AFLATOXIN B_1 IN CORN SILAGE

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Nineteen piles and bunk silos of corn silage were sampled in late fall of 1976 and early spring of 1977. These samples were assayed for aflatoxin B_1, a potent mycotoxin, using a newly developed procedure. No aflatoxin B_1 (<5 ug/kg) was detected in any of the 270 samples of corn silage.

Every year the Veterinary Diagnostic Laboratory receives numerous requests for evaluation, for safety of feeding, of moldy feeds and silages. The production of toxins in a moldy feed is classically demonstrated in sweet clover poisoning (1). Mycotoxins (toxins produced by molds), however, may also be produced by mold action on other grains and forages (2, 3). The most important mycotoxins related to livestock health problems are aflatoxin, zearalenone, and T-2 toxin (3).

Aflatoxin B_1 is a potent carcinogen and toxin which is produced by *Aspergillus flavus* (a storage mold), often on damaged or high moisture corn. The growth of *Aspergillus flavus* on corn requires adequate moisture (18-20%) and a temperature of 12 to 42°C (optimum at 37°C) (4). Consumption of aflatoxin by livestock may lead to acute losses, but the greatest economic threat probably occurs in cases of chronic aflatoxicosis. In chronic aflatoxicosis there may be a reduction of feed efficiency, reduced disease resistance, reduced daily gain, rough hair coat, anemia, mild icterus, and eventually depression and anorexia (2).

The legal limit for total aflatoxins in food for human consumption is 20 ug/kg food. In livestock feeds the legal limit is not defined, but it appears that levels below 100 ug/kg feed will probably have no toxic effect (3).

In the spring of 1976 we analyzed two shelled corn samples from North Dakota which contained approximately 120 ug/kg aflatoxin B_1. These samples showed that aflatoxin could be formed in this climate. Other reports indicated the possibility of aflatoxins in corn silage (6). Therefore, we initiated a survey for aflatoxin B_1 in corn silage.

Procedure

Nineteen silage piles in Cass, Ransom, and Richland counties were sampled in October and November of 1976 and during March and April of 1977. Approximately 270 samples were collected from bunk silos and silage piles. Samples were collected from the top layer (5-10 cm thick, moldy), middle layer (15-25 cm thick, moldy), and the good quality silage (non-moldy). At the time of sampling, the silage pH and temperature were measured. The samples were frozen until just prior to analysis when they were dried (60°C) and ground (20 mesh). Protein content of the non-moldy corn silage was determined by a commercial laboratory*.

Attempts to use two of the existing aflatoxin procedures (7, 8) with corn silage were unsuccessful and the extracts were unsatisfactory for quantitative analysis. A new procedure was developed (9) which had an estimated detection limit of 5 ug/kg corn silage. The average recovery of aflatoxin B_1 from silage samples spiked to 20 and 85 ug/kg was 73 ± 8 per cent.

Results and Discussion

No aflatoxin B_1 (less than 5 ug/kg corn silage) was detected in 270 samples collected from 19 silage piles. On the basis of this survey it appears unlikely that moldy corn silage, in North Dakota, contained toxic levels of aflatoxin B_1 during the 1976-1977 feeding season. A long-term survey for aflatoxin in corn silage will be continued on samples which are sent in for veterinary diagnostic services. The Department of Veterinary Science will also be working on the assays for T-2 toxin and zearalenone to enable a broader assay for potential mycotoxins in moldy feedstuffs.

On the basis of the pH, temperatures, and moisture content of the silage piles (See Table 1), conditions were favorable for the growth of *Aspergillus flavus*. Although it is not certain why no aflatoxin was formed, it is possible that other molds in the silage interfered with the aflatoxin formation (4). What effect the weather (1976 was a drought year) could have had on the possible formation of aflatoxin in corn silage is also unknown.

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TABLE I. SILAGE MEASUREMENTS[1]

Silage Layer	% Protein Dry Wt. Basis	pH	Per Cent Moisture	Temperature °C.
Moldy Top Layer	—	8.3 ± 0.9 (110)	66 ± 13 (110)	24.5°C. ± 6.6[2]
Moldy Middle Layer	—	8.3 ± 0.8 (72)	30 ± 8 (72)	—
Non-Moldy Layer	8.4 ± 1.2 (19)	4.0 ± 0.3 (114)	66 ± 6 (114)	53.7 ± 12.0[3]

[1]*Number of replicates in brackets*
[2]*Five cm. into the silage pile*
[3]*Sixty cm. into the silage pile*

REFERENCES

1. Schipper, I.A. and H. Casper; **Sweet Clover Poisoning**. North Dakota State University Circular V-608; April 1976.
2. Buck, W. B., Osweiler, G. D., and G. A. Van Gelder, 1976. **Clinical and Diagnostic Veterinary Toxicology**. Kendall/Hunt Publishing Company.
3. Christenson, C. M., Mirocha, D. J., and R. A. Meronuck, 1977. **Molds, Mycotoxins and Mycotoxicoses**. Miscellaneous Report 142-1977. Agricultural Experiment Station, University of Minnesota.
4. Diener, U. L., and N. D. Davis, 1969. **Aflatoxin formation by** *Aspergillus flavus*. *In* "**Aflatoxin**" (L. A. Goldblatt, Ed.) p. 13-46. Academic Press, New York and London.
5. Allcroft, R. 1969. **Aflatoxicoses in Farm Animals.** *In* "**Aflatoxin**" (L. A. Goldblatt, Ed.) p. 237-264. Academic Press, New York and London.
6. College of Veterinary Medicine, Iowa State University — **Personal Communications** — Dr. H. M. Stahr.
7. Romer, T. R. 1975. **Screening method for the detection of aflatoxin in mixed feeds and other agricultural commodities with subsequent confirmation and quantitative measurement of aflatoxin in positive samples.** J.A.O.A.C., Vol. 58, p. 500-506.
8. Shannon, G. N. and O. L. Shotwell, 1975. **A quantitative method for determinations of aflatoxin B_1 in roasted corn.** J.A.O.A.C., Vol. 58, p. 743-745.
9. Haggblom, P. E., 1978. **Aflatoxin B_1** in Corn Silage. M.S. Thesis, North Dakota State University, Fargo, North Dakota.

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for periodic reevaluation of our personal resources and capabilities to assure that our productive skills are sensitive to and capable of changing with the trends. Keeping abreast of changes in technology, and prudently applying and adapting appropriate new technologies and procedures for our specific needs will assist in improving our competitive position. The agricultural experiment station is a key resource in providing information, demonstrations, techniques, and new genetic materials for the enhancement of North Dakota's agricultural industry. The cooperative extension service provides an affiliated educational system to facilitate communication and transfer of current relevant information. Working together they can assist materially in improving North Dakota's life style.

Our foreign visitors frequently comment that the partnership of state and federal support for research and extension has contributed to the outstandingly successful agricultural industry in the United States. However, the partnership is being eroded by new policies being implemented at the federal level. The federal share of research funds at the agricultural experiment stations has been reduced relatively over the past several years to a point where they now represent only 22% of the support of the main Agricultural Station. We expect this trend to continue. Moreover, the attitude in Washington is to restrict or deny federal funds for projects which primarily benefit a state or region; let the state support its special interests. This philosophy ignores the fact that food is rarely consumed where it is produced; food research applied in rural regions provides benefits for both rural and urban people.

A second attitude that is currently prominent encourages competitive research; this sounds like a great idea. However, funds for competitive research projects were taken from the long-term Hatch Funds which historically have supported work at the State Agriculture Experiment Stations. Additionally, the subjects for competitive research grants were selected and the competition restricted to those pre-selected topics. This action has a serious impact on the smaller research teams such as ours. The currently popular topics, photosynthesis and human nutrition, are not areas where our research workers have a history of refereed publications. In short, by these standards currently employed, we are not competitive in these current topics. Consequently, we are faced with a dilemma. Should we continue research emphasis on North Dakota's problems? Or, should we change our goals and become competitive in the subjects selected as national research goals? Because our research efforts have led to development of new varieties of hard red spring wheat, durum wheat, barley, potatoes, sunflower, etc., plants which are widely adapted to our climate and accepted by our farmers, we will for the foreseeable future continue to direct our research efforts to meet North Dakota's perceived research needs.

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Indeed, how many wheat, barley, or other small grains have we grown in North Dakota that were developed by the major universities which emphasize basic research? The record shows that more than 95% of the acreage of most small grains was planted with varieties produced by the plant breeding team at the North Dakota Agricultural Experiment Station. Consequently, as a research institution, we plan to move slowly in adapting the new federal research agenda.

Other changes have occurred which we look forward to with anticipation. With this issue of *Farm Research* we introduce a new director of the North Dakota Agriculture Experiment Station and dean of the College of Agriculture. Dr. H. Roald Lund grew up on a North Dakota farm, graduated from North Dakota State University with B.S. and M.S. degrees in agronomy and with a Ph.D. in agronomy from Purdue University. Returning to NDSU, he taught agronomy and conducted research on corn when he was selected as assistant, later associate, dean and director. Roald succeeds Arlon G. Hazen who has accepted a regional experiment station position after leading our station for 22 years. H. Roald Lund brings to his new position knowledge of the state, enthusiasm for research, and a strong desire to succeed in this new task. We wish him well!

As we go into a new year, a new administration, and a new legislative session, one thing remains certain.

The value of the North Dakota Agricultural Experiment Station, the Extension Service, and the NDSU College of Agriculture to the people of North Dakota will continue to increase, meriting their continued support and trust.