

COMMUNICATION I

Lead, Chromium and Cadmium in Coloured Printing Inks Used in Children's Magazines

ABSTRAK

Seratus lima majalah yang mudah terdapat di Malaysia telah dikaji untuk menentukan plumbum, kromium dan kadmium. Sebilangan kecil yang kandungan plumbumnya tinggi diekstrakan seperti dalam keadaan perut. Keputusan-keputusan yang didapati dari Amerika Syarikat, England and Finland dibandingkan.

ABSTRACT

One hundred and five coloured magazines and comics commonly available in the Malaysian market were analysed for lead, chromium and cadmium. A few with high lead content were extracted under simulated stomach conditions. Results were compared with those from the United States, England and Finland.

INTRODUCTION

It is well known that certain heavy metals like lead, cadmium and chromium are serious health hazards even if ingested in small quantities. It is especially so for lead and cadmium. Children face a greater risk in view of the susceptibility of their immature central nervous system. Hence it is recommended that children should not be exposed unnecessarily to materials containing a high percentage of such metals.

One source of lead, cadmium and chromium that children are likely to come into contact with is coloured magazines and comics. Hankin and co-workers (1973) found that the coloured inks used in American magazines contained a very high level of lead. Values of 1140 - 3170 ppm of lead were reported. Eaton and co-workers (1975) investigated the heavy metals of coloured pages of some U.K. and European magazines and comics. One group of magazines had extractable lead in the 1500 - 600 ppm range while the other had between 500 - 600 ppm. The Finnish coloured magazines and comics were reported to contain lead as high as 1330 ppm and barium at 490 ppm. Chromium was found together with lead (Minkinen, 1976).

In view of the detrimental health effects posed by these heavy metals, we investigated the lead, cadmium and chromium contents of coloured magazines and comics on sale in Malaysia. In this paper we report not only the total heavy metals but also the amount that could be extracted under simulated stomach conditions.

MATERIALS AND METHODS

Magazines and comics were purchased from various shops in Kuala Lumpur and Petaling Jaya. The samples purchased from these areas were expected to provide a fair representation of the various popular types commonly available in Malaysia.

A total of 105 popular titles of children's magazines and comics from 27 different publishers were chosen for the study. Countries of origin of the various magazines and comics were Hong Kong, India, United States, United Kingdom and Malaysia. All magazines and comics were published between 1980 - 84.

The first part of the study involved the determination of the total amount of lead,

cadmium and chromium in the coloured printing inks used for the magazines and comics. For this purpose the coloured page of each magazine was cut into small pieces. They were then pulverised in an aluminium grinder. 1.00 g samples of the pulverised paper was digested with concentrated nitric acid (25 cm³). After digestion, the residue was washed with deionised water and filtered. The total volume of the filtrate was 25 cm³. A control using concentrated nitric acid was treated in the same manner.

Since it was possible that some of the lead, cadmium and chromium might come from sources other than the pigments of the printing ink, blanks were carried out using black and white pages in some of the magazines and comics.

The filtrate was examined for its total lead, cadmium and chromium contents using a sequential scanning inductively coupled plasma emission spectrometer (Labtest 2000).

All analyses were carried out in duplicates. The results were the means of two readings. They were expressed as parts per million (ppm) of dry paper.

The second part of the investigation involved acid extraction of those magazines and comics

with high levels of metal content. The analytical method used was the same as that reported by Eaton *et al.* (1975).

In order to establish the variability of the ink density of the printed pages, tests were made on four copies of an issue of comic number 14. Lead values were 5.1, 5.4, 5.1 and 5.4 ppm with a mean of 5.3 and relative standard deviation of 3.3%. Subsequently only one sample of each issue of a given comic or magazine was examined.

RESULTS AND DISCUSSION

The total concentration of Pb, Cr and Cd of coloured pages of children's magazines and comics is shown in Table 1. The results show that the children's magazines and comics published in Malaysia contained low levels of Pb, Cr and Cd. Only 3 out of the 24 Malaysian magazines and comics had Pb contents in the 10–30 ppm range. The lowest value recorded was 2.4 ppm. Cr and Cd were detected in every sample. Cr was below 7.0 ppm whereas Cd was less than 3.0 ppm in all the samples.

Magazines and comics from the United Kingdom showed relatively little Pb, Cr and Cd. The Pb concentration was within the 3–11 ppm range whereas Cr was found to be in the range of

TABLE 1
Amount of Pb, Cd and Cr contents of coloured pages of some children's magazines and comics
(ppm dry weight)

Publisher	Pb	Cr	Cd
Malaysia 1–8 (25)*	2.4–29.0	1.3–6.9	0.2–2.1
United Kingdom 9–11 (13)	2.8–10.8	0.5–5.0	0.1–1.8
Hong Kong 12–20 (44)	0.7–25.1	0.2–23.9	0.1–1.8
United States 21–27 (25)	3.4–148.8	1.9–17.7	0.2–1.2
India 28–30 (3)	12.1–18.4	30.0–62.2	1.9–2.6

*Each publisher is given a code number and the number of different magazines analyzed is given in parentheses.

0.5–5.0 ppm. Cd was below 2.0 ppm in all the samples.

Pb content of coloured pages of Hong Kong children's magazines and comics varied from 0.7–25.1 ppm. Only 10 out of the 144 samples exceeded the 10 ppm level. Cr varied from 0.2 to 23.9 ppm. However, only 3 samples exceeded the 10 ppm level. Cd was found to be less than 2 ppm.

Of the 25 different American magazines and comics, only 3 showed Pb contents of less than 10 ppm. Four particular magazines had high lead contents of more than 100 ppm. The values obtained in our study are still very much lower than those of Hankin and co-workers (1973). In their brief study on 6 American magazines, they reported total Pb levels of 1140–3170 ppm in the coloured pages. The reason for the difference could be the use of 'lead-free' ink since the results were made known to the printers. The Cr content was below 7 ppm in all samples except for one with 17.7 ppm. Cd was below 2.0 ppm in all the samples.

Results of analyses of 3 Indian magazines are tabulated in Table 1. Pb content was relatively low (10–20 ppm). Cr levels ranged from 30–62.2 ppm whereas Cd was below 3 ppm.

Chemical analyses were also performed on the black and white pages of different magazines from different countries. This was to determine the possibility of some Pb, Cr and Cd coming from sources other than the colour printing ink.

The results (Table 2) show that all black and white pages had a low Pb content, with magazines and comics from the United States below 8 ppm and the magazines from United Kingdom and Malaysia below 3 ppm. This is consistent with the results obtained by Hankin and co-workers (1973). Cr was found to be less than 6.0 ppm whereas Cd was less than 1.0 ppm.

The results indicate that the inks used in printing colour magazines are the major source of Pb, Cr and Cd.

It can be argued that these heavy metals normally used as pigments are not necessarily harmful because the pigment particles may be insoluble. Accordingly, an acid extraction simulating the conditions of the human stomach was carried out (Eaton *et al.*, 1975).

Magazines with high metal contents were chosen for this experiment. The results are shown in Table 3. Magazines from the United States had extractable lead in the 9.6–101.4 range. This represents percentages of Pb removed by acid extraction from 74.4 to 86.6%. The considerably high extractable Pb indicates that these magazines contained pigments that were not completely insoluble under stomach conditions. The corresponding Cr and Cd extracted under similar conditions were low; Cr was less than 4 ppm for all samples whereas Cd was less than 1.0 ppm. These results are low compared to those obtained by Eaton and co-workers (1975) and Minkinen (1976).

TABLE 2
Amount of Pb, Cd and Cr contents of black and white (inside pages)
of some children's magazines/comics (ppm dry weight)

Publisher	Pb	Cr	Cd
Malaysia 2, 3, 5, 7 (7)	0.4–2.9	<0.1–4.4	<0.1–0.2
United Kingdom 10–11 (2)	2.4–2.4	<0.1	0.3–0.4
United States 21–26 (16)	0.8–7.6	<0.1–5.3	0.1–0.4

TABLE 3
Amount of extractable Pb, Cr and Cd in coloured pages of some selected children's magazines

Publisher	Pb content (ppm)		% removed by acid extraction	Cr content (ppm)		% removed by acid extraction	Cd content (ppm)		% removed by acid extraction
	Total	acid extraction		Total	acid extraction		Total	acid extraction	
United States									
21 (1)	12.9	9.6	74.4	5.8	2.0	34.5	1.0	0.2	20.0
22 (1)	39.9	31.3	78.5	11.6	3.4	29.3	0.5	0.1	20.0
23 (1)	87.7	71.9	82.0	5.1	2.0	39.2	0.5	0.2	40.0
24 (1)	88.3	76.3	86.4	6.6	2.4	36.4	0.5	0.1	20.0
25 (1)	117.6	101.4	86.6	7.5	3.1	41.3	0.4	0.2	50.0
Malaysia									
1 (1)	29.0	13.4	47.2	4.1	1.6	39	0.9	0.8	88.9

The lone sample from Malaysia shows a very low level of extractable Pb, Cr and Cd - 13.4, 1.6 and 0.8 ppm respectively. All values are low in comparison with those of Eaton (1975) and Minkkinin (1976).

CONCLUSION

Our studies showed that with the exception of a few, the coloured pages of children's magazines and comics on sale in Malaysia contained relatively low levels of Pb, Cr and Cd and hence do not contribute a major source of Pb, Cr and Cd ingestion by children.

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