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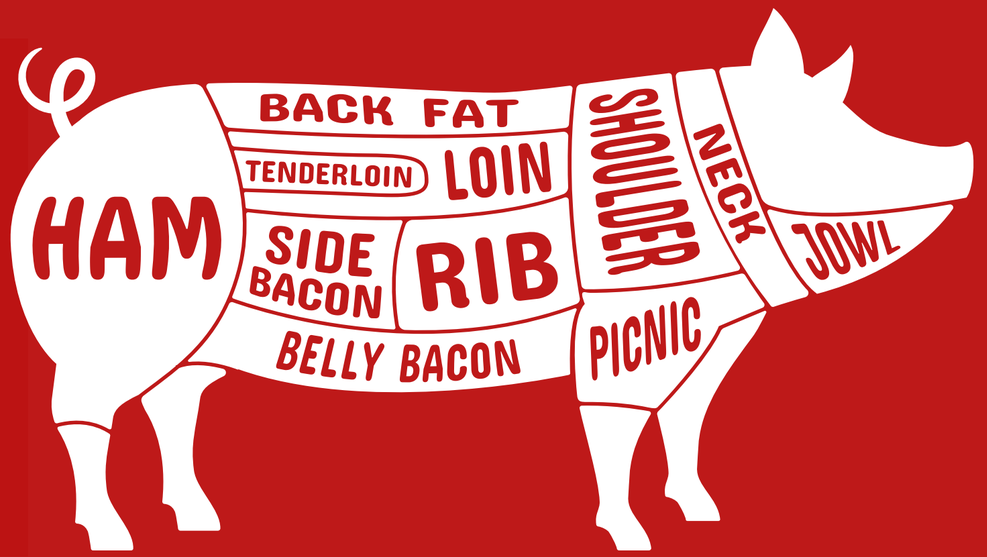
Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

agritech
National Research Center for Technology in Agriculture

CHEMICAL AND PHYSICAL QUALITY TRAITS OF MEAT FROM HEAVY PIGS FED DIETS WITH A PARTIAL TO TOTAL REPLACEMENT OF SOYBEAN MEAL WITH SPIRULINA POWDER

G. Don, D. Giannuzzi , A. Toscano, S. Schiavon, L. Gallo



EAAP European Federation of Animal Science

The 75th EAAP Annual Meeting, Session 62
Feeding for improving the nutritional, safety and organoleptic characteristics of animal-derived foods

DAFNAE Department of Agronomy, Food Natural resources Animals and Environment

Universitas Studii Paduani MCCXXII

Background

The **pig sector** is a large contributor to **global meat yield**

This sector is facing **environmental sustainability challenges** due to the emissions of pollutants, overuse of water, loss of biodiversity, and a **large use of agricultural land for feed production**, which is **in direct competition with human food production**

Background

Soybean meal (SBM) is used as main protein source in growing pig diets but its production has been associated to increased **land utilization, degradation and deforestation**

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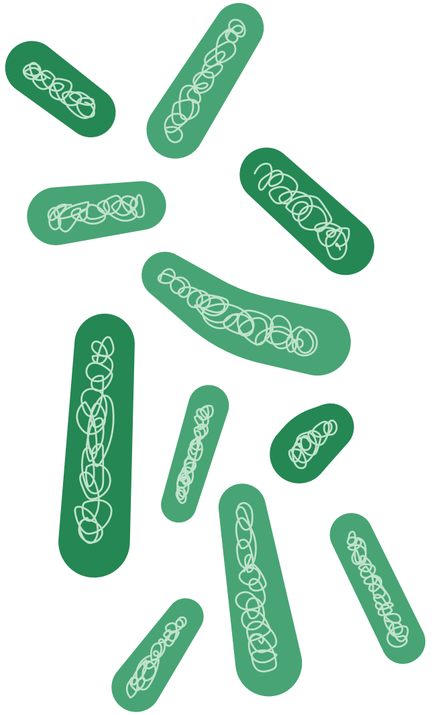
Arthrospira platensis (Spirulina, SP) is an interesting alternative to SBM due to a high protein content and also because it does not require land for its cultivation



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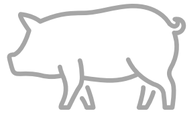
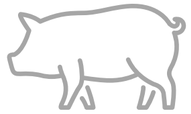


chemical composition of SBM and SP (g/kg DM)

	Soybean meal	*A. platensis*
Dry matter	888	923
CP (N × 6.25)	490	711
Major amino acids:		
Lysine	31.3	39.5
Methionine + cysteine	14.8	21.6
Threonine	19.9	33.7
Triptophane	7.8	6.2
Leucine	37.6	57.8
Isoleucine	23.5	33.6
Valina	24.6	36.3
Ether extract	17	85
Chlorophyll A	-	5
Chlorophyll B	-	1.2
Carotenoids	-	2.2
Ash	71	76

Background



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Higher crude protein in *A. platensis*

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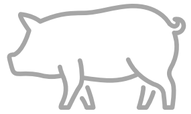

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Higher crude protein in *A. platensis*

Higher content of major amminoacids in *A. platensis*

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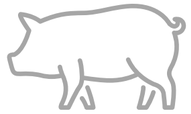

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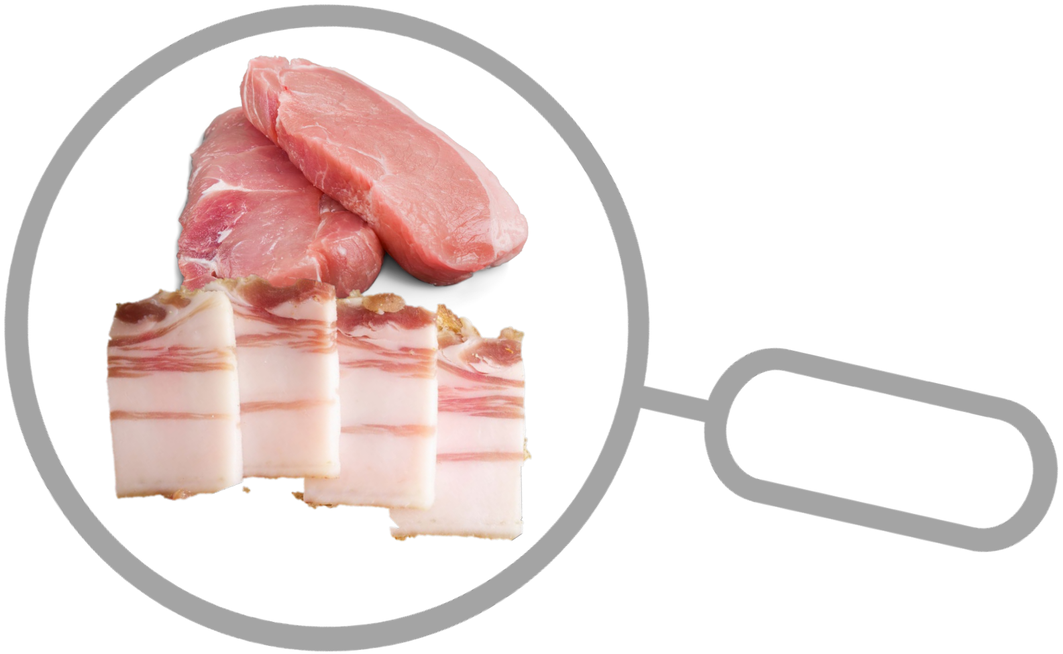
→ Higher crude protein in *A. platensis*

→ Higher content of major amminoacids in *A. platensis*

→ Higher lipids content in *A. platensis*

Aim

This **study * aims** to investigate the effect of a **partial to full replacement of SBM with SP**, in diets for growing pigs, on **chemical and physical characteristics of meat**



*study performed within the frame of Agritech National Research Center, funded by the European Union Next–Generation EU, task 5.3.4 focused on Alternative protein sources for animal nutrition

Experimental design

experimental pig unit of the DAFNAE department of the University of Padova

Experimental design

1 **8 pens** 3.75 × 5.75 m (21.6 m ^2)

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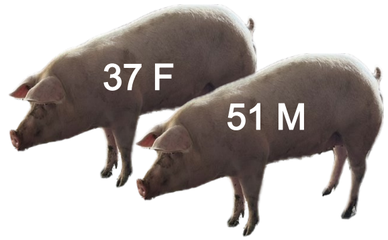
1 **8 pens** 3.75 × 5.75 m (21.6 m ^2)

2 **88 pigs** Goland C21× Camborough 43
11 pigs/pen (2 m ^2/pig)
Initial body weight (BW) 52.4 ± 4.2 kg



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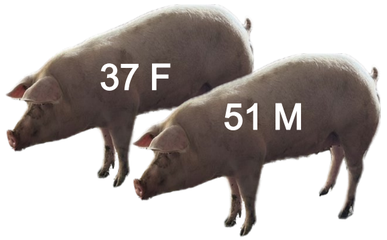

3. **4 diets (treatments)** 2 pens/treatment:

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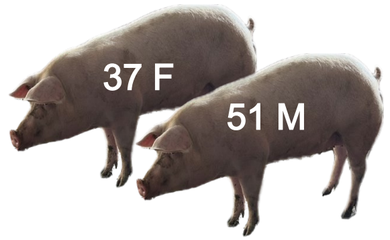

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   - **Control diet (CTR)** based on cereals and soybean meal

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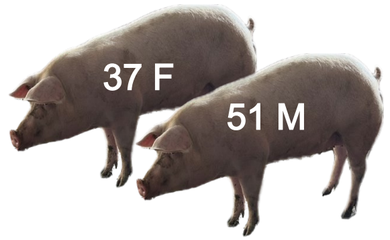

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   - **Control diet (CTR)** based on cereals and soybean meal
   - **SP33** formulated by replacing 33% of SBM with SP

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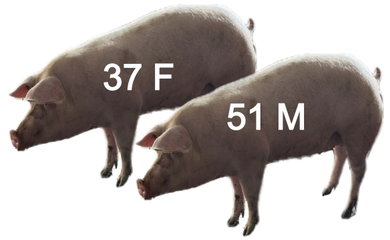
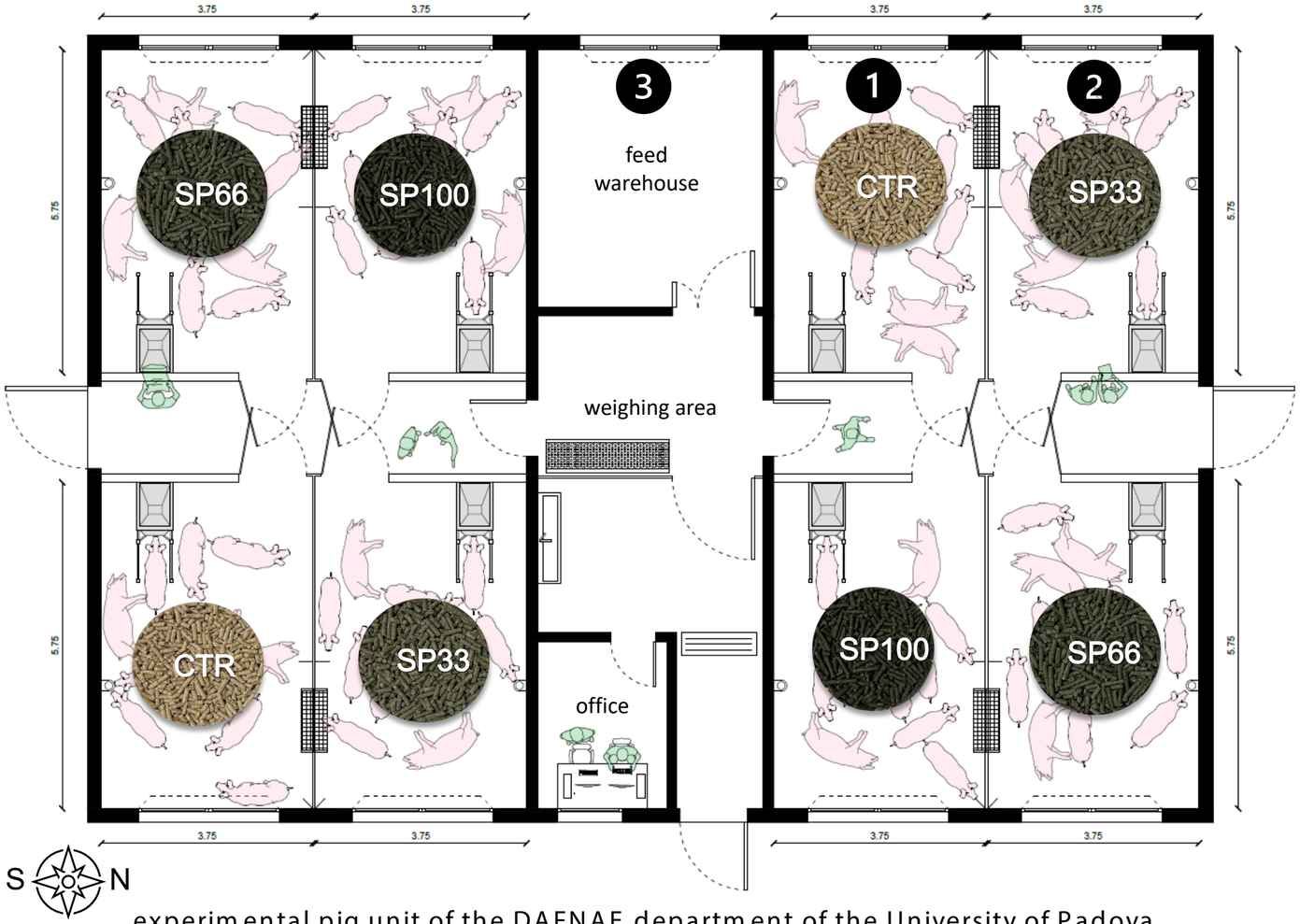


3 **4 diets (treatments)** 2 pens/treatment:

- **Control diet (CTR)** based on cereals and soybean meal
- **SP33** formulated by replacing 33% of SBM with SP
- **SP66** formulated by replacing 66% of SBM with SP

Experimental design



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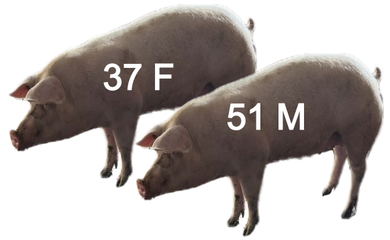

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- **SP66** formulated by replacing 66% of SBM with SP
- **SP100** formulated by replacing 100% of SBM with SP

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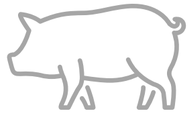

SP nucleus with ***A. platensis*** **as main ingredient** was formulated to mirror the composition of soybean meal with regard to its major nutrients

SP nucleus ingredients (g/kg as fed)

Artrosphira platensis	626
Sugar beet pulp	311
Soft wheat	41
L-Lysine Monoclohydrate	6
L-Triptophan	6

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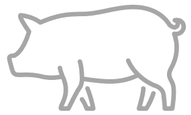

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Diets characteristics (g/kg as fed)

	CTR			SP33			SP66			SP100		
	SBM	SP Nucleus	Crude Protein	SBM	SP Nucleus	Crude Protein	SBM	SP Nucleus	Crude Protein	SBM	SP Nucleus	Crude Protein
50 -90 kg BW	185	0	155	124	63	156	63	124	158	0	185	160
90 -140 kg BW	155	0	149	104	52	145	53	104	146	0	157	147
140-170 kg BW	120	0	136	80	41	134	40	81	139	0	122	141

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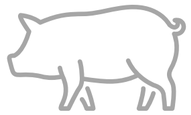

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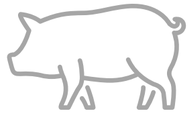

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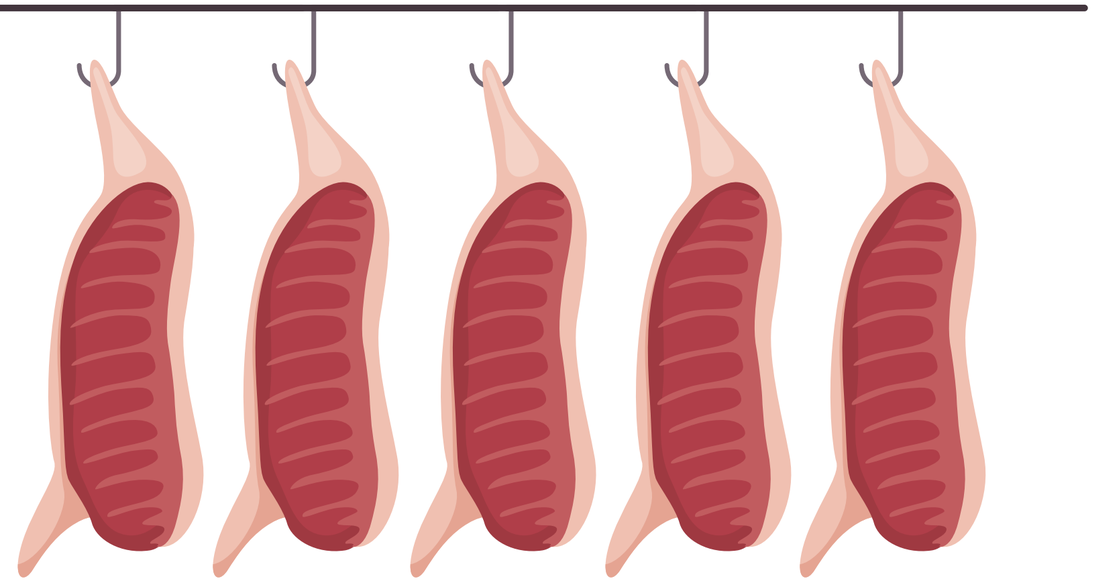
Slaughter and sampling

86 pigs were slaughtered at **174.9** ± 6.4 **kg BW**



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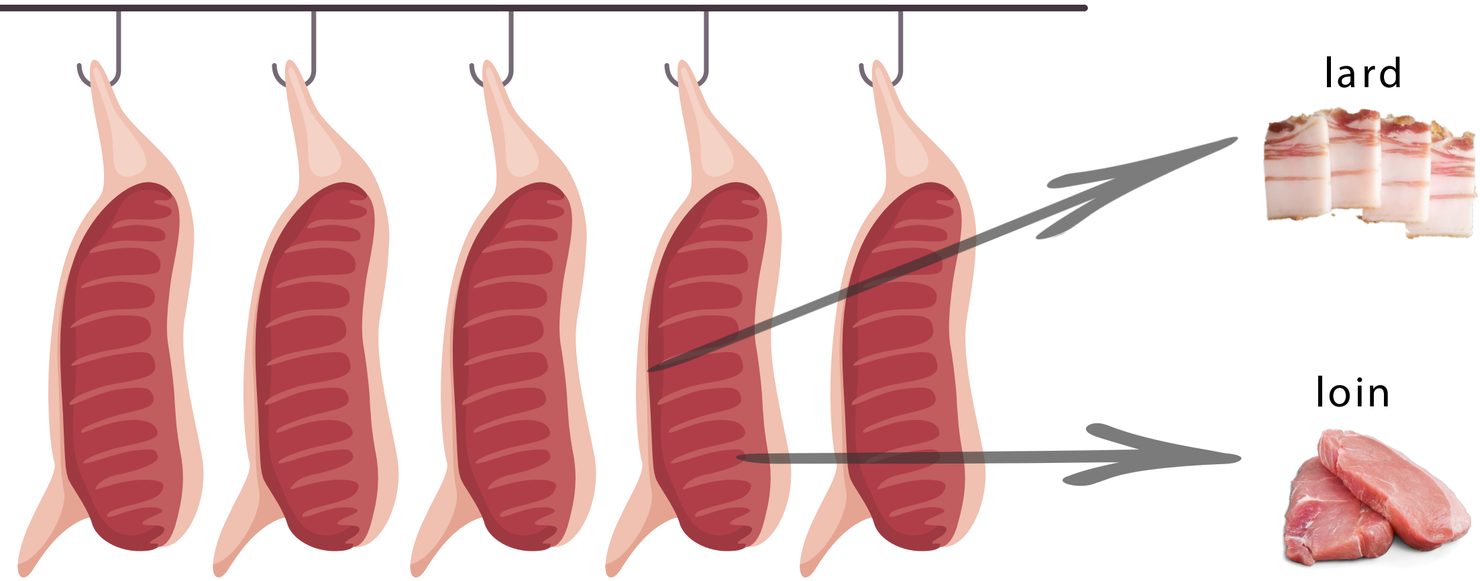

Samples of:

lard

loin

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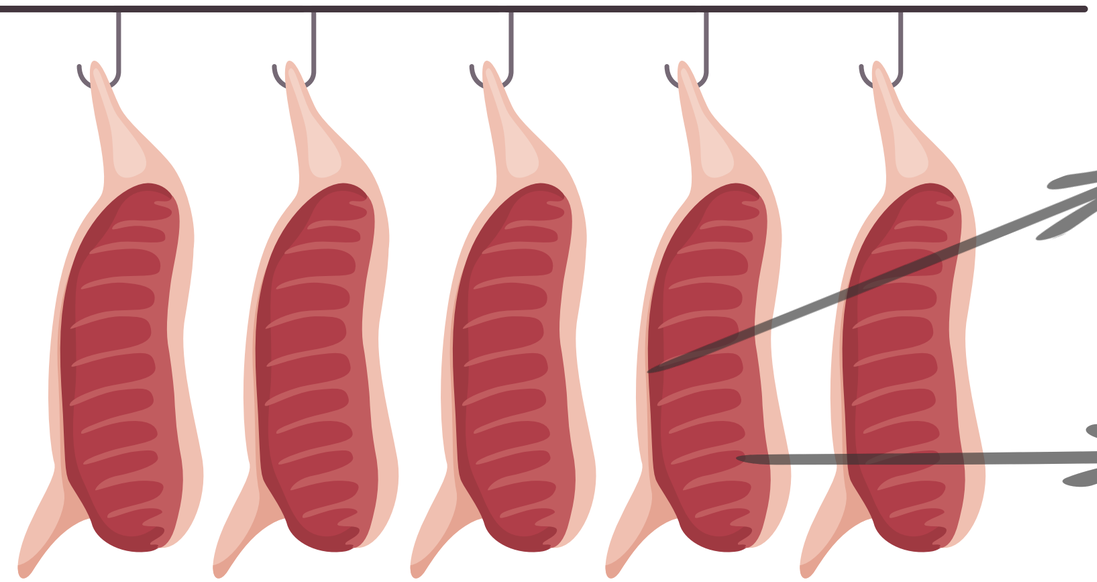
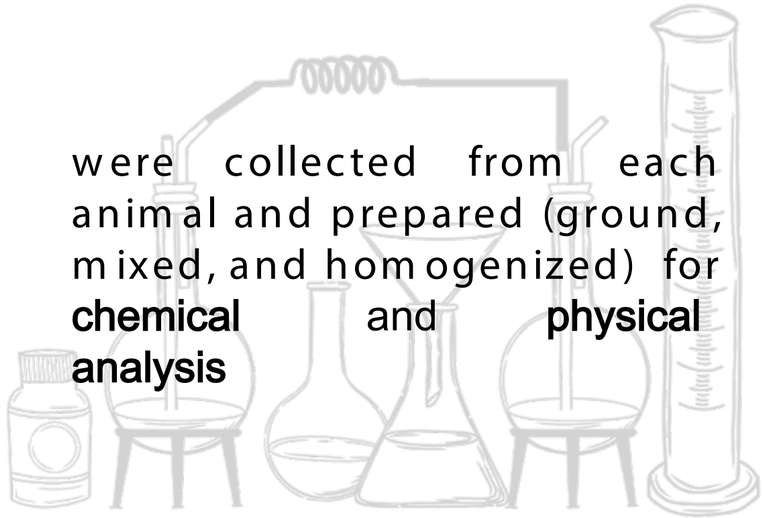


Samples of:

lard

loin

were collected from each animal and prepared (ground, mixed, and homogenized) for **chemical** and **physical analysis**



Laboratory analysis

1 Color

Spectrophotometer (Minolta CM-600d, Konica Minolta Sensing Americas, Inc, NJ, USA)

2 Chemical composition

Performed according to AOAC, 2012 standards

- Dry matter (#950.46)
- Crude protein (Kjeldahl method)
- Fat content (#991.36)
- Ash(#920.153)

3 Fatty acid profile

Gas chromatography analysis

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Gas chromatography analysis

4 pH_{24}

Bench pH-meter (Sension pH-meter, Hach Company, CO, USA)

5 Cooking losses

The cooking loss percentage was calculated by dividing the weight difference before and after cooking (75°C for 50 min) by the pre-cooked weight

6 Shear force

LS5 electronic dynamometer (Lloyd Instruments, AMETEK Inc., Berwyn, PA, USA) and an Allo-Kramer shear cell with 10 flat-bottomed blades.

Statistical analysis

Linear mixed model

$$y_{ijkl} = \mu + diet_i + sex_j + (diet \times sex)_{ij} + pen(diet)_{k:i} + e_{ijkl}$$

- y_{ijkl} was the observed trait;
- μ was the overall intercept of the model;
- $diet_i$ was the fixed effect of the i^{th} diet (i = 1, …, 4);
- sex_j was the fixed effect of the j^{th} sex (j: 1 = gilts, 2 = barrows);
- $(diet \times sex)_{ij}$ was the interaction effect between treatment and sex;
- pen_k was the random effect of the l^{th} pen (l = 1,..,8) within the $(diet)_i$;
- e_{ijkl} was the random residual.

Results

Table 1: descriptive statistics of experimental traits → Results presented by Gallo et al. in session 5 of this meeting

Trait:	No.	Mean	Std Dev	MIN	MAX
Initial BW, kg	85	52.4	4.2	40.5	64.5
Final BW, kg	85	174.9	6.37	157.5	187
Average Daily Gain (ADG), g/d	85	888	40	790	978
Delta BackFat (ΔBF), mm	85	8.9	2.1	4	15
Feed Intake, g/d	85	2622	57	2362	2699
Gain:Feed	85	0.339	0.015	0.304	0.378
Carcass Wt*, kg	85	139	5.6	123.8	148.6
Lards Wt, kg	84	8.42	1.04	5.61	10.4
Loins Wt, kg	85	26.01	1.81	21.2	30.2

*Without head

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*Without head

Results

Table 2: LS means of meat quality traits

Item:	Diet:					
	CTR	SP33	SP66	SP100	*P* Diet	RMSE
Loin pH_{24}	5.62	5.56	5.59	5.56	0.60	0.17
Loin chemical composition, %:						
- Humidity	72.48	72.26	72.68	72.85	0.34	0.92
- Crude protein	22.62	22.63	22.38	22.11	0.29	0.82
- Lipids	3.22	3.47	3.34	3.57	0.85	0.95
- Ashes	1.14	1.13	1.15	1.13	0.47	0.05
Loin cooking loss, %	27.85^{ab}	28.85^{ab}	26.12^{a}	30.04^{b}	0.01	2.04
Loin shear force, kg/g	9.81	8.59	9.00	8.81	0.60	1.99

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- Crude protein	22.62	22.63	22.38	22.11	0.29	0.82
- Lipids	3.22	3.47	3.34	3.57	0.85	0.95
- Ashes	1.14	1.13	1.15	1.13	0.47	0.05
Loin cooking loss, %	27.85^{ab}	28.85^{ab}	26.12^{a}	30.04^{b}	0.01	2.04
Loin shear force, kg/g	9.81	8.59	9.00	8.81	0.60	1.99

Results

Table 3: LS means of meat and lard color parameters

Item:	Diet:				*P* Diet	RMSE
	CTR	SP33	SP66	SP100		
Loin color:						
- CIE L*	46.00	45.44	48.03	44.01	0.20	3.30
- CIE a*	3.49	4.32	3.62	3.91	0.77	1.84
- CIE b*	11.99	12.40	12.58	11.84	0.63	1.50
- Chroma (c)	12.58	13.23	13.19	12.56	0.73	1.93
- hue (h)	74.49	71.59	74.93	72.22	0.64	6.04
Lard color:						
- CIE L*	75.53	75.87	76.51	75.31	0.14	1.33
- CIE a*	0.63 ^{ab}	0.78 ^{ab}	0.52 ^{a}	1.59 ^{b}	0.04	0.81
- CIE b*	8.61 ^{a}	9.00 ^{ab}	8.77 ^{a}	10.71 ^{b}	0.02	1.32
- Chroma (c)	8.67 ^{a}	9.06 ^{ab}	8.82 ^{ab}	10.87 ^{b}	0.02	1.37
- hue (h)	86.68	85.64	86.88	82.07	0.08	4.48

Results

Table 3: LS means of meat and lard color parameters

Item:	Diet:				*P* Diet	RMSE
	CTR	SP33	SP66	SP100		
Loin color:						
- CIE L*	46.00	45.44	48.03	44.01	0.20	3.30
- CIE a*	3.49	4.32	3.62	3.91	0.77	1.84
- CIE b*	11.99	12.40	12.58	11.84	0.63	1.50
- Chroma (c)	12.58	13.23	13.19	12.56	0.73	1.93
- hue (h)	74.49	71.59	74.93	72.22	0.64	6.04
Lard color:						
- CIE L*	75.53	75.87	76.51	75.31	0.14	1.33
- CIE a*	0.63 ^{ab}	0.78 ^{ab}	0.52 ^{a}	1.59 ^{b}	0.04	0.81
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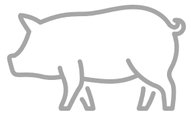
Results

Table 4: LS means of meat and lard fatty acid profile

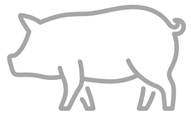
Item:	Diet :					
	CTR	SP33	SP66	SP100	*P* Diet	RMSE
Loins fatty acid profile (%) :						
- Saturated fatty acids	37.34	36.84	37.85	36.16	0.74	2.19
- Monounsaturated FA	52.80	53.14	52.52	52.74	0.83	1.65
- Polyunsaturated FA	9.86	10.03	9.63	11.13	0.44	1.68
- Omega3	0.59	0.58	0.52	0.56	0.75	0.14
- Omega6	0.67	0.66	0.57	0.64	0.64	0.16
Lards fatty acid profile (%) :						
- Saturated fatty acids	34.65	34.79	35.77	35.30	0.28	1.40
- Monounsaturated FA	45.75	45.24	44.92	44.18	0.13	1.57
- Polyunsaturated FA	19.61	19.97	19.31	20.58	0.53	1.49
- Omega3	1.13	1.13	1.02	1.08	0.60	0.11
- Omega6	1.18	1.18	1.07	1.12	0.52	0.11

Conclusions



- **No differences** on **chemical characteristic** of **meat** between treatments

Conclusions



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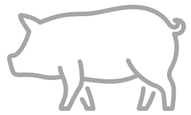

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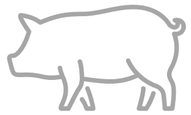

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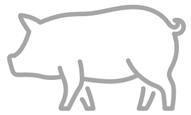

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The results obtained indicate that a partial to full replacement of SBM with SP does not affect meat quality parameters

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THANK YOU FOR YOUR ATTENTION!

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