Schothorst Feed Research

Increasing nutritive values of raw materials and compound feed by feed technology

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Schothorst Feed Research

Current situation:

- Feed production determines technological development
- Feed characteristic: pellet quality
- Effect on performance often unknown
- Variation in nutritional quality caused by production

Many different technologies

- Milling
- Conditioning
- Pelleting
- Expanding
- Extruding
- Cooling
- Heating
- Chemical treatment

Different objectives feed technology

- Compacting
- Homogenise/demixing prevention
- Reduce microbial contamination
- Improve nutritional value

Different objectives feed technology

- Compacting
- Homogenise/demixing
- Reduce microbial contamination
- Improve nutritional value

But it may also have adverse effects or over processing may occur

What is nutritional value ?

- Better availability of nutrients through digestion
  - *Extent*
  - Rate
  - Site
- Reduction of ANF's
- Feed intake
- Health improvement

Main effects of technology on digestion

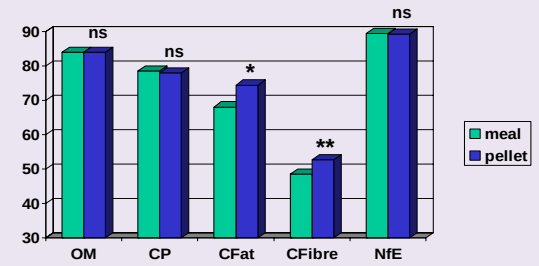
- Gelatinisation of starch: water, pressure, heat
- Making nutrients better accessible for digestive enzymes
- Particle seize reduction
- Denaturation of antinutritional factors

Effect of pelleting on digestibility (broilers, grower phase)

Treatment	D.C. (%) Protein	D.C. (%) Fat	M.E. (kcal/DM)
Meal	85.2	84.5	3458
Pelleted	86.5	90.2	3542

PSF-23

Effect of pelleting on app. faecal digestibility in pigs



(B. Smits et al., 1994)

Effect of pelleting on digestibility of rapeseed meal in swine

	Meal	Pellets	rel.difference
protein digestion (%)	**79**	**82**	**+ 4%**
fat digestion (%)	**68**	**76**	**+ 12%**
fibre digestion (%)	**39**	**47**	**+ 20%**

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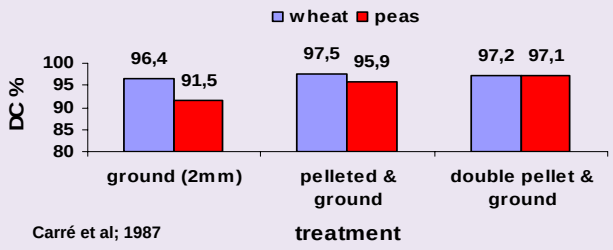
Normally for feeds 2 – 4 %

Starch digestibility of peas and wheat in broiler diet



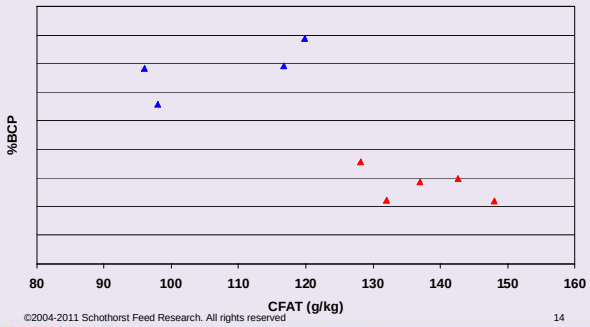
Carré et al; 1987

What is nutritional value ?

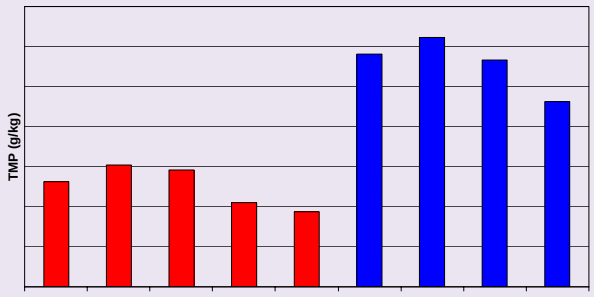
- Better availability of nutrients through digestion
  - Extent
  - *Site of digestion*
  - Rate of digestion
- Reduction of ANF's
- Feed intake
- Health improvement

For ruminants for protein and starch sources it is beneficial that these are only partially fermented in the rumen. It is more efficient if they are digested in the small intestine

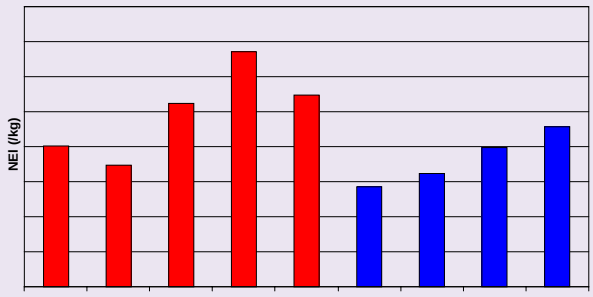
Bypass protein Rapeseedexpeller



True Metabolisable Protein Rapeseedexpeller



Net energy Rapeseedexpeller



Effect production process on rumen bypass of starch

	Decrease in bypass (absolute %)
pelleting	12
double pelleting	16
BOA / pelleting	17
TMC / pelleting	5
expander / pelleting	13

Effect of sorghum particle size on digestibility

	rollermill (course particles)	hammermill (fine particles)
ileal starch digestibility	72 %	86 %
faecal starch digestibility	96 %	98 %

(Owsley et al, 1981)

What is nutritional value ?

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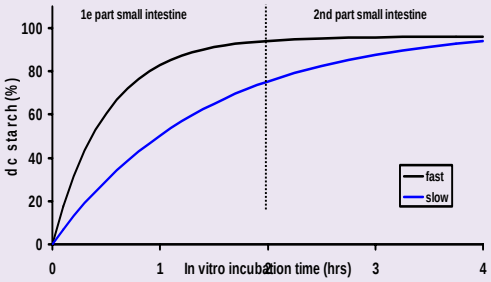
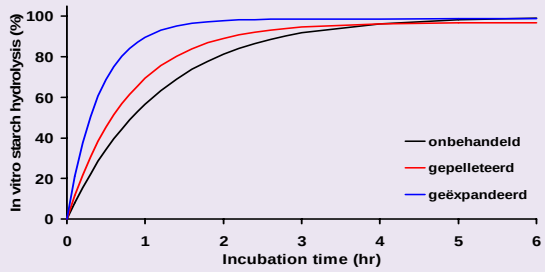
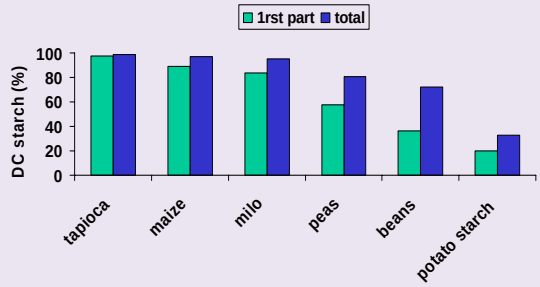
Rate and site of starch digestion in piglets and broilers



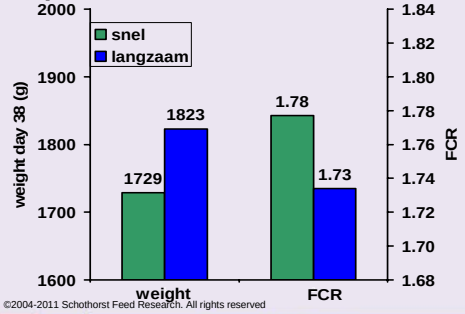
Effect technology on in-vitro starch digestion

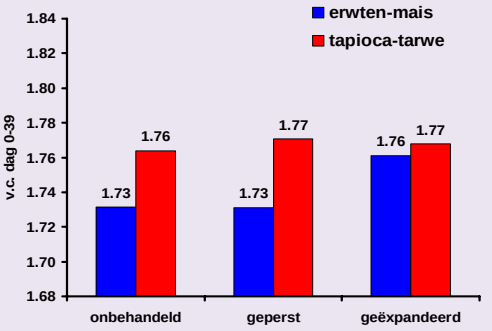


Digestibility of starch in broilers



Effect of rate of intestinal starch digestion on performance of broilers





What is nutritional value ?

- Better availability of nutrients through digestion
  - Extent
  - Rate
  - Site
- *Health improvement*
- Feed intake
- Reduction of ANF's

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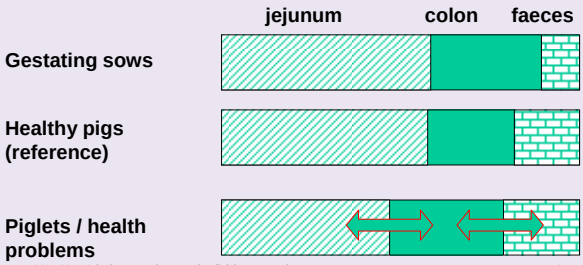
Health

Nutrient digestion in relation to age and physiological stage



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In general a faster digestion due to technological treatment will improve digestibility, but other aspects might temporarily be more important

Effect of fineness on performance of piglets after weaning

ksv

		fine	coarse	
week 1-2	intake	314	343	23
	growth	235	261	22
	fcr	1.35	1.32	0.05
week 3-4	intake	806	810	44
	growth	537	523	31
	fcr	1.49	1.55	0.04

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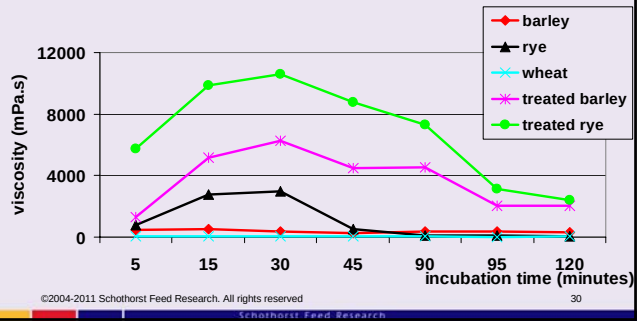
In-vitro viscosity of cereals

(SFR experiment report no 679)



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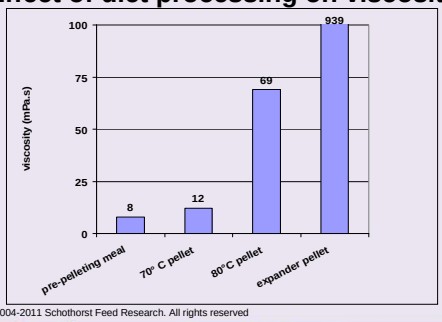
Effect of diet processing on viscosity



Effect of treatment on viscosity (Lundblad ea , 2011)

	Mash	Pell 47	Pell 90	Expanded	Extruded
Viscosity	38	36	41	94	315

Effect of treatment of feed of piglet diets (Lundblat e.a., 2011)

	Mash	Pell 47	Pell 90	Expanded	Extruded
0-13					
gain	287	289	288	287	328
G/F	0.94	1.01	1.11	1.06	1.17
14-36					
gain	503	524	510	510	511
G/F	0.71	0.76	0.79	0.74	0.78

Effect of particle size distribution on production and stomach ulcers

(fattening pigs 25 - 110 kg)

	fine	medium	course
% > 1.4 mm (meal)	5	15	24
growth (g/d)	886	892	892
feed conversion	2.49	2.52	2.55
intake (kg/d)	2.19	2.22	2.26
stomach ulcer	2.65	2.47	2.36

SFR report 2001

Incidence of stomach ulcers in swine

- Roller mill vs hammer mill
- Average particle size in hammer mill
- Need for structure in the feed

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- *Feed intake*
- Health improvement

Effect of pellet diameter on feed intake of growing rabbits (Aveux e.a. 2000)

Dye	2.5X25	3.5X45	5.0X55
Feed intake			
Day 1-21	111.9	113.5	119.7
Day 22-35	161	161.1	157.5

Effect of pellet quality on piglet performance

Hardness	6,2	7,8	9,4	6,2
Diameter	3,4	3,4	3,4	2,6
Growth	382	363	350	354
FCR	1,51	1,51	1,49	1,51
Feed intake	577	546	520	535

- Feed intake of piglets depends on pellet diameter
- Feed intake depends on Kahl number
- Pallets should not be too hard

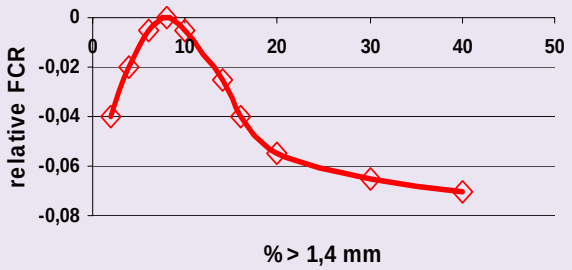
Effect of processing on starch digestibility of peas (layers)

Treatment	D.C.
Course ground	75.6
Finely ground: 1mm	88.1
Toasted 121°/30' + ground	90.4

Longstaff and McNab; 1987

Particle size, broilers

(growth fase)



Effect of particle size distribution (layers, week 22-41, ISA-Brown, 1996)

Avg Particle size (mm)	1.32	1.60
Intake (g/d)	111.3	112.5
F.C.R.	2.07	2.08
Laying %	92.4	93.1
Egg mass (g/d)	53.7	54.4

circ. 1997/11

What is nutritional value ?

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  - Extent
  - Rate
  - Site
- Feed intake
- Health improvement
- *Reduction of ANF's*

Effect of dehulling Vicia Faba beans

	tannins (g/kg)	tryp inhibitors (g/kg)
Vicia faba beans		
Whole bean	10.4	0.61
dehulled	5.6	1.8
hulls	45	

Effect of pelleting and dehulling on digestibility of Vicia Faba beans

	cp	cfat	cfiber	OM	NE
normal					
mash	66.8	50.7	7.1	72.1	7.9
pelleted	74.1	71.4	11.8	76.1	8.3
dehulled					
mash	81.5	65.3	59.2	89.4	9.7
pelleted	80.7	68.9	45.8	89.4	9.7

Treatment of soybeans

1. Toasted (10 min,100C) feed:pelleted
2. As 1 feed: exp,pell
3. Toasted (5 min, 100C) feed: pelleted
4. Raw feed:toasted ,exp, pell
5. Raw feed: exp, pelleted

Effect of treatment of soybeans in broilers (21 days)

	T10. pell	T,pel, exp	T5 pell	Raw,T exp,pel	Raw, exp,pell
weight	816	837	804	803	500
Feed conversion	1.43	1.44	1.46	1.52	1.86
Feed intake	1106	1140	1111	1154	848
Litter score	6.4	6.4	6.7	6.6	6.8

Table 7. Effects of heat treatment on amino acid concentration and digestibility of soybean meal in poultry.

Auto calving time (minutes)	Concentration, %			
	Lysine	Methionine	Cystine	Threonine
0	3.27	0.7	0.71	1.89
20	2.95	0.66	0.71	1.92
40	2.76	0.63	0.71	1.87
	Digestibility, %			
0	91	82	86	84
20	78	69	86	86
40	69	62	83	80
	Digestible amino acid concentration, %			
0	2.98	0.57	0.61	1.59
20	2.30	0.46	0.61	1.65
40	1.90	0.39	0.59	1.50

Conclusions

- Technology can improve the nutritional value of feed.
- The benefit of technological treatment depends on the feedstuff and on the objective.
- Due to the variation in effects treatment of feedstuffs is preferred over the treatment of complete feeds.

- Technology is beneficial for digestibility especially of oil seed meals and feedstuffs containing ANF's.
- Technological treatment is not always beneficial.
  - Over processing protein sources
  - Reduction rumen bypass of starch
  - Health related aspects : ulcers, structure in ruminants, piglets

The choice for technology to be used
should be an integrated decision.
In order to benefit more from the possibilities
of technological treatments nutritionists
should have an early pro-active attitude
towards technologists and should set requirements
for feed factors affected by technology.

