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CHEMICAL ANALYSIS OF MULBERRY LEAVES AND *BOMBYX MORI* L SILK PRODUCED FROM MULBERRY FIELDS IRRIGATED BY SEWAGE WATER.

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INTRODUCTION

The growth and development of land plants is largely limited by water shortage. Reuse of wastewater in agriculture has been, therefore, practiced in several countries (Siebe *et al.*, 1995 and El-Sokkary and Sharaf, 1996).

Heavy metals have significant toxicity for human, animals, micro-organisms and plants. Root systems absorbed heavy metals causing chlorosis leaf deficiency of essential elements and inhibition of root penetration and growth (Scott, 1992 and Fortakis and Timbrell, 2006).

Egyptian government turns to use the sewage wastewater for forest irrigation. But, in some places of Egypt many farmer use sewage wastewater for irrigation many crops illegally. Also, some persons drainage wastewater in the canals in slums. Which used for using in irrigation crops. Sewage wastewater and mixture of canal water and sewage water (1:1) were used in the present study to determine accumulation of heavy metals in mulberry leaves and silk to insure the safety of using sewage wastewater in irrigation mulberry trees and feeding silkworm to produce silk. Also, to insure the resulted mulberry leaves can consumed by human being or not? As well as the resulting silk can be used for cosmetics and fabrics or used for producing carpet only.

MATERIAL AND METHODS

Mulberry fields of *Morus alba* var Kokuso 27 was irrigated by canal water (consider as control), Sewage wastewater and mixture of canal water and sewage water (1:1). mulberry Leaves resulted from different treatments were used for feeding silkworm *Bombyx mori* L. (hybrid Giza B (D_{162} X F_{262})), obtained from Sericulture Research Department. The experiments were carried out at Sericultural Research Station Al- Qanatir Al-Khayriyah - Qalybia during autumn 2009 ,spring 2010 and autumn 2010. Fresh leaves were offered to larvae three times daily. Foam strips and polyethylene sheet were used during young instars (Ghazy, 2008). Sopped fresh mulberry leaves were offered for young instars, while whole leaves were offered for grown instars. Collapsible frames were used for mountage. Temperature and relative humidity were recorded inside the rearing room .

Chemical analysis were carried out to estimate elements of Nickel Ni, Iron Fe, Chrome Cr, Cobalt Co, Cadmium Cd, Copper Cu in canal, sewage and the sewage wastewater, and mixture of canal water and sewage water (1:1) according to Greenfield *et al*,(1964). Pervious elements were estimated in leaves and Similar elements were estimated in silk were according the method of Chapman and Pratt (1961) , and Greenfield *et al*, (1964).

Total proteins were estimated in leaves and larvae according to Chapman and Pratt (1961) and Koch and Mc Meekin (1924), respectively.

RESULTS AND DISCUSSION

- **Chemical analysis of heavy metals in irrigation water:**

Data in Table(1) recorded the amount of Nickel, Iron, Chrome, Cobalt, Cadmium and Copper (mg/L) elements in canal water , sewage waste and the mixture between them (1:1) in different seasons (Autumn 2009, Spring 2010 and Autumn 2010) compared with Egy.short cod and Egy.long cod. Data showed that, the concentrations of all recorded elements in canal water, sewage water and mixture less than Egy.short cod and Egy.long cod. Also, the data of Egyptian code of maximum concentrations of both short and long term usage of treated sewage in irrigation so that, the sewage water and mixture are safe to use in irrigation according to Anonymous (2004).

- **Chemical analysis of heavy metals in mulberry leaves:**

Table(2) show the estimated amounts of Nickel, Iron, Chrome, Cobalt, Cadmium and Copper (mg/g) elements in mulberry leaves irrigated by different irrigation waters compared with Egyptian code of maximum concentrations of both short and long term usage of treated sewage in irrigation .

All treatments have low concentration of all heavy metals comparing with short and long term of Egyptian code . By comparing the estimated amount of Nickel, Iron, Chrome, Cobalt, Cadmium and Copper (mg/g) elements in different irrigation waters (table 1) and mulberry leaves irrigated with the same different irrigation waters table(2) show that, the concentrations of most elements in mulberry leaves irrigated with sewage water at different seasons (Autumn 2009, Spring 2010 and Autumn 2010) lower than the elements in swage water except Fe element which noticeably increased in mulberry leaves (0.357, 0.319 and 0.357 (mg/g) than in sewage water (0.131, 0.129 and 0.166 (mg/g) respectively) in different seasons. Ashfaq *et al.*, (2009) stated that heavy metals of Nickel, Iron, Chrome, Cobalt, Cadmium and Copper seems to be non-accumulative element in mulberry leaves. And also reported that, mulberry was found to be Cobalt (II) non-hyper accumulator. When the initial Cobalt (II) concentration was low, and bioaccumulation in mulberry leaves was also reduced.

- **Chemical analysis of heavy metals in silk:**

Data recorded in table (3) represent the estimated amounts of different elements in silk resulting from larvae fed on mulberry leaves irrigated by different irrigation waters comparing with the Egy. Short cod and Egy.long cod .

Similar results of estimation heavy metals in mulberry leaves are obtained in silk during the three successive rearing seasons when compared with both of short and long term of Egyptian code Anonymous (2004).

- **Estimation of total protein of mulberry leaves and larvae:**

Table (1, 2) show that the estimated amounts of total protein in mulberry leaves and larvae for different irrigation treatments. Total protein amounts in mulberry leaves were the highest in all seasons for mulberry irrigated by mixture (canal water and sewage wastewater (1:1)) followed by sewage wastewater. Except in autumn 2010 has the lower value (1.68 mg/g) than other seasons in mulberry leaves irrigated by sewage water. This may be due to environmental factors. The protein content of leaves and silkworm larvae during Spring is higher than autumn seasons except the mulberry leaves irrigated by canal water.

Similar results were obtained for estimation of total protein in silkworm larvae. Treatments of mixture (1:1) and sewage water has higher respectively for both mulberry leaves and silkworm larvae. Canal water has low values, because the sewage wastewater is an additional source of mulberry nutrients supply, Peterson *et al.*, (1994). These results are coincidence with results of Sadek and Sawy (1989), Peterson *et al.*, (1994), Pradhan *et al.*, (2001) and Abd- Elfattah, *et al.*, (2002) who reported that, the value of sewage effluents for crop irrigation has been recognized as a potential water resources, an auxiliary supply for nutrients and soil structure improvement.

SUMMARY

Mulberry fields of *Morus alba* var Kokuso 27 was irrigated by canal water (consider as control), sewage and mixture of the same amount of canal water (control) and sewage (1:1). Leaves of mulberry irrigated by different treatments were used for feeding silkworm *Bombyx mori* L. of hybrid Giza B (D_{162} X F_{262}), The experiments were conducting during autumn 2009, Spring 2010, and autumn 2010. Chemical analysis were carried out to estimate elements of Nickel Ni, Iron Fe, Chrome Cr, Cobalt Co, Cadmium Cd, and Copper Cu in irrigation water treatments,

mulberry leaves and silk. Total protein in mulberry leaves and silkworm larvae were estimated.

The present study reveal that, sewage wastewater, leaves, silkworm larvae and silk have very low amount of the previous heavy metals comparing with data of Egyptian code of maximum concentrations of both short and long term usage of treated sewage in irrigation. Total protein is estimated in mulberry leaves and silkworm larvae. So that it safe to use sewage wastewater in irrigation mulberry trees and feeding mulberry silkworm.

Table(1). Amount of several elements in some treatments of irrigation waters.

Treatments	Season					
	Autumn 2009 (mg/L)					
	Ni	Fe	Cr	Co	Cd	Cu
Canal water (Control)	0.000	0.250	0.001	0.001	0.000	0.013
Mixture (1:1)	0.001	0.165	0.003	0.002	0.000	0.016
Sewage waters	0.004	0.131	0.004	0.004	0.001	0.017
Spring 2010						
Canal water (Control)	0.000	0.249	0.001	0.001	0.000	0.014
Mixture (1:1)	0.001	0.170	0.003	0.003	0.000	0.017
Sewage waters	0.003	0.129	0.004	0.004	0.002	0.018
Autumn 2010						
Canal water (Control)	0.000	0.247	0.001	0.002	0.000	0.014
Mixture (1:1)	0.001	0.180	0.002	0.003	0.000	0.016
Sewage waters	0.002	0.166	0.004	0.004	0.002	0.017
Egy.short cod	2	20	1	5	0.05	5
Egy.long cod	0.20	5.0	0.10	0.05	0.01	0.20

Table (2)Amounts of elements in mulberry leaves irrigated with different irrigation waters.

Treatments	Season					
	Autumn 2009 (mg/g)					
	Ni	Fe	Cr	Co	Cd	Cu
Canal water (Control)	0.000	0.126	0.000	0.002	00.00	0.014
Mixture (1:1)	0.002	0.170	0.001	0.002	00.00	0.016
Sewage waters	0.002	0.357	0.002	0.003	0.000	0.018
Spring 2010						
Canal water (Control)	0.000	0.128	0.000	0.001	0.000	0.013
Mixture (1:1)	0.002	0.168	0.001	0.002	0.000	0.016
Sewage waters	0.002	0.319	0.002	0.003	0.001	0.018
Autumn 2010						
Canal water (Control)	0.000	0.130	0.000	0.001	0.000	0.014
Mixture (1:1)	0.002	0.170	0.001	0.002	0.001	0.016
Sewage waters	0.002	0.357	0.002	0.003	0.001	0.018
Egy.short cod	2	20	1	5	0.05	5
Egy.long cod	0.20	5.0	0.10	0.05	0.01	0.20

Table (3) Amount of some elements in natural silk produced from larvae fed on mulberry leaves irrigated with differed irrigation waters .

Treatments	Season					
	Autumn 2009 (mg/g)					
	Ni	Fe	Cr	Co	Cd	Cu
Canal water (Control)	0.009	1.453	0.008	0.001	0.000	0.021
Mixture (1:1)	0.011	2.705	0.009	0.001	0.003	0.038
Sewage waters	0.020	3.965	0.020	0.002	0.009	0.040
Spring 2010						
Canal water (Control)	0.007	1.455	0.007	0.001	0.000	0.020
Mixture (1:1)	0.012	2.817	0.008	0.002	0.003	0.035
Sewage waters	0.022	3.911	0.011	0.004	0.008	0.039
Autumn 2010						
Canal water (Control)	0.008	1.465	0.005	0.001	0.000	0.019
Mixture (1:1)	0.012	2.818	0.009	0.002	0.004	0.029
Sewage waters	0.028	3.901	0.012	0.005	0.008	0.040
Egy.short cod	2	20	1	5	0.05	5
Egy.long cod	0.20	5.0	0.10	0.05	0.01	0.20

Table (4)Amounts of total protein in mulberry leaves of irrigated by different of irrigation waters.

Total protein	mulberry leaves (mg/g)		
	Canal water Control)	Mixture (1:1)	Sewage waters
Autumn 2009	1.68	4.49	3.93
Spring 2010	2.81	7.85	5.05
Autumn 2010	3. 93	6.73	1.68

Table (5)Amounts of total protein in mulberry silkworm larvae fed on mulberry leaves irrigation by different of irrigated waters.

Total protein in mulberry silkworm larvae (mg/g)			
Season	Canal water (Control)	Mixture (1:1)	Sewage waters
Autumn 2009	3.37	4.49	3.93
Spring 2010	7.29	10.37	9.53
Autumn 2010	7.01	9.53	6.73

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الملخص العربى

تم استخدام مياة الصرف الصحى فى رى اشجار التوت واستخدامها فى تغذية يرقات دودة الحرير التوتية وتم تقسيم الاشجار المستخدمة فى التربية الى ثلاثة معاملات كل معاملة ثلاثة مكررات المعاملة الاولى الرى بمياة الصرف الصحى غير المعالج والمعاملة الثانية الخلط بين مياة الصرف الصحى غير المعالج ومياة الرى العادية بنسبة (1:1) بجانب الكنترول.

وتم اختيار سلالتين من يرقات دودة الحرير التوتية Giza B وتمت الدراسة من العمر اليرقى الاول الى العمر اليرقى الخامس وتم تغذية اليرقات اربع وجبات يوميا وكانت نتائج المتحصل عليها من الدراسة كالتالى .

اوضحت النتائج ان اشجار التوت المروية بمياة الصرف الصحى المخلوط بنسبة (1:1) من مياة الرى العادية مع مياة الصرف الصحى غير المعالج كانت الافضل من الرى بمياة الصرف الصحى غير المعالج (الخام) وذلك خلال اربعة مواسم متتالية من الدراسة.

وكانت الافضلية من ناحية الصفات البيولوجية والتكنولوجية والاقتصادية لديدان الحرير التوتية المرباة على ورق التوت المروى بتلك المياة المخلوطة بنسبة (1:1) .

كما ان الحرير الناتج كانت نسبة العناصر الموجودة بة والمخلوطة بنسبة (1:1) اقل من النسبة الموجودة فى مياة الصرف المسموح باعادة استخدامها فى مجال الزراعة والمذكورة فى الكود المصرى .