

Misuse of organomercury fungicides in Brazil

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A methoxyethyl mercuric compound, licensed in Brazil as a fungicide for seed dressing, was widely used for spraying tomato and other vegetable crops in 1966 and 1967.

Mercury residues ranging from 0.05 to 0.30 mg/kg were detected in 14% of the tomatoes, 13% of other vegetable samples, and 57% of the tomato paste batches.

A wide campaign through newspapers, radio, and television was quickly established to educate farmers and the population in general on the hazards of ingestion of mercury-contaminated food.

All samples of tomatoes and other vegetables positive for mercury (residues above 0.05 mg/kg) were destroyed. Inspection posts on the main roads and highways prevented the delivery of contaminated food to cities and food processing plants.

The sale of organomercury fungicides is now controlled in Brazil; however, treated seeds which are not planted may be diverted to human or animal consumption. There is no official record of accidents, but occasional cases of poisoning are known.

The mercury residue level in Brazilian fish is low, indicating that environmental pollution by mercury is not a big problem in the country. However, some fresh-water and estuarine fish may contain mercury residues ranging from 0.01 to 0.66 mg/kg.

Phytosanitary agronomists of the Biological Institute of São Paulo disclosed in 1966 that many horticulturalists and farmers were spraying tomato crops and other vegetable crops. The label of the fungicide stated that it should be used only for seed dressing. However, there were no selling restrictions and farmers could buy the fungicide although they had no seed to be treated.

Organomercurials were used illegally in a very large agricultural area of São Paulo State where there are many small farms involved in the production of tomato, egg plant, bell pepper, cucumber, and potato for the local population and for the capital city, São Paulo. The total population potentially exposed to organomercurials through the consumption of the treated vegetables might have reached over 8 million people.

METHOD

As soon as the illicit use of organomercurial fungicides was brought to light, tomatoes, egg plants, cucumbers, and potatoes were analysed for total mercury content in two institutions, the Biological Institute of São Paulo and the Adolfo Lutz Institute of the State Departments of Agriculture and of Health respectively.

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The total mercury content was determined by the chemical methods used in Brazil. In the Adolfo Lutz Institute the organic matter was oxidized in a strong acid medium and the total mercury was subsequently extracted and spectrophotometrically evaluated as a dithizone complex.¹ In the Biological Institute the destruction of the organic matter was carried out in an open quartz tube with a controlled flow of oxygen. The volatilized mercury was trapped in a solution of potassium permanganate. Total mercury was extracted and spectrophotometrically evaluated as a dithizone complex.²

RESULTS

In São Paulo in 1966 total mercury residues above 0.05 mg/kg were detected in 14% of the tomatoes, 13% of other vegetable samples, and 57% of the tomato paste batches analysed. The problems continued in 1967 and decreased in subsequent years. The range and mean values of the total mercury residues found in another series of specimens are shown in Table 1.

TABLE 1. TOTAL MERCURY RESIDUES IN SOME FOODS, BRAZIL 1967

Food	No. of analysed samples	Amount of total mercury (mg/kg) ^a	
		Range	Mean
Tomato	9	0.05-0.14	0.09
Tomato paste	3	0.05-0.20	0.15
Egg plant	2	0.06-0.15	0.10
Bell pepper	1	0.15	-
Cucumber	1	0.06	-
"Jilô"	2	0.05-0.05	0.05
Potato	18	0.08-0.19	0.11
Cultivated mushroom	5	0.12-0.31	0.22

^a Sensitivity of the method: 0.05 mg/kg.

Analyses of cultivated edible mushrooms were also carried out in order to check whether organomercurials had been sprayed on the mushrooms to prevent the superficial development of fungi responsible for dark spots on the mushroom surface. This assumption was confirmed (Tables 1 and 2).

MEASURES TAKEN TO STOP THE MISUSE OF FUNGICIDES

As soon as the illegal use of organomercury fungicides was confirmed, phytosanitary agronomists started the inspection of all farms and vegetable gardens in São Paulo State.

A wide campaign through newspapers, radio and television for education of farmers and the general public helped to prevent the consumption of tomatoes and other vegetables sprayed with organomercurials.

Physicians in health centres in the interior of São Paulo State assisted in informing farmers, horticulturalists, and the general population on the hazards of the consumption of food contaminated with mercury. They also tried to detect any clinical cases related to the ingestion of mercury-contaminated food.

TABLE 2. MERCURY RESIDUES IN FOODS, BRAZIL, 1966-74
(No. of >0.05 mg/kg total mercury samples/No. of samples examined)

Years	Tomatoes	Other fruit or vegetables	Tomato pastes	Other foods
1966	79/566	16/125	38/67	0/1 ^a
1967	6/14	11/21	10/29	29/58 ^b
1968	0/2	1/1	6/77	9/12 ^c
1969	...	...	0/24	0/1 ^d
1970	0/8	...	0/118	...
1971	0/1	0/23	0/12	0/5 ^a
1972	...	...	2/6	...
1973	...	...	0/2	...
1974	...	...	0/35	1/1 ^e

^a Carrot.

^b Potato and cultivated edible mushroom.

^c Cultivated edible mushroom.

^d Potato.

^e Peanut.

During the inspection of farms and vegetable gardens, all organomercury fungicides were seized if the farmers did not have seeds to be treated with these fungicides before planting. Samples of tomatoes and other vegetables were also taken during the inspection and sent for analysis of total mercury content. In the cases where these analyses were positive (>0.05 mg/kg of mercury) the crop was always destroyed. This scheme was not easy to enforce and the cooperation of the police was sometimes needed.

All trucks with vegetables were stopped at inspection posts at different points on the main roads and highways. Permission to continue the trip depended on the presentation of a written licence issued by a plant sanitary agronomist stating that he had examined the farm or the vegetable garden where the vegetables originated. If the driver did not have this licence, representative samples would be taken for analysis for mercury content, and the truck waited for one or two days in the inspection post for the result of the analysis. In the case of a positive result, all vegetables were destroyed or rendered useless for human and animal consumption.

The manufacturing company responsible for unauthorized advertisement of the fungicide was punished and the licence for the selling of the chemical was interrupted for 6 months.

After the acute phase of the problem, the Ministry of Agriculture established a control system to restrict the sales of organomercury fungicides. The name and address of the buyer, the name and amount of the fungicide, the amount of seed to be treated, and the name of the salesman are now noted in a special book for subsequent inspection by officers of the Ministry of Agriculture. The salesman must also complete a form to show the destination of imported or locally formulated organomercury fungicides.

Chemical analyses for total mercury residues in tomato paste have been carried out as a routine to check whether crops are kept free from organomercurial spraying. All the results have been negative except for 2 cases in 1972 (Table 2).

MISUSE OF MERCURY-TREATED SEEDS

Seed dressing with organomercury fungicides is common in Brazil. Wheat, peanut, and rice seed are usually treated. Many other seeds may be treated with organomercurials before planting.

Organomercury formulations always include a dye to act as a warning signal that seeds have been treated. In spite of this, constant vigilance is needed to prevent the diversion of organomercury-treated seeds for human and animal consumption. Two human fatal cases recently occurred in the interior of São Paulo through the ingestion of peanuts previously treated with organomercury fungicide and intended for planting.

MERCURY IN BRAZILIAN FISH

Up to the present, only low levels of mercury residues have been found in Brazilian fish (Table 3). In oceanic fish the residue is usually below 0.1 mg/kg, however, some fresh-water and estuarine fish may give mercury residues ranging from 0.01 to 0.66 mg/kg, with an average value of 0.25 mg/kg.¹

TABLE 3. MERCURY RESIDUES IN FISH, BRAZIL, 1974
(No. of >0.01 mg/kg total mercury samples/No. of samples examined)

Region	Fresh water fish	Sea fish
São Paulo	4/10	7/67
Rio Grande do Sul	-	20/42

Total mercury residue in the positive samples: average - 0.25 mg/kg; range - 0.01-0.66 mg/kg.

The maximum permissible level for mercury in fish is 0.5 mg/kg in many countries.³ Therefore, Brazilian fish do not show evidence of high environmental pollution by mercury in this region.

DISCUSSION

The firm and resolute action of phytosanitary agronomists prevented the spreading of the misuse of organomercury fungicides on vegetable crops in São Paulo State in 1966 and 1967. The main fungicide utilized for spraying on tomato and other vegetable crops was methoxyethyl mercuric chloride.

At that time, the toxicological differences of alkylmercury, alkoxyalkylmercury, and arylmercury compounds were not known in Brazil. Fortunately, the main fungicide involved was an alkoxyalkylmercury compound. This probably accounts for the fact that no cases of central nervous system damage were found in the Brazilian population exposed.

The provisional acceptable weekly intake of total mercury is 0.3 mg per person, with a maximum of 0.2 mg of methylmercury per person.⁴ However, no limits have as yet been recommended for mercury in food by the Codex Alimentarius Commission and no Codex referee method of analysis has as yet been established.

During the illicit application of organomercurials in Brazil, the maximum acceptable intake was probably not reached. If we consider a daily ingestion of 200 g of tomatoes and other vegetables with an average level of 0.10 mg/kg of mercury, the weekly intake will be 0.14 mg of mercury per person. In this calculation no other source of mercury intake was considered. However, the spraying of vegetables with organomercury compounds is highly undesirable because it contributes to pollution of the environment by mercury and does not improve agricultural yield or food quality.

Some farmers treat more seed with organomercury fungicides than they are able to plant. After some time the germinative power of the seeds decreases and the farmer may try to sell them as food or feed in spite of the hazards to human and animal health. A central office for the collection of all information on pesticide toxicology is urgently needed in Brazil.

The low level of mercury residues in Brazilian sea fish indicates that environmental pollution by mercury is not a problem in this region. However, the development of pulp, paper, and chlor-alkali industries using mercury is contributing to the pollution of estuaries in Brazil.

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RESUME

UTILISATION ABUSIVE DE FONGICIDES ORGANOMERCURIELS AU BRESIL

Un composé mercuriel méthoxyéthylé dont l'emploi comme fongicide est autorisé au Brésil pour l'enrobage des semences a été largement utilisé en aspersion sur des plantations de tomates et d'autres légumes en 1966 et 1967.

Des résidus de mercure de 0,05 à 0,30 mg/kg ont été observés sur 14% des échantillons de tomates, sur 13% des échantillons d'autres légumes et dans 57% des lots de purée de tomates examinés.

Une vaste campagne visant à éclairer les agriculteurs et la population en général au sujet des risques entraînés par l'ingestion d'aliments contaminés par les composés mercuriels a été immédiatement lancée par les journaux, la radio et la télévision.

Tous les lots de tomates et d'autres légumes contaminés par le mercure (résidus supérieurs à 0,05 mg/kg) ont été détruits. Des postes de contrôle ont été établis sur les grandes routes pour empêcher le transport d'aliments contaminés vers les villes et les usines de traitement des denrées alimentaires.

La vente des fongicides organomercuriels est désormais soumise à contrôle au Brésil; le danger subsiste néanmoins de voir utiliser pour l'alimentation humaine ou animale des

graines traitées qui n'ont pas été semées. Il n'y a pas d'enregistrement officiel des intoxications, mais on sait que des cas sporadiques se sont produits.

La concentration des résidus mercuriels dans le poisson est faible, ce qui indique qu'au Brésil la pollution de l'environnement par le mercure ne constitue pas un problème important. Néanmoins, certains poissons d'eau douce ou d'estuaire contiennent parfois des résidus mercuriels qui peuvent aller de 0,01 à 0,66 mg/kg.

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