Mycotoxins in Soybean Feedstuffs Used in Germany
H. Valenta*, S. Dänicke¹ and A. Blüthgen²

1, Institute of Animal Nutrition, Federal Agricultural Research Centre (FAL), Bundesallee 50, D-38116 Braunschweig, Germany
2, Institute for Hygiene and Food Safety, Federal Dairy Research Centre Kiel (BafM), Hermann-Weigmann-Str. 1, D-24103 Kiel, Germany
*, Corresponding Author

Abstract
Fifty samples of soybean meal – 25 of them samples of high-protein soybean meal - and one sample of soybean hulls obtained from the feed industry in Germany were analysed for the mycotoxins aflatoxins, deoxynivalenol (DON), zearalenone (ZON) and ochratoxin A (OTA). Additionally, 4 samples of high protein soybean meal which were suspected of containing high mycotoxin levels were analysed. Aflatoxin B₁ (AFB₁) was detected in 32 of the 51 non-suspicious samples but the maximal concentration was only 0.41 µg/kg. DON could not be detected in any of the non-suspicious samples. ZON was detected in 23 of the 51 samples with a maximal concentration of 18 µg/kg. It was present in 18 of 25 samples of soybean meal and in the sample of soybean hulls but only in 4 of 25 samples of high-protein soybean meal. This finding suggests that ZON is mainly located in the hulls of soybeans, because high-protein meal does not contain hulls. OTA was found in 4 samples, with the greatest concentration detected being 1 µg/kg.

All of the four suspicious samples of high protein soybean meal contained high ZON concentrations of up to 363 µg/kg. The contamination with other mycotoxins was on the same order of magnitude as in the case of the non-suspicious samples.

Keywords: mycotoxins, soybean meal, aflatoxin B₁, deoxynivalenol, zearalenone, ochratoxin A

Introduction
Soybean meal is widely used as a protein source for human consumption as well as for mixed feeds. Mycotoxin contamination of soybeans is not considered as a significant problem as compared to commodities such as corn, cottonseed, peanuts, barley and other grains. This assessment is mainly based on surveys about contamination of soybeans with aflatoxins which suggested that soybeans were not a good substrate for aflatoxin production [1].

Only little is known about contamination of soybeans and soybean products with mycotoxins other than aflatoxins. In damaged soybeans, zearalenone, deoxyniva-
lenol, diacetoxyiscirpenol, T-2 toxin and HT-2 toxin were detected, partly in high concentrations [1,2]. ZON also was detected in soybean produced in Korea, the average level in positive samples was 8 µg/kg [3].

In the present study, soybean meal used in the feed industry in Germany was analysed for the most important mycotoxins aflatoxins, deoxynivalenol, zearalenone and ochratoxin A.

Materials and Methods

Materials
Fifty five samples of soybean meal – 29 samples of them high-protein soybean meal - and one sample of soybean hulls were obtained in the year 1999 mainly from the feed industry in Germany. Four samples of high-protein soybean meal were suspected of containing high levels of mycotoxins. Forty four samples originated from Brazil, 3 samples from Argentina, the origin of the remaining samples was not known.

Methods

AFB1, AFB2, AFG1 and AFG2
The samples were extracted with chloroform, the extracts were purified by GPC (gel permeation chromatography) and immunoaffinity columns (IAC) and aflatoxins were determined by HPLC (high performance liquid chromatography) with post-column derivatisation and fluorescence detection according to [4]. The detection limit of all aflatoxins was 0.03 µg/kg.

DON
The samples were screened by ELISA (Ridascreen® Fast-DON, r-Biopharm, Darmstadt, Germany) with a detection limit of 110 µg/kg. The positive samples were analysed by HPLC with DAD (diode array detector) after a clean up with IAC (DONtest HPLCTM, VICAM, Watertown, USA) according to a modified method of VDLUFA (Verband Deutscher Landwirtschaftlicher Untersuchungs- und Forschungsanstalten) [5] as described in [6]. The detection limit was 50 µg/kg.

ZON
The samples were screened by ELISA (Ridascreen® Zearalenon, r-Biopharm, Darmstadt, Germany) with a detection limit of 1.3 µg/kg. Positive samples with ZON concentrations greater than 3 µg/kg were analysed by HPLC with fluorescence detection after clean up with IAC (ZearalaTestTM, VICAM, Watertown, USA) according to a slightly modified method of VDLUFA [5]. The detection limit was 2 µg/kg.

OTA
The samples were analysed by HPLC with fluorescence detection after clean up with liquid-liquid-extraction according to a modified method of [7]. Positive samples and samples with uncertain results were re-analysed using a clean up with IAC (OchrarepTM, Coring System Diagnostix, Gernsheim, Germany) according to the test description of Coring (extraction by acetonitrile-water). The detection limit was 0.2 µg/kg.