Original Article

Hygienic evaluation of heavy metals levels in meat tissues and fats after adding selenium and zinc

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Abstract

Given the great diversity of heavy metals in the environment and their concentration within different feds, it is impossible to achieve levels of contamination below the detection limit for all elements in tissues. Therefore, it is necessary to work at different levels in order to control contamination with heavy metals and reduce the risks of human exposure in the fed chain, as well as prepare detection methods to control these pollutants in the fed chain and different body tissues from heavy metals. Heavy metals were analyzed in meat and fat of lambs of Kurdi sheep after taking a dose of selenium at a concentration of 0.5 mg / kg and zinc at a concentration of 100 mg / kg for a period of 90 days separately or their combination. The results showed the determination of the metallic elements of each of Selenium (Se), zinc (Zn), Copper (Cu), Iron (Fe), Palladium (Pd), thallium (Ti), Antimony (Sb), Tin (Sn), Molybdenum (Mo), Tungsten (W), Strontium (Sr), Tantalum (Ta), argon (Ar), Lead (Pb), Nickel (Ni), Platinum (Pt), Bromine (Br), arsenic (As), Zirconium (Zr), Bismuth (Bi), Cobalt (Co) and Iridium (Ir) in meat and fat tissues, there was no percentage of mineral elements for each of Silver (Ag), Cadmium (Cd), Manganese (Mn), indium (In), mercury (Hg), Platinum (Pt), Vanadium (V), Rhenium (Re) and Chromium (Cr) Concentrations of some metal elements were within the permissible limits It was approved by WHO, ANZFA, and Institute of Medicine, but some mineral elements do not have data on permissible limits.It is concluded from these results that supplementation of selenium and zinc improves animal health and does not have a harmful effect on meat and fat tissues. It needs careful studies to know the toxic concentration of the metallic elements that were challenged for the first time.

Keywords: Selenium , Zinc, Meat, Fat, heavy metals, Kurdi sheep.

INTRODUCTION

Given the great diversity of heavy metals in the environment, it is impossible to avoid the presence of heavy metals in the food chain, and in the environment. In the last decade, the European Union has been promoting nutrient reduction and heavy metal contamination of water and soil as these pollutants are the main cause of nutrient enrichment. Contamination of fed and fed with heavy metals It has become a serious problem in intensive farming. Moreover, with regard to global livestock farming a food environment strategy is needed in order to ensure both human and animal health status and sustainable production. Nutritional ecology is a multidisciplinary focus primarily on organisms, ecology and the nutritional basis between organisms (function, development) and ecology (Rubenheimer et al., 2009).Essential trace elements are usually added as food additives in animal feds to promote health and to improve production (European Union (EU) Reg. 1881/2006).. However, overexposure with a high concentration of these elements has been linked to cellular or systemic disturbances and could represent a source of contamination ,Certain minerals are necessary to maintain various biochemical and physiological functions in humans, animals, and plants. The nutritional requirements for these trace elements, such as cobalt (Co), copper (Cu), chromium (Cr), iron (Fe), manganese (Mn), molybdenum (Mo), selenium (Se) and zinc (Zn) are generally low and called microelements. They are present in different matrices, although their bioavailability varies, in trace concentrations (ppm or ppm) (Hembage, 2003). Cow and sheep manure contains large amounts of heavy metals, especially selenium (Se), nickel (Ni), cobalt (Co), tin (Sn), lead (Pb) and cadmium (CD) in Sulaymaniyah Governorate in the Kurdistan region of Iraq. And plants and reduces environmental pollution as it is useful for recycling waste and reduces risks to human health(Palani et al.,2022a). All animals need to be fed mineral salts, including some heavy metals that have been shown to be essential nutrients are part of many enzymes that coordinate many processes of biological activities, and are therefore essential for the maintenance of animal health and production (López Alonso et al., 2012) . Essential minerals perform four important types of functions which are structural, physiological, catalytic and regulatory (Satel, 2010). Supplied on a minimum requirement basis so as to prevent poisoning and contamination that could harm production Feds are often supplemented with minerals in order to promote optimal growth rate, functional bioactivity and antimicrobial properties. For example, Se is naturally present in many feds, such as yeast. It plays a critical role in reproduction, DNA synthesis, hormone metabolism and protects the body from infection and oxidative damage and has an important vital role related to a decrease in susceptibility to carcinogens (Dai et al., 2016). Farmers usually balance animal diets and minerals accordingly to the maximum acceptable levels set by the European Union. However, resulting in a wide spread of metals in the environment. For example, the minimum nutrient requirement for zinc (NRC, 2012) is between 50 and 100 ppm at various growth stages, however it is often used as an additive thus taking the level to 150 ppm, and selenium 0.5 mg / kg fed, which is the acceptable maximum recommended by European Food Safety. Although the net requirements for essential minerals are less than the nutritional requirements, different aspects must be in order to determine the optimal concentration in the fed: genetic influences, nutritional factors, interaction between nutrients, bioavailability and subclinical toxic effects. The optimal mineral supplement, which is represented as the band between adequate and insufficient toxic fed The concentration determined by the dose/response must also consider the unnecessary levels excreted into the environment. The ban on growth stimulants with antibiotics (EU law 1831/2003) in livestock has led to the study of alternative compounds (Rossi et al., 2013 and 2014a). Selenium supplementation with a concentration of 0.5 mg/kg of fed in Kurdi sheep resulted in improvement of some important elements and no adverse effects on the environment and its levels within the permissible limits of ANZFA, RDA, NIST, SRM, World Health Organization and Institute of Medicine (USA). Moreover, there are no negative effects from the mineral elements in the muscles and liver which is important for animal health as well as for human consumption (Palani et al.,2019). This study focuses on the addition of selenium and zinc supplements separately or their mixture in the fed to evaluate the heavy metal content in meat and fat tissues of lambs of the Kurdi sheep breed.

Materials and methods

This current study was conducted during the summer in the Bakrgo area in the city of Sulaymani in the Sulaymaniyah governorate in the Kurdistan Region of Iraq. He used 16 lambs of Kurdi sheep, aged between 4-5 months of Kurdi sheep. Lambs and rams were divided into four groups, each group 4 lambs in each group separately, where the first group was fed without any addition, the second group added Sodium Selenite Na_2SeO_3 at a dose of 0.5 mg / kg of food, the third group added zinc (Zinc sulfate) $ZnSO_4$ at a dose of 100 mg / kg feed. The fourth group added a mixture (selenium with zinc) at a dose of 0.5 + 100 mg / kg feed. After that, lambs were randomly distributed and each of them was placed in a cage with an area of 1 * 1.5 m 2 for a 90-day experiment. The fodder consisted of 60% barley and 12% soybeans and did not contain any amount of selenium. The feed also contained 26% wheat bran, 1% salt, 0.5% limestone, 0.5% mixed minerals and vitamins. Empty gelatin capsules were used to put selenium and zinc in the animals' mouth, where the amount of selenium and zinc is taken and weighed with a sensitive scale, and this quantity is calculated based on the amount of daily fed consumed for each animal. Mix selenium and zinc individually or mix with cornmeal and put into an empty gelatin capsule. The capsule was administered to sheep daily for 90 days in the morning before feeding. After that, the animals slaughtered and took samples of their meat and fat and then dried in oven at 105ºC and grinding them. ICPE-9000 from Shimadzc Japanese made use to evaluate the minerals content in liver and muscle. Finally 200 mg samples were taken after diluting with 1-4 Sulphuric acid (H_2SO_4), Perchloric acid Hclo4 for 16 hours, and added to 50 ml deionized water. the trial design was a fully factorial randomized design (CRD) to determine the effects of selenium and zinc on shelf life. The analysis is performed with XLstat (2016) according to this equation: $Y_{ijk} = \mu + A_i + + + B_j + AB_{(ij)} + e_{ijk}$ where Y_{ijk} = dependent variable, μ = general mean, A_i = effect of Se application and Zn factor B_j: effect Age factor, AB_{ij} = effect of interactions between two factors, e_{ijk} = standard error, mean comparison according to Duncan (1955) within the programme.

Results and Discussion

The results of Table 1 showed that the level of zinc increased in the treatments of adding zinc to a single and in the treatment of adding a mixture of zinc and selenium compared to the treatment of adding selenium and the control group without any addition in meat and fat. The level of selenium in meat and fat also increased in the treatments of adding selenium alone and the treatment of adding selenium with zinc compared to the treatment adding zinc and the control group without any addition. It was also shown from the results that when adding a mixture of selenium with zinc, the levels of copper, iron, tungsten, argon, antimony, lead, arsenic and cobalt decreased in meat and fat of male sheep of the Kurdish breed compared to the rest of the treatments and the control group. And palladium decreased in fat in the treatment of adding a mixture of selenium and zinc compared to the rest of the treatments and compared to its level in meat. The level of nickel in meat and fat also increased in the addition treatments compared to the control group. And the level of arsenic decreased in the addition treatments compared to the control group for both meat and fat. The level of zirconium in meat and fat was also accumulated when adding the mixture of selenium and zinc compared to the rest of the treatments and the control group, where its level was completely free and zero. The level of iridium was also accumulated in the fat when zinc was added compared to the rest of the treatments and the control group and in the meat. The level of bismuth element was also accumulated in the meat when zinc was added compared to the rest of the treatments and the control group and in the fat. The results of the analysis showed that meat and fat were free of chromium, rhenium, mercury, vanadium, indium, manganese, cadmium and silver. The results showed the presence of strontium and niobium in fats in all addition treatments, and they were free in meat.

Table (1): Determination of the levels of mineral elements in meat and fat tissues after adding Selenium and Zinc in Kurdi sheep.

Metals	Meat (ppb)				Fat (ppb)			
	Treatment (Control)	Treatment (Se)	Treatment (Zn)	Treatment (Se+Zn)	Treatment (Control)	Treatment (Se)	Treatment (Zn)	Treatment (Se+Zn)
Selenium (Se)	17.333 f ± 3.28	96.567 bcd ± 3.78	25.567 ef ± 3.79	97.367 bcd ± 4.65	15.667 f ± 2.73	91.667 cd ± 6.84	17.000 f ± 9.24	103.667 bc ± 2.96
zinc (Zn)	29.393 d ± 0.21	29.533 d ± 1.63	41.947 b ± 1.04	44.980 a ± 0.13	8.253 i ± 0.2	3.290 j ± 0.08	9.503 hi ± 0.06	11.123 h ± 0.43
Iron (Fe)	13.290 e ± 0.02	9.050 h ± 0.04	14.073 e ± 0.03	7.727 i ± 0.07	26.167 a ± 0.63	15.773 d ± 0.18	25.410 a ± 0.13	7.383 i ± 0.12
Cobalt (Co)	1.653 a ± 0.12	0.360 d ± 0.02	0.957 bc ± 0.1	0.377 d ± 0.1	1.763 a ± 0.23	0.670 bcd ± 0.01	0.957 bc ± 0.15	0.447 cd ± 0.25
Copper (Cu)	1.560 ij ± 0.02	1.150 jk ± 0.02	1.327 ijk ± 0.17	0.627 k ± 0.11	2.670 h ± 0.02	1.613 ij ± 0.01	2.027 hi ± 0.4	0.723 k ± 0.09
Molybdenum (Mo)	2.100 d ± 0.17	7.250 b ± 1.48	6.633 bc ± 1.28	11.500 a ± 0.64	1.033 d ± 0.28	2.467 d ± 0.38	4.967 c ± 1.09	6.167 bc ± 1.59
Tin (Sn)	4.257 d ± 0.08	2.397 ef ± 0.06	5.313 b ± 0.01	4.400 d ± 0.15	6.050 a ± 0.01	1.987 gh ± 0.01	4.950 c ± 0.05	1.467 ij ± 0.3
Strontium (Sr)	0.000 f ± 0	0.000 f ± 0	0.000 f ± 0	0.000 f ± 0	0.313 c ± 0	0.153 de ± 0.02	0.220 cde ± 0.05	0.157 de ± 0.01
arsenic (As)	1.900 b ± 0.21	0.313 c ± 0.02	0.917 bc ± 0.03	0.170 c ± 0.03	0.527 c ± 0.11	0.163 c ± 0.03	0.240 c ± 0.02	0.067 c ± 0.01
Lead (Pb)	2.033 bc ± 0.19	0.767 fg ± 0.38	0.467 g ± 0.23	0.633 g ± 0.18	2.767 b ± 0.24	2.067 bc ± 0.09	1.567 cde ± 0.18	0.867 efg ± 0.2
Chromium (Cr)	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0
Tantalum (Ta)	0.000 e ± 0	0.613 bc ± 0.09	0.000 e ± 0	0.533 c ± 0.06	0.000 e ± 0	0.567 bc ± 0.02	0.000 e ± 0	0.273 d ± 0
Rhenium (Re)	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0
argon (Ar)	0.000 b ± 0	0.487 a ± 0.02	0.000 b ± 0	0.467 a ± 0.14	0.000 b ± 0	0.000 b ± 0	0.000 b ± 0	0.000 b ± 0
Palladium (Pd)	0.723 b ± 0.04	0.327 d ± 0.04	0.500 bcd ± 0.09	0.617 bc ± 0.08	0.000 e ± 0	0.000 e ± 0	0.000 e ± 0	0.000 e ± 0
Nickel (Ni)	0.567 fg ± 0.18	1.667 abcde ± 0.41	1.267 cdef ± 0.23	1.733 abcd ± 0.12	0.500 fg ± 0.15	2.433 ab ± 0.58	1.533 bcde ± 0.28	1.900 abc ± 0.36
mercury (Hg)	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0
Vanadium (V)	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0
Manganese (Mn)	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0
indium (In)	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0
Bromine (Br)	1.190 fg ±	0.703 h ±	1.470 c ±	1.333 de ±	1.423 cd ±	0.547 i ±	1.267 ef ±	0.127 k ±

	0.01	0.11	0.01	0.02	0.01	0.01	0.12	0.01
thallium (Ti)	0.000 e ± 0	0.613 bc ± 0.09	0.000 e ± 0	0.533 c ± 0.06	0.000 e ± 0	0.567 bc ± 0.02	0.000 e ± 0	0.273 d ± 0
Antimony (Sb)	6.447 c ± 0.21	5.033 d ± 0.01	8.223 a ± 0.01	0.000 l ± 0	0.967 j ± 0.12	1.757 i ± 0.02	7.077 b ± 0.07	0.537 k ± 0.06
Zirconium (Zr)	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.063 c ± 0.01	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.117 b ± 0.01
Cadmium (Cd)	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0
Niobium (Nb)	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.357 a ± 0.01	0.157 b ± 0.01	0.347 a ± 0.01	0.050 c ± 0.01
Silver (Ag)	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0	0.000 a ± 0
Bismuth (Bi)	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0	0.000 d ± 0
Tungsten (W)	1.157 a ± 0.02	0.677 cd ± 0.16	1.073 a ± 0.02	0.160 g ± 0.13	1.090 a ± 0.01	0.950 ab ± 0.01	0.807 bc ± 0.12	0.313 efg ± 0.03
Iridium (Ir)	0.000 c ± 0	0.000 c ± 0	0.000 c ± 0	0.000 c ± 0	0.000 c ± 0	0.000 c ± 0	0.000 c ± 0	0.000 c ± 0

Means with different letters within each column differ significantly (P≤0.05) according to Duncan's test.

Mineral elements are essential to animal health for its production and growth as they are part of physiological, structural and regulatory functions. Therefore, they must be present in fed. When taking these minerals in excessive doses due to errors in the balance of mineral supplements, and eating plants with a high concentration of minerals, resulting from the addition of fertilizers, herbicides and insecticides in pastures or plowing, where plants or grains enter the fed of animals, and the decomposition of urban and industrial waste may lead to the accumulation of elements Toxic metal in the environment, which leads to poisoning of animals and may lead to their death. However, toxic doses, physiological changes during poisoning, symptoms, and metal concentrations in tissues of infected animals to confirm the diagnosis are not fully known. (Reis et al., 2010). Through this study, we search for the level and detection of mineral elements that some authors considered toxic and some of the mineral elements considered essential for animal consumption. Environmental pollution is a major global problem that poses significant risks to humans and animals. The development of modern technology and rapid industrialization are major factors of environmental pollution as environmental pollutants spread through various channels, many of which enter the fed chain of livestock and humans (Kaplan et al., 2011). There are essential and essential heavy metals for the body (Fe, I, Co, Cu, Mn, Zn, Mo, Se), selenium and zinc significantly improve some important elements of minerals, there are no harmful effects of mineral elements in the blood, which is important for animal health (Palani et al, 2022b). Heavy metals, such as cadmium (Cd), chromium (Cr), arsenic (As), nickel (Ni), mercury (Hg), lead (Pb), SnTin, thallium, tungsten, and bromine, are a group of toxic metallic elements that are Compounds of concern when dealing with quality animal feed. Providing safe animal fed products is critical not only to protect animal health and production but also to reduce human exposure to toxic heavy metals and organic pollutants. Accumulation of heavy metals in soil can lead to agricultural land degradation. It acts on eutrophication and uptake of toxic substances. This leads to long-term effects on agricultural soil quality, including phytotoxicity in high concentrations and transport of zoonotic toxic elements into the human diet due to increased uptake of crops. or soil by uptake by grazing cattle (Nicholson et al., 2003). Ruminants are less susceptible to toxin poisoning and show no sign of toxicity unless the concentration is more than 200 to 300 mg of inorganic matter/kg of fed (Kochare and Tamir, 2015). Feds of animal origin (both wild and aquatic) play a major role in the human diet because they provide proteins, vitamins and other important nutrients (Pieniak et al, 2010) (Chen et al, 2017) () with potential health benefits. Otherwise, its consumption represents the main route of exposure to potentially harmful compounds, such as toxic heavy metals, thus constituting an important public health issue (Storelli et al, 2003) (Chen et al, 2017). Indeed, animals are constantly exposed to pollutants in the environment and are able to accumulate pollutants at a high concentration in their tissues, particularly in lipids (Krokos et al, 1996). Therefore, the European Union Scientific Committee on the Federal Reserve has set an upper limit for certain contaminants in foodstuffs, and they are monitored periodically by the European Food Safety Authority (EFSA). Moreover, the concentrations of some minerals were within the permissible limits by the World Health Organization, ANZFA, NIST and the Institute of Medicine (USA). It has no harmful effect on animal health and has no harmful effects on meat and fat tissues.The results of our study cannot be compared with the results of other studies because of these results. This is the first study and the detection of new mineral elements such as (Niobium, Iridium, Antimony, Tungsten, Strontium, Tantalum, Bromine, Zirconium) in meat and fat tissues, which may be the reason for adding selenium and zinc to The fed and leads to the interaction or absorption of these elements and also depends on the differences in the geographical location and sources of fed for sheep of the Kurdish breed in Sulaymaniyah Governorate in the Kurdistan Region of Iraq. In our study, the presence of metallic elements was detected, and this is the first of its kind for this study. Toxic doses are not known so far, and the physiological mechanisms related to metal poisoning are still not understood so far. For some new metal elements, the published research that evaluated these mechanisms is likely lacking. It is difficult to describe the physiological mechanisms and changes involved in the poisoning process, as well as the difficulty of determining a toxic dose of a mineral element due to the dependence of each of the mineral elements on its shape, type, animal age and the interaction between minerals in metabolism. Also, some mineral elements have not determined the fatal level because there are no studies of its kind .

Conclusion

Some metals are a toxic environmental and health pollutant, the growth of which has increased significantly as a result of human activities. It is necessary to monitor their level in the environment and in soil, plants and animal tissues, especially in meat and fat tissues, as they accumulate in them and are a source of food. Pollution control aims to estimate human risks and assess an area contaminated with mineral elements. Moreover, determining the level of mineral elements in meat and fat tissues For animals lets assess environmental pollution. For this purpose the metallic elements Selenium, zinc, Copper, Iron, Cobalt, Palladium, Lead, Antimony, Tin, Molybdenum, arsenic, Tungsten, Strontium, Tantalum, argon, Nickel, Platinum, thallium, Bromine, Zirconium, Bismuth, and Iridium. The metallic elements were within the permissible limits, but some metallic elements did not know the permissible limits so far and their effects. Therefore, more studies are needed on understanding and determining the accumulation and toxic levels of the metal elements that were detected in this study in the meat and fat tissues of Kurdish sheep, where selenium and zinc work on the interactions and absorption of some metal elements and their accumulation in the tissues of the meat and fat tissues.

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