ZANCO Journal of Pure and Applied Sciences
The official scientific journal of Salahaddin University-Erbil
https://zancojournals.su.edu.krd/index.php/JPAS

ISSN (print):2218-0230, **ISSN (online):** 2412-3986, **DOI:** **http://dx.doi.org/10.21271/zjpas**

RESEARCH PAPER

Assessment of Heavy Metals in Wheat Grain and Broad Bean Pods Irrigated with Sewage water in Koya City-Erbil- Kurdistan region

Zhakaw Mustafa Saeed[1*], Arol Mohsen Anwar [2]

[1,2]Department of Biology, Faculty of Science and Health, Koya University, Koya KOY45, Kurdistan Region-F.R. Iraq

A B S T R A C T:

Environmental pollution with heavy metals is very harmful to human and animals, even in low concentrations. The current study aimed to determine the concentrations of several metals such as cadmium, lead, copper, zinc, manganese, cobalt, nickel, iron, molybdenum, and vanadium, in wheat grains and broad bean pods irrigated with wastewater from different sources of five locations in Koya city. by XRF device (X-ray fluorescence spectrophotometer)(Genius 5000 XRF).The findings showed that plants in the study areas contained varying concentrations of heavy metals (Cd, Pb, Cu, Zn, and Mn), as well as the lack of the elements (Co, Cr, Ni, Fe, Mo, and V). The metal accumulation range of wheat grain were; Cd (1.120 - 1.279 mg/kg) Pb (13.983 - 24.393 mg/kg), which Cd and Pb exceeded the permissible limits from all locations. Cu (4.769 - 18.080 mg/kg)exceeded in Kany qara, Alyawa and Azady of wastewater locations. Zn (23.713 - 67.081 mg/kg)with in safe limits except Alyawa of wastewater location. Mn (14.458 - 33.012 mg/kg)the sites within allowable cap.Also the metal accumulation range in broad bean pods were; Cd (1.222 - 1.401 mg/kg), Pb (18.048 - 21.938 mg/kg) Cu (10.140 - 15.064 mg/kg), which Cd and Pb exceeded the permissible limit in all locations also control location, Cu exceeded from Hamamok which control location and Alyawa of waste water, Zn (26.916 - 54.538 mg/kg) and Mn (15.846 - 18.688 mg/kg) which Zn and Mn were lower than the permissible limit.

KEY WORDS: Sewage water; Heavy metals; Wheat grain; Broad bean pod.
DOI: http://dx.doi.org/10.21271/ZJPAS.35.SpD.8
ZJPAS (2023) , 35(SpD);69-74 .

1.INTRODUCTION :

The use of sewage water in agriculture is considered one of the important means to address the limited sources of water suitable for agricultural use and the increasing demand for water to meet the steady population increase also to drought seasons tolerance in Koya city, as it provides crops with water and nutrients (macro and micro) nutrients and at the same time it is considered a means of sewage disposal, and the prolonged use of waste water for irrigation may cause heavy metals to build up in agricultural soils and plants, soil sickness, groundwater contamination and phytotoxicity (Rashid and Mohammed, 2016; Shekha et al., 2019).

Cities are typically regarded as major sources of pollutants, especially heavy metals, due to their diverse geographic, geological, meteorological, and sociological characteristics(Bernard et al., 2003). Environmental heavy metal pollution is a problem that plants absorb could enter the food chain (Intawongse and Dean 2006). The amount of heavy metals that accumulate in plants depends on their species and how well they are able to absorb metals(khan et al., 2008).

High Cd levels cause damage that can be seen as chlorosis, growth inhibition, browning of the root tips, and ultimately death(Nagajyoti et al., 2010). Shrinkage of leaf surface area, yellowing, formation of necrotic spots, suppression of leaf growth, and leaf rolling are seen in plants exposed to dangerous levels of Cd (Ozyigit and Nazligenc, 2020). Many plant species have aberrant morphology, growth, and photosynthetic

* **Corresponding Author:**
Zhakaw Mustafa Saeed
E-mail: Arol.anwar@koyauniversity.org, Zhakaw.mustafa@koyauniversity.org
Article History:
Received: 17/12/2022
Accepted: 08/03/2023
Published: 01/11 /2023
:

processes as a result of elevated lead levels in the soil (Asati et al., 2016). Leaf tips suffered greater damage than the base(Clark et al., 1981). Humans who are exposed to excessive levels of Pb may experience toxic effects that include issues with the synthesis of hemoglobin (Hb), effects on the kidneys and gastrointestinal tract (GIT), and acute or long-term nervous system damage,and all levels of the reproductive axis in the animal model (Govind and Madhuri, 2014; Soetan et al., 2010).

Cu overabundance results in the production of ROS, stunted growth and lateral root inhibition, as well as the inhibition of photosynthesis and reduce soil microbial activity(Dalcorso et al., 2014; Alengebawy et al., 2021).

Zn is a crucial micronutrient for plants and has an impact on the soil's pH, bicarbonate and organic matter content, and enzymatic activity. Neuronal damage and mortality linked to traumatic brain injury, stroke, epilepsy, and neurodegenerative disorders in humans have been linked to Zn-toxicity-induced neurotoxicity(Alengebawy et al., 2021).

Manganese is a crucial element for plant nutrition and is crucial for enzyme activities. However, excessive Mn buildup in leaves reduces photosynthetic activity (Ahmed and Aziz, 2017). Artificial Mn supplementation at low doses has been demonstrated to cause modest skin lesions and irritation in humans (Miah et al., 2020).

(Hassan et al., 2013) studies on the levels of heavy metals in wheat grown with sewage water, Cd 0.8, Pb 0.35, Cu 4.1, Zn 35 .3 and Mn 4.9 mg/Kg.

(Chaoua et al., 2018) used waste water in Morocco, the rate of Cd ND, Pb 36.275, Cu 3.925 and Zn were56.785 mg/Kg in wheat*(Triticum œstivum)* seeds. And Cd 11.185, Pb 36.925, Cu 2.905 and Zn were33,88 mg/km in a pod of *Viciafaba*.

The objective of this study : was to evaluate the disadvantage of using sewage water for crops production at drought seasons by accumulation of heavy metals in wheat grains and Broad bean pods and determine its validity of consumption by human and animals according to safe limits consumed.

2. MATERIALS AND METHODS

2.1 Study Area and Sampling

Koya district located 60 km southeast of Erbil city, is one of the largest district belonging to Erbil administration (Othman et al., 2012). The soil and plants were acquired from five different locations in Koya city like Hamamok(S1), Kany qara(S2), Shawgerawa(S3), Alyawa(S4) and Azady(S5). The geographic selection for each location is 36°05'33"N 44°36'53"E for Hamamok, 36°03'51"N 44°37'39"E for Kany qara, 36°03'47"N 44°38'19"E for Shawgerawa, 36°03'42"N 44°37'06"E for Alyawa and Azady is 36°04'15"N 44°38'45"E

2.2 Collection and Preparation of Samples

2.2.1 Water Samples

To get water samples from the research locations for heavy metal analysis, a 0.5 liter polyethylene bottle was used. The bottle was rinsed twice with water before being filled with one drop of toluene. The samples were taken from four sources of waste water used for plant irrigation in Koya city and one source of well water as a control according to (Esmail and Baba, 2010) at the lab, water samples were stored in cold boxes.

2.2.2 Soil samples

For the purpose of analyzing heavy metals, soil samples were gathered from several locations within the investigated areas. The samples came from a certain depth. of 0 to 30 cm, were put in polyethylene bags, and transported back to the lab where they were air-dried, sieved, and stored for chemical analysis (Ismaeel, 2015).

2.2.3 Cultivated plants

(Fito- LUZ DE OTONO) variety of broad bean was cultivated in the studied sites on 20/11/2021 and which harvested on 20 April 2022, and (Hewler 4) wheat variety which obtained from the Agricultural Research Center in Koya city, which cultivated in the studied sites on 31/12/2021 and harvested in 28 May 2022.

2.3 Determination of Heavy Metals

2.3.1 Concentration of Heavy Metals in Water

Heavy metals in collected water were determined after preparation of samples using ICPE-9820 shimadzu in Atmosphere Company for Environmental and Laboratory Services as shown in table 1

Table(1) Heavy metals concentration in sewage water of the studied sites Mg/L

H.M.	Locations				
	Hamamok	**Kany qara**	**Shawgerawa**	**Alyawa**	**Azady**
Cd	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.003	<0.001	<0.001	<0.001	<0.001
Zn	<0.001	0.031	0.023	0.014	0.011
Mn	<0.001	<0.001	<0.001	<0.001	<0.001
Co	0.001	0.004	0.002	0.005	0.004
Cr	<0.001	<0.001	<0.001	<0.001	<0.001
Ni	<0.001	<0.001	<0.001	<0.001	<0.001
Fe	0.003	0.083	0.080	0.047	0.017
Mo	0.025	<0.001	0.006	0.000	0.003
V	0.006	<0.001	<0.001	0.005	0.012

2.3.2 The Concentration of Heavy Metals in Plants and Soils

This analysis was done at the laboratories of Science college, Ecological department, University of Salahaddin by using XRF (X-ray fluorescence spectrophotometer) This is a recognized analytical method for evaluating both qualitative and quantitative elements. It is a multi-element, simultaneous method that is also non-destructive, making it appropriate for plant analysis where about (5g) of dry plant material was powdered and compressed by (Die press machine) to obtain a disc which is used by XRF device (Genius 5000 XRF) (Mamand et al., 2020).

Table (2) Heavy metals concentration in soil of the studied Locations Mg/kg

H.M.	Locations				
	Hamamok	**Kany qara**	**Shawgerawa**	**Alyawa**	**Azady**
Cd	1.29	1.48	1.86	1.32	1.41
Pb	9.98	13.42	9.37	8.75	14.44
Cu	23.87	39.37	27.84	10.33	29.96
Zn	58.46	84.80	77.44	78.23	62.56
Mn	661.44	410.43	332.27	560.21	435.10
Co	0	0	0	0	0
Cr	59.34	81.43	102.67	64.21	102.19
Ni	25.44	13.53	67.96	75.27	14.38
Fe	24279.32	22472.86	24827.91	27456.2	22465.63
Mo	0	0	0	0	0
V	0	0	0	0	0

2.4 Statistical Analysis:

Using a computer program called SAS Program, 2000, the data were examined using the Randomizes Complete Block Design (RCBD) consisting of 5 sites which are Hamamok (well water- control), (Kany qara, Shawgerawa, Alyawa and Azady) sewage water with three replication for each site. The comparison between the means were done using Duncan's method (1955) with a significant level of 5%, which indicates that Means followed by the same letters with in column are not significantly different at $p \leq 0.05$ according to Duncan multiple range test

3. RESULTS AND DISCUSSION

3.1 Concentration of Heavy Metals in Wheat Grain

The result in table (3) reveals the elements' concentrations in wheat grain (Cd, Pb, Cu, Zn, Mn, Co, Cr, Ni, Fe, Mo, and V). The concentrations of heavy metals in wheat grain vary from metal to other in studied locations.

According to Duncan’s test Cd show non-significant differences on wheat grain in study sites, while have the differences ratio between locations, the highest value was 1.279 mg/kg in (Alyawa), and the lowest in Hamamok was 1.120mg/kg. And Kany qara, Azady and Shawgerawa were (1.168, 1.228 and 1.256mg/kg) respectively, higher than (Hassan et al., 2013). The level of Cd in wheat grain is greater than the safe limits in all locations (0.1mg/kg) (Huang et al., 2008).

The results in (table 3) revealed that the concentration of Pb element in wheat grains differed significantly in study sites, which ranged from (13.983 to 24.393) mg/kg, the highest from Alyawa and the lowest from Kany qara, and the difference between sites Hamamok, Kany qara, Shawgerawa, and Azady not reached a significant level, higher than (0.35mg/kg) reported by (Hassan et al., 2013). The concentration of Pb at all sites higher than the safe limits (0.4 mg/kg) of Chinese standards (Huang et al., 2008).

The relatively high concentration of Cd and Pb in Hamamok (control location) have been the result of uptake from polluted soil that located on main road with traffic density. Additionally, the foliar uptake of atmospheric heavy metals from vehicle emissions which has been identified as another path way of heavy metal pollution in vegetable crops (Mamand, 2008)

Cu was significantly affected, the highest value from Alyawa was 18.080 mg/kg and the lowest from Hamamok and Shawgerawa were (4.769 and 5.511mg/kg) respectively agree with (Hassan et al., 2013). Non-significant differences between Hamamok and Shawgerawa. Also non-significant differences between Kany qara (11.014 mg/kg) and Azady (13.851mg/kg) , Cu concentration in

Kany qara, Alyawa and Azady higher than safe limits (10mg/kg) (Huang et al., 2008), but in (Hamamok and Shawgerawa) lower than this standard level. The contrast of sewage water pollution cause the contrast of the soil pollution due to the variation of the use of powders and chemical detergent according to Cultural awareness and family income, in another hand, the environmental factors, especially the soil factor, have a role in this contrast (Chibuike and Obiora, 2014)

Zn is the most studied element in wheat grains (Hassan et al., 2013).Zn at Wheat grain were significantly affected ($p<0.05$) (table 3), the highest value from Alyawa was (67.081mg/kg) and the lowest from Shawgerawa (23.713mg/kg), in Hamamok site was(40.940 mg/kg). Which Significantly superior to the sites Kany qara, Shawgerawa and Azady while close results were between (Kany qara and Azady) (36.069 and 36.843mg/kg) respectively agree with ((Hassan et al., 2013; Chaoua et al., 2018). Concentrations of Chinese tolerance limits for Zn in wheat grains were not exceeded; only Alyawa (67.081 mg/kg) indicated over the tolerance limit (50 mg kg1) in wheat grains (Huang et al., 2008).

(table 3) Mn content in wheat grain was fluctuated between (14.458 - 33.012) mg/Kg, the highest level found from Azady and the lowest value recorded from Kany qara. On the other hand , differences between studied locations were significant. Results of Mn are higher than 4.9 mg/kg reported by (Hassan et al., 2013). Mn concentration in wheat grain at all studied locations is lower than standard level (30-300) stated by (Abdlbary, 2000).

As illustrated in table (3), the concentration of (Co, Cr, Ni, Fe, Mo and V) in Wheat grain were zero, Despite their presence in varying concentrations in the results of laboratory analysis of wastewater samples (table 1) and soil samples (table 2), may be due to the ability of some of these elements to rapid dissolve and leaching away from the plant root zone during the rainy season, may be some elements adhered with Soil particles that exceed strength of plant to absorb them or efficiency absence to absorb these metals by plant root.

Table(3) Concentration of Heavy Metals in Wheat Grain Mg/kg (Milligram)

H. M	**Locations**					**Safe limits of heavy metals**
	Hamamok	**Kany qara**	**Shawgerawa**	**Alyawa**	**Azady**	
Cd	1.12 a	1.168 a	1.25 a	1.27 a	1.22 a	0.1 (Huang et al., 2008)(wheat)
Pb	15.32 b	13.98 b	14.08 b	24.39 a	16.29 b	0.4 (Huang et al., 2008) (wheat)
Cu	4.76 c	11.01 b	5.51 c	18.08 a	13.85 b	10 (Huang et al., 2008) (wheat)
Zn	40.940 b	36.06b c	23.71 c	67.08 a	36.84 b c	50 (Huang et al., 2008) (wheat)
Mn	25.76 a	14.45 b	31.43 a	31.43 a	33.01 a	30-300 (Abdlbary, 2000) (Plant)

*The concentration of Co, Cr, Ni, Fe, Mo and V were zero in studied sites.

** Means followed by the same letters within column are not significantly different at $p \leq 0.05$ according to Duncan multiple range test.

3.2 Concentration of Heavy Metals in Broad Bean pods

The findings in (table 4) show that the elements Cd, Pb, Cu, Zn, Mn, Co, Cr, Ni, Fe, Mo, and V are concentrated in broad bean pods. According to Duncan's test, we find that the concentration of Cd in broad bean pods differed significantly in the study sites, Azady site show the highest value (1.401mg/kg), and the lowest was (1.222mg/kg) in Alyawa, while the close concentrations were in Hamamok, Kany qara and Shawgerawa (1.259, 1.267 and 1.262 mg/kg) respectively. Cd higher than standard level at all locations (0.1 mg/kg) (Bordean et al., 2015).

The presented results in(table 4) show difference in the concentration of Pb in broad bean pods in the studied sites , but not reach the significant level. High concentrations were in Kany qara and Shawgerawa (21.938 and 21.008mg/kg)respectively, while the low concentration were in Hamamok and Azady (18.337 and 18.048mg/kg) respectively but Alyawa site have the concentration

(19.530mg/kg).The concentration of Pb in broad bean pods in all sites higher than Safe limits (0.2 mg/kg) (Bordean et al., 2015).

According to the results in (table 4), Cu concentration in broad bean pods at studied sites not reached a significant level, while site concentration of Hamamok (11.552 mg/kg), Kany qara (10.927mg/kg), Shawgerawa (10.140mg/kg), Alyawa (15.064 mg/kg) and Azady (10.642mg/kg) don't agree with (Chaoua et al., 2018) were higher than Safe limits(10 mg/kg) according to (Bordean et al., 2015).

From the results of table (4), it was found that Zn concentration in Kany qara (54.538mg/kg) was significantly superior on sites Hamamok (33.601 mg/kg), Shawgerawa(30.762 mg/kg), Alyawa (26.916 mg/kg)and Azady (30.314 mg/kg) ,the result agree with (Chaoua et al., 2018). According to (Bordean et al., 2015) Zn concentration in all sites were lower than Safe limits (100 mg/kg).

The result shown in table (4) indicate that the concentration of Mn in studied sites Hamamok (18.688 mg/kg), Kany qara (16.460 mg/kg), Shawgerawa(17.971 mg/kg) , Alyawa (15.846 mg/kg) and Azady (17.669 mg/kg) without significant superior between them, and according to (Abdlbary,2000) (30-300mg/kg) the concentration of Mn in broad bean pods with in studied sites were lower than Safe limits.

The results in (table4) revealed the absence of elements (Co, Cr, Ni, Fe, Mo and V) in Broad bean pods at studied sites, Despite their presence in varying concentrations in the results of laboratory analysis of wastewater samples (table 1) and soil samples (table 2), The result is correspond with the result of wheat grain.

Table (4) Concentration of Heavy Metal in Broad Bean Pods Mg/kg

H.M	**Locations**					**Safe limits of heavy metals**
	Hamamok	**Kany qara**	**Shawgerawa**	**Alyawa**	**Azady**	
Cd	1.25 ab	1.26 ab	1.26 ab	1.22 b	1.40 a	0.1 (Bordean et al., 2015) (faba bean)
Pb	18.33 a	21.93 a	21.00 a	19.53 a	18.04 a	0.2 (Bordean et al., 2015) (faba bean)
Cu	11.55 a	10.92 a	10.14 a	15.06 a	10.64 a	10 (Bordean et al., 2015)(faba bean)
Zn	33.60 b	54.53 a	30.76 b	26.91 b	30.31 b	100 (Bordean et al., 2015)(faba bean)
Mn	18.68 a	16.46 a	17.971 a	15.84 a	17.66 a	30-300 (Abdlbary,2000) (Plant)

*The concentration of Co, Cr, Ni, Fe, Mo and V were zero in studied sites.

** Means followed by the same letters within column are not significantly different at p ≤ 0.05 according to Duncan multiple range test.

4. CONCLUSIONS

Based on the results of this investigation, Daily crops irrigation by sewage water in fields causes the accumulation of heavy metals in varying proportions in the irrigated locations, wheat grain and broad bean pods. In the studies locations, the content of several elements, such as Cd and Pb, with Cu in some sites exceeded safe levels. The daily consumption of these crops by humans and animals results in the accumulation of these metals in the body, the consequently health risk, consequently it is not suitable for consumed as food.

5. REFERENCES

Abdlbary, S. A., 2000. Environmental Pollution soil and Plant. *universities Publishing house*.

Ahmed, A. M. and Aziz, F. H., 2017. Study of heavy metal accumulation in soil and Some Plants in Erbil governorate. Master Thesis, *Salahadin University*.

Alengebawy, A. , Abdelkhalek, S. T. ,Qureshi, S. R.and Wang, M. Q., 2021. Heavy metals and pesticides toxicity in agricultural soil and plants: ecological risks and human health implications. *Toxics. 9*(3): 42.

Asati A., Pichhode M. and Nikhil K., 2016. Effect of heavy metals on plants: an overview. *International Journal of Application or Innovation in Engineering & Management*. 5(3): 56-67.

Bernard D. J., Grzebiszwitold and Apolinarskakatarzyna, 2003. A Study of soil pollution by heavy metals in the city of poznań (poland) using dandelion (Taraxacum Officinale Web) As A Bioindicator. *electronic Journal of polish agricultural Universities*, (6)2.

Bordean D.M., Raba, D., Pintilie S., Raican, D., Catargiu, A., Borozan, A. B., Pirvulescu L., CojocariuL., 2015. Accumulation of heavy metals in *viciafaba* beans. *22nd international Symposium on analytical and environmental problems*, (47): 78- 82.

Chaoua, S., Boussaa, S., El Gharmali, A., Ali, B., 2018. Impact of irrigation with wastewater on accumulation of heavy metals in soil and crops in the region of Marrakech in Morocco. *Journal of the Saudi society of agricultural sciences,* 18(4): 429-436.

Chibuike, G.U.,Obiora, S. C., 2014. Heavy Metal Polluted Soils: Effect on Plants and Bioremediation Method. Applied and Environmental Soil Science

Clark, R. B., Pier, P. A., Knudsen, D., and Maranville, J. W., 1981. Effect of trace element deficiencies and excesses on mineral nutrients in Sorghum. *Journal of Plant nutrition*, 3(1-4): 357–374.

Dalcorso, G. ,Manara, A. , Piasentin, S., and Furini, A., 2014. Nutrient metal elements in plants, *metallomics*, 6(10), pp. 1770–1788.

Duncan, B.O. 1955. Multiple range and Multiple F test Biometrics,11: 1- 42.

Esmail. A. O. and Baba A. B. A.,2010. The role of chemical composition of some water resources in limiting its suitability for irrigation purpose in Sulaimani governorate Kurdistan Region- Iraq, thesis. *Salahadin University.*

Govind P. And Madhuri, S., 2014. Heavy metals causing toxicity in animals and fishes. research journal of animal, *veterinary and fishery Sciences*, 2(2): 17-23.

Hassan, N. U., Mahmood, Q., Waseem, A., Irshad, M., Faridullah, Pervez A., 2013. Assessment of heavy metals in wheat plants irrigated with contaminated wastewater. *Pol. J. Environ. Stud*. 22 (1): 115-123.

Huang, M., Zhou, S., Sun, B., Zhao, Q., 2008. Heavy metals in wheat grain: assessment of Potential health risk for inhabitants in Kunshan, China.*Science of the total environment*.405(1-3): 54–61**.**

Intawongse, M., & R., Dean, J., 2006. Uptake of heavy metals by vegetable plants grown on contaminated soil and their bioavailability in the human gastrointestinal tract. *Food Additives and Contaminants*, (23): 36–48.

Ismaeel D. S., 2015. Concentration of some heavy metals in water, soil, settle able dust, forage and milk in a dairy farm, Hewlêr -Kurdistan Region Of Iraq. Msc. Thesis. *Council of The College Of Science*. Salahaddin University.

Khan S., Cao, Q. Y.M., Zheng, Y.Z., Huang, Y.G. Zhu, 2008. Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing, China. *environmental Pollution*, 152(3): 686–692.

Mamand, B. A., 2008, A study on (Cd, Cr, Mn, and Zn) levels in some vegetables irrigated by waste water of the main sewage canal in Hawler city. Msc. Thesis. Salahaddin University

Mamand, S. F., Khudhur, N. S. and Darwesh, D. A., 2020. Phytoremediation efficiency of some evergreen Plant genera for lead Polluted soil. *Zanco Journal of Pure and Applied Sciences*, 32(5): 174-178.

Miah, M. R., Ijomone, O. M., Okoh, C. O.A., Ijomone, O. K., Akingbade, G. T., Ke, T. K., Bárbara, D. C. M., Airtonakinyemi, A., Nicole A., Felix A. B., Aaron B., Aschner, M., 2020. The Effects of manganese overexposure on brain health. *Neurochemistry International*, (135): 104688.

Nagajyoti, P. C., Lee, K. D., Sreekanth, T. V. M., 2010. Heavy metals occurrence and toxicity for plants: a review. *Environmental Chemistry Letters*, 8(3): 199–216.

Othman, B. A., Ganjo, D. G. A. and Goran, S.M. A., 2012. Quality and hygienic status of main sewage channel of Koya town/ Erbil Kurdistan Region Iraq. *Journal of Koya University*.

Ozyigit A. H., Nazligenc B., 2020. Cadmium in plants, humans and the environment. *Frontiers In Life Sciences and Related Technologies*, 1(1): 12-21.

Rashid, K. A. and Mohammed Zh. K., 2016. Heavy metal accumulation in celery from Sarchnar and Kalar In Kurdistan of Iraq Region. *Journal of Zankoy Sulaimani*, 18-(1): 29-37.

Shekha, Y.A., Maulood, P.M., Sadraddin, Z.A. and Khalifa, M.H., 2019. Phytotoxicity of sewagewater and leachate of solid waste on seed germination and seedling growth of *Viciafaba* L. (Faba bean). *Zanco Journal of Pure and Applied Sciences*, 31(2): 65-70.

Soetan, K. O., Olaiya, C. O. and Oyewole, O. E., 2010. The importance of mineral elements for humans, domestic animals and plants. *African Journal Of Food Science*, 4(5): 200-222.