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**Agroscope**

# **Soya in animal nutrition: which improvements can be expected?**

**5<sup>th</sup> International Donau Soja Congress "The Protein Transition in  
Progress: Sustainable, Regional and Non-GMO Soya in Europe"**

19 June 2018

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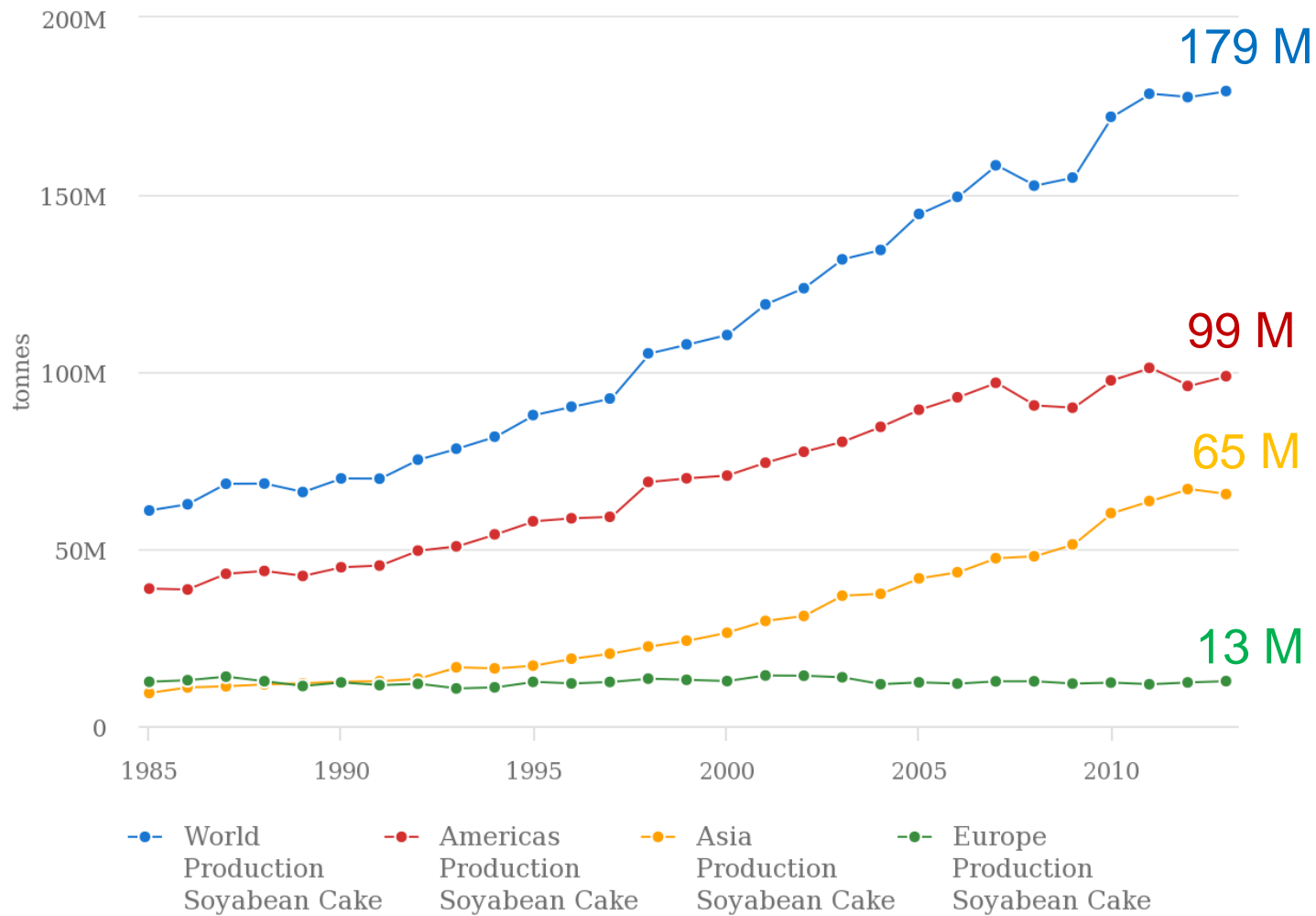
# Soybean meal

- By-product of the extraction of soybean oil
- Soybean meal is the most important protein source used to feed farm animals
- Soybean meal is classified according to its crude protein content:
  - “high protein” soybean meal (47-49% crude protein, dehulled seeds)
  - “conventional” soybean meal (43-44% crude protein, with hulls).





# Production of soybean meal



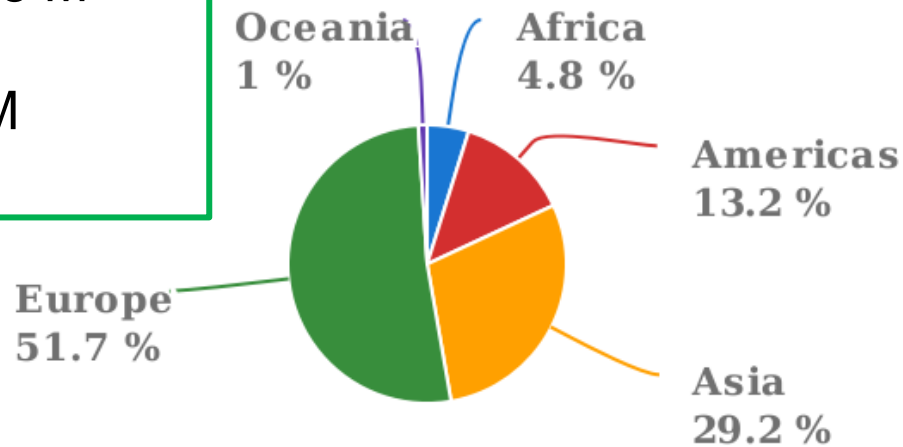
Source: FAOSTAT (Jun 10, 2018)

# 🇨🇭 Main importers of soybean meal

## Imports by region Soyabeen Cake

Average 2003 - 2013



Netherlands: 4,8 M  
France: 3,9 M  
Germany: 3,1 M  
Spain: 2,8 M



● Africa ● Americas ● Asia ● Europe ● Oceania

Source: FAOSTAT (Jun 10, 2018)

# Soybean meal extraction processes

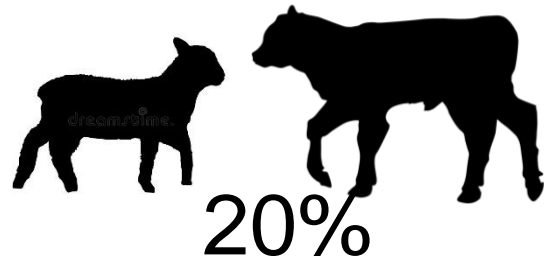
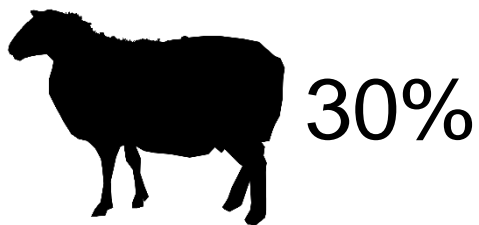
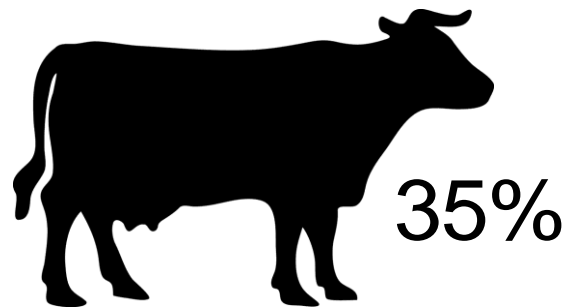
	SOLVENT EXTRACTION	MECHANICAL EXTRACTION	
	With or without hulls	Screw pressing (Expeller)	Extruding/Pelleting
Procedure	Cracked, dehulled (optional), heated, flaked and passed (or not) through an expander. The extracted flakes are dried (to eliminate the solvent) then toasted and ground	Cracked, dried, heated (steamed) and mechanically pressed. The resulting flakes are dried and ground	Soybean flakes are fed to a dry extruder. After dry extrusion, the meats are passed through a screw press
	Effective oil extraction High protein content (48%) and low fat content (<1,5%)	Greater rumen by-pass values Allowed in organic farming	Do not require steaming
	Solvent: hexane: extremely flammable and non-renewable Forbidden in organic farming	Less oil produced Higher fat content and lower protein content	

Johnson and Smith, 2004

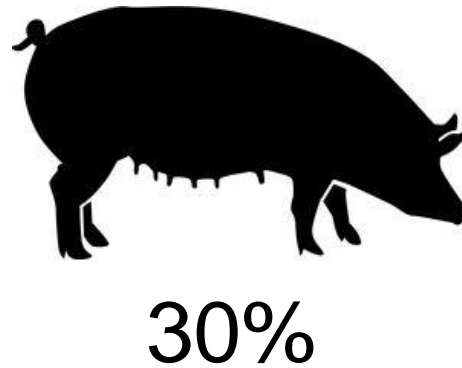
[https://www.soymeal.org/wp-content/uploads/2018/04/soybean\\_processing.pdf](https://www.soymeal.org/wp-content/uploads/2018/04/soybean_processing.pdf)

# Levels of inclusion in diets

## Ruminants



## Swine



## Poultry



# Chemical composition

The chemical composition is variable according to the type of soybean meal

	Soybeans	Solvent extracted			Srcew press
		soybean meal dehulled	Soybean meal with hulls	Soybean meal DONAU Soja*	Soybean meal with hulls (Expeller)
Dry matter	900	880	880	872	880
Crude protein <sup>1</sup>	396 (356)	563 (496)	515 (453)	513 (447)	495 (436)
Crude fat <sup>1</sup>	246 (221)	29 (26)	29 (26)	28 (24)	81 (72)
Crude fiber <sup>1</sup>	64 (57)	44 (38)	66 (58)	55 (48)	59 (52)
Starch <sup>1</sup>	42 (38)	65 (58)	82 (72)	50 (44)	65 (57)
Sugars <sup>1</sup>	94 (84)	94 (83)	121 (106)	131 (114)	94 (83)

<sup>1</sup> Expressed in g/kg DM and in g/kg in brackets

From the Swiss feed database  
<https://www.feedbase.ch/index.php>  
 \* Information from Leopold Rittler

# 🇨🇭 Proteins and amino acids

- 🟡 Soybean meal is a standard to which other protein sources are compared.

	Soybeans	Solvent extracted		Srcew press
		soybean meal dehulled	Soybean meal with hulls	Soybean meal with hulls
LYS	25.7 (30)	34.6 (87)	32.3 (89)	29.9 (88)
MET	5 (30)	7.9 (88)	6.7 (89)	6.9 (88)
CYS	6.4 (29)	8 (80)	7.9 (82)	7.6 (81)
THR	15.7 (28)	22.2 (82)	20.2 (83)	19.1 (82)
TRP	4.9 (29)	7.5 (85)	7 (86)	6.5 (85)
ILE	17.2 (30)	24.9 (85)	22.7 (87)	21.7 (86)
LEU	31.3 (30)	43.8 (85)	39.8 (86)	38.2 (85)
PHE	20.1 (30)	29.3 (86)	26.3 (88)	24.3 (87)
TYR	14 (30)	21.5 (86)	18.7 (88)	17.4 (87)
VAL	18.6 (29)	27 (84)	23.9 (86)	23 (85)
ARG	29.9 (31)	42 (92)	39.3 (94)	36.6 (93)
HIS	10.5 (30)	14.7 (87)	13.5 (89)	12.6 (88)



*Expressed in g/kg DM and percentage of digestibility in brackets*



# 🇨🇭 Oligosaccharides

- 🟡 Presence of oligosaccharides such as raffinose and stachyose (not digestible by monogastric animals) → can cause diarrhea and decrease digestion and absorption of nutrients.
- 🟡 Content can be affected by processing methods but not fully removed.

	Soybean			Soybean meal		
	1	3	10	1	3	10
galactose	3.7a	1.2bc	4.0a	nd	nd	nd
glucose	3.1	3	3.1	nd	nd	nd
fructose	3	2.9	3	nd	nd	nd
sucrose	48.1	45.8	42	69.4a	68.5a	48.2b
raffinose	6.2	6.3	5.9	13.3a	10.8b	11.8b
stachyose	38.4a	38.9a	34.3b	57.2a	51.6b	41.0c
verbascose	1.6	1.6	1.5	2.3	2.2	2
uronic acids	33.1	34.2	34.2	34.7b	36.6b	41.5a

1, 3, 10: soybean processing plants  
Plants 1 and 3 were solvent extraction facilities, while plant 10 was a mechanical extraction facility.  
Data are expressed in mg/g.

Grieshop *et al.*, 2003

- 🟡 Low oligosaccharide soybean meals are available.

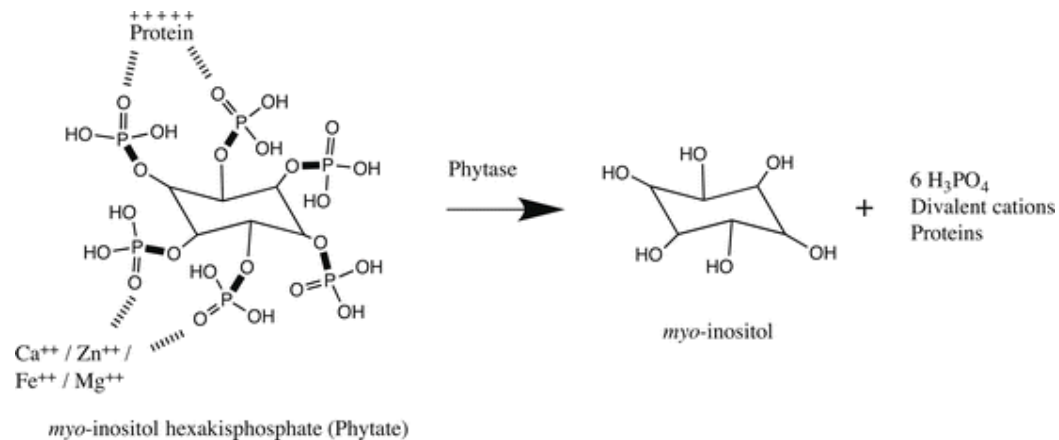
Chen *et al.*, 2013: Metabolizable energy: Low oligosaccharide SBM > conventional SBM

Amino acids digestibility: Low oligosaccharide SBM = conventional SB

# 🇨🇭 Phosphorus (P)

- 🕒 For environmental issues, it is important to reduce phosphorus excreted in the urine and feces.
  - 🕒 High phytate content = bound-phosphorus → P and other minerals (Zinc) are not available  
Example: Soybean meal dehulled solvent: 65 g/kg total P but only 21 g/kg of available P.
- Supplementation with inorganic sources of phosphorous and Zinc in monogastrics.  
Dietary P in excess is excreted into environment.
- Addition of phytase

Low-phytate soybeans are under development



# Antinutritional factors:

## Trypsin inhibitors and lectins:

Example: Diet with low trypsin inhibitor activity (1.8 vs 4.8 mg/g) increases digestibility of dry matter, nitrogen and amino acids in broilers (Dourado et al., 2011).

Several heat treatments destroy trypsin inhibitors or lectins.




**Underheating**: does not totally destroy antinutritional factors

**Overheating**: decreases the concentration and availability of some amino acids such as lysine and it suppresses phytate degradation in the rumen (less P available)

## Non-Starch Polysaccharides:

Soluble NSP decrease digestibilities of protein, starch and fat and increase microbial activity (may cause intestinal disorders). Birds cannot degrade alpha,1,6-galactoside so enzyme such as xylanase, protease and amylase can be added.

 Contains **goitrogenic substances** and genistein (1g/kg) that has oestrogenic properties.

 Poor in **B vitamins**: may cause reproductive and performance problems in sows. 

# Conclusions

🟡 Soybean meal can be included in high amounts in animal diets. Small change in quality might have a big impact on animal performances.

🟡 Importance of monitoring its quality :

- genetics
- growing conditions
- storage conditions
- processes

→ cause variations in its composition and nutritional values.





**Thank you for your attention**

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