Carla Cristina Bauermann Brasil
(Organizadora)

4

ALIMENTOS, NUTRIÇÃO E SAÚDE

Atena Editora
Ano 2021

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APRESENTAÇÃO

A presente obra ‘’Alimentos, Nutrição e Saúde’’ publicada no formato *e-book*, traduz o olhar multidisciplinar e intersetorial da Alimentação e Nutrição. Os volumes abordarão de forma categorizada e interdisciplinar trabalhos, pesquisas, relatos de casos e revisões que transitam nos diversos caminhos da Nutrição e Saúde. O principal objetivo desse *e-book* foi apresentar de forma categorizada e clara estudos desenvolvidos em diversas instituições de ensino e pesquisa do país em quatro volumes. Em todos esses trabalhos a linha condutora foi o aspecto relacionado à avaliação antropométrica da população brasileira; padrões alimentares; avaliações físico-químicas e sensoriais de alimentos e preparações, determinação e caracterização de alimentos e de compostos bioativos; desenvolvimento de novos produtos alimentícios e áreas correlatas.

Temas diversos e interessantes são, deste modo, discutidos nestes volumes com a proposta de fundamentar o conhecimento de acadêmicos, mestres e todos aqueles que de alguma forma se interessam pela área da Alimentação, Nutrição, Saúde e seus aspectos. A Nutrição é uma ciência relativamente nova, mas a dimensão de sua importância se traduz na amplitude de áreas com as quais dialoga. Portanto, possuir um material cientifico que demonstre com dados substanciais de regiões específicas do país é muito relevante, assim como abordar temas atuais e de interesse direto da sociedade. Deste modo a obra "Alimentos, Nutrição e Saúde’’ se constitui em uma interessante ferramenta para que o leitor, seja ele um profissional, acadêmico ou apenas um interessado pelo campo das ciências da nutrição, tenha acesso a um panorama do que tem sido construído na área em nosso país.

Uma ótima leitura a todos(as)!

Carla Cristina Bauermann Brasil

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CAPÍTULO 12

MYCOTOXINS, A PROBLEMATIC AFFECTING FOOD SAFETY IN FOOD INDUSTRY FOR PETS WORLDWIDE

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ABSTRACT: The feeding of companion animals has some objectives of its own that differentiate it from that of other animals. In addition of providing a correct and balanced amount of nutrients, it should allow them to optimize their health, activity and longevity, since these are often considered as “family members” and are treated as such. Through different investigations it has been shown that the pet food can be contaminated with mycotoxins. These metabolites are produced by different fungal species which contaminate cereals and their derivatives, used as raw materials for the manufacture of these products. This has greatly favoured the risk of poisoning with these substances. Therefore, the pet food industry must ensure that the concentration of mycotoxins in its products remains below the established toxicological limits. It is known that the different stages of the pet food production process, cannot completely inactivate these fungal metabolites, so the best way to avoid contamination with fungal toxins is through prevention, however, it is often insufficient. Several alternatives have been sought to treat the contaminated grain. One of the most promising approaches to solve this problem is the addition of adsorbents materials, such as clay materials, activated carbon and yeast cell wall extracts. It should be noted that all these practices do not replace the need to use high-quality ingredients, from trusted suppliers, with established processing guidelines to avoid the production of mycotoxins.
KEYWORDS: pet food, mycotoxins, food safety, raw materials.

MICOTOXINAS, UM PROBLEMÁTICO QUE AFETA A SEGURANÇA ALIMENTAR NA INDÚSTRIA DE ALIMENTOS PARA ANIMAIS DE ESTIMAÇÃO EM TODO O MUNDO

RESUMO: A alimentação de animais de companhia tem alguns objetivos próprios que a diferenciam da de outros animais. Além de fornecer uma quantidade correta e equilibrada de nutrientes, deve permitir que eles otimizem sua saúde, atividade e longevidade, já que muitas vezes são considerados “membros da família” e são tratados como tal. Por meio de diferentes investigações, foi demonstrado que os alimentos

para animais de estimação podem estar contaminados com micotoxinas. Esses metabólitos são produzidos por diferentes espécies de fungos que contaminam os cereais e seus derivados, utilizados como matéria-prima na fabricação desses produtos. Isso tem favorecido muito o risco de intoxicação por essas substâncias. Portanto, a indústria de alimentos para animais de estimação deve garantir que a concentração de micotoxinas em seus produtos permaneça abaixo dos limites toxicológicos estabelecidos. Sabe-se que as diferentes etapas do processo de produção de rações, não conseguem inativar completamente esses metabólitos fúngicos, portanto a melhor forma de evitar a contaminação com toxinas fúngicas é através da prevenção, porém muitas vezes é insuficiente. Várias alternativas têm sido buscadas para tratar o grão contaminado. Uma das abordagens mais promissoras para resolver este problema é a adição de materiais adsorventes, como materiais argilosos, carvão ativado e extratos de parede celular de levedura. Deve-se observar que todas essas práticas não substituem a necessidade de usar ingredientes de alta qualidade, de fornecedores confiáveis, com diretrizes de processamento estabelecidas para evitar a produção de micotoxinas.
PALAVRAS - CHAVE: alimentos para animais de estimação, micotoxinas, segurança alimentar, matérias-primas.

INTRODUCTION

History of the dry pet food industry

Humans have fed, domesticated, and adopted dogs and cats for work and/or pleasure for thousands of years. Research mentions that dogs were in the company of humans for more than 30,000 years (Gomez et al. 2007). At beginning, their diet was very similar to that of their owners, and consisted of whatever food they could spare. But over the years, these animals became an integral part of homes, and scientific understanding of pet nutrition and food safety focused on their diet to protect their health. During the new millennium, dry pet food companies have continued to develop specific foods for different life stages, psychological states, and disease states (Arango, 2016).

World and Latin America market

Pets are part of the family in most homes around the world. More than half of people worldwide have a pet at home (57%), according to a global study conducted by GfK in 2016. Argentina, Mexico and Brazil present the highest rate of pet ownership, among 22 consulted countries, being the dogs the most popular pet in the three nations. Contrary, Asian countries have obtained the lowest percentages in terms of pet ownership (in more than 27,000 people, over 15 years of age, from 22 countries, belonging to the five continents).

Regarding the Latin American market, Brazil is the main producer and consumer in the sector (46%), followed by Mexico (20%) and Argentina (11%).

Despite the economic crises that Argentina has faced cyclically over the years, this topic is in continuous growth. Figure 1 shows the evolution in the sale of dry pet food from 2008 to the present.

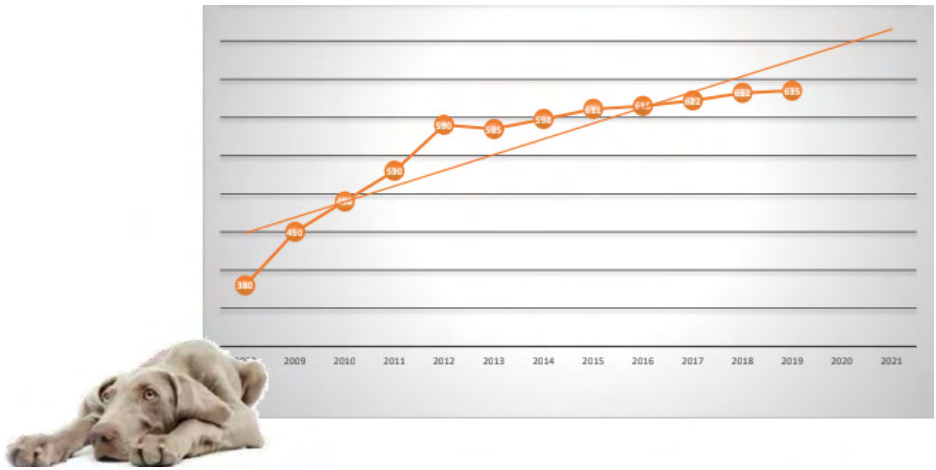

Figure 1. Tons of dry pet food sold in the last decade. Source: Argentine Chamber of Animal Nutrition Companies.

In the local market a very wide variety of products formulated according to the following criteria may be found:

- Age range: puppies, juveniles, adults, seniors.
- Breed requirements: size (small, medium, large), special breeds (Sheepdog, French Bulldog, Labrador, etc), activity (sedentary, active), etc.

But, the market segmentation is divided into the following categories based on the quality of the raw materials used in the formulation: Super Premium, Low Premium, Premium, Standard and Economy.

Technology of the production process during its elaboration

Dry pet foods are considered high fat, low moisture, and low water activity (a_w) products. When formulated without humectants or preservatives, these products have an a_w of 0.65 or less, and are generally coated with fat (beef or chicken fat) to improve palatability (Crane et al., 2000). At these low levels of a_w, dry pet foods are considered stable to microbial growth (Carrión and Thompson, 2014). However, as the main ingredients that compose it are cereals and their derivatives (corn, soy flour, wheat, rice, corn gluten, etc.) it is necessary to pay special attention to the contaminants that may be introduced into the food. The main risk posed by these ingredients are due to the possible contamination by mycotoxins, a topic that will be developed below.

Mycotoxins

Mycotoxins are fungal secondary metabolites that cause biochemical, physiological and pathological changes in other species, including animals, plants, microbes and even humans (Pleadin et al., 2019). The disease resulting from exposure to mycotoxins is called “mycotoxicosis”. These metabolites are capable of causing both acute (high dose of

mycotoxin, short-term exposure) and chronic (lower dose of mycotoxin, long-term exposure) toxic effects in humans and animals. Situation is to be considered since pets consume balanced food throughout their lives and these contaminants may cause a wide variety of mutagenic, carcinogenic, teratogenic, dermatotoxic, immunosuppressive, neurotoxic effects, among others, and can even be lethal. The target organs can be liver, kidneys, lungs, central nervous system and immune system. The degree of susceptibility of an organism depends on genus, age, diet, general health, the amount and type of mycotoxin, and the duration of exposure (Kabak et al., 2006; Pleadin et al., 2019).

The contamination of food with filamentous fungi producing mycotoxins and yeasts is the cause of great economic losses in the food industry throughout the world. The most colonized crops around the world are those of rice, corn, wheat, barley, oats, peanuts, cotton seeds and soybeans (Haschek and Voss, 2013).

Legislation on mycotoxins in dry pet food

Regulations regarding permissible concentrations of mycotoxins in animal feeds focus mainly on farm animals used for food production. While much of what is known about mycotoxins in animals is based on toxicological data demonstrating adverse effects in farm and laboratory animals exposed to naturally occurring concentrations of mycotoxins, there is perhaps even more concern for companion animals who are often maintained and fed for longer periods of time on a homogeneous, grain-containing diet and thus more likely to have chronic exposures to pet foods contaminated with either single mycotoxins, or multiple mycotoxins in various combinations (Böhm et al. 2010). Moreover, none of these studies have investigated the long-term chronic exposures that likely occur if pets are fed a contaminated feed over a typical lifespan (Leung et al. 2006).

More recently, following some scientific opinions provided by the European Food Safety Authority (EFSA), specific “guidance values” recommended for DON, ZEA, OTA, T-2, and HT-2 also referred to the compound feed intended for dogs or cats have been introduced (Grandi et al. 2019).

In Argentina there is no exclusive legislation for food for companion animals, but they are considered within the current regulations of SENASA resolution 594/15 “Technical Standard for Animal Food of the Argentine Republic” (http://www.senasa.gob.ar/normativas/resolucion-594-2015-senasa-servicio-nacional-de-sanidad-y-calidad-agroalimentaria).

Mycotoxin reports in dry pet food

In the last 20 years, some monitoring initiatives carried out in different parts of the world have revealed a significant presence of mycotoxins in the pet food samples analyzed. More specifically, the principal mycotoxins investigated were aflatoxins, fumonisins, deoxynivalenol (DON), zearalenone (ZEA) and ochratoxin A (OTA). Table 1 summarizes the main scientific works reported worldwide with the corresponding highlighted results and authors.

Location	Samples surveyed	**Analitical methods**	**Quantification limits (LOQs)**	**Mycotoxins detected**	**References**
Argentine	Raw materials and pelletized ready dog foods samples	HPLC	AFB_1: 0.1 μg/Kg FB_1: 0.02 μg/Kg	AFB_1 was detected only in wheat and soybean pelletized	FERNANDEZ JURI et al. 2009a
Argentine	260 samples of extruded commercial dog foods (standard, premium and super premium)	HPLC	AFB_1: 0.1 μg/Kg FB_1: 0.02 μg/Kg	AFB_1 was detected in 20 and 40% of premium and super premium puppy food samples, respectively. From 40 to 75% of the samples were contaminated with FB_1.	FERNANDEZ JURI et al. 2009b
Vienna, Austria	Seventy-six dry dog food samples from 27 producers	ELISA Kit	AFs: 1 μg/kg OTA: 2 μg/kg FUM: 50 μg/kg DON and ZEA: 25 μg/kg	DON was found in 83% of the samples (with median of 308 μg/kg). ZEA (47% positives) and FUM (42% positives) were also frequently detected in dog food. OTA was found only in 5% of the samples whereas AF were not detected in any sample.	BÖHM et al. 2010
Italy	41 dry dog food samples (32 complete and 9 complementary formulations)	HPLC-MS/MS	FB_1: 0.100 μg/g FB_2: 0.005 μg/g	FB_1 and FB_2 were quantified in 63.4 and 56.1% of the samples, respectively. The range of FB_1 + FB_2 was between 150 and 8800 µg/kg. Two samples (one complete and one complementary dog food), containing 5190 and 8800 µg/kg of FB_1 + FB_2, respectively.	PAGLIUCA et al. 2011
South Africa	60 dog food samples	HPLC	Not mentioned	87% of the samples were positive for AFs (mainly AFB_1 and AFB_2): mean of 248 µg/kg, FUM were detected in 98% of the samples: mean of 1556 µg/kg. OTA was detected in 68% of the samples (mean of 13.7 µg/kg). ZEA was detected in 96% of the samples (mean value of 354 µg/kg).	MULUNDA et al. 2013
China	420 feedstuff samples	HPLC with fluorescence detection	Not mentioned	The incidence of T-2, ZEA and FB_1 was 79.5%, 85.2% and 96.1%, respectively; levels detected ranged from 10-735, 35-1478 and 20-6568 μg/kg, respectively.	WANG et al. 2013

Poland	25 dog and 24 cat food samples	HPLC-MS/MS	DON: 20 μg/kg T-2 toxin: 1.5 μg/kg HT-2 toxin, FUM: 5 μg/kg ZEA: 0.10 μg/kg	DON and ZEA were detected in all samples. T-2 and HT-2 toxins were present in 88% and 84% of the samples, respectively. Two samples contained FUM. AFB_1 and OTA were detected in 8% and 45% of the samples, respectively.	BLAJET-KOSICKA et al. 2014
Poland	6 commercial dry foods for growing dogs	HPLC-MS	Not mentioned	All assayed substances were present in all products, however in small amounts. The average content of DON, ZEA, α-ZEL and β-ZEL were 11.2, 2.6, 5.3 and 3.9 μg/Kg, respectively.	HOLDA and GŁOGOWSKI 2014
Italy	48 samples of complete extruded dry dog foods	UPLC-MS/MS	DON and FB_1: 1 μg/Kg AFB_1 and AFB_2: 0.5 μg/Kg AFG_1, AFG_2, FM_2 and OTA: 2 μg/Kg ZEA: 5 μg/Kg	DON was found in 100% of the samples; AFB_1 and AFG1 not detected; AFB_2 and AFG_2 detected in 4% and 8% of the samples, respectively; FUM and OTA in 88% and 81% of the samples, respectively	GAZZOTTI et al. 2015
EU, the UK and Korea	510 commercially pet food samples of cat and dog	HPTLC	AFB_1, AFG_1, OTA: 0.1 ng/g AFB_2, AFG_2: 0.5 ng/g	Among all total analyzed samples, 28.82% (n = 147) samples were found positive for AFB_1, 5.80% of AFB_2 and 21.37% for OTA. However, neither cat food nor dog food was found contaminated for AFG_1 and AFG_2	TAHIRA et al. 2015
Egypt	20 pet food (5 wet dog foods, 5 wet cat foods, 5 dry dog foods, 5 dry cat foods)	ELISA kit	AFs: 5 μg/kg AFB_1: 1 μg/kg OTA: 2.5 μg/kg ZEA: 1.75 μg/kg	15% of the samples were positive for AFB_1 (max 18.4 µg/kg); OTA was detected in most of the samples (max 6.65 µg/kg); ZEA was measured in 20% of the samples at levels between 148 and 1170 µg/kg	ABD-ELHAKIM et al. 2016
Parana State, Brazil	100 dry dog feed samples	HPLC	FB_1: 45.8 μg/kg FB_2: 58.8 μg/kg ZEA: 6.08 μg/kg AFB_1: 0.32 μg/kg AFG_1: 0.15 μg/kg AFB_2: 1.09 μg/kg AFG_2: 0.48 μg/kg	Despite the high frequency of FUM (68%), ZEA (95%) and AFs (68%) in feed samples, the mean levels detected were low.	BISSOQUI et al. 2016

South Africa	20 dry dog foods	HPLC	Not mentioned	All the samples were positive for FUM; OTA and ZEA were detected in most of the samples at very low concentrations; AFs were identified in all the samples with relatively high concentrations of AFB_1	SINGH and CHUTURGOON 2017
Brazil	87 feed samples intended for dogs (included standard, premium and superpremium quality)	HPLC	Not mentioned	FUM (FB_1+FB_2) were detected in 77.6% Standard followed by Premium (72%) and Super Premium (42.9%) feed samples. ZEA levels in most feed samples (90.1%) were below 50 μg/kg. Concerning total AFs (AFB_1 + AFB_2 + AFG_1 + AFG_2): Standard feed samples showed the highest mean levels (1.29 μg/kg), which differed significantly from the Premium (0.49 μg/kg) and Super Premium feed (0.53 μg/kg)	TEXEIRA et al. 2017
USA	58 dogs, cats, birds, and rabbits Pet food samples	ELISA and HPLC-MS/MS to confirm	AF: 0.02 μg/kg OTA: 0.05 μg/kg DON: 0.5 μg/g	OTA was detected in one rabbit pet food and AFs were detected in two samples. DON was detected in 74% of samples. One rabbit sample tested positive for both OTA and DON.	OKUMA et al. 2018
China	32 dry dog food samples of different commercial brands	HPLC-MS/MS	DON: 16.5 μg/Kg AFG_1: 0.7 μg/Kg AFB_1: 1.7 μg/Kg CIT: 3.3 μg/Kg FB_1: 10 μg/Kg T-2 toxin: 3.3 μg/Kg OTA: 10.7 μg/Kg ZEA: 2.5 μg/Kg BEA: 0.2 μg/Kg	Only one sample was free of contamination. All the other samples (96.9%) contained at least three mycotoxins. DON, ZEA, AFB_1, FB_1, CIT, and BEA displayed a relatively high occurrence (78.1, 62.5, 87.5, 93.8, 68.8, and 96.9%, respectively). T-2 toxin was found in only one sample (15.4 µg/kg) and OTA in two samples (15.1 and 17.3 µg/kg).	SHAO et al. 2018
Italy	64 extruded cat foods	UPLC-MS/MS	ZEA: 5 μg/Kg DON, FUM and AF_1: 3 μg/Kg T-2 toxin: 10 μg/Kg HT-2 toxin: 20 μg/Kg	DON and FUM were the most common contaminants (quantified in 80 and 95% of the samples, respectively). Conversely, AFB_2, AFG_1, and AFG_2 were not identified in any sample.	GRANDI et al. 2019

Southern California	60 samples of dry and wet dog foods	HPLC-MS/MS	AFB_1, AFB_2, AFG_1 and AFG_2: 1 μg/g DON, FUM, T-2 toxin and HT-2 toxin: 0.1 μg/Kg OTA: 2 μg/g ZEA: 20 μg/g	None of the total samples tested had concentrations above the detection limits for AFB_1, AFB_2, AFG_1, AFG_2, HT-2 toxin, OTA, or T-2 toxin	TEGZES et al. 2019
Poland	42 samples (which consisted of 17 veterinary diets for cats and 25 veterinary diets for dogs)	HPLC	ZEA: 1 ng/g FB_1: 2 ng/g DON and NIV: 10 ng/g	ZEA was detected in 69% (range, 1.22-51.7 µg/kg), DON in 52% (24.87-2451 µg/kg), FB_1 in 33% (4.89-80.13 µg/kg), and NIV in 26% (17.43-200 µg/kg) of the samples.	WITASZAK et al. 2019
Canary Islands (Spain)	60 packages of pelleted dry food for cats and 62 packages of pelleted dry food for dogs	UPLC-MS/MS	AFs = 0.025 ng/g OTA: 0.1 ng/g FUM: 2.5 ng/g T-2 toxin: 0.2 ng/g HT-2 toxin: 0.1 ng/g DON: 5 ng/g ZEA: 0.04 ng/g	AFB_1, HT-2 toxin, DON, and FB_1 and FB_2 were detected in 100% of the samples analyzed.	MACÍAS-MONTES et al. 2020

Table 1. Studies on the incidence of the main mycotoxins present in pet food.

AFs: aflatoxins; AFB_1: aflatoxin B_1; AFB_2: aflatoxin B_2; AFG_1: aflatoxin G_1; AFG_2: aflatoxin G_2; FUM: fumonisins; ZEA: zearalenone; ZEL: zearalenol; DON: deoxynivalenol; OTA: ochratoxin A; CIT: citrin; BEA: beauvericin; NIV: nivalenol; HPLC: high-performance liquid chromatography; UPLC-MS/MS: ultra-performance liquid chromatography (UPLC) coupled with tandem mass spectrometry; ELISA: enzyme-linked immunosorbent assay.

Mycotoxins and the production process of dry pet food

Most of these mycotoxins found in pet food are chemically and thermally stable compounds. Once mycotoxins are formed in the feed ingredients, efforts must be made to ensure detoxification during processing and/or prevent mycotoxicosis without compromising the nutritional quality of the pet food (Atungulu et al. 2018). It has been shown that extrusion cooking can lead to a reduction in the mycotoxins levels present in cereals such as corn, wheat and rice (Castells et al. 2005) but not their elimination. The rate of reduction of the mycotoxin concentration in a finished product depends on several factors including the initial concentration and group of mycotoxins, the temperature of the extruder, the speed and type of screw, the moisture content of the extrusion mixture, the residence time inside the extruder and the use of additives. Among these factors, extrusion temperature and residence time appear to have the greatest effect. The greatest reductions in mycotoxin concentrations in extrudates occur at temperatures of 160 °C (or higher) and long residence times (Bullerman et al. 2007). Unfortunately the extrusion process to obtain dry pet food does not reach the necessary temperature to obtain a significant destruction of mycotoxins.

In other words, the temperature in the extruder does not exceed 130 °C since the availability of proteins, vitamins and other thermolabile nutrients could be affected.

Prevention strategies applied to dry pet food

Mycotoxin contamination of grains (used as raw material for the elaboration of dry pet food) can occur during the pre- or post-harvest stages due to the application of inappropriate agricultural practices (Kabak et al. 2006; Neme et al. 2017). At present it is not feasible to completely eliminate products contaminated by mycotoxins, therefore, it is important that grain producers are aware that good agricultural practices are the first line of defense against contamination of cereals by mycotoxins, followed by good manufacturing practices during the handling, storage and distribution of cereals intended for human and animal consumption.

Methods used by the pet food industry to prevent mycotoxicoses include processing techniques, nutrient supplementation, use of mycotoxin adsorbent, and microbial inactivation. Contamination levels in most cereal-based pet food ingredients can be reduced by sieving, washing, and pearling techniques. Broken, malformed, and immature kernels, as well as dust and other materials, tend to promote fungal growth and mycotoxin contamination. The use of sieves to remove unwanted grain fractions can significantly prevent mycotoxin contamination (Geetanjali, 2013). Successful mycotoxin reduction has also been achieved by washing methods. A wash treatment may require the moistened product to dry, which could mean additional expense; this can have significant financial consequences for pet food manufacturers. Peeled or sequential removal of the outer portions of the kernels by abrasive pearling procedures has also been used to decrease mycotoxins. Other processing techniques to prevent mycotoxin contamination in pet food include ozonation and the addition of acid-based fungal inhibitors (benzoic, acetic, sorbic, and propionic acid) (Atungulu et al. 2018).

The effectiveness of the use of nutritional supplements, especially neutral amino acids, antioxidants, and polyunsaturated fatty acids has been reported to manage mycotoxin-induced tissue damage and altered behavior. In many circumstances, there are still numerous clinical feeding trials that need to be conducted to determine the efficiency of using these dietary supplements to treat mycotoxicoses in pets.

The most common strategy to mitigate the exposure of animals to mycotoxins is to reduce the bioavailability of these toxins by incorporating various detoxifying agents in the feed in order to reduce their absorption and distribution through the bloodstream to vulnerable organs. Mycotoxin adsorbing agents are high molecular weight compounds that are not digested by the animal and are excreted in the faeces. The two most widely studied categories of mycotoxin sequestrants include hydrated calcium sodium aluminosilicate and silicate minerals (HSCAS) (Amer et al. 2018). Other minor categories include activated charcoal, cholestyramine, chlorophyllin, and yeast cell wall derived agents (EFSA, 2009).

Silicate minerals comprise the largest class of mycotoxin sequestering agents and include bentonites and zeolites. The latter are widely used because they have a high degree of ion exchange capacity and are primarily effective against aflatoxins. The disadvantage of most of these mycotoxin sequestering agents include the fact that they only absorb specific mycotoxins, require a high inclusion rate in animal feed, can cause other health complications, or are too expensive for industrial applications. In contrast, polymers containing naturally occurring glucomannan extracted from yeast cell wall may have some merits for practical use in the pet food industry. Glucomannan has a high adsorption capacity to bind to a combination of different mycotoxins; this, together with low inclusion rates, make them attractive for preventing mycotoxicosis in the pet food industry (Jard et al. 2011).

The use of some microorganisms, such as lactic acid bacteria and bifidobacteria, has been shown to prevent mycotoxicosis in pet food (Muhialdin et al. 2020). These bacteria have the ability to reduce the bioavailability of aflatoxins by binding them through peptidoglycans and polysaccharides in the bacterial cell wall. Saccharomyces cerevisiae yeast can reduce the bioavailability of mycotoxins. The presence of beta-D-glucans in the yeast cell wall has been correlated with the elimination of mycotoxins such as zearalenone, aflatoxin B_1, deoxynivalnol and ochratoxin A.

In the Argentine market, dry products for pets are currently for sale (regardless of whether they are dogs or cats, puppies or adults), where some of the ingredients mentioned above are declared among the components. The vast majority are present in products in the super premium segment.

CONCLUSIONS

Good processing techniques, sequestering agents, nutritional supplementation, and microbial inactivation methods used to prevent mycotoxicoses in pet food should not replace the need to use high-quality ingredients to avoid the presence of these metabolites in such feeds. The procurement of ingredients from the point of supply, prior to procurement, and subsequent storage and handling methods significantly affect their quality. It is important to purchase ingredients from trusted suppliers, with established processing guidelines, to avoid mycotoxin production in source products. In the case of ingredients of plant origin, several strategies could be used for plantations, ranging from (1) the selection of varieties of crops resistant to mycotoxin-producing fungi; (2) proper production practices, such as the correct choice of planting and harvest dates, crop rotation, plant population, irrigation, and sanitation schemes to limit the proliferation of mycotoxin-producing fungi, and (3) the appropriate application of chemicals for crop protection or biological controls to mitigate mycotoxin production.

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