The Hematological Parameters and Serum Protein Values in Tuberculin Reactor and Non-reactor Dairy Cattle

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Abstract

The study aimed to evaluate some blood parameters and serum proteins in dairy cattle farm in Baghdad Governorate\ Iraq. The study was conducted on 100 dairy cattle both sexes (13 males and 87 females) aged 1-6 years, 1-2, >2-3 and >3-6 age groups. A comparative intradermal tuberculin test was carried out on these animals. The results showed that the range and mean ± standard error (SE) of hematological and serum protein values were as follows; Hb 3-15 g/dl and 9.37 ± 0.27 g/dl, PCV 12-44.5% and 30.7 ± 0.96%, RBCs 3-10 × 10^6/µl and 6.37 + 0.20 × 10^6/µl, total WBCs 4000 - 20000/µl, 9606± 431/µl, ESR 2-12 mm/1 hr and 4.44 ± 0.21 mm/1 hr, Total Serum Protein (TSP) 2.1-8 g/dl and 6.00 ± 0.14 g/dl, Serum Albumin 0.9-3.5 g/dl and 2.42 ± 0.06 g/dl and Serum Globulin was 0.8- 4.9 g/dl and 3.58 ± 0.08 g/dl. The males showed a significant decrease (P<0.05) in globulin compared to that of females, and the >2-3 years age group showed a significant increase in globulin compared to that of the >3 years age group. On the other hand 28 out of hundred (28%) cattle were tuberculin reactor and the values in tuberculin reactor and non- reactor were as follows; Hb 7.82 ± 0.64 g/dl and 9.98 ± 0.24 g/dl, PCV 24.57± 2.1% and 33.08 ± 0.91%, RBCs 5.34 ± 0.48 X 10^6/µl and 6.77 ± 0.19 × 10^6\ µl, WBCs 11786 ± 1033/µl and 8758 ± 406 /µl, ESR 4.41 ± 0.35 mm/1hr and 4.45 + 0.26 mm/1hr, TSP 5.55 ± 0.34 g/dl and 6.18 ± 0.13 g/dl, Serum Albumin 2.51 ± 0.15 g/dl and 2.38 ± 0.06 g/dl and Serum Globulin 3.05 ± 0.20 g/dl and 3.79 ± 0.07 g/dl respectively. The Hb, PCV, RBCs, WBCs, TSP and serum globulin showed a significant differences (P<0.05) between tuberculin reactor and non-reactor. In conclusion, the current study recorded changes in some hematological parameters and serum proteins in relation to sex, tuberculin reaction and different age groups in dairy cattle.

قيم معايير الدم وبروتين المصل في الأبقار الموجبة والسالبة لاختبار السلين في ماشية الحليب

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الخلاصة

هدفت الدراسة الحالية إلى تقييم بعض معايير الدم وبروتينات المصل في ماشية الحليب في محافظة بغداد/ العراق. اشتملت الدراسة على 100 رأس من الماشية من كلا الجنسين (13 ذكـور و87 إنـاث) بعمـر 1–6 سنوات موزعة حسب الفئة العمرية من 1–2 سنة، >2–3 سنة و>3–6 سنوات. اجري اختبار السلين المقـارن داخل الجلد على تلك الحيوانات. وقد بينت النتائج ان المديات والمعدل الحسابي ± الخطأ القياسي لمعايير الـدم وبروتينات المصل كما يأتي: خضاب الـدم (Hb) 3-15 g/dl وبمعـدل 9.37±0.27 g/dl، حجـم الخلايـا المرصوصة (PCV) 12- 44.5% وبمعدل 30.7 ± 0.96%، العد الكلي لخلايا الدم الحمر (RBCs) 3–10 × 10^6/ µl بمعدل 6.37 ± 0.20 × 10^6/ µl، العد الكلي لخلايا الدم البـيض (WBCs) 4000 – 20000 /µl بمعدل 9606 ± 431/ µl، معدل ترسيب كريات الدم الحمر (ESR) 2–12 ملم/1 سـاعة وبمعـدل 4.44 ± 0.21 ملم/1 ساعة، بروتين المصل الكلي (TSP) 2.1 – 8 g/dl بمعدل 6.00 ± 0.14 g/dl، البومين المصل 0.9–3.5 g/dl بمعدل 2.42 ± 0.06 g/dl وكلوبيولينات المصـل 0.8– 4.9 g/dl بمعـدل 3.58 ± 0.08

g/dl. أظهرت الذكور انخفاضا معنويا (P<0.05) في مستوى الكلوبيولينات مقارنة بالإناث في حين أظهرت الفئة العمرية >2 – 3 سنوات ارتفاعا معنويا (P<0.05) عند المقارنة مع المجموعة ذات عمر >3 – 6 سنوات. ومن ناحية أخرى 28 رأسا من مجموع 100 (28%) رأس من الماشية كانت موجبة لاختبار السلين وقد كانت القيم في كل من الحيوانات الموجبة والسالبة لاختبار السلين كما يأتي: خضاب الدم 7.82 ± 0.64 g/dl و9.98 ± 0.24 g/dl، حجم الخلايا المرصوصة 24.57 ± 2.1% و33.08 ± 0.91%، العد الكلي لخلايا الدم الحمر 5.34 ± 0.48 × 10^6/ µl و6.77 ± 0.19 × 10^6/ µl، العد الكلي لخلايا الدم البيض 11786 ± 1033/ µl و 8758 ± 406/ µl، معدل ترسيب كريات الدم الحمر 4.41 ± 0.13 ملم/1 ساعة و4.45 ± 0.26 ملم/1 ساعة، بروتين المصل الكلي 5.55 ± 0.34 g/dl و6.18 ± 0.13 g/dl، البومين المصل 2.51 ± 0.15 g/dl و2.38 ± 0.06 g/dl وكلوبيولين المصل 3.05 ± 0.20 g/dl و3.79 ± 0.07 g/dl على التوالي. أظهرت نتائج خضاب الدم وحجم الخلايا المرصوصة والعد الكلي للخلايا الحمر والبيض وبروتين المصل الكلي وكلوبيولينات المصل اختلافات معنوية بين المجاميع الموجبة والسالبة لاختبار السلين بمستوى معنوية (P<0.05). نستنتج من هذه الدراسة تسجيل مستويات بعض معايير الدم وبروتينات المصل في كلا الجنسين وحسب الاستجابة لفحص السلين وبمختلف الفئات العمرية لماشية الحليب.

Introduction

Blood picture determination and serum proteins could provide valuable information related to nutrition, sex, age and physiological status of the dairy cattle (1). In addition, they were very useful to get insight in the metabolic functions and general health conditions of cattle and to compare the standards obtained from ill animals with those normal in healthy cattle (2). A range of factors like home environment, demands for elevated productivity, densities of herds and individual susceptibility, could predispose cows to several disorders, which might affect the general health condition (3). Some investigations illustrated how animal welfare is progressively of interest, particularly concerning blood biochemical response, which were varied to reflect the different physiological situations in animals and resulted in an significant diagnostic methods to evaluate general animal health (4). Tuberculosis is a risky zoonotic disease and the infection of animals with tuberculosis outbreaks represented possible sources of infection to other animals as well as human being (5). Tuberculin test has usually been used to determine the prevalence of TB infection in both animals and human as a screening test. Blood picture is an excellent guide in the detection and outcome of a disease or any disorder and it has been a focus of study in several affections in cattle (6). Hematological parameters and serum proteins were studied by (7) at two livestock experiment stations in Pakistan in which they detected the prevalence of tuberculosis in buffaloes on the basis of comparative intradermal tuberculin test which were 8.48% and 2.45% on the basis of positive reaction to bovine PPD. Recent studies refer to gamma-interferon (γ-IFN) assay as a higher sensitive than intradermal tuberculin test for detection of bovine tuberculosis, that γ-IFN assay is easier to perform and it shortens time for diagnosis of bovine tuberculosis (8), while intradermal tuberculin test was still used as standard method for detection of bovine tuberculosis worldwide (9). The present study was designed to recognize the blood picture and serum proteins in dairy cattle with comparison between different hematological features in both sexes; the tuberculin reactors and non-reactors, and in different age groups.

Materials and Methods

The present study was carried out on 100 dairy cattle (13 males and 87 females) aged 1-6 years, which divided into 4 age groups (35 aged 1-2; 35 aged >2-3 and 30 aged

>3-6). A comparative intradermal tuberculin test was carried out on these dairy cattle present near Baghdad according to (10) by injection of the avian and bovine allergins (Institute of Animal Science & Health– Leyland, Holland) intradermally and the results were recorded at 0, 24, 48 and 72 hr. About 10 ml of whole blood was collected from both positive and negative reactors in EDTA tubes for hematological parameters estimation and also into plain tubes; the samples were centrifuged for 5- 10 minutes at 3000 rpm for sera separation (11). Hematological tests were carried out according to (11) including Hb, which was estimated using cyanomethemoglobin method, PCV, which was carried out using microhematocrit method, total RBCs and WBCs counts, that counted by using hemocytometer method, ESR values estimated by using Westergren tubes and recording values in millimeter after one hour. Blood indices MCV, MCH, and MCHC were calculated according to formulas of (11) and finally sera were investigated for total serum protein according to (12), serum albumin and serum globulin concentrations were estimated according to (13). SAS program was used for statistical analysis. Data were subjected to analysis of variance (ANOVA) and significant means were compared by T-test at a level ($P<0.05$).

Results

The hematological values of Hemoglobin (Hb), packed cell volume (PCV), RBCs count, MCV, MCH, MCHC, WBCs count, ESR, total serum protein (TSP), serum albumin and serum globulin for the total cattle without any sub-divisions and according to sex are presented in (Table 1). The results revealed range and mean ± standard error (SE) as follows; Hb 3-15 g/dl and 9.37 ± 0.27 g/dl, it was 8.48 ± 0.89 g/dl in males and 9.51 ± 0.28 g/dl in females; PCV: 12-44.5% and 30.7 ± 0.96%, it was 27.27 ± 2.78% and 31.21 ± 1.01% in males and females, respectively; RBCs count: 3-10 X 10^6/µl and 6.37 ± 0.20 × 10^6/µl, it was 5.76 ± 0.61 × 10^6/µl in males and 6.46 ± 0.21 × 10^6/µl in females; MCV: 35-57.5 fl and 48.33 ± 0.4 fl, it was 47.5 ± 1.32 fl and 48.46 ± 0.41 fl in males and females, respectively; MCH: 7.5-20 pg and 14.74 ± 0.16 pg, it was 14.76± 0.48 pg in males and 14.74 ± 0.17 pg in females; MCHC 15.8-40 g/dl and 30.57 ± 0.34 g/dl, it was 30.94 ± 1.09 g/dl and 30.51 ± 0.36 g/dl in males and females respectively; WBCs count 4000-20000 /µl and 9606± 431 /µl, it was 11808 ± 1474/µl in males and 9277 ± 436/µl in females, which were significantly ($P<0.05$) higher in males than females; ESR 2-12 mm/1hr and 4.44 ± 0.21 mm/1hr, it was 4.5 ± 0.48 mm/1hr and 4.43 ± 0.29 mm/1hr in males and females respectively; TSP 2.1-8 g/dl and 6.00 ± 0.14, it was 5.34 ± 0.44 g/dl in males and 6.09 ± 0.14 g/dl in females; serum albumin 0.9-3.5 g/dl and 2.42 ± 0.06 g/dl, it was 2.16 ± 0.18 g/dl and 2.45 ± 0.07 g/dl in males and females respectively; serum globulin 0.8-4.9 g/dl and 3.58 ± 0.08 g/dl, it was 3.18 ± 0.28 g/dl in males and 3.64 ± 0.09 g/dl in females, which were significantly ($P<0.05$) higher in females compared to males. The range and mean ± SE of hematological values and serum proteins in tuberculin reactor and non-reactor are presented in (Table 2) as follows: Hb 5-14 g/dl and 7.82 ± 0.64 g/dl in tuberculin (TBN) +ve, 3-15 g/dl and 9.98 ± 0.24 g/dl in TBN –ve with a significant difference ($P<0.05$) between them; PCV 12-44% and 24.57 ± 2.1% in TBN +ve, 18-44.5% and 33.08 ± 0.91% in TBN –ve with a significant difference ($P<0.05$) between them; RBCs 3-10 × 10^6/µl and 5.34 ± 0.48 × 10^6/µl in TBN +ve, 4-9.5×10^6/µl and 6.77± 0.19× 10^6/µl in TBN –ve with a significant difference ($P<0.05$) between them; MCV 35-57.1 fl and 46.61± 0.92 fl in TBN +ve, 37.7-57.5 fl and 49.00 ± 0.39 fl in TBN –ve with a significant difference ($P<0.05$) between them; MCH 7.5-20 pg and 14.53 ± 0.51 pg in TBN +ve, 12.2-16.7 pg and 14.83 ± 0.11 pg in TBN –ve; MCHC 15.8-40 g/dl and 31.23 ± 0.96 g/dl in TBN +ve, 27-37.5 g/dl and 30.31 ± 0.29 g/dl in TBN –ve.

Table (1) The hematological parameters and serum protein concentrations in dairy cattle according to sex (Range and Mean ± SE)

Parameters	Total (n=100)	Males (n=13)	Females (n=87)
Hb (g/dl)	3-15 9.37 ± 0.27	6.1-11.4 8.48 ± 0.89	3-15 9.51 ± 0.28
PCV (%)	12-44.5 30.7 ± 0.96	12-41 27.27 ± 2.78	15-44.5 31.21 ± 1.01
RBCs (× 10^6/µl)	3-10 6.37 ± 0.20	3-10 5.76 ± 0.61	3-10 6.46 ± 0.21
MCV(fl)	35-57.5 48.33 ± 0.4	40-57.3 47.5 ± 1.32	35-57.5 48.46 ± 0.41
MCH (pg)	7.5-20 14.74 ± 0.16	10-16.6 14.76 ± 0.48	7.5-20 14.74 ± 0.17
MCHC (g/dl)	15.8-40 30.57 ± 0.34	25-38.4 30.94 ± 1.09	15.8-40 30.51 ± 0.36
WBCs (/µl)	4000-20000 9606 ± 431	4000-20000 A 11808 ± 1474	4800-20000 B 9277 ± 436
ESR (mm/1hr)	2-12 4.44 ± 0.21	3-10 4.5 ± 0.48	2-12 4.43 ± 0.29
Total serum protein (g/dl)	2.1-8 6.00 ± 0.14	2.2-6.9 5.34 ± 0.44	2.1-8 6.09 ± 0.14
Serum albumin (g/dl)	0.9-3.5 2.42 ± 0.06	1-3.4 2.16 ± 0.18	0.9-3.5 2.45 ± 0.07
Serum globulin (g/dl)	0.8-4.9 3.58 ± 0.08	1.2-4.1 B 3.18 ± 0.28	0.8-4.9 A 3.64 ± 0.09

The differences in letters horizontally refer to presence of significant value at (P<0.05)

WBCs count was 5000-20000/µl and 11786 ± 1033 /µl in TBN +ve, 4000-20000/µl and 8758 ± 406 /µl in TBN –ve with a significant difference (P<0.05) between them; ESR 2-10 mm/1hr and 4.41 ± 0.35 mm/1hr in TBN +ve, 2.25-12 mm/1hr and 4.45± 0.26 mm/1 hr in TBN –ve; TSP 2.1-8 g/dl and 5.55 ± 0.34 g/dl in TBN +ve, 2.7-7.7 g/dl and 6.18 ± 0.13 g/dl in TBN –ve with a significant difference (P<0.05) between them; serum albumin 1.1-3.5 g/dl and 2.51 ± 0.15 g/dl in TBN +ve, 0.9-3.4 g/dl and 2.38 ± 0.06 g/dl in TBN –ve; serum globulin 0.8-4.6 g/dl and 3.05 ± 0.20 g/dl in TBN +ve and 1.5-4.9 g/dl and 3.79 ± 0.07 g/dl with a significant difference (P<0.05) between them.

Table (2) The hematological parameters and serum protein concentrations in tuberculin reactor and non-reactor (Range and Mean ± SE)

Parameters	Tuberculin +ve (n=28) Range and Mean ± SE	Tuberculin –ve (n=72) Range and Mean ± SE
Hb (g/dl)	5-14 B 7.82 ± 0.64	3-15 A 9.98 ± 0.24
PCV (%)	12-44 B 24.57 ± 2.1	18-44.5 A 33.08 ± 0.91
RBCs (× 10^6/µl)	3-10 B 5.34 ± 0.48	4-9.5 A 6.77 ± 0.19
MCV(fl)	35-57.1 B 46.61 ± 0.92	37.7-57.5 A 49.00 ± 0.39
MCH (pg)	7.5-20 14.53 ± 0.51	12.2-16.7 14.83 ± 0.11
MCHC (g/dl)	15.8-40 31.23 ± 0.96	27-37.5 30.31 ± 0.29
WBCs (/µl)	5000-20000 A 11786 ± 1033	4000-20000 B 8758 ± 406
ESR (mm/1hr)	2-10 4.41 ± 0.35	2.25-12 4.45 ± 0.26
Total serum protein (g/dl)	2.1-8 B 5.55 ± 0.34	2.7-7.7 A 6.18 ± 0.13
Serum albumin (g/dl)	1.1-3.5 2.51 ± 0.15	0.9-3.4 2.38 ± 0.06
Serum globulin (g/dl)	0.8-4.6 B 3.05 ± 0.20	1.5-4.9 A 3.79 ± 0.07

The differences in letters horizontally refer to presence of significant value at (P<0.05).

The hematological and serum protein values in different age groups presented in table (3). The mean values of Hb, PCV, RBCs count, MCV, MCH, MCHC, WBCs count, ESR, TSP, and serum albumin which did not show significant differences (P>0.05) among them according to the age groups except in serum globulin which ranged 1.4-4.9 g/dl and mean of 3.82 ± 0.12 g/dl in >2-3 years age group that illustrated significantly (P<0.05) higher values than those of >3-6 years age group which ranged 0.8-4.5 g/dl and mean of 3.39 ± 0.18 g/dl.

Table (3) The hematological parameters and serum protein concentrations in different age groups of dairy cattle (Range and Mean ± SE)

Parameters	1- 2 years (n=35)	>2 – 3 years (n=35)	>3-6 years (n=30)
Hb (g/dl)	3-14.2 9.16 ± 0.46	5-14 9.63 ± 0.47	5-13 9.32 ± 0.47
PCV (%)	12-44 29.74 ± 1.71	15-44 31.60 ± 1.63	18-44 30.77 ± 1.65
RBCs ($\times 10^6$/µl)	3-10 6.14 ± 0.35	3-10 6.62 ± 0.33	3.7-9.5 6.35 ± 0.32
MCV(fl)	37-57.1 48.45 ± 0.72	37.7-57.5 48.10 ± 0.67	35-57.5 48.47 ± 0.69
MCH (pg)	10-20 14.93 ± 0.30	12.2-17.5 14.71 ± 0.23	7.5-17.5 14.55 ± 0.32
MCHC (g/dl)	25-40 30.81 ± 0.60	24.3-38.8 30.72 ± 0.55	15.8-36.8 30.11 ± 0.65
WBCs (/µl)	4000-20000 10351 ± 778	4700-20000 9200 ± 720	4300-18000 9210 ± 734
ESR (mm/1hr)	2-10 4.11 ± 0.32	3-12 4.85 ± 0.43	2.75-11 4.34 ± 0.28
Total serum protein (g/dl)	2.2-7.7 5.82 ± 0.20	2.9-8 6.35 ± 0.21	2.1-7.9 5.79 ± 0.29
Serum albumin (g/dl)	1.1-3.4 2.31 ± 0.10	0.9-3.5 2.53 ± 0.11	1.3-3.4 2.40 ± 0.13
Serum globulin (g/dl)	1.2-4.3 AB 3.51 ± 0.15	1.4-4.9 A 3.82 ± 0.12	0.8-4.5 B 3.39 ± 0.18

The differences in letters horizontally refer to presence of significant value at (P<0.05).

Discussion

The hematological and serum protein values in total and in males and females, both tuberculin reactors and non-reactors, and in different age groups dairy cattle were presented in tables 1,2, and 3 give an idea about the nature of the health conditions of those investigated cattle. In this study, WBCs count showed higher values (P<0.05) in males than those of females , while serum globulin showed reverse results which were higher in females than those recorded in males (P<0.05), whereas other parameters showed no significant differences between them. This could be attributed to the role of immunity in both sexes which denoted to immune response to the tuberculin that stimulate local immune response and enhance delayed type hypersensitivity (DTH) in which the mononuclear cells (including lymphocytes, macrophages, dendritic cells, and others) played an important role in regulation of this type of immunity. In general, this study compared between tuberculin reactor and non-reactor dairy cattle and recorded that values of Hb, PCV, RBCs, MCV, total serum protein, and serum globulin were higher (P<0.05) in tuberculin non-reactor than those of reactor cattle, while WBCs count were higher (P<0.05) in non-reactor than those reactor. That finding could be implicated to the role of immunity (DTH) mentioned above. The role of age has no valuable effect in this study except serum globulin which was higher (P<0.05) in the age group >2- 3 years old in comparison with >3-6 age group which might be due to good health condition in this age group when compared with aged animals. Many studies

were performed in this regard; researchers registered data nearer to what found in the present study like (14) who studied the correlation between the tuberculosis positive reactors with non-reactors in 126 animals from an organized dairy farm by using the hematological and biochemical parameters. They found significant variations in ESR, Hb content, RBCs, MCV, monocytes, neutrophils and eosinophils counts in reactors when compared to non-reactors. They attributed their results to poor health status and chronicity of the disease as well as atrophy of the bone marrow. Anyway, serum albumin values were altered as reported by many researchers like (15). Some researchers like (16) studied haematological parameters and changes in serum proteins along with tuberculin test in 2057 buffaloes, 2273 cattle, 4983 sheep and 1987 goats; they found significant lower RBCs, WBCs, Hb, neutrophils and eosinophils while significantly higher monocytes percentage , serum total proteins, albumin and globulins were observed in tuberculin positive reactors buffaloes, whereas in cattle, significantly lower RBC count, PCV, neutrophils and serum albumin, while lymphocyte percentage was significantly higher in positive reactor animals. In addition, they noticed that albumin showed significant positive correlation with globulins in negatively reacting cattle, while this correlation was non-significant in positive reactor animals. In general, there were 21-30% of Hb, PCV, and RBCs, where at 1-3% of MCV, MCH and MCHC ranges of the present study were lower than the lowest reference ranges recorded by (11, 17, 18), and the MCV in line with their observations, this may not exclude the presence of normocytic normochromic anemia. This perhaps due to the chronic inflammatory diseases or rarely parasitism (17), while the upper limits of this study ranges were higher in Hb, PCV, and RBCs compared to the values registered by (11), and this may be attributed to individual variations or genetic factors. Other investigators used some blood parameters like (19), which conducted on 10 dairy cows to assess the trend of annual variations of some blood biochemical parameters; they depend on the results of blood constituents to compare between them according to the season and register some variations according to the age and season. Blood samples of 40 dairy cows were analyzed by (20) and tested for urea, albumin, total serum protein and glucose values. He found that albumin was low in the first week before parturition and returned to the normal level at the end of the fourth week after parturition (contrary to what we found).

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