

# Atomic Absorption Spectrophotometry Detection of Microelement in Some Animal Products from Various of Merowe–Sudan

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**Abstract:** Environmental problems related to pollution of soil, food, and water have been increased with industrialization. The determination of the twenty one microelements performed by atomic absorption spectrometry (AAS) namely (Cadmium, Cobalt, Copper, Manganese, Lead, Iron and Zinc) in some animal products (yoghurt, Poultry and white cheese) that Sold in groceries public in Merowe-city-Sudan. Results indicated high concentration of Zn and Pb especially in white cheese samples. The lowest concentrations of metals were found in yoghurt. Mean metals concentration (mg/kg) in poultry were ND ND (mean Not Detected) for Cd, 0.14 for Co, 0.014 for Cu, 2.28 for Fe, 0.16 for Mn, 2.78 for Zn. Poultry were found to contain significantly more Zn and Fe than yoghurt but generally less Co. Finally, further investigation is needed to identify the cause of elevated Zn and Fe especially in poultry and whit cheese. Data analysis was carried out by the statistical software SPSS as well as Excel to compare heavy metal concentration between different brands.

**Keywords:** Yoghurt, Poultry, White Cheese, Microelements, AAS, Sudan

## 1. Introduction

Animal products and in particular dairy product contain variety of very an important nutrients they are considered as nearly complete food in that's a good source of protein, fat, vitamins, carbohydrate and mineral's [1]. Therefore milk and dairy products are important components of human diets that are widely consumed by human children and adults especially elderly people around the world [2] which are crucial to maintain healthy life of every individual thus their regular daily consumption has been widely recommended. However there is evidence that milk and other dairy products might contain varying amounts of different toxic contaminants. According to the newest report from WHO one in eight to global deaths were linked with air pollution making it the world's largest single environmental health risk thus, it is a vital topic to study pollutant particles such as heavy metals in the air pollution are as. Human exposure to these compounds occurs in different ways including inhalation, dermal contact and via food items with the later

accounting for at least 90% of overall human exposure [3]. Therefore, the contamination of living environment with potentially toxic heavy metals is considered as. A very important health concern, which may result in accumulation of the elements' in many food items. Heavy metals have been named in this attribute because high atomic weight [4] metals differ from other toxic substances in that they are neither created nor destroyed by humans, metal are redistributed in the air water soil and food through geological biological and anthropogenic pathways [5]. Minerals nutrients are involved in the most fundamental process of life [6]. They are inorganic elements that maintain their structure throughout the processes of digestion absorption and metabolism and play critical roles in virtually all aspects of human health and function. On the basis of body requirements the two categories of minerals in our diets are the major minerals (<100mg/day). and the trace minerals (<100mg/day). Amount of major minerals present in the human body is greater than 5g, in contrast trace minerals exit in the human body is less than 5g. Major minerals include such as Ca, P,

Na, K, Cl, Mg while trace minerals include such as Fe, Zn, Cu, Mn, Co, Cd, and Pb [7]. These trace elements are responsible for many pernicious effects on human health as immune depression and skin diseases (zinc and copper contamination), neurological disorders (manganese), or blood disorders (iron) have been experienced [8]. Animal products such as milk, dairy products (yoghurt, cheese) and whole meats are an excellent source of microelements such as Calcium, potassium and sodium) and microelements such as Lead. Lead which is chemically identical to calcium is excreted into milk to a considerable extent [9]. Chemically identical divalent essential metals such as iron, calcium and zinc are replaced from some of their metabolic sites by lead and disable to perform their functions for example, lead competes with iron in heme, but then cannot act as an oxygen carrier, similarly, lead competes with calcium in neurons but cannot signal messages from nerve cells [10]. Whereas milk, fasting, low levels of calcium, vitamin D and iron have been shown to increase lead absorption in laboratory animals [11]. Effluence of the environment with lead is a global dilemma. Combustion of gasoline with tetraethyl lead (tell) as an anti-knocking additive and exhaust into the atmosphere and creates lead toxicity in the vicinity of roads, earth, atmosphere, water and vegetation [12]. Lead does not break down in the environment and this potent neurotoxin can harm the nervous system, reproductive complications and kidney failure especially in young children. Children under the age of 6 and unborn fetuses even with low blood level of lead are particularly vulnerable to nervous system impairment low IQ shortened attention span, hyperactivity, hearing damage and various behavioral disorders [13]. Cadmium is toxic when increased into the environment in high concentration Its toxic effect may originate the industrial sludge meets the rivers and also the wide usage of phosphate fertilizers in the fields [14]. Cd is an identical metal to Zn, located just below the Zn in periodic table and makes compounds in the oxidation state II. Being similar, it replaces to Zn (II) from the active site of Zinc-dependent enzymes and proteins, which in turn lose their biological activities. A widely occurring pollution caused by Cd was manifested in a malady called itai-itai disease and it causes a symptom of severe osteoporosis [15]. In addition, it is concerned in high blood pressure, prostate malignancy, mutations and fetal death [16]. The foremost path of access of cadmium to the organs of an individual is the digestive system and intestinal assimilation. Vegetation acquires cadmium from irrigation water only in the of from activated Cd ion past discharge since the sorption compound or commencing soil solution [17]. Iron the human body contains approximate 2 to 4 giron (~38mg iron per kg body weight for women and ~50mg per kg body weight for men), above 65% of body iron found in hemoglobin up to approximate 10% is found as myoglobin, ~1% to 5% is found as a part of enzymes and the residual body iron is found in the blood [18]. Some animal products such as bovine milk contains a very low amount of iron [19], and far too much protein for infant consumption, to and high casein content

makes it much harder for the infant to digest and absorb [20]. Excess feeding of breast milk or formula may limit the infant intake of iron-rich food, causing milk anemia that can affect child's energy level, attention span and mood [21]. Copper is widely distributed in nature and is nutritionally essential element. Daily intake of copper in adults varies between 0.9 to 2.2mg while in children has been estimated to be 0.6 to 0.8mg/day, the copper content in human body ranges from 50 to 150 mg. It exists in the body in two oxidation states  $Cu^{+1}$  and  $Cu^{+2}$  [22]. The main form of Copper used in mineral-fortified food products is copper sulfate, other bioavailable and water soluble forms of copper include cupric chloride, cupric acetate and copper carbonate [23]. In human and rats, large amount of iron intake decreases the absorption of copper [24]. It has been shown that milk supplies a little quantity of Cu [25]. A significantly lower absorption was found in infants fed on formulated fortified products with iron (10.8ppm iron) as compared to that infants fed without fortified formula providing only 1.8ppm iron [26]. Zinc is found in all body organs, most notably the liver, kidney, muscle, skin and bones. Zinc appears to be part of greater number of enzyme systems than the rest of the trace minerals combined it may affect the activity of several enzymes attached to plasma membranes, including alkaline phosphatase, carbonic anhydrase and superoxide dismutase, among others [27]. Zinc deficiency results in wide spectrum of clinical effect depending on age, stage of development, and deficiencies of related metals Zinc deficiency was first characterized by Prasad [28]. In adolescents with growth failure and delayed sexual maturation [29]. Pellagra, and iron and folate deficiency. Zinc deficiency in the newborn may be manifested by dermatitis, loss of hair, impaired healing, susceptibility to infections, and neuropsychological abnormalities. Other chronic clinical disorders such as ulcerative colitis and the malabsorption syndrome, chronic renal disease and hemolytic anemia are also associated with zinc deficiency [30]. It is known that increased industrial and agricultural processes has resulted in increased concentration of metals such as Cu, Zn, Mn, Fe, Pb, Cd, Cr, and Se, in air, water and soil. Such metals are taken in by plants and subsequently get accumulated in their tissues. Thereafter such metals get accumulated in the animals that graze on such contaminated plants and/or in the animals that drink polluted waters and/or inhale polluted air. Metals enter the human body through inhalation of pollution air, ingestion of polluted food and water or absorption through the skin [31]. Thus, large amount of these metals that are taken up by plants and animals subsequently find their way into the food chain. The scientific community is greatly concerned about the ever increasing pollution of the environment, especially about the intake of harmful metals by human beings, plants and animals. The consumption of animal products (milk, dairy products and meats) has increased in recent years as they have become the main requirement of daily diets, especially for the vulnerable groups such as infants, school going children and old persons [32]. In recent times, the amount of metals in animal products such as milk widely studied, particularly and polluted areas of

the developed and the developing countries of the world since animals grazing freely on open fields are considered as bio-indicators of environmental pollution [33]. Many reports indicate the presence of heavy metals in, and often it is needed to assess the levels of heavy metals in food [34]. The aim of the present study is to assess the concentration of microelements in some animal products (yoghurt -Poultry and white Cheese) and study of the polluted factors has available. Determination of levels of some microelements (Cd, Co, Cu, Mn, Pb, Zn, and Fe) in different some Animals products and to identify public citizens with health risk of such contamination and awareness the conformity of such products with SSMO specifications.

To assess the effect of such contaminations on food safety. Determine the factors which effect in the quality of products (Yoghurt, white cheese and Poultry). This study was designed to the levels of some heavy metals in various commercially available brand of products which sold in Sudan markets by using atomic absorption spectrometry and Comparing the results with the existing Standards for allowable amount set by WHO.

## 2. Materials and Method

### 2.1. Sample Collection and Preparation

Samples were collected commercially available some animals products (yoghurt, Poultry and white Cheese) from open groceries in Merowe city in the north Sudan

Three samples of different animals products (Yoghurt, poultry and white Cheese) were taken and labeled for further determination concentrations of some microelements (Cd, Co, Cu Mn, Fe, Pb and Zn).

5gm from each products was taken put in beaker the beaker was placed in muffle furnace and dried shed at 550°C for 6-8 hour then cooled one ml of concentrated HCl (20%) was added to the obtained ash then transferred to 50ml volumetric flask by carefully washing beaker with ml of diluted HCl then the mixture was diluted with de ionized water to 50 ml for latter Determination of concentrations in samples.

For Determination of some microelements. Atomic Absorption Spectrometry was used determine the concentration of samples after treatment the through different condition Atomic Absorption Spectrometry was used determine the concentration of samples after treatment the through different condition.

### 2.2. Data Assessment

Data was gathered and ordered all data in tables the concentration of some animal products in ppm yielding positive results for the occurrence of microelements were transformed in to concentration in mg/kg.

## 3. Results and Discussion

-Heavy metals contents varies widely due to many factors such differences between species, characteristic of manufacturing practices possible contamination coming from equipment's during the process. The results of analyses of seven studied microelements are shown in table 1 the highest concentrations of microelement were detected in the case of zinc (0.92, 2.8, and 3.77mg/kg), in Yoghurt, Poultry and White Cheese, Iron (0.60, 2.28 and 1.16, mg/kg), lead (0.48, 0.34 and 0.42mg/kg), Copper (0.25, 0.14 and 0.15mg/kg), Manganese (0.16, 0.16 and 0.16 mg/kg) Cobalt (0.19, 0.14, 0.26mg/kg) and Cadmium (ND) respectively

**Table 1.** The obtained concentrations (mg/kg) of some metals in some animal products in (5gin 50ml).

Element	Yoghurt	Poultry	White Cheese
Cd	ND	ND	ND
Co	0.19	0.14	0.26
Cu	0.25	0.14	0.15
Fe	0.60	2.28	1.16
Mn	0.16	0.16	0.14
Pb	0.48	0.34	0.42
Zn	0.92	2.87	3.77

ND mean Not Detected

**Table 2.** The allowable limit proposed by (WHO) of some metals concentration (mg/kg) in some animal products

Element g/Kg	Yoghurt	Poultry	White Cheese
Cd	0.58	0.05	0.58
Co	0.005	0.02	0.005
Cu	0.5	2.1	0.5
Fe	0.5	0.2	0.5
Mn	0.5	0.26	0.5
Pb	0.02	0.01	0.02
Zn	121	79.83	121

**Table 3.** Standard Atomic Absorption Condition For element.

Element	Wavelength (nm)	Slit (nm)	Relative Noise	Characteristic (mg/l)	Characteristic Check (mg/l)	Linear Range (mg/l)
Cd	228.8	0.7	1.0	0.028	1.5	2.0
Co	240.7	0.2	1.0	0.012	7.0	3.5
Cu	324.8	0.7	1.0	0.077	4.0	3.0
Fe	248.3	0.2	1.0	0.11	6.0	6.0
Mn	279	0.2	1.0	0.052	2.5	2.0
Pb	283.3	0.7	0.43	0.45	20.0	20.0
Zn	213.9	0.7	1.0	0.018	1.0	1.0

### 3.1. Cadmium Concentration

The concentration of Cd in the different animal products samples are ND(ND) mean Not Detected the cadmium concentration in three products samples analyzed were lower than allowed limit (0.5 mg/kg) the recorded by [37, 38]. Thus could be as result of low pollution to this metal in the study. Regular absorption of Cadmium causes damage to the proximal renal tubules and Calcium phosphorus, glucose, amino acid and small peptides are loss in the urine. once calcium accumulates in tissues it cannot be removed safely by chelation therapy without causing kidney damage. Cadmium affects Calcium metabolism and skeletal changes resulting from Calcium loss

and ends in a decrease bone mineral density [38].

### 3.2. Cobalt Concentration

The concentration of Co in all samples was presented (0.19, 0.14 and 0.26 mg/kg) respectively no significance difference between yoghurt and poultry values recorded was observed. However white cheese was higher. Where the concentration of Co in all samples in present study were higher than reported by (U.S. Food and Nutrition Board [39]. Cobalt is a key mineral in the large vitamin B12 the presence of Co above the established limit suggests that there are toxicological risk. Co compounds can be carcinogenic if available in ionic form [40]

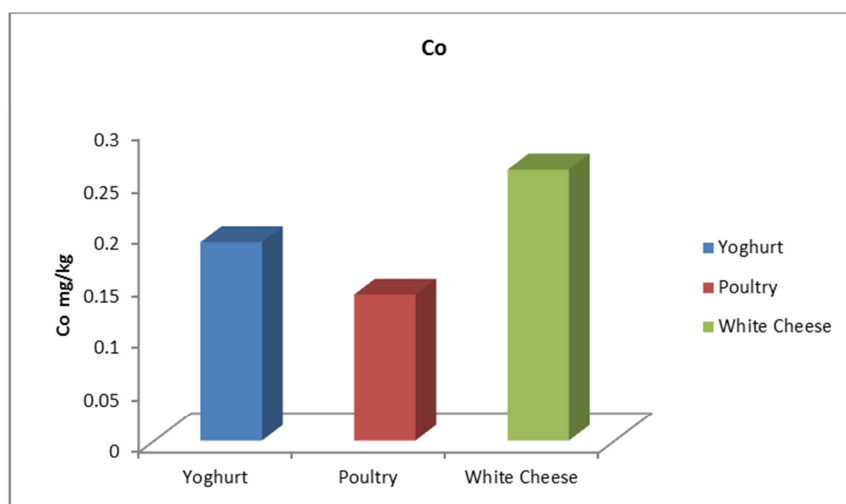


Figure 1. Cobalt concentration (mg/kg) of Some Animal products.

### 3.3. Copper Concentration

The concentration of Cu in the samples products there was no statistical difference between poultry and white cheese concentrations of Cu (0.14 and 0.15mg/kg) were observed for yoghurt contained the highest level of Cu(0.25mg/kg), these are below recommended dietary value of(1.5 -3.0mg/day) stipulated by [41]. However, the WHO limit for Copper is

24.2mg/g this indicates that animals of this study city is poor source of copper. On the other hand Copper is essential trace element that plays a vital role in the physiology of animal for fetal growth and early post-natal development. Excess copper in the body leads to Wilson's disease which characterized by deficient of ceruloplasmin [42].

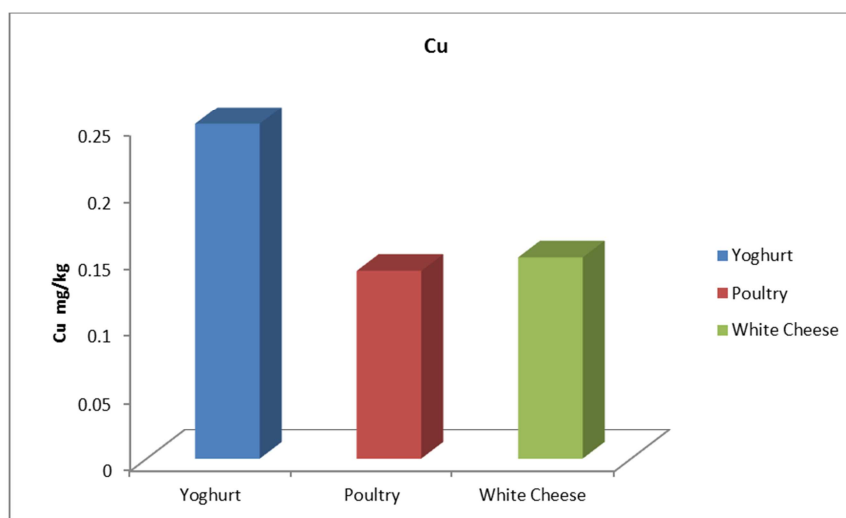


Figure 2. Copper Concentration (mg/kg) of Some Animal products.

### 3.4. Iron Concentration

The concentration of Fe in three samples products the highest Fe concentration were noticed in poultry and white cheese samples are ( 1.16 and 2.28 mg/kg) while the lowest

(0.60mg/kg) was found in yoghurts, the concentration in all samples white Cheese> poultry> yoghurt. The permissible limits of World Health Organization (WHO limits for iron is 0.5mg/kg) [2, 43]

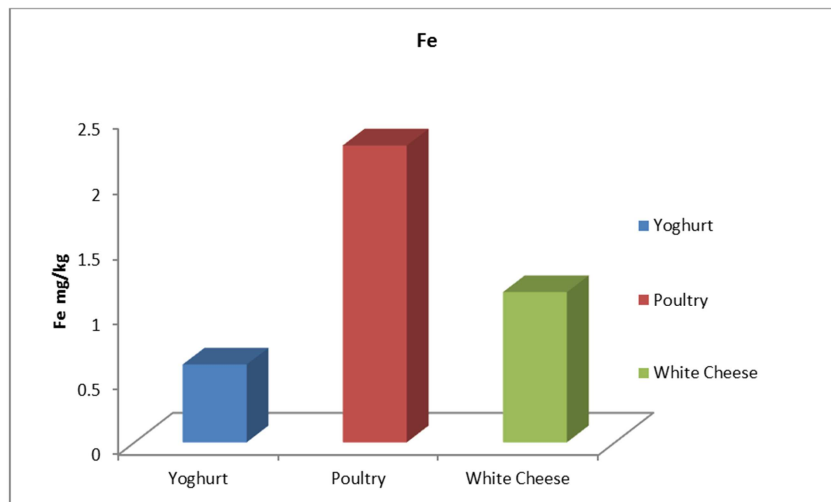


Figure 3. Concentration (mg/kg) of Some animal products.

### 3.5. Manganese Concentration

The concentration of Mn in all samples product (yoghurt, poultry and white Cheese) is given in figure 4. Highest Mn concentration was noticed in products yoghurt and poultry (0.16 and 0.16 mg/kg) and lowest is found in white Cheese (0.14mg/kg). Mn level in all samples were recorded lower than that limit shown in table 2. lower limit of latest safe and

adequate daily dietary intakes of Mn (2.3mg for men and 1.8mg for women). A common source responsible for increased Mn levels in animal products fodder, particularly whole grain fodder [44]. Mn toxicity can occur individuals with liver failure characterized by Mn accumulation with in the liver other organs such as the brain, the latter results in neurological abnormalities [45].

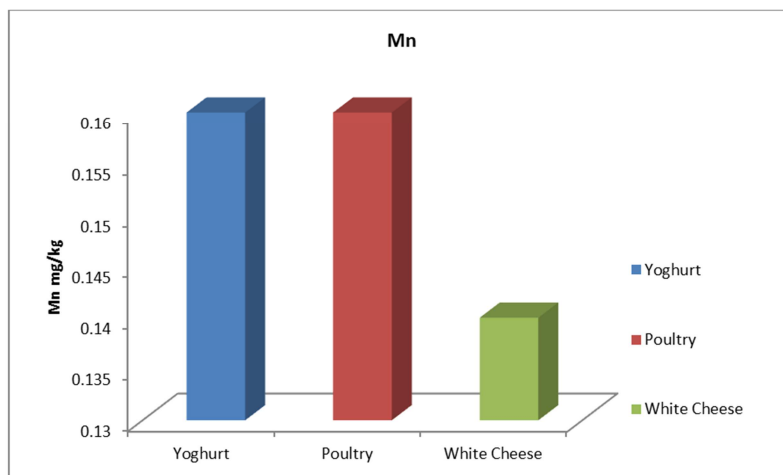


Figure 4. Mn Concentration (mg/kg) of Some Animal products.

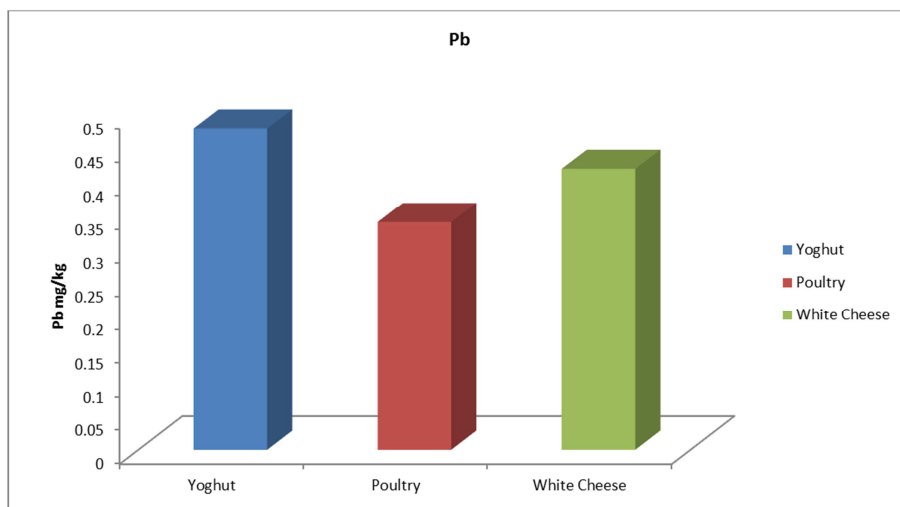
### 3.6. Lead Concentration

The concentration of Pb in samples product were present concentrations (0.48, 0.34, 0.42 mg/kg) there was significant difference ( $p < 0.5$ ) between the values obtained in different collection sites which is above the recommended dietary allowance for adult study is ( 0.02mg/kg)in yoghurt and white Cheese. However (0.01mg/kg) in poultry. This could be

ascribed to the fact that is cosmopolitan area where a lot human activities were taken part. At the same time, there is a big motor garage situated there, as such there is high concentration of car exhaust which source of lead thereby pollution the grazing land for animals and products in return. this significant high amount of lead may be due to contamination by industrial plants located around the area

were the animals grazed. lead has no beneficial biological function and is known to accumulate in the body. Lead exposure can adverse health effects, especially in young

children and pregnant women, since lead is neurotoxin that permanently interrupts normal brain development [46].

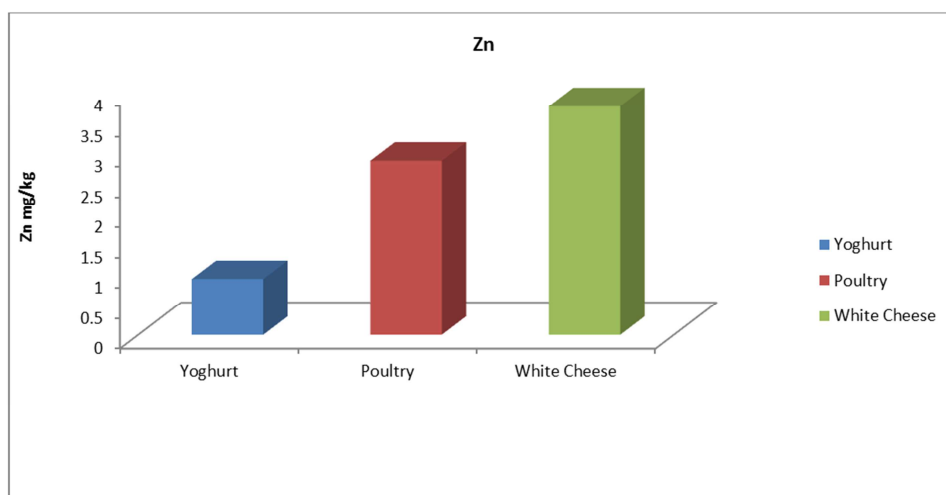


**Figure 5.** Lead Concentration (mg/kg) of Some animal products.

### 3.7. Zinc concentration

In this study, Zn is obtained from animal products with concentration were presented in Figure (6) has the lest concentration of (0.92mg/kg) in yoghurt and highest concentration of (2.87and 3.77 mg/kg)in poultry and white Cheese, respectively lower recommended dietary value (12-15mg/day) given by [38]. Zinc plays an important immune system but excessive absorption of zinc suppresses Copper and iron absorption, which results in decrease in

erythrocyte. Zinc has numerous functions in the body and it is essential element for human health. At the same time zinc function as a cofactor for many enzymes of the body. Excess intake of zinc in to the body through food, water or dietary supplements can affect health if large doses of zinc by mouth even for a short time, stomach cramps, nausea and vomiting may occur. Ingesting high levels of zinc for several months may cause anemia, damage the pancreas and decrease levels of high –density lipoprotein (HDL) cholesterol [39]



**Figure 6.** Zinc Concentration (mg/kg) of some animal products.

## 4. Conclusion

Concentration of Cd, Co, Cu, Fe, Mn, Pd and Zn in some animal products (Yoghurt, poultry and white Cheese) in Merowe city north Sudan. Our results indicted that little variability with brand. Generally, Fe concentration in animal products (except yoghurt exceeded the stipulated WHO

limit(0.5mg/kg). Zn concentration in all samples has least recommend dietary allowance given as (12-15mg/day). The WHO limit for zinc 121mg/kg is shown in tables (2). Elevated level could be related to contamination during industry processing and environmental pollution. White Cheese and poultry are found be the richest in iron, while Yoghurt was found to be the poorest. Among the seven metals studied, white Cheese and Yoghurt are highest concentration of Co, Cu

and Pb than Poultry. No significant different observed between three products on Mn metal. However cadmium in all samples it is not detected. Animal products samples for heavy metals in the study work pose a threat of lead and zinc toxicity due to their exposure to direct sources of air, water and plants in these grazing area.

## References

- [1] Buldini, P, L, Cavalli, S. and Sharana, J. L2002. Matrix removal for the ion chromatographic determination of some elements in milk. *Micro chemical Journal* 72:277-284.
- [2] Enb A. AbouDonia M. A., Abd –Rabou, Abou Arab and El-Senaity M. H, 2009. Chemical Composition of Raw Milk and Heavy Metals Behaviour During processing of products *Global veterinaria* 3(3)268-275.
- [3] LlobetJM, Marti-Cid R, castell VDomínguez JL. Significant decreasing trend in human dietary exposure to PCDD/PCDFs and PCBs in Catalonia, Spain. *Toxicol/Lett* 2008;:178:117-126. doi:10.1016/J.toxlet.2008.02.012.
- [4] Klaaeeen CD. Casarett and Dolls' toxicology: the basic science of poisons. 8<sup>th</sup>ed. New York McGraw –Hill., 2013. s.
- [5] Beigier K and A Jernelov(1986) Sources, transport and transformation of metals in the environment in firbergl, Nordberg GFandVouk VB (eds)H and book on the toxicology of Metals, 2<sup>nd</sup> ed General Aspects Amsterdam, Elsevier, pp. 68-74.
- [6] Hui YH (1992) Ancylopedia of food science and technology Wiley & Sons Inc USA, 3:p1805.
- [7] Thompson J and M Man ore (2009). *Nutrition An Applied Approach*. 2<sup>nd</sup> Ed. Pearson Benjamin Cummings New York, p. 728.
- [8] Konuspayeva G, B Faye, GLoiseau, E Diacono and S AKhmetsady Kova (2009). Pollution of camel heavy metals in KazaKhtan. *Open Environ. Poll. Taoxic. J*, 1:112-118.
- [9] KlaassenCD (2001). Casarett and Doull;Toxicology the Basic sciences of poison 6<sup>th</sup>ed. Mc Graw-Hill, USA129:848-1073.
- [10] Whitney EandRolfes SR (2005) *Understanding Nutrition* 10<sup>th</sup> Ed., Thompson Wadswort Australia p. 458.
- [11] Mudgal V, N Madaan, A Mudgal, RB Singh and S Mishra (2010). Effect of toxic metals on human health. *open Nutraceutical J.*, 3:94-99.
- [12] Burgurera JL and C Rondon (1987). lead content in hair as related to petrol –lead exposure in Merida city, Venezuela, in S. E. L Lindbergh and T. C. Hutchinson (Eds), *Heavy metals in the Environment*, int. Conf. 6<sup>th</sup>, New Orleans, LA, 1987, CEP Consultanta L td Edinburgh, 2:274-276.
- [13] Miller GT, JScotte and ESpoolman (2009). *Living in the Environment concepts, connection, and Solutions*. Brooks/cole CENGAGE L earning 16<sup>th</sup> Ed, P. 474.
- [14] Venugopal B and TLuuckey (1978). *Metal toxicity to mammals*. Vol. 2. Chemical toxicity of metals and metalloids. Press New York, USA, PP.
- [15] OchiaiE (2011). *Chemicals for Life and Living*. Springer-Verlag Berlin Heidelberg, P. 186.
- [16] Perry HM, MERlanerg and Perry (1979). Incease in the systolic pressure of rats chronically fed cadmium. *Environ. Health Perspect.*, 28:261.
- [17] Smirjchkova S, ocovd, Akakov and KLaktiioovd (2005). the effect of cadmium and lead pollution on human and Health. *Folia Veterinaria*, 493: Supp. 5:31-532.
- [18] Gropper SS, JL Groff (2005). *Advanced Nutrition and Human Metabolism*. Thomson Wadsworth, 4<sup>th</sup>ed. Chapter 12, pp. 491, 436, 446.
- [19] Jigam AA, BENDauda, T Jimoh, NH Yusuf and ZT Umer (2011). Determination of copper, zinc, lead and some biochemical parameters in fresh Cow milk from different locations in Niger states, Nigeria. *Afr. J Food Sci.*, 5:156-160.
- [20] Omposn LJ, MM Manore and AL Vaughan (2008). *the Science of Nutrition*, Pearson Benjamin Cummings, New York, p. 728.
- [21] Perween R, M Mumtaz, QHaque and T Mehmood (2011). Nutritional values in aspects of essential Non-essential element in variety of milk sample by AAS and FES. *Analytical and inorganic, J. Chem. Soc. Pak.*, 33:313-316.
- [22] Baker D (1999). Cupric oxide should not be used as a copper supplement for either animals or human. *J. Nutr.*, 129:2278-2279.
- [23] YuS, West C and Beynen (1994). Increasing intakes of iron reduce status, absorption and biliary excretion of copper in rats. *Brit J. Nutr.*, 71:887-895.
- [24] Snedeker S, S Smith and JGreger (1982). Effect dietary calcium and phosphorous level on the utilization of iron copper and zinc by adult males. *J Nutr.*, 112:136-143.
- [25] Finely E and F Cerklewski (1983). Influence of ascorbic acid supplements on copper status in young adult men. *Am.J. Clin. Nutr.*, 37:553-556.
- [26] Hascke F, E Ziegler, B Edwards and S Fomon (1986). Effect of iron fortification of infant formula on trace mineral absorption. *J. Pediatr, Gastroenterol. Nutr.*, 5:768-773.
- [27] Beata, K., Magdalena, S. and Pavel, N. (2005). concentration of some heavy metals in cattle reared in the vicinity of a metallurgic industry, *Veterinarski Arhiv*72(5), 259-267.
- [28] Prasad AS (1983). Clinical, biochemical and nutritional spectrum of zinc deficiency in human subjects: Anupdate. *Nutr. Rev.*, 41:197-208.
- [29] Ayar, A, Sert, D. and Akin, N. 2009. The trace metals levels in milk and diary products consumed in e Anatolia-Turkey *Environment Monitoring Assessment* 152:1-12.
- [30] Ryan-Harshman M and W Aldoori (2005). Health benefits of selected minerals. *can. Fam. Physician*, 51:673-675.
- [31] Buachoon N (2004) determination of Trace Element in Cow's milk in Saudi Arabia. *JKAU: EngSci* 15:131-140.
- [32] Ahmed, W. M. S. A., 2002. Studies on heavy metals pollution farms in relation to production performance Ph, D thesis Fac vet, Med. Zag University.
- [33] LI-Quangphn, Xino Ping Wang, Wei Li, Xing Tong and Wei – Jun Tong 2009. the minerals and heavy metals in Cow's milk from China and Japan: *Journal of Health Sciences* 555(2), 300-305.

- [34] Korenekovg B. M., SKalicka, and P. Spettoli, Nai. 2002 concentration of some heavy metals in cattle reared in the vicinity of metallurgic industry Vet. Archiv. 72, 254-267.
- [35] Licaata P., Trombetta D., Cristani M., Giofre F., Martino D., Calo M., NaccaeiF., 2004 Levels of toxic and essentaial metals in samples of bovine milk from variusdiary farms in Catalonia, Italy. Environ Res. 30, 16.
- [36] Nnadozie, C, U, Birnin –Yauri, U. A., Muhammad C (2014) Assessment of some dairy products sold in Sokoto Metropolis, Nigeria. Inter. J., Adv. Res. in Chem. Sci 1(10), 31-37.
- [37] Nordberg G. F. (2004): Cadmium and health in the 21 centaury –historical remarks atrends for the future Bio Metals. 17(5):485-489.
- [38] Food and Nutrition Board, Institute of Medicine. Manganese Dietary reference intakes for vitamin A, vitamin K boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium and zinc Washington, D. C National Academy Press: 394-419, 2001.
- [39] G R E I M H., SNYDER R. Toxicology and Risk Assessment: A
- [40] N. R. C., National Research council, (1989). Recommended dietary allowance, National Academy press Washington DC, Pp. 36-39.
- [41] Lawal, A. O., Mohammed, S. S., Damisa, D., 2006, Assessment of levels of copper, cadmium and lead in secretion of mammary gland of Cows grazed on open fields., Sci world J., 1(1), 7-10.
- [42] Meshref AMS, Moselhy WA Hassan NE-H (2014) Heavy metals and trace element levels in milk products. food measure 8:381-388. Pp.
- [43] G ROPPET S, S., SMITH J. L, GROFF J. L., Advanced Nutrition and Human M etabolism. Thomson Wadsworth, 4<sup>th</sup> Ed. Chapter 12, 2005.
- [44] HAUSER R. A., ZESIEWICZT. A ROSEMURGY A., S., MARTINEZ C OLANOWC. W. Manganese intoxication and chronic liver failure. Ann. Neurol., 36871, 1994.
- [45] ATSDR (2011), Agency for Toxic Substance and Disease Registry. lead toxicity:How Are People Exposed lead ? Achieved Prom the original.
- [46] SSMO (2008a) and (2008b). Sudanese standard and metrology Organization. Concentrations in milk SDS, 3952/2008. And concentrations in meat and meatproducts, SDS4144/2008