Fractionation as a method to improve the nutritional value of rapeseed meal

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Introduction

- Reduce EU dependency on imported protein sources
- Improve utilisation of locally grown sources, e.g. rapeseed
- Rape seed meal (RSM)
  - Not-dehulled before oil extraction
  - Relatively low protein content
  - High fibre content in RSM → limits use in young animals
- Literature: tail-end dehulling may improve nutritional value
- AIM: feasibility of an industrial scale process for fractionation of RSM and impact on nutritional value

Processing of ingredients

Rapeseeds

Cooked + pressed

75 – 85 °C, 60 min

Rapeseed cake

Solvent extraction

50 – 60 °C
90 min

Rapeseed meal + solvent

Toasting

100 – 110 °C
30 - 60 min

Rapeseed meal

Quick method to remove hexane
Degradation ANFs

M&M Industrial (large) scale processing

- Raw RSM, non-pelleted (13 big bags)

Mixing

- Mixing and sampling (0.5-ton batches) → 26 big bags.

Crushing

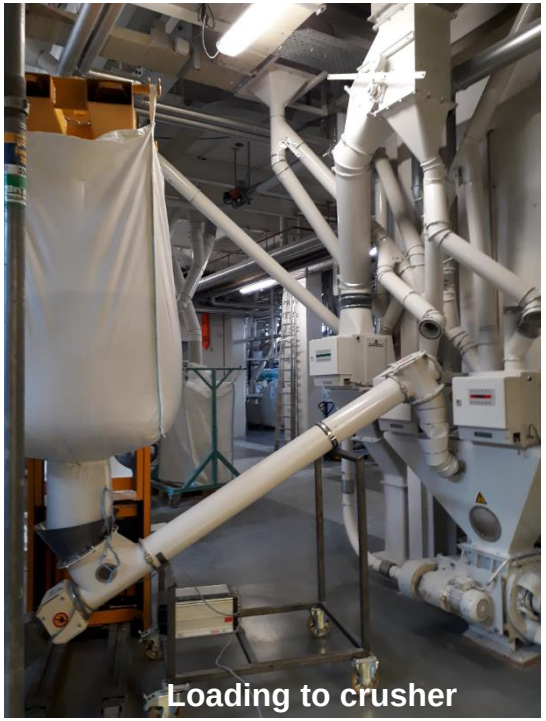
- Raw RSM discharged with pneumatic transport → to surge hopper → to crusher by gravity

Sifting

- Crushed product continuously to sifter (300 µm)
- Fine fraction → paper bags of 50 kg + sampling
- Coarse fraction → big bags + sampling

M&M
Equipment for industrial scale processing


Paddle mixer


Loading to crusher


Crusher (roller mill)

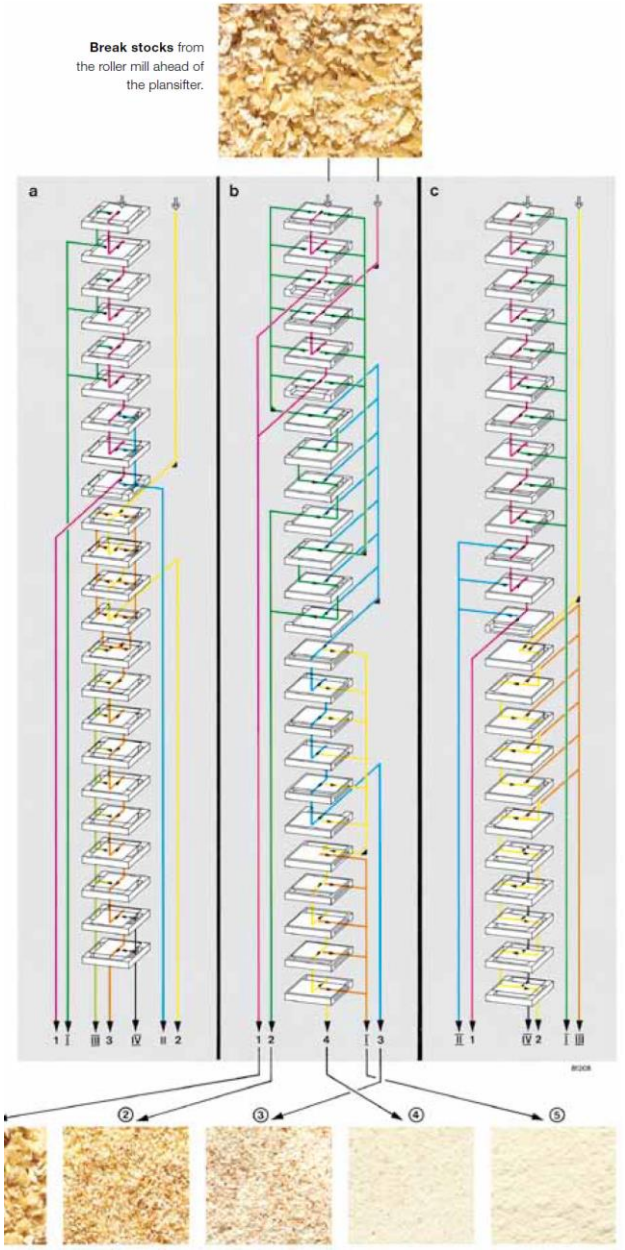

Fractionation: Plansifter

M&M

Plansifter (Bühler)

NOVA sieve.
Type B (wide).

NOVA sieve with combined NOVA cleaners.



M&M
RSM in lab scale test (random order)

Company	Oil mill	Seed origin
A	G / B / F	10% France / 90% Australia
B	G / B / F	Imported from third country
C	G / B / F	EU 28, non-GMO
D	G / B / F	50% France / 50% Australia
E	G / B / F	EU-28

M&M

Equipment for lab tests of RSM products

Roller mill and 300 µm mesh sieve

M&M Analyses

- Proximate components
- Amino acids and reactive lysine
- In vitro protein degradation (pH-stat)
- Fibre components
- Glucosinolates
- IRTA: in vivo study

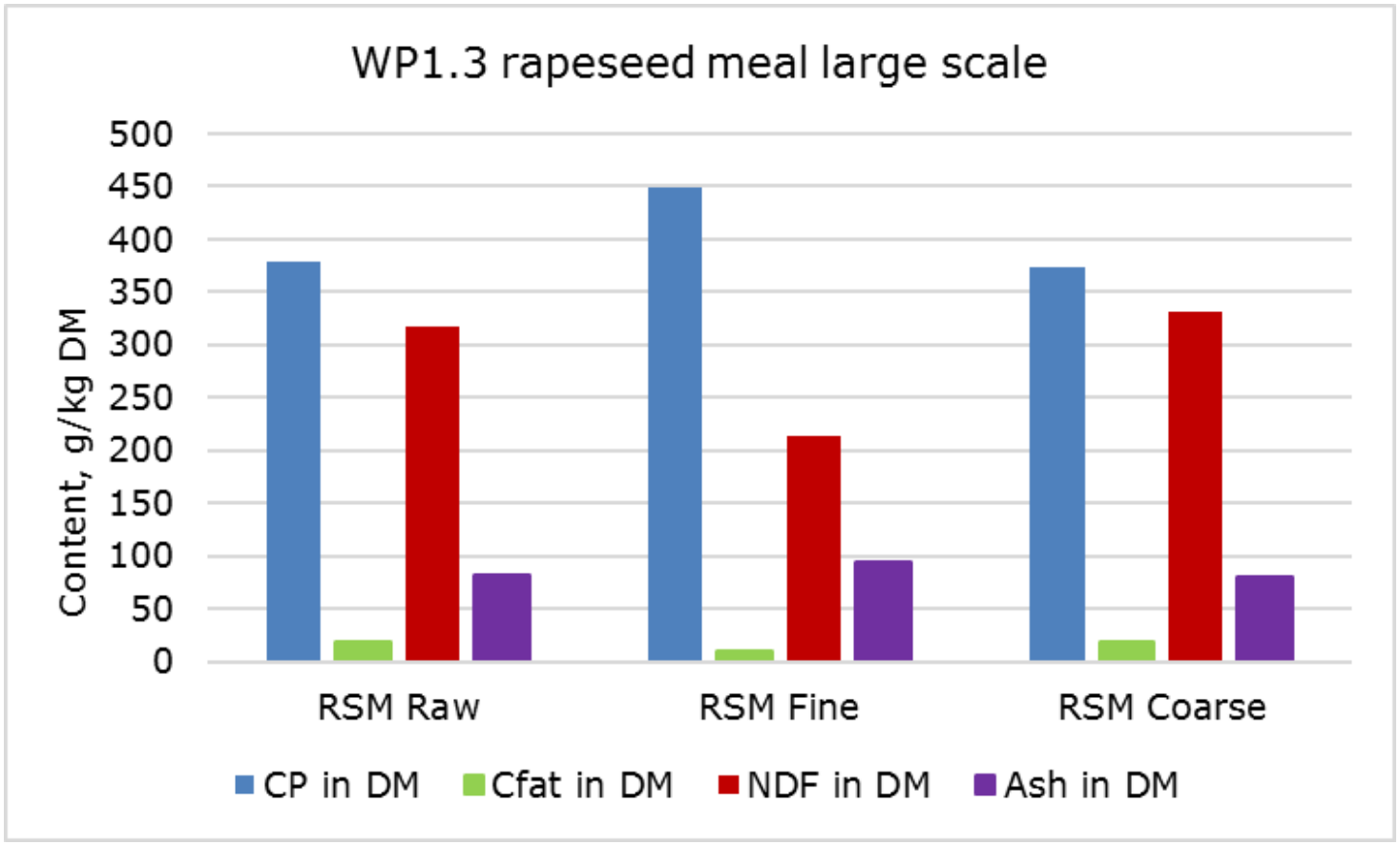
Results
Coarse (L) and Fine (R) RSM fraction

Results
RSM fractionation (sifting)

- Large scale
- 14.5% fine fraction, by weight (throughs)
- 85.5% coarse fraction (overs)

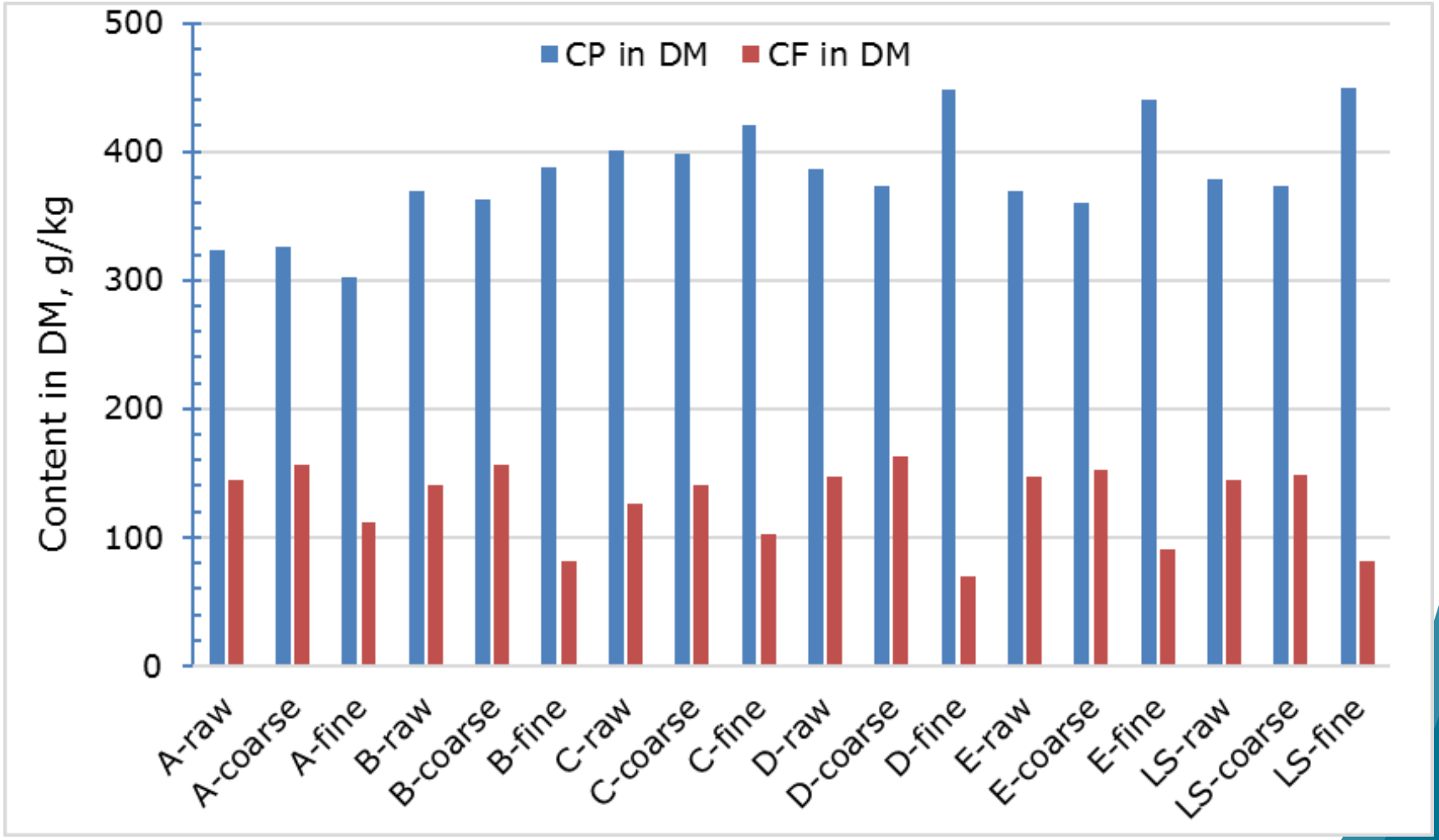
- Lab scale
- Fine fraction: 12 to 20% by weight

Large scale RSM fractionation: proximate components



- Fine fraction: higher in CP and ash, lower in fibre content

RSM fractionation, CP and CF

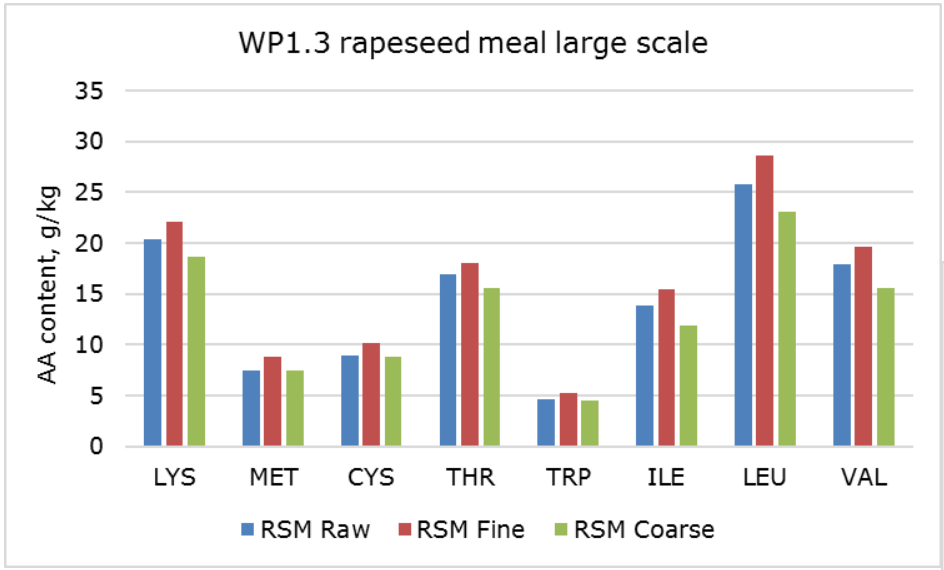


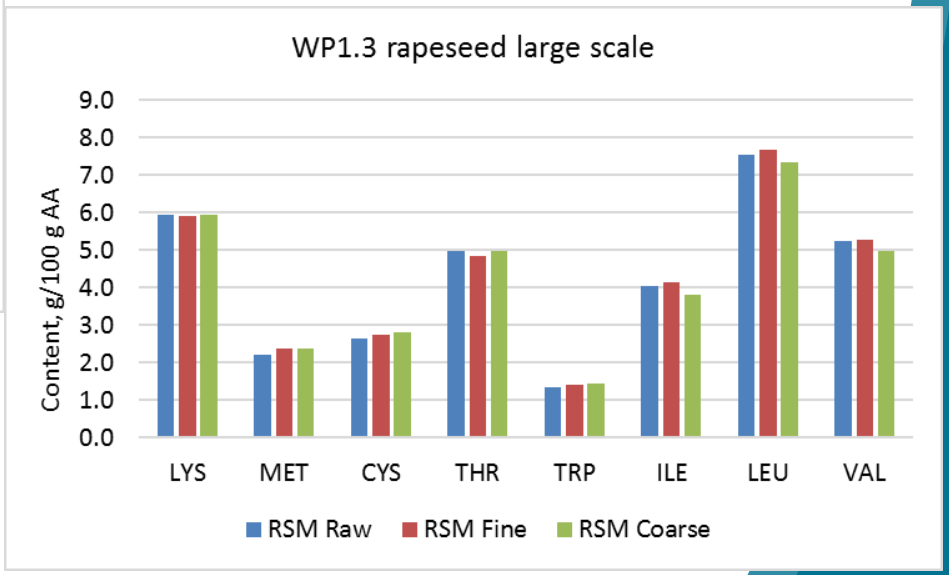
Fine fraction: higher CP content, lower CF content

Mean results of fractionation

- Fine fraction: 12 to 20% by weight
- Mean CP increase from 380 to 430 g/kg DM
- Variation: +5 to +19% relative increase
- Mean CF reduction from 140 to 86 g/kg DM
- Overall increase in ash content

Large scale RSM sifting: amino acids



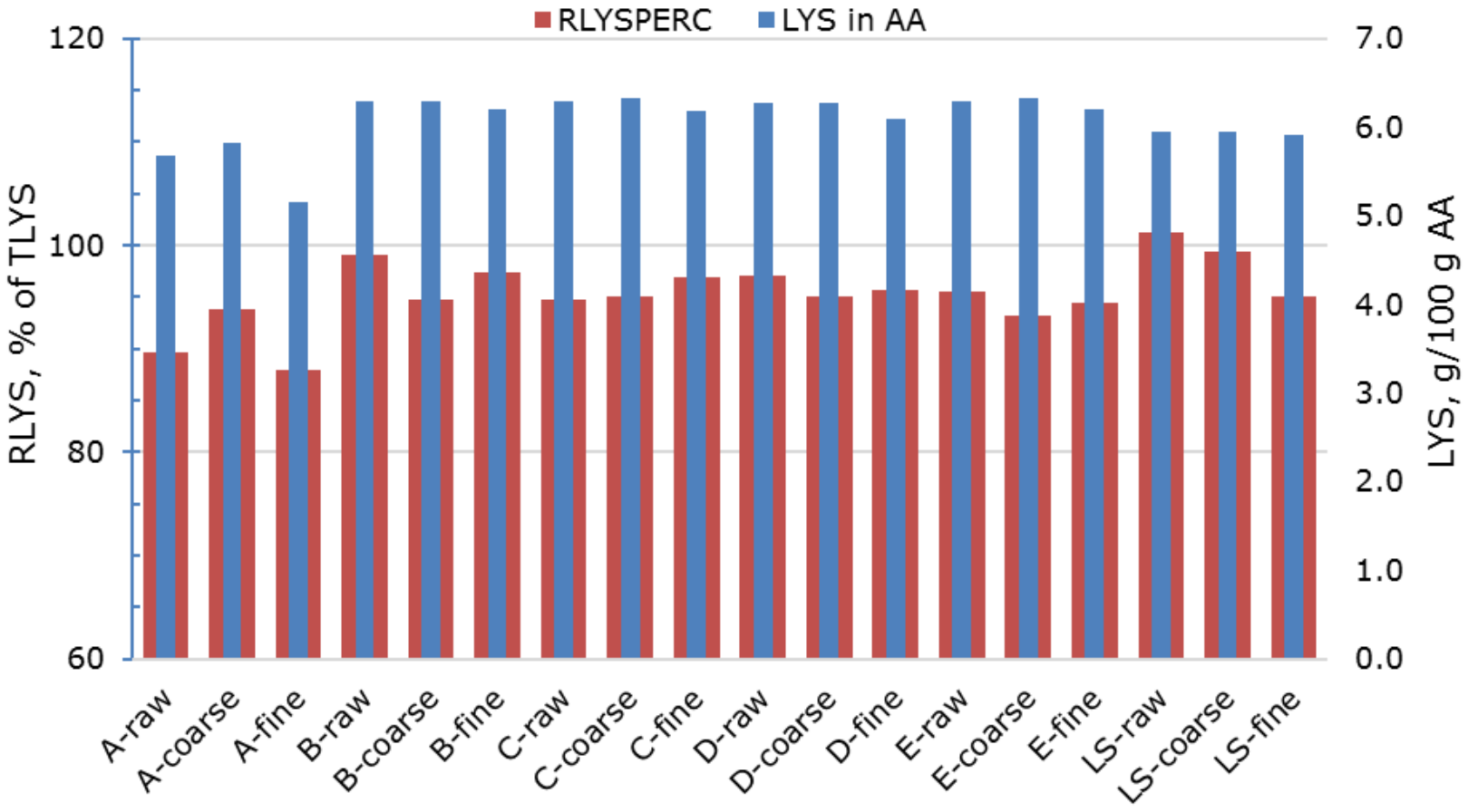


- Increase in AA-content in fine fraction, similar AA-pattern

Large scale RSM fractionation: Reactive Lysine (RLYS)

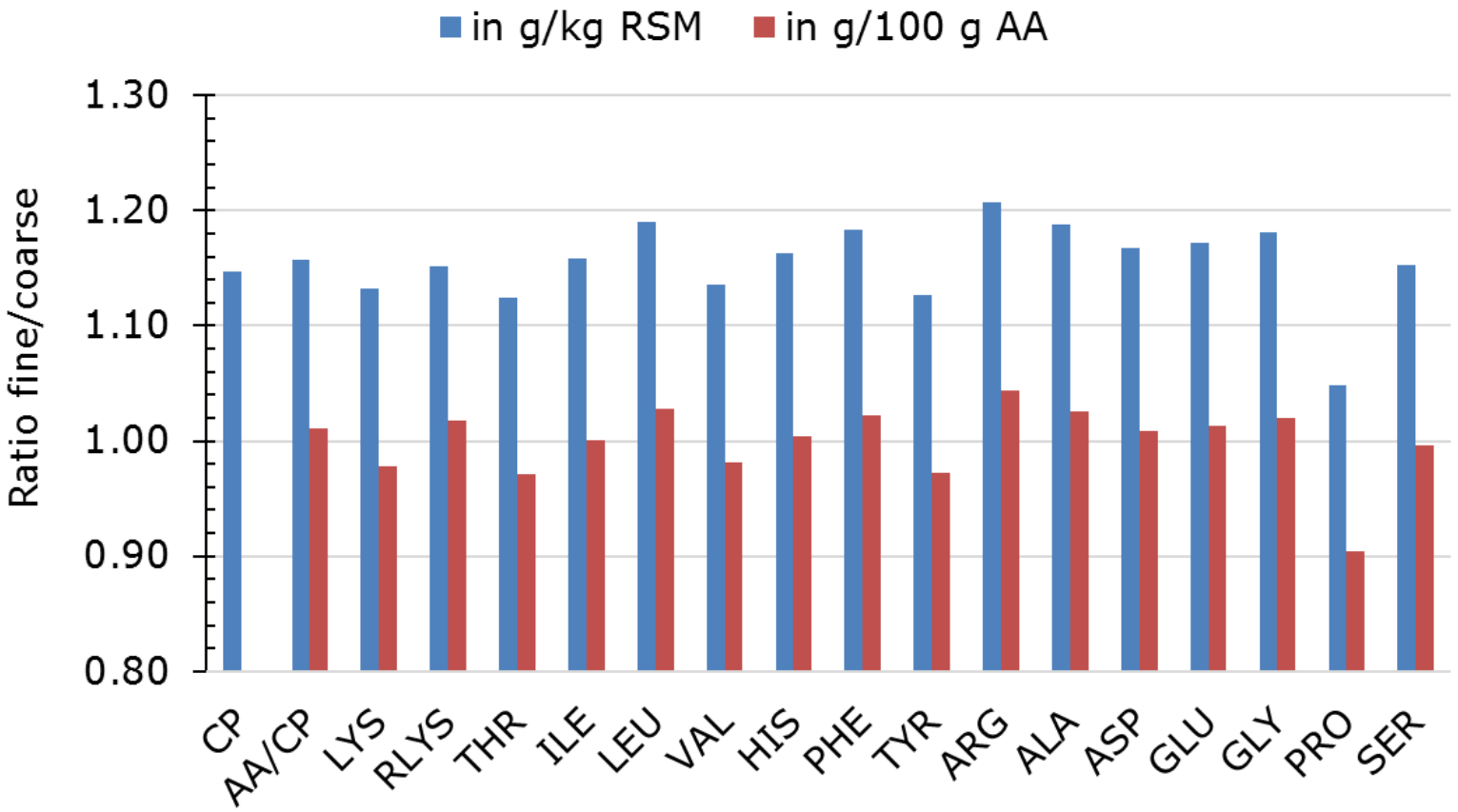
	Raw	Fine	Coarse	SEM	P
RLYS, g/kg	17.1	21.5	17.8	0.40	<0.001
RLYS, % of TLYS	101.3	95.11	99.4	2.3	0.379

RSM fractionation, 6 origins



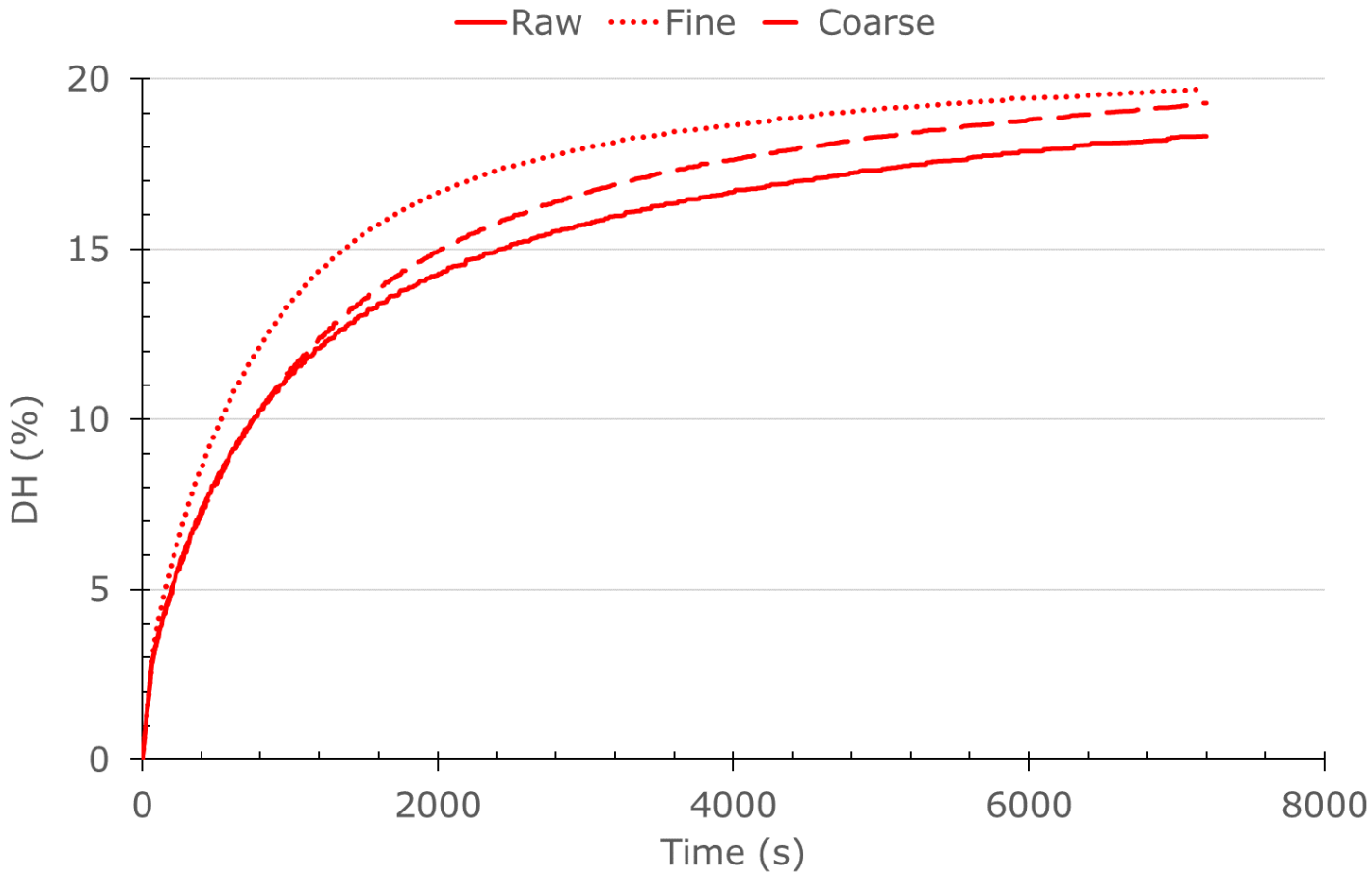
- Lower LYS and % RLYS in product A
- Reduction in LYS in fine fraction product A

Relative increase in AA in fine fraction



- Small, but consistent effect of fractionation on AA-pattern

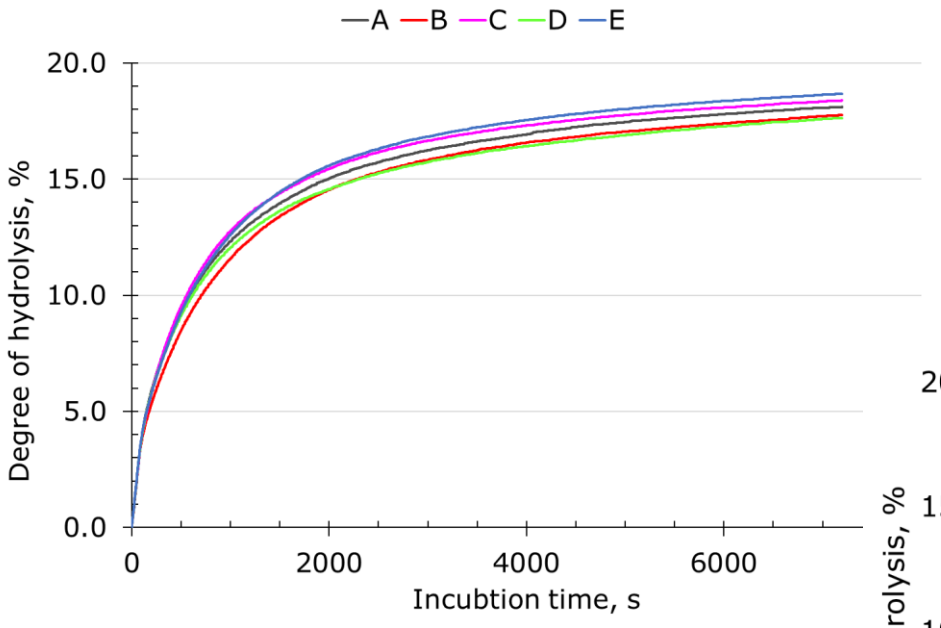
Degree of protein hydrolysis (pH-stat)



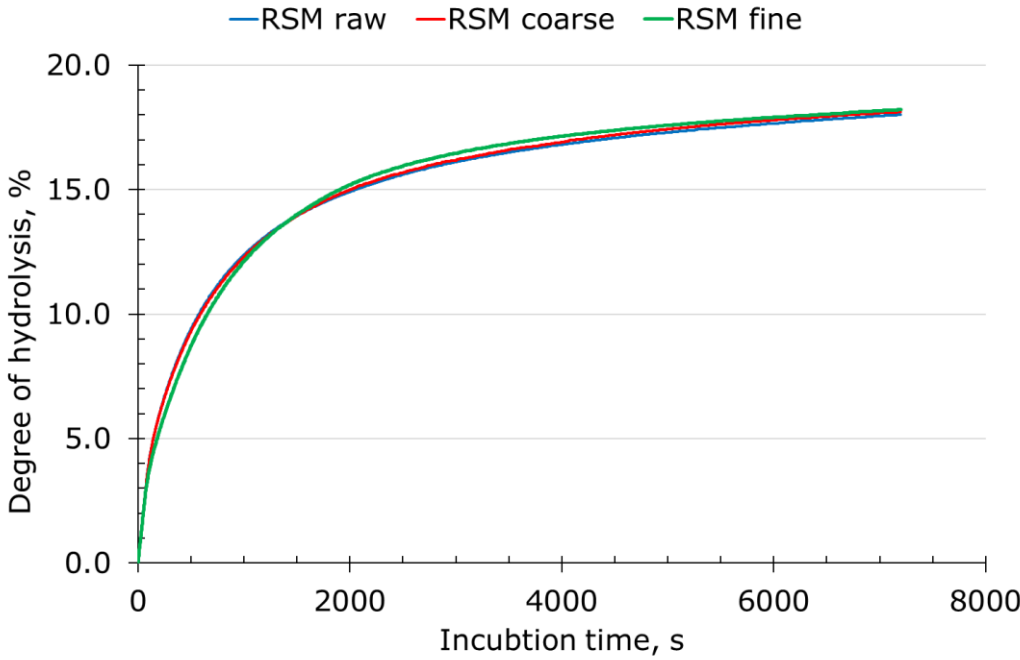
Large scale RSM sifting: DH% in pH-stat

	Raw	Fine	Coarse	SEM	P
DHmax, %	21.38	21.38	20.00	0.54	0.133
Rate constant, k (10^{-5})	6.80	8.10	5.54	1.01	0.233
Initial pH	6.22	6.13	6.14	0.066	0.500

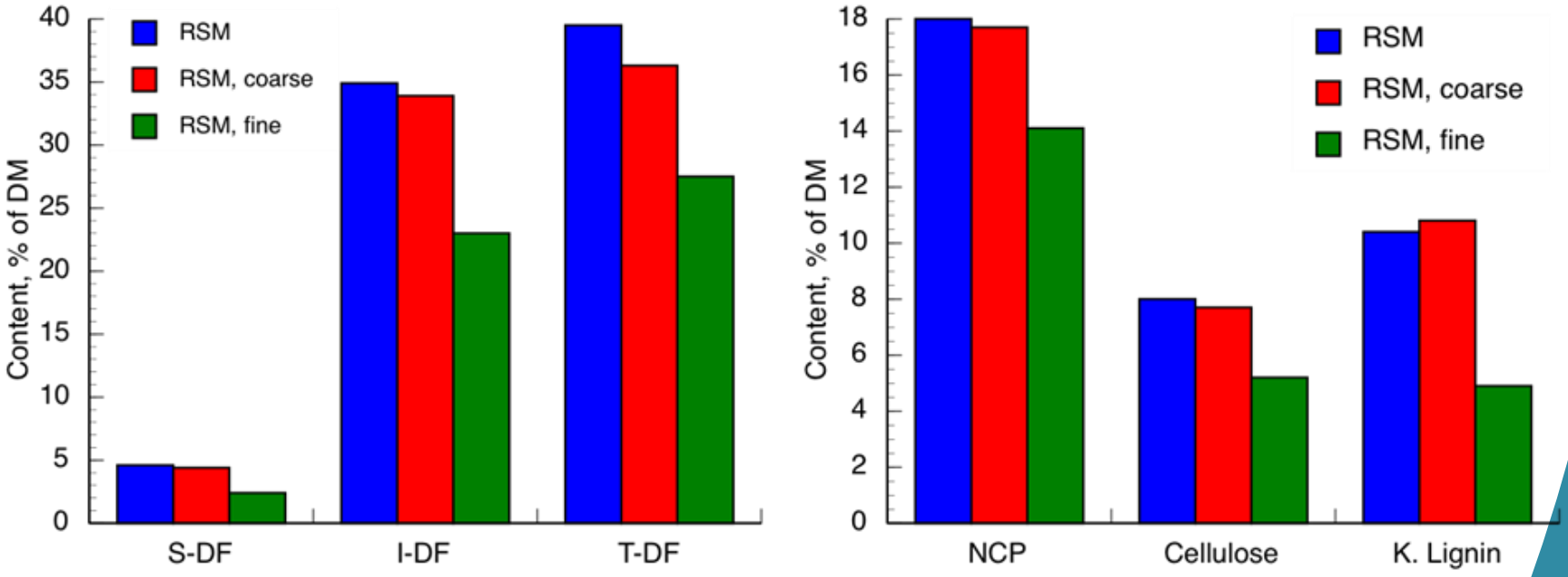
Lab scale RSM fractionation Bühler, WP1.3



- Rate (k)
- raw > coarse > fine

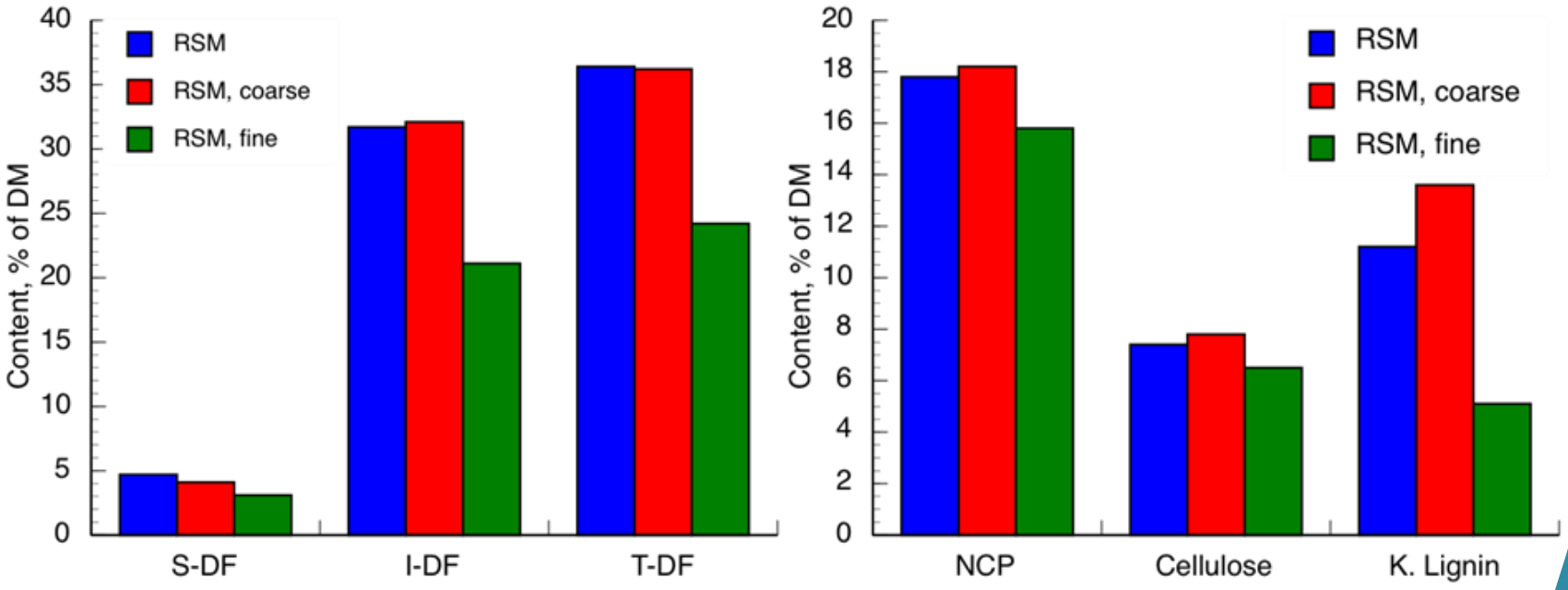


Large scale RSM fractionation: fibre fractions



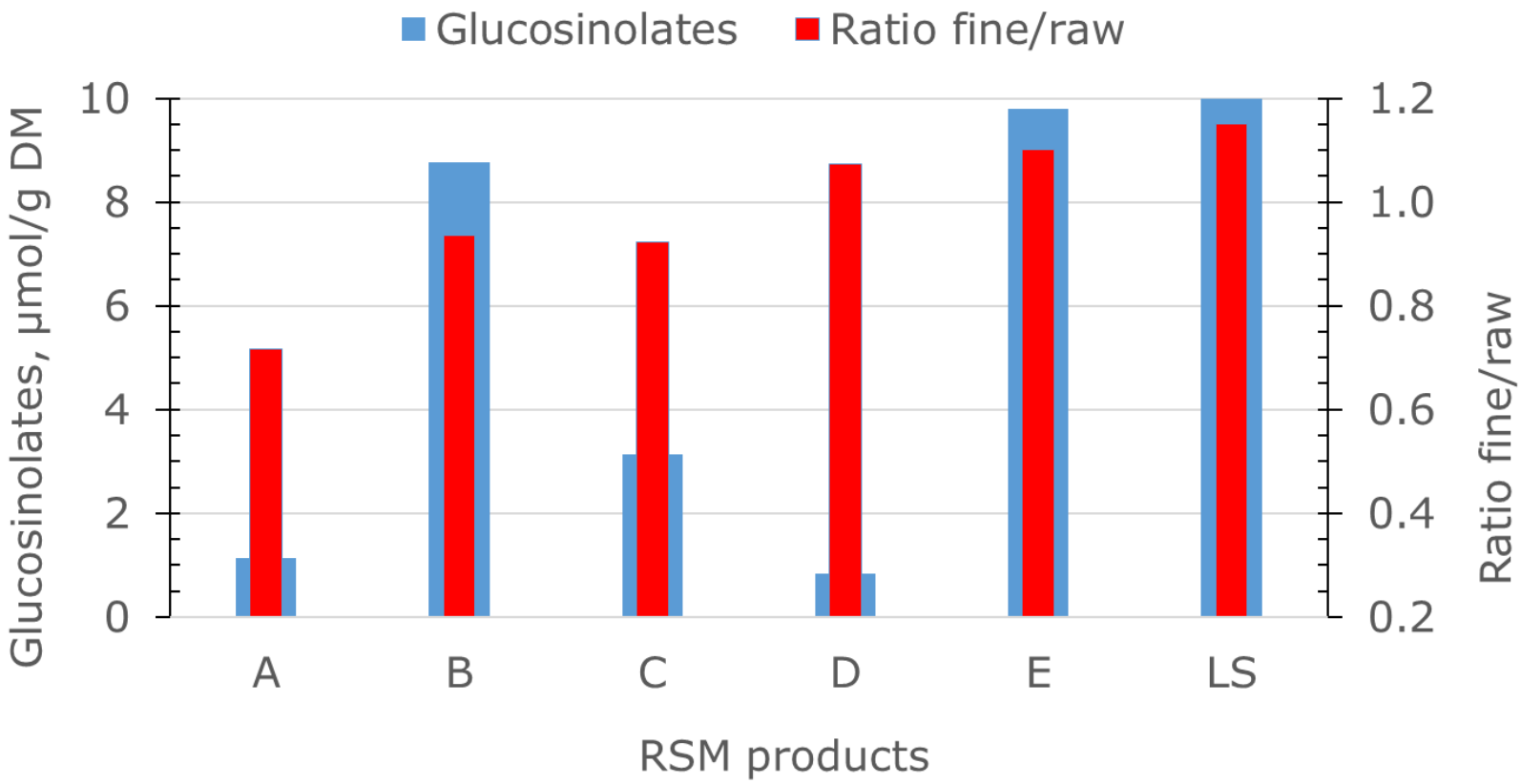
- Reduction in all fibre fractions, biggest in Klason lignin

Lab scale RSM fractionation: fibre fractions



- Reduction in all fibre fractions, biggest in Klason lignin

RSM fractionation, glucosinolates



- Large variation; potential increase in fine fraction

IRTA study, Material & Methods

- Factorial design 2x2x2
  - RSM: raw vs fine
  - die size: 4x40 vs 4x60 mm
  - Pelleted with/without steam
- 144 pigs in 72 pens
- 7 weeks, ~27 – 60 kg BW

- **Growth performance**
- **Total tract apparent digestibility**

RSM Fraction, growth performance and ATTD

	Performance				ATTD			
	Raw	Fine				Raw	Fine	
ADFI, kg/d	1.55	1.54	ns		CP	78.4	80.5	***
ADG, g/d	704	763	**		Fat	84.7	86.3	**
FCR	2.20	2.03	**		CFibre	33.5	54.4	***
BW (49 d)	62.0	65.0	**		NDF	62.0	64.7	**
					GE	84.6	86.4	***

Diego A. B. Melo, E. Esteve-García & R. Lizardo, 2019

Conclusions

- Fractionation (sifting) can be used to produce a nutritionally improved RSM product with:
  - Upto 20% enhanced CP
  - Minor effect on AA pattern
  - Substantially lower fibre fraction
- Demonstrated effects (FCR, ATTD) in vivo
- Efficacy of the process depends on origin (crusher) of the oil seed
- Insight required in influencing factors during oil crushing

Thank you for your kind attention

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