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A comparative study on the measurement of iron on the blood serum of healthy and infected Iraqi camels

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Abstract

A total of 75 blood samples were randomly collected from Iraqi camels in Karbala Governorate for both sexes, with different ages, ranging from 6 months – 19 years) for the time period from the beginning of 1/6/2022 until 1/6/2023, where the number of healthy camels was (45) by (60%) and the number of sick camels (30) b (40%). The results of the clinical examination of sick camels were compared with healthy camels, which were characterized by the following symptoms and clinical signs: (fatigue - sluggishness - loss of appetite - paleness and yellowing of the mucous membranes - changes in degree of fever - diarrhea - irregularity and roughness of the hair - intolerance to carrying weights and walking long distances). The results of examining the temperature, rate of pulse and respiration for healthy camels were less than they are in sick camels. The temperature of healthy camels was (35.88-36.94) C^o, while sick camels were (36.8-38) C^o, the pulse and respiration speed respectively in healthy camels was (37.59) - 43.58) pulse / minute, (9.05 - 13.08) Res./minute. As for the pulse and respiration speed of sick camels, respectively, they were (44.72 - 64.42) pulse / minute, (11.8 - 1) Res./minute. Thus, the results of the statistical analysis of temperature, pulse and respiration speed, there was a significant statistical difference at the level ($p<0.05$) between the values of healthy and sick camels to all samples for both sexes. As for the results of examining the concentration of iron in blood serum, the average of iron concentration in healthy camels was (70-82) µg /dL, while sick camels recorded (42-116) µg /dL. The statistical results showed that the least significant statistical difference (L.S.D) had (22.38). We noticed that there was no statistically significant difference in the percentage of iron with respect to sex at the level of $p>0.05$. The results also showed that there were statistically significant differences at the level of $p<0.05$ in the concentration of iron between healthy and sick camels.

Keywords: Camels, Iron, Blood serum, Healthy, Sick.

دراسة مقارنة لقياس مستوى الحديد في مصل دم الإبل العراقية السليمة والمريضة

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الخلاصة

تم جمع (75) نموذج دم بشكل عشوائي من الابل العراقية في محافظة كربلاء لكلا الجنسين باعمار مختلفة تراوحت (6 month – 19 years) للفترة الزمنية من بداية 2022/6/1 ولغاية 2023/6/1 حيث كان عدد

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الابل السليمة (45) بنسبة (60 %) وعدد الابل المريضة (30) حيوان بنسبة (40 %) .كانت نتائج الفحص السريري للابل المريضة بمقارنتها مع الابل السليمة التي تميزت بالاعراض والعلامات السريرية الاتية :(التعب – النحول - فقدان الشهية - شحوب واصفرار الاغشية المخاطية – تغيرات بدرجة الحرارة - الاسهال - عدم انتظام الوبر وخشونته - عدم التحمل لحمل الاثقال والسير لمسافات طويلة). كانت نتائج فحص درجة الحرارة وسرعة النبض والتنفس للابل السليمة اقل مما هي عليه في الابل المريضة فكانت درجة حرارة الابل السليمة (35.88 – 36.94) م ^{o} اما الابل المريضة كانت (36.8 – 38) ^{0}م. سرعة النبض والتنفس على التوالي بالابل السليمة كانت (37.59 - 43.58) Pulse /minute ، (9.05 – 13.08) Res./minute اما سرعة النبض والتنفس للابل المريضة ايضا على التوالي كانت (44.72 - 64.42) Pulse /minute، (11.8 – 1) Res./minute وبذلك اظهرت نتائج التحليل الإحصائي لدرجات الحرارة وسرعة النبض والتنفس وجـود فـرق احصائي معنوي بمستوى ($p < 0.05$) بين قيـم الإبل السليمة والمريضة لجميع النماذج ولكلا الجنسيـــن .اما نتائج فحص تركيز الحديد بمصل الدم ،سجل معدل تركيز الحديد بالإبل السليمة (70 - 82) مايكروغرام/ دسي لتر أما الابل المريضة سجلت (42 – 116) مايكروغرام/ دسي لتر ، وذلك بينت النتائج الإحصائية ان الفرق الاحصائي المعنوي الاصغر (L.S.D) لها (22.38) .لاحظنا عدم وجود فرق احصائي معنوي بنسبة الحديد بالنسبة للجنس بمستوى ($p >0.05$) كما أظهرت النتائج وجود فروق احصائية معنوية بمستوى ($p < 0.05$) في تركيز الحديد بين الإبل السليمة والمريضة .

الكلمات المفتاحية: الابل ، الحديد ، مصل دم ، ، السليمة ، المريضة.

Introduction

The Arab man benefited from camels in several fields and over many ages. The camel is considered a symbol of independence, wealth and strength. The presence of the camel in our Arab countries has contributed to the enrichment of our heritage and civilization. The camel is hardly mentioned without the characteristics of suffering and patience coming to mind, for it is that creature capable of living and giving in the midst of the harsh conditions of the Arabian desert (WHO, 2011; FAO, 1994; FAO, 2013; Bernard Faye *et al*., 2012). All the findings of scientific studies regarding the camel in recent years are few and far between it, where still hides many secrets that may be revealed with time (Richard Didier *et al*., 1984). The amount of blood in a camel is 93 mm / kg of live weight, and this number is much higher than that of other animals. The shape of the red blood cells in the camel are characterized by being oval in shape and their size is subject to change according to the state of hydration, also they are distinguished by their tremendous hardness that resists explosion (Al-Janabi, & Al-Jalili,1990); (Wu *et al*., 2014). The number of red blood cells reaches 4-10 million cells m^3, while the percentage of the total blood is 25-30%. The life span of red blood cells is prolonged during the period of thirst so that the camel does not cost its death and renewal (Mohammed El Khasmi & Bernard Faye, 2019). A decrease in the amount of water in the bodies of many animals causes an increase in the viscosity of the blood, which leads to a rise in the internal temperature of the body and sometimes to death; While the camel, the viscosity of its blood remains constant, even if there is a lack of water in its body, which allows the process of thermal transfer from the extremities of the body to the heart (Wernery and Kaaden, 2002).

The camel is a warm-blooded animal (stable body temperature), but it can change its body temperature, adapting to the ambient temperature (Brini, 2021). When the outside temperature drops at night, the camel's body temperature drops to (34) degrees Celsius, but when it's hot, its body temperature reaches (42) degrees Celsius without having a fever; Such temperature fluctuation is fatal to most mammals (Rassim Khelifa *et al*., 2021; Annarita Mariotti *et al*., 2015). The desert environment is not only hot and dry, but it is characterized by poor food sources and weak seasonal and annual diversity, but the camel has techniques to adapt to every shortage that may occur in the basic components of food (energy, protein, salts); (Ayoub Zeroual *et al*.,

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2016; Sahnoune Fatiha *et al*., 2013). Several studies have shown that the camel has the highest conversion energy for fodder with poor nutritional value compared to other domesticated animals, and the secret is that the food remains for a long time in its stomach (Ayoub Zeroual *et al*., 2016). The iron element is one of the salts of minerals, it is a highly toxic substance; therefore, it is never found in a free form inside the body, but rather there is linked to a substance called apotransferrin to be a new substance that floats in the blood plasma or serum called transferrin. This substance goes to the cells to release iron and binds to other proteins forming enzymes or Hemoglobin; iron in excess of the body's need is linked again to a new enzyme responsible for storing iron in the cells called apoferritin, forming another enzyme called ferritin, which is the substance that is stored in the body until the body needs iron to be released again into the cell and used when the iron coming from the blood decreases (Krishnamurthy, 1984; Kaneko *et al*., 1997). Hemoglobin enters the formation of red blood cells, which transport oxygen from the lungs to the cells of the body, to complete the oxidation process, and transport carbon dioxide from the cells to the lungs, to be exhaled during the exhalation process (Hawkey and Gullan, 1988). It is also included in the composition of the enzymes responsible for the oxidation of carbohydrates, fats and proteins, and it is included in the composition of muscle myoglobin, which is responsible for storing oxygen for use in muscle contraction. Thus, most of the iron in the body is found in red blood cells to manufacture hemoglobin, then in the liver it is stored in the form of ferritin and then in Muscles in the form of myoglobin (Krishnamurthy, 1984; Kaneko *et al*., 1997). Iron is absorbed in the upper part of the small intestine, in the form of ferrous compounds, with the help of gastric juice and vitamin C. absorption decreases when there are alkaline substances, such as oxalate and tannic acid. Iron is stored in the liver, spleen, and bone marrow until the body needs it (Jain, 1986). A sufficient amount of hydrochloric acid must be present in the stomach in order for iron to be absorbed, also requires the presence of copper elements and / or vitamin B complex to ensure complete absorption of iron, and taking vitamin C can increase the absorption of iron at a rate (30%) On the other hand, excessive amounts of zinc and vitamin E hinder iron absorption (Houten Van, 1992). Another benefit of iron is that it strengthens the immune system and raises the body's ability to resist diseases. As for iron deficiency, it leads to anemia, which is called iron deficiency anemia; This type of anemia is also called according to the shape of the red blood cell and its hemoglobin content (Hypochromic microcytic anemia); This type of anemia occurs either due to iron deficiency or the body's failure to use iron optimally to manufacture hemoglobin ; Also, this type of anemia may occur with chronic blood loss and copper deficiency, because copper contributes to the formation of hemoglobin through its important role in the reuse and use of iron liberated from the natural breakdown of hemoglobin (Janz *et al.*, 2013). The normal values of iron in camels range from (40-56) mg/100 ml in whole blood, (85-120) µg/100 ml in plasma, and (100-320) µg/100 ml in serum (Longmore *et al*., 2004; Higgins and Kock, 1984). Racing camels (camels) need iron in building red blood cells necessary for transporting oxygen and energy, as well as in building muscles and in forming enzymes responsible for vital processes in the body. Any decrease in iron negatively affects the performance of the animal (Krishnamurthy US, 1984; Kaneko *et al*., 1997). Symptoms of iron deficiency include dry, pale skin, digestive disorders, lethargy, fatigue, shortness of breath, rapid heart palpitations, itching, fragility and falling or breaking of the hair of skin and its lack of shine (Radostits *et al*., 2000; Rodak, 2007; Babeker *et al*., 2013; Badiei *et al*., 2006).

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Despite the efficiency of camels and their physiological ability to withstand the desert environment and adapt to the harsh conditions of the desert, this animal can be affected by an imbalance in the proportion of minerals in the animal's body, as a result it affects the animal's health and productivity. Therefore, we were chosen for the subject of this research to find out the normal levels of iron in the blood serum of camels that have good health and compare them with the levels of iron in the blood serum of camels that suffer from diseases, then to see if the veterinarians can use or depended values that were obtained in the research in the diagnosis of diseases in camels.

Materials and Methods

Selection of research animals: A total of 75 Iraqi camels were randomly selected from the camels that graze in the natural pastures of Karbala Governorate, those that are brought for treatment in the veterinary clinic in the governorate, and those that are slaughtered in the Karbala massacre for the period of time from the beginning of 6/1/2022 to 6/1/ 2023 As for the ages of the camels, they were between (6 months - 19 years), where the animals were divided into groups according to age, sex and health status, as shown in Table (1).

Table (1): Total number, number and ages of healthy and sick camels for both sexes

Age/Year	Sex	Total Number	Healthy Camels	Sick Camels
6 month – 4 years	She camel	16	10	6
6 month – 4 years	Camel	6	4	2
5 years – 9 years	She camel	21	15	6
5 years – 9 years	Camel	10	6	4
10 years – 14 years	She camel	7	2	5
10 years – 14 years	Camel	6	3	3
15 years – 19 years	She camel	5	3	2
15 years – 19 years	Camel	4	2	2
Total		75	45	30

Clinical examination of research animals: We conducted the clinical examination of the research camels according to the method of (Radostits *et al*., 2000; Rodak, 2007), by examining the health status of camels, which included examining the skin covering, measuring the rate of pulse and respiration, and temperature. Some camels were in good health, while others were infected with various diseases, such as respiratory, skin, or digestive diseases, or infection with internal parasites and blood parasites, such as infection with trypanosomiasis.

Collection of blood samples: A total of 75 blood samples were collected from Iraqi camels used in research randomly using the method of (Schalm *et al*., 2010), where (10) ml of venous blood volume was drawn after the jugular vein was sterilized by wiping apiece of cotton in ethyl alcohol by a syringe with a volume of (10 mm 3), the blood was placed in bottles free of anticoagulant in order for the blood to coagulate to isolate the serum, and after the complete clotting process of the blood, it was placed in a centrifuge of 5000 cycles / minute, then the separated serum was withdrawn and

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placed in clean and sterile bottles using droppers used Once, the bottles are closed well and kept in freezers at a temperature of (-30°C) until the process of measuring the percentage of iron for each sample is carried out after all samples are collected.

Check the amount of iron in the serum: We used a special kit to test iron in serum, produced by Biomaghreb Company. It consists of reagent No. (1) guanidine and hydrolic acid (4.5 mmol / L) PH5 acetate buffer, reagent No. (2) consists of ascorbic acid). reagent No. (3) consists of ferrous compounds (40 mmol / liter), and reagent No. (4) consists of the standard (mg / liter).

Data analysis: The data was analyzed in MS Excel spreadsheets (coded, entered, corrected and validated by the research team using (Core, 2021).

Results and Discussion

The total number of the animals' research was (75) animals for both sexes and ages. It is age (6 months - 19 years), as shown in Figure No. (1,3,2) were divided into two main groups (a group of healthy camels and a group of sick camels) also each group was divided into four groups according to age and sex, where the number of healthy camels was (45) by (60%) and the number of sick camels was (30) animals by (40%). The results of the clinical examination of sick camels were compared with healthy camels with the following symptoms and clinical signs (fatigue - emaciation - loss of appetite - paleness and yellowing of the mucous membranes - changes in temperature - diarrhea - irregularity and roughness of the hair - inability to walk long distances and carry weights).

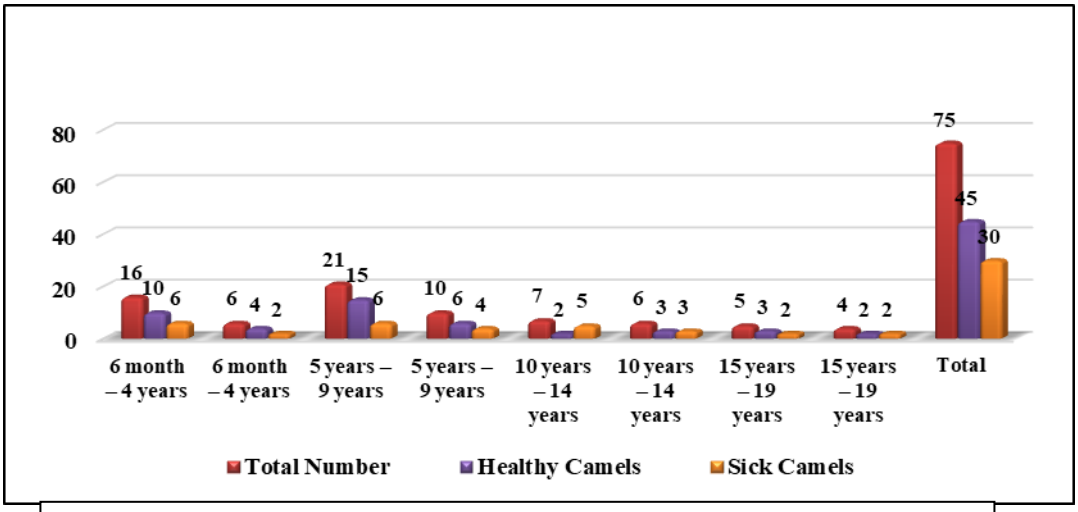

Figure (1): Total number number and ages of healthy and sick camels for both sexes

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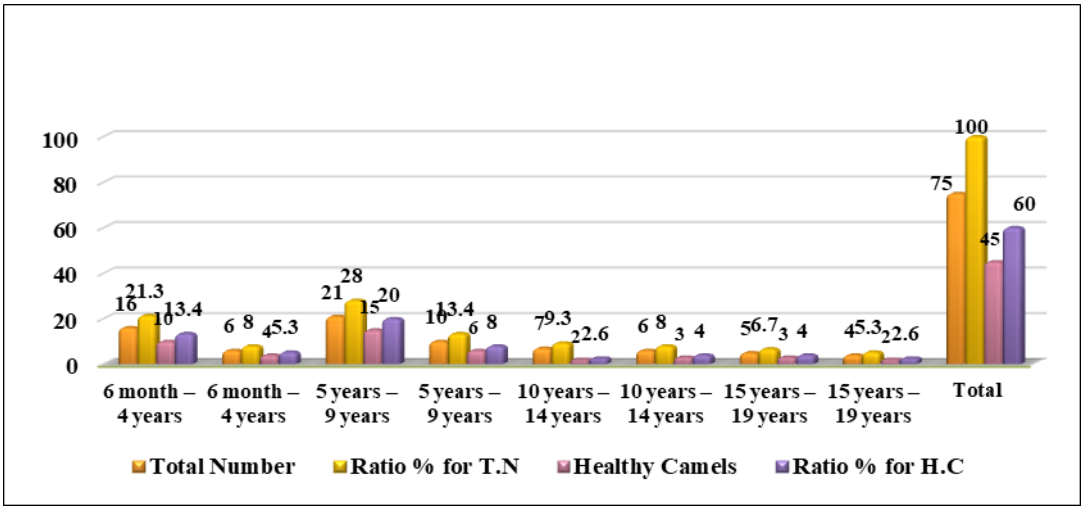

Figure (2): The ratio of healthy camels and its relationship with the total ratio of research camels by age and sex

Abbreviation means: T.N: Total number, H.C: Healthy camels

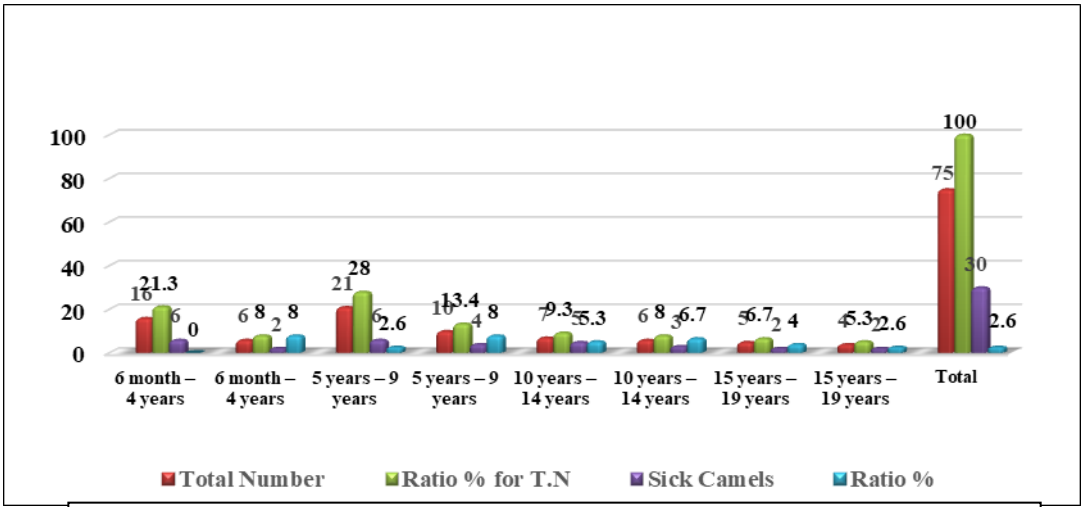

Figure (3): The ratio of sick camels and its relationship with the total ratio of research camels by age and sex

Abbreviation means: T.N: Total number, S.C: Sick camels

The results of examining the temperature, rate of pulse and respiration are shown in Figures No. (4,5,6). The body temperature of sick camels was higher than that of healthy camels; it was (35.88-36.94) °C in healthy camels and (36.8-38) °C in sick camels. As for the rate speed of pulse and respiration, respectively, in healthy camels, it was (37.59 - 43.58) pulse / minute, (9.05 - 13.08) Res./minute; while the rate speed of pulse and respiration in sick camels, respectively, it was (44.72 - 64.42) pulse / minute, (11.8 - 1). (Res./minute) Thus, the results of the statistical analysis of temperature, rate speed of pulse and respiration showed that there was a statistically significant difference at the level ($p<0.05$) in relation to the rate speed of pulse and respiration between the values of healthy and sick camels for all samples to both sexes. As for the temperature, there was also a significant statistical difference at the

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level (p >0.01) between healthy and sick camels. These results are consistent with what he mentioned (Radostits *et al.*, 2000; Bradford, 2002; Mohammed *et al.*, 1991; Coles, 2015). They mentioned that when animals are infected with various bacterial, viral or parasitic diseases, there is an increase in temperature and changes in the speed of the pulse and breathing as a result of the resistance or reactions of the body against these germs that caused the infections also (Tornquist *et al* 2010; Durrani *et al.*, 2017) they agree with their opinion as well.

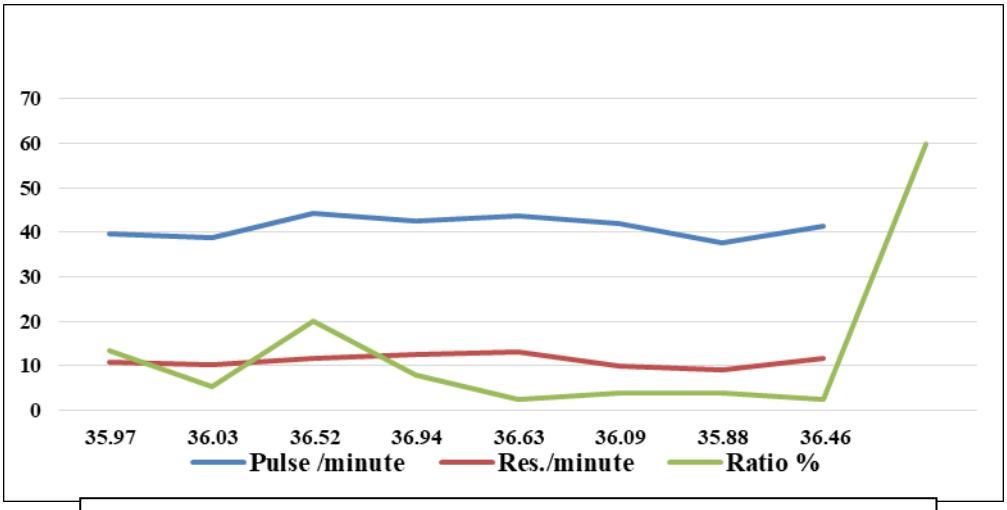

Figure (4): Clinical examination (the rate of temperature, pulse and respiration rate) in healthy camels

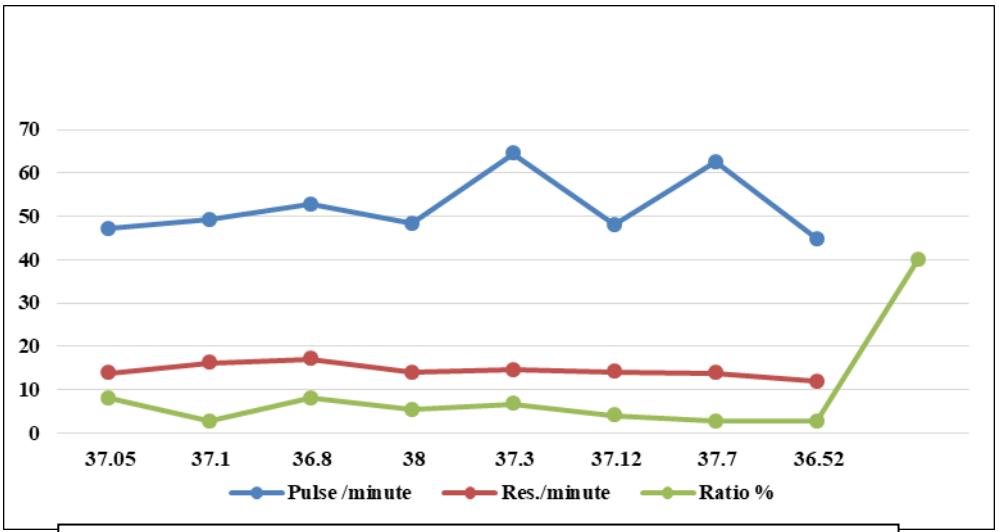

Figure (5): Clinical examination (the rate of temperature, pulse and respiration rate) in sick camels

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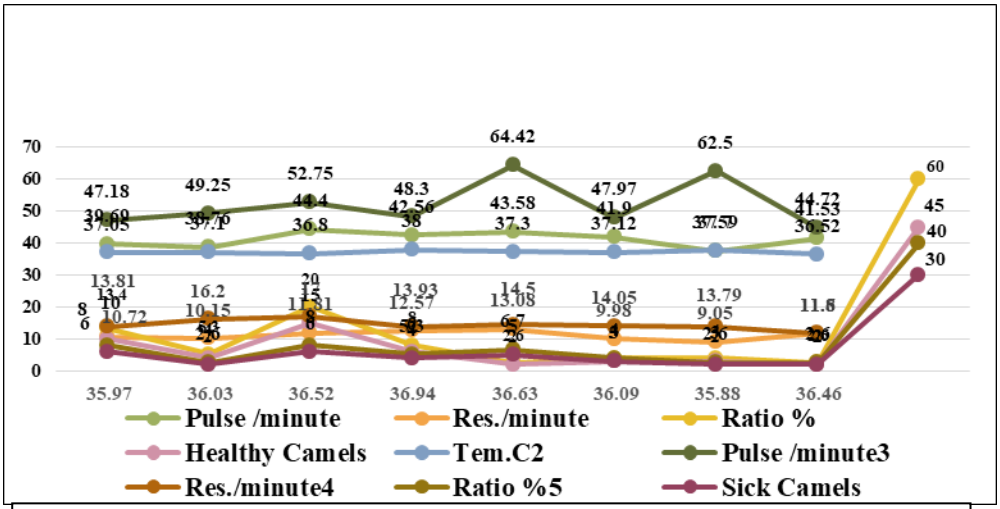

Figure (6): Clinical examination (temperature, pulse and respiration rates) and it is ratio for healthy, sick camels and their relationship with total number and with each other.

As for the results of the iron concentration test, it is shown in Table (2) and Figure (7), where the iron concentration rate in healthy camels was (70-82) µg/dL, while those suffering from diseases ranged from (42-116) µg/dl. The statistical results show that the least significant statistical difference (L.S.D) has (22.38), so the statistical results indicate that there is no significant statistical difference in the percentage of iron by sex, that is, between (females and males) at the level of ($p > 0.05$). The results also showed that there were significant statistical differences at the level ($p < 0.05$) in the concentration of iron between healthy and sick camels. These results are consistent with the results indicated by (Rhamadan *et al.*, 2001; Smith, 1989; Weiser and Kociba, 1983) they mentioned that the type of anemia microcytic normochromic is due to iron and copper deficiency in the animal's body, they attributed the reason for the iron deficiency most likely to be due to a lack of dietary iron or due to an imbalance in the use of iron stores in the body that was caused by a lack of copper (lack of Iron-binding caused by a lack of copper in the body, either due to its deficiency in food or due to poisoning with poisonous plants that interferes with the metabolism of copper in the body) ; The results of our study also agree with (Harter *et al*., 1985; Singh and Mistra, 1986; Momin *et al*., 1987; El-Magawry *et al*., 1986).
The results of our study also agree with (Dlouhy and Outten, 2013; Farooq *et al.*, 2011).

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Table (2): Standard error and the average iron concentration in the blood serum of healthy and sick camels

Age/Year	Sex	Statistics	Fe µg /dl Sick Camels	Fe µg /dl Healthy Camels	L.S.D
6 month – 4 years	She camel	M	78	81	19.97
		± SE	7.1	8.9	
6 month – 4 years	Camel	M	116	79.5	
		± SE	8.5	12	
5 years – 9 years	She camel	M	98.5	73	
		± SE	7	13.3	
5 years – 9 years	Camel	M	68	70	
		± SE	10	9.2	
10 years – 14 years	She camel	M	42	78.9	
		± SE	6	11.5	
10 years – 14 years	Camel	M	89.7	81	
		± SE	4	10	
15 years – 19 years	She camel	M	58.7	80.2	
		± SE	5.2	11	
15 years – 19 years	Camel	M	112	82	
		± SE	**6**	**10.7**	

Abbreviation means: L.S.D: least significant statistical difference, Fe µg /dl: Iron microgram / deciliter

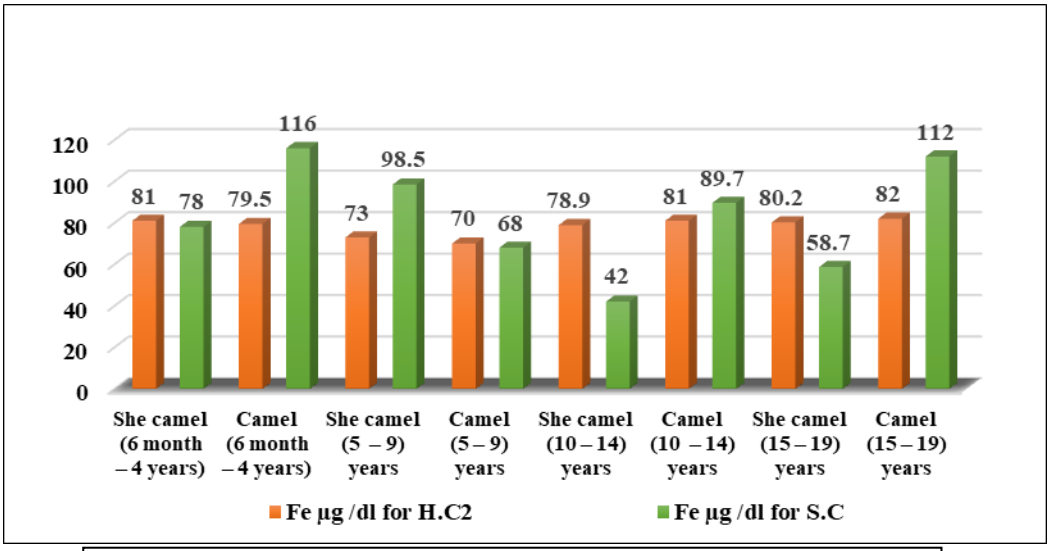

Figure (7): Measuring iron concentration in the serum of healthy and sick camels by age and sex

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Recommandations

1-Mixed feeding should be relied upon in feeding camels (open pastures and concentrated fodder).
2- Giving nutritional supplements to camels, in addition to grazing them in the desert.
3- Conducting other studies on camel blood accompanied by a change in the natural concentrations of iron.
4- Conducting a study on the blood smear image of animals suffering from iron deficiency.

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