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# Investigation on the Effect of Polluted underground water With Minerals metals and Trace elements on different Meat Types in Tambol area- Sudan

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**ABSTRACT**

This study was carried out to investigate the effect of contaminated underground water with heavy metals and trace elements such as (chromium (Cr), Nickel (Ni), Zinc (Zn), Iron (Fe), Lead (Pb) and Manganese (Mn)) in different types of meat produced at Tambol area -Sudan. Samples of water and animals meat tissues were collected and analyzed for metals presence by using flame atomic absorption spectrophotometer (FAAS). The study revealed that the levels of heavy metals and trace elements in meat of (beef, sheep, goat and camel) varied in concentration. The mean concentration of heavy metals was Chromium: (0.14, 0.26, 0.17 and 0.16 mg/kg. Nickel: (0.12, 0.15, 0.13 and 0.12 mg/kg), Zinc: (8.04, 6.47, 7.8 and7.67 mg/kg). Iron: (5.54, 3.25, 3.26 and 3.56 mg/kg). Lead: (1.17, 1.24, 1.25 and 1.36 mg/kg). Manganese: (0.08, 0.13, 0.10 and 0.07 mg/kg) for beef, sheep, goat and camel respectively. There was significant different at ($p \leq 0.01$) in Iron content of different meat types. The study showed that the concentrations of heavy metals and trace elements of underground water were (0.003 ± 0.001, 0.002 ± 0.001, 0.02 ± 0.002, 0.01 ± 0.001, 0.01 ± 0.001 and 0.01 ± 0.001 mg/l) for Cr, Ni, Zn, Fe, Pb and Mn in water respectively. The results showed that the levels of all metals under investigation were comparable with the corresponding recommended permissible limits stated by international agencies such as WHO, US-EPA, EU, SSMO and Japan. Significant positive and negative correlation was observed between the metal content in meat, whereas the study did not indicate any correlation between metals concentration in groundwater and muscle tissues.

## INTRODUCTION:

The contamination with heavy metals is a serious threat because of their toxicity, bioaccumulation and bio magnifications in the food chain. These pollutants often in irrigation ground water in Burkina Faso ranged as (0.016 -0.116, 0.043 – 0.462, 0.036 – 0.406, 1.048 – 1.286, 0.00 – 0.451 and 0.086 – 0.272 mg/l) for (Cr, Mn, Zn, Fe, Ni and Pb) respectively as reported by Luc et al (2015). Fahad (2015) found the concentration of metals in ground water in Alahsa Oasis farms as (0.063, 0.101, 0.010 and 0.005) for Mn, Fe, Zn and Pb respectively. Eshraga (2005) found the concentration of metals in groundwater at Khartoum state ranged as (0.0015-0.0025 , 0.0048-0.0069 and (0.005-0.011, 0.0002-0.0008 mg/l) for Pb , Ni , Zn and Cr respectively , and the admissible concentration of in drinking water according to WHO and SSMO Standards was 0.05 , 0.02 , 5.00 and 0.05 mg/l for lead , nickel , zinc and chromium respectively . Kumar et al (2016) reported the concentrations of nickel and chromium in groundwater of the West Bokaro Post- monsoon, and Pre- monsoon were (9.4 mg/l and 21, 0.8 and 2.8 mg/l) respectively and the permissible level of the elements stated by (WHO (2011), BSI (2003), USEPA (2009) Standards is (20 mg/l) for nickel and50, 50, and 100 mg/l for chromium respectively. Purnama *et al*., (2014) found the concentration of chromium in animal drinking water was 0.52 mg/l. Kumar *et al*., (2016) reported the concentration of (Mn) in groundwater of the West Bokaro in Post- monsoon and Pre- monsoon were (28.6 , 53 mg/l ) respectively and added the permissible level of (Mn) as stated by WHO (2011), BSI( 2003) and USEPA (2009) were (100 ,100 ,and 50 mg/l) respectively. Shaheen *et al*., (2016) reported that the have direct physiological toxic effects because they are stored or incorporated in tissues, sometimes permanently (Abd EI-Salam *et al.,* 2013). Concentration of heavy metals concentration of Lead in beef was 0.48 mg/kg, while the concentration in mutton ranged as (0.15 – 4.25 mg/kg). Marta *et al*., (2003) found the concentrations of (Pb) in liver, kidney and muscle of calves slaughtered in Asturias –Spain were (34.5, 34.6, and 11.1 mg/kg) respectively. Ubong *et al*., (2016) reported the concentration of manganese and nickel in muscles, liver and kidney of cow in Nigeria as Mn: (2.76, 8.72, and 6.05) for muscles, liver and kidney respectively, Ni: (0.001, 9.62, and 2.73 mg/kg) for muscles, liver and kidney respectively. Akan *et al*., (2010) reported the concentration of heavy metal and trace elements in meat of beef, sheep and goat ranged as ( 0.23 to 1.22mg/kg Cr; 0.1 to 1.34mg/kg, Pb; 0.98 to 4.65mg/kg Fe; 0.01 to 1.09mg/kg Ni; 0.45 to 4.11 mg/kg Mn and 1.10 to 6.23 mg/kg Zn. Hozan & Hemin (2013) found the concentration of heavy metals and trace elements in beef meat ranged as Cr: ( 0.10 – 0.40 mg/kg) , Zn: (2.43 – 3.81 mg/kg) , Fe: (1.43 – 5.41 mg/kg), Pb: (0.53 – 2.07 mg/kg) whereas there was no reading for nickel and manganese. The average concentration of lead in fresh meat from beef, sheep, and camel produced in Algeria as reported by Bendeddouche *et al*., (2014) were (8.80, 3.49 and 2.01 gm/kg) for beef, sheep and camel respectively. Rashed (2002) stated that the concentration level of major and trace elements in camel tissue ranged as Fe: (0.47 to 0.55 mg/kg), Zn: (0.06 to 0.10 mg/kg), Cr: (3.3 to 4.2 mg/kg), Ni: (1 to 4 mg/kg) and Mn: (2 to 2.5 mg/kg). Morta *et al*., (2004) reported the

concentrations of (Pb) in tissues of cattle from North and West Spain were (28.0, 20.0, 14.5 mg/kg) for (liver kidney and muscle) respectively. Richard et al., (2014) stated the concentrations of (Pb) in meat of goat and cattle ranged as (0.001 -0.5 mg/kg), (0.001 -0.1 mg/kg) for goat and cattle respectively whereas the concentration of (Pb) in fresh meat reported by Badis *et al*., (2014) was (7.76, 3.49, 2.01 mg/kg) for beef, sheep and camel respectively. Marian and Ansah (2014) found the concentration level of (Pb) in meat as (1.154, 0.377 and 0.377 mg/kg) for beef, mutton and goat respectively.

The Objectives were**:** to investigate the contamination of underground water in Tambol area with Heavy metals, and to determine the effect of polluted water in contamination of different meat type at Tambol area.

## MATERIALS AND METHODS:

***Sampling and preparation of Muscles:***Forty samples of muscle beef, sheep, goat and camel were collected from slaughterhouse and butchers shops in Tambol public market. A slice of muscle sample of approximately 200 g was taken with a clean stainless steel knife from each carcass and placed in a plastic bag. All samples were placed in a cooler box at 4 Cº and transported to the laboratory and stored at –20 Cº for further analysis.

***Sample Preparation:*** the samples were thawed, cut into small pieces using a stainless steel knife and about 50.0 g. taken into crucible then dried in drying oven at 105 ºc for 24 hour and then put in desiccators to absorb residual of moisture to a fixed weight, 5 gm of dried samples were put in crucible. Then the crucible was placed in muffle furnace and ashed at 550ºc for 2 hour, then cooled. One ml of concentrated HNO3 was added to the obtained ash then transferred to 50 ml volumetric flask by carefully washing crucible with 1ml of diluted HNO3 then the mixture was diluted with de ionized water to 50 ml.

***Water samples Collection and preparation:*** ten samples of ground water were randomly collected from farms at Tambol area. Cleaned polyethylene bottles with de-ionized water were used for collecting water samples. Water sampling was conducted as described by Miller & Baker (2001). Samples were transported to laboratory and stored at -20° C for further analysis.

***Atomic Absorption Spectrophotometer (AAS):*** atomic absorption spectrophotometer (210VGP Buck Scientific double beam manufactured by United States of America) was used in measuring the concentration of Cr, Ni, Zn, Fe, Pb and Mn. The samples were subsequently analyzed on wet weight basis using the hollow cathode lamps for lead (Pb), Chromium (Cr), Nickel (Ni) Zinc (Zn), Iron (Fe) and Manganese (Mn) at the proper wave length and other Atomic Absorption Spectrophotometer conditions were employed in the analysis.

***Statistical analyses:*** the data collected presented as mean ± standard deviation was subjected to one way analysis of variance (ANOVA) ($p<0.01$) to assess whether heavy metals varied significantly between samples. All statistical calculations were performed with SPSS 17 (Gomez and Gomez 1984).

## RESULTS AND DISCUSSION:

The mean values ± standard deviation of Chromium, Nickel, Zinc, iron, Lead and manganese, concentrations in groundwater samples and meat of cattle , sheep , goat and Camel from Tambol

area presented in Table 1 and Table 2. The results of this study showed significant different at ($p \leq 0.01$) in the concentration of Iron in muscle.

**Table 1: Comparison of average metal levels in ground water (mg/l) with some international water quality standards**

| | Present study | WHO 2011 | SSMO 2008 | US.EPA (2009) | EU (2010) | Japan (2012) |
|---|---|---|---|---|---|---|
| Cr | 0.003 | 0.05 | 0.033 | 0.10 | 0.05 | 0.05 |
| Ni | 0.002 | 0.02 | 0.05 | 0.10 | 0.05 | 0.01 |
| Zn | 0.02 | 3.00 | 3.00 | 5.00 | 0.10 | - |
| Fe | 0.01 | 0.30 | 0.30 | 0.30 | 0.20 | 0.30 |
| Pb | 0.01 | 0.01 | 0.007 | 0.015 | 0.05 | 0.05 |
| Mn | 0.01 | 0.1-0.5 | 0.27 | 0.05 | 0.05 | 0.1-0.05 |

The results showed that the concentrations of heavy metals and trace elements in ground water were found to be (0.003 ± 0.001 , 0.002 ±0.001, 0.02± 0.002 , 0.01 ± 0.001,0.01±0.001 and 0.01±0.001 mg/l) for (chromium, Nickel, Zinc, Iron, Lead and Manganese) respectively. These results are in-line with that reported by, Sirajudeen and Vahith (2012), Olafisoye *et al*., (2013), Luc *et al*., (2015), Tadiboyinaa, Ptsrkb (2016) and Elumalai *et al.*, (2017). Regarding water quality standards the results presented in Table (1) were matching with the permissible limits recommended by international agencies such as WHO (2011), US-EPA (2009), EU, SSMO (2008) and Japan.

**Table 2: Levels of some heavy metals and Trace elements in various meat samples from Tambul area, in (mg/kg)**

| | Chromium | Nickel | Zinc | Iron | Lead | Manganese |
|---|---|---|---|---|---|---|
| Beef | 0.14 ±0.08 | 0.12 ±0.10 | 8.04± 1.94 | $5.54^{a}$±2.14 | 1.17 ±0.52 | 0.08±0.04 |
| Mutton | 0.26 ± 0.19 | 0.15±0.13 | 6.47±2.4 | $3.25^{b}$±1.61 | 1.24±1.02 | 0.13±0.15 |
| Goat meat | 0.17± 0.12 | 0.13 ± 0.1 | 7.8±0.7 | $3.26^{b}$±0.70 | 1.25±0.60 | 0.10±0.05 |
| Camel meat | 0.16± 0.14 | 0.12± 0.11 | 7.67±1.9 | $3.56^{b}$ ±0.71 | 1.36±0.54 | 0.07±0.04 |

a, b , c: - means within the same column followed by different superscripts are significantly ($p < 0.01$) different.

In beef, sheep, goats and camel meat chromium levels ranged as 0.14 - 0.26 mg/kg reported this results in line with that by Hozan *et al*., (2013) and disagree with result reported by Rashed (2002). From present result Nickel was ranged from 0.12 – 0.15 mg/kg found this result is matching with that by Akan (2010) and disagrees with Rashed (2002) and Ubong *et al*., (2016). A highest concentration of Zinc was detected in beef meat (8.04 mg/kg) but without significance different, while the minimum value was recorded in mutton (6.47mg/kg), this result is similar to that reported by Akan (2010) and disagrees with result found by Rashed (2002) and Hozan & Hemin (2013). Iron concentration ranged from 3.25 to 5.54 mg/kg, this result disagrees with that recorded by Akan (2010), Hozan *et al*., (2013) and Rashed (2002). Lead concentration ranged from 1.17 to 1.36 mg/kg recorded this results matching with that by Akan (2010), Marian and Ansah (2014) and disagrees with Shaheen *et al*., (2016), Hozan *et al*., (2013), Out *et al*., (2014) and Badis *et*

*al*., (2014). The results of this study showed significant positive correlation between muscle Cr and Muscle Ni r= (0.906) and between Muscle Pb and Muscle Fe r = (0 .361) Table (3). Significant negative correlation between Muscle Cr and Muscle Zn r = (- 0.505) and between muscle Cr and muscle Fe r = (- 0.560) and showed negative correlation between muscle Cr and muscle Pb r = (- 0.659) also these results showed significant negative correlation between muscle Ni and muscle Fe r = (- 0.549) and between muscle Ni and muscle Zn r = (-0.658) and showed also significant negative correlation between muscle Zn and muscle Fe r = (- 0.325) .Whereas the study did not indicate any correlation between metals concentration in groundwater and muscle tissues (Table 3 and Table4).

**Table 3: Muscle Metal to muscle metal correlation coefficient matrix for some metals in muscle and ground water samples (n=40)**

| Parameters | | Muscle | | | | | |
|---|---|---|---|---|---|---|---|
| | | Chromium | Nickel | Zinc | Iron | Lead | Manganese |
| Muscle | Chromium | 1 | | | | | |
| | Nickel | 0.906 | 1 | | | | |
| | Zinc | - 0.505 - | -0.281- | 1 | | | |
| | Iron | - 0560 - | - 0.549 - | 0.325 | 1 | | |
| | Lead | 0.659 | - 0658 - | 0.218 | 0.361 | 1 | |
| | Manganese | 0.167 | 0.211 | 0.123 | -0.060 | -0.143 | **1** |

Bold values are significant at p<0.00

**Table 4: Muscle Metal to water metal correlation coefficient matrix for some metals in muscle and ground water samples (n=40)**

| Parameters | | Water | | | | | |
|---|---|---|---|---|---|---|---|
| | | Chromium | Nickel | Zinc | Iron | Lead | Manganese |
| Muscle | Chromium | 0.146 | | | | | |
| | Nickel | -0.073- | -0.177- | | | | |
| | Zinc | 0.171 | -0.013- | -0.073- | | | |
| | Iron | -0.142 | 0.116 | -0.065- | -0.064- | | |
| | Lead | -0.177- | 0.079 | -0.197 | 0.01 | -0.133- | |
| | Manganese | -0.094 | 0.212 | 0.205 | 0.004 | 0.254 | -0.240- |

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