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LEAD, IRON, COPPER, ZINC, MANGANESE AND CADMIUM EVELS IN SOME FOODSTUFFS OF ANIMAL ORIGIN: CHEESE AND NCHEON.

(With 2 Table and 3 Figures)

By

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مستويات الرصاص والحديد والنحاس والزنك والمنجنيز والكادميوم فى بعض المنتجات الغذائية ذات الاصل الحيوانى(الجبن واللا نشون)

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تم جمع سبعين عينة جبن عشوائيه من أسواق مدينه أسيوط ممثلة لمعظم الأنواع المستهلكه فى مصر من جبن جاف ومطبوخ وطرى (مستورد ومحلى) على مدى عشرة شهور من يناير حتى أكتوبر سنه ١٩٩٤ وفى ذات الوقت تم تجميع عدد خمسون عينة لانشون ممثلة لأكبر شركتين لأنتاج اللانشون فى مصر ممثلة (A&B) وتم تحليل تلك العينات لتعيين مستويات الرصاص والحديد والنحاس والزنك والمنجنيز والكادميوم بجهاز الامتصاص الذرى (Atomic Absorption Spectrophotometer) . ولقد أوضحت النتائج عن قيم متوسطات الانواع المختلفه من الجبن لتلك العناصر المعدنيه سالفه الذكر على الترتيب كمايلى : ٢٨ ± ١٠٠، ٤و٢٦ ± ٧و١٠٩، ٢و ± ١و٠، ٢و٢٠ ± ٧و٤، ٤و٢ ± ١و٠ و٩و٢ ± ٢و٠ مجم/كجم وزن جاف على التوالى. ولقد أحتوت الجبن القريش على أعلى القيم للرصاص والنحاس والمنجنيز والكادميوم بمتوسطات :٥٥و٠ ± ٣٠٣و٠ ، ٢و٥ ± ٨و٠، ٥و٤ ± ٤و٠ و ٤و٥ ± ٤و٠ مجم/كجم وزن كما أسفرت النتائج عن وجود أعلى مستوى للحديد بالجبنه الدمياطى بمتوسط ٤٧و٣٢ ±٤و٥، ٠ جاف على التوالى. مجم/كجم. وزن جاف بينما أظهرت الجبنه الجافه المحليه عن أعلى القيم للزنك بمتوسط ٦و٤٣ ± ٣و٢٠ مجم/كجم وزن كجم وزن/جاف- كما تبين أن جميع عينات الجبن (١٠٠٪) محل الفحص تحتوى على معدل رصاص أعلى من ١,مجم

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جاف كذلك أوضحت النتائج عن أرتفاع نسبى للمعادن المفحوصة فى الجبن المحلى اذا ما قورنت بالأنواع المناظرة من الجبن المستورد. ولقد أظهرت نتائج تحليل عينات اللانشون أن متوسط قيم والمتوسط الكلى لهذه العناصر فى اللانشون لهاتين الشركتين كان على النحو التالى ٩٣و٠ ±١٥و ، ١٥و١ ±١٧و٠ ، ٠٣و١ ± ١١و٠ للرصاص و ٩و٧١ ± ٠٧و١٢ ، ٨و٧٦ ± ٢و١١ ، ١و٧٣ ± ٠٥و٨ لعنصر الحديد ٩و١٢ ±٨٧و٣ ، ٩و١٣ ± ٠٣و٣ ، ٩و١٢ ± ٣٨ز٢ لعنصر النحاس و ٦و٦٠ ± ٨٤و٨ ،٣و٦١ ± ٨و٧ ، ٦١ ± ٨و٥ لعنصر الزنك ٣و٥ ± ٤و١ ، ٢٥و٧ ± ٥و١ ، ٢٧و٦ ± ٠٥و١ للمنجنيز وكانت للكادميوم ٠٨و٥ ± ٥٦و١ ، ٣و٥ ± ٣٢و١ ، ١٣و٥ ± ٩٩و٠ ملجم/كجم وزن عينة ووجد أن ٥٩٪من العينات الكليه التى أجرى تحليلها تحتوى على أكثر من نصف ملجم رصاص /كجم وأن ٥٨،٥٪ من العينات تحتوى على أعلى من ٥٦ مجم زنك/كجم وأن ٥٥٪من العينات به أكثر من ٩و مجم كادميوم/كجم . وقد بين البحث أهميه أتباع الاشتراطات الصحيه السليمه فى صناعه اللانشون والجبن وخاصه الجبن القريش حرصا ووقايه للصحه العامه كما ناقش البحث أيضا آثار تلك المعادن سالفة الذكر على صحه الانسان والحيوان.

SUMMARY

Seventy cheese and fifty luncheon samples were randomly collected from Assiut city markets representing the most kinds consumed in Egypt including hard, processed and soft (imported and local) cheese and luncheon products of two main companies (represented by A and B) over a period of ten months from January to October 1994. Samples were analyzed for estimation of lead, iron, copper, zinc, manganese and cadmium levels by atomic absorption spectrophotometer. The obtained results revealed that lead, iron, copper, zinc, manganese and cadmium mean values in different kinds of cheese were 0.28± 0.01, 26.4±1.7, 2.9±0.1, 20.2±4.7, 2.4±0.1 and 2.9±0.2 mg/kg dry weight, respectively. Kareish cheese was found to contain the highest values of lead, copper, manganese and cadmium with an averages of 0.55±0.03, 5.2±0.8, 4.5± 0.4 and 5.4±0.4 mg/kg, respectively. Damietta cheese contained the highest levels of iron with a mean level of 32.7±5.4, while the highest values of zinc was found in local hard cheese with a mean level of 43.6±20.3 mg/kg dry weight. 100% of cheese samples contained lead values higher than 0.10 mg/kg dry weight. Relatively higher values of estimated elements were recorded in local cheeses in comparison with imported types. The mean values and the total mean of these elements in luncheon of the two companies (A and B) were, 0.93 ±0.15, 1.15 ± 0.17 and 1.03 ±0.11 for lead; 71.9±12.07, 76.8±11.2 and 73.1± 8.05 for iron; 12.9 ±3.87,.13.9 ±3.03 and 12.9 ±2.38.for copper; 60.6 ±8.84, 61.3 ±7.8 and 61.0 ±5.8 for zinc; 5.3 ±1.4, 7.25 ±1.5 and 6.27±1.05 for manganese and 5.08 ± 1.56, 5.3 ±1.32 and 5.13 ±0.99 mg/kg for cadmium. 59% of the total samples contained more than 0.5 mg lead/kg; 58.5% of samples contained zinc values higher than 56 mg/kg and 55% contained higher levels than 0.9 mg cadmium/kg. Possible health risk of these elements was also discussed.

INTRODUCTION

Trace amounts of various elements are necessary for the proper nutrition of human and animal body. Excess amounts of copper, cobalt, selenium, and others in foods have however, given rise to outbreaks of poisoning, but little is known about the minimum amounts that may lead to toxicity *(GRACEY, 1986)*.

Metals are used extensively in the work-place and employee exposure can result from numerous industrial operations. Various chemicals are used at different stages in the production and processing of food. At farming level several hundred compounds are used to enhance soil fertility, pests and diseases control in crops and livestock and to increase live weight gain in animals. Some of these substances may find their way into animal tissues by direct routes such as injections or indirectly via the feed . In the preservation and processing of foods many substances are employed to prevent the onset of spoilage, promote binding properties and enhance flavor and nutritive value, etc.; antioxidants, coloring agents and others. Many of these chemicals used in livestock production are quickly excreted while other are not metabolized or excreted readily constituting a greatest risk to public health. Although, some of these elements are non-deletrious, certain contaminants have been clearly established as causative agents of animal and human diseases *(GRACEY, 1986)*. Furthermore, metals may contaminate a food source by a leaching process between the food and its container. Acids from meat cause the cadmium to leach and adhere to the meat, where it is subsequently ingested *(HAGSTAD and HUBBERT, 1986)*.

As a pollutant of food, lead from animal food products constitutes about 8% of the total mean dietary intake of human beings *(GRACEY, 1986)*. Lead, iron and copper were estimated in 175 milk samples collected from lactating cows, buffaloes, sheep and goat in Assiut Governorate by *SHEHATA and SAAD (1992)*. The results revealed that mean lead levels were 0.019, 0.24, 0.4 and 0.197 mg/L, respectively. On the other hand the previous toxicological studies in Assiut Governorate revealed a high levels of lead in examined water sources and plants *(EL- SHREIF, 1991 and ZAKI et al. 1994)*.

In recent years, the toxic effects of a number of non-essential metalic elements, especially lead, cadmium, mercury and manganese, have claimed attention as they have a number of the essential elements such as copper, nickel but at higher concentration than normal *(Lucas, 1975)*. It is worthwhile, to have a monitoring system for heavy metals in cheese, meat and their products to ensure its safety for consumers. In Egypt, informations concerning heavy metals in cheese and luncheon are relatively incomplete. Therfore, this work was planned to investigate the levels of these contaminants in cheese and luncheon as a milk and meat products highly consumed in Egypt.

MATERIAL and METHODS

Seventy random cheese samples were collected from Assiut city markets representing the most types of cheese consumed in Egypt [imported hard, local hard, imported processed, local processed, imported soft and local soft (Damietta and Kareish)] during the period from January to October 1994. At the same time fifty representative luncheon samples were collected representing the most commonly consumed products in Egypt

The samples were kept in separate plastic bags, and frozen until analysis. Two grams from the dry samples were digested according to the method of *KOIRTYOHANN et al. (1982)*. Lead, iron, copper, zinc, manganese and cadmium were analyzed by using Shimadzu Atomic Absorption Flame Emission Spectrophotometer AA-630-02.

RESULTS

The results of lead, iron, copper, zinc, manganese and cadmium in cheese samples analyzed are recorded in Table 1 and Fig. 1 & 2, while results of luncheon samples are summerized in Table 2 and Fig. 3.

DISCUSSION

Lead is a cumulative poison that causes both acute and chronic intoxication. Although acute poisoning is rare, chronic poisoning is more common and serious (*GOSSEL and BRICKER, 1990*). The results revealed that the mean concentration of lead was 0.28 mg/kg dry weight. This concentration is relatively high in relation to the permissible limit previously recorded. 0.1 and 0.3 mg/kg are the maximum Egyptian permissible limits of lead in low fat cheese and processed cheese with plant oil respectively reported by *Egyptian Organization For Standardization (1993)*. About 16 and 11% of the imported and local processed cheese samples were found to contain more than 0.3 mg/kg lead in mean values of 0.22± 0.02 and 0.26± 0.01 respectively. The hygienic standards of the foreign substances content in food stated that, 0.1 ppm is the maximum lead content in milk *(BARTIK and PISKAC, 1981)*. 100% of cheese samples contained lead values higher than 0.10 mg/kg dry weight. According to *MARLETTA and FAVRETTO (1983)* the concentration of lead in cheese produced from lead contaminated milk will be about six times that in milk. The enrichment in lead is consistent with that for the proteins in milk with which it is bound . A comprehensive survey of lead in foodstuffs in the UK was undertaken by the Association of Public Analysts jointly with the Local Authorities Organization revealed that the mean concentration of lead in cheese was 0.16 mg/kg *(LUCAS, 1975)*. Kareish cheese is considered to be the highly contaminated type with lead (average of 0.55±0.03 mg/kg) in comparison with the other types of cheeses, probably due to the lower hygienic measures taken during Kareish cheese manufacturing which is home made.

Normal tissues levels of lead in Sweden were reported to be 0.1, 0.05 and <0.005 mg/kg in kidney, liver and muscles respectively *(DOYLE et al., 1993)*. The obtained results of the analyzed luncheon samples revealed that the mean lead concentration in the product of the company A and B were 0.93±0.15 and 1.15±0.17 in a total mean of 1.038±0.11 mg/kg. 0.5 mg/kg is the maximum Egyptian standard lead level in luncheon cited by the *Egyptian Organization For Standardization, (1993)*. A comperhensive survey of lead in foodstuffs in the UK was undertaken by the Association of Public Analysts jointly with the Local Authorities Organisation (1971) revealed that the mean concentration of lead in cereals and meat were 0.17 and 0.10 mg/kg. A similar wide variation also exists in results undertaken in USA for lead concentration in cooked beef as 0.003-0.63 mg/kg *(LUCAS, 1975)*. High lead levels in these products may be originated from animal tissue used, cereals and/or during processing. Cooking salt may be a potential hazardous source of this element. Local cooking salts used by some villagers in Nigeria has been found to contain high level of lead (433 µg/L) as compared to common salt containing 1 µg Pb/L *(DIM et al., 1991)*.

Chronic iron overload in humans results in hepatocellular damage and fibrosis *(DOYLE et al., 1993)*. Iron is present in relatively high concentrations in most grains and grain products, most nut and nut products as well as meat, are good sources of iron *(YESHAJAHU 1994)*. Iron is absorbed from the small intestines in the divalent (ferrous) form into the gastrointestinal mucosa and converted there to the trivalent (ferric) form, and then combines with apoferritin to form ferritin. Toxicity occurs whenever its binding sites become saturated *(GOSSEL and BRICKER, 1990)*. Our results revealed that the mean iron concentration in different cheese samples was 26.4±1.7 mg/kg dry weight. Damietta cheese contained the highest iron concentration (32.7±5.4 mg/kg dry weight) in comparison with the other kinds. The normal iron level in hard cheese is 1.0 mg/100 grams *(OCKERMAN, 1978)*. 83% of local hard cheese samples and 80% of imported hard cheese samples contains a level higher than 1.0 mg/100 grams dry weight for iron. On the other hand the achieved results for luncheon samples revealed that the mean iron concentration in the product of the company A and B were 71.9±12.07 and 76.83±11.2 in a total mean of 73.1±8.05 mg/kg respectively. Many countries have established maximum permissible levels for certain trace elements in food. The joint FAO/WHO Codex Alimentarius Commission (CAL/FAL, 2- 1973), however, set levels for lead, copper and iron in rendered pork fat and edible tallow at 0.1, 0.4 and 1.5 mg/kg respectively *(GRACY, 1986)*.

Copper is considered an essential mineral for the functioning of certain

enzymes, and a daily dietary intake of 2 to 3 mg is recommended for adult *(GRANDJEAN, 1986)*. Copper appears to be present in meat and cereals in larger amounts than in other types of food being as high as 2.5 mg/kg *(GRACEY, 1986)*. Repeated copper exposures have been associated with haemolytic anemia *(MANZLER and SCHREINER, 1970)*. Our results revealed that the mean level of copper in different kinds of cheese was 2.9±0.1 and the highest concentration was recorded in Kareish cheese as 5.2±0.8 mg/kg dry weight. 0.1 and 0.3 mg/kg are the maximum Egyptian permissible limits of copper in low fat cheese and processed cheese with plant oil respectively reported by *Egyptian Organization For Standardization, (1993)*. 100% of the imported and local processed cheese samples were found to contain more than 0.3 mg/kg. *OCKERMAN (1978)* reported that 0.09 mg/100 grams is the normal copper level in hard cheese. 66.6% of local hard cheese and 40% of imported hard cheese samples contained levels higher than 0.09 mg/100 grams dry weight for copper. Our results of luncheon samples analyzed revealed that the mean copper concentration in the product of the company A and B were 12.9±3.8 and 13.9±3.03 in a total mean of 12.9 ±2.3 mg/kg respectively .

Zinc is an essential trace element, necessary for enzyme reactions, protein synthesis and carbohydrate metabolism. As in the case of many elements, food provide the largest source of zinc and cadmium intake for human beings. Some reports of cases of zinc poisoning arising from the use of galvanised utensils for acidic foods have probably been due to the cadmium content of zinc *(LUCAS, 1975)*. Meat is a major source of zinc. It is being added to vegetable protein products intended to simulate meat. *(BENDER, 1984)*. Our results revealed that the mean value of zinc in different kinds of cheeses was 20.2±4.7 mg/kg dry weight and the highest concentration was recorded in local hard and local processed cheese as 43.6±20.3 and 28.1±9.3 mg/kg dry weight, respectively. 20 mg/kg is the maximum Egyptian permissible limit of zinc in processed cheese with plant oil reported by *Egyptian Organization For Standardization, (1993)*. About 16 and 17% of the imported and local processed cheese samples contain more than 20 mg/kg zinc respectively. One of the most comprehensive surveys of zinc concentration in food was carried out in the USA revealed that 35.1 ppm is the normal zinc concentration in dried non-fat cheese and 31.5 and 56.6 ppm, is the normal zinc concentration in cereals and beef meat respectively *(LUCAS, 1975)*. Results of lucheon samples analyzed revealed that the mean zinc concentration in the product of the company A and B were 60.66±8.8 and 61.34±7.8 in a total mean of 61.04 ±5.8 mg/kg respectively.

Certain chemicals are capable of causing perminent brain damage,

physical and/or personality disorders that are irreversible; manganese is one of these chemicals *(JAMES, 1985)*. Manganese intoxication in man is more important than deficiency; chronic manganism has been reported among manganese miners in Latin America. The effect is similar to idiopathic or post encephalitic Parkinsonism *(BENDER, 1984)*. Manganese in human milk is found mostly in the whey whereas in cows' milk it is present primarily in the casein fraction *(FAIRWEATHER-TAIT, 1992)*. Our results revealed that the mean concentration of manganese in different types of cheese was 2.4±0.1 mg/kg and the highest concentration was recorded in Kareish cheese as 4.5 ±0.4 mg/kg dry weight. *OCKERMAN, (1978)* reported that the normal manganese level in hard cheese was 0.11 mg/100 grams. *DIM et al., (1991)* found a high level of manganese (2340 µg/L) in local cooking salts used by some villagers in Nigeria as compared to common salt containing 8.7 µg Mn/L. Luncheon results revealed that the mean manganese concentration in the products of the company A and B were 5.31±1.4 and 7.25±1.5 in a total mean of 6.27±1.05 mg/kg respectively. *MCDONALD et al., (1969)* reported that protein supplements of animal origin are usually, low or very low in manganese level, whereas 5-15 ppm manganese are common in such food as dried skim milk, butter milk, fish meal and meat meal.

Cadmium and its salts are widely employed in numerous industrial processing and it is a component of many commercial products. Cadmium is found in nature in close association with lead and zinc *(KLAASSEN, 1985)*. By experiments involving farm animals it has been reported that higher than average concentrations of cadmium in the diet can interfere with copper metabolism leading to reduced levels of copper in the liver and in the blood. This suggested that cadmium is a more powerful competitor with copper than is zinc *(LUCAS, 1975)*. It is obvious from animal, clinical and/or industrial studies that cadmium is a potent metal toxicant. Nearly all cadmium salts are hazardous. Human exposure to cadmium may result from both occupational and environmental sources and mainly through food *(POUNDS, 1985)*. Cadmium is the heavy metal most prone to accumulate in human body. Its level increases throughout life because its biological half-life is 10 to 30 years *(KLAASSEN, 1985)*. Food represents the second major source of exposure to cadmium *(LEE and WHITE, 1983)*. 0.05 mg/kg is the maximum permissible limit of cadmium in processed cheese with vegetable oil *(Egyptian Organization For Standardization, 1993)*. Our results revealed that the mean value of cadmium in different kinds of cheese was 2.9±0.2 and the highest concentration was recorded in Kareish cheese as 5.4±0.4 mg/kg dry weight. In the USA, *LUCAS, (1975)* reported

that 0.49 ppm is the normal cadmium concentration in dried non-fat cheese. On the other hand, results of luncheon revealed that the mean cadmium concentration in the product of the company A, B, and total mean were 5.08± 1.5, 5.37±1.3 and 5.13±0.9 mg/kg respectively. The maximum permissible concentration in kidney as reported by *(DOYLE et al., 1993)* was 2.5 mg/kg. One of the most comperhensive surveys of concentrations of cadmium in food was carried out in the USA by Henry Schroeder and his colleagues revealed that 0.25 and 0.89 ppm, is the normal cadmium concentration in cereals and beef meat respectively *(LUCAS, 1975)*.

In conclusion, the obtained results illustrated that the various types of local soft, processed and imported hard cheeses relatively contained high values of the estimated elements. This may be due to the use of contaminated milk and salt with these elements in cheese manufacture; improper sanitary measures during milking, manufacture processes, packing and marketing of these cheeses. Good hygienic measures must be applied during cheese production accompanied with milk and salt free from contamination with these elements.

It is percisely evident from the study that luncheon (company A and B products) is highly contaminated with lead, zinc and cadmium. Good hygienic measures also must be applied in luncheon production. Meat, cereals, salts and other additives used for production must be analysed for these elements before, during and after manufacture.

REFERENCES

Bartik, M. and Piskac, A. (1981): Veterinary Toxicology. 1st. Edition Elsevicer Scientific Publishing Company, Amsterdam, Oxford, New York, p. 108-118.

Bender, A. E. (1984): Nutrition. In Food Industries Manual. 21st Edition. Ranken M.D. (ed.), Leonard Hill, USA PP.375.

Dim, L. A., Kinyua, A. M., Munyithya, J. M., and Adetunji, J., (1991): Lead and other metals distribution in local cooking salt from the Fofi saltspring in Akwana, Middle Benue Trough, Nigeria. J. Environ. Sci. Health B26: 357-365.

Doyle, M. E., Steinhart, C. E. and Cochrane, B. A. (1993): Food Safety 1993. pp.324-329. Food Research Institute. Marcel Dekker, Inc. New York.

Egyptian Organization For Standardization (1993): Egyptian Standard, Maximum Levels For Heavy Metal Contaminants In Food. ES: 2360-1993, UDC:546.19:815. Arab Republic Of Egypt.

EL-Shreif, A. A. (1991): Lead levels in macro-and micro environment of cattle at Assiut Governorate. M.V.Sc. thesis. Assiut University.

Fairweather-Tait, S. J. (1992): Bioavailability of trace elements. Food Chemistry 43 pp. 213-217.

Gossel A. T. and Bricker, J. D. (1990): Metals. In principles of clinical toxicology. 2nd edition. pp. 162-192. Raven press-New York.

Gracey, J. F., (1986): Chemical Residues in Meat. In Meat Hygiene.8th edition, English Language Book Society/Bailliere Tindall. pp. 191-210.

Grandjean, P. (1986): Diseases associated with metals, in Last J M (Ed) Public Health and Preventive Medicine, 23 rd ed. Norwalk, Conn., Appleton Century-Crofts, 1986, pp. 587-661.

Hagstad, H. V. and Hubbert, W. T. (1986): Food Quality Control, Foods of Animal Origin. The Iowa State University Press / Ames. pp. 86-87.

James, R. C.(1985): Neurotoxicity: Toxic Effects in the Nervous System. In Industrial Toxicology, Safety and Health Applications in the Workplace. Williams, P. L., and Burson, J. L.(ed.). Lifetime Learning Publications, Van Nostrand Reinhold Company, New York.pp.123-137.

Klaassen, C. D. (1985): Heavy metals and heavy metal antagonists in: the pharmacological basis of therapeutics. 7th ed., edited by A. J. Gilman, L. S. Goodman, T. W. Rall and F. Murad. Macmillan, Newyork. pp. 1605-1627.

Koirtyohann, S. R.; Koiser, M. L., and Hinderberger, E. J. (1982): Food analysis for lead using furnace atomic absorption and alvov platform. J. A. O. A. C. 65, 999-1004.

Lee, J. S. and White, K. L. (1983): Cadmium, in Rom WN (Ed): Environmental and occupational Medicine. Boston, Little, Brown 1983. pp. 465-472.

Lucas, J. (1975): Industreal pollution by the mineral elements. In Our Polluted Food, A Survey of the Risks. Charles Knight & Company Limited, London and Tonbridge. pp. 157-199.

Manzler, A. D., and Schreiner, A. W. (1970): Coppper-induced acute hemolytic anemia. A new complication of hemodialysis. Ann. Intern. Med., 73;409-412.

Marletta, G. A. and Favretto, L. G. (1983): Zeitschrift fur Lebensmittel-Untersuchung und Forschung 176, 32.

McDonald, M. W., Humphries, C. , Short, C. C., Smith, L. and Soluyns, A. (1969): Proc. Austpoult. Seci-Conv. p.223.

Ockerman, H. W. (1978): Source book for food scientists. The Avi publishing company, Inc., Westport, Connecticut. pp. 670.

Pounds, J. G. (1985): The Toxic Effects of Metals. In Industrial Toxicology, Safety and Health Applications in the Workplace. Williams, P. L., and Burson, J.L.(ed.). Lifetime Learning Publications, Van Nostrand Reinhold Company, New York.pp.197-210.

Shehata, A. and Saad, M. Nagah (1992): Lead content in milk of lactating animals at Assiut Governorate. Assiut Vet. Med. J. Vol. 26, No. (52), 135-141.

Yeshajahu, P. C. E., (1994): Ash and Minerals. In Food Analysis, Theory and Practice. 3rd. edition. pp.602. Chapman &Hall, New York, London.

Zaki, Z. M., Abdel-Nasser M, Nagwa M. EL-Sawi and Saddek A. Sh. (1994): Toxicological elements in different water sources in Assiut Governorate and possible health risk. Bull., Fac. Sci., Assiut Univ., 23 (1-E), pp. 225-241.

Table 1. Range and mean values (mg/kg dry weight) of lead, iron, copper, zinc, manganese and cadmium in different analyzed cheese

Cheese	Values	Elements					
		Lead	Iron	Copper	Zinc	Mang	Cadmium
Imported hard	Range	0.12 - 0.42	12.0 - 28.0	0.4 - 3.3	4.9 - 21.8	1.0 - 2.8	1.1 - 2.9
	Mean	0.245±0.05	19.6±2.6	1.4±0.5	12.8±2.8	1.5±0.2	2.1±0.3
Local hard	Range	0.16 - 0.28	6.0 - 49.0	0.3 - 3.4	6.6 - 77.0	1.3 - 2.8	1.1 - 3.1
	Mean	0.198±0.01	30.4±0 5.8	2.0±0.5	43.6±20.3	2.1±0.27	2.1±0.27
Imported processed	Range	0.13 - 0.37	15.7 - 42	0.4 - 4.8	4.6 - 99.2	1.3 - 2.6	1.9 - 3.3
	Mean	0.22±0.02	29.7±2.7	3.0±0.4	21.7±8.4	2.1±0.1	2.7±0.12
Local processed	Range	0.14 - 0.37	14.0 - 35.0	0.9 - 4.5	4.9 - 111.9	0.8 - 3.6	1.5 - 4.5
	Mean	0.266±0.01	22.5±1.2	3.5±0.2	28.1±9.3	2.1±0.1	2.7±0.2
Imported soft	Range	0.11 - 0.37	14 - 49	0.4 - 4.8	5.0 - 9.0	1.3 - 2.6	1.9 - 3.3
	Mean	0.22±0.02	24.0±2.7	3.0±0.4	8.4±0.5	2.1±0.1	2.7±0.1
Damietta	Range	0.17 - 0.36	14.7 - 67.8	0.9 - 3.9	4.4 - 15.3	1.3 - 5.8	2.0 - 4.0
	Mean	0.25±0.018	32.7±5.4	2.5±0.4	8.9±1.1	2.8±0.5	2.8±0.2
Kareish	Range	0.24 - 0.77	15.2 - 45.6	1.9 - 10.0	8.0 - 27.0	2.7 - 7.3	2.8 - 8.3
	Mean	0.55±0.03	26.1±2.8	5.2±0.8	18.3±2.2	4.5±0.4	5.4±0.4
Mean	Range	0.11 - 0.77	6.0 - 67.8	0.3 - 10.0	4.4 - 112	0.8 - 7.3	1.1 - 8.3
	Mean	0.28±0.01	26.4±1.7	2.9±0.1	20.2±4.7	2.4±0.1	2.9±0.2

LEAD, IRON, COPPER, ZINC, MANGANESE, CADMIUM CHEESE & LUNCHEON

Table 2. Range and mean values (mg/kg dry weight) of lead, iron, copper, zinc, manganese and cadmium in Egyptian luncheon.

Product	Values	Elements					
		Lead	Iron	Copper	Zinc	Mang.	Cadmium
A	Range	0.23 - 2.07	3.47 - 162.1	0.51- 49.65	5.75- 154.8	1.14 - 18.1	0.92-22.47
	Mean	0.93±0.15	71.9±12.07	12.9±3.8	60.6±8.8	5.3±1.4	5.08±1.5
B	Range	0.08 - 2.82	6.94 - 167.2	0.57- 42.28	7.64- 173.6	1.2 - 19.92	0.94 - 19.9
	Mean	1.15±0.175	76.8±11.2	13.92±3.03	61.3±7.8	7.2±1.5	5.3±1.3
Mean	Range	0.08 - 2.82	3.47 - 167.2	0.51- 49.65	5.75- 173.6	1.14 - 19.9	0.92 - 22.4
	Mean	1.03±0.11	73.1±8.05	12.9±2.38	61.04±5.8	6.2±1.05	5.1±0.9

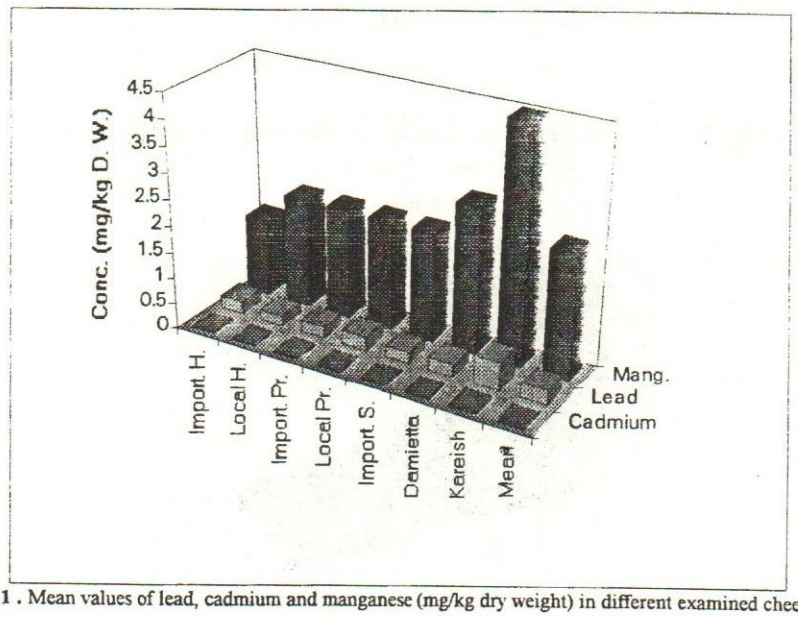

Figure 1 . Mean values of lead, cadmium and manganese (mg/kg dry weight) in different examined cheeses.

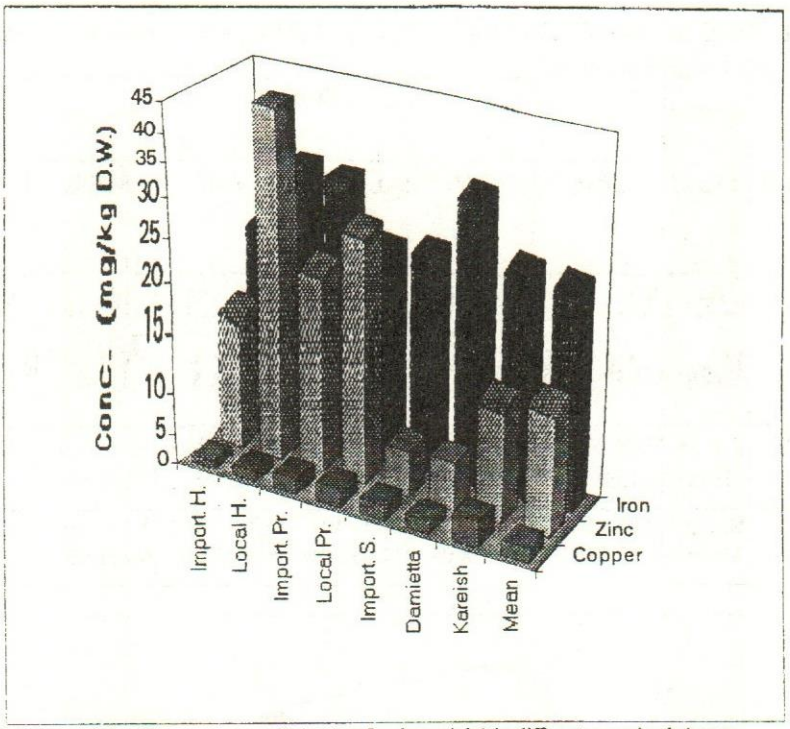

Figure 2. Mean values of iron, copper and zinc (mg/kg dry weight) in different examined cheeses.

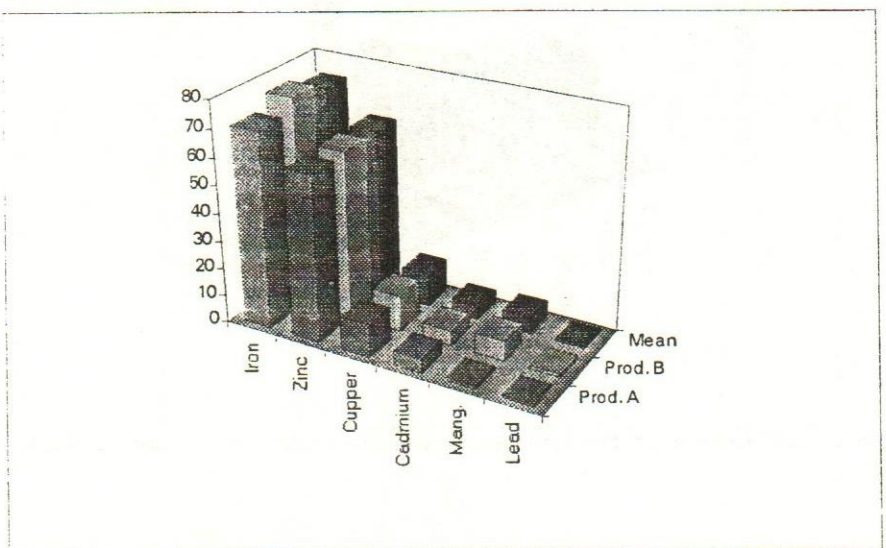

Figure 3. Mean values (mg/kg dry weight)of lead, iron, zinc, copper, cadmium and manganese in luncheon