Cadmium, Copper and Lead in Some Kinds of Cheeses

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Summary
A total of seventy five samples of different kinds of cheese (15 each of Kariesh, Domiati, Pickled Domiati, Ras and Processed) were collected randomly from various markets in Kaliobya governorate to estimate the levels of some heavy metals in such cheese samples. Results revealed that the incidence of cadmium were 2 (13.33%), 5 (33.33%), 4 (26.67%), 8(53.33%) and 6(40%), respectively of the examined Kareish, Domiati, Pickeld Domiati, Ras and Processed cheese samples. While, 4(26.67%), 5 (33.33%), 7 (46.67%), 7 (46.67%) and 10 (66.67%), respectively, were the incidence of copper in the examined cheese samples. On the other hand the percentage of lead in the examined samples were 40%, 20%, 46.67%, 73.33% and 53.33%, respectively. The public health significance and some recommendations to minimize contamination of cheeses with such pollutants were discussed.

Introduction
Heavy metals are considered toxic substances resulting in serious health hazards to human and other living organisms through progressive irreversible accumulation in their bodies resulting from repeated consumption of small amounts of such elements (1). Environmental pollution with some heavy metals leads to increase of metal contamination in air, water, milk and various food stuffs that represent an important role in man’s and animal’s (2). The main sources of heavy metals to milk and its products are the cow that grazed near motor ways, roads with heavy car traffic, industrial pollutants including: coal or oil combustion, sewage effluents, over-use of pesticides, using some types of plastics and/or phosphate fertilizers and sludge used in agricultural land (3,4;5). With respect to human health impacts, cadmium and lead are of primary concern.
because of their toxicity for human, while copper is the metal of secondary concern (6).

Copper is an essential element for human and animals. It acts as a cofactor for several enzymes and several biological oxidation reactions but, it is toxic at high concentrations (7,8). There is a narrow range between the concentration at which the metal is considered essential or toxic (9).

Therefore, the aim of the present study was to determine the incidence of cadmium, copper and lead in some kinds of cheeses marketed at Kaliobya governorate to evaluate the level of various environmental pollution. The public health hazard of such metals was discussed.

**Material and Methods**

Seventy five samples of different cheese kinds represented by Kariesh, Domiati, Pickled Domiati, Ras and Processed cheese (15 of each) were collected randomly from different markets in Kalyobia governorate for estimation of their contents of Cadmium, Copper and lead using the technique recommended by (10) on basis of wet weight.

**Preparation of samples:**

One gram of cheese samples was digested with 5 ml concentrated nitric acid over night. The mixture was heated at 70°C for 2 hours and filtered through Whitman filter paper No. 42. The filtrate was completed to 50 ml with deionized water. The concentration of heavy metals in the solution were determined by Atomic Absorption spectrophotometer (Perkin Elmer, 2380, USA) which adjusted at 228.8nm for cadmium, 324.8nm for copper and 217.0 nm for lead. Absorption and concentrations were recorded on the digital scale of the Atomic Absorption spectrophotometer. The obtained results of each heavy metal were recorded as mg/kg on wet weight of the examined samples.
Results and Discussion

Table (1): Concentrations of Cadmium in the examined samples of different cheese kinds (n= 15)

<table>
<thead>
<tr>
<th>Kinds of cheese</th>
<th>Egyptian* standard limit (mg/kg)</th>
<th>Samples exceeded the permissible limit</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Kariesh</td>
<td>0.05</td>
<td>2</td>
<td>13.33</td>
<td>0.01</td>
</tr>
<tr>
<td>Domiati</td>
<td>0.05</td>
<td>5</td>
<td>33.33</td>
<td>0.02</td>
</tr>
<tr>
<td>Pickled Domiati</td>
<td>0.05</td>
<td>4</td>
<td>26.67</td>
<td>0.01</td>
</tr>
<tr>
<td>Ras</td>
<td>0.05</td>
<td>8</td>
<td>53.33</td>
<td>0.03</td>
</tr>
<tr>
<td>Processed</td>
<td>0.05</td>
<td>6</td>
<td>40</td>
<td>0.03</td>
</tr>
</tbody>
</table>

* The maximum Egyptian limit for processed cheese according to EOS (11).

Table (2): Concentration of Copper in the examined samples of different cheese kinds (n=15)

<table>
<thead>
<tr>
<th>Kinds of cheese</th>
<th>Egyptian* standard limit (mg/kg)</th>
<th>Samples exceeded the permissible limit</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Kariesh</td>
<td>0.3</td>
<td>4</td>
<td>26.67</td>
<td>0.09</td>
</tr>
<tr>
<td>Domiati</td>
<td>0.3</td>
<td>5</td>
<td>33.33</td>
<td>0.14</td>
</tr>
<tr>
<td>Pickled Domiati</td>
<td>0.3</td>
<td>7</td>
<td>46.67</td>
<td>0.18</td>
</tr>
<tr>
<td>Ras</td>
<td>0.3</td>
<td>7</td>
<td>46.67</td>
<td>0.15</td>
</tr>
<tr>
<td>Processed</td>
<td>0.3</td>
<td>10</td>
<td>66.67</td>
<td>0.19</td>
</tr>
</tbody>
</table>

* The maximum Egyptian limit for processed cheese according to EOS(11)
Table (3): Concentrations of Lead in examined samples of different cheese kinds (n=15)

<table>
<thead>
<tr>
<th>Kinds of cheese</th>
<th>Egyptian* standard limit (mg/kg)</th>
<th>Samples exceeded the permissible limit</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kariesh</td>
<td>0.3</td>
<td>6</td>
<td>0.13</td>
<td>0.98</td>
</tr>
<tr>
<td>Domiati</td>
<td>0.3</td>
<td>3</td>
<td>0.08</td>
<td>0.65</td>
</tr>
<tr>
<td>Pickled Domiati</td>
<td>0.3</td>
<td>7</td>
<td>0.15</td>
<td>1.06</td>
</tr>
<tr>
<td>Ras</td>
<td>0.3</td>
<td>11</td>
<td>0.21</td>
<td>1.48</td>
</tr>
<tr>
<td>Processed</td>
<td>0.3</td>
<td>8</td>
<td>0.16</td>
<td>1.20</td>
</tr>
</tbody>
</table>

* The maximum Egyptian limit for processed cheese according to EOS(11)

From the results recorded in Table (1) it is evident that the concentrations of cadmium ranged from 0.01 to 0.46 in Kareish cheese, 0.02 to 0.59 in Domiati cheese, 0.01 to 0.51 in Pickled Domiati, 0.03 to 0.12 in Ras cheese and 0.03 to 0.78 mg/kg in processed cheese. For Cadmium, 13.33%, 33.33% 26.67%, 53.33% and 40% of the examined Kariesh, Domiati, Pickled Domiati, Ras and Processed cheese samples were exceeded the recommended standard by *E.O.S (11)* which recorded for processed cheese with plant oil (Max 0.05 mg/kg). Nearly similar results were recorded by (12). While lower findings were recorded by (13) for Kareish cheese and (14) in which the stranded not mentioned any values for the other types of cheese. The high cadmium level may due to the over use of pesticides, some chemical fertilizers, plastic pipes used for drinking water, sewage sludge used on agrculture land as well as contamination of water supply (15, 12). Raw milk with high cadmium content should not used in cultured milk products manufacture as Cadmium decreases or inhibits the starter culture action (16). Cadmium is non essential trace element that progressively accumulates inside the body particularly kidneys. Thus,
incidence of kidney stones is increased in people affected with cadmium poisoning(17). Human toxicity of cadmium may lead to acute gastroentritis, acute pulmonary odema, hypertension and may causes a case called Itai, Itai or Ouch-Ouch disease that characterized by severe pain, softy bones finally death may occur as a result renal failure (18,19,20). However, cadmium acts synergistically with other metals leads to increase its toxicity. In this respect, when copper concentration at 1ppm or more substantially increases the toxicity of cadmium(21).

According to the guideline value of E.O.S (11) for permissible limits of copper in processed cheese (Max 0.3mg/kg), 26.67%, 33.33%, 46.67%, 46.67% and 66.67% of examined kareish, Domiati, Pickled Domiati, Ras and processed cheese, respectively were exceeded such limits. Nearly similar findings were reported by (13) for kareish cheese. While, higher findings were reported by (22) for processed cheese. Ingestion of an excessive dose of copper leads to severe nausea, bloody diarrhea, hypotension and jaundice (23). But copper poisoning is rare owing to its powerful emetic action and at which the taste becomes repulsive (24, 25).

Concerning to the lead levels, 40%, 20%, 46.67%, 73.33% and 53.33% of the examined kareish, Domiati, Pickled Domiati, Ras and processed cheese samples were exceeded the guideline values of Lead for processed cheese (Max 0.3mg/kg) according to E.O.S (11) as shown in Table (3). Lower results were reported by (12) for Domiati cheese and (26) for processed cheese. While higher results were recorded by(13). Lead has a cumulative and severe toxic effect due to its low rate of elimination. The symptoms of lead toxicity includes ulcerative stomatitis, a blue gingival (lead line), abnormalities in sperm number, decreases, in sexual drive, unpotance and sterility. Women exposed to lead poisoning may suffer from abnormal ovarian cycle, menstrual disorders with spontaneous abortion(27, 28, 29).

The high levels of cadmium and lead in examined Ras and processed cheese samples may attributed to that they made from milk contaminated with such pollutants and/or during cheese manufacturing procedures especially the equipment used (30,31).
It was found that 40-90% of toxic heavy metals in milk remained in cheeses after processing especially hard cheese than soft one (32). Furthermore, the health risk may come from using of contaminated salt with heavy metals in cheese manufactures (33, 13, 26). In this respect they recommended the using of a purified salt or brine solution.

In conclusion, all the examined cheese samples were contaminated with cadmium, copper and lead with variable concentrations that the continuos consumption of such cheeses may constitute a public health hazard through progressive accumulation of these elements inside the consumer body. Therefore the raw ingredients used in cheese manufacture including (raw milk, milk powder, salt, emulsifier, etc) as well as, water supply, equipment used and packaging materials should be free from any traces of heavy metals and all the cheese manufacturing procedures as well as the hygienic conditions of the cheese factory should be regularly checked by the local authorities at cheese factors. The cheese procedures should have an educational programmes about hygienic disposal of their wastes, sewage drainage especially at water sources.

References


وجود الكادميوم، النحاس والرصاص
في بعض أنواع الجبن

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قسم مراقبة الأغذية – كلية الطب البيطرى بمشتهر
جامعة الزقازيق - فرع بنها

أجريت هذه الدراسة على خمسة وسبعون عينة من أنواع (الجبين المختلفة الجبن القريش،
الدميابي، المملكة، الرومي والمطبوخ) بواقع خمسة عشر عينة من كل نوع لتحديد
مستوى بعض المعادن الثقيلة في هذه الأنواع من الجبن الذي تم تجميعه من المولات
المختلفة بمحافظة القليوبية

وقد وجد أن نسبة الكادميوم هي 13.33%، 26.67%، 33.33% و40% في
عينات الجبن القريش، الدمياطي، المملكة، الرومي والمطبوخ على التوالي

وшла نسبة النحاس لعينات الجبن هي 26.67%، 33.33%، 46.67% و66.67% على التوالي أما نسبة الرصاص فكانت 40%، 67.67% و73.33% و53.33% لعينات الجبن القريش، الدمياطي، المملكة، الرومي والمطبوخة
على التوالي

وقد تمت مقارنة هذه النتائج مع الحدود المسموح بها للجن المطبوخ المذكور بالمكونات
القياسية المصرية، وقد تمت مناقشة الأهمية الصحية لهذه العناصر مع وضع بعض
التوصيات لمنع تلوث الجبن بهذه المعادن الثقيلة.