

Moldy Silage Syndrome: The Economic Impact on Dairy Farms

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**How many mycotoxins
can you name?**

There are 500 of them!

Mycotoxin sources to ruminants



(Source: Purcell mountain Farms)

Fusarium mycotoxins



Ergot mycotoxins



Fusarium mycotoxins

Molds and Mycotoxins in Dairy Feed

Silage mycotoxins



Fusarium mycotoxins



Fusarium mycotoxins



The Major Mycotoxins



Field Fusarium mycotoxins

- *Deoxynivalenol
- *Zearalenone
- *T-2 Toxin
- *Fumonisin
- Moniliformin
- Nivalenol
- Diacetoxyscirpenol
- *Fusaric Acid



Storage Penicillium mycotoxins

- Ochratoxin
- *PR Toxin
- *Patulin
- *Penicillic Acid
- Citrinin
- Penitrem
- Cyclopiazonic acid

Deoxynivalenol (DON) or vomitoxin

**Fusarium graminearum or roseum
and also labeled Gibberillium**



Pink Ear Rot



Scab on Wheat
USDA

Animal Symptoms

- Change in feed intake
- Digestive disorders
- Diarrhea
- Reduced performance
- Weight loss

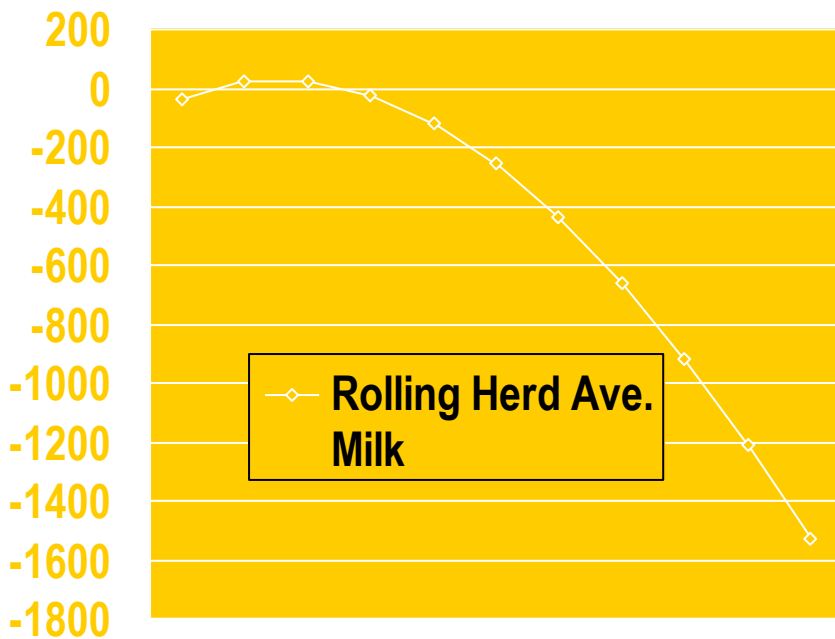
Relationship of deoxynivalenol to change in rolling herd average milk

300 HERDS 50,000 COWS

Deoxynivalenol level in Concentrate, ppb

100 300 500 700 900

Rolling Herd average Milk, Lb.



* $P < 0.05$



Whitlow et al. 1991. North Carolina State University, 1982-1983

Effect of DON on ruminal protein synthesis

Duodenal Flow of:	Control	DON 3.1 ppm
Crude Protein, g/day	1180	950
RUP, g/day	225	186
Microbial Protein, g/day	862	680
Metabolizable Protein, g/day*	1091	871

Danike et al., 2005 J Animal Physiol. and Animal Nutrition 89:303-315.

*** 20% less MP**



Zearalenone



Estrogenic effects

Competes with estrogen for binding sites

(Hidy et al., 1977. Adv Appl Microbiol 22:59-82)

Reduces reproductive performance/conception

(Weaver et al., 1986. Am J. Vet Res. 47:1395)

Sheep - prolapse

(Bennetts, 1946. Aust. Vet J 22:2)

Bulls - Reduced semen quality

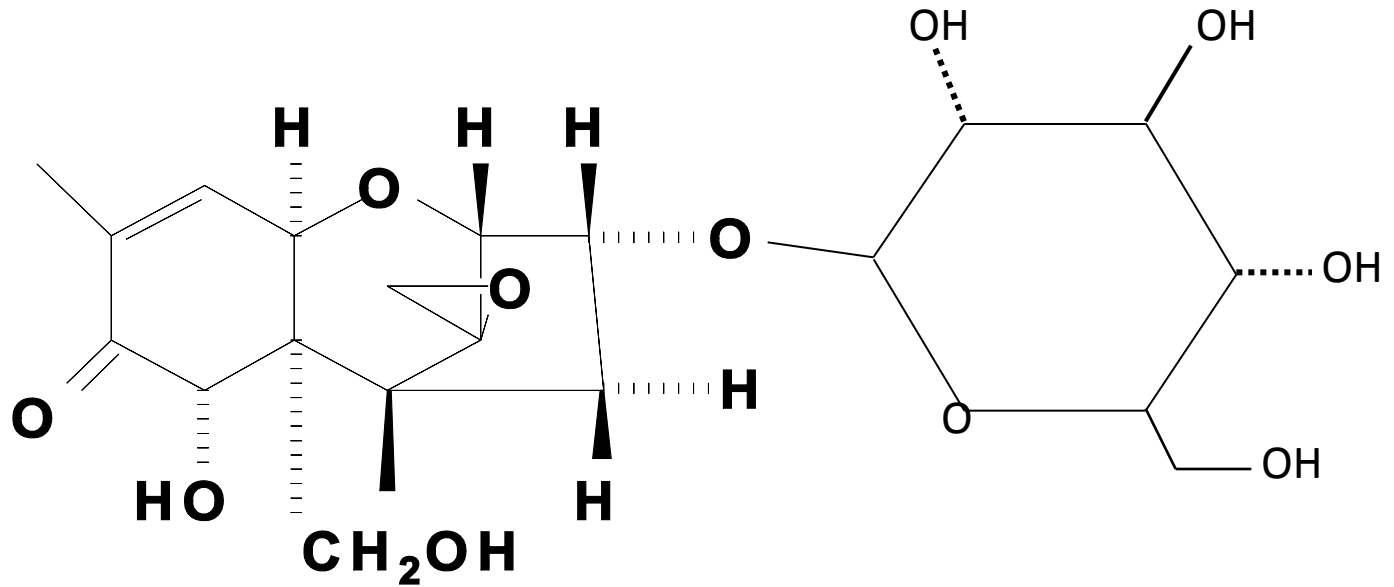
(Deschamps, 1987. Am. J. Vet. Res. 48:137)

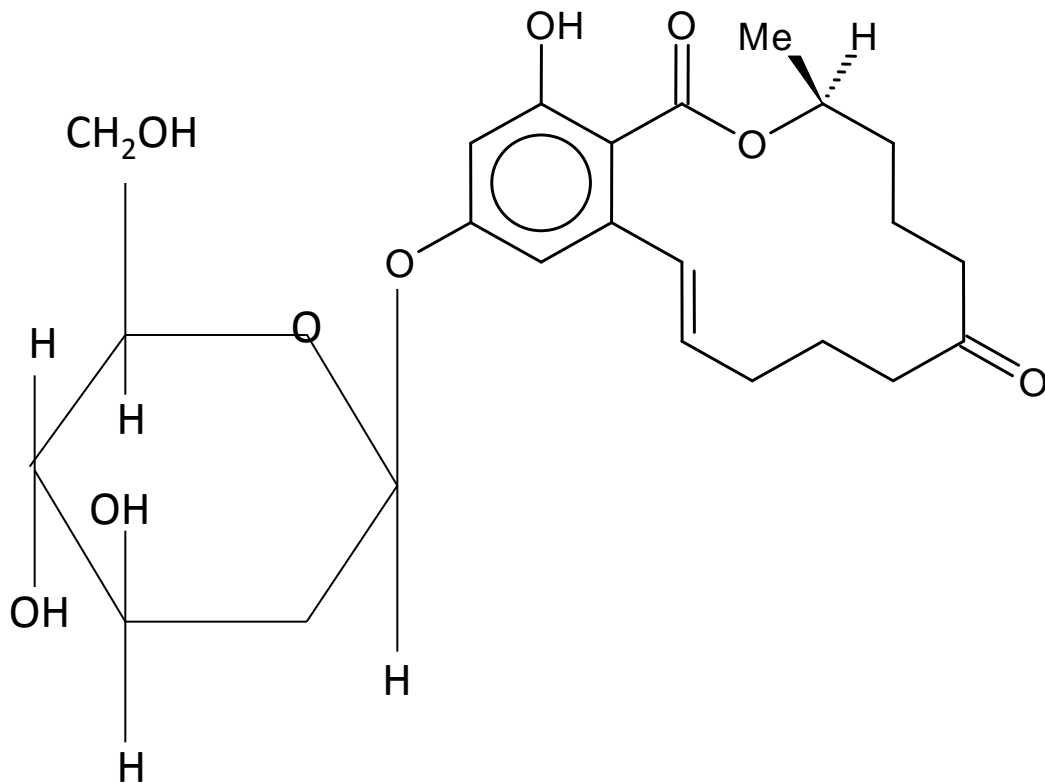
Heifers - Accumulation of fluid in udder of virgin heifers

(Bloomquist, 1982. J.A.V.M.A. 180:164)



Structure of masked DON (DON-3-glucoside)





**Structure of Masked zearalenone
(Zearalenone-4-beta-D-glucopyranoside)**

Silage/Haylage mycotoxins



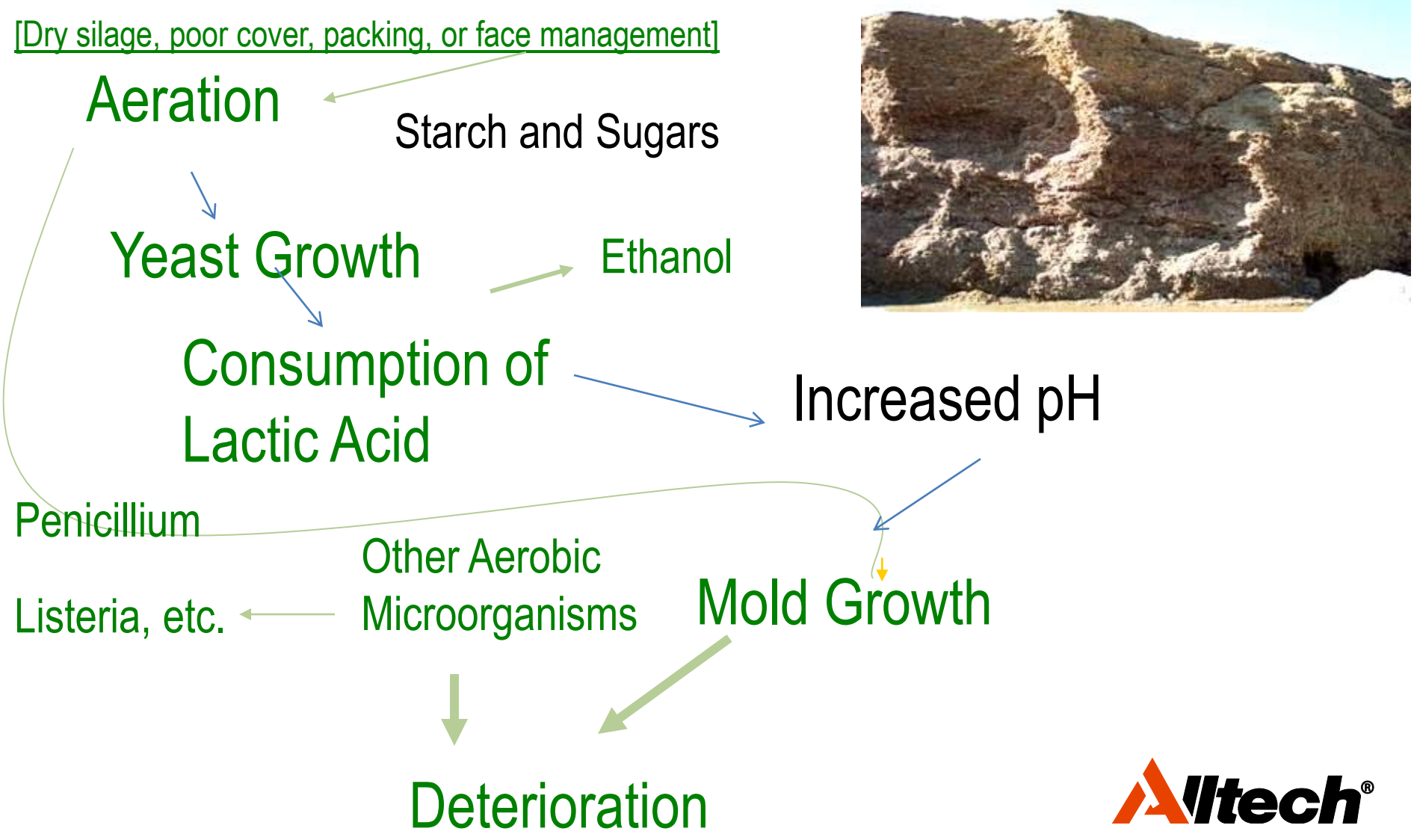
Penicillium molds – the most common organisms in silage or big bales



Penicillium spp.
are micro-aerobic
& acid tolerant



Mycotoxin Formation in Silage

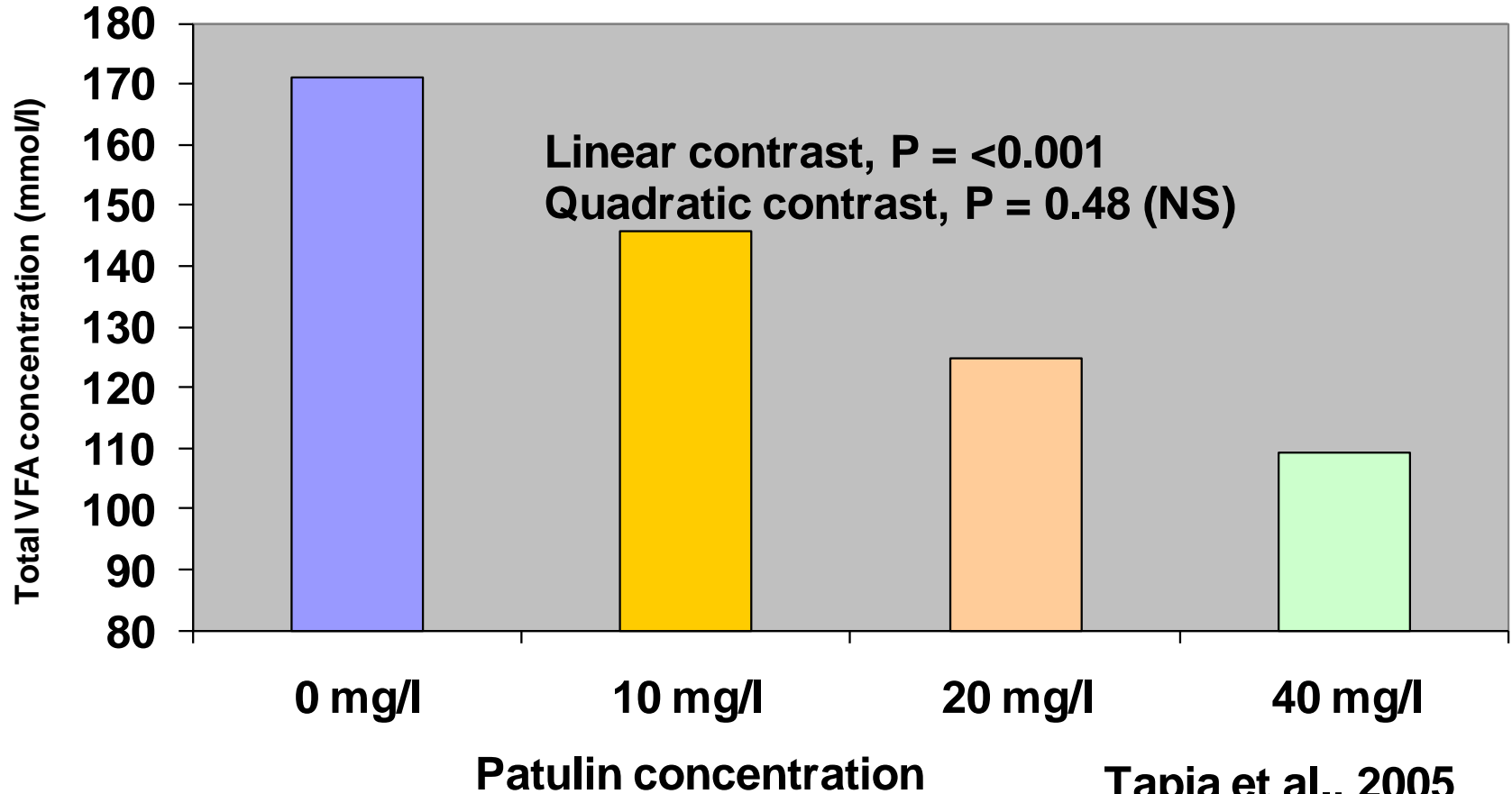


Selected *Penicillium* Mycotoxins



- **PR Toxin** - Related to reduced intake, rumen stasis, intestinal irritation, abortion and retained placenta in dairy cattle. A marker for problem silages (Seglar).
- **Roquefortine C** - Implicated in toxic silage.
- **Mycophenolic Acid** - Implicated in toxic silage.
- **Patulin** - A common mycotoxin in silage. Affects ruminal fermentation. Has been implicated in deaths of cows (Lacey), but has received limited study.
- **Ochratoxin** - Kidney Toxin, toxic to calves, but less toxic to mature (functional) ruminants.

Effect of graded levels of patulin on Total VFA production in fermenters



Typical effects



Oxidative stress

Liver damage

Ketosis

Impairment of fatty acid metabolism

Rapid Response Program Results

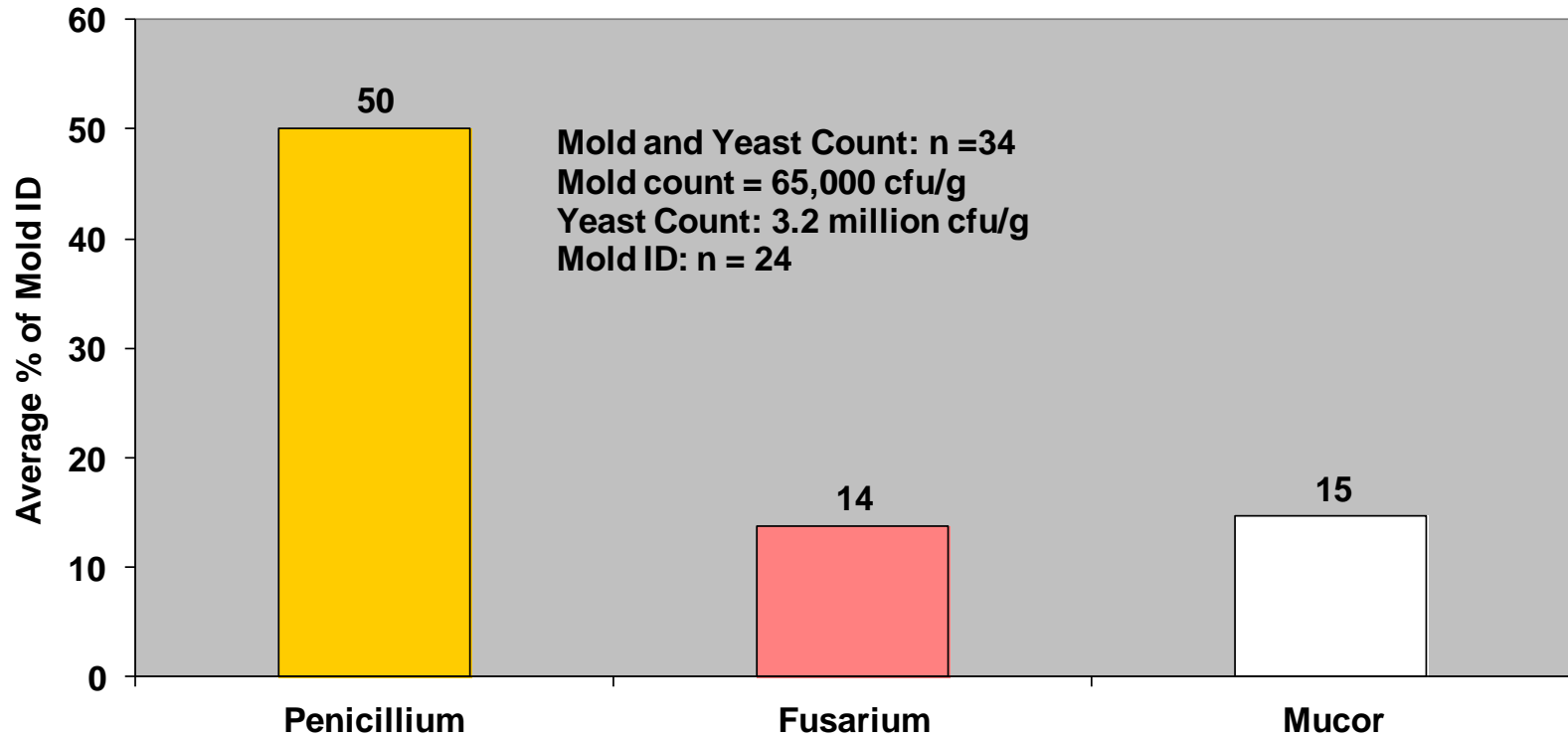
1. Mold Interpretation

GMP suggest anything more than 10,000 cfu/g can be a concern

2. Yeast interpretation

Caution advised: >1,000,000 cfu/g

Mold and Yeast Counts and Mold Identification in Silages (2008-2009)



Sampling Error

- Taking a representative sample from silage or grain lot is very important
- 85% of error in mycotoxin or mold analysis comes from sampling!
- So analysis is just an effort to understand the severity of contamination

The Sampling Dilemma



NATIONAL FORAGE TESTING ASSOCIATION--Excellence in Forage Testing