Hematology profile of Sumatran Orangutan (*Pongo abelii*) in the Sumatran Orangutan Quarantine Center, Sibolangit, Indonesia

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Abstract. This research aims to obtain hematological database of healthy Sumatran orangutans *(Pongo abelii)* at the Sumatran Orangutan Quarantine Centre, in Batu Mbelin, Sibolangit, North Sumatra, Indonesia. This secondary data comes from hematological examination results in 52 healthy Sumatran orangutans in Batu Mbelin, from May 2003 to August 2010. This research used a factorial complete randomized design (CRD) that has two factors namely, gender as the first factor and age as the second factor. Data was analyzed using analysis of variance (ANOVA). The results of ANOVA show that gender affects ($P<0.05$) on the value of mean cell hemoglobin concentration (MCHC) in Sumatran orangutans. Age influences ($P<0.05$) on the lymphocytes and monocytes Sumatran orangutans. The results of least significant different (LSD) test of the lymphocyte show that there are significant differences ($P<0.05$) between the lymphocyte value of infants and that of juveniles. The lymphocyte value of infant is also significantly different ($P<0.05$) that of adolescent. While the lymphocyte value of adolescent and juveniles are not significant different. The results of LSD test of the value of monocytes show that there is a very significant difference ($P<0.01$) between the monocyte value of infants and that of juveniles. Furthermore, the value of infant's and adolescent's monocytes is significantly different ($P<0.05$). However, the value of adolescent's and juvenile's monocytes does not show any influences. Interaction of sex influences on the red blood cell (RBC) of Sumatran orangutans whereas age do not influences on the RBC. The results of Duncan test show that there are significant differences ($P<0.05$) between the RBC values of adolescent female orangutans and adolescent male orangutans. Other hematological values do not show any effects on both gender and age.
Keywords: Sumatran orangutan, *Pongo abelii*, hematology profile, Sibolangit

Introduction

At this moment, orangutans are only found in Sumatera, Kalimantan, Sabah and Sarawak. More than 90% of their natural habitat is in the territory of the Republic of Indonesia (Meijaard *et al*., 2001). There are two subspecies of orangutans, namely *Pongo pygmaeus abelii* and *Pongo pygmaeus pygmaeus* (Zhi *et al*., 1996). Total population of wild Sumatran orangutans *(Pongo abelii)* in the jungle is estimated only 6600 individuals (Singleton, 2010). Therefore, IUCN (2009) stated that this species is currently listed as critically endangered. Its population always declines each year. These precipitous decreases are caused by expansion of human population, loss of habitat, illegal capture and wildlife trade (Robertson and van Schaik, 2001). Furthermore, according to Wich *et al*. (2008) commercial loging, habitat conversion, and in some cases, forest fires and infectious diseases also significantly contribute to their declining population.

Sumatran Orangutan Quarantine Centre (SOQC) was built in Batu Mbelin, one of the villages in the Sibolangit District, Deli Serdang, North Sumatra Province, Indonesia. This centre was built to accommodate orangutans confiscated from the community (Singleton, 2010). These orangutans come from various parts of Indonesia, including Aceh, North Sumatra, Jambi, Javanese island and even from Malaysia.

Hematology profile of Sumatran orangutans in SOQC can be used as a basis to determine health status of these orangutans. This profile is affected by some factors such as age, gender, race, nutrition, environment, altitude, equipment and testing methods used. Therefore, this study aims to obtain the hematological database of healthy Sumatran orangutan in SOQC, Batu Mbelin.

Materials and Methods

This study uses secondary hematology data obtained from 52 healthy Sumatran orangutans in the Sumatran Orangutan Quarantine Center, Batu Mbelin, Sibolangit, North Sumatra, Indonesia from May 2003 until August 2010. Forty eight data is obtained from results of the examination in the laboratory of the International Gleni and four data comes from the International Spectrum Laboratory, both of them are located in Medan. The data is grouped by sex and age level. Each of the gender (male and female) is grouped into 3 age

levels. According to MacKinnon cited by Tuttle (1986) infants orangutans aged 0 to 2.5 years, juveniles aged >2.5-<7.0 years and adolescents aged 7-10 years. This research uses a factorial complete randomized design (CRD) that has two factors namely, gender as the first factor and age as the second factor.

Statistical Analysis

Data was analyzed by using program of statistical product and service solutions (SPSS) version 12. To determine the effect and interaction of each factor, the data was analyzed by analysis of variance (ANOVA). If there was the effect of each factor, analysis was continued by least significant different (LSD) and if there was interaction of both factors so this analysis was followed by Duncan test (Gaspersz, 1989).

Results and Discussion

Based on medical records of Sumatran orangutan *(Pongo abelii)* at the Sumatran Orangutan Quarantine Center in Batu Mbelin, Sibolangit, there were 52 healthy Sumatran orangutans of 196 orangutans in this quarantine from May 2003 to August 2010. They consisted of 24 females and 28 males. Female orangutans consisted of 5 heads of infants (0-2.5 years), 15 heads of juveniles (>2.5-<7.0 years) and 4 heads of adolescents (7.0-10 years), whereas males consisted of 5 heads of infants (0-2.5 years), 15 heads of juveniles (>2.5-<7.0 years) and 8 heads of adolescents (7.0 - 10 years).

The results of variance analysis show that there is a real effect and interaction ($P<0.05$) of each factor (gender and age) on hematologic values of Sumatran orangutans. Gender significantly affect ($P<0.05$) the mean cell hemoglobin concentration (MCHC) while age significantly influences ($P<0.05$) the value of lymphocytes and monocytes. Moreover, the interaction of the gender significantly affects ($P<0.05$) the red blood cell (RBC) but levels of age do not affect the value of RBC in Sumatran orangutáns.

Other hematological values such as hemoglobin (Hb), packed cell volume (PCV), mean cell volume (MCV), mean cell hemoglobin (MCH), red blood cell distribution width (RDW), white blood cell (WBC), neutrophils, eosinophils, basophils, platelets and (erithrocyte sedimentation rate (ESR) do not show any differences. In other words, there are no influences of both gender and age level on these parameters. The results are presented in Table 1.

According to Kaya *et al*.; Mochsen *et al*.; and Tsegaye *et al*. cited by Aprianti *et al*. (2006), the hematological parameters are influenced by several factors such as age, gender, race, nutrition, environment, altitude, equipment and testing methods used.

In recent research, researchers found a significant effect ($P <0.05$) of sex on the value of MCHC Sumatran orangutans. MCHC values of female infants (30.24 ± 1.63), juveniles (29.98 ± 1.64) and adolescents orangutan (29.63 ± 0.60) were lower than those of male infants (31.12 ± 0, 66), juveniles (30.93 ± 1.35) and adolescents (31.91 ± 2.88) orangutan. Thrall *et al*. (2004) states that the number of hemoglobin in primates is influenced by gender and age. According to Dacie (1996) adult males generally have higher hemoglobin values than females. This is partly caused by androgen hormones in the process of erythropoiesis and blood loss during menstruation. In this study, also was found that age level influences on the lymphocytes and monocytes of Sumatran orangutans. To know the differences of the lymphocyte value between the age level in orangutan, the analysis was followed by least significant different (LSD) test. Here are the results of LSD test of the value of lymphocytes (Table 2).

Table 1. The average value of hematology of Sumatran orangutan *(Pongo abelii)* at the Sumatran Orangutan Quarantine Center in Batu Mbelin, Sibolangit, North Sumatra, Indonesia

Hematology		Infants (0-2,5 years)	Juveniles (>2,5 - <7 years)	Adolescents (7-10 years)
Hb (g/dl)	♀	10.90 ± 3.00	11.45 ± 1.04	10.57 ± 1.29
	♂	11.06 ± 2.18	10.76 ± 1.22	12.39 ± 1.72
PCV (%)	♀	35.90 ± 7.70	38.02 ± 3.53	35.00 ± 4.65
	♂	35.46 ± 6.73	34.88 ± 4.07	39.57 ± 6.87
RBC ($x10^6$/µl)	♀	4.70^{ab} ± 0.70	4.93^{ab} ± 0.31	4.23^{b} ± 0.42
	♂	4.58^{ab} ± 0.50	4.77^{ab} ± 0.52	5.18^{a} ± 0.88
MCV (fl)	♀	75.70 ± 549	77.18 ± 4.06	83.33 ± 3.22
	♂	76.60 ± 6.02	73.51 ± 5.14	76.46 ± 4.55
MCH (pg)	♀	22.92 ± 2.44	23.13 ± 1.56	24.67 ± 1.36
	♂	23.82 ± 2.07	22.75 ± 1.94	24.41 ± 2.65
MCHC (g/dl)	♀	30.24^{a} ± 1.63	29.98^{a} ± 1.64	29.63^{a} ± 0.60
	♂	31.12^{b} ± 0.66	30.93^{b} ± 1.35	31.91^{b} ± 2.88
RDW (%)	♀	17.55 ± 0.93	16.15 ± 1.90	16.00 ± 3.25
	♂	16.80 ± 2.52	17.24 ± 1.69	16.51 ± 1.45
WBC ($x10^3$/µl)	♀	16.30 ± 4.89	19.75 ± 8.38	15.57 ± 3.02
	♂	13.30 ± 5.59	15.09 ± 4.74	12.25 ± 2.99
Neutrophils (%)	♀	55.80 ± 8.63	46.67 ± 11.83	57.40 ± 1.78
	♂	57.90 ± 13.87	56.77 ± 14.97	49.03 ± 14.06
Eosinophils (%)	♀	5.02 ± 2.81	3.68 ± 1.93	2.97 ± 1.69
	♂	9.10 ± 11.71	3.81 ± 2.39	4.01 ± 1.81
Basophils (%)	♀	0.64 ± 0.15	0.55 ± 0.25	0.60 ± 0.28
	♂	0.62 ± 0.26	0.78 ± 0.23	0.47 ± 0.31
Lymphocytes (%)	♀	30.34^{a} ± 7.39	44.23^{b} ± 10.25	31.57^{b} ± 0.66
	♂	23.88^{a} ± 7.34	32.21^{b} ± 13.93	40.71^{b} ± 14.04
Monocytes (%)	♀	8.20^{a} ± 2.00	5.49^{b} ± 2.53	7.00^{b} ± 1.82
	♂	8.50^{a} ± 1.04	6.64^{b} ± 1.96	5.70^{b} ± 2.26
Platelets ($x10^3$/µl)	♀	506.00 ± 206.75	389.07 ± 96.17	433.25 ± 175.68
	♂	356.60 ± 35.46	413.80 ± 158.05	353.62 ± 132.48
ESR (mm/hour)	♀	1.50 ± 0.71	1.58 ± 2.00	1.50 ± 0.71
	♂	1.00 ± 0.00	1.60 ± 1.26	2.00 ± 1.73

The same superscript letters of MCHC, lymphocytes, monocytes and RBC show no significant differences

Table 2. LSD test results on the value of lymphocyte Sumatran orangutans

(I) Age	(J) Age	Mean Difference (I-J)
Juveniles	Infants	10.6793*
	Adolescents	-0.1807
Adolescents	Infants	10.8600*
	Juveniles	0.1807

* The mean difference is significant at the level .05

Based on the results of LSD test above shows that there are significant differences (P <0.05) between the lymphocyte values of infants and juveniles. The lymphocyte values of infants are also significantly different (P <0.05) with those of adolescents. However, there

are no significant differences between the lymphocyte values of juveniles and adolescents. In female orangutans, the lymphocyte value of infants (30.34 ± 7.39) was lower than that of juveniles (44.23 ± 10.25) and adolescents (31.57 ± 0.66). The similar result was found in male orangutans, the lymphocyte value of infants (23.88 ± 7.34) was also lower than that of juveniles (32.21 ± 13.93) and adolescents (40.71 ± 14.04). This difference may be influenced by stress and age.

According to Karkan (2007), in stress people cortisol hormone will be secreted higher than in normal condition. Chemical structure of the cortisol is similar to corticosteroid hormone which is immunosuppressive. Thus, increased secretion of this hormone can reduce the number of lymphocytes. Then, Baratawidjaja (2002) also said that stress stimulates the release of corticotrophin releasing hormone (CRH) from the hypothalamus which then stimulates the anterior pituitary gland to release adrenocorticotropic hormone (ACTH). Afterwards, ACTH stimulates the adrenal glands to release cortisol hormones that are pressing the immune system (immunosuppressive). The cortisol shows regulatory effects on the immune system by reducing the number of lymphocytes in the blood circulation. Irianti (2008) stated that differences in the number of types of leukocytes is influenced by age. This is related with growth hormone (GH). According to Baratawidjaja (2002), GH hormones play a role in modulating the immune response. These hormones increase cell differentiation and proliferation of lymphocytes. According to Munoz-Cueto *et al*. cited by Johnny *et al*. (2003), GH stimulates hemopoietic tissues to increase blood cell formation.

Lymphocytes and monocytes are a class of leukocytes that have no granules or they are also called agranulocytes. Lymphocytes and monocytes have function as defense cells that protect the body against foreign substances in the body by destroying them. This process is also called phagocytosis. Beside that, lymphocytes also serve as producer of antibodies in the body (Guyton and Hall, 1990b). Corwin (2000) stated that the role of white blood cells (leukocytes) is to recognize and fight the microorganisms on the immune reaction, and to assist the process of inflammation and healing. Lymphocytes are produced in the bone marrow and also are generated by the various lymphogen organs, including lymph nodes, spleen, thymus and tonsils, whereas monocytes are only produced in the bone marrow (Guyton, 1990a). The results of LSD test of the value of monocytes are presented in Table 3.

Table 3. LSD test results on the value of monocyte in Sumatran orangutan

(I) Age	(J) Age	Mean Difference (I-J)
Juveniles	Infants	-2.2204*
	Adolescents	0.0396
Adolescents	Infants	-2.2600*
	Juveniles	-0.0396

* The mean difference is significant at the level .05

Based on the results of LSD test above shows that there is a very significant difference ($P<0.01$) between the monocyte value of infants and juveniles. Furthermore, there is a significant difference ($P<0.05$) between the monocyte value of infants and adolescents. However, the value of monocyte in adolescents and juveniles does not show any differences. In female orangutan, the monocyte value of infants (8.20 ± 2.00) is higher compared to that of juveniles (5.49 ± 2.53) and adolescents (7.00 ± 1.82). It is also similar to male orangutan, the monocyte value of infants (8.50 ± 1.04) is much higher than that of juveniles (6.64 ± 1.96) and adolescents (5.70 ± 2.26). Kumala (2010) stated that the number of leukocytes is influenced by age and deviation from the basal state. In newborns, leukocyte counts are high, about 10.000-30.000/µl. The highest leukocyte counts are in infants aged 12 hours that is between 13000-38000 /mL. After that the number of leukocytes decreases gradually and at the age of 21 years the number of leukocytes ranges from 4500 to 11.000/µl. According to Hoffbrand and Pettit (1987), in infancy all the bone marrow forms blood cells (hemopoietic), but during childhood there is a progressive change of fatty of bone marrow along the long bones so that in adults hemopoietic is limited to the central skeleton.

In this study was also found a gender interaction effect which was significant ($P<0.05$) on the value of RBC Sumatran orangutans. In addition, the RBC value of adolescent females

was significantly different (P<0.05) with adolescent males. The RBC value of adolescent females (4.23 ± 0.42) was lower than that of adolescent males (5.18 ± 0.88). Thrall *et al*. (2004) said that in primates the number of erythrocytes/RBC is influenced by gender. Adult male primates have a higher concentration of erythrocytes compared to adult female primates. Nemeth *et al*. (2010) stated that gender differences in mammals affect the number of RBC. For instance, the value of RBC in male rats and male beagle dogs is higher than female animals. According to Dacie (1996) adult males have generally higher RBC values compared to women. This is partly caused by androgen hormones in the process of erythropoiesis and blood loss during menstruation.

Guillet *et al*. (1998) stated that the changes of reproductive hormones also have effects on hematological parameters. Steroid hormones such as testosterone have two different effects, namely the effect of anabolic and androgenic effects. Anabolic effects of steroid hormones means that this hormones can increase anabolisme or cell growth, while androgenic effects of these hormones affect the development and maintain the masculine characteristics. Some examples of the effects of anabolic steroid hormones is an increase of bone growth and stimulation of bone marrow that will increase the production of erythrocyte (RBC), increase protein synthesis of amino acids and increase appetite.

Conclusions

Genders affect the mean cell hemoglobin concentration (MCHC) of Sumatran orangutan, whereas levels of age influence the lymphocytes and monocytes of Sumatran orangutans. Gender interaction affects the value of red blood cell (RBC), whereas age levels do not affect the value of RBC in Sumatran orangutans.

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