

Fate of Deoxynivalenol During Wet Milling

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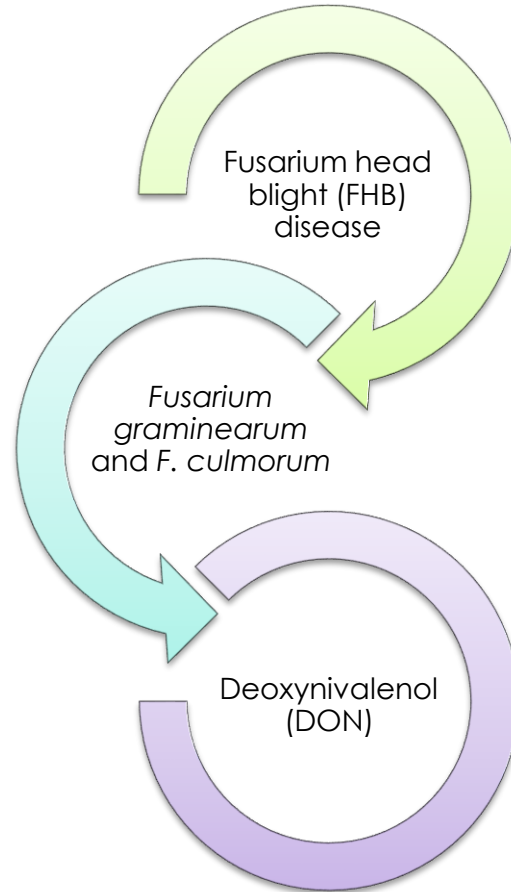
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Introduction



Michigan State University Extension. FHB. [Picture]. Retrieved. http://msue.anr.msu.edu/news/managing_fusarium_head_blight_on_wheat



✓ Disease spread

- Reduced tillage systems
- No crop rotations
- Environmental changes

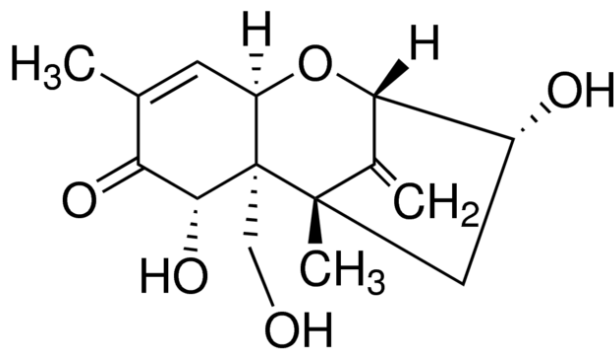
✓ Mycelia

- Inoculum in spring
- Carried to anthers
- Fungus in floret
- Mycotoxin development

DON

✓ Health concerns

- Feed refusal
- Immunosuppressive effects
- Gastroenteritis



SIGMA-ALDRICH. Deoxynivalenol. [Picture] Retrieved <https://www.sigmaaldrich.com/catalog>

FDA advisory levels

DON ($\mu\text{g g}^{-1}$)	Utilization
1	Finished wheat products (flour, bran, germ) consumed by humans.
10	Grains & byproducts for ruminating beef (dairy & feedlot cattle) older than 4 months.
5	Grains & byproducts for swine, not exceeding 20% of their diet.

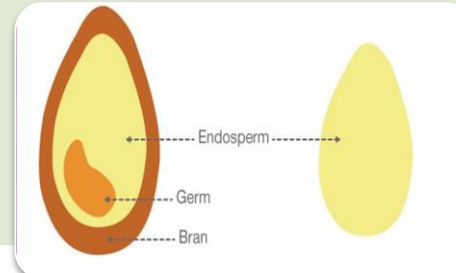
Strategies for Deoxynivalenol Reduction



Cleaning



Dry milling



Debranning



Further processing

Wet Milling

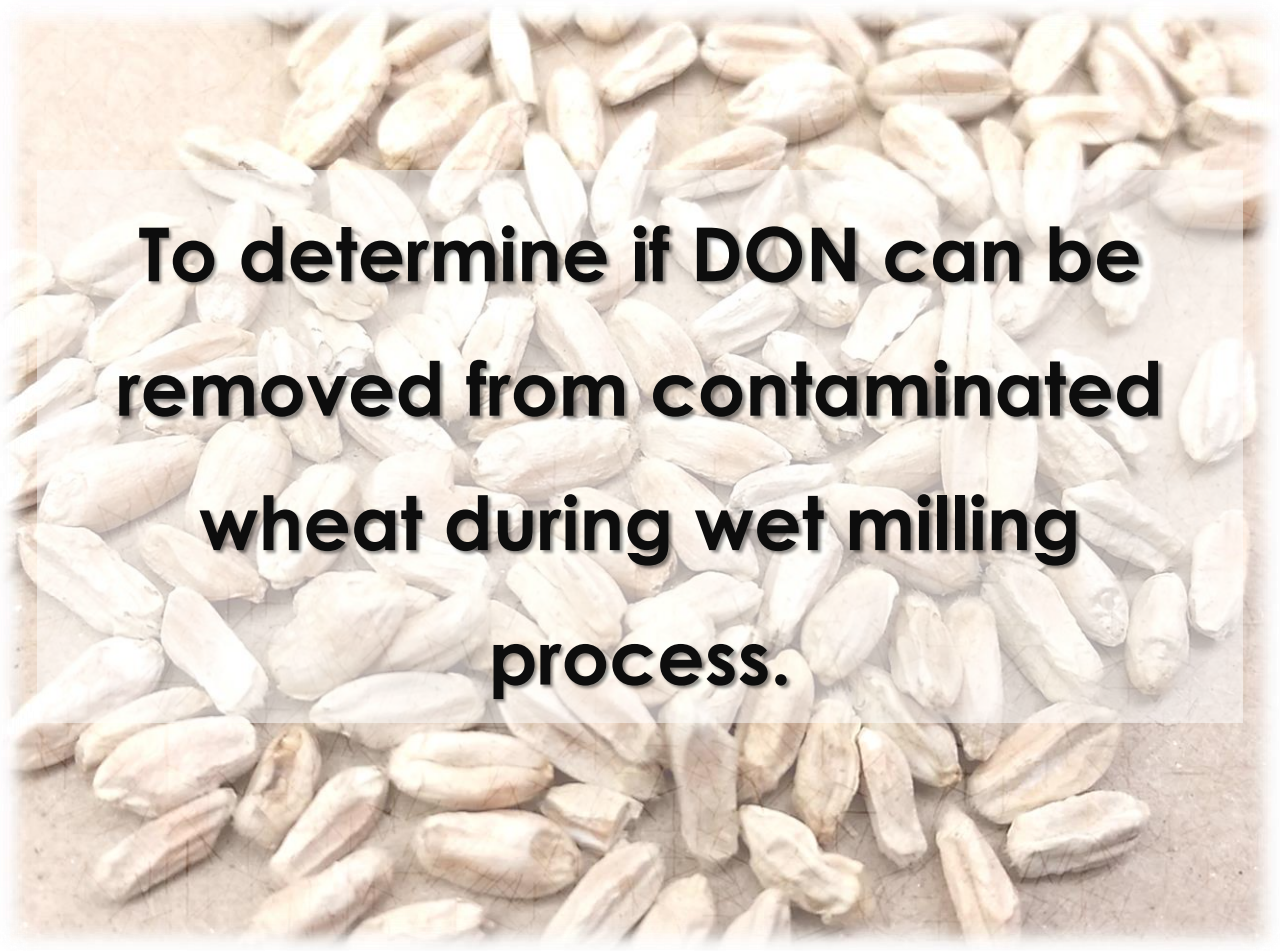
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graph LR; A[Wet Milling] --- B[Chemical separation of plants main components.]; A --- C[Obtain gluten proteins, starch granules, fiber and water soluble.]; A --- D[Starts with physical separation of grain parts.]
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Chemical separation of plants main components.

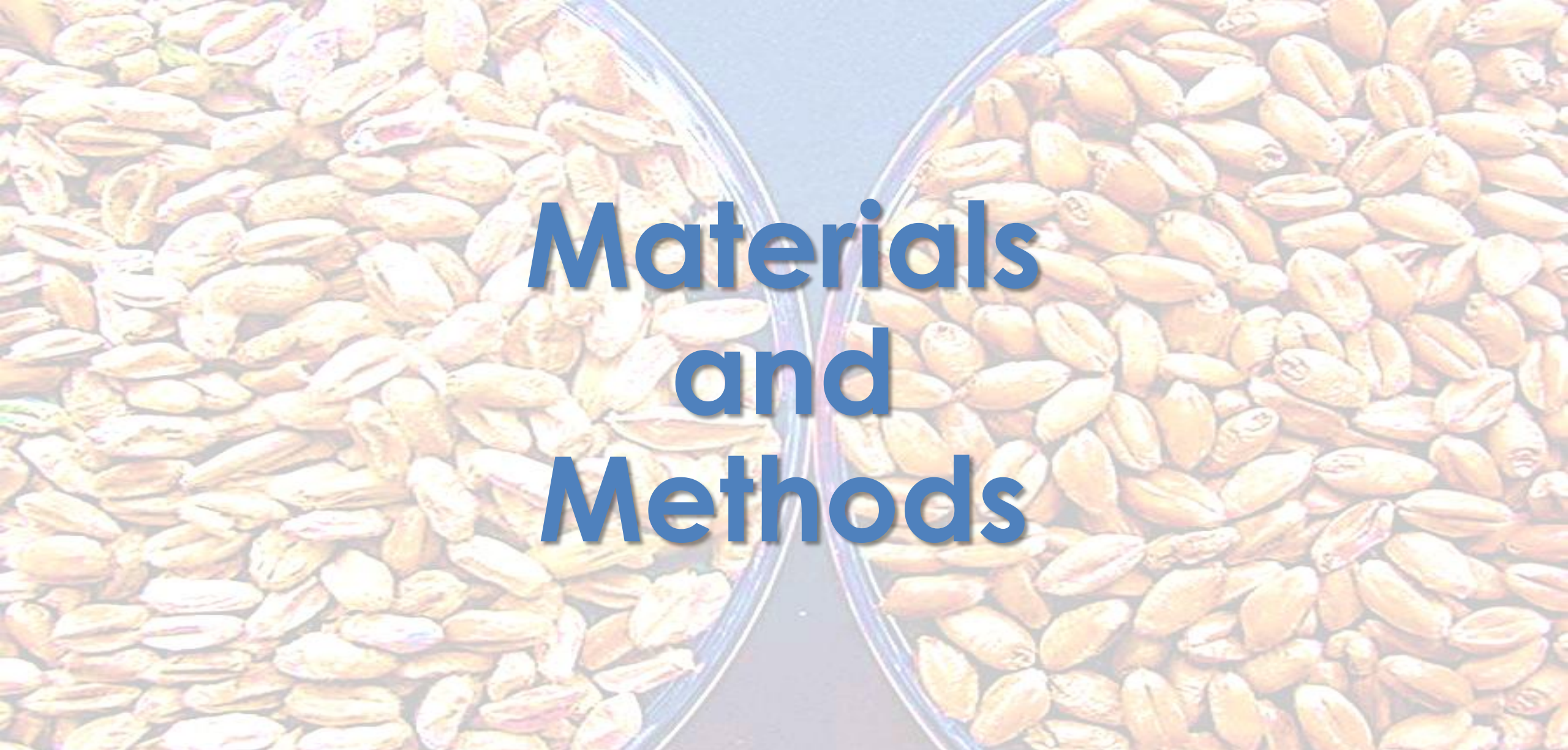
Obtain gluten proteins, starch granules, fiber and water soluble.

Starts with physical separation of grain parts.

Objective



To determine if DON can be removed from contaminated wheat during wet milling process.

The background of the slide features two glass bowls filled with almonds, positioned on either side of the central text. The almonds are light brown and appear to be in their natural state. The text is overlaid on a semi-transparent blue rectangular area in the center.

Materials and Methods

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Grain Material

Durum wheat



Hard red
spring wheat



Dry Milling

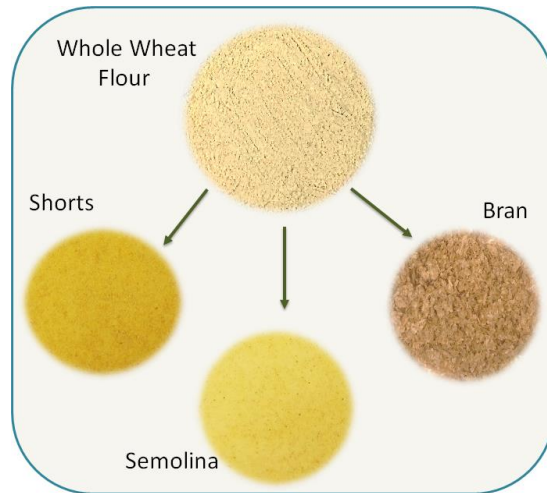


Udy mill:
Whole
wheat flour

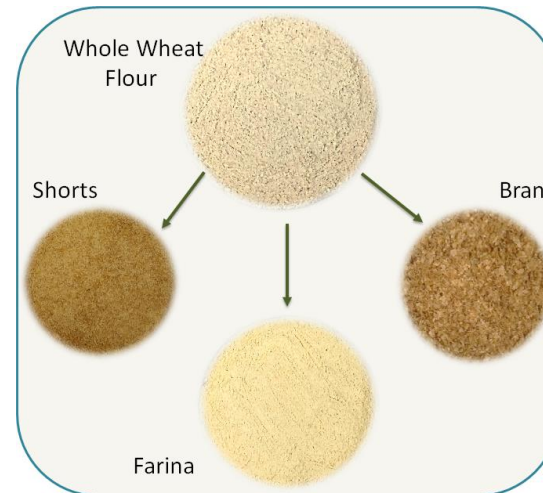
Brabender Quadrumat Jr:
Bran
Shorts
Semolina/Farina



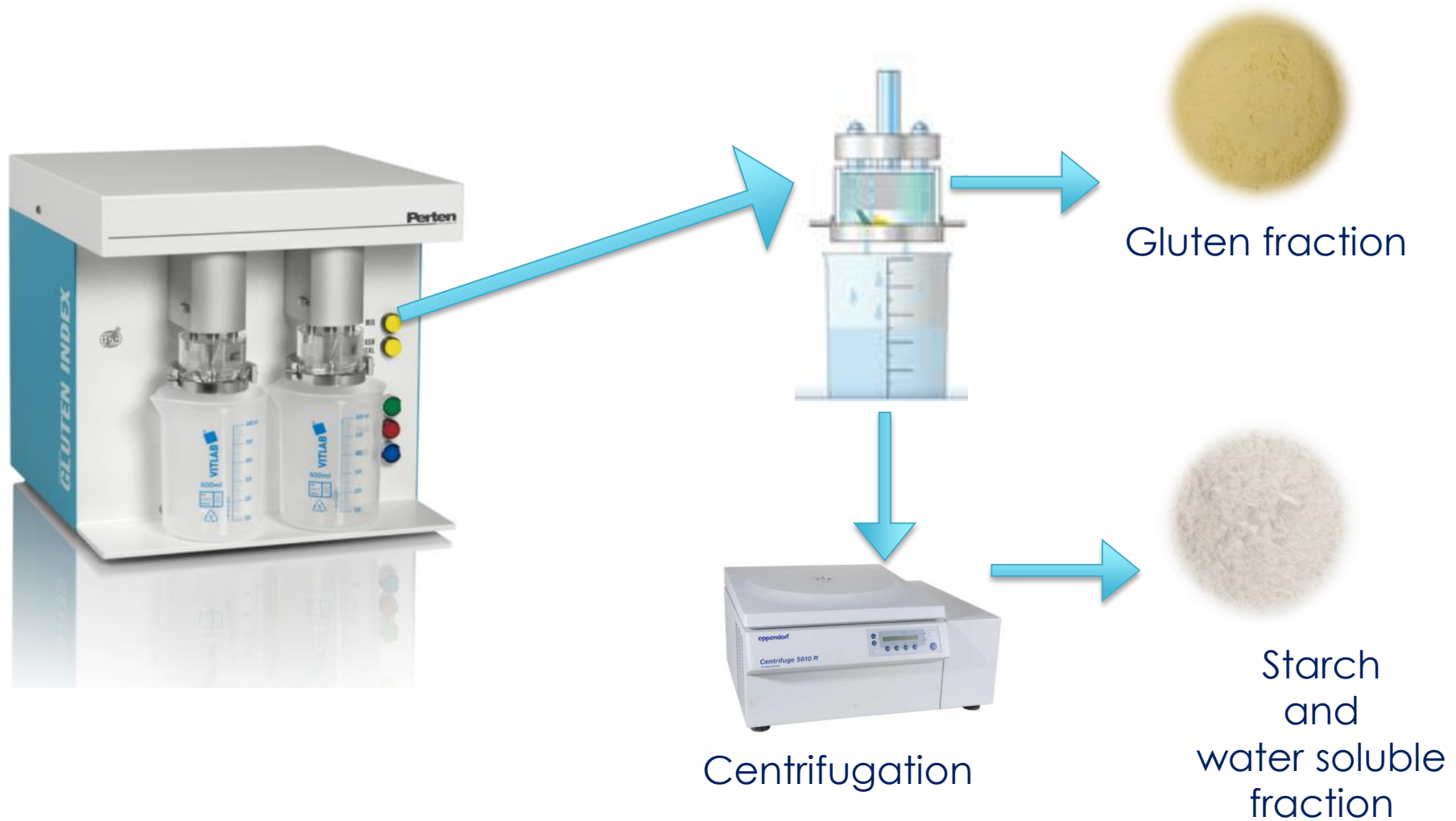
Durum wheat



Hard red spring wheat



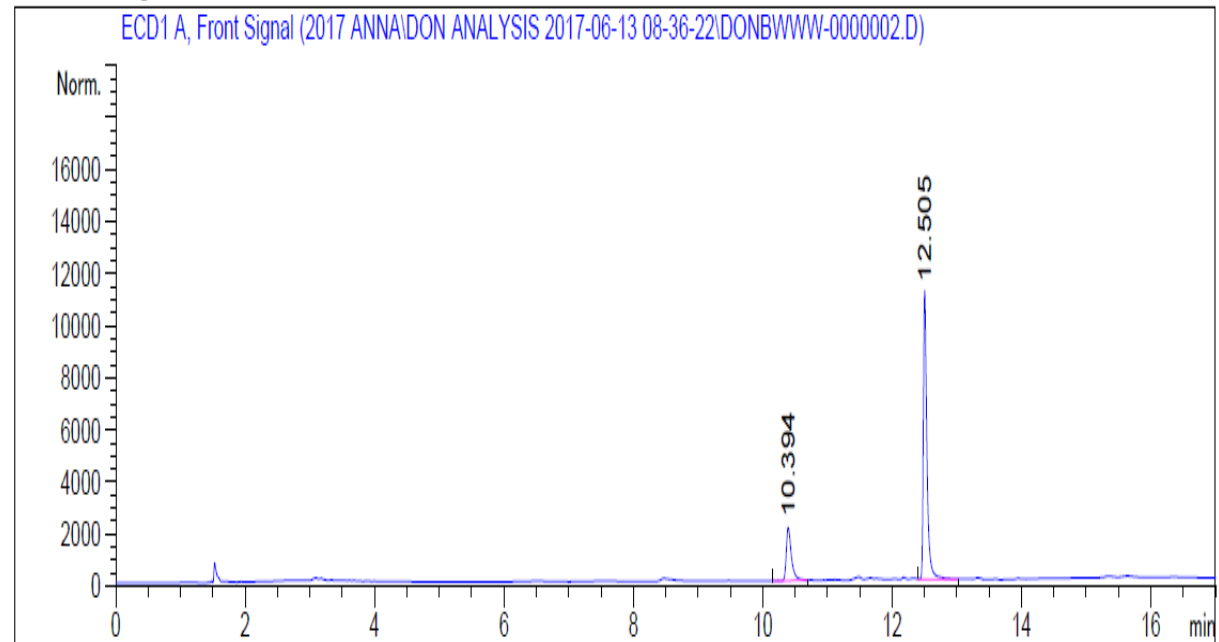
Wet Milling: Martin Process



Analysis of Deoxynivalenol

- ✓ Gas Chromatography with Electron Capture Detection (**GC-ECD**)
(Tacke & Casper 1996)

Detection
 $0.2 - 40 \text{ (}\mu\text{g g}^{-1}\text{)}$



Statistical Analysis

RCBD

All analyzes were repeated
four times, reporting means

ANOVA ($p < 0.05$)

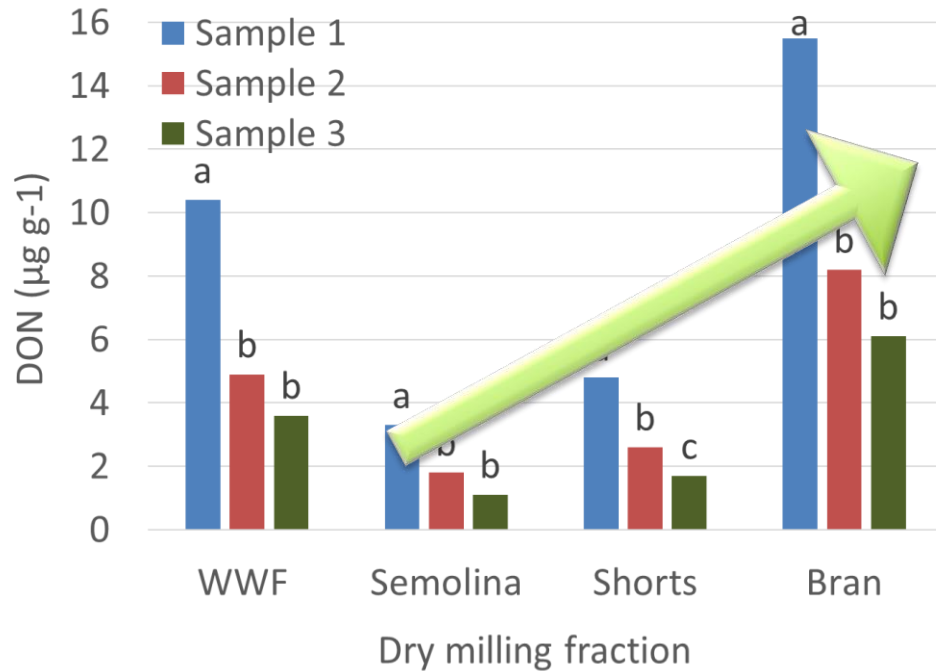
Fisher's protected LSD
(significance level 5%)



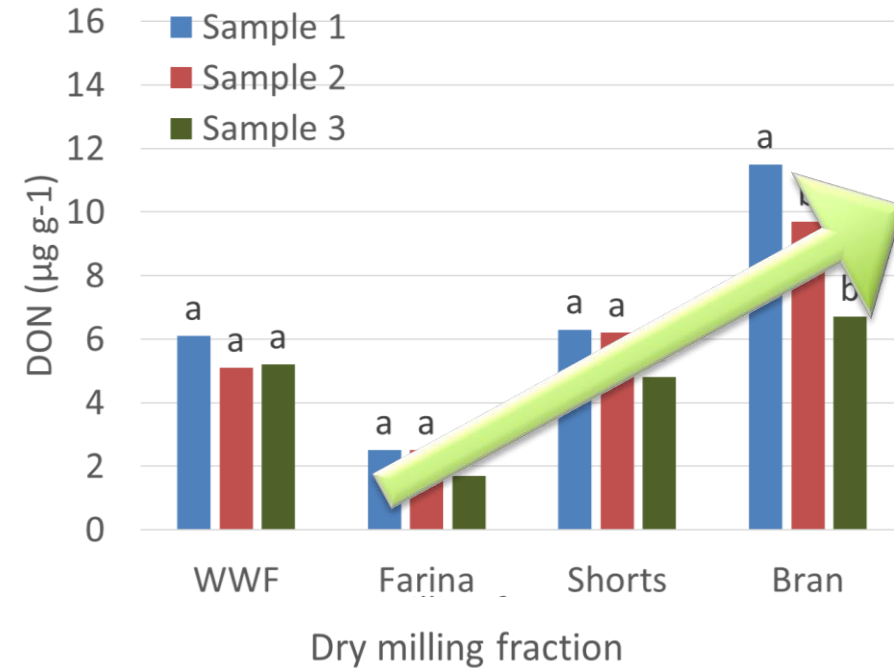
Results: Fate of DON

Average DON Levels

Durum wheat



Hard red spring wheat



*Columns for the same milling fraction group with the same letter are not statistically significant ($P < 0.05$).
WWF= Whole wheat flour.

Wet Milling Fractions From Wheat Semolina / Farina

	Starch fraction	Gluten fraction	Water soluble fraction
Semolina/ Farina	Starch (% of flour solids)	Protein (% of flour solids)	Water soluble (% of flour solids)
Durum Wheat			
Sample 1	76.6 ab	13.6 a	7.4 a
Sample 2	76.7 ab	11.3 b	7.3 a
Sample 3	72.6 b	11.8 b	5.8 b
Hard Red Spring Wheat			
Sample 1	77.6 a	16.2 b	6.0 a
Sample 2	72.6 a	16.5 b	5.4 b
Sample 3	74.8 a	19.1 a	5.8 ab

*Means with the same letter within columns are not significantly different for the same wheat type ($P < 0.05$).

Average DON Levels in Wheat Semolina / Farina

Semolina / Farina	Before WM		After WM	
	DON ($\mu\text{g g}^{-1}$)	Starch fraction DON ($\mu\text{g g}^{-1}$)	Gluten fraction DON ($\mu\text{g g}^{-1}$)	Water soluble DON ($\mu\text{g g}^{-1}$)
Durum Wheat				
Sample 1	3.3 a	ND	ND	104.3 a
Sample 2	1.8 b	ND	ND	55.7 b
Sample 3	1.1 c	ND	ND	46.3 ab
Hard Red Spring Wheat				
Sample 1	2.5 a	ND	ND	48.0 a
Sample 2	2.5 a	ND	ND	49.3 a
Sample 3	1.7 b	ND	ND	32.9 b

*Means with the same letter within columns are not significantly different for the same wheat type ($P < 0.05$).

WM= Wet milling.

DON = Deoxynivalenol.

ND = Below the limit of quantification ($<0.2 \mu\text{g g}^{-1}$).

Average DON Levels in Wheat Shorts

Before WM		After WM		
Shorts	DON ($\mu\text{g g}^{-1}$)	Starch fraction DON ($\mu\text{g g}^{-1}$)	Gluten fraction DON ($\mu\text{g g}^{-1}$)	Water soluble DON ($\mu\text{g g}^{-1}$)
Durum Wheat				
Sample 1	4.8 a	ND	ND	56.2 a
Sample 2	2.6 b	ND	ND	29.4 b
Sample 3	1.7 c	ND	ND	43.8 ab
Hard Red Spring Wheat				
Sample 1	6.3 a	ND	ND	77.0 a
Sample 2	6.2 a	ND	ND	74.5 a
Sample 3	4.8 b	ND	ND	53.8 b

*Means with the same letter within columns are not significantly different for the same wheat type ($P < 0.05$).

WM= Wet milling.

DON = Deoxynivalenol.

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Average DON Levels in Wheat Bran

Before WM		After WM	
Bran	DON ($\mu\text{g g}^{-1}$)	Bran fraction DON ($\mu\text{g g}^{-1}$)	Water soluble DON ($\mu\text{g g}^{-1}$)
Durum Wheat			
Sample 1	15.5 a	0.8 a	73.3 a
Sample 2	8.2 b	0.2 b	41.6 b
Sample 3	6.1 b	0.7 b	41.4 b
Hard Red Spring Wheat			
Sample 1	11.5 a	1.6 a	54.2 a
Sample 2	9.7 b	1.3 a	51.0 a
Sample 3	6.7 c	0.6 ab	55.2 a

*Means with the same letter within columns are not significantly different for the same wheat type ($P < 0.05$).

WM= Wet milling.

DON = Deoxynivalenol.

Conclusions

DON

Removed from
starch, gluten
and bran
fractions during
the wet milling.

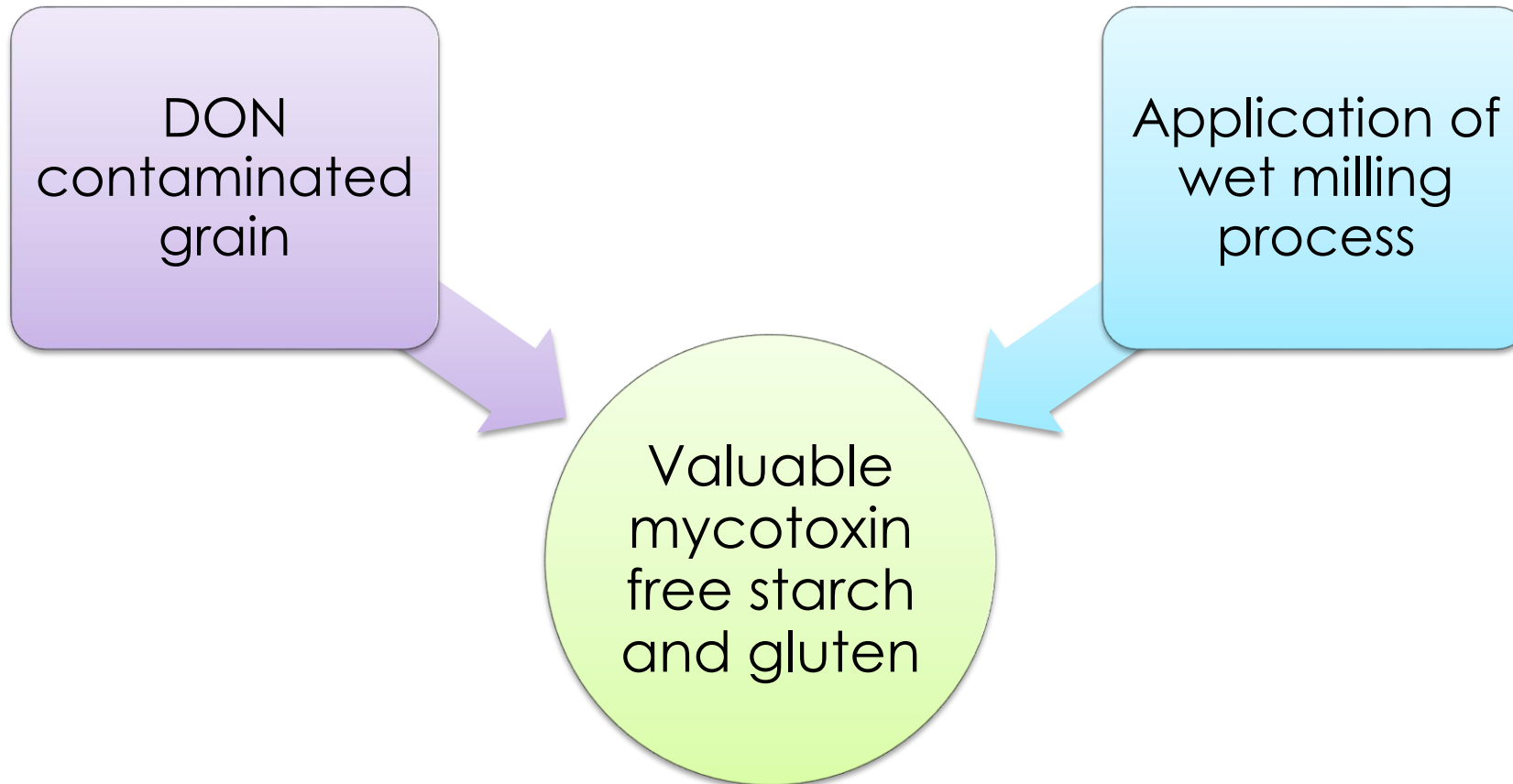
FDA advisory levels

Detected
below the
recommended.

Potential uses

Ingredients in
food / industrial
systems.

Take Home Message



Thank You



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