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Are more restrictive food cadmium standards justifiable health safety measures or opportunistic barriers to trade? An answer from economics and public health

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ABSTRACT

In the past, Cd regulations have imposed trade restrictions on foodstuffs from some developing countries seeking to access markets in the developed world and in recent years, there has been a trend towards imposing more rigorous standards. This trend seems to respond more to public and private sectors strategies in some developed countries to create disguised barriers to trade and to improve market competitiveness for their industries, than to scientifically justified health precautions (sanitary and phytosanitary measures) and/or technical barriers to trade acceptable under the Uruguay Round Agreement of the WTO. Applying more rigorous Cd standards in some developed countries will not only increase production costs in developing countries but it will also have a large impact on their economies highly dependent on international agricultural markets. In the current literature there are large uncertainties in the cause–effect relationship between current levels of Cd intakes and eventual health effects in human beings; even the risk of Cd to kidney function is under considerable debate. Recent works on the importance of zinc:Cd ratio rather than Cd levels alone to determine Cd risk factors, on the one hand, and on the declining trends of Cd level in foods and soils, on the other, also indicate a lack of scientific evidence justifying more restrictive cadmium standards. This shows that developing countries should fight for changing and making more transparent the current international structures and procedures for setting sanitary and phytosanitary measures and technical barriers to trade.

1. Introduction

Cadmium (Cd) inputs are mainly from atmospheric deposition, application of biosolids, use of phosphate fertilizers, and from effluents from cadmium-using and recycling industries (Syers and Gochfeld, 2000).

While the sources of Cd emissions to the environment have been listed in some detail in many reports (Nriagu and Pacyna, 1998; Jackson and MacGillivray, 1993; WHO, 1992; Cook and Morrow, 1995; Jensen and Bro-Rasmussen, 1992), there have been very few attempts to determine human Cd exposure to its various sources. One such effort is reported by Van Assche and Ciarletta (1993) and Van Assche (1998), who developed a model for Cd exposure for human beings and allocated this exposure to the various sources. The model estimated that the relative importance of various cadmium sources to human exposure is as follows (Van Assche, 1998): phosphate fertilizers 41.3%, fossil fuel combustion 22%, iron and steel production 16.7%, natural sources 8%, non-ferrous metals 6.3%, cement production 2.5%, cadmium products 2.5% and incineration 1%.

Recently, there has been an increasing concern, mainly in the developed world, about exposures, intakes and absorption

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of Cd by humans, where increasingly affluent populations are demanding a cleaner environment in general, and reductions in the amounts of contaminants reaching people as a result of increasing human activities. A practical implication of this trend in the developed countries has been the imposition of new and more restrictive regulations, which prohibit or restrict the production, uses and/or ways of disposing of goods, services and byproducts and wastes. Such changes also increase the costs of acquiring, using, enjoying or discarding products. Another implication is the potential and/or real distortion created by these regulations in different markets, which sometimes extend to the international trade and affect not only the developed countries issuing such regulations but also the markets and producers in the developing countries.

This paper analyzes the effects that more restrictive cadmium standards can have for the developing countries in the future.

2. Cadmium and people

Food products account for most of the human exposure to cadmium, except in the vicinity of cadmium-emitting industries (ExtoxNet, 2003). The average cadmium levels in food range from 2 to 40 ppb. The level of cadmium in most drinking water supplies is less than 1 ppb. Air levels normally range from 5 to 40 ng/m^3 (EBI, 2003). For the general population, the average person ingests about 30 micrograms (μg) of cadmium from food each day. The intake from inhaled air is small because the Cd concentration is usually below 0.01 μg/m^3 (WHO, 1972). For smokers, cigarette smoke is a large potential source of Cd exposure, their intake can be an additional 1 to 4 μg per day from cigarettes, assuming that 20 cigarettes per day may lead to an inhalation of 2–4 μg Cd of which 25% can be absorbed (WHO, 1972). Average cadmium levels in cigarettes range from 1000 to 3000 parts per billion (ppb).

Cadmium is taken up through the roots of plants to edible leaves, fruits and seeds. During the growth of grains such as wheat and rice, cadmium taken from the soil is concentrated in the core of the kernel, while zinc (Zn) is found mostly in the germ and bran. With processing Zn is lost, increasing the Cd:Zn ratio. Refined flours, rice, and sugar all have relatively higher ratios of cadmium to zinc than do the whole foods. Cadmium will also accumulate in animal milk and fatty tissues (Kaneta et al., 1986). Therefore, people are exposed to cadmium when consuming plant- and animal-based foods. Seafood, such as mollusks and crustaceans, can be a source of cadmium, as well. In fact, most foods, including shellfish, have trace amounts of contaminants and heavy metals. For most species the levels of these contaminants are well below established standards at which adverse health effects might occur. However, Canadian authorities advise consumers to be aware of elevated levels of cadmium found in British Columbia oysters and whole scallops, because exposure to elevated levels of cadmium over an extended period of time may result in damage to the kidneys (CFIA, 2003).

Cadmium concentrations in most foods range from about 0.01 to 0.05 mg/kg, although higher levels were found in nuts and oil seeds, mollusks, and offal (especially liver and kidney) (JECFA, 2003). In a recent study regarding the major dietary sources of cadmium in several countries, the Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additives (JECFA) determined that the following foods contribute 10% or more to the Provisional Tolerable Weekly Intake (PTWI) in at least one of the GEMS/Food regions: rice, wheat, starchy roots/tubers, and mollusks. Vegetables (excluding leafy vegetables) contribute >5% to the PTWI in two regions.

Table 1 shows that the daily intake of Cd appears to be of the order of 50 μg in some European countries and the United States, whereas in unpolluted areas of Japan the level is higher. The accuracy of these data is supported by data on the Cd content of faeces, because the fecal output of Cd is about 90% of the amount ingested. In West Germany, the mean daily fecal output of Cd was found to be 31 μg; 42 μg in three American individuals; and 57 μg in Japanese subjects (WHO, 1972). In Table 1 it is possible to see that in other European

Table 1 – Daily intake of cadmium from food; different countries

Country	Daily intake (μg/day)	Reference
Australia	4.9–15.4 [a]	FSANZ (2002)
	5.6 – 16.8 [b]	Satarug et al. (2002)
	20–30	Hardy (1998)
	22	Satarug et al. (2003)
Basque Country (Spain)	11 [c]	Jalón et al. (1997)
Canada	13	Dabeka and McKenzie (1995)
Canary Island (Spain)	11.2 [c]	Rubio et al. (2006)
Catalonia (Spain)	15.7 [d]	Llobet et al. (2003)
Croatia	17.3	Sapunar-Postruznik et al. (1996)
Czech Republic	15 [c]	Ruprich (1998)
Europe	10–30	Nasreddine and Parent-Massin (2002)
Finland	14.5	Louekari et al. (1991)
Germany	25.9 [c]	Wilhelm et al. (2002)
	2.6 [e]	Wilhelm et al. (2005)
	48	Essing et al. (1969)
Hong Kong	21.4 [f]	HKSAR (2002)
Italy	19–46 [g]	Coni et al. (1992)
Japan	59–113	JPHA (1970)
	41	Tsuda et al. (1995)
Lebanon	12 [c]	Nasreddine et al. (2006)
New Zealand	28	NZTDS (2000)
Poland	15–21 [g]	Marzec and Bulinski (1991)
Romania	38–64	Rautu and Sporn (1970)
Several countries	7–63	JECFA (2003)
Slovak Republic	12–14 [c]	Krizova et al. (2005)
United States	4–60	Schroeder and Balassa (1961)
UK	16 [c]	MAFF (1999)

Source: elaborated with data from WHO (1972) and the additional mentioned sources.
[a] For a 70 kg-female of 25–34 years.
[b] For a 70 kg-male of 25–34 years.
[c] For an adult of 70 kg.
[d] Male adult.
[e] Child of 8 kg.
[f] For an average secondary student of 60 kg. Those above the 95 percentile of highest showed an intake 2.3 times higher.
[g] Average person.