Original Article

Changes in concentration of iron and lead in food due to rotting

Shakila Zaman, Hameed A. Tahir, Uzaira Rafiq

From Department of Environmental Science, Fatima Jinnah Women University, Rawalpindi, and Riphah International University, Islamabad, Pakistan

Correspondence: Dr Hameed A. Tahir, Riphah International University, Islamabad. Email: hameed_iiec@yahoo.co.uk

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ABSTRACT

***Objective*:** To determine whether there is any change in concentration of iron and lead due to rotting process of food.

Methods: The concentration of iron and lead in fresh samples of apple, precement (Japanese fruit), banana, grapes, potato and tomato and normally marketed cereal, brand name "cerelac", was determined, using atomic absorption spectroscopy. Samples were taken each week for six weeks.

Results: The highest concentration of lead (3.336μg/g), in fresh samples, was in precement, perhaps, its thin peel and soft internal tissue has greater diffusivity and is more absorptive for lead from environment. Cerelac had higher iron content. The change in concentration of iron and lead with respect to rotting time is inconsistent and does not follow any derived mathematical relationship. Initially, it increases, followed by a decline in value and then increases again, with variation depending upon the nature of sample. However, on the average, it is showing an increase.

Conclusion The inconsistency in concentration of metal ions at various rotting stages, perhaps, is due to different rotten products, with varied absorbency at different states of decay. (Rawal Med J 2005;30:6-9)

***Key Words*:** Iron, lead, rotten, bacteria, fungus

INTRODUCTION

Psychologically, human requires food that is attractive to the sight, taste and smell. Graham[1] states "food rots if it is not preserved properly". Banwart[2] said that rotting is due to microorganism, fungus and oxidation processes. The change in concentration of lipid, carbohydrates and proteins due to the process of decay is well documented but no literature is available as to testify any change in metal concentration or their transformation into other compounds. It is imperative that a study is carried out to determine whether there is any change in concentration of metals due to rotting process of food. Iron and lead are the two metals that have been selected for this study, as these are usually present in food.

METHODOLOGY

The fresh samples of fruits and vegetables were collected from the main market of I-10 markaz, a heavy traffic area and subjected for determination of water contents and dry matter by placing a crushed sample of 10g in oven at 110 C for 24 hours. The 10g crushed sample was digested in nitric acid as it digest most sample adequately[3] and subjected to atomic absorption spectrometer analysis, being widely used[4], that had been calibrated earlier with the help of standard solutions. The results were noted down. The food samples, half of these in the covered jar and other halves in the open, then, were left to rot for duration of 2 days to more than two weeks. The samples were drawn at intervals of a week for six weeks to repeat the procedure.

RESULTS

The levels of iron and lead found in fresh samples and at various decay states in uncovered jars of apple, precement (Japanese fruit), banana, grapes, potato and tomato and normally marketed cereal, brand name "cerelac", are given in Table 1. Those of covered samples have been tabulated in Table 2. The change in values of lead and iron with respect to time is shown in figures 1 to 7.

Table 1. Presence of Lead and Iron in Fresh fruits and Change in levels with respect to Decay Time in uncovered Samples.

0 Hours					
Food Samples	Sample Code	Moisture content %	Dry Matter in one gram	Matter on dry weight basis for lead in µg/g	Matter on dry weight basis for iron in µg/g
Apple	No.1	84.8	0.152	0.736	2.506
Precement	No.2	88.4	0.116	3.336	2.137
Banana	No.3	87.2	0.128	0.023	0.835
Potato	No.4	81.9	0.181	0	2.005
Tomato	No.5	93.2	0.068	0	4.235
Grapes	No.6	84.2	0.158	0	2.993
Cerelac	No.7	85.3	0.147	0	7.503
72 Hours					
Apple	No.8	84.8	0.152	1.203	5.796
Precement	No.9	89.5	0.105	21.72	9.32
Banana	No.10	90.2	0.098	0	11.744
Potato	No.11	81.9	0.181	0	5.07
Tomato	No.12	94.5	0.055	3.218	16.945
Grapes	No.13	86.3	0.137	1.62	8.708
Cerelac	No.14	86.4	0.136	0	14.77
168 Hours					
Apple	No.15	85.1	0.149	0	5.67
Precement	No.16	90.3	0.097	2.649	12.237
Banana	No.17	91.7	0.083	0	14.4
Potato	No.18	81.9	0.181	0	8.4
Tomato	No.19	95.4	0.046	3.434	22.086
Grapes	No.20	88.7	0.113	0.477	8.424
264 hours					
Apple	No.21	86.7	0.133	3.736	6.721
Precement	No.22	92.6	0.074	4.608	16.702
Potato	No.23	81.9	0.181	2.143	3.011
Tomato	No.24	95.8	0.042	4.5	17.54

Grapes	No.25	89.3	0.107	9.158	9.644

Table 2. Change in Levels of Lead and Iron in Covered Samples with Respect to Decay Time

0 hours					
Food Samples	Sample Code	Moisture content %	Dry Matter in one gram(g)	Matter on dry weight basis for lead in µg/g	Matter on dry weight basis for iron in µg/g
Apple	No.26	86.2	0.138	1.949	6.956
Precement	No.27	87.4	0.126	0	5.658
Banana	No.28	82.5	0.175	1.114	4.028
Potato	No.29	83.6	0.164	3.536	15.817
Tomato	No.30	92.2	0.058	5.103	36.982
Grapes	No.31	89.1	0.109	1.385	6.146
Cerelac	No.32	80.2	0.198	0.985	7.111
48 hours					
Apple	No.33	86.2	0.138	2.688	4.92
Precement	No.34	87.6	0.124	4.185	5.5
Banana	No.35	83.4	0.166	1.295	5.493
Potato	No.36	83.7	0.163	0.57	6.226
Tomato	No.37	93.4	0.066	5.787	20.681
Grapes	No.38	89.7	0.103	34.93	6.533
Cerelac	No.39	81.3	0.187	1.791	7.716
120 hours					
Apple	No.40	86.9	0.131	3.04	6.908
Precement	No.41	88.3	0.117	0	7.547
Banana	No.42	85.3	0.147	4.319	3.721
Potato	No.43	84.1	0.159	3.106	6.515
Tomato	No.44	94.2	0.058	3.362	17.655
Grapes	No.45	90.1	0.099	4	6.444
Cerelac	No.46	81.3	0.187	3.604	6.481
168 hours					
Apple	No.47	87.1	0.129	0	5.255
Precement	No.48	89	0.11	0	10.681
Banana	No.49	86.2	0.138	0	5.688
Potato	No.50	84.7	0.153	0.196	5.209
Tomato	No.51	95.2	0.048	0	15.729
Grapes	No.52	93.4	0.066	2.348	11.969
Cerelac	No.53	83.1	0.169	1.059	8.153
Sweet potato	No.54	82.3	0.177	0.361	5.288
216 hours					
Apple	No.55	87.6	0.124	1.862	13.612
Precement	No.56	89.8	0.102	1.176	31.598
Banana	No.57	87.3	0.127	0	31.251
Potato	No.58	96.2	0.038	5.21	49.394
Tomato	No.59	94.2	0.058	6.068	27.189
Grapes	No.60	83.8	0.162	4.339	10.969
Sweet potato	No.61	82.3	0.177	2.762	12.621
312 hours					
Apple	No.62	87.9	0.121	4.121	4.571

Precement	No.63	90.2	0.098	2.806	5.285
Banana	No.64	88.5	0.115	1.165	5.669
Tomato	No.65	96.6	0.004	4.525	14.25
Grapes	No.66	95	0.05	17.38	134.68
Cerelac	No.67	84.3	0.157	1.484	7.063

Figures 1 to 7 explain the change in levels of lead and iron in uncovered (left half) and covered (right half) food samples, with respect to time during the process of rotting.

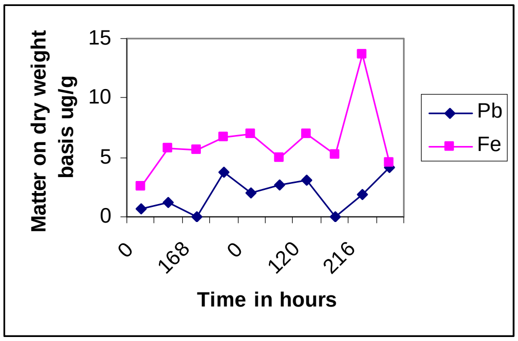

Figure 1 Change in lead and iron levels in apple with respect to time.

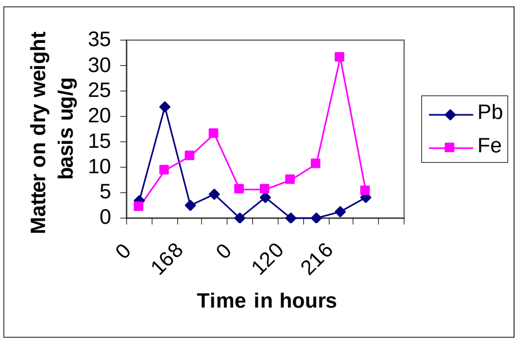

Figure 2 Change in lead and iron levels in precement with respect to time

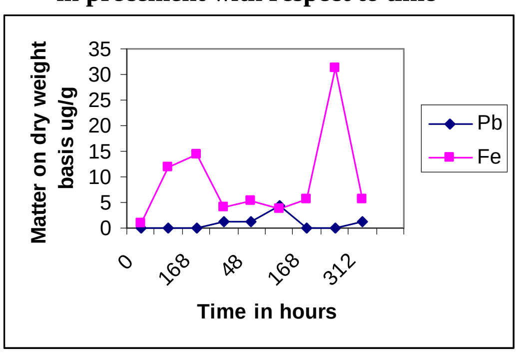

Figure 3 Change in lead and iron levels in banana with respect to time

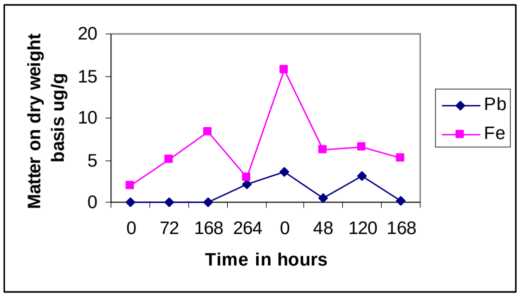

Figure 4 Change in lead and iron levels in potato with respect to time

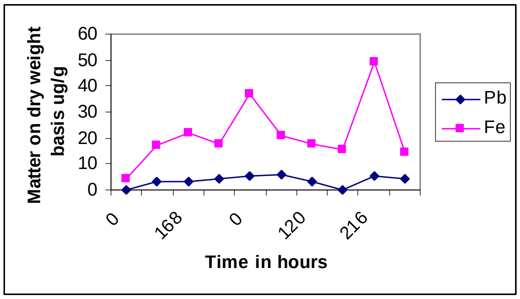

Figure 5 Change in lead and iron levels in tomato with respect to time.

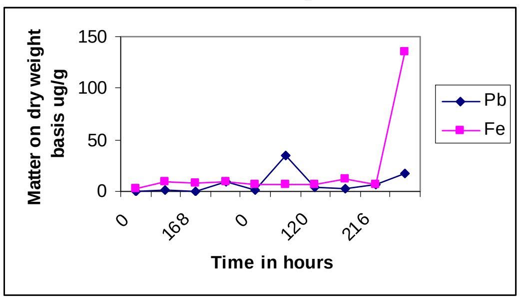

Figure 6 Change in lead and iron levels in grapes with respect to time

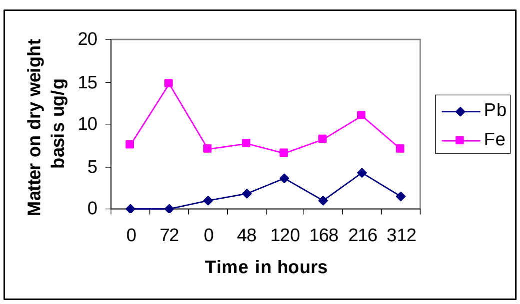

Figure 7 Change in lead and iron levels in Cerelac with respect to time

DISCUSSION

A review of table 1, that enlists the initial and change in values of iron and lead with respect to time for apple precement, banana, grapes, potato, and tomato indicates that precement has the highest initial concentration of lead (3.336µg/g) with a decreasing order of apple (0.736µg/g), banana (0.023µg/g), while potato, grapes and cerelac have no traces of lead contents. These samples were collected from roadside shops, where air particles were deposited on them and metal ions due to their mobility diffused into the body. The iron contents found in these samples, in decreasing order, are highest in cerelac (7.503µg/g), grapes (2.993µg/g), apple (2.506µg/g), potato (2.005µg/g), tomato (4.235µg/g), precement (2.137µg/g) and least in banana (0.835µg/g). Cerelac has higher iron contents because iron is added in it during manufacturing.

The change in concentration of iron and lead with respect to rotting time, presents a different picture. It is inconsistent and does not follow any derived mathematical relationship. Initially it increases and then decreases and then there is again an increase with variation depending upon the nature of sample. However, on the average, it is showing an increase. Ramonaiyti[5] has reported that the dependence of lead on storage time of evaporated sterilized milk is nearest to the parabolic and in sweet condensed milk to the exponential function, whereas zinc concentration can be described by a straight line function. Our findings are same. Lewis,[6] while discussing the deterioration of food quality concluded that it is caused by enzymes may be within or produced by microorganisms such as bacteria, yeast and molds growing in the food. The inconsistency in diffusivity and equilibrium constant of absorption of lead and iron ions, observed in this study confirms findings of Lewis[6] that spoilage bacteria with short reproduction time will deteriorate the food more quickly.

In conclusion, our results indicate that in the process of decaying, initially there is an increase in concentration of lead and iron up to 48-72 hours of rotting and the levels of lead starts decreasing after 168 hours but iron contents keep on increasing. There is an overall decrease in concentration of iron and the concentration of lead starts increasing. Another detailed study is needed to determine as to what volatile organic metallic complexes are formed during decaying of fruits and vegetables, and their levels in the confined space above it, with the help of mass spectrometry.

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