Microbiological Hazards in Pet Foods

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Nowadays, dogs are usually equally treated with other family members. Due to the growing caregivers' awareness, the pet foods industry is changing dynamically. Pet foods are manufactured with a myriad of ingredients. Few authors of scientific papers deal with the topic of foods products' safety for pet animals, assessed from the perspective of their caregivers. Despite the many methods of producing foods of the highest quality, there are still cases of contamination of pet foods and treats. In the case of dried chews for dogs, bacteria of the genus Salmonella are the most common risk. In the case of both dry and wet foods, in addition to many species of bacteria, we often deal with mold fungi and their metabolites, mycotoxins.

pet foods | dog chews | microbiological hazards | safety | mycotoxins | bacteria | RASFF notifications | European Union

1. Introduction

The companion animal population is increasing worldwide. According to statistics reported by the Fédération Cynologique Internationale (FCI), the approximate total number of dogs (pure-breed or not) around the world is about 147 million [1]. The nutrition of dogs mainly involves dry foods and their industry is still growing—the annual growth rate of the pet food industry (average value over the past 3 years) is 2.6% [2]. An increasing share of these impressive numbers of animal owners is becoming more aware of the nutritional needs of their animals. The constant demand from owners for better quality products means that the pet food sector is becoming particularly aware of providing nutritious food for animal health and welfare.

In the era of globalization, we deal with international trade and a constantly growing flow of goods. This allows animal diseases and zoonoses to spread around the world. Previously eradicated animal diseases risk reintroduction into the European Union (EU) as significant amounts of animal foods products from endemic countries are continuously imported into the EU, both legally and illegally [3][4][5].

In the EU, control over the safety of raw materials and food products is carried out by relevant authorities, including Rapid Alert System for Food and Feed (RASFF). As reported by RASFF [6], pet foods might be a significant source of many hazards associated with biological, physical or chemical agents in animal feed. These factors can cause illness or injury in pets in the absence of adequate production control.

Treats and chews are a regular part of our dogs' diet [7]. In addition to providing the basic portion of foods, caregivers often reach for it during training or when it is necessary to keep a pet busy for a while. It should be kept

in mind that these types of products should only be a small part of a dog's diet because excessive consumption of treats can lead to obesity and even nutritional imbalance. It should be mentioned that, according to the law, such products are classified as complementary products.

Dogs have a continual desire to bite and chew. If we do not provide pets with chews, they may damage home furnishings or elements in the garden or elsewhere. There is a trend in many countries to feed dogs and cats a raw meat-based diet and to include treats that are animal by-products [7][8]. This is mainly due to perceptions of the health benefits for pets and the belief that dried chews are of natural origin. Important aspects are their specific smell, as pets love aromas as well as taste and texture. This proves the taste of dried chews. However, are they really safe for pets?

Dog chews consist of animal by-products (ABPs) or derived products. ABPs are materials of animal origin that are not intended for human consumption or that humans do not consume [9]. Derivative products are products obtained from at least one treatment, transformation or processing step of ABPs.

Not only are chews produced from animal by-products, but also meat and bone meals, fish meals, blood meals, blood products, animal fats and pet foods.

Currently, there is a wide range of dried natural chews and treats in supermarkets. They are primarily from many species of animals—ears, the trachea, tendons, masseters and much more. Such chews are usually sold loose, "in pieces", without the original packaging. We do not know often their use-by date and storage time. These factors increase the risk of contamination of the products with pathogenic microorganisms. Raw dog foods are more likely to be contaminated because they are not subjected to rigorous processing procedures such as heating and sterilization. There is also a risk of dry foods, which can also become contaminated with bacteria after heat treatment [10].

2. Pet Foods—Contamination with Mycotoxins

It should be mentioned that not only chews can be a source of microbiological threats to dogs. Maintenance foods can also be dangerous, not only in terms of the presence of bacteria. More and more research is being conducted on the presence of mycotoxins in the foods of domestic animals. As reported by Pigłowski, mycotoxins were the most frequently reported hazard category in RASFF in 1981–2017. The largest number of notifications was related to aflatoxin B1 [11].

Mycotoxins are harmful metabolites of mold fungi that are found in various foods. Most mycotoxins belong to three types of fungi—*Aspergillus, Penicillium*, and *Fusarium*. The most disturbing substances are aflatoxins, vomotoxins, ochratoxins, zearaleon, fumonisin [12]. The large group of EU recommendations on safe levels in animal products only apply to three mycotoxins (Table 1).

Table 1. Guideline limit values for deoxynivalenol, zearalenone, ochratoxin A in pet products [13].

Mycotoxin	Pet Foods Product	Guide Value in mg/kg for a Feed with a Moisture Content of 12%
deoxynivalenol	cereals and cereal products with the exception of maize by-products	8
	maize-by products	12
	compound feed	5
zearalenone	cereals and cereal products with the exception of maize by-products	2
	maize-by products	3
	compound feed for adult dogs and cats other than those intended for reproduction	0.2
	compound feed for puppies, kittens, dogs and cats intended for reproduction	0.1
ochratoxin A	cereals and cereal products	0.25
	compound feed for dogs and cats	0.01

Mycotoxins are produced in cereal grains, as well as in fodder before, during and after harvesting in various environmental conditions [14]. In the case of cereals, it has been shown that most of the impurities are close to the surface of the grains. By removing only part of the outer layers of the grains, microbial contamination can be significantly reduced [15]. Research by Oliveira et al. [16] showed that metabolites of lactic acid bacteria (LAB) are a reliable alternative for reducing fungal infections before and after harvest.

The presence of mycotoxins in feed may reduce feed consumption and adversely affect the health of the animals [17][18][19]. Their presence can also cause inhibition of the total weight gain [20]. In addition, the possible presence of toxic residues in edible animal products such as milk, meat and eggs can have a detrimental effect on human health [21][22]. Contamination with fungi and their metabolites in the form of mycotoxins affects both the organoleptic properties and the nutritional value of the feed and carries the risk of poisoning. Studies have shown that a high percentage of feed samples are contaminated with more than one mycotoxin [23]. The effects of consumption of foods contaminated with mycotoxins depend on the amount of toxins present and the duration of exposure, as well as the individual sensitivity of the animals. Mycotoxins have a variety of chemical structures responsible for their various biological effects. Depending on their exact nature, these toxins can be carcinogenic, teratogenic, mutagenic, immunosuppressive, trembling, hemorrhagic, hepatotoxic, nephrotoxic and neurotoxic [24][25]. For example, aflatoxin B1 has a strong hepatotoxic effect, however, it has been shown that it can be minimized by supplementing the feed with curcumin [26]. Controlling the growth of mold fungi and the production of mycotoxins is very important for the feed producer and for the animals [27]. The study by Singh and Chuturgoon [28] aimed to compare the microbiological quality of standard feeds with premium feeds. These studies showed that regardless of the brand, all foods samples were contaminated with fungi (mainly *Aspergillus flavus*, *Aspergillus fumigatus* and *Aspergillus parasiticus*) and mycotoxins (most often aflatoxins and fumonisins). The obtained results

suggest that more expensive dog foods do not provide the highest quality, nor do they guarantee microbiological purity. On the other hand, research by Leiva et al. [29] has shown that in the case of dry feed, the extrusion process may be helpful in reducing the pathogenicity of microorganisms and does not affect the digestibility of the feed.

In another studies, an alarming presence of fumonisins in animal feed was found [30]. The simultaneous contamination of the feed with fumonisin fractions was also quite common. It should be kept in mind that toxins show a synergistic effect, especially since the coexistence of fumonisin with other *Fusarium* sp. toxins is a real possibility.

Studies by Witaszak et al. [31] confirmed the presence of five types of fungi-producing mycotoxins in the amounts permitted by EU regulations. However, the low level of mycotoxins in dog foods does not eliminate the risk and caution should be exercised because long-term daily consumption of even small amounts of mycotoxins can lead to slow damage to the animal's body and the development of many diseases, including cancer. The presence of mycotoxins in foods was confirmed by a study by Shao et al. [32]. Only one of 32 samples was free from mycotoxin contamination. Moreover, all other samples were contaminated with at least three different types of mycotoxins.

Analyses by Tegzes et al. [33] aimed to compare cereal and cereal-free dog foods in terms of their mycotoxin content. The test results confirmed the presence of mycotoxins in dry cereal dog foods, while in cereal-free foods they were not found. This study suggests that the risk of exposure to mycotoxins is higher with dry dog foods containing cereals. To minimize the risk, dog food manufacturers should choose grain types that are less susceptible to the presence of mycotoxins.

Cereals are usually the main component of veterinary foods, intended for dogs with various diseases that require safe and wholesome nutrition. Cereal grains can often be contaminated with *Fusarium* fungi, which can produce mycotoxins. In studies by Witaszak et al. [34], samples of veterinary feeds were examined for the presence of mold species and mycotoxins. Only 9.5% of the samples were free from mycotoxins produced by Fusarium, however, none of the tested samples exceeded the permissible limits of mycotoxin content in feed, as defined by EU regulations. This means that it is necessary to systematically test both domestic animal and veterinary feeds in terms of the content of harmful microorganisms and their metabolites, because especially veterinary feeds should be characterized by the highest level of safety for animals.

Studies by Macías-Montes et al. [35] showed that the presence of mycotoxins is quite common in dry dog foods. However, the concentrations of most of them are among the lowest reported so far. It was proven that the mycotoxin content was not influenced by the feed quality. Chronic exposure to mycotoxins and their hidden forms may prove problematic.

The results of Okuma et al. [36] research revealed a low incidence of aflatoxin and ochratoxin in commercial pet foods. Although deoxynivalenol has been detected in many trials, its levels were well below those that can cause acute toxic effects.

A study by Gazzotti et al. [37] showed that all samples of extruded complete dog foods were compliant with current European legislation on mycotoxin contamination. However, these results revealed the need for further research into the potential risks of chronic low-dose exposure to various types of mycotoxins to which pet species are currently exposed.

3. Conclusion

In summary, despite the many methods of detecting and preventing food contamination, there are still cases of bacterial contamination of both pet foods and treats, while in terms of the overall mycotoxin content, these products may appear safe. In order to minimalize the risk to the health of pets, the priority should be prevention, i.e. systematic testing of the raw materials and feeds, in terms of the content of harmful microorganisms and their metabolites. One form of simple risk reduction is, for example, leak testing of treat packages.

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