

Lead Content of Some Malaysian Foodstuffs

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Recognizing that food and drinks are important sources of lead exposure, numerous studies on the concentration of lead in various foods and beverages have been conducted worldwide. Large variations have been reported and on the average, foods contain lead in concentrations varying from 0–2.5 $\mu\text{g/g}$ wet weight (NHMRC, 1981).

In Malaysia there have been few studies on the lead content of foodstuffs besides those of the Malaysian Agricultural Research and Development Institute (MARDI) (Chia, 1983) and the Institute for Medical Research (IMR). This report provides further data on the lead content of a variety of Malaysian foods.

Commonly consumed Malaysian food samples were purchased from retail outlets around Kuala Lumpur and other parts of Peninsular Malaysia. A total of 80 food items from 11 food groups were studied. For each food item, a minimum of two samples obtained from different sources were analysed. Each sample was determined in duplicate. The organic extraction technique using the diethylammonium diethyldithiocarbamate–xylene system established by Roschnik (1973) was chosen for the study. The recovery of this method was evaluated using standard addition.

Table 1 shows the levels of lead found in several food groups analysed. Results obtained are expressed as the fresh or wet weight of the food items.

The mean lead content of cereal and cereal products ranged from 0.29 ppm (noodles) to 1.11 ppm (milled rice) with 0.69 ppm as the average value. This value seems to be high when compared to the average lead content of some British and American cereal and cereal products of 0.17 ppm and 0.10 ppm respectively (Jelinek, 1982). The mean levels in granulated sugar and *gula melaka* were 1.71 ppm and 1.10 ppm respectively. The values obtained seemed to exceed the permitted level of 0.5 ppm (for refined sugar) set by His Majesty's Government Gazette (HMGG) Malaysia (1985). The mean lead levels in various roots, vegetables and fruits obtained ranged from 0.21–2.12 ppm. The Australian NHMRC permitted level of lead in this food group is 4.0 ppm (NHMRC, 1981).

Lead values in various red meat and poultry products were found to range from 0.22 to 1.28 ppm but often fell below 1 ppm. The Malaysian maximum permitted proportion of lead in meat and meat products is 2 ppm (HMGG, Malaysia, 1985). Compared to the values obtained by Dalton and Malanoski (1969) of 1–10 ppm, these values can be considered to be low. Products such as burgers and frankfurters, which are produced from meat by additional handling or processing operations such as grinding, appear to have appreciably higher levels than the original muscle.

Processed foods are generally expected to contain more lead. Doyle and Spaulding (1978) commented that animals grazing near highways and smelters usually contain large amounts of the metal in their tissues.

For lead in eggs, the mean level found in fresh eggs was about 0.54 ppm, and in the preserved eggs it was 1.56 ppm. The mean value for the century eggs of 2.35 ppm seems to exceed the

general allowable limit of 2 ppm (e.g. NHMRC, 1981; HMGG, Malaysia, 1985). The use of lead oxide in the preparation of these eggs may affect their lead content (Hou, 1981).

Fish and shellfish were found to have lead content close to 1 ppm. The maximum allowable limit for this food group is 2 ppm (HMGG, Malaysia, 1985). Lead content of spices, which ranged from 3.01 ppm (pepper) to 9.69 ppm (clove), seemed to exceed the maximum permitted level of lead in spices of 2 ppm (HMGG, Malaysia, 1985). The elevated level of lead (2.35 ppm) in chocolate wafer may be due to contamination from the wrappers. Hankin, Heichel and Botsford (1974) had shown that the coloured portions of wrappers may contain lead as high as 8 to 10,100 ppm.

Good recovery with percentages ranging from 88 to 109 and a central tendency of 97% was obtained over a fairly wide range of foodstuffs. The good recovery obtained shows that this method can be used quite successfully in normal laboratory conditions.

It can thus be seen that there was a fair amount of variation in lead levels between samples of the same food item (e.g. lead values in cockles were found to range from 0.19 ppm to 2.00 ppm) as well as between different food items (e.g. the lowest mean value was found in fresh milk with 0.13 ppm of lead and highest in clove with 9.69 ppm of lead). However, most products contain less than 2 ppm of lead, which is a common permitted limit for the lead content of foods for most countries (NHMRC, 1981; HMGG, Malaysia, 1985).

The amount of lead present in certain foodstuffs may be reduced to some extent. For example, in the case of vegetables, Low and Lee in 1979 showed that some 35–54% of surface lead could be removed by washing. Hence, careful washing of the vegetables before cooking is crucial in removing not only lead but other dirt and contaminants as well. The positive steps taken by the Government of Malaysia to enforce the reduction of lead in petrol from 0.84 g/l to 0.4 g/l and finally to none should be able to help reduce the amount of lead in the atmosphere.

It must be emphasized that results reported here are not to be taken as representative of lead level in a particular food or food group, since proper sampling was not carried out. The values are only indicative of the levels that may be expected in the particular food.

Particular concern should be directed towards those food items consumed by infants and small children. This is especially so because gastrointestinal absorption of lead is known to be much more efficient in young children than adults. Metabolic balance studies carried out by Ziegler and co-workers (1978) have shown that children absorb approximately 40% of ingested lead from the gastrointestinal tract, whereas studies of adults (World Health Organization, 1977) have indicated that only about 10% of the intake of lead from food is absorbed from the gastrointestinal tract.

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Table 1.
Lead Content of Foodstuffs

| | Food items | Number of samples | Lead content (ppm) | |
|-----|--|-------------------|---------------------------------------|------|
| | | | Individual values | Mean |
| a) | Cereal, Legume, Sugar and Products | | | |
| 1. | Milled rice (<i>Beras</i>) | 2 | 0.83, 1.39 | 1.11 |
| 2. | Glutinous rice (<i>Beras pulut</i>) | 5 | 0.13, 0.22, 0.78 0.89, 1.86 | 0.78 |
| 3. | Wheat flour (<i>Tepung gandum</i>) | 3 | 0.10, 0.20, 0.71 | 0.34 |
| 4. | Rice flour (<i>Tepung beras</i>) | 4 1.20 | 0.35, 0.55, 1.10 | 0.80 |
| 5. | Noodles (<i>Mee basah</i>) | 3 | ND, 0.31, 0.57 | 0.29 |
| 6. | Bread (<i>Roti</i>) | 5 | 0.41, 0.72, 0.82, 0.97, 1.26 | 0.84 |
| 7. | Soy bean cake (<i>Tau Kua</i>) | 6 | 0.13, 0.14, 0.34, 0.65, 0.69, 1.25 | 0.53 |
| 8. | Soy sauce, thick (<i>Kicap pekat</i>) | 2 | 1.25, 1.28 | 1.27 |
| 9. | Soy bean milk, packet (<i>Susu Kacang Soya</i>) | 2 | 0.06, 0.61 | 0.34 |
| 10. | Soy bean curd (<i>Tim Chok</i>) | 2 | 0.61, 2.21 | 1.41 |
| 11. | Peanut, shelled (<i>Kacang tanah</i>) | 2 | 0.59, 1.87 | 1.23 |
| 12. | Granulated sugar (<i>Gula putih</i>) | 3 | 1.03, 1.78, 2.33 | 1.71 |
| 13. | Brown sugar (<i>gula melaka</i>) | 3 | 0.46, 1.40, 1.43 | 1.10 |
| 14. | Strawberry jam (<i>Jem Buah strawberi</i>) | 2 | 0.41, 0.42 | 0.42 |
| 15. | Honey (<i>Madu lebah</i>) | 2 | 0.85, 0.97 | 0.91 |
| b) | Roots, Vegetables and Fruits | | | |
| 16. | Potato (<i>U'bi kentang</i>) | 2 | 0.13, 0.86 | 0.49 |
| 17. | Sweet Potato (<i>U'bi keledak</i>) | 2 | 0.49, 0.75 | 0.62 |
| 18. | Tapioca (<i>U'bi kayu</i>) | 2 | 0.10, 0.32 | 0.21 |
| 19. | Tapioca leaves (<i>Pucuk U'bi kayu</i>) | 2 | 0.32, 0.65 | 0.49 |
| 20. | Spinach (<i>Bayam putih</i>) | 4 | ND, 1.83, 3.32, 3.35 | 2.12 |
| 21. | Mustard leaves (<i>Sawi</i>) | 6 | 0.81, 1.04, 1.36 1.44, 2.25, 2.34 | 1.54 |
| 22. | Swamp cabbage (<i>Kangkong</i>) | 2 | 0.31, 0.91 | 0.61 |
| 23. | Lady's finger (<i>Kacang bendi</i>) | 3 | 0.43, 0.88, 1.07 | 0.79 |
| 24. | French beans (<i>Kacang buncis</i>) | 2 | ND, 1.63 | 0.82 |
| 25. | Cucumber (<i>Timun</i>) | 3 | 0.28, 0.42, 0.69 | 0.46 |
| 26. | Tomato (<i>Tomato</i>) | 2 | 0.70, 0.73 | 0.72 |
| 27. | Banana (<i>Pisang</i>) | 2 | 0.40, 0.74 | 0.57 |
| 28. | Water melon (<i>Tembikai</i>) | 2 | 0.18, 0.37 | 0.28 |

Table 1.
Lead Content of Foodstuffs (continued)

| Food items | Number of samples | Lead content (ppm) | |
|--|-------------------|--|------|
| | | Individual values | Mean |
| b) Roots, Vegetables and Fruits (continued) | | | |
| 29. Guava (<i>Jambu Batu</i>) | 2 | 0.43, 0.74 | 0.59 |
| 30. (<i>Durian</i>) | 2 | 0.13, 0.30 | 0.22 |
| c) Meat and Poultry | | | |
| 31. Beef (<i>Daging Lembu</i>) | 2 | 0.13, 0.30 | 0.22 |
| 32. Lungs, ox (<i>Paru-paru Lembu</i>) | 2 | 0.63, 1.17 | 0.90 |
| 33. Heart, ox (<i>Jantung Lembu</i>) | 2 | 0.34, 1.16 | 0.75 |
| 34. Kidney, ox (<i>Buah Pinggang Lembu</i>) | 3 | 0.61, 0.82, 0.91 | 0.78 |
| 35. Liver, ox (<i>Hati Lembu</i>) | 3 | 0.91, 1.36, 1.57 | 1.28 |
| 36. Beef burger (<i>Berger Lembu</i>) | 2 | 0.95, 1.04 | 0.99 |
| 37. Beef frankfurter (<i>"Hot-dog" Lembu</i>) | 2 | 0.68, 1.03 | 0.85 |
| 38. Mutton (<i>Daging Kambing</i>) | 2 | 0.45, 0.60 | 0.53 |
| 39. Chicken (<i>Ayam</i>) | 2 | 0.24, 0.37 | 0.30 |
| 40. Chicken liver (<i>Hati ayam</i>) | 2 | 0.46, 0.53 | 0.50 |
| 41. Chicken burger (<i>Berger Ayam</i>) | 2 | 0.44, 0.98 | 0.71 |
| 42. Chicken frankfurter (<i>"Hot-dog" Ayam</i>) | 2 | 0.57, 0.70 | 0.64 |
| d) Eggs and Milk | | | |
| 43. Chicken egg (<i>Telur Ayam</i>) | 4 | ND, 0.23, 0.36, 0.39 | 0.39 |
| 44. Quail egg (<i>Telur Puyuh</i>) | 2 | 0.51, 1.03 | 0.77 |
| 45. Turtle egg (<i>Telur Penyu</i>) | 2 | ND, 0.94 | 0.47 |
| 46. Century egg (<i>Telur Abad</i>) | 2 | 2.18, 2.52 | 2.35 |
| 47. Salted egg (<i>Telur Asin</i>) | 2 | 0.75, 0.80 | 0.77 |
| 48. Powdered milk (<i>Susu tepung</i>) | 3 | 0.10, 0.40, 0.58 | 0.36 |
| 49. Fresh milk (<i>Susu segar</i>) | 2 | 0.08, 0.19 | 0.13 |
| e) Fish and Shellfish | | | |
| 50. Cockles (<i>Kerang</i>) | 9 | 0.19, 0.24, 0.56, 0.67, 0.67, 1.41, 1.45, 1.68, 2.00 | 0.99 |
| 51. Canned cockles (<i>Kerang tin</i>) | 2 | 0.93, 1.39 | 1.16 |
| 52. Cuttlefish (<i>Sotong</i>) | 5 | ND, 0.23, 0.31, 0.41, 1.12 | 0.41 |
| 53. Canned cuttlefish (<i>Sotong tin</i>) | 2 | 0.39, 0.43 | 0.41 |
| 54. Shrimps (<i>Udang</i>) | 4 | 0.55, 0.57, 0.70, 1.18 | 0.75 |

Table 1.
Lead Content of Foodstuffs (continued)

| Food items | Number of samples | Lead content (ppm) | |
|---|-------------------|----------------------|------|
| | | Individual values | Mean |
| e) Fish and Shellfish (continued) | | | |
| 55. Dried shrimps (<i>Udang kering</i>) | 2 | 0.97, 3.81 | 2.39 |
| 56. Shrimp paste (<i>Belacan</i>) | 2 | 1.71, 2.15 | 1.93 |
| 57. Canned shrimp (<i>Udang tin</i>) | 2 | 0.34, 0.39 | 0.37 |
| 58. Indian Mackerel (<i>Ikan Kembong</i>) | 5 0.49, 1.08 | 0.46, 0.47, 0.48, | 0.60 |
| 59. Hairtail Scad (<i>Ikan Cincaru</i>) | 4 | ND, 0.48, 0.49, 2.02 | 0.75 |
| 60. Threadfin Bream (<i>Ikan Kerisi</i>) | 4 | ND, 0.08, 1.11, 1.38 | 0.64 |
| 61. Sting Ray (<i>Ikan Pari</i>) | 2 | ND, 0.43 | 0.21 |
| 62. Little Tuna (<i>Ikan Ayu Kurik</i>) | 2 | 0.79, 1.23 | 1.01 |
| 63. Pomfret, black (<i>Ikan Bawal Hitam</i>) | 2 | 1.37, 2.70 | 2.04 |
| 64. Longtail Scad (<i>Ikan Terubok</i>) | 3 | 0.23, 0.89, 0.90 | 0.67 |
| 65. Threadfin (<i>Ikan Senangin</i>) | 2 | 0.93, 1.15 | 1.04 |
| 66. Wolf Herring (<i>Ikan Paung</i>) | 2 | 1.07, 1.15 | 1.11 |
| 67. Threadfin (<i>Ikan Kurau</i>) | 2 | 0.73, 0.94 | 0.83 |
| 68. Catfish Eel (<i>Ikan Semilang</i>) | 2 | 0.87, 2.33 | 1.60 |
| 69. Yellowtail Fusilier (<i>Ikan Delah</i>) | 2 | ND, 0.28 | 0.14 |
| 70. African Bream (<i>Ikan Tilapia</i>) | 2 | 0.45, 0.65 | 0.55 |
| 71. Canned sardine (<i>Sardin tin</i>) | 2 | 0.55, 1.76 | 1.15 |
| 72. Canned anchovies (<i>Ikan Bilis tin</i>) | 2 | 0.44, 1.52 | 0.98 |
| f) Miscellaneous Foodstuffs | | | |
| 73. Pepper (<i>Lada Hitam</i>) | 2 | 2.57, 3.44 | 3.01 |
| 74. Clove (<i>Bunga Cengkih</i>) | 2 | 8.73, 10.65 | 9.69 |
| 75. Star anise (<i>Bunga lawang</i>) | 2 | 4.19, 6.74 | 5.47 |
| 76. Cinnamon (<i>Kulit kayu manis</i>) | 2 | 3.88, 4.62 | 4.25 |
| 77. Chocolate Wafer (<i>Wafer coklat</i>) | 2 | 1.83, 2.88 | 2.35 |
| 78. Margarine (<i>Marjerin</i>) | 3 | 0.10, 0.25, 0.41 | 0.25 |
| 79. Cooking oil (<i>Minyak masak</i>) | 2 | 0.19, 0.76 | 0.47 |
| 80. Salt (<i>Garam</i>) | 2 | 0.10, 0.31 | 0.21 |

Results given as fresh or wet weight of the foods.
Local names of foods given in italics within brackets.
ND = not detected.

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