SEEDS FROM EUROPE

SORGHUM,
A KEY TO BUILD
OUR FUTURE.

THE SORGHUM
A committed industry for promising outlets

OCTOBER
12TH&13TH
TOULOUSE
2021

3RD EUROPEAN SORGHUM CONGRESS

Valorization of Sorghum in pork production

Dr. Reinhard Puntigam[1] & Dr. Julia Slama[2]

[1]*Institute of Nutritional Physiology and Animal Nutrition*
Faculty of Agricultural and Environmental Sciences
University of Rostock

[2]*University College for Agricultural and Environmental Pedagogy*

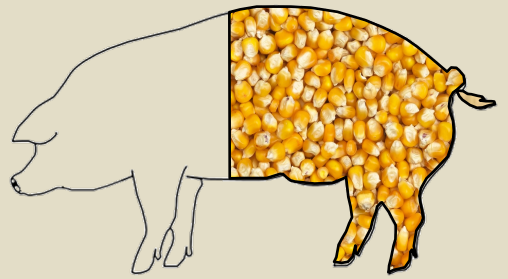
Universität Rostock
Traditio et Innovatio

ENJOY IT'S FROM EUROPE

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

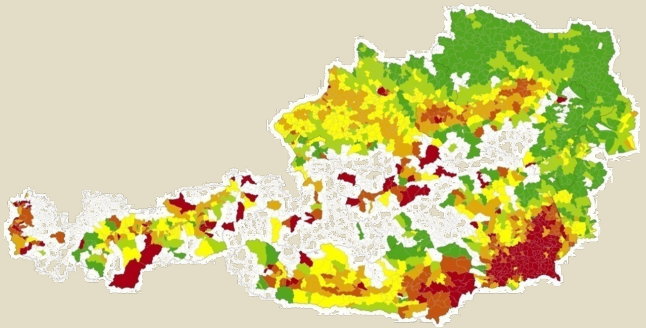
SEEDS FROM EUROPE

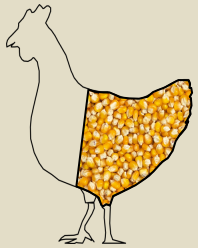
SORGHUM,
A KEY TO BUILD
OUR FUTURE.

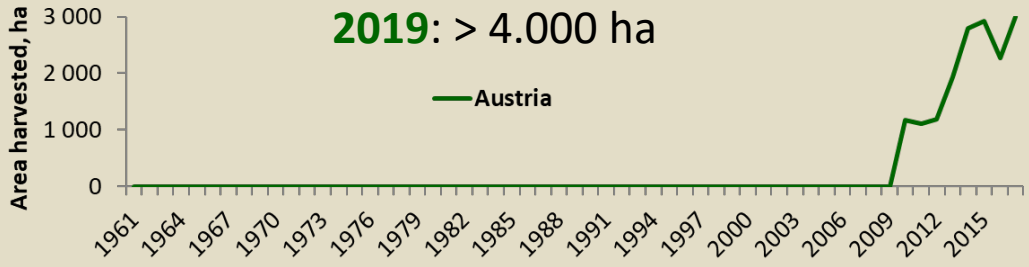


Sorghum as an alternative

- < 10%
- 10% - 20%
- 20% - 30%
- 30% - 40%
- 40% - 50%
- 50% -...%







Transpiration coefficient (l H_2O/kg DM)	Grain
200 - 300	sorghum
300 – 400	corn, sugar beet
400 – 500	barley, rye, wheat
600 – 700	canola, pea, oat

ENJOY IT'S FROM EUROPE

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum - Austria

RAGT

Verhounig Hermann	Anbau:	04.05.2021
9433 Andrä	Ernte:	02.10.2021

Sorte	RZ	Pfl./ha in tsd	H_2O (%)	Nasshirse kg/ha	Trockenhirse kg/ha[1)]	Trockenhirse rel. in %
RGT GGUSTAV	spät	330	29,9%	16.667	13.155	*106%*
RGT ANGGY	spät	330	31,5%	16.944	13.015	*105%*
RGT HUGGO	mspät	330	26,9%	15.417	12.782	*103%*
RGT ALIGGATOR	mspät	330	31,4%	16.171	12.442	*100%*
VGL - rosario	spät	330	31,6%	16.071	12.324	*99%*
RGT ICEBERGG	mittel	330	29,9%	15.377	12.137	*98%*
RGT DODDGE	mittel	330	26,3%	14.266	11.941	*96%*
VGL - pr88y47	spät	330	31,8%	15.079	11.523	*93%*
Versuchsmittel			29,9%	15.749	12.415	*100%*

Kranewitter A., 2021

Sorte	Korntyp	RZ	water % 2018	water % 2019	water % 2020	harvest dt/ha 2018	harvest dt/ha 2019	Harvest dt/ha 2020
P9978	Z	440	20.5	27.2	27.6	198.2	185.3	**179.0**
P9900	Z	430	19.8	27.0	26.2	191.2	174.6	**175.2**
DKC5141 DieStefanie	Zh	450	20.2	25.4	25.7	189.9	173.1	**168.3**
DKC5068 DieSissy	Zh	420	19.7	26.3	24.5	190.9	171.9	**167.6**
DKC5065 Absoluto	Z	420	19.4	24.3	25.1	185.7	169.3	**166.0**
Kerala	Z	380	19.3	23.9	23.6	185.0	164.2	**165.5**
DKC4621 Alberto	Zh	410	19.2	25.0	24.8	181.0	167.7	**165.2**
P9610	Z	370	18.5	24.4	23.2	192.0	184.8	**163.6**
P9363	Z	410	19.1	26.1	24.3	190.2	172.1	**162.8**
P9415	Z	410	19.6	26.3	25.1	196.1	176.2	**162.5**
DKC4162	Z	360	18.2	23.0	22.3	187.9	161.7	**159.1**
RGT Noemixx	Zh	410	19.8	24.9	24.2	175.3	166.0	**158.3**
P9241	Z	380	18.7	24.7	24.4	176.6	160.5	**154.1**
DKC4541 Arnauto	Z	390	18.7	24.5	23.1	177.5	167.1	**150.8**
Mean			19.3	25.1	24.6	187.0	170.8	**164.3**

Cultivation always took place between 10 and 18 April Mayer, K., 2021

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

« Les bonnes dans le petit pot, les autres dans votre jabot »

„Die Guten ins Töpfchen, die Schlechten ins Kröpfchen?"

„The good ones go into the pot, the bad ones go into crop?"

Sorghum

Storage: **Fermentation of whole grain**

animals
MDPI

Article

Fermentation of Whole Grain Sorghum (*Sorghum bicolor* (L.) Moench) with Different Dry Matter Concentrations: Effect on the Apparent Total Tract Digestibility of Energy, Crude Nutrients and Minerals in Growing Pigs

Reinhard Puntigam [1,*], Julia Slama [1], Daniel Brugger [2], Karin Leitner [3], Karl Schedle [3], Gabriela Wetscherek-Seipelt [3] and Wolfgang Wetscherek [3]

1 Faculty of Agricultural and Environmental Sciences, University Rostock, 18059 Rostock, Germany; julia.slama@uni-rostock.de
2 Institute of Animal Nutrition, Vetsuisse-Faculty, University of Zurich, 8057 Zurich, Switzerland; dbrugger@nutrivet.uzh.ch
3 Institute of Animal Nutrition, Livestock Products, and Nutrition Physiology, University of Natural Resources and Life Sciences, 1190 Vienna, Austria; karin.leitner@schaumann.at (K.L.); karl.schedle@boku.ac.at (K.S.); gabriela.wetscherek-seipelt@boku.ac.at (G.W.-S.); wolfgang.wetscherek@boku.ac.at (W.W.)
* Correspondence: reinhard.puntigam@uni-rostock.de

Contents lists available at ScienceDirect
Animal Feed Science and Technology
journal homepage: www.elsevier.com/locate/anifeedsci
ELSEVIER

Effect of maize conservation technique and phytase supplementation on total tract apparent digestibility of phosphorus, calcium, ash, dry matter, organic matter and crude protein in growing pigs

E. Humer, W. Wetscherek, C. Schwarz, K. Schedle*

Institute of Animal Nutrition, Products and Nutrition Physiology, University of Natural Resources and Life Sciences Vienna, Muthgasse 11, A-1190 Vienna, Austria

Contents lists available at ScienceDirect
Animal Feed Science and Technology
journal homepage: www.elsevier.com/locate/anifeedsci
ELSEVIER

Effects of maize conservation techniques on the apparent total tract nutrient and mineral digestibility and microbial metabolites in the faeces of growing pigs

E. Humer, W. Wetscherek, C. Schwarz, K. Schedle*

Institute of Animal Nutrition, Products and Nutrition Physiology, Department for Agrobiotechnology, University of Natural Resources and Life Sciences Vienna, Muthgasse 11, A-1190 Vienna, Austria

MISSING INFO

→ The **lower the DM** content, combined with **fermentation in ground form** → the **higher the digestiblity** of nutrients.

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

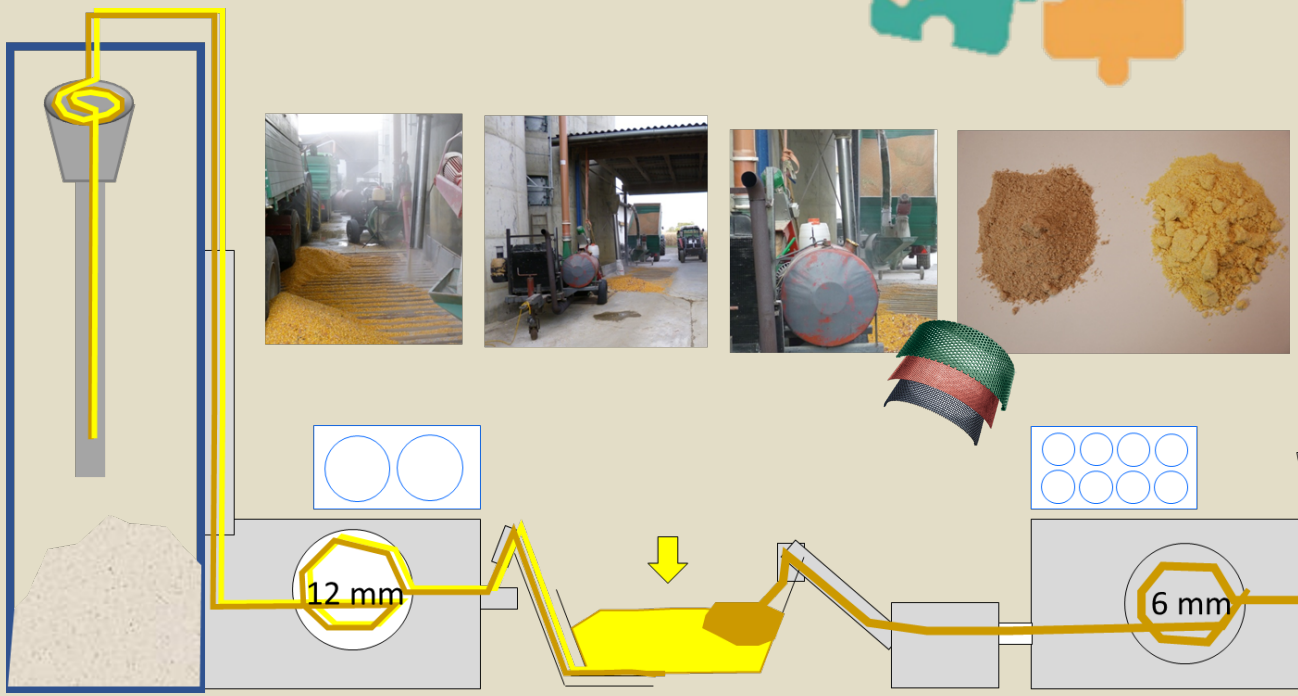
ENJOY IT'S FROM EUROPE

Sorghum – storage - Future?

Storage: **fermented as “sandwich” or in mixed form “synergistic effects?”**

Corn

Sorghum



CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

SEEDS FROM EUROPE

SORGHUM,
A KEY TO BUILD
OUR FUTURE.

3RD [illegible] IM CONGRESS

Sorghum whole grain

Wetscherek W., 2021

Livestock Science 241 (2020) 104187

Contents lists available at ScienceDirect

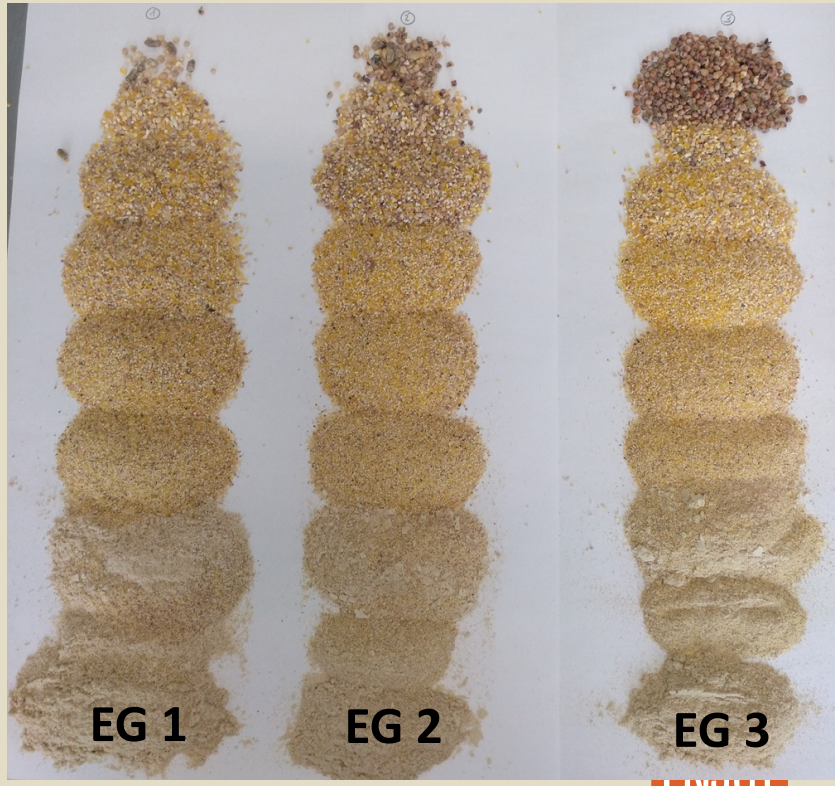
Livestock Science

journal homepage: www.elsevier.com/locate/livsci

The effects of a partial or total replacement of ground corn with ground and whole-grain low-tannin sorghum (*Sorghum bicolor* (L.) Moench) on zootechnical performance, carcass traits and apparent ileal amino acid digestibility of broiler chickens

Reinhard Puntigam[a,*], Daniel Brugger[b], Julia Slama[a], Vivienne Inhuber[c], Brett Boden[c], Valentina Krammer[d], Karl Schedle[d], Gabriela Wetscherek-Seipelt[d], Wolfgang Wetscherek[d]

[a] Faculty of Agricultural and Environmental Sciences, University of Rostock, Germany
[b] Institute of Animal Nutrition, Vetsuisse-Faculty, University of Zurich, Switzerland
[c] Chair of Animal Nutrition, TUM School of Life Sciences Weihenstephan, Technical University of Munich, Germany
[d] Institute of Animal Nutrition, Livestock Products, and Nutrition Physiology, University of Natural Resources and Life Sciences Vienna, Austria



	Experimentalgroup (EG)		
	1	2	3
Sorghum, whole grain	-	-	10%
Sorghum, roller mill	-	10%	-
Sorghum, hammer mill	10%	-	-

MISSING INFO

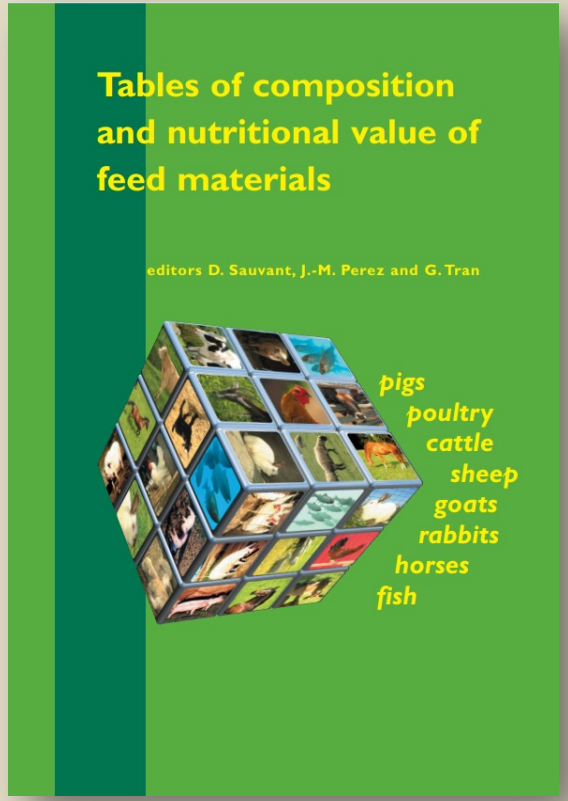
CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

ENJOY IT'S FROM EUROPE

Sorghum in diet preparation

Precision livestock feeding aims to match **nutrient supply** precisely with the **nutrient requirements** of the animals

characterizing nutrient requirements of animals (**supply**)
characterizing of nutrient availability of feedstuffs (**demand**)
blending ingredients to optimally match nutrient supply to nutrient demand (**formulation**) Zuidhof, 2019

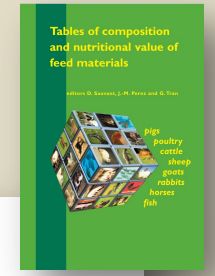


"As always, *proper characterization* of each raw material is key to successful feed formulation, and sorghum grain is no exception here".

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum *vs.* Corn

Crude protein:	+ 10-20%
Lysine per protein:	2.8 *vs.* 2.5% (*Kafirin)*
Ether extract:	- 20%
C18:2 and C18:3:	36 *vs.* 58% of EE
Xanthophylls:	0
Reduced content of AA and SID	
ME identical?	EE ↓RS ↑



90 *Tables of composition and nutritional value of feed materials*

Sorghum

Sorghum grain (Sorghum bicolor (L.) Moench). The nutritional values for monogastric animals correspond to low-tannin varieties (n = 790).
All values are expressed on an as fed basis unless otherwise noted.

Main constituents	mean	sd
Dry matter (%)	86.5	1.6
Crude protein (%)	9.4	1.1
Crude fibre (%)	2.4	0.5
Ether extract (%)	2.9	0.4
Ash (%)	1.4	0.2
Insoluble ash (%)	0.1	0.1
Neutral detergent fibre (%)	9.4	1.8
Acid detergent fibre (%)	3.8	1.3
Acid detergent lignin (%)	1.1	0.8
Water insoluble cell walls (%)	8.5	0.8
Starch (%)	64.1	2.6
Total sugars (%)	1.1	0.4
Gross energy (MJ/kg)	16.3	0.4

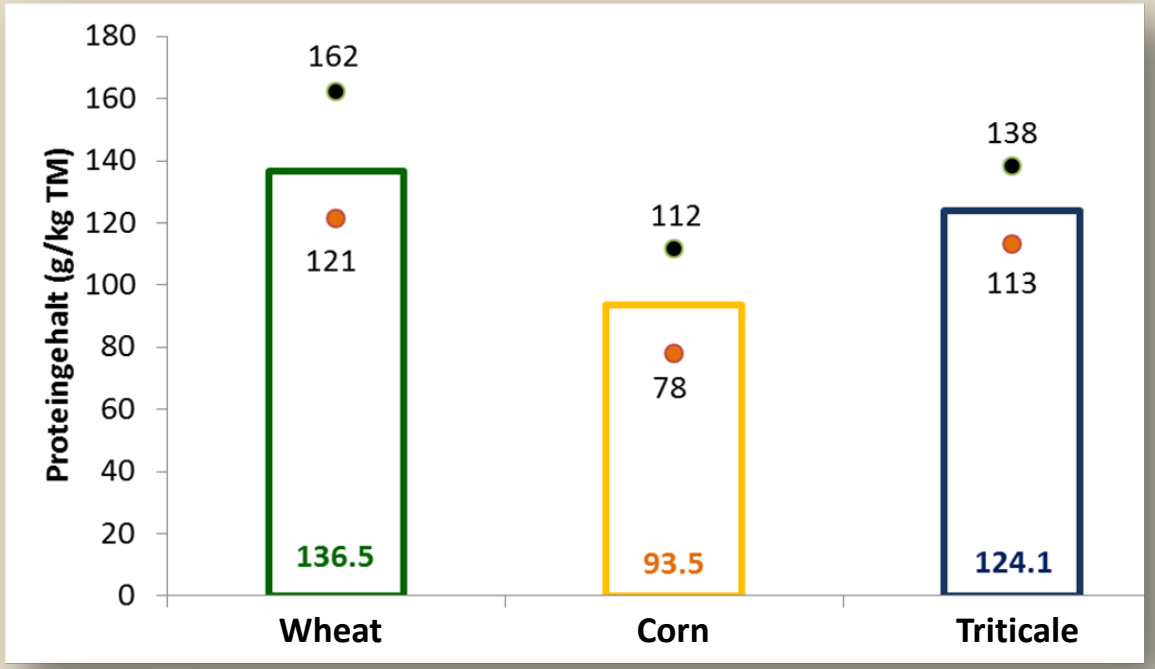
Fatty acids	%FA	g/kg
Myristic acid C14:0	0.2	0.1
Palmitic acid C16:0	13.5	3.5
Palmitoleic acid C16:1	3.2	0.8
Stearic acid C18:0	2.3	0.6
Oleic acid C18:1	33.3	8.7
Linoleic acid C18:2	33.8	8.9
Linolenic acid C18:3	2.6	0.7
Fatty acids/ether extract (%)	90	

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

The nutritional variability

MISSING INFO

Wheat (n=21), Corn (n=29) und Triticale (n=27)



Minimum Maximum

GrainUp

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

ENJOY IT'S FROM EUROPE

“precision feeding” is a…

…Balance

DEMAND

characterizing nutrient requirements of animals

SUPPLY

characterizing nutrient availability of feed stuffs

blending ingredients to optimally match nutrient supply to nutrient demand (formulation).

CAMPAIGN FINANCED
WITH AID FROM
THE EUROPEAN UNION

Sorghum in weaning pigs

	Experimental Group (EG)			
Ingredient	**EG 1**	**EG 2**	**EG 3**	**EG 4**
Corn, %	50.00	20.33	-	-
Barley, %	20.67	20.00	20.33	-
Sorghum, %	-	**30.00**	**50.00**	**69.17**
Soybean meal 44% CP, %	24.50	24.00	23.33	24.00
Fibre, %	0.50	0.67	0.83	1.50
Canola oil, %	-	0.67	1.17	1.00
Premix, %	4.33	4.33	4.33	4.33

NO difference in zootechnical performance (ADG; ADFI; F:G ratio)

Wetscherek et al.

CAMPAIGN FINANCED
WITH AID FROM
THE EUROPEAN UNION

Sorghum in fattening pigs (2013)

Puntigam et al.

Experimental Group

	Corn		Sorghum	
Stage of fattening	**31-73 kg**	**73-119 kg**	**31-73 kg**	**73-119 kg**
Whole grain corn fermented	50.4	52.1	51.4	53.0
Corn, dried	20.0	20.0	0	0
Sorghum, dried	0	0	**20.0**	**20.0**
Soybean meal, 44% CP	24.0	22.0	23.1	21.2
Fibre	2.5	3.0	2.0	2.5
Canola oil	0	0	0.4	0.4
Premix for Sorghum	0	0	3.1	2.9
Premix for Corn	3.1	2.9	0	0
MJ ME/kg	11.72	11.69	11.71	11.68

NO difference in zootechnical performance (ADG; ADFI; F:G ratio)

NO differencer in slaughter performance (lean [%], Fat thickness, mm; Muscle thickness, mm)

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum in fattening pigs

	Experimental Group		
Grower phase (35-75 kg), %	**1**	**2**	**3**
Corn, dried	67.5	27.3	-
Sorghum, dried	-	**40.0**	**66.7**
Soybean meal, 44% CP	26.5	26.0	25.9
Fibre	-	0.7	1.4
Canola meal	2.5	2.5	2.5
Premix	3.5	3.5	3.5

Wetscherek et al.

CAMPAIGN FINANCED
WITH AID FROM
THE EUROPEAN UNION

Sorghum in fattening pigs

	Experimental Group		
Finisher phase (75-115 kg), %	**1**	**2**	**3**
Corn, dried	69.2	29.1	-
Sorghum, dried	-	**40.0**	**68.6**
Soybean meal, 44% CP	24.5	24.0	23.8
Fibre	-	0.6	1.3
Canola meal	3.0	3.0	3.0
Premix	3.3	3.3	

NO difference in zootechnical performance (ADG; ADFI; F:G ratio)
NO differencer in slaughter performance (lean [%], Fat thickness, mm; Muscle thickness, mm)

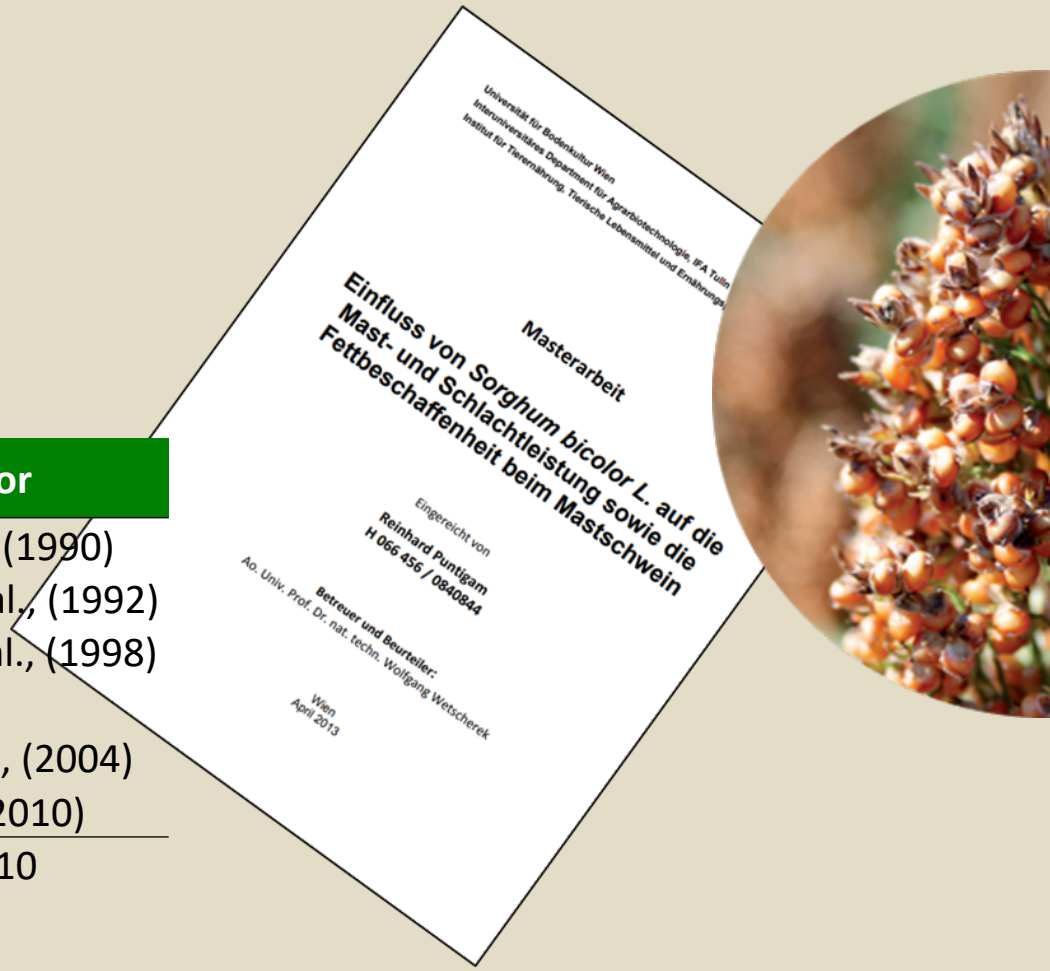
Wetscherek et al.

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum “works”

Corn is 100 %, Sorghum…

Study	ADG	ADFI	FCR	Author
1	104	109	96	Brand, et al., (1990)
2	98	104	95	Hancock, et al., (1992)
3	106	106	100	Johnston et al., (1998)
4	104	100	104	Issa, (2009)
5	104	109	95	Shelton et al., (2004)
6	106	105	101	Benz et al., (2010)
Cromwell (1985 review)	98	102	97	Summery of 10 Studies

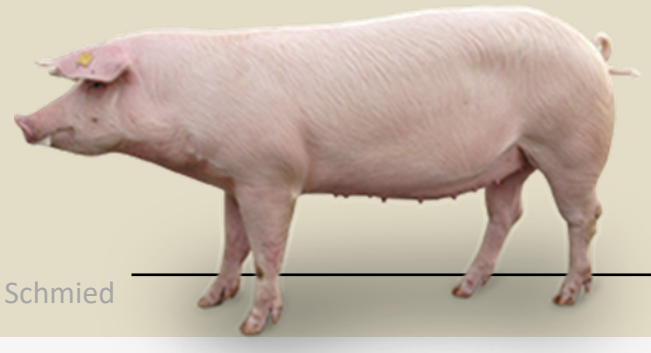


Tokach et al. (2012)

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum in diets of sows

Ingredient	DM, g	Corn/Sorghum, %				Corn/Sorghum (wet), %			
		pregnant		lactation		pregnant		lactation	
Corn fermented (whole or ground), 32 % H_2O, 7 % CP (88 % DM)	680	-	-	-	-	33.0	-	40.0	-
Sorghum fermented 28 % H_2O, 9 % CP (88 % DM)	720	-	-	-	-	-	33.0	-	40.0
Corn dried, 7 % CP	880	25.0	-	30.0	-	-	-	-	-
Sorghum dried, 9 % CP	880	-	25.0	-	30.0	-	-	-	-
Wheat, 12 % CP	880	-	-	15.0	15.0	-	-	10.0	10.0
Barley, 10.5 % CP	880	50.0	51.0	26.5	28.0	43.5	44.0	23.5	24.5
Soybean meal 44 % CP	880	9.0	8.0	19.0	17.5	8.5	8.0	18.0	17.0
Fibre concentrate 30 % CF	880	13.0	13.0	4.0	4.0	12.3	12.3	3.5	3.5
Canola oil/Soy oil	999	-	-	1.5	1.5	-	-	1.5	1.5
Premix sow	950	3.0	3.0	4.0	4.0	2.7	2.7	3.5	3.5
		100	100	100	100	100	100	100	100
Premix-Amino acids:		Content in % / kg Premix							
Lysine		4.0	5.0	7.0	8.0	4.0	5.0	7.0	8.4
Methionine		-	-	2.5	2.5	-	-	2.5	2.6
Threonine		-	-	2.5	2.7	-	-	2.5	2.8
Tryptophan		-	-	0.4	0.3	-	-	0.4	0.3

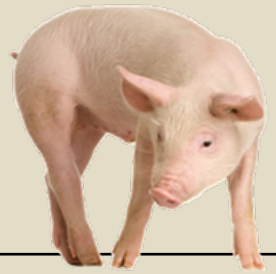


Schmied

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum in weaning pigs (12-32 kg)

Ingredient	DM g	Corn/Sorghum, %			Corn/Sorghum, %		
Corn fermented (whole or ground), 32% H2O, 7 % CP (88% DM)	680	-	-	-	50.0	25.0	-
Sorghum fermented, 28% H_2O, 9 % CP (88 % DM)	720	-	-	-	-	25.0	50.0
Corn dried, 7 % CP	880	50.0	25.0	-	-	-	-
Sorghum dried, 9% CP	880	-	25.0	50.0	-	-	-
Barley, 10.5 % CP	880	19.0	20.0	22.0	23.0	24.0	25.0
Soybean meal, 44 % CP	880	23.0	22.0	21.0	20.5	19.5	18.5
Fibre concentrate, 30 % CF	880	4.0	4.0	3.0	3.0	3.0	3.0
Premix	950	4.0	4.0	4.0	3.5	3.5	3.5
		100	100	100	100	100	100
Premix-Amino acids:		Content in %/ kg Premix					
Lysine		10.0	10.6	11.3	9.2	10.5	11.8
Methionine		3.5	3.4	3.3	3.0	3.2	3.4
Threonine		4.5	4.5	4.6	4.0	4.4	4.9
Tryptophan		0.7	0.5	0.4	0.5	0.4	0.4



Schmied

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum in diets of fattening pigs

Ingredient	TM g	Grower (32 - 70 kg), %			Finisher (70 - 120 kg), %		
Corn fermented (whole or ground), 32 % H_2O, 7 % CP (88 % DM)	680	60.0	30.0	-	60.0	30.0	-
Sorghum fermented, 28 % H_2O, 9 % CP (88 % DM)	720	-	30.0	60.0	-	30.0	60.0
Barley, 12 % CP	880	14.5	15.2	16.0	17.5	18.2	19.3
Soybean meal, 44 % CP	880	20.5	19.5	18.5	16.8	15.8	14.5
Fibre concentrate, 30 % CF	880	2.0	2.3	2.5	3.0	3.3	3.5
Premix	950	3.0	3.0	3.0	2.7	2.7	2.7
		100	100	100	100	100	100
Premix-Amino acids:		Content in % / kg Premix					
Lysine		8.5	10.0	11.6	8.5	10.0	11.6
Methionine		2.0	2.1	2.3	2.0	2.1	2.3
Threonine		3.0	3.5	4.0	3.0	3.5	4.0
Tryptophan		0.2	0.1	0.0	0.2	0.1	0.0

Schmied

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum – product quality

The **higher the content of PUFA** in the diet, the higher it is **in the body fat** – the lower its **quality**!

CAMPAIGN FINANCED
WITH AID FROM
THE EUROPEAN UNION

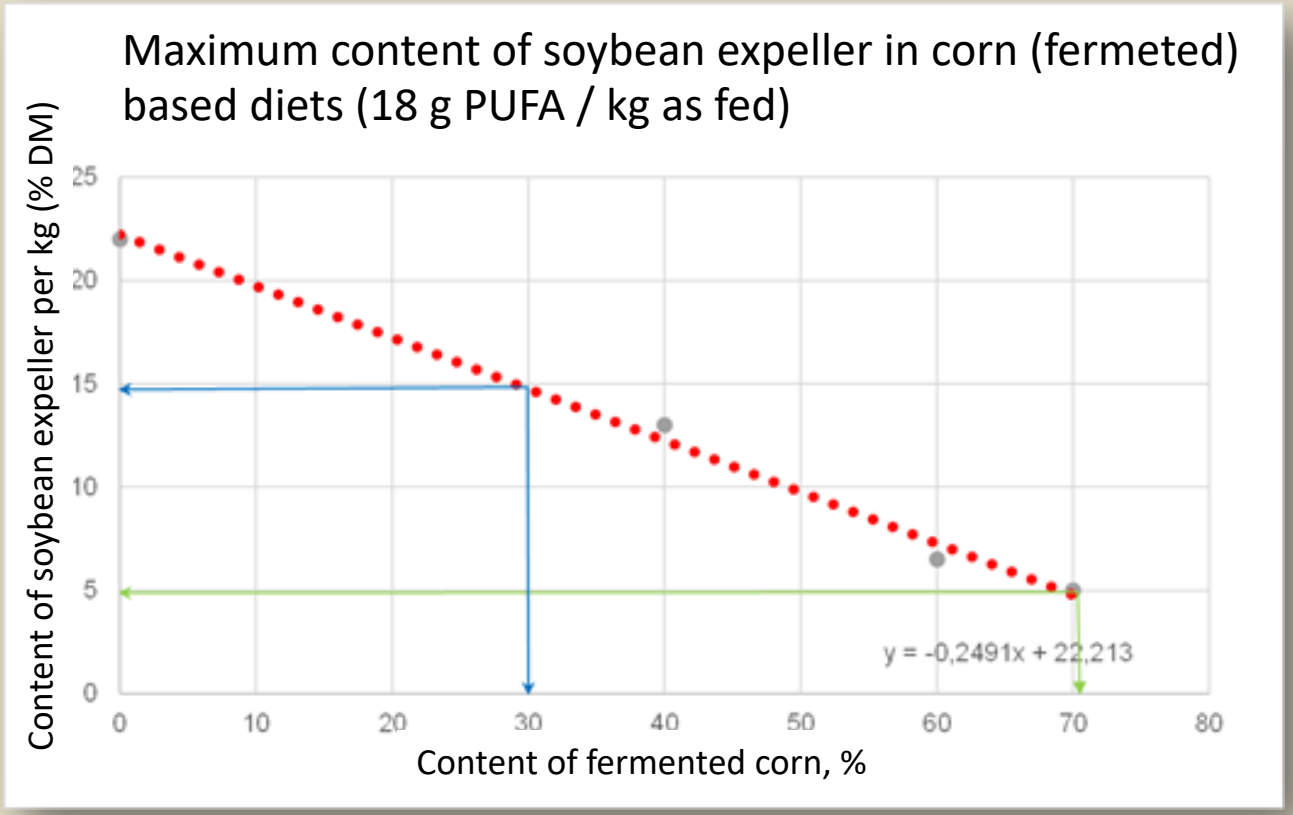
Sorghum to lower PUFA in diets

Ingredient	TM g	PS g	Diet – fattening pigs											
Corn fermented, 33% H_2O	670	15,2	75,5	74,2	75,2		75,7		50,0		50,0			
Sorghum fermented, 28% H_2O	720	12,3				75,5		77,0		50,0		50,0		
Wheat, Barley, Triticale	870	9-10							26,0	26,8	26,5	28,3	76,5	79,5
Soybean meal, 44% CP	870	8	21,7	20,0	21,0	18,1	20,0	13,5	18,0	15,5	14,5	9,0	13,0	2,0
Soybeans full fat, 19% EE	935	120			**1,0**	**3,5**			**3,0**	**4,5**			**7,0**	
Soybean expeller, 10% EE	945	64					**1,5**	**6,5**			**6,0**	**9,5**		**15,0**
Canola meal, 31% CP, 12% EE	900	38		3,0										
Premix	950	0	2,8	2,8	2,8	2,9	2,8	3,0	3,0	3,2	3,0	3,2	3,5	3,5
Content of PUFA, g/kg DM (88%)		ca.	**16,2**	**17,1**	**17,5**	**17,2**	**17,2**	**17,0**	**17,2**	**16,9**	**17,1**	**17,0**	**16,7**	**17,2**

Schmied

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

Sorghum to lower PUFA in diets



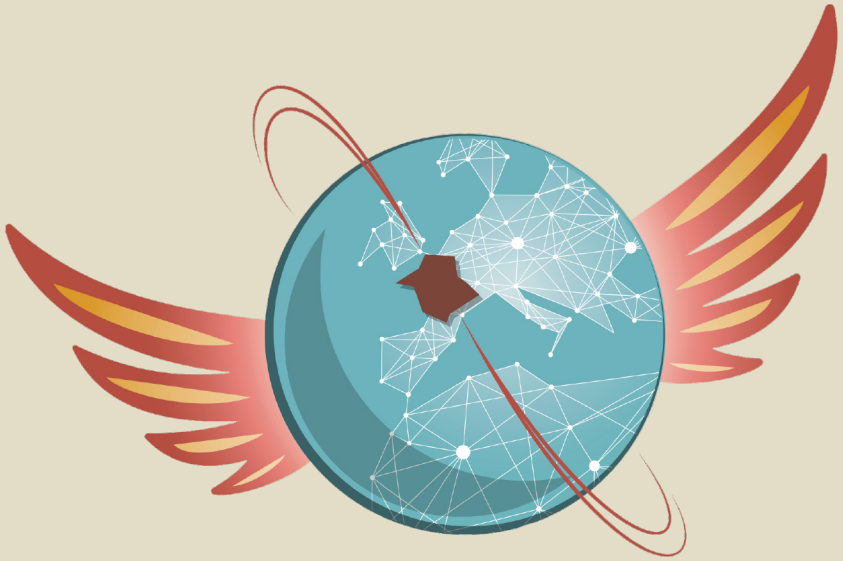
A higher level of sorghum in diets of fattening pigs allows the incorporation of higher levels of soybean cake (nonGMO).

Priller

CAMPAIGN FINANCED WITH AID FROM THE EUROPEAN UNION

SEEDS FROM EUROPE

SORGHUM,
A KEY TO BUILD
OUR FUTURE.



Thank you

Partners

PZ PK

FNPSMS
maïz'EUROP'

CAMPAIGN FINANCED
WITH AID FROM
THE EUROPEAN UNION

ENJOY
IT'S FROM
EUROPE