The Hematological and Biochemical Profiles of Wonosobo Sheep Blood in Various Physiological Conditions

Sarmin*, Pudji Astuti, and Claude Mona Airin

Department of Physiology, Faculty of Veterinary Medicine, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia

ABSTRACT

The study aimed at examining the hematological and biochemical profiles of Wonosobo sheep blood in various physiological conditions. There were 32 Wonosobo sheep in the various physiological conditions, including 17 ewe lamb of 1-2 months of age, 5 pregnant female sheep of 12-48 months of age at 3 months of pregnancy, 5 ewe of 12-48 months of age in second lactation period of 1-2 months and 5 ram of 12-48 months of age. Each of the sheep was put in individual sheepfold and given Pakhong-1 grass, dried kangkong, and concentrate. Drinking water was given ad libitum. Blood sample was drawn from jugular vein and put into tubes for blood hematological and biochemical analyses. The results of the study showed that total leukocyte and lymphocyte were high in young sheep, while neutrophils was high in pregnant female sheep (P<0.05). There was not any significant physiological impact on hemoglobin, MCV, MCH, MCHC, RDW, hematocrit, platelet, monocyte, eosinophil, and basophil (P>0.05). The highest ALP activity and Pt levels were found in the ewe lamb, while low creatinine was found in the ram (P<0.05). The parameter of the activities of SGPT, SGOT, LDH, calcium, kalium, chloride, sodium, magnesium, TIBC, UIBC, TS, globulin, albumin, total protein, BUN, creatinine, glucose, cholesterol, triglyceride, HDL and LDL was not affected by physiological conditions (P>0.05). It was concluded that the impact of the physiological conditions of the Wonosobo sheep caused high total leukocyte and lymphocyte in ewe lamb and high neutrophil in pregnant female sheep, the increase in the Pt level and ALP activity of the ewe lamb, and high creatinine in the ram.

Keywords: Ewe lamb, Hematology, Physiological conditions, Pregnant, Wonosobo sheep

Introduction

Wonosobo sheep have been established as Indonesian local livestock on the Decision Letter of the Minister of Agriculture Number 2915/Kpts/OT.140/ 6/2011 (Suswono, 2011). The sheep represented the crossbreed between Texel sheep and local sheep (Hakim et al., 2019), including thin tailed sheep and thick tailed sheep that are bred by local people of Wonosobo district of Central Java from generation to generation. The body weight of the Wonosobo sheep was up to 108.±13.0 Kg (male) and 82.0±4.5 Kg (female) (Suswono, 2011). The first mating age of the sheep ranged from 10 to 12 months, the first breeding age ranged from 15 to 19 months, the number of ewe lamb in a birth was 1-2 sheep, the estrous cycle lasted for 17-19 days and the estrous period was 25-35 hours, while the motherhood characteristics were good (Suswono, 2011), birth weight was 2.81 Kg and the post-weaning weight was 31.20 Kg (Hakim et al., 2018).

The Wonosobo sheep had uniform physiology and genetic composition and good adaptability to environmental limitation, typical characteristics that were different from those of other endemic sheep or other local sheep and represented Indonesian local livestock genetic resource (Suswono, 2011). However, there have not been any hematological and biochemical parameters of the blood of the sheep. The blood hematological and biochemical parameters played an important role in establishing livestock health. The hematological and biochemical parameters contained in reference book (Jackson and Cockcroft, 2002; Kramer, 2000; Feldman et al., 2002; Jain, 1986) could not accommodate the hematological and biochemical data of the blood of the Wonosobo sheep because of the difference in sheep race, geographic area, climate, time, method, instrument, and environment and also forages. Each race of sheep had hematological characteristics (Azimzadeh and Javadi, 2020). It was also the case of goat race (Al-Bulushi et al., 2017). It has been reported that other causal
The hematological and biochemical parameters of the blood of the Wonosobo sheep based on the variation of the physiological conditions were very important as indicators of sheep health and metabolic status (de Souza et al., 2020). Additionally, the data were also important in making comparative diagnosis of livestock diseases (Russell and Roussel, 2007). Therefore, the study aimed at examining the hematological and biochemical parameters of the blood of the Wonosobo sheep in various physiological conditions.

Materials and Methods

All the methods used in the study have been accepted by the Ethical Clearance Committee of the Integrated Laboratory Study and Testing of Gadjah Mada University for preclinical study (No 0004/04/LPPT/VII/2019).

The location and the time of study

The study was conducted in Griya Ternak Farm, Kemiri, Wringinanom, Kertek subdistrict, Wonosobo district, Central Java, 7.22°S, 109.55°E, at 743 m above sea level. It lasted from May 2019 to August 2019, while sample was drawn in July 2019.

Experimental animals and treatment management

All the experimental animals were under the supervision of veterinarians and considered to be healthy and without any physical defect and any medication such as hormone, antibiotics, and electrolyte and glucose solution infuse. The recording of the data of livestock was managed by animal nurses. Each of the animals was regularly examined, including possible infection by microbes, ectoparasite and endoparasite infestation, while physical examination included temperature, pulse, respiration, eye mucus, appetite, fecal consistency and clinical laboratory examination. The animals during the study was prevented by regularly eradicating ectoparasites once in three weeks, while anthelmintic was given before the study.

Each of the sheep was put in individual wooden raised platform sheepfold, except young sheep that were raised along with their mothers. There were 32 Wonosobo sheep in various physiological conditions sampled out randomly, including 17 ewe lamb of 1-2 months of age, 5 pregnant female sheep of 12-48 months of age at 3 months of pregnancy, 5 ewe in second lactation period of 1-2 months and 5 ram of 12-48 months of age.

The sheep were given drinking water ad libitum. Each of the sheep was put in individual sheepfold and given forage of Pakchong-1 grass, dried kangkong, and concentrate. The ingredient of the feed were summarized in Table 1. The ewe lamb got milk directly from their mothers and ate along with their mother in a sheepfold.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakchong-1 grass</td>
<td>35</td>
</tr>
<tr>
<td>Dried kangkong</td>
<td>35</td>
</tr>
<tr>
<td>Concentrate</td>
<td>30</td>
</tr>
<tr>
<td>Total (%)</td>
<td>100</td>
</tr>
</tbody>
</table>

Blood sampling and analysis

Blood sample (10 mL) was drawn from jugular vein at 06:00-07:00 a.m. before the sheep were given forage in the morning and they have been fasted for several hours before blood sampling. Five mL of blood was put into VacuLab® Onemed tubes (PT Jayamas Medica Industri, Sidoarjo, Indonesia) containing ethylenediaminetetraacetic acid (EDTA). Hematological analysis included hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red distribution width (RDW), hematocrit, platelet, total leukocyte, lymphocyte, monocyte, eusinophil, basophil and neutrophil and was made using Sysmex KX-21 hematology analyzer (Sysmex Corporation, Japan).

The remaining 5 mL of the blood was put into plain tube VacuLab® Onemed (PT Jayamas Medica Industri, Sidoarjo, Indonesia) and then centrifuged at 3000 rpm for 15 min. The resulting serum was kept at -20°C for blood biochemical analysis. The serum included glutamic pyruvic transaminase (GPT), glutamic oxaloacetic transaminase (GOT), alkaline phosphatase (ALP), lactate dehydrogenase (LDH), phosphor inorganic (Pi), calcium, kalium, chloride, sodium, magnesium, ferrum, unbound iron-binding capacity (UIBC), globulin, albumin, blood urea nitrogen (BUN), creatinine, total protein, glucose, cholesterol, triglyceride, High-density lipoprotein (HDL), and low-density lipoprotein (LDL) were analyzed using a kit supplied by Roche Diagnostics in Roche/Hitachi Cobas c systems Cobas c 502 (Japan). The level of total iron-binding capacity (TIBC) = Ferum + UIBC (Demir et al., 2020; Weiss and Wardrop, 2010). Transferrin saturation (TS) resulted from Ferrum/TIBC×100.

Statistical analysis

The blood hematological and biochemical parameters were analyzed using general linear model of ANOVA and the impact of the physiological conditions on the blood hematology and biochemistry was analyzed using Duncan’s multiple range test at the significance of P=0.05. The data of the parameters were expressed in standard deviation of various physiological
conditions (ewe lamb, pregnant female sheep, lactating female sheep and ram).

Results and Discussion

Table 2 summarized the hematological data of the Wonosobo sheep in various physiological conditions. It was found that the physiological conditions had significant impact on total leukocyte and resulted in the low total leukocyte of pregnant female sheep, the high lymphocyte percentage of ram and ewe lamb and the low neutrophil of ewe lamb and ram (P<0.05), while there was not any significant impact of the physiological conditions on hematocrit, MCV, MCH, platelet, RDW, monocyte, eosinophil and basophil (P>0.05).

The resulting hemoglobin in the study was consistent with the reference parameter (Kramer, 2000; Feldman et al., 2002). The hemoglobin level was that of Iraq thick-tailed sheep, which was 9.83 ± 0.57 g/dl (Sarmin et al., 2021b). It was reported that among Iraqi Awassi sheep the hemoglobin of the lactating sheep was lower than that of the ram (Badawi and AL-Hadithy, 2014). Mostaghni et al. (2005) reported that the hemoglobin of ewe was lower than that of ram. It was reported that among Egyptian sheep the hemoglobin of ewe lamb was higher than that of adult sheep (Ashour et al., 2015). The results of the study showed that the physiological status (Murphy, 2014; Ahmadi-hamedani et al., 2016) and reproduction status (Dias et al., 2010) of both male and female sheep did not have any significant impact on the hemoglobin. The results of the analysis showed that the sheep in the study were not anemic because of ferrous deficiency (Cihan et al., 2016) and the oxygen-carrying capacities were normal (Sarmin et al., 2021b).

The MCV level of the Wonosobo sheep in the various physiological status was consistent with that of Churra-da-Terra-Quent sheep, which was 41.60±0.00 fl (Dias et al., 2010); it was higher than the reference parameter (Feldman et al., 2002), while that of the Iraqi Awassi sheep was 27.54-37.10 fl (Badawi and AL-Hadithy, 2014). There were some influencing factors of the MCV level such as altitude (Barsila et al., 2020), the difference in season (Karthik et al., 2021; Ribeiro et al., 2018) and the difference in ambient temperature (Mazzullo et al., 2014).

The MCH level of the Wonosobo sheep in all of the physiological conditions was higher than the reference parameter (Feldman et al., 2002), and that of Iraqi fat-tailed sheep, which was 9.94±0.12 pg (Ahmadi-hamedani et al., 2016), or that of Merino sheep, which was 11.00±0.7 pg (Lepherd et al., 2009), that of Churra-da-Terra-Quent sheep, which was 12.2±0.8 pg (Dias et al., 2010) and that of Iraqi Awassi sheep, which was 10.31±0.07 pg (Badawi and AL-Hadithy, 2014).

The MCHC level of the Wonosobo sheep was still in the range of 40.60±6.40% and equivalent to that of the sheep in Capital of Salta province of Argentina (Pizetti et al., 2021).

However, it was higher that the reference parameter (Feldman et al., 2002) and that of the Iraqi fat-tailed sheep, which was 33.30±0.16% (Ahmadi-hamedani et al., 2016), that of Merino sheep, which was 36.10±15.2% (Lepherd et al., 2009), that of Iraqi Awassi sheep, which was 32.9±0.19% (Badawi and AL-Hadithy, 2014). It was indicative of the accuracy of red blood cell index so that its increase would cause anemia because of ferrous deficiency (Polizopoulos, 2010).

The RDW level was indicative of the variation of the magnitude, the heterogeneity index and the anisocytosis index usually used in making comparative diagnosis of microcytic and normocytic anemia (Fava et al., 2019; Salvagno et al., 2015). It was higher than 16.44±0.34% (Börne et al., 2009) and equivalent to 21.13±0.43% (Zura Zaja et al., 2019). Its increase was indicative of anemia (May et al., 2002).

The hematocrit of the Wonosobo sheep in all the physiological conditions was consistent with the reference parameter (Feldman et al., 2002; Jackson and Cockcroft, 2002). It was higher in young sheep than adult Baruwal sheep (Barsila et al., 2020) and the hematocrit reported by Elnageeb and Abdelatif (2013) because of the impact of growth (Singh et al., 2018).

The physiological status did not have any significant impact on platelet (P>0.05) as reported in Sokoto sheep and Sahel goats (Okonkwo et al., 2011). On the contrary, Habibu et al. (2017) reported that the platelet in pregnant goat was higher than that in non-pregnant goat. It was reported that the platelet level in young Sahel goat was higher than that in adult goat (Habibu et al., 2017). It closely related to wound blocking function (Okonkwo et al., 2011).

The resulting total leukocyte in the study was still in the range of the reference parameter (Kramer, 2000). The total leukocyte was used to monitor inflammation status (Feldman et al., 2002), physiological mechanism in the adaptation to environment and defense system against infectious agents (Pizetti et al., 2021) and the progress of sheep health (Daramola et al., 2005). The lymphocyte level of the Wonosobo sheep was still in the range of 40-55% of the reference of 40-75% according to Kramer (2000); it was also the case of Etiopian sheep, which was 49.07±0.76% (Tibbo et al., 2005) and Indonesian fat-tailed sheep, which was 77.57±4.04% (Sarmin et al., 2021b). The resulting monocyte in the study was still in the range of the reference parameter of 0-6 (Kramer, 2000; Feldman et al., 2002), it was also the case of Etiopian sheep, which was 2.08±0.10% (Tibbo et al., 2005), and Iranian red sheep, which was 2.52±0.68% (Azimzadeh and Javadi, 2020). The resulting eosinophil in the study was still in the range of the reference parameter of 0-10% (Kramer, 2000; Feldman et al., 2002), and Etiopian sheep, which was 3.69±0.18% (Tibbo et al., 2005). The increase and the decrease in the eosinophil level related to immune response to nematode parasitic.
infestation (Pernthaner et al., 2005; Biddle et al., 1992). Basophil related to eosinophil (Jain, 1986). The resulting basophil level in the study was consistent with the reference parameter of 0-3 (Kramer, 2000; Feldman et al., 2002), and that of Etiopian sheep, which was 0.53±0.07% (Tibbo et al., 2005). The resulting neutrophil level in the study was still in the range of the reference parameter (Jackson and Cockcroft, 2002).

The biochemistry of the Wonosobo sheep blood

Table 3 summarized the biochemical parameters of theWonosobo sheep blood in various physiological conditions. The physiological conditions did not have any significant impact on the resulting GPT activity of the thick-tailed sheep in the study (P>0.05) as reported by Sarmin et al. (2021a). It was reported that the GPT of Tsigai lactating sheep was high because of the increase in hepatic metabolic activity (Antunović et al., 2011). The same result has been reported in Rasa Aragonesa sheep (Ramos et al., 1994). The GPT activity of the Wonosobo sheep was in the range of the reference parameter (Jackson and Cockcroft, 2002). The normal GPT activity was indicative of the deficit of protein and fat supply in hepatic metabolism and in normal physical activity (Antunovic et al., 2004).

The physiological conditions did not have any significant impact on the GOT activity (P>0.05) and it was consistent with the report of the fat-tailed sheep (Sarmin et al., 2021a). On the contrary, the GOT activity was higher in pregnant Tsigai sheep than in the lactating sheep (Antunovic et al., 2004). It indicated that the hepatic metabolic activity of the Wonosobo sheep was normal.

The physiological conditions had significant impact on the ALP (P<0.05) and the parameter was as high as that in Tsigai sheep (Antunovic et al., 2004). On the contrary, the physiological condition did not have any significant impact (Sarmin et al., 2021a). The ALP activity was found to be high in Bighorn sheep (Borjesson et al., 2000). In the Wonosobo sheep, it was still in the range of the reference parameter (Jackson and Cockcroft, 2002).

The physiological conditions did not have any significant impact on the resulting LDH activity in the study (P>0.05), as reported in Tsigai sheep (Antunovic et al., 2004). The LDH activity of the Wonosobo sheep was higher than the reference parameter (Jackson and Cockcroft, 2002) and that of Bighorn sheep, which was 409–788 U/L (Borjesson et al., 2000).

The physiological conditions had significant impact on the resulting PI level in the study. The highest PI level was found in ewe lamb, while the lowest one was found in pregnant sheep (P<0.05). Meanwhile, it was reported that among the fat-tailed sheep the highest PI level was found in ram (Sarmin et al., 2021a). Low PI level was found in adult Merinolandshaf sheep (Antunovic et al., 2004). The resulting PI level in the study was consistent with the reference parameter (Jackson and Cockcroft, 2002).

The physiological conditions did not have any significant impact on the resulting calcium level in the study (P>0.05) as reported in the fat-tailed sheep (Sarmin et al., 2021a) though other study showed high calcium in the sheep of a year of age (Antunovic et al., 2004). The resulting calcium level in the study was still in the range of the reference parameter (Jackson and Cockcroft, 2002).

The physiological conditions did not have any significant impact on the resulting kalium level in the study (P>0.05) as reported in the fat-tailed sheep (Sarmin et al., 2021a; Azimzadeh and Javadi, 2020; Mostaghni et al., 2005) though Antunovic et al. (2011) suggested that the kalium of pregnant sheep was higher than that of lactating sheep. It was also reported that there did not have any significant impact on the kalium of sheep (Antunovic et al., 2004). The resulting kalium level in the study was in the range of the...
The physiological conditions did not have any significant impact on the resulting ferrum level in the study (P>0.05) and it was consistent with the reference parameter (Jackson and Cockcroft, 2002) of Turkish sheep, which was 183.10±10.10 (µg/dL) (Cihan et al., 2016) and Akkaraman sheep, which was 117.80±4.20 (Kozat et al., 2006). The physiological condition did not have any significant impact on the resulting TIBC level in the study (P>0.05) that was concordance with 466.30±11.70 (µg/dL) in Turkish sheep (Cihan et al., 2016). The physiological conditions did not have any significant impact on the resulting UIBC level in the study (P>0.05) that was concordance with 317.00±17.70 (µg/dL) in Turkish sheep (Cihan et al., 2016). The TS level of the sheep was higher than that of Turkish Akkaraman sheep, which was 38.60±1.6% (Kozat et al., 2006).

The physiological conditions did not have any significant impact on the resulting globulin level in the study (P>0.05), while high globulin level was found in the lactating fat-tailed sheep (Sarmin et al., 2021a). In cows, higher globulin level was found in calves of 5 days of age as compared to calves of 30 days of age (Nagy et al., 2014). The resulting globulin level in the study was consistent with the reference parameter of 3.5–5.7 g/dL (Kaneko et al., 2008). The physiological conditions did not have any significant impact on the resulting albumin level in the study (P>0.05), while on the contrary, the physiological condition had significant impact on the albumin level of the fat-tailed sheep (Sarmin et al., 2021a). It was reported that high albumin level was found in calves of a month of age (Nagy et al., 2014). Also, albumin level was higher in lactating sheep than that of pregnant and non-

<table>
<thead>
<tr>
<th>Variables</th>
<th>Units</th>
<th>Physiological condition</th>
<th>Reference parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPT</td>
<td>U/L</td>
<td>Ewe lamb</td>
<td>Pregnant female sheep</td>
</tr>
<tr>
<td>GOT</td>
<td>U/L</td>
<td>17.65±3.22</td>
<td>12.00±2.08</td>
</tr>
<tr>
<td>ALP</td>
<td>mg/dL</td>
<td>7.06±0.54</td>
<td>8.80±0.43</td>
</tr>
<tr>
<td>Calcium</td>
<td>mg/dL</td>
<td>2.27±0.06</td>
<td>2.37±0.14</td>
</tr>
<tr>
<td>Kallum</td>
<td>mmol/L</td>
<td>4.82±0.15</td>
<td>4.68±0.18</td>
</tr>
<tr>
<td>Chloride</td>
<td>mg/dL</td>
<td>105.88±0.81</td>
<td>106.80±1.62</td>
</tr>
<tr>
<td>Sodium</td>
<td>mmol/L</td>
<td>148.29±1.24</td>
<td>148.20±1.88</td>
</tr>
<tr>
<td>Magnesium</td>
<td>mg/dL</td>
<td>3.14±0.23</td>
<td>3.16±0.11</td>
</tr>
<tr>
<td>Ferrum</td>
<td>mg/dL</td>
<td>176.29±13.16</td>
<td>186.40±19.24</td>
</tr>
<tr>
<td>Globulin</td>
<td>mg/dL</td>
<td>95.82±0.14</td>
<td>93.00±0.21</td>
</tr>
<tr>
<td>Albumin</td>
<td>mg/dL</td>
<td>3.29±0.10</td>
<td>3.60±0.17</td>
</tr>
<tr>
<td>Total protein</td>
<td>mg/dL</td>
<td>6.21±0.15</td>
<td>6.64±0.19</td>
</tr>
<tr>
<td>BUN</td>
<td>mg/dL</td>
<td>19.45±0.87</td>
<td>21.32±0.28</td>
</tr>
<tr>
<td>Creatinine</td>
<td>mg/dL</td>
<td>0.85±0.03</td>
<td>0.72±0.06</td>
</tr>
<tr>
<td>Glucose</td>
<td>mg/dL</td>
<td>42.88±0.49</td>
<td>30.80±1.68</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>mg/dL</td>
<td>66.00±3.09</td>
<td>81.20±3.92</td>
</tr>
<tr>
<td>Triglyceride</td>
<td>mg/dL</td>
<td>31.82±3.51</td>
<td>25.60±7.69</td>
</tr>
<tr>
<td>HDL</td>
<td>mg/dL</td>
<td>39.47±3.29</td>
<td>45.80±1.98</td>
</tr>
<tr>
<td>LDL</td>
<td>mg/dL</td>
<td>21.24±3.32</td>
<td>30.80±9.53</td>
</tr>
</tbody>
</table>

**The same superscripts in a row were indicative of significant difference (P<0.05).**
P: glutamic pyruvic transaminase; GOT: glutamic oxaloacetic transaminase.

ALP: alkaline phosphatase; LDH: lactate dehydrogenase; Pi: phosphor inorganic; TIBC: total iron-binding capacity; UIBC: unbound iron-binding capacity; TS: Transferrin saturation; BUN: blood urea nitrogen; HDL: High-density lipoprotein; LDL: low-density lipoprotein.
pregnant sheep (Antunović et al., 2004). The resulting albumin level in the study was in the range of the chloride of the reference parameter (Jackson and Cockcroft, 2002).

The physiological conditions did not have any significant impact on the resulting total protein in the study (P>0.05) as reported in the fat-tailed sheep (Sarmin et al., 2021a). It was reported that among Bangladeshi sheep the total protein was higher in young sheep than adult sheep and it related to protein intake (Rahman et al., 2018). The resulting total protein level in the study was in the range of 6.61±1.20 mg/dL as reported in Bangladeshi sheep (Rahman et al., 2018) and in the range of the reference parameter (Jackson and Cockcroft, 2002; Kaneko et al., 2008).

The physiological conditions did not have any significant impact on the resulting BUN level in the study (P>0.05) as reported in the fat-tailed sheep (Sarmin et al., 2021a) though the BUN level of Barki sheep increased in a month after weaning (Abdel-Fattah et al., 2013), while it was low in the male Bighorn sheep (Kock et al., 1987). The resulting BUN level in the study was consistent with the reference parameter (Jackson and Cockcroft, 2002).

The physiological condition had significant impact on the resulting creatinine level in the study (P<0.05) and the lowest level was found in the ram as reported in the fat-tailed sheep (Sarmin et al., 2021a). High creatinine level was found in non-pregnant Tsigai sheep (Antunović et al., 2004). The resulting creatinine level in the study was in the range of the reference parameter (Kaneko et al., 2008). The creatinine served as the main marker of glomerular filtration rate in ruminants (Russell and Roussel, 2007) and was not significantly influenced by external factors (de Souza et al., 2020).

The physiological conditions did not have any significant impact on the resulting glucose level in the study (P>0.05) though the glucose level of lactating and pregnant Ossimi sheep was reported to be low (Soliman, 2014). The glucose level was lower than the reference parameter (Jackson and Cockcroft, 2002; Kaneko et al., 2008). The glucose level of ruminants was not influenced by forage, but by hormonal homeostatic mechanism to maintain glucose level (de Souza et al., 2020).

The physiological conditions did not have any significant impact on the resulting cholesterol level in the study (P>0.05), while high cholesterol level was found in the young fat-tailed sheep (Sarmin et al., 2021a), the pregnant Tsigai sheep (Antunović et al., 2004), young suckling Suffolk and it decreased after weaning (Fernandes et al., 2012) and pure and cross-bred Rambouillet sheep (Cavender et al., 1995). The resulting cholesterol level in the study was in the range of the reference parameter (Jackson and Cockcroft, 2002; Kaneko et al., 2008).

The physiological conditions did not have any significant impact on the resulting triglyceride level in the study (P>0.05), while on the contrary, high triglyceride level was found in the male and young fat-tailed sheep (Sarmin et al., 2021a) and low triglyceride level was found in the ewe lamb of 30 days of age (Cruz et al., 2017; de Souza et al., 2020) and also in Dorper sheep of 5 days and 121 days of age (Cruz et al., 2017) because milk intake began to decrease, while hepatic maturation and lipid metabolic capacity increased (de Souza et al., 2020). The triglyceride level was still in the range of that of cross-bred White Dorper x Suffolk sheep at the levels of 26.45±9.27 mg/dL (de Souza et al., 2020) and 23.70±5.30 mg/dL for Bangladesh male sheep and 24.80±7.10 mg/dL in Bangladesh female sheep (Rahman et al., 2018).

The physiological conditions did not have any significant impact on the resulting HDL level in the study (P>0.05) and the HDL level was different from that of the fat-tailed sheep (Sarmin et al., 2021a) and Mouflon sheep and Iranian thick-tailed sheep (Azimzadeh and Javadi, 2020). Lower HDL level was reported in Iranian fat-tailed sheep of 2 years of age than that of the sheep of more than 2 years of age (Azimzadeh and Javadi, 2020). The resulting HDL level in the study was higher than 14.49±5.68 mg/dL for young Mouflon sheep and 13.84±9.05 mg/dL for adult Mouflon sheep (Pošiváková et al., 2019). Physiological condition did not have any significant impact on the resulting LDL level in the study (P>0.05) as reported in the fat-tailed sheep (Sarmin et al., 2021a). It was reported that among Mouflon sheep age did not have any significant impact on LDL level (Pošiváková et al., 2019). High LDL level was found in young Suffolk sheep before weaning (Fernandes et al., 2012). Lower LDL level was reported in Iranian fat-tailed sheep of 2 years of age than that of the sheep of more than 2 years of age (Azimzadeh and Javadi, 2020). The resulting LDL level in the study was higher than that of young Mouflon sheep, which was 5.75±5.87 mg/dL and that of adult Mouflon sheep, which was 5.95±3.20 mg/dL (Pošiváková et al., 2019).

The results of the study showed that it was necessary to consider the factor of the variation of the physiological conditions of the Wonosobo sheep in interpreting the hematology and the biochemistry of the sheep.

Conclusions

It was concluded that the impact of the physiological conditions of the Wonosobo sheep caused high total leucocyte and lymphocyte in ewe lamb and high neutrophil in pregnant female sheep, the increase in the Pi level and ALP activity of the ewe lamb, and high creatinine in the ram.

Acknowledgement

Authors thank the Faculty of Veterinary of Gadjah Mada University for the grant Number: 984/J01.1.22/HK4/2019. We also thank drh. Rizal Aidi, M.Sc and drh. Nur Adianto, M.Sc for their
help in animal health monitoring and in sampling and drh. Akhmad Abror As Sidiqi for his help in analyzing data.

References


The Hematological and Biochemical Profiles of Wonosobo Sheep Blood

https://doi.org/10.1016/j.smallrumres.2010.04.015


