Study of the Some Heavy Metals Residues in the Camel Meat in different regions of Kirkuk governorate during the spring and Summer Seasons

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Abstract
For the purpose of searching for levels of some heavy contamination in muscle, liver and kidney meat for Camel in Kirkuk governorate in spring and summer seasons, samples were collected randomly from males (aged 4-5 years) from three reigns of Kirkuk governorate (Kirkuk center, Shwan and Laylan) During the March and April (spring season) and May and July months of (summer season) in 2020. There was a significant effect (p≤0.05) on the factors (meat type, location and season) in the concentration of lead, Kidney meat in the Kirkuk center in the spring season recorded the highest concentration of lead and significant difference (8.008 ppm) The lowest concentration (2.211 ppm) was found in Liver in Spring. The highest concentration level of cadmium in muscle in summer season from Kirkuk center (4.191 ppm) in muscle, and lowers Concentration of cadmium (2.961 ppm) recorded in kidney from Laylan in summer season. The concentration of zinc in the Liver at the Kirkuk center in the summer season was the highest concentration (138.221 ppm), while the Kidney in the spring season from Kirkuk center recorded the lowest concentration (28.347 ppm). For Copper the liver in the Kirkuk center in the spring season had the highest concentration (26.754 ppm), while the Liver from the Kirkuk center at summer was recorded lowest concentration (4.663 ppm). For Cobalt, in spring season in Kirkuk, the Muscle recorded the highest concentration of cobalt (8.194 ppm) in summer, while the lowest concentration was recorded in Kidney the spring season from Kirkuk center (1.913 ppm). All types of metals recorded levels higher than the internationally accepted limits.

Key words: camel, muscle, liver, kidney, heavy metals.

1. Introduction
Meat and meat product form are an important part of human diet as well as an important of a wide range of nutrient, but they may also carry certain toxic material. Also the level of these toxic material in muscle is general low, offal, such as liver and kidney, appears higher concentration of toxic material than most other food [1]. Toxic metal is defined as that metal, which is neither essential nor has beneficial effect, on the contrary, it displays severe toxicological symptoms at low levels. With increasing industrialization, more and more metals are entering into the environment. These metals stay permanently because they cannot be degraded from the environment. They pass into the food and from food they ultimately make their passage into the tissue [2]. Also passes by animal drugs in recent years, there has been increasing interest in determining the concentration levels of heavy metals in various food products [3]. Minerals form more than 40 different elements that are diffused in the environment. Some of us are necessary for life, such as those that make up the alkaline earth crust group, some microelements, others have the ability to cause poisoning to different organisms, and even the group necessary elements for life. If the focus exceeds the natural limit, it becomes toxic and some microelements enter. Within the arrangement is the part into some enzymes needed for vital processes, though its high concentration is also toxic [4]. Foodstuffs grown on contaminated soil or irrigated with impure water accumulate metal contents and are a big source of heavy metals exposure to the animals and humans [5]. Land applications of sewage mire and sewage water gradually increase the toxic concentration of heavy metals in soil and these are increasingly up taken by the plants and vegetables and afterwards relocate into the food chain causing severe damage to both animals and human health [6]. Heavy metals often have direct physiologically toxic effects and are stored or incorporated in living tissues, sometimes permanently [7]. 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 [8]. Different researchers have reported the instances of contamination of heavy metals in meat products during processing [9]. 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 [2,8,9].
The region in general and Iraq in particular have witnessed pollution from wars, the absence of health control, quality control, and strict laws against violators [10]. In recent times, interest has increased greatly from researchers and specialists in collecting databases and conducting studies and surveys to know what risks a person is exposed to human, including reducing and identifying the risks resulting from the residue of heavy metals from eating contaminated animal meat contaminated with these animals [4]. The city of Kirkuk is one of the oldest cities in Iraq; it is considered one of the richest oil cities in the world. It has the benefits of Baba Gerger, which are the richest oil production fields in the world and the fields of Bay Hassan. In addition to oil wealth, there is sulfur that is produced during the preliminary liquidations of oil and natural gas and other wealth including salt. Plaster used in construction and many factories fill gas, asphalt and ghee in addition to a very large number of citizens who live in this city [10]. This study was conducted for investigating the levels of contamination of muscle, liver and kidney meat for Camel in Kirkuk during the summer and spring seasons.

2. Materials and Methods

2.1. Source of meat

In this study, adopted the muscles, liver and kidneys of the Camel and the male species. All animals were in Iraqi regain and local species. The animals, which are replete from pasture and concentration diet feeding, are from three districts of Kirkuk locations, which include Kirkuk center, Shwan and Laylan. During the two seasons Spring of March 15, and May 15, and the summer of June 15 and July 15, 2020.

2.2. Collection of samples

The samples were collected from Camel aged 4-5 years. Meat samples (muscles and all organs) were used and three replicates were randomly and selected from three areas of Kirkuk (kirkuk center, Shwan and Laylan) during March and May Spring) and June and July (summer season), the leg muscle was meat muscle samples which used for study, while the Internal organs samples consisted of liver and kidneys. After the slaughter of camel the samples were left and pending from the tenth hour in the place of sale until 15 clocks. Samples were taken from animals studied from the leg muscle in all areas and all animals, and the 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 0.55. 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 also 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 tests were conducted to measure the ratio of heavy elements. During a single season, a total of 270 meat and organ samples were collected from Camel.

2.3. Determination of heavy elements

The heavy metals concentrations were determined by method as described by [11].

2.4. 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 program was used in statistical analysis

\[ Y_{ijklm} = m + A_i + B_j + C_k + CD (kl) + ABC (ijk) + e_{ijklm} \]

Where: 
- \( Y_{ijklm} \): View values for each attribute. 
- \( M \): General average Effect of meat type (muscles, liver and kidney). 
- \( A_i \): Effect of season (Spring and summer). 
- \( B_j \): Effect of location (Kirkuk center, Laylan and Shwan). 
- \( C_k \): Effect of interaction between meat, season and location. 
- \( e_{ijklm} \): random error which distributes a normal distribution with a mean of zero and a variation of S2 e.

3. Results and Discussion

Table 1 appears a significant effect (p≤0.05) on the effect of the tripartite interaction of the factors (type of meat, location and season) at the level of lead concentration in meat, liver and kidney meat samples in Camel in three locations of Kirkuk areas during the Spring and summer seasons. In the Spring season, the Kidney recorded the highest concentration of lead in the Kirkuk center with a significant difference (p≤0.05), reaching (8.008 ppm), whereas in the Spring season the Shwan regain the liver sample recorded the lowest level of concentration (2.211 ppm). Table 1 shows difference significant (p≤0.05) between the areas in the effect of the site at the level of lead concentration of the above factors mentioned, the Kirkuk center recorded the highest concentration of lead element (5.764 ppm) and the lowest level of concentration of the scoredin the area of Shwan was (3.028 ppm) in muscle sample. When comparing the effect of regions by type of meat, liver meat was recorded in the Kirkuk center the highest concentration (4.578 ppm) and the Shwan area recorded the lowest concentration (4.171 ppm). Table 1 appears a significant effect (p≤0.05) for the Spring season on the summer season at the level of concentration of the lead element when studying the effect of the season on lead contamination. The Spring season recorded the highest results than the summer season in the kidney where the concentration of lead was (5.275 ppm) the lowest concentration of a scored in the summer season in the kidney also to (3.286 ppm). When comparing the effect of the season to the type of meat, the Spring season recorded the highest concentration of lead compared to the summer season in muscle, liver and kidney meat. As for the type of meat, it was appears from Table 1 that there was a significant difference (p≤0.05).
between the liver and both kidney and muscle and no significant differences (p≤0.05) between muscle and kidney meat at the level of lead concentration.

Table 1. Lead contamination in camel samples from three areas in Kirkuk during two seasons (spring and summer) (mean ± standard error).

| Sample     | Location | Season  | Mean       |
|------------|----------|---------|------------|
|            |          | Spring  | Summer     |
| Muscle     | Laylan   | 4.781±0.041 e | 2.663±0.141 ij | 3.722±0.238 e |
|            | Kirkuk center | 7.468±0.115 b | 4.060±0.083 f | 5.764±0.365 |
|            | Shwan    | 2.443±0.023 jk | 3.613±0.026 g | 3.028±0.125 g |
|            | Mean     | 4.897±0.359 b | 3.445±0.108 d | 4.171±0.204 b |
| Liver      | Laylan   | 4.286±0.071 f | 2.921±0.051 h | 3.603±0.155 ef |
|            | Kirkuk center | 7.370±0.135 b | 3.736±0.027 g | 5.553±0.394 a |
|            | Shwan    | 2.211±0.023 k | 6.946±0.073 c | 4.578±0.503 c |
|            | Mean     | 4.622±0.371 | 4.534±0.299 | 4.578±0.348 a |
| Kidney     | Laylan   | 5.183±0.035 d | 3.069±0.089 h | 4.126±0.230 d |
|            | Kirkuk center | 8.008±0.169 a | 2.549±0.040 j | 5.278±0.596 b |
|            | Shwan    | 2.636±0.058 ij | 4.242±0.305 f | 3.439±0.238 f |
|            | Mean     | 5.275±0.386 a | 3.286±0.164 d | 4.280±0.237 b |

The averages with identical letters are not significantly different (P>0.05) between them. Table 2 appears significant effect (p≤0.05) of the scored on the cadmium concentration between the regions, the Kirkuk center recorded the highest concentration of cadmium (4.191 ppm) in muscle sample and the lowest concentration of the element was recorded in the Laylan (2.961 ppm) in kidney. When we compare the effect of regions, we found the Kirkuk center has recorded the highest concentration (3.921 ppm) and the Laylan recorded lowest concentration of cadmium was (3.024 ppm). Table 2 appears significant effect (p≤0.05) of season on the cadmium concentration, The summer season appears a higher concentration from Spring at the level of pollution, where the summer recorded the highest concentration in the liver and recorded (3.885 ppm). The lowest Spring concentration in the kidney was recorded (3.242 ppm), and when compared to the meat season, the summer recorded the highest concentration of cadmium compared to Spring in muscle, liver and kidney meat. There were significant in the type of meat in muscle, liver and kidney as shown in table 2. The muscle recorded the highest results, with cadmium concentration (3.698 ppm) and the lowest concentration recorded in the kidney, where the concentration of cadmium (3.382 ppm).

Table 2. Cadmium contamination in cattle samples from three areas in Kirkuk during two seasons (Spring and summer) (mean ± standard error).

| Sample     | Location | Season  | Mean       |
|------------|----------|---------|------------|
|            |          | Spring  | Summer     |
| Muscle     | Laylan   | 3.079±0.043 fg | 3.496±0.083 d | 3.287±0.066 e |
|            | Kirkuk center | 3.582±0.033 d | 4.191±0.020 a | 3.886±0.066 a |
|            | Shwan    | 4.087±0.038 fg | 3.756±0.019 c | 3.921±0.073 d |
|            | Mean     | 3.582±0.046 d | 3.814±0.058 a | 3.698±0.049 b |
| Liver      | Laylan   | 3.231±0.060 e | 3.813±0.037 c | 3.522±0.071 c |
|            | Kirkuk center | 3.588±0.034 d | 3.877±0.025 bc | 3.732±0.037 b |
|            | Shwan    | 3.202±0.037 ef | 3.966±0.034 b | 3.587±0.085 c |
|            | Mean     | 3.340±0.038 c | 3.885±0.021 a | 3.613±0.039 a |
| Kidney     | Laylan   | 3.088±0.054 fg | 2.961±0.038 g | 3.024±0.034 f |
|            | Kirkuk center | 3.538±0.023 d | 3.993±0.061 b | 3.765±0.058 b |
Camel in three location of Kirkuk areas (Laylan, Kirkuk center and Shwan) during Spring and summer, the Kirkuk center in the summer recorded the highest concentration and significant effect (P≤0.05) from the other factors of the study, as recorded (138.221 ppm), while the kidney recorded in the Kirkuk center in Spring the lowest concentration (28.327 ppm). Table 3 appears effects (P≤0.05) of location between all regions in both liver and kidney, and there were no significant effects (P>0.05) in the kidney between the Shwan and the Kirkuk center. The concentration of zinc in the Kirkuk center was the highest concentration at (100.713 ppm) and the lowest concentration was recorded in the kidney in the Shwan (44.619 ppm). Table 3 appears the effect of the season on the concentration of zinc. The summer recorded a higher concentration than Spring. There were significant effects (P≤0.05) between them. Summer recorded the highest concentration in the liver It recorded (103.813 ppm). The Spring scored low concentration in the kidney was also recorded (28.347 ppm). When comparing the effect of the season to the type of meat, the Spring recorded the highest concentration of zinc from the Spring in muscle, liver and kidney meat. Table 3 shows the effect of the type of meat on the zinc element. There were significant effects (P≤0.05) between muscle, liver and kidney meat. The liver scored the highest concentrations (83.928 ppm) and lowers concentration recorded in the kidney (48.764 ppm).

Table 3, Zinc contamination in camel samples from three areas in Kirkuk during two seasons ( spring and summer) (mean ± standard error).

| Sample | Location | Season  | Mean      |
|--------|----------|---------|-----------|
|        |          | Spring  | Summer    |
| Muscle | Laylan   | 50.542 ± 2.482 f | 56.765 ± 1.268 ef | 53.653 ± 1.594 de |
|        | Kirkuk center | 77.004 ± 5.899 d | 88.651 ± 2.200 c | 82.827 ± 3.369 b |
|        | Shwan    | 59.072 ± 5.531 e | 78.329 ± 1.95 d | 68.855 ± 3.609 c |
|        | Mean     | 62.206 ± 3.651 b | 74.581 ± 2.495 b | 68.445 ± 2.286 b |
|        | Laylan   | 55.003 ± 2.618 ef | 118.665± 0.659 b | 86.834 ± 6.702 b |
| Liver  | Kirkuk center | 62.761± 1.448 e | 138.221± 1.189 a | 100.713± 8.154 a |
|        | Shwan    | 61.777± 2.964 c | 54.555 ± 0.710 ef | 58.166± 1.681 d |
|        | Mean     | 61.964 ± 1.45 c | 103.813± 6.12 a | 83.928± 4.092 a |
|        | Laylan   | 40.512 ± 0.92 g | 57.456 ± 1.407 ef | 48.984± 1.963 ef |
| Kidney | Kirkuk center | 28.347± 2.254 h | 77.034± 0.907 d | 52.690± 5.141 dc |
|        | Shwan    | 40.123± 0.923 g | 49.116± 0.113 f | 44.619± 1.012 f |
|        | Mean     | 36.327 ± 1.356 d | 61.202± 2.111 c | 48.764± 1.920 c |

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

Table 4 shows the effect of interaction of type meat, location and season at the copper concentration. Appears significant effect (P≤0.05) of the location, season and type of meat in the concentration of copper. The highest concentration of copper in the liver found in Kirkuk center in the Spring (26.754 ppm), while the lowest concentration of copper in the liver was recorded in the summer in Kirkuk center (4.663 ppm). Table 4 appears 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 Kirkuk center and the both Shwan and Laylan and no significant effects (P>0.05) between both Laylan and Shwan in all types of meat (muscle, liver and kidney). The concentration of copper in the Kirkuk center reached the highest level (15.709 ppm) liver and the lowest level of concentration was recorded in Laylan (7.067 ppm) in the muscle. As for the effect of the season on the level of copper concentration, table 4 appears the superiority of the Spring on the summer and the significant effects (P≤0.05), where the Spring recorded the highest concentration in the liver was (14.268 ppm) the summer in the liver also reached (6.878ppm). When comparing the effect of season to the type of meat, the Spring recorded the highest concentration of copper than the summer in muscle, liver and kidney meat. Table 4, shows the effect of the type of meat at the concentration...
level of the copper element. There were significant effects ($P \leq 0.05$) between the liver and both muscle and kidney, and no significant ($P > 0.05$) between muscle and kidney. The liver had the highest concentration with copper concentration (10.570 ppm) and the lowest concentration recorded in muscle (6.496 ppm), while the kidney was (8.417 ppm).

**Table 4.** Copper contamination in Camel samples from three areas in Kirkuk during two seasons (Spring and Summer) (mean ± standard error).

| Sample | Location | Season         | Mean                   |
|--------|----------|----------------|------------------------|
|        |          | Spring         | Summer                 |
| Muscle | Laylan   | 8.127 ± 0.4 defg | 6.08± 0.136 i          | 7.067 ± 0.313 c |
|        | Kirkuk center | 9.743 ± 0.236 cde | 10.036± 0.474 bc      | 9.889 ± 0.279 b |
|        | Shwan    | 7.686± 0.12 gh   | 8.901± 0.231 cdefg     | 8.293± 0.155 bc |
|        | Mean     | 8.519 ± 0.205 bc | 8.315± 0.336 c        | 8.417 ± 0.194 b |
|        | Laylan   | 8.178 ± 0.324 efg | 6.430± 0.356 i       | 7.304 ± 0.321 c |
| Liver  | Kirkuk center | 26.754 ± 1.268 a | 4.663 ± 0.09 j        | 15.709 ± 2.436 a |
|        | Shwan    | 7.874 ± 0.423 fgh | 9.543 ± 0.594 cd      | 8.708± 0.428 bc |
|        | Mean     | 14.268± 1.554 a | 6.878± 0.452 d       | 10.570 ± 0.914 a |
|        | Laylan   | 10.009 ± 0.079 bc | 7.111 ± 0.247 hi     | 8.577 ± 0.337 bc |
| Kidney | Kirkuk center | 11.221 ± 0.055 b | 9.302 ± 0.124 cdef   | 10.16 ± 0.236 b |
|        | Shwan    | 8.334 ± 0.217 fgh | 6.444 ± 0.569 i     | 7.23± 0.337 c  |
|        | Mean     | 9.854 ± 0.232 b | 7.619± 0.292 cd      | 8.736± 0.273 b  |

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

The results of Table (5) appears the effect of the interaction of type meat, location and season in the cobalt concentration of Camel in three locations of Kirkuk areas during the spring and summer. The muscle at the Kirkuk center in the summer recorded the highest concentration (8.194 ppm) and significant effects ($P \leq 0.05$) when compared with the other factor the meat, season and locations, while the kidney recorded the lowest concentration (1.912 ppm) in the Kirkuk center. Table (5) shows a significant effects ($P \leq 0.05$) for some location without the anther areas in the concentration of the cobalt, where the Kirkuk center and recorded the highest concentration and significant effects ($P \leq 0.05$) (5.320 ppm) in the liver , and the Laylan recorded the lowest concentration (2.436 ppm). When comparing between types of meat, there were significant effects ($P \leq 0.05$) between location of muscle meat, and significant effects ($P \leq 0.05$) were found between Laylan and Kirkuk and Shwan in relation to the liver. There were significant effects ($P \leq 0.05$) between the Kirkuk center and there were no significant differences ($P > 0.05$) between the Shwan and each of the Kirkuk center and Laylan. Table 5 shows the effect of the season in the concentration of cobalt. The results appears the summer was superior to the Spring. There were significant effects ($P \leq 0.05$). The summer recorded the highest concentration in the liver (5.045 ppm). And the lowest concentration level in Spring Scored in muscle (4.203 ppm). When comparing the effect of the season for the type of meat, the summer recorded the highest concentration than the Spring in muscle, liver and kidney meat. The results from the Table 5 appears the effect of type of meat in the concentration of cobalt, where significant effects ($P \leq 0.05$) between meat, liver, and kidney. The muscle had the highest concentration of (4.624 ppm) and the lowest concentration was recorded in kidney (3.322 ppm).

**Table 5.** Cobalt contamination in camel samples from three areas in Kirkuk during two seasons (Spring and Summer) (mean ± standard error).

| Sample | Location | Season         | Mean                   |
|--------|----------|----------------|------------------------|
|        |          | Spring         | Summer                 |
| Laylan | 3.886 ± 0.109 fg | 2.042 ± 0.083 h | 2.964 ± 0.125 e |
Acknowledgements

All the meat sample exceed the limited value of heavy metals.

Conclusion

All the meat sample exceed the limited value of heavy metals.

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