APPLIED AND ENVIRONMENTAL MICROBIOLOGY, Oct. 1979, p. 749-750
0099-2240/79/10-0749/02$02.00/0

Vol. 38, No. 4

Incidence of Zearalenol (*Fusarium* Mycotoxin) in Animal Feed†

C. J. MIROCHA,[1]* B. SCHAUERHAMER,[1] C. M. CHRISTENSEN,[1] M. L. NIKU-PAAVOLA,[2] AND M. NUMMI[2]

Department of Plant Pathology, University of Minnesota, St. Paul, Minnesota 55108,[1] and Biotechnical Laboratory, Technical Research Center, Helsinki, Finland SF-00121[2]

Received for publication 12 July 1979

Zearalenol, the reduction product of zearalenone produced by *Fusarium roseum* growing in cereals, was found for the first time naturally occurring in oats and corn. This metabolite is three to four times more active estrogenically than zearalenone.

Zearalenone is a fungal estrogen produced by *Fusarium roseum* growing in corn which causes hyperestrogenism in swine when ingested in their diet (1). Typical signs of hyperestrogenism in swine include tumefaction of the vulva, swelling of the mammae in prepubertal gilts, and enlargement of the uterus; a more serious consequence is infertility. In some years the incidence of this affliction in swine herds ingesting corn is very high. When feedstuff associated with animals showing these signs is analyzed, most often zearalenone, diethylstilbestrol, or both can be found in significant amounts. At times, however, no signs of this estrogen could be found in such feedstuff, and the cause remained unknown. Recently, we analyzed samples of oats and corn used as animal feedstuff and found zearalenol, a reduction product of zearalenone, which is the subject of this report (Fig. 1).

In the fall of 1978, we received from Finland a sample of oats suspected of being contaminated with mycotoxins. Surface disinfected kernels (NaOCl) of the oats plated on acidified PDA agar media yielded many colonies of *F. roseum* and *Fusarium tricinctum*. We also received from New York a sample of corn associated with porcine hyperestrogenism and refusal of feed by swine; no attempt was made to isolate fungi from the sample. Using the method of Mirocha et al. (2), we analyzed the samples of oats and corn for zearalenone, zearalenol, diacetoxyscirpenol, and deoxynivalenol (Table 1). The alpha isomer of zearalenol (naturally occurring diastereomer), along with other *Fusarium* mycotoxins (zearalenone and deoxynivalenol), was present in both samples in significant amounts (0.15 to 4.0 μg/g). The identity of all of the metabolites was confirmed by mass spectroscopy (LKB-9000) after resolution by gas chromatography. The metabolites were resolved as their respective trimethylsilyl ether derivatives on a 3% OV-1 column (1 m by 3 mm) with a temperature program of 8°C/min ranging from 150 to 250°C. Deoxynivalenol is a trichothecene (3) and has been implicated in the refusal of feed by swine

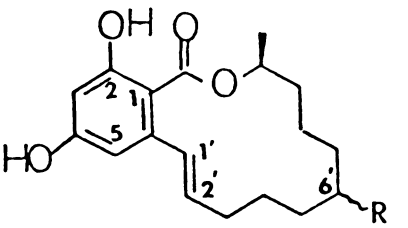

FIG. 1. *Structure of zearalenone (R=O) and zearalenol (R = OH) produced by F. roseum in stored oats.*

TABLE 1. *Concentrations of Fusarium mycotoxins in feedstuff*

Mycotoxin	Concn (μg/g) in:		
	Oats, sample 1[a]	Oats, sample 2[a]	Corn[b]
Zearalenone	25.0	135.0	18.00
Zearalenol[c]	1.5	4.0	0.15
Deoxynivalenol	0.0	5.0	1.00

[a] Sample obtained from Marja-Leena Niku-Paavola and M. Nummi from Biotechnical Laboratory, Technical Research Center, Helsinki, Finland.

[b] Sample obtained from Monica Crispin, Department of Plant Pathology, Cornell University, Ithaca, N.Y.

[c] Zearalenol is about three times more active than zearalenone; accordingly, its biological activity is equivalent to 4.5, 12, and 0.45 μg/g, respectively, of zearalenone.

† Paper no. 10,788, Scientific Journal Series, Agricultural Experiment Station, St. Paul, Minn.

and as causing emesis in swine. It is also a potent inhibitor of protein synthesis.

Zearalenol is three to four times as active, estrogenically, as zearalenone, and its presence in these samples may help explain outbreaks of estrogenism in the absence of zearalenone. Until we obtain more data regarding quantities of zearalenol likely to be encountered, we cannot evaluate its significance in the estrogenic syndrome, but it seems reasonable to suggest that analyses of suspect feed samples should include tests for zearalenol and zearalenone.

LITERATURE CITED

1. **Mirocha, C. J., and C. M. Christensen.** 1974. Oestrogenic mycotoxins synthesized by *Fusarium*, p. 129–148. *In* I. F. H. Purchase (ed.), Mycotoxins. Elsevier Scientific Publishing Co., Amsterdam.
2. **Mirocha, C. J., B. Schauerhamer, and S. V. Pathre.** 1974. Isolation, detection, and quantitation of zearalenone in maize and barley. J. Assoc. Off. Anal. Chem. **57**:1104–1110.
3. **Yoshizawa, T., and N. Morooka.** 1977. Trichothecenes from mold-infested cereals in Japan, p. 309–321. *In* J. V. Rodricks, C. W. Hesseltine, and M. A. Mehlman (ed.), Mycotoxins in human and animal health. Pathotox Publishers, Inc., Park Forest South, Ill.