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Lecture title: Milk contaminants (Part 2).

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Milk contaminants (Part 2)

2. Chemical contaminants

Chemical contaminants found in milk have been classified into five groups:

a. Pesticides.
b. Heavy metals.
c. Antibiotics.
d. Mycotoxins.
e. Hormones.

a. Pesticides:

Pesticides are substances used by humans to kill pests that threaten human health and well-being, the health and well-being of pets and livestock, or cause damage to crops. Pesticides include insecticides, herbicides, fungicides, nematicides, rodenticides, and others (Figure 3). Among these, insecticides (to control insects) and herbicides (to control unwanted plants) are used in the largest quantities and have the greatest impact on the environment.

A variety of pesticide residues in detectable amounts in raw, pasteurized, and UHT (ultra-high temperature) milk has been reported.

Factors contributing to the presence of pesticide residues in raw milk:

1. The lipophilic properties of pesticides.
2. Pesticides resistance to biodegradation.

Three possible forms in which pesticides can enter the animal's body:

(i) Through contaminated water.

(ii) Through the pores of the skin when the animal is sprayed or soaked to treat ectoparasites.

(iii) Through contaminated feed and forage, which is the main source of entry.

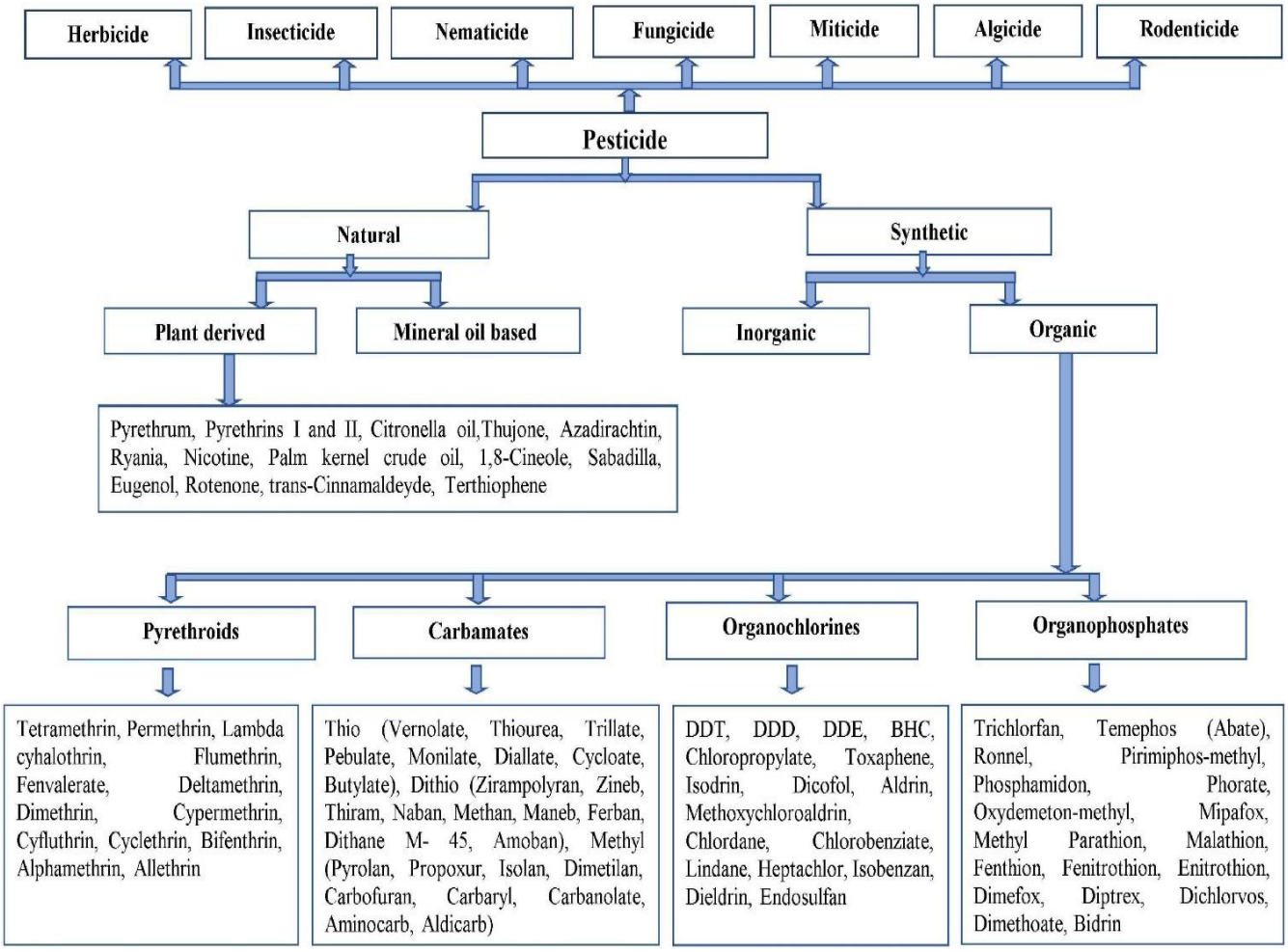

Figure 3: Classification of pesticides.

Pesticides are one of the most commonly found contaminants, not only in raw cow's milk but also after the pasteurization and UHT process. Their presence in milk, even below the maximum permitted levels, represents a health risk to the consumer. It is related to Hodgkin's lymphoma (HL), non-Hodgkin's lymphoma (NHL), Parkinson's disease, endocrine disruption, in addition to respiratory and reproductive disorders.

It is important to know that organochlorine pesticides such as hexachlorocyclohexane, dichlorodiphenyltrichloroethane (DDT), and endosulfan are still detected in milk despite being banned since the 1970s due to their high persistence in the environment and their harmful effects on human health. This indicates that they are still used in agriculture and animal husbandry.

b. Heavy metals:

Environmental pollution with heavy metals occurs as a result of natural sources and human activities. Some heavy metals including copper, cobalt, chromium, manganese, zinc, nickel, and iron are essential to living organisms in trace amounts and play a vital role in various processes, while others are non-essential to living organisms including arsenic, cadmium, lead, mercury, and have acute to chronic toxic effects. Long-term exposure to arsenic, cadmium, chromium, mercury and lead beyond the permissible limits can cause serious effects on human health, including neurotoxicity, carcinogenicity, and organ damage (Figure 4).

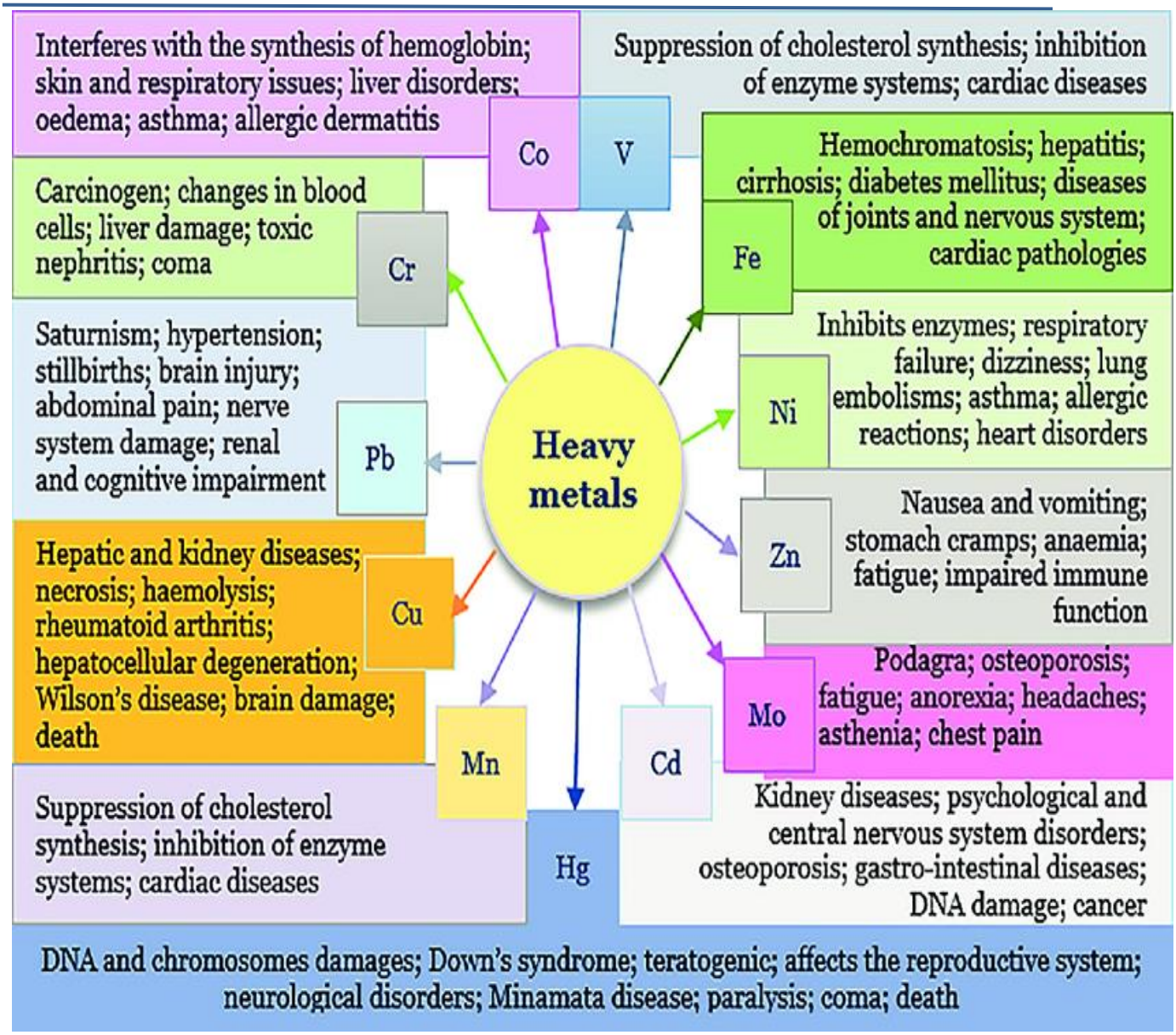

Figure 4: Pathological effects associated with excess amounts of some heavy metals.

There are several ways in which heavy metals reach milk, including:

(i) Ingestion of contaminated feed (in the soil, metals are absorbed by many crop plant species, which, when ingested by animals, are transferred to the lactating glands and finally excreted in milk).

(ii) Drinking contaminated water.

(iii) Equipment used in the dairy industry.

(iv) Pesticides and fertilizers (arsenic (As), cobalt (Co), chromium (Cr), nickel (Ni), lead (Pb), and others).

Several heavy metals have been reported in raw milk. Less common metals in raw milk are tin and molybdenum. These elements are not abundant in nature, and their presence in feed or water intended for animal consumption depends on soil characteristics, while the most reported metals are lead, cadmium, copper, and zinc, due to environmental pollution produced mainly by humans in industrial activities.

c. Antibiotics:

Antibiotics are used in livestock activities in three basic ways: therapeutic, prophylactic, and growth promoters. About 80% of dairy cattle are treated with antibiotics throughout their lives, mostly as growth promoters and for treatment of various diseases such as mastitis, arthritis, respiratory diseases, gastrointestinal diseases, and bacterial infections.

Elimination of antibiotics and their metabolites through milk depends on:

1. Antibiotic dose.
2. Route of application.
3. Level of milk production.
4. Type and degree of mammary disease.
5. Time between treatment and milking.

On the other hand, oral, intramuscular, or intravenous administration is less important from the point of view of milk hygiene than intramammary administration. However, intramammary administration of antibiotics is generally easier and cheaper, so they are preferred on dairy farms.

The most common disease in dairy cows is mastitis, and its treatment includes the widespread use of β-lactam antibiotics and tetracyclines. As a result, penicillin,

amoxicillin, tetracycline, and oxytetracycline are the most common antibiotics in milk.

Consumption of milk contaminated with antibiotic residues is an emerging public health problem worldwide. The presence of antibiotics in milk can cause undesirable effects on human health such as ototoxicity, nephrotoxicity, carcinogenicity, mutagenicity, teratogenicity, endocrine disruption, hypersensitivity, bacterial resistance and normal intestinal flora disruption.

In order to avoid the presence of antibiotics in milk, it is important to:

1. Avoid excessive use of antibiotics.
2. Take into account the withdrawal period before milking.