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Lead Levels in Argentine Market Wines

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Many research workers have described the alimentary tract as the main route of exposure to a diversity of environmental contaminants. The presence of pollutants in the daily diet is attributable to the existence of components, whether of animal, vegetable or mineral nature, employed as raw materials in food production processes, as well as those incorporated during production processes, whether industrial or domestic. Thus, such a continual yet imperceptible access to undesirable components contributes to increase their burden in the organism.

Among the major potentially toxic components are the heavy metals, which are widely distributed in nature and utilized by man in a great number of activities. Within the category of heavy metals, the one displaying greatest diffusion in the environment is lead, which is actually the main industrial contaminant in Argentina. The toxic properties of lead, known since antiquity, have made this element the subject of study from the physiopathological viewpoint.

In Argentina and in other Latin American countries little is known concerning lead content in all kinds of food. In contrast, this is hardly the case in other countries where pertinent data have been documented, such as in Germany (ex-Western) and Japan (Louekari and Salminen 1986), Poland (Falandysz 1990), Finland (Tahvonen and Kumpulainen 1993) and Holland (Vos et al 1990).

Several authors have indicated the significance of the relation between the exposure of the organism expressed by lead blood levels and daily intake (Moore et al 1977, Sherlock and Quinn 1986a and Louekari et al 1991), so that the determination of lead levels in food and its incidence in the diet allow alimentary exposure of the population to such element to be reliably evaluated.

The presence of lead in alcoholic beverages poses a double risk for the user, namely that of lead itself and that of alcohol. The interaction between both components has been dealt with in several reports, such as those of Nation et al (1993). Brivet et al (1990) described greater lead accumulation in microsomes and mitochondria of rats treated with ethanol and low lead doses.

It is obvious that, in the absence of interferences, lead is more rapidly absorbed from a liquid than from a solid preparation, so that its quantitation in non-solid diet components, such as milk, water, soft drinks and alcoholic beverages, among others, is essential to determine the daily intake of this metal.

The present work is aimed at establishing lead levels in Argentine wines as the first step in a comprehensive evaluation of its contribution to the diet and to explain the difference in levels between red and white wines.

MATERIALS AND METHODS

A total of 59 wines belonging to 54 different brands were randomly chosen from supermarket

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shelves in the city of Buenos Aires, Argentina, then classified according to type, packaging and corking.

The amount of lead in samples was determined by atomic absorption spectrophotometry employing flame atomization, according to AOAC method (25.068 to 25.073), with modifications previously carried out by some of the present authors (Garcia Femández et al. 1990). A Varian AA 475 atomic absorption spectrophotometer, supplied with double beam, background correction, and hollow cathode lead lamp, was employed. Working conditions were as follows: 5 mA lamp current intensity, 283.3 nm wavelength and a 0.5-nm slit. An air-acetylene flame was used for atomization.

Glassware was treated during 12 hours with 50% nitric acid and washed sequentially three times with distilled water and deionized water. Reagents and drugs were of analytical grade.

The procedure was as follows: 100 ml of wine were taken from the original packaging by means of a pipette, placed in Vitreosil capsules and evaporated to dryness on a hot plate. In a muffle furnace the dry residue was heated to 350°C till white ashes were obtained. After cooling, 5 ml of 1N nitric acid were added to the capsule and the contents transferred to a 50-ml measuring flask, making up the volume with successive capsule washings with the same acid. Two 20-ml aliquots were taken from the flask and transferred to separate 100-ml decantation flasks in order to perform analysis by duplicate.
To each aliquot, III bromocresol green (Mallinckrodt) and 4 ml of 10% citric acid (Mallinckrodt) aqueous solution (w/v) were added. After adjusting to pH 5.4 with concentrated ammonia (Mallinckrodt), 4 ml of 2% ammonium pyrrolidine dithiocarbamate (APDC) (Sigma, St. Louis) in deionized water (w/v) were added and the mixture strongly stirred for one minute.
The resultant Pb-APDC complex was extracted from the aqueous phase by stirring during one minute with 5 ml of methylisobutylketone (MIK) (Merck) saturated with deionized water. The organic phase was atomized in the oxidizing air-acetylene flame, taking readings to zero with MIK. The control was prepared by performing the operations described above for the sample on 20 ml of deionized water.

Values were interpolated in a calibration curve plotted by processing standard solutions as indicated above for the sample. Such solutions contained lead as nitrate, at 50, 200,400, 600 and 800 µg/L concentrations, obtained by dilution with 1% nitric acid of a commercial standard (Titrisol, Merck) whose concentration was 1 mg/ml. Under the given conditions, the threshold concentration was regarded as 5 µg/L. Samples exceeding the maximum value of the calibration curve were suitably diluted in 1N nitric acid in order to adapt them to the available range and then reprocessed. Samples were processed by duplicate, regarding as valid for each sample the mean value for lead concentration provided the difference between parallel determinations was less than 10% of the one having the lower value.

Wines that showed undetectable values of lead were fortified with 50, 400 and 800 µg/L of lead (lead nitrate) and processed as the samples of the survey. The recovery of lead from wines (mean percentage ± SD) was : 89 ± 1.2 (n=6); 88 ± 0.9 (n=7); 86 ± 1.3 (n=6), respectively.

Our laboratory participates in an external quality control program for lead with a country belonging to the European Community (Spain) and maintains its own internal quality control.

RESULTS AND DISCUSSION

Findings are listed in Tables 1,2 and 3, as well as in Figures 1 and 2. The tables summarize values obtained by means of two criteria for “undetectable” samples (UD): either to regard such values as 0 (zero) µg or to make them equal to 4 µg/L that is, one µg less than the lowest point on the calibration curve.

Before discussing the results, it seems useful to make some observations on the presentation of wines at sales outlets in Argentina. Wines of better quality, termed "fine table wines", are sold in 750-ml cylindrical glass containers, while those of standard quality are known as "common table wines" and sold in 930- and 1000-ml cylindrical glass or plastic containers, although lately the so-called "tetrabrik" ("tetrapak" in Europe) containers have appeared, prismatic in shape and made of cardboard, aluminium foil and nylon film. Wines sold in demijohns are those of the lowest quality.

Table 1. Lead content in red and white Argentine wines

Type	n	Pb (µg/L)[a]	Pb (µg/L)[b]	Range
White	32	55 ± 36	56 ± 33	UD[c]-140
Red	27	85 ± 55	86 ± 55	UD[c]-190
White + Red	59	69 ± 46	70 ± 45	UD[c]-190

[a]Values obtained regarding undetectable (UD) samples as 0 µg/L. [c]Undetectable (UD).
[b]Values obtained regarding undetectable (UD) samples as 4 µg/L.

Table 2. Lead content in red and white Argentine wines according to capping material.

Type	Plastic[a]	Aluminium[b]	Lead	Tinplate[c]
White[d]	58 ± 39	42 ± 40	40	68 ± 34
White[e]	58 ± 39 (n = 14)	43 ± 38 (n = 8)	40 (n = 1)	68 ± 34 (n = 7)
Red[d]	137 ± 47	66 ± 51	130 ± 71	---
Red[e]	137 ± 47 (n = 5)	67 ± 50 (n = 19)	130 ± 71 (n = 2)	---
White + Red[d]	79 ± 41	59 ± 48	100 ± 72	68 ± 34
White + Red[e]	79 ± 41 (n = 19)	62 ± 45 (n = 27)	100 ± 72 (n = 3)	68 ± 34 (n = 7)

All values are means ± SD, expressed in µg/L. [a] Thermocontracted PVC. [b] Aluminium foil.
[c] Screw-cap made of tinplate. [d] Values obtained regarding undetectable (UD) samples as 0 µg/L.
[e] Values obtained regarding undetectable (UD) samples as 4 µg/L.

Table 3. Lead content in red and white Argentine wines according to packaging material.

Type	750 ml	930-1000 ml	Demijohn	Tetrabrik
White[a]	47 ± 38	65 ± 34	55 ± 39	60 ± 0
White[b]	49 ± 35 (n = 11)	65 ± 34 (n = 7)	57 ± 36 (n = 12)	60 ± 0 (n = 2)
Red[a]	85 ± 55	UD	175	70
Red[b]	86 ± 53 (n = 24)	UD (n = 1)	175 (n = 1)	70 (n = 1)
White + Red[a]	71 ± 54	57 ± 39	65 ± 50	63 ± 6
White + Red[b]	74 ± 50 (n = 35)	57 ± 39 (n = 8)	66 ± 48 (n = 13)	63 ± 6 (n = 3)

All values are means ± SD, expressed in µg/L. [a]Values obtained regarding undetectable samples as 0 µg/L. [b]Values obtained regarding undetectable (UD) samples as 4 µg/L. UD, undetectable.

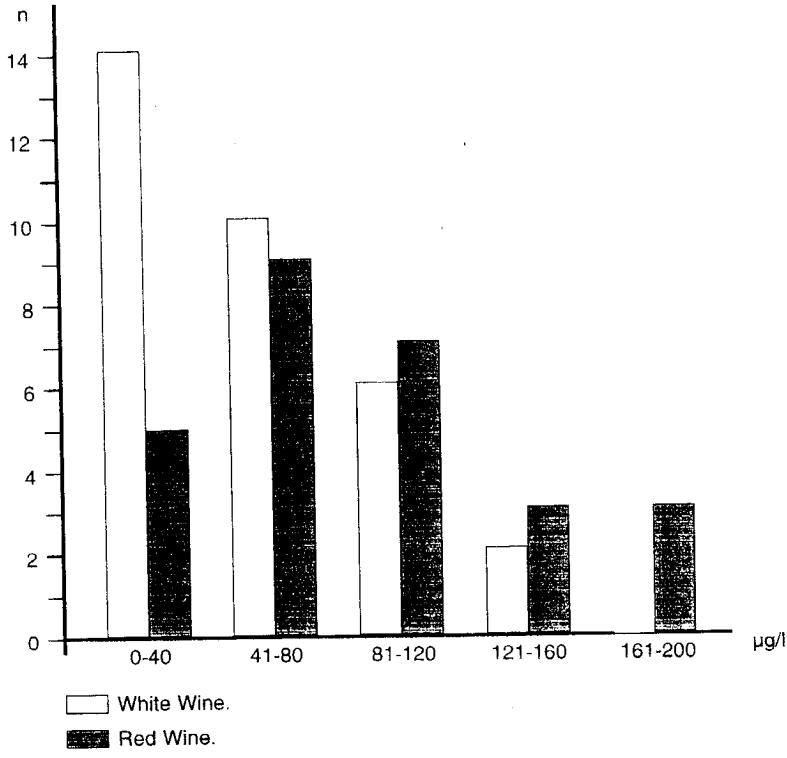

Figure 1. Lead content in white and red wine.

Corks are covered by a film made of plastic, of a foil made of lead or of an alloy having a high aluminium content, which has displaced lead ahmost entirely. Lead covers are rarely seen, so much so that in this study they were found in only three samples.

Neither were any appreciable differences observed for each kind of wine, whether white or red, as regards the type of capping (Table 2) or lack of same, as in the case of the so-called "tetrabrik" packaging (see Table 3). White wines presented greater values in the latter packaging or in those with screw-type tinplate capping than in the remainder, while in the case of red wines lead levels were highest in bottles with natural corks.

As regards packaging, the peak value for white wines was found in common table wines (930-1000 ml) and for red wines in tine wines, provided wines in demijohns are disregarded (Table 3). On considering mean values and ranges, both for red and for white wines, it may be observed that mean lead levels found in our study (55 and 85 µg/L, respectively) are not dissimilar to those recorded in other countries: 65 and 71 µg/L for Denmark (Pedersen et al. 1994), 75 and 76 µg/L for Sweden (Jorhem et al. 1988) and 74 and 106 for the United Kingdom (Sherlock et al. 1986b). In every case indicated levels are mean values, the first corresponding to white and the second to red wines. In our survey the difference between white and red wine are highly significant ($p < 0.02$) by the Welch test. The difference may be a consequence of the manufacturing process.
Despite the fact that several authors have described differences in levels between wines having lead capping and those without, which were attributed to lead foil capping, in our case it happens that mean values for red wines with lead capping and those without any capping are not dissimilar (130 and 137 µg/L, respectively), whereas levels for plastic capping are higher.

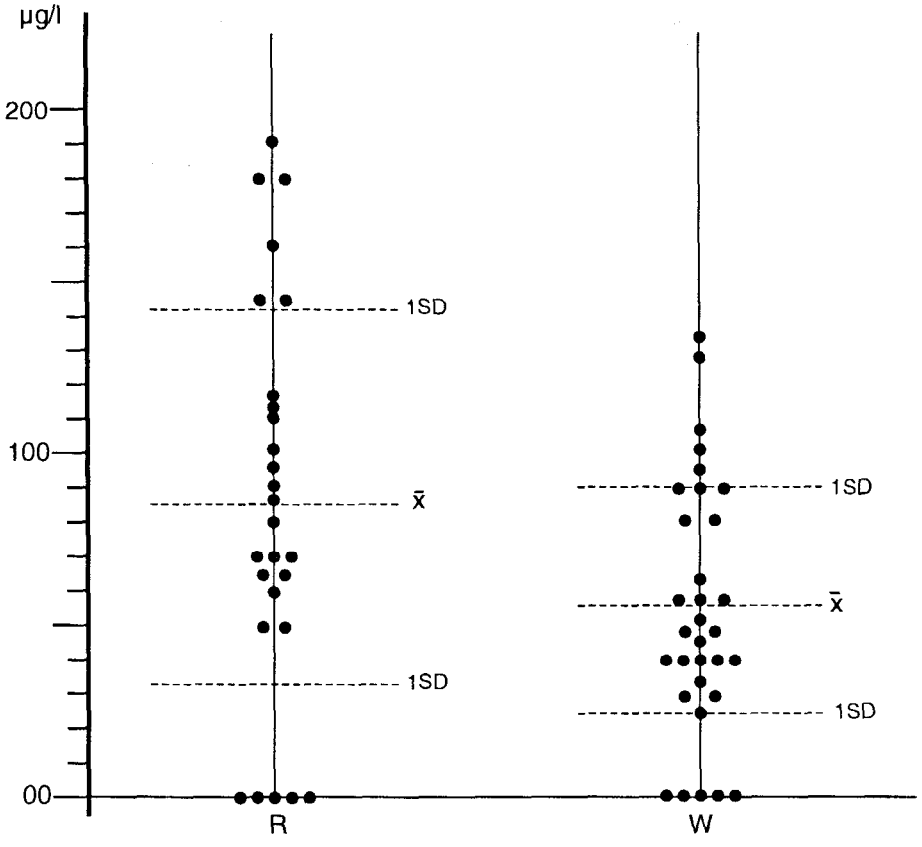

Figure 2. Distribution of lead values in red and white wine.

Out of the total number of samples evaluated herein, there were five duplicates. In these wines from different harvest years, mostly disparate values were obtained, as follows: 90 and 180 µg/L; 120 and 180 µ/L; 40 and 90 µg/L; and 60 and 115 µg/L; in fact, there was only one case of coincident values (60 µg/L).

Lead content values for wines sold on the Argentine market are similar to those reported for other countries. However, since alcoholism due to wine is the main drug addiction in Argentina (2 millions people), as well as the fact that a heavy drinker consumes from 1500 to 2000 ml of wine daily, it may readily be appreciated that this population makes up a high-risk group for lead poisoning, as the mean lead intake would range from 600 to 1200 µg weekly, according to the type of wine, representing per se between 20 and 40% of the PTWI for this element.

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