these three breed juvenile bucks were higher than those of MCV in red Sokoto and Sahel goats [25] and juveniles of Black Bengal and Jamnapari goats [14].

4.2. Leukocytic Indices
There was no significant influence of breed on leucocyte indices in this study, including WBC, L, and N levels (p > 0.05). WBC counts affect the immune system [29]. In this study, there was no significant influence of breed on WBC, L, and N counts, which differed from the report of sheep in Northern Nigeria [11]. The lower L count was recorded in this study than in buck kids of red Sokoto goats [25] and buck kids of Ganjam goats [26]. The N content (%) in the present study was higher than that in kids of red Sokoto goats during the hot-dry season [25] and buck kids of Ganjam goats [26].

4.3. Comparison of Platelet Indices
Breed significantly influenced only in MPV and P-LCR among the platelet indices (p < 0.05), in which MPV in juvenile bucks of Ettawa crossbred goats (12.37 ± 1.09 fL) was lower than that in juvenile bucks of both Saanen (14.46 ± 0.89 fL) and Sapera goats (14.80 ± 1.05 fL). Also, both Saanen and Sapera goats' juvenile bucks did not show a difference in MPV (p > 0.05). P-LCR of juvenile bucks of Ettawa crossbred goats (41.30 ± 10.95%) was significantly lower than that of juvenile bucks of Saanen (63.48% ± 8.98%) and Sapera goats (69.00% ±12.00%). In contrast, Saanen and Sapera goats' juvenile bucks did
not differ in P-LCR ($p > 0.05$). Only a few new platelet studies have provided hematological analyses in goats as well as in humans [30–34], dogs [35], and horses [36]. Platelets have important functions in hemostasis and thrombosis, and the immune and inflammatory processes [34]. In this report, no effect of breeds on PLT counts was not found, similar to that reported by Habibu et al. [37]. Platelet counts in this study were lower than those in Sokoto red and Sahel goats during the cold-dry seasons [37]. PDW indicates changes in platelet size [38] represents its heterogeneity [35] and its activation [31]. In this study, PDW is not influenced by breed. MPV constitutes an index of platelet production and activation reflecting the alteration in platelet size in various conditions [39]. In this report, MPV was influenced by breed ($p < 0.05$), with the values of juvenile bucks of Saanen and Sapera goats being higher than those of juvenile bucks of Ettawa crossbred. However, the values of MPV of the three animal breeds were still comparable with the value of MPV of Saanen bucks [24], P-LCR represents the percentage of huge platelets [40] that functions as an indicator of circulating larger platelets. P-LCR also works to monitor the activities of platelet [41]. This result reported that P-LCR was influenced by breed ($p < 0.05$), where P-LCR of juvenile bucks of Saanen and Sapera goats was higher than that of juvenile bucks of Ettawa crossbred goats, showing that the MPV trend is similar to the P-LCR trend [40].

4.4. Comparison of Enzyme Activity
Table 3 showed a comparison of enzyme activity among three breeds of juvenile bucks kids. This study reported no effect of breed on enzyme activities of ALP, ALT, and AST ($p > 0.05$) in three breeds of juvenile bucks kids. ALP values were $172.20 \pm 166.34$ U/L in Saanen kids, $295.57 \pm 242.29$ U/L in Sapera kids, and $149.25 \pm 94.69$ U/L in Ettawa crossbred kids. ALT values of $17.40 \pm 2.96$ U/L in Saanen kid, $19.28 \pm 10.86$ U/L in Sapera kid, and $18.75 \pm 5.44$ U/L in Ettawa crossbred kid. AST activity with values of $76.00 \pm 11.04$ U/L in Saanen kid, $84.43 \pm 34.32$ U/L in Sapera kid, and $80.50 \pm 17.21$ U/L in Ettawa crossbred kid. The results of the current study indicated that animal breed did not affect ALP activity in juvenile bucks of Saanen, Sapera, and Ettawa crossbred goats. Results of other studies indicated that breed influenced activities of ALP in, namely, buck kids of Ganjam, Black Bengal, and Bolangir goats [29] and kids of Kano Brown buck, Borno white, and Sokoto red goats [27]. Other factors that influenced the activities of ALP are feed [9], temperature [42], and age [4,29]. Overall, the activity of ALP in three breed juvenile buck kids in this study was comparable with that of ALP in neonates, nursing, and juveniles of Saanen goats [25]; buck kids of Sokoto red, Borno white, and brown canoe goats [27]; and Alpine X Beetle cross kids [43]. The ALP’s higher activity in this study possibly has a relationship with iso-enzymes of bone-ALP [4]. Breed no influence the activity of ALT three breed juvenile buck kids in this study compared with ALT activity in buck kids of Ganjam, Black Bengal, and Bolangir goats [29]. In addition to being affected by the animal breed, the activity of ALT is also influenced by age, with the activity being higher than that in adult goats [27], genital [44], and season [42,44]. The activity was comparable with that in kids of Saanen goats [24], neonates and nursing Saanen goats [25], indigenous goats (C. hircus) of Chittagong, Bangladesh, namely the juvenile bucks of Black Bengal and Jamnapari goat [14], buck kids of Ganjam and Black Bengal goats [29], Alpine × Beetle cross goats [43], kid and yearling goat Surti in South Gujarat [19] but was lower than that in Juvenile Saanen [25] and higher than that in Buck Kid Bolangir [29]. Serum aspartate aminotransferase (AST) can be found in every tissue of the body. AST induces RBCs and is highly concentrated in cardiac muscle, liver, and in skeletal muscle, which can be found in other tissues at lower levels. As such, AST levels are employed to diagnose myocardial infarction and diseases in liver cells, disorders, or trauma in skeletal muscles after a renal infarction, and many different hemolytic conditions [27]. The activity of AST is high in both hepatocytes and skeletal muscle tissues [25]. AST is influenced by age [44] and season [42,45]. The activity of AST in three breed juvenile buck kids in this study was comparable with that in juvenile Saanen goats [25]; and lower than that in kids of Saanen goats [24]; and comparable with that in neonates, nursing, and juvenile Saanen goats [25]; buck kid Ganjam and Bolangir Black Bengal goats [29]; Sokoto red, Borno white, and brown canoe goats [27]; and Alpine X Beetle cross goats [43].
4.5. Comparison of Mineral Parameters
There was no difference \( (p > 0.05) \) in the parameters of minerals and electrolytes, including Na, K, Cl, Ca, Mg, and P, among three breed kids as presented in Table 4. Animal breed did not affect Na, K, Cl, Ca, Mg, and P levels in this study. Na levels were influenced by animal breed, as reported by Njidda et al. [27], in addition to age [29]. This report indicated that Na levels were lower than those in buck kids of brown canoe goats in Northern Nigeria [27] and 50-day suckling kids of Alpine goats [46] and comparable with those in buck kids of Borno white goats [27] and male and suckling kids Alpine × Beetle cross goats [43], and 20-days suckling kids of Alpine goats [46] but were higher than those in buck kids of Sokoto red goats [27]. Results of this study were comparable with K levels in buck kids of Borno white goats [27], kids of Alpine × Beetle cross male goats [43], suckling kids of Alpine goats aged 20 days and 50 days [46]; were lower than those in buck kids of Borno white goats [27], and higher than those in buck kids of Sokoto red goats [27]. In this study, Cl levels were comparable with those of buck kids of white Bono goats, bucks of Borno white goats, and buck kids of Sokoto red goats [27] and 20-day suckling kids of Alpine goats [46]; were higher than those of kids of Alpine × Beetle cross goats [43]; and lower than those of 50-day-old suckling kids of Alpine goats [46]. The results of this study were comparable with those seen in 50-day suckling kids of Alpine goats [46] and kids and yearling of Surti goats [19], but higher than those seen in 20-day suckling kids of Alpine goats [46]. Concerning Mg in this research, goats were comparable kids and yearlings of Surti goats [19]. The Pi levels obtained in this study were higher than those in Black Bengal and Jamnapari goats [14] and kids and yearlings of Surti goats [19].

4.6. Comparison of Iron
Table 5 shows that iron, TIBC, UIB, and TS levels in three breed kids no different \( (p > 0.05) \). Iron is supplied to goat kids through colostrum and milk. With animal growth, the demand for iron also increases. Iron levels in goats of this study were comparable with those in kids of Polish goats [47] and suckling kids of Alpine goats aged 20 days and 50 days [46]. Recorded that iron levels in this report were higher than those in Najaf Iraq goats [17] but lower than those in goats of Rajasthan Iran [20]. The iron levels in kid goats during the first days of postnatal life can be observed based on the increase in TIBC [47]. TIBC results in this study were lower than those in Najaf Iraq goats [17], but comparable with those in kids of Polish goats [47] and goats of Rajasthan [20]. The UIB in this research was higher than that in the Najaf Iraq goat [17].

4.7. Comparison of Glucose Parameters
The glucose concentration in the present research goats was lower than that in juveniles of Saanen [25]; comparable with that in goats of Rajasthan, Iran [20] and buck kids of Kano Brown, Borno white, and Sokoto red goats [27] and Alpine × Beetle cross [43] and lower than that in goats of the Arid Zone of Rajasthan [20].

4.8. Comparison of Protein Parameters
Table 6 shows serum protein and other metabolite levels in three breeds of juvenile bucks kids. Important roles of albumin are maintaining homeostasis, transporting substances, and functioning as a free-radical scavenger [48]. Some factors that cause low albumin levels (hypoalbuminemia). Conversely, dehydration causes high albumin levels, mostly. Albumin levels in this study were comparable with that in kids of Saanen goats [25], kids of Alpine × Beetle cross goats [43], Goats of Arid Zone of Rajasthan [20], Baladi goats [49], kids and yearlings of Surti goats [19], suckling kids of Alpine aged 20 days and 50 days [46], but were lower than those in juveniles of Saanen goats [25] and Black Bengal and Jamnapari goats [14], buck kids of Kano Brown, Borno white, and Sokoto red and goats of Rajasthan [20]. An increase in globulin is commonly found in the presence of inflammation or infection, whereas a decrease in globulin is commonly found in the presence of malnutrition [48]. The result of globulin in the current study was comparable with that in kids of Saanen goats [24] and the goats of the Rajasthan, Iran [20], but was lower in comparison with that in Alpine × Beetle cross goats [43]. The A/G ratio
could reflect changes in homeostatic factors [50]. The A/G ratio in this study was comparable with that in goats of the Arid Zone of Rajasthan, Iran [20], and both kids and yearlings of Surti goats at South Gujarat [19]. The concentration of TP in this experiment was not influenced by the goat breed. However, Habibu et al. [26] and AL-Hadithy and Badawi [51] reported the influence of goat breed on serum TP. Results of TP in this study were comparable with those in buck kids of Saanen goats [24], Alpine × Beetle cross goats [43], buck kids of Kano Brown and Borno white goats [27], and red Sokoto red goats in the cold-dry seasons [37] but lower than those in juveniles of Saanen [24] and Ganjam goats, buck kids of Black Bengal goats [29], and buck kids of Sokoto red goats [27]. The creatinine concentration was not influenced by goat breed as observed in goats in Sudan [52]. The creatinine result of this study was lower than that in kids of Kano Brown bucks, but higher than that in buck kids of Borno white goats, and was comparable to the buck kids of Sokoto red goats [27]. The area from this study was comparable to Black Bengal and Jamnapari goats [14] and the suckling kids of Alpine aged 20 days and 50 days [46], but lower than the urea in kids of Saanen [24] and juvenile of Saanen [25], buck kids of Kano Brown, and Sokoto red goats [27].

4.9. Comparison of Lipid Parameters
Table 7 indicates that the cholesterol level was the highest in juvenile bucks of Ettawa crossbreed goats compared with that in juvenile bucks of Sapera and Saanen goats (p< 0.05). The high cholesterol level in this study was comparable to that in the kids of Saanen [24], and juveniles of Saanen [25], buck kids of Kano Brown, suckling kids of Alpine goats aged 20 days and 50 days, and kids and yearlings from Surti goat [19], Sudanese Nubian Goats Kids [9], but lower than that in buck kids of Sokoto red goats [27]. The cholesterol level was relatively higher in concentration than TG because of more utilization of lipid components [4, 24]. The breed did not affect triglycerides. The TG results of this report were comparable within kids of Saanen [24] and juvenile of Saanen [25], Sudanese Nubian Goats Kids [9], and kids and yearlings from Surti goats [19], and suckling kids of Alpine goats aged 20 days and 50 days [19]. The HDL in this study was comparable to the kids of Saanen [24] and juveniles of Saanen [25], suckling kids of Alpine goats aged 20 days and 50 days [46]. The LDL of this study was comparable to the LDL in the kids of Saanen [24] and juveniles of Saanen [25] suckling kids of Alpine goats aged 20 days and 50 days [53].

5. Conclusion
The results of this study have led to the first comprehensive hematological and biochemical references in three breeds of juvenile bucks kids in Indonesia as the basis to determine health status, evaluate diagnostic findings, or assess management plans.

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