

Feeding Soybeans to Dairy Cattle

A guide for dairy farmers



Introduction

With the volatility of the feed market, more producers are looking to reduce feed costs without compromising production. One avenue is to grow more feed on farms. Recently there has been an increased interest in feeding soybeans to dairy cattle. While many farms are concerned that soybeans are difficult to successfully grow in New Hampshire's climate, there are several varieties that are suitable. In fact, Canada has successfully grown soybeans for years, despite having less optimal conditions than New Hampshire. Most experts have recommended soybean maturity groups 1 and 2 for New Hampshire, with group 1 in the northern half of the state (above the notches), and group 2 in the southern half of the state (below the notches)¹.

Both raw (cracked) and roasted soybeans can be fed effectively and potentially reduce the overall feed costs on the farm. If fed correctly, soybeans are a great source of rumen degradable protein, fat, and digestible fiber. This factsheet will review how to feed soybeans to dairy cattle and will present some cautions associated with feeding them.

Rules for Feeding Raw Soybeans

1. Do not feed raw soybeans and urea together. Raw soybeans contain urease, an enzyme that breaks down urea to ammonia in the rumen. When fed with urea, this could cause ammonia toxicity, which is deadly to dairy cattle. Death can occur within four days of ingestion, and symptoms include excessive salivation, frequent defecation and urination, and pupil dilation.
2. Do not feed raw soybeans to young calves. Raw soybeans should only be fed to animals 4 months or older. In addition to urease, raw soybeans also contain Trypsin Inhibitor. Trypsin is an enzyme secreted in the small intestine that aids in the digestion of protein. The trypsin inhibitor found in raw soybeans will stop protein digestion, resulting in diarrhea in young calves.

Below are some frequently asked questions regarding feeding raw soybeans.

How can I feed raw soybeans?

You should crack the raw soybeans. When raw soybeans are cracked, rumen microbes have access to the urease and trypsin inhibitors. Rumen microbes are then able to degrade these undesirable proteins.

What is the benefit of roasting soybeans?

Roasting soybeans results in the denaturation of the trypsin inhibitor and urease thereby protecting the animals from their detrimental effects. Roasting soybeans results in the production of rumen undegradable protein. Roasting does not affect the fat content of the soybeans.

Can I use both roasted and raw soybeans in my cow's diet?

Yes, they are complimentary to each other.

How much can I feed?

We suggest feeding no more than 5 pounds of traditional soybeans to lactating cows. This will approximate 1 pound of supplemental fat.

Rules for Lactating Cow Diets

- 1. Feed 1% calcium in the diet. The polyunsaturated fat content can cause milk fat depression if the diet is not modified. Calcium will help form fatty acid soaps in the rumen and protect the rumen microbes from degradation by the polyunsaturated fatty acids. This level of calcium can easily be accomplished by adding limestone. If there is too little calcium, fiber degradation will be reduced due to the toxic effects of the polyunsaturated fatty acid load in the rumen, which will negatively impact production. However, feeding calcium to form these soaps will reduce this challenge.
- 2. Don't store cracked raw soybeans for more than 2 weeks. The shelf life of raw beans is lower as the fats can get rancid.

If you are looking to add soybeans to your dairy diet, consider the nutrient composition.

Table 1. Nutrient content of raw and roasted soybeans		
Item	Raw	Roasted
DM, %	89.1	94.0
CP, %	40.0	40.0
Soluble CP, % CP	42.1	15.6
Fat, %	20.7	21.3
Starch, %	4.2	1.5
Ca, %	0.27	0.28
P, %	0.65	0.62
From NASEM 2021 ² .		

Example Lactating Dairy Diet

Below is an example basic diet for a dairy cow producing 85 pounds of milk using feeds available in New Hampshire. We have used book values to calculate this diet. Please test your feeds first as these are only estimates.

Table 2. Example diet for a 1540-pound Holstein cow making 85 pounds of 3.8% fat, 3.1% protein milk		
Ingredient	% As Fed	DM lb/d
Calcium carbonate	0.92	1.00
Corn grain dry, fine grind	18.50	17.57
Corn silage, typical	21.47	8.29
Grass legume mix	51.11	22.12
Soybeans, whole raw	2.03	1.98
Soybeans, whole roasted	2.90	2.97
VitTM Premix, generic	0.20	0.21
Soybean meal, solvent 48CP	2.37	2.32
Blood meal, high dRUP	0.50	0.50
Total	100.0	56.96
From NASEM 2021 ² .		

Table 3. Nutrient analysis of example ration	
Nutrient	Content
Dry Matter, %	52.1
Forage, % DM	53.4
CP, % DM	15.8
ME, Mcal/lb	1.21
MP, % DM	9.03
NEL, Mcal/lb	0.80
RDP, % DM	10.8
RUP, Base, % DM	5.0
ADF, % DM	20.1
NDF, % DM	33.3
ADF/NDF, Ratio	0.60
Forage NDF, % DM	28.4
Starch, % DM	27.9
WSC, % DM	5.8
Ash, % DM	6.8
Fatty Acids, % DM	3.75
Ca, % DM	1.00

High Oleic Soybeans

Many concerns surrounding feeding soybeans are related to the polyunsaturated fatty acid load and storage life. Traditional soybeans contain polyunsaturated fatty acids, while high oleic soybeans are bred to contain more oleic acid, a more stable unsaturated fatty acid, and less polyunsaturated fatty acids. This difference reduces the risk of milk fat depression. Research has shown that high oleic soybeans reduce the risk of milk fat depression and potentially increase milk fat content compared to traditional soybeans^{3,4}. Because the risks are lower, high oleic soybeans can be included in greater quantities or be fed with other byproducts that also contain polyunsaturated fatty acids. If you are interested in high oleic soybeans contact your seed dealer for more information.

Summary

If fed correctly, soybeans may be a good option for New Hampshire dairy farms looking to reduce the amount of feed purchased off farm. While many farms may be concerned about growing conditions and nutrition concerns, there are several options available to New Hampshire dairy farmers. When managed correctly, soybeans provide a great source of rumen degradable protein, fat, and digestible fiber.

References

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²National Academies of Sciences, Engineering, and Medicine. 2021. *Nutrient Requirements of Dairy Cattle: Eighth Revised Edition*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25806>

³Muhollem, J. 2020. High oleic acid soybeans offer benefits to dairy cows, farmers, research shows. <https://www.psu.edu/news/research/story/high-oleic-acid-soybeans-offer-benefits-dairy-cows-farmers-research-shows/>

⁴Weld, K. A., and L. E. Armentano. 2018. Feeding high oleic soybeans in place of conventional soybeans increases milk fat concentration. *J. Dairy Sci.* 101:9768-9776. <https://doi.org/10.3168/jds.2018-14498>

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