Monitoring of Pesticidal Contamination of Vegetables from Maharashtra

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Abstract: Samples of brinjal. lady finger and onion leaves analysis carried out by analytical technique. Samples contained residues above MRL values. The contamination was mainly with organophosphates followed by organochlorines. Among organophosphates, residues of monocrotophos, quinalphos and chlorpyriphos exceeded the MRL value in 36% and 23% samples of brinjal and fenugreek. Residues of monocrotophos were higher than MRL value in 3 samples of brinjal and lady finger. chlorpyriphos in samples of onion leaves and quinalphos in of lady finger. Among synthetic pyrethroids, cypermethrin was the major contaminant and its residue exceeded the MRL value in sample each of brinjal, lady finger .The residues of some organochlorines, i.e. HCH, DDT and endosulfan were found in all the samples but did not exceed the tolerence limit.

Key word: Vegetables, Maximum residue limit (MRL) - monitoring , organochlorines , organophosphates , brinjal , fenugreek, onion leaves.

Introduction

Food is major pathways to body burden. Vegetable group constitutes part of core Indian diet. Vegetables are the second largest production in the worldwide. Significant production is in urban and pre urban areas. Many studies reveal contamination of vegetables with heavy metals and pesticides. The main source of contamination to vegetables crops are the air, water, soil, pesticides (pre harvesting) from which these are taken up by the roots or foliage. During transport, marketing and retailing (post harvesting), vegetables are gradually becomes polluted because of rapid urbanization and industrialization.

It has been reported that sewage effluents of municipal origin contain appreciable amount of major essential plant nutrients. Therefore the fertility levels of the soil are improved considerably under sewage irrigation of crop field[1]. However Studies on the water of Vasai creek, Maharashtra, reveal that the presence of toxic heavy metals and pesticides reduce soil fertility and agriculture output.[2]

Comprehensive studies related to the analyses of pesticides in the vegetables around the particular creek are only few in the country. Therefore the present study has been undertaken, to assess the extent of heavy metal contamination and pesticidal contamination in Vegetables.

Materials and Methods:

Sampling of vegetables

A total three vegetables; brinjal, fenugreek, onion leaves were collected from three different local market . Put in sterile polyethylene bags and transported on ice to the laboratory where they were analyzed immediately or stored at 4^{o}C until analysis within 24 hours.

Chemical analysis for pesticide residues

Extraction:

Approximately 1000 gm of each fresh vegetables was homogenized in a mortar and extracted by Soxhlet extractor. Test were carried out in accordance with previous studies[3] .The samples were cleaned concentrated eluted with hexane in a solid-phase extraction column.

Result and Discussion:

Pesticide Residues on brinjal, fenugreek, onion leaves

Table 1 shows pesticide prevalence, residue level recorded on brinjal, fenugreek, onion leaves and maximum residue limits (MRLs) for consumption.

In Maharashtra, farmers are using pesticide on vegetables. Insecticides are the most widely used among the different classes of pesticides.41% and 37 % of these insecticides are pyrethroids and organophosphates respectively. Rest are organ chlorines and carbamates.

The result is percentage contamination of pesticide in vegetables, which is shown in table 1.however some samples of vegetables are shown below detectable limits. Recommend values of residue level 0.05 to 0.2 for chlorpyriphos, DDT- 3.5, qunalphos -0.05.

A rough calculation shows risk potential because of this contamination however, the data shows clearly that these more potent agrochemicals are used irrespective of whether they are approved for vegetables production or not.[4]

The result of this study that typical pesticides contamination level of vegetables in Maharashtra markets pose a threat to human health. Due to waste water, education and awareness campaigns in the markets and households may decrease the risk .

Washing or cooking food before eating is common in Maharashtra. It may eliminate pesticide residue but still detail study required .

Table 1 Pesticide prevalence: Residue level on brinjal, fenugreek, onion leaves

Pesticide	Brinjal with pesticide residues (%)	Fenugreek with pesticide residues (%)	Onion leaves with pesticide residue (%)
Chlopyrifos	36	23	0.01
Organophosphates	0.2	14.3	65-78
Monocrotophos	11	12	0.72-1.8
Quinalphos	0.5	17.84	0.05
DDT	33	3.5	34

There is no such MRL value of pesticide but presence of pesticide is the contamination of it in vegetables.

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A Brief Review of Mycotoxins as Contaminants in Foods with Special Reference to Aflatoxins

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Abstract: Mycotoxins are secondary metabolites of fungal origin. They are important contaminants of food. They elicit toxic responses, referred to as mycotoxicoses, in human beings and animals alike. Instances of mycotoxin toxicity have occurred since ancient times but the concept of mycotoxins developed in 1960s. Of the thousands of fungi that colonize food commodities, only a few can produce mycotoxins. Various types of mycotoxicoses, fungal organisms responsible, their mycotoxins and toxic effects are discussed in the paper.

Aflatoxins are a group of highly carcinogenic mycotoxins produced by three species of the fungus *Aspergillus.* Aflatoxins B1 is a Class I human carcinogen. Conditions for contamination of foods by aflatoxins, aflatoxicosis and human health are discussed.

Initial screening of oilseeds from Thane district for aflatoxins was carried out and results are discussed in the paper.

Mycotoxins are secondary metabolites produced by fungi colonizing crops in the field or grains, oil-seeds and agri-products during storage. Although they are synthesized by fungus, they apparently have no role in its metabolism, growth and reproduction and hence their designation as secondary metabolites. Mycotoxins are unerringly capable of eliciting a toxic response, referred to as mycotoxicoses in human beings and warm-blooded animals. They have been linked with several physiological and pathological changes and disorders. The toxic response manifests itself through various organs namely the liver, kidney, lungs and nervous system.

Historical Aspects

Classical instances of mycotoxins have been known since ancient times through cases of ergotism and mushroom poisoning. Mycotoxin related toxicity has caused epidemics in humans and animals, although the cause could not be ascertained and attributed to mycotoxins. St.Anthony's fire (Ergotism) accounted for the most important epidemics in medieval Europe resulting from consumption of ergot (*Claviceps purpurea*) contaminated rye. The true magnitude of mycotoxin related toxicity however remained unrealized until the middle of the twentieth century. Alimentary toxic aleukia is, arguably, the only, mycotoxicosis, other than ergotism, to have caused human deaths on a colossal scale. Initially recorded in the nineteenth century as a food intoxicant, the first epidemic in 1932, followed by more severe ones during the second world war, recorded mortality rates of up to 60% and resulted in the loss of approximately 1,00,000 lives in Russia (Joffe, 1971;Palti, 1978). The disease was attributed to consumption of mouldy food grains, contaminated with mycotoxins produced by infection of species of fungus *Fusarium* on the overwintered grains. In Japan, investigations on 'cardiac beriberi' in the late nineteenth century indicated the role of mouldy rice contaminated with fungi (Uraguchi & Yamazaki, 1978). Stachybotryotoxicosis, one of the earliest and intensively investigated mycotoxicosis, which killed thousands of horses in the former USSR in the 1930s, was traced to poisoning by mouldy hay contaminated with mycotoxin producing fungus. *Stachybotrys atra* (Forgacs, 1972). Aflatoxins, a group of highly toxic metabolites, produced by the fungus *Aspergillus* were linked to the mysterious death of turkeys and diseases in many other animals including man (Smith and Moss, 1985).

The concept of mycotoxins developed in the 1960s. A sudden outbreak of an unknown disease killed a large number of poultry birds. This disease, affecting ducklings in Kenya and young turkeys in U.K, designated as Turkey X disease, was traced to presence of mycotoxins in the groundnut meal feed imported from Brazil (Blount, 1961). Around the same time, a potentially carcinogenic compound was shown to be present in the contaminated groundnut meal, which was later proved as the same mycotoxin, aflatoxin, that had caused the Turkey X disease (Wogan & Pony, 1970). This created the much required awareness regarding mycotoxicosis as a threat to human and animal life, thereby triggering massive and thorough research on the topic. Research on mycotoxins has provided valuable new insights into our understanding of food poisoning.

Ample evidence of fungi, that commonly colonize food and feed, producing mycotoxins has emerged in the past five decades. The growth of fungus and subsequent production of mycotoxins is a result of a combination of interactions between the fungus, substrate and environment, also dependent on the species as well as strain (Sweeney & Dobson, 1998; Pitt *et al.*, 2000). Thousands of fungi routinely colonize stored grains, agricultural products, forage and feeds but only a few are known to produce mycotoxins (Miller, 1994). Infection and colonization can occur in the field in standing crops, after harvest, during drying of grains or subsequent strorage. The major mycotoxigenic fungi related to human food chain apparently belong to three genera - *Aspergillus*, *Fusarium* and *Penicillium*. All of them are very common inhabitants of soil, indoor and outdoor environment, causing deterioration of several manmade articles and cultural property (Gilman, 1967; Kolet, 2003) and are widely believed to be potential health hazards as well as stimulators of allergic responses (English, 1980; Bennett, 1994). Table 1 illustrates mycotoxin related diseases and disorders. Table 2 shows toxigenic fungi, their mycotoxins and potential activity.

Mycotoxicosis poses challenges before clinicians owing to the fact that it is extremely difficult to diagnose, as very few mycotoxins produce overt signs of poisoning or related symptoms (Samson, 1992; Pitt *et al*., 2000). This happens probably because most mycotoxins are bizarre molecules with variable structures, their molecular weights ranging from 50 to more than 500, and, such small molecules induce no immediate response in the human immune system. A major drawback and danger of mycotoxin contamination in food is our inability to detect them biologically (Pitt, 2000). Also, the fact that production of actual symptoms requires few days to years or even decades, makes it near impossible to pin point the source of a disease or disorder that manifests itself after so long a period.

Four fundamental types of toxicity levels are characteristic to mycotoxins: Acute toxicity, Chronic toxicity, Mutagenic toxicity and Teratogenic toxicity.

The most commonly described effect of acute mycotoxin toxicity is deterioration of hepatic and renal functions, leading to death in extreme cases. Some mycotoxins affect skin sensitivity, even resulting in necrosis and extreme immunodeficiency; some cause disturbances in synthesis of proteins while neurotoxic mycotoxins cause sustained trembling in animals, which at higher doses can damage the brain and even lead to death (Subramanian, 1983; Oyeka, 2004). Chronic mycotoxin toxicity primarily results in the induction of cancer, especially of the liver, oesophagus and lungs as well as induction of tumors. The toxicity is never detected till the disease manifests itself. Some mycotoxins interfere with normal replication of DNA, thereby inducing mutagenic and teratogenic effects (Rodricks, 1977; Stoloff, 1983;Pitt, 2000).

Classification:

Currently, between 300-400 mycotoxins have been isolated from various fungi and classified according to the biological effects of their toxigenic action (Subramanian, 1983;Oyeka, 2004).

Table 3 shows the classification of mycotoxins into groups according to their action while Table 4 lists some other known and important mycotoxins.

Symptoms:

The symptoms of mycotoxin toxicity are as diverse as the chemical structures of the compounds themselves. In human beings, mycotoxicosis may bring about wide ranging effects and inductions (Joffe, 1971;Uraguchi, 1978;Subramanian, 1983; Oyeka, 2004) as are listed below:

i. Abdominal pain
ii. Anaemia
iii. Anorexia
iv. Bleeding from the nose, throat and gums
v. Breast enlargement in boys
vi. Burning sensation in the mouth, palate, pharynx, oesophagus and stomach
vii. Cardiovascular damage
viii. Chills
ix. Convulsions
x. Destruction/Exhaustion of bone marrow
xi. Disturbance of haematopoetic system
xii. Diarrhoea
xiii. Fever
xiv. Food poisoning
xv. Giddiness
xvi. Haemorrhagic rash
xvii. Haemorrhage in kidneys, lungs, pleura and adrenalin glands
xviii. Headache
xix. Increase in trytophan level in blood and brain, thereby affecting appetite, muscular corordination and sleep pattern
xx. Inhibition of protein synthesis
xxi. Leukopenia
xxii. Lowering of body temperature
xxiii. Lowering of blood pressure
xxiv. Nausea
xxv. Neurotic angina
xxvi. Precocious pubertal changes in children
xxvii. Physiological and pathological changes
xxviii. Reproductive and mammary changes
xxix. Respiratory failure
xxx. Role in hormonal balance and breast cancer
xxxi. Role in induction of cancer
xxxii. Role in renal failure

In animals, mycotoxins are known to cause equally wide ranging and many a times more shocking effects (Hayes, 1977;Palti, 1978;Uraguchi, 1978;Subramanian, 1983;Oyeka, 2004) as listed herein:

i. Abortion
ii. Acute & chronic liver damage, liver diseases & carcinoma
iii. Anorexia
iv. Blindness
v. Centro lobular necrosis
vi. Circulatory disturbances & failure
vii. Convulsions followed by death
viii. Dehydration
ix. Depression of spinal & medullary functions
x. Diarrhoea
xi. Development of abnormalities
xii. Enlarged uterus, atrophied ovaries
xiii. Facial eczema
xiv. Food poisoning
xv. General toxicosis
xvi. Haemorrhage in internal organs
xvii. Increased foetal mortality
xviii. Hepatic carcinoma & necrosis
xix. Interruption of oestrus
xx. Itchiness
xxi. Jaundice
xxii. Lacrymation
xxiii. Liver damage & haemorrhage, causing rapid death
xxiv. Liver cirrhosis & fibrosis
xxv. Loss in weight
xxvi. Nasal discharge
xxvii. Nervous symptoms
xxviii. Paralysis of diaphragm & thorax
xxix. Progressive ascending paralysis
xxx. Renal necrosis
xxxi. Respiratory disturbance & failure
xxxii. Salivation
xxxiii. Somnolence
xxxiv. Spastic, hyperkinetic or convulsive signs
xxxv. Swelling of hind legs
xxxvi. Vomiting
xxxvii. Death occurs in acute cases of mycotoxin toxicity

Many fungi with the potential to produce mycotoxins are commonly and frequently observed as contaminants on food and agricultural products. It is true that mycotoxins cannot be synthesized in food unless there is fungal growth. However detection of fungal colonization on food does not automatically mean the contamination of mycotoxins, but ample potential for their production always exists(ISU, 2005). On the other hand, absence of toxigenic fungi also is no guarantee that the food item is safe and free from mycotoxin contamination as toxins persist long after all signs of the colonizing fungi have disappeared with time (Peckham *et al*., 1971). A combination of several factors including nutrients available in the food, environmental factors and preservatives is known to affect production of mycotoxins in food (ICMSF, 1996)

AFLATOXINS

Aflatoxins are a group of highly toxic carcinogenic secondary metabolites produced by fungi, namely i. *Aspergillus flavus* ii. *Aspergillus parasiticus* and iii. *Aspergillus nomius* (Pitt, 1992). They are one of the most important, thoroughly studied and well-documented group of mycotoxins, having direct relevance to human and animal health. Aflatoxin B_1 is considered to be Class I human carcinogen (IARC, 1993).

The naturally produced aflatoxins undergo modifications during metabolism and food processing to further produce several derivatives with variable and wide ranging toxic, mutagenic and teratogenic effects (Wong & Heish, 1976;Palmgren & Hayes, 1987). The structure and chemistry of aflatoxins has been studied in great detail. Chemically, aflatoxin belongs to the category of *bis furano-isocoumarins* (Subramanian, 1983). Detroy et al (1971) described 18 aflatoxins of which around 13 are naturally occurring. Four of them viz. aflatoxin B_1, B_2, G_1 and G_2 are common contaminants in food commodities. B and G refer to blue and green fluorescence respectively, produced by the toxins when separated by thin layer chromatography and viewed under ultraviolet light. Their hydroxylated derivatives are also known, as well as the aflatoxins M_1 and M_2 which are produced when natural aflatoxin B_1 and B_2 are partly metabolized by animals and excreted in milk and urine (Frobish *et al*., 1986;Guerre *et al*., 2000). Aflatoxin P_1, a urinary metabolite of experimental value is also a derivative of aflatoxin B_1.

Among the aflatoxins, the best studied, described and documented is aflatoxin B. It has a molecular weight of 312. Its chemical formula is $C_{17}H_{12}O_6$ (Oyeka, 2004).

The implicated fungi have been isolated from aflatoxin contaminated food material. They are basically storage moulds, however, weak parasitic activity is also reported (Subramanian, 1983). They come from contamination during handling, storage and processing of foods. Presence of higher moisture content in grains due to inadequate drying is a prime factor favouring their colonization by aflatoxin producing fungi. These fungi are known to grow on almost every raw as well as processed food. They readily grow on foods, once their abundant spores in the environment get an opportunity to settle, further aided by favourable tropical temperatures and water activity. Pitt (1995), specified parameters favouring activity of aflatoxigenic fungi in foods. Aflatoxin contamination is fundamentally a problem in tropical and allied areas only.

The conditions for initiation of aflatoxin production are more specific in comparison to other mycotoxins. Presence of lipids (oils) in foods largely favours the production of aflatoxins. Hence, groundnuts and corn (maize) are substrates of choice for accumulation of aflatoxin. Aflatoxin is present in significant amounts in various edible nuts, grains and their processed products. While rice and other food grains show lesser tendency to produce aflatoxins, the level of contamination is high in parboiled rice (Subramanian, 1983). Soyabean, reportedly has lower ability to accommodate aflatoxin due to presence of an inhibitor protein but misidentifications are however common due to

presence of a chemical compound similar in fluorescence characteristics and Rf value (Samarajeewa, 2004).

Aflatoxins and Human Health:

Aflatoxin B_1 has an unsaturated structure and can inflict damage even at extremely low doses (Rippon, 1974). Aflatoxin related health implications are well documented (Shank, 1978;Hendrickse, 1997;Hendrickse, 1997;Pitt, 2000;Oyeka, 2004). The effects on human health are summarized below:

i. Carcinogenic (especially cancer of the liver)
ii. Headache
iii. Mutagenic
iv. Nausea
v. Outbreaks of aflatoxicosis
vi. Outbreaks of hepatitis
vii. Rare incidences of acute toxicity
viii. Renal diseases
ix. Teratogenic
x. Toxicological action
xi. Transient rash
xii. Exposure to aflatoxin M_1, is a major potential threat to human health especially to infants and children (Bosch & Peers, 1991)
xiii. Aflatoxins may also act synergistically with other mycotoxins and microbial agents in weakening human resistance to diseases (Samarajeewa, 2004)

Similar effects are elicited in animals (Robens, 1990;Bray & Ryan, 1991)

Modern techniques in molecular biology have facilitated deeper understanding on interactions of aflatoxins at cellular level. Aflatoxin has a unique capacity to selectively target gene p53, described as the 'guardian of the genome', thereby throwing open the possibility of rapid accumulation of mutations in the cells, eventually leading to cancer (Puisieux et al., 1991;Smela et al., 2001)

Owing to their extreme toxicity, low acceptance/tolerance limits for aflatoxins in food have been prescribed by many countries. While 15mg/kg of total aflatoxin is stated as the maximum level permitted in foods in world trade (Pitt, 2000), studies have revealed that the actual levels of aflatoxins in some tropical foods and blood samples are much higher (Miller, 1996;Pitt & Hocking, 1996). The intricate, complex nature of international trade compounded with diverse foods, climatic and environmental conditions, differences in aflatoxin tolerance levels (FAO, 1997) in different parts of the world and the dire need of some food commodities such as milk powder for impoverished and malnourished children make it difficult to set a fixed value as uniformly acceptable level.

Current Work from Thane District

Samples of oil seeds from Thane, Kalyan and Ulhasnagar, in Thane district were screened for aflatoxins. The experiments were carried out in September, 2007. Five types of oil-seeds viz. castor, maize(corn), mustard, groundnut and sesame were investigated. Apparently healthy and damaged oil seeds were procured from the retail markets in the respective cities. Samples were drawn from fresh and one-year old lots and exposed to the black light test at a wavelength of 365nm (ISU, 2005). Samples of entire grains as well as damaged and broken grains were qualitatively screened for

aflatoxins. The results are documented in Table 5.

Results hinted at the presence of mycotoxins in few of the samples investigated. Castor did not show presence of mycotoxins except for a single heavily damaged seed which could render the entire lot unacceptable (ISU, 2005). The heavy damage probably facilitated entry of mycotoxigenic fungal colonizers. Mustard seeds did not reveal mycotoxins. Maize grains from old stock demonstrated some glowing particles revealing possibility of aflatoxins. Undamaged groundnuts did not reveal aflatoxin contamination, however damaged nuts indicated their presence. Sesame showed possibility of aflatoxin contamination in only one sample. Plant pathologists prescribe this test only as an initial screening and do recommend a thorough further verification by laboratory analysis.

Table 1. Mycotoxin related diseases and disorders in human beings and animals (Subramanian, 1983; Marasas et al., 1988)

No.	Disease / Disorder	Contaminated food	Mycotoxigenic food contaminants
1	Aflatoxicosis	Aflatoxin contaminated nuts, grains and processed products, milk and milk products	*Aspergillus flavus, A.nomius, A.parasiticus*
2	Alimentary toxic aleukia	Mildewed cereals	*Fusarium poae, F.sporotrichioides, Cladosporium epiphyllum, C.fagi*
3	Mouldy Rice Toxicosis (Cardiac beriberi)	Mouldy rice	*Penicillium citreonigrum,P.citrinium, P.islandicum, P.pulvillorum*
4	Dendrodochiotoxicosis (Horse, sheep, pigs)	contaminated wheat straw	*Myrothecium verrucaria*
5	Equine leukoencephalomalacia (ELEM)(Horses, rabbits)	Mouldy corn	*Fusarium verticillioides (F.moniliformae), F.oxysporum*
6	Facial Eczema (Sheep, cattle)	Infected grass, mouldy feed	*Sporidesmium bakeri, Periconia minutissima*
7	Fescue foot (cattle)	Contaminated feed & fodder	*Fusarium poae, F.sporitrichioides*
8	Oestrogenic Syndrome (Pigs)	Mildewed cornfeed	*Fusarium germinearum, Fusarium* sps.
9	Stachybotryotoxicosis (Horses, sheep, calves, pigs, guinea pigs, rabbits)	Contaminated fodder	*Stachybotrys atra*
* diseases of animals may also affect human beings in direct contact with the fungus			

Table 2. Toxigenic fungi, their mycotoxins and toxic potential (Subramanian, 1983;Blackwell *et al.*, 1995;Dutton, 1996; Pitt, 2000; Oyeka, 2004)

Fungi	Mycotoxin	Toxic Potential
Aspergillus flavus, A.nomius, A.parasitcus	Aflatoxin	Class I carcinogen; Acute poisoning; Jaundice
Apergillus nidulans, A.rugulosus, A.versicolor, Drechslera sps.	Sterigmatocystin	Hepatotoxin, Hepatocarcinogen
Aspergillus ochraceus, A.carbonarius, Penicillium verrucosum	Ochratoxin A	Nephrotoxin; Accumulates in blood, milk, binds with macromolecules in plasma and plasma proteins
Fusarium graminearum	Zearalenone	Precocious pubertal changes in children; probable role in breast cancer
Fusarium oxysporum, F.verticillioides	Fumonisin	Class II carcinogen
Fusarium sps.	Deoxynivalenol (DON)/(Vomitoxin)	Human toxicosis, emetic, food refusal
Fusarium poae, Fusarium sps.	T-2 toxins	Severe anaemia, emetic, destruction of bone marrow, agranulocytosis
Myrothecium verrucaria	Roridin, Verrucarin	Targets cardiovascular system & CNS
Penicillium citreonigrum, P.citrinum, P.ochrosalmoneum, P.pulvillorum	Citreoviridin	Cardiovascular damage, Paralysis, Respiratory failure
Penicillium islandicum	Islanditoxin, Cyclochlorotine, Luteoskyrin, Rugulosin	Hepatotoxin, Hepatoxic carcinogen
Penicillium citrinum, P.viridicatum, Aspergillus terreus, A.niveus	Citrinin	Nephrotoxin
Stachybotrys atra	Stachybotryotoxin, Satratoxin, isosatratoxin, verrucarin	Affects skin & mucous membrane; general toxicosis affects circulatory system; necrosis in tissues causes haemorrhage; affects nervous system; causes abortions

Table 3. Classification of Mycotoxins according to biological effects (Subramanian, 1983)

Group	Mycotoxins
Hepatotoxins sterigmatocystin	Aflatoxin, B_1, G_1; Austocystin cyclochlorotine, luteoskyrin, maltoryzine rubratoxin B, rugulosin, spordesmin,
Nephrotoxins	Ochratoxin A, citrinin
Neurotoxins	Citreoviridin, Patulin, Roquefortine
Tremorgenic toxins	Penitrem A,B,C; Paxilline, Cyclopiazonic acid; Fumitremorgen A (FTA).FTB & FTC;Verruculogen TR1 & T Austamide,Oxaline
Dermatotoxins	T-2 toxin, Butenolide
Emetic & Feed	Trichothecenes, Deoxynivalenol/Vomitoxin, T-2 toxin refusal toxins
Cardiotoxins	Viridicatumtoxin, Xanthoascin
Gastrointestinal toxins	Austdiol
Hemolytic toxins	Toxins from *Aspergillus fumigatus*
Teratogenic toxins	Ochratoxin A, aflatoxin B, rubratoxin B
Cytochalasins	cytochalasin, A,B,C,D,E & F, Zygosporin D,E,F & G, (cytological effects) Chaetoglobosin C
Carcinogenic mycotoxins (circumstantial evidencep in humans & laboratory tests on animals)	Aflatoxins, cyclochlorotine griseofulvin, luteoskyrin, Patulin, enicillic acid, rugulosin, sterigmatocystin

Table 4. Partial list of other known mycotoxins (Subramanian, 1983;North Carolina Cooperative Extension Services, 1994)

Alternariol	Fusariocin
Brevianamide A	Fusarius
Diacetoxyscipenol	Monoacetoxyscirpenol
Diacoumarol	Neosolaniol
Disthylstisbestrol	Oosporein
Ergometrine	Paspalitrems
Ergotamine	Phomin
Ergotoxin	Tryptoquivaline
Fusaric acid	Tryptoquivalone

Table 5 Initial Screening for the presence of Aflatoxin

Oilseeds	Undamaged oilseeds						Damaged/broken oilseeds					
	Fresh stock			1 Year old stock			Fresh stock			1 Year old stock		
	Thn	Kyn	Unr	Thn	Kyn	Unr	Thn	Kyn	Unr	Thn	Kyn	Unr
Castor	-	-	-	-	-	-	-	-	-	+	-	-
Mustard	-	-	-	-	-	-	-	-	-	-	-	-
Maize (Corn)	-	-	-	-	-	+	-	-	-	+	+	+
Groundnut	-	-	-	-	-	-	-	-	+	+	+	+
Sesame	-	-	-	-	-	-	-	-	-	-	-	+
(Thn: Thane; Kyn: Kalyan; Unr: Ulhasnagar) ('-' : Aflatoxin absent; '+': Aflatoxin poss												

Preventive Measures for control of mycotoxins in food:

Some recommended control measures for proper management of mycotoxin contamination (Joffe, 1971;ISU, 2005) are listed below:

i. Control of insects in the field and during storage
ii. Detect early in the field
iii. Routine checks of grain samples
iv. Mycotoxin analysis
v. Aeration of bins keeps stored grains dry
vi. Control moisture content of grains/feed
vii. Control other sources of moisture
viii. Keep processing equipment clean
ix. Use fresh feeds
x. Remove old stock
xi. Never mix old and new feed/grain stock
xii. Use safe mould inhibitors
xiii. Food commodities should not come in contact with soil
xiv. Proper education and orientation

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Lecture on regulatory aspext of contamination in Food & Beverages

Mr. H.D. Salunkhe,
Joint Commissioner (Kokan Division)

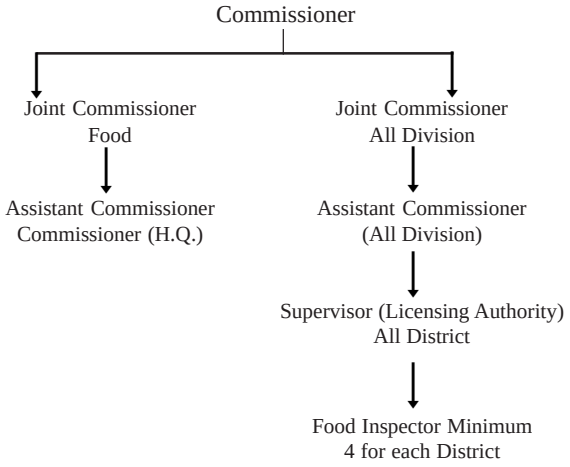
Subject : Role of F.D.A. in Prevention of Adulteration of Food Articles

- Introduction of F.D.A.
  - Main object of F.D.A.
  - Machinery available with F.D.A.
  - Law enforced by F.D.A.
  - Important provision of P.F.A. Act
    - Definition of Food
    - Adulterated Food
    - Duties of Food Inspector
    - Duties of Food Supervisor (Licensing Authority)
    - Duties of Assistant Commissioner (Local Health Authority
    - Duties of Food Joint Commissioner (Consenting Authority)
    - Duties of Commissioner (Food Health Authority)
  - Procedure of drawing food samples and prosecution
  - Food testing Laboratories and their capacities and duties (Public Analyst)
- Figures of prosecution samples inspection, suspension & cancellation of License.

Introduction of F.D.A.

- **Commissioner**
- **Joint Commissioner**
- **Assistant Commissioner**
- **Food Supervisor**
- **Food Inspector**

STRUCTURE



Mail objects of F.D.A.

- To control adulteration Food Articles
- To control manufacturer, distribution and sale of drugs & medicines and to ensure availability of standard quality at reasonable price.

Law enforced by F.D.A. to control the food adulteraion

- P.F.A. Act. 1954
- P.F.A. Rules 1955
- M.P.F.A. Rules 1962

Important Provision of P.F.A. Act

- P.F.A. Act. 1954
- P.F.A. Rules 1955
- M.P.F.A. Rules 1962

Procedures for drawing food samples

- Preparation
  - Samples
  - Samples material
  - Panch witness
  - purchase bill
  - Panchanama
  - Form 14A
  - Sealing of sample
  - Form 6
  - Delivery of documents to Vendor

And next day sending samples for analysis P.A. Report
proposal for consent to prosecute & launching prosecution

Capacities of Public Health Laboratories and Duties of P.A.

Figures of inspection, sampling, prosecutions, suspension & cancellation of License

Methodology adopted by F.D.A.

- Licensing
- Inspection
- Sampling
- Norms of F.I.
- Prosecution
- License suspension, cancellation & warning
- Public awarness by exhibition and pamplet distribution

Act has given Right to consumers for drawing the sample Section 12 of P.F. A. Act.

CONTAMINATION OF FOOD AND WATER DUE TO MUNICIPAL SOLID WASTE: SPECIAL FOCUS ON BIO-MEDICAL WASTE MANAGEMENT

DR. SANJAY JOSHI
DR. VIKAS HAJIRNIS
PROF. VIDYADHAR WALAVALKAR

Municipal solid waste

- **Garbage mounds rotting in the streets create an unhygienic environment for a city's inhabitants**
- **The gravity of the problem is increasing rapidly in Metropolitan cities in particular**
- **This is mainly due to massive migration of people form rural to urban regions**
- **Ever-increasing population is causing an overburden upon the basic amenities including solid waste management**

Municipal Solid Waste

- **A UN Report of 1995 states that 40 percent of the India's total population will be clustered in the Indian cities by the year 2025**
- **Thus Urban India is on the brink of massive Waste Disposal Crisis**
- **MSW Management Rules of 2004 are barely enough even to maintain a system of waste collection and disposal**

Municipal Solid Waste

- **The most important aspect of MSW management is the community participation**
- **Common people are the generators of the waste and need to be made aware of health hazards of mismanaged MSW**
- **Enviro-Vigil is trying hard in this area of awareness creation**

Municipal Solid Waste

- **Until recently, the hospital waste was one of the major solid waste components found in the city garbage**
- **Major part of this waste is extremely hazardous and is responsible for transmission of pathogens through contaminated food and water**

WHAT IS BIO-MEDICAL WASTE?

- **The Bio-Medical (hospital) waste is the waste generated in a hospital during diagnosis of a disease and treatment of a patient**
- **It consists of –**
  - **a) Human Anatomical Waste**
  - **b) Pathological and Hazardous material that can cause serious health problems**
  - **c) Plastic Waste**
  - **d) Glass Waste**
  - **e) General Waste**

Hazards due to BIO-MEDICAL WASTE

- **This kind of waste when mixed with common municipal waste can easily contaminate food and water through unprotected, unscientific handling and direct exposure to disease transmitting agencies**
- **In this age of dreadful and commonly occurring diseases like Hepatitis, AIDS and many more, this kind of waste must be managed and handled with utmost care in a scientific manner**

BIO-MEDICAL WASTE DISPOSAL

- **The hospital waste is disposed as per the rules defined under "Bio-Medical Waste Management and Handling Rules (1998)" of Ministry of Environment & Forest, Government of India.**

Common Bio-Medical Waste Treatment Facility of Enviro-Vigil

- **Enviro-Vigil has set up a Common Bio-Medical Waste Treatment Facility for Thane Municipal Corporation**
- **It houses a pyrolytic incinerator, an autoclave and other necessary infrastructure specified in the rules**
- **Segregated BMW from more than one thousand hospitals is collected, transported, treated and disposed off strictly in accordance to the rules**

Segregation at Source: Key to Success

- Waste is segregated at source into different coloured plastic bags specially manufactured for the purpose
- Segregation is done as follows

Human Anatomical Waste AND Pathological and Hazardous material : YELLOW BAG

Segregation at Source: Key to Success

Plastic Waste: RED BAG

Glass Waste: BLUE BAG

General Waste: BLACK BAG

Metal Sharps: BLACK CANNISTER FILLED WITH SODIUM HYPOCHLORITE

Enviro-Vigil's Common BMW Treatment Facility

Treatment Facility is provided with the following Equipments and Provisions as per the Guidelines issued by CPCB

Incinerator : Diesel fired, with Venturi scrubber, burning capacity of 50 kg/h,PLC based with tamper proof panel and a recording device

Autoclave : PLC based with tamper proof control panel and recording device

Shredder : Run on electricity and used for shredding sterilized plastic material

Facilities for : Bin washing, floor washing and vehicle washing

Other Requirements: Sharps pit, effluent treatment plant and secured landfill for the burial of ash

Incinerator in working…..

Enviro-Vigil's Common BMW Treatment Facility

- **Thane Municipal Corporation's Rajiv Gandhi Medical College and Shri. Chhatrapati Shivaji Maharaj Hospital Campus, Thane-Belapur Road, Kalwa, Thane, Maharashtra**
- **Secluded from the residential and sensitive areas**
- **Located along the scenic banks of Thane Creek**
- **Facility has been set up in compliance with CRZ (Coastal Regulatory Zone) Rules**

Present Scenario

- **As of this date, we are catering to the need of almost 1050 hospitals with approx. 7200 beds Transport Vehicle**
- **We have 5 vehicles, which are three wheeler tempos and a manually driven tricycle**
- **These are fully dedicated for the collection of Bio-Medical Waste from the source of generation**
- **These vehicles are designed and modified as per the prescribed rules**

Salient features…….

- **We have obtained ISO 9001:2000, quality system Certificate from Det Norske Veritas (DNV) , Netherlands for our CBMWTF**
- **So far, we are running this CBMWT facility almost for past FOUR years without any serious problem.**
- **CBMWTF is self funded without any govt. funding or otherwise and as yet we have been able to run it quite successfully**
- **The funds generated from this facility are used for our other projects, maintenance, salaries of our employees etc.**

Is the city of Thane free from the hazards of BMW?

- To some extent, YES!
- Although we have not been able to reach ZERO BMW target yet, so far we have been able to create awareness about the hazards of BMW in the health care workers and other fractions of the society
- Such scientific treatment of BMW will certainly reduce the high risk of water and food contamination to a large extent

Who are we? What on the Earth are we doing?

Enviro-Vigil is an environmental NGO committed to provide Clean, Healthy and Hygienic Environment to the citizens of Thane

With a group of dedicated and committed volunteers, we have undertaken many environmental activities

Some of these activities are……

- **School of Environment to provide informal education to the school children**
- **Organizing seminars on the theme "Green Careers", carrier opportunities in the field of environment**
- **A monthly magazine entitled "Aaple Paryavaran" (Our Environment) in our native language ,i.e.Marathi is being published for the past two years**

Activities

- We provide consultancy for Rain Water harvesting to various residential societies in Thane city
- Organizing public meetings and discussions on environmental issues from time to time
- Educating the people about ill effects of Ganapati idol immersion on the lake water ecosystem and providing alternatives
- Creating public awareness regarding solid waste management with the involvement of famous cinema and stage actors and actresses
- Development of "Theme Park"for solid waste management to educate the people in this regard

Recognition!

- **In Recognition of Enviro-Vigil's modest contribution in the area of Water Education and Awareness Creation, Enviro-Vigil has been selected for an award of "Best Water NGO, 2006-2007"**
- **This award has been instituted by the Water Digest, New Delhi, in collaboration with UNESCO and CNBC TV 18**

Recognition!

- **In Recognition of its work in the area of Bio-Medical Waste Management, Enviro-Vigil was recently awarded Green Cube Award (G-3 for Good Green Governence) for the year 2006**
- **This award has been instituted by the Srishti Publications, New Delhi**

Thane Bharat Sahakari Bank Ltd.

Acknowledgement

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Section I

About

Contaminants in Food and beverages

Section II

Preparatory Workshops

Section III

Research Papers

Section IV

Presentations
October 06, 2007