Heavy metals and pesticides residue in the foodstuff.

1. Introduction

Increasing industrialization has been accompanied throughout the world by the extraction and distribution of mineral substances from their natural deposits.
Many of these have undergone chemical changes through technical processes and finally pass, finely dispersed and in solutions, by way of effluent, sewage, dumps and dust, into the water, the earth and the air and thus into the food chain. These include metals and thus also the heavy metals relevant for this document.
Together with essential nutrients, plants and animals also take up small amounts of contaminant heavy metal compounds and can concentrate them. As certain heavy metals such as Lead, Cadmium, Mercury, Arsenic (Arsenic is usually regarded as a hazardous heavy metal even though it is actually a semi-metal) have been recognized to be potentially toxic within specific limiting values, a considerable potential hazard exists for human.
Those metals are described as "heavy metals" which, in their standard state, have a specific gravity (density) of more than about 5 g/cm3. Some of them, such as copper, nickel, chromium and iron, for example, are essential in very low concentrations for the survival of all forms of life. These are described as essential trace elements.
Only when they are present in greater quantities, can these, like the heavy metals lead, cadmium which are already toxic in very low concentrations, cause metabolic anomalies. Here, the boundary between the essential and the toxic effect is somewhat problematic.
There are 60 heavy metals. These also include the precious metals platinum, silver and gold. For this study, however, only the smaller group of toxic heavy metals is of significance.

2. The context of the heavy metal problem

Essentially, the heavy metals have only become a focus of public interest since analytical techniques have made it possible to detect them even in very small traces. The relatively reckless handling of heavy metals and their compounds in former times can partly be explained by the fact that their effects were unknown. Today, analytical detection is possible down to a thousandth of a mg/kg for certain matrixes. This has made it possible for toxicologists, in animal experiments, to follow up the effects of individual substances down to the smallest concentrations.

Their warnings, particularly with regard to the effects on health of chronic consumption and the accumulations to which this leads, have startled the public and, at times, mostly as a result of the activities of so-called pressure groups, have generated genuine hysteria.
All this has taken place against the background of a steady increase in the processing of all types of heavy metals in industry and the household. Therefore, proper disposal, recycling and the regulation of the application of sewage to agricultural land, have assumed great importance.

Lead

The origin of lead in foodstuffs and their surroundings.

Lead has been mined since ancient times and has been processed in many ways, e.g. for water pipes, containers and, as acetate, even for sweetening wine ("lead sugar"). World production amounts to millions of tons and is used in the manufacture of accumulators, solders, pigments, cables and anti-rust agents (red lead/lead oxide) and, a considerable amount still, into anti-knock petrol.
The main sources of lead pollution in the environment are: Industrial production processes and their emissions, road traffic with leaded petrol, the smoke and dust emissions of coal and gas-fired power stations, the laying of lead sheets by roofers as well as the use of paints and anti-rust agents.
Problems for foodstuffs were caused for a long time, and are still caused today on occasion, by the soldered seams of cans and the soldered closures of condensed milk cans, the metal caps of wine bottles and, still, by lead pipes in drinking water systems.

Toxic effects

Lead can trigger both acute and chronic symptoms of poisoning. Acute intoxications only occur through the consumption of relatively large single doses of soluble lead salts. Chronic intoxications can arise through the regular consumption of foodstuffs only slightly contaminated with lead. Lead is a typical cumulative poison. The danger of chronic intoxications is the greater problem.
Basically, as a result of their comparatively high affinity for proteins, the lead ions consumed bond with the haemoglobin (red blood pigment) and the plasma protein of the blood. This leads to inhibition of the synthesis of red blood cells and thus of the vital transport of oxygen. If the bonding capacity here is exceeded, lead passes into the bone-marrow, liver and kidneys.
Such an intoxication leads to:

- Encephalopathies in the central nervous system (CNS);
- Disturbances in kidney and liver functions progressing as far as necrosis;
- Damage to the reproductive organs;
- Anaemias and many metabolic deficiency symptoms.

Some of the injurious processes are still not properly understood. Particularly dangerous to all forms of life are the organic lead compounds. They cause injuries to mental development such as reduction of intelligence, growth disturbances and plasticity. Children are particularly at risk from lead consumption, both before and after birth, as they absorb lead more rapidly than adults. Particularly affected are small children, with their habit of placing dirty fingers and objects of all kinds into their mouths or licking them (so-called mouth/hand activity) and, in this way, swallowing dust and soil particles containing heavy metals, for example from lead-based paints. In animal experiments, the consumption of domestic and surface dust leads to a measurably increased heavy metal content in the blood. Little is known about the excretion of lead, once it has been absorbed. The greatest part accumulates in the body. Lead is not considered to be a carcinogen or mutagen.

Cadmium

Origin of cadmium in foodstuffs and their surroundings

Cadmium exists in low concentrations in all soils. It is actively extracted from its ores for commercial purposes and is also emitted in industrial processes such as metal melting and refining, coal and oil fired power stations, electroplating plants, etc.

It is spread by air and water (sewage sludge) far over sea and land, but especially in the vicinity of heavy industrial plants. Cadmium is today regarded as the most serious contaminant of the modern age. It is absorbed by many plants and sea creatures and, because of its toxicity, presents a major problem for foodstuffs. Contamination through fertilizers becomes an increasing problem.

Unlike lead, cadmium contamination cannot be removed from plants by washing them; it is distributed throughout the organism. It is often difficult to be certain of the cause of a cadmium content found in fruit or vegetables, as the substance in its natural form exists everywhere in the soil and is absorbed by the roots.

Toxic effects

Cadmium is concentrated particularly in the kidneys, the liver, the bloodforming organs and the lungs. It most frequently results in kidney damage (necrotic protein precipitation) and metabolic anomalies caused by enzyme inhibitions. It is now known that the ltai-itai sickness in Japan (with bone damage) is a result of the regular consumption of highly contaminated rice. Cadmium, like lead, is a cumulative poison, i.e. the danger lies primarily in the regular consumption of foodstuffs with low contamination. However, in contrast to lead, the definition of an exact toxicity limit is not possible for cadmium. The decisive point is whether absorption of the existing cadmium actually takes place. This is, firstly, dependent upon the composition of the diet as a whole and, secondly, on the bio-availability of the cadmium compound present. No connection with cancerous disorders has been found.

Detection method

The lead and cadmium concentrations were determined by flame technic, using Atomic Absorption Spectrophotometer (AAS). The sensitivity limit of the method for lead was 0.1 mg/kg, for cadmium 0.1 mg/kg.

Result was analyzed according: Prevention of Food Adulteration Act, 1954 with Prevention of Food Adulteration Rules, 1955 and Commodity Index with Short Notes. 12th Edition, 1998 Amemded Uptodate.

Samples were collected from Pour Tous complex - from food shopping place and from the snack bar and from La Ferme – cheese production unit.

Maximum limits fir the poisonous metals in the foods.
Lead – 2.5 mg/kg
Cadmium – 1.5 mg/kg

No.	**Identification**	Lead ppm			Cadmium ppm		
		11/03/03	18/03/03	27/03/03	11/03/03	18/03/03	27/03/03
1	Raw milk AVF	ND	ND	6.6	ND	ND	ND
2	Raw milk	0.1	-	7.0	ND	-	ND

	AVF						
3	Raw milk AVF	0.1	ND	8.2	ND	ND	ND
4	Raw milk AVF	0.1	ND	0.6	ND	ND	ND
5	Raw milk AVF	0.1	ND	0.2	ND	ND	ND
6	Cheese LF	0.8	ND	0.6	ND	ND	ND
7	Cheese LF	1.0	ND	18.2	0.2	ND	ND
8	Yogurt LF	ND	ND	0.5	ND	ND	ND
9	Cooked food mix PT	0.2	ND	ND	ND	ND	ND
10	Snack bar PT	ND	-	0.3	ND	-	ND
11	Banana Lassi PT	ND	ND	ND	0.1	ND	ND
12	Tea PT	ND	ND	7.2	ND	0.1	-
13	AV Squash/Gourd	-	ND	-	-	-	-
14	KOFPU Peanut	-	ND	-	-	ND	-
15	Jam AV FPU	-	ND	-	-	ND	-

ND – Not Detected
Heavy metals Detection Limit Pb, Cd – 0.1 ppm

Conclusion:

3 samples of the raw milk have concentration of the Lead 6.6; 7.0; 8.2 mg/kg that exceed permissible level for such product in 2.6; 2.8; 3.3 times respectively.
1 sample of cheese has concentration of the Lead 18.2 mg/kg that 7.3 times more than permissible level.
1 samples of the tea has concentration of the Lead 7.2 that 2.9 times more than permissible level.
The Lead contamination in milk and cheese could happen due to feeding the cows with fodder collected from along the road sides and can be controlled by choosing the sours of the fodder without Lead contamination.
Incase of tea should be done more study, for instant to check Lead level in the dry tea (permissible level for the Lead in dry tea 10.0 mg/kg).
Cadmium was detected in 3 samples only with concentration less than permissible.

Pesticides residue

The pesticide industry in India

The production of pesticides started in India in 1952 with the establishment of a plant for the production of BHC near Calcutta, and India is now the second largest manufacturer of pesticides in Asia after China and ranks twelfth globally. There has been a steady growth in the production of technical grade pesticides in India, from 5,000 metric tonnes in 1958 to 102,240 metric tonnes in 1998. In 1996-97 the demand for pesticides in terms of value was estimated to be around Rs. 22 billion (USD 0.5 billion), which is about 2% of the total world market.

The pattern of pesticide usage in India is different from that for the world in general. In India 76% of the pesticide used is insecticide, as against 44% globally. The use of herbicides and fungicides is correspondingly less heavy. The main use of pesticides in India is for cotton crops (45%), followed by paddy and wheat.

Tremendous benefits have been derived from the use of pesticides in forestry, public health and the domestic sphere - and, of course, in agriculture, a sector upon which the Indian economy is largely dependent. An area of 169 million hectares consists of permanently cropped land. Food grain production, which stood at a mere 50 million tonnes in 1948-49, had increased almost fourfold to 198 million tonnes by the end of 1996-97. This result has been achieved by the use of high-yield varieties of seeds, advanced irrigation technologies and agricultural chemicals.

According to the 1991 census, 66.8% of the entire economically active workforce - i.e. about 180 million people - was engaged in agriculture. Thus a large segment of the Indian population is exposed occupationally and/or environmentally to some types of pesticides. The evidence accumulated over the last few decades indicates that the use of such chemicals in agriculture has much greater health consequences and environmental consequences than was originally believed.

The target group of pesticides we analyzed is foods are Organochlorine pesticides.

Organochlorine pesticides the most persistent in the environment and have high health hazard due to possibility to be accumulate in body tissue.

List of the pesticides and metabolites analyzed.

1. Aldrin and Dieldrin
2. Alpha–BHC
3. Beta–BHC
4. Gamma–BHC (Lindan)
5. Endosulfan I and II
6. Endosulfan sulfate
7. Endrin and Endrin Aldehyde
8. Heptachlor and Heptachlor Epoxide
9. Total DDT (4,4-DDT, 4,4-DDD, 4,4-DDE)

Aldrin and Endrin banned in India now but widely used in the past.
Dieldrin, DDT, Gamma–BHC (Lindan) restricted for use in India.
Endosulfan widely used in India.

Organochlorine pesticides residue in foodstuff (ppb) from Pour Tous snack bar and La Ferme

No.	**Identification**	**11/02/03**	**18/02/03**	**19/02/03**	**20/02/03**	**27/02/03**
1.	Raw milk AVF	-	-	Endosulfan trace	Endosulfan trace	-
2.	Raw milk AVF	-	-	-	ND	-
3.	Raw milk AVF	-	-	-	Endosulfan trace	-
4.	Raw milk AVF	-	-	-	Endosulfan sulfate 0.8	-
5.	Cheese LF	-	Endosulfan trace	-	Endosulfan- trace	-
6.	Cheese LF	-	-	Endosulfan trace	-	-
7.	Yogurt LF	-	Heptachlor 0.6	-	ND	-
8.	Cooked food mix PT	ND	ND	ND	ND	-
9.	Snack bar PT	ND	ND	ND	ND	-
10.	Banana Lassi	ND	-	-	-	-
11.	Cucumber AV Orchard	Endosulfan I – 0.4	-	-	ND	ND
12.	AV Root	Endosulfan I	ND	ND	ND	Endosulfan

		– 0.3				trace
13.	AV Leaves	Endosulfan I – 0.3 Heptachlor – 0.7	δ - BHC 0.3	ND	ND	ND
14.	AV Fruit		ND	ND	ND	Endosulfan, α-BHC trace
15.	AV Cereal	ND	ND	ND	-	ND
16.	AV Squash/Gourd		Endosulfan sulfate trace	ND	ND	-

ND – Not Detected
Trace - Detected but at concentrations below level of quantification

Organochlorine pesticides residue in foodstuff (ppb) from Pour Tous shopping complex 19/03/03

Type of Food	Code number	Results
1. Oil Peanut oil Pondy	106	ND
2. Oil Panut oil AV	107	ND
3. Oil refined	109	ND
4. Oil sesame	111	γ-BHC-9.3 μg/l
5. Oil Sunflower	112	ND
6. Bean red	11	ND
7. Dal gram	53	γ-BHC-3.8 μg/kg
8. Dal gram roaste	54	ND
9. Dal masur black	93	ND
10. Dal masur red	94	γ-BHC- Trace
11. Dal moong split	55	ND
12. Dal moong whole	56	ND
13. Dal toor	57	ND
14. Peanut raw AV	430	ND
15. Dry banana	531	ND
16. Cashew broken	758	ND
17. Cashew full	24	ND
18. Grapes dry black	443	Endosulfan- Trace
19. Grapes dry white	71	ND
20. Cashew roaste AV	511	γ-BHC-9.85 μg/kg

Conclusion:

From Pour Tous snack bar and La Ferme we analyzed 42 samples and from Pour Tous shopping complex 20 samples. Totally 62 samples. 19 samples were contaminated with organochlorine pesticides. Residue of Endosulfan was in 14 samples, residue of BHC in 6 samples and residue of Heptachlor in two samples. In all food samples level of pesticides residue was below permissible.
Future study should include organophosphorous pesticide, carbomates and pyrethroids pesticides.