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The peculiarities of rye regarding its fibre constituents

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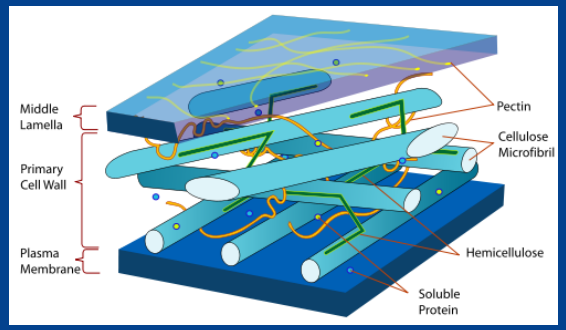
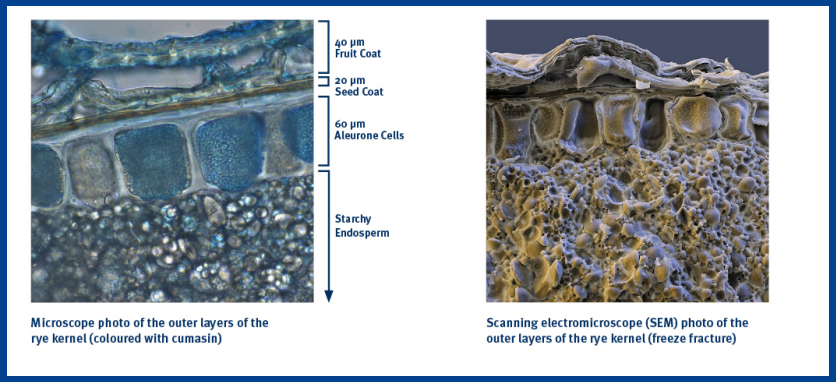
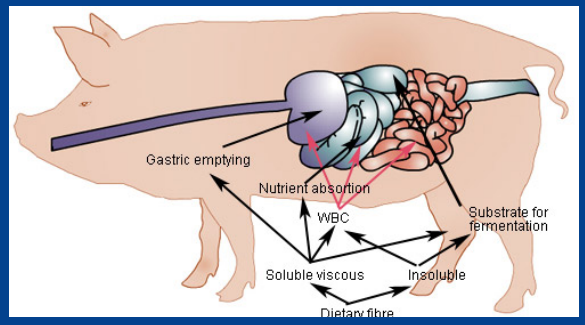






Points to be addressed

- Introduction – general remarks
- Dietary fibre definition
- The fibre components in rye and its distribution in the rye kernel
- The composition of fibre in rye compared to other cereals
- Current knowledge on the site of degradation of rye fibre in the GIT of pigs
- Take home message

Introduction – general remarks

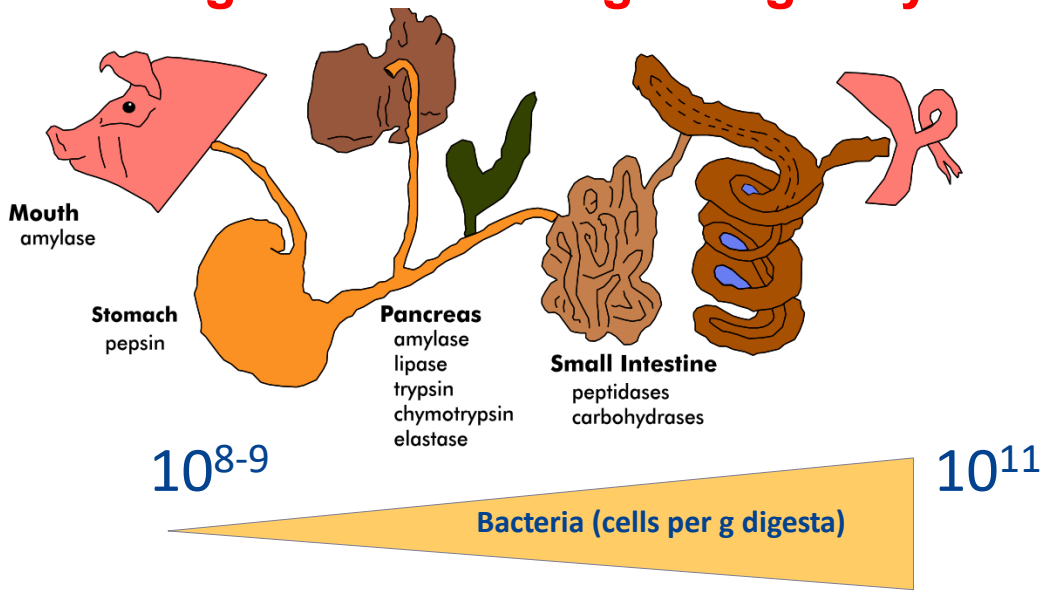
- Fibre represent carbohydrates and lignin that cannot be digested by endogenous enzymes but potentially can be fermented by the microbiota
- The fibre composition varies between different cereals and between the different tissue layers of individual cereals
- Fibre influences digestion and absorption at all sites of the gastrointestinal tract and the microbial fermentation in the large intestine

Recent human dietary fibre definition

› Carbohydrate polymers (and lignin) with three and more monomeric units which are neither digested nor absorbed in the human small intestine.

Codex Alimentarius and the
European Commission (2009)

No endogenous fibre degrading enzymes!



But a variety of fibre degdading microbial enzymes

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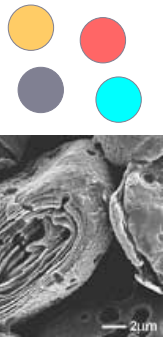
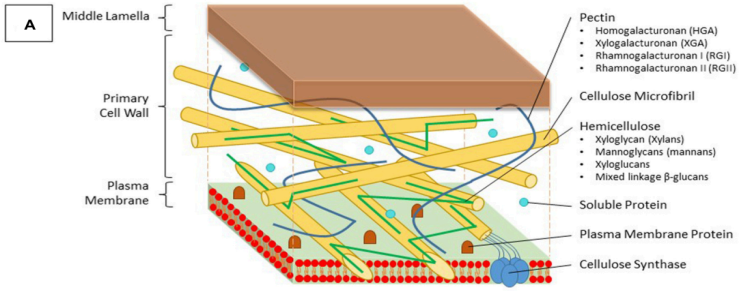
The main classes of dietary fibres

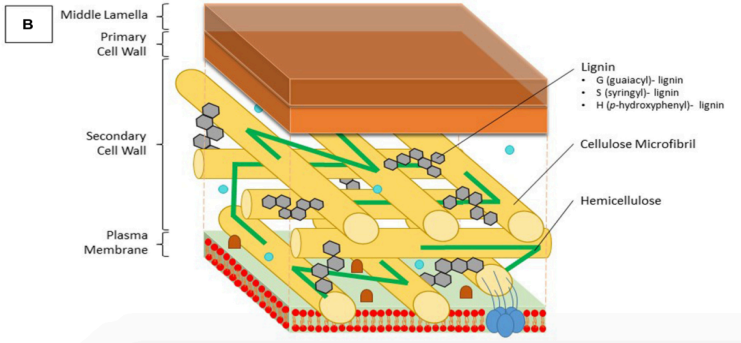


Oligosaccharides

Resistant starch



Non-lignified



Lignified

Cell walls

Simple

Complex

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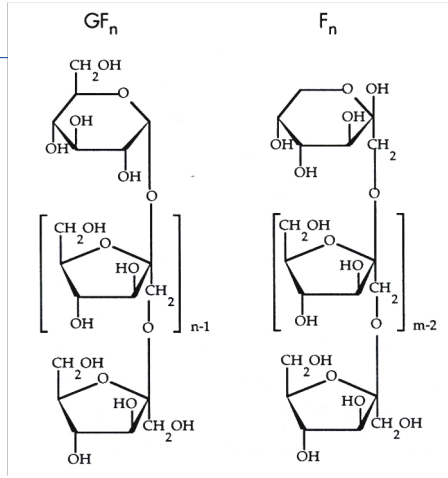
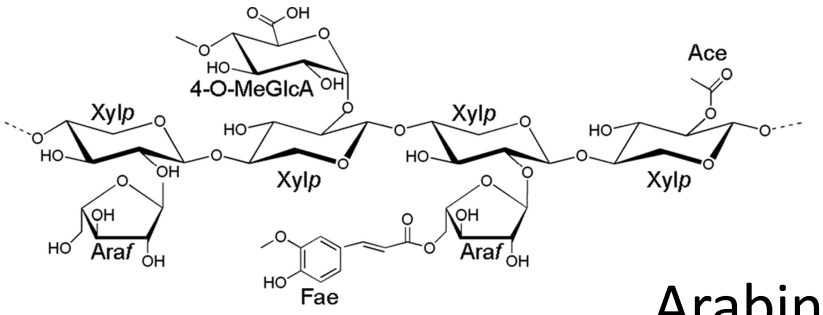
The main fibre components in cereals

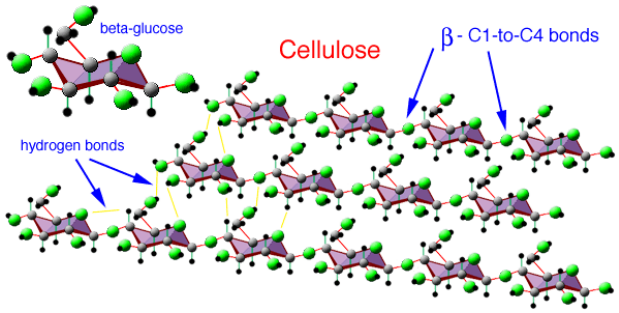


Fructans

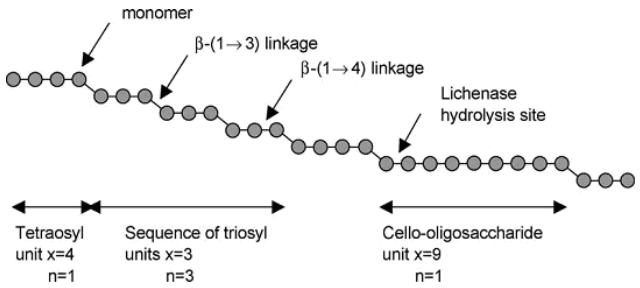


Arabinoxylan

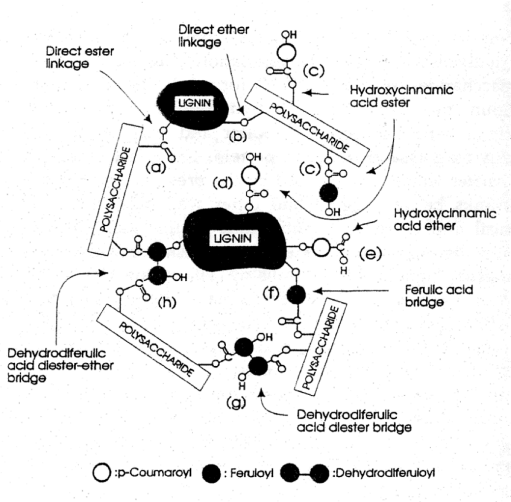
Ace = acetate
Araf = α-L-arabinofuranose
Xylp = β-D-xylopyranosse
Fae = ferulate
4-O-MeGlcA = 4-O-α-D-methyl glucuronic acid



Cellulose



β-glucan



Lignin

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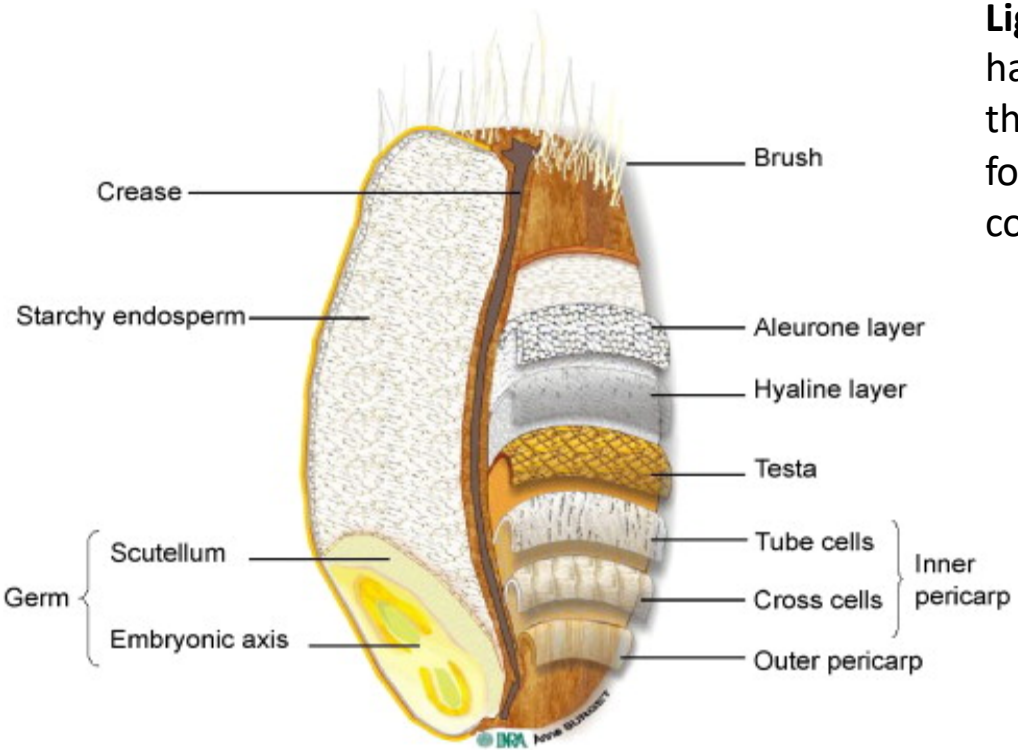
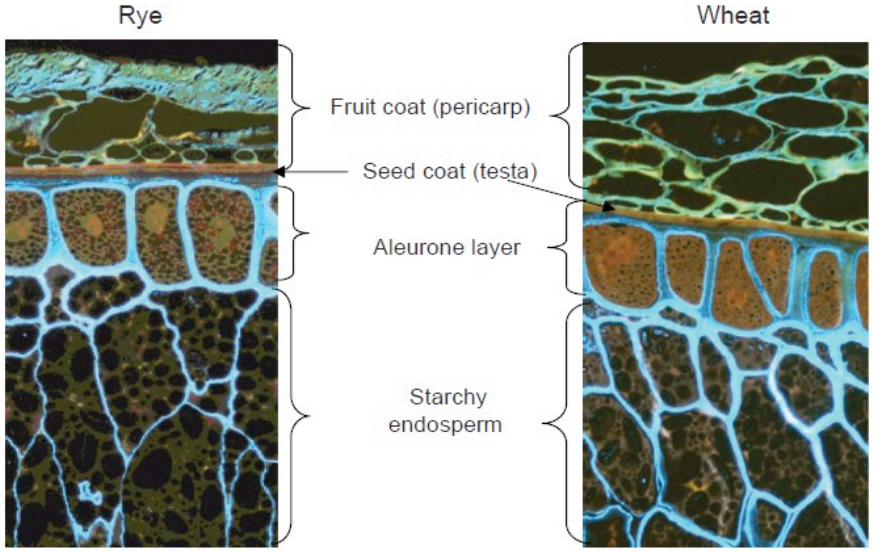
Non-lignified and lignified cell walls, i.e. wheat and rye



Lignified: The tissues of the outer part of the kernel have primarily a role of protection. Cell walls in these tissues are thick, hydrophobic and essentially formed of cellulose and complex xylans but also contains significant amounts of lignin.



Non-lignified: In endosperm tissues, cell walls represent 2-7% of the tissue, they are thin and hydrophilic and essentially formed of two polymers: arabinoxylan and mixed linkage (1-3)(1-4)-β-glucan.

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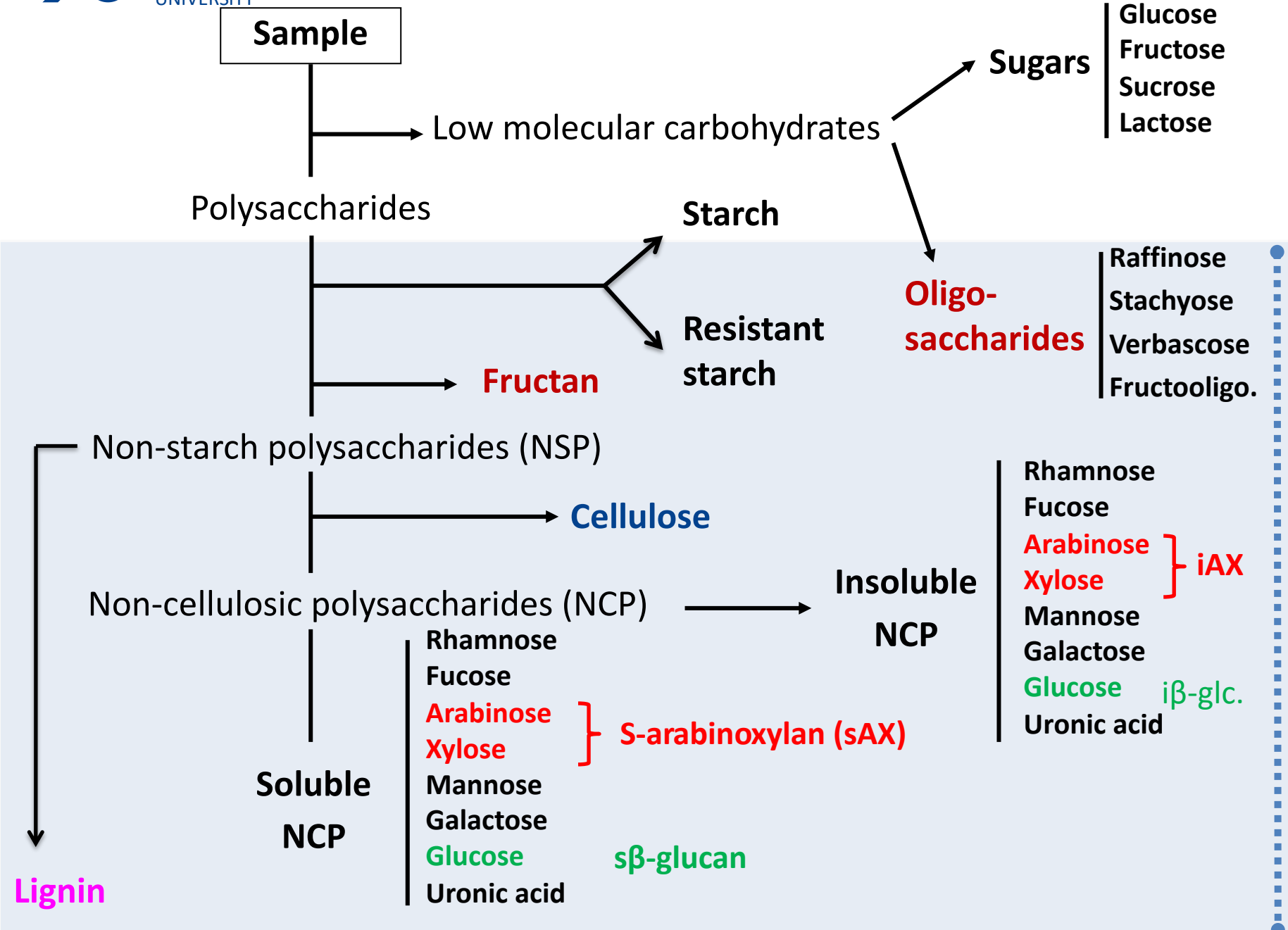
Determination of carbohydrates and lignin



Composition (% of DM) of rye and wheat

	Rye	Wheat	Δ
Number of samples…	8	16	
Resistant starch	0.2	0.2	
Fructans + oligosaccharides	3.4	1.5	+1.9
Non-starch polysaccharides			
Cellulose	1.4	1.9	-0.5
$NCP_{glucose}$ (β-glucan)	2.4 (0.6)	1.2 (0.9)	+1.2
Arabinoxylan	9.0 (3.1)	7.5 (2.0)	+1.5
NCP_{Others}	1.3	1.1	+0.2
Total NDC	17.6 (4.2)	13.4 (3.6)	
Lignin	2.3	1.8	+0.5
Dietary fibre	19.8 (4.2/7.6)	15.2 (3.6/5.1)	+4.6

$NCP_{glucose}$, non-cellulosic polysaccharides glucose;
NDC, non-digestible carbohydrates.

The fibre in rye compared with other cereals

- **Principal component analysis (PCA)** is a common statistical tool used for visualizing groupings of samples and for identifying variables. The method involves a mathematical procedure that transforms a number of correlated variables into a small number of uncorrelated variables called principal components.

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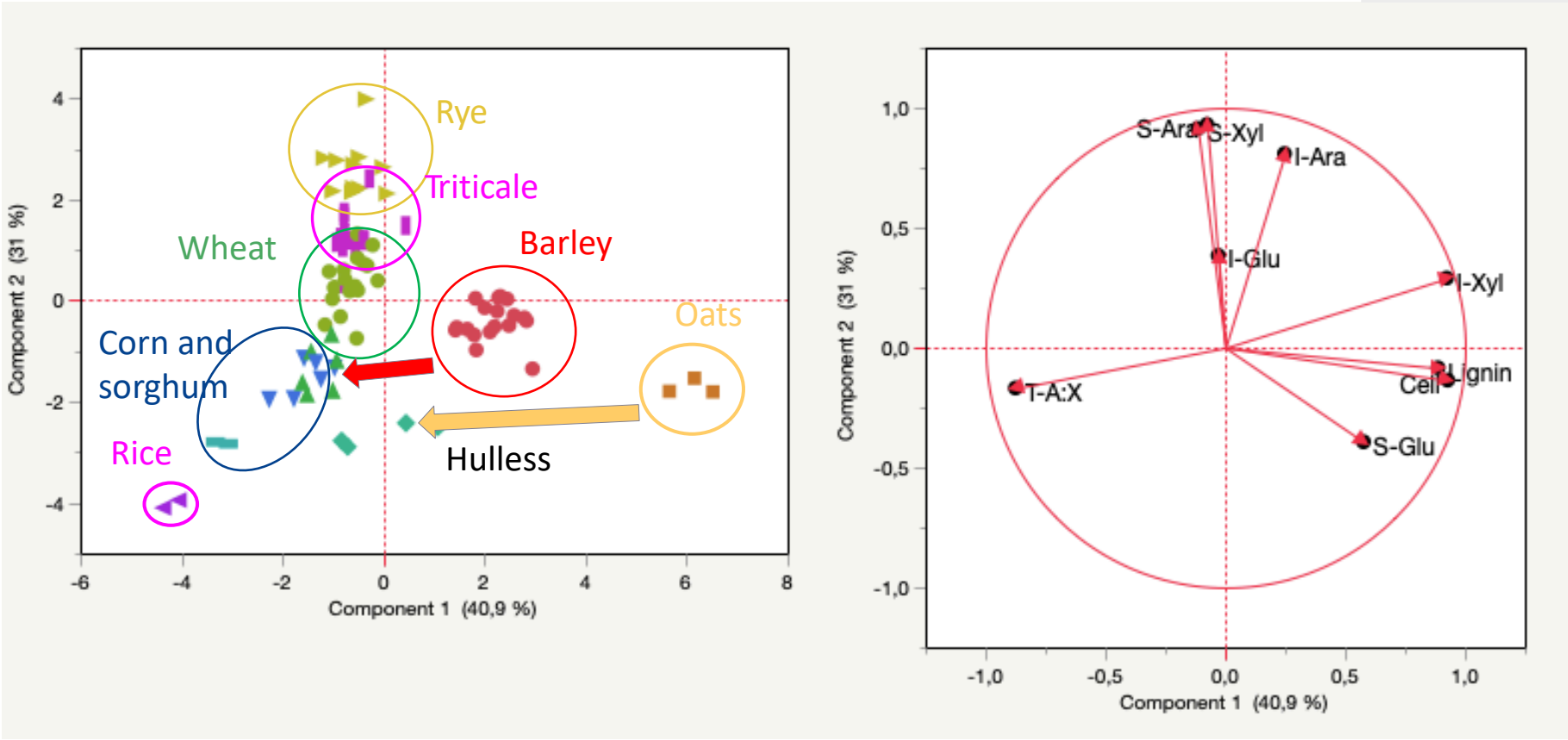
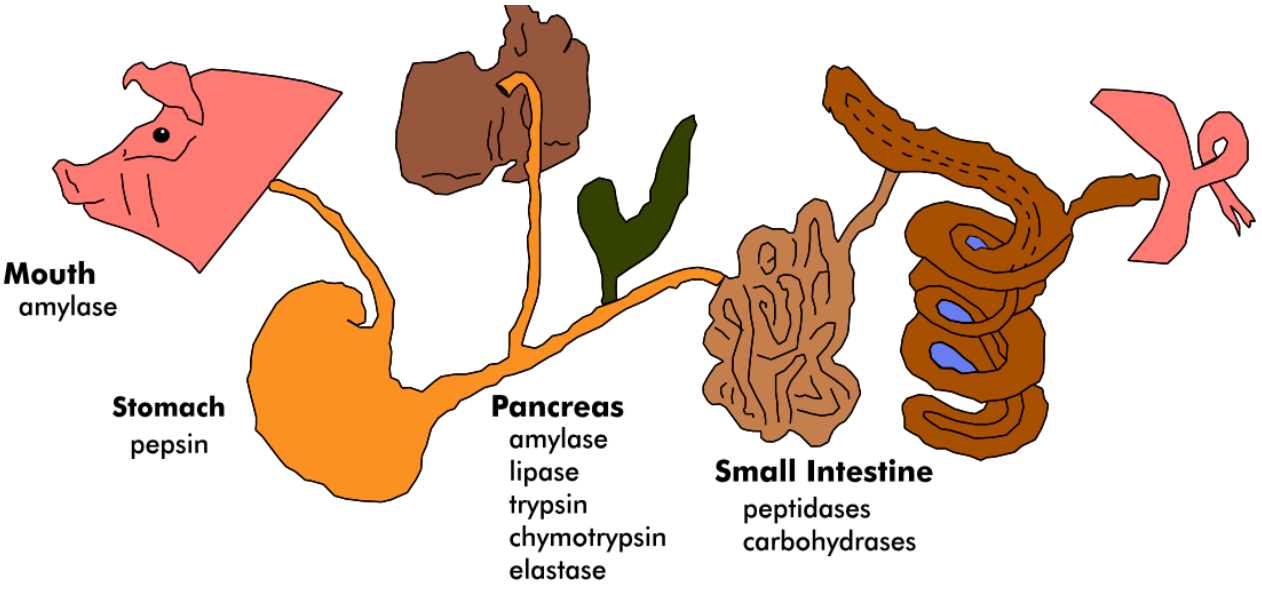
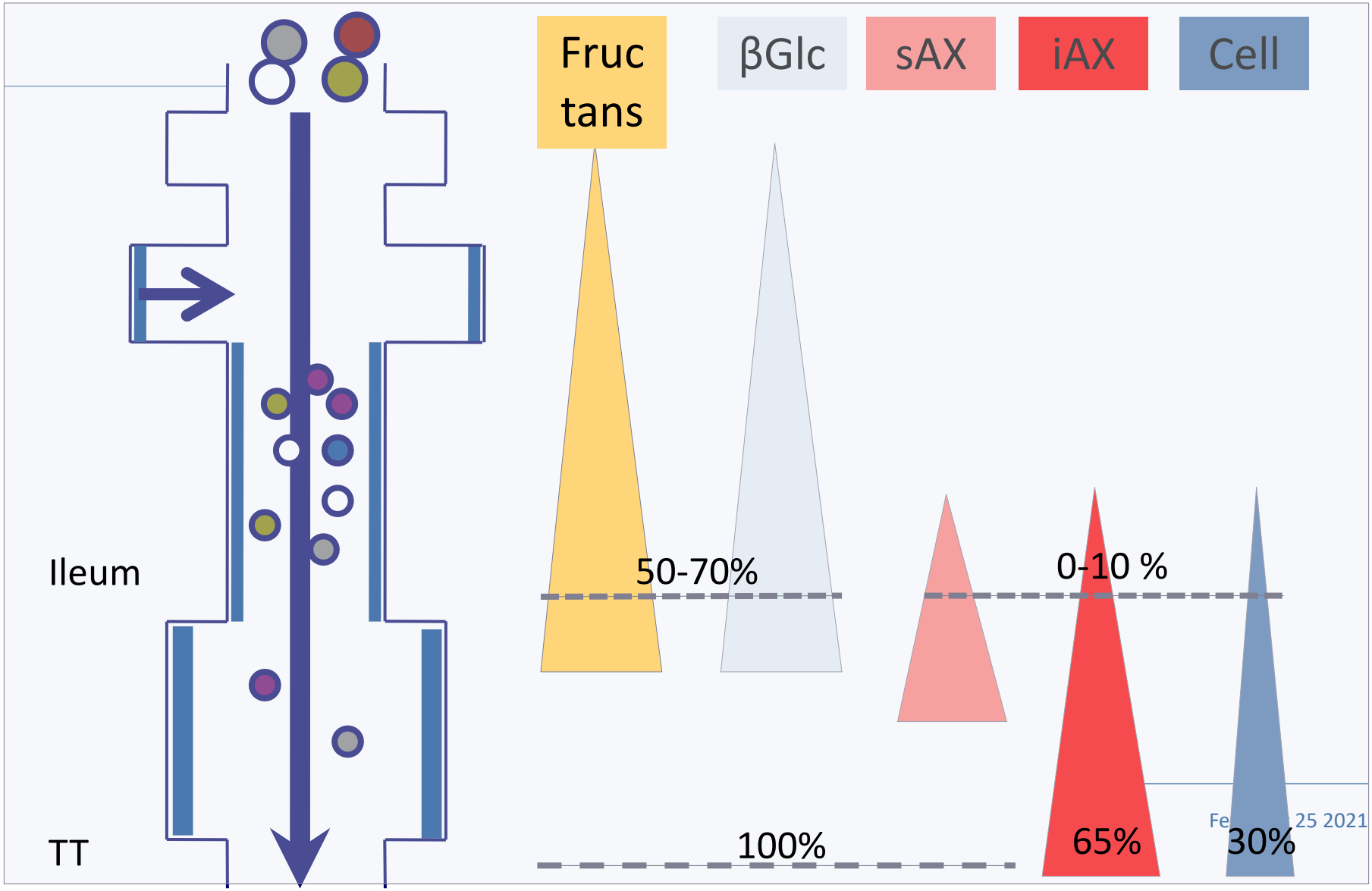
Diversity in NSP monomeric composition and lignin among cereals



Current knowledge on the degradation of rye fibres in the GIT of pigs



What we know about the degradation of rye fibre components in the GIT of pigs



Take home message

- The main fibre components of rye and other cereals are: fructans, cellulose, β-glucan, arabinoxylan and lignin
- There is a wide variation in fibre composition between the different grain tissues and between different cereals
- The fibre components from rye are degraded at different sites in the GIT tract of pigs:
  - Fructans and β-glucan > sAX > iAX > cellulose
- The site for the degradation is to a large extent determined by the chemical composition of the polysaccharides and the cross-linkages between macromolecules.

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Thank you very much for your attention!