Estimation of Some Minerals In The Tissues and Blood Profile of Goats From Different Localities In Kaleubia Governorate

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ABSTRACT

Thirty male goats (with average weight of 35kg) were obtained from six centers from Kaleubia Governorate (five goats per center). The goats were randomly selected for obtaining meat (Steronecphalic muscle) and serum samples during their ordinary slaughtering in the villages of the centers. The samples were used for determination of some micro- (trace) and macro- elements (lead, zinc, selenium, cobalt, iron, copper, magnesium and potassium), in their muscles and serum using atomic absorption spectrophotometry. Also, the serum protein profile (immunoelectrophoretic fractionation of the serum protein) was determined to chicking the possible toxicity or deficiency of determined elements on the immunoglobulins. From the results it could be concluded that there was lead pollution in the Banha, Kanater El-Khairia and Shubra El-Khaima centers, with considerable residual values of lead over the permissible value, so lead contamination of the environments in these 3-centers should be minimized, and the lead in goats (or perhaps in other animals) should be reduced in their bodies to minimizing its harmful effects in animals which used for meat production. Also, the zinc, selenium, iron, magnesium and cobalt values were under toxic limits and above deficiency ones. But the copper and potassium values were under the normal limits and should be consider the deficient elements in the studied centers of Kaleubia governorate, perhaps due to the presence of their deficiencies in the soil, water and pastures, so that, dietary copper and potassium supplementation should be supplied. Also, there were hypergammaglobulinemia in goats of Shibin K., Shubra Kh. and Tokh-centers compared to the other centers. The selenium, zinc and magnesium may showed the immunostimulant effects, while lead may showed the immunosuppressive one, or the immunosupressive effects may be due to other undefined factors than that of the currently investigated.

INTRODUCTION

The heavy metals are the Iron (Fe) and the metals denser than it, e.g. Manganese (Mn), Copper (Cu), Cobalt (Co) and Zinc (Zn) which are essential to the organisms, while others are non-essential, harmful or toxic metals (depend on the species and concentration) as lead (Pb), mercury (Hg) and cadmium (Cd) ***(1).*** The distinction between macro minerals and micro-or trace minerals is based on the relative amounts required in the diet for normal body function. 25-different trace elements have been reported in blood serum and kidney tissue. Of these elements, only about half are required in the diets of organisms. The list of trace minerals required by animals continues to grow. The latest mineral added to the list is silicon (Si) to be required for growth of chickens. The required minerals by one or more animals are: Iodine (I), Fe, Cu, Zn, Mn, selenium (Se), chromium (Cr), fluorine (F), molybdenum (Mo) and Si. The minerals which possibly required as: Aluminum (Al), Arsenic (As), Cd, Nickel (Ni), Vanadium (V), Tin (Sn), Boron (B), Bromine (Br), Lead (Pb) and Lithium (Li) ***(2).***

The higher concentrations of Magnesium (Mg) and copper (Cu) are detected in goats with congenital goiter that accompanied by lowered T3, T4 and TSH-hormones, but cobalt (Co), Zinc (Zn) and Selenium (Se) are decreased ***(3).*** Lice infested goats showed lowered Cu, Zn, calcium (Ca) and phosphorus (P), these minerals are accompanied by anaemia, cachexia and anorexia ***(4).***

The average values of serum potassium (K) and Mg in goats are 18.85 and 2.57mg %

respectively *(5)*. The levels of dietary Cu to 50-100mg/head may induced Cu-toxicity in sheep, but not in goats which could induced by 150-200mg/head/day for 8-12 weeks, so goats more resistant to Cu-toxicity than sheep *(6)*. Lactating goats fed contaminated ration with 200 ppb Aflatoxin-B_1 showed lowered serum concentrations of Mg, K, Ca, P, total protein, albumin and globulins *(7)*. The naturally occurring K-deficiency is thought to be rare, K-deficiency in soil affect its concentration in roughage with the development of hypokalaemia with the signs of anaemia, poor growth and diarrhea. Hyperkalaemia induced hypomagnesaemic tetany with signs of tetany, tremors and death *(8 and 9)*. The Cd, Cu, lead (pb) and Zn concentrations are increased in polluted water in Assiut villages (Egypt) than that of tap-water with subsequent increased their concentrations in samples from sheep drunk this polluted water *(10)*.

The lead (pb) toxicity induced CNS-abnormalities (as convulsive seizures, circling, blindness, and maniacal behaviours), anaemia, increased reticulocytes (with basophilic stippling) and substantial and functional renal damage with presence of tubular nuclear inclusion bodies *(11)*. Lambs fed Astragalus plant which contain 20-25 ppm selenium (se) induced toxicity with signs of ataxia, paralysis, hair loss, lacrimation, cracked hoof walls, reduced feed intake and weight gain within 30-days of feeding *(12)*.

Concerning the effects of metals on the immune responses, the Cd (strongly) and Pb (weakly) inhibited the repair of damaged DNA of lymphocytes (previously UV-damaged) and this effect of Cd and Pb could be restored by adding 0.4M $Mgcl_2$, indicating that Mg reduced the genotoxicity of Cd and Pb to lymphocytes *(13)*. Cobalt sulfate therapy increased body weight gain, immune response, haemopoiesis and carbohydrate metabolism *(14)*. The Cd and Pb affecting the lymphocyte population, thereby influencing on the immune response against viral pathogens as bovine lymphocyte virus (BLV) infection compared to metal untreated lymphocytes obtained from BLV-infected sheep *(15)*. Oral Zn-oxide therapy increases the body weight gain and immunoglobulins. Zn and Cu combination are useful than Zn-alone, but Zn-alone might cause decrease of Cu-concentration *(16 and 17)*. Se-therapy alone induced significantly increase of Chlamydia antibody response, but not when it was given in combination with vitamin-E (vit. E). Animals that received Vit. E therapy had much lower antibody titers just above those of the control animal *(18)*. The most common sign of Se and Vit. E-deficiencies is nutritional myodegeneration (white muscle disease) *(19)*.

There are few data concerning the trace and macro elements on the goats compared to that on sheep or other animals. The native goats was also chosen for mineral evaluations as it thought to be freely moved on the streets of the Egyptian villages and their adjacent agricultural fields, allover the day time, so these goats may feeding and drinking on any polluted wasts. We believed also that the native goats may be considered as indicator for metal deficiencies in soil, water and pastures or the metal pollution, so that, the mineral status of native goats from different localities in Kaleubia Governorate were compared, with the studying the possible effects of the levels of these elements on the function of the immune system, and this is the target of the current study.

MATERIAL AND METHODS

Animals

Thirty male goats (with average weight of 35kg) not suffering from clinical signs of specific disease were used in the present study. The goats were obtained from six-different localities (centers) in Kaleubia governorate, five animals from each center randomly chosen during their normal slaughtering in the villages of: Banha, Tokh, El-Kanater El-Khairia, Shibin El-Kanater, Kaleub and Shubra El-Khaima-centers. Blood (for serum) and meat (Sternocephalic muscle) samples were obtained form all of the animals of the 6-centers for heavy metal determination (in serum and muscle) and for serum protein immunoelectropheresis.

Determination of elements in the meat (Sternocephalic muscle) samples

From each of 30-slaughtered goats, 1 gm of sternocephalic muscle was placed in a clean dry screw-capped bottle and digested and the digested meat solution samples were used for metal determinations of: lead, zinc, cobalt, selenium, copper, iron, magnesium and potassium by part per million (ppm) using atomic absorption spectrophotometer.

Determination of elements in the serum samples

The collected 30 serum samples (5 samples × 6 centers) were prepared and digested according to the technique recommended by ***(21)***. The digested serum samples were filtered and prepared for measurements of the levels of: lead, zinc, selenium, cobalt, iron, copper, magnesium and potassium (by ppm) using atomic absorption spectrophotometer.

Serum protein-immunoelectrophoresis

The serum samples of goats of the 6-centers were used for fractionation of their serum protein according to procedure of Helna laboratories publications, Titan III-Cellulose Acetate Plates, Electra-HR-Buffer, and Ponceau-S-Stain were used. The electrophoretic patterns of serum proteins were scanned and graphed by auto-scanner Flur-Vis to reveal the densitometer tracing ***(22)***.

Statistical analysis

The obtained data were statistically analysed through the Analysis Of Variance (ANOVA), Two-way classification method (F-Test) ***(23)***.

RESULTS

The Elements of Meat (Sternocephalic muscle)

1- **Lead:** The highest amount could be detected in Banha center (0.920 ppm), the medium amounts in Kanater El-Khairia center (0.600 ppm), and the lowest amount could be detected in Shubra El-Khaima center (0.310 ppm) with significant variations between the 3- centers,, no lead (0.00 ppm) in the other centers of Kaleubia governorate (Tokh, Shibin El-Kanater and Kaleub centers).

2- **Zinc (Zn):** The Kanater El-Khairia center showed the highest concentration of meat Zn (12.600 ppm), while the other centers of Kaleubia governorate showed meat-Zn with concentrations ranged between 2.410 ppm (Shibin El-Kanater) to 5.490 ppm (Tokh).

3- **Selenium (Se):** The highest Se-concentration in goat's meat could be detected in Tokh center (2.270 ppm). No Se could be detected in Banha centre, but the other centers showed Se-concentrations ranged between 1.040 ppm (Kaleub) to 2.270 ppm (Tokh) without any significant differences between them.

4- **Cobalt (Co):** Co-concentrations ranged between 2.96 ppm (Banha) to 4.390 (Tokh), but there were no significant variations of Co-concentrations between all centers.

5- **Iron (Fe):** The Fe concentrations ranged between 12.66 (Kanater El-Khairia) to 14.180 ppm (Shubra), but without any significant variations in Fe-concentrations between all centers.

6- **Copper (Cu):** The highest concentration of Cu in meat could be detected in Shibin El-Kanater (0.860 ppm), but the lowest Cu-concentration in Kaleub center (0.610 ppm).

7- **Magnesium (Mg):** The highest Mg-concentration (407.50 ppm) was detected in Tokh center, but the lowest Mg concentration could be detected in Shibin-K and Kaleub (288 and 289 ppm respectively), Mg-concentrations ranged between 334 ppm to 355 ppm in the remaining of the 3-centers without significant variation between them.

8- **Potassium (K):** The highest K-concentration in the meat of goats was detected in Kanater Kh. Center (1142.50

ppm), the medium concentrations (901 & 880.05 ppm) were detected in Tokh and Shubra centers respectively with no significant changes, followed by Banha and Kaleub (794 & 761 ppm respectively with no significant changes), but the lowest K-concentration was detected in Shibin K. (637.5 ppm). The muscle elements are tabulated in Table 1 and illustrated in fig. 1.

The Elements of the Serum of Goats

1- **Lead (pb):** The serum lead could be detected only in Banha center (0.690 ppm, the highest concentration) and in Kanater Kh. center (0.220 ppm, the lower concentration), the Pb in serum could not be detected in goats of the remaining four centers.

2- **Zinc (Zn):** The highest serum-Zn concentration could be detected in Tokh (16.09 ppm), the other remaining centers showed Zn-concentrations ranged between from 0.410 ppm to 0.550 ppm, without significant variations in Zn-concentrations between them.

3- **Selenium (Se):** No Se could be detected in the serum of goats of the all centers of Kaleubia governorate .

4- **Cobalt (Co):** The serum Co concentrations of goats ranged between 4.14 ppm to 5.15 ppm in all centers with no significant changes between all centers.

5- **Iron (Fe):** The serum Fe-concentrations in goats ranged between 6.59 ppm in Tokh (the lowest) to 8.34 ppm in Shubra Kh. (the highest). No significant variations in Fe-concentrations between all centers (except in Tokh).

6- **Copper (Cu):** The highest serum Cu could be detected in Tokh (0.900 ppm), the medium Cu-concentration in Shibin K, Kaleub and Shubra (0.6900, 6700 and 0.6096 ppm respectively, without any significant changes). The lowest Cu-concentrations could be detected in goat serum from Banha and Kanater Kh. (0.420 and 0.550 ppm respectively, with significant difference between the Cu of the two centers).

7- **Magnesium (Mg):** The highest Mg-concentrations in the serum are detected in Shibin K and Banha centers (370 and 353 ppm respectively), the medium Mg-concentration could be detected in Shubra Kh. and Kanater Kh. (344 and 329 ppm respectively without significant change), but the lowest serum Mg were detected in Kaleub and Tokh (295 and 307ppm respectively, without significant changes).

8- **Potassium (K):** The highest serum K concentration (865 ppm) could be detected in Shibin K. center, the medium concentrations (694, 688 and 686.5 ppm) could be detected in Banha, Kanater Kh. and Shubra Kh. centers respectively, without significant changes between them, the lower K-concentrations (552 and 623 ppm) could be detected in the serum of goats from Kaleub and Tokh centers respectively, with significant difference between them. (The concentrations of serum elements of goats from the different centers are tabulated in table (2) and illustrated in fig. 2).

Immunoelectrophoresis (protein fractions) of the serum proteins of goats

1- **Albumin:** The highest serum albumin concentration (4.88g/dl) could be detected in goats from Kanater Kh., the medium concentrations (4.42 and 4.26 g/dl) could be estimated from goats of Shubra Kh. and Banha centers respectively (without significant difference between them), the lowest serum albumin concentrations (3.21, 3.59 and 3.838 g/dl) could be measured from goats of Shibin K., Tokh and Kaleub respectively. No significant change of albumin of goats between Tokh and Kaleub or between Tokh and Shibin K. centers.

2- **Alpha$_1$ (α_1) Globulin fraction:** The highest concentration of serum α_1-globulin could be detected in goats from Shibin K. (0.400 g/dl), the α_1-globulins of the others centers ranged between 0.200 to 0.270

g/dl, with no significant differences between them.

3- **Alpha$_2$ (α_2) globulins:** The highest concentration of serum α_2-globulin was detected in Tokh (2.53 g/dl). Banha, Shubra ad Shibin K. showed medium concentrations of α_2-globulins (1.53, 1.34 and 1.26 g/dl respectively with no significant differences between them), but its lowest concentration was found in Kanater Kh. (0.900 g/dl).

4- **Beta (β) Globulin fractions:** The highest β-globulin fractions of serum of goat was found in Kaleub center (1.72 g/dl), the medium (1.040 g/dl) found in Shibin K., the remaining centers (ranged between 0.150-0.460 g/dl) with no significant variations in β-fractions between the remaining 4-centers.

5- **Gamma (γ) globulins (immunoglobulins):** The highest concentration of the immunoglobulins (γ-fractions) was detected in Shibin K. and Shubra Kh. (0.990 and 0.880 g/dl respectively, with no significant variation between them), the medium concentrations were detected in Tokh, Banha and Kaleub centers (0.500, 0.370 and 0.350 g/dl, respectively, with no significant change between their concentrations), and the lowest concentration obtained from Kanater Kh. (0.290 g/dl) with no significant change between Kanater and Kaleub centers.

6- **Albumin/globulin (A/G-Ratio):** The highest A/G ratio was found in goat of Kanater Kh. (3.020), the medium ratios found in Banha (1.820), Kaleub (1.540) and Shubra Kh. (1.490) with no significant difference between them. The lower A/G ratio found in Shibin K. (0.870) and Tokh (1.020) with no significant difference between them.

7- **The serum total proteins:** The serum total proteins of goats from different centers of Kaleubia governorate ranged between 6.30 to 7.40 g/dl, with no significant differences between all centers. The serum protein immunoelectrophoresis of goats of the different centers was tabulated in Table 3 and illustrated in figs. 3 and 4.

Table 1. The Concentrations Of The Different Elements In The Meat (Sternocephalic Muscle) Of The Male Goats From 6-Centers In Kaleubia Governorate.

Centers	Lead (pb) (ppm)	Zinc (Zn) (ppm)	Selenium (Se) (ppm)	Cobalt (Co) (ppm)	Iron (Fe) (ppm)	Copper (Cu) (ppm)	Magnesium (Mg) (ppm)	Potassium (K) (ppm)
Banha	0.9200 ^{a} ± 0.01	4.4600 ^{bc} ± 0.32	0.0000 ^{c} ± 0.00	2.9600 ^{a} ± 0.12	13.6600 ^{a} ± 0.88	0.8300 ^{ab} ± 0.01	334.00 ^{b} ± 7.92	794.00 ^{c} ± 25.44
Tokh	0.0000 ^{d} ± 0.00	5.4900 ^{b} ± 0.41	2.2700 ^{a} ± 0.37	4.3900 ^{a} ± 0.49	12.9800 ^{a} ± 0.99	0.7700 ^{b} ± 0.03	407.50 ^{a} ± 13.86	901.00 ^{b} ± 15.18
Kanater Kh.	0.6000 ^{b} ± 0.01	12.6000 ^{a} ± 1.26	1.1000 ^{b} ± 0.14	4.0108 ^{a} ± 0.54	12.6600 ^{a} ± 1.18	0.7800 ^{b} ± 0.01	353.50 ^{b} ± 8.51	1142.50 ^{a} ± 31.11
Shibin.K	0.0000 ^{d} ± 0.00	2.4100 ^{d} ± 0.41	1.0500 ^{b} ± 0.12	3.9800 ^{a} ± 0.58	13.4300 ^{a} ± 0.93	0.8600 ^{a} ± 0.04	288.00 ^{c} ± 6.52	637.50 ^{d} ± 15.00
Kaleub	0.0000 ^{d} ± 0.00	4.1700 ^{bcd} ± 0.32	1.0400 ^{b} ± 0.15	4.0600 ^{a} ± 0.53	13.4700 ^{a} ± 1.14	0.6100 ^{c} ± 0.03	289.00 ^{c} ± 8.06	761.00 ^{c} ± 15.96
Shubra Kh.	0.3100 ^{c} ± 0.01	3.2400 ^{cd} ± 0.26	1.2100 ^{b} ± 0.13	4.1900 ^{a} ± 0.69	14.1800 ^{a} ± 0.73	0.6400 ^{c} ± 0.03	355.00 ^{b} ± 9.06	880.50 ^{b} ± 17.39
LSD ≤ 0.05	**0.29**	**1.76**	**1.04**	**NS**	**NS**	**0.08**	**45.00**	**86.50**

LSD = Least significant difference ($P \leq 0.05$), NS = Non significant. ^{abc} Values within a column followed by different superscript letters were significantly different ($P \leq 0.05$), while values within a column followed by the same superscript letters were not significantly different ($P \leq 0.05$).

Table 2. The Concentrations Of The Different Elements In The Serum Of The Male Goats From 6-Centers In Kaleubia Governorate.

Centers	Lead (pb) (ppm)	Zinc(Zn) (ppm)	Selenium (Se) (ppm)	Cobalt(Co) (ppm)	Iron (Fe) (ppm)	Copper (Cu) (ppm)	Magnesium (Mg) (ppm)	Potassium (K) (ppm)
Banha	0.6900 ^{a} ± 0.01	0.4800 ^{b} ± 0.070	0.0000 ^{a} ± 0.00	4.6200 ^{a} ± 0.59	7.5000 ^{ab} ± 0.35	0.4200 ^{d} ± 0.02	353.00 ^{ab} ± 7.78	694.50 ^{b} ± 22.47
Tokh	0.0000 ^{c} ± 0.00	16.09 ^{a} ± 1.26	0.0000 ^{a} ± 0.00	4.1400 ^{a} ± 0.54	6.5900 ^{b} ± 0.34	0.9000 ^{a} ± 0.04	307.00 ^{d} ± 6.07	623.00 ^{c} ± 13.34
Kanater Kh.	0.2200 ^{b} ± 0.01	1.0988 ^{b} ± 0.09	0.0000 ^{a} ± 0.00	5.1300 ^{a} ± 0.77	6.9900 ^{ab} ± 0.35	0.5500 ^{c} ± 0.03	329.00 ^{c} ± 6.77	688.00 ^{b} ± 13.86
Shibin.K	0.0000 ^{c} ± 0.00	0.5500 ^{b} ± 0.02	0.0000 ^{a} ± 0.00	4.4500 ^{a} ± 0.82	6.9800 ^{ab} ± 0.58	0.6900 ^{b} ± 0.04	370.00 ^{a} ± 7.11	865.60 ^{a} ± 12.61
Kaleub	0.0000 ^{c} ± 0.00	0.5300 ^{b} ± 0.03	0.0000 ^{a} ± 0.00	4.5200 ^{a} ± 0.79	7.0786 ^{ab} ± 0.52	0.6700 ^{b} ± 0.02	295.00 ^{d} ± 7.62	552.00 ^{d} ± 7.78
Shubra Kh.	0.0000 ^{c} ± 0.00	0.4100 ^{b} ± 0.03	0.0000 ^{a} ± 0.00	5.1500 ^{a} ± 0.79	8.3400 ^{a} ± 0.43	0.6096 ^{bc} ± 0.03	344.00 ^{bc} ± 6.94	686.50 ^{b} ± 11.90
LSD ≤ 0.05	**0.22**	**14.99**	**NS**	**NS**	**1.35**	**0.12**	**22.00**	**63.50**

LSD = Least significant difference ($P \leq 0.05$), NS = Non significant. ^{abc} Values within a column followed by different superscript letters were significantly different ($P \leq 0.05$), while values within a column followed by the same superscript letters were not significantly different ($P \leq 0.05$).

Table 3. The Different Serum Protein Fractions, As Determined By Immunoelectrophoresis Of Serum Proteins Of Male Goats From 6-Centers In Kaleubia Governorate.

Centers	Albumin (g/dl)	Alpha$_1$ (α_1) Globulins (g/dl)	Alpha$_2$ (α_2) Globulins (g/dl)	Beta (β) Globulins (g/dl)	Gamma (γ) Globulins (g/dl)	A/G ratio	Total protein (g/dl)
Banha	4.2600 ^{b} ± 0.23	0.2600 ^{b} ± 0.01	1.5300 ^{b} ± 0.25	0.1500 ^{c} ± 0.01	0.3700 ^{bc} ± 0.03	1.8200 ^{b} ± 0.14	6.6000 ^{a} ± 0.49
Tokh	3.5900 ^{cd} ± 0.94	0.2000 ^{b} ± 0.01	2.5300 ^{a} ± 0.14	0.2600 ^{c} ± 0.03	0.5000 ^{b} ± 0.04	1.0200 ^{cd} ± 0.07	7.1000 ^{a} ± 0.51
Kanater Kh.	4.8800 ^{a} ± 0.12	0.2200 ^{b} ± 0.03	0.9000 ^{c} ± 0.02	0.1800 ^{c} ± 0.02	0.2900 ^{c} ± 0.01	3.0200 ^{a} ± 0.37	6.5000 ^{a} ± 0.64
Shibin. K	3.2100 ^{d} ± 0.14	0.4000 ^{a} ± 0.03	1.2600 ^{bc} ± 0.04	1.0400 ^{b} ± 0.05	0.9900 ^{a} ± 0.04	0.8700 ^{d} ± 0.06	6.9000 ^{a} ± 0.48
Kaleub	3.8380 ^{c} ± 0.08	0.2600 ^{b} ± 0.02	0.1300 ^{d} ± 0.03	1.7200 ^{a} ± 0.32	0.3500 ^{bc} ± 0.01	1.5400 ^{bc} ± 0.14	6.3000 ^{a} ± 0.44
Shubra Kh.	4.4200 ^{b} ± 0.11	0.2700 ^{b} ± 0.04	1.3400 ^{b} ± 0.12	0.4600 ^{c} ± 0.04	0.8800 ^{a} ± 0.11	1.4900 ^{bc} ± 0.12	7.4000 ^{a} ± 0.52
LSD ≤ 0.05	**0.42**	**0.13**	**0.44**	**0.58**	**0.21**	**0.62**	**NS**

LSD = Least significant difference ($P \leq 0.05$), NS = Non significant. ^{abc} Values within a column followed by different superscript letters were significantly different ($P \leq 0.05$), while values within a column followed by the same superscript letters were not significantly different ($P \leq 0.05$).

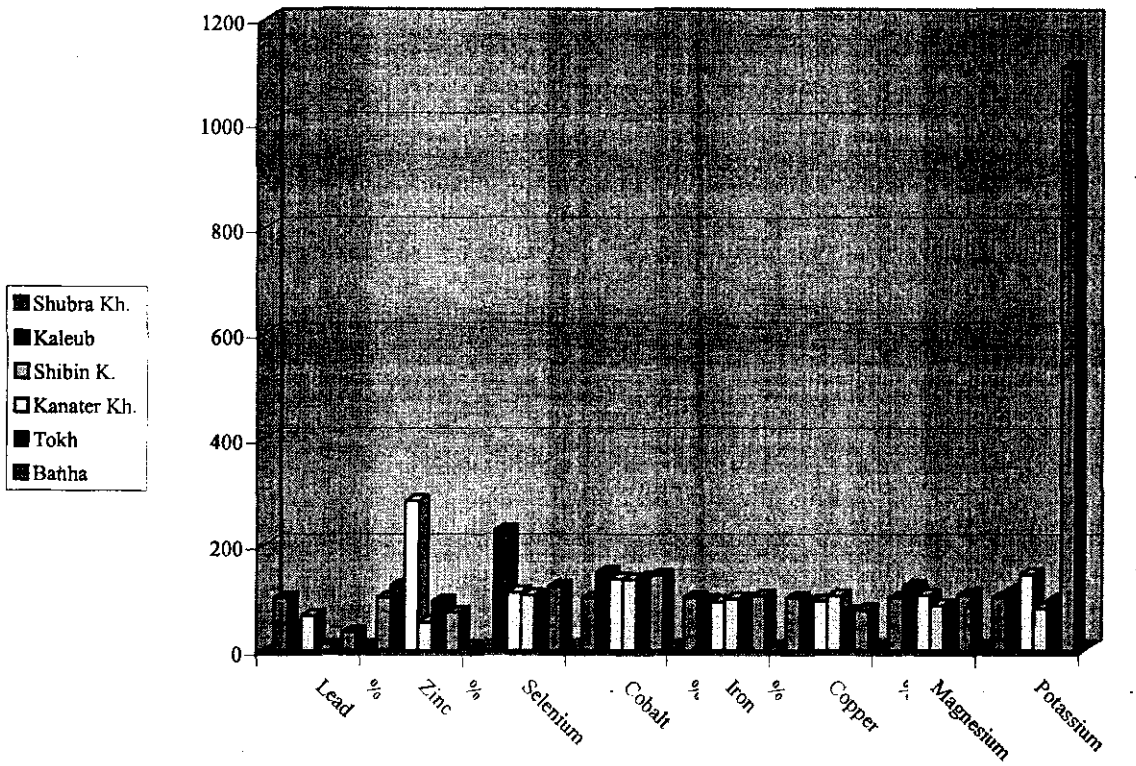

Figure 1. The percentage of different elements in the meat (sternocephalic muscle) of goats from the different centers of Kaleubia Governorate (Egypt) (in relation to Banha Center).

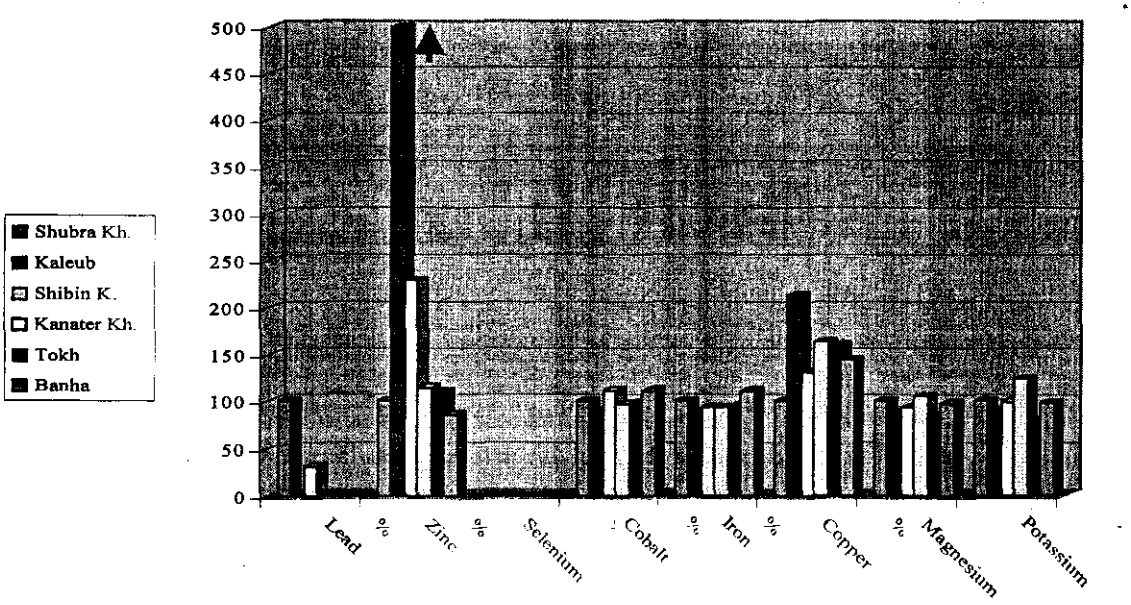

Figure 2. The percentage of different elements in the serum of goats from the different centers of Kaleubia Governorate (Egypt) (in relation to Banha Center).

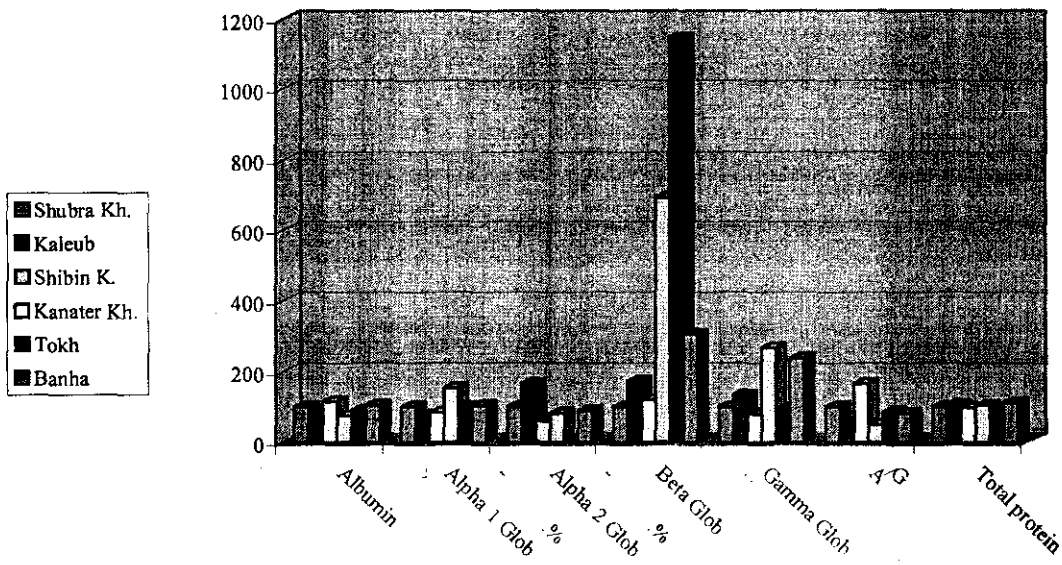

Figure 3. The percentage of the different serum protein fractions, as determined by Immunoelectrophoresis of serum proteins of goats from the different centers of Kaleubia Governorate (Egypt) (in relation to Banha Center).

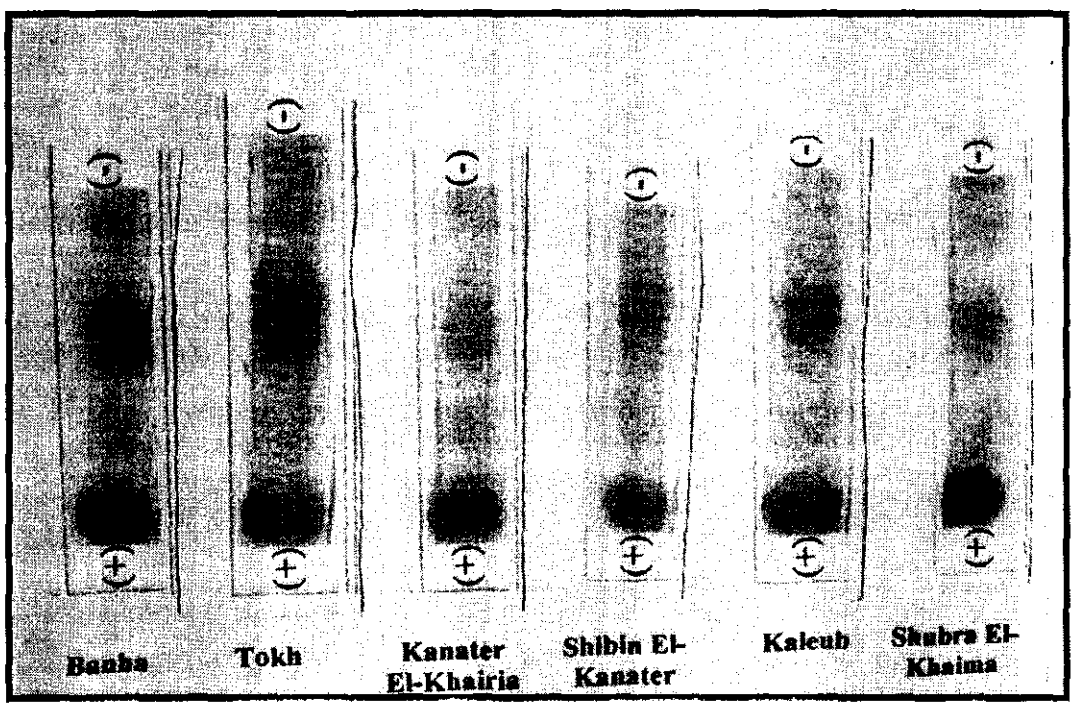

Figure 4. The serum protein fractions of the goats from the six different centers, as determined by cellulose-Acetate immunoelectrophoresis.

DISCUSSION

Although several elements play a major role in physiological activities, the others may pollute the soil, water, air, plants, feed and food with excess of heavy metals may reach to the animal tissues to be gradually accumulated to a level induces harmful toxic effects. The continuous metal ingestion make the meat to contain values over the permissible level, making it unfit for human consumption *(2)*. Lead, zinc, selenium, cobalt, iron, copper, magnesium and potassium were determined in muscle and serum of different centers of Kaleubia governorate to identify the possible deficiencies or toxicities of any of the studied elements and their possible effects on immune system function, as immunodepressants or immunostimulants, according to the type of the element, its concentration and the period of exposure *(6)*.

The present study revealed that the lead (Pb) concentration in the muscle of goat was 0.920 ppm (in Banha center), 0.600 ppm (in Kanater Kh. center) and 0.310 pm (in Shubra Kh. center), while the pb concentrations in the serum were 0.690 (in Banha center) and 0.220 ppm (in Kanater Kh. center), but no pb could be detected in the other centers of Kaleubia governorate. It noticed that the level of pb in muscle was higher than in serum indicating that pb was accumulated in goat tissues *(2)*. The obtained Pb concentration in muscle seem to be over the permissible value (0.100 ppm) as recommended by the Egyptian organization for standardization and quality 1993 *(25)* and 0.350 ppm in blood *(11)*, but Wood *(26)* reported the lead value of 10-20 ppm in liver and kidney was needed to confirm Pb-toxicity. The highest concentration of Pb was detected in Banha center then decreased in Kanater center (in both muscle and serum) then lowered in Shubra center (in serum only), and this indicating the pollution by lead in Banha > Kanater Kh. > Shubra Kh. centers, and all these 3-centers showed higher Pb-concentrations above the permissible limimits (as previousely mentioned). The most common source of lead in the environment is related to the burning of gasoline containing tetramethyl lead by the tractors and automobiles, also the lead containing paints, lead storage batteries, and lead containing insecticides *(27)*. Lead is still performing one of the common causes of poisoning in animals that it induced neurotoxicity, nephrotoxicity, hematotoxicity and other chronic forms of toxicity signs as previousely reviewed *(11)*. Lead affecting the immune function by affecting the lymphocyte directly through its effect on DNA synthesis of the lymphocytes, and consequently lead is immunosuppression to infectious diseases *(13,15)* and this could be detected by the present work, where there was a significant decrease of gamma (immuno)-globulins in Banha, Kanater and Kaleub centers than that of other centers, where the immunosuppressive effect in Kaleub center may be due to other factors than lead toxicity, so that the source of lead pollution in Banha, Kanater Kh. and Shubra Kh. should be recognized for minimizing it, and the Pb-intoxicated animals in these localities should be treated. The calcium gluconate and alkaline diets may suggested to demobilizing the plasma Pb into the bones *(28)*. The reason of increased gamma globulins in goats from Shubra Kh. Center (inspite of pressure of Pb in the serum), perhaps due to 2- causes, the first may be due to the recent pb-intoxication (where no muscle Pb-residue could be detected), the second or probably due to the high magnesium (Mg) concentrations in meat and serum, that Mg may play a role in minimizing Pb and cadmium (Cd) intoxication to lymphocytes *(13)*. So $MgCl_2$ should be used also for minimizing the Pb-induced immunosuppression in animals.

The preset study, revealed that the highest Zinc (Zn) concentrations in the meat muscle of goats were detected in Kanater Kh. center (12.60 ppm) followed by Tokh center (5.49 ppm), while Zn-concentrations in the other centers ranged between 2.41 to 4.64 ppm. On the other hand, the highest Zn-concentrations in the serum were detected in Tokh (16.09 ppm) followed by Kanater (1.0988 ppm), while the Zn-concentrations in the other centers ranged between 0.410 to 0.550 ppm. The higher Zn-concentration in

serum of Tokh goat and in the muscle of Kanater Kh. goat indicated the recent pollution with Zn-salts in Tokh center than that of Kanater Kh., with the consequent accumulation in their meat. But these Zn-values in meat seem to be less than the permissible limit (40 ppm) according to FAO (1980) ***(29)***. Zn is a constituent of numerous metalloenzymes and insulin hormone, it is required for normal protein, carbohydrate, and nucleic acids metabolisms. Its deficiency induced retardation of bone formation and growth ***(2)***. Zn-oxide therapy induced immunostimulant effect through increasing the immuno (γ)-globulins ***(16, 17)***, so that the increased serum-Zn (as a mobile Zn in the body) in goats of Tokh center perhaps the only reason of hyper gamma globulinemia in goats than that of goats from Kanater Kh. (of higher muscle Zn than their serum-Zn).

The highest selenium (Se) concentration could be detected in muscle of goats of the Tokh center (2.270 ppm), but no Se could be detected in Banha center and no Se could be detected in the serum of goats of the all studied centers. The level of muscle-Se expected to be less than the toxic levels (20-52 ppm) ***(12)***, and where Banha center showed no detectable Se in the muscles of the goats, it showed also hypogamma-globulinemia compared to the other centers, indicating the possible role of selenium as immunostimulant as recorded by Giadinis et al. ***(18)***. The Se plays a role in maintaining the integrity of cellular membrane ***(30)*** and incorporated in WBCs, RBCs, myoglobin, nucleo-proteins and several enzymes ***(31)***.

The concentration of Cobalt (Co) in the muscles of goats ranged between 2.96 ppm (Banha) to 4.39 ppm (Tokh), and in the serum it ranged between 4.14 ppm (Tokh) to 5.15 ppm (Shubra), no significant variations of Co-concentrations between all centers in either muscle or serum of goats, and these values suspected to be non-toxic for goats, as the signs of Cobalt toxicity not found in the studied goats. Because the Co has low absorption rate, so, Co-toxicity is not likely, the lethal dose for sheep is 300mg of soluble Co-salt/kg.b.wt (32). On the other side, Cobalt therapy induced immunostimulant effects and increased the body weight gain (14). Also co-deficiency is far to occur, due to the daily requirement for Co is around 0.08 ppm of feed dry matter ***(8)***.

The current study revealed that muscle iron (Fe) ranged between 12.66 ppm (Kanater) to 14.18 ppm (Shubra) with no significant changes in elements of muscle of goats between all centers. But Fe in serum ranged between 6.59 ppm (Tokh) to 8.4 ppm (Shubra). It seem that the concentration of Fe in muscle was more than that in blood, indicating its accumulation in the tissue to a limit as a reservoir avoiding Fe-deficiency, as Fe in muscle near its normal values in muscle (11-30ppm) ***(33)***. It seem also that Fe level in muscle and serum of goats suspected to be less than the toxic level, as no signs of Fe-toxicity were appeared in the studied goats from all centers. The signs of Fe- toxicity are diarrhoea, reduced growth and feed conversion, vasoular congestion of tissues ans metabolic acidosis. Death occurred by 200 mg ferrioammonium citrate por animal. Absorption of Fe is more efficient under acid conditions at PH 2-3.5 hence the deficiency or toxicity of Fe may enhanced by increased acidity or alkalinity of GIT respectively ***(2)***.

The Copper (Cu) concentrations in the muscle of goats in the present study ranged between 0.610 ppm (Kaleub) to 0.860 ppm (Kanater Kh.), while Cu-concentration in serum ranged between 0.420 ppm (Banha) to 0.900 ppm (Tokh). This limits of Cu-seem to be under the permissible limit value (20 ppm) according to WHO, (2000) ***(34)***. In ruminants, The deficiencies of Se, Zn, Cu or Fe, or the toxicities with lead or molybdenum may enhancing Cu-deficiency ***(9)***. Goats were more resistant to Cu-toxicity than sheep which in turn it could be induced in goats by 150 1200mg/head/day for 8-12 weeks ***(6)***.

The magnesium (Mg) concentrations in goats muscle in Kaleubia centers ranged between 288,289 ppm (Shibin K. and Kaleub) to 407.5 ppm (Tokh), and its concentrations in the serum ranged between 329 ppm (Kanater)

to 370 ppm (Shibin K.), indicating that the serum Mg-level is higher than the tissue level. The Mg-levels obtained suspected to be under the toxic values, and above the deficiency limits (202ppm in muscle) ***(35)***, where there were no sings of toxicity or deficiency with Mg. Mg seem to be alleviating the Co and pp genotoxicity to lymphocytes ***(13)***, so that Mg may considered as immunostimulant by the therapeutic requirement.

The potassium (K) concentration in the muscle of goats, in the present study, ranged between 637.5 ppm (Shibin K.) to 1142.50 (Kanater Kh.), while in serum, the K was ranged between 552 ppm (Kaleub) to 885 ppm (Shibin K.) indicating the higher K-concentration in tissue than that in the serum. The K provides for a stable osmotic pressure of the intracellular fluid, acetylcholine synthesis, generation of rest and action potential ***(36)***. The K seem to be under the normal level, where the average value of serum potassium in goats is 18.85mg% ***(5)***, indicating a degree of K-deficiency, K-deficiency in soil affect its level in roughages (with the development of poor growth, anemia and diarrhea). The higher potassium may interfere with Mg-absorption with the consequent hypomagnesemic signs ***(8 ,9)***.

The goats of most centers showed that the total protein, albumin, α_1- and α_2-globulins, and the β-globulins are within normal serum values ***(37)***, but there are some exceptions, as the prominent increase of α_1-globulin (0.400g/dl) in goats of Shibin K., the increase of α_2-globulins (2.53g/dl) in Tokh, and the increase β-globulin (1.72g/dl) in Kaleub center. Kaneko ***(38)*** reviewed that, there are 13 types of α-globulins of diagnostic values, the elevated levels of some α-globulins have reported with some toxic chemicals. The increased β-globulins levels may also attributed to some immunoglobulins (γ-fractions) transferred to the region of β-fractions in response to autoimmune diseases. McPherson ***(39)*** reported that while the albumin, α-globulins and β-globulins are synthesized in the liver, the immunoglobulins are synthesized by the plasma cells which maturated from β-lymphocytes in the spleen, bone marrow and lymph nodes.

It could be concluded that there were lead pollution in Banha, Kanater Kh. and Shubra Kh. centers, with considerable residual values of Pb over the permissible limits, so lead contamination should be minimized in the environment of these centers, and the lead in goats (or perhaps in other animals) should be reduced to minimize its harmful effects to animals used for meat production, also, the zinc, selenium, iron, magnesium and cobalt-elements under the toxic limits and above the deficiency values, but the copper and potassium were under the normal values and potassium should be the deficient elements in goats of all the studied centers of Kaleubia governorate (perhaps due to their deficient in soil, water or pastures), so that dietary copper and potassium should be supplied. Also, there were hyper gamma-globulinaemia in Shibin K., Shubra Kh. and Tokh centers compared to the other 3-centers.. The selenium, zinc and magnesium may showed immunostimulant effects, but the immunosuppression in the other sites may be due the high lead levels and/or due to other undetermined factors out of the scope of current work.

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الملخص العربي

تعيين بعض العناصر المعدنية في الأنسجة والدم مع دراسة الفصل الكهربي لبروتين المصل في الماعز من بعض المناطق بمحافظة القليوبية

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من محافظة القليوبية تم أخذ عدد ثلاثون من ذكور الماعز الناضجة (المتوسط وزن ٣٥كجم) من ستة مراكز بالمحافظة وهم مراكز بنها وطوخ والقناطر الخيرية وشبين القناطر وقليوب وشبرا الخيمة. حيث تم أخذ خمسة ماعز من قرى كل مركز بالاختيار العشوائي أثناء عمليات الذبح العادي، وذلك لأخذ عينات من لحم عضلات الرقبة (Sternocephalic M.) وعينات سيرم، وكان الغرض من الدراسة هو تقدير بعض العناصر (الرصاص والزنك والسلينيوم والحديد والكوبالت والنحاس والمغنسيوم والبوتاسيوم) في عضلات وسيرم الماعز من المراكز المختلفة وذلك باستخدام جهاز الامتصاص الذري الطيفي (Atomic Absorption (Sepctrohotometer، وكذلك عمل الفصل الكهربي لبروتين السيرم لنفس الحيوانات وذلك لتقدير الجلوبيولينات المناعية، وتحديد المستويات السامة للعناصر أو مستويات النقص لهذه العناصر، ولمعرفة أماكن التلوث أو النقص للعناصر المقدرة، وتأثير الزيادة أو النقص لهذه العناصر على مستوى الجلوبيولينات المناعية في ماعز المراكز المختلفة بالمحافظة.

وبناء على نتائج هذه الدراسة فقد أمكن استخلاص أنه يوجد زيادة بعنصر الرصاص في الماعز بمراكز بنها والقناطر الخيرية وشبرا الخيمة عن المستوى المسموح به وهذه يدل على وجود تلوث بالرصاص في بيئة هذه المراكز عن المراكز الأخرى، وبالتالي فإنه يجب تقليل التلوث بالرصاص بهذه المراكز بمنع مصادر التلوث به ومعالجة الماعز (وربما الحيوانات الأخرى) من ارتفاع الرصاص بأنسجتها، وذلك من أجل تقليل خطره على الحيوانات بهذه الأماكن خاصة المستخدمة في إنتاج اللحم للاستهلاك الآدمي، وكذلك فإن مستوى عناصر الزنك والسلينيوم والحديد والماغنسيوم والكوبالت بأنسجة وسيرم الماعز كانت تحت المستويات السامة وفوق مستويات النقص، ولكن وجد نقص في عنصري النحاس والبوتاسيوم في أنسجة وسيرم الماعز بالمراكز المختلفة دون المستوى المطلوب بالجسم، وبالتالي فإنه يجب إضافة عنصري النحاس والبوتاسيوم بعلائق الماعز (وربما الحيوانات الأخرى) لسد النقص بها، وذلك لاحتمال وجود نقص بهما في التربة والحشائش والنباتات والماء المستخدمين في تغذية وشرب هذه الحيوانات، ومن جهة أخرى فقد وجد زيادة معنوية في مستوى الجلوبيولينات المناعية في مراكز شبين القناطر وشبرا الخيمة وطوخ بالمقارنة مع المراكز الثلاثة الأخرى (ربما لوجود عناصر السلينيوم والزنك والمغنسيوم بالمستويات المطلوبة) وكذلك فإن النقص في الجلوبيولينات المناعية في مراكز بنها والقناطر الخيرية ربما كان بسبب الزيادة في عنصر الرصاص عن المستوى المسموح، إلا أن نقص المناعة قد يكون لعوامل أخرى خارج نطاق هذه الدراسة.