

Mycotoxin Monitoring: Safeguarding Co-Products Quality & Safety

Patricia Jackson

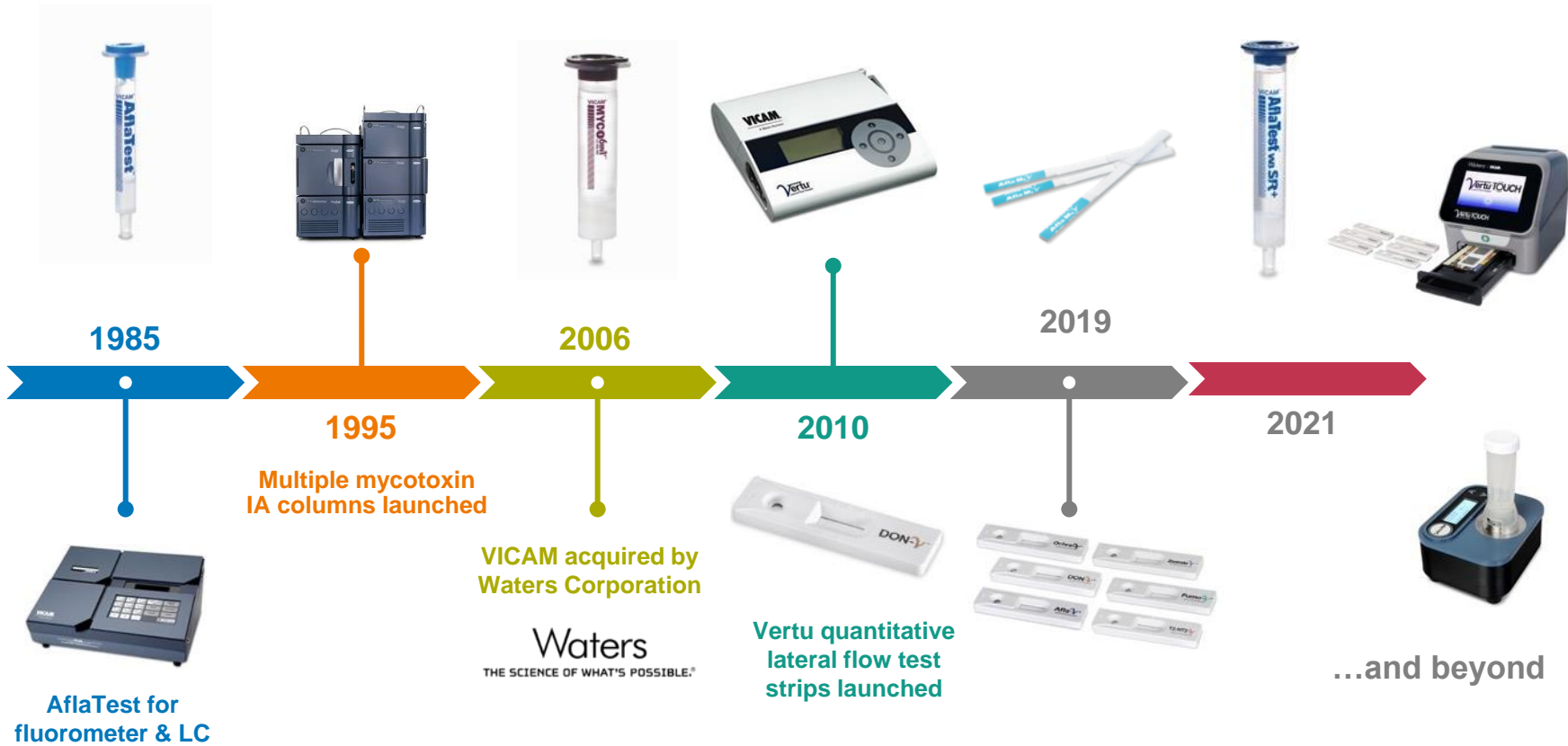
Market Development Manager

Our History in the Agriculture and Food Industries

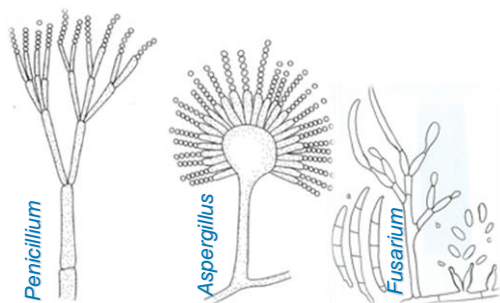
- VICAM launched its first product in 1987 – AflaTest
- Aflatoxin outbreak impacted poultry/egg production
- Specialization in antibody-based diagnostics and laboratory sample prep
- Our First Work: Enable prevention and confirmatory testing for mycotoxins on-site or in the food and agricultural laboratory.



Mycotoxin Testing & Management Through The Years



What are mycotoxins?



Fumonisin

Zearalenone

Aflatoxin

Citrinin

T2/HT-2

Deoxynivalenol

Ochratoxin A









Food & Agricultural Products Affected by Mycotoxin Contamination



- Tree Nuts
- Peanuts
- Grain
- Wine
- Coffee
- Flour Milling
- Cereals
- Feed
- Oats
- Ethanol
- Dairy
- Rice
- Botanicals
- Spices
- Snack Foods
- Pet Food
- Hemp/Cannabis



- Diverse range of toxins
- Array of health impacts
- Economic Impact

						
Mycotoxins	AFLATOXINS B1, B2, G1, G2, M1	VOMITOXIN (DON)	FUMONISINS B1, B2, B3	OCHRATOXIN A	T-2/HT-2	ZEARALENONE
Selected Molds That Produce Toxins	<i>Aspergillus flavus, Aspergillus parasiticus</i>	<i>Fusarium graminearum</i>	<i>Fusarium verticillioides</i>	<i>Aspergillus ochraceus Penicillium verrucosum</i>	<i>Fusarium and other mold species</i>	<i>Fusarium graminearum</i>
Foods Susceptible to Contamination	Maize, groundnuts, nuts, cottonseed, copra, spices, milk, wheat, oats, barley, and rice	Maize, wheat, barley, malted barley, and oats	Maize and other cereal grains	Maize, wheat, barley, beer, oats, sorghum, dried vine fruits, wine, coffee, and cocoa	Maize, wheat, barley, oats, rice, sorghum, and other cereal grains	Maize, wheat, barley, grain, and sorghum
Health Effects	<ul style="list-style-type: none"> ▪Liver cancer and damage ▪Immunosuppression ▪Decreased milk and egg production 	<ul style="list-style-type: none"> ▪Damage to digestive tract, bone marrow, spleen, reproductive organs ▪Weight loss, vomiting, and feed refusal 	<ul style="list-style-type: none"> ▪Cancer in rats ▪Brain decay in horses ▪Lung congestion in pigs ▪Human Esophageal Cancer 	<ul style="list-style-type: none"> ▪Kidney damage and cancer ▪Immunosuppression 	<ul style="list-style-type: none"> ▪Skin and oral lesions in livestock and humans ▪Alimentary toxic aleukia in humans ▪Considered 10x more toxic than DON 	<ul style="list-style-type: none"> ▪Negatively impacts reproduction, fetal development, and the health of newborns ▪Causes feminization in animals at 1 ppm

Mycotoxins: Economic and Health Risks

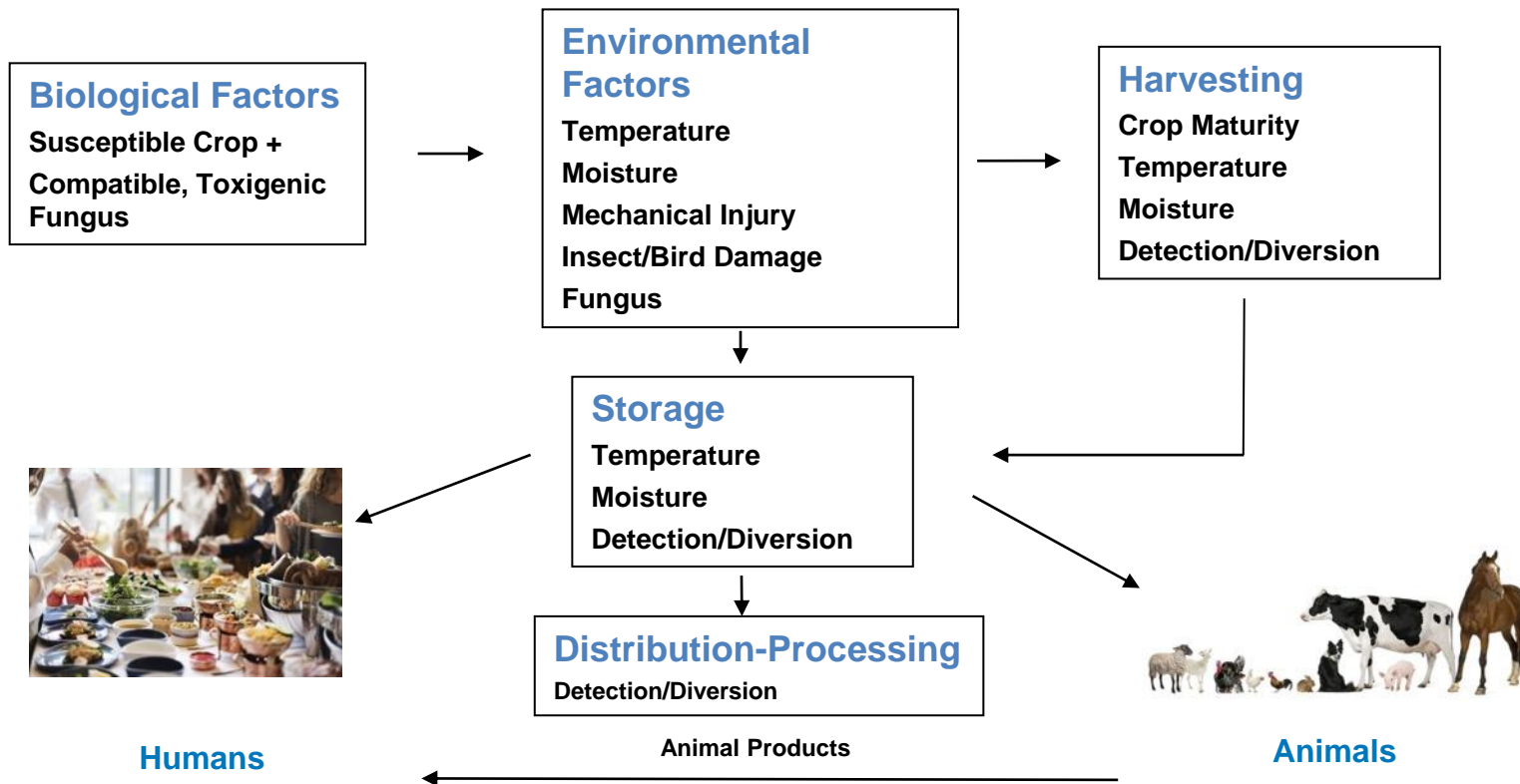
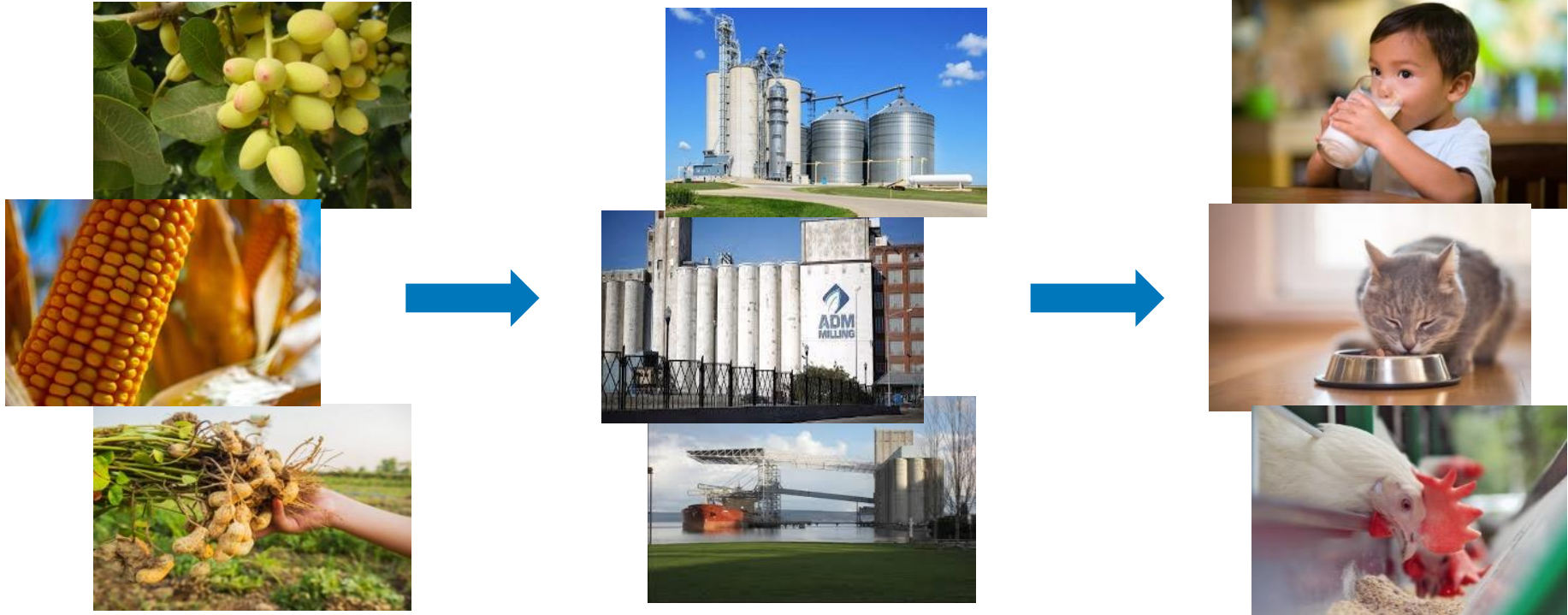


Figure 6.1. Factors affecting mycotoxin occurrence in the food chain (Pestka and Casale, 1989) from CAST report 1989.

Mycotoxin Monitoring from Field to Market: Where is the Need?

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■ Field

■ Storage/Processing/Transport

■ Market

When Should I Suspect Mycotoxins?

- Weather conditions.....
- Where did my ingredients come from???
- How was it stored???




Ethanol Co-Products In Animal Feeds

- High energy, middle protein content
- Longer shelf-life compared with traditional grain or oilseed meals
- DDGs, Dried and Pelletized Forms enable protective storage, easier handling and long-distance shipments
- Used as a 1:1 substitute for corn grain in feed rations
- May be used for cattle, dairy cows, swine and some poultry diets




Source: <https://www.ers.usda.gov/amber-waves/2019/october/dried-distillers-grains-ddgs-have-emerged-as-a-key-ethanol-coproduct/>

Poultry Feed & Mycotoxins


Poultry				
Mycotoxins	Commodity	FDA level	Health effects	Performance effects
Aflatoxin	Corn/peanut/other ingredients excluding cottonseed meal	100 ppb*	Liver damage Liver cancer Lower immunity	Reduced egg production Contaminated eggs/poultry
	Cottonseed meal	300 ppb†	Embryo death Birth defects Hemorrhage	
DON	Grain/byproducts	10 ppm	Lower immunity Intestinal disorders	Impaired performance/productivity
Fumonisin	Corn/byproducts	100 ppm‡	Diarrhea Liver damage	Decreased egg production/quality
OTA			Liver/kidney damage	Reduced egg production Decreased feed intake/growth Contaminated eggs/poultry
T-2			Intestinal symptoms Oral lesions Bruising Lower immunity	Reduced feed intake/weight loss Reduced egg production

Dairy Cow Rations & Mycotoxins


Dairy cattle

Mycotoxins	Commodity	FDA level	Health effects	Performance effects
Aflatoxin	Corn/peanut/ other ingredients	20 ppb*	Liver damage Embryo death Birth defects Hemorrhage Diarrhea	Reduced reproductive performance Contaminated milk Lower milk production
DON	Grain/byproducts	10 ppb	Digestive symptoms	Feed refusal
	DDG/brewers grains/gluten	30 ppm		Lower milk production Reduced reproductive efficiency
Fumonisin	Corn/byproducts	60 ppm [‡]	Liver/kidney damage	Weight loss Lower milk production
OTA [§]			Depression Dehydration	Feed refusal/weight loss
T-2			Intestinal symptoms/ hemorrhage Lower immunity	Decreased milk production Feed refusal Reduced reproductive performance
ZEA			Hormonal disorders Abortions	Reproductive problems Reduced feed intake Lower milk production


Beef Cattle Feeds & Mycotoxins

Beef cattle				
Mycotoxins	Commodity	FDA level	Health effects	Performance effects
Aflatoxin	Corn/peanut/other ingredients excluding cottonseed meal	300 ppb*	Liver damage Embryo death Birth defects	Reduced reproductive performance Contaminated meat Feed refusal
	Cottonseed meal	300 ppb†	Hemorrhage Diarrhea	
DON	Grain/byproducts	10 ppm	Digestive symptoms	Reduced feed intake Impaired reproductive performance
	DDG/brewers grains/ gluten	30 ppm		
Fumonisin	Corn/byproducts	60 ppm‡	Liver/kidney damage	Weight loss
OTA§			Depression Dehydration	Feed refusal/weight loss
T-2			Intestinal symptoms Lower immunity	Decreased feed intake Reduced reproductive performance
ZEA			Hormonal disorders Abortions	Reduced reproductive performance

Swine Feed & Mycotoxins

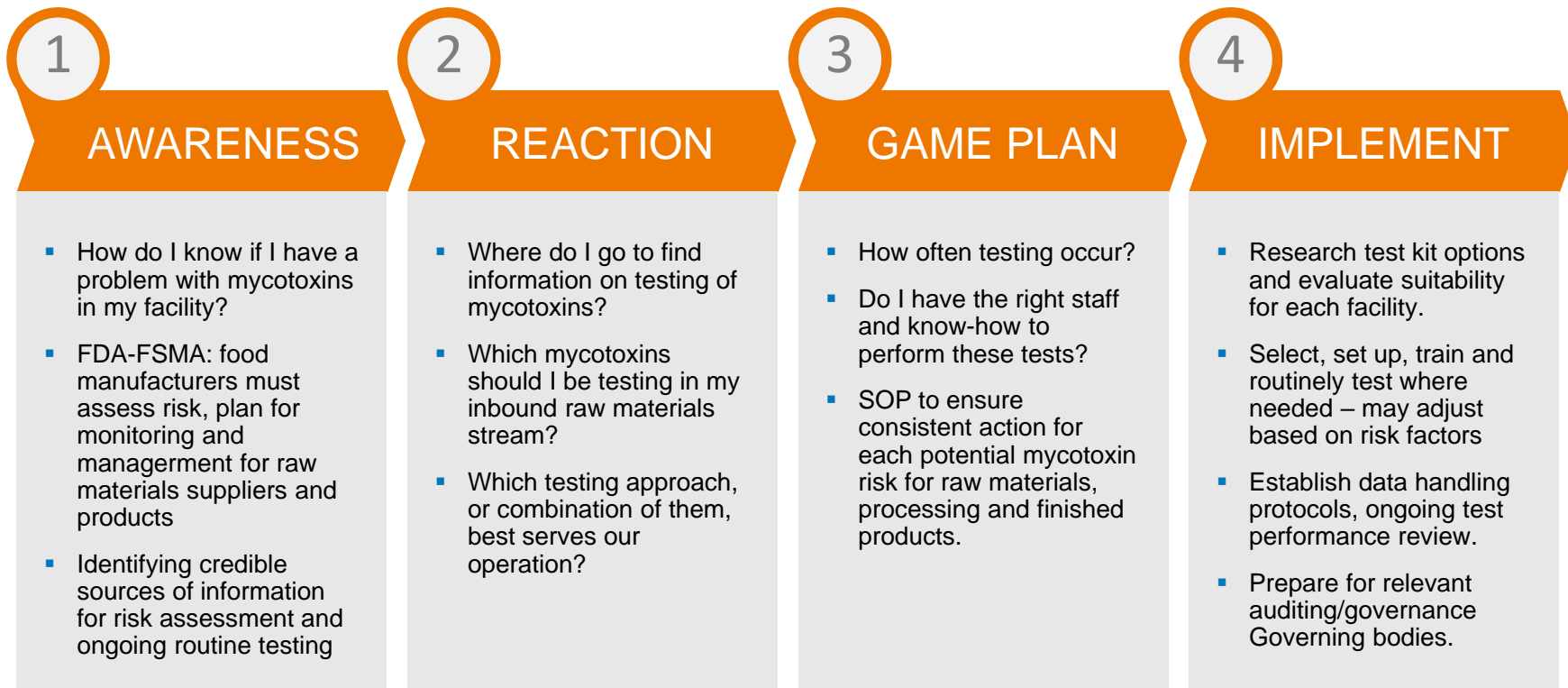
Swine				
Mycotoxins	Commodity	FDA level	Health effects	Performance effects
Aflatoxin	Corn/peanut/other ingredients excluding cottonseed meal	200 ppb*	Liver damage Liver cancer Lower immunity	Reduced reproductive performance Feed refusal/weight loss
	Cottonseed meal	300 ppb†	Embryo death Birth defects Hemorrhage	
DON	Grain/byproducts	5 ppm	Vomiting/intestinal symptoms Lower immunity	Feed refusal/decreased weight gain
Fumonisin		20 ppm	Porcine pulmonary edema (PPE) Heart/liver/pancreas damage Lower immunity	Reduced feed intake/growth
OTA§			Liver/kidney damage	Decreased productivity Decreased feed intake/weight loss Contaminated meat
T-2			Intestinal symptoms Blood disorders Lower immunity Intestinal lesions	Reduced feed intake/ lower weight gain
ZEA			Embryo death Vomiting/diarrhea Hemorrhage Hormonal disorders	Reduced reproductive performance Feed refusal/weight loss

Horse Feed & Mycotoxins

Horses				
Mycotoxins	Commodity	FDA level	Health effects	Performance effects
Aflatoxin	Corn/peanut/ other ingredients	20 ppb	Liver damage Seizures Lower immunity Embryo death Birth defects Hemorrhage	Reduced reproductive performance Weight loss
DON	Grain/byproducts	5 ppm		Feed refusal/decreased intake
Fumonisin	Corn/byproducts	5 ppm	Equine leukoencephalomalacia	
OTA			Kidney damage	Reduced growth/performance
T-2			Intestinal symptoms Lower immunity	Decreased feed intake
ZEA			Hormonal disorders	Reduced reproductive performance



Designing A Preventive Monitoring Strategy



Technologies for Analysis of Mycotoxins

**Lower complexity
and cost
Less information**

**Higher complexity and cost
More information**



**Qualitative
Strip tests**

**Quantitative
Strip tests or
Immunoaffinity
columns with
Fluorometer**

**HPLC/UPLC
LC-MS
UPLC-MS-MS**



Rapid Detection: Field, Process & Laboratory Approaches

Waters™ | **VICAM**

- Immunoaffinity Columns with Fluorometer
 - Wide dynamic range (0-1,000 ppb Aflatoxin)
 - AOAC & USDA-GIPSA Certified Methods



- Qualitative Strip Tests
 - Quick screening
 - Simple procedure
 - Yes/No visual indication



- Quantitative Lateral Flow Strip Tests
 - Fully Quantitative
 - USDA-GIPSA Approved Methods
 - Sustainable, simple and solvent-free extraction
 - Single Extraction for analysis of up to 5 mycotoxins



Inbound Corn Testing

- Qualitative Strip Tests
 - Yes/No Result
 - 6-7 Minutes
 - No Equipment Investment Required
- Quantitative Strip Tests
 - Aflatoxin, Fumonisin, DON, Ochratoxin, Zearalenone and T-2/HT-2
 - Water-based extraction
 - Single extraction used for all strip tests
 - Results for 6 toxins in less than 10 minutes



Optimizing For Multi-Mycotoxin Testing in Corn

One Extraction Enables up to 6 Different Toxins to be Tested

- Ideal for incoming raw materials
- Select only the toxins you are targeting
- Apply 100 uL of filtered extract to each strip
- Results for **up to 6** toxins in less than 10 minutes



Waters™ | VICAM.

Myco 5-in-1 PLUS with Vertu TOUCH:
Detect **SIX** mycotoxins with **ONE** extraction.



For more information visit www.vicam.com

VICAM, A Waters Business Headquarters:

34 Maple Street Milford, MA 01752 USA • Tel.: +1 800 338 4381 • +1 508 482 4935 • Fax: +1 508 482 4972

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DDGS - Single Extraction For Multiple Mycotoxins

- One Water-Based Extraction
- Aflatoxin, Vomitoxin (DON) and Fumonisin Results
- Less Than 10 Minutes

Afla-V™ AQUA

QUANTITATIVE STRIP TESTS

Procedure for DDGS

Consumable kit reorder number: 176005018

DON-V™

QUANTITATIVE STRIP TESTS

Room Temperature

Consumable kit reorder number: 176005019

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Fumo-V™ AQUA

QUANTITATIVE STRIP TESTS

Consumable kit reorder number: 176003952

Use strips at room temperature 20–25 °C (68–77 °F)

• Warm up the strips to room temperature 20–25 °C (68–77 °F) for 20 minutes or longer before using.
• Do not open the strip pouch until ready to use the strip.

1 Calibrate the Vertu reader by scanning in the Afla-V AQUA barcode for DDGS and the lot of strips being used.

2 Weigh 5 g ± 0.1 g ground sample into extraction tube. Add 25 mL AQUA Premix to extraction tube.

3 Vortex at maximum speed for 2 minutes. Filter the extract into a clean tube for no more than 5 minutes.

4 Draw ~ 2 mL filtered extract up into syringe, attach syringe filter to syringe and push extract through into a clean strip test vial.

1 Calibrate the Vertu reader by scanning in the Afla-V AQUA barcode for DDGS and the lot of strips being used.

2 Weigh 5 g ± 0.1 g ground sample into extraction tube. Add 25 mL AQUA Premix to extraction tube.

3 Vortex at maximum speed for 2 minutes. Filter the extract into a clean tube for no more than 5 minutes.

4 Add 1 mL of purified water to a strip test vial. Then, a 100 µL of the filtered extract to the vial. Cover and mix by vortexing (for light DC add 600 µL of purified water to a strip test vial then add 100 µL of filtered extract).

1 Calibrate the Vertu reader by scanning in the Fumo-V AQUA barcode for the specific commodity and the lot of strips being used.

2 Weigh 5 g ± 0.1 g ground sample into extraction tube. Add 25 mL AQUA Premix to extraction tube.

3 Vortex at maximum speed for 2 minutes. Filter the extract into a clean tube for no more than 5 minutes.

4 Transfer 100 µL of filtered extract to the Fumo-V strip by dropping (~1 drop/second) vertically into the sample well. Allow the strip to develop for 5 minutes on a flat surface.

5 Insert the Fumo-V strip into the Vertu. Press the center key to take a reading. To print, use the arrow keys to move the cursor to "P" and press the center button.

6 If the reader displays ">Range", dilute filtered extract by pipetting 400 µL of AQUA Premix to a new strip test vial. Then, using the same tip, add 100 µL of the filtered extract to the vial and mix well by vortexing.

7 Repeat steps 4–5 with the diluted extract and multiply the displayed result by 5 to obtain the true level of contamination.

8 To run the next sample, use the arrow keys to move the cursor to "NT" and press the center button on the keypad.

Strips must be stored at 2–30 °C (36–86 °F)
Store AQUA Premix at room temperature
Limit of Detection: 5 ppb
Range: 0–80 ppb
For detailed instruction guide, please visit vicam.com/aflatoxin-test-kits

Strips must be stored at 2–41 °C (36–106 °F)
Limit of Detection: 0.2 ppm
Range: 0–5 ppm (1st strip), 5–10 ppm (2nd strip with dilution)
For detailed instruction guide, please visit vicam.com/don-test-kits

Strips must be stored at 2–8 °C (36–46 °F)
Store AQUA Premix at room temperature.
Limit of Detection: 0.2 ppm
Range: 0–20 ppm (1st strip), 20–100 ppm (2nd strip with dilution)

For detailed instruction guide, please visit vicam.com/fumonisin-test-kits/fumo-v-aqua

Orders: Tel: +1-877-228-4244
Fax: +1-877-228-4244
Email: orders@vicam.com

Technical Support: Tel: +1-800-335-4391
Fax: +1-877-228-4244
Email: techservice@vicam.com

Orders: Tel: +1-877-228-4244
Fax: +1-877-228-4244
Email: orders@vicam.com

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Fax: +1-877-228-4244
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Email: orders@vicam.com

Technical Support: Tel: +1-800-335-4391
Fax: +1-877-228-4244
Email: techservice@vicam.com

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Thank you!