Phenotypic Classification and Clinical Examination of Anemia in Iraqi Water Buffalo in Nasiriyah Governorate

Khitam Lateaf[1,*], Manar Hadi Allawi[2] and Nuha Jameel Akmoosh[2]

[1]AL-Furat AL-Awsat Technical University /Al-Mussaib Technical Institute, Najaf, Iraq

[2]University of Sumer/College of Agriculture, Al-Rifa'i District, Iraq

Abstract: This research aims to classify anemia cases in the Iraqi water buffalo population by collecting 140 blood samples from buffaloes in Nasiriyah Governorate pastures. These samples were collected randomly from three age groups: > 1 year, 1-4 years, and < 5 years. Blood sample analysis revealed 45 anemia cases (32.12%) and 95 healthy cases (67.88%). Phenotypic classification of anemia encompassed microcytic hypochromic (12.14%), macrocytic hypochromic (7.85%), normocytic hypochromic (6.42%), and normocytic normochromic (5.71%) cases. Erythrocyte sedimentation rate (ESR) notably increased in anemic buffaloes, displaying a statistically significant disparity (P< 0.05) compared to healthy counterparts. Anemia cases exhibited higher neutrophil counts in white blood cell relative differentials. For the three age groups, hemoglobin (Hb), packed blood cell volume (PCV), and total red blood cell count (RBC) values indicated significant decreases from normal levels, showcasing statistical significance (P< 0.05) between healthy and anemic buffaloes. While anemia cases generally displayed normal iron concentrations, microcytic anemia demonstrated lower iron levels in the 1-4 and >5 years age groups, with iron levels reaching the minimum global normal range in the <1 year age group. Copper concentrations remained normal in all healthy cases and anemia cases, except for microcytic anemia, which showed reduced levels across age groups.

In conclusion, this study comprehensively characterizes anemia in Iraqi water buffaloes through clinical, hematological, and elemental analyses. The findings underscore the prevalence of various anemia types, their age-related variations, and significant hematological deviations in anemic buffaloes compared to healthy counterparts. This research enhances our understanding of anemias' impact on this population and provides valuable insights for future diagnostic and management strategies.

Keywords: Buffalo, microcytic, macrocytic, hypochromic anemia.

INTRODUCTION

Anemia, characterized by an absolute reduction in packed cell volume (PCV), hemoglobin concentration, or red blood cell (RBC) counts, poses significant health concerns. Clinical manifestations include pale mucous membranes, elevated heart rate, and hypotension. While the diagnosis can be initiated through a complete blood count (CBC), further tests might be necessary for confirmation. Anemia arises from various factors, encompassing nutritional deficiencies, genetic predispositions, chronic diseases, and environmental factors. Buffalo is one of the important agricultural animals that spread around the world. It is found in Asian, African, South American, and some Mediterranean countries. The largest part of the world's population depends on the local water buffalo and not on the rest of the animals in the world because of its economic importance [1]. Buffalo is the main source of good-quality meat and milk in Egypt and some other developing countries. These animals are mainly raised on small farms, although there are difficulties in feeding [2]. In addition to the decrease in the number of buffaloes, the productivity of milk and meat decreased, which led to the inability of the local production of red meat and dairy to meet the increasing demand for these products until the Iraqi per capita share of animal protein did not exceed 17g of red meat and 7.4g of dairy, at a time when this demand is increasing due to the increase in population, high per capita income, and high rates of urbanization, compared to some other agricultural animals, and most of that research was conducted in special stations established for this purpose, with a focus On the study of the effect of environmental factors, especially nutrition, on animal productivity of milk and fat under those controlled conditions, it did not address other administrative and physiological factors that are less important in their impact on production, such as the size of the herd, the age at the first calving, the number of open days, the season of production, and others, especially in the prevailing production conditions in Iraq. The open or pastoral breeding system and the variation in the size of the herd between several animals led to several hundreds of them for a single breeder. As well as the scarcity of fodder and other factors led to a large variation in the animal's productivity of milk and meat [3].

Despite the substantial role that buffalo populations play in global food production, there exists a critical gap in our understanding of anemia classification and its

*Address correspondence to this author at the AL-Furat AL-Awsat Technical University /Al-Mussaib Technical Institute, Najaf, Iraq;
E-mail: khitam.hussain.ism@atu.edu.iq

ISSN: 1927-5196 / E-ISSN: 1927-520X/23

impact on buffalo health. Furthermore, the relationship between mineral element deficiencies, particularly iron, and copper, and the prevalence of anemia remains inadequately explored. Such knowledge gaps hinder comprehensive strategies for mitigating anemia and its associated negative effects on buffalo productivity and well-being. Addressing these gaps is not only essential for the sustainable production of meat and milk but also for ensuring the welfare of these animals. Therefore, this study aims to delve into the phenotypic classification of anemia and the potential influence of mineral element losses, contributing to a more holistic understanding of buffalo health and productivity optimization.

MATERIALS AND METHODS

The research was designed based on collecting blood samples from Iraqi water buffaloes, and 140 were collected randomly over more than five months. It contains a percentage of a group of proteins, enzymes, and salts taken from the animal station. Blood samples were collected from buffaloes after the animal was well controlled by the breeders, and 10ml was collected from the jugular vein immediately after sterilizing the place of withdrawal by wiping it with ethyl alcohol and then using syringes of 10ml with a size of 22G. Blood was collected with EDTA. The tubes containing the blood were moved quietly in the form of Letter 8 to ensure that the blood mixed with the anticoagulant substance in which the blood combines with calcium ions that are involved in the coagulation process [4]. The study included general clinical examination (temperature, pulse rate, respiration, and examination of mucous membranes) and conducting the following blood tests: counting total red blood cells (RBC) and white blood cells (WBC), calculating the amount of hemoglobin (Hb) and calculating the volume of blood cells. PCV. Determination of blood indicators, which are finding (MCV) average spherical volume, (MCH) average spherical hemoglobin, and (MCHC) average spherical hemoglobin concentration using a blood analyzer. For the examination of stained blood smears and calculation of the blood sedimentation rate (ESR), the Winthrop method was used, according to the approved source [5]. Moreover, conducting some biochemical tests included calculating the concentration of iron (Fe) in the serum and calculating the concentration of copper (Cu) in the serum using the spectrophotometer.

Statistical Analysis

Statistical analysis was performed using the Statistical Analysis System (SAS) program from 2012. The effects of different factors on study parameters were assessed using appropriate statistical techniques. Mean values ± standard deviation (SD) was utilized to establish significant comparisons between means, facilitating a robust evaluation of the data significance.

RESULTS

The results of the general clinical examination of 140 buffaloes showed that they varied in rates of temperature, respiration, and pulse, with the preservation of the normal color of the mucous membranes of 95 heads, which constituted 67.88%, while the rest 45 cases that suffer from anemia constituted 32.12%. It was distinguished by its pale color. As for the results of the general examination of buffaloes, which were suffering from varying symptoms of general weakness, lethargy, lack of appetite, and

Table 1: The Rates of Heat, Pulse, and Respiration of Healthy Buffaloes According to Age and Sex

Res./minute		Pulse/minute		Tem.C^0		SE±M Rang	Number		Age
F	M	F	M	F	M		F	M	
1.83±35.92 A	2.35±32.76 a	4.37± 78.27 a	4.12±79.77 a	0.37±37.99 A	0.66± 38.02 a	SE±M	14	13	Less than 1 year
(42-27)	(39-24)	(103-55)	(107-63)	(38.2-37)	(38.3-37.5)	Rang			
1.76±31.25 B	3.21±31.77 b	3.42±71.4 b	5.90±70.88 b	0.95±37.93 A	1.5±37.94 A	SE±M	20	9	1-4 years
(36-27)	(34-28)	(79-63)	(77-54)	(38.3-37.6)	(38.5-37)	Rang			
2.14±26.72 C	-	2.32±65.6 c	-	0.27±37.80 A	-	SE±M	39	0	More Than 4year
(29-24)	-	(67-61)	-	(38-37.4)	-	Rang			

**//The different English letters in one column indicate significant differences at the level ($p<0.05$) between ages.

paleness of the mucous membranes, it may be an indication of anemia, as in other animals, and this is consistent with what was mentioned in the sources [6, 7].

It was noted that there are statistically significant differences at the level ($p<0.05$) in the pulse and respiration of the three age groups. It was noted that the results of the study were no significant differences between males and females in healthy animals as well as in infected animals with regard to clinical values, which is consistent with what was mentioned by [6]. The results of the general clinical examination of temperature, pulse, and respiration of buffaloes suffering from anemia for the age group less than 1 year showed that the temperature in males had a rate of 39.60 and a range of 39.75-38.8, while for females the rate was 39.02 and a range 39.6-38.5. As for the pulse, it was recorded in males at a rate of 66.74 and with a range of 87-56, while in females, the pulse rate was recorded at 80.50 and with a range of 108-76, while respiration was recorded in males at a rate of 32.97 and in a range 40-26. Females have a respiratory rate of 37 and a range of 30-50. As for the age group 1-4 years, with regard to the temperature in males, the average was 39.22, and the range was 39.40-38.6, while the females had the rate of 39.96 and the range of 39.5-38.6, while the pulse was recorded in males with the rate 92 and the range 103-81, while for females, the pulse rate was recorded at 76.33 with a range of 92-63, while respiration was recorded in males at a rate of 36 and with a range of 33-39, while for females, the respiration rate was recorded at 34.28 with a range of 37-37.31. As for the age group of more than 4 years, in relation to the temperature of females suffering from anemia, the rate was 39.39, with a range of 39.75-39.10, while the pulse was recorded in females at a rate of 70.21 and a range of 91-53, while respiration was recorded in females, averaging 28.48 with a range of 47-21. It was found that the rate and range of temperature, pulse, and respiration for cases suffering from anemia recorded a rise in the rate and range compared to the international values for cows, except for the age group 1-4 years, as it was slightly higher than the global level 38.5, reaching 38.96. The range is 39.5-38.6 compared to the global range of 39-38, as shown in Table **2**.

Table **2** shows the case of comparison between males and females, where it was found that there are statistical differences at the level ($p<0.05$) between males and females in temperature, pulse, and respiration for cases with anemia in the age groups less than 1 year and 1-4 years, and there are also statistical differences at the level ($p<0.05$) between the age groups less than 1 year and 1-4 years in relation to temperature while the pulse and respiration were high in the age group 1-4 years:

1. 9 cases of normocytic hypochromic anemia appeared, with a rate of 6.42%, which included 3 cases from the age of 1-4 years and constituted 6.66% of the affected cases and 6 cases over the age of 4 years and 13.33 of the total infected, as shown in (Figure **1**). There are no significant differences between ages for all clinical values. Paleness of the mucous membranes has been observed in all animals, consistent with what was indicated by [5].

2. The results also showed 8 cases of normocytic anemia, with a rate of 5.71%, which included 4 cases of age less than 1 year, and constituted 8.88% of the total affected cases, and 2 cases were recorded at the age of 1-4 years old, which

Table 2: Rates of Heat, Pulse, and Respiration of Buffalo that Suffer from Anemia According to Age and Sex

Res./minute		Pulse/minute		Tem.C^0		SE±M Rang	Number		Age
F	M	F	M	F	M		F	M	
3.75±37 A	3.36±32.97 B	5.96±82.5 A	3.98±66.74 B	0.16±39.02	0.24±39.60	SE±M	5	7	Less than 1 year
(50-32)	(40-26)	(108-76)	(87-56)	(39.6-38.5)	(39.75-38.8)	Rang			
2.35±34.28 B	6.60±36 A	6.42±76.3 B	5.98±92 A	0.37±38.96	0.53±39.22	SE±M	10	2	1-4 years
(37-31)	(39-33)	(92-63)	(103-81)	(39.5-38.6)	(39.4-39.8)	Rang			
1.44±28.48 C	-	2.34±70.2 c	-	0.38±39.40 A	-	SE±M	21	0	More Than 4year
(47-21)	-	(91-53)	-	(39.75-39.1)	-	Rang			

included 4.44% of the total infected cases, and 2 cases were recorded over the age of 4 years, and constituted 4.44% of the total infected cases, as shown in (Figure **1**). There are no significant differences between ages for this type of anemia.

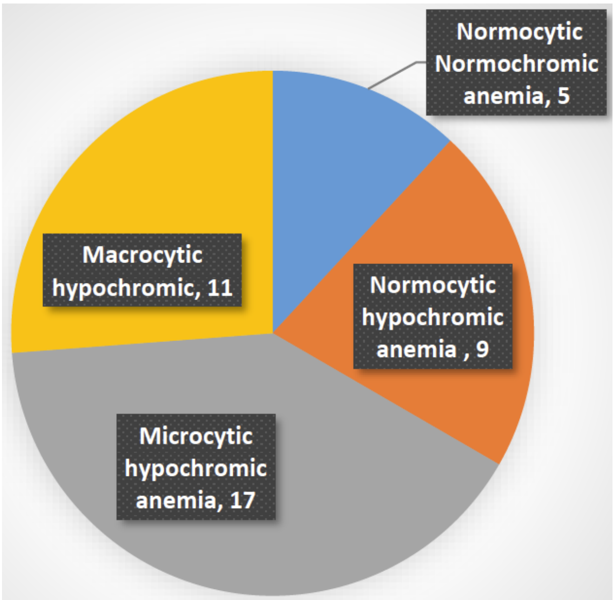

Figure 1: The types of anemia and the numbers and proportions of infected buffaloes for both sexes.

3. The results showed 17 cases of microcytic anemia with a rate of 12.14%, which included 6 cases with an age of less than 1 year and constituted 13.33% of the total affected cases, and 3 cases with an age of 1 year recorded. 4 years old, which constituted 6.66% of the total infected cases, as shown in (Figure **1**). 8 cases were recorded over 4 years old and constituted 17.77% of the total infected cases. A temperature was recorded at a rate of 38.81-39.80°C, a respiration rate of 26.87-35 times/min, and a pulse rate of 65.28-76.66 beats/min. There were no significant differences between ages, as shown in (Table **3**).

4. The results showed 11 cases of megaloblastic anemia with a rate of 7.85%, which included 2 cases of age less than 1 year and constituted 4.44% of the total affected cases, and 3 cases recorded at the age of 1-4 years old, which constituted 6.66% of the total infected cases, and 6 cases were recorded at the age of more than 4 years, which constituted 13.33% of the total infected cases, as shown in (Figure **1**).

The average number of red blood cells for healthy buffalo males was (8.07-8.39) X 106 /µl, while healthy buffalo females recorded a rate of (7.72-8.47) X 106 /µl, while the rate of red blood cells in infected male buffaloes was (7.22-7.40). X 106 / µl, either infected buffalo females recorded a rate of (6.64-7.84) X 106 /µl, or the rates of the number of red blood cells in infected buffaloes differed according to each type of anemia, reaching the normal normocytic type (6-8.25) X 106 /µl, either in normal balls with low pigmentation (7.27-7.33) X 106 /µl, in small balls with little pigmentation (7.93-8.30) X 106 /µl, and in large balls with little pigmentation (4.43-4.58) X 106 /µl. The statistical results showed that there was no significant difference at the level of ($p \geq 0.05$) between males and females of different ages, but there was a significant difference at the level of ($p \leq 0.05$) between the volume of red blood cells of infected and healthy buffaloes.

The rate of hemoglobin in healthy buffalo males was 11.16-11.49g/dl, while the rate of 10.42-12.21g/dl was recorded in healthy females. As for the infected males, the rate was 8-8.27g/dl, and the infected females had a

Table 3: Heat, Pulse, and Respiration Rates for Infected Buffaloes with Hypochromic Anemia According to Age

Res./minute	Pulse/minute	Tem.C^{0}	SE±M Rang	Number	Age
1.41±35 A	2.59±65.28 C	0.11±39.12 B	SE±M	6	Less than 1 year
(42-31)	(83-56)	(39.5-38.8)	Rang		
2.80±30 B	3.72±76.66 A	0.60±39.80 A	SE±M	3	1-4 years
(36-28)	(94-62)	(40-38)	Rang		
2.47±26.87 C	4.52±67.37 B	0.21±38.81 C	SE±M	8	More Than 4year
(27-24)	(70-54)	(39.3-38.6)	Rang		

rate of 7.46-8.26g/dl, and its rates differed in infected buffaloes according to each type of anemia. It reached 6.20-8.85g/dl in normocytic and hypochromic 7.40-7.48g/dl and normocytic microcephaly 7.40-7.48g/dl, 7.42-8.11g/dl and with a large, slightly pigmented globule 7.70-8.66g/dl.

The rate of (PCV) in healthy buffalo males was 35.15-37.32%, and the rate of 33.15-36.28% was recorded in healthy females. As for the infected males, the rate was 26.34-27%, and for the infected females, it was 24.76-27.72%, and the rates differed. In infected buffaloes, according to each type of anemia, where the normocytosis reached 20-28.50%, the normocytosis with little pigmentation 25.83-28.80%, the small globule with little pigmentation 23.87-27%, and the large globule with little pigmentation 25.66-28.66%.

The average spherical size rates in healthy buffalo males were 43.10-45.11FL; in healthy females, the rate was 43.12-48.19FL. Either the infected males recorded a rate of 34.30-36.48FL and infected females a rate of 31.57-39.70FL. The rates differed. In infected buffaloes, according to each type of anemia, where normal leukemic, normal pigmentation was 33.33-34.62FL, either normal leukemic low pigmentation 35.02-35.49FL, small leukemic low pigmentation 30.07-31.88FL, and large leukemic low pigmentation 30.07-31.88FL, 58.08-62.59FL.

The average levels of hemoglobin concentration in healthy buffalo males were 30.84-32.45g/dl, and in healthy females, the rate was 31.59-33.66 g/dl. Either infected males recorded a rate of 29.62-31.44g/dl, and infected females recorded a rate of 29.75. -30.87g/dl, and its rates differed in infected buffaloes according to each type of anemia, reaching 31-31.74g/dl in normal hemoglobin or between 28.80-29.34g/dl in hemochromatosis. The small globule has little pigment 29.23-31.14g/dl, and the large globule has little pigment 30.23-31.69g/dl.

The average spherical hemoglobin reached rates in healthy buffalo males 13.92-14.36pg; in healthy females, it recorded a rate of 14.23-15.30pg. Either infected males recorded a rate of 10.80-12.22pg, and infected females recorded a rate of 10.02-11.98pg. Its rates differed in infected buffaloes according to each type of anemia, and it reached 10.33-10.98pg in normocytic normocytosis 10.08-10.27pg, microglobulin with little pigment 9.32-9.76pg, and macroglobulin 9.32-9.76pg Low pigmentation 17.46-18.90pg.

The mean of the total count of white blood cells in healthy buffalo males was (8.50-9.05) X 103 /µl, while healthy buffalo females recorded a rate of (9.74-10.34) X 103 /µl, while the rate of white blood cells in infected buffalo males was (9-9.49) X 103 /µl, either the infected female buffaloes recorded a rate of (8.14-9.02) X 103 /µl or the rates of the number of white blood cells in the infected buffaloes differed according to each type of anemia, reaching the normal normocytic type (6.50-8.60) X 103/µl, either in normal balls with low pigmentation (8.58-11.66) X 103/µl, in small balls with a little pigmentation (8.93-9.65) X 103/µl, and large balls with a little pigmentation (8.93-9.15) X 103/µl.

The sedimentation rate of red blood cells in healthy buffalo males in the first hour was 19.53-28mm/hr, and in 24 hours, 88.56-93.44mm/hr. As for healthy females, it was in first hour 16.49-65.27mm/hr and 24 hours 91.27-115.46mm/hr; in males with anemia, it reached 44.05-50mm/hr in the first hour and 24 hours 108.57-133mm/hr. In females with anemia, it reached 29.60 in

Table 4: Sedimentation Rates of Erythrocytes for Healthy Buffaloes of both Sexes, According to Age

24hr mm/hr		1hr mm/hr		SE±M Rang	Number		Age
F	M	F	M		F	M	
13.47±85.20 B	14.40±108.57 A	7.85±29.60 B	11.20±44.05 a	SE±M	5	7	Less than 1 year
(93-78)	(115-100)	(33-25)	(46-30)	Rang			
11.21±119.6 B	12.07±133.9 A	13.21±57.33 A	11.68±50 B	SE±M	10	2	1-4 years
(116-101)	(141-117)	(63-)45.5	(60-43)	Rang			
4.24±128.9 A	-	15.11±75.14 A	-	SE±M	21	-	More Than 4year
(122-135)	=	(80-53.5)	-	Rang			

Table 5: Average Values of Iron and Copper for Healthy Buffaloes According to Age and Sex

μmol /dl Fe		Cu μmol /dl		SE±M Rang	Number		Age
F	M	F	M		F	M	
0.90± 26.65 A	0.84± 25.88 b	0.85± 15.20 A	0.73± 13.91 b	SE±M	14	13	Less than 1 year
(37-21)	(19-36)	(17-13.5)	(20-12)	Rang			
0.86± 26.60 A	0.91± 27.30 a	0.78± 15.78 A	0.82± 15.29 a	SE±M	20	9	1-4 years
(32.5-18)	(29-25)	(21.5-13)	(18-12.5)	Rang			
0.81± 26.44 A	-	0.76± 15.82 A	-	SE±M	39	0	More Than 4year
(31-23.4)	-	(17-13.75)	-	Rang			

Table 6: Iron and Copper Levels for Anemic Buffaloes by Age and Sex

Age	Number		SE±M Rang	Cu μmol /dl		μmol /dl Fe	
	F	M		F	M	F	M
Less than 1 year	5	7	SE±M	0.64±13 a	0.62± 12.37 b	0.65± 13.72 A	0.67± 14.49 b
			Rang	(13.5-9)	(14-8.25)	(15-7)	(16.5-9)
1-4 year	10	2	SE±M	0.62± 12.11 b	0.82± 16.40 a	0.67± 12.43 B	0.86± 17.30 A
			Rang	(13-9.5)	(19-10.5)	(13.25-8)	(21-10)
More than 4 year	21	-	SE±M	0.70± 13.09 a	-	0.68± 13.53 A	-
			Rang	(13.8-11.2)	-	(15-8.75)	-

the first hour -75.14mm/hr and 24 hours 85.20-128.9mm/hr.

The average concentration of copper in blood serum in healthy buffalo males was 13.91-15.29 μmol/dl. In healthy females, the rate was 15.20-15.82 μmol/dl. As for infected males, the rate was 12.37-16.40 μmol/dl, and for infected females, at 12.11-13.09 μmol/dl. Its rates differed in infected buffaloes according to each type of anemia, as it reached 7.33-9.79 μmol/dl in microcytic oligomers, as shown in Table **5**.

The mean concentration of iron in blood serum in healthy buffalo males was 25.88-27.30 μmol/dl; in healthy females, the rate was 26.44-26.66 μmol/dl. As for infected males, the rate was 14.49-17.30 μmol/dl, and for infected females, at 12.43-13.72 μmol/dl. Its rates in infected buffaloes according to each type of anemia, reaching 8.90-10.08 μmol/dl in microcytic oligomers, as shown in Table **6**.

The results showed that the rate and extent of iron and copper in the healthy cases of the three age groups fall within the global normal range, and there are no statistical differences between males and females, as shown in Table **6**.

DISCUSSION

The present study showed, in the case of comparison between males and females, that there are statistical differences at the level ($p<0.05$) between males and females in temperature, pulse, and respiration for cases with anemia in the age groups less than 1 years and 1-4 years, and there are also statistical differences at the level ($p<0.05$) between the age groups less than 1 years and 1-4 years in relation to temperature, as the average temperature was 39.60 for the age group less than 1 compared with the age group 1-4 years old, when the average temperature was 39.22, while the pulse and respiration were high in the age group 1-4 years, where the pulse rate was 92 and respiration 36, compared to the age group less than 1 years, when it reached Pulse rate 66.74 and respiration rate 32.97. The reason for the rise, which is the opposite of expectation (as the pulse and respiration usually rise at young ages), may be attributed to the small number of animals taken for males, which does not constitute a statistical value. By examining 140 blood samples, it was found that there are 45 cases suffering from anemia, i.e., 32.12% of the total blood samples. The reason for this is the presence of blood parasites that are usually active in the summer due to the presence of ticks, which are the main carriers of many diseases.

The research results did not agree with what was mentioned by 10 that the ESR values in the infected buffalo varied between 57-111mm/hr in the first hour. The sedimentation rate of erythrocytes may explain that it is affected by the following: The presence of electric charges on The surface of red blood cells and the number of red blood cells per unit volume of blood. The results of measuring the sedimentation rate of red blood cells for blood samples taken from buffaloes showed an increase in the sedimentation rate of red blood cells, and this could be explained by changes in the difference in the negative electrical charges on the surface of blood cells Erythrodermas, and related to changes in the positive charges of plasma and plasma colloids, which leads to possible physical and chemical changes on the surface of red blood cells and occurs due to inflammatory diseases that cause the formation of dead and shattered tissues, which leads to aggregation of red blood cells and leads to an increase in fibrinogen in the plasma that plays a role in an increase in the rate of sedimentation Erythrocytes, as indicated by both [8]. As for the varying degrees of plasma color from pale yellow to orange, this may explain the cases of (Hyperbilirubinemia) and be due to cases of hemolysis, diseases of the gastrointestinal tract that cause the return of bilirubin, type Food intake (carotenoids and xanthophylls), states of hunger as indicated [5]. Poikilocytes, which are related to endothelial breakdown and/or fibrin storage, are also observed during infectious diseases, inflammation, or tumors in multi-vascular organs such as the lung, liver, spleen, kidney, bone marrow, and placenta. (during the last trimester of pregnancy), and this is consistent with what was indicated by [7, 9, 10]. Researchers have confirmed that a lack of protein in food or damage to the liver leads to a decrease in the amount of fibrinogen and most globulins in plasma, which delays the process of erythrocyte sedimentation [11].

The study showed a decrease in the value of serum iron in all diseased groups compared to healthy cases, followed by a decrease in the degree of saturation of transferrin, which is the protein responsible for transporting iron in the body, and an increase in the total iron binding capacity and the unsaturated iron binding capacity for all diseased cases, and these results are similar to what was mentioned by both [12, 13]. The toxicity of infections and pathological secretions lead to a short life of red blood cells, Which increases the catabolism of iron and its conversion to ferritin, which turns into hemosiderin deposited in tissues [14]. It has also been explained that continuous and chronic bleeding affects iron stores in the body and blood, in addition to the lack of absorption from the intestines due to digestion problems or the presence of toxic substances that impede iron absorption [6]. The imbalance may be in the use of iron stores, and one of its causes is copper deficiency. The results of examining the concentration of iron and copper in the serum amounted to 8.90-10.08μmol/dl and 7.33-9.79μmol/dl, respectively, which we obtained through research for the type of microcytic anemia. Al-Sabbagh confirms that there is a decrease in the concentration of iron and/or copper in the serum of buffaloes affected with this type of anemia when comparing the results of the tests we obtained for iron and copper with the results of the healthy buffalo, and this is consistent with what was indicated by [4, 5]. However, the results of the study did not agree with what was indicated by [15], which may explain and indicate an increase in copper during pregnancy and a decrease during lactation due to the demand from the fetus at different periods of pregnancy, and the reason for the difference may be due to environmental conditions as well as the amount of copper provided to the animal through the diet and fodder. The reason may be mainly due to its deficiency in the soil, Which leads to a decrease in animal diets.

CONCLUSION

In conclusion, this comprehensive study aimed to classify anemia cases in the Iraqi water buffalo population through clinical, hematological, and elemental analyses. The research was based on collecting 140 blood samples from buffaloes in Nasiriyah Governorate pastures, randomly selected from three age groups: less than 1 year, 1-4 years, and over 4 years. Analysis of these samples demonstrated that 32.12% of the cases exhibited anemia, while 67.88% were healthy.

The anemia cases were further characterized based on phenotypic classification, including microcytic hypochromic, macrocytic hypochromic, normocytic hypochromic, and normocytic anemias. Erythrocyte sedimentation rate (ESR) was remarkably increased in anemic buffaloes compared to healthy ones. Notably, anemia cases displayed distinct variations in neutrophil counts among white blood cell differentials.

Between the three age groups, considerable decreases in hemoglobin (Hb), packed blood cell volume (PCV), and total red blood cell count (RBC) were observed in anemic buffaloes than in healthy counterparts. Interestingly, while most anemia cases showed average iron concentrations, microcytic anemia displayed lower iron levels, particularly in the 1-4 and >4 age groups, even reaching the minimum global normal range in the <1 year age group. Copper concentrations remained mainly within the normal range, except for microcytic anemia, which exhibited reduced levels across age groups.

This research sheds light on various aspects of anemia in Iraqi water buffaloes. It highlights the prevalence of different anemia types, age-related variations, and significant hematological deviations in anemic buffaloes compared to healthy ones. The study contributes valuable insights into the impact of anemia on buffalo health and productivity. By deepening our understanding of anemia in this population, the research provides essential information for future diagnostic and management strategies to improve buffalo welfare and optimize productivity.

REFERENCES

[1] Bilal MQ, Suleman M, Raziq A. Buffalo: Black gold of Pakistan 2006; 18(9).

[2] Ahmed WA, Nabil GM, EL-Kadrawy HH, Hanafi EM, Abdel-Moes SI. Monitoring Progesterone level and markers of oxidative stress in a blob of buffalo cows with impaired fertility. Egyptian Journal of Biophysics and Biomedical Engineering 2006; 7: 71-83.

[3] Ragab ET. Buffalo production with emphasis on marsh areas AG: DP/IRAQ/71/ 5360 Terminal report, Rome, Italy 2009.

[4] Coles EH. Veterinary Clinical Pathology. 4th ed., WB Saunders Co Philadelphia, London, Toronto 1986; pp: 31, 86, 376, 408-436.

[5] Weiss DJ, Wardrop KJ. Schalm's Veterinary Hematology . 6th ed. Wiley – Blackwell. The USA 2010.

[6] Radostits OM, Gay CC, Hinchcliff KW, Constable PD. Veterinary Medicine: A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats. 10th Edition, Elsevier Saunders, London 2007; pp. 966-994.

[7] Smith BP. Large Animal Internal Medicine, 4th Ed. Mosby-Elsevier Publishing. St. Louis, MO 2009; pp. 1058-1059.

[8] El-Magd MA, Fathy A, Kahilo KA, Saleh AA, El Sheikh AI, Al-Shami S, El-Komy SM. Polymorphisms of the PRLR Gene and Their Association with Milk Production Traits in Egyptian Buffaloes. National Library of Medicine 2021; 11(5): 1237. https://doi.org/10.3390/ani11051237

[9] Hugher-Jones NS. Iron Metabolism and Iron Deficiency Anemia in Lecture Notes on Hematology. Oxford Blackwell Scientific Publication 2003; pp. 1-13.

[10] Cooper ACD. Hematology of normal native cattle in Botswana. Trop Anim Health and Prod 2002; 6: 53-54. Constituents during the fattening of Hereford and Angus cows can. J Anim Sci 55: 403-408. https://doi.org/10.1007/BF02380749

[11] Khan MS, Ahmad N, Khan MA. Genetic resources and diversity in dairy buffaloes of Pakistan. Pakistan Vet J 2007; 27: 201-207.

[12] Abdel-Salam M, Mahran OM. Some biochemical changes in the blood serum of Balady goats infested with internal and external parasite Assiut Governorate. Assuit Vet Med J 2004; 50(102): 150. https://doi.org/10.21608/avmj.2004.178957

[13] Jacgues W. Interpretation of Diagnostic Tests. 7th. ed. Lippin Cott Williams and Wilkins 2000; pp. 332-348.

[14] Feldman BF, Kaneko JJ, Farver TB. Anemia of inflammatory disease in dog: Clinical characterization. Am J Vet Res 2001; 42(7): 1109-1112.

[15] Akhtar MS, Farooq AA, Muhammad SA, Lodhi LA, Hayat CS, Aziz MM. Serum electrolyte and mineral variations during pregnancy and lactation in Nili-Ravi buffalo. Biol Trace Elem Res 2010; 137(3): 340-3. https://doi.org/10.1007/s12011-009-8581-9

Received on 13-07-2023 Accepted on 08-09-2023 Published on 25-09-2023

https://doi.org/10.6000/1927-520X.2023.12.12

© 2023 Lateaf *et al*.; Licensee Lifescience Global.
This is an open-access article licensed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the work is properly cited.