Rapeseed feeds for swine - Recent studies and perspectives

Since the 1990s only 00 rapeseed is grown and processed in Germany. 00 means almost free of erucic acid and a low glucosinolate content.
## Pig performance data yesterday and at present in Germany
- data from > 100,000 fattening pigs, > 1 mio. sows and litters -

<table>
<thead>
<tr>
<th></th>
<th>1998</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fattening pigs, 28-115 kg live weight</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Weight gain, g/day</td>
<td>699</td>
<td>834</td>
</tr>
<tr>
<td>- Feed: gain ratio, kg/kg</td>
<td>2.98</td>
<td>2.78</td>
</tr>
<tr>
<td><strong>Farrowing performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Piglets born alive per litter</td>
<td>10.3</td>
<td>14.7</td>
</tr>
<tr>
<td>- Piglets weaned per litter</td>
<td>8.9</td>
<td>12.9</td>
</tr>
<tr>
<td><strong>Performance weaned piglets up to 28 kg live weight</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Weight gain, g/day</td>
<td>no data*</td>
<td>434</td>
</tr>
<tr>
<td>- Feed: gain ratio, kg/kg</td>
<td>no data*</td>
<td>1.70</td>
</tr>
</tbody>
</table>

*400 g/day and 1.90 as results in former piglet experiments

https://erzeugerring.info/

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06/2019
Rapeseed feeds – Rapeseed meal, solvent extracted (RSM) and rapeseed press cake/ expeller

1. Production (00 Quality) and pig yield levels

2. Fiber and available energy

3. Protein quality and toasting

4. Acceptance/performance and thyroid health of g/f pigs and sows – Is there a glucosinolate problem, also now?

5. Phosphorus and phytase

6. Recommendations and conclusions
Rapeseed meal/Canola meal solvent extracted (RSM/CM) vs. soya-bean meal (SBM) – Fiber and Energy (Basis 89% dry matter, DM)

<table>
<thead>
<tr>
<th></th>
<th>RSM(^1) 34% CP, 3% fat</th>
<th>CM(^2) 36% CP, 3 fat</th>
<th>SBM(^2) 44% CP, 1.2% fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid detergent fiber</td>
<td>g/kg</td>
<td>206</td>
<td>150</td>
</tr>
<tr>
<td>Acid detergent lignin</td>
<td>g/kg</td>
<td>85</td>
<td>?33?</td>
</tr>
<tr>
<td>Digestibility energy</td>
<td>%</td>
<td>67 (^3)</td>
<td>76</td>
</tr>
<tr>
<td>Metabolisable energy</td>
<td>MJ/kg</td>
<td>10</td>
<td>12.3</td>
</tr>
</tbody>
</table>

1) UFOP monitoring (Weber, M. 15th IRC Berlin 2019, Poster 514)
3) digestible org. matter (DLG-Futterwerttabellen SCHWEINE, DLG Feed-Tables Swine, 7th Ed., Frankfurt, M. 2014)
Digestibility of energy (DE) of two batches expeller pressed B. napus canola 13.3 and 13.8% fat and of canola meal, solvent extracted, 3.2 % fat vs. expeller, 10.9 % fat according to three studies with cannulated pigs.

Simple ileal T-cannula for digesta collection and digestibility studies
by courtesy of R. Mosenthin
Standardized ileal digestibility (SIS) of crude protein (CP) and lysine in European rapeseed meal, solvent extracted (RSM) and rapeseed expeller (RE).

Mean and max.-min. range

- **CP**
- **Lysin**

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Mean SID (%)</th>
<th>Max.-Min. Range</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSM</td>
<td>74.7±1.9</td>
<td>74.7–71.9</td>
<td>Maison and Stein (2014): J. Anim. Sci. 92:3502–3514</td>
</tr>
<tr>
<td>RE</td>
<td>78.0±1.9</td>
<td>78.0–74.7</td>
<td>Messerschmidt et al. (2014): Anim. Feed Sci. Technol. 187:68–76</td>
</tr>
<tr>
<td>RSM gently desolventized</td>
<td>74±1.7</td>
<td>74–73</td>
<td></td>
</tr>
</tbody>
</table>

Number of samples:
- **RSM**: 10
- **RE**: 5
- **RSM**: 5
- **RSM gently desolventized**: 5
Toasting intensity and apparent ileal digestibility (AID) of crude protein (CP) and lysine (Salazar-Villanea et al. 2018: Animal 12, 950-958. doi: 10.1017/S175173111700247)

Significance of the treatment effects P<0.001

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Protein quality of rapeseed (RS) from Thuringian harvest 2017 and 2018 and solvent extracted rapeseed meal (RSM) as well as soya bean meal (SBM)

Amino acids g/100 g crude protein

RS
- Lysine: 4.9
- Methionine/Cystine: 4.6
- Threonine

RSM
- Lysine: 4.5
- Methionine/Cystine: 4.5
- Threonine

SBM
- Lysine: 2.8
- Methionine/Cystine: 3.4
- Threonine
RSM solvent extracted for sows in two long-term experiments in France and Germany

F: Quiniou et al. (2012) 25-27 sows per group in 3 reproduction cycles 28 days per lactation, D: Preißinger et al. (2014) 24 sows per group in 4 reproduction cycles, 26-28 days per lactation

<table>
<thead>
<tr>
<th></th>
<th>Quiniou et al. 2012</th>
<th>Preißinger et al. (2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>10%RSM</td>
</tr>
<tr>
<td>Per litter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- piglets born alive</td>
<td>n</td>
<td>12.2</td>
</tr>
<tr>
<td>- piglets weaned</td>
<td>n</td>
<td>10.7</td>
</tr>
<tr>
<td>Weaning weight per piglet</td>
<td>kg</td>
<td>9.4</td>
</tr>
<tr>
<td>Weight gain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- per piglet</td>
<td>g/d</td>
<td>282</td>
</tr>
<tr>
<td>- per litter</td>
<td>kg/d</td>
<td>2.79</td>
</tr>
</tbody>
</table>

Preißinger et al. 2014: UFOP-SCHRIFTEN | AGRAR
https://www.ufop.de/files/6714/3887/5150/RZ_UFOP_1263_Schriften_Agrar_Zuchtsauen_150521.pdf
Canola expeller in a four-week trial with 4x12 pigs, initial body weight 20 kg, 0.4 mg iodine/kg diet


Thyroxine nmol/L serum

Performance kg/day

Significance (P < 0.001)

Glucosinolates nmol/kg diet

Canola expeller % of the diet

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**Perfomance and health of pigs in dependence on the glucosinolate content of the diet**


<table>
<thead>
<tr>
<th>Glucosinolates mmol/kg diet</th>
<th>0</th>
<th>0.5 – 1(^1)</th>
<th>1.5</th>
<th>3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed intake, weight gain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCN(^-) im Serum</td>
<td></td>
<td>(↑)</td>
<td></td>
<td>(↑)</td>
</tr>
<tr>
<td>Thyroxine Serum</td>
<td></td>
<td>(↓)</td>
<td>(↓)</td>
<td>(↓)</td>
</tr>
<tr>
<td>Thyroid weight</td>
<td></td>
<td>(↑)</td>
<td></td>
<td>(↑)</td>
</tr>
<tr>
<td>Iodine in the thyroid</td>
<td></td>
<td>(↓)</td>
<td></td>
<td>(↓)</td>
</tr>
</tbody>
</table>

\(^1\) per kg diet 100 g RSM with <10 mmol Glucosinolaten/kg
Mean glucosinolate content of harvested 00-rapeseed from three long-term monitorings ¹)


¹) Number samples per year in brackets; in Canada started the 00-quality (spring rapeseed!) growing sooner than in France or in Germany.

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Glucosinolate content of rapeseed meals from 28 compound feed plants (Schumann, 2005)\(^1\)

Glucosinolates (µmol/g dry matter, DM; a class represents 1 µmol)

Number samples: 457
Mean ± SD (µmol/g DM): 7.9 ± 4.8
Range (µmol/g DM): 1 - 37

\(^1\) Glucosinolatgehalt von in Deutschland erzeugten und verarbeiteten Rapssaaten und Rapsfuttermitteln. UFOP-Schriften, Heft 27, 69 Seiten, [https://www.ufop.de/files/9513/3922/7312/Glucosinolatgehalt_Bericht.pdf](https://www.ufop.de/files/9513/3922/7312/Glucosinolatgehalt_Bericht.pdf)
Rapeseed Quality Chain*

Seeds for sowing

Control system

Harvested seed

Control?

Oil mills

Control?

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Glucosinolates µmol/g seed
EU: 25  Germany: 18  Canada: 12

Glucosinolates mmol/kg solvent extracted meal
<10  10-15  15-20  >20
good  satisfying  not satisfying  not acceptable

*Recommendations 11th Int. Rapeseed Congress Copenhagen 2003 modified.
Phosphorus content of selected feedstuffs (ALTEMUELLER and CAMPBELL 2009, mod.)


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The principle of phytase addition (ALTEMUELLER and CAMPBELL 2009)
Standardized total tract digestibility of phosphorus (STTDP) of rapeseed feeds without vs. with added phytase (1500 U/kg diet)

Testing of 2X18 diets, each with 40% RF as sole phosphorus source, in 36X6 barrows over 12 days (Maison et al. 2015: J. Anim. Sci. 93, 3494-3502)

Phytase effect      P < 0.001
CM vs. RSM         P > 0.05
RSM vs. Expeller    P < 0.001

STTDP %

Phytase effect
CM vs. RSM
RSM vs. Expeller
High livestock density with high nitrogen and phosphorus load in Benelux and in the north-western region of Germany.

In spite the high P content of the manure extra P via mineral fertilizers is applied.

1 LSU refers to a cow with 500-700 kg body weight. Livestock dependent on species and age is aggregated by using respective conversion factors, e.g. for gilts and growing sows 0.3 and breeding sows 0.5 LSU.

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Maximum inclusion levels for solvent extracted rapeseed meal (RSM) as compared with CM
Even low percentages of rapeseed feeds require additional iodine.

<table>
<thead>
<tr>
<th>Pig growth</th>
<th>UFOP % of the diet</th>
<th>Canola meal feeding guide 2015 % of the diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaned piglets (wk. 5-10; 42-45 d)</td>
<td>5-10</td>
<td>20</td>
</tr>
<tr>
<td>Growing pigs</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Finishing pigs</td>
<td>15</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Breeding sows</th>
<th>UFOP % of the diet</th>
<th>Canola meal feeding guide 2015 % of the diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>low pregnancy</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>high pregnancy and lactation</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>


Weber et al., 2016: Rapsextraktionsschrot in der Schweinemast

Canola Council of Canada, 2015: CANOLA MEAL FEEDING GUIDE, FEED INDUSTRY GUIDE • 5th EDITION.
https://www.canolacouncil.org/media/516716/2015_canola_meal_feed_industry_guide.pdf
Conclusions

Need for valid data of fiber contents and standardized ileal energy digestibility (SIED) related to RS breeding and processing
Future calculation of ME and NE from SIED data
Need for data of AA availability related to RS breeding and processing

Glucosinolates redistribute the organism’s iodine with less in thyroid and milk and more in extrathyroid and extramammary tissues, urine and faeces. More iodine added to feed for compensation!

Establishing a quality chain for RS and derived RSM and RPC by using GSL analysis

High P content may be beneficial by making the dominating phytate P bioavailable via phytase addition to the feed