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Evaluation of Heavy Metals Content in Some Cereals Crops Grown Around the Established Industries in Singrauli Region

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ABSTRACT

Evaluation of heavy metals content were perfumed in samples of cereals crops grown around the industries in Singrauli region for the two sequential experimental duration of 2020-2021 and 2021-2022. There are four cereals crops Paddy (*Oryza sativa*), Wheat (*Triticum aestivum*), Maize (*Zea mays*), and Jowar/Sorghum (*Sorghum vulgare*) *were* studied for two respective years 2020-21 and 2021-22. All the crops were according to their concern seasons and irrigated with waste irrigated water. Eight heavy metals (Cd, Cr, Pb, Fe, Cu, Zn, Mn, and Ni) were studied in the grains of investigated crops. All selected four stations were specific and completely ensure the sites of contamination situated around the established industries in Sigrauli region. Grown crops were shown variable accumulation of heavy metal content. Standard acid digestion methods were employed to perform multiple residues determination through AAS. The grain samples were taken at the complete maturity of crop grains. The maximum to minimum heavy metal in respective crop order was determined. Oder of Fe and Ni was in (*Oryza sativa)* < (*Triticum aestivum*) Jowar/Sorghum (*Sorghum vulgare*) Maize (*Zea mays).* For Cu and Zn the crop order was (*Oryza sativa)* < (*Triticum aestivum*) < *(Zea mays)* < (*Sorghum vulgare*). Cd content crops order was (*Triticum aestivum*) < (*Oryza sativa)* < (*Zea mays)* < (*Sorghum vulgare*). The order for Pb content was (*Zea mays*) < (*Sorghum vulgare*) < (*Triticum aestivum*) < (*Oryza sativa*). The order of Cr in experimental crops was as (*Oryza sativa*) < (*Triticum aestivum*) < (*Zea mays)* < (*Sorghum vulgare*). The order of Mn was as (*Sorghum vulgare*) < (*Zea mays)* < (*Triticum aestivum*) < (*Oryza sativa).* The levels of heavy metals determined in the analyzed cereal samples were found to be below the permissible limit set by FAO/WHO; hence, the concentration of these heavy metals in the selected cereals analyzed, may not presently pose a health hazard in the population and can as well serve as good and dependable sources of essential trace metals to the human population.

Keywords: Cereal crops, heavy metal contents, industries, Singrauli region, acid digestion, AAS

I. INTRODUCTION

Cereals are grown and sold throughout the nation through retail outlets, serving as a dependable source of energy and minerals for people in particular [1]. Cereals are a major source of nutrition in India and the most widely consumed foods in the region. They are abundant in protein, oil, carbohydrates, trace minerals, and vitamins [2]. Lysine is, however, scarce in grain protein [3, 4]. Simply put, "food safety" refers to the absence or presence of safe levels of pollutants, adulterants, naturally occurring poisons, or any other substance that could cause food to be harmful to health either acutely or chronically. Food quality can be viewed as a complicated attribute that affects a food's value or consumer acceptability. Plant species, genetics, soil and metal kinds, soil conditions, weather, environment, maturation stage, and supply route to market all affect how much metal accumulates in plants [5-8]. Because they are persistent, non-biodegradable, have a long biological half-life, and can bio-accumulate through biological chains, heavy metals are environmental contaminants that can harm humans if an excessive amount is consumed through food [9]. Heavy metal toxicity may result from industrial emissions, fertiliser and metal-based pesticide use, contaminated irrigation water, harvesting, transit, storage, or sale. Crops produced in heavy metal-contaminated soils accumulate the pollutants more than those grown in non-contaminated soils [10]. This is due to the fact that farmlands located in industrialised areas are vulnerable to chemical pollution, which can contaminate plant crops [11]. While Fe, Cu, Mn, Zn, and Ni are regarded as necessary trace elements, elements like Cd, Cr, and as are thought to cause cancer. The consumption of cereal crops polluted with heavy metals may be harmful to human health [7]. Although trace elements do not contain calories, they are crucial for the regulation of the body's metabolism if present in the right amounts. For instance, they are co-enzymes and co-factors in the human system, which play various functions in the development of the immune system, metabolism, and growth, [7]. However, if the concentrations of these vital substances exceed the acceptable ranges, they endanger our health [13]. Musculoskeletal, renal, ophthalmic, immunological, and reproductive consequences can be brought on by lead exposure in the body [14]. When plants are produced on or close to hazardous sites, it is crucial to take care of heavy metal contamination of food. Food metal analysis is a crucial component of food quality assurance [12]. Region of Singrauli known for evolving industrial pollution, main discharge consist heavy metals. The current study focuses on the industrial setting and the surrounding agricultural area. Heavy metals are released by industries after being disposed of. It is crucial to periodically evaluate the quality of food items in this region by metal analysis due to the significance of these metals for humans and the associated threat they cause, as well as a growth in environmental contamination. The evaluation will increase public knowledge of the dangers related to eating food that contains significant amounts of heavy metals and provide information on the degree of metal contamination and, consequently, the effect on food safety standards and consumer risk.

II. MATERIAL AND METHODS

All the four crops samples were collected specific commercially growing sites from the specific survey Singrauli region. One kg each crop samples of (*Oryza sativa),* (*Triticum aestivum*), Jowar/Sorghum (*Sorghum vulgare*), and Maize (*Zea mays).*were collected from the field sites was transported to the laboratory. These samples were preserved in a freezer till further processing.

Procedure of Digestion

2.5 g of the sample, previously dried to constant weight was placed in 100 mL reflux flask. 15 mL of concentrated HNO_3 and 5 mL of concentrated H_2O_2 were mixed with the sample. The mixture was allowed to stand for about 48 hrs at room temperature. It was then refluxed on a heating mantle at 90°C until brown fumes ceased to evolve, 4-6 hrs and allowed to cool. 5 mL of 60% (v/v) $HClO_4$ was added to the mixture and further refluxed for 30 min. The digest was allowed to cool to room temperature. It was filtered into a 100 mL volumetric flask with a Whatman's No. 42 filter paper and made to the mark with de-ionized water. This was repeated for all the samples in triplicate. A blank was also prepared similarly [15,16]. The digests were analyzed for their content of eight heavy metals with the aid of an Atomic Absorption Spectrophotometer at lab. The acetylene gas pressure and flow rate as well as burner positioning were automated. The instrument was allowed to warm for 30 min before analysis.

III. RESULTS AND DISCUSSION

Concentration of heavy metals in cereals crops sample during 2020-21 and 2021-22 in all studies stations (1-4)

Four cereals crops Paddy (*Oryza sativa*), Wheat (*Triticum aestivum*), Maize (*Zea mays*), and Jowar/Sorghum (*Sorghum vulgare*) *were* studied for two respective years 2020-21 and 2021-22. All the crops were according to their concern seasons and irrigated with waste irrigated water. Eight heavy metals (Cd, Cr, Pb, Fe, Cu, Zn, Mn, and Ni) were studied in the grains of investigated crops. In 2020-21 and 2021-22 maximum Cd (1.22±0.26) and (1.32±0.36) were accounted in (*Sorghum vulgare*) in station 1 collected sample. Most Cr content was (3.14±0.16) and, (3.34±0.14) in *Triticum aestivum.* Maximum Pb content was recorded in wheat crop (0.66±0.05) during 2020-21 and in Paddy (0.72±0.21) in 2021-22. Most Fe content in 2020-21 was found in (*Sorghum vulgare*) at 1.65±0.47 and during 2021-22 was 1.42±0.02 in *Zea mays.* Maximum Cu content was 87.46±0.19 in *Triticum aestivum* during 2020-21, whereas most were 87.96±0.11 in 2021-22 in the same crop. Maximum Zn was found in *Oryza sativa* 90.50±0.09 and 91.50±0.22 mg/kg in investigating years for station 1. Utmost Mn content 840±0.63 and 854±0.63 mg/kg was recorded in *Sorghum vulgare* during 2020-21, and 2021-22. Maximum Ni content 76.46±0.11 and 78.59±0.31 mg/kg were found in (*Triticum aestivum*) in observation duration. Due to the fact that heavy metals are not biodegradable [17], have a long biological half-life, and can bio-accumulate via the biological chain [18], environmental contamination by heavy metals has recently become a global issue. One of the main food pollutants is heavy metals, which also poses a potential threat to the ecosystem. Through the consumption of tainted drinking water, grains and vegetables grown in soil tainted with metals, industrial liquid waste, and sediments [18,19], heavy metals may enter the human body. Food quality and safety have grown to be a major global concern due to the possible environmental hazards that heavy metals pose to human health if they are present in higher concentrations in food grains [20].

The increasing order of Cd was during 2021 as 1.02±0.25 (*Triticum aestivum*) < 1.03±0.08 < (*Oryza sativa*) 1.06±0.16 (*Zea mays*) and 1.22±0.26 (*Sorghum vulgare*), whereas in 2021-22 the order was 1.13±0.21 (*Oryza sativa*) < 1.17±0.26 (*Zea mays*) < 1.22±0.20 and 1.32±0.36 (*Sorghum vulgare*). The order of Cr was 2.10±0.18 (*Sorghum vulgare*) < 2.54±0.20 (*Zea mays*) < 3.02±0.06 (*Oryza sativa*), and 3.14±0.16 (3.14±0.16) during 2021 and in 2022 was 2.18±0.17 (*Oryza sativa)* < 2.59±0.22 (*Zea mays)* < 3.22±0.21 (*Oryza sativa)* and 3.34±0.14 (*Triticum aestivum*) (Table 1).

Maximum Cd 1.32±0.36 mg/kg was found in (*Sorghum vulgare*), Cr and Pb contents were 3.22±0.21 and

0.72±0.21 mg/kg. Maximum Fe was 1.42±0.02 mg/kg in (*Zea mays*), Cu was 87.96±0.11mg/kg in (*Triticum aestivum*), Zn status was 91.50±0.22 mg/kg in (*Oryza sativa),* Mn content was 854±0.63mg/kg in (*Sorghum vulgare*) and Ni status was 78.59±0.31 mg/kg in (*Triticum aestivum*) crops during 2021-22 (Table 2)

Similarly, the order of heavy metal concentration (mg/Kg) was variable in station 2. Maximum Cd, Cr, Pb, and Cu content was as 1.25±0.22, 3.11±0.21, 0.56±0.14, and 88.46±0.10 mg/kg were accounted in *Triticum aestivum*, whereas maximum Fe content was 1.26±0.25mg/kg in *Oryza sativa*, Zn content was 89.50±0.12 mg/kg in *Oryza sativa,* 860±0.03 mg/kg in *Sorghum vulgare*, and 77.23±0.40 mg/kg was in *Oryza sativa* during 2021 (Table 3). In an analysis of 2022 of station 2 harvested cereal crops maximum Cd and Cr content was 1.80±0.12 and 3.81±0.12 mg/kg in *Triticum aestivum,* Pb was 0.97±0.24 mg/kg in *Zea mays,* Fe, Cu, Zn, and Ni was 1.76±0.23, 98.23±0.02, 94.50±0.14 and 81.03±0.30mg/kg in *Oryza sativa.* Only Mn represents the most content 874±0.13 mg/kg in *Sorghum vulgare.* Finding suggested that maximum Mn content was expressed in *Sorghum vulgare* during 2022 (Table 4).

Similarly, the order of heavy metal status (mg/kg) was variable in station 3 in 2021 and 2022. Maximum Cd was 1.26±0.06 in *(Zea mays*), Cr and Cu was 3.54±0.06 and 87.46±0.20 mg/kg in *Triticum aestivum,* most Fe was 1.47±0.47 in *Oryza sativa,* maximum Cu and Ni were examined in (*Triticum aestivum*) as 87.46±0.20 and 74.40±0.11 mg/kg, similarly most Zn content was 91.50±0.02 mg/kg in *Oryza sativa* and Mn was 894±0.13 mg/kg in *Sorghum vulgare* recorded (Table 5). In the observation study of 2022 subsamples of the same crops were examined in which most Cd was 1.66±0.04mg/kg in *Zea mays,* Cr and Pb was 3.72±0.03 and 0.65±0.03mg/kg in (*Oryza sativa*), Most Fe 1.55±0.12 and Mn 896±0.10 mg/kg were found in *Sorghum vulgare*, most Cu and Ni was 85.90±0.11 in *Zea mays* and 74.50±0.02 mg/kg was in *Triticum aestivum* (Table 6).

In 2021, station 4 growing cereals crops samples were also represent altercation in values of heavy metal contents most Cd, Cr, Pb, and Zn were with values of 1.44±0.01,3.52±0.02, 0.56±0.03, 93.51±0.12mg/kg in *Oryza sativa* (Table 7). Maximum Mn and Fe content were 844±0.23 and 1.65±0.02 mg/kg in *Sorghum vulgare* and Most Ni content was 73.42±0.04 mg/kg in *Triticum aestivum* (Table 4.91). During 2022 most Cd, Cr, Pb, Zn, and Ni were 1.49±0.04, 3.62±0.05, and 0.65±0.4294. 94.51±0.10, 75.01±0.25 mg/kg in *Oryza sativa* whereas most Mn was 848±0.03mg/kg accounted in *Sorghum vulgar* (Table 8). To determine the extent of contamination, the levels of Cr, Cu, Pb, and Cd in the grains were compared to the acceptable limit set by the FAO/WHO [21].

Table 1. Concentration of heavy metals in cereals crops sample during 2020-21 in station 1

Cereals Crops	**Heavy metal concentration (mg/Kg) Mean±SD (n=10)**							
	Cd	**Cr**	**Pb**	**Fe**	**Cu**	**Zn**	**Mn**	**Ni**
Paddy (*Oryza sativa*)	1.03±0.08	3.02±0.06	0.60±0.16	1.26±0.35	80.23±0.30	90.50±0.09	599±0.32	75.23±0.30
Wheat (*Triticum aestivum*)	1.02±0.25	3.14±0.16	0.66±0.05	1.06±0.31	87.46±0.19	86.16±0.04	660±0.37	76.46±0.11
Maize (*Zea mays*)	1.06±0.16	2.54±0.20	0.45±0.39	1.03±0.22	80.40±0.31	88.20±0.05	736±0.25	66.40±0.31

Jowar/Sorghum *(Sorghum vulgare*)	1.22±0.26	2.10±0.18	0.38±0.30	1.65±0.47	71.36±0.22	78.40±0.14	840±0.63	69.36±0.22

Table 2. Concentration of heavy metals in cereals crops sample during 2021-22 in station 1

Cereals Crops	**Heavy metal concentration(mg/Kg) Mean±SD (n=10)**							
	Cd	**Cr**	**Pb**	**Fe**	**Cu**	**Zn**	**Mn**	**Ni**
Paddy (*Oryza sativa*)	1.13±0.21	3.22±0.21	0.72±0.21	1.36±0.30	83.23±0.24	91.50±0.22	602±0.30	78.23±0.40
Wheat (*Triticum aestivum*)	1.22±0.20	3.34±0.14	0.69±0.04	1.23±0.41	87.96±0.11	89.26±0.14	670±0.27	78.59±0.31
Maize (*Zea mays*)	1.17±0.26	2.59±0.22	0.49±0.23	1.42±0.02	81.40±0.31	90.22±0.15	739±0.15	69.40±0.31
Jowar/Sorghum *(Sorghum vulgare*)	1.32±0.36	2.18±0.17	0.43±0.35	1.36±0.42	75.46±0.12	81.44±0.14	854±0.63	71.30±0.22

Table 3. Concentration of heavy metals in cereals crops sample during 2020-21 in station 2

Cereals Crops	**Heavy metal concentration(mg/Kg) Mean±SD (n=10)**							
	Cd	**Cr**	**Pb**	**Fe**	**Cu**	**Zn**	**Mn**	**Ni**
Paddy (*Oryza sativa*)	1.00±0.04	3.06±0.05	0.50±0.26	1.26±0.25	81.23±0.21	89.50±0.12	589±0.30	77.23±0.40
Wheat (*Triticum aestivum*)	1.25±0.22	3.11±0.21	0.56±0.14	1.16±0.21	88.46±0.10	84.16±0.15	640±0.30	71.40±0.21
Maize (*Zea mays*)	1.11±0.10	2.12±0.21	0.47±0.29	1.08±0.20	83.40±0.01	85.20±0.14	756±0.05	66.30±0.31
Jowar/Sorghum *(Sorghum vulgare*)	1.03±0.21	2.21±0.11	0.39±0.20	1.06±0.12	74.36±0.42	74.40±0.22	860±0.03	66.06±0.32

Table 4 Concentration of heavy metals in cereals crops sample during 2021-22 in station 2

Cereals Crops	**Heavy metal concentration(mg/Kg) Mean±SD (n=10)**							
	Cd	**Cr**	**Pb**	**Fe**	**Cu**	**Zn**	**Mn**	**Ni**
Paddy (*Oryza sativa*)	1.74±0.14	3.46±0.14	0.80±0.16	1.76±0.23	98.23±0.02	94.50±0.14	689±0.21	81.03±0.30
Wheat (*Triticum aestivum*)	1.80±0.12	3.81±0.12	0.86±0.10	1.76±0.21	89.46±0.12	87.16±0.25	650±0.34	74.30±0.24
Maize (*Zea mays*)	1.26±0.15	2.82±0.22	0.97±0.24	1.45±0.00	89.40±0.31	91.30±0.24	768±0.15	68.20±0.34
Jowar/Sorghum *(Sorghum vulgare*)	1.31±0.31	2.31±0.41	0.73±0.30	1.45±0.02	78.36±0.12	92.20±0.22	874±0.13	69.16±0.02

Table 5 Concentration of heavy metals in cereals crops sample during 2020-21 in station 3

Cereals Crops	Heavy metal concentration (mg/Kg) Mean±SD (n=10)							
	Cd	**Cr**	**Pb**	**Fe**	**Cu**	**Zn**	**Mn**	**Ni**
Paddy (*Oryza sativa*)	1.01±0.08	3.42±0.04	0.64±0.05	1.47±0.42	80.23±0.01	91.50±0.02	569±0.10	71.23±0.03
Wheat (*Triticum aestivum*)	1.02±0.05	3.54±0.06	0.61±0.01	1.15±0.23	87.46±0.20	83.16±0.05	642±0.05	74.40±0.11
Maize (*Zea mays*)	1.26±0.06	2.04±0.02	0.50±0.01	1.12±0.26	85.40±0.01	82.20±0.04	778±0.15	63.30±0.09
Jowar/Sorghum (*Sorghum vulgare*)	1.13±0.06	2.40±0.08	0.44±0.02	1.43±0.12	71.36±0.22	80.40±0.02	894±0.13	64.06±0.02

Table 6 Concentration of heavy metals in cereals crops sample during 2021-22 in station 3

Cereals Crops	Heavy metal concentration (mg/Kg) Mean±SD (n=10)							
	Cd	**Cr**	**Pb**	**Fe**	**Cu**	**Zn**	**Mn**	**Ni**
Paddy (*Oryza sativa*)	1.22±0.02	3.72±0.03	0.65±0.03	1.51±0.02	82.53±0.01	91.80±0.03	570±0.11	71.83±0.03
Wheat (*Triticum aestivum*)	1.41±0.05	3.56±0.04	0.64±0.01	1.25±0.04	81.26±0.03	83.46±0.05	645±0.25	74.50±0.02
Maize (*Zea mays*)	1.66±0.04	2.65±0.04	0.51±0.02	1.24±0.01	85.90±0.11	82.30±0.07	777±0.01	63.40±0.02
Jowar/Sorghum (*Sorghum vulgare*)	1.14±0.05	2.51±0.01	0.47±0.04	1.55±0.12	71.76±0.02	80.70±0.01	896±0.10	65.06±0.04

Table 7 Concentration of heavy metals in cereals crops sample during 2020-21 in station 4

Cereals Crops	Heavy metal concentration(mg/Kg) Mean±SD (n=10)							
	Cd	**Cr**	**Pb**	**Fe**	**Cu**	**Zn**	**Mn**	**Ni**
Paddy (*Oryza sativa*)	1.44±0.0	3.52±0.0	0.56±0.0	1.55±0.0	84.47±0.04	93.51±0.12	559±0.20	72.21±0.0
Wheat (*Triticum aestivum*)	1.23±0.02	3.21±0.04	0.51±0.02	1.45±0.02	85.44±0.20	85.15±0.15	644±0.15	73.42±0.04
Maize (*Zea mays*)	1.24±0.0	2.41±0.0	0.35±0.0	1.52±0.0	84.45±0.11	81.21±0.14	728±0.25	64.52±0.0
Jowar/Sorghum (*Sorghum vulgare*)	1.24±0.04	2.51±0.01	0.54±0.02	1.65±0.02	73.31±0.32	81.30±0.12	844±0.23	65.14±0.03

Table 7 Concentration of heavy metals in cereals crops sample during 2021-22 in station 4

Cereals Crops	Heavy metal concentration(mg/Kg) Mean±SD (n=10)							
	Cd	**Cr**	**Pb**	**Fe**	**Cu**	**Zn**	**Mn**	**Ni**
Paddy (*Oryza sativa*)	1.49±0.0	3.62±0.0	0.64±0.4	1.65±0.25	84.57±0.05	94.51±0.10	563±0.30	74.01±0.2
Wheat (*Triticum aestivum*)	1.28±0.0	3.41±0.0	0.62±0.0	1.75±0.12	85.64±0.05	85.45±0.10	651±0.05	73.82±0.1
Maize (*Zea mays*)	1.27±0.0	2.21±0.1	0.42±0.3	1.58±0.03	84.75±0.01	81.75±0.24	735±0.05	64.92±0.0
Jowar/Sorghum (*Sorghum vulgare*)	1.32±0.14	2.65±0.11	0.58±0.22	1.67±0.03	73.39±0.02	81.95±0.22	848±0.03	65.17±0.13

The maximum to minimum heavy metal in respective crop order was determined. Oder of Fe and Ni was in (*Oryza sativa)* < (*Triticum aestivum*) Jowar/Sorghum (*Sorghum vulgare*) Maize (*Zea mays).* For Cu and Zn the crop order was (*Oryza sativa)* < (*Triticum aestivum*) < *(Zea mays)* < (*Sorghum vulgare*). Cd content crops order was (*Triticum aestivum*) < (*Oryza sativa)* < (*Zea mays)* < (*Sorghum vulgare*). The order for Pb content was (*Zea mays*) < (*Sorghum vulgare*) < (*Triticum aestivum*) < (*Oryza sativa*). The order of Cr in experimental crops was as (*Oryza sativa*) < (*Triticum aestivum*) < (*Zea mays)* < (*Sorghum vulgare*). The order of Mn was as (*Sorghum vulgare*) < (*Zea mays)* < (*Triticum aestivum*) < (*Oryza sativa).*

Order content of heavy metals was recorded in different stations as Fe (station 1 > 2 > 3 and 4), Ni (station 4 > 3 > 2 and 1), Cu (station 2 > 1 > 3 and 4), Zn (station 1 > 2 > 4 and 3), Cd (station 2 > 4 > 1 and 3) Pb (station 2 > 1> 3 and 4), Cr (station 2, 3, 4 and 1), Mn (station 3 > 2 >1 and 4). Overall maximum heavy metal affected sites were found in station 2 grown samples and the minimum was in station 4.

According to the findings, crops were produced on a field using wastewater application, and the soil's properties of pH, organic content, Pb material, and Cd content promoted plant growth. While the level of Pb in plants was similarly influenced by the level of Pb in the soil, the highest concentration in the edible portion of carbohydrates generally grew as the soil Cd concentration [22,23].

Application of wastewater and its impact on Cd and Zn accumulation in each of the evaluated crops, they discovered that, in the case of crops, the amount of waste irrigated water caused an increase in the leaf Cd and Zn concentration [24,25]. Crop to crop and wastewater type all have an impact on how crops react to wastewater in specific places. In terms of productivity and growth traits, the observation shows that the crops responded well to wastewater treated as irrigation water. In certain cases, however, inhibitory effects were also seen, especially when the wastewater was applied in a more concentrated form [26,27].

The biological, organic, and chemical components of wastewater were usually suitable for watering horticulture plants and providing them with certain nutrients, according to an opinion with conclusion. It was discovered that wastewater, which is readily available and contains the nutrients needed for plant growth, can be used as a source of fertilizer [28]. According to the results, just a minimal amount of water was lost through transpiration and evaporation, in contrast to conventional irrigation. The spread of disease is facilitated due to the use of wastewater for irrigation.

They suggested treating wastewater before using it and took into account the financial advantages of utilizing water for agriculture. The quality of wastewater used for irrigation routinely has an impact on the soil and plants. The wastewater had an alkaline pH, but its EC was high by comparison to the established criteria. It was also discovered that the pH and EC of soil that had been watered with wastewater did not significantly change. On the other hand, both the crop and the soil had accumulated Pb, Cr, and Ni as well as heavy metals in general. All crops' leaves accumulated more inorganic chemical components and heavy metals than the others. According to reports, no contributing effluent was suitable for irrigation. Fe, Mn, Cu, and Zn concentrations were higher in the field cereal crops that were irrigated with effluent.

IV.CONCLUSION

Oder of Fe and Ni was in (*Oryza sativa)* < (*Triticum aestivum*) Jowar/Sorghum (*Sorghum vulgare*) Maize (*Zea mays).* For Cu and Zn the crop order was (*Oryza sativa)* < (*Triticum aestivum*) < *(Zea mays)* < (*Sorghum vulgare*). Cd content crops order was (*Triticum aestivum*) < (*Oryza sativa)* < (*Zea mays)* < (*Sorghum vulgare*). The order for Pb content was (*Zea mays*) < (*Sorghum vulgare*) < (*Triticum *aestivum*) < (*Oryza sativa*). The order of Cr in experimental crops was as (*Oryza sativa*) < (*Triticum aestivum*) < (*Zea mays)* < (*Sorghum vulgare*). The order of Mn was as (*Sorghum vulgare*) < (*Zea mays)* < (*Triticum aestivum*) < (*Oryza sativa).*

Order content of heavy metals was recorded in different stations as Fe (station 1 > 2 > 3 and 4), Ni (station 4 > 3 > 2 and 1), Cu (station 2 > 1 > 3 and 4), Zn (station 1 > 2 > 4 and 3), Cd (station 2 > 4 > 1 and 3) Pb (station 2 > 1> 3 and 4), Cr (station 2, 3, 4 and 1), Mn (station 3 > 2 >1 and 4). Overall maximum heavy metal affected sites were found in station 2 grown samples and the minimum was in station 4. The observation shows that the crops responded well to wastewater treated as irrigation water. In certain cases, however, inhibitory effects were also seen, especially when the wastewater was applied in a more concentrated form. After the analysis, the selected cereals were found to have heavy metals; (Cu), Zn, and Fe in each of the samples. Cd was not present in all the cereals analyzed. However, the concentrations of these metals in the cereals analyzed were below the safe limit set by WHO. Therefore, these cereal samples should be considered safe for consumption and may as well serve as sources of trace metals to the population.

V. REFERENCES

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