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Detection Of Some Heavy Metals Residues In The Local Goat Meat In Kirkuk During The Winter And Summer Seasons

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Abstract

The purpose of these investigating to now the levels of some heavy metals contamination in muscle, liver and kidney meat for Goat in Kirkuk governorate in summer and winter seasons, samples were collected randomly from animals (aged 6-8 months) from three districts of Kirkuk governorate (Downtown, Daquq and Debis) During the January to February (winter season) and July to August months (summer season). There was a significant effect ($p \leq 0.05$) of (muscle, liver and kidney) location and season in lead concentrations, the liver in the center of Kirkuk during winter season recorded highest concentration (7.983 ppm), the lowest concentration (0.983 ppm) was found in muscles of Daquq in Winter. Highest concentration level of cadmium in kidney during summer season from Daquq was recorded (4.430 ppm), and lowers Concentration of cadmium (3.773 ppm) recorded in liver from Debis during winter. For Copper, the liver in the center of Kirkuk during the summer season had the highest concentration (20.734 ppm) and was a significant effect ($p \leq 0.05$), while the Liver from the Daquq at winter was recorded lowest concentration (3.773 ppm). For Cobalt, in summer season in Kirkuk, the liver recorded the highest concentration of cobalt (5.926 ppm), while the lowest concentration was recorded in muscle in Winter season from Debis (0.864 ppm). All types of metals recorded levels higher than the internationally accepted limits.

Introduction:

Goat belongs to farm animals in many countries. Iraq is one of them, where Goat breeding is the part of animal husbandry. Goat meat is one of the consumed meats in the Iraq region *[1]*. Meat plays a very important role in human nutrition contributing high quality proteins, Essential minerals and trace elements, and a range of vitamins in bio available forms *[2]*. Consumers of today are health conscious and demand high quality food products. Ultimately, the success of any food product is determined by consumer acceptability, which is largely determined by the perception of quality *[3]*. Widened and redefined the concept of meat quality to include the following quality traits: hygienic, compositional, nutritional, sensory and technological quality *[4]*.The term "heavy metals" refers to any metallic element that has a relatively high density and is toxic or poisonous even at how concentration *[5]* with a density more than 5g/cm^3 *[6]*.Heavy metal contamination in meat and other edible tissues is a matter of great concern for food safety and human health. These metals are toxic in nature and even at relatively low concentrations can cause adverse effects *[7]*. Different researchers have reported the instances of contamination of heavy metals in meat products during processing *[8]*. While the feeding of cattle on the contaminated feed and rearing of livestock in proximity to polluted surroundings were found to be responsible for heavy metal pollution in meat *[9; 10]*.This study was conducted for the purpose of investigating the levels of contamination of muscle, liver and kidney meat for Goats in Kirkuk during the summer and winter seasons.

Materials and Methods

A. Source of meat

In this study, adopted the muscles, liver and kidneys of the male goats species ,, All animals were Local Iraqi species, The animals, Were breeding in pasture, are from three districts of Kirkuk locations, which include Kirkuk center , Debis and Daquq. During the December and February (winter season) and July and August months (summer season)

B. Collection of samples

The samples were collected from goats aged 6-8 months. Meat samples (muscles liver and kidney) were used in three replicates were randomly selected from three locations of Kirkuk (downtown, Debis and Daquq) during January and February(Winter) and July and August (summer season), The thigh muscle was meat muscle samples which used for study, while the Internal organs samples consisted of liver and kidneys. After the slaughter of animals the samples were left until samples were taken from animals studied from the thigh muscle in all carcasses area, and samples were then put in polyethylene bags and then placed in special packages and boxes Refrigerated for this purpose until it reaches the laboratory. The meat and kidney samples were cut into medium pieces by a knife and then encased by a thermocouple machine. A sieve was used with a diameter of 0.45. These models were then placed in polythene bags and then placed in special plastic containers prepared for this presentation and numbered. The samples of the liver were cut into pieces and then placed in plastic bags and then in plastic containers for this purpose. After that, all samples were placed in frozen temperature (-18 ° C) until chemical tests were conducted and tests were conducted to measure the ratio of heavy elements.

C. Determination of heavy elements

The heavy metals concentration were determined by method as described by Ropme (1983) *[11].*

D. Statistical analysis:

The complete random design (CRD) was applied to study the effect of meat type, season of the year and location in different traits. According to the mathematical model below, The differences between the averages were compared with the Duncan Multidimensional Test. Xlstat *[12]* was used in statistical analysis

Yijklm = m + Ai + Bj + Ck + CD (kl) + ABC (ijk) + e ijkm

As:

Yijkm: View values for each attribute.

m:General average

Effect of meat type (muscles, liver and kidney)(Ai:

Bj : Effect of season (winter and summer)

Effect of location (center of Kirkuk, Daquq and Dibs)(: Ck

ABC (ijk): Effect of interaction between meat, season and location.

e ijkm: random error which distributes a normal distribution with a mean of zero and a variation of S2 e.

Results and Discussion:

Table (1) showed a significant effect ($p \leq 0.05$) of the effect of the tripartite interaction of the factors (Muscle, liver and kidney, location and season) at the level of lead concentration in meat, liver and kidney in three locations of Kirkuk areas during the winter and summer seasons, In the winter, the Liver recorded the highest concentration of lead in the center of Kirkuk with a significant difference ($p \leq 0.05$) , reaching (7.983 ppm), whereas in Summer season the liver recorded the lowest level of concentration (0.983 ppm).

Table (1) shows difference significant ($p \leq 0.05$) between Different location in level of lead concentration of the above factors mentioned, the center of Kirkuk recorded highest concentration of lead element (5.047 ppm) and the lowest level of concentration record in Debis (1.598 ppm). When comparing the effect of regions by muscle, liver and kidney, muscle meat was recorded in the center of Kirkuk the highest concentration (4.531 ppm) and the Debis location recorded the lowest concentration (1.891 ppm). In

the Liver, The region of center Kirkuk was the highest concentration (5.047 ppm) and the lowest concentration was recorded in the region of Debis (2.085 ppm), while in the Kidney in the center of Kirkuk has recorded the highest concentration (4.713 ppm) and less record concentration in Debis location reached (1.598 ppm).

Table (1) showed a significant effect ($p \leq 0.05$) On winter and summer season in level of concentration of lead element when studying the effect of the season on lead contamination. The winter season recorded the highest results than the summer season in Liver concentration (5.019 ppm) the lowest concentration record in summer season in Meat (1.394 ppm)

When comparing the effect of the season to the, the winter season recorded the highest concentration of lead compared to the summer season in muscle, liver and kidney.

As for the muscle, liver and kidney, it was showed from Table (1) that there was a significant difference ($p \leq 0.05$) between the liver and both kidney and muscle and no significant differences ($p \leq 0.05$) between muscle and kidney meat at the level of lead concentration, The liver recorded the highest concentration of lead, which reached (3.501 ppm), while Kidney scored the lowest concentration (1.598 ppm).

Table- 1: Lead contamination in Goat samples from three areas in Kirkuk during two seasons(winter and summer) (mean ± standard error)

Sample	location	Season		Mean
		Winter	Summer	
Muscle	Daqouq	4.475 ±0.125 d	**0.983 h**±0.050	2.729 ±0.378 d
	Downtown	7.735 ±0.211 ab	1.326 ±0.042 g	**4.531** ±0.691 **b**
	Debis	1.910 ±0.117 f	1.872 ±0.021 f	±0.056 e1.891
	Mean	4.707 ±0.423 b	**1.394** ±0.066 **f**	3.050 ±0.288 b
Liver	Daqouq	5.2803 ±0.140 c	1.465 ±0.026 g	3.37 c±0.041
	Downtown	**7.925** ±0.175 **a**	2.169 ±0.114 ef	**5.047** ±0.0612 a
	Debis	1.851 ±0.0221 f	2.318 ±0.028 e	2.085 ±0.005 e
	Mean	**5.019** ±0.439 **a**	1.984 d±0.077	**3.501** ±0.284 **a**
Kidney	Daqouq	4.338 ±0.088 d	1.145 ±0.080 gh	2.741 ±0.347 d
	Downtown	7.508 ±0.218 b	1.918 ±0.081 f	**4.713** ±0.610 **b**
	Debis	1.322 ±0.036 g	1.74 ±0.038 f	1.598 ±0.063 f
	Mean	4.389 ±0.445 c	1.646 ±0.070 e	**3.017** ±0.275 **b**

The averages with identical letters (same cells color) are not significantly different (P> 0.05) between them.

Table (2) showed significant effect ($p \leq 0.05$) of the location on the cadmium concentration between the regions , The center of Kirkuk showed significant effect ($p \leq 0.05$) and recorded the highest concentration of cadmium (3.005 ppm) in Kidney And the lowest concentration of these element was recorded in the Daquq in Liver (2.504 ppm). When we compare the effect of regions by muscle, liver and kidney muscle, we found that muscle in center of Kirkuk has recorded the highest concentration and the Daquq recorded lowest concentration of cadmium (2.639 , 2.539 ppm) Respectively, in the liver the center of Kirkuk record the highest level of concentration and the Daquq record lowest level (2,912, 2,504 ppm) respectively in the kidney Kirkuk center has recorded the highest concentration area Daquq lowest level reached (2.005, 2.758 ppm), respectively.

Table (2) showed significant effect (p≤0.05) of season on the cadmium concentration, The summer season showed a higher concentration from winter at the level of pollution, where the summer recorded the highest concentration in the liver and recorded The lowest winter concentration in the kidney was recorded, and when compared to the season, the summer recorded the highest concentration of cadmium compared to winter in muscle, liver and kidney muscle.

There were significant in the muscle, liver and kidney muscle in as shown in table (2). The Kidney recorded the highest results, with cadmium concentration (2.915 ppm) and the lowest concentration recorded in the muscle where the concentration of cadmium (2.587 ppm) while the concentration

Table- 2: cadmium contamination in Goat samples from three areas in Kirkuk during two seasons (winter and summer) (mean ± standard error)

Sample	location	Season		Mean
		Winter	summer	
Muscle	Daqouq	2.510 ±0.060 gh	2.567 ±0.033 gh	2.539 ±0.033 c
	Downtown	2.733 ±0.107 efg	2.544 ±0.104 gh	2.639 ±0.077 bc
	Debis	2.247 ±0.045 ij	2.920 ±0.040 cde	± 0.076 c2.584
	Mean	2.497 ±0.053 d	2.677 ±0.049 c	2.587 ±0.371 c
Liver	Daqouq	2.409 ±0.071 hi j	2.600 ±0.021 gh	2.504 ±0.040 c
	Downtown	2.705 ±0.050 fg	3.119 ±0.062 bc	2.912 ±0.060 a
	Debis	2.228 ±0.042 j	2.960 ±0.027 bcd	2.594 ±0.082 c
	Mean	2.447±0.045 d	2.893 ±0.044 b	2.670 ±0.040 b
Kidney	Daqouq	2.531 ±0.107 gh	3.430 ±0.136 a	2.981 ±0.130 b
	Downtown	2.853 ±0.022 def	3.156 ±0.085 b	3.005 ±0.056 a
	Debis	2.450 ±0.090 hi	3.067 ±0.041 bc	2.758 ±0.080 b
	Mean	2.611 ±0.052 c	3.218 ±0.061 a	2.915 ±0.054 a

The averages with identical letters (same cells color) are not significantly different (P> 0.05) between them.

Table 3 shows the effect of interaction of muscle, liver and kidney muscle muscle, liver and kidney muscle, location and season at the copper concentration. Showed significant effect (P≤0.05) of the location, season and muscle, liver and kidney muscle was found in the concentration of copper. The highest concentration of copper in the liver was found in Kirkuk center In the Summer (20.730ppm), while the lowest concentration of copper in the liver was recorded in the winter in Daquq (3.773 ppm).

Table (3) showed the effect of the location on the level of contamination of the copper element. It was found that there were significant effects (P≤0.05) between the center of Kirkuk and the other region and no significant effects (P> 0.05) between both Daquq and Debis in all muscle, liver and kidney muscle (muscle, liver and kidney)), The concentration of copper in the center of Kirkuk reached the highest level (19.147 ppm) and the lowest level of concentration was recorded in Daquq (4.299 ppm) in the liver.

In comparison the effect of location on as the muscle, liver and kidney muscle the center of Kirkuk in the meat recorded the highest concentration (11.792 ppm) and the lowest area of Daquq (5.878 ppm), while the liver The concentration of copper in the center of Kirkuk was the highest and the lowest

concentration was Daquq (19.147, 4.299 ppm) respectively. The kidney The highest concentration was in the center of Kirkuk and lowest concentration in Debis (11.175, 5,474 ppm) respectively.

As for the effect of the season on the level of copper concentration, Table (3) showed the superiority of the winter on the summer and the significant effects (P≤0.05), where the winter recorded the highest concentration in the Muscle was the summer in the Muscle also reached (4.283 ppm). When comparing the effect of season to the, the winter recorded the highest concentration of c0pper than the summer in muscle, liver and kidney meat.

Table (3) shows the effect of the muscle, liver and kidney muscle at the concentration level of the copper element. There were significant effects (P≤0.05) between the liver and muscle, and no significant (P> 0.05) between muscle and kidney, The liver had the highest concentration with copper concentration (10.464 ppm) and the lowest concentration recorded in Kidney (7.436 ppm), while the muscle was (8.020 ppm.

Table- 3: Copper contamination in goat samples from three areas in Kirkuk during two seasons(winter and summer) (mean ± standard error).

Sample	Location	Season		Mean
		Winter	Summer	
Muscle	Daqouq	7.256 ±0.233 ef	4.500 ±0.105 gh	5.878 ±0.323 d
	Downtown	19.115 ±1.601 ab	4.469 ±0.092 gh	11.792 ±1.77 b
	Debis	8.902 ±0.1975 e	3.879 ±0.124 h	6.391 ±0.548 d
	Mean	11.758 ±1.053 a	4.283 ±0.075 e	8.020 ±0.688 b
Liver	Daqouq	3.773 ±0.153 h	4.826 ±0.283 gh	4.299 ±0.186 e
	Downtown	17.561 ±1.290 b	20.734 ±0.612 a	19.147 ±0.847 a
	Debis	10.785 ±0.432 d	5.109 ±0.442 gh	7.947 ±0.660 c
	Mean	10.706 ±1.080 b	10.223 ±1.312 b	10.464 ±0.836 a
Kidney	Daqouq	6.259 ±0.224 fg	5.025 ±0.549 gh	5.660 ±0.339 d
	Downtown	13.438 ±1.007 c	8.912 ±0.162 e	11.170 ±0.636 b
	Debis	5.431 ±0.453 fgh	5.516 ±0.258 fgh	5.474 ±0.514 de
	Mean	8.388 ±0.734 c	6.485 ±0.347 d	7.436 ±0.419 b

The averages with identical letters (same cells color) are not significantly different (P> 0.05) between them.

The results in Table (4) showed the effect of the interaction of muscle, liver and kidney muscle, location and season in the cobalt concentration of goats in three locations of Kirkuk areas during the winter and summer. The liver at the center of Kirkuk in the summer recorded the highest concentration (5.926 ppm) and significant effects (P≤0.05) when compared with the type of meat, season and locations, while the muscle recorded the lowest concentration (0.864 ppm) in the Debis.

Table (4) shows a significant effects(P≤0.05) for some location without the anther regionin the concentration of the cobalt, where the center of Kirkuk recorded the highest concentration and significant effects (P≤0.05) in liver (4.346 ppm) and the muscle in Daquq recorded the lowest concentration (1.700 ppm).When comparing between muscle, liver and kidney muscle, there were significant effects (P≤0.05) between location of muscle, and significant effects (P≤0.05) were found between Kirkuk and Debis and Daquq in relation to the muscle. There were significant effects (P≤0.05) between the all location in liver and

there were significant differences (P≤0.05) between the Debis and each of the center of Kirkuk and Daquq, muscle was recorded in the center of Kirkuk the highest concentration (4.001 ppm) and the Daquq lowest concentration (1.700 ppm), in the liver the center of Kirkuk recorded highest concentration (4.346 ppm), while the concentration of the element in the Debis was the lowest concentration (2.346 ppm), As for the kidney was the highest level of concentration of cobalt in the center of Kirkuk (3.251 ppm) and the lowest level was in the Debis (1.821 ppm).

Table (4) shows the effect of the season in the concentration of cobalt. The results showed the summer was superior than the winter. There were significant effects (P≤0.05).The summer recorded the highest concentration in the liver (3.643 ppm).And the lowest concentration level in winter Record in muscle (2.120 ppm). When comparing the effect of the season for the type of meat, the summer recorded the highest concentration than the winter in muscle, liver and kidney meat.

The results from the Table (4) showed the effect of type of meat in the concentration of cobalt, where significant effects (P≤0.05) between meat, liver, and kidney. The liver had the highest concentration of (3.330 ppm) and the lowest concentration Was recorded in muscle (2.503 ppm) while the kidney recorded (2.722 ppm).

Table- 4: Cobalt contamination in goat samples from three areas in Kirkuk during two seasons(winter and summer) (mean ± standard error)

Sample	Location	Season		Mean
		Winter	summer	
Muscle	Daqouq	0.988±0.057 j	2.412 ±0.122 fg	1.700 ±0.166 e
	Downtown	2.621 ±0.128 f	5.381 ±0.201 b	4.001 ±0.317 b
	Debis	2.751 ±0.154 ef	0.864±0.077 j	1.807 ±0.222 e
	Mean	2.120 ±0.153 d	2.886 ±0.334 b	2.503 ±0.186 c
Liver	Daqouq	1.474 ±0.133 i	3.124 ±0.250 e	2.299 ±0.213 d
	Downtown	2.766 ±0.146 ef	5.926 ±0.188 a	4.346 ±0.357 a
	Debis	4.808 ±0.134 c	1.879 ±0.109 hi	3.344 ±0.329 c
	Mean	3.016 ±0.248 b	3.643 ±0.313 a	3.330 ±0.199 a
Kidney	Daqouq	2.125 ±0.093 gh	2.125 ±0.093 gh	3.154 ±0.242 c
	Downtown	4.601 ±0.150 cd	4.601 ±0.150 cd	3.251 ±0.311 c
	Debis	2.061 ±0.243 gh	2.061 ±0.243 gh	1.821 ±0.141 e
	Mean	2.929 ±0.227 b	2.924 ±0.277 b	2.722 ±0.156 b

The averages with identical letters (same cells color) are not significantly different (P> 0.05) between them.

The reason for high concentration of all heavy metals may be that the source of drinking water in the Kirkuk, by the river Zab and water wells contaminated with heavy metals and also not suitable for drinking and for agriculture as well as also for drinking animals, where the concentration of heavy elements in this water is higher than the permissible limits and the lead was concentration in the water of the Lower Zab River and water (2.39, 2.61 µg / L) respectively, and the cobalt concentration was recorded (2.38, 2.8 µg / L) (Shwani, 2009).also the reason is that the province of Kirkuk suffers is pollution but in different degrees and from different sources due to the existence of different factories and petrochemical plants (cement, North Oil Company and North Gas Company), pollutants emitted from them, vehicle exhausts and residues directly from the residential in addition to chemical fertilizers and various pesticides added (89.8, 13.9, 12.1, 335.2

ppm) and were higher than the average *[13]* . Also AL-Jumaily (2009) *[14]* show the concentration of cadmium, lead is high reached (3.55, 433ppm) in soil of Kirkuk.

The increase in the level of pollution in the soil of Kirkuk effects on the level of concentration of the element in animal meat through its impact on the soil, plants and environment of the location, it was noted in the soil of Kirkuk high level of contamination with the copper (42 ppm) *[15].*The reason is that there are large numbers of people, large and small markets, streets, shops selling animal products The absence of a sewage system, the absence of a building plan, and the large number of oil and gas fields all have polluted the Kirkuk environment *[16]*.

The results are consistent with Al-Kabbani (2015) *[17]* which found significant effect of location, season and type of meat in the concentration of heavy elements. For the effect of type of meat, the liver was higher than the muscles for lead, cadmium, copper and cadmium as our results, The effect of the location, there were significant differences between location as we are recorded in our results. Also the season effect significantly on concentration of heavy metals, which most heavy metals in summer than winter. The results also converge with Abou-Donia (2008) *[18]* indicating that the areas within the city have a lower lead concentration than the industrial areas where the lead level was recorded in three areas of Cairo in goats, buffaloes and cows (0.030, 069, 0,065 ppm) respectively. The results do not correspond with Oladipo and Okareh (2015) *[19]* in the presence concentrations of lead Nigerian goat meat within the internationally permissible limits. The concentration of the lead element (0.1 ppm).

The study coincided with Bilandzic and workers (2009) *[20]* which found the concentration of cadmium in the internal organs was higher than the muscles. The concentration of cadmium in muscle, liver and kidneys was (0.07, 0.18 and 3.3 ppm) respectively. The results also agree with Iwegbue (2008) *[21]* that there is a disparity between places in Nigeria due to variability in exposure to heavy metals. The average cadmium concentration in kidneys was recorded in several regions of southern Nigeria (0.08 ppm) more than muscles.. The results also consistent with Sharif and workers (2005) *[22]* which found that the liver had the highest concentration of copper than kidney and the muscles were (36.88, 8.66, 4.14 ppm) respectively. The study also coincided with Miranda (2005) *[10]* in the effect of the location on the level of copper concentration in calves in the industrial and rural areas of northern Spain which was recorded (3.35, 2.66 ppm) respectively. The results agree also with Okoye and Ugwu (2010) *[23]* in his study of the levels of copper in the muscles, liver, kidney and heart of the goats in Nigeria which found (10.44, 134.02, 49.62 and 38.84 ppm) respectively. The study also agree with Jerzy (2003) *[24]* which found that the average concentration of copper in the liver is higher than the kidneys and the muscles. The mean copper concentration in the liver was recorded (29 ppm) while the kidney and muscular score (5.6, 1.2 ppm) respectively.

The study also agrees with Akan et al.(2010) *[14]* that the concentration of cobalt in liver and kidney in goats in Maiduguri, capital of Borno state in Nigeria, was higher than its muscles.

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