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Comparison Study of Some Hematological and Biochemical Blood Characteristics Between Domestic and Barn Chickens

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Abstract:
This work was carried out at the Faculty of Veterinary Medicine and Agriculture, University of Zawia, in November 2022, to a comparison of hematological and biochemical blood characteristics between domestic and barn chickens.
Blood was collected from the wing vein of 20 chickens and divided into two parts. The first part was for blood hematology and the second one for biochemical analysis.
The results showed there were no significant differences in the values of RBC, HB, and PLT, the significant differences in PCV were the group of domestic chickens, recorded the highest percentage of 37.36, while the control group 35.1.
There was a significant increase in WBC, and the group of domestic chickens recorded the best value (25,36) followed by the control group, which recorded (25,28).
Total lipids showed no significant differences in the values of T. Lipid and Triglyceride. Cholesterol, in the group of barn chickens, recorded the highest significant difference 150, 6 on the group of domestic chickens, which recorded106, 4, while the domestic chickens recorded the highest significant difference in HDL values compared to the control group, where it recorded 82, 76,2 respectively.
The total protein in the control group recorded a slightly significant difference compared to the group of domestic chickens, as it recorded 5.98, while the other group recorded 5.3. Albumin in the group of domestic chickens was recorded at 2.28 and in the control group at 1.84. In the group of barn chickens, Globulin recorded 1,472 while in the other group recorded 3.64, respectively.

Keywords: Hematological and Biochemical Blood Characteristics, Domestic Chicken, Barn Chicken.

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دراسة مقارنة لبعض خصائص الدم وكيمياء الدم الحيوية بين الدجاج الداجن ودجاج الحظيرة

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الملخص
تم تنفيذ العمل التجريبي الحالي في كلية الطب البيطري والزراعة بجامعة الزاوية، في نوفمبر 2022، لمقارنة خصائص الدم والكيمياء الحيوية بين الدجاج الداجن ودجاج الحظيرة، تم جمع عينات الدم من وريد الجناح لعشرين دجاجة وتم تقسيمها إلى قسمين متساويين، تم جمع الجزء الأول من الدم، لتحليل صورة الدم الكاملة والجزء الثاني ليستخدم في التحليل البايوكيميائي.
أظهرت النتائج عدم وجود فروق معنوية في قيم عدد كريات الدم الحمراء، والهيموجلوبين، والصفائح الدموية، وكانت الفروق المعنوية في حجم الكرية المكدسة (الهيماتوكريت) حيث سجلت مجموعة الدجاج الداجن اعلى نسبة 37.36 بينما سجلت مجموعة السيطرة 35.1.
كانت هناك زيادة معنوية في قيم خلايا الدم البيضاء، وسجلت مجموعة الدجاج الداجن أفضل قيمة (36 ،25) تليها مجموعة دجاج الحظيرة والتي سجلت (25، 28).
أظهرت النتائج الكلية للدهون عدم وجود فروق ذات دلالة إحصائية في قيم الدهون الثلاثية والغليسريد الثلاثي وأظهرت النتائج وجود فرق معنوي كبير في قيم الكولسترول، حيث سجلت مجموعة دجاج الحظيرة أعلى فرق معنوي 150.6 على مجموعة الدجاج الداجن والتي انخفضت معنويا بمقدار 160.4، بينما سجلت الدجاج الداجن أعلى فرق معنوي في قيم كوليسترول البروتين الدهني عالي الكثافة مقارنة بمجموعة التحكم، حيث سجلت 82، 76.2 على التوالي، عند مستوى p <0.05.
سجلت قيمة البروتين الكلي في المجموعة الضابطة فرقاً معنوياً طفيفاً مقارنة بمجموعة الدجاج المنزلي، حيث سجلت 5.98، بينما سجلت المجموعة الأخرى 5.3. سجل الألبومين في مجموعة الدجاج المنزلي 2.28 ومجموعة السيطرة 1.84. في مجموعة دجاج الحظيرة سجل الجلوبيولين 1.472 بينما في المجموعة الأخرى سجل 3.64 على التوالي.

الكلمات المفتاحية: خصائص الدم والكيميائية الحيوية، الدجاج الداجن، دجاج الحظيرة.

Introduction:

Chickens are the most abundant domestic bird in the world, with more than 52 billion animals reared worldwide [1].

These birds have fascinated scholars and researchers since the dawn of Western civilization, and recent studies are beginning to reveal their complexity and depth of cognitive abilities [2].

The quality of poultry meat is good, the production cycle is short, and the price is relatively low, so it occupies a high position in the consumption of animal-derived food [3].

Chicken meat and eggs provide high-quality protein, essential vitamins, and minerals [4].

Domestic birds have been observed to eat a variety of plant matter, including berries, seeds, and grasses, and will utilize all food sources in their habitat [5].

They scratch the forest floor for insects and snails, and they snatch figs and other fruits from the trees by pecking at flies swarming around cow faces and scavenging on their waste, chickens form symbiotic relationships with cattle [6].

For adults, plant matter makes up the majority of their diet, whereas young chicks consume significantly more invertebrates [7]. Additionally, chickens eat stones, sand, and fine grit, which are retained in the gizzard and grind food when digested [8].

To ensure the birds' optimum performance, management must provide optimum conditions [9].

For poultry diets to be nutritious, they must provide many nutrients and requirements. It is important to give the chickens a diet based on their age and strain [10].

The majority of developing nations raise poultry by using the traditional system which includes backyard raising, this system differs from the large-scale commercial systems in the feed resources and feed requirements for the poultry, Household garbage, natural materials from the environment (such as insects, worms, snails, greens, and seeds), crop remnants and water plants are all potential feed sources for the birds which raised in this system [11].

On the other hand, poultry raised in the barn feed on a balanced and integrated diet that contains all nutrients and elements such as protein, essential amino acids, essential fatty acids, minerals, and vitamins. Poultry obtains energy from these nutrients and maintains their current state to enable body growth and egg production [12].

The domestic bird feeds on materials from nature. Humic substances can be found in soil, compost, sewage, natural waters, landfill leachates, and the atmosphere [13]. Humic materials beneficially affect the growth of microorganisms [14].

They also stimulate microbial growth, as a source of nutrients [15]. Materials from nature like plant extracts, herbs, and organic acids consider feed additives [16].

Plant extracts like garlic products in poultry diets improved the lipid profile [17]. By contrast, found that the use of garlic supplementation in poultry diets does not influence the performance results as well as serum biochemistry and plasma [18].

The present study was conducted to a comparison of hematological and biochemical blood characteristics between domestic chickens and barn chickens.

It has been reported that hematological parameters provide valuable information about the immune status of animals [19]. Blood profiles can be used as a diagnostic tool to assess the health of individuals and/or herds [20].
Hematologic changes are often used to determine the various effects of environmental, nutritional, and/or pathological factors [21]. The cellular properties of Avian blood differ from those of mammalian blood [22].
Several factors affect the blood profile of healthy chickens such as environmental, and physiological conditions, feed additives like vitamins, administration of drugs, fasting, and age [20].
Also, factors such as age, diet, animal health, physical activity level, sex, and environmental factors have been observed to affect the blood values of poultry [23].
There is a correlation between nutrition and immune response, for example, leaf extracts affect the hematology, and serum biochemistry of chicken [24].
The present research was undertaken to investigate hematological parameters, such as Total Erythrocyte Count (TEC), Hemoglobin (Hb) concentration, Packed Cell Volume (PCV), and Differential Leukocyte Count (DLC).

Materials and methods

This study was carried out in November 2022, the investigation was conducted on healthy chickens 20 laying hens were brought from different places in the same city (Surman city), and the birds were divided into two groups of ten chickens each, first group consisted of ten hens raised in a barn. The first group was considered as a control group and an independent group at the same time, and the second group contained ten domestic chickens (Home breeding chickens).
The present experimental work was carried out at the Research Laboratory belonging to the Faculty of Veterinary Medicine and Agriculture (Al-Ajeelat), University of Zawia.

Blood collection and laboratory examination

Collection of Blood Samples:
Individual blood samples were taken from 20 females to determine the different hematological and biochemical characteristics. Blood samples were collected from the wing vein and divided into two equal parts. The first part of the blood was collected in EDTA-coated tubes as an anticoagulant to determine the blood hematology (red blood cell counts (RBCs) and White blood cell (WBCs) counts. The white blood cells were counted using a magnification count on an Ao bright line hemocytometer using a light microscope at 100 X. The specimens of the cells were examined with a Leica DM3000 microscope. Blood samples were diluted 20 times with a diluted fluid (3 ml acetic acid glacial + 97 ml distilled water + some of Leishman stain) according to [25,26]. packed cell volume (PCV). As those in mammals, PCV was determined according to [27] by microhematocrit tubes which were filled approximately two-thirds full with non-coagulated blood, sealed from one end by special clay, and centrifuged at 12000 rpm for 5 minutes. The percentage of packed cells to total volume was determined by direct measurement in a special chart.
Hemoglobin determination (Hb). The hemoglobin concentration was determined in fresh blood samples using a hemoglobinometer as the method described by [28].
The second part of each blood sample was collected in coated tubes without anticoagulant and centrifuged at 3500 rpm for 16 minutes to separate blood serum. Serum samples were used for biochemical analysis.
Serum total protein(g/dl), the colorimetric determination of total protein level was carried out by specific diagnostic kits according to [29] with the principle that in the presence of alkaline cupric sulfate the protein produced a violet color the intensity of which is proportional to their concentrations.
Serum albumin(g/dl). the colorimetric determination of albumin was carried out by specific diagnostic kits produced by Bio-ADWIC according to [30]. An albumin / Bromo cresol-green complex is formed at pH 4.2 and the complex is measured photometrically.
Serum globulin(g/dl), globulin concentration was calculated by the difference between total protein and albumin since the fibrinogen usually comprises a negligible fraction [31].
Serum total cholesterol, the colorimetric determination of cholesterol was carried out using kits produced by Bio-system according to [32]. The principle of the method is that cholesterol forms a colored complex with acetic anhydride and concentrated sulfuric acid and the colored complex is measured photometrically.
Serum low-density lipoproteins (LDL-cholesterol), and low-density lipoproteins (LDL) are precipitated by heparin at their isoelectric point (pH 5.04). After centrifugation, the high-density lipoproteins (HDL) and the very low-density lipoprotein (VLDL) remain in the supernatant. These can then be determined by enzymatic methods [33].
Serum high-density lipoproteins (HDL-cholesterol), phosphotungstic acid, and magnesium ions selectively precipitate all lipoprotein except the HDL fraction–cholesterol present in the supernatant which can be determined by the same method used for total cholesterol [34].

Statistical Analysis
Hematological data were analyzed statistically by one-way randomized block at a significant level of 5% using the Co-Stat software program for data manipulation and statistical analysis. 2008 Version 6.45.

Results and discussion:
Table (1) and Figure (1) show a comparison of some hematological characteristics in chickens. The results showed that there were no significant differences in the number of RBC, HB, and PLT values, between the different treatments at the level $p < 0.05$, while the domestic chickens recorded a slight significant increase for the different treatments in the values of White blood cells, which the domestic chicken group recorded the best value 25.28, 25.36, respectively, and this indicates that feeding on agricultural waste increases the raising of the immune characteristic and stimulates white blood cells, and this is consistent with [18] mentioned, Whereas, the use of garlic supplements in poultry food does not affect the performance results as well as the biochemistry of blood and plasma, but rather increases their efficiency.
The results also showed that there were significant differences in PCV, where barn chickens recorded a significant decrease compared to the group of domestic chickens, which recorded the highest percentage of 37.36a, while the control group recorded 35.1b, which differs from what the scientist reported [35]. Normal PCV indicates the absence of normal cellular anemia, which is said to be detected only by a low red blood cell count.
The concentration of hemoglobin did not have any significant differences between the treatments at the level $p < 0.01$, while the barn chickens, which are a control group, recorded a slightly significant difference compared to the domestic chickens, where the barn chickens recorded a percentage of 12.22, while the record of domestic chickens was 12.18 during the winter, and this was mentioned by [36] reported that the normal range of hemoglobin values indicates that the vital physiological relationship of hemoglobin to oxygen in transporting gases (oxygen and carbon dioxide) to and from body tissues has been preserved and was normal in all cases.
The PCV for different treatments, in domestic chickens increased significantly over the barn chickens, as the domestic chickens recorded 37.36a, while the control group decreased significantly and non-significantly and recorded 35.1b.
PCV% values indicate the absence of cytological normal anemia that is normally characterized by normal MCV and MCH and is only detected by a low RBC count or PCV ratio [35].
[37] showed that diets supplemented with an oil extract derived from thyme and cinnamon for broilers resulted in a significant increase in the values of RBCs, PCV, Hb, and WBCs compared to the control group.
Hematopoietic components reflect the animal's physiological response to its internal and external environment, which includes forage and nutrition [38].
It was observed that there was a significant increase in Table (1) and Figure (1) for different treatments in the values of white blood cells, and the group of domestic chickens recorded the best value (25,36) followed by the group of barn chickens, which recorded (25,28) since the use of garlic supplements in poultry food does not affect the performance results as well as the biochemistry of blood and plasma, but rather increases their efficiency [18]. This study was conducted between domestic and barn chickens.

Table 1. Level of blood cells, concentration of PCV, and hemoglobin in the barn, and domestic chickens.

	Blood cells				
	RBCs (10^6/mm^3)	Hb g/dl	PCV %	WBCs (10^3/mm^3)	PLT %
T1	2,974b	12,22a	35,1b	25,28a	8,77a
T2	3,048a	12,18a	37,36a	25,36a	8,31a

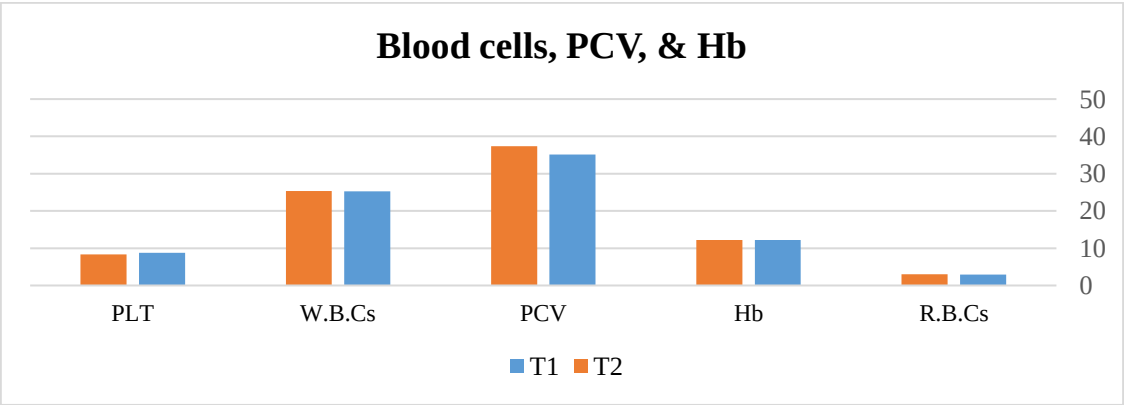

Figure 1. Level of blood cells, concentration of PCV, and hemoglobin in the barn, and domestic chickens.

The comparison of white blood cells detailed in Table (2) and Figure (2), the results showed that there was no significant difference between the different treatments in the values of Neutrophils, Monocytes, Basophils, and Eosinophils, while the results showed a significant difference in the cells of Lymphocyte, where the barn chicken group (the control group) recorded the highest percentage of 41.86a and 28.82b, respectively. These obtained results are consistent, to a greater or lesser degree, with the results presented by [39] who indicated that the percentage of Lymphocyte cells did not differ significantly (P< 0.05) among broiler chicks that were given antibiotic-fortified diets (flavophospholipol) compared to the control group.

Table 2. Comparison of white blood cells, lymphocytes, Neutrophils, Monocytes, Basophils, and Eosinophils in the barn, and domestic chickens.

	White blood cells				
	Lymphocytes (%)	Neutrophils (%)	Monocytes (%)	Basophils (%)	Eosinophils (%)
T1	41,86a	14,96a	4,4a	0,2a	3,2a
T2	28,82b	13,01a	5,6a	0,4a	3a

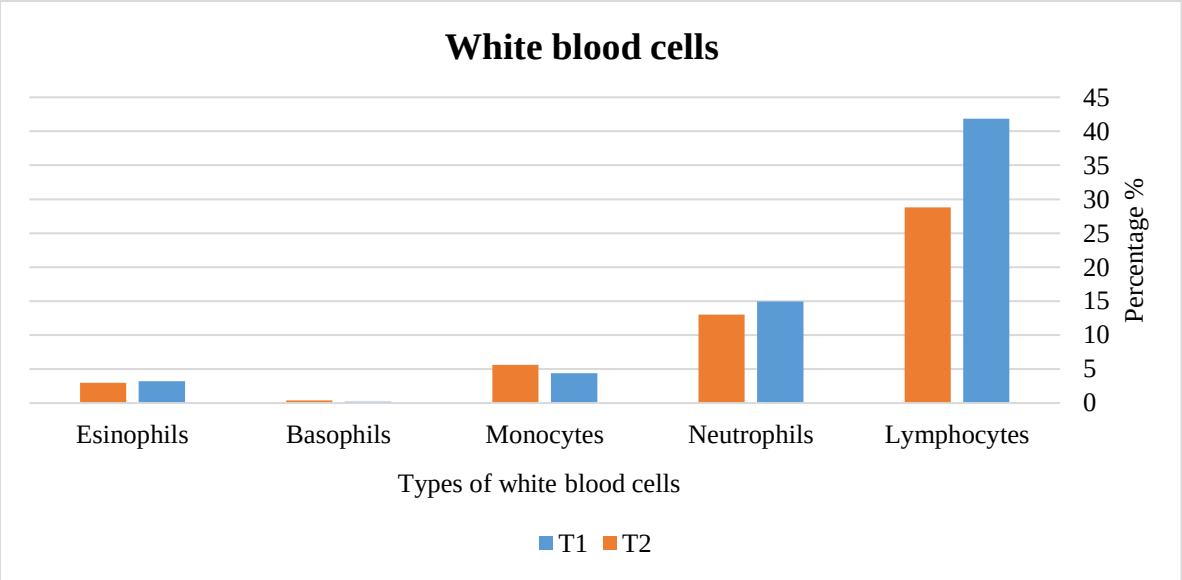

Figure 2. Comparison of white blood cells, lymphocytes, Neutrophils, Monocytes, Basophils, and Eosinophils in the barn chicken, and domestic chickens.

The comparison of some characteristics of total lipids in the blood, where the results showed that there were no significant differences in the values of T. Lipid and Triglyceride, while the results indicated a highly significant difference in the values of cholesterol, where the group of barn chickens recorded the highest significant difference 150, 6a on the group of domestic chickens, which decreased significantly by 106, 4b, shown in the Table (3) and Figure (3), and this is consistent with what was reported by [40] that the values of cholesterol in the blood decreased due to supplementation of dried garlic and household waste in the diet of broiler chickens, especially at the level of 1%. This may be due to the possible mechanism of hypocholesterolemic and hypolipidemic action of food waste products that reduce the hepatic activity of lipid and cholesterol-forming enzymes such as a malic enzyme, fatty acid synthase, glucose-6-phosphatase dehydrogenase. Also, poultry feeding on a commercially concentrated diet increases their body weight [41], as well as the fat ratios increase in Poultry reared indoors when compared to free-range chicken [42].

While the domestic chickens recorded the highest significant difference in HDL values compared to the control group, where it recorded 82a, 76,2b respectively, at the level of p<0.05, and this agrees with the results of [43] showed that plasma HDL-cholesterol levels in quail diets fed with 1, 2, or 4% dehydrated garlic powder were higher than those in the control group (P<0.05). Recently [44] found that quail chicks fed diets containing thyme showed significantly higher levels of HDL-C in plasma than those in control birds, and interestingly, LDL-cholesterol levels were significantly reduced (P < 0.05) in the domestic chicken group compared to the control group. [45] also reported that LDL cholesterol decreased by 28-41%. But HDL cholesterol fails when laying hens are fed a corn and soy-based diet or an experimental diet.

Table 3. Comparison of the total blood lipids, total lipid, cholesterol, triglycerides, HDL, LDL, and HDL/LDL ratio in the barn, and domestic chickens.

	Lipids					
	Total Lipid mg/dl	Cholesterol mg/dl	Triglycerides mg/dl	HDL mg/dl	LDL mg/dl	HDL/LDL ratio mg/dl
T1	771a	150,6a	129,4a	76,2b	71,2a	1,068b
T2	611,2a	106,4b	144,6a	82a	65b	1,262a

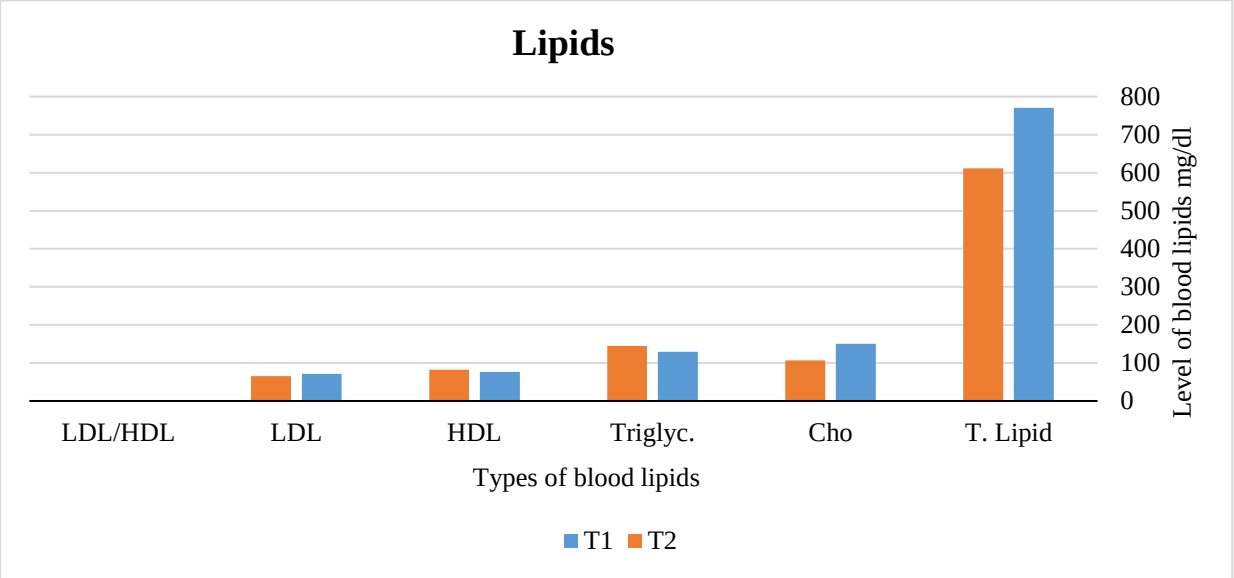

Figure 3. Comparison of the total blood lipids, total lipid, cholesterol, triglycerides, HDL, LDL, and HDL/LDL ratio in the barn, and domestic chickens.

The results showed some characteristics of protein in the blood, where the results showed that there were no significant differences between the different treatments in the protein values at the level of $p<0.05$, while the control group recorded a slightly significant difference compared to the group of domestic chickens, where chickens recorded the percentage of protein was 5.98a, while the other group recorded 5.3a, respectively as mentioned in Table (4) and Figure (4) this is consistent with what [39] said that there was no significant effect of 5 and 10 g/kg of thyme powder nor corona on blood protein compared to the control group.
While the group of domestic chickens recorded a highly significant difference in the values of albumin compared to the group of barn chickens, which is considered a control group, where the group of domestic chickens recorded 2.28a and the control group recorded 1.84b. In the control group, Globulin recorded 1,472b and domestic chickens recorded 3.64a, respectively, and this does not differ from what [46] found that dietary residues of essential oils of rosemary, garlic, potato peelings, and some other residues resulted in non-significant changes in serum levels of total protein, albumin, and globulin compared to a control group.

Table 4. Comparison of the total blood Protein, Total Protein, Albumin, Globulin, and Alb/Glob ratio in the barn, and domestic chickens.

	Protein			
	Total protein g/dl	Albumin g/dl	Globulin g/dl	Alb/Glob ratio g/dl
T1	5,30a	1,84b	1,47b	1,374a
T2	5,98a	2,28a	3,64a	1,002b

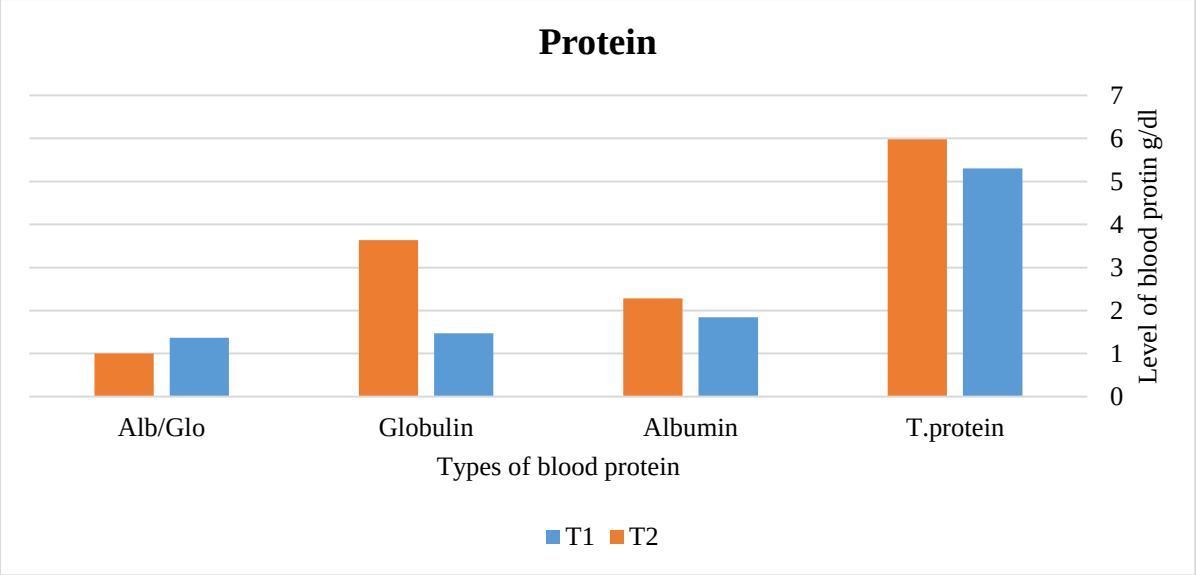

Figure 4. Comparison of the total blood Protein, Total Protein, Albumin, Globulin, and Alb/Glob ratio in the barn, and domestic chickens.

Conclusion:

In conclusion, there are hematological and biochemical differences between domestic, and barn chickens. The study showed that poultry raised in the traditional way (backyard raising) and fed on household garbage and natural materials from the environment (such as insects, worms, snails, greens, and seeds) have some differences in their blood characteristics and develop a high immune system to resist diseases.

Extra reports, additional surveys, and immunological studies of the immune system are required from various poultry species. These will offer extra data and further information, and probably facilitate an explanation of the differences between barn, and domestic chickens.

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