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Occurrence and Levels of Vomitoxin in Commercial Quail Feed Assessed by ELISA

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Abstract: *The objective of this study was to quantitatively assess the concentrations of vomitoxin in feed samples intended for quails using an ELISA-based analytical approach. Vomitoxin was detected in 9 out of 12 samples (75%), with concentrations ranging from 0.320 mg/kg to 2.525 mg/kg and an average value of 1.075 mg/kg. All measured concentrations complied with the relevant regulatory limits established in Commission Recommendation 2006/576/EC concerning the presence of deoxynivalenol, zearalenone, ochratoxin A, T-2 and HT-2 toxins, and fumonisins in feed products.*

I. INTRODUCTION

Safe and high-quality feed is an integral part of the food chain and plays an important role in the growth, welfare, and productivity of livestock, and consequently in the composition and quality of animal products (milk, meat, and eggs). Complete feed is produced, among other things, mainly from a mixture of raw materials of plant origin and is formulated to achieve several objectives in animals, primarily related to health and performance [1]. One of the biggest challenges faced by farmers and the feed industry is the presence of microscopic filamentous fungi in forage and subsequently in compound feed. The presence of microscopic fungi affects the quality of feed, its organoleptic properties, and its nutritional value [2]. Microscopic filamentous fungi, like other microorganisms, assimilate and utilize the most readily available nutrients in the substrates on which they grow. Deterioration of feed by microscopic fungi can lead to a significant loss of nutrients [3]. Regarding the nutritional quality of feed, nutrients such as proteins, carbohydrates, fats, and mineral elements are essential for the proper development and growth of animals. The amount and nutritional requirements of feed depend on the weight and age of the poultry, as well as on the season. Healthy poultry require a sufficient amount of energy and nutrients in feed mixtures, the main component of which is cereals [4].

In addition to their detrimental effects on the nutritional and organoleptic properties of feed, certain species of microscopic filamentous fungi are capable of producing various mycotoxins [5]. Contamination of animal feed with mycotoxins can adversely affect animal health and performance, and may also pose risks to human health through the transfer of residues into animal-derived products (milk, eggs, and meat). The ingestion of feed and food contaminated with mycotoxins can result in acute or long-term chronic diseases [6]. In general, mycotoxins

exert negative effects on the organism and are characterized by carcinogenic, mutagenic, teratogenic, and estrogenic properties [2]. Thus, mycotoxins represent a significant threat to animal health and productivity and reduce the safety of food of animal origin. The most important mycotoxins in agricultural systems include aflatoxins, deoxynivalenol (vomitoxin), zearalenone, ochratoxin A, T-2 toxin, and others [7].

Vomitoxin, also known as deoxynivalenol, is a secondary metabolite produced by microscopic fungi of the genus Fusarium. It is the most widespread mycotoxin found in cereals such as wheat, rye, barley, maize, and oats, as well as in cereal by-products. Recent surveys have shown that vomitoxin is the most common feed contaminant in Europe [8]. Poultry are generally considered less sensitive to vomitoxin compared with other animal species. At low concentrations, the main clinical manifestation is reduced feed intake (anorexia), whereas higher doses result in significant weight loss and decreased resistance to infections, particularly bacterial infections. A key aspect of vomitoxin toxicity, similar to that observed in other species, is its detrimental effect on the gastrointestinal tract. Vomitoxin affects intestinal morphology, particularly in the duodenum and jejunum, as evidenced by alterations in the structure of intestinal villi, which may ultimately impair nutrient absorption [9].

The aim of this study was to determine the presence and concentrations of vomitoxin in 12 samples of complete feed mixtures intended for quails using ELISA immunoenzymatic analysis.

II. Material and Methods

Sample collection and preparation

Quail feed samples (500 g each) were obtained from various feed vendors and private breeders. The samples were stored in a dry and cool place. The sample preparation itself before ELISA analysis was carried out as follows: 10 g of each quail feed sample was homogenized by grinding and mixed with 100 ml of distilled water. Subsequently, the samples were mixed on a shaker (Orbital Shaker – Biosan) for 3 minutes and filtered through Whatman 1 filter paper. The obtained filtrates (with a minimum volume of 5 ml) were diluted with distilled water in a ratio of 1:2 and used for quantitative determination of vomitoxin concentrations using an ELISA kit.

ELISA analysis

The assay was conducted in a microtiter plate following the Veratox for DON 5/5 protocol (Lansing, USA). The absorbance values of the individual samples were measured spectrophotometrically at 650 nm using an ELISA microplate reader (Dynex Technologies, Inc., Chantilly, USA). A standard curve was generated from the absorbance values of the calibration standards and subsequently used to determine the precise concentration of vomitoxin in mg/kg (ppm).

Data analysis

The statistical functions of the MS Excel program were used to evaluate average value.

III. Results and Discussion

Of the 12 analysed samples of complete feed mixtures for quails, vomitoxin was detected in 9 samples, corresponding to an incidence rate of 75%. The maximum vomitoxin concentration determined by ELISA analysis was 2.525 mg/kg, while the minimum concentration measured was 0.320 mg/kg. On average, the samples contained 1.057 mg/kg of vomitoxin (Table 1). According to the Commission Recommendation on the presence of deoxynivalenol, zearalenone, ochratoxin A, T-2 and HT-2 toxins, and fumonisins in products intended for animal feeding (2006/576/EC), the guideline value for deoxynivalenol (vomitoxin) is 5 mg/kg. It should be emphasized that the vomitoxin concentrations in the quail feed samples analysed in this study did not exceed the guideline limits specified in the aforementioned Commission Recommendation [10].

Vomitoxin is frequently detected in poultry feeds, and poultry are generally considered relatively tolerant to its adverse effects on growth and performance parameters [11]. According to several studies, the inclusion of 5 mg/kg of vomitoxin, the guideline value established by Commission Recommendation 2006/576/EC did not

negatively affect the growth performance of broiler chickens [12,13]. These findings may indicate a degree of physiological adaptation of birds to mycotoxins and further suggest that poultry exhibit greater tolerance to vomitoxin compared with other species, particularly pigs, due to differences in the absorption, distribution, metabolism, and elimination of this toxin [14]. The lower sensitivity of poultry to vomitoxin may also be attributed to their ability to metabolize the compound into the less toxic deoxynivalenol-3-sulfate [8].

Table 1. Concentrations of vomitoxin (mg/kg; ppm) in complete feed for quails

Monitored parameters	Samples of quail feeds
Total number of samples	12
Number of positive samples	9
Incidence (%)	75
Maximum concentration (mg/kg)	2,525
Minimum concentration (mg/kg)	0,320
Average concentration (mg/kg)	1,075

In the present study, vomitoxin was detected in 9 out of 12 analysed samples of quail feed, corresponding to an incidence rate of 75%, with concentrations ranging from 0.320 mg/kg to 2.525 mg/kg. However, in a comparable study investigating the occurrence of mycotoxins in quail feed mixtures, a 100% incidence of aflatoxin B_1 was reported in three examined samples, with concentrations ranging from 56.20 µg/kg to 93.70 µg/kg [15]. According to Filazi et al. (2017), aflatoxins are also among the most frequently detected mycotoxins in poultry feed mixtures, and poultry exhibit high sensitivity to their toxic effects [16]. Aflatoxins induce a variety of detrimental outcomes in poultry, including reduced weight gain, poor feed conversion, decreased egg production, and lower egg weight, among others [17].

IV. Conclusion

Mycotoxins represent a multifaceted threat to poultry production. In addition to impairing growth and overall health, they also compromise the safety of animal-derived food products. The wide diversity of mycotoxins, the environmental factors that influence their occurrence, and their potential to act synergistically with infectious pathogens underscore the necessity for comprehensive and integrated control strategies within the poultry industry. Effective prevention requires a combination of routine feed monitoring, adherence to good agricultural and storage practices, and the application of mycotoxin adsorbents to reduce the adverse effects associated with mycotoxin exposure.

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