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West Bengal – Poultry Mela
18th Feb 2016
Kolkatta

Hydrothermal refinement of carbohydrate-rich feedstuffs for use in poultry diets –

actual results and experiences

GRASP®

Overview

1. Overview of technical refinement methods

2. Technical refinement of grain

3. Technical refinement of raw materials high in fibre and structured carbohydrates

4. Take-Home Message

Influence on physical properties of feed

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grinding
-technique
-sieve diameter
-clearance hammer – sieve
-particle size

components
-kind of raw material
-structure of e.g. premixes
-structure of by-products
-viscosity of raw materials

INFLUENCE on FEED STRUCTURE and PHYSICAL PROPERTIES in FEEDING SYSTEM and GIT

agglomeration
-pelletizing
-technique of pelletizing
-granulation and sieving

Technical refinement – overview

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✓ ***Grinding, pelletizing***	➔ hygiene, technical behaviour ➔ *different raw materials*
✓ **Toasting**	➔ lowering ANF; digestibility? ➔ *soybean seed; SBM*
✓ ***Extrusion, Expansion***	➔ lowering ANF; maintaining digestibility ➔ *soybean and other legume seed; by-products*
✓ ***Extrusion, Expansion***	➔ physical properties in GIT for better digestion and „health in GIT“ ➔ *grain / starch-rich raw material*
✓ ***Extrusion, Expansion***	➔ fermentability / physical behaviour in GIT ➔ *fiber-rich raw materials like SFM, RSM, soybean hulls*

Expansion + Extrusion combined: opticon®

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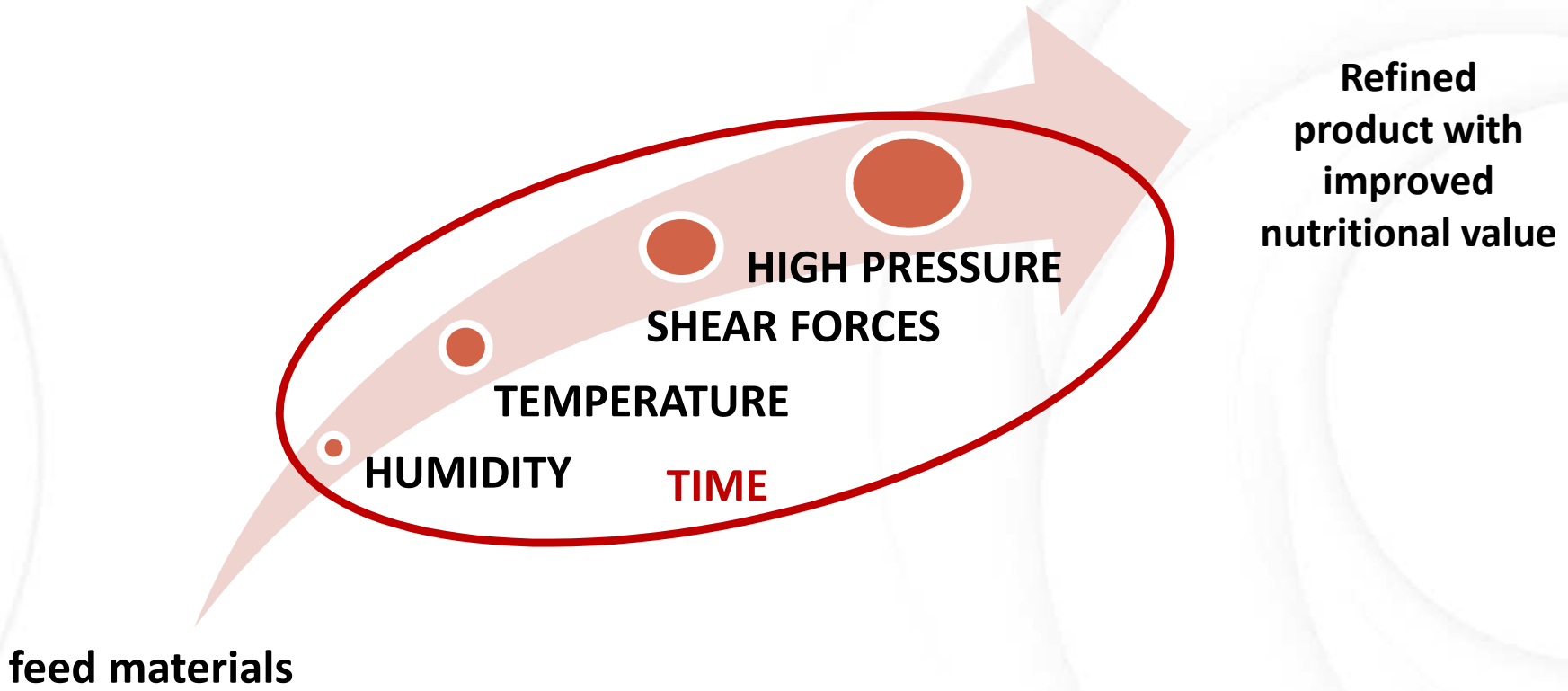
Patented technology for processing of feed materials with final goal to change their properties (nutrition-wise and physical).



Expanding + Extrusion combined: opticon®

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Principle of „moist extrusion“

- Combined advantages of a moist extrusion like in a HTST extruder (intensive material transformation), and of an expander (only product cooling, no drying)
- Energy transfer via steam, mechanical energy, pressure; expansion of the material
- *Characteristic changes in the matrix structure of the products*
- *Modification of the starch granula as well, as the structural carbohydrates like NDF / ADF right down into molecular range*
- *Enlargement of the starch granula surface and far-reaching desintegration of the semi-cristalline and cristalline structure of the amlyopectin and amylose resp. of the cristalline carbohydrate structure in NDF / ADF-rich raw materials*
- *Significant reduction of ANF‘s*

technical refinement of soybeans

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Control on urease activity (Kresolred-test)

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Concentration of ANF's and in vitro digestibility of protein

	untreated	opticon® refined
dry matter, %	90,6	90,3
protein, %	35,7	35,9
PDI	**91**	**14**
Urease activity, %	**80**	**<1**
TIU/mg TS	**32**	**7,4**
in vitro-dg protein 3 h, %	**26,9**	**56,5**
in vitro-dg protein 24 h, %	**37,9**	**71,1**

technical refinement of grain

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Example: mixture of 50 % wheat, 25 % barley and 25 % corn

Influence of refinement on the structure of starch

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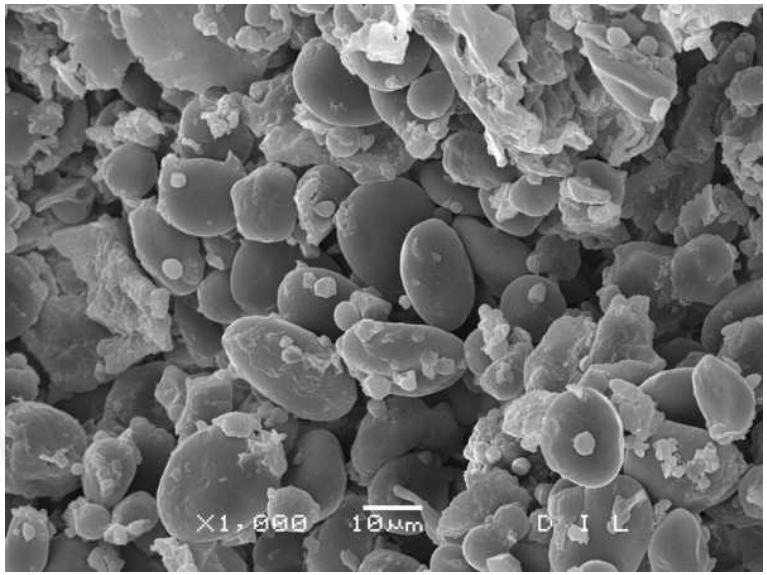
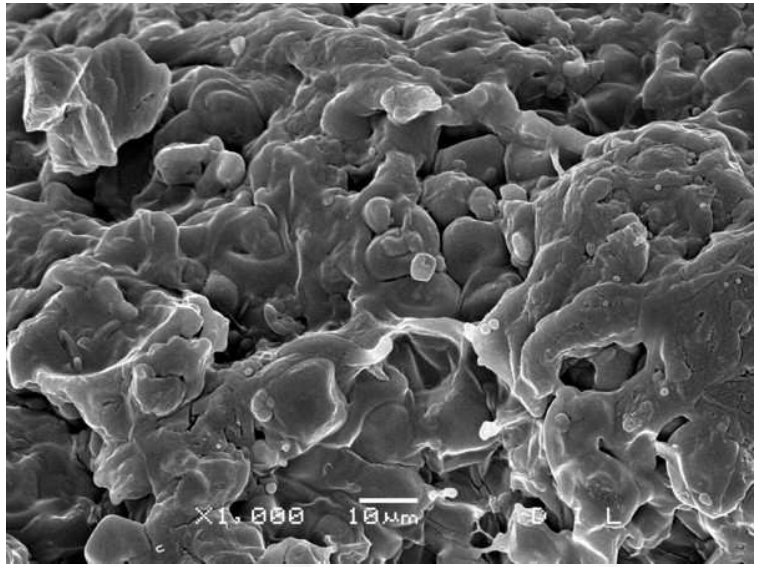


untreated mixture



opticon® refined

(scanning electron microscope, 1000-fold magnification)

(mixture of 50 % wheat, 25 % barley und 25 % corn)

Influence on the physical properties in liquid

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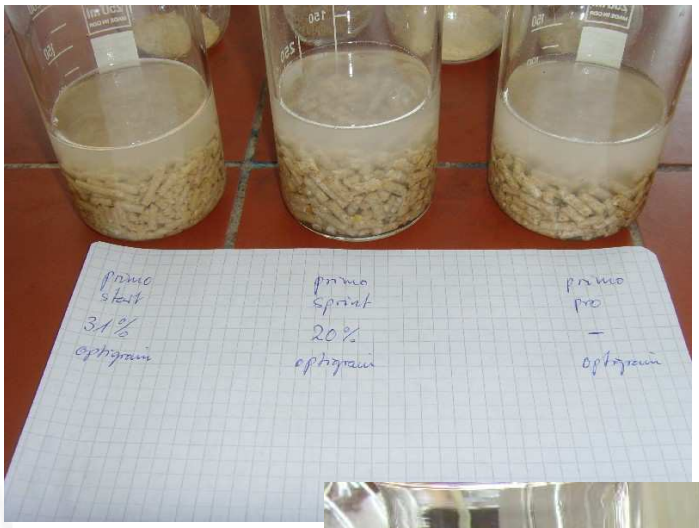
mixture of 50 % wheat, 25 % barley und 25 % corn

untreated

refined

Refined grain – influence on dissolution of pellets



0 minutes

5 minutes

10 minutes

Refined grain – influence on viscosity

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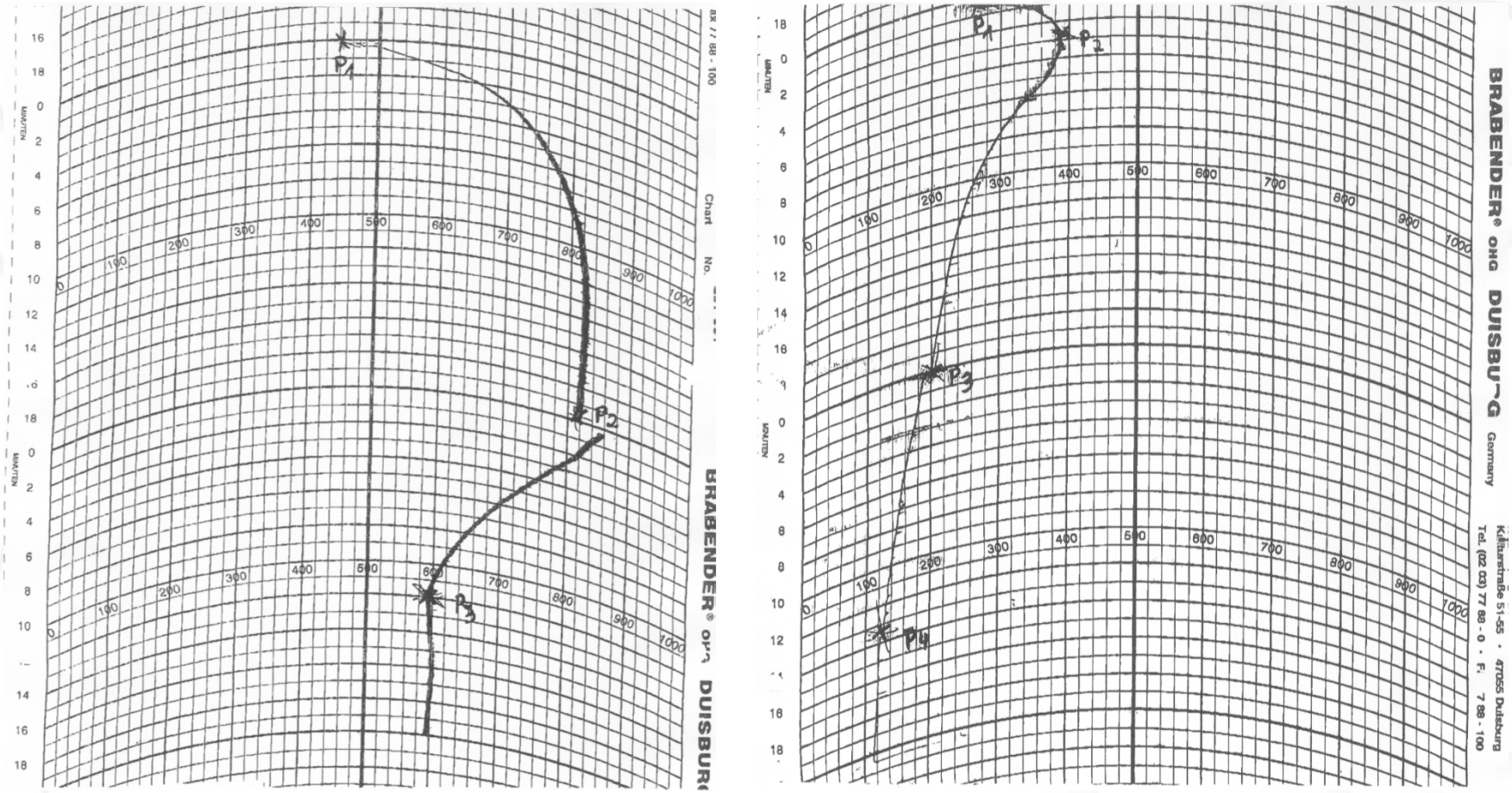
Viscosity of the cooked grain mixture is caused by starch hydrolysis



left: 50 g refined grain mixture + 250 g water

right: 50 g refined grain mixture + 250 g water + 3 mg Alpha Amylase (60 g per MT)

start temperature 25°C; after 20 min temperature increase up to 60°C with 3°C/min

Refined grain – influence on viscosity

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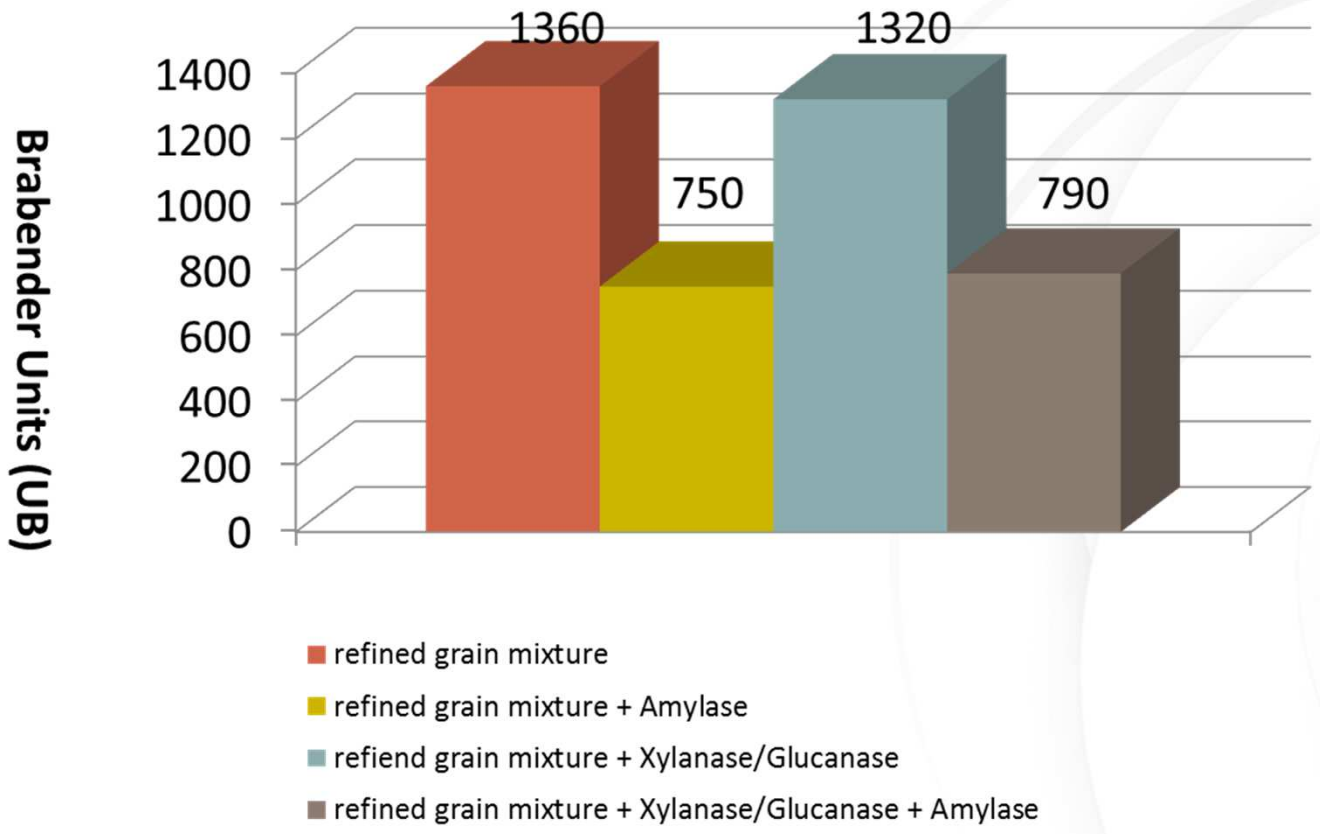
Viscosity of the cooked grain mixture is caused by starch hydrolysis



Viscosity in refined grain

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Viscosity of the refined grain mixture is caused by starch hydrolysis

left: 50 g refined grain mixture and 250 g water

right: 50 g refined grain mixture and 250 g water plus 3 mg Alpha Amylase (60 g per MT)

diet viscosity and influence on digestion in stomach

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Influence of feed viscosity on physiological parameters and protein digestion in young monogastric animals

Treatment	Control	Trial	Significance
Viscosity (mPa s)	3.6	21.8	
Retention time of the solid phase in the stomach - Recovery of marker (%)	21.4	25.7	0.18
Protein hydrolysis in the stomach (%)	26	34	0.13
Aminopeptidase activity (U/g protein)	359	516	<0.01
ileal N digestibility (%)	75.2	79.8	0.22
faecal N digestibility (%)	80.3	84.2	0.04

Source: Fledderus et al.: Increasing diet viscosity using carboxymethylcellulose in weaned piglets stimulates protein digestibility Livestock Science 109 (2007) 89-92

technical refinement of grain and protein value

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Effect of hydrothermal refinement on in vitro protein digestibility in barley

	Nativ		opticon treated	
batch	**3-hour dig% nativ**	**24-hour dig% nativ**	**3-hour dig% treated**	**24-hour dig% treated**
1	73,7	90,5	85,8	91,5
2	79,5	89,1	84,9	91,1
3	76,7	90,1	81,8	90,4
4	77,5	90,8	84,3	90,4
5	77,2	87,4	81,8	90,3
6	76,0	91,3	81,0	90,0
average	**76,8**	**89,9**	**83,3**	**90,6**

Source: trial report Provimi b.v. (2011)

technical refinement of grain and protein value

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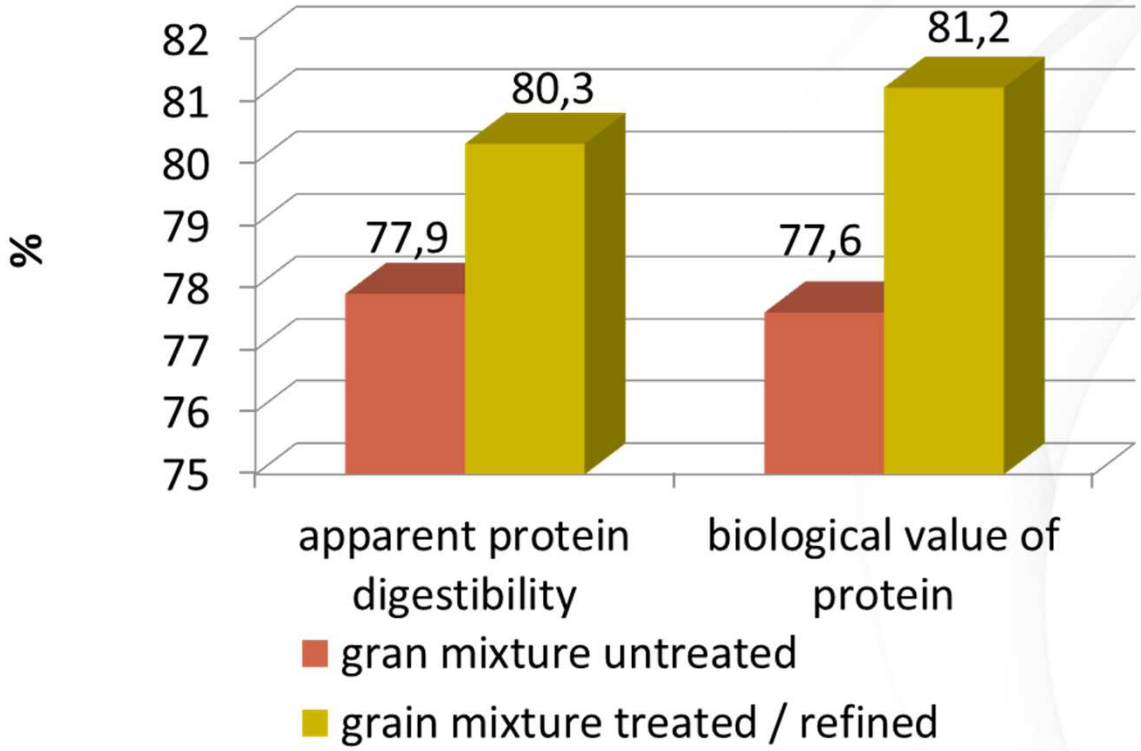
Investigation on apparent protein digestibility and biological value of protein in a growth trial with rats (University of Rostock)



Average results from investigation with n=6 rats per group.
Differences are statistically not significant.

technical refinement of fiber-rich raw materials

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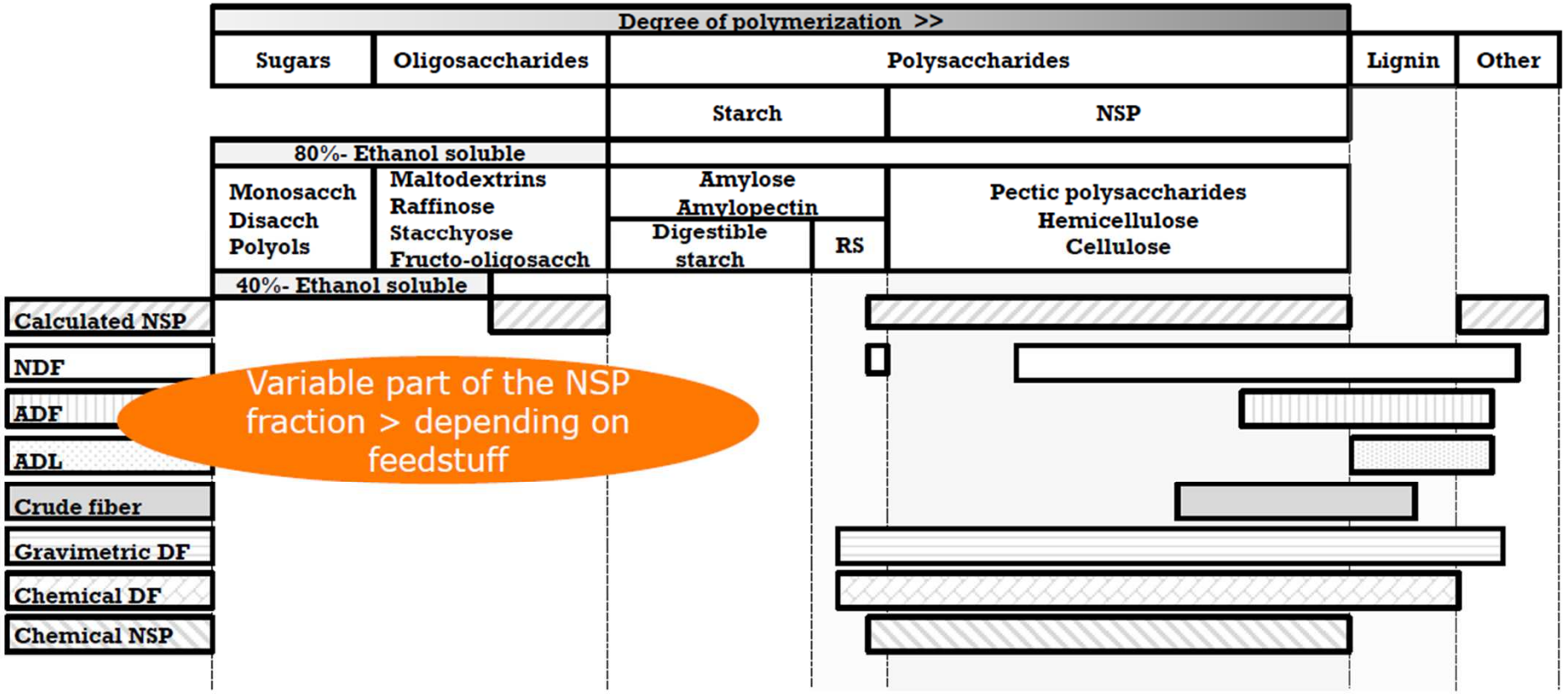
Influence on structural carbohydrates, their fermentability and meaning for health and performance



technical refinement of fiber-rich raw materials

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Raw materials in focus:

- rapeseed by-products
- sunflower by-products
- sugarbeet by-products
- hulls from soybeans, from sunflower seed, from …..
- ……

Target:

Improving physical matters in GIT, fermentability, energy release
➔ in general: improving value for application in feed recipies

technical refinement of fiber-rich raw materials

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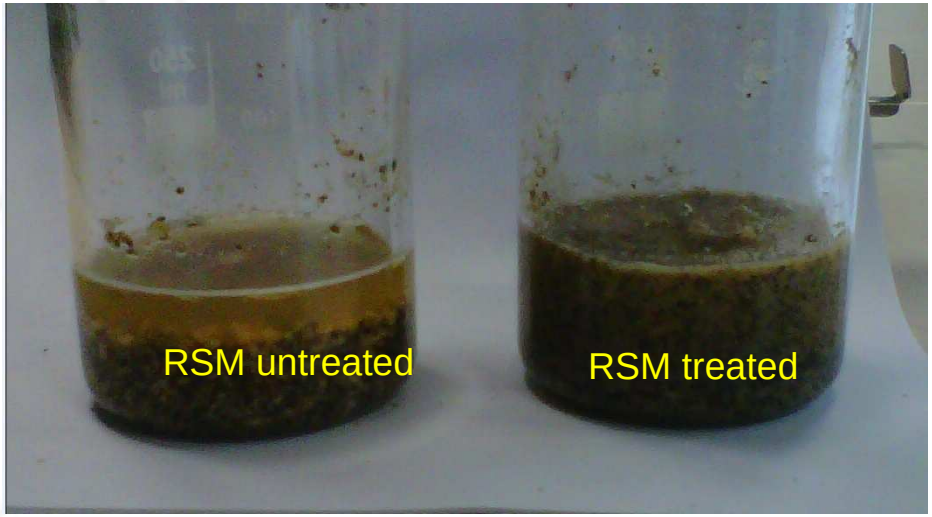

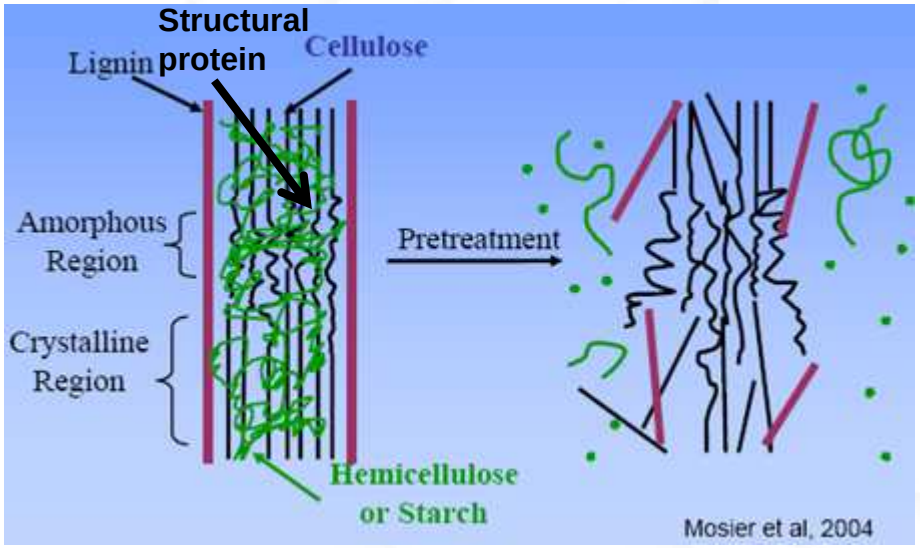

refinement of sunflower meal and NDF breakdown

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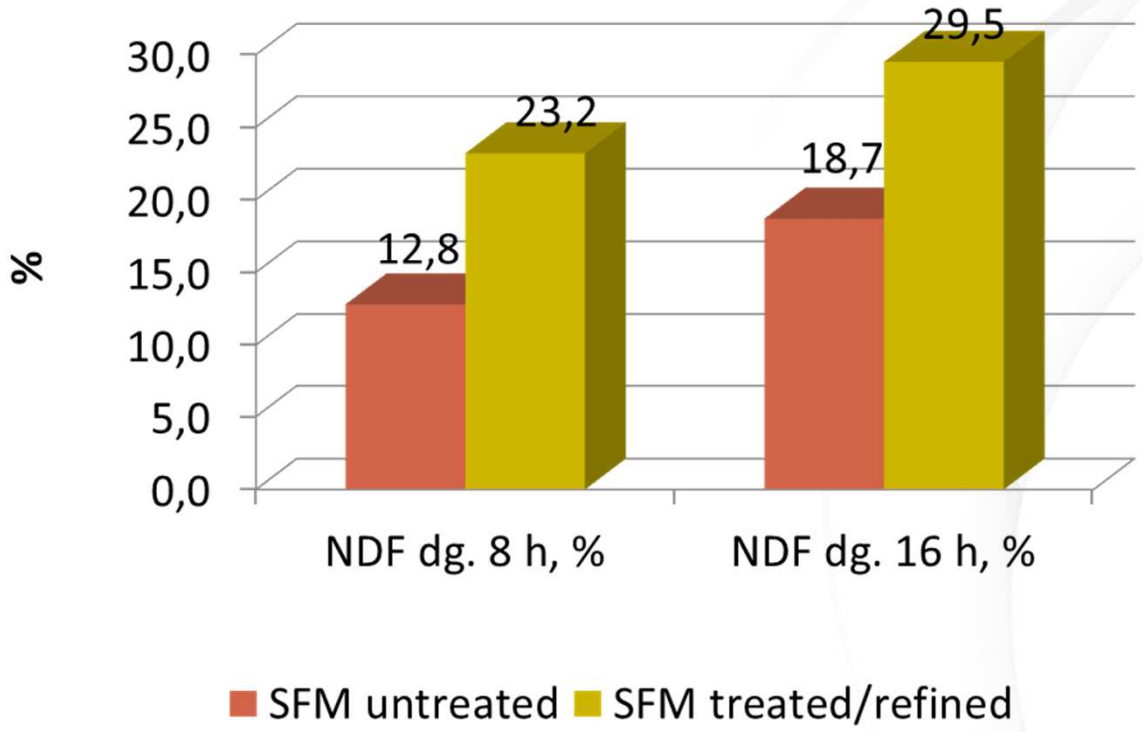
Investigation on NDF breakdown in „Daisy Ankom“ (University of Udine, 2011)



Source: University of Udine (2011)

Broiler fattening with refined RSM, SFM, DDGS

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- Broiler ROSS 308 Male - 9 groups with 35 animals/group – floor keeping
- Fattening to 42nd day of life – trial carried out May-June 2013

Group	1	2	3	4	5	6	7	8	9
SBM	++	+	+	+	+	+	-	-	-
Prodigest*	-	+	+	+	+	+	++	++	++
Feature	POSITIVE CONTROL	(RSM+SFM+ DDGS) opticon	((RSM+SFM ultrafine) +DDGS)) opticon	(SFM+ DDGS) opticon	((SFM ultrafine)+ DDGS)) opticon	(RSM+SFM+ DDGS) untreated	(RSM+SFM+ DDGS) opticon	((SFM ultrafine)+ DDGS)) opticon	((SFM ultrafine)+ DDGS)) untreated
ALW (42)	3,23	3,30	3,02	3,30	3,18	3,44	3,24	3,54	3,47
FCR (42)	1,49	1,48	1,50	1,51	1,51	1,43	1,58	1,49	1,52
p<0,001 (ALW)	ABDEFG	ABDEFGI	CE	ABDEFG	ABCDEG	ABDFGHI	ABDEFG	FHI	BFHI
Feed: CF, g/kg	32	42				44		69	69
Feed: NDF, g/kg	136	172				175		235	235
Feed: ADF, g/kg	71	93				96		150	150

***Prodigest: RSM, SFM, DDGS – different combination, particle size and processing parameters**

Source: Faculty of Agronomy, Zagreb; 2014

technical refinement of fiber-rich raw materials

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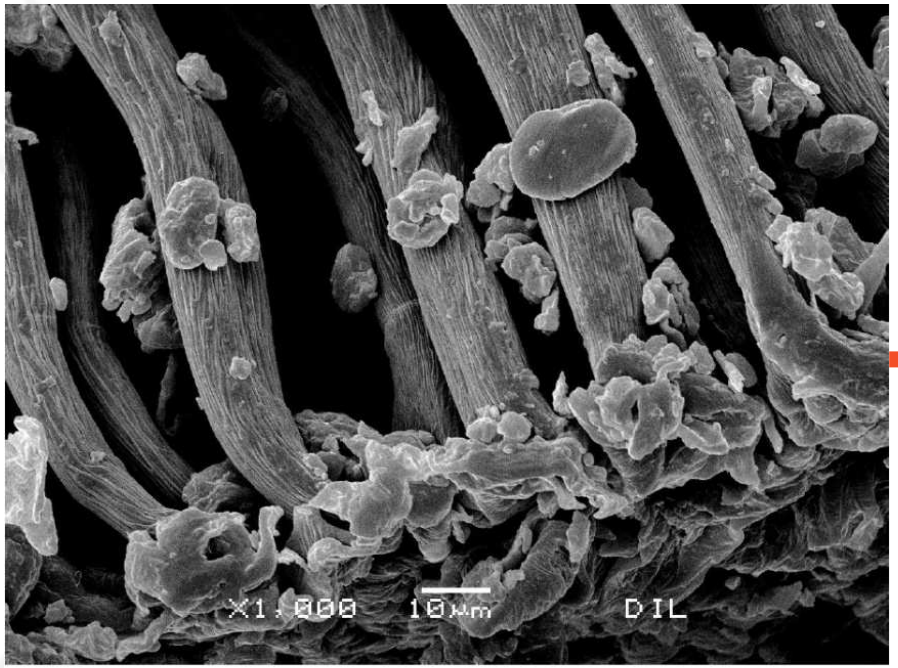
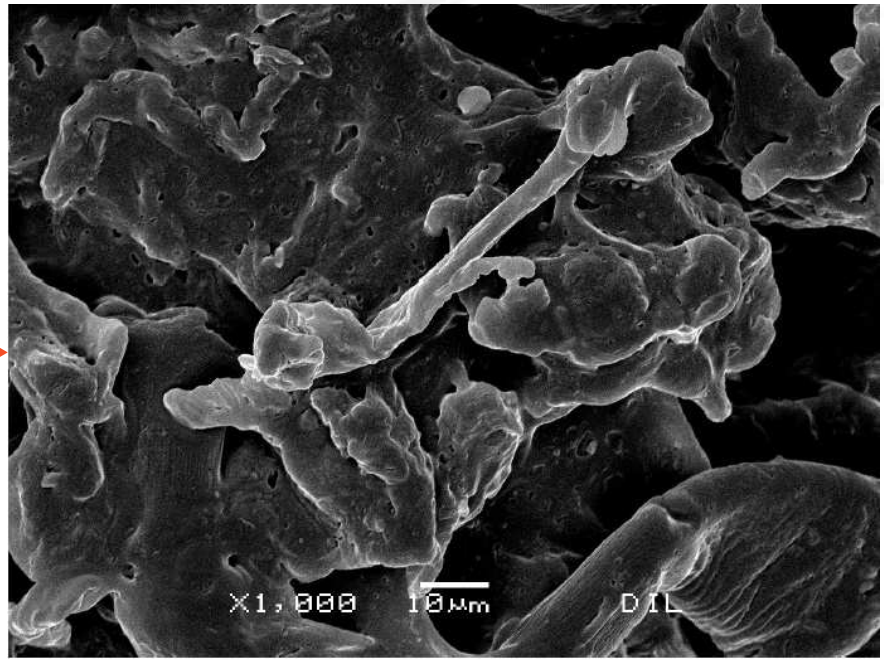
soybean hulls, untreated



Länge des Balkens: 10 µm

soybean hulls, hydrothermally treated



Länge des Balkens: 10 µm

(scanning electron microscope, 100-fold magnification)

Whc in different untreated and refined raw materials

WHCmax. = (a+b)/c *100 = H_2O/100 g DM

a = water incorporation in 100 g sample

b = humidity in 100 g sample

c = DM of 100 g sample

Take-Home Message

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- Intensive technical refinement of raw materials alters their physical properties and agencies, and also the nutritive value.
- Technically refined grain supports protein digestion in the GIT and effectively reduce nutrition-induced diarrhea ➔ „healthier GIT“
- Technical refinement of protein-rich raw materials with higher concentration of „structural carbohydrates“ (fiber / NDF / ADF) alters their physical properties, improves degradability of the usually less degradable carbohydrates and enables the replacement of classically used SBM in broiler (and turkey) fattening feed.
- In future refined fiber-rich raw materials will becoming more and more important for support of „intestinal health“ as well, as for animal welfare.

Thank you for your attention.

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