Factors affecting quality of grain

"Grain Gathering"

Lille Bakery

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BOOST (Organic RDD-6)
and DIVERSILIENCE (CoreOrganic)

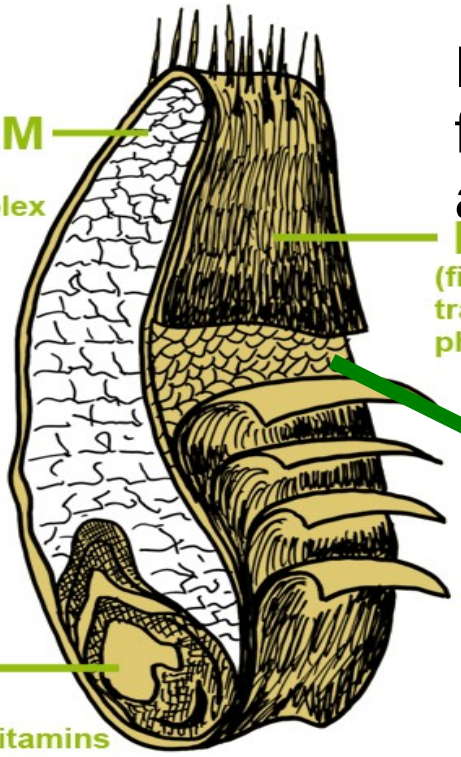
wheat is not just wheat,

and quality is not just quality


weather
soil
milling
harvest conditions
drying
Variety
fertilisers
wheat is not just wheat,
and quality is not just quality
health issue
bread volume
texture
taste

The Whole Grain Kernel

Inflammatory food



ENDOSPERM
(source of complex carbohydrates, B-complex vitamins and proteins)

Gluten, starch
No taste,
Low nutrition
Baking quality

GERM
(essential fatty acids, vitamin E, B-complex vitamins and trace minerals)

Minerals, mycotoxins, taste, fibres, tannins, phytic acid anti nutrients

BRAN
(fiber, B-complex vitamins, trace minerals and phytonutrients)

Aleuron
ATI,
proteins with essential amino acids
enzymes for gluten degradation

Bitter healthy
Anti inflammatory

Crucial for human health and taste, but with a potential side-effect

Quality of wheat

Quality of wheat

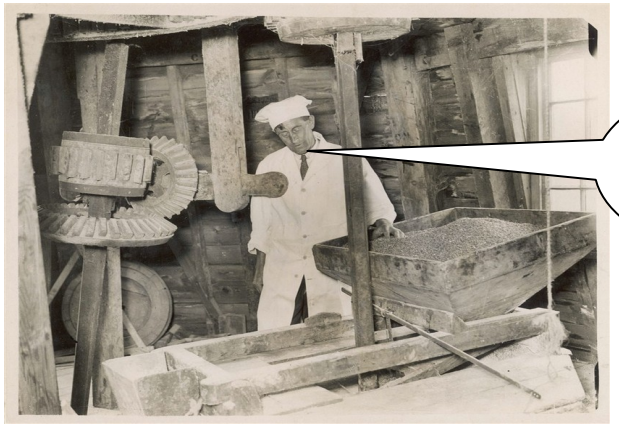
Seed hardiness
Bran content

Quality of wheat

Seed hardiness
Bran content

Bread volume
Gluten elasticity

Quality of wheat



Seed hardiness
Bran content

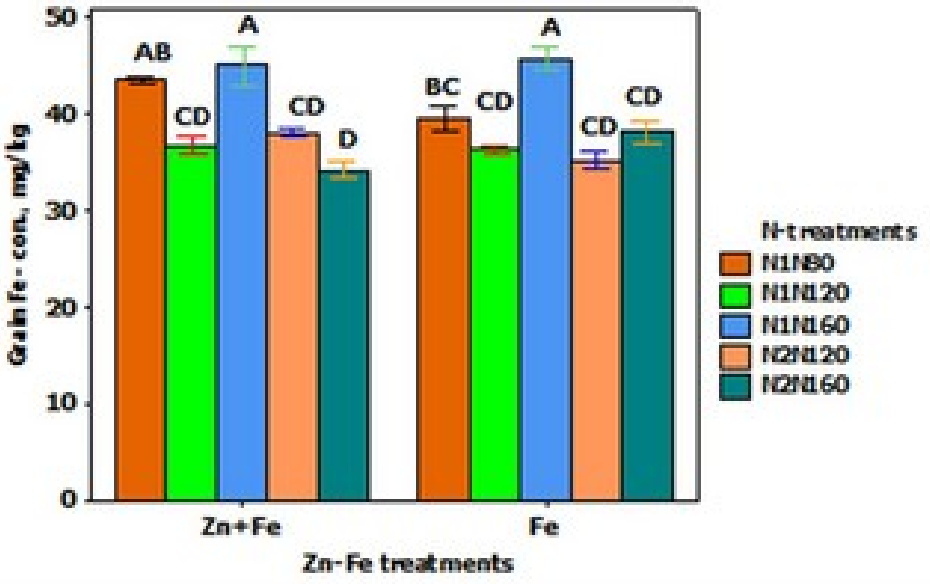
Taste
Colour

Bread volume
Gluten elasticity

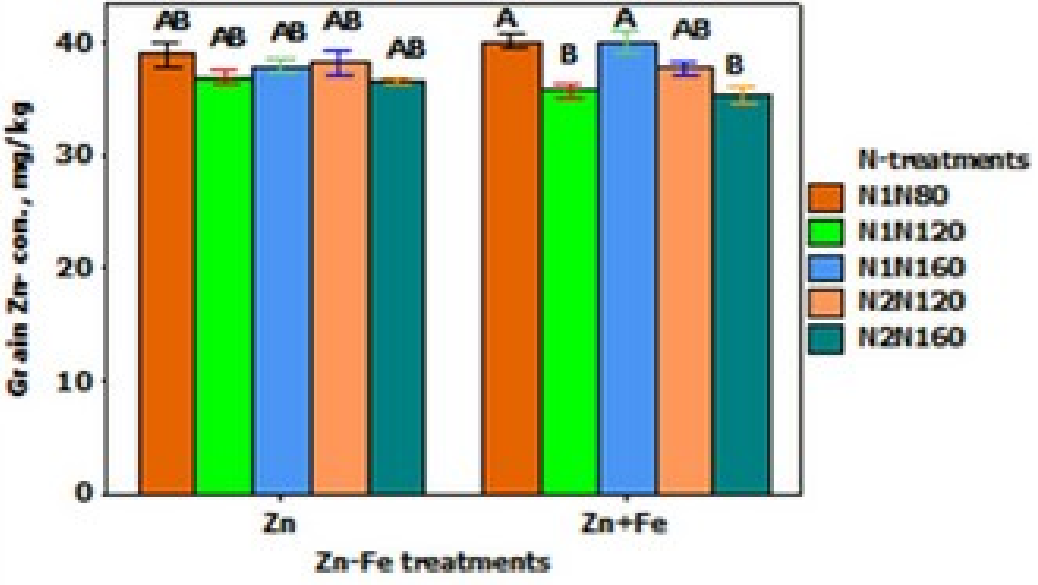
Allergy
Minerals
Phytic acid
Amino-acids
Obesity
Dietary fibres
Diabetes

Mineral concentration as affected by nitrogen application

Iron

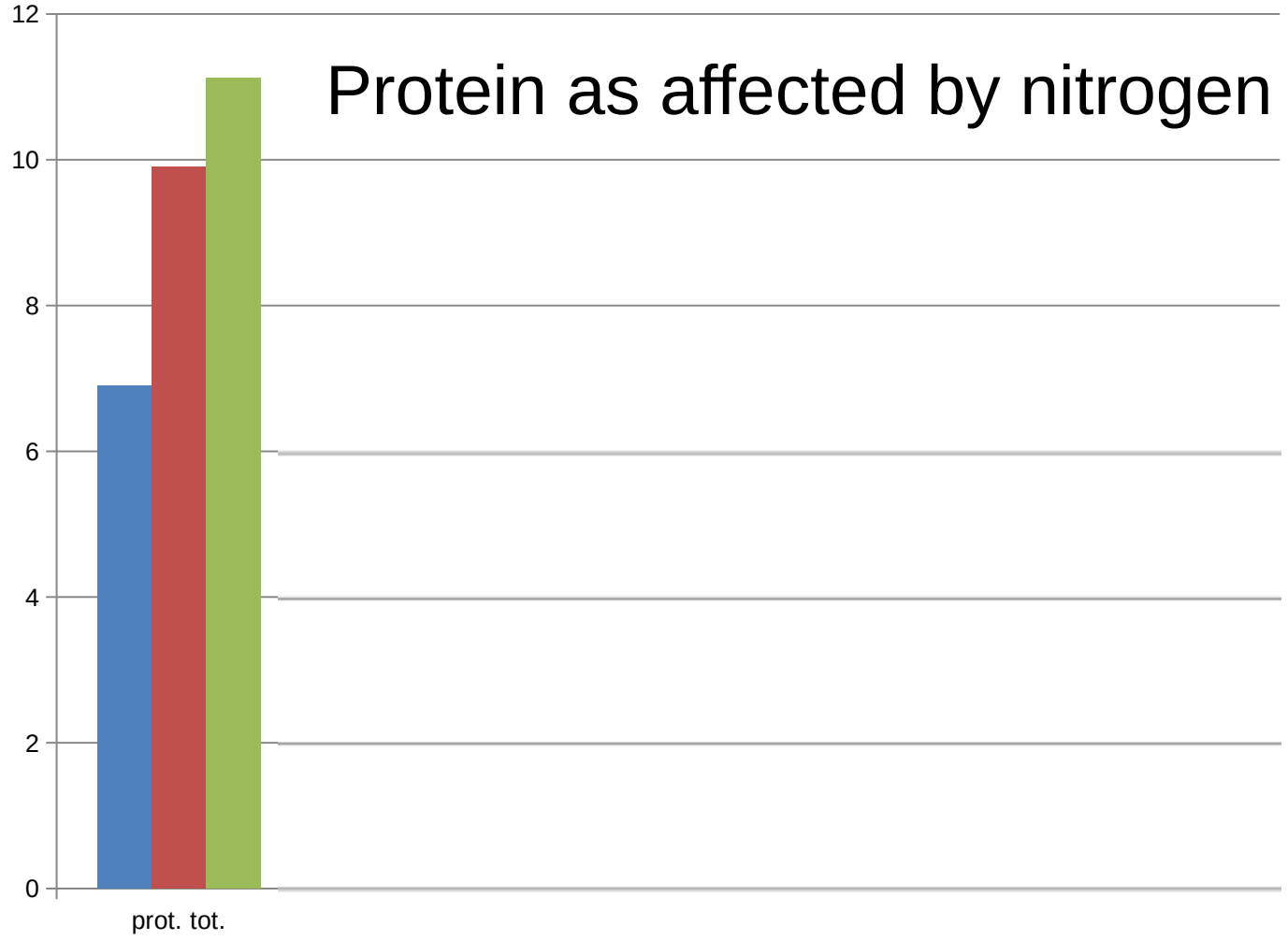


Zink



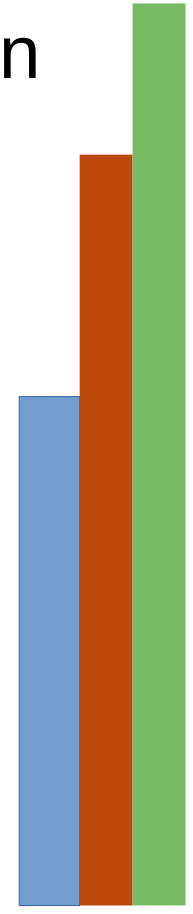
A small almost insignificant decrease. Effect on taste??

Protein as affected by nitrogen application



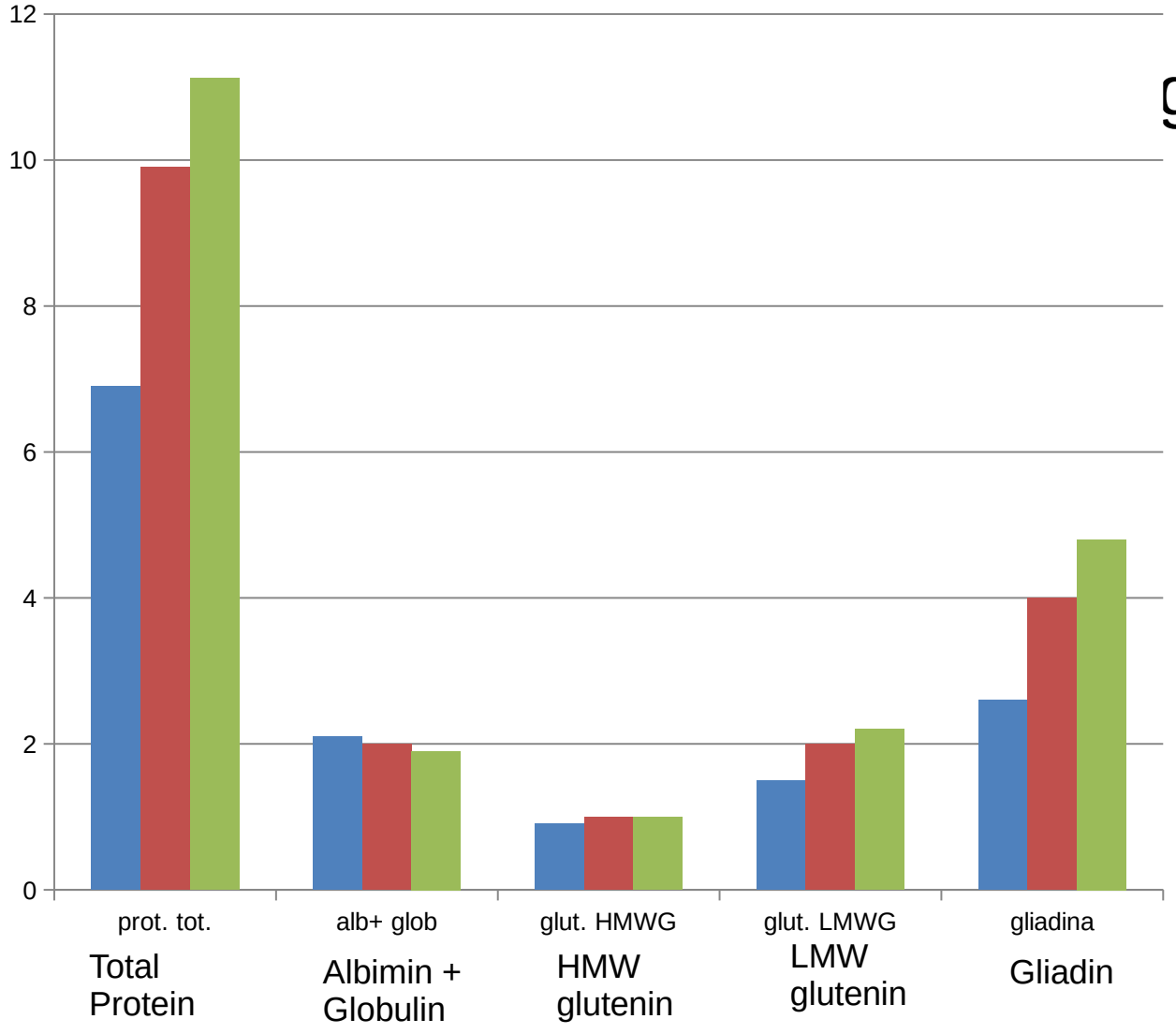
Total Protein

N: 0 kg/ha
N. 120 kg/ha
N: 200 kg/ha



Yield

gen application



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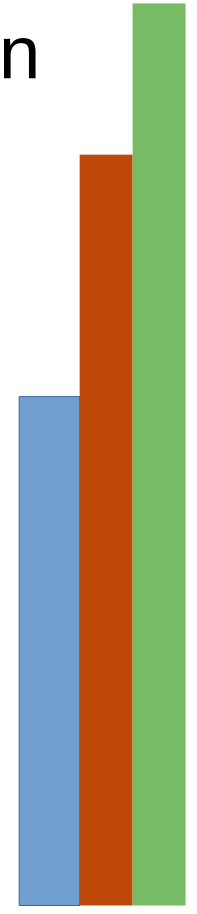
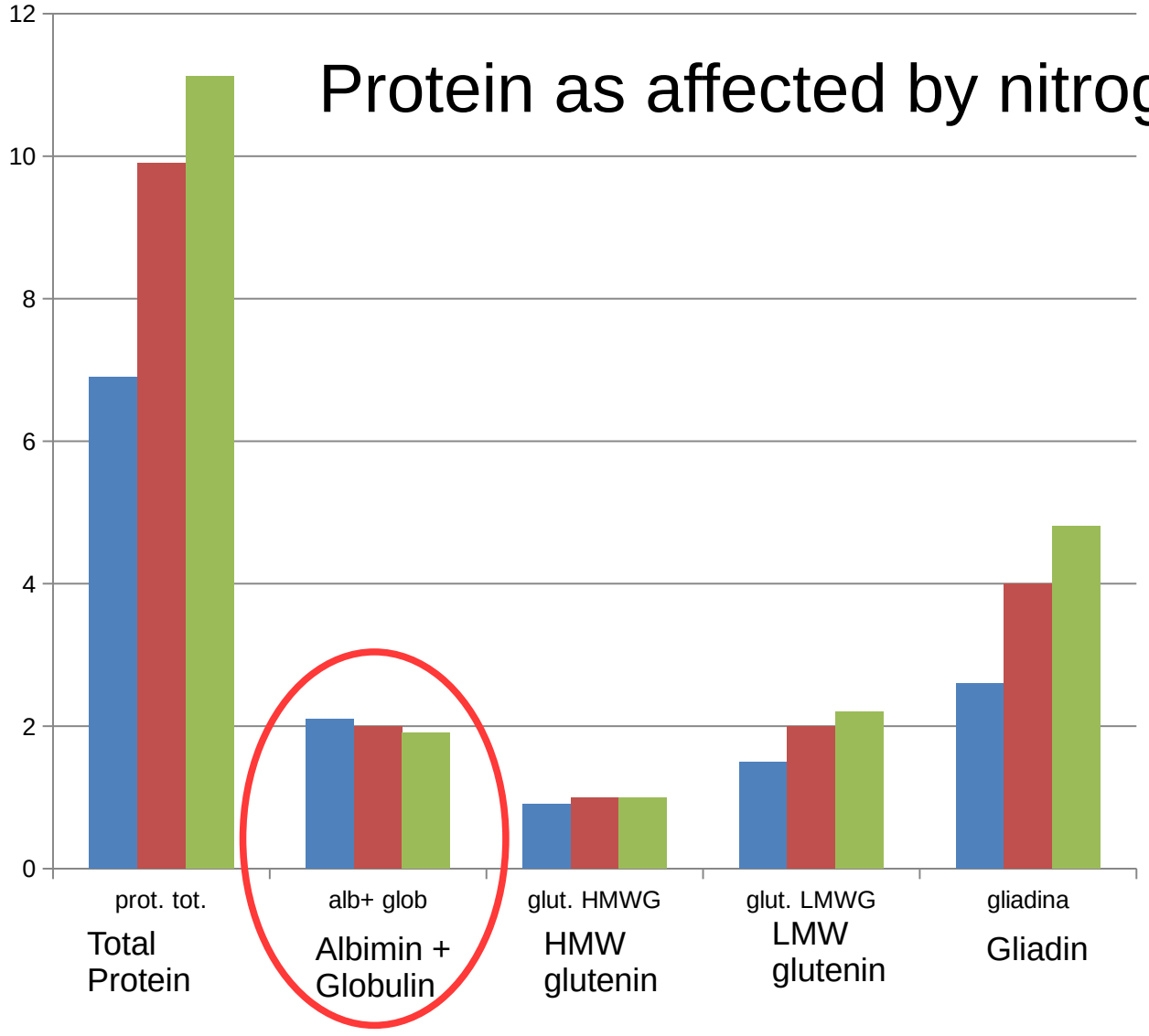
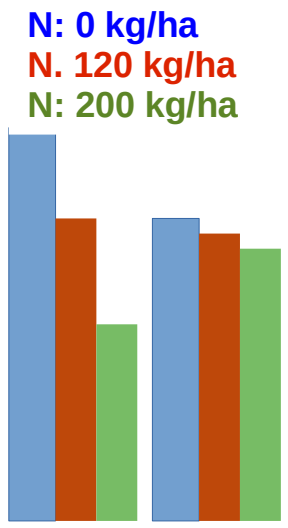


Yield

Protein as affected by nitrogen application





N: 0 kg/ha
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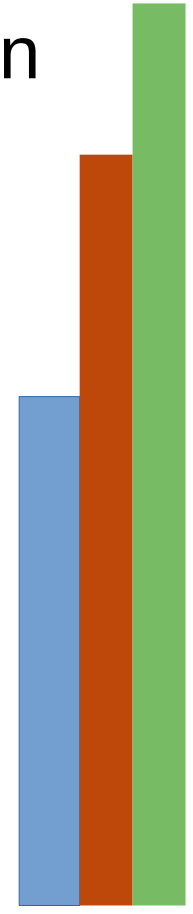
Taste?



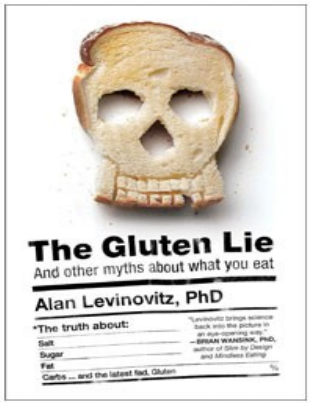
Yield

The miller’s and baker’s nightmare is the low carp paleo diet

- 11.000 years ago, the change into grain based diet, resulting in:
  - reduced life expectancy age, reduced height (11cm), cardiovascular diseases, cancer, rheumatism, allergies, autoimmune diseases, dental caries
  - increased fertility and population
  - increased violence and work load
- In the past decades, lifestyle diseases incl. diabetes, autism, obesity, celiac and NCGS increase epidemically


Jørn Ussing Larsen
Fremtidens brød
af
fortidens korn
Olivia

Modern wheat
taste like nothing and is unhealthy



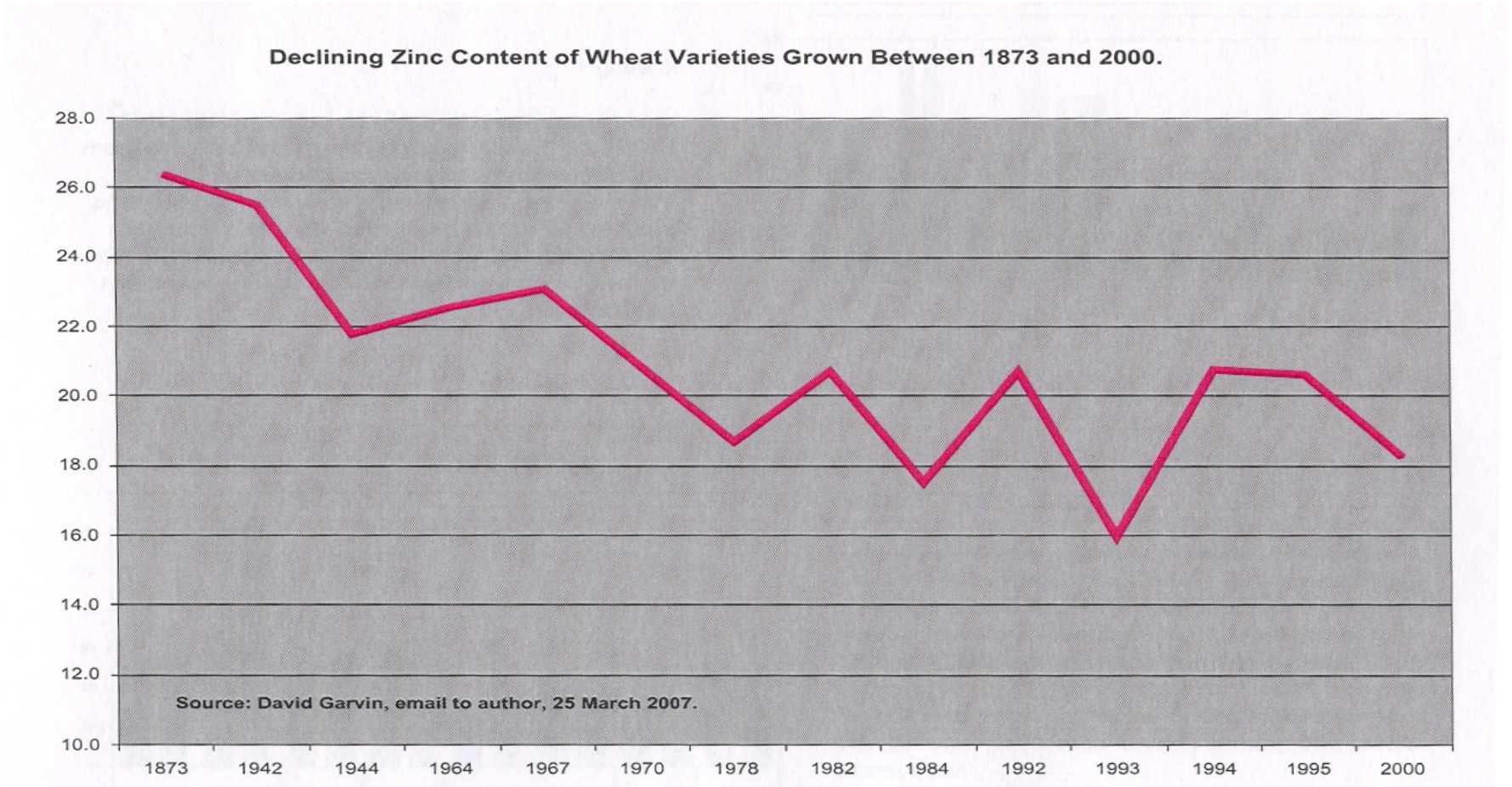
(Vu et al 2015)

- 63% were more allergic to wheat compared to spelt,
- 30% were more allergic to spelt than to wheat

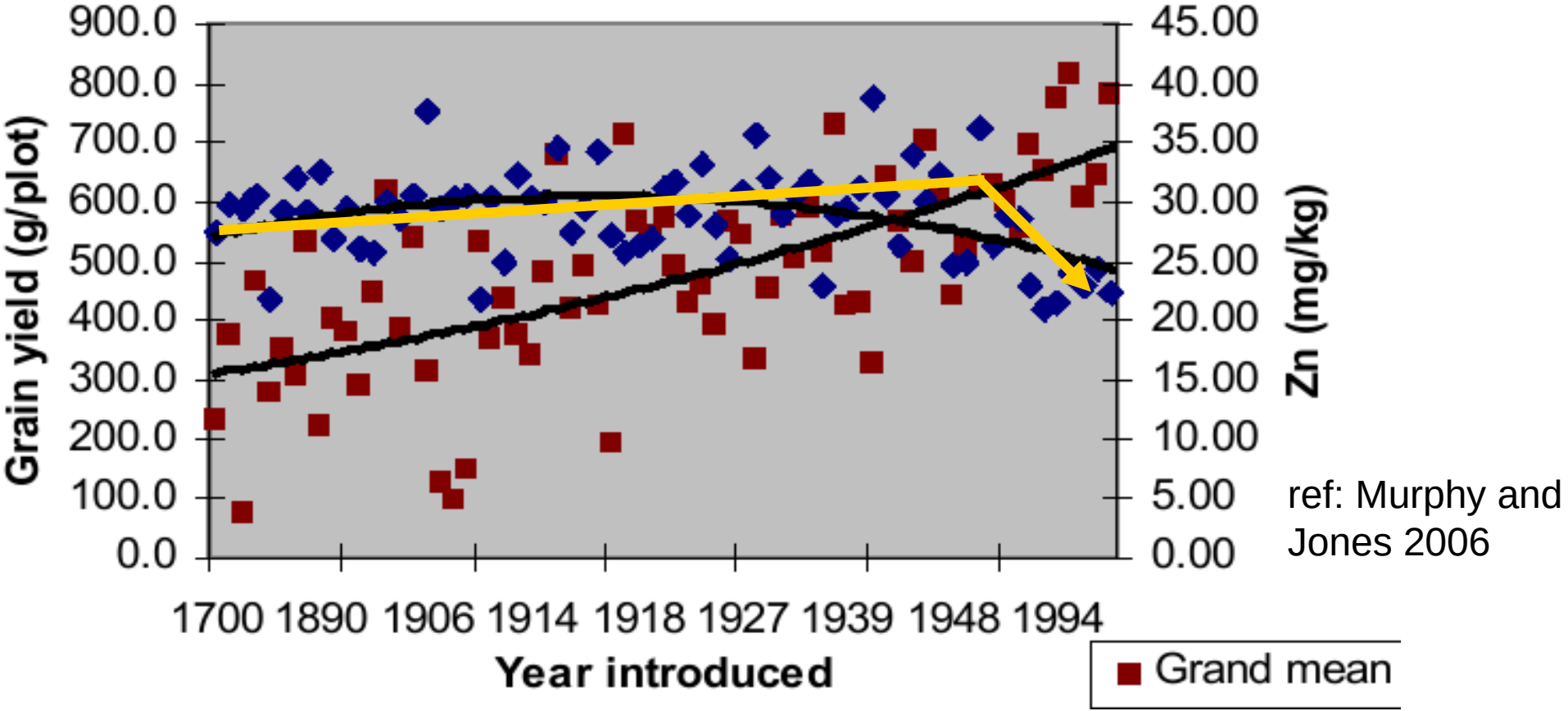
(Van den Broeck et al 2010b)

- 12 out of of 44 heritage wheat produced low levels of the epitope,
- 1 out of 36 modern wheat produced low levels of the epitope,

The hidden hunger



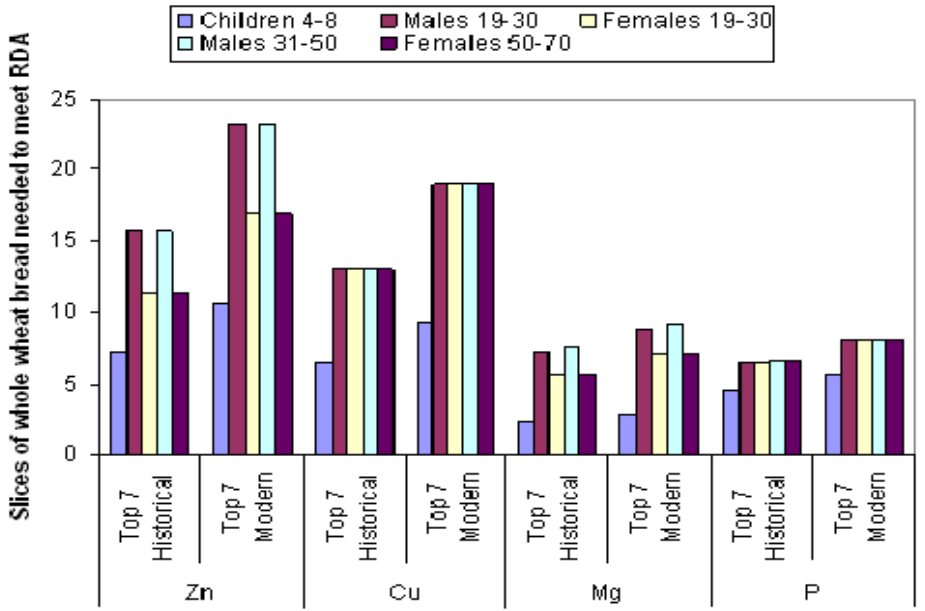
Zink concentration in wheat



ref: Murphy and Jones 2006

Mineral content i conservations varieties

Figure 2. Estimated number of slices of bread required to meet the Recommended Dietary Allowance (RDA) levels for Zn, Cu, Mg, and P, with flour from both modern varieties (denoted 'Top 7 Modern') and historical varieties with high levels of nutrient content (denoted 'Top 7 Historical').



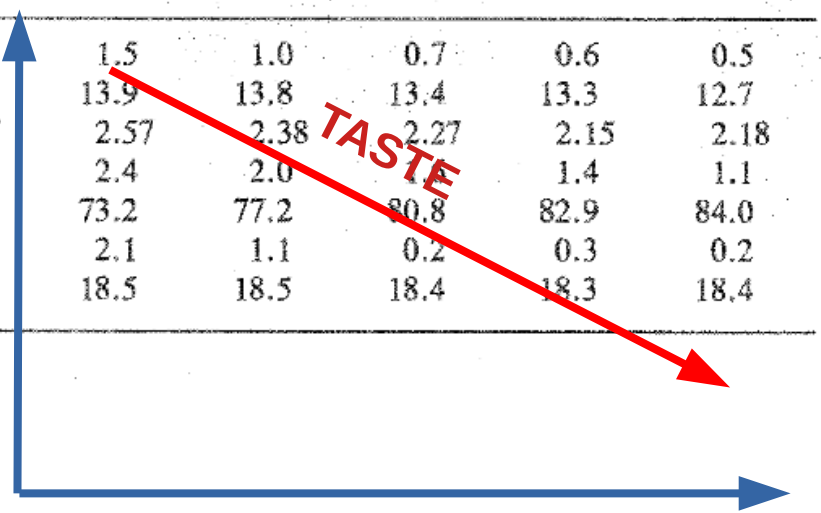
ref: Murphy and Jones 2006

The effect of milling

Tipo 00

Tabel 1. Kemisk sammensætning (tørstofbasis) af hvedemel med forskellig udmalingsgrad

Udmalingsgrad (%) Percent of whole grain	100	95	87	80	75	66
Minerals — Aske (%)	1.8	1.5	1.0	0.7	0.6	0.5
Protein (%)	14.2	13.9	13.8	13.4	13.3	12.7
Lysin (g/16 g N)	2.57	2.57	2.38	2.27	2.15	2.18
Fat — Fedt (%)	2.7	2.4	2.0	1.5	1.4	1.1
Stivelse + sukker (%)	69.9	73.2	77.2	80.8	82.9	84.0
Fibers — Træstof (%)	2.4	2.1	1.1	0.2	0.3	0.2
Energi (kJ/g)	18.5	18.5	18.5	18.4	18.3	18.4

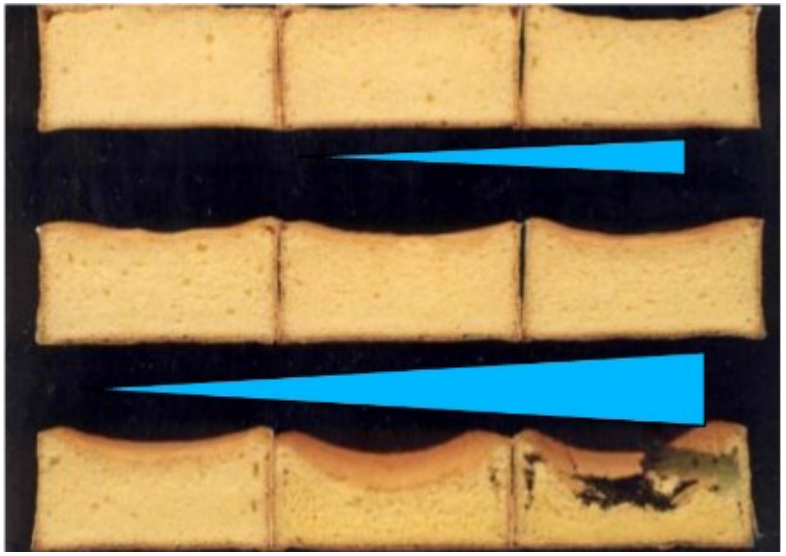


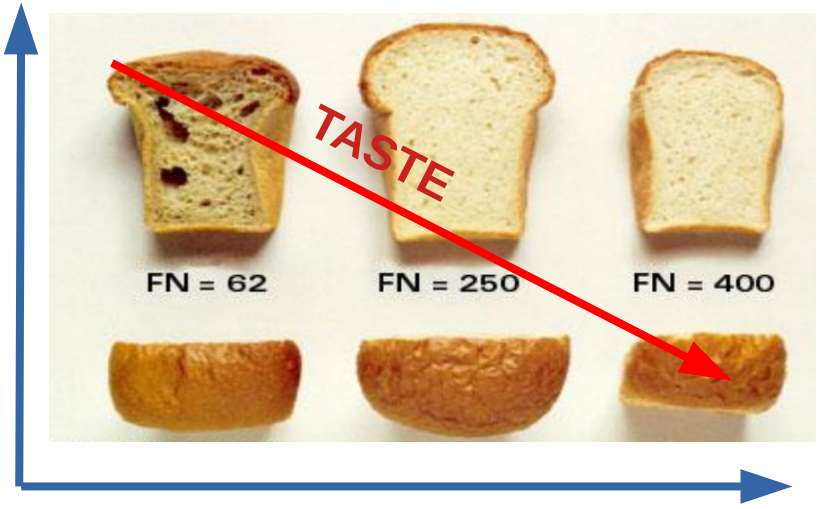
Does the mineral content of the wheat varieties matter, since we discard most of it anyway?

Mineral	Bioavailability	Source
Ca	78	Levrat-Verney et al. (1999)
Cu	23	Egli et al. (2004)
Fe	13	Hallberg and Hulthen (2000)
Mg	70	Levrat-Verney et al. (1999)
Mn	2.2	Johnson et al. (1991)
P	50	Weremko et al. (1997)
Se	81	Fox et al. (2005)
Zn	35	Levrat-Verney et al. (1999)

Bioavailability of minerals is more important for human health than mineral content

Falling number





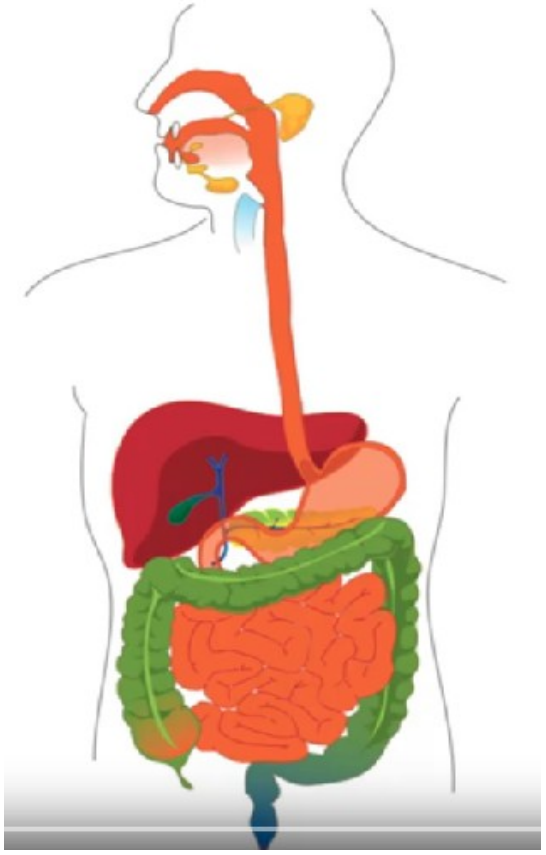
Crucial for baking quality, but with a potential side-effect

Quality is whatever makes the consumers happy

- technical malting or baking quality
- taste
- nutrition and anti-nutrition
- immaterial quality

- effect of the grain itself
- effect of cropping
- effect of processing
- story telling

Our digestion system

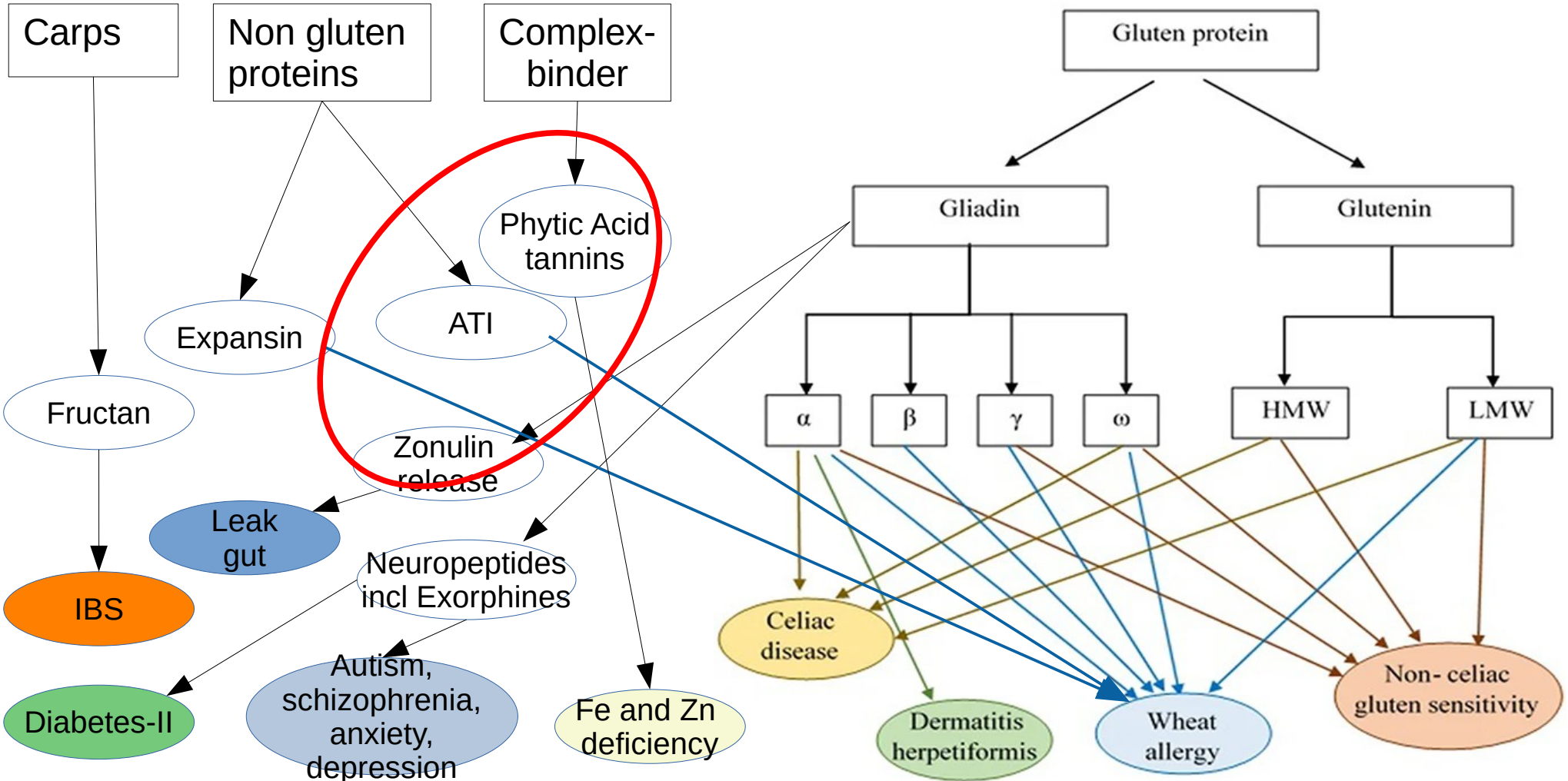


- Food is reduced to sugar and amino acids in the stomach and duodenum
- Proteins and peptides cannot pass the intestinal wall

However,

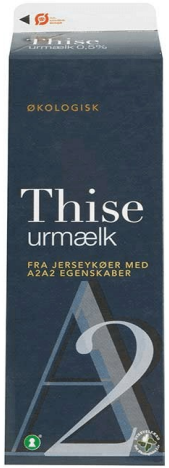
1) not all proteins are fully digested, and
2) some peptides can pass into the bloodstream through the tight junctions

Anti-nutrients in wheat



Zonulin

- Gluten increases production of Zonulins
- Zonulins directly affect tight junction (paracellular) intestinal permeability
- Increase in zolulins increases overall permeability



Lifestyle affecting gut permeability

- Fructose HFCS (activates zonulin and cause inflammation)
- NSAID (ibuprofen) (activates zonulin)
- Sleep depression (activates zonulin)
- Stress (activates zonulin)
- Omega-6 fatty acid (activates general immune response) (a few decades ago, our animals changed from grass based diet to grain based diet, resulting in further decrease in omega-3 and increase in life style diseases)

Digestion of bread

By sifting we remove:
Bran, incl. minerals and antioxidant
Aleuleuron (proteaser)
Germ, incl vitamins and omega-3

Phytate
ATI
Expansin
Exorphins
Gliadin
Glutenin

Breakdown starts
when water is added,
but is blocked by ATI

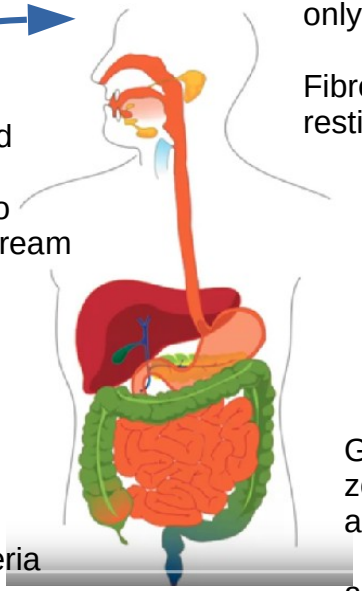
even worse if
Vital-gluten
is added
without protease

Enzymes
denatures
when baking starts
and break down stops
until consumption

Breakdown of
protein into peptides
only if given enough time

Fibres prolongs
resting time

Not digested
peptides
may slip into
the blood stream
if opened
by zonulin



Fructan
feeds bacteria
but may
release gas

Gliadin triggers
zonulin, opening gut-blood barrier
and brain barrier

as does our life style such as
sleep depression
NSAID and
fructose

Wheat varieties with altered health profile

- **Cadenza**: Low content of Glia-α9 and Glia-α20
- **Goldritter**: Low content of ATI
- **E3-spelt**: Low content of expansin and fructan
- **Purpurhvede**: High content of anthocyanin in the bran
- **Blå hvede**: High content of anthocyanin i aleuron
- **Gul hvede**: High content of lutein in endosperm
- **Yumai and Courtot**: High content of arabinoxylan

Examples of **Landsortens** organic heterogeneous material

- **Mariagertoba**: Spring wheat from 2020. a mixture of 25 breeding lines with good baking quality
- **Popkorn**: Winter wheat mixture from 2017. Mixture of 50 breeding lines with good baking quality
- **Pop Pjerrot**: White wheat from 2020. Mixture of 15 breeding lines with good baking quality
- **Pop Giraf**: Winter wheat from 2020. Mixture of 15 breeding lines with good baking quality and +95cm
- **Pop Gurli**: Winter wheat from 2020. Mixture of 25 breeding lines with high yield potential
- **Pop Fitnis**: Winter wheat with altered protein content

Conclusion

- You can get it all, but not at the same time
- either loaf volume, or taste and nutrition
- Variety (eg. purple or blue wheat) has some influence on taste and nutrition, but grain processing (harvest, baking, milling) is generally more important
- Wheat can be nutritious, but only if you treat it right
- raising time is by far the most important


Tank you for your attention