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ALUMINUM LEACHING FROM ALUMINUM TEAPOT TO THE TEA INFUSION AND FROM ALUMINUM COATED CARTOON BOX TO THE MILK AND FRUIT JUICE

*H. Tansu AKTAN**
*Ahmet SAYAL***
*Ahmet AYDIN***
*Aşkın IŞIMER***

Aluminyum Demlikten Çaya ve Alyuminyum Kaplı Karton Kutudan Meyve Suyuna Geçen Aluminyum Miktarı

Özet: *Günümüzde çay demlemek için aluminyum kap, süt ve meyve sularını muhafaza etmek için de Aluminyum Kaplı Karton Kutular (AKKK) kullanılmaktadır. Bu çalışmada, aluminyum demlikten çaya geçen aluminyum miktarı, AKKK'dan meyve suyuna geçen aluminyum miktarı araştırılmıştır. Aluminyum düzeyleri elektrotermal atomik absorpsiyon spektrometresi ile ölçülmüştür. Aluminyum kapta hazırlanan çaydaki aluminyum düzeyi (Otuz dakikada 10.012±0.02µg/ml) cam kapta hazırlananlardan dört kat daha yüksek (Otuz dakikada 2.452±00.030 µg/ml) bulunmuştur (p<0.001). Aseptik koşullarda ineklerden alınan süt numunelerindeki aluminyum seviyesi 122.999±2.003 ng/ml olurken, AKKK'da paketlenmiş süt numunelerinin aluminyum düzeyi 184.125±3.156 ng/ml olarak bulunmuştur. Aradaki fark anlamlıdır (p<0.001). Cam şişedeki kayısı ve vişne sularındaki aluminyum konsantrasyonları sırası ile 0.996±0.10 µg/ml ve 0.918±0.03 µg/ml olurken AKKK'larda saklananlarda sırasıyla 1.723±0.04 µg/ml ve 1.305±0.06 µg/ml olarak bulunmuştur. AKKK'larda saklanan meyve suları ile cam şişede saklanan meyve suları arasında da anlamlı fark bulunmuştur (p<0.001).*

Anahtar Kelimeler: *Aluminyum, Meyve Suyu, Süt, Çay.*

Summary: *Now, aluminum cups are used to prepare tea infusions and aluminum coated cartoon boxes (ACCB) are used to store milk and fruit juice. In this study, we wanted to investigate the amount of aluminum leaching from the aluminum tea pot to the tea infusions and from the ACCB to the fruit juice. Aluminum levels were determined by electrothermal atomic absorption spectrometer. Aluminum levels in tea infusions that was prepared in aluminum tea pot (10.012±0.02 µg/ml at 30 th minutes) were about four fold higher than that of tea infusions that was prepared in Pyrex tea pot (2.452±0.030 µg/ml at 30 th minutes) (p<0.001). While aluminum levels of milk samples taken from cows under the aseptic conditions was 122.999±2.003 ng/ml. aluminum content of milk samples packaged in ACCB was 184.125±3.156 ng/ml. This difference was significant (p<0.001). While aluminum concentrations in apricot and cherry juice bottled in glass bottle were 0.996±0.10 µg/ml and 0.918±0.03 µg/ml respectively, aluminum levels of same brand apricot and cherry juice packaged in ACCB were found out as 1.723±0.04 µg/ml and 1.305±0.06 µg/ml respectively. Also there was significant difference between these fruit juices when compared with samples packaged in ACCB (p<0.001).*

Keywords: Aluminum, Fruit juice, Milk, Tea.

* Gülhane Military Medical Academy Department of Military Health Sciences
** Gülhane Military Medical Academy Department of Pharmaceutical Sciences, Ankara, Turkey

Introduction

Aluminum (Al) is a toxic element. The human body takes the aluminum from the environment, from the mixed ingredients of food and drinks and from the antacid, antidiarrheal and antiphosphate drugs (3, 7, 8). It has been reported that, in average, 2-160 mg of aluminum is taken through daily diets (5). An increase in the Al levels of the serum is determined (6). The Al in the serum with the concentration of 25-30 μg/L may be tolerated, however, the Al in the serum with the concentration of 100-150 μg/L may cause Al intoxication (10). Overdose of Al is the risk factor for the development of some diseases such as encephalopathy, Alzheimer's disease, osteodistrohpy, anemia (7). The World Health Organization suggests the maximum amount of Al to be 0.2 μg/L in drinking water (8). In the study carried out by Fairweather-Tait and Moore (3), the amount of Al in dry tea leaves is determined to be 39 mg/kg. Similarly, in one of our studies, we have determined the amount of Al to be 33.6 mg/kg in dry tea leaves of our country (1). The amount of Al in milk is emphasized to be 700 ng/ml by Greger (4), while it is reported to be 90 ng/ml by Weintraub et al (9). Delwes et al (2) has reported the level of Al in bottled fruit juices to be 1020 μg/L.

Materials And Methods

Al measurement were performed with electrothermal atomic absorption spectrophotometer (Varian 30/40). Standard solutions have been prepared from Al stock solution (Sigma) in 0.5% nitric acid (Merck) as 20, 40, 60 and 80μg/L. Milk samples were digested in an microwave digestion unit (Milestone MEGA-1200) before analysis.

Samples of tea are prepared in a glass cup (Pyrex) with 10 grams of tea and 500 ml of water in an aluminum cup with 10 grams of tea and 500 ml of water.

Milk samples were obtained as follows: From 20 cows in a farm, from a milk factory in which milk is collected from 7 different regions, from milk with the same brand name which are sold in ACCB.

Fruit juice samples (morello cherry and apricot) were obtained from either bottled samples and packaged in ACCB and they were all same brand.

Table 1. Aluminum leaching to tea infusions (10 grams of tea+500 milliliters of water)

(Tablo 1: Çaya aluminyum geçişi (10 gram çay+500 mililitre distile su))

Time of Infusion (min)	Aluminum leaching (μg/ml) (mean±SE)	
	Pyrex cup	Aluminum cup
10	2.213±0.03	9.208±0.02
20	2.313±0.02	9.676±0.03
30	2.452±0.02	10.012±0.02

Table 2. The levels of Aluminum in cow-milk and in milk sold in ACCB.

(Tablo 2: İnek sütünde ve aluminyum kaplı karton kutuda satılan sütdeki aluminyum seviyesi)

	Aluminum levels of milk samples (ng/ml)			
Region (n=20)	minimum	maximum	mean	SE
20 cows*	108.42	135.09	122.99	2.005
Ankara	120.15	145.49	133.579	2.306
Konya	49.17	71.26	60.244	2.507
Bala	41.16	84.62	67.146	3.147
Burdur	152.31	198.44	175.671	3.115
Kastamonu	150.19	177.24	166.672	2.573
Beypazarı	116.64	141.21	127.974	2.586
Antalya	66.24	105.66	84.935	3.582
ACCB	171.24	206.94	184.125	3.156

* Milk samples obtained from 20 different cows.

Findings

The Al levels determined in the 10th, 20th and 30th minutes of tea infusions prepared in aluminum and Pyrex cups were shown in Table 1.

As it was observed in Table 1, aluminum leaching to tea in the Pyrex cup was likely to be 4 times more than that of the aluminum cup, and this was statistically significant ($p<0.01$).

As it is seen in Table 2, the levels of Al in ACCB milk is statistically higher than that of

Table 3. The levels of Aluminum in fruit juice
(Tablo 3. Meyve sularındaki aluminyum seviyesi)

Type of Fruit juice (n: 10)	Aluminum levels (μg/ml)					
	Bottle			ACCB		
	Minimum	Maximum	Mean±SE	Minimum	Maximum	Mean±SE
Apricot	0.875	1.025	0.996±0.10	1.652	1.775	1.723±0.04
Morello Cherry	0.875	0.952	0.918±0.03	1.272	1.317	1.305±0.06

cow-milk obtained from 20 different cows and 7 different regions (P<0.001).

Table 3 shows the levels of Al in fruit juices sold in bottles or in ACCB.

As it is observed in Table 3, the values of Al in fruit juices sold in ACCB are significantly higher than the values of Al in bottled fruit juices (p<0.001).

Discussion and Results

We have found different levels of Al in the milk of a milk factory in Ankara, to which milk comes from 7 different regions. This difference is thought to be due to variations in the soil and plant structures of the regions. Our results were parallel to the findings of the study carried out by Weintraub et al. (9).

The results of our study on the Al values in bottled fruit juices were parallel to the findings of Delwes et al (2). According to our results, the Al levels of milk sold in ACCB were significantly higher than those of cow milk, whereas the Al levels of fruit juices sold in ACCB were significantly higher than those of bottled fruit juices. These findings show that there is a risk for human health especially for the children who drink ACCB milk every day in terms of anemia, encephalopathy, osteomalasia and Alzheimer's disease.

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