

UNIVERSIDADE DE SÃO PAULO
FACULDADE DE CIÊNCIAS FARMACÊUTICAS
FBA0201 – Bromatologia Básica

FIBRA ALIMENTAR

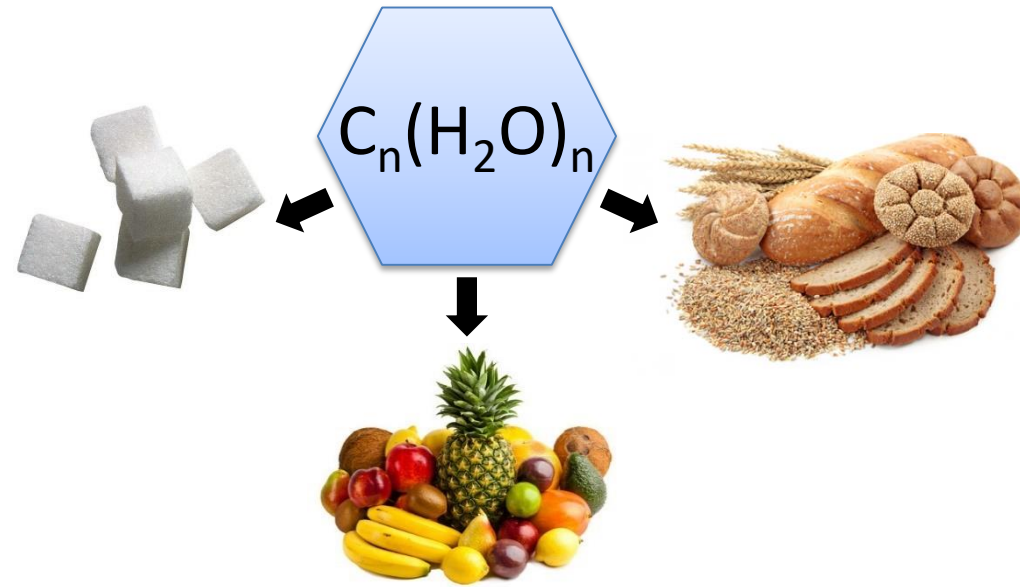
ERIC DE CASTRO TOBARUELA

Farmacêutico – UFC

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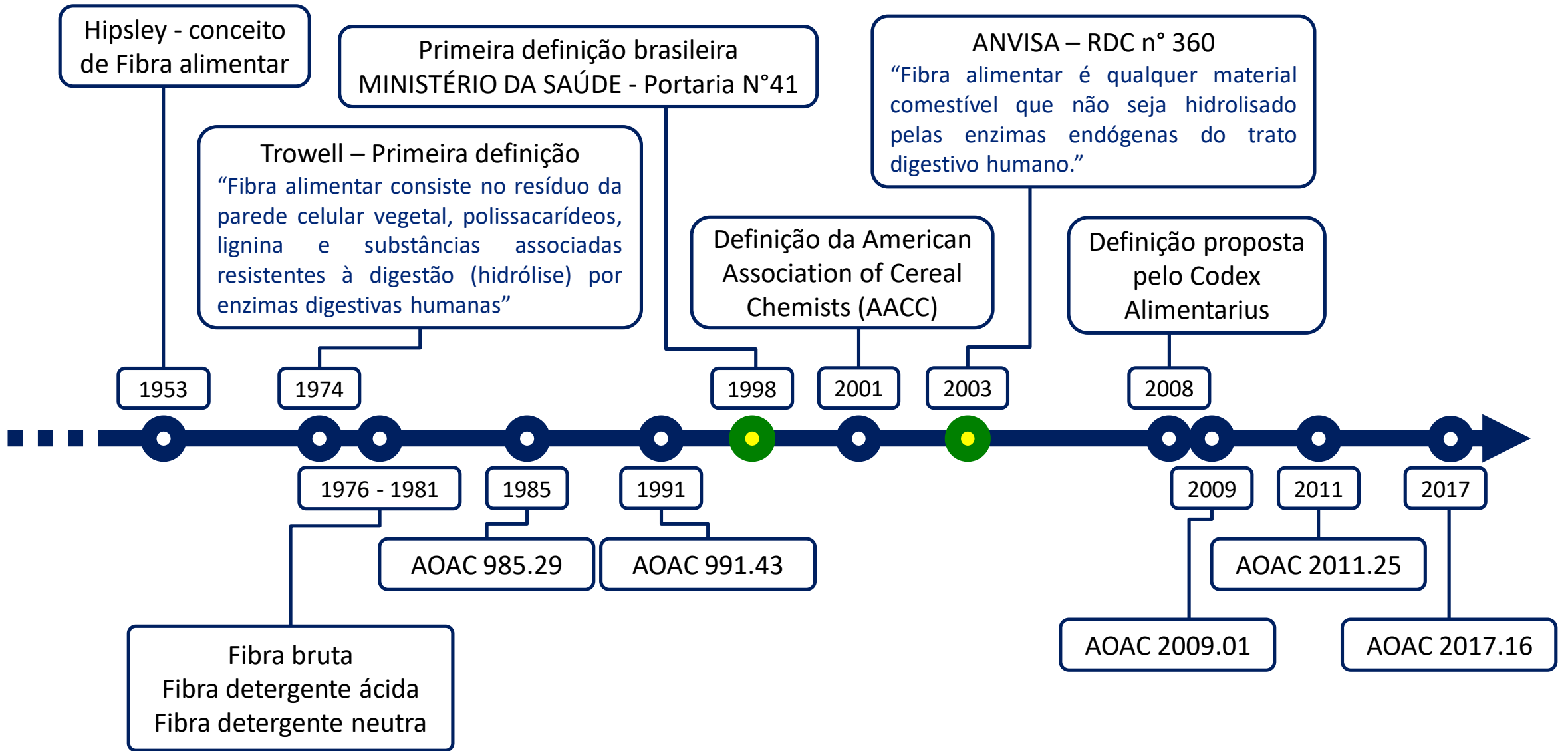
Doutorando – Ciência dos Alimentos - USP

O QUE É UM CARBOIDRATO?



COMPOSIÇÃO CENTESIMAL				
CARBOIDRATOS TOTAIS	PROTEÍNAS	LIPÍDIOS	CINZAS	UMIDADE
CHO DISPONÍVEIS	FIBRA ALIMENTAR			

O QUE É FIBRA ALIMENTAR?



2008

CODEX ALIMENTARIUS

1963

Fórum internacional de normatização do comércio de alimentos;

Visa garantir a segurança, a qualidade e a equidade deste comércio;

Implantação de normas, códigos de boas práticas, orientações e outras recomendações relativas a alimentos, produção de alimentos e segurança alimentar.



**World Health
Organization**



2008

CODEX ALIMENTARIUS

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Comitê Codex sobre Nutrição e Alimentos para Dietas Especiais

codex alimentarius commmission

Definition:

Dietary fibre means carbohydrate polymers¹ with ten or more monomeric units², which are not hydrolysed

Fibra alimentar é constituída de polímeros de carboidratos* com dez* ou mais unidades monoméricas, que não são hidrolisados pelas enzimas endógenas no intestino delgado e que podem pertencer a três categorias:

- Polímeros de carboidratos comestíveis que ocorrem naturalmente nos alimentos na forma como são consumidos;
- Polímeros de carboidratos obtidos de material cru por meio físico, químico ou enzimático e que tenham comprovado efeito fisiológico benéfico sobre a saúde humana, de acordo com evidências científicas propostas e aceitas por autoridades competentes;
- Polímeros de carboidratos sintéticos que tenham comprovado efeito fisiológico benéfico sobre a saúde humana, de acordo com evidências científicas propostas e aceitas por autoridades competentes.

TODA FIBRA ALIMENTAR É
CARBOIDRATO?

codex alimentarius commission

Definition:

Dietary fibre means carbohydrate polymers¹ with ten or more monomeric units², which are not hydrolysed by the endogenous enzymes in the small intestine of humans and belong to the following categories:

- Edible carbohydrate polymers naturally occurring in the food as consumed,
- carbohydrate polymers, which have been obtained from food raw material by physical, enzymatic or chemical means and which have been shown to have a physiological effect of benefit to health as demonstrated by generally accepted scientific evidence to competent authorities,
- synthetic carbohydrate polymers which have been shown to have a physiological effect of benefit to health as demonstrated by generally accepted scientific evidence to competent authorities

Methods of Analysis for Dietary Fibre

→ To be agreed.

¹ When derived from a plant origin, dietary fibre may include fractions of lignin and/or other compounds when associated with polysaccharides in the plant cell walls and if these compounds are quantified by the AOAC gravimetric analytical method for dietary fibre analysis : Fractions of lignin and the other compounds (proteic fractions, phenolic compounds, waxes, saponins, phytates, cutin, phytosterols, etc.) intimately "associated" with plant polysaccharides are often extracted with the polysaccharides in the AOAC 991.43 method. These substances are included in the definition of fibre insofar as they are actually associated with the poly- or oligo-saccharidic fraction of fibre. However, when extracted or even re-introduced into a food containing non digestible polysaccharides, they cannot be defined as dietary fibre. When combined with polysaccharides, these associated substances may provide additional beneficial effects (pending adoption of Section on Methods of Analysis and Sampling).

² Decision on whether to include carbohydrates from 3 to 9 monomeric units should be left to national authorities.



Codex dietary fibre definition – Justification for inclusion of carbohydrates from 3 to 9 degrees of polymerisation

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Ausência de embasamento científico, metodológico ou fisiológico que justifique a diferenciação entre carboidratos não disponíveis com $GP < 10$ e $GP \geq 10$;

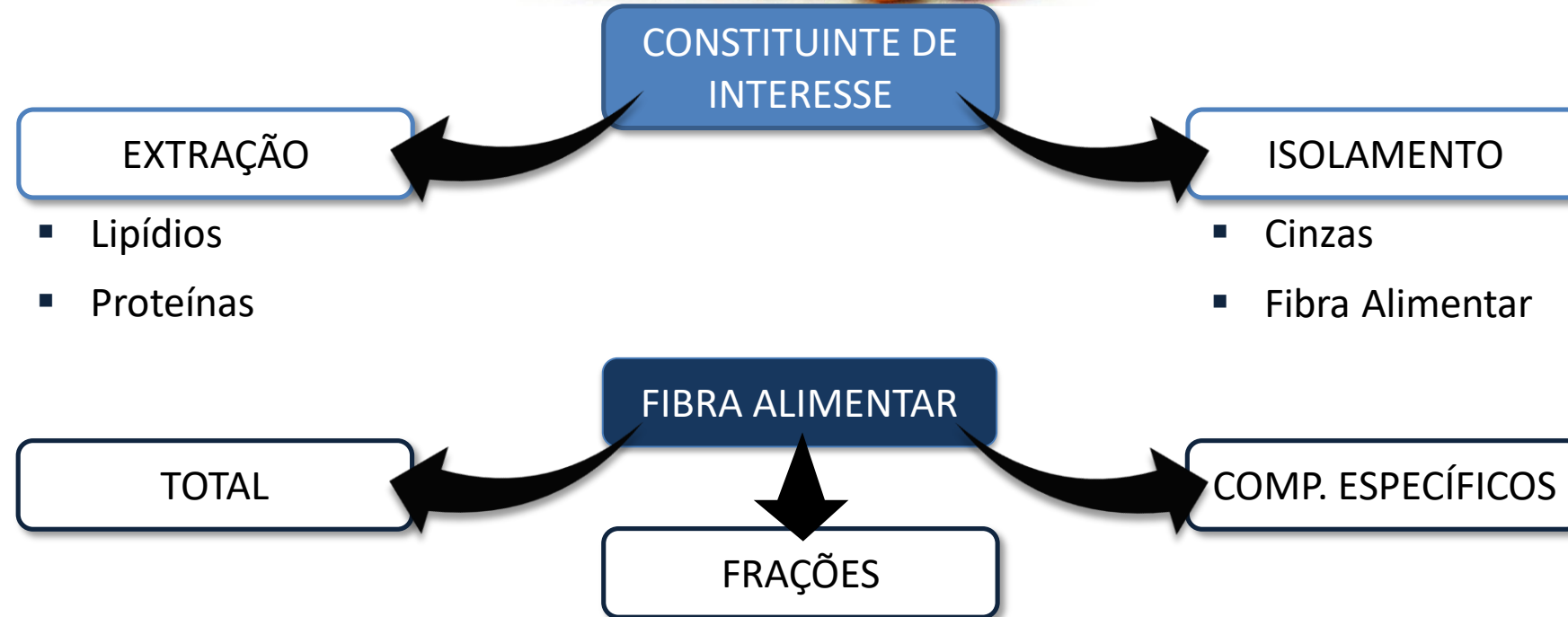
Harmonização (vários países e entidades já incluíram carboidratos de $GP 3-9$ na definição de FA);

Existência de métodos analíticos adequados



COMO ANALISAMOS FIBRA ALIMENTAR?

COMO ANALISAMOS FIBRA ALIMENTAR?



Standard	Provisions	Method	Principle	Type
General methods that do not measure the lower molecular weight fraction (i.e. monomeric units ≤ 9)⁽²⁾				
All foods ⁽¹⁾	Dietary fibre based on precipitation in 4 parts alcohol and 1 part water. Resistant insoluble and soluble polysaccharides, lignin, and plant cell wall. ⁽⁴⁾	AOAC 985.29	Enzymatic gravimetric	III
All foods ⁽¹⁾	Dietary fibre based on precipitation in 4 parts alcohol and 1 part water. Resistant insoluble and soluble polysaccharides, lignin, and plant cell wall ⁽⁴⁾ .	AOAC 991.43	Enzymatic gravimetric	III
All foods ⁽¹⁾	Dietary fibre based on precipitation in 4 parts alcohol and 1 part water. Resistant insoluble and soluble polysaccharides, lignin, and plant cell wall ⁽⁴⁾ .	AOAC 992.16	Enzymatic gravimetric	III
All foods ⁽¹⁾	Dietary fibre in food and food products with less than 2% starch ⁽⁴⁾ .	AOAC 993.21	Non-enzymatic gravimetric	III
All foods ⁽¹⁾	Dietary fibre based on precipitation in 4 parts alcohol and 1 part water, quantitated as component neutral sugars, uronic acids, plus Klason lignin. ⁽⁴⁾	AOAC 994.13	Enzymatic chemical	III

(at Step 8 of the Procedure)

General methods that measure both the higher (monomeric units > 9) and the lower molecular weight fraction (monomeric units ≤ 9)⁽²⁾				
All foods ⁽¹⁾	Dietary fibre based on precipitation in 4 parts alcohol and 1 part water. Resistant insoluble and soluble polysaccharides, resistant malto-dextrins, lignin, and plant cell wall. ⁽³⁾	AOAC 2001.03	Enzymatic gravimetric and Liquid chromatography	III
All foods ⁽¹⁾	Dietary fibre (Soluble + insoluble polysaccharides + lignin + resistant starch + oligosaccharides).	AOAC 2009.01	Enzymatic-Gravimetric-High Pressure Liquid Chromatography Method	III
All foods	Dietary fibre based on precipitation in 4 parts alcohol and 1 part water. Resistant insoluble and soluble polysaccharides, lignin, and plant cell wall ⁽⁴⁾ .	AOAC 992.16	Enzymatic gravimetric	III

Methods that measure individual specific components (monomeric units: the whole range for each type of components is covered) ⁽²⁾				
All foods ⁽¹⁾	Insoluble dietary fibres in food and food products	AOAC 991.42	Enzymatic gravimetric	III
All foods ⁽¹⁾	(1→3)(1→4) <i>Beta</i> -D-Glucans	AOAC 992.28	Enzymatic	III
All foods ⁽¹⁾	Soluble dietary fibres in food and food products	AOAC 993.19	Enzymatic gravimetric	III
All foods ⁽¹⁾	(1→3)(1→4) <i>Beta</i> -D-Glucans	AOAC 995.16	Enzymatic	III
All foods ⁽¹⁾	Fructans (oligofructoses, inulin, hydrolyzed inulin, polyfructoses, fructooligosaccharides)	AOAC 997.08	Enzymatic & HPAEC-PAD	III
All foods ⁽¹⁾	Fructans (oligofructoses, inulin, hydrolyzed inulin, polyfructoses, fructooligosaccharides)	AOAC 999.03	Enzymatic & colorimetric	III
All foods ⁽¹⁾	Polydextrose	AOAC 2000.11	HPAEC-PAD	III
All foods ⁽¹⁾	Trans-galacto-oligo saccharides	AOAC 2001.02	HPAEC-PAD	III
All foods ⁽¹⁾	Resistant starch (Recommended for RS2 & RS3)	AOAC 2002.02	Enzymatic	III
Other methods ⁽²⁾				
All foods	Insoluble glucans and mannans of yeast cell wall (for yeast cell wall only)	Eurasyp (European association for specialty yeast product) – LM Bonnanno. Biospringer- 2004 – online version : http://www.eurasyp.org/public.technique.home.screen .	Chemical & HPAEC-PAD	IV
All foods	Fructo-oligosaccharides (monomeric units<5)	Ouarne et al. 1999 in <i>Complex Carbohydrates in Foods</i> . Edited by S. Sungsoo, L. Prosky & M. Dreher. Marcel Dekker Inc, New York	HPAEC-PAD	IV
All foods	Non-starch polysaccharides (NSP) ⁽³⁾	Englyst H.N, Quigley M.E., Hudson G. (1994) Determination of dietary fibre as non-starch polysaccharides with gas-liquid chromatographic high performance liquid chromatographic or spectrophotometric measurement of constituent sugars – Analyst 119, 1497-1509	Enzymatic Gas-Liquid Chromatography Method	IV

Tipos de métodos

- Gravimétricos

Fibra bruta (FB)

Fibra detergente neutro (FDN) e ácido (FDA)

- Enzímico-gravimétricos

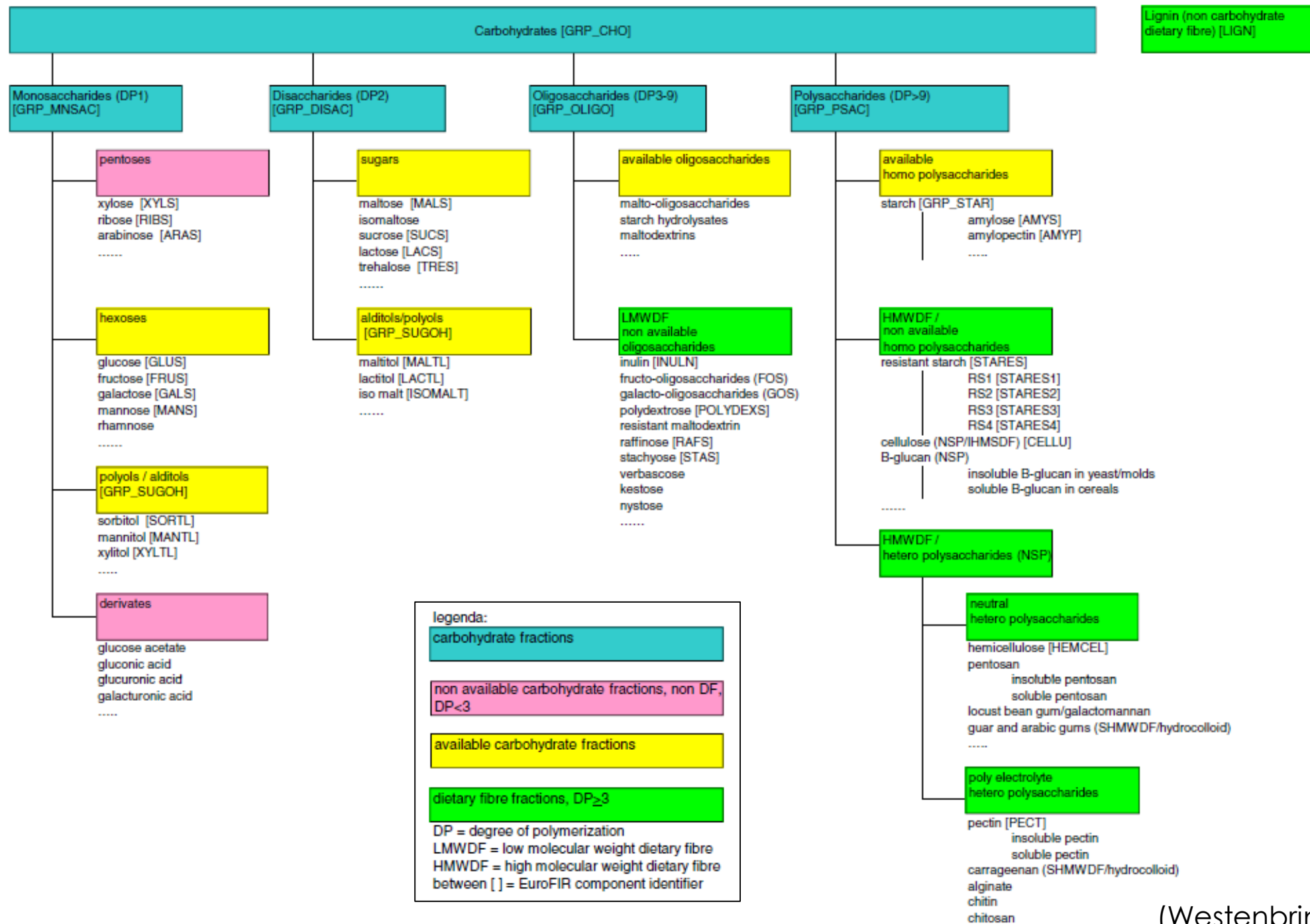
Fibra alimentar total (FAT)

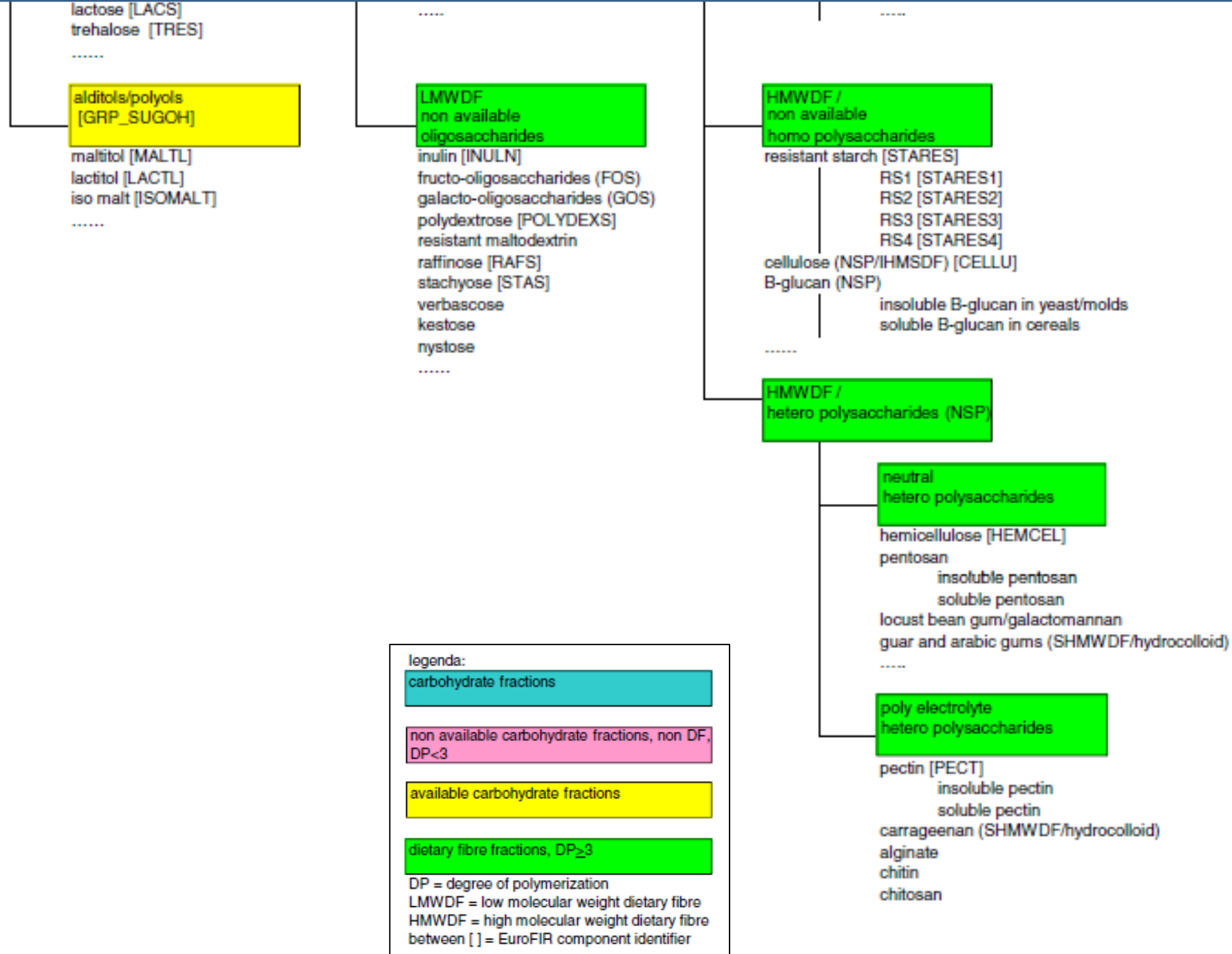
Fibra alimentar solúvel (FAS) e insolúvel (FAI)

- Enzímico-químicos

Por espectrofotometria

Por cromatografia líquida de alta eficiência (HPLC)





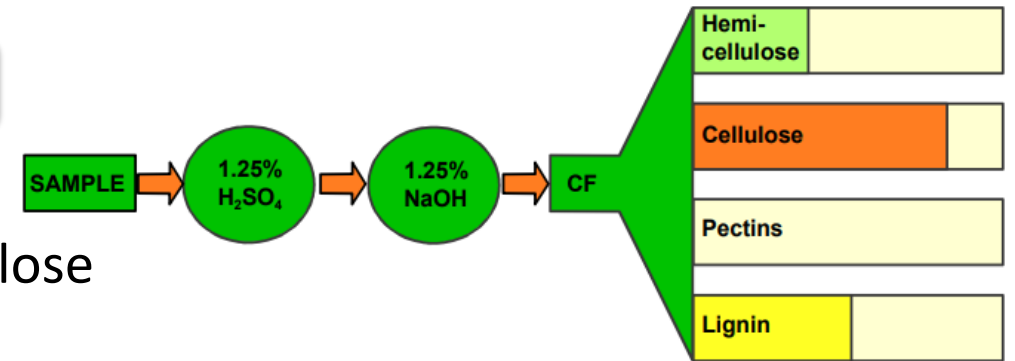
Fibra bruta (FB)

Ácidos (H_2SO_4) e bases (NaOH) fortes

Ácido → amido; açúcares; parte da pectina e da hemicelulose

Base → proteínas; pectinas; hemicelulose e lignina

(Henneberg *et al.*, 1865)



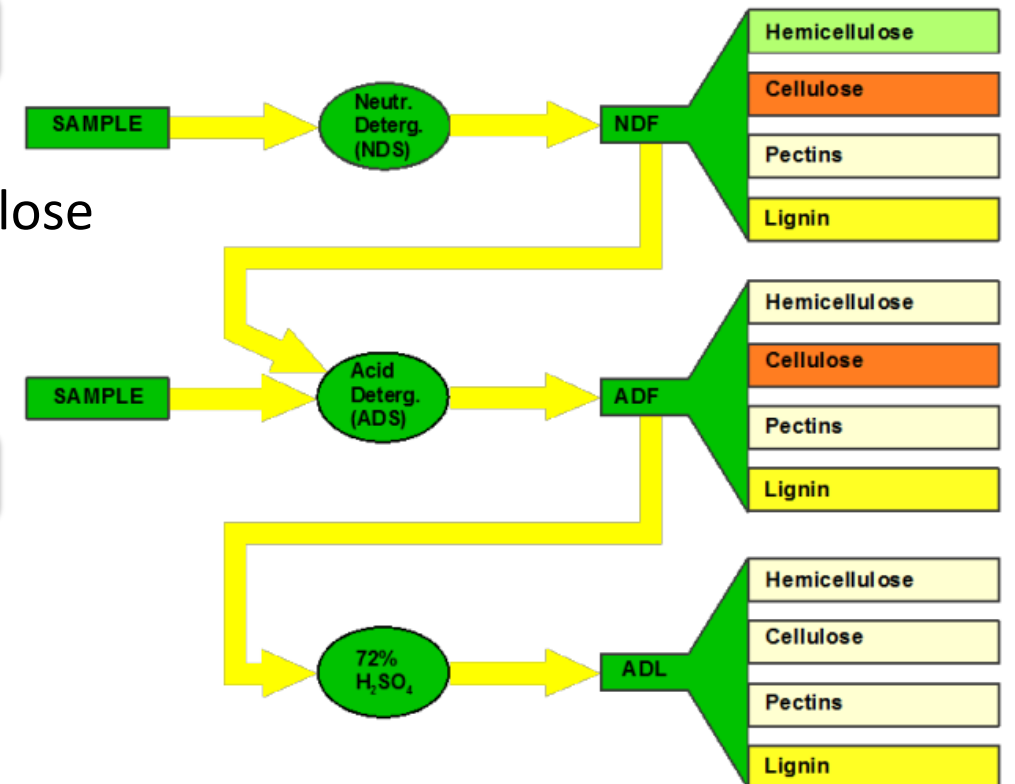
Fibra insolúvel em detergente ácido (FDA)

Ácido (H_2SO_4) e detergente (CTAB ou Cetremide)

Acido → amido; açúcares; parte da pectina e da hemicelulose

Detergente → proteínas

(Van Soest, 1963)



Fibra insolúvel em detergente neutro (FDN)

Tampão de borato-fosfato mantém pH próximo a 7.0

Lauril sulfato de sódio e sultado de sódio → proteínas

Trietileno glicol → amido

(Goering & Van Soest, 1970)

Tipos de métodos

- Gravimétricos

Fibra bruta (FB)

Fibra detergente neutro (FDN) e ácido (FDA)

- Enzímico-gravimétricos

Fibra alimentar total (FAT)

Fibra alimentar solúvel (FAS) e insolúvel (FAI)

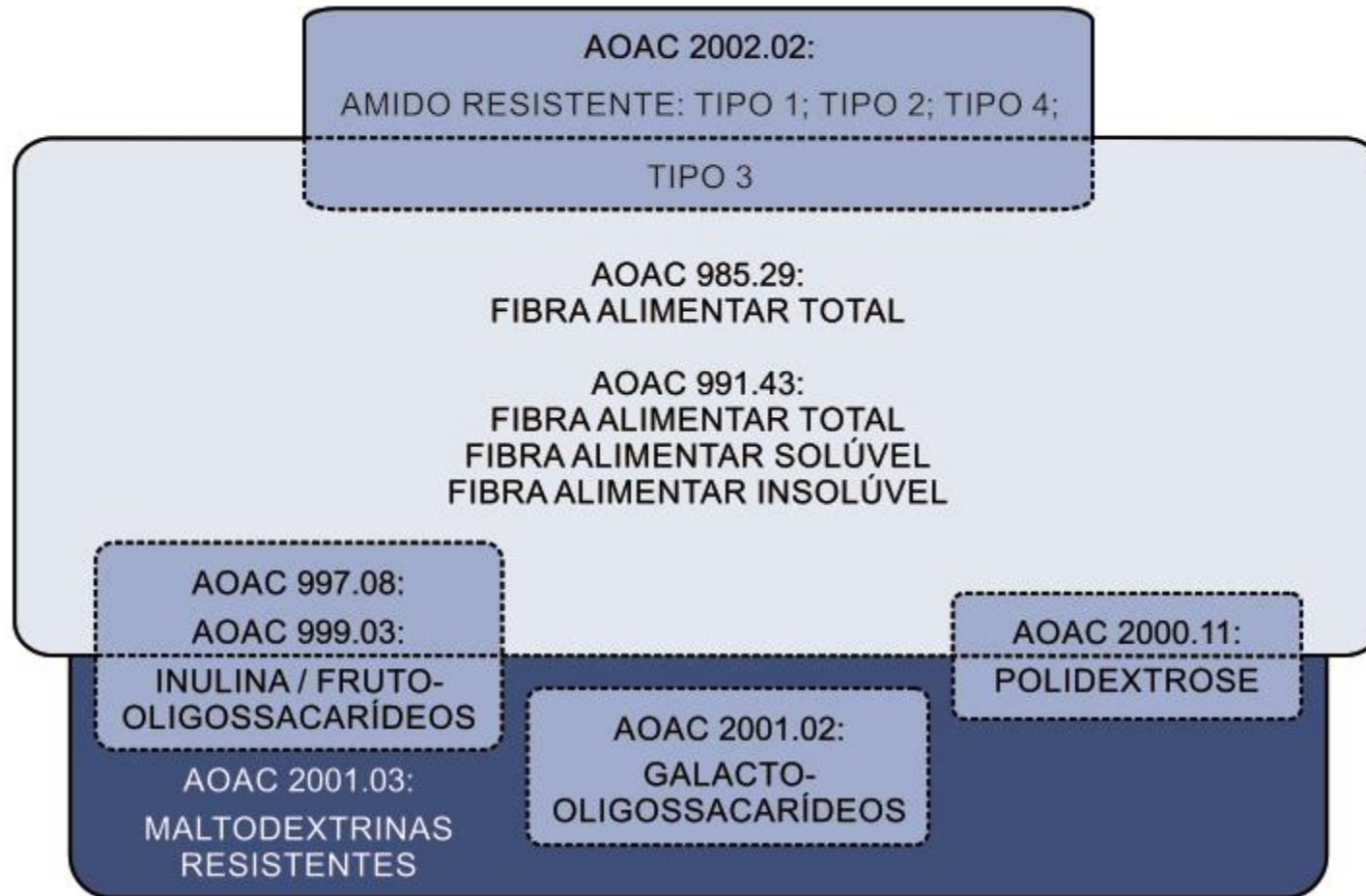
- Enzímico-químicos

Por espectrofotometria

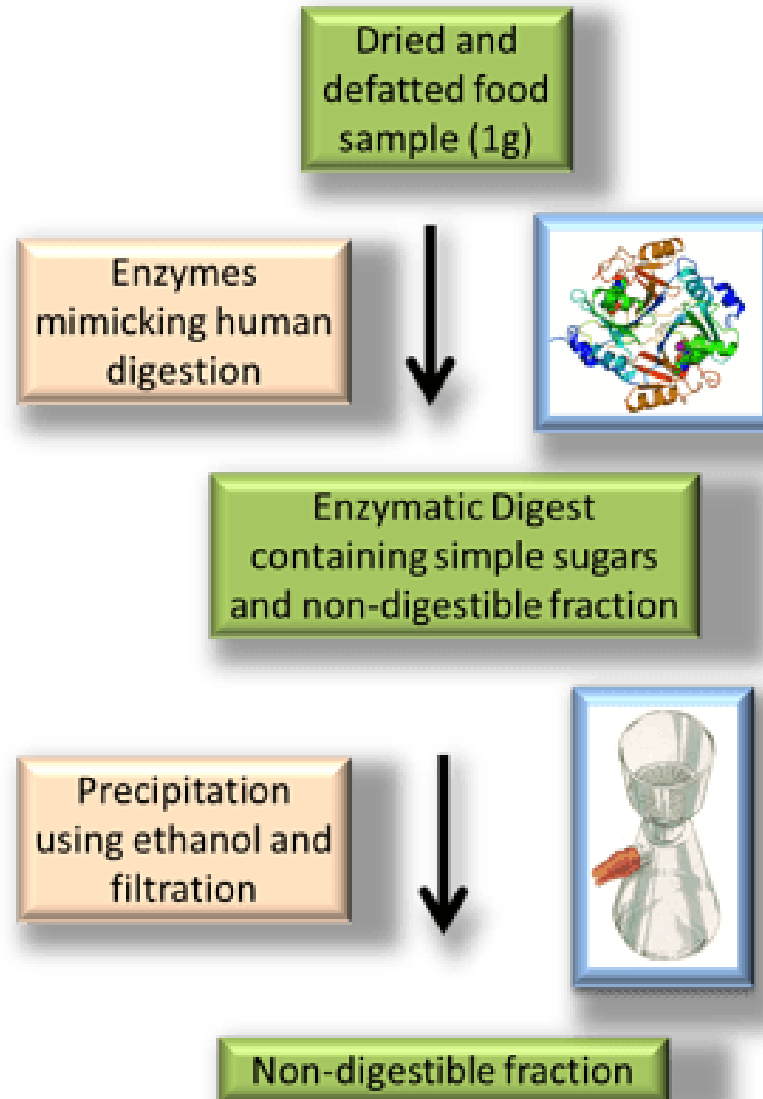
Por cromatografia líquida de alta eficiência (HPLC)

AOAC 2009.01:
FIBRA ALIMENTAR DE ALTO PESO MOLECULAR
FIBRA ALIMENTAR DE BAIXO PESO MOLECULAR
FIBRA ALIMENTAR TOTAL DE ALTO E BAIXO PESO MOLECULAR

AOAC 2011.25:
FIBRA ALIMENTAR SOLÚVEL DE ALTO PESO MOLECULAR
FIBRA ALIMENTAR SOLÚVEL DE BAIXO PESO MOLECULAR
FIBRA ALIMENTAR INSOLÚVEL
FIBRA ALIMENTAR TOTAL DE ALTO E BAIXO PESO MOLECULAR



Método enzimico-gravimétrico



Preparo da amostra

✓ Vidraria



✓ Granulometria

60 mesh = 0,250 mm



✓ Máximo de 5% de lipídios

Extração em Soxhlet



Cuidados e correções

- ✓ Enzimas

Devem ser altamente purificadas

- ✓ Precipitação da fração solúvel

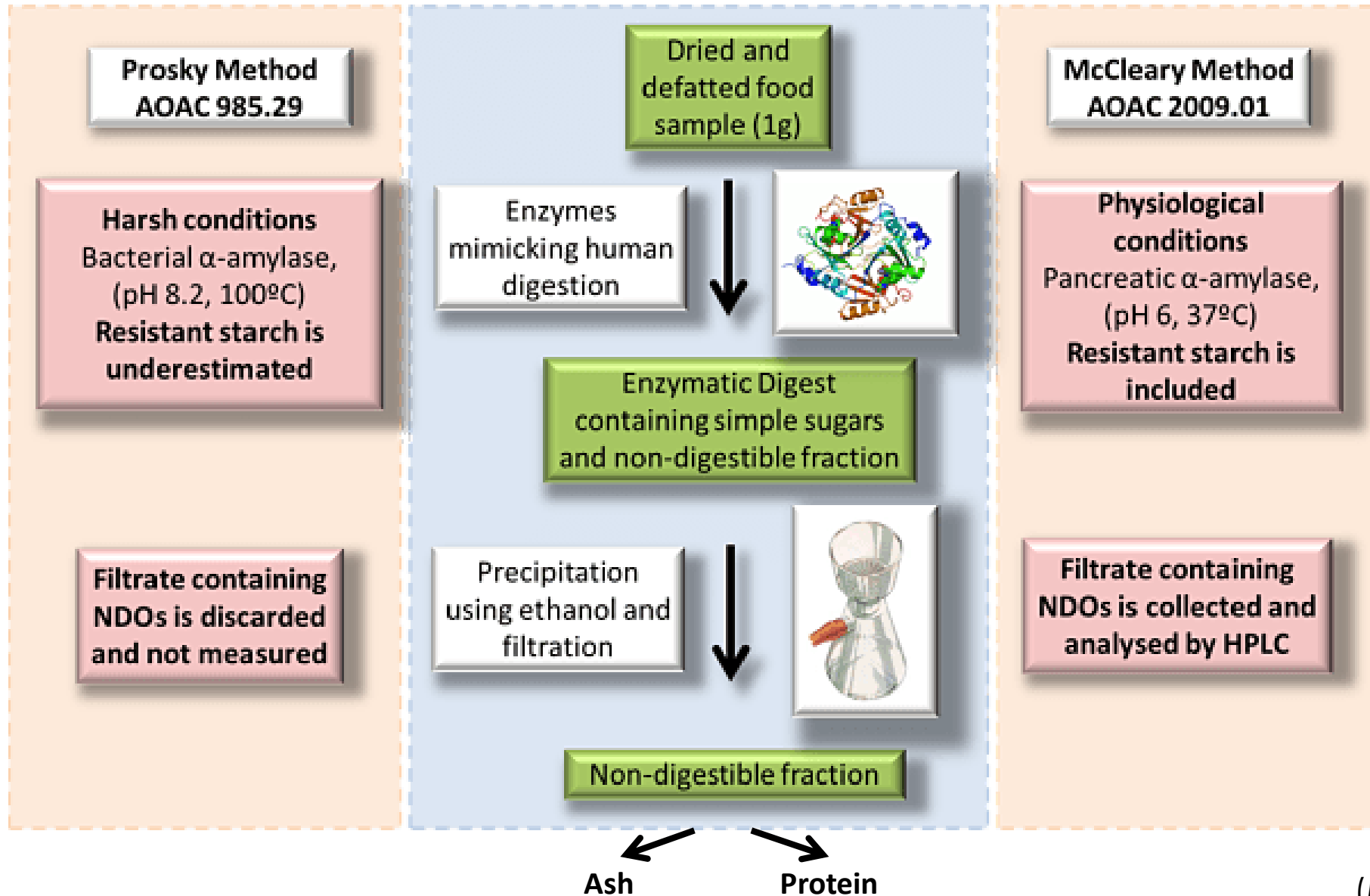
- ✓ Proteína residual

Deve ser descontada → Análise de proteína no resíduo

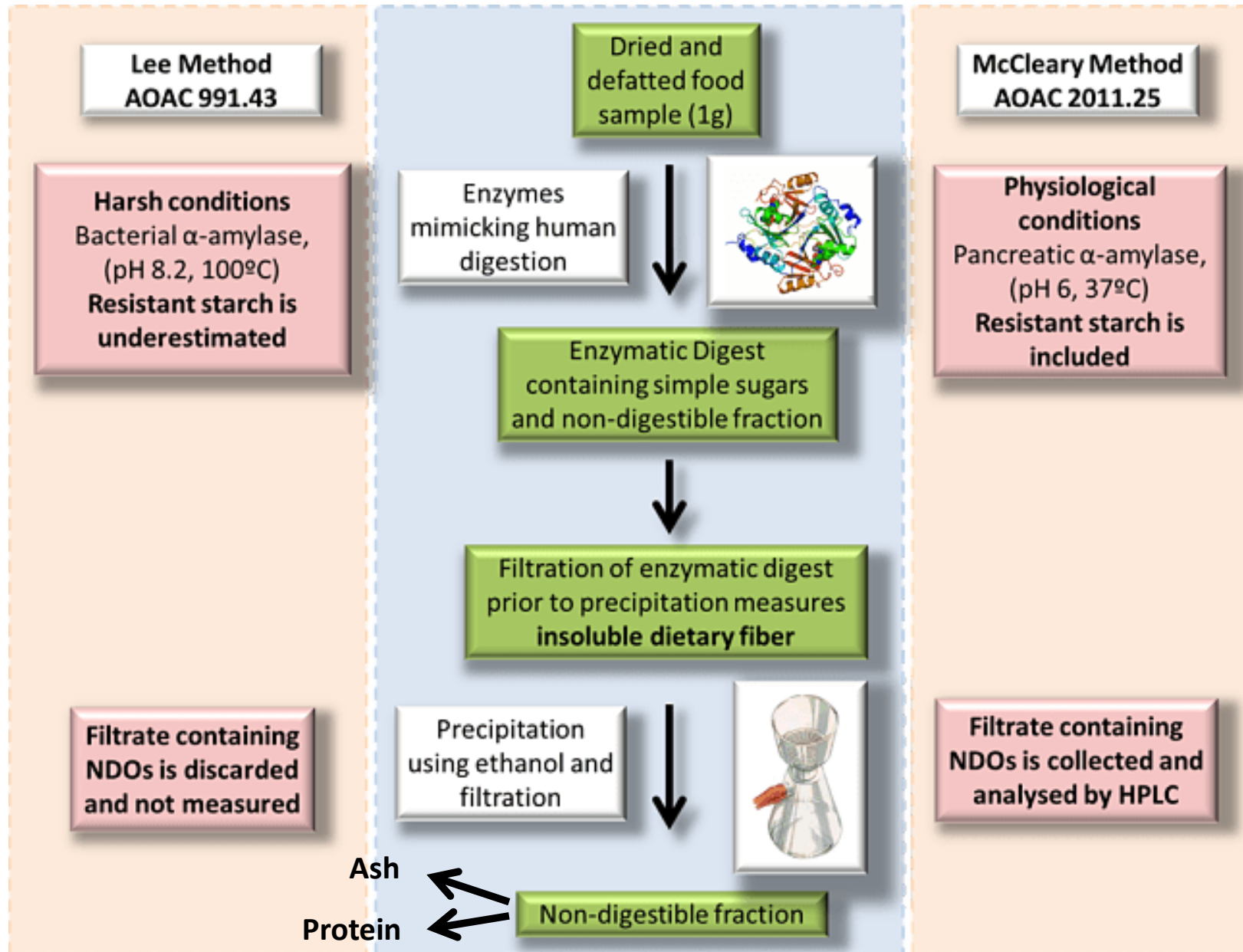
- ✓ Minerais residuais

Devem ser descontados → Análise de cinzas no resíduo

AOAC 985.29 ↔ AOAC 2009.01

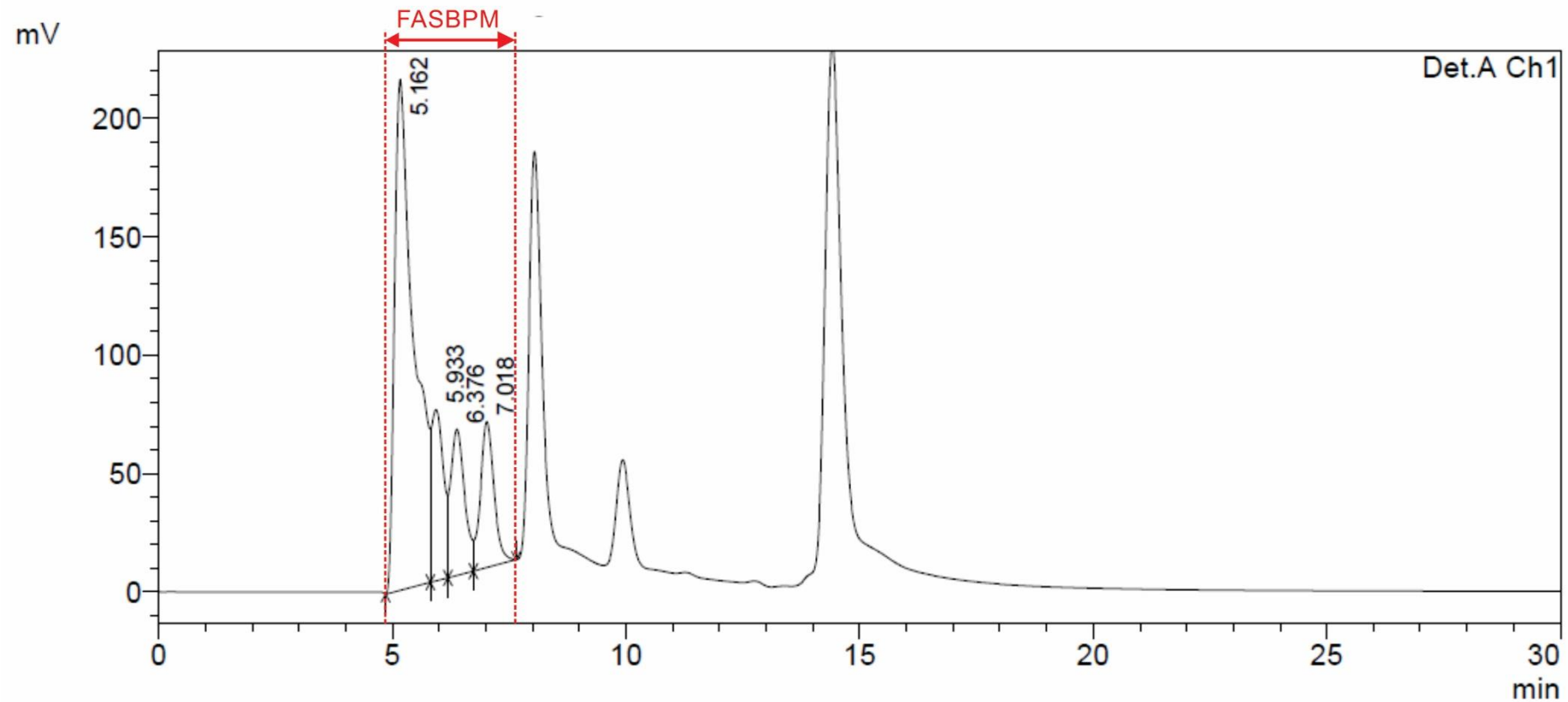


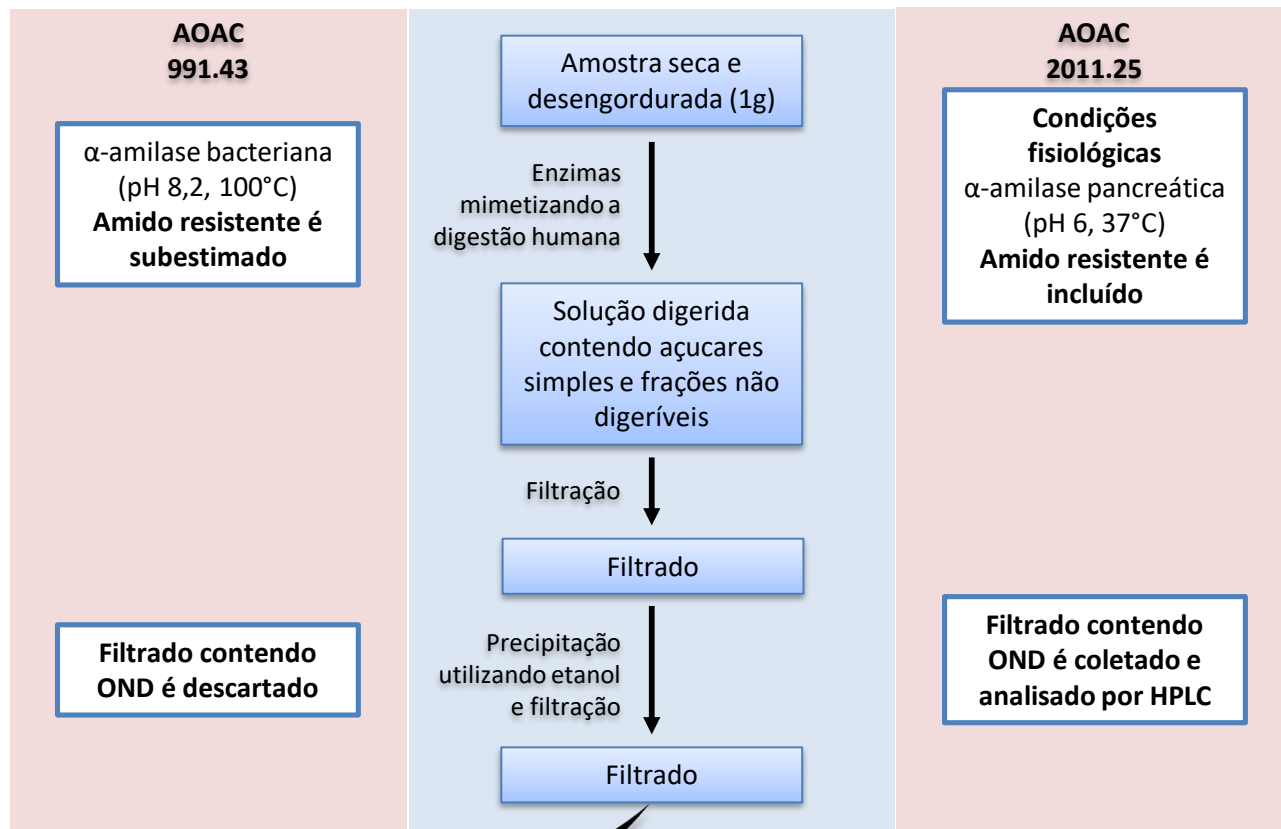
AOAC 991.43 ↔ AOAC 2011.25



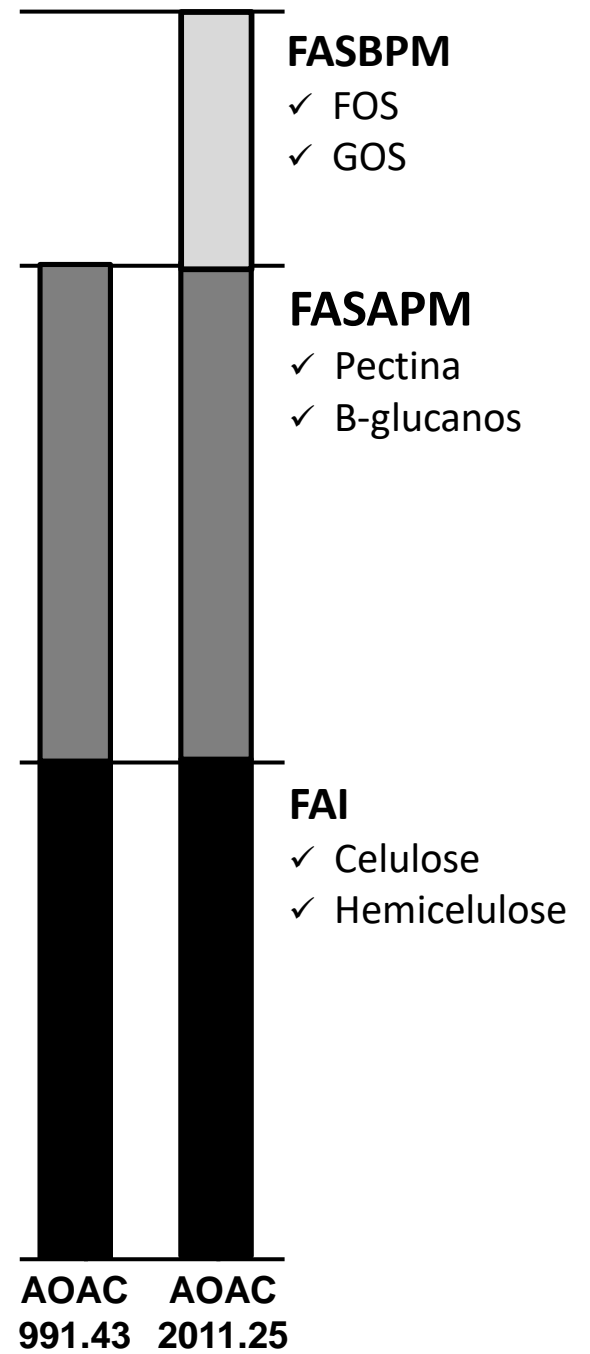
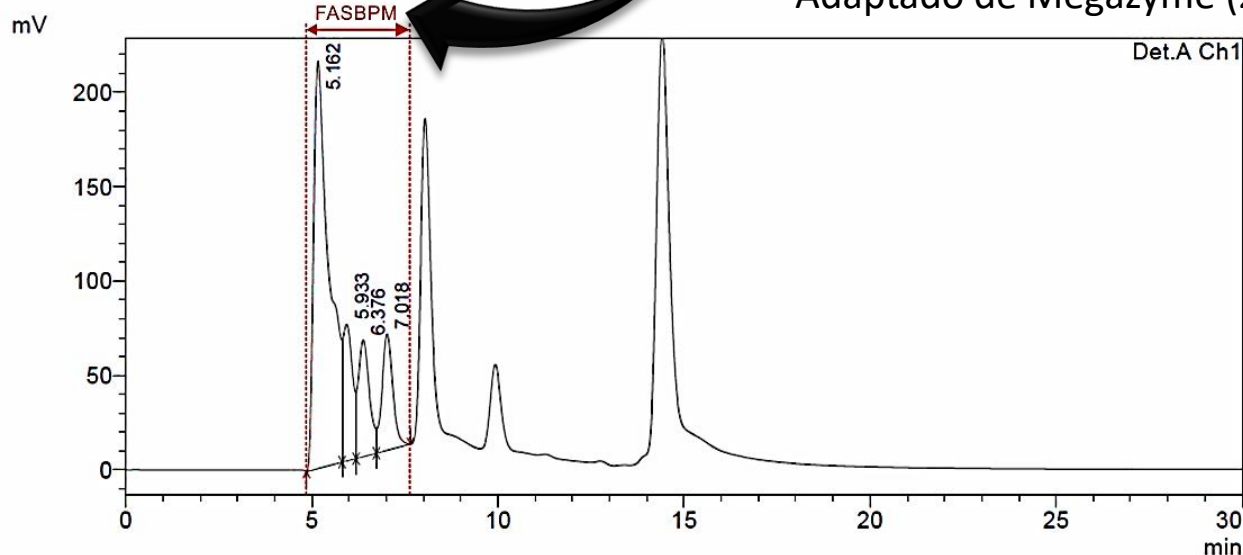
AOAC 985.29 ↔ AOAC 2009.01

HPLC-RID





Adaptado de Megazyme (2015)

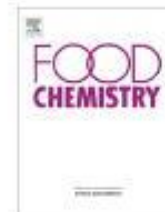




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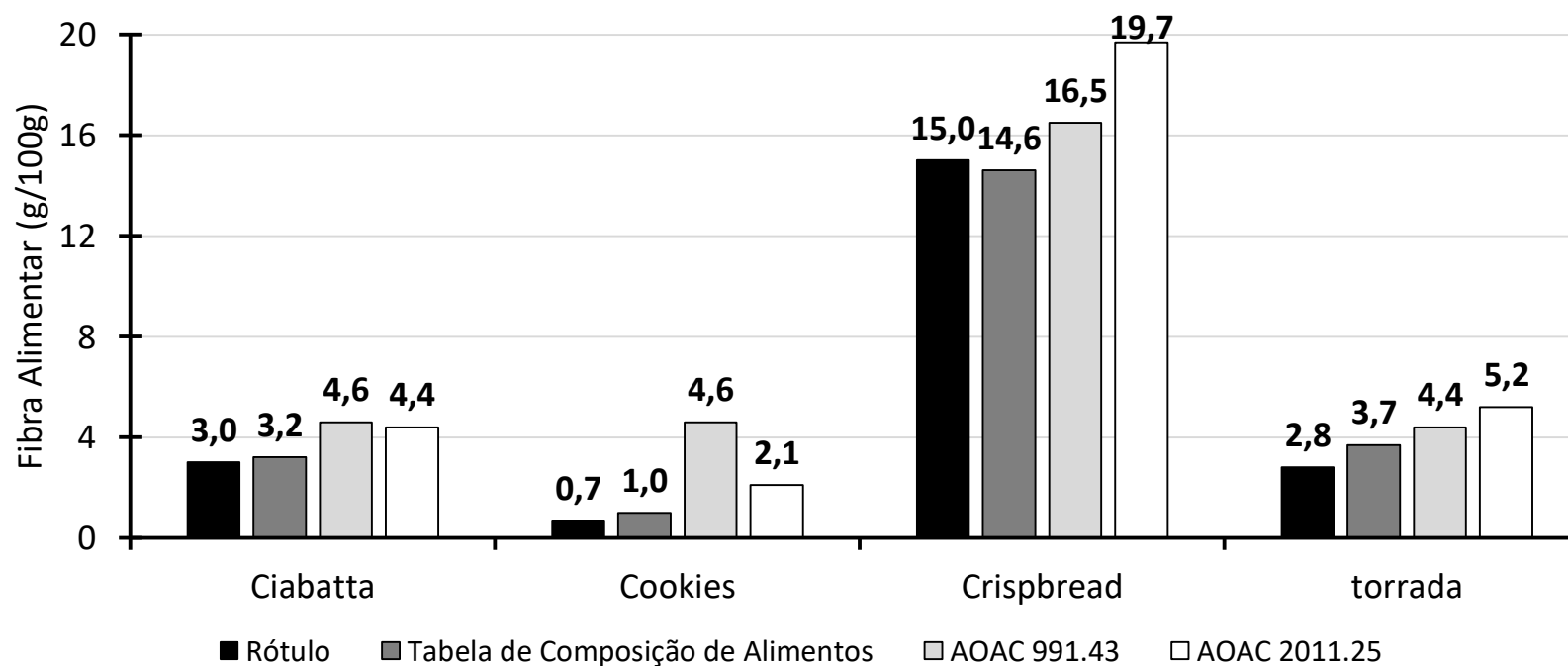


Short communication

Dietary fibre fractions in cereal foods measured by a new integrated AOAC method

Juergen Hollmann, Heinz Themeier, Ursula Neese, Meinolf G. Lindhauer*

Max Rubner-Institute (MRI), Federal Research Institute for Nutrition and Food, Department of Safety and Quality of Cereals, D-32756 Detmold, Schuetzenberg 12, Germany





- Ameixa
- Atemoia
- ◆ Jaca
- ★ Coco maduro



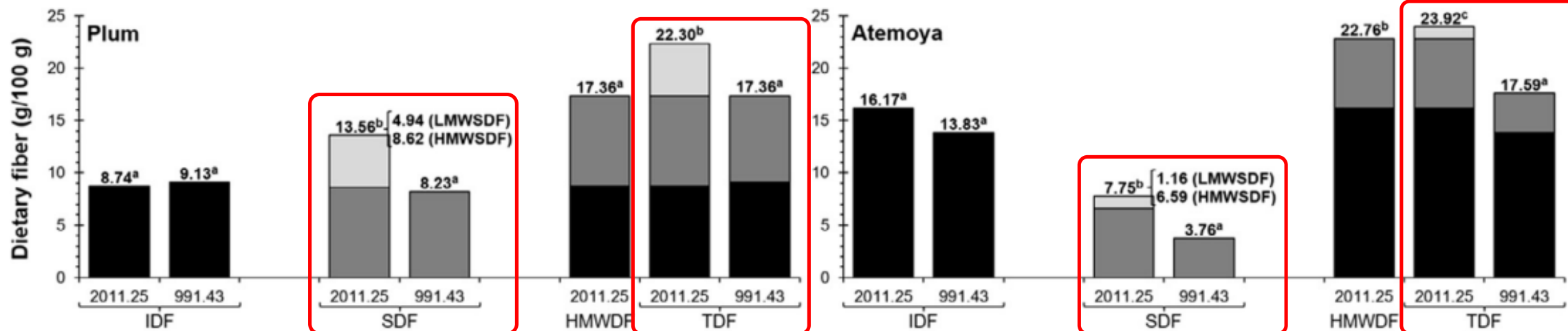
ELSEVIER



Application of dietary fiber method AOAC 2011.25 in fruit and comparison with AOAC 991.43 method



Eric de C. Tobaruela^{a,b,c}, Aline de O. Santos^{a,b,c}, Ligia B. de Almeida-Muradian^a, Elias da S. Araujo^{a,b,c}, Franco M. Lajolo^{a,b,c}, Elizabete W. Menezes^{a,b,c,*}



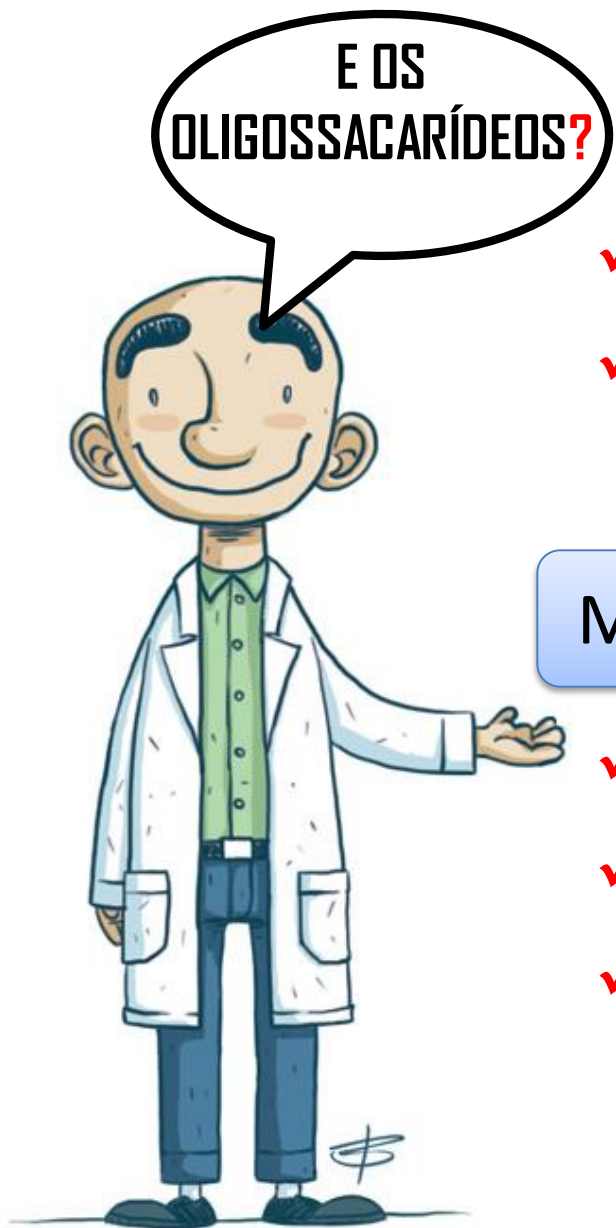
Considerações finais

E OS
OLIGOSSACARÍDEOS?

- ✓ Falta de consenso em relação à definição;
- ✓ Posicionamento da ANVISA;

Métodos enzimico-gravimétricos

- ✓ Custo ↑;
- ✓ Conhecimento aprofundado;
- ✓ Mão de obra capacitada.



Considerações finais

Métodos	Alto Peso	Baixo Peso	Separa solúvel de insolúvel	Amido Resistente	Oligossacarídeos não digeríveis
AOAC 985.29	Sim	Não	Não	Somente AR3	Não
AOAC 991.43	Sim	Não	Sim	Somente AR3	Não
AOAC 2009.01	Sim	Sim	Não	Sim	Sim
AOAC 2011.25	Sim	Sim	Sim	Sim	Sim



OBRIGADO!

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