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# Plasma biochemistry levels and hematological parameters in Mallard ducks (*Anas platyrhynchos* Linn.) from selected semi-free range duck farms in Misamis Occidental and Zamboanga Del Sur, Philippines

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**Abstract**. The Philippine duck industry is lucrative mainly due to egg production for a special street delicacy. However, studies show that there has been a steady decrease in duck egg production over the years. Very little is known on the health indices of the Philippine mallard ducks or Pateros ducks (*Anas platyrhynchos* Linn.) specifically on plasma biochemistry and hematological parameters. This study aimed to assess the cholesterol and lipoprotein levels of the blood plasma as well as some hematological parameters like leukocyte, RBC and hemoglobin. Thirty-nine randomly selected female ducks were collected on September 17 - 18, 2012, from two farms practicing semi-free ranged system wherein ducks are free to feed in the rice fields during daytime and are housed at nighttime. The ducks were categorized into age groups (young or 6 - 12 month-old and old or 13 - 20 months-old) based on their farm location (Pagadian or Pg and Bonifacio or Bn). The plasma biochemistry levels of the 12 female sub samples (Pg-1, Pg-2, Bn-1, and Bn-2) were determined using four biochemical tests: total cholesterol, triglycerides, HDL, and LDL levels, while the hematologic parameters of the 24 female sub samples (Pg-1, Pg-2, Bn-1, and Bn-2) were determined via a CBC test. The plasma biochemistry results showed that cholesterol levels of the ducks from Pagadian farms (Pg-1, Pg-2) were higher compared to the Bonifacio farm (Bn-1, Bn-2). Pg-2 had the highest triglyceride levels compared to the other groups. The HDL levels in all groups were higher compared to their LDL levels. Bn-2 was found to have the highest WBC count while Bn-1 had the highest heterophil/leukocyte (H/L) ratio. Both Pg-2 and Bn-2 have higher hemoglobin values compared to Pg-1 and Bn-1. Hematocrit values and platelet counts showed no significant variation with regards to age and location. Stress level, genetics, feed types, feed nutrition, and age appear to affect biochemical and hematological test results.
**Key Words**: Cholesterol, haemoglobin, leukocytes, lipoprotein, red blood cell.

**Introduction**. Ducks are considered one of the most versatile avian species that are of commercial significance due to their ability to subsist under a wide range of climatic and nutritional conditions. Ducks are shown to be relatively hardy and resistant to common avian diseases, and feed on a variety of food (Chang et al 2003). In South East Asian countries, the practice of flocking ducks is commonly used in rice-growing regions (Ikani 2003). Chang et al (2005) stated that in the Philippine livestock industry, duck raising is concentrated mainly towards egg production, in which the eggs are made into popular street delicacies due to their unique taste such as the *balut* (boiled partially incubated duck eggs), *penoy* (boiled dead duck embryo), century eggs and red salted eggs sold by street vendors along streets or sidewalks.

The Pateros type Mallard duck, locally called *pato* or *itik*, is the breed of duck most commonly raised due to certain characteristics such as being a good layer, being a non-sitter and its ability to lay large-sized eggs. It has a black, brown or gray plumage and has an average egg production rate of about 175 eggs each per laying year (Asian Rural Development Foundation 1996). Chang et al (2005) reported that about 90 % of the total duck egg production is used for *balut* making in the Philippines. They further reported that some meat types are being raised mainly for restaurant, but demands are very low due to the duck's low meat quality due to its tough, coarse texture and a fishy meat taint.

Reports on the egg production of the Philippine duck industry varied throughout the past ten years. In 2002, total supply of duck eggs slightly dropped by 0.7 percent compared to 2001 (Department of Agriculture 2003). An increase of 0.74 percent of the total duck egg supply occurred in 2003 (Department of Agriculture 2004) and was further increased to 4.7 % the following year (Department of Agriculture 2005). However, in 2005, duck egg production decreased by 5.94 % (Department of Agriculture 2006). An increment of 6.02 % in the total egg supply was recorded in 2006 (Department of Agriculture 2007) but then dropped by 6.07 % the following year due to declines in the volume of production and imports (Department of Agriculture 2008). Total egg supply continued to decline by 9.65 % in 2008 (Department of Agriculture 2009) and by 6.68 % in 2009 (Department of Agriculture 2010). By 2010, a 7.4 2% decrease in total egg supply further took place (Department of Agriculture 2011). Total egg production only increased by 2.73 % in 2011 (Department of Agriculture 2012) and by 5.49 % last year (Department of Agriculture 2013). Chang (2005) reported that more than 75 % of ducks in the Philippines are raised in the backyards by rural households since they provide good source of supplementary income and low-cost animal protein. Gajendran & Karthickeyan (2011) reported that since duck rearing has not undergone any process of industrialization, its husbandry practices are traditional, nomadic and sometimes primitive. Therefore, the traditional practices which have evolved from time to time still exist and proved to be efficient, economical, and sustainable. Prabakaran (2003) even noted that the production practices despite being indigenous and facing various difficulties such as unfavorable seasons and migrations, are so highly developed that some stocks would be better classified as middle-level.

Omonona et al (2011) stated that blood is a special type of connective tissue composed of formed elements (erythrocytes, leukocytes and platelets) in a fluid matrix, with plasma as the fluid portion. The use of plasma biochemistry and hematology for monitoring the conditions of birds has been found to be a useful tool in ecological research as it provides a more integrative picture of the state of the animal than condition indices based on body mass alone (Gladbach et al 2010). It is also useful for distinguishing pathogenic processes from those that might be purely physiological (Omonona et al 2011). Blood biochemistry profiles and hematology are often used to assess the physiological status of lower vertebrates such as fish, amphibians, reptiles, and birds. However, since there is a general lack of controlled studies designed to clarify the meaning of changes in the blood chemistry of these animals compared to those of domestic mammals, the clinical chemistry of lower vertebrates has not achieved the same degree of critical evaluation as demonstrated in domestic mammals (Metin et al 2008).

Heard et al (2008) stated that the prevalence and population effects of contaminants and pathogen are unknown for most ducks. There are no well-established values on plasma biochemical levels or in hematological parameters on Mallard ducks as most studies on these species are focused on the performance of the duck industry or the duck rearing practices itself such as those conducted by Chang & Dagaas (2004), Chang et al (2005) and Gajendran & Karthickeyan (2011). Jansson et al (2009) reported that for many avian species other than chickens, normal values are not available or data are old or incomplete. Application to population and conservation medicine has been hampered to date by a scarcity of "normal" values incorporating age, sex, and physiological variables (Monk & Forbes 2010). So far, clinical chemistry parameters are routinely employed to evaluate the health of free-ranging wildlife including waterfowl, and baseline parameters have been published for many anseriformes in various situations (Stoskoft et al 2010). Islam et al (2004) reported that analysis of normal haematological parameters in chickens is essential in diagnosing the various pathological and metabolic disorders. The same can be said as a vital diagnostic tool in assessing the current health status of an individual or whole population of ducks in the Philippine poultry industry. van Wyk et al (1998), Cooper (2002), and Monk & Forbes (2010) noted that nutritional status, disease, and food supply differences among populations or immune suppression due to various stressors can all be detected using hematology.

Several studies regarding the plasma biochemistry and hematology of wild and domesticated birds have been studied and reported; examples include those of Kasprzak & Hetmański (2004), Jelena et al (2007), Gladbach et al (2010) and Kabir (2012). A number of researches have been documented in the Philippine Mallard ducks with regards to the duck industry performances and duck rearing practices in the Philippine and Asian settings (Prabakaran 2003; Chang et al 2005; Gajendran & Karthickeyan 2011). However, there are no published data on the hematology and plasma biochemistry of the Philippine Mallard ducks. This study was designed to investigate the selected plasma biochemical and hematological parameters in Philippine Mallard ducks (*Anas platyrhynchos* Linn.) in two farms practicing semi-free range system in Misamis Occidental and Zamboanga Del Sur, with the view of establishing the relation of the hematological and biochemical parameters to the physiology of the ducks and determining how these parameters would affect the health and, potentially, the egg production in reared ducks. Kabir (2012) previously reported that hematological values in birds are influenced by age, geographical location, nutritional value, life habit of the species, and present status of the individual. The semi-free range duck farms in Bonifacio and Pagadian City were chosen as the site of the study because duck-rearing and *balut* production have been currently reported to be increasing (Department of Agriculture 2013) while at the same time little to no information regarding plasma biochemical and hematological parameters have been documented in the region.

## Material and Method

***Sample collection***. Samples were collected from two farms practicing semi-free range system: one in Bonifacio, Misamis Occidental and the other in Pagadian City, Zamboanga Del Sur (Figure 1). Collection was made on September 17 - 18, 2012. Thirty-nine Mallard ducks (*Anas platyrhynchos*) were randomly collected and subdivided into four groups based on the location and on their age group of either 6 - 12 months old or 13 - 20 months old. The four groups formed were: Pagadian Group- Pg-1, consisting of ten 6 - 12 month-old ducks, Pg-2, consisting of ten 13 - 20 month-old individuals; and Bonifacio Group- Bn-1, consisting of nine 6 - 12 month-old ducks, and Bn-2, consisting of ten 13 - 20 month-old individuals. Proper handling and transportation of the ducks were observed so as to reduce stress on the ducks. Sanitation and preparation of the cages followed for a two-day acclimatization. All ducks were then tagged based on their groups. For the experiment proper, six ducks per group were randomly selected for the hematological tests while the remaining three ducks in each group were subjected to the biochemical tests. The samples collected served as representative farm-grown individuals for the study.

***Blood sampling***. Blood collection was performed two days after acclimatization of the ducks in the new environment. Duck feathers were carefully removed from the area surrounding the jugular vein to avoid contamination of the blood. Blood samples were collected by jugular cut. Approximately 2.0 mL of blood were collected from each duck into sterile EDTA-coated screw-capped tubes (0.25 g/mL Ethylene Diamine Tetraacetic Acid (EDTA), liquid as anti-coagulant) for the hematological tests and approximately 4.0 mL of blood per sample was collected into non-EDTA-coated screw-capped test tubes for the biochemical tests. The collected blood samples for the hematological tests were sealed immediately and inverted several times (8 - 10 times for 10 seconds to ensure that the DTA has thoroughly mixed into blood sample) while the blood samples for biochemical tests were sealed and left to stand for few minutes to allow blood components to settle for ease of obtaining serum for analysis.

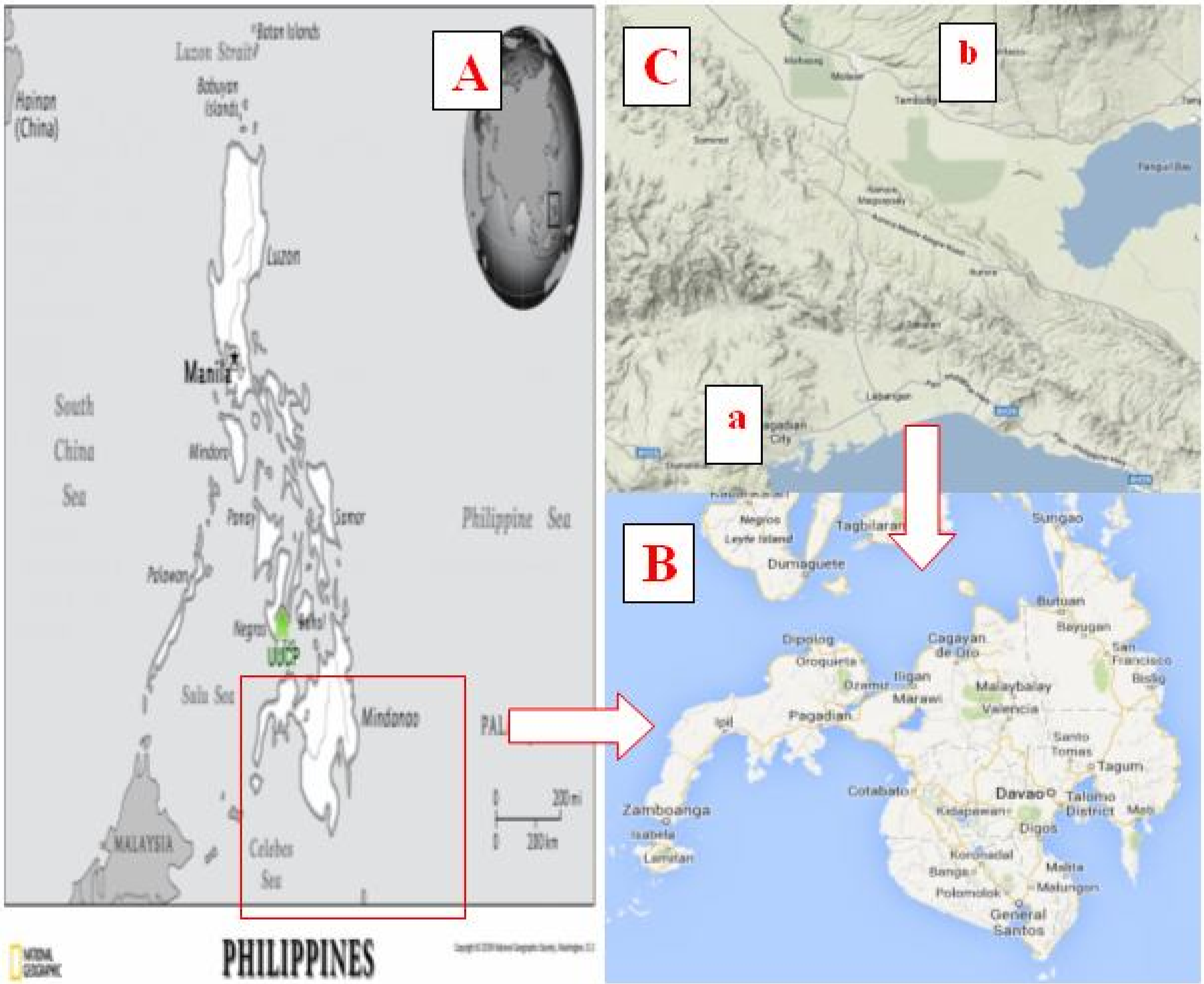

Figure 1. (A) Map of the Philippines (uupcc.org 2013) and (B) Mindanao (cityofbacolod.com 2013), (C) showing the location of the two sampling sites (maps.google.com 2014): (a) Pagadian City, Zamboanga Del Sur and (b) Bonifacio, Misamis Occidental, Philippines.

***Sample analysis***. All blood samples were forwarded to the laboratory within three hours of collection. EDTA-treated samples were subjected to a complete blood count and different hematological parameter analysis while the non-EDTA-coated blood samples were analyzed for blood cholesterol and lipoprotein levels. The hematological parameters included WBC differential count, total leukocyte count, platelet count, hemoglobin, and hematocrit levels; while biochemical tests include total cholesterol, triglycerides, high density lipoprotein (HDL) and low density lipoprotein (LDL) levels.

***Statistical analysis***. The data gathered for both plasma biochemical levels and hematological parameters were computed for their mean and standard deviation values using the software SPSS (Statistical Package for the Social Sciences) version 16.0 (Polar Engineering and Consulting 2007).

## Results and Discussion

***Cholesterol and lipoprotein levels***. Table 1 shows the values (Mean ± SD) obtained for total blood cholesterol, triglycerides, HDL, and LDL levels of the four duck groups under a semi-free range management in two provinces of Mindanao. Comparative analysis may not be suggested as of this time because of lack of available standards or normal values for farm-grown ducks. However, this present report may be useful in the establishment of the blood cholesterol, triglyceride, HDL, and LDL levels of different age groups of ducks under a semi-free range farm system in Mindanao. The results presented herein may be used as basis to identify unhealthy ducks in the flock.

Table 1

Total cholesterol, triglyceride, high density lipoprotein, and low density lipoprotein levels (Mean ± SD) of blood of age groups of Pateros ducks from the farms in Misamis Occidental and Zamboanga Del Sur, Mindanao, Philippines

| *Group* | *n* | *Parameters (mg/dL)* | | | |
|---|---|---|---|---|---|
| | | *Cholesterol* | *Triglycerides* | *HDL* | *LDL* |
| Pg-1 | 3 | 139.33 ± 17.16 | 45.67 ± 3.21 | 95 ± 7.94 | 35.2 ± 12.01 |
| Pg-2 | 3 | 132.33 ± 25.7 | 132.33 ± 144.92 | 72.33 ± 52.3 | 33.53 ± 14.7 |
| Bn-1 | 3 | 110 ± 23.39 | 49 ± 15.1 | 58.67 ± 10.02 | 41.53 ± 23.74 |
| Bn-2 | 3 | 116 ± 15.13 | 53.33 ± 3.51 | 77.67 ± 17.01 | 27.67 ± 2.77 |

The blood cholesterol of ducks from Pagadian City (Pg-1 and Pg-2) showed higher values compared to the Bonifacio counterparts (Bn-1 and Bn-2). Villegas et al (2004) reported higher cholesterol level of 244.5 ± 53.7 mg/dL in adult *Geronticus emeriti* (Bald Ibis) compared to the young birds with only 190.4 ± 15.5 mg/dL. The result was attributed to different diet or hydration state of the two age groups. Alonso-Alvarez et al (2002) found that female Yellow-Legged Gulls have lower cholesterol concentrations of 5.82 ± 0.40 mg/dL in the first 10 days of incubation, but later increased to 7.60 ± 0.40 mg/dL in the last 10 days of incubation, suggesting that diet composition influenced the cholesterol values since females invest in egg production thus appreciably increasing their energy requirements leading to increased nutrient uptake. Ismoyowati & Sumarmono (2011) reported that several factors would affect blood cholesterol but the most significant of which is the heredity or by the inherited genes from the parental lines and by the environment itself via the feeds. Feed composition greatly contributes to the blood cholesterol and fat components as products of metabolism where it serves as precursors of cholesterol-based blood components as synthesized elsewhere. The commercial or conventional feeds administered to the Pagadian Pateros ducks were noted to be in paste form. Feed type of this form can be indirectly correlated to high cholesterol content in the blood and even in duck meat.

The triglyceride levels obtained from the biochemical analysis are almost uniform in all groups except for Pg-2 comprising of ducks at age 13 or more months, or ducks at the peak of laying. Kasprzak & Hetmański (2004) observed triglycerides levels in pigeon to be considerably high ranging between 800 - 1400 mg/dL. The extreme increase of triglyceride levels was associated mostly with immobility and changes of diet. The same was observed by Hernawan et al (2012) where triglyceride level of broiler chicken ranges from 77.45 mg/dL to 87.26 mg/dL where it was more than 2 - 3 times than the normal levels of triglycerides, 27 mg/dL. Plasma triglyceride concentration has been suggested as an indicator of body fatness in chickens and could also be true in ducks (Farhat & Chavez 2001). A positive correlation was found between abdominal fatness and blood cholesterol concentration in female Peking ducks. This is because carbohydrates and fatty acids are converted into triglycerides that are deposited in tissues such as liver and muscles. Excess triglycerides are deposited in the form of body fat which then causes more deposition of cholesterol in muscles and blood (Ismoyowati & Sumarmono 2011). High triglyceride levels in the Pg-2 ducks could be attributed to the type of feeds provided to the ducks and the physiological state of the ducks prior or during the collection. It may also be due to stress caused by noise in their location since Bedáňová et al (2010) reported that noise level of at least 100 dB caused an increased triglyceride levels in broilers with a time range between 6 to 12 minutes. However, there are still some factors to be identified in future studies.

Comparing HDL levels among the four groups, Pg-1 had the highest while Bn-2 got the lowest. On the other hand, Bn-1 had highest LDL level while Bn-2 had the lowest. Piotrowska et al (2011) found very low levels of HDL and LDL where in the 42nd and last day of the fattening season of broilers, the HDL levels were 1.40 ± 0.13 mg/dL and LDL levels were 1.93 ± 0.65 mg/dL. The authors reported that both the HDL and LDL levels rose at the middle of the fattening period, in the 21$^{st}$ day, but later decreased in the last day, stating that changes in the lipid serum metabolite in relation to bird age strongly affected the results of their study. Liu et al (2010) reported that the HDL levels of ducks were higher (83.45 ± 15.96 mg/dL) than the LDL levels (42.91 ± 12.20 mg/dL). The same is true on the studies conducted by Aksu et al (2010), Daneshyar et al (2011) and Navidshad et al (2010) in broiler chickens. Peebles et al (2004) and Musa et al (2006) both found that in growing birds, the High Density Lipoprotein (HDL) represent the major lipoprotein class and are the main carriers of cholesterol, followed by Low Density Lipoprotein (LDL) which exceeds the Very Low Density Lipoprotein (VLDL). In the mature, egg-laying birds, the VLDL levels dominate, followed by HDL and LDL. Result of the biochemical tests of the blood of two age groups of Pagadian and Bonifacio ducks indicated that HDL levels were consistently higher than the LDL levels suggesting that both age groups of ducks have yet to reach the reproductive age. The inconsistent aspect was the high HDL levels among the 13 or more month-old ducks from Pagadian and Bonifacio farms. This observation may explain the low egg production of ducks from these semi-free range farms as egg production greatly depends on the bird's lipid metabolism and the capacity to initiate and sustain the assembly of VLDLs in eggs. The differences in the HDL and LDL levels in two age groups from two farms in Mindanao could be attributed to feed types and quality and to the genetics of Pateros ducklings being supplied to the farms. Peebles et al (2004) and El-Badry et al (2008) further reported that bird age and feed nutrition may influence the lipid metabolism and ultimately egg production.

While the results for each biochemical parameters vary in comparison to the results indicated from other avian studies with the same parameter, it should also be taken into consideration that in avian medicine, interpretation and sensible utilization of blood profiles are often limited by lack of values for physiological parameters relevant to the individual avian species and in each species to breeding lines, production types, etc. Comparison of reported values for biochemical parameters among different species of birds in different studies which includes ostriches, captive birds, wild sea-birds, and broiler strains, indicates that biochemical parameters values of birds are species-dependent. This means that the results and interpretation of the blood and biochemistry parameters in one avian study may not hold true towards the result of another avian biochemical parameter (Talebi 2006).

***Hemoglobin and hematocrit levels***. Table 2 summarizes the haemoglobin and hematocrit levels (Mean $\pm$ SD) of the Pateros ducks from two Mindanao farms in Pagadian and Bonifacio. No significant difference (p value = 0.95, alpha = 0.05) was observed from the four groups in terms of their hemoglobin counts but Pg-2ducks had the highest hemoglobin levels. Similar finding was noted by Milani (2009) in free-ranging common loons (*Gavia immer*). Islam et al (2004) noted average increases in Hb concentration in ducks from semi-free ranged farms and lower Hb in completely-confined (housed) ducks which they suggested to be due to several factors like environment, nutrition and management system. Since ducks from this present work were previously raised under semi-free range farm system, this may have caused the average increase in hemoglobin values in older ducks. Increased hemoglobin concentration was also found in female pheasants, suggesting that the increasing hemoglobin levels compensate for the decrease in RBC during the laying period in hens (Hauptmanova et al 2006). It was noted that Pg-1 and Bn-1 ducks (6 - 12 months) had lower hemoglobin values compared to Pg-2 and Bn-2 ducks (13 - 20 months) or Hb levels coincided with age. Priya & Gomathy (2008) observed the same in both male and female turkeys at growing ages.

Table 2

Hemoglobin and hematocrit (Mean ± SD) levels of four age groups of Pateros ducks from the farms in Misamis Occidental and Zamboanga Del Sur, Mindanao, Philippines

| *Group* | *N* | *Parameters* | |
|---|---|---|---|
| | | *Hemoglobin (g/L)* | *Hematocrit (mm)* |
| Pg-1 | 6 | 124.67 ± 23.91 | 0.375 ± 0.07 |
| Pg-2 | 6 | 150.33 ± 19.43 | 0.41 ± 0.01 |
| Bn-1 | 6 | 128.33 ± 8.07 | 0.39 ± 0.02 |
| Bn-2 | 6 | 135.5 ± 2.95 | 0.41 ± 0.01 |

The age-related changes in hematological parameters such as Hb levels in mallard ducks were similar to those of wild bearded vultures (*Gypaetus barbatus*) between nestlings and free-living vultures wherein increased Hb level with age was attributed to greater physical activity and increased oxygen demands for flight (Hernandez & Margalida 2010); and increased body size, greater energy effective mating, and increased oxygen demands for the laying period. In addition, the reduction in haematological parameters during egg production could be explained by the receptor-mediated action of endogenous estrogens which otherwise have essential reproductive functions during egg production as hypothesized by Wagner et al (2008).

Results evidently showed that hematocrit levels are higher in Pg-2 and Bn-2 (both composed of 13 - 20 months old ducks) than those of Pg-1 and Bn-1 (both comprising 6 - 12 months old ducks). Overall, there is no significant difference (p value = 0.95, alpha = 0.05) in the hematocrit levels of all four groups. The similarity in the type of farming and feeding type may have contributed to this no significant difference in hematocrit levels. In the semi-free range farm system, ducks are allowed to feed on available natural food resources (*e.g*. snails and weeds) in plowed rice fields but later fed in confinement where there is shelter during nighttime. Cuervo et al (2011) found that the food-supplemented and commercially-fed spotless starling (*Sturnus unicolor*) nestlings showed lower hematocrit levels than the control ones which were not food-supplemented. It was suggested that hematocrit level is not a good estimate of phenotypic condition under certain circumstances such as in certain nutritional states.

Seliger et al (2012) stated that BC differentials and their total counts are among the most significant and commonly used diagnostic tools in medicine, allowing clinicians to evaluate the current health and immune status of individuals or a given group. Abnormalities in the total WBC count and white blood cell differential frequently present as first indications for life-threatening infections and that leukocyte quantification provides important information in a wide range of research areas. On a different spectrum, Jelena et al (2007) documented that platelets have important roles in homeostasis, possessing phagocytic functions against foreign materials. Similar to WBCs, platelets also stand as an essential part of any haematological research with regards to growing avian physiology blood studies.

***Hematological analysis***. Table 3 is the hematologic record of the young (Pg-1 and Bn-1, 6 - 12 months) and old (Pg-2 and Bn-2, 13 - 20 months) Pateros ducks from Bonifacio and Pagadian City farms. It was found that the total WBCs of the old ducks was higher compared to the young. Bn-2 had a relatively high total leukocyte count of 10.63 ± 4.30. The results suggest that total leukocyte count did not coincide with the age of the ducks from the farms in Pagadian and Bonifacio. The results of hematological analysis, however, could be explained by how the young and old duck groups are affected by housing or environmental quality, food availability, or susceptibility to pollutants or toxins (Monks & Forbes 2010) that, in one way or another, are present in the sites considered in this work. The values of differential counts for heterophils, lymphocytes and eosinophils also differ without being associated to age.

Table 3

Leukocyte (Mean ± SD) profile of the four age groups of ducks from the two selected farms in Misamis Occidental and Zamboanga Del Sur, Mindanao, Philippines

| *Hematologic parameters* | *Group* | | | |
|---|---|---|---|---|
| | *Pg-1* | *Pg-2* | *Bn-1* | *Bn-2* |
| Total WBC | 8.9 ± 2.30 | 7.43 ± 2.82 | 7.73 ±1.61 | 10.63 ± 4.30 |
| Heterophils | 39 ± 27.03 | 50.67 ± 9.95 | 72 ± 8.88 | 52.67 ± 24.65 |
| Lymphocytes | 16 ± 11.31 | 40 ± 4.86 | 18 ± 7.85 | 29.17 ± 13.45 |
| Eosinophils | 20.33 ± 15.62 | 7.17 ± 8.61 | 2.1 ± 2.43 | 1.67 ± 2.25 |
| H/L ratio | 2.37 ± 1.29 | 1.30 ± 0.36 | 6.21 ± 6.30 | 3.047 ± 3.46 |
| Total platelet | 4.43 ± 0.62 | 4.1 ± 1.00 | 4.8 ± 1.70 | 4.87 ± 1.29 |

Comparatively, studies on owl species showed lymphocyte percentage ranges of 40 – 70 %, whereas in most other raptors, the heterophils are most common (Cooper 2002; Monks & Forbes 2010). It is believed that the eosinophil differential count can range from 10 to 35 % in healthy raptors (Monks & Forbes 2010). Comparing it on this work on ducks, no eosinophil was even found in the blood, which agrees with Gladbach et al (2010) that lymphocytes and heterophils make up the majority of white blood cells in birds. Conversely, Monks & Forbes (2010) found that eosinophils are closely associated with parasitism and may not be present in such proportions in "normal" individuals. Only the total platelet counts did not give any significant variation (p value = 0.95, alpha = 0.05) in this study suggesting that platelets consistently play a significant role in the recognition and clearance of pathogen in mammalian study (Beaulieu & Freedman 2010). A lower platelet count may be an expression of immature system (Jelena et al 2007). Moreover, a multitude of studies (Beaulieu & Freedman 2010) have shown that platelets can interact with bacterial proteins, predominantly seen during inflammation.

The H/L ratio was recently used to compare stress effects following different procedures in the translocation of birds (Vleck et al 2000). The mean heterophil/lymphocyte ratio of the Bn-1 Pateros ducks was very high but since the normal values for Pateros duck variety has yet to be established, the present values can just be initially compared with the secondary data from other avian species. H/L ratio in sea gulls was about 0.6 in normal and may increase to more than 2.9 when injured or infected with endoparasites (Vleck et al 2000). It appears that ducks from Bonifacio farm were apparently more stressed and injured than those from Pagadian. Bonifacio samples got the highest total leukocyte values and the highest H/L ratio. Dissection of the ducks after blood sampling confirmed that ducks from Bonifacio had fatty livers, yellowish lobes, liver hematomas, and even tumors. Pagadian ducks were observed to have edematous and fatty liver as well. The hematological values were congruent to the obtained records from the dissection of Bonifacio ducks that also exhibited hepatic conditions.

Figure 2 shows the relationship that could be established between the total WBC counts and the total platelet counts in the duck age groups regardless of the source. The old ducks, of age 13 - 20 months from the farms in Mindanao, indicated an inverse correlation between total WBC and total platelet counts (y = 0.8388x + 12794), while it was the opposite for the young age group (6 - 12 months) from two sources in Mindanao (y = 0.667x + 5237.4). Overall, this indicated that the increase in the total WBC count could be associated with the increased total platelets in the young ducks, which may be translated as relative hardiness and resistance of young ducks.

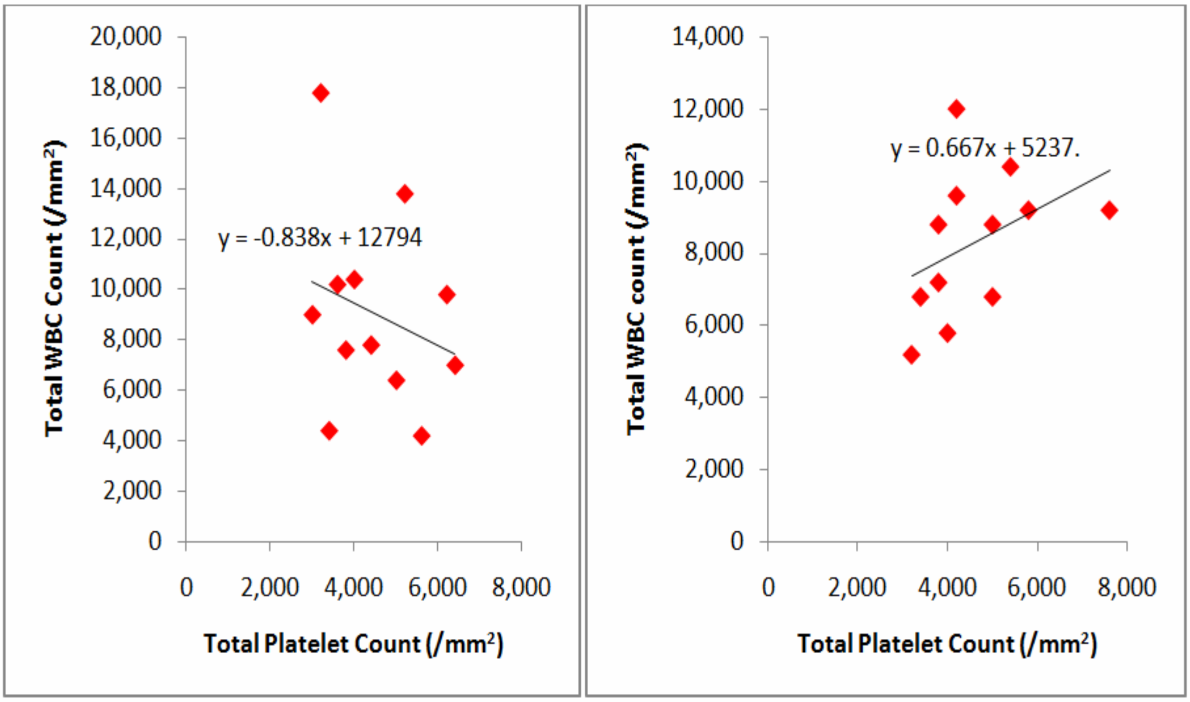


Figure 2. Correlation coefficient and regression equation between total WBC and platelet counts (/mm$^2$) in young (Pg-1, Bn-1) and old (Pg-2, Bn-2) ducks.

**Conclusions**. The results of the plasma biochemical and hematological levels on young and old ducks from semi-ranged system in Mindanao are good indicators of the general physiological status of the Pateros ducks in Mindanao Setting. The randomly selected samples of ducks from Bonifacio, Misamis Occidental and Pagadian City, Zamboanga Del Sur appear healthy and sturdy externally prior to all the analysis. However, the biochemical and hematological tests conducted proved otherwise. Several factors that influence the levels of blood lipids such as age, genetics, feed type, stress levels, and farm practices were to be considered. Data gathered may serve as initial reference for future studies that would establish plasma biochemistry (specifically cholesterol and lipoprotein levels) and hematologic parameters (hematocrit, hemoglobin and leukocyte profiles) of Pateros ducks especially for improving productivity, profitability, and economic soundness of duck industry in Mindanao and of the Philippines.

It is recommended that a standard or normal blood biochemical values be established at the farm level for comparative conditions of the "normal" or "unhealthy" Pateros ducks in the production farms. It is also recommended that other plasma biochemical parameters such as total protein, total bilirubin, AST, ALT, and Glucose; and other hematological parameters like erythrocyte profiling to be assessed and their standard or normal values to be established specifically for farm management use in the Philippines.

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