Soft Plastic Bread Packaging: Lead Content and Reuse by Families

Clifford Weisel, PhD, Michele Demak, MPH, Steven Marcus, MD, and Bernard D. Goldstein, MD

Introduction

Low level effects of lead on intelligence and on behavior have been repetitively documented,1-6 and a causal relation between low levels of lead and fetal malformations, adult hypertension, and auditory acuity has been suggested.7-10 This recognition has led to efforts to diminish lead exposure, particularly from older homes containing indoor lead paint and from gasoline.

Lead and other metals are also present in colored plastics. However, only submicrogram/cm² amounts were extractable in acid or ethanol solutions when these are imbedded in the plastic itself.11,12 Pigments used to decorate plastics sometimes included lead chromates13 and if used on food wrappings the potential for transference to food exists.14,15 While such painting is done on the outside of plastic food wrappings, the opportunity exists for the paint to come in contact with food, particularly if the soft plastic bag is reused. Additionally, the wrappings eventually are included in municipal solid waste disposal facilities and, therefore, the added lead is transferred to the environment.

Methods

Lead Analysis

We purchased 18 breads representing 14 different national brands from three different national chain supermarkets in three New Jersey towns about 80 miles apart: Westfield; Highland Park; and Woodbury. The breads included: white bread, whole wheat, bagels, and pita. A 50 or 200 cm² section of each wrapper, containing the printing, was removed, weighed, rinsed with distilled water, and placed in an acid washed beaker. Sections of clear plastic were also cut from several bags to serve as blanks. The total lead content was determined by either a hot or cold concentrated acid extraction. The hot acid extract consisted of 5 mL of nitric acid followed by heating at 250 °C until approximately 0.5 mL remained, then 5 mL HCl with heating until 0.5 mL remain. The cold acid extraction used 5 mL of HCl. The residue from each treatment was diluted to 25 mL with distilled water and analyzed using flame atomic absorption spectroscopy.

Survey Methods

A survey was designed to assess the extent to which soft plastic bread packages may be reused. We targeted families with young children, the subgroup of major concern for increased lead body burden. Two parent groups were surveyed by questionnaire in May and June of 1990. Fifty-three of 84 questionnaires were returned from the first group, and 53 of 90 from the second group (overall response rate 61 percent).

Most respondents are in their thirties, and are well-educated mothers of young children. They are the usual buyers of bread for their households, buying an average of two such packages per week.

Results

Lead was detected in the sections containing printing or designs on all but one of the soft plastic bread bags that were analyzed, but was not present in any of the clear sections of the bags (Table 1). The mean ± S.E. amount of lead for these bags with lead was 26 ± 6 mg. Incubation of the plastic wrappers in 5 percent acetic acid resulted in extraction of 6.8 percent of the lead pigment (mean of 4 studies) in 10 minutes and 10 percent in 60 minutes (mean of 6 studies).

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Editor's Note: See also related editorial on page 685 of this issue.
### Survey Results

Of the 106 respondents, 41 (39 percent) report reusing the packaging or bag from bread products. The reasons for doing so included: concern for the environment (34 families); convenience (24 families); and saving money (17 families). Food storage and/or packing lunch were the uses most often cited, with more than half of the “reusers” reporting these applications. These packages may be used on multiple occasions: eight families reused them at least three times.

Of the 41 reusers, 23 do so after turning the package inside out, and 17 of these families report using the bags while inside out for food storage. Thus 17 of the 106 respondents (16 percent) store food in contact with the painted label.

Preliminary analyses indicate no relationship between respondents’ level of education and package reuse, although respondents who attended graduate or professional school are somewhat more likely to turn the bags inside out. Similarly, no obvious or significant relationship emerges for respondents who are full-time homemakers compared with those working outside the home. Anecdotal information suggests that the rationale for turning the bag inside out before reuse includes removal of bread crumbs that might become moldy, and drying the inside of the bag which picked up moisture from the bread. We were told of paint flaking from the inverted packaging onto stored food.

### Discussion

The Environmental Protection Agency (EPA) estimates that 10 percent of municipal waste is incinerated, 10 percent recycled, and the remainder ends up in landfill.\(^5\) The Food and Drug Administration (FDA) estimates that between 35 and 55 g of white bread and an additional 15 to 25 g of rolls and whole wheat bread are consumed daily across several age groups.\(^6\) Assuming that each package of bread contains one pound and that 60 g of bread are consumed daily, \(3.0 \times 10^2\) bread bags are disposed daily in the US. Assuming bread bags have an average lead content of 26 mg, 0.8 metric tons of lead would be added to the municipal waste stream daily. This lead could enter the environment as a result of incineration or leaching into groundwater from a landfill. Plastics are currently a prime candidate for recycling. The reduction of toxins is needed\(^\) to minimize exposure to workers involved in recycling and to increase potential uses of the final product.

EPA estimates that the daily baseline ingestion of lead from food, water, and beverages is between 32 and 40 \(\mu g\).\(^7\) Inhalation is estimated to give an additional exposure of 20 \(\mu g\) daily.\(^8\) Based on our present findings, we conservatively estimate that a weak acid, such as vinegar, in contact with the pigment for as little as 10 minutes, could extract about 5 percent of the lead. For a 100 cm\(^2\) surface, the size of a single slice of bread, this would produce an exposure of about 100 \(\mu g\) of lead.

Efforts are underway to reduce lead exposures through the removal of lead from gasoline, solder from cans, and, most importantly, from homes with deteriorated lead paints. However, our findings suggest that an additional source that is dependent upon the habits of individuals, and not measured by current procedures for food analysis, may need to be considered when estimating total lead exposure.

Although presenting an unnecessary risk to health which should be discontinued, we do not believe it likely that the use of inverted bread packaging to store or transport food presents an immediate threat to the health of family members necessitating an emergency response. However, obtaining blood free erythrocyte protoporphyrin or lead levels is a valuable part of the routine medical evaluation of all young children and is particularly important for high-risk groups.\(^9\) Until this use of lead is prohibited, plastic packaging should not be turned inside out to store or transport food.

### Acknowledgments

We acknowledge the assistance of Arlene Yang, Ruyu Yu, Elaine Randolph, and Eugene F. Peters, Jr. Supported by NIEHS Center Grant #ES05022.

### References

8. Mushak P, Davis JM, Crocetti AF, Grant L: Prenatal and postnatal effects of low-level lead exposure: Integrated summary of

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**TABLE 1—Amount of Lead in Plastic Food Wrappers from Fourteen Brands of Bread**

<table>
<thead>
<tr>
<th>Bread</th>
<th>Amount per painted portion (ug/cm²)</th>
<th>Estimated % of bag with painted writing</th>
<th>Total Lead per bag (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>7.4</td>
<td>90</td>
<td>13</td>
</tr>
<tr>
<td>White</td>
<td>7.8, 27</td>
<td>60</td>
<td>9.4, 32</td>
</tr>
<tr>
<td>White</td>
<td>46, 36</td>
<td>80</td>
<td>58, 74</td>
</tr>
<tr>
<td>White</td>
<td>14</td>
<td>40</td>
<td>11</td>
</tr>
<tr>
<td>White</td>
<td>2, 7, 3, 44</td>
<td>95</td>
<td>3.8, 14, 84</td>
</tr>
<tr>
<td>White</td>
<td>17</td>
<td>80</td>
<td>27</td>
</tr>
<tr>
<td>Pita</td>
<td>17</td>
<td>50</td>
<td>9</td>
</tr>
<tr>
<td>Italian</td>
<td>ND</td>
<td>50</td>
<td>ND</td>
</tr>
<tr>
<td>Rye</td>
<td>0.9</td>
<td>50</td>
<td>0.9</td>
</tr>
<tr>
<td>White</td>
<td>7.9</td>
<td>40</td>
<td>6.3</td>
</tr>
<tr>
<td>White</td>
<td>22</td>
<td>95</td>
<td>39</td>
</tr>
<tr>
<td>Pita</td>
<td>2.8</td>
<td>50</td>
<td>1.1</td>
</tr>
<tr>
<td>White</td>
<td>29</td>
<td>75</td>
<td>44</td>
</tr>
<tr>
<td>Rolls</td>
<td>13</td>
<td>40</td>
<td>10</td>
</tr>
</tbody>
</table>

ND—not detected.

An average bag size of 2000 cm\(^2\) was used to calculate the total lead content on the bags of white bread, 1000 cm\(^2\) for the smaller bags.

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Public Health Briefs

Non-Hodgkin’s Lymphoma in a Cohort of Vietnam Veterans

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Introduction

Results of studies of occupational groups exposed to phenoxy herbicides have raised concerns that Vietnam veterans may have an increased risk of developing non-Hodgkin’s lymphoma (NHL) because of possible exposure to the phenoxy herbicide Agent Orange, used in South Vietnam between 1966 and 1970.1–3 These concerns have been heightened by reports of an increased risk of NHL among Vietnam veterans.4,5 In the Centers for Disease Control Vietnam Experience Study (VES), the health of US Army Vietnam veterans was compared with that of Vietnam-era Army veterans who had not served in Vietnam. Although the VES was not designed to assess the risk of rare cancers among Vietnam veterans, the high level of concern about NHL led us to investigate and report the findings for NHL.

Methods

The study population consisted of 18,313 randomly selected, male US Army veterans (9,324 Vietnam veterans and 8,989 non-Vietnam veterans) who entered military service between January 1965 and December 1971. The VES included both mortality and health interview components, and the methods have been described in detail elsewhere.6,7 In this analysis, we combined mortality and interview data to determine the number of veterans with NHL in the cohort. Two hundred forty-six Vietnam veterans and 200 non-Vietnam veterans had died between separation from active duty and December 31, 1983, the closing date of the mortality component. A panel of physicians examined medical records of these veterans to determine the causes of death for each veteran.

In the interview component of the VES, we attempted to locate and contact all veterans not identified as deceased. Altogether, we interviewed 15,288 veterans (87.3 percent of eligible Vietnam veterans and 83.8 percent of non-Vietnam veterans) by telephone during 1985–86. If the veteran reported that he had been diagnosed with cancer, we asked him to describe the type of cancer that he had. To verify three self-reported cases of NHL and to identify other cases, we sought medical records for 47 veterans, including men who reported a malignant neoplasm of the lymphatic or hematopoietic tissues, men who reported a diagnosis of cancer of a site that could be NHL (e.g., lung, neck, stomach, lymph nodes), and men who reported a diagnosis of cancer but could not name a specific type or site. We could not

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