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Lecture title: Milk contaminants (Part 3).

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Milk contaminants (Part 3)

2. **Chemical contaminants:**

d. Mycotoxins.

e. Hormones.

d. Mycotoxins:

Mycotoxins are toxic secondary metabolites with low molecular weight, produced by molds mostly related to the genera of Aspergillus, Penicillium, and Fusarium, which colonize human food and animal feed ubiquitously. The mycotoxins of most concern are aflatoxins, fumonisins, zearalenone, ochratoxins, and trichothecenes such as deoxynivalenol and T-2 toxin, in addition to ergot alkaloids.

Exposure of humans to mycotoxins can happen by two ways:

i. Directly through consuming of the contaminated food.

ii. Indirectly through consuming foods of animal origin obtained from animals fed on contaminated feed.

Human or animal poisoning caused by the consumption of mycotoxin-contaminated foods or feeds, respectively is known as mycotoxicosis, which has an effect either individually or additively. Mycotoxins can cause several negative impacts on human

and animal health. Many human diseases are associated with the ingestion of mycotoxins, especially chronic consumption, with the main toxic effects being genotoxicity, carcinogenicity, hepatotoxicity, nephrotoxicity, reproductive disorders, and immunosuppression.

Ruminants are less susceptible than other animal species to the adverse health effects associated with exposure to mycotoxins because of the ability of the forestomach (rumen) flora to convert a number of mycotoxins into metabolites that are less potent or even biologically inactive at common exposure levels (ochratoxin A and deoxynivalenol). This applies, however, not to all mycotoxins that contaminate feed materials (aflatoxins). The barrier function of the rumen largely determines the susceptibility of dairy cows and other ruminant species towards individual mycotoxins. An impairment of this barrier function due to diseases or the direct antimicrobial effect of certain mycotoxins, may increase absorption rates.

In case of aflatoxins, following ingestion of contaminated feeds, a part of the ingested aflatoxin B1 (AFB1) is degraded in the rumen, resulting in the formation of aflatoxicol. The remaining fraction is absorbed in the digestive tract and is hydroxylated in the liver to aflatoxin M1 (AFM1). Aflatoxin M1 is either conjugated to glucuronic acid, and subsequently excreted via bile, or enters the systemic circulation. Circulating aflatoxin M1 can be excreted in the urine or appear in the milk (Figure 5).

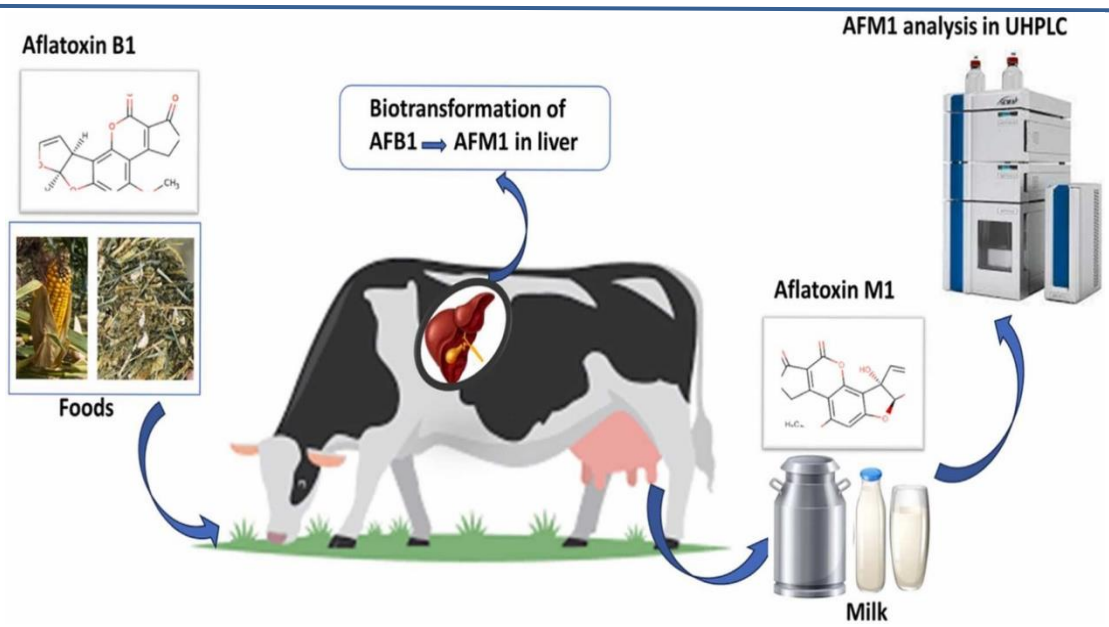

Figure 5: Biotransformation of AFB1 to AFM1.

Initially, the excreted amount of aflatoxin M1 in milk of dairy cows was estimated to represent 1-2% of the ingested aflatoxin B1. The extent of transfer from feed-to-milk (carry-over) is influenced by various nutritional and physiological factors, including:

1. Feeding regimes and rate of ingestion.
2. Rate of digestion.
3. Health of the animal.
4. Hepatic biotransformation capacity.
5. Actual milk production.

This implies that the rate of absorption of aflatoxin B1, and the excretion of aflatoxin M1 in milk varies between individual animals, from day to day, and from one milking to the next. In high yielding cows, the consumption of significantly higher amounts of concentrated feeds may result in carry-over percentages as high as 6.2%.

AFM1 is relatively stable in raw and processed milk products and cannot be destroyed by heat treatments or pasteurization.

There is a seasonal trend in mycotoxin levels in milk, with levels being higher in the cold months possibly due to the prolonged storage of feed which provides favorable conditions for mold growth. Therefore, good agricultural and storage practices are of fundamental importance in controlling the growth of mycotoxigenic molds and the production of mycotoxins.

Although aflatoxins (especially aflatoxin M1) are the most prevalent mycotoxins in milk and dairy products, other mycotoxins, such as fumonisin, ochratoxin A, zearalenone, T-2 toxin, and deoxynivalenol, can also be found in milk and dairy products.

e. Hormones:

Hormones are chemicals that act as signaling molecules in multicellular organisms that are sent to distant organs or tissues by complex biological processes to regulate physiology and behavior. Hormones are used in the livestock industry to:

- Increase productivity.
- Support medical treatments (prednisolone in combination with amoxicillin and clavulanic acid is used to treat mastitis in cows, being an access route of this contaminant to milk).

The fat-soluble characteristics of hormones favor their high persistence and presence in milk. Therefore, the supply of hormones to dairy animals represents a form of direct contamination that, like other contaminants, is excreted through milk. For this reason, the European Union banned the use of hormones.

The most common hormones found in cow's milk are 17β-estradiol and progesterone. These sex hormones are widely used for:

1. Inducing lactation.
2. Improving fertility
3. Synchronizing the estrous cycle.
4. Promoting growth.

The hormones less abundant in milk are testosterone, somatostatin, and cortisone.

The presence of hormonal residues in milk poses a risk to human health and leads to:

1. Hormonal disorders.
2. Increased risk of various types of cancer.