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LEACHING OF LEAD FROM LOCAL EARTHEN WARE POTTERY

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An attempt has been made to estimate the amount of leachable toxic lead from local earthenwares available in the market, under ordinary household conditions. The unchained lead present in glazes of cheap local earthenwares was leached out with 1.5% lactic acid and 10% citric acid and estimated by Dithiozone method. The results obtained reveal that the concentration of lead extracted from all the samples is under limit except Sample I, hence the possibility of any health hazard due to the continuous domestic use of such earthenwares could be ruled out.

Key words: Glaze, Earthenware, Leaching

Introduction

Glazed earthenwares are either lead glazes or leadless glazes. The local manufacturers prefer to use lead borosilicate glazes containing 0.05-0.30% as PbO in the production of less costly earthenware pottery.

The lead in the lead borosilicate has the tendency to dissolve in acids, as the lead salts are easily attacked by acids. This dissolved lead may accumulate in the body until a dangerous level is reached. It may cause diseases of which anemia, partial pyralysis and malfunctioning of kidneys are prominent.

Experimental

Earthenwares like tea cups, tea pots and bowls were collected from the local market. In addition three samples of imported variety from China, England and Germany were taken for comparative study. The present investigations were carried out by leaching out lead from the collected samples, with 1.5% lactic acid (Test-I) the concentration which is usually present in the curd i.e. (0.5 - 1.5%) and 10% citric acid (Test-II) which is equivalent in reaction to the lemonade of vinigar for the extraction of lead [3].

Since in usual practice the local earthenwares are used to store food items like, curd milk and juices at room temperature for a few hrs. or days, so on this basis 100 ml of the above acid solutions were kept in the samples for different time intervals i.e. 4,8,24 and 48 hrs. at room temperature. The extracted lead was estimated by Dithizone method [5]. The absorbance was read out at 510 nm on double beam spectrophotometer UV 160 (Shimatdzu Japan) using 1 cm glass cell. The experiments procedure were repeated twice for the confirmation of the results.

Estimation of Lead: Dithizone is used to estimate metals upto microgram quantities. Lead and zinc can be separated from interfering under specified conditions, testing procedure described in the text book of quantitative inorganic analysis [5] was adopted to estimate the leached out lead from the samples under investigation.

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Results and Discussion

In the results of six local earthenware samples (Test-1) the solubility of lead in sample No. 1 stands at the maximum, varying from 58 and 960 µg/LTR in the reacted acid solution after 4 and 48 hrs. respectively, while sample No. 5 is at the minimum with 50 and 240 µg/LTR after the same time interval. The results of the rest of the four samples vary in between these two (Table 1).

In Test-II sample No. 1 and No. 4 has the maximum and minimum quantity of leachable lead i.e. 1100 and 2750 µg/LTR and 380-680 µg/LTR respectively after the same leaching time interval (Table-2).

TABLE 1. SOLUBILITY OF LEAD µG/LTR IN 1.5% LACTIC ACID

S. No.	Manufacturer	Leaching Time Interval 4 Hrs. µg	8 Hrs. µg	24 Hrs. µg	48Hrs. µg
1.	Aero Ceramic Gujrat	58	100	440	960
2.	Anyat Ceramics Gujrat	50	70	200	340
3.	Rafiq Ceramics Gujrat	80	96	250	450
4.	Manzoor Ceramics Gujrat	80	96	250	440
5.	S.P.F. Ceramics Shahdara	50	68	90	240
6.	Butt Ceramics Shahdara	60	100	280	520
7.	Chinese Sample (Imported)	0.0	0.0	0.0	10
8.	British Sample (Imported)	0.0	0.0	0.0	0.0
9.	German Sample (Imported)	0.0	0.0	0.0	0.0

TABLE 2. SOLUBILITY OF LEAD µG/LTR IN 10% CITRIC ACID

S. No.	Manufacturer	Leaching Time Interval 4 Hrs. µg	8 Hrs. µg	24 Hrs. µg	48Hrs. µg
1.	Aero Ceramic Gujrat	1100	1600	2200	2750
2.	Anyat Ceramics Gujrat	400	540	730	960
3.	Rafiq Ceramics Gujrat	280	410	580	900
4.	Manzoor Ceramics Gujrat	280	410	580	900
5.	S.P.F. Ceramics Shahdara	380	490	610	680
6.	Butt Ceramics Shahdara	260	480	620	960
7.	Chinese Sample (Imported)	20	20	30	60
8.	British Sample (Imported)	0.0	0.0	20	30
9.	German Sample (Imported)	0.0	0.0	0.0	0.0

The results of test-II are higher than test-I (Fig. 1). It is obviously due to the reaction of stronger acid. The solubility of lead from all the local earthenware in case of test-II is 2-4 times higher than test-I, while the concentration ratio of acid is 1:7. This confirms the conclusion drawn by Shakil and *et al.* [4] that the acids stronger than 10% citric acid would not be much more effective to extract lead from glazes.

Sample No. 1 in case of test-II shows the exceptionally high result i.e. 2750 µg/LTR after a leaching time of 48 hrs. as compared to the others. Since the permissible limit of intake lead is 2000 µg [3] so its use is definitely much more objectionable under such circumstances.

The solubility of lead in case of imported samples, varies from 0.1 - 10 µg/LTR with the increasing time period in case of test-I, (Table 1) while 0.0 - 60 µg/LTR in case of test-II after the same time period (Table 2). The German made sample registers 0.0 µg/LTR in both the test I and II, while chinese sample shows 0-10 µg/LTR in test 1 and 20-60 µg in test-II.

The very low results of imported samples are either due to application of leadless glaze or the lead have been matured at a very high temperature. Comparing this solubility of lead with local earthenware, it can be fairly concluded that the behaviour of local earthenware sample is more toxic than the imported samples (Specially sample No. I).

The results of both the tests in Table 1 and 2 reveal that the solubility of lead decreases expectedly with the increased leaching time period because of hydrated lactic acid layer which forms on the surface of the glass due to leaching. Results of almost all the samples after 48 hrs. are 3-4 times higher than the results after 4 hrs., while the proportion of the time period is 1:12. It is evident that the extraction of lead from the glazes of local earthenwares is not directly proportional to the leaching time period and the curves are not linear (Fig. 1). It is concluded that the local earthenwares would have the same toxic effects even if they are used for a longer time than 48 hrs. under household conditions in usual practice.

The amount of lead extracted from all the test samples of local earthenware pottery except sample-I is within the permissible limits, hence the domestic continuous use of such type of pottery is not objectionable and the possibility of any health hazard could be ruled out.

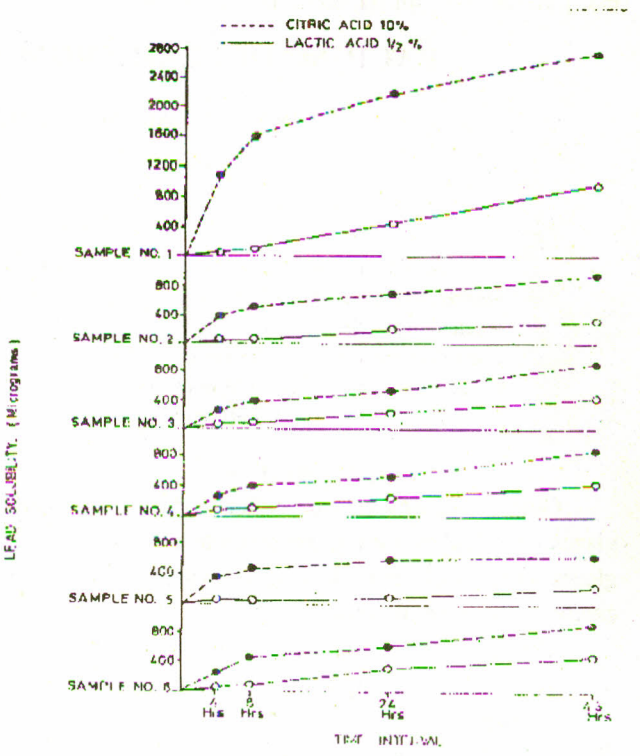

Fig. 1. Comparasion of lead solubility in 10% citric acid & 1/2% lactic acid

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