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Concentrations of Lead, Cadmium, Copper and Iron in Raw Cow's Milk in Beni Suef Province, Egypt

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Abstract: The aim of this study was to evaluate the content of Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) in raw cow's milk of traditional and industrial sites from 4 different places in Beni Suef Province, Egypt. A total of 72 samples (24 milk samples, 24 feed stuff samples and 24 water samples) were collected from four dairy farms in different cities representing Beni Suef Province, Egypt via subjective sampling method. Samples were prepared, digested then detection and estimation of Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) were carried out by using UNICAM 969 Atomic Absorption Spectrophotometer (AAS). There were significant increase in the mean values of Lead, Cadmium and Iron while there was no significant difference in the mean values of Copper in all milk samples of all Districts in comparison with the permissible limit. The comparison of the concentrations of those toxic heavy metals and trace elements in water and feed in different Districts were estimated. In conclusion: High Lead and Cadmium contents of some milk samples from this region might be potentially hazardous to consumers. Further, none of the other tested metals crossed permissible levels.

Keywords: Lead, Cadmium, Copper, Iron, Milk, Water, Feed stuff, Atomic Absorption, Correlation.

1. Introduction:

Heavy metals are a quasi-scientific term, used to describe group of toxic metallic elements and their compounds, of which a few are known to travel long distances through the atmosphere via the grasshopper effect. Some metals such as Cu, Zn, Fe and Mn are essential at very low concentrations and have a variety of biochemical function for the survival of all forms of life. While, they can be toxic when taken in excess, both toxicity and necessity vary from element to element [1]**.**The sources of heavy metal pollution include natural sources, ore mining or metal smelting, municipal waste, industrial effluents, application of sewage sludge and animal manure on agricultural land and aerial deposition of particulates from vehicular emission [2] & [3]**.**Plants are exposed to heavy metals through the uptake of water; animals eat these plants; ingestion of plant- and animal-based foods are the largest sources of heavy metals in humans[4] & [5]**.**

The spill of heavy metals in water may enter the food chain, because of their extreme persistence, high toxicity, and its tendency to accumulate [6]**.** [7] reported that heavy metals represent the chemical residues, which have a major role in animal and human health. These elements are cumulative poisons, causing health injury through progressive and irreversible accumulation in the body as a result of ingestion of repeated small amounts. They cause kidney damage, liver cirrhosis, renal failure, human hypertension, neuropathy of both central and peripheral nervous system, gastroenteritis, diabetes mellitus, anaemia and osteomalicia. Environmental sources, industrial sources, human activities and contamination by certain agricultural practices may be the source and the main contributors to contamination of food with most metals and other elements. Metals and other elements in food are of interest because of their possible health effects [8]**.**

The milk from cow and goat is utilized almost entirely to produce cheese, butter, yoghurt, and some other traditional dairy products in Egypt. Milk and dairy products are amongst the important dietary components for infants and children. It is already known that their minerals and proteins are essential for the growth and health of both humans and animals. Infants and children have been shown to be more sensitive to lead contents than adults. The regular consumption of small amounts of certain metals, such as lead, may cause different impacts on the health of growing infants and children. For instance, retardation of mental development (such as reading and learning disabilities) and deficiencies in concentration, the adverse effects on kidney function, on blood chemistry, and on the cardiovascular system, and hearing degradation. Therefore, it is of significant importance to monitor the level of trace elements in milk and dairy products, which are accounted as the major sources of nutrition in childhood [9]**.** Milk as an excretion of the mammary gland can carry numerous xenobiotic substances, which constitute a technological risk factor for dairy products and, above all, for the health of the consumer. Determination of the residual concentrations of metals in milk could be an important "direct indicator" of the hygienic status of the milk, as well as an "indirect indicator" of the degree of pollution of the environment in which the milk was produced [10] & [11]**.** Milk has been described as a complete food because it contains vital nutrients including proteins, essential fatty acids, lactose, vitamins and minerals in balanced proportions. However, milk and dairy products can also contain chemical hazards and contaminants, which constitute a technological risk factor for dairy products, for the related commercial image and, above all, for the health of the consumer [10]**.**Some heavy metals such as zinc, copper and cobalt are essential in trace amounts for normal growth and development; however others such as mercury, cadmium and lead have no biological importance but all heavy metals are potentially harmful to most organisms at some level of exposure and absorption [12]**.** Egypt face singular challenges related to food quality and safety. Therefore, good quality measurements are essential to control and maintain products and processes quality in manufacturing, trade and research. In view of the fact that there are very little available regular original data on content of metals in raw milk in Beni Suef province. This study is designed in order to determine the concentrations of Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) in raw cow's milk, and the comparison of the concentrations of those toxic heavy metals and trace elements in correlation with their concentration in the water and feed of cows in different Districts Beni Suef Province, Egypt with emphasis on hygienic and toxicological aspects.

2. Materials and Methods:

1- Site characteristics

Beni Suef is one of the governorates of Egypt. It is located in the center of the country. The capital of the governorate is the city of Beni Suef, located about 120 km south of Cairo on the west bank of the Nile River. The total size of Beni Suef governorate is 10954 km^2, it constitute about 0.7% from the total size of Egypt [13]**.** Four farms in four study areas were included in this study Somosta city, represent south area, Ehnasia city, represent west area, Beni Suef city, represent east area and Naser city represent north area of Beni Suef province as shown in Figure (1).

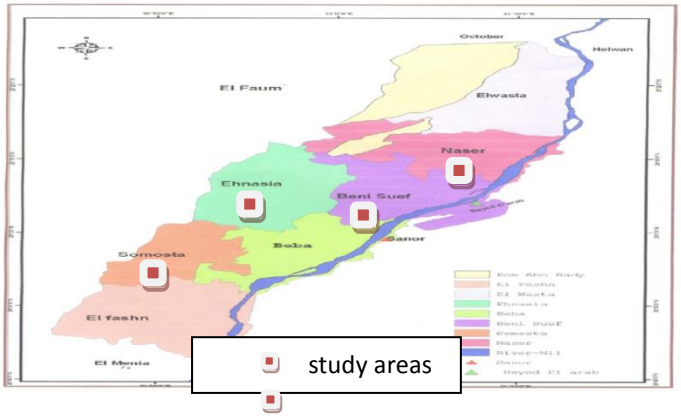

Fig. (1) Location of the province and the farms

2- Time of sampling:

Samples were collected during winter season where the temperature in the range of (17-21^{o}c); collection of samples begins from 20 December 2016 till 20 March 2017.

3- Sampling , preparation and digestion:

A total of 72samples (24 milk samples, 24 feed stuff samples and 24 water samples) were collected from four dairy farms. Water samples were prepared according to the method of [14]. The water samples were filtered through a Whitman filter. The required volume (100ml) of filtrate were measured and collected in clean dark glass bottles, preserved by 0.3 ml of concentrated nitric acid and kept in refrigerator to avoid evaporation. Feed samples were prepared according to [15]**;** two gm. from each feed stuff good homogenized samples were transferred into clean and acid-washed digestion tubes. Then adding 10 ml solution of concentrated nitric acid and 3 ml perchloric acid 60% and heated on hot plate, slowly at first, until frothing ceases. After cooling 10ml HCL (1:1) were added and transfer quantitatively to 50ml volumetric flask. Then each digest was filtered through Whitman filter paper NO.42. The clear filtrate of each sample was kept in refrigerator to avoid evaporation till time of analysis. Milk samples were prepared according to the method of [16], a

measured volume of one ml of thoroughly mixed raw milk were transferred into clean and acid-washed digestion tubes. All digestion tubes were identified for examination. Milk samples (2 mL) were digested with nitric and perchloric acid mixture (HNO3: HClO3 = 4:1 v/v) until a transparent solution was obtained. After digestion, samples were filtered and diluted to a suitable concentration. Three blank samples, where bio sample was substituted by de-ionized triple distilled water, were run simultaneously with each batch of the digestion. Working standard solutions of Pb, Cd, Cu, Zn and Fe were prepared by dilution of certified standard solutions to desired concentration.

4- Atomic Absorption measurements

Elements (Pb, Cd, Cu and Fe) were determined by using UNICAM 969 Atomic Absorption Spectrophotometer (AAS) in Animal Health Research Institute, Dokki, Giza, Egypt.

5- Quality Assurance:

Appropriate quality assurance procedures and precautions were taken to ensure the reliability of the results. In addition, samples were carefully handled to avoid contamination. Moreover, the glass wares had been properly cleaned, and reagents were of analytical grades. It should be commented that deionized water was used throughout the study.

6- Statistical analysis:

The data obtained from four Districts were analyzed using SPSS. (16.0). Results were evaluated statistically significant by One Way ANOVA and two-tailed Pearson correlation, p value < 0.05. Furthermore, the data are shown as mean ± standard error.

3. Results and Discussion:

Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in water samples:

- **Lead concentration in water:**

As shown in Table (1) and figure (2), the highest mean Pb concentrations in water samples were found in Somosta city, Naser city, Beni Suef city and Ehnasia city respectively. There were significant increases ($P < 0.05$) in the mean values of Pb and Cd in all water samples of all Districts in comparison with the permissible limit recommended by WHO [17] (0.05 ppm & 0.005 ppm) respectively. The U S. EPA's MCL, Goal of zero in drinking water is based on "occurrence of low-level effects and because The U.S. EPA classifies Lead as a class B2 carcinogen [18]**.** [19] reported that the analysis of water samples revealed that water contains a lead level of (0.07±0.002), 0.091±0.0019, 0.107±0.036, 0.0879±0.014, 0.086±0.019, 0.089±0.0034 ppm (mg/l) in El-fashn, Beba, Beni-Suef, Somosta, Naser and Ahnasia districts. In the same way [20] found that the highest amount of recorded soluble level was 0.096 ± 0.005, 0.091 ± 0.0004, 0.078 ± 0.004 and 0.074 ± 0.006 ppm in the small canal, River Nile, El-Ibrahimia and tap water respectively. In the same time [21]estimates a high lead concentration in both superphosphate waste water discharges (6.5 mg/L) and River Nile water in the area of the plant pollution (4.5 mg/L). Other samples in Assiut Governorate revealed that about 33.3% of analyzed water samples contained more than 0.05 mg/L which the highest contaminant level is recommended by the National Interim Primary Drinking Water Regulations. [22] collected eighty representative water samples from Aswan, Qena, Assiut and Beni Suef cities, the River Nile running water in Aswan, Assiut, Beni Suef and from Bahr Yousef canal. The results indicated that all cities drinking water samples contained lead with an average below 0.1- mg/L, while all surface water contained more than 0.1-mg/L lead. This finding could be attributed to the pollution of surface water and/or air with lead after emission from high way or motor boat traffic, industrial and agriculture discharge. The results for the lead concentrations of water samples were higher than that reported by [20] ; [22]**&**[19] but lower than that reported by [21]**.** Lead can enter drinking water when service pipes that contain lead corrode, especially where the water has high acidity or low mineral content that corrodes pipes and fixtures. The most common problem iswith brass or chrome-plated brass faucets and fixtures with lead solder, from which significant amounts of lead can enter into the water. [23] identified a new source of lead, namely gravel from the mine and smelter which used for roads and as landfill in swampy areas, including farmland. Lead and its compounds can enter the environment at any time during mining, smelting or processing.

- **Cadmium concentration in water:**

Cadmium is a by-product of zinc or lead production it is used in metal plating, alloys, small cadmium -nicked batteries and anti seborrheic shampoos (cadmium sulfide). Cadmium accumulates moderately in plants fertilized with cadmium contained sewage sludge or fertilizer [24]**.** There are many sources for cadmium pollution including the mining company which releasing effluents into the river and many industrial companies as those of pigments and stabilizer for plastics. Mine drainage sewage sludge applied to land and phosphate fertilizer and also significant sources of cadmium to the environment [25]**.** The highest mean values of Cd were found in water samples collected from Ehnasia city, Beni Suef city, Naser city and Somosta city respectively. There were significant increases ($P < 0.05$) in the mean values of Pb and Cd in all water samples of all Districts in comparison with the permissible limit recommended by WHO [17] (0.05 ppm & 0.005 ppm) respectively. [21] reported that About

48.72% of analyzed water samples from Assiut Governorate contained more than 0.01 mg/L cadmium (The maximum contaminant level recommended by the public health service) Drinking Water Standard. Cadmium in water reached its highest levels at areas of Gaz El-Akrad area and Manqabad area (0.042±0.004 and 0.045±0.0097mg/L) while the lowest values were recorded at Ilwan and El-Twabiya which recorded 0.014±0.0039 and 0.017±0.0016mg/L. the concentration of cadmium in water from Dairut area was 0.004± 0.0003 mg/L [26]**.** Water from the River Nile in Aswan, Assiut and Beni-Suef regions have Cadmium averages of 0.011 ± 0.005, 0.011 ± 0.01 and 0.013 ± 0.007 mg/L. Bahr Yousef Canal contained the highest Cadmium average of 0.023 ±0.02 mg/L [22] **.** The investigation of water samples in Beni-Suef Governorate revealed no increase in cadmium levels than the recommended limit (0.01 mg/l) by the U.S. EPA [27]except in area of Beni-Suef district, which has an average of 0.0136 ppm and a maximum concentration of 0.023ppm [19]**.** The results for the Cadmium concentrations of water samples were higher than that reported by [21] & [19]**,** but lower than that reported by [22] & [26]**.** The source of cadmium and lead can arise from mine drainage water, wastewater from the processing of ores, and overflow from the tailing ponds and rain water run-off from the general mine areas as documented by [28]**.**

- **Copper and Iron concentration in water samples:**

The copper residues (ppm) in water samples collected from Beni Suef city and Naser city was not detected. The mean values of Cu were equal in both Somosta city and Ehnasia city. The highest mean values of Fe were found in Ehnasia city, Somosta city, Beni Suef city and Naser city respectively. There were no significant differences in the mean values of Cu and Fe in comparison with the permissible limit recommended by WHO[17] (0.05 ppm & 0.3 ppm) respectively. Only a significant decrease in the mean values of Fe in water samples of Naser city in comparison with the permissible limit (0.3 ppm) as shown in Table (1) and Figure (2).

Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in feed stuff samples:

From table (2) and figure (3), the highest mean concentrations of Pb were found in feed stuff samples collected from Beni Suef, Ehnasia, Naser and Somosta respectively. The highest mean concentrations of Cd were found in feed stuff samples collected from Beni Suef city, Somosta city, Naser city, and Ehnasia city respectively. The highest mean concentration of Cu were found in Naser city, Ehnasia city,Somosta city and Beni Suef city respectively. As shown in Table (2) there was a significant increase in the mean values of Cu residues in feed stuff samples in Naser city in comparison with Somosta city and Beni Suef city. The highest mean values of Fe were found in Ehnasia city, Naser city, Somosta city and Beni Suef city respectively and there was a significant increase in the mean values of Fe concentration in feed stuff samples collected from Ehnasia city in comparison with Somosta city and Beni Suef city. Significant decrease in the mean values of Pb, Cd, Cu and Fe concentrations in all feed stuff samples collected from four districts in comparison with the permissible limit adopted by NRC [29].

Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in raw cow's milk samples:

- **Lead concentration in raw milk samples:**

Food, air, water and dust or soils are the main potential sources of exposure of infants and young children [30]**.** Lead has multiple toxic effects on human; it is a probable human teratogen, associated with increased incidence of hypertension and cardiovascular disease, affect the brain development and function causing neurotoxicity and affect the male fertility [31]**;** [30]**;** [32] & [33]**.** Metals are intrinsic to nature, the environmental influences may alter the form or valence of a metal, but as elements, metals cannot be destroyed. Redistribution of metals in the environment exposes humans and animals to toxic forms of metals that are not normally accessible. The spill of heavy metals (Lead, Cadmium and Mercury) in water may enter the food chain, because of their extreme persistence, high toxicity, and its tendency to accumulate [6]**.** As shown in Table (3) and figure (4). According to the data analysis, the highest mean concentrations of Pb were found in Somosta city, Naser city, Beni Suef city and Ehnasia city, respectively. Pb content in the milk of cows of the four districts was significantly exceeded the standards proposed by [34]**.**

It is worthwhile to express that these results were higher than those achieved by [35] in Nigeria and [9] in Iran, but lower than those of [36] in Egypt.

- **Cadmium concentration in raw milk samples:**

The cadmium concentration in raw milk samples of different regions were shown in Table (3) and Figure (4). The highest mean values of Cd were found in Somosta city, Beni Suef city, Naser city and Ehnasia city respectively. There were significant increases in the mean concentration of Cd in all milk samples from

Table (1) Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in water samples

Heavy metal	Lead			Cadmium			Copper			Iron		
Districts	Min	Max	Mean ± SE	Min	Max	Mean ±SE	Min	Max	Mean ± SE	Min	Max	Mean ± SE
Somosta city	ND	1.42	0.31±0.23^{a*}	ND	0.12	0.04±0.02^{a*}	ND	0.04	0.01±0.01^{a}	ND	0.34	0.22±0.05^{b}
Ehnasia city	ND	0.19	0.09±0.03^{a*}	ND	0.12	0.05±0.02^{a*}	ND	0.06	0.01±0.01^{a}	ND	0.74	0.33±0.10^{b}
Beni Suef city	ND	0.27	0.1±0.05^{a*}	ND	0.14	0.05±0.02^{a*}	ND	ND	ND	ND	0.34	0.18±0.05^{a}
Naser city	ND	1.01	0.28±0.15^{a*}	ND	0.13	0.05±0.02^{a*}	ND	ND	ND	ND	0.12	0.05±0.03^{a*}
WHO(2008) MPL(mg/L)	0.05			0.005			0.05			0.3		

- Data expressed as mean ± S.E.
- The different letter in the same column indicates significant difference according to one way ANOVA ($p \leq 0.05$).
- (*) Significantly different from permissible limit by One-way ANOVA at $p \leq 0.05$.
- ND "Not Detected".

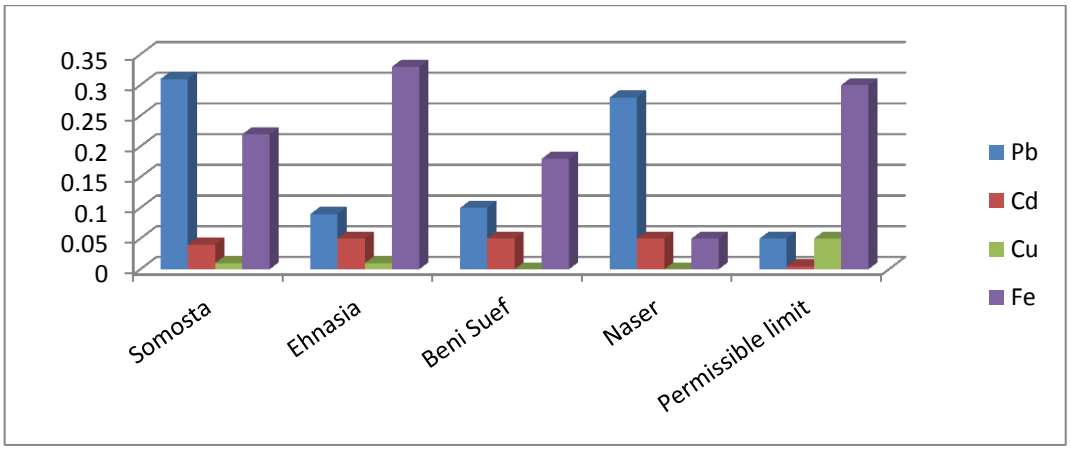

Fig. (2) Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in water samples

Table (2) Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in feed stuff samples

Heavy metal	Lead			Cadmium			Copper			Iron		
Districts	**Min**	**Max**	**Mean ± SE**	**Min**	**Max**	**Mean ± SE**	**Min**	**Max**	**Mean ± SE**	**Min**	**Max**	**Mean ± SE**
Somosta city	**ND**	**00.42**	**00.11 ±.06^{a*}**	**00.14**	**01.73**	**00.79 ±.23 ^{a*}**	**01.14**	**08.68**	**05.03 ± 1.16 ^{a*}**	**07.96**	**124.91**	**06.96E1 ±2.09E1 ^{a*}**
Ehnasia city	**ND**	**00.61**	**0.22 ±.10 ^{a*}**	**00.11**	**01.57**	**00.64 ±.24 ^{a*}**	**01.39**	**023.25**	**01.43E1 ± 4.2^{ab*}**	**026.93**	**353.62**	**01.82E2±5.82E1^{b*}**
Beni Suef city	**ND**	**01.05**	**00.33 ±.16 ^{a*}**	**00.13**	**03.92**	**01.07 ±.60 ^{a*}**	**02.10**	**07.15**	**04.57 ± .78 ^{a*}**	**09.59**	**127.37**	**06.21E1±1.79E1^{a*}**
Naser city	**ND**	**00.69**	**00.20 ±.10 ^{a*}**	**00.19**	**02.05**	**00.71 ±.29 ^{a*}**	**01.10**	**31.92**	**01.64E1 ± 5.28 ^{b*}**	**07.92**	**179.53**	**01.02E2±2.53E1^{ab*}**
NRC, (2005) MTL (ppm)	**100**			**10**			**40**			**500**		

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- (*) Significantly different from permissible limit by One-way ANOVA at $p \leq 0.05$.
- ND "Not Detected"

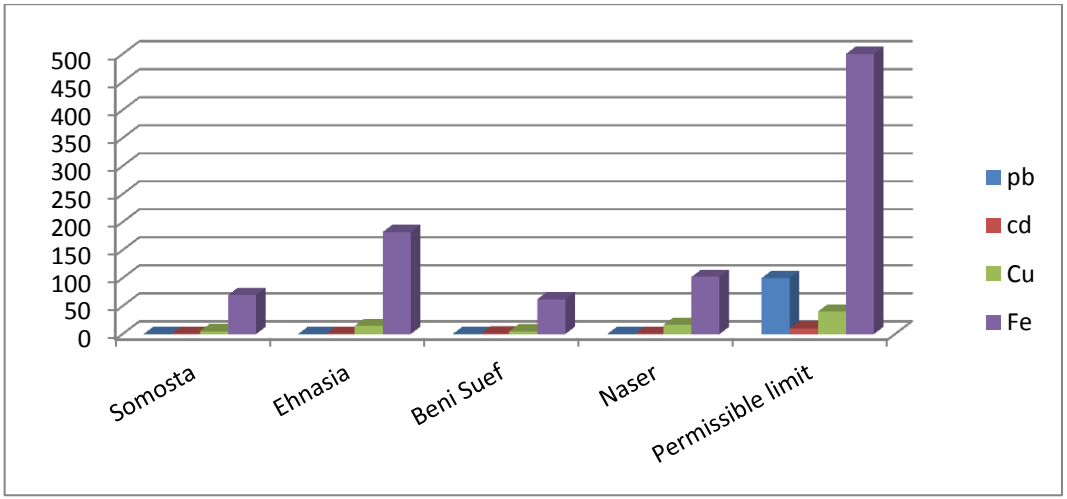

Fig. (3) Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in feed stuff samples

Table (3) Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in raw cow's milk samples

Heavy metal	Lead			Cadmium			Copper			Iron		
Districts	Min	Max	Mean ± SE	Min	Max	Mean ± SE	Min	Max	Mean ± SE	Min	Max	Mean ± SE
Somosta city	ND	2.10	0.40±0.34^{a*}	ND	2.54	0.72±.39^{a*}	0.14	1.22	0.68±.17^{a}	11.58	21.67	1.69E1±1.64^{b*}
Ehnasia city	ND	0.41	0.18±0.07^{a*}	0.07	1.58	0.58±.25^{a*}	0.11	1.20	0.67±.15^{a}	10.63	27.42	1.64E1±2.75^{b*}
Beni Suef city	ND	1.05	0.28±0.16^{a*}	0.08	2.36	0.71±.36^{a*}	0.02	1.19	0.64±.16^{a}	5.59	33.09	1.67E1±4.11^{b*}
Naser city	0.09	1.08	0.38±0.18^{a*}	0.07	1.81	0.69±.28^{a*}	0.21	1.12	0.73±.14^{a}	1.07	29.12	1.47E1±4.07^{b*}
Anonymous, 1998	0.02			0.1			0.4			5		

- Data expressed as mean ± S.E.
- The different letter in the same column indicates significant difference according to one way ANOVA ($p \leq 0.05$).
- (*) Significantly different from permissible limit by One-way ANOVA at $p \leq 0.05$.
- ND "Not Detected".

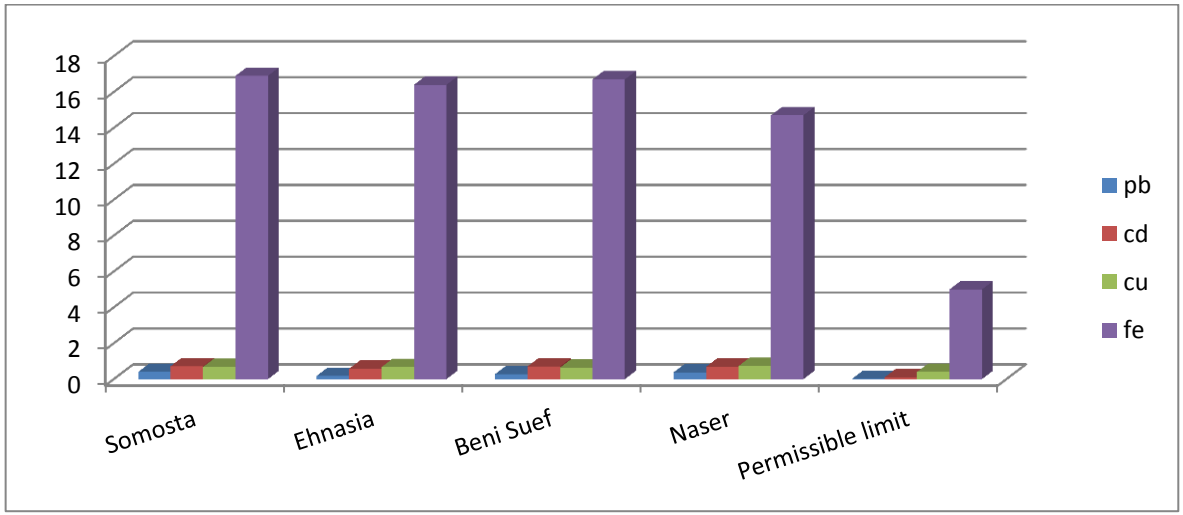

Fig. (4) Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in raw cow's milk samples

Table (4) Correlation between Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in feed& water and their concentrations in milk

Heavy metal / Districts	Feed to milk correlation				Water to milk correlation			
	Pb	Cd	Cu	Fe	Pb	Cd	Cu	Fe
Somosta city	-0.017	-0.053	0.607	-0.144	0.990**	0.290	0.564	0.006
Ehnasia city	0.776	0.299	0.224	0.792	0.467	-0.062	0.815*	0.366
Beni Suef city	0.309	0.996**	-0.450	0.922**	0.806	-0.025	ND	0 .809
Naser city	0.250	0.641	0.021	0.837*	0.996**	0.085	ND	0.162

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

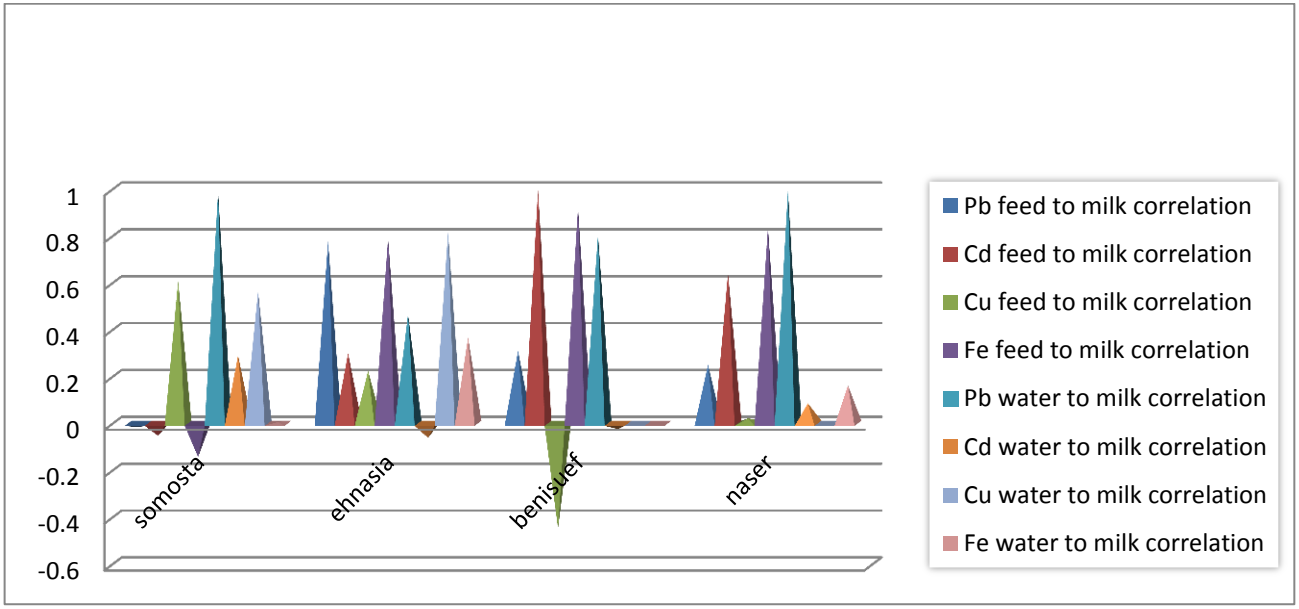

Fig. (5) Correlation between Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in feed& water and their concentrations in milk.

all districts compared with the permissible limit 0.1 ppm [34]**.** The unhygienic sources of water and food are of reasons of sickness in human beings. In the environment, among the different contaminants, heavy metals are directly associated to health issues in humans [37]**.** Heavy metals pollution is a severe risk due to their bioaccumulation, toxic effects, and then continuity in different food chains [38]. These environmental unfriendly pollutants have direct deadly special effects since they are incorporated in body tissues [39]**.** These metals enter the human body mainly by two routes i.e. inhalation and ingestion [40]**.** Cadmium is a toxic metal with extremely long biological half life time of 15-20 years in human, cadmium exposure can cause a variety of adverse health effects among which kidney dysfunction, lung disorders, disturbed calcium metabolism and bone effect are most prominent. Cadmium and most compounds give rise to lung cancer after inhalation. Since the blood -brain barrier keeps cadmium outside the CNS reported neurotoxic effect of cadmium during development are likely to be secondary to an interference of cadmium with zinc -metabolism [41]**.**

- **Copper and Iron concentrations raw milk samples:**

The highest mean values of Cu were found in Naser city, Somosta city, Ehnasia city and Beni Suef city respectively. There were no significant differences in the mean concentration of Cu in all milk samples of all districts in comparison with the permissible limit (0.4 ppm) established by [34]**.**The highest mean values of Fe were found in Somosta city, Beni Suef city, Ehnasia city and Naser city, respectively. There was significant increase in the mean values of Fe in all milk samples in comparison with the permissible limit (5ppm).

Correlation between Lead (Pb), Cadmium (Cd), Copper (Cu) and Iron (Fe) concentrations (ppm) in feed& water and their concentrations in milk:

It is evident from Table (4) and Figure (5) that the highest feed to milk correlation for Somosta city was recorded for Cu, and the negative feed to milk correlation was recorded for Pb, Cd and Fe. The highest feed to milk correlation for Ehnasia city was recorded for Fe followed by Pb and Cd and the lowest feed to milk correlation was recorded for Cu. The highest feed to milk correlation for Beni Suef city was recorded for Cd followed by Fe and Pb and the negative feed to milk correlation was recorded for Cu.

The highest feed to milk correlation for Naser city was recorded for Fe followed by Cd and Pb and the lowest feed to milk correlation was recorded for Cu. The obtained results in Table (4) and Figure (5) showed that the highest water to milk correlation Somosta city was recorded for Pb followed by Cu and Cd and the lowest positive water to milk correlation was recorded for Fe. The highest water to milk correlation Ehnasia city was recorded for Cu followed by Pb and Fe and the negative water to milk correlation was recorded for Cd. The highest water to milk correlation Beni Suef city was recorded for Fe followed by Pb and the negative water to milk correlation was recorded for Cd. The highest water to milk correlation Naser city was recorded for Pb followed by Fe and the lowest positive water to milk correlation was recorded for Cd.

4. Conclusion:

The study indicates contamination of water, feed and raw milk samples collected from the four districts in Beni Suef province by metals exhibiting a wide range of hazardous impact on human health. There are significant increase in the mean values of Pb and Cd in all water samples of all districts in comparison with the permissible limit recommended by [17] (00.05 and 0.005 ppm respectively). Pb content in the milk of cows of the four districts was significantly exceeded the standards proposed by [34]**.**There are significant increases in the mean concentration of Cd in all milk samples of all districts compared with the permissible limit (0.1 ppm). Increase the Pb and Cd concentration may be due to their high concentration in water. Further regular studies are necessary to evaluate the levels of metals on a large number of samples from province. Determination of metal levels in fodder and water fed to the animals are also necessary.

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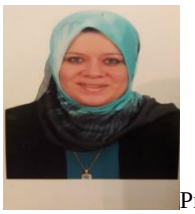

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