Sunflower seed meal in fattening pig diets

Sunflower seed meal, a by-product of sunflower oil extraction

Sunflower seed meal is the by-product of the sunflower oil extraction process. Sunflower oil is obtained from the seeds of the common sunflower (Helianthus annuus, L.). Together with soybean, cottonseed, groundnut and rapeseed, sunflower is one of the major oilseed crops produced in the world[1]. Oil extraction usually involves mechanical extraction followed by solvent extraction; the resulting product is referred to as solvent-extracted sunflower meal (SFM). When only mechanical extraction is applied, the product is referred to as sunflower cake, sunflower expeller, or expeller-extracted meal[2]. In the European Union and the US, only mechanical extraction products can be used in organic farming, due to a ban on the use of solvents for the production of feed ingredients in organic farming[3, 4]. To enhance the oil-extraction process, seeds are often completely or partially dehulled before oil extraction – although part of the removed hulls can be added back to the meal later in the process – and thus the remaining meal or expeller may contain varying proportions of hulls, contributing to the large variation observed in these products[2].

Nutritive value of sunflower seed meal in fattening pigs diets

Sunflower seed meal is relatively rich in sulphur-containing amino acids, but has relatively low lysine and available threonine content[5]. The composition of SFM and sunflower expeller can vary highly due to differences in the oil extraction process and variable inclusion of the hulls. The protein content of SFM ranges from less than 25% to levels of up to 45%, and crude fibre levels range from 15% to 40% (Table 1). Sunflower seed expeller, resulting from mechanical extraction, contains up to 30% oil, whereas the meal resulting from solvent-extracted sunflower seeds generally contains less than 5% oil. Because of the high content of unsaturated fat, high inclusion levels of sunflower seed expeller with high oil content may result in soft pork fat. While the digestibility of amino acids has been reported to vary between hulled and partially dehulled SFM by some authors[6], others did not observe differences between hulled and dehulled meals[7], instead highlighting the large variability between batches of meals, and even within trading classes. Although SFM contains relatively high levels of phosphorous, only 16–34% of phosphorous is present as non-phytate phosphorous[5, 8], contributing to the low availability of phosphorous from SFM for swine. Sunflower meal contains considerable amounts of fibre, which is mainly insoluble and highly lignified. Fibre present in sunflower hulls is rich in lignin, cellulose (around 50% of non-starch polysaccharides; NSP) and xylans (around 25% of NSP), whereas in the seeds pectic polysaccharides and small amounts of cellulose are found[9, 10]. The fibre fraction from SFM features many cross-links and crystalline structures with abundant lignin-carbohydrate and lignin-protein complexes[9, 11]. Enzyme accessibility seems to be the major factor limiting the degradation of sunflower meal fibre[9].

Because of its high fibre content, lower availability of several essential amino acids compared with other feed ingredients, and low palatability, SFM inclusion is generally limited in fattening pig diets. However, several research investigations have reported that SFM can be included in grower diets at levels of up to 10%, and in finisher diets at levels of over 20%, without hampering performance.
Effect of sunflower seed meal inclusion rates on growth performance in fattening pigs

In a series of studies, we tested the effects of SFM inclusion in fattening pig diets. The first experiment tested the effects of 0%, 5% and 10% SFM inclusion in diets for fattening pigs (26–86kg), and found no differences in growth performance between diets with or without SFM inclusion. A second experiment tested the effects of 0%, 5%, 10% or 15% SFM inclusion in finisher (43–100kg) diets. This study showed no differences in growth performance between diets with or without SFM inclusion. In another study, where 22% SFM meal was substituted for 22 soybean meal, growth in the finisher phase was slightly reduced. In a final experiment, SFM was included at 0%, 8%, 16% and 24% in starter (30–50kg), grower (50–70kg), and finisher (>70kg) diets\(^{[18]}\). In contrast to what might be expected, average daily feed intake increased linearly with higher inclusion of SFM (10g/day with every percentage inclusion of SFM) within the range tested (Figures 1 and 2). Average daily gain was not affected, resulting in a reduced gain to feed ratio (G:F). It is possible that the digestible amino acid content of SFM was overestimated, resulting in suboptimal energy to protein ratios, which caused the pigs to increase their feed intake.

In growth performance between diets with or without SFM inclusion. In another study, where 22% SFM meal was substituted for 22 soybean meal, growth in the finisher phase was slightly reduced. In a final experiment, SFM was included at 0%, 8%, 16% and 24% in starter (30–50kg), grower (50–70kg), and finisher (>70kg) diets\(^{[18]}\). In contrast to what might be expected, average daily feed intake increased linearly with higher inclusion of SFM (10g/day with every percentage inclusion of SFM) within the range tested (Figures 1 and 2). Average daily gain was not affected, resulting in a reduced gain to feed ratio (G:F). It is possible that the digestible amino acid content of SFM was overestimated, resulting in suboptimal energy to protein ratios, which caused the pigs to increase their feed intake.

Lower inclusion of sunflower seed meal in starter phase or under challenging health conditions

Although SFM was found to have no considerable effects on performance, faeces consistency was affected by SFM inclusion. The occurrence of wet faeces increased linearly with SFM inclusion levels from 0% to 24%, especially in the starter phase. Furthermore, tests with piglets indicate that pigs that suffer from lower health levels may be more sensitive to SFM inclusion. In piglets with lower health levels, inclusion levels beyond 6% reduced daily weight gain and daily feed intake, whereas no negative effects of inclusion of SFM (18%) were observed in healthy piglets (7–16kg)\(^{[19]}\). These results emphasise that the inclusion of SFM should be limited in young pigs and pigs with poorer health.

Sunflower meal may lower rate of feed intake in fattening pigs

In one study, inclusion of SFM in diets, when exchanged with wheat bran, increased the time pigs spent at the feeder and reduced their rate of feed intake\(^{[20]}\). In another study, however, inclusion of SFM did not affect the time pigs spent at the feeder or their rate of feed intake\(^{[20]}\), but the frequency of meals during the day was higher, resulting in smaller meal size and shorter duration of meals. In this study, feed intake was higher and the slightly higher stocking density (1.1m\(^2\)/pig versus 1.3m\(^2\)/pig) may have prevented the pigs from spending more time at the feeder with the higher inclusion of SFM.

Table 1. Typical composition\(^1\) of sunflower seed expeller and solvent-extracted sunflower meal, hulled or partially dehulled, as reported in several studies\(^{[2, 6-8, 12-17]}\).

<table>
<thead>
<tr>
<th>Composition</th>
<th>Sunflower seed expeller</th>
<th>Sunflower seed meal hulled</th>
<th>Sunflower seed meal partially dehulled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash</td>
<td>45 – 70</td>
<td>47 – 88</td>
<td>59 – 85</td>
</tr>
<tr>
<td>Crude protein</td>
<td>225 – 425</td>
<td>235 – 390</td>
<td>255 – 460</td>
</tr>
<tr>
<td>Ether extract</td>
<td>77 – 230</td>
<td>0 – 113</td>
<td>8 – 33</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>180 – 345</td>
<td>235 – 400</td>
<td>153 – 349</td>
</tr>
<tr>
<td>Neutral detergent fibre</td>
<td>320 – 455</td>
<td>280 – 540</td>
<td>300 – 470</td>
</tr>
<tr>
<td>Acid detergent fibre</td>
<td>230 – 370</td>
<td>424</td>
<td>224 – 355</td>
</tr>
<tr>
<td>Acid detergent lignin</td>
<td>58 – 120</td>
<td>60 – 130</td>
<td>55 – 100</td>
</tr>
<tr>
<td>Calcium</td>
<td>2 – 8</td>
<td>4</td>
<td>3 – 5</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>6 – 13</td>
<td>11 – 13</td>
<td>10 – 14</td>
</tr>
<tr>
<td>ME Swine, MJ/kg</td>
<td>7.8 – 11.1</td>
<td>NA(^2)</td>
<td>7.1 – 12.0</td>
</tr>
<tr>
<td>NE Swine, MJ/kg</td>
<td>6.2 – 8.9</td>
<td>NA(^2)</td>
<td>5.7 – 7.0</td>
</tr>
</tbody>
</table>

\(^1\) Data is presented as g/kg DM, unless indicated otherwise.  \(^2\) Not available.
Sunflower seed meal inclusion in high-fibre diets for fattening pigs

Although minor effects of SFM inclusion were observed in the studies described above, it can be hypothesised that SFM inclusion can be more restrictive in high-fibre diets, as pigs may require more time to consume their meals, diets may be more satiating, and feed intake may become a limiting factor. Therefore, one of the experiments described above was designed to test inclusion of SFM (0%, 5%, 10% and 24%) in corn-wheat-based diets containing 12% and 16% neutral detergent fibre (NDF), during the fattening period\[6\]. No correlation between SFM inclusion and NDF level was found for performance parameters, indicating that the negative effects of high SFM inclusion on performance are similar, irrespective of the dietary fibre content.

When stocking density was low (1.3m²/pig), time spent at the feeder was reduced, and the rate of feed intake increased linearly with SFM inclusion in diets containing 16% NDF, similar to results observed for diets with 12% NDF. However, when stocking density was increased (0.8 pigs/m²), the rate of feed intake seemed to be reduced by SFM inclusion in high-fibre diets (16% NDF), although not consistently over all periods.

**Recommendations**

The results of these four studies indicate that SFM inclusion in G-F pig diets has no adverse effect on growth performance. For young pigs, or pigs with poorer health, the increased incidence of wet faeces with high inclusion levels of SFM may still be of concern. In conclusion, up to 8% SFM levels can be recommended in the starter phase, 10% in the grower phase, and 15% in the finisher phase (Table 2). A prerequisite is that quality and matrix values are properly assessed. Your local Trouw Nutrition representative can assist you with this.

**Table 2. Recommended maximum inclusion levels (%) for sunflower seed meal in fattening pig diets.**

<table>
<thead>
<tr>
<th>Inclusion level</th>
<th>Starter (20–50 kg)</th>
<th>Grower (50–70 kg)</th>
<th>Finisher (&gt;70 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFM (g/kg DM)</td>
<td>8</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

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**References**

12. CVB, Feed Table. 2011, Centraal Veevoederbureau, Lelystad, The Netherlands.