HEAVY METAL RESIDUES IN MEAT AND ITS PUBLIC HEALTH SIGNIFICANCE

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Due to increasing extent of industrialization and their growing entanglement with animal production we can assume that human foodstuffs can be contaminated with various chemical residues. Heavy metal is one such pollutant, which seriously interferes with bioenvironmental processes and thereby posing a menace to the life on this planet. We cannot avoid such environmental toxins entirely, as we come in contact with many substances throughout our normal daily activities. However, we can increase our awareness of toxins, their known effects on humans, the sources and routes of exposure, and reduce or eliminate exposure as much as possible.

Heavy metals are of ubiquitous distribution in the total environment. The metal residues can come from two sources by getting into animal via feed and thus into meat by a process known as carry over. One such source is of geogenic origin i.e., naturally present in soil in high concentrations than normal. These are absorbed by roots and lead to contamination of fodder and eventually to food. The second source can be brought by man into biosphere from natural deposits - a process known as anthrogenic, wherein the contamination of an area has been above its natural level by human intervention caused due to waste from mining or smelting or from processes such as battery manufacture, auto exhaust, thermal plants, refineries etc., contaminating the whole earth with relevant residues.

Apart from this excessive feeding of such minerals as growth promoters in livestock production can also lead to its accumulation in body tissues.

HEAVY METAL RESIDUES IN MEAT

In general, the metals have been classified into essential and non-essential groups. The former consist of Ca, Mg, K, Fe, Mn, Zn, Cu and the latter of Hg, Pb, Cd, Cr, As and Se. The metals of the second group have directly or indirectly adverse consequence of biological activities. The essential metals also have harmful effects at higher concentration limits.

The heavy metals, which reach the animals edible tissues via their feed, accumulate mostly in the target organs like liver and kidney and for some metals, also bones. Muscles as well as lungs, brain, heart etc., contains much lower levels in most cases. The animals consuming heavy metal burdened feed from polluted areas are bearing higher contents than those kept in low polluted districts. Cattle, because of their inquisitive nature appear in general to be more prone for poisoning than other species, although the large size of the rumen with its micro floral synthesizing ability tends to have a protective effect. Young animals are more often affected, probably because the detoxifying efficiency is under developed and also because they are less discerning.

The Maximum Residue Level is the maximum concentration of residues that is regarded to be legally permitted or recognized as acceptable in food.

MRL values of some heavy metals in meat (mg/kg),Cadmium 0.05,lead,0.1,mercury 0.05.

PUBLIC HEALTH SIGNIFICANCE

Excessive intakes of heavy metals in food have caused intoxications in man. The diversity of ways in which metal toxicity manifests itself makes it difficult to recognise by observation alone. Toxic metals may interfere with the normal function of any system of the body. Hence apart from medical assistance, nutritional support etc., it is also necessary to identify the source by considering the food eaten or product used in order to take precaution to avoid any further exposure.

HEAVY METALS OF PUBLIC HEALTH SIGNIFICANCE WHEREIN MEAT ACT AS SOURCE INCLUDES;

LEAD

Lead can cause severe health effects at relatively low levels of exposure. Larger amounts ingested within 1 or 2 days may be fatal, but smaller amounts ingested over a period of several weeks may not be so.

SOURCE

Lead occurs widely in the environment and is a well known contaminant of drinking water. Certain foods cooked in water containing lead have been shown to concentrate the metal and hence be a potential hazard to the consumer. Lead is widely used in the manufacture of batteries, paints, gasoline additives, glazes, piping etc.Lead can accumulate in the tissues of animals grazing close to smelting plants or animals ingesting paints or substances with high lead contents. Chronic exposure can result in accumulation in bones of animals. Acute cases have highest concentration in liver and kidney. Processing and packaging can significantly increase the total lead contents in foodstuffs.

HEALTH EFFECTS

Lead affects the human nervous system, the production of blood cells, renal damage, abortion, still birth, and immune suppression. Lead passes the placenta and can damage the total nervous system, increasing the risk for premature birth or low birth weight babies.Gonadal dysfunction in man, including depressed sperm counts, has been associated with blood levels of 40-50 microgram/deciliter. Nutritional deficiencies increase the risk for lead absorption and toxicity. Young children's and infants are more vulnerable to lead poisoning. High blood levels in children can cause learning disabilities, behavioral problems, and mental retardation.

CADMIUM

SOURCE

Cadmium contamination of the soil and water can occur through municipal wastewater treatment, electroplating, metal processing, plastic and dye manufacturing etc. Cadmium enters plants and animals from soil, air and water thus entering the food supply. Currently, food contributes 80-90% of cadmium dose received by most people. Cadmium accumulates in greatest concentration in kidney and liver of farm animals.

HEALTH EFFECT

The estimated lethal oral dose for humans is 350-3500 milligram of Cadmium. Cadmium has no known function in human metabolism. Acute effects are nausea, salivation, gastrointestinal disorders, vomition and diarrhoea with abdominal discomfort and pain. Chronic exposure can result in kidney damage, skeletal weakening, anemia, liver and heart diseases. Although the target organ of Cadmium toxicity is the kidney, other adverse effects may occur in bones and stomach. Bone pain due to Cadmium toxicity is common in ribs, backbone and femur.

MERCURY

Mercury is a persistent, Bioaccumulation and Toxic Pollutant (PBT).

SOURCE

Mercurial preparation has a number of important industrial, agricultural and medicinal uses. Such preparation contaminates the grazing areas. Animals are also exposed through feeding seed grain treated with mercury containing dressing used for preventing fungal growth. Organic mercurial like methyl mercury are continuously taken in small amounts by fishes from marine water, which accumulate them in very high concentration. This becomes a source of potential toxicity in fish eating animals and humans.

HEALTH EFFECTS

The average daily intake of mercury from food is in the range 2-20 microgram per day. Mercury intoxication can lead to neurotoxicity and renal damage. Mercury is also a mutagens, teratogen and carcinogen. Acute toxicity can cause thirst, inflammation of mouth and stomach lining, nausea, abdominal pain, tenesmus. Chronic conditions lead to inflammation of guns, nervousness, tremors and ovarian dysfunction. Mental retardation may be seen in children due to placental transfer of methyl mercury.

Dangers of mercury have come to public attention numerous times throughout history.Infact mercury poisoning has variety of other names related to various incidence. These includes ' Pink disease' from teething powder , 'Madder halter's Disease' which occurred when hat makers dipped the felt or fur into vats of mercury, and "Minmata Disease" when Japanese ate fish contaminated by industrial waste dumped in Minmata Bay.

ARSENIC

Arsenic is found in soil, water and air as a common environmental toxicant. Arsenic contamination of environment can arise from smelting of metals and burning of coal. Poultry and swine producers add as to feed as growth enhancers (sodium arsanilate). Animals are also exposed to arsenical herbicides (sodium arsenite), rodenticides (arsenic trioxide), or insecticides.

HEALTH EFFECTS

The mean daily intake of Arsenic in food for adults has been estimated to range from 16.7-129 microgram. Early clinical symptoms of acute intoxication include abdominal pain, vomiting, diarrhoea, muscular pain and weakness with flushing of skin. Chronic toxicity can occur when arsenical compounds are fed low levels. Although accumulation occurs in exposed animals, the risk to consumers is less because the concentrations in the muscle are not above the maximum safe level for human consumption. The predominant manifestations are goiter or skin cancer. Infants may develop liver enlargement, anemia and reduction in WBC number.

CHROMIUM

This bluish white, brittle and lustrous metal is widely distributed in the earth's crust. Its main uses are as a plating metal and as an alloy in stainless steel. It is also often used in tanning of hides. Food contains Chromium at a concentration ranging from <10 to 1300 microgram per kilogram. Utensils used in the preparation of food may also contribute to high levels.

HEALTH EFFECTS

As per US National Academy of Science the acceptable intake of Chromium for man is estimated to be 35microgram per day and for women as 25 microgram. Ingestion of 1-5 gram of chromate resulted in severe acute effects such as gastrointestinal disorder, hemorrhagic diathesis and convulsion. Death may occur following cardiovascular shock. Chromium is also a potent mutagens and carcinogen, hence occupational exposure of chromium compound can increase the incidence of genotoxic effects and lung cancer.

COPPER

Copper is a ubiquitously distributed element essential to the animal at trace mineral levels. Foods especially rich in copper are veal and pig, sheep, and calf liver. The metal tends to accumulate in the liver and kidney.

HEALTH EFFECTS

Humans via food and drinking water ingest copper. Average intake of 1-5milligram per day is required. The lethal oral dose for adult lies between 50-and 500 milligrams per kilogram body weight. Acute exposure leads to vomiting, diarrhoea, nausea, and behavioral changes.Apart from this various other metals like, Selenium, Zinc, Nickel etc., may be also seen in edible animal tissues, however their toxicity to humans are rare. They produce toxic effects only if present in higher amounts. Their relative concentration is based on degree and type of pollution present in the locality.

DETECTION OF HEAVY METAL RESIDUES

Detection of these unwanted residues presents a new challenge to meat hygienists. Traditional Ante mortem and Postmortem inspection cannot guarantee the detection of residues. Hence to reassure the consumer health the traditional meat inspection procedures need to be complemented by an increasing wide range of sophisticated laboratory analyses. A regular screening of animal and their products from heavy metals is a prerequisite so as to safe guard the consumer health in a particular locality.

Laboratory testing of heavy metal residues involves highly sensitive instruments and dedicated skilled personnel. For detecting heavy metal residues in meat animal the specimen collected should be packed individually, preferably in plastic containers and properly labeled.

The principal organs to be tested are liver (in all cases) and kidney (where As,Pb,Cu,Hg) are suspected. Bone and blood sample also required if lead poisoning is suspected.

The method used for detection includes, colorimetric analyses, chromatography, x-ray spectroscope, x-ray fluoroscope, polarography, neutron activator analyses, constant current anodic stripping potentiometer, spectroscopic analyses

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SIGNPOST

Mr. Mathew C. Kunnungal, IAS took charge as Principle Secretary to Government for Agriculture and Animal Husbandry.

Dr. B. Ashok, IAS took charge as Director, Animal Husbandry Department. He belongs to 1990 batch of CoVAS, Mannuthy and 1998 IAS batch. He holds additional charge of Executive Director Jalanidhi.

Dr. Ani S. Das, took charge as the M.D., Kerala Livestock Development Board. He belongs to 1982 batch. He completed his MVSc in A. R. and MBA from M.G. University. He has to his credit a certificate in HACCP from Starford University, London and a Diploma in Consumer Protection and International Trade (Free Uni. of Berlin). He started his carrier with Milma and then joined KAU as Asst. Professor. Subsequently he shifted to NDDB as Senior Executive and later on he was selected as MD of Meat Products of India, Koothattukulam. He hails from Trivandrum and now settled down in Ernakulam.

Dr D Jayachandran, who hails from Trivandrum district, took charge as the managing director, Meat products of India, Koothatukulam on June 1,2004. He belongs to 1972 batch. He started his career in Amul, Gujurat (1976-1981) and joined the Animal Husbandry Department, Kerala in 1981. He joined MILMA in 1982 and underwent training in embryo transfer in 1987 at IVRI, under the auspices of FAO and UNDP. He has the first embryo transfer born calf to his credit (1991) and worked as manager, State Centre for Implementing embryo transfer technology. Subsequently, he was instrumental in successfully working on embryo transfer in buffaloes and Vechur cattle in Kerala. He is considered as a resource person by the NDDB for the implementation of ET in the country. Till recently he was working as General Manager, of TRCMPU- a unit with ISO certification. He is the first veterinarian to hold the post of GM, TRCMPU. He had been to the Netherlands in 2002 to undertake a study of the co-operative sector.