Advances in Physics Theories and Applications
ISSN 2224-719X (Paper) ISSN 2225-0638 (Online)
Vol 13, 2013
www.iiste.org

Tracing and Analysis of Manganese, Nickel, Cadmium ,Copper, zinc , Lead And Aluminum Concentration and PH Values In Iraqi Chewing Gums

Dr. Noori Kh. Fayad* Dr. Taghreed H. Al-Noor** and Dr. Nadia H. Al-Noor***

*Physical Chemistry and Environmental Pollution, Iraqia University, IRAQ. Email: fayad56@yahoo.com
**Chemistry Department,Ibn-AI-Haithem College of Education,University of Baghdad, IRAQ. ***Mathematic Department, College of Science, Al-Mustansiriyah University, IRAQ

ABSTRACT

Evaluation of trace elements in Iraqi chewing gums are unavailable, particularly pollution of toxic elements, materials which change the values of PH in the Oral. Atomic Absorption Spectroscopy (AAS) were successfully employed to determine the concentration of 7 trace elements (essentially toxic and nonessential) and the PH, in thirteen different brands of chewing gum generally consumed in Iraq. Combined wet and dry digestion procedures were applied. Two types of heated graphite tubes were used, coated and uncoated tubes treated with tungsten solution. Result showed that Cu, Al and Zn were at very high levels in almost all brands whereas Mn was found to be high in brands A and O only.

Keywords: Trace metals – heavy elements, Chewing gums - AAS- Baghdad – Iraq.

Introduction

Metal ions affect the well-being of human in various ways. Several of these elements are indispensable for life and nature governs their uptake, metabolism, and excretion. Consequently, their concentrations in a human body are compartmentalized and well defined. (1).

Extensive use of chewing gums, by children in particular, entails the evaluation of trace element contents in them. Radiochemical neutron activation analysis (RNAA) was successfully employed to determine the concentration of 35 trace elements (essential, toxic and nonessential) in eight different bands of chewing gum generally consumed in Rawalpindi-Islamabad area (2,3,4).

The chemical literature reveals an increasing interest in the determination of trace concentration of essential and non-essential elements in food and other agriculture products (2, 5, 6, 7). Most of the published data involve preliminary destruction of organic matter by wet or dry digestion. Furnace atomic absorption is the most widely used analytical method for

determination of trace metals in most agricultural matrices. Apparently, chewing gum, a quite widespread product all over the world, has got little attention in this respect (2, 3, 8).

Different brands of chewing gum are widely distributed in Iraq such as a crude, Juicy Fruit, Orange, Trident, Extrat, Big red, Winter Fresh, Fruit Strip, Freshen Up, Mastic and more chewing gums. The chemical composition of chewing gum (Gutta) is the transisomers of rubber which is formed mainly by palaguigutta and mimusops balata and other tropical trees that exist naturally in Iraq (4). Crude gum containsgutta, resin, arabin, sugar, calcium and different soluble salts (4,8). The annual consumption of chewing gum in Iraq can be contrasted with 1000-2000 tons in USA.

In a 2006 study published in Archives of Oral Biology, researchers found that mastic gum may help prevent cavities (2, 6, 8). On other hand, many successive articles have been published regarding the contamination of chewing gum with trace elements (6, 10, 11).
Boudene reported that Pb, Cd, and Hg contents of ten brands of chewing gum in France are within permissible standards. Fetterolf and syty (2) found that lead content in USA chewing gum varied between 0.215 to 1.14 µg per stick which is equivalent to 0.072-063 µg per gram of the product,whereas Kupchella and syty (3) byapplying different and new methods of extraction and determination have reported that American brands of chewing gum contain an average per weight of $1.5x10^{-4}$ % Zn. $4.2x10^{-4}$%Ni, $2.7x10^{-4}$ % Mn and $6.1x10^{-5}$% Al.

In this study trace concentrations of Pb, Ni, Al, Mn, Zn, Cd and Cu in Iraq chewing gum were determined. The method applied was the extension of sample preparation technique used by (Bauden, Fetterolf and syty, Kupchella and syty), using pyrocoated and uncoated treated and tungsten solution atomizer .

Materials and Methods

Reagents: All reagents used were of a suitable grade with low content of the elements under study. Standards solutions were freshly prepared from stock standard solution, specially prepared for atomic absorption spectra photometry ($1.000gm^{-1}$ L Fluka AG). Redistilled and deionized water is used .

Sample Preparation: A new glassware and porcelain casseroles were initially cleaned with concentrated HNO_3, then rinsed five times with redistilled water. After that all glassware were soaked for 24hours in 0.1 HNO_3, followed by four times rinsing with deionizer and redistilled water. Ultimately the glassware dried in a vacuum oven overnight.

The procedure of Fetterolf and syty was applied for dissolution of different samples of chewing gum. The weighed samples (sticks of gums) were placed in pre-cleaned covered

casserole for ashing. Four hours at 500^{o}C was sufficient for brands A, B, C, D, E, F and I, whereas five hours at 450^{o}C was applied for brand J, K, L, M, N and O, in the muffle furnace (carbolated electric furnaces). When samples were cooled, one ml of concentrated Ultrix nitric acid was added to each sample in order to dissolve the residue. Samples were carefully evaporated to dryness on a hot plate .Each residue then ashed again for two hours at 500^{o}C but brand K was ashed for 2.5 hours at 450^{o}C. Samples were cooled, then one ml of concentrated Ultrix nitric acid was added to each sample, then diluted to 25 ml with redistilled water.

Apparatus: The main apparatus used for measurements is the Atomic Absorption Spectroscopy (PerkinElmer 370A instrument). The tool is equipped with lamps for background correction and HGA500 graphite atomizer.

Two types of graphite tubes were employed, viz. the pyrolytic coated tube and uncoated tube treated with tungsten solution. The graphite furnaces were purged with 99.9%purity of argon as a carrier gas. Preliminary atomic absorption spectroscopy measurements were made to establish the optimum drying ashing atomization, temperature and time.

Results and Discussion

Pyrolytic coated tube was used for brands A, B, C, E, F, I, M, and N of chewing gum without any difficulties. It was found to be quite suitable as no interference has been noticed. In the case of brands D, J, K, Land O, these coated tubes were found to be unsuitable because of the interference. Alloyed is formed from the reaction between Mn and Al with the carbon furnace. This leads to some atom loss; ultimately unreliable results of atomic absorption were obtained for Mn and Al values.

In order to overcome this problem, temperature and time were manipulated until the most suitable conditions were achieved experimentally. The application of treated uncoated tube with tungsten solution was applied by embedding the uncoated carbon furnace in tungsten solution for two hours. Then heated at 800^{o}C for 8 hours using the muffle furnace. It is quite possible that structural component of those five brands of chewing gum after such problems. Table 1 show that Mn and Al concentrations in these 5 brands were quite compatible and highest in comparison with other brands. These results indicate that Mn and Al concentrations in such gums may be the cause of high interference found with this brand the reaction of Mn and/or Al with carbon is a well-documented (lohan1976, Fayad 1980).

Table. 1 illustrate the results of analysis of 13 brands of Iraqi chewing gum in respect to seven different heavy metals (Pb, Mn, Cu ,Cd, Al, Ni and Zn).Cu and Al elements were found

to have higher concentration as an average than other heavy metals in all brands examined. The increased concentration of Al may be due to binding and folding the sticks of gum with aluminum foil (12, 13, 14). The result obtained supports this explanation as brand A which represent crude gum (normally unfolded) was characterized with lowest concentration of Al. The concentration levels of elements Pb, Cd, Ni and Zn are as recorded, quiet low and still under the permissible limits.

Cu concentration, on other hand, was highest in brand A (crude gum) this comes with normal traditional method of collecting gum in copper containers and oven preserving and storing in such containers.

The high concentrations of these elements in Iraqi chewing gum can be contrasted with other published data in other parts of the world, (15, 16, 17, 18).It may be also contrasted with maximum permissible consumption limits. For example allowable limit in the diet is 300 μg/day for lead Fetterolf and syty (9)...

The objectives of measuring the PH were to determine how salivary flow rate and pH vary with time during use of chewing-gums and lozenges. Twenty-eight young adults collected unstimulated saliva and then, on different occasions, chewed one of six flavoured gums, or gum base, or sucked on one of two lozenges, for 20 min, during which time eight separate saliva samples were collected. Flow rate peaked during the 1st minute of timulation with all nine products. With the lozenges, flow rate fell towards the unstimulated rate when the lozenges had dissolved. There were no significant differences in the flow rates elicited by cinnamon- or peppermint-flavoured gums or between sugar-containing or sugar-free gums.

Comparison of trace element data of our work with literature has been presented. None of the elements detected in the brands of chewing gum examined was found to be present at a level representing a substantial contribution to the total dietary intake of the element. These results emphasize the need of continuous estimation of heavy metal in other Iraqi food products. More detailed study on determination of all trace metals is necessary because of the health hazard they cause.

Statistical analysis of trace elements in Iraqi chewing gums

In Statistical analysis mean, median, mode, minimum, maximum, range, standard deviation, kurtosis, skewness and coefficient of variation have been studied. Skewness gives the symmetry of data and coefficient of variation describes the relative measure of sample. Kurtosis refers the degree of flatness or peakedness and it also indicates impulsiveness of the

signal. The statistical analysis of each trace parameters in Iraqi chewing gums Pb, Mn, Cu, Cd, Al, Ni and Zn, pH have been discussed below as given in Table 2.

PH: Mean, median and mode value of PH is 7.039, 7.1 and 7.2 respectively. These values are close to 7.0 thus data exhibits normal behavior. Standard deviation is 0.320, skewness approximates to 0 thus PH is symmetrical and values are close to each other. Curve is platykurtic as Kurtosis is less than 3.

Pb: Mean and median value is 0.066, 0.065 respectively. Thus data exhibits normal behavior. Standard deviation is 0.031, skewness approximates to 0 thus Pb is symmetrical and values are very close to each other. Curve is platykurtic.

Mn: Mean and median value is 0.643, 0.587 respectively. Data exhibits normal behavior. Standard deviation value is 0.583. Curve is symmetric and platykurtic.

Cu: Mean and median value is 1.455, 1.267 respectively. Standard deviation value is 0.302. It is skewed 1.810 and curve is leptokurtic because Kurtosis is more than 3.

Cd: Mean, median and mode value is 0.070, 0.058 and 0.073 respectively. Standard deviation value is 0.038. It is skewed 1.136 and curve is platykurtic.

Al: Mean, median and mode value is 2.339, 2.175 and 1.896 respectively. Standard deviation value is 0.927, skewness approximates to 0 thus Al is symmetrical and curve is platykurtic.

Ni: Mean and median value is 0.099 and 0.059 respectively thus curve is not normal. Standard deviation value is 0.119. It is skewed 3.230 and curve is leptokurtic.

Zn: Mean, median and mode value is 0.329, 0.083 and 0.083 respectively thus curve is not normal. Standard deviation value is 0.460. It is skewed 1.740 and curve is platykurtic.

Figure 1, plots the graphical representation of mean of chewing gum parameters (trace elements). The mean of trace elements was decreased in the order:

Al > Cu > Mn > Zn > Ni > Cd > Pb.

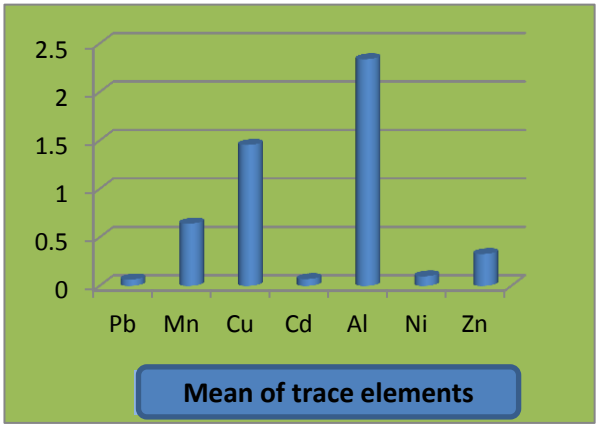


Figure 1. Mean of chewing gum parameters

Correlation Coefficient between trace elements in Iraqi chewing gums

The Pearson correlation coefficient is defined as:

$$r_{xy} = \frac{\sum x_i y_i - n\bar{x}\,\bar{y}}{(n-1)\delta_x \delta_y} = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n\sum x_i^2 - \left(\sum x_i\right)^2}\sqrt{n\sum y_i^2 - \left(\sum y_i\right)^2}}$$

Where $\bar{x}$ and $\bar{y}$ are the sample means of X and Y, and δx and δy are the sample standard deviations of X and Y. Table. 3, gives the value of correlation coefficient between pairs of trace elements in Iraqi chewing gums. It has been observed that Pb is positively correlated with Ni. Positive correlation means persistent behavior with the variables. Mn is positively correlated with Cu. Cu is negatively correlated with Al. Cd is positively correlated with Zn. Al is positively correlated with Zn and negatively correlated with Cu. Ni is positively correlated with Cd and PH is positive correlated with Cu and negatively correlated with Al. Figure 2, plots the graphical representation of correlation coefficient of chewing gum parameters with other parameters.

Table 1: Concentration values (each value x10^{-2} µg/gm) represents an average of seven readings of seven elements and PH Values in Iraqi chewing gums

Chewing gum names	Brand	(each value x10^{-2}(µg/gm) Element concentration							
		Pb	Mn	Cu	Cd	Al	Ni	Zn	PH
Crude	A	0.065	1.214	3.025	0.073	0.605	0.023	0.233	7.6
Extrat	B	0.082	0.104	1.648	0.049	1.896	0.109	0.052	7.2
Orange	C	0.041	0.891	1.957	0.073	2.324	0.058	0.083	6.6
Trident	D	0.021	0.458	1.317	0.058	2.587	0.0849	0.043	7.2
Lotte xylitol	E	0.061	0.994	1.264	0.024	1.896	0.0486	0.026	7.1
Big red	F	0.102	0.396	0.794	0.057	2.084	0.0843	0.083	7.2
Winter fresh	I	0.096	0.587	1.075	0.146	2.175	0.0491	0.535	7.0
Excel	J	0.058	0.621	1.958	0.082	1.284	0.0815	0.428	7.3
Fruit stripe	K	0.0913	0.798	1.093	0.029	3.174	0.127	0.083	6.4
Juicy fruit	L	0.087	0.493	1.064	0.037	2.582	0.0591	0.051	6.7
Freshen up	M	0.031	0.374	1.283	0.052	2.0593	0.0417	0.065	7.1
Shock	N	0.019	0.895	1.163	0.081	4.109	0.0382	1.383	7.2
Mastic	O	0.108	0.534	1.267	0.143	3.637	0.482	1.214	6.9

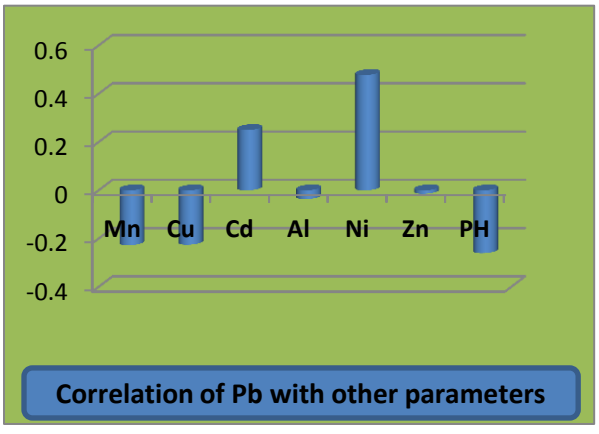
Table 2: Statistical Analysis of Chewing gum in Iraq

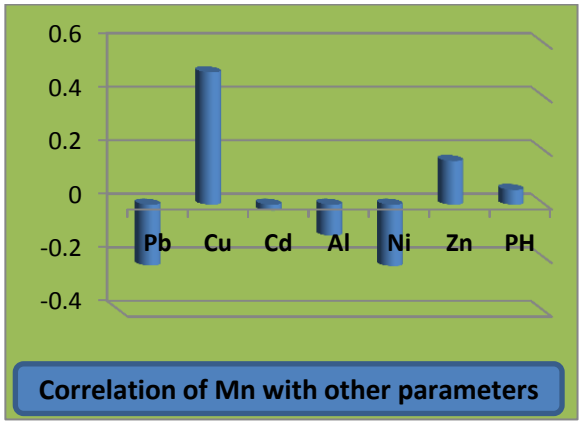
Parameters	Pb	Mn	Cu	Cd	Al	Ni	Zn	PH
Mean	0.066	0.643	1.455	0.070	2.339	0.099	0.329	7.039
Median	0.065	0.587	1.267	0.058	2.175	0.059	0.083	7.100
Mode	-	-	-	0.073	1.896	-	0.083	7.20
Minimum	0.02	0.10	0.79	0.02	0.61	0.02	0.03	6.40
Maximum	0.11	1.21	3.03	0.15	4.11	0.48	1.38	7.60
Range	0.09	1.11	2.23	0.12	3.50	0.46	1.36	1.20
Std. Deviation	0.031	0.302	0.583	0.038	0.927	0.119	0.460	0.320
Skewness	-0.294	0.222	1.810	1.136	0.213	3.230	1.740	-0.521
Kurtosis	-1.323	-0.196	3.804	0.808	0.457	11.029	1.919	0.313
Coeff. of Variation	0.470	0.470	0.401	0.543	0.396	1.202	1.398	0.045

Table 3: Correlations between Chewing gum parameters in Iraq

		Pb	Mn	Cu	Cd	Al	Ni	Zn	PH
Pb	Pearson Correlation	1	-.227	-.225	.250	-.036	.478	-.014	-.260
	Sig. (2-tailed)	.	.455	.460	.411	.908	.098	.963	.392
	N	13	13	13	13	13	13	13	13
Mn	Pearson Correlation	-.227	1	.494	-.023	-.116	-.229	.163	.055
	Sig. (2-tailed)	.455	.	.086	.940	.707	.452	.596	.858
	N	13	13	13	13	13	13	13	13
Cu	Pearson Correlation	-.225	.494	1	.046	-.644*	-.175	-.102	.460
	Sig. (2-tailed)	.460	.086	.	.881	.018	.567	.741	.114
	N	13	13	13	13	13	13	13	13
Cd	Pearson Correlation	.250	-.023	.046	1	.181	.491	.679*	.125
	Sig. (2-tailed)	.411	.940	.881	.	.554	.089	.011	.685
	N	13	13	13	13	13	13	13	13
Al	Pearson Correlation	-.036	-.116	-.644*	.181	1	.451	.605*	-.523
	Sig. (2-tailed)	.908	.707	.018	.554	.	.122	.028	.067
	N	13	13	13	13	13	13	13	13
Ni	Pearson Correlation	.478	-.229	-.175	.491	.451	1	.488	-.228
	Sig. (2-tailed)	.098	.452	.567	.089	.122	.	.091	.453
	N	13	13	13	13	13	13	13	13
Zn	Pearson Correlation	-.014	.163	-.102	.679*	.605*	.488	1	.116
	Sig. (2-tailed)	.963	.596	.741	.011	.028	.091	.	.705
	N	13	13	13	13	13	13	13	13
PH	Pearson Correlation	-.260	.055	.460	.125	-.523	-.228	.116	1
	Sig. (2-tailed)	.392	.858	.114	.685	.067	.453	.705	.
	N	13	13	13	13	13	13	13	13

*. Correlation is significant at the 0.05 level (2-tailed).





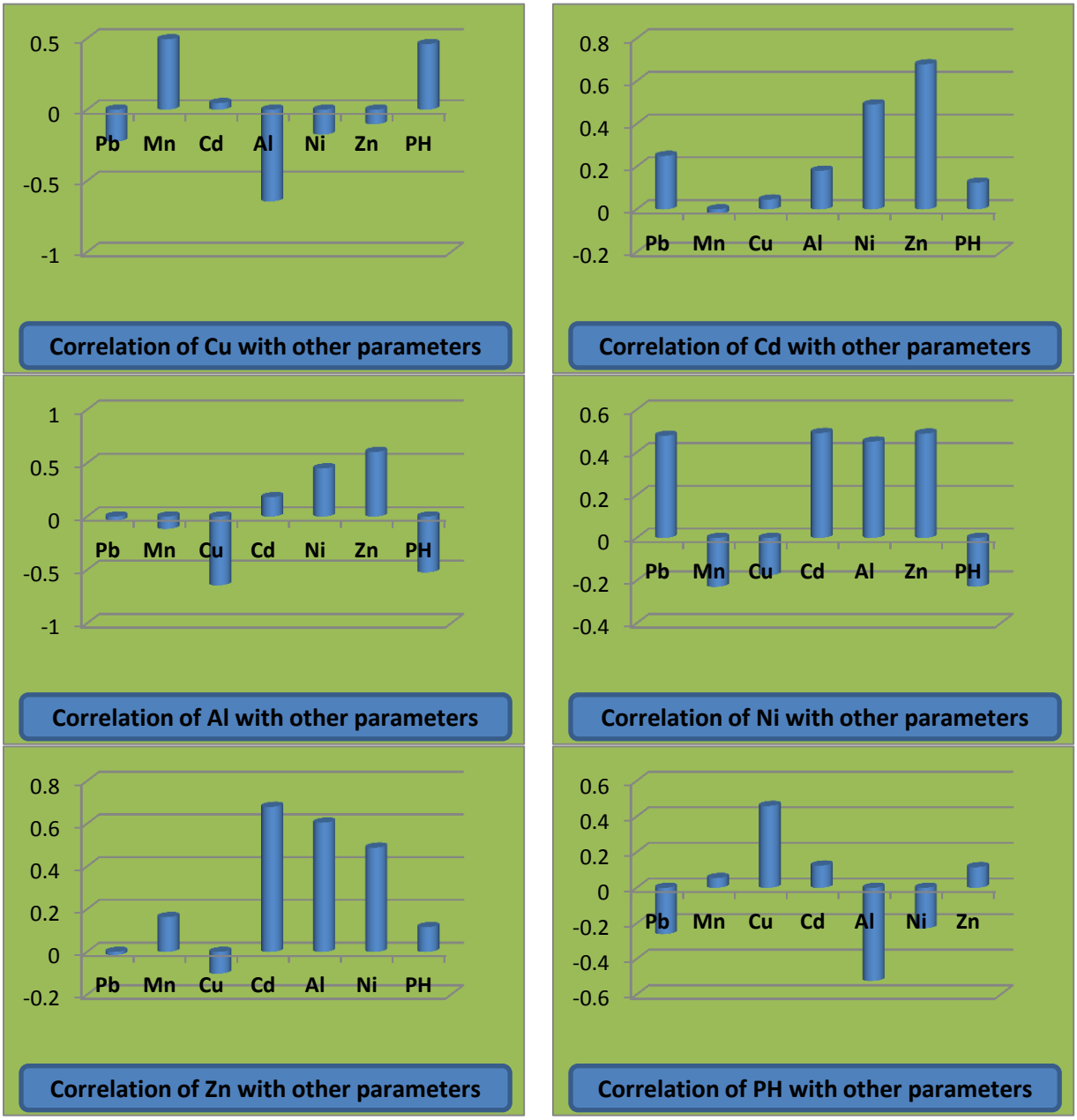


Figure 2. Pearson correlation coefficient of each parameter with other parameters

REFERENCES:

1- Sangeeta Jain, Sheela Longia, V.K. Ramnani, (2009) Metal Complexes as Magic Bullet - An Overview, People's Journal of Scientific Research , Vol.2(1).
2- Aksoy A, Duran N, Koksal F. (2006). "In vitro and in vivo antimicrobial effects of mastic chewing gum against Streptococcus mutans and mutans streptococci." Arch Oral Biol. 51(6):476-81. 3- Dabos

KJ, Sfika E, Vlatta L, (2010) "Is Chios mastic gum effective in the treatment of functional dyspepsia? A prospective randomised double-blind placebo controlled trial." JEthnopharmacol. 3;127(2):205-9. 4- Kupchella , L.(2003). Determination of Ni ,Mn , Cu, and Al in chewing gum by non –flame atomic absorption spectrometry .J .Agric .food chem.,Vol.11. No.12, 1035-1046.
5- Giaginis C, Theocharis S..(2011). "Current evidence on the anticancer potential of Chios mastic gum."Nutr Cancer. 63(8):1174-84.
6- Christina Koutsoudaki, Martin Krsek ,And Alison Rodge(2005). "Chemical composition and antibacterial activity of the essential oil and the gum of Pistacialentiscus Var. chia." J Agric Food Chem. 5;53(20):7681. 7- Mahmoudi M, Ebrahimzadeh MA, Nabavi SF, Hafezi S, Nabavi SM, Eslami Sh. (2010). "Anti-inflammatory and antioxidant activities of gum mastic."Eur Rev Med Pharmacol Sci. 14(9):765-9
8- Paraschos S, et al.(2012). "Chios gum mastic: a review of its biological activities." Curr Med Chem. 19(14):2292-302.
9- Fetterolf, D. (2001).Sample preparation and the determination of lead in chewing gum by non-flame atomic absorption on spectrometry. Agric food chem.Vol.27 No. 2.3,77-380. 10- Guest, E. (1999). Ministry of Agriculture, Iraqi Flora, Vol.1, No.3, (33-46), Republic of Iraq.
11- Adam , k.A.(2010). Iraqi Environmental pollution, Vol.5. No.2, (87-94). 12- Boudene, C.(2004).Modes chewing gum , France Contamination by heavy metals .Med .Nutr Vol. 13 No. 3. (199-207). 13- Alin, S. (2011).Effect of chewing gum on tooth, Agric. Food Chem. Vol.10, No.3 (89 – 94).
14- Lohan, E (2008).Refractories Handbook and directory International Public Co. London and Sheffield.
15- Fayad, N. K. and Alazawe F. (1990). The impurities in Iraqi chewing gum. J. Agric. Food Chem. Vol.2, No. 10, (82-91). 16- Duran A, et al.(2009) Trace metal contents in chewing gums and candiesmarketed in Turkey. Environ Monit Assess.;149(1-4):283-9.16-Qureshi, H. et al. (1990), Intern, J. Environ. Anal .Chem., vol.11, No.8, (38 -49). 17-Lario, Y.et al.(2002).Carbonell -Barrachina, A. A. Organic arsenicals toxicity andtotal arsenic accumulation in bush beans.*Food Addit.Contam*., in press.