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Effects of Deoxynivalenol on Feed Consumption and Body Weight Gains in Mink *(Mustela vison)*

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Under favorable environmental conditions, certain molds or fungi that grow naturally on plants, grains, or feedstuffs in storage produce secondary metabolites known as mycotoxins. The trichothecene mycotoxins are a group of chemically related compounds which are synthesized primarily by *Fusarium spp.* A common naturally-occurring trichothecene found in cereal grains such as corn and wheat is deoxynivalenol [3α,7α,15-trihydroxy-12,13-epoxytrichothec-9-en-8-one; (DON, vomitoxin)]. DON is produced by *Fusarium graminearum* in temperate climates in years that are cool and wet at the time of harvest (Cote *et al.* 1984). DON was identified as an emetic and feed refusal factor in *Fusarium*-infected corn (Vesonder *et al.* 1976). Subsequent studies identified swine as being particularly sensitive to the feed refusal effect of this mycotoxin (Forsyth *et al.* 1977) while cattle and poultry are relatively tolerant (Trenholm *et al.* 1984).

Because a portion of the diet of ranch-raised mink is cereal, there has been concern about the potential contamination of their feed by mycotoxins. However, little work has been done with DON in terms of its effects on mink. In a preliminary trial conducted in our laboratory, rice inoculated with *Fusarium graminearum* R6576 to result in production of DON as well as zearalenone (Z) was incorporated into mink diets (Cameron *et al.* 1989). Dietary concentrations ranged from 0.625 ppm DON plus 0.407 ppm Z to 2.5 ppm DON plus 1.628 Z. There was a dose-dependent decrease in feed consumption during the first week of the trial, but a reversal of this trend during the subsequent 21 days. The present report describes a similar trial in which mink were exposed to DON through the incorporation of naturally-contaminated wheat into their diets to determine the effects on feed consumption and body weights. A second trial was conducted to determine if mink would display a dietary preference when given a choice between DON-contaminated feed and clean feed.

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MATERIALS AND METHODS

In the first trial, 32 adult female pastel mink were randomly allocated into 4 groups of 8 mink per group. Following a 1 week acclimation period, animals were placed on dietary treatments on October 9, 1991 for a period of 28 days. The control group was fed the basal diet consisting of 35.8% water, 22.4% commercial mink cereal, 22.4% poultry by-products, 17.9% fish by-products, and 1.5% ground uncontaminated wheat. Proximate analysis of the basal diet yielded 59.4% moisture, 5.9% fat, 12.9% crude protein, 1.5% crude fiber, and 3.5% ash (Litchfield Analytical Services, Litchfield, MI). The other 3 treatments consisted of a basal diet to which ground DON-contaminated wheat was added as a replacement for the uncontaminated wheat in amounts which resulted in actual DON concentrations of 0.28, 0.62, and 1.18 ppm. The mink were housed individually in an indoor animal room in wire cages (76 cm L x 61 cm W x 46 cm H) suspended above the floor. The photoperiod was regulated to simulate natural light conditions. Temperature in the room approximated ambient temperature. Ventilation was provided by an exhaust fan. Food and water were available *ad libitum*. Feed consumption was recorded daily and body weights were recorded weekly.

In the second experiment, which examined the ability of mink to distinguish between DON-contaminated feed and clean feed, 8 additional adult female pastel mink were provided with a choice between non-contaminated feed and feed containing progressively lower concentrations of DON. The diets used were the same as those described for Experiment 1. Each concentration of DON (1.18, 0.62, and 0.28 ppm) was tested for a 2-week period beginning on October 14, 1991. The 2 feed containers containing DON-contaminated feed and clean feed were rotated daily in each cage to prevent a positional bias. The mink were housed and maintained as described above. Feed consumption was recorded daily and body weights were recorded weekly.

Feed consumption data are presented as mean grams of feed consumed/kg body wt/day for each treatment on a weekly basis. Body weights are presented as weekly means for each treatment. Where appropriate, differences between control means and treatment means were tested by use of Student's "t" test (Gill 1978). Statements of significance are based on $p < 0.05$.

RESULTS AND DISCUSSION

The incorporation of DON-contaminated wheat into the diets of adult female mink had no significant effect on feed consumption or body weights over the 28-day trial period (Tables 1 and 2). During the first week, mink fed the 1.18 ppm DON diet consumed 24% less feed than controls, but this reduced intake was transitory. Examination of data for individual animals (data not shown) indicated a degree of variability in feed consumption between animals in the same group as well as for the same animals over a period of time. This was particularly true for the 1.18 ppm DON group in that one animal consistently ate very little of the contaminated diet while other animals would consume a limited amount of feed for 2 or 3 days, consume a large amount of feed for 1 day, and then again limit consumption for the next 2 to 3 days. Casual observation indicated that animals did not waste food.

Table 1. The effect of dietary DON on feed consumption of adult female mink.

	Feed consumption[1] (gm/kg body weight/day)			
Treatment	Week 1	Week 2	Week 3	Week 4
Control	182 ± 10	170 ± 7	152 ± 7	175 ± 9
0.28 ppm	174 ± 12	165 ± 12	136 ± 16	179 ± 13
0.62 ppm	189 ± 13	183 ± 8	140 ± 8	156 ± 6
1.18 ppm	138 ± 17	177 ± 8	141 ± 11	171 ± 12

[1] Data presented as mean ± standard error. Sample size is 8.

These results are similar to those reported for other species. Trenholm *et al.* (1984) reported that swine can consume diets containing as much as 2 ppm DON without serious health implications although a transitory decrease in feed consumption and body weight gain occurred. In the same study, poultry and dairy cattle tolerated up to 5 and 6 ppm DON, respectively, with only a slight effect on feed consumption. Pollman *et al.* (1985) reported that feed intake of swine was reduced when DON concentrations in the diets approached or exceeded 1 ppm. At concentrations of 1 ppm, the decrease in consumption was transitory while pigs consuming diets containing in excess of 2 ppm DON displayed a markedly reduced consumption as long as they were on treatment. Rats fed diets containing 4 and 8 ppm DON ate less food only on the first day of exposure, after which consumption was comparable to that of the control animals (Clark *et al.* 1987).

When mink were given a choice between clean feed and DON-contaminated feed, there was an obvious preference for the non-contaminated diet (Table 3). Consumption of the 1.18 and 0.62 ppm diets accounted for only 21% of the total daily intake of feed while 30% of the total daily consumption was of the 0.28 ppm DON diet. As with the first trial, individual variability was apparent. There was one animal

Table 2. The effect of dietary DON on body weights of adult female mink.

Treatment	Body weight (gm)[1]				
	Initial	Week 1	Week 2	Week 3	Week 4
Control	984 ± 10	1002 ± 17	1007 ± 24	990 ± 24	1007 ± 25
0.28 ppm	997 ± 30	1009 ± 38	1001 ± 37	951 ± 34	959 ± 32
0.62 ppm	1021 ± 37	1077 ± 35	1128 ± 40	1084 ± 44	1105 ± 39
1.18 ppm	995 ± 25	941 ± 15	941 ± 23	912 ± 20	914 ± 25

[1] Data presented as mean ± standard error. Sample size is 8.

that consistently showed a preference for the DON-contaminated diets and some animals would occasionally alternate between the two sources. Body weights of the mink increased by 9% over the 42-day test period (Table 4).

Table 3. Feed consumption of adult female mink given a choice between control feed and DON-contaminated feed.

Treatment	Days on trial	Feed consumption[1] (gm/kg body wt/day)
Control	1-14	117 ± 11
1.18 ppm		31 ± 11[2]
Control	15-28	147 ± 6
0.62 ppm		38 ± 6[2]
Control	29-42	112 ± 5
0.28 ppm		47 ± 9[2]

[1] Data presented as mean ± standard error. Sample size is 8.
[2] Significantly different from the respective control value at $p < 0.05$.

In a similar trial conducted with chickens, Hamilton *et al.* (1986) reported that birds given a choice between clean feed and feed containing contaminated wheat which provided DON concentrations of 0.35, 0.70, 1.4, and 4.5 ppm consumed on the average 14, 27, 17, and 27% less of the contaminated feed, respectively. Birds provided a choice between a diet containing 1.4 ppm purified DON ate 31% less feed than controls. These authors indicated that there were individual birds that showed a preference for the diet containing DON as well as birds that displayed a bias toward the position of the feed container. When the same population of birds was subsequently provided clean feed or feed containing 4.5 ppm DON, there was no difference in feed consumption between the control group and the treatment group. Clark *et al.* (1987) provided rats a choice between a control diet and a diet containing 8 ppm DON derived from contaminated corn. They reported that animals consumed less total feed on day 1 compared to subsequent days but the food choice ratio was not significantly different.

Table 4. Body weights of adult female mink given a choice between clean feed and DON-contaminated feed.

Body weight (gm)[1]				
Initial	Day 9	Day 23	Day 37	Day 43
1032 ± 35	1042 ± 44	1107 ± 58	1119 ± 59	1126 ± 63

[1] Data presented as mean ± standard error. Sample size is 8.

In summary, mink given a choice between clean feed and DON-contaminated feed displayed a preference for the clean feed at DON concentrations as low as 0.28 ppm. However, when no choice was available, mink readily consumed feed containing DON at concentrations as high as 1.18 ppm with no apparent ill effects. In comparing mink with other species, the present study suggests that mink are close in sensitivity to swine and more sensitive to DON than rats and chickens. It should be acknowledged, however, that feed containing contaminated grain could have a variety of mold metabolites in addition to the mycotoxin of interest which are contributing to the observed effects. Thus, species differences in sensitivity could simply reflect differences in the composition of the contaminated grain.

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