# تأثير التدخين في مستويات بعض المعادن في مصل الدم

**قيس احمد ابراهيم**
**قسم الكيمياء ،كلية الزراعة، جامعة بغداد**

## الخلاصة

يحتوي دخان السكائر على عوامل سامة ومؤكسدة كثيرة التي تؤدي الى سمية الجسم وانخفاض مستويات العوامل المضادة للأكسده مؤدية الى امراض كثيرة جداً. قيست مستويات الزنك والنحاس التي تعد من العوامل المضادة للأكسدة عند المدخنين وغير المدخنين ولوحظ انخفاض مستوى الزنك عند المدخنين مقارنة بغير المدخنين لأن اوكسيد النايتروجين (NO) الموجود ضمن مكونات دخان السكائر يعمل على فقدان الزنك، كذلك تبين انخفاض مستوى النحاس الذي استهلك في تخليص الجسم من سموم الكادميوم وهو من محتويات دخان السكائر.

# Effect of Smoking on Serum Level of Some Mineral

**Q. A. Ibraheem**
**Department of Chemistry ,Collage of Agriculture, Baghdad University,**

## Abstract

Cigarette smoke contains a lot of toxic and oxidizing materials which causes body toxicity and reduces antioxidant that results in many diseases. In this study, levels of Zinc and Copper (which are antioxidant) were measured in serum of smokers and nonsmokers. It was found that the level of Zinc in serum of smokers was significantly lower than nonsmokers because nitric oxide which is one of cigarette contents acts to increase zinc loss, also a significantly lower copper levels were found in smokers than nonsmokers due to consumption of copper in reducing cadmium toxicity which is a cigarette smoke content.

**Keywords: - Smoking, Copper, Zinc**

## Introduction

Tobacco smoking is a known cause of approximately 25 diseases, and even the WHO declared that its impact on world health is not fully assessed [1,2]. Also it is responsible for approximately 3.5 million deaths worldwide every year, primarily from vascular diseases, cancer and multiple sclerosis. [3,4]. The number of smokers in the world equal to 1/5 of its population. The Cigarette smoke contains at least 3500 identified chemical constituents, many of which have toxic or carcinogenic properties [5]. It results in the formation of more than a billion oxyradicals in each puff [6].

Developing countries start to strengthening of national programs and initiatives for smoking prevention and cessation is needed to reduce smoking-related mortality and morbidity [7, 8].

In smokers, the mitochondrial respiratory chain function of lymphocyte is disturbed; and it correlates with the degree of oxidative damage of membranes, and thus mitochondrial dysfunction could contribute to increase endogenous production of reactive oxygen species (ROS) [9].

The presence of oxidants, which include free radicals in cigarettes smoke, has been reviewed.

Zinc is one of essential elements in human, it is necessary for cell division and cellular immunity and it is considered as antioxidant. Diet is the main source of zinc, the adequate amount of daily dietary intake is 5mg which is present in meat, marine organisms, and poor in grain vegetables and fruits. Essential level of zinc in 70 kg man is 1.4 -2.3 g [10]. Intake of dietary zinc is associated with a decreased risk of both proximal and distal colon cancer [11]. Zinc and various antioxidants have been proposed as treatments for Age-related macular degeneration [12]

Copper is considered as an important element in defense against oxidant so it protects the body from cancer, heart disease and aging. It has a role in merge iron in hemoglobin and also facilitate absorption of iron. Daily need of copper in adult is 30µg /Kg body weight, while children require 40µg/Kg body weight. Copper is present in liver, kidney, raisin and mother milk that contains (1.05-0.6) mg/L [13].The copper value in venous plasma is (13-24) µmol/L [14]. Copper deficiency decreased the final body weight of the rats by 5% compared to copper-adequate control rats. Severe copper-deficient state in the rats fed decrease of ceruloplasmin activity in serum (by 97%) [15]

**Aim of the study**

Determine the danger of smoking that contains many oxidizing agents and their effect on the levels of antioxidant in the body which become more liable of having a lot of medical problems.

**Subjects, Materials and Methods**

**Smoker and nonsmoker (control) subjects**

Samples were obtained from 31 healthy subjects (male) as nonsmokers, aged between 20-35 years and 37 smokers (male), aged 20-35 years. The samples were obtained from National center of blood transfer / Baghdad.

**Blood sampling**

Blood samples (3ml) were withdrawn from both subjects after overnight fasting with abstinence for 4 hours before test. Samples then transferred to metal free plastic centrifuge tubes. Blood samples were left to clot for one hour, then centrifuged at 3000×g for 10 min. using Janetzki $K_{23}$ centrifuge. Serum (1.5 ml) was separated and used for further measurements.

**Determination of serum metal level**

Serum metal levels ($Zn^{+2}$ and $Cu^{+2}$) were measured by atomic absorption spectrometer (AAS), type shimadzu AA – 646 (Japan) at specific wave length (copper at 324.7nm and zinc at 213.9nm). Generated by hollow cathode lamb this is absorbed by the sample (after conversion into atomic vapor). Elements present in serum in µg/ml level can be determined by flame atomic absorption spectrometer (FAAS), serum Cu and Zn concentration were determined after setting the optimal conditions for each element.

## Results

In this study, data obtained reflects a serum zinc level of (105.01±28.78µg/dl) and for copper level of (128.20±22.32µg/dl). These levels were found to be significantly lowered ($p<0.05$) in smokers, than those found in nonsmokers group (129.13±33.71 µg/dl, 148.60±34.34 µg/dl) respectively. The statistic of the results is done by using T – test.

## Discussion

The majority of the health risks are correlated with cigarette consumption. However, natural antioxidant systems are thought to provide protection against free radicals and increased activity of antioxidant system is associated with reduced risk of certain disease [16]. Cigarettes smoke reduces the activity of antioxidant system; these may lead to imbalance between oxidant-antioxidant in favor of the prooxidant leading to potential damage and dominant risk factor of many diseases [17].

Nitric oxide (NO) is found in cigarette smoke which has been considered as health hazards the concentrations of it reached up to 600 pg/cigarette [18].

The data in this study show that the level of zinc in serum of smokers was significantly lower compared with nonsmokers.

Changes in intracellular zinc were critically dependent on (NO) production which produce changes in zinc homeostasis, and increase in labile zinc [19]

The reaction of (NO) with metallothionein has been investigated previosly, and literatures reflects that NO mediates zinc release from metallothionein by destroying zinc-sulphur clusters [19,20,21]. Aravindakumar, etal observed that the percentage loss of $Zn^{2+}$ and thiolate groups after 3hours of NO treatment are 62% and 39%, respectively [20].

Indeed, the rate of attack by NO on metallothionein domain is intuitively expected to increase with the extent of reaction(at the level of this domain), by a decrease in steric hindrance as a result of gradual unfolding of the protein as $Zn^{2+}$-thiolate bonds are broken. A further increase with respect to $Zn^{2+}$ release may be expected to result from the fact that such $Zn^{2}$+ release probably only occurs efficiently when several $Zn^{2+}$-thiolate bonds are broken.[20,22,23]

There was significant ($P<0.05$) decrease in serum copper level in smoker if compared with nonsmoker.

Cadmium is one of toxic elements in tobacco smoke and it is copper antagonist [24,25]. The accumulation of cadmium in the cell layer was significantly decreased by copper; however, it was therefore suggested that copper significantly protects cadmium-induced cytotoxicity primarily through decreasing the cellular cadmium accumulation [26]. So that cadmium uptake into the body has a combined stronger effect in decreasing copper and zinc levels [27].

Antioxidants in smokers consumed for neutralization of free radicals present in cigarette smoke.

# References


1- Benowitz, N.L.; Hansson, A. and Jacob, P. (2002) Cardiovascular effects of nasal and transdermal nicotine and cigarette smoking. : Hypertension. 39(6): 1107-12.

2- Butler, R.; Morris, A.D. and Struthers, A.D. Lisinopril improves endothelial function in chronic cigarette smokers. (2001): Clin-Sci. (Lond) 101(1): 53-8.

3- Robert, J. and Fox, M.D. (2009 May)Smoking and MS Progression.:Journal Watch medicine that matters, 26,

4- Hernán, M.A., Brain, (2005 Jun) Cigarette smoking and the progression of multiple sclerosis. : 128:1461-5.

5. Hecht, S.S. (ed) (1997):Carcinogenesis Due to Tobacco. Molecular Mechanism. In: Encyclopedia of cancer, (1): 221.

6. Borck, C., (1997)Antioxidant and cancer.: SCI. Med, 112: 52-61

7- Gu, D., Kelly, T.N., Wu ,X., Chen, J., Samet, J.M., Huang, J.F., Zhu, M., Chen, J.C., Chen, C.S., Duan, X., Klag, M.J.and He, J., (2009 Jan) Mortality attributable to smoking in China.: -N Engl J Med.: 360(2):150-9.

8- Harlan, M. and Krumholz, S.M., (January 7, 2009) Smoking and Mortality in China. ,Journal Watch Cardiology,25:34

9- Miro, O.; Alonso, J.R. and Jarreta, D., (1999) Smoking disturbs mitochondrial respiratory chain function on human circulating lymphocytes. Carcinogenesis. 20(7): 133-6.

10. Ericson, S. P.; Mchaslsky, M. L. and Rabinow, B. E. (1986):Chem. 32(7): 1350,

11. Lee,D-H., Anderson,K.E.and Harnack,L.J., (2004 Mar): J-Natl-Cancer96(5): 403-7,

12- Brett, A.S., Antioxidants and Zinc for Age-Related Eye Disease . (2009 March 14): Watch medicine that matters, 23:

13. Al-seba'e, L. (2000):Malnutrition disease, Hisy, J (ed).Al-ma'aref, 44 Sa'ad Saghlol street-Al-ramla station, Pp174

14.Davidson,S. (1992) Principles and Practice of Medicine , 6th(ed).Christopher ,R.W.and Ian,A.D.,(ed). Churchill Livingstone LE - BS Pp989,

15- Kralik, A.; Kirchgessner, M. and Eder, K. (1996Sep) Concentrations of thyroid hormones in serum and activity of hepatic 5' monodeiodinase in copper-deficient rats: Ernahrungswiss, 35(3):288-91

16- Michiels, C.; Raes, M.; Toussan, O. and Remacie, J. (1994) Importance of Se-Glutathione, peroxidase, catalase and Cu-Zn-SOD for cell survival against oxidative stress: Free readical Biological Medicine. 17: 235-248.

17- Ross, R. (1996):Atherosclerosis. In: CECIL textbook of medicine. 18th (ed).Wyngarrden, J.B. and Smith, L.H. (eds). W.B.SAUNDERS Puplishing Company. Pp. 320.

18- Freeman, G.; Dyer, RL.; Juhos, L.T.; John, G.A. and Anbar, M. (1978) Identification of nitric oxide (NO) in human blood. Archives of EnvironmentalHealth January/February 33: 19-23,

19- Paula J. B.; Karanee L.; Eileen B.; Rong, C.; Annette, W.; Karla, J.; Wasserloos, S. C.; Watkins, R.P. and Claudette, M. St., (2008) Croix Nitric Oxide–Mediated Zinc Release Contributes to Hypoxic Regulation of Pulmonary Vascular Tone., Circulation Research. 102: 1575.

20- Aravindakumar, C.T.; Ceulemans,J. and De Ley, M., (1999) Nitric oxide induces Zn2+ release from metallothionein by destroying zinc-sulphur clusters without concomitant formation of S-nitrosothiol. Biochem J. 344 (pt 1): 253–258.

21- Stitt M.S., Wasserloos, K.J., Tang, X., Liu, X., Pitt, B.R.and Croix, C.M., (2006 Mar)Nitric oxide- induced nuclear translocation of the metal responsive transcription factor,MTF-1 is mediated by zinc release from metallothionein.: 44(3):149-55

22- Kroncke, KD.; Fehsel, K.; Schmidt, T.; Zenke FT.; Dasting I.; Wesener JR.; Bettermann, H.; Breunig, K. D. and Kolb-Bachofen, V., (1994) Nitric oxide destroys zinc-sulfur clusters inducing zinc release from metallothionein and inhibition of the zinc finger-type yeast transcription activator LAC9.: Biochem Biophys Res Commun. 200: 1105–1110.

23- St Croix, C.M.; Wasserloos, K.J.; Dineley, K.E.; Reynolds, I.J.; Levitan, E.S. and Pitt, BR. (2002): Nitric oxide-induced changes in intracellular zinc homeostasis are mediated by metallothionein/thionein. Am J Physiol Lung Cell Mol Physiol. 282: 185–192.

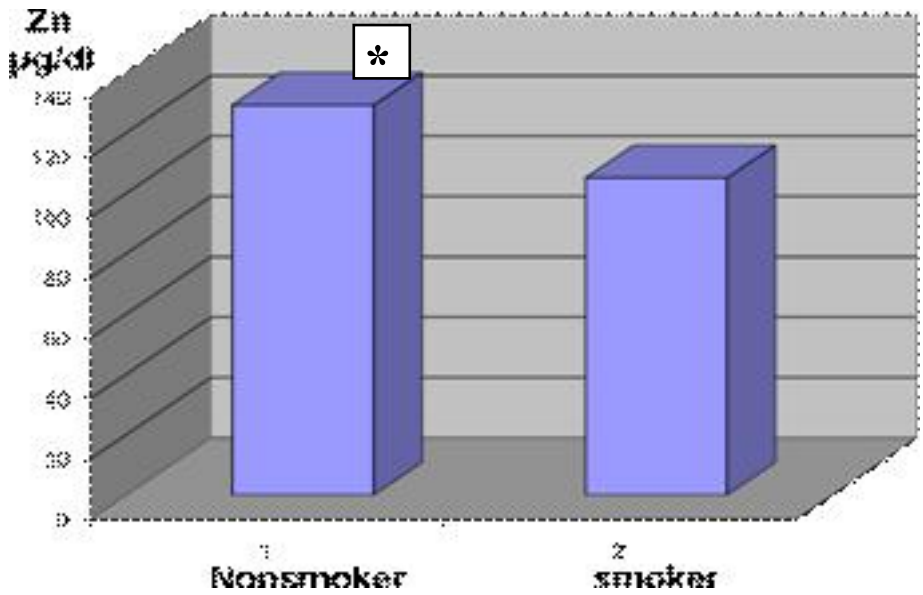
24-Hendrick, D. J. Smoking, cadmium, and emphysema. (2004):Thorax 59:184-185

25- Mannino D.M.; Holguin, F. and Greves, H. (2004): Urinary cadmium levels predict lower lung function in current and former smokers: data from the Third National Health and Nutrition Examination Survey. Thorax, 59:194.

26- Kaji,T.; Fujiwara, Y.; Koyanagi, E.; Yamamoto, C.; Mishima, A.; Sakamoto, M. ;Kozuka, H.and Mishima, A., Sakamoto, M.,and Kozuka, H., (1992 Oct) Protective effect of copper against cadmium cytotoxicity on cultured vascular endothelial cells.: Toxicol Lett, 63(1):13-20

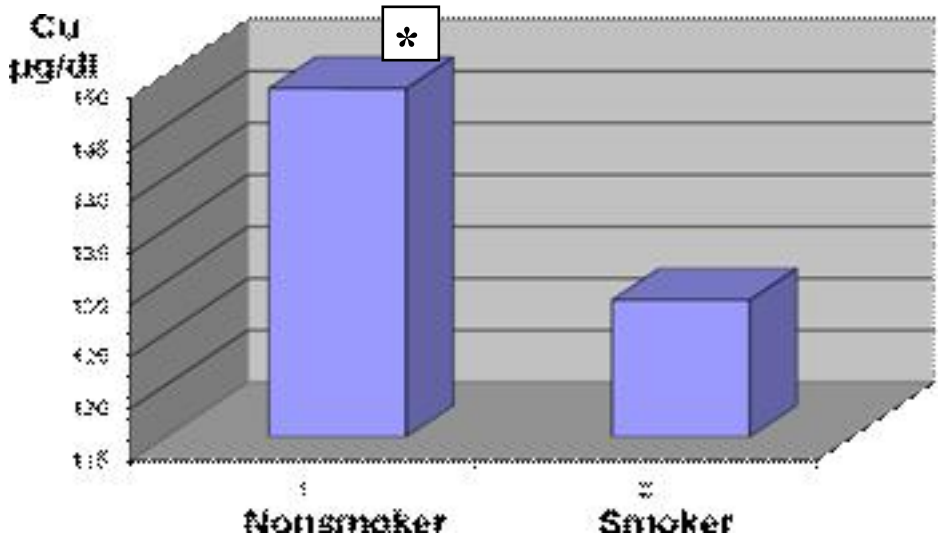
27- Gill Sharma, G.; Sandhir, R. and Nath, K., (1991 Jan): Effect of ethanol on cadmium uptake and metabolism of zinc and copper in rats exposed to cadmium. J Nutr, 121(1):87-91

Appendix




* p<0.05

**Fig. (1): Effect of smoking on serum level of zinc**




* p<0.05

**Fig. (2): Effect of smoking on serum level of copper**