# INDICATION OF NON-THERMAL LOW ELECTRIC TREATMENT ON THE REDUCTION OF THE STATIONARY CONCENTRATIONS OF CADMIUM IN THE BLOOD AND URINE OF SELECTED PROBANDS

Albrecht Friess[1], and Harun Parlar[1,2*]

[1] Department for Chemical-Technical Analysis and Chemical Food Technology, Technische Universität München, Weihenstephaner Steig 23, 85350 Freising-Weihenstephan, Germany

[2] Parlar- Research&Technology,Vimy Str.1E,85354 Freising,Germany

* Corresponding author; E-mail: parlar@wzw.tum.de, phone: +49-(0)8161-887988

**ABSTRACT**

In this work the effects of low electric treatment on the possible reduction of Cadmium in blood and urine from 10 probands was investigated. Before and after the treatment with Power Tube QuickZap® (level 3, for 21 min minimum) the blood and urine samples were examined for Cadmium. The obtained results showed a semi-significant reduction of cadmium in all investigated proband - samples after the treatments. In addition to this findings, there is a weak correlation between Cadmium elimination ratio and relevant blood parameters such as creatinine- and urea-levels of the probands. These findings point out that there is a possibility to decrease the blood- and urine-concentration of Cadmium using non thermal low electric device.

**KEYWORDS:** Cadmium excretion, human body, low electric treatment, Power tube

## INTRODUCTION

Cadmium is a widespread hazardous pollutant of environmental and occupational concern , because of its different and uncalculated toxic effects(1,2). Especially , on the one hand its extremely high biological half life time in human of 20-30 years and on the other hand its low rate excretion from

the body make Cadmium particulary dangerous for humans(3,4) .It storages predominantly in soft tissues such as liver and kidney(5) and can induce cancer(6-8).It is also teratogenic ,influences further proteomic of cell proteins and shows endocrine activities(9-11).Cadmium has been industrial use for a very long period of time as anticorrosive agent, color pigment, oxygen-quencher ,stabilizer for many plastics and as catalyst for different chemical processes. A very important area of application of Cd is the use in nickel/cadmium batteries , available on the world market in the last decades(12-14) .Many research groups have suggested that cadmium occurs in remarkable concentrations in people in developed countries(15,16)). In these studies, it was demonstrated that some human tissues such as kidney, liver and lung were significantly contaminated by cadmium [17-19).In addition to that ,analytical measurements of human blood and urine samples from different regions in USA, UK, Japan and Germany confirmed the high dispersion tendency of this element in whole body(20-22). Therefore it is desirable to reduce Cd-concentration from human blood and urine to reduce its hazardous potential. In this context different techniques were applied, unfortunately without significant success(24).

In this paper, we have made the attempt to determine the concentration of cadmium, without speciation, in the human blood and urine samples of 10 probands during the applying of PowerTube QuickZap technology. The electric field was produced from the therapeutic device Powertube QuickZap from Fritonex AG (Switzerland), which is intended for the electric stimulation of nerves. It is primarily used for self-treatment of different symptoms (25-27). Recently, a proteomic study on the cellular responses to non-thermal low electric field , revealed that a stress protein, homoserin dehydrogenase, was over-expressed [28].An additional study ,in the field of chlorinated phenols point out, that these kind of polar environmental contaminants can be eliminated from human blood and urine by low-electric treatment(29).That means, the therapeutic devise PowerTube QuickZap clearly stimulates the excretion processes in the body, leading to detoxification. If applied regularly, the probability is high that the some polar contaminants are entirely eliminated from the human body.Concentration of Cadmium in blood is influenced from different factors, especially complex

formation with albumin, thionein, and also interaction with triglyeride etc. Therefore, the used analytical method should allow to determine whole Cadmium bounded in different form on organic polymer matrices .Because of these problem, we have decide to use digestions bombs to totally destroy such polymers and use an special ICP-AES device to eliminate any interfering signals. Urinary Cadmium(UCd) excretion is also very complex and can be associated for example with increased synthesis of Cortico-and Sex- Steroids, which can be also detected in the urine samples. These values can be significantly correlated with UCd-values(30).But ,they have no direct effect on the absolute levels of UCds.

**MATERIALS AND METHODS**

All experiments with probands were carried out in Istanbul-Turkey because of the strong restrictions and rules in Germany concerning "Human Experiments".The organization of the study in Turkey were accomplished by the Dr.Y.Z.P-Consulting Ltd- Muvezzi Cad.Akademik Palas.Besiktas-Istanbul. Blood was sampled from the probands on an empty stomach and immediately stabilized afterwards using a citrate buffer(Merck AG-Germany) for avoiding coagulation. 10 ml of blood were taken two-times by venipuncture. For sampling the urine, the morning-urine was taken. The sample was stored at −20 °C without further stabilization. All samples were frozen in super-clean sealed glass vessels, as losses of Cadmium can be expected when applying plastic- or metal-composed containers. After applying the PowerTube device for 21 min at level 3, the blood and urine samples of all probands were analyzed after 1.5 for Cadmium content. For the analysis of cadmium ,ICP-AES was applied after extraction with isobutyl methyl ketone containing 1,5-Bis(di-2-pyridylmethylene)thiocarbonohydrazide (31).The measurements were made on a Perkin-Elmer plasma 40 sequential emission spectrometer. A microwave oven(Panasonic) and a Microwave Acid Digestion bomb were used for sample digestion. All chemicals were analytical-reagent grade. De-ionized water was used in all experiments. Acetic acid –acetate buffer of pH5,6 was prepared by mixing of ACOH and NaOAc. In the following table operating conditions for the ICP-AES are summarized.

**Table 1.** Conditions for ICP-AES

| | | | |
|---|---|---|---|
| Wavelength | 228.800 nm | Plasma viewing height | 15mm a.IC |
| Background correction | 0.040+0.055nm | Integration time | 100s |
| Rf-generator | 40 MHz | Read delay | 20s |
| Photomultiplier voltage | 600 V | Peristaltic pump flow rate | 1ml/min |
| Plasma gas flow rate | 12.1l/min | Rf-generator incident power | 1.1kW |
| Auxiliary gas flow rate | 0.63l/min | Linear calibration of Cd | 0.2-150ng/ml |
| Nebulizer gas flow rate | 0.42l/min | Estimated detection limit | 0,7ng/ml |

All 10 probands, investigated were healthy, without any kind of disease and in good condition with characteristics as outlined in Table 2 . It is clear, that the number of the probands for a clinical trial is not sufficient .Likewise, we know that the selection criteria were not optimal .Despite these gaps, our work is relevant because it provides analytically proven results and tendencies for Cd-elimination.

**Table 2.** Individual characteristics of the probands

| Proband-No. | Characteristic | Proband-No. | Characteristic |
|---|---|---|---|
| 1 | 62 years of age, smoker, male | 6 | 33 Years of age, non-smoker, male |
| 2 | 66 years of age, smoker, female | 7 | 38 Years of age, non-smoker, female |
| 3 | 33 Years of age, non-smoker, female | 8 | 16 Years of age, non-smoker, female |
| 4 | 40 Years of age, smoker, female | 9 | 18 Years of age, non-smoker, female |
| 5 | 34 Years of age, non-smoker, female | 10 | 30 Years of age, smoker, male |

**RESULTS AND DISCUSSION**

Before starting the experiments, probands morning urine and blood samples were determined at start and after 1.5 h for cadmium without Power Tube treatment. There was no differences between the Cadmium-values. In contrast to that,the results ,coming from the experiments with power tube, clearly indicate that after a therapy of only 1.5 h, the Cadmium concentrations in blood of all probands decrease approximately 0.0-28.6 % .(Table.3)

**Table 3.** Cadmium concentrations (in µg/kg) in blood and urine samples according to each proband.

| **Proband-No.1** | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach- | After 21.min treatment and 1.5 hour waiting time-empty stomach- | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium 1 | 1.22 | 1.10 | 0.80 | 0.69 |
| Cadmium 2 | 1.22 | 0.90 | 0.60 | 0.55 |
| Cadmium 3 | 1.02 | 0.90 | 0.80 | 0.55 |
| Cadmium 4 | 1.02 | 1.10 | 0.60 | 0.69 |
| Cadmium –Mean Value | 1.12±0.10 | 1.00±0.10 | 0.70±0.10 | 0.62±0.070 |

| **Proband-No.2** | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach- | After 21.min treatment and 1.5 hour waiting time-empty-stomach | Start-empty stomach- | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium1 | 1.32 | 1.37 | 0.94 | 0.64 |
| Cadmium2 | 1.08 | 1.37 | 0.68 | 0.64 |
| Cadmium3 | 1.08 | 1.03 | 0.94 | 0.78 |
| Cadmium4 | 1.32 | 1.03 | 0.68 | 0.78 |
| Cadmium-Mean value | 1.20±0.12 | 1.20±0.17 | 0.81±0.13 | 0.71±0.07 |

**Proband-No.3**

| | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach- | After 21.min treatment and 1.5 hour waiting time-empty-stomach | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium 1 | 0.97 | 0.97 | 0.60 | 0.37 |
| Cadmium 2 | 0,73 | 0.97 | 0.50 | 0.37 |
| Cadmium 3 | 0.73 | 0.61 | 0.50 | 0.33 |
| Cadmium 4 | 0,97 | 0.61 | 0.60 | 0.33 |
| Cadmium –mean value | 0.85 ± 0,12 | 0.79 ± 0.18 | 0.55±0.05 | 0.35±0.02 |

**Proband-No.4**

| | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach | After 21.min treatment and 1,.5 hour waiting time empty-stomach | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium1 | 1,17 | 1.10 | 0.51 | 0.44 |
| Cadmium2 | 1.17 | 1.10 | 0.43 | 0.36 |
| Cadmium3 | 1.51 | 1.00 | 0.43 | 0.36 |
| Cadmium4 | 1.51 | 1.00 | 0.51 | 0.44 |
| Cadmium –mean value | 1.34±0.17 | 1,05±0.05 | 0.47± 0.04 | 0.40 ± 0.04 |

**Proband-No.5**

| | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach | After 21.min treatment and 1,.5 hour waiting time empty-stomach | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium1 | 0.85 | 0.35 | 0.44 | 0.28 |
| Cadmium2 | 0.55 | 0.75 | 0.44 | 0.32 |
| Cadmium3 | 0.85 | 0.75 | 0.36 | 0.28 |
| Cadmium4 | 0.55 | 0.35 | 0.36 | 0.32 |
| Cadmium-Mean value | 0.70 ± 0.15 | 0.55 ± 0.20 | 0.40 ± 0,04 | 0.30 ± 0.02 |

**Proband-No.6**

| | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time empty stomach | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium1 | 0.66 | 0.75 | 0.46 | 0.32 |
| Cadmium2 | 0.84 | 0.60 | 0.46 | 0.29 |
| Cadmium3 | 0.66 | 0.45 | 0.38 | 0.29 |
| Cadmium4 | 0.48 | 0.60 | 0.38 | 0.26 |
| Cadmium-mean value | 0.66 ± 0,18 | 0.60±0.15 | 0.42±0.04 | 0.29±0.03 |

**Proband-No.7**

| | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time empty stomach | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium 1 | 0.72 | 0.85 | 0.40 | 0.14 |
| Cadmium 2 | 0.86 | 0.85 | 0.40 | 0.14 |
| Cadmium 3 | 0.72 | 0.55 | 0.36 | 0.24 |
| Cadmuim 4 | 0.58 | 0.55 | 0.44 | 0.24 |
| Cadmium-Mean value | 0.72± 0.14 | 0.70 ± 0.15 | 0.40± 0.04 | 0.19 ± 0.05 |

**Proband-No.8**

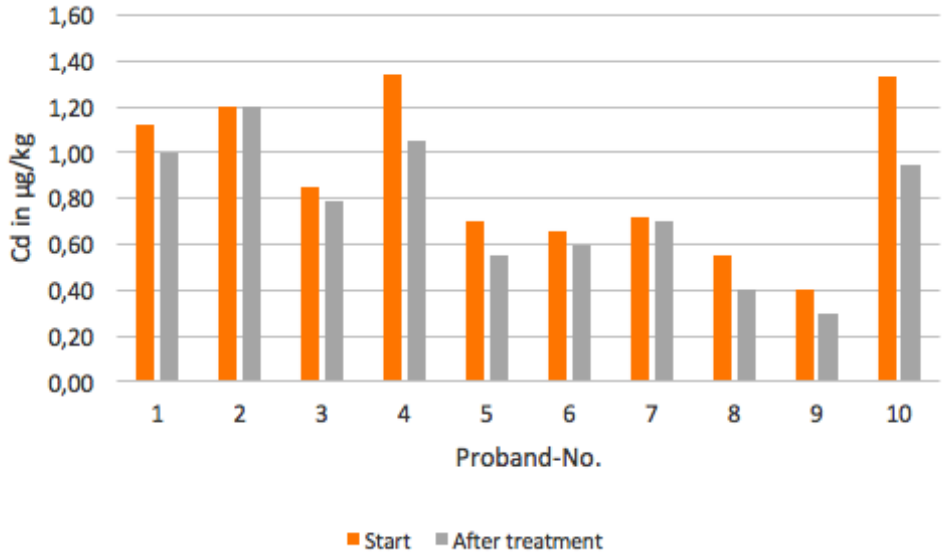
| | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time empty stomach | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium1 | 0.55 | 0.45 | 0.25 | 0.20 |
| Cadmium2 | 0.50 | 0.45 | 0.27 | 0.20 |
| Cadmium3 | 0.60 | 0.35 | 0.23 | 0.24 |
| Cadmium4 | 0.55 | 0.35 | 0.25 | 0.16 |
| Cadmium- Mean value | 0.55 ± 0.05 | 0.40 ± 0.05 | 0.25 ± 0.02 | 0.20± 0.04 |

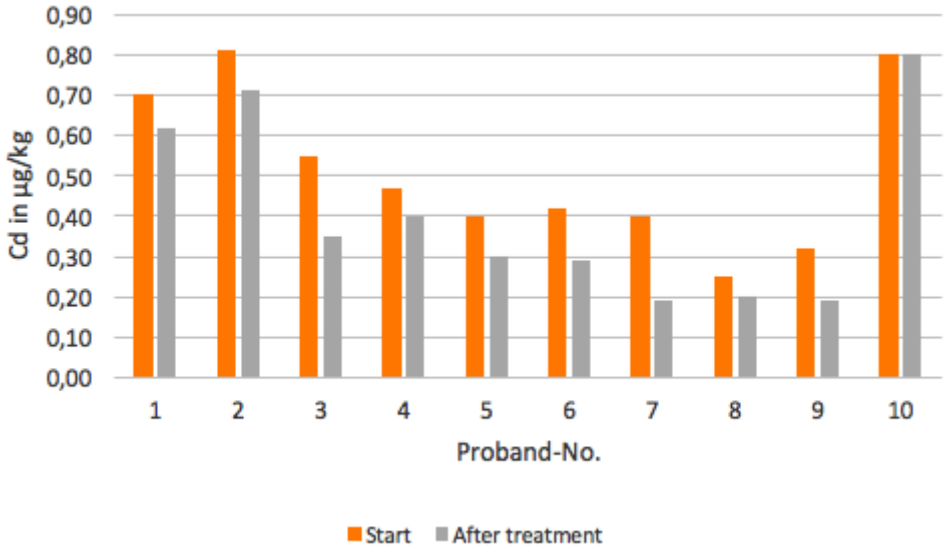
| **Proband-No.9** | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time empty stomach | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium1 | 0,40 | 0.35 | 0.32 | 0.14 |
| Cadmium2 | 0.40 | 0.35 | 0.35 | 0.24 |
| Cadmium3 | 0.35 | 0.25 | 0.32 | 0.24 |
| Cadmium4 | 0.45 | 0.25 | 0.29 | 0.14 |
| Cadmium-Mean value | 0.40± 0.05 | 0.30 ± 0.05 | 0.32 ± 0.03 | 0.19 ± 0.05 |

| **Proband-No.10** | Blood | | Morning urine | |
|---|---|---|---|---|
| | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time empty stomach | Start-empty stomach | After 21.min treatment and 1.5 hour waiting time-empty stomach |
| Cadmium1 | 1.33 | 1.15 | 0.80 | 0.70 |
| Cadmium2 | 1.33 | 0.95 | 0.80 | 0.90 |
| Cadmium3 | 1.16 | 0.75 | 0.70 | 0.70 |
| Cadmium4 | 1.16 | 0.95 | 0.90 | 0.90 |
| | 1.33 ± 0.17 | 0.95 ± 0.20 | 0.80 ± 0.10 | 0.80 ± 0.10 |

It is also extraordinary remarkable to observe that the Cadmium- concentration in urine decrease in the same time 0.0-52.0, which indicates that Camiumd-elimination in urine takes place increasingly(Table.3,4).

Table.4.Blood and urine values of probands(1-10)




If one tries to correlate the blood and urine values of individual probands with each other,so satisfactory good results for the probands No.**1,4,5,8 and 9** can be obtained and acceptable values for No.**3**.The behaviour of the probands **2,7** and **10** is extraordinary.For the proband No.2,there is no Cd-elimination in blood but 12.35% reduced urine concentration.No.**7** shows a low Cd-elimination rate in blood(2.9%),but extremely high excretion rate in urine(52.7%).No.**10** is an exception. Here, the decreasing rate in blood very high(28.6%)but in urine no extraction could be detected.(0.0%).These findings can only be explained by the fact that in some probands cadmium is

also excreted by faeces. The another disadvantage of this study is that only two measurements were performed, one at start and the other one after 1.5 h, which leads to the question as to how will be exactly the decreasing in the coming hours and what would be the elimination rates during a continuous application of power tube. This can only be answered by additional measurements as part of a clinical study. Moreover, additional measurements should be performed after 2-3 days in order to ascertain whether the values remain either constant, or start to increase. It is assumed without speculation that the values reach their initial level after a certain time. This however would mean that the duration of the therapy should be prolonged (2-3 weeks) in order to irreversibly eliminate or excrete Cadmium from the human body, presuming that no additional contamination of the proband with Cadmium would occur.

In order to find out whether individual blood parameter may play a role during the Cd-elimination from blood, a new attempt was made to try to correlate Cd-excretion rates with selected blood count parameters of the probands(Tab.5a and 5b).

**Tab 5a. Decreasing of Cd-concentration in blood samples of probands in % and corresponding selected blood test-parameter.Part 1**

| Proband | Cd-eliminationationrate in % | Bilirubin mg/dl | LDL/HDL Quotient | Creatinine mg/dl | Urea mg/dl | Triglyceride mg/dl | Alkyl-phosphase U/l |
|---|---|---|---|---|---|---|---|
| 1 | 16.6 | 0.39 | 2.12 | 0.84 | 52 | 91 | 77 |
| 2 | 0.0 | 0.12 | 1.50 | 0.70 | 19 | 89 | 40 |
| 3 | 7.0 | 0.60 | 1.69 | 0.83 | 22 | 90 | 70 |
| 4 | 21.7 | 0.22 | 2.86 | 0.90 | 54 | 121 | 80 |
| 5 | 21.4 | 0.21 | 2.82 | 0.97 | 51 | 112 | 78 |
| 6 | 9.1 | 0.40 | 1.75 | 0.85 | 23 | 91 | 71 |
| 7 | 2.9 | 0.39 | 1.56 | 0.76 | 20 | 88 | 52 |
| 8 | 27.9 | 0.35 | 2.72 | 1.02 | 45 | 110 | 110 |
| 9 | 25.0 | 0.30 | 2.60 | 1.11 | 44 | 133 | 105 |
| 10 | **28.6** | **0.28** | **2.98** | **1.09** | **55** | **130** | 101 |

**Tab 5b. Decreasing of Cd-concentration in blood samples of probands in % and corresponding selected blood test-parameter.Part 2**

| Proband | Cd-elimination ationrate in % | Hämoglobin g/dl | Hämatokrit % | GOT U/l | GPT U/l | MCH pg | λ-GT U/l |
|---|---|---|---|---|---|---|---|
| 1 | 16.6 | 13.3 | 38.1 | 27.4 | 23.0 | 27.45 | 13.6 |
| 2 | 0.0 | 12.4 | 39.8 | 29.3 | 22.9 | 32.6 | 36.7 |
| 3 | 7.0 | 16.0 | 43.0 | 32.4 | 31.3 | 33.4 | 45.0 |
| 4 | 21.7 | 11.7 | 42.4 | 40.1 | 43.4 | 32.0 | 42.0 |
| 5 | 21.4 | 13.0 | 46.0 | 28.0 | 33.3 | 30.9 | 32.9 |
| 6 | 9.1 | 16.4 | 37.9 | 30.0 | 33.3 | 30.0 | 14.7 |
| 7 | 2.9 | 16.2 | 40,8 | 41.1 | 32.6 | 33.2 | 18.8 |
| 8 | 27.9 | 17.0 | 41.2 | 42.6 | 22.7 | 28.3 | 22.06 |
| 9 | 25.0 | 12.9 | 47.7 | 27.0 | 25.4 | 31.0 | 38.0 |
| 10 | 28.6 | 13.9 | 39.6 | 28.4 | 33.1 | 27.9 | 19.,4 |

Only two of them seem to be important namely,creatine -and triglyceride-values.The creatine levels of the probands **4,5,8,9** and **10** are significant higher(<0.90 even more then 1.00) than of the others probands.Their Cd-Excretion rates are also more than 21.4%.In the caseof triglyceride, the same tendency can be found. The higher the Triglyceride values,the higher the Cd-excretion rates.For example,the triglyceride levels of the probands **9** and **10** are extreme (130 and133mg/dl) and the Cd-elimination rates of them are with 25.0 and 28.6 % are the highest.

**CONCLUSION.**

In conclusion, the therapeutic devise Power Tube Quick Zap stimulates the elimination process in the body, leading to detoxification. If applied regularly, the probability is high that the Cadmium is entirely eliminated from the human body. The results obtained in this work could included in the final results for a clinical evaluation of power tube. Particulary, noteworthy is the fact that excretion tendencies of the the test persons after the application increase. But,in how far the Cadmium-

excretion potential evolved in a daily use of power tube, can only be answered by additional long-term experiments.

**REFERENCES**

1.Fleischer M.,Sarofim AF.,Fasselt DW.,Hammond P.,Shacklette HT.,Nisbet IC.,Epstein S(1974)Environmental impact of Cadmium.a review by the panel on hazardous trace substances. Environ Health Perspect.7,253-323.

2.Rani A.,Kumar A.,Lal A.,Pant M(2014)Cellular mechanism of Cadmium-induced toxicity.a review.Int J Environ Health Res.24(4)378-399.

3.Suwasano Y.,Kido T.,Nakagawa H.,Honda R.,Kobayashi E.,Dochi M.,Nogawa K(2009) Biological half-life of cadmium in the urine of inhabitans after cessation of Cadmium exposure.Biomarkers.14(2)77-81.

4.Koyama H.,Satoh H.,Suzuki S.,Tohyama C(1992)Increased urinary Cadmium excretion and its relationship to urinary N-acetyl-ß-d-glucosaminidase activity in smokers. Archives of Toxicology.66(8)598-601.

5.Johri N., Jacquillet G., Unwin R(2010)Heavy metal poisoning. The effect of cadmium on the kidney. Biometals 23(5)783-792.

6.Hartwig A(2013)Cadmium and cancer. Met Ions Life Science 11(1)491-507.

7.National Cancer Institute(2015)Cancer causing substances-Cadmium.Report,March 20, 2015.

8. Waalkes MP(2000)Cadmium carcinogenesis in review.J.inorganic Biochemistry 79(1),240-244

9. Ferm VH., Carpenter SJ(1967) Teratogenic effect of Cadmium and its inhibition by zinc. Nature 216(5120),1123-1124

10.Henson MC.,Chedrese PJ(2004).Endocrine disruption by Cadmium,a common environmental toxicant with paradoxical effects on reproduction. Exp Biol Med.229(5)383-392.

11.Fanous A.,Weiss W.,Görg A.,Parlar H(2008)A proteome analysis of the Cadmium and mercury response in Corynebacterium japonicum.Proteomics,8(23-24)4976-4986.

12.Bernhoft RA(2013)Cadmium toxicity and treatment.The Scientific World Journal.Article ID.394652

13.Bergstrom S(1952)Nickel-Cadmium Batteries-pocket type.Report –The electrochemical Society-USA.

14.Daniel C.,Jürgen O(2011)Handbook of battery materials.Wiley-VCH,Weinheim

15.Nordic Council of Ministers(2003).Cadmium Review.28.January

16.Mezynska M.,Brzoska MM(2018)Environmental exposure to Cadmium-a risk for health 0f the general population in industrialized countries and preventive strategies.Environ Sci Pollut Res,25(4)3211-3232.

17.Drasch GA(1983)An increase of cadmium body burden for this century-An investigation on human tissues,26(2)11-119.

18.Lech T.,Sadlik JK(2017)Cadmium concentration in human Autopsy tissues. Biol Trace Elem Res,179(2)172-177.

19.Angerer.P.,Kessel R.,Bencze K.,Tewordt M.,Mauermayer R.,Friesen A(1988)The Cadmium content of human tissues from biopsies. Zenralbl Bakteriol Mikrobiol Hyg B,187(1)18-30.

20.Adams SV.,Newcomb PA(2014)Cadmium blood and urine concentrations as measures of exposure:NHANES1999-2010.J.expo Sci Environ Epidemiol,24(2)163-170.

21.Krueger WS.,Wade TJ(2016)Elevated blood lead and Cadmium levels associated with chronic infections among non-smokers in a cross-sectional analysis of NHANES .Environ Health 15(16)1-23.

22.Menke A.,Muntner P.,Silbergeld EK.,Plkatz EA.,Guallar E(2009)Cadmium levels in urine and mortality among U.S adults.Environ health Perspect,117(2)190-196.

23.Hassler E.,Lind B.,Piscator M(1983)Cadmium in blood and urine related to present and past exposure.a sudy of workers in an alkaline battery factory.Britisch J.of Industrial Medicine,40,420-425

24.Beltran Llerandi G.,Abreu M.,Garcia Roche MO.,Symington R.,Castillo A.,Gonzales L.,Menendez R.(1987) The effect of wheat bran on the extraction of Cadmium in rats. Molecular Nitration Food Research,31(10)987-991.

25. Power Tube QuickZap®, TENS device for transcutaneous electrical nerve stimulation; www.quickzap.de, www.wellbalance.eu.

26. Report No.34(2009) Selected proteomic and metabolomics studies after the use of Power Tube QuickZap Technology. Department for Chemical-Technical Analyses and Chemical Food Technology, Technische Universität München.

27.Fanous, A., Görg, A. and Parlar, H. (2009) Proteomic study on the cellular responses to non-thermal low electric field in *Saccharomyces cerevisiae*. Special report 43 CTA-TUM

28.Fanous A.,Ekici P.,Görg A.,Parlar H.(2011)Proteomic study on the cellular response to non-thermal low electric field in Saccharomyces cerevisiae. Fresen Environ Bull,20(1)117-121

29.Parlar H.,Friess A.(2014) The role of non-thermal low electric treatment on the elimination of chlorophenols from human body. Fresen Environ Bull,23(7)1574-1584

30.Bochud M.,Jenny-Burry J.,Brujm M.,Ponte B.,Guesous J.,Ehret G.,Petrovic D.,DudlerV.,Haldiman M.,Escher G.,Dick B.,Mohacup M.,Paccoud F.,Burnier M.,Pechere A.,Bertchi A.,Martin P.,Vogt

B.,Ackermann (2018) Urinary Cadmium excretion is associated with increased synthesis of cortio-and sex steroids in a population study.J.Clin Endocrin.l.Metab,103,748-758.

31.Espinosa Almendro JM.,Bosch Ojeda C.,Garcia de Torres A.,Cano Pavon M(1992) determination of cadmium in biological samples by inductively coupledplasma atomic emission spectrometry after extraction with 1,5-bis(di-2-pyridylmethylene)thiocarbonohydrazide.Analyst,117(11),1749-1751.