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Detection of some Trace Elements in Sera of Detergent Industry Workers

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Abstract

The piece of this study describes the estimation of three trace elements (chromium, nickel and vanadium) using Electrothermal atomic absorption spectrometer in twenty two sera samples workers of the detergents industries in Baghdad city. Also, twenty two sera samples were used as a control in this study. It is found that chromium concentrations in the sera samples of workers are with the control cases, vanadium and nickel concentrations are decreased in the sera of workers cases compared to that control cases. The result is analyzed statistically by using ANOVA method to the decide differences between the results at 99% confidence level. It was found that the chromium concentration in the range of ages 15-29 years. are significantly differences ,nickel concentrations in the sera samples of workers in the range of ages 15-29 and 45-58 years are showed significantly differences, and it was found that the differences in the vanadium concentrations in all ranges of ages of workers .

Keywords: Detection, trace elements, sera, detergent industry.

Introduction

Trace elements are present in human body at a very low concentration values at amounts of microgram (μg) to milligrams (mg) that are essential for certain biomedical processes. In modern medicine, trace elements are receiving considerable attention as the two extremes of great excess and gross deficiency continue to be recognized. The importance of trace minerals metabolism has only become appreciated in the past thirty years[1].

Chromium is a naturally occurring element found in rocks, animals, plants, and soil. It can exist in several different forms. Depending on the form it takes, it can be a liquid, solid, or gas. The most common forms are chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds. Chromium(III) is an essential nutrient that helps the body sugar, protein, and fat Breathing high levels of chromium(VI) can cause irritation to the lining of the nose, nose ulcers, runny nose, and breathing problems, such as asthma, cough, shortness of breath, or wheezing. The concentrations of chromium in air that can cause these effects may be different for different types of chromium compounds, with effects occurring at much lower concentrations for chromium(VI) compared to chromium(III)[2].

Sperm damage and damage to the male reproductive system have been seen in laboratory exposed to chromium(VI) in human being[3].

Skin contact with certain chromium(VI) compounds can cause skin ulcers. Some people are extremely sensitive to chromium(VI) or chromium(III). Allergic reactions consisting of severe redness and swelling of the skin have been noted[3].

Although nickel and chromium are essential elements of human body, but; over high concentration of nickel and chromium ion will produce many adverse effects to human body[4].

Nickel and vanadium are considered to be new trace or ultratrace elements within tissue concentrations in the nanogram per gram amounts and dietary requirements of about 50 ng/g of diet or less. These elements have been shown to be essential for humans, however no well-defined cases of deficiency of these elements have been described in humans. Several publications gave evidence for the essentiality and proposed functions of these elements[5,6].

Health hazards associated with exposure to nickel in the occupational environment have resulted primarily from inhalation. However, in addition to this main exposure route, workers are also indirectly exposed to nickel by ingestion of drinking-water and food, and through skin contact. Tobacco smoking is also an important source of nickel exposure[7]. The relative amounts of nickel absorbed by an

organism are determined, not only by the quantities inhaled, ingested, or administrated, but also by the physical and chemical characteristics of the nickel compounds.

Nickel carbonyl is the most rapidly and completely absorbed nickel compound (in both animals and human beings).

The aim of this work is to investigate about the effect of the selected trace elements which are present in chemical additions of detergent industries upon the health of workers.

Experimental Part

Materials and methods:

Apparatus:

1-Electrothermal Atomic Absorption Spectrometer type (AAS VARID 6 Analytik Jena AG)was used for trace elements analysis.

2-Centerfuge (speed 4000rpm.) to separate the sera samples from the whole blood.

3- Many plastic tubes, appendorf, stick, and stirrer sterilized before used with deionized water

The chemicals were obtained from Aldrich Company.

No.	*Chemicals*	*Formula compound*	*Mr. (g/mole)*	*Wave length (nm)*	*Conc. %*
1.	**Chromium Nitrate**	**$Cr(NO_3)_2$**	**176.01**	**425.4**	**1000 μg/ml**
2.	**Vanadium Nitrate**	**$V(NO_3)_3$**	**174.85**	**437.9**	**1000 μg/L**
3.	**Nickel Nitrate**	**$Ni(NO_3)_2$**	**182.73**	**341.5**	**1000 μg/ml**

1-Sampling:

Twenty two blood samples of workers (men only) who are working in one of the detergents industries in Baghdad and other twenty two blood samples as a control were collected,(five ml of blood sample was collected from vein of workers by disposable syringe and centrifuged to separate the sera samples from whole blood and sent it for analysis after the samples saved in the refrigerator till analyzed in one time).

2-Analysis:

The blood sera samples were analyzed to detect their containing from the elements under our study (chromium, nickel and vanadium).

Chromium (Cr) and Nickel (Ni) standard solutions covering the concentration range (0.5,1.0, 1.5, 2.0, and 2.5) μg/mL were prepared by the dilution of the standard solutions (1000 μg/mL) for each elements, with deionized water and stored in tightly closed polyethylene bottles. (and 0.5,1.0,1.5,2.0 and 2.5 μg/L for Vanadium (V) concentration analysis) was prepared by the dilution of the standard solutions (1000 μg/L)using deionized water.

Using the range of concentrations (0.5-2.5 μg/mL) for chromium and nickel elements and (0.5-2.5 μg/L) for vanadium blood sera samples were analyzed under the standard curves which shown in Fig.(1).after injection of about 10 μL of the standard in the graphite furnace and the heating cycles were applied according to the instruction manual.

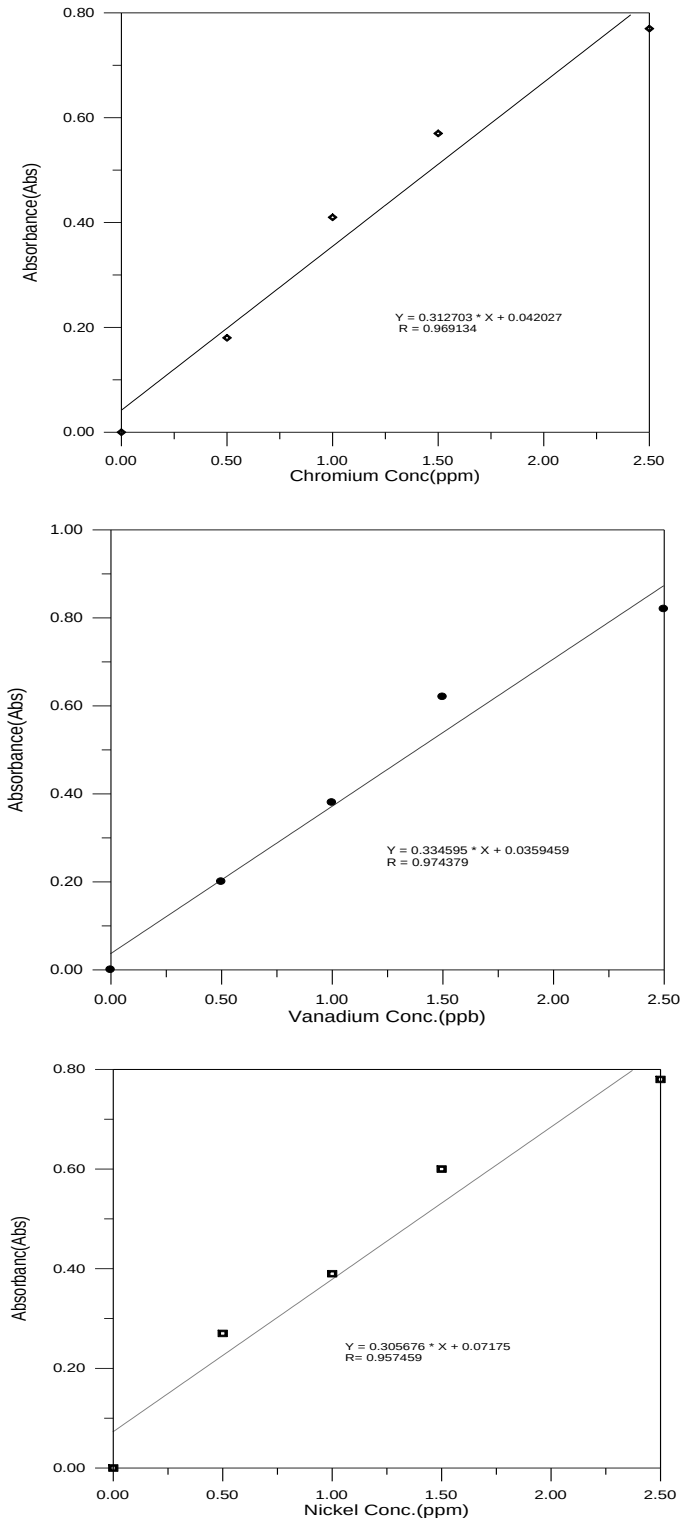

Fig.(1) Calibration curves for the (AAS) determination of (a)-Chromium(425.4nm), (b)-Vanadium(437.9nm), (c)-Nickel(341.5nm) in sera samples.

Results and Discussion

Samples are collected from workers whose ages ranged between 15 and 58 years with occupational duration ranged from 10 to 30 years, all of them residents of Baghdad city. The concentrations of the elements under study were measured in sera of workers and the control cases. The control cases were collected from people living out side the industry with the same ages.

a- chromium concentrations:

The concentrations of chromium were detected in sera of workers in detergent

industry under the standard curve of chromium that obtained from the electro- thermal Atomic Absorption Spectrometer.

It was found that the chromium concentrations in serum blood of workers were higher that of control cases Table (1).

Using ANOVA method the results were analyzed with precision of 99%, and it was found that the chromium concentrations in the rang of ages 15-29 years and 45-58 are significantly differences with t-Test 0.0037 and 0.0050 respectively, but the differences in the chromium concentrations for ages 30-44 years are insignificant

Table (1)
Chromium concentrations in sera of workers and control cases.

Age(year)	*chromium concentrations (ppm)*				*t-Test*
	workers		*Control cases*		
	Range	*Mean Average±SD*	*Range*	*Mean Average±SD*	
15-29(10 cases)	0.042-0.051	0.046±0.012	0.041-0.042	0.042±0.005	0.0037S
30-44(8 cases)	0.052-0.056	0.054±0.010	0.041-0.050	0.043±0.002	0.0089N.S
45-58(4 cases)	0.058-0.060	0.059±0.011	0.044-0.045	0.045±0.001	0.0050S
Mean value±SD	0.053±0.011		0.043±0.0026		

S=Significant, N.S=Not Significa.

Table (1) shows that the chromium concentration in the sera of workers is higher than the concentrations in the sera of control cases under our study so, this result was expected, because the workers used some of the colors in the detergents that contain upon the chromium element .It was also found that the concentration increased below (Table (1)), when the ages are increased and their occupational duration increased. This explains by; the age of workers who have the long duration than the other younger workers in the same place of industry (laboratory) Fig.(2).

Fig.(2) Comparison between chromium concentrations in sera of workers and control cases.

b- Concentration of nickel:

Nickel levels in sera of workers and the control cases were measured under the standard curve of Nickel.

Low concentrations of nickel in sera samples of workers compared with the control cases were found, Table (2).

The statistical analysis found significantly differences in the Nickel concentrations of sera samples for the ages 15-29 and 45-58 years with the value of t-Test 0.0029 and 0.0102 respectively(between the workers and control cases); but the differences between workers and the control cases with range of ages (30-44) was insignificant.

Table (2)
Nickel concentrations in sera of workers and control cases.

Age(year)	*Nickel concentrations (ppm)*				*T-Test*
	workers		*Control cases*		
	Range	*Mean Average±SD*	*Range*	*Mean Average±SD*	
15-29(10 cases)	0.001-0.010	0.005±0.001	0.023-0.033	0.0280±0.0015	0.0029S
30-44(8 cases)	0.012-0.020	0.016±0.002	0.003-0.034	0.0185±0.0010	0.0085N.S
45-58(4 cases)	0.003-0.021	0.012±0.001	0.022-0.040	0.0155±0.0011	0.0102S
Mean value±SD	0.011±0.001		0.020±0.0012		

S=Significant, N.S=Not Significant.

However the decreasing in the nickel serum blood of workers is statistically not significant when it compared with control cases. Some papers shows that interfering between nickel and iron in the blood may be effect upon the absorption of nickel elements from the cells and this reflect on serum nickel[3] Fig.(3).

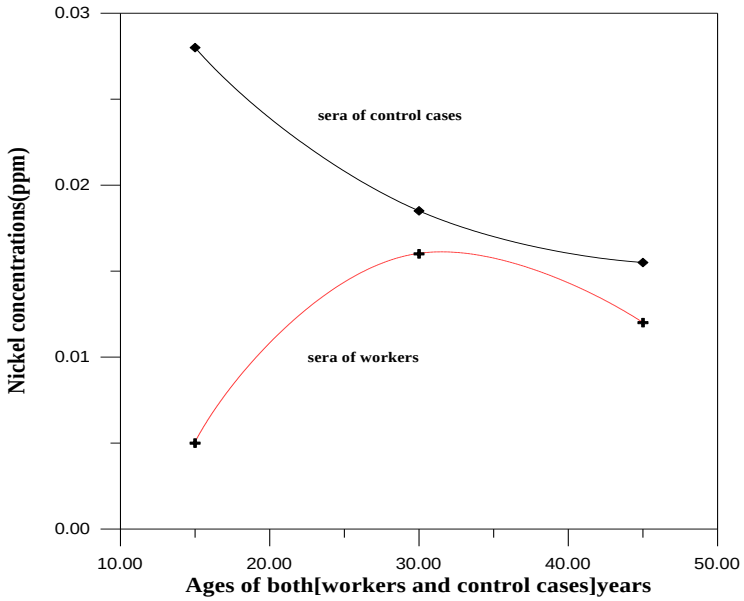

Fig.(3) The comparison between nickel concentrations in sera of workers and control cases

c-Vanadium concentration.

vanadium was measured using the fameless atomic absorption, the concentr-ations of vanadium was found at ultra trace level (ppb), it was very low in sera of both workers and the control cases, Table (3), Fig.(4).

Table [3]
Vanadium concentrations in sera of workers and control cases.

Age(year)	*vanadium concentrations (ppb)*				*T-Test*
	workers		*Control cases*		
	Range	*Mean Average±SD*	*Range*	*Mean Average±SD*	
15-29(10 cases)	0.011-0.020	0.016±0.001	0.023-0.025	0.024±0.001	0.0029S
30-44(8 cases)	0.012-0.023	0.018±0.001	0.030-0.036	0.033±0.003	0.0039S
45-58(4 cases)	0.022-0.035	0.028±0.002	0.035-0.039	0.037±0.001	0.0055S
Mean value±SD	0.031±0.0013		0.047±0.0016		

S=Significant

In general, the values of vanadium are low but in workers the concentrations of blood serum, vanadium was a lowest than the concentrations of vanadium in control cases, because the normal value in serum blood is 0.014-0.23 ppb[9], and it is very important for many enzymes, because of its linked with them as a co-factor, also it is very important for increasing the activity of ATP.[10] Using the ANOVA method , it was found that the differences in the vanadium concentrations in the different ranges of ages between the workers and the control cases are significantly differences. Table (3)].

V is considered by some as an essential trace mineral; vanadyl sulphate supplements (at microgram to milligram levels) are marketed to normalize blood glucose (in diabetics) and to promote muscle growth (in body builders), and are not associated with reports of any short-term adverse effects[9]

Most orally ingested vanadium in humans appears to be unabsorbed, only 1-5% of dose being excreted, so the increasing may be excreted by feces, but the lower concentrations of vanadium effects on enzymes activity(which is related with vanadium) also; vanadium plays an important role as do vitamins[9].

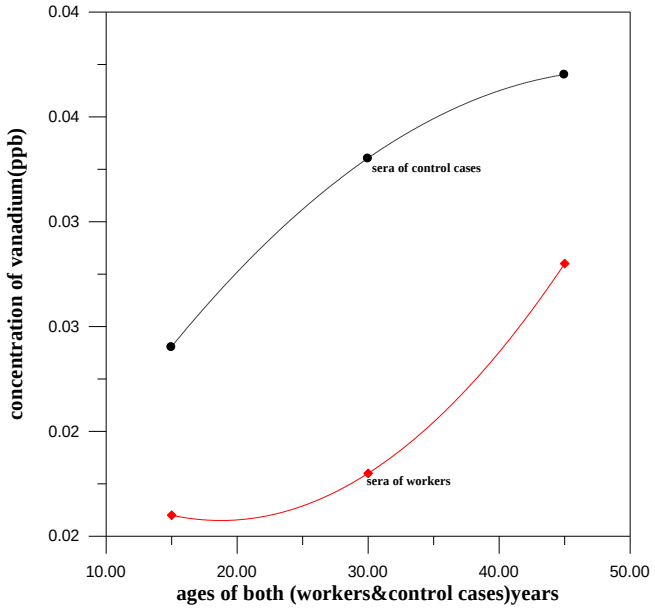

Fig.(4) The comparison between vanadium concentrations in sera of workers and control cases.

الخلاصة

تتضمن هذه الدراسة تقدير بعض العناصر النزرة في امصال العاملين في احد معامل المنظفات في مدينة بغداد، محتوى مصل الدم من العناصر الكروم النيكل والفناديوم تم تحليله في اثنين وعشرين مصل للعاملين في المعمل باستخدام جهاز الامتصاص الذري الغير لهبي نوع *(AAS)* . كذلك استخدم اثنان وعشرين نموذج مصل لاشخاص خارجيين كعينات سيطرة.

وجد ان تراكيز عنصر الكروم ازدادت في امصال العمال في مصنع المنظفات مقارنة بعينات السيطرة، لكن انخفاض في مستويات كل من عنصري النيكل والفناديوم في امصال العمال مقارنة بامصال عينات السيطرة.

تم تحليل النتائج باستخدام طريقة ANOVA للمقارنة بين النتائج عند مستوى ثقة مقداره 99% .

لوحظ أن تراكيز الكروم في أمصال العاملين للفئة العمرية (15–29) سنة تتغير معنوياً بمقارنتها ونماذج السيطرة. بينما تتغير تراكيز النيكل للفئتين العمريتين(15–29) و(45–58) سنة تغييراً معنوياً.و لوحظ ان التغيير المعنوي لتراكيز الفناديوم يحدث في جميع الفئات العمرية.

Conclusion

This study gave the concentrations of the three under study elements (Chromium, Nickel and Vanadium) in sera of workers who worked in one of the detergent industries in Baghdad city, the results that obtained appeared that decreasing in both elements (Vanadium and Nickel) in sera of workers compared with control cases. While the Chromium concentration are increased in the sera of workers compared with the control cases.

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