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Oilseed Crops in Beef Cattle Rations

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Oilseed crops are produced throughout South Dakota for human consumption. However, when unpredictable environments create immature, frost-damaged, or otherwise poor quality oilseeds unfit for human consumption or if market prices are low, feeding livestock is an alternative outlet for oilseed crops.

Meals produced from the processing of these crops have been used for years in livestock rations; however, the unprocessed whole seed is the primary focus here.

**Nutrient composition**

**Whole oilseeds**

Typical nutrient content of various whole oilseeds are listed in Table 1. Sunflowers, canola, and safflower seeds are considered moderate protein sources with crude protein concentrations of 19.6, 21.0, and 17.5% of DM, respectively. Protein levels are higher than most cereal grains but lower than some protein feeds. Whole soybean seeds have approximately double the crude protein content (41% CP) of the other oilseeds listed.

Due to the oil content of oilseeds, energy levels of oilseed crops are typically higher than that of most cereal grains. Fat contains 2.25 times as much energy as the equal amount of carbohydrates from feed grains or forages. Whole safflower and soybean seeds have similar concentrations of net energy for maintenance (NE\textsubscript{m}) and growth (NE\textsubscript{g}) as corn. Canola and sunflower seeds have 1.3 and 1.4 times the NE\textsubscript{m}, respectively, and 1.4 and 1.5 times the NE\textsubscript{g}, respectively, found in corn.

**Meals**

Oilseed meals such as soybean meal and cottonseed meal are commonly used as protein supplements in beef, dairy, and sheep diets. However, due to proximity of processing plants in North Dakota and South Dakota, sunflower seed meal and canola meal may be available at reasonable cost.

The meal forms of these oilseed crops have lower fat content than the whole seed since the oil has been removed during the extrusion or solvent processes, but crude protein is higher in oilseed meal than in whole seeds. Nutrient concentrations for specific oilseed meals are listed in Table 2. The increase in protein content of the meal form is due to the removal of oil from the seeds, which concentrates the remaining nutrients.

Normally, the crude protein concentrations are 40% of dry matter or higher. However, safflower meal crude protein concentrations are approximately 25% of dry matter.

Energy levels of oilseed meals are typically lower than in whole seeds due to the removal of a high portion of oil from the seeds. Soybean meal NE\textsubscript{m} and NE\textsubscript{g} concentrations are slightly lower than corn. Net energy for maintenance concentrations for cottonseed, canola, sunflower,

<table>
<thead>
<tr>
<th>Component</th>
<th>Canola</th>
<th>Safflower</th>
<th>Soybean</th>
<th>Sunflower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter (DM), %</td>
<td>92.0</td>
<td>93.0</td>
<td>90.0</td>
<td>90.0</td>
</tr>
<tr>
<td>Crude Protein, % of DM</td>
<td>21.0</td>
<td>17.5</td>
<td>41.7</td>
<td>19.6</td>
</tr>
<tr>
<td>NE\textsubscript{m} Mcal/lb</td>
<td>1.34</td>
<td>1.00</td>
<td>0.96</td>
<td>1.42</td>
</tr>
<tr>
<td>NE\textsubscript{g} Mcal/lb</td>
<td>0.97</td>
<td>0.65</td>
<td>0.67</td>
<td>1.03</td>
</tr>
<tr>
<td>TDN, % of DM</td>
<td>151.0</td>
<td>191.2</td>
<td>191.0</td>
<td>101.0</td>
</tr>
<tr>
<td>Fat, % of DM</td>
<td>20.0</td>
<td>35.0</td>
<td>18.8</td>
<td>44.0</td>
</tr>
<tr>
<td>Fiber</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADF, % of DM</td>
<td>12.0</td>
<td>40.0</td>
<td>10.0</td>
<td>16.5</td>
</tr>
<tr>
<td>Calcium, % of DM</td>
<td>0.35</td>
<td>0.26</td>
<td>0.27</td>
<td>0.26</td>
</tr>
<tr>
<td>Phosphorus, % of DM</td>
<td>0.68</td>
<td>0.67</td>
<td>0.63</td>
<td>0.67</td>
</tr>
</tbody>
</table>
and safflower are approximately 80, 72, 66, and 54%, respectively, of the \( \text{NE}_m \) provided from corn.

Remember that these feedstuffs are normally used as a protein supplement and only fed to the required protein level due to cost.

### Feeding guidelines

#### Whole oilseeds

Total dietary fat content should not exceed 8% of diet dry matter, and 4 to 5% is optimal for beef cattle. More than 8% of the total ration dry matter will likely cause digestive problems, interfere with ruminal fermentation, and influence postruminal digestibility. Because of this, the oil content of oilseeds determines the maximum inclusion level in the diet. Recommended intake of oilseeds are 3 to 5 pounds daily to increase dietary fat content by 3 to 4 percentage points.

Most forages and grains contain 2 to 4% fat. Because of this fat already in the diet no more than 3 to 5 pounds per cow per day of oilseeds should be added to a ration so as not to increase total fat by more than 3 to 4%.

#### Recommendations, whole oilseeds

**Whole soybeans**

The recommendation is that whole soybeans be rolled or ground, but this is not essential. Processing (rolling and grinding) limits the storage life of soybeans due to increased potential for rancidity. Plan to use processed raw soybeans within 7 days to minimize the potential for rancid flavors.

Raw soybean seeds have a trypsin inhibitor present, so this limits the use of raw whole soybean seeds to young calves, but trypsin inhibitor is not a problem in weaned cattle with a fully functional rumen.

Do not use raw soybean seeds (whole or processed) with urea. The protein contained in soybeans is highly rumen degradable, thus additional rumen degradable protein is not necessary. Furthermore, raw soybeans contain a urease enzyme that will break down the urea and release ammonia, which can reduce palatability.

Soybeans do not need to be roasted or extruded to be used by ruminants. With high oil-bearing soybeans, consumption should not exceed 1.5 lb. per cow per day.

**Sunflower seeds**

Whole sunflower seeds can be fed to beef cattle without processing. Cattle find sunflower seeds highly palatable.

Safe consumption levels vary by type (oil or confectionery). Feed at a rate equal to 1 lb of fat intake. Oil-type sunflower seeds should be limited to 2 to 2.5 lb per cow per day; and confectionery-type sunflower seeds should be limited to 5 lb per cow per day.

**Safflower seeds**

Whole safflower seeds can be fed to beef cattle without processing. When higher levels of safflower seeds are contained within a diet, lower animal performance has been seen due to fiber content. Safflower seeds are less palatable than the other oilseeds. The upper limit of inclusion for safflower seeds is 2.5 lb. per cow per day.

### Table 2. Composition of oil seed meals.

<table>
<thead>
<tr>
<th>Component</th>
<th>Canola</th>
<th>Cottonseed</th>
<th>Safflower</th>
<th>Soybean</th>
<th>Sunflower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter (DM), %</td>
<td>92.0</td>
<td>92.0</td>
<td>92.0</td>
<td>89.0</td>
<td>90.0</td>
</tr>
<tr>
<td>Crude Protein, % of DM</td>
<td>40.9</td>
<td>48.9</td>
<td>25.4</td>
<td>52.9</td>
<td>42.8</td>
</tr>
<tr>
<td>Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEM, Mcal/lb</td>
<td>0.73</td>
<td>0.81</td>
<td>0.55</td>
<td>0.94</td>
<td>0.67</td>
</tr>
<tr>
<td>NEG, Mcal/lb</td>
<td>0.45</td>
<td>0.53</td>
<td>0.29</td>
<td>0.64</td>
<td>0.40</td>
</tr>
<tr>
<td>TDN, % of DM</td>
<td>69.0</td>
<td>75.0</td>
<td>57.0</td>
<td>84.0</td>
<td>65.0</td>
</tr>
<tr>
<td>Fiber</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NDF, % of DM</td>
<td>27.2</td>
<td>28.0</td>
<td>14.9</td>
<td>14.9</td>
<td>40.0</td>
</tr>
<tr>
<td>Calcium, % of DM</td>
<td>0.70</td>
<td>0.16</td>
<td>0.37</td>
<td>0.40</td>
<td>0.45</td>
</tr>
<tr>
<td>Phosphorus, % of DM</td>
<td>1.20</td>
<td>0.76</td>
<td>0.81</td>
<td>0.71</td>
<td>1.02</td>
</tr>
</tbody>
</table>
Whole cottonseed
Whole cottonseed can be fed to beef cattle. However, due to availability and cost, cheaper sources of protein and energy can typically be found in South Dakota.

Gossypol is a natural toxin present in the cotton plant that protects it from insect damage. Cattle have the ability to detoxify some gossypol because the rumen microorganisms bind it so the gossypol cannot be absorbed. However, cattle can be fed whole cottonseeds at high enough concentrations to overwhelm the ability of the microbial population to detoxify the gossypol. Ingestion of excess gossypol can be detrimental to fertility in both males and females.

Calves should not be fed cottonseed until they have a well-developed rumen (post weaning). The recommended safe level to feed whole cottonseed is less than 5 lb per cow per day and 1.5 lb per weaned calf per day.

Recommendations, oilseed meals
Typically, oilseed meals are used as protein sources to meet nutrient requirements due to the high amount of crude protein remaining after extrusion processing to remove the oil.

Oil-seed meals are normally low in fat content, so diets are not restricted due to fat. Research conducted in Montana indicated that sunflower, soybean, canola, and safflower meals could be used in backgrounds diets without significant effect on animal performance. These oilseed meals were fed at relatively low levels in the study, so use caution when including them at higher levels. Overfeeding protein supplements is economically unwise and can result in an unnecessary increase in the nitrogen concentration of the manure.

Soybean meal
Soybean meal is the standard that most other protein sources are compared in terms of cost.

Sunflower meal
The nutrient composition of sunflower meal will vary by the extraction processing and the amount of hulls removed or added to the sunflower meal.

Safflower meal
Safflower meal has the lowest energy and protein content of the oilseed meals listed here. Inclusion of the hulls with the meal is the reason for the lower energy content. Safflower meal is a good natural protein that can be used with low-quality forage diets. However, when high levels of safflower meal are included in the diet, lower animal performance can be observed.

Canola meal
Canola meal makes a good protein source for cattle fed low-protein forages or cows grazing dormant range. Canola meal will vary in amount of fat remaining in the meal due to the processing methods.

Cottonseed meal
Cottonseed meal is commonly used in range cubes and pre-packaged protein supplements. Of the meals discussed here, cottonseed meal is closest in energy and protein content to soybean meal. Gossypol in cottonseed meal is not completely destroyed in the oil extraction process and limits the amount that should be used in cattle rations.

Fat supplementation
These naturally grown, high-oil crops have also been researched as fat supplements for replacement heifers, 2-year old heifers, and mature cows to positively influence reproduction.

Results have varied by location, amount of supplementation, and timing and type of supplementation. The key to good cost effective reproductive performance is meeting the nutritional requirement of the animals.

Summary
Any of these oilseeds crop can be used in beef cattle rations. To ensure the best return for your feed investment, compare cost of each feed on a cost per unit nutrient (energy or protein) basis. Remember to keep the fat content under 5% of the total ration, which limits the amount of some of these whole seed feeds.