



## **Determination of some biochemical parameters in clinically healthy and anemic goats**

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### **Abstract**

The study was conducted on 130 healthy and 72 affected with iron deficiency anemia (IDA) by used local breed goats to determine serum iron, total iron binding capacity (TIBC), unbound iron binding capacity (UIBC), copper concentration and transferrin saturation (TS%). The 130 normal goats (40 males and 90 females). while 72 diagnosed iron deficient anemic goats (18males and 54females), both groups aged 6 months- 4 years in Najaf governorate. Blood samples were collected from the jugular veins into plain tubes during October 2013 till February2014, and the separated sera were directly used for chemical investigation.

Result showed in normal and iron deficient anemic goats; Serum iron concentration was 7-17.9 **and**  $11.8 \pm 0.22$ , 1.2-6.9 **and**  $4.3 \pm 0.17$  respectively, TIBC 67.5-107.3 **and**  $89.7 \pm 0.69$ , 67.3-265 **and**  $112.4 \pm 4.35$  respectively ,UIBC 59.1-94.9 **and**  $78 \pm 0.69$ , 60.9-260 **and**  $108.1 \pm 4.36$  respectively, TS% 7.4-20 **and**  $13.1 \pm 0.25$ , 0.90-10.1 **and**  $4.1 \pm 0.23$  respectively and serum copper 1.1-4.6 **and**  $2.4 \pm 0.05$ , 0.7-3.0 **and**  $1.7 \pm 0.06$  respectively.

However, There were a significant ( $P < 0.05$ ) decrease in serum iron, TS% and copper, while there was a significant increase ( $P < 0.05$ ) in serum TIBC and UIBC of IDA goats as compared with normal control. Also, a significant differences( $P < 0.05$ ) between males and females, as well as, in subgroups of normal and anemic goats have been recorded . In conclusion the present data recorded reference ranges of some biochemical parameters in local breed goats with a significant differences between normal, anemic ,males and females, and in different physiologic status .

**Key words:** Serum Iron, TIBC, UIBC, TS%, Copper , local breed goats.

## تقدير بعض المعايير الكيموحيوية في المعز السليم سريريا والمصاب بفقر الدم

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## الخلاصة:

اجريت الدراسة على مائة وثلاثون من المعز المحلي السليم سريريا و72 من المصاب بفقر الدم واجريت الفحوصات الكيموحيوية لتعيين تركيز حديد مصل الدم, السعة الكلية للحديد المرتبط (TIBC), السعة للحديد غير المرتبط (UIBC), نسبة تشبع الحديد الناقل (% TS) وتركيز النحاس في مصل الدم. اشتملت التجربة على مجموعة المعز السليم سريريا (40 ذكور و90 اناث) بينما تضمنت مجموعة المعز المشخص بفقر الدم (18 ذكور و54 اناث). وكانت أعمار المجموعتين تتراوح بين 6 اشهر الى 4 سنوات في مدينة النجف. تم جمع عينات الدم من الوريد الوداجي في انابيب خالية من المانعة للتخثر خلال الفترة من شهر تشرين الاول 2013 لغاية شهر شباط 2014 لأجراء الاختبارات المطلوبة.

اظهرت النتائج في المعز الطبيعي والمعز المصاب بفقر الدم ان تركيز حديد مصل الدم  $7-17.9$  و  $0.22 \pm 11.8$ ,  $1.2-6.9$  و  $4.3 \pm 0.17$  على التوالي, السعة الكلية للحديد المرتبط  $67.5-107.3$  و  $89.7 \pm 0.69$ ,  $67.3-265$  و  $112.4 \pm 4.35$  على التوالي, السعة للحديد غير المرتبط  $59.1-94.9$  و  $78 \pm 0.69$  و  $60.9-260$  و  $108.1 \pm 4.36$  على التوالي, نسبة تشبع الحديد الناقل  $7.4-20\%$  و  $13.1 \pm 0.25$ ,  $10.1-0.90$  و  $4.1 \pm 0.23$  على التوالي وتركيز النحاس في مصل الدم  $1.1-4.6$  و  $2.4-0.05$ ,  $0.7-3.0$  و  $1.7 \pm 0.06$  على التوالي.

كذلك بينت النتائج انخفاض معنوي في تركيز حديد مصل الدم والنحاس و نسبة تشبع الحديد الناقل بينما لوحظ زيادة معنوية في السعة الكلية للحديد المرتبط والسعة للحديد غير المرتبط في المعز المصاب بنقص الحديد مقارنة بالسليم, كذلك وجود فروقات معنوية بين الذكور والاناث بالإضافة الى المجاميع الثانوية الطبيعية المختلفة وبين المعز الذي يعاني من فقر الدم.

هدف الدراسة تثبيت المدى والمعدلات الطبيعية لبعض القيم الكيموحيوية للمعز المحلي الطبيعي مع وجود الاختلافات المعنوية بين الطبيعي وفقر الدم, الذكور والاناث والحالات الفسلجية المختلفة.

**الكلمات المفتاحية:** حديد المصل, القدرة الكلية للحديد المرتبط, القدرة للحديد غير المرتبط, نسبة تشبع الحديد الناقل, مصل النحاس, المعز المحلي.

## Introduction:

The role of iron was a major structural component of hemoglobin and directly required for erythropoiesis, while other elements were indirectly required for interaction,

metabolism and utilization iron (1). Moreover during pregnancy, the requirement for iron is reported to increase fetus growth, continued gestation and parturition (2).

Iron deficiency anemia could cause low birth weight, preterm delivery and increased oxidative damage to erythrocytes in placenta – fetus unites (3). Iron deficiency (ID) was the most common nutritional worldwide disorder (4). It's deficiency initiated with reduced normal serum iron level, due to low dietary iron intake, insufficient intestinal iron absorption or increased iron losses , resulting in decreased hemoglobin synthesis (5).

Although, iron deficiency caused by chronic blood loss, gastro-intestinal blood loss and internal parasitic infestations like *H. contortus* (6,7). While, cutaneous blood loss caused by external parasites – fleas, lice may cause iron deficiency (8,9). Moreover iron deficiency can be divided into three different stages; storage iron deficiency, iron deficient erythropoiesis, and iron deficiency anemia (10). However, Serum iron, TIBC, UIBC ,TS% and Ferritin consider essential biochemical tests for diagnosis iron deficiency anemia (11 ).

Serum iron concentration have been reported in anemic and healthy goats of arid zone of Rajasthan (12). Many authors studied serum iron and copper in goats (13,14,15,16,17,18,19). Other researchers reported serum copper in goats (20,21,22,23,24,25,26). There is only one known study in kids reported serum TIBC (27). However, Many of the above mentioned studies were conducted on a smaller numbers and on one or two parameters, therefore this study was carried out on a larger

number to measure some of the biochemical values which is believed that have not been previously measured in clinically healthy and anemic goats.

## MATERIALS AND METHODS

Blood samples were collected into plain tubes from jugular vein of 130 goats clinically normal (40 males and 90 females) and 72 goats diagnosed clinically suffering from iron deficiency anemia in Najaf governorate- Iraq. Normal males was divided into two groups according to age 20 adult bucks aged 1.5-4 years and 20 male kids aged 6- 12 months and normal females divided into 20 female kids aged 6-12 months, 20 dry does aged 1.5-4 years, 25 pregnant does aged 1-4 years and 25 lactating does aged 1.5-4 years. On other hand 72 anemic goats (18 male kids and 54 females; 6 female kids; 4 dry does ; 23 pregnant and 21 lactating does) aged 6 month-4 years similar to that of the relevant normal groups. The blood centrifuged for 5-10 minutes at 3000 round (28). The separated sera were used directly for the measurement of iron, TIBC and copper. The serum iron was measured by atomic absorption spectrophotometers, while TIBC was measured according to colorimetric method by (29), serum copper was assayed according to colorimetric method by (30). On the other hand, TS and UIBC were calculated according to the following formula:  $TS\% = \frac{\text{serum iron}}{\text{TIBC}} \times 100$  and  $UIBC = \text{TIBC} - \text{Serum iron}$  (31).

Data were analyzed using SPSS version 20. The least significant differences test (LSD) was used to determine differences among groups. Data were subjected to analysis of variance statistically using one-way ANOVA and the Duncan range test (Statistic a ).

## Results

The result showed the mean value of Serum iron concentration was 7-17.9 $\mu\text{mol/L}$  **and** 11.8 $\pm$ 0.22  $\mu\text{mol/L}$  in normal, 1.2-6.9 $\mu\text{mol/L}$  **and** 4.3 $\pm$ 0.17 $\mu\text{mol/L}$  in IDA goats. On the other hand, the serum TIBC was 67.5-107.3 $\mu\text{mol/L}$  **and** 89.7 $\pm$ 0.69 $\mu\text{mol/L}$ , 67.3-265  $\mu\text{mol/L}$  **and** 112.4 $\pm$ 4.35  $\mu\text{mol/L}$  in normal and IDA goats respectively. Moreover, the UIBC was 59.1- 94.9 $\mu\text{mol/L}$  **and** 78  $\pm$  0.69 $\mu\text{mol/L}$  in normal, 60.9-260  $\mu\text{mol/L}$  **and** 108.1 $\pm$ 4.36  $\mu\text{mol/L}$  in IDA goats. Also, the TS% was 7.4-20 **and** 13.1 $\pm$ 0.25, 0.90-10.1 **and** 4.1 $\pm$ 0.23 in normal and IDA goats and serum copper was 1.1-4.6 $\mu\text{mol/L}$  **and** 2.4 $\pm$ 0.05 $\mu\text{mol/L}$  in normal, 0.7-3.0 $\mu\text{mol/L}$  **and** 1.7 $\pm$ 0.06 $\mu\text{mol/L}$  in IDA goats.

There were a significant decrease( $P<0.05$ ) in serum iron, TS% and copper, while a significant increase( $P<0.05$ ) in serum TIBC and UIBC as compared with normal control (table 1).

**Table (1). The biochemical parameters in sera of clinically normal and iron deficient anemic goats**

Parameters	Groups	
	Normal goats (n=130)	IDA goats (n=72)
Iron $\mu\text{mol/L}$	7-17.9 11.8 $\pm$ 0.22a	1.2-6.9 4.3 $\pm$ 0.17b
TIBC $\mu\text{mol/L}$	67.5-107.3 89.7 $\pm$ 0.69b	67.3-265 112.4 $\pm$ 4.35a
UIBC $\mu\text{mol/L}$	59.1-94.9 78 $\pm$ 0.69b	60.9-260 108 $\pm$ 4.36a
TS%	7.4-20.9 13.1 $\pm$ 0.25a	0.9-10.1 4.1 $\pm$ 0.23b
Copper $\mu\text{mol/L}$	1.1-4.6 2.4 $\pm$ 0.05a	0.7-3 1.7 $\pm$ 0.06b

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

The result show serum iron 13.8 $\pm$ 0.30 and 10.9 $\pm$ 0.24  $\mu\text{mol/L}$  in normal, 4.2 $\pm$ 0.32 and 4.3 $\pm$ 0.20 $\mu\text{mol/L}$  in IDA goats, TIBC 89 $\pm$ 1.13 and 90.1 $\pm$ 0.86  $\mu\text{mol/L}$ , 101.1 $\pm$ 3.94 and 112 $\pm$ 5.58  $\mu\text{mol/L}$  in normal and IDA goats respectively, UIBC 75.5 $\pm$ 1.09 and 79.1 $\pm$ .85  $\mu\text{mol/L}$  in normal, 96.3 $\pm$ 3.97 and 112 $\pm$ 5.58  $\mu\text{mol/L}$  in IDA goats, TS% 15.5 $\pm$ 0.35 and 12.1 $\pm$ 0.27 in normal , 4.4 $\pm$ 0.52 and 4 $\pm$ 0.26 in IDA goats and serum Copper was 2 $\pm$ 0.07

and  $2.5 \pm 0.07$   $\mu\text{mol/L}$ ,  $1.2 \pm 0.06$  and  $1.8 \pm 0.07$   $\mu\text{mol/L}$  in normal and IDA goats respectively (table 2). Serum iron, TS% and serum copper were significantly decreased ( $P < 0.05$ ) in IDA males and females compared to that of normal males and females, while TIBC and UIBC showed a significant increase ( $P < 0.05$ ) in IDA

males and females compared to that of normal. On other hand, present study revealed no significant differences between normal males and females in values of TIBC, UIBC but higher significant in normal males compared to females in values of serum iron and TS% (Table 2).

**Table (2). The biochemical parameters sera of males and females in normal and iron deficient anemic goats**

parameters	Groups			
	Normal Male(n=40)	IDA Male (n=18)	Normal Female(n=90)	IDA Female(n=54)
Iron $\mu\text{mol/L}$	9.5-17.8 $13.8 \pm 0.30a$	2.5-6.6 $4.2 \pm 0.32c$	7-17.9 $10.9 \pm 0.24b$	1.2-6.9 $4.3 \pm 0.20c$
TIBC $\mu\text{mol/L}$	74.3-101.3 $89 \pm 1.13c$	67.3-125.8 $101.1 \pm 3.94b$	67.5-107.3 $90.1 \pm 0.86c$	67.9-265 $116.1 \pm 5.58a$
UIBC $\mu\text{mol/L}$	61.7-88.3 $75.5 \pm 1.09c$	60.9-116.6 $96.3 \pm 3.97b$	59.1-94.9 $79.1 \pm .85c$	61-260 $112 \pm 5.58a$
TS%	11-20.9 $15.5 \pm 0.35a$	2-9.5 $4.4 \pm 0.52c$	7.4-18.8 $12.1 \pm 0.27b$	0.9-10.1 $4 \pm 0.26c$
Copper $\mu\text{mol/L}$	1.1-3 $2 \pm 0.07b$	0.9-1.9 $1.2 \pm 0.06c$	1.4-4.6 $2.5 \pm 0.07a$	0.7-3 $1.8 \pm 0.07b$

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

The serum biochemical of the measured parameters according to the different physiologic status in normal and IDA goats are presented in( table3). There were some significant ( $P < 0.05$ ) differences in mean values of normal subgroups ,also between normal and IDA goats as well as, in IDA subgroups(table 3)

**Table (3). The biochemical tests of different physiologic status in normal and IDA goats; ranges and means $\pm$  SE.**

Groups	Parameter				
	Iron $\mu\text{mol/L}$	TIBC $\mu\text{mol/L}$	UIBC $\mu\text{mol/L}$	TS%	Copper/ $\mu\text{mol/L}$
Adult bucks (n=20)	10.8-17.8 A 14.6 $\pm$ 0.43	76.5-99.1 AB 87.9 $\pm$ 1.59	61.7-83.6 B 73.3 $\pm$ 1.47	13.7-20.9 A 16.6 $\pm$ 0.48	1.5-3 CD 2.2 $\pm$ 0.09
normal Male kids(n=20)	9.5-15.9 B12.9 $\pm$ 0.34a	74.3-101.3 AB90.1 $\pm$ 1.60b	64.8-88.3 AB77.7 $\pm$ 1.49b	11-17.6 B14.3 $\pm$ 0.38a	1.1-2.7 D1.9 $\pm$ 0.09a
IDA Male kids(n=18)	2.5-6.6 4.2 $\pm$ 0.32b	67.3-125.8 101.1 $\pm$ 3.94a	60.9-116.6 96.3 $\pm$ 3.97a	2-9.5 4.4 $\pm$ 0.52b	0.9-1.9 1.2 $\pm$ 0.06b
normal Female kids(n=20)	9.5-17.9 B13 $\pm$ 0.52a	81.7-103.4 A93.1 $\pm$ 1.47a	69.4-91.3 A80.2 $\pm$ 1.47a	10.5-18.8 B13.9 $\pm$ 0.55a	1.9-3.6 AB2.5 $\pm$ 0.11a
IDA Female kids(n=6)	3.2-5.7 4.4 $\pm$ 0.44b	74.7-100.3 85.6 $\pm$ 4.43b	69.1-97 82.8 $\pm$ 5.08a	3.2-7.4 5.3 $\pm$ 0.76b	1.1-2.2 1.6 $\pm$ 0.21b
Normal Dry does(n=20)	8.3-16 C11.4 $\pm$ 0.49a	70.3-107.3 AB88.3 $\pm$ 1.98a	61.8-93.5 AB76.8 $\pm$ 1.89a	9.2-18.3 B12.9 $\pm$ 0.55a	1.5-4.2 A2.8 $\pm$ 0.17a
IDA Dry does(n=4)	5-6.9 5.9 $\pm$ 0.50b	67.9-122.3 93.4 $\pm$ 11.26a	61-117.3 87.4 $\pm$ 11.70a	4-10.1 6.8 $\pm$ 1.33b	1.3-2.5 1.8 $\pm$ 0.30b
Normal Pregnant does(n=25)	7.5-13.9 CD10.3 $\pm$ 0.37a	76.2-104.5 AB91.5 $\pm$ 1.66b	65.2-94.9 A81.1 $\pm$ 1.74b	8.5-16.4 C11.4 $\pm$ 0.49a	1.5-4.6 AB2.5 $\pm$ 0.14a
IDA Pregnant does (n=23)	1.7-6.9 4.4 $\pm$ 0.29b	85.3-265 131.2 $\pm$ 10.6a	81.5-260 126.8 $\pm$ 10.5a	1.2-5.8 3.6 $\pm$ 0.30b	1-2.9 1.8 $\pm$ 0.09b
Normal Lactating does (n=25)	7-11.8 D9.3 $\pm$ 0.27a	67.5-98.7 B87.6 $\pm$ 1.61b	59.1-90.8 AB78.2 $\pm$ 1.65b	7.4-14.3 C10.7 $\pm$ 0.38a	1.4-3.5 C2.3 $\pm$ 0.11a
IDA Lactating does (n=21)	1.2-6.2 3.9 $\pm$ 0.35b	79.6-205.3 112.7 $\pm$ 6.32a	73.4-200.3 108.7 $\pm$ 6.40a	0.9-7.7 3.7 $\pm$ 0.41b	0.7-3 1.8 $\pm$ 0.15b

Different capital letters vertically refers to the presence of significant difference at(p<0.05)between normal subgroups .

Different small letters vertically refers to the presence of significant difference at ( $p < 0.05$ ) between normal and anemic subgroups

## Discussion

The values of the measured serum iron, TIBC, UIBC, copper concentration and TS% of goats independent of any subdivision are presented in (table 1), according to sex in (table 2) and the physiologic status in (table 3). The values presented were obtained from clinically normal and IDA goats in order to provide the lower and upper limits and means for local breed goats. To our knowledge there were no previous researches on some biochemical parameters, so the current results were compared with some available studies in Iraq.

Serum iron of local breed and Shammi breed goats have been reported (18) It was found a significantly higher if compared to the mean values of the present study. While Serum iron of present study was significantly lower than valued reported in anemic and healthy goats of arid zone of Rajasthan (12).

However, Many authors studied serum iron and copper concentration in goats; (13) reported a very high mean and range of serum iron, while copper revealed a higher mean and a wider

range, 96 out of 130 (73.8%) of our copper results within their reported range. Also, (14) some investigation reported a non significant increase in

serum iron and a significant increase in serum copper. While, a significantly

higher serum iron and copper were recorded (15,16,19). While, (17) reported more or less similar to serum iron and a significant increase in serum copper, on the other hand (25) who documented a significant decrease of serum copper in comparison with the finding of this study. Although, a significant increase of serum copper concentration have been reported (24), while, (25) have been reported a significantly lower serum copper values in compared with the findings of this study.

There is only one study reported serum TIBC in kids during the first few weeks (27) and their observation was significantly lower than values mentioned in this study. The differences in serum iron and copper concentration in clinically normal goats of this study compared to other researchers may be attributed to one or more of the followings; absence of scientific feeding program, type of feed and breeding, living in hot areas, season, sex or genetic factors.

Moreover, there were significant differences between normal and IDA in measured biochemical values (table 1, 2 and 3). However, iron deficiency in goats may be attributed to the grazing on pasture deficient with iron, although poor or deficient soil in

copper which may interfere with the utilization of iron (28). This is confirmed the findings of low copper level in soil and water in south Baghdad (32), and also, the observation in Najaf by (33) who reported a different copper level in soil with the lowest during January and the highest in July in hot weather. Although, internal and external parasite is not excluded as a causative agent in iron deficiency anemia(34). Furthermore, a decrease in plasma iron and copper concentration during the acute phase in response to immunological challenges( 35). However, high TIBC in IDA goats confirm the findings by (36) of high or normal TIBC in low serum iron. This may explain the differences between IDA and normal goats.

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