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Some heavy metals residues in beef and sheep Liver in Anbar province

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Abstract

The aim of the study To see the effect of location, season and display time on the accumulation of some heavy metals (Lead, copper, zinc, cadmium and cobalt) in sheep and cattle liver. Liver samples were obtained from three districts in Anbar province (Ramadi, Hit and Baghdadi). This study began from January 2017 to November 2017 for all seasons (winter, spring, summer and autumn) Samples were taken from the liver immediately after slaughter for cattle and sheep at 8 am and taken at 4 pm for all areas of study. The results of the study were summarized in the quadratic overlap of the animal type, season, location and time as follows:

The highest concentration of lead in liver (38.86 µg / g liver) was recorded in sheep for spring and evening in Ramadi. The lowest concentration was in sheep in Baghdadi for morning and winter (20.06 micro g / g liver). The highest concentration of copper in the liver (34.65 microgram / g liver) was recorded in cows in Ramadi for the winter season and evening time. The lowest concentration was in the sheep liver during the summer season for morning time in the city of al-Baghdadi (20.43 microgram / g liver). The highest concentration was in the liver (603.99 microgram / g liver) in the sheep for the autumn season and the evening time in the city of Ramadi. The lowest concentration was in the sheep in the city of Baghdadi for morning and summer (560.32 microgram / g liver). The highest concentration of cadmium in the liver (30.88 micro g / g liver) was in sheep in Ramadi for the autumn and evening season, and the lowest concentration was in beef in the summer season for morning time in al-Baghdadi city (9.66 µg / g liver). Cobalt was the highest concentration (1.34, 1.34 and 1.35 micro g / g liver) in cow and sheep liver, autumn, summer and evening time for Ramadi. While the lowest concentration of sheep and cattle liver for the city of Baghdadi for the winter season and morning time (0.64 and 0.63 microgram / g liver).

متبقيات بعض المعادن الثقيلة في اكباد الابقار والاغنام في محافظة الانبار

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الخلاصة

ان الهدف من اجراء الدراسة هو معرفة تأثير كل من الموقع والموسم ووقت العرض على تراكم بعض المعادن الثقيلة (الرصاص ، النحاس ، الزنك ، الكادميوم و الكوبلت) في كبد الابقار والاغنام حيث تم الحصول على عينات الكبد من ثلاثة مناطق في محافظة الانبار (الرمادي ، هيت والبغدادي). بدأت هذه الدراسة من كانون الثاني 2017 الى تشرين الثاني 2017 لكافة فصول السنة (الشتاء ، الربيع، الصيف والخريف) ، تم اخذ العينات من الكبد بعد الذبح مباشرةً للأبقار والاغنام في الساعة الثامنة صباحا واخذت ايضاً في الرابعة مساءاً ولجميع مناطق الدراسة حيث تلخصت نتائج الدراسة في التداخل الرباعي لنوع الحيوان والموسم والموقع والوقت بما يلي:

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سجل اعلى تركيز لعنصر الرصاص في الكبد (38.86 مايكرو غرام/غم كبد) في الاغنام لموسم الربيع وللوقت المسائي في مدينة الرمادي ، اما اقل تركيز كان في الاغنام في مدينة البغدادي للوقت الصباحي ولموسم الشتاء (20.06 مايكرو غرام/غم كبد). اما لعنصر النحاس سجل اعلى تركيز للنحاس في الكبد (34.65 مايكرو غرام/غم كبد) في الابقار في مدينة الرمادي لموسم الشتاء وللوقت المسائي ، واقل تركيز كان في كبد الاغنام في موسم الصيف للوقت الصباحي في مدينة البغدادي (20.43 مايكرو غرام/غم كبد). اما عنصر الزنك فكان اعلى تركيز في الكبد (603.99 مايكرو غرام/غم كبد) في الاغنام لموسم الخريف وللوقت المسائي في مدينة الرمادي ، اما اقل تركيز فقد كان في الاغنام في مدينة البغدادي للوقت الصباحي ولموسم الصيف (560.32 مايكرو غرام/غم كبد). اعلى تركيز للكادميوم في الكبد (30.88 مايكرو غرام/غم كبد) في لحوم الاغنام في مدينة الرمادي لموسم الخريف وللوقت المسائي ، واقل تركيز كان في لحوم الابقار في موسم الصيف للوقت الصباحي في مدينة البغدادي (9.66 مايكرو غرام/غم كبد). اما عنصر الكوبلت فكان اعلى تركيز (1.34 ، 1.34 و 1.35 مايكرو غرام/غم كبد) في كبد الابقار والاغنام ولموسم الخريف والصيف وللوقت المسائي لمدينة الرمادي. فيما كان اقل تركيز في كبد الابقار والاغنام لمدينة البغدادي لموسم الشتاء وللوقت الصباحي (0.64 و 0.63 مايكرو غرام/غم كبد).

الكلمات المفتاحية : المعادن ، اكباد الاغنام والماعز

Keywords :- metals , beef and sheep Liver

Introduction

Pollution is a change in the environment caused by nature or human , which in turn causes damage to living organisms. Heavy metals are the most common contaminants (24). Heavy metals are dangerous to human life as they threaten water, air and soil with pollution (11). Some developing countries have indicated that heavy metals are a problem for the environment. The source of contamination of heavy metals is either from the erosion of the earth's crust (16). Or from radiation (22). Crude oil is the source of water pollution(14 , 13). population growth and vehicular traffic are also increasing the degree of contamination of these minerals. Wastewater disposal is also a factor in increasing environmental pollution (2).

Materials and methods

Two types of animals (cows and sheep),aged 1-2 years were used.The samples were obtained and collected from three areas of Anbar province (Ramadi, Hit and Al-Baghdadi). in all seasons (winter, spring, summer and autumn), the liver was collected from January 2017 to November 2017 with three replicates. Winter included (December, January and February) ,the spring included (March, April and May) and summer included (June, July and August) ,the autumn season included (September, October and November).Samples of animals were collected at slaughter at 8 am. The remaining samples were left in the sales areas until 4 pm then collect all the samples were stored in plastic bags andbin refrigerated boxes for transporting the meat until the storage place was reached.

Estimation of heavy elements

Heavy metals estimated by the method described by (23):

1- 2g of liver in a muffle furnace at (500-600°C) after the ash weight be constant.

2- Weight remaining ash and add 5 ml solution of nitric acid HNO3

3- Absorption was red using (Atomic Absorption-Spectrophotometer) Japanese origin.

4- Calculated the concentration of heavy metals in the samples by the following equation:

Heavy metals (ppm) = R×V/D

R = reading in atomic absorption spectrophotometer

V = the final sample volume

D = dry weight of the ash

Statistical analysis:

Use experiment (A3 × B4 × C2 × D2) was applied with complete random design (CRD) to study the effect of location, season, time and animal type.

Results and discussion

1- Lead (Pb)

The results of Table (1) showed a significant effect (P≤0.05) of the interaction (animal, season, location and time) in Pb element in liver. recorded of Pb concentration in sheep in spring season in Al-Ramadi the evening Highest concentration 38.86 micro g / g liver, while the sheep liver in Al-Baghdadi for the winter season in morning time less concentration 20.06 micro g / g liver. (18 , 25) found that there are significant differences in the level of heavy metals in the muscles and liver of the animal and this depends on the concentration of the metal, age of the animal, breeding systems, animal type, time of exposure, season and place of breeding in which animals live. (20) found that the concentration of lead increases as the animal progresses in age, where its concentration in the liver is higher than the muscles. The results of the statistical analysis showed a significant increase (P≤0.05) for the seasons (winter, spring, summer and autumn) in the concentration of the Pb element as shown in Appendix (1). record of Pb in Autumn season Highest concentration 26.71 µg / g liver, while Pb concentration in summer season in less concentration 24.04 µg / g liver. This Result is consistent with (4), which found a significant effect of the study seasons in the concentration of Pb element in animal liver.

The results Appendix (1) significant effect in area of concentration Pb element in animal liver. showed significant increase (P≤0.05) in the city of Ramadi with 34.40 micro g / g liver, The concentration of copper in Al-Baghdadi a lowest 21.44 micro g / g liver. This result is in line with what (3 , 4) found to have a significant effect on the concentration of Pb. The cause for the increase in the Pb component in the city of Ramadi compared to the other of the study areas and for all seasons and the periods of study due to the density of the city or perhaps also due to the type of food and drinking water consumed by the animal. The results of the Appendix (1) showed significant effect (P≤0.05) of time in the concentration of Pb element in liver. showed significant increase (P≤0.05) in evening time 27.00 µg / g liver, The concentration of Pb in morning time a lowest 24.61 micro g / g liver. This result is consistent with the Results of (3 , 4). Appendix (1) there is no significant difference in the Pb concentration in animal type (cow and sheep).

2-Copper (Cu)

The results of Table (2) showed a significant effect (P≤0.05) of the interaction (animal, season, location and time) in copper element in liver. recorded of Cu concentration in cow in winter season in Al-Ramadi the evening Highest concentration 34.65 micro g / g liver, while the sheep liver in Al-Baghdadi for the summer season in morning time less concentration 20.43 micro g / g liver. This may be due to the pollution of soil sources and the transfer of water to the animal through the food chain and the cause for the abundance of plants that feed animals may be contaminated by these elements and may be the cause of pollution to the military operations in the city of Ramadi also heavily to the burning operations and operations Cleaning and other oration followed by population density are all factors that increase pollution of heavy elements. (8 , 9 , 10). The results of the statistical analysis showed a significant increase (P≤0.05) for the seasons (winter, spring, summer and autumn) in the concentration of the copper element as shown in Appendix (1). record of Cu concentration in spring season 32.03 µg / g liver, while Cu concentration in summer season in less concentration 23.90 µg / g liver. This Result is consistent with (4), which found a significant effect of the study seasons in the concentration of copper element in animal liver. The results Appendix (1) significant effect in area of concentration copper element in animal liver. showed significant increase (P≤0.05) in the city of Ramadi with 33.54 micro g / g liver, The concentration of copper in Al-Baghdadi a lowest 22.80 micro g / g liver. This result is in line with (3 , 4) found to have a significant effect on the concentration of copper. The cause for the increase in the copper component in the city of Ramadi compared to the other of the study areas and for all

seasons and the periods of study due to the density of the city or perhaps also due to the type of food and drinking water consumed by the animal. The results of the Appendix (1) showed significant effect (P≤0.05) of time in the concentration of copper element in liver. showed significant increase (P≤0.05) in evening time 33.23 µg / g liver, The concentration of copper in morning time a lowest 25.89 micro g / g liver. This result is consistent with the Results of (3 , 4) who observed a significant effect of the time factor on the concentration of the copper element in animal liver. This may be due to what (1) observed that the concentration of some minerals In the concentration according to the proportion of pollution of those areas. The results of the Appendix (1) there is no significant difference in the cu concentration in animal type (cow and sheep).

3-Zinc (Zn)

The results of Table (3) showed a significant effect (P≤0.05) of the interaction (animal, season, location and time) in Zn element in liver. Recorded of Zn concentration in sheep in autumn season in Al-Ramadi the evening Highest concentration 603.99 micro g / g liver, while the sheep liver in Al-Baghdadi for the summer season in morning time less concentration 560.32micro g / g liver. may be zinc is used in metal plating, alloying, dry battery cells and dental materials. Topical antibiotics and lubricants (7, 27). The contamination of heavy metal elements in animal meat and livers is caused by the industrial environment of plants and factories and contaminated with fuel. All this leads to contamination of the atmosphere by minerals and then passes through the food chain through the food chain (28 , 26). These results agreed with what (2) found, noting that the concentration of heavy metal elements in the animal body in the industrial areas was higher than in the rural areas. This was found by (26), where they observed the rise of zinc in animal livers due to grazing in areas with soil contaminated with zinc. The results of the statistical analysis showed a significant increase (P≤0.05) for the seasons (winter, spring, summer and autumn) in the concentration of the Zn element as shown in Appendix (1). record of zn concentration in Autumn season 588.71 µg / g liver, while Zn concentration in summer season in less concentration 545.35 µg / g liver. This Result is consistent with (4), which found a significant effect of the study seasons in the concentration of Zn element in animal liver. The results Appendix (1) significant effect in area of concentration Zn element in animal liver. showed significant increase (P≤0.05) in the city of Ramadi with 589.13 micro g / g liver, The concentration of Zn in Al-Baghdadi a lowest 553.77 micro g/g liver. This result is in line with (3 , 4) found to have a significant effect on the concentration of Zn. The cause for the increase in the Zn component in the city of Ramadi compared to the other of the study areas and for all seasons and the periods of study due to the density of the city or perhaps also due to the type of food and drinking water consumed by the animal. The results of the Appendix (1) showed significant effect (P≤0.05) of time in the concentration of Zn element in liver. showed significant increase (P≤0.05) in evening time 584.91 µg / g liver, The concentration of Zn in morning time a lowest 565 micro g / g liver. This result is consistent with the Results of (3 , 4) who observed a significant effect of the time factor on the concentration of the Zn element in animal liver. The cause for this may be due to the exposure of the meat of these animals to the accumulation of metal elements in the meat of animals due to exposure to a longer period of supply (6 , 17). The results of the Appendix (1) there is no significant difference in the Zn concentration in animal type (cow and sheep)

4- cadmium (Cd)

The results of Table (4) showed a significant effect (P≤0.05) of the interaction (animal, season, location and time) in Cd element in liver. recorded of Cd concentration in sheep in autumn season in Al-Ramadi the evening Highest concentration 30.88 micro g / g liver, while the Cow liver in Al-Baghdadi for the summer season in morning time lowest concentration 9.66 micro g / g liver. (15)

noted that sheep have the ability to accumulate cadmium more than other animals. (21, 5) found that the kidneys and liver were the most exposed to contamination and the accumulation of heavy elements from muscle tissue. This was observed by (19) the cadmium in liver was highest percentage of cadmium in muscle (12). The results of the statistical analysis showed a significant increase (P≤0.05) for the seasons (winter, spring, summer and autumn) in the concentration of the Cd element as shown in Appendix (1). record of Cd concentration in Spring season 22.55 µg / g liver, while Cd concentration in summer season in lowest concentration 13.72 µg / g liver. This Result is consistent with (4), which
found a significant effect of the study seasons in the concentration of Cd element in animal liver. The results Appendix (1) significant effect in area of concentration Cd element in animal liver. showed significant increase (P≤0.05) in the city of Ramadi with 22.14 micro g / g liver, The concentration of Cd in Al-Baghdadi a lowest 11.84 micro g/g liver. This result is in line with (3 , 4) found to have a significant effect on the concentration of Cd. The cause for the large population density in the city of Ramadi and the military operations in the province against terrorist groups and the frequent use of weapons led to the concentration of cadmium in the liver in the atmosphere, which led to the transition to plant and water and from it to the animal. As observed by (19) in the calves in Spain, where they observed their rise in industrial areas and their decline in rural areas. The results of the Appendix (1) showed significant effect (P≤0.05) of time in the concentration of Cd element in liver. showed significant increase (P≤0.05) in evening time 18.61 µg / g liver, The concentration of Cd in morning time a lowest 11.34 micro g / g liver. This result is consistent with the Results of (3 , 4) who observed a significant effect of the time factor on the concentration of the Cd element in animal liver. The cause for this may be due to the exposure of the meat of these animals to the accumulation of metal elements in the meat of animals due to exposure to a longer period of supply. (17). The results of the Appendix (1) there is no significant difference in the Cd concentration in animal type (cow and sheep).

5- cobalt (Co)

The results of Table (5) showed a significant effect (P≤0.05) of the interaction (animal, season, location and time) in Co element in liver. recorded of Co concentration in cow in summer and autumn seasons in Ramadi in the evening time and sheep liver Ramadi in autumn season in the evening time were significantly higher (P≤0.05) 1.34, 1.34 and 1.35 µg /g Respectively, while the sheep liver in Al-Baghdadi for the winter in morning time lowest concentration 0.63 µg /g liver. These results are consistent with (4), which indicated between the animal type, season, region and time has a significant effect on Cobalt height. The results of Appendix (1) showed a significant increase (P≤0.05) in seasons (winter, spring, summer and autumn) in the concentration of the Co element . Co concentration in autumn season was 1.06 µg / g liver, while Co concentration in winter season in lowest concentration 0.86 µg / g liver. This Result is consistent with (4), which found a significant effect of the study seasons in the concentration of Co element in animal liver . The results Appendix (1) significant effect in area of concentration Co element in animal liver. showed significant increase (P≤0.05) in the city of Ramadi with 1.17 micro g / g liver, The concentration of Co in Al-Baghdadi a lowest 0.81 micro g/g liver. This result is in line with (4) found to have a significant effect on the concentration of Co. The cause for the large population density in the city of Ramadi and the military operations in the province against terrorist groups and the frequent use of weapons led to the concentration of Co in the liver in the atmosphere, which led to the transition to plant and water and from it to the animal. The results of the Appendix (1) showed significant effect (P≤0.05) of time in the concentration of Co element in liver. showed significant increase (P≤0.05) in evening time 1.21 µg / g liver, The concentration of Co in morning time a lowest 0.91micro g / g liver.

This result is consistent with the Results of (4) , who observed a significant effect of the time factor on the concentration of the Co element in animal liver. The cause for this may be due to the exposure of the meat of these animals to the accumulation of metal elements in the meat of animals due to exposure to a longer period of supply. (17). The results of the Appendix (1) there is no significant difference in the Co concentration in animal type (cow and sheep).

Table (1) The effect of the interaction between the animal type, the region, the season and the time in the accumulation of lead in the liver of the studied animals

Mean Microgram / g + standard error Hit				Season
Sheep		Cow		
PM	AM	PM	AM	
22.95 ± 0.008 T	20.32 ± 0.005 Z	23.34 ± 0.008 R	20.65 ± 0.005 Z	Winter
23.44 ± 0.008 Q	20.43 ± 0.01 Z	22.34 ± 0.008 Y	20.16 ± 0.008 Z	Spring
22.08 ± 0.008	20.53 ± 0.005 Z	22.63 ± 0.01 W	20.13 ± 0.008 Z	summer
22.86 ± 0.008 U	20.43 ± 0.008 Z	22.13 ± 0.01 Z	20.77 ± 0.008 Z	autumn
Mean Microgram / g + standard error Al-Ramadi				
Sheep		Cow		
PM	AM	PM	AM	
33.12 ± 0.01 J	30.77 ± 0.01 N	33.07 ± 0.01 K	30.31 ± 0.008 O	Winter
38.86 ± 0.008 A	31.81 ± 0.01 M	35.77 ± 0.008 F	32.87 ± 0.01 L	Spring
35.43 ± 0.008 E	36.25 ± 0.01 D	37.94 ± 0.003 B	36.74 ± 0.01 C	summer
35.20 ± 0.01 G	33.43 ± 0.008 H	35.75 ± 0.01 F	33.17 ± 0.008 I	autumn
Mean Microgram / g + standard error Al-Baghdadi				
Sheep		Cow		
PM	AM	PM	AM	
22.18 ± 0.008 Z	**20.06 ± 0.01 Z**	23.56 ± 0.01 P	20.20 ± 0.008 Z	Winter
23.11 ± 0.01 S	20.12 ± 0.008 Z	22.75 ± 0.01 V	20.31 ± 0.005 Z	Spring
22.72 ± 0.01 V	20.13 ± 0.01 Z	22.24 ± 0.01 Z	20.85 ± 0.008 Z	summer
22.43 ± 0.01 X	20.22 ± 0.008 Z	22.05 ± 0.02 Z	20.13 ± 0.01 Z	autumn

The averages with similar characters are not significantly different (P≤0.05)

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Table (2) The effect of the interaction between the animal type, the region, the season and the time in the accumulation of copper in the liver of the studied animals

Season	Mean Microgram / g + standard error Hit			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	31.11 ± 0.005 G	32.76 ± 0.01 C	29.87 ± 0.01 I	31.86 ± 0.01 D
Spring	26.54 ± 0.01 V	28.77 ± 0.01 N	26.15 ± 0.01 W	28.54 ± 0.01 O
Summer	22.15 ± 0.008 Z	24.32 ± 0.005 Z	22.04 ± 0.01 Z	24.28 ± 0.01 Z
Autumn	24.75 ± 0.01 Z	26.11 ± 0.008 W	24.23 ± 0.008	26.04 ± 0.01 X
	Al-Ramadi Mean Microgram / g + standard error			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	32.75 ± 0.005 C	**34.65 ± 0.005 A**	31.64 ± 0.01 E	34.42 ± 0.008 B
Spring	29.31 ± 0.005 L	31.66 ± 0.01 E	29.74 ± 0.01 J	31.15 ± 0.01 F
Summer	25.54 ± 0.01 Y	27.92 ± 0.01 Q	25.11 ± 0.008 Z	27.16 ± 0.005 T
Autumn	26.12 ± 0.01 W	29.41 ± 0.01 K	26.84 ± 0.01 U	29.22 ± 0.005 M
	Al-Baghdadi Mean Microgram / g + standard error			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	28.75 ± 0.01 N	30.13 ± 0.008 H	25.12 ± 0.008 Z	28.14 ± 0.01 P
Spring	23.87 ± 0.01 Z	27.34 ± 0.01 S	25.42 ± 0.01 Z	27.86 ± 0.008 R
Summer	20.74 ± 0.01 Z	23.75 ± 0.01 Z	**20.43 ± 0.008 Z**	21.31 ± 0.008 Z
Autumn	23.42 ± 0.01 Z	24.53 ± 0.008 Z	21.95 ± 0.01 Z	24.03 ± 0.01 Z

The averages with similar characters are not significantly different (P≤0.05)

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Table (3) The effect of the interaction between the animal type, the region, the season and the time in the accumulation of zinc in the liver of the studied animals

Season	Mean Microgram / g + standard error Hit			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	574.88 ± 0.01 LMNOP	581.36 ± 0.008 HIJ	574.75 ± 0.01 LMNOPQ	577.67 ± 0.008 KL
Spring	573.54 ± 0.02 MNOPQ	586.11 ± 0.07 EF	572.30 ± 0.05 OPQ	581.39 ± 0.05 HIJ
Summer	561.68 ± 0.03 UV	578.26 ± 0.01 JK	564.25 ± 0.01 TU	597.38 ± 0.05 C
Autumn	585.34 ± 0.06 FG	589.24 ± 0.07 DE	581.39 ± 0.05 HIJ	590.39 ± 0.05 D
	Al-Ramadi Mean Microgram / g + standard error			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	582.04 ± 0.01 GHI	591.73 ± 0.01 D	585.87 ± 0.01 F	589.48 ± 0.05 D
Spring	590.72 ± 0.05 D	596.35 ± 0.04 C	584.25 ± 0.02 FGH	595.21 ± 0.06 C
Summer	575.78 ± 0.05 LMNO	572.69 ± 0.04 OPQ	565.95 ± 0.02 ST	584.96 ± 0.01 FGH
Autumn	598.40 ± 0.05 BC	601.37 ± 0.01	601.37 ± 0.01 AB	**603.99 ± 0.01 A**
	Al-Baghdadi Mean Microgram / g + standard error			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	568.57 ± 0.06 RS	580.41 ± 0.06 IJK	571.13 ± 0.04 QR	576.56 ± 0.03 LMN
Spring	567.54 ± 0.05 ST	583.02 ± 0.07 FGHI	571.97 ± 0.05 PQ	577.18 ± 0.07 KLM
Summer	561.65 ± 0.06 UV	572.91 ± 0.06 NOPQ	**560.32 ± 0.05 V**	572.07 ± 0.08 OPQ
Autumn	575.24 ± 0.01 LMNOP	585.42 ± 0.05 FG	575.03 ± 0.08 LMNOP	581.36 ± 0.05 HIJ

The averages with similar characters are not significantly different (P≤0.05)

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Table (4) The effect of the interaction between the animal type, the region, the season and the time in the accumulation of cadmium in the liver of the studied animals

Hit Mean Microgram / g + standard error				Season
Sheep		Cow		
PM	AM	PM	AM	
16.45 ± 0.05 M	14.12 ± 0.07 P	16.63 ± 0.07 LM	14.51 ± 0.1 O	Winter
14.14 ± 0.05 P	13.37 ± 0.08 RS	14.48 ± 0.07 O	13.30 ± 0.08 S	Spring
13.59 ± 0.08 QR	11.50 ± 0.08 X	13.40 ± 0.07 RS	11.34 ± 0.06 XY	Summer
16.73 ± 0.09 L	15.52 ± 0.05 N	16.74 ± 0.1 L	15.40 ± 0.07 N	autumn
Al-Ramadi Mean Microgram / g + standard error				
Sheep		Cow		
PM	AM	PM	AM	
22.74 ± 0.05 K	27.26 ± 0.02 E	27.43 ± 0.06 E	22.72 ± 0.1 K	Winter
27.91 ± 0.02 D	24.74 ± 0.09 H	28.97 ± 0.04 C	24.62 ± 0.08 H	Spring
25.37 ± 0.1 G	23.59 ± 0.04 I	25.37 ± 0.1 G	23.14 ± 0.04 J	summer
30.88 ± 0.05 A	26.59 ± 0.09 F	30.57 ± 0.1 B	26.42 ± 0.04 F	autumn
Al-Baghdadi Mean Microgram / g + standard error				
Sheep		Cow		
PM	AM	PM	AM	
12.66 ± 0.03 VW	10.74 ± 0.05 Z	12.93 ± 0.04 TU	10.47 ± 0.1 Z	Winter
12.97 ± 0.04 T	11.56 ± 0.1 X	13.26 ± 0.09 S	11.11 ± 0.06 Y	Spring
11.09 ± 0.05 Y	9.96 ± 0.02 Z	10.70 ± 0.09 Z	**9.66 ± 0.1 Z**	summer
13.71 ± 0.07 Q	12.69 ± 0.07 UV	13.51 ± 0.07 QRS	12.43 ± 0.1 W	autumn

The averages with similar characters are not significantly different ($P \leq 0.05$)

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Table (5) The effect of the interaction between the animal type, the region, the season and the time in the accumulation of cobalt in the liver of the studied animals

Season	Mean Microgram / g + standard error Hit			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	0.75 ± 0.01 T	0.86 ± 0.01 OPQ	0.81 ± 0.008 RS	0.93 ± 0.01 LM
Spring	0.83 ± 0.006 PQR	0.91 ± 0.01 M	0.84 ± 0.008 OPQ	0.93 ± 0.01 LM
summer	0.98 ± 0.005 J	1.16 ± 0.01 EF	0.94 ± 0.005 LM	1.22 ± 0.01 CD
Autumn	0.94 ± 0.005 LM	1.08 ± 0.005 G	0.91 ± 0.008 M	1.02 ± 0.01 HI
	Al-Ramadi Mean Microgram / g + standard error			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	0.98 ± 0.008 J	1.14 ± 0.01 F	1.00 ± 0.008 IJ	1.14 ± 0.02 F
Spring	1.04 ± 0.008 H	1.17 ± 0.01 EF	1.02 ± 0.01 HI	1.16 ± 0.01 EF
summer	1.23± 0.008 C	**1.34 ± 0.008 A**	1.18 ± 0.008 DE	1.30 ± 0.008 B
Autumn	1.17 ± 0.01 EF	**1.34 ± 0.008 A**	1.19 ± 0.01 DE	**1.35 ± 0.01 A**
	Al-Baghdadi Mean Microgram / g + standard error			
	Cow		Sheep	
	AM	PM	AM	PM
Winter	**0.64 ± 0.01 V**	0.78 ± 0.02 ST	**0.63 ± 0.005 V**	0.72 ± 0.01 U
Spring	0.72 ± 0.01 U	0.86 ± 0.008 OPQ	0.75 ± 0.005 T	0.87 ± 0.005 N
summer	0.74 ± 0.01 U	0.90 ± 0.008 MN	0.80 ± 0.008 RS	0.94 ± 0.01 LM
Autumn	0.82 ± 0.01 QR	0.96 ± 0.01 K	0.87 ± 0.008 N	1.03 ± 0.01 HI

The averages with similar characters are not significantly different ($P \leq 0.05$)

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Appendices

Appendix (1) Effect of each type, season, region and time in the concentration of heavy metals in the liver of the studied animals. Effect of each type, season, region and time in the concentration of heavy metals in the liver of the studied animals

Elements / Type	Pb Microgram / g	Cu Microgram / g	Zn Microgram / g	Cd Microgram / g	Co Microgram / g
Cow	25.83 ±0.75 A	27.29±0.43 A	580.96±1.25 A	17.46±0.77 A	0.97± 0.02 A
Sheep	25.79 ±0.70 A	26.83±0.41 A	579.65±1.25 A	17.49±0.76 A	0.98±0.02 A
Season	Pb	Cu	Zn	Cd	Co
Winter	25.72±0.84 B	30.93±0.44 B	579.54±1.18 B	17.39±0.98 B	0.86±0.02 C
Spring	26.75±1.02 A	32.03±0.37 A	581.63±1.54 B	22.55±1.10 A	0.92±0.02 B
Summer	24.04±1.28 C	23.90±0.37 D	545.35±1.45 C	13.72±1.05 C	0.96±0.03 B
Autumn	26.71±1.47 A	28.38±0.40 C	588.71±1.60 A	19.27±1.15 B	1.06±0.02 A
Area	Pb	Cu	Zn	Cd	Co
Hit	27.57±0.17 B	26.84±0.46 B	568.02±1.15 B	18.45±0.24 B	0.94±0.01 B
Al-Ramadi	34.40±0.34 A	33.54±0.42 A	589.13±1.00 A	22.14±0.36 A	1.17±0.01 A
Al-Baghdadi	21.44±0.18 C	22.80±0.41 C	553.77±1.02 C	11.84±0.18 C	0.81±0.01 C
Time	Pb	Cu	Zn	Cd	Co
AM	24.61±0.73 B	25.89±0.41 B	565.70±1.24 B	11.34±0.69 B	0.91±0.02 B
PM	27.00±0.73 A	33.23±0.38 A	584.91±1.00 A	18.61±0.81 A	1.21±0.02 A

The averages with similar characters are not significantly different (P≤0.05)

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