

Does Processing Grains Impact Nutrition?

Kevin Miller, PhD

Principal Scientist

Global Scientific and Regulatory Affairs

General Mills





Times
have
changed

8 in 10 Canadians
SAY NUTRITION IS IMPORTANT
WHEN CHOOSING FOODS, BUT...



60%

of the foods
we buy are
**PROCESSED
AND PACKAGED**

MANY of these
foods are HIGH IN
**SUGARS
SODIUM
SATURATED FAT**

Positions have changed

Beliefs impact *all* decisions

Consumer opinions of processed food extend beyond their own plates



Study Shows a Dramatic Improvement in Longevity by Feeding Fresh Foods

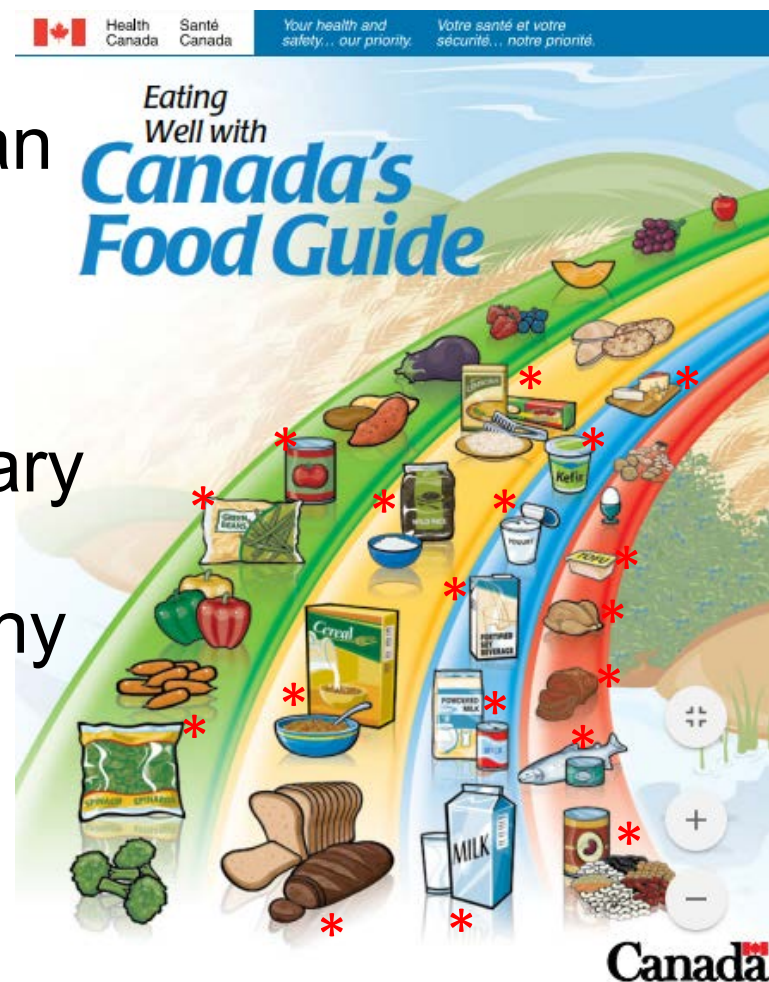
THE PROBLEMS WITH
PROCESSED PET FOOD
(PLEASE FEED YOUR PET RAW!)



Evidence-based dietary guidance do not restrict 'processed' foods



US / Canadian Dietary Guidelines describe 'healthy' dietary patterns including many processed foods



* Processed

What is 'processing'?



Processing grains

- Romanticized view of milling

Questions:

- Why do we 'process' grains?
- What does industrial processing do to nutrients?

Why do we process grains?

1. Digestibility & Palatability

- Removal of the inedible outer seed coat (e.g., hulls)
- Outer hull of grains are indigestible (by humans)

2. Shelf-life / stability

- Germ contains oils that oxidize and become rancid
 - Solution: remove germ OR stabilize (heat/enzymes)

3. Safety

- Microbes/fungus
 - Solution: peel outer bran layer (<10%)
 - Flour and other unprocessed grains are not 'ready to eat'

4. Function

- Consistency (e.g., flour) to deliver consistent products that meet consumer requirements (e.g., bakers)
- Solution: mill grains, separate fractions and grind to specific size, return fractions in precise proportions



‘Contaminants in foods’

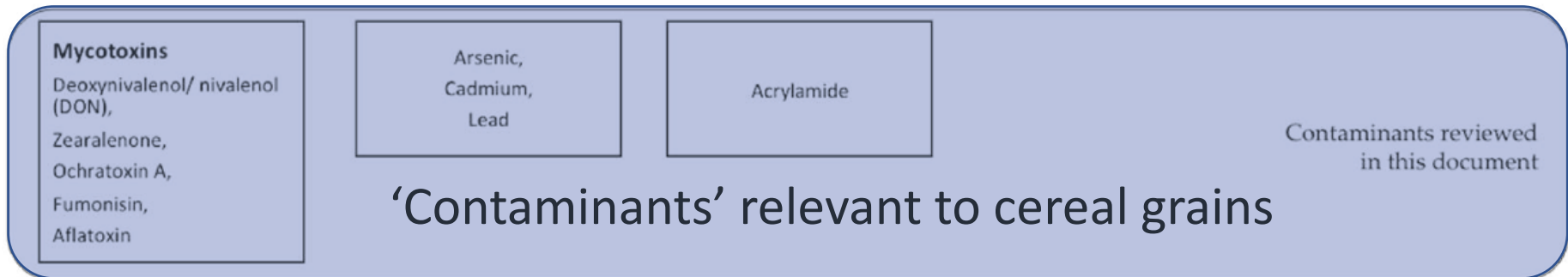
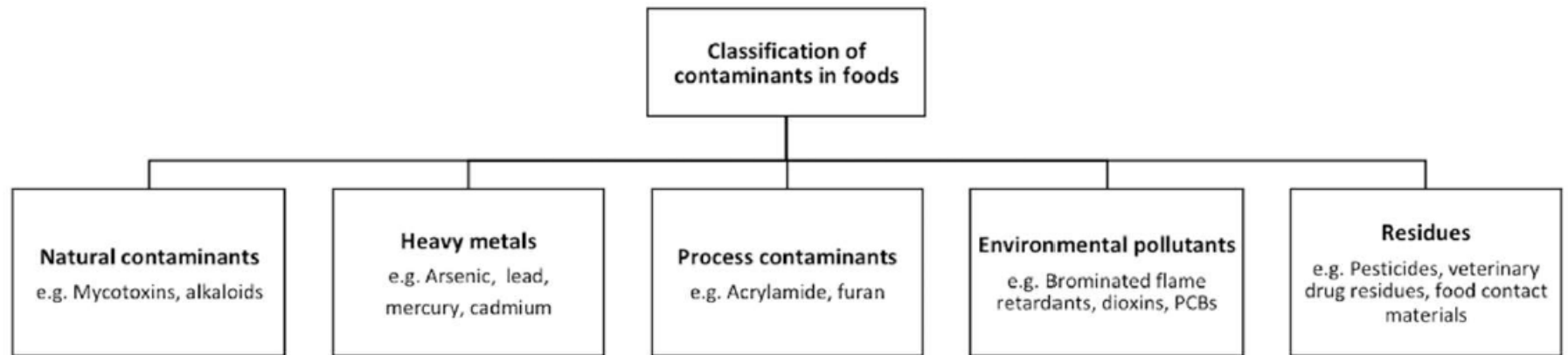


Illustration: Thielecke t al. 2018

- Milling grains has many goals, including safety
- Some plants are good at increasing mineral content
- High heat (e.g., cooking) can cause reactions among food components

Processing grains

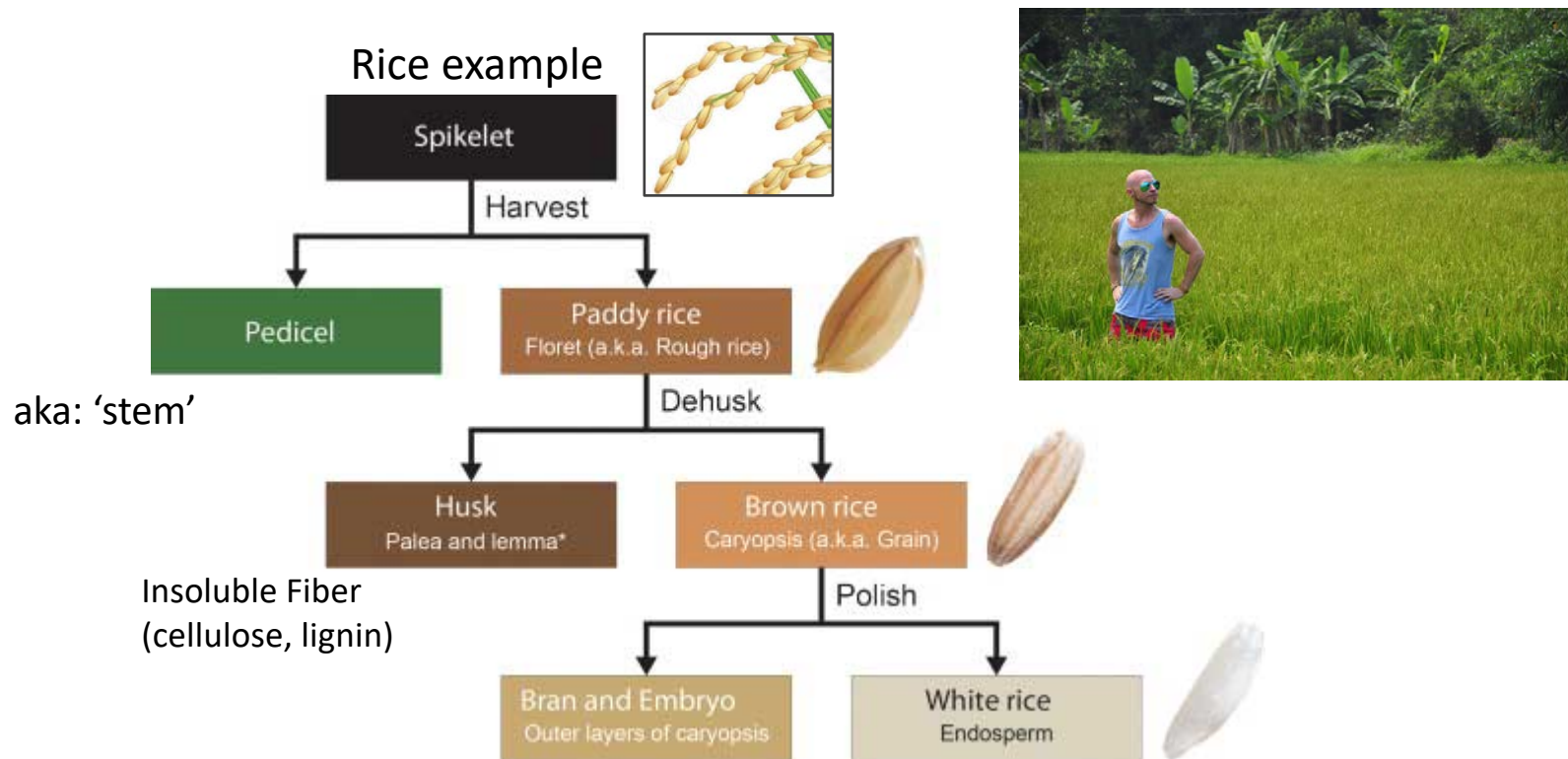
- Romanticized view of milling

Questions:

- Why do we 'process' grains?
- **What does industrial processing do to nutrients?**

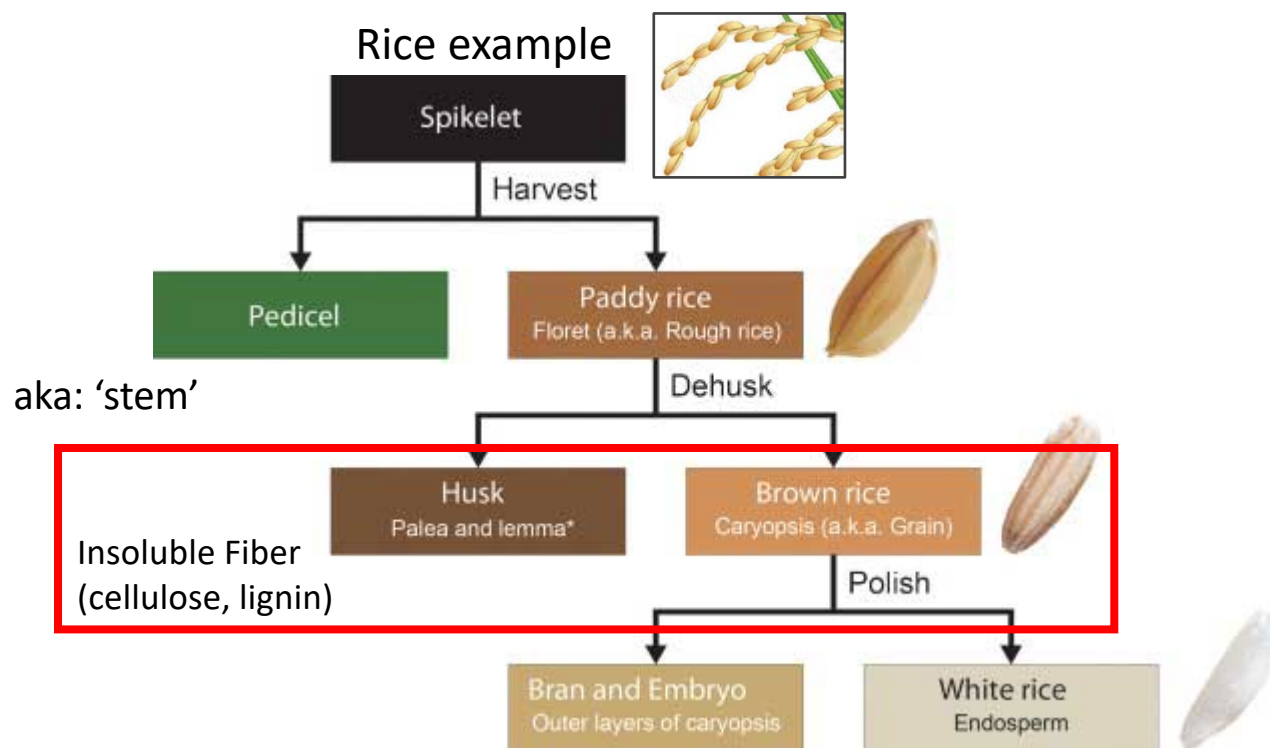
Does processing change nutritional status?

- Intact grains are not necessarily 'whole grains'
- Husk / hull must be removed to be edible



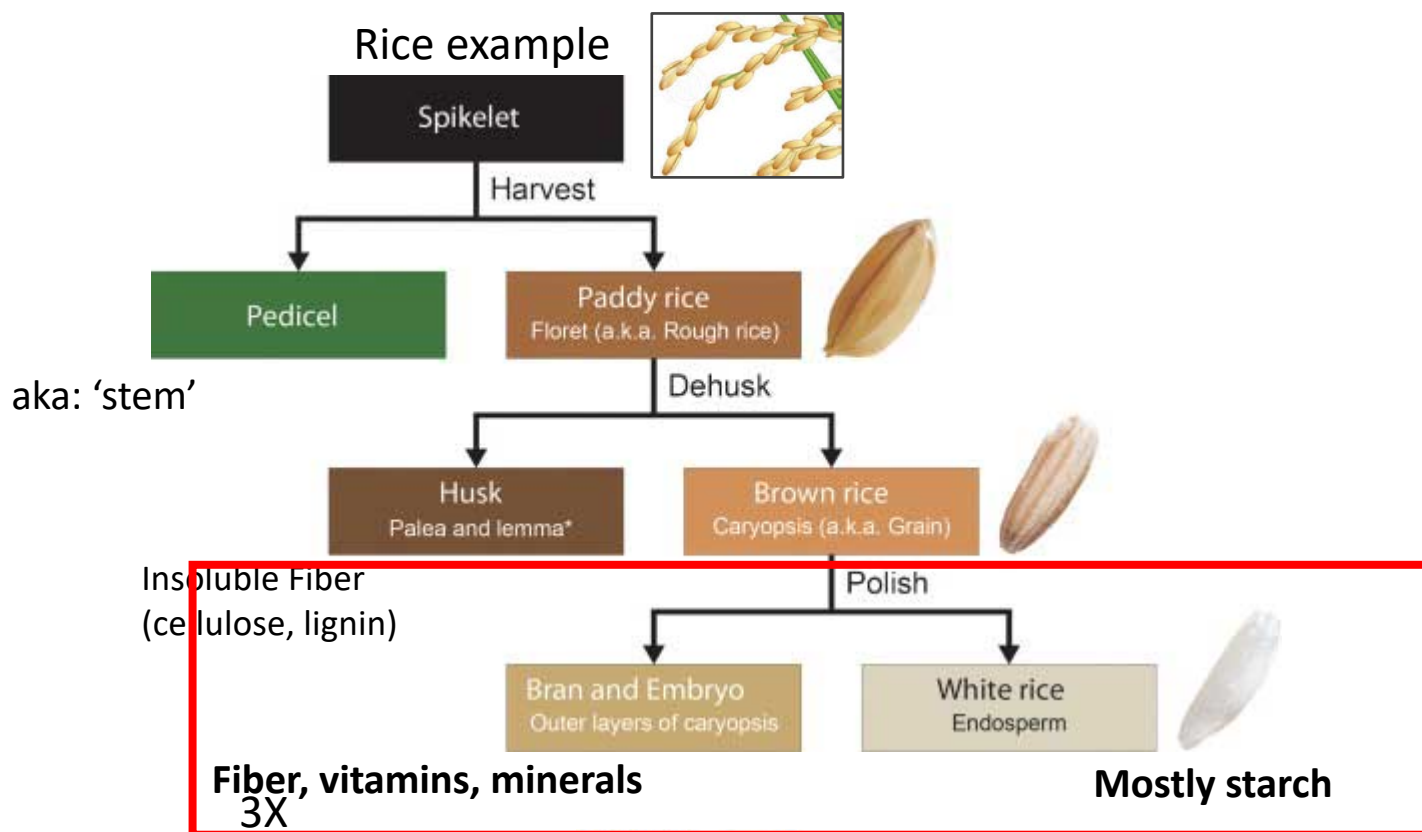
Does processing change nutritional status?

- Intact grains are not necessarily 'whole grains'
- Husk / hull must be removed to be edible



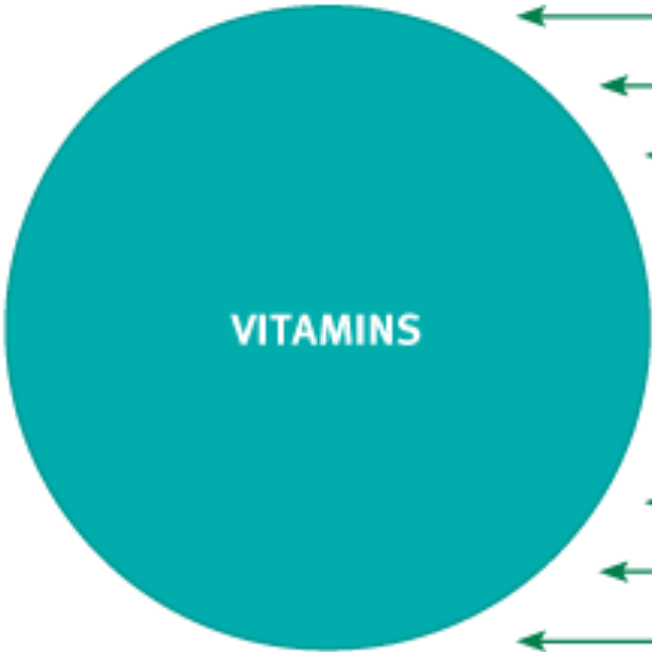
Whole → Refined grain

- Removal of bran and germ removes many nutrients

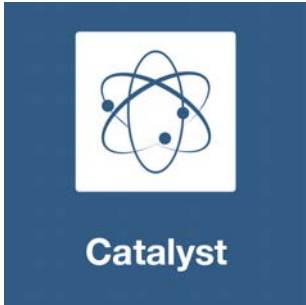


Factors affect nutrient stability

Factors Affecting the Stability of Vitamins



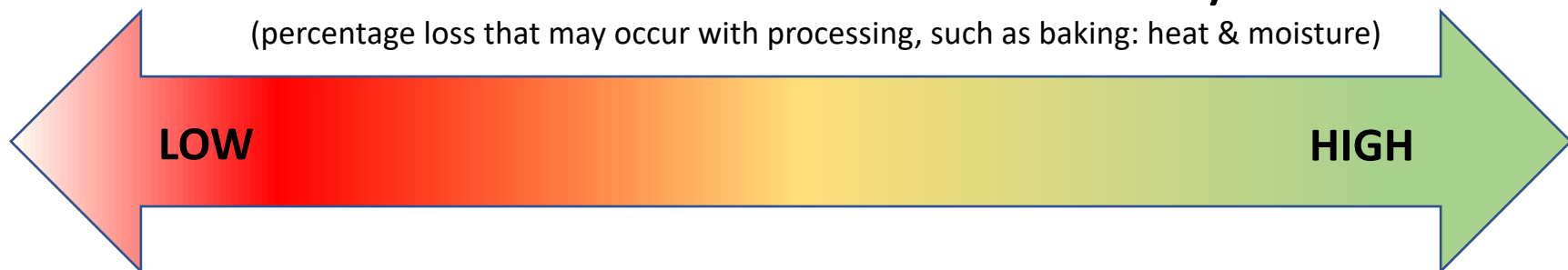
- Temperature
- Water Content
- pH
- Oxygen
- Light/Irradiation
- Catalysts (Fe, Cu, etc.)
- Inhibitors
- Interactions
- Energy
- Time



Nutrient stability

Continuum of vitamin stability

(percentage loss that may occur with processing, such as baking: heat & moisture)



Vitamin K

Pyridoxine (B6)

Choline

Riboflavin (B2)

5-10%

Vitamin A

10-20%

Thiamin (B1)

15-25%

Folic Acid

20-30%

Vitamin E

Vitamin B12

Vitamin D3

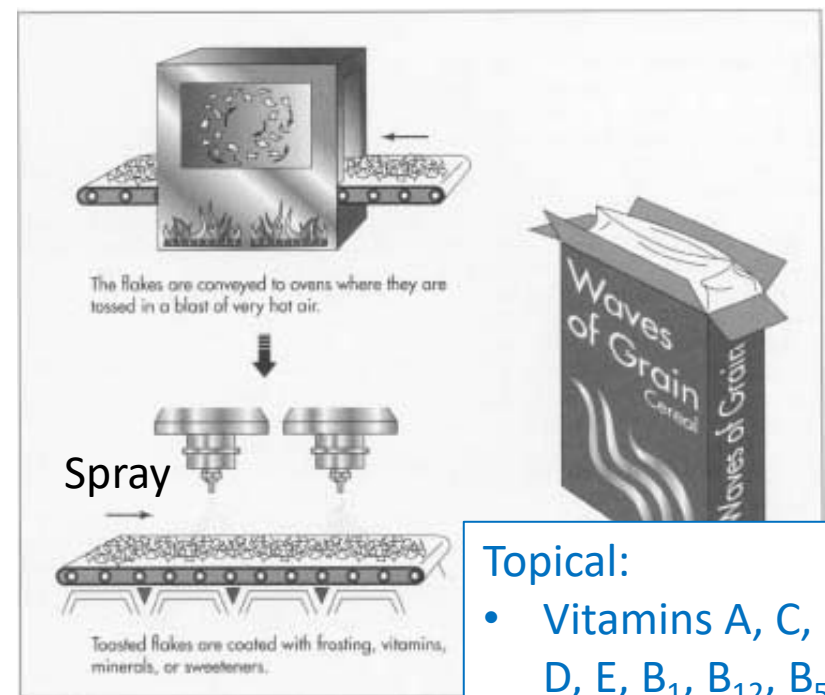
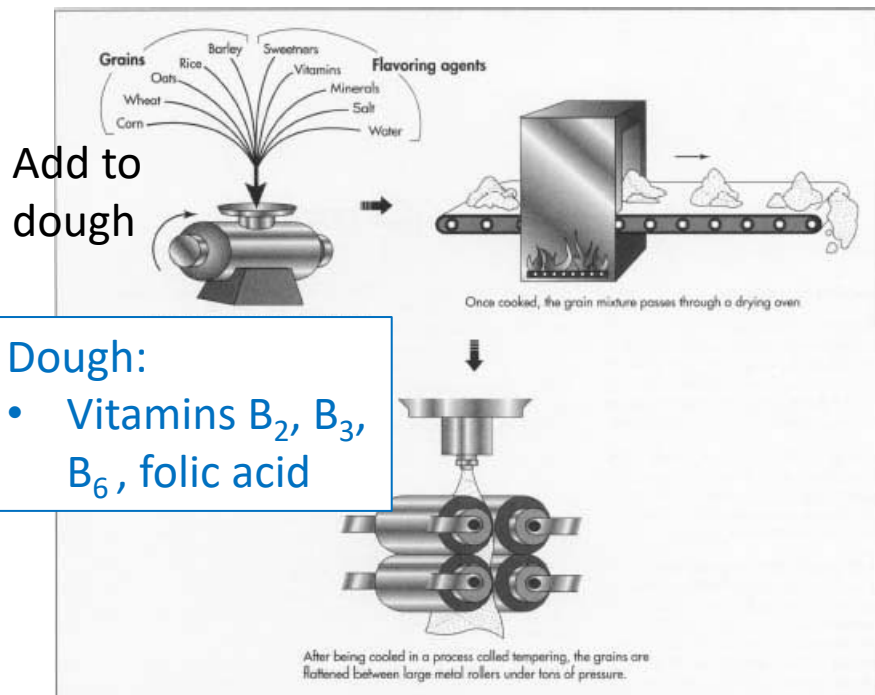
Biotin

Ca-pantothenate

So what can we do?

RTE Cereal: Heat (& Moisture)

- Overages
 - Vitamin decay offset by additions
 - Products must contain the labeled amount until end of shelf-life
- Application – add heat / O₂ labile post-cooking



Baking: Heat & Moisture

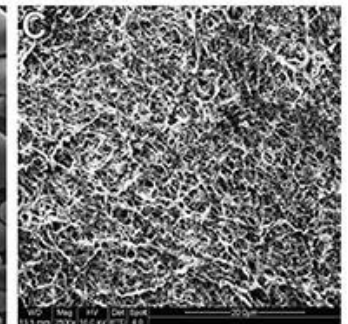
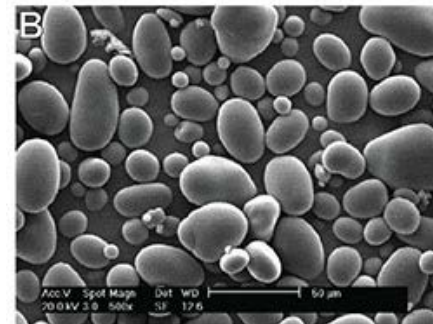
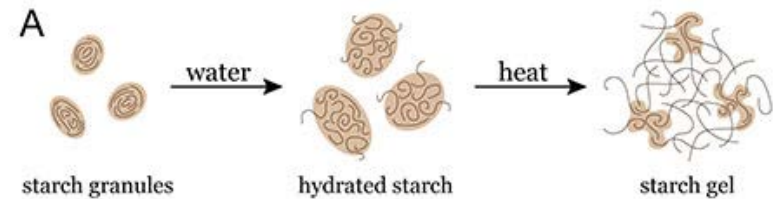


Vitamin Losses During Typical Bread Baking

Nutrient	% Loss during baking
Vitamin A	10 - 20
Thiamin	15 - 25
Riboflavin	5 - 10
Niacin	0 - 5
Folic Acid	20 - 30

Source: F. Hoffmann - La Roche. Unpublished Data. Basel.

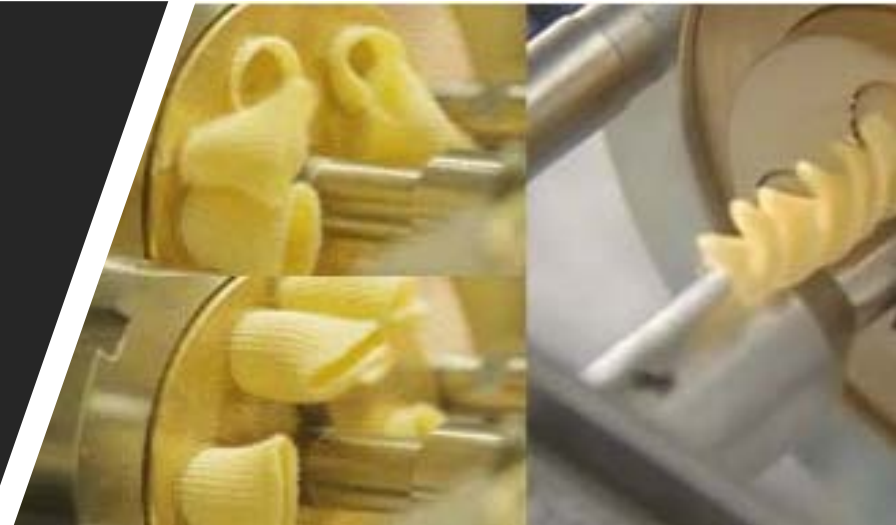
- https://www.dsm.com/content/dam/dsm/nip/en_US/documents/stability.pdf



Higher moisture + heat =
'gelatinized' starch

Extrusion: Hot & Cold

- Mixed ingredients forced through opening and cut into pieces
- Process may be cold (e.g., pasta) or hot (e.g., cereal, snacks)
 - Non-WG pasta (refined flour) has few nutrients to impact
- High heat gelatinizes starch and increases bioavailability



Sprouting whole grains

- Loss of starch often mis-reported as increase in other nutrients
 - Nutrients may appear higher in relation to lower grain weight
- Sprouting (temp. & moisture): breakdown some nutrients
 - Starch broken down
 - Some vitamins lost (thiamin)
 - Some vitamins formed (riboflavin, niacin)

is a Sprouted Grain?



When a grain kernel – the seed of a wheat plant or other grain – is given just the right temperature and moisture conditions, it begins to sprout.

A sprouted grain has begun to grow into a new plant – but just barely. The new sprout will be shorter than the length of the original grain.

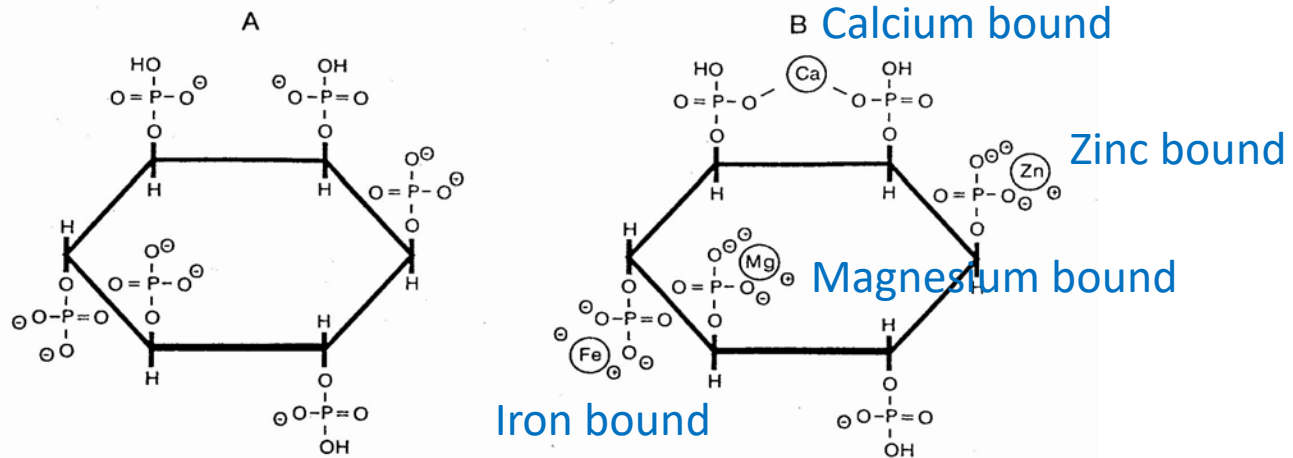


Plants don't share their nutrients

- Phytic acid stores plant phosphorus...but binds minerals (calcium, iron, zinc, magnesium)
- Extrusion (hot processes) degrade phytate

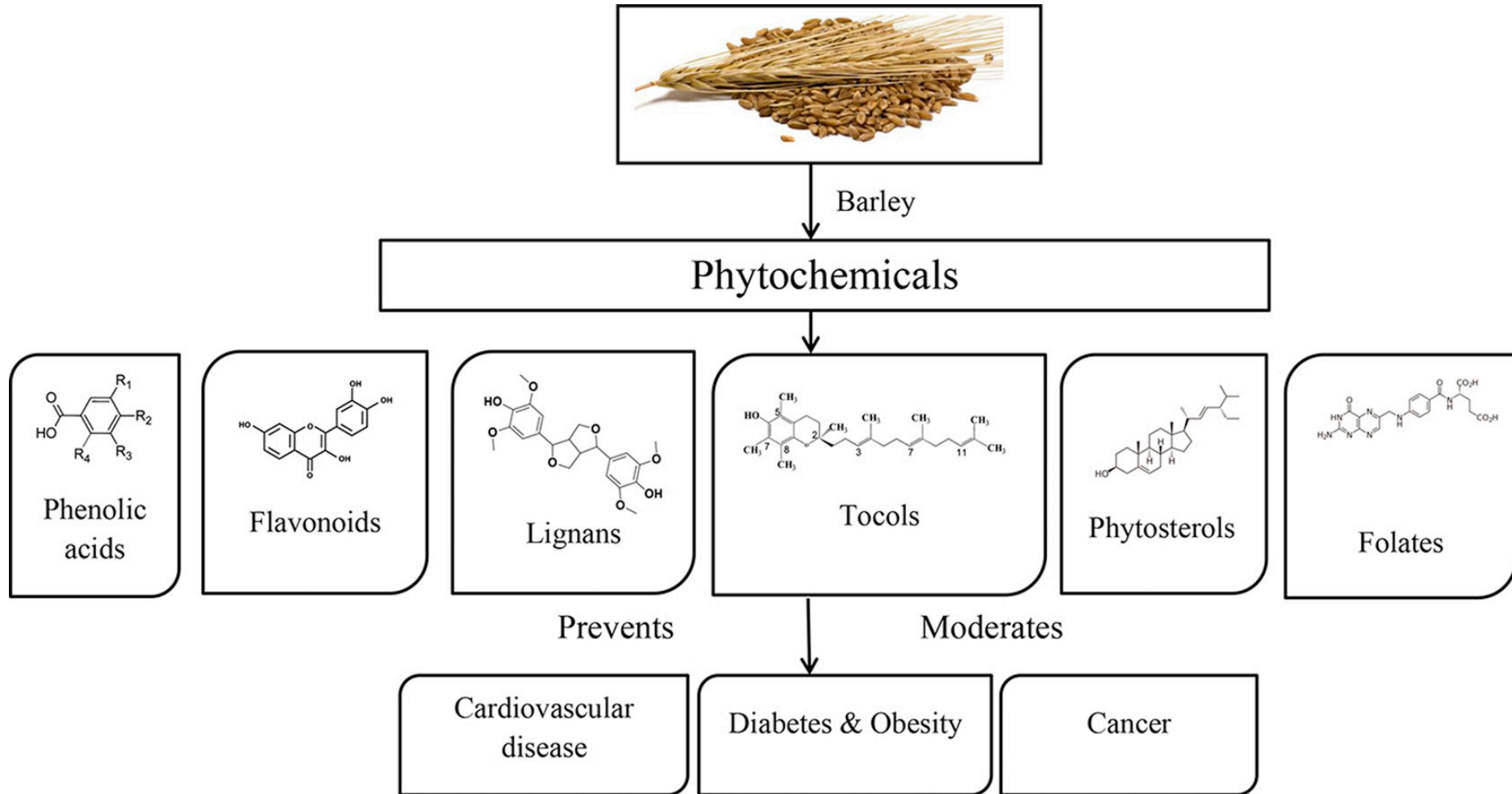
Br J Nutr. 2002 Aug;88(2):117-23.

Structure of Phytic Acid (A) and Phytic Acid Chelate (B)



Myo-inositol hexaphosphoric acid

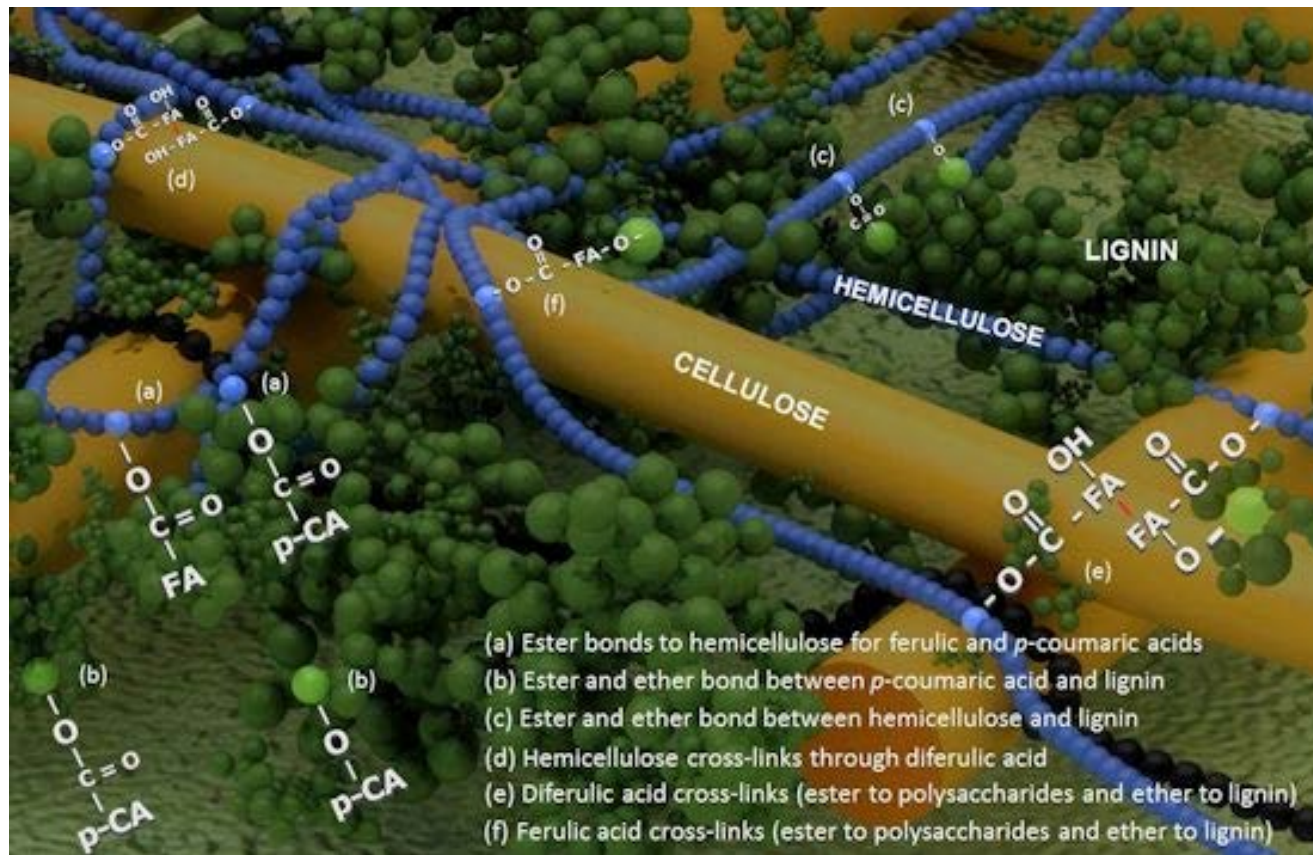
Processing and Phytonutrients



<https://www.sciencedirect.com/science/article/pii/S1021949816301223>

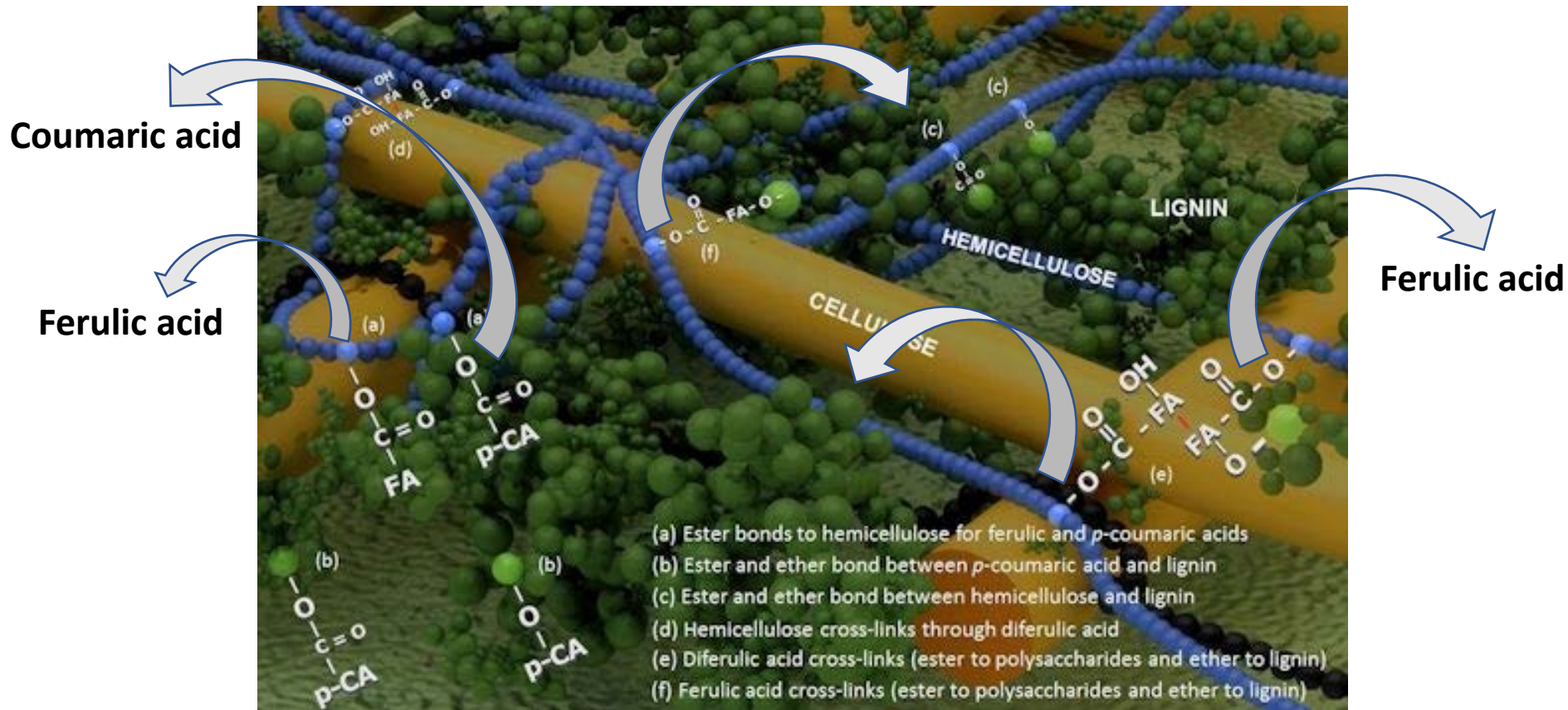
Liberating antioxidants from grains

- Phytonutrients can be tightly bound to fiber in the grain's bran layer (nutrient is unavailable)



Liberating antioxidants from grains

- Processing disrupts the matrix; antioxidant compounds are available for absorption



Summary

- Commercial processing encompasses many of the same steps that occur in-home
- Milling of whole grains necessary to make them edible
 - Safety drives modern processes
- Multiple variables impact foods' nutrients
 - Light, time, heat, air, water ...
- Nutritional trade-off of processing
 - Some vitamins degrade
 - Other nutrients become available
- How do we improve nutrition content of grain foods?
 - Support and demand whole grain foods

Thank you!

Stay connected for more
Whole Grain news



Bellinstitute.com



[@Bellinstitute](https://twitter.com/Bellinstitute)



[@Bell.institute](https://www.instagram.com/Bell.institute)



Bell Institute of Health &
Nutrition at General Mills



General Mills Bell Institute of
Health & Nutrition

Check out our upcoming
webinars at:
Bellinstitute.com

Thank you!

How to contact me:



Kevin Miller, Ph.D.
Global Scientific and Regulatory Affairs
Principal Scientist
✉: kevin.miller2@genmills.com
☎: (763) 764.2719 | 612-354-0596 (Mob)