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Feeding Soybeans to Beef Cattle

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Various factors such as delayed planting, early frost, drought or suppressed market prices may lead one to consider feeding soybeans to cattle. Soybeans can be fed to beef cattle as a source of both energy and protein. Depending upon the stage of development, soybeans will have varying degrees of feed value and a feed test for nutrient content is recommended.

Nutrient Content

Soybeans can be processed to yield soybean oil, soybean hulls, and soybean meal. When considering feeding whole soybeans, knowing the nutrient content (Table 1) will aid in developing effective feeding programs. Soybeans can be a good protein supplement for growing cattle based on their protein level (~ 40% crude protein) and amino acid profile, particularly the high lysine content. Their high oil content, highly digestible fiber, and protein provide energy to cattle as well.

There are a couple of considerations when feeding soybeans to cattle. The high oil content (~ 18%-20%) can negatively impact fiber digestion in the rumen. The total diet fat/oil content is generally recommended to be 6% or less to avoid detrimental impacts on the rumen microflora and fiber digestion. Forages commonly contain 2%-3% ether extractable lipids leaving approximately 3% to be contributed from the oil in soybeans. For a growing calf consuming 15 pounds of dry matter, the upper limit of soybeans to feed, based on providing 3% oil from the bean, would be approximately 2.5 pounds per day.

Raw soybeans contain a trypsin inhibitor that will interfere with protein digestion. Nursing calves and calves without a fully functional rumen should not be offered raw soybeans for this reason. Additionally, raw soybeans contain urease, an enzyme that releases ammonia from urea. The rumen microbes provide urease to breakdown urea and the additional urease from raw soybeans increases the rate of ammonia formation. Excessive ruminal ammonia can be toxic to cattle as it can diffuse across the rumen wall and into the bloodstream. The urease activity of raw soybeans requires caution when feeding urea and other non-protein nitrogen containing protein supplements. High levels of urea should not be included in rations with soybeans. If a need exists for feeding urea with soybeans, roasting the soybeans is recommended because roasting destroys the enzymes and eliminates the risks.

Table 1. Nutrient content of soybeans and soybean coproduct feedstuffs.[1]

Item	Soybeans	Soybean meal	Soybean hulls
Crude protein, %	40	55	9.4
NEm, mcal/lb	1.04	0.96	0.82
NEg, mcal/lb	0.71	0.64	0.53
TDN, %	93	87	77
Oil/fat, %	19.4	1.2	2.5
Calcium, %	0.27	0.28	0.60
Phosphorus, %	0.64	0.70	0.22

[1] Source: MF2438: Soybean hulls: Composition and feeding value for beef and dairy cattle.

Finishing Rations

Whole raw soybeans are an acceptable protein and energy source for finishing cattle. Research has shown when raw soybeans are used as the primary protein source in a balanced ration, no detrimental effects are seen in performance or carcass traits. The key is to work with a nutritionist to develop a balanced ration that meets the nutritional requirements of the cattle to be fed.

When feeding whole raw soybeans, the lipid or oil content should be considered. Inclusion rates should be kept to less than 15% of the complete diet dry matter for finishing cattle if the total diet ether extract or lipid content is to be limited to 6%. Whole raw soybeans can be included in the diet up to 25% of the total diet DM. However, the high dietary lipid or oil content will result in decreased feed intakes, a reduction in fiber digestibility, and watery or diarrhea-like feces.

Growing Rations

If whole raw soybeans are to be fed to growing cattle, cattle must have a developed rumen. For beef cattle, the rumen develops by two months of age or when calves are approximately 250-300 pounds. A general recommendation would be to not feed raw soybeans to cattle under 300 pounds.

When developing diets for growing calves, consider the diet composition. As discussed above, the oil content of whole soybeans is near 20%. Higher inclusion rates will increase total diet lipid content with a greater impact on ruminal fiber degradation. Most growing diets are higher in forage or roughage content and increasing dietary lipid will have a greater impact on rumen fermentation. Diet inclusion rates are recommended to be limited to 10% of the diet dry matter targeting a total diet ether extract content near 5%. For stocker cattle grazing pasture, the target supplementation level for soybeans is 0.3% of body weight. For a 500-pound feeder calf, this equates to 1.5 pounds of soybeans or approximately 10% of total diet DM intake.

Supplementing Poor Quality Forage

As previously stated, whole soybeans can be both an energy and protein supplement. Normal recommendations for supplementing forage-based diets for older cattle follow guidelines discussed above. Target supplement levels for soybeans would be 2.0-2.5 lb/day for mature animals or 10% of the diet for growing cattle. Providing either raw or roasted soybeans was shown to correct protein deficiencies of cattle consuming wheat straw improving intake and diet digestibility. Feeding whole soybeans to steers consuming low-quality meadow

hay provided similar gain and efficiency compared to extruded soybeans and soybean meal. Thus, utilizing soybeans to supplement protein of low-quality forages has positive impacts on animal performance.

Reproduction Response

Soybeans can be offered to cows and developing heifers as a supplement to increase energy and protein intake on forage-based diets. In a research trial, feeding mature beef cows three pounds of soybeans reduced the length of anestrus, but did not impact overall reproduction rates and no improvement was observed in younger cows. Other studies have not been conclusive on the impact on fertility with some studies having no improvement while others observed greater pregnancy rates. However, no detrimental effects on reproduction have been reported when offering raw soybeans to cows or heifers. Cows fed drought-stressed soybeans, whole or rolled, maintained body weight similarly to cows supplemented with a 1:1 mixture of soybean meal and soybean hulls. Supplemented cows produced 36% more milk daily during early lactation than non-supplemented cows. Greater milk production for supplemented cows resulted in approximately 37 more pounds at weaning.

Processing Soybeans

Roasting or extruding soybeans has not been shown to consistently improve calf performance compared to feeding raw soybeans in several studies. Roasting soybeans would add cost with little to no performance response. However, roasting soybeans would be recommended to destroy the trypsin inhibitor when soybeans were to be included in calf starter rations fed to dairy calves or bottle-fed calves.

Feeding roasted soybeans early in the finishing phase (first 80 days) resulted in a reduced response to an estrogenic growth promoting implant in comparison to steers and heifers offered soybean meal. Earlier research revealed that feeding roasted soybeans resulted in lower gains and decreased release of somatotropin and thyroid stimulating hormone while administration of an estrogenic growth promoting implant negated this effect.

Table 2. Value of raw soybeans for feed using FeedVal III.

	Ref. Energy	**Ref. Protein**	**Ref. Calcium**	**Ref. Phosphorus**
Feed	Cracked corn	Soybean meal	Lime	Dicalcium phosphate
	$5.25/bu	$405/ton	$0/cwt	$0/cwt
DM,%	87	89	98	98
CP, %	8	54	na	na
NEm, mcal/lb	0.99	0.96	na	na
Ca, %	--	--	36	23
Phos, %	--	--	--	18
Value of nutrients				
Calcium, $/lb	Phos, $/lb	Energy, $/lb	Protein, $/lb	
0	0	0.094	0.266	

Feed	**DM, %**	**CP, %**	**Ca, %**	**P, %**	**Value As-fed, $/ton**
Corn gluten feed, dry	90	23	0.36	0.82	210.21
Dist. Grains Corn	90	30	0.15	0.71	255.60
Soyhulls	91	12	0.49	0.21	159.76
Soybeans	92	42.8	0.27	0.65	332.62

These studies imply there may be a reduced response observed from estrogenic implants during the early finishing phase when roasted soybeans are offered in the ration. This may be a result of reduced DM intakes or could be a result of the phytoestrogens contained in soybeans.

Processing soybeans by cracking or rolling may have an impact on animal performance. Studies conducted would suggest that grinding or cracking raw soybeans may result in lower performance in comparison to raw soybeans fed whole. This may be due to greater amount of the oil being released in the rumen having greater impact on rumen microflora. In general, processing appears to have minimal to no improvement in animal performance for cattle over 300 pounds.

Immature Soybeans

A potential avenue for immature soybeans due to drought or frost is livestock feed (Figure 1). For beef cattle, this is a viable option and a sample should be obtained for nutrient analysis. Realize that frosted beans may be higher in moisture content and care should be taken for increasing the storage life. Reports on the direct comparisons of the feed value of immature and mature soybeans were not found at the time of writing this article. When immature soybeans are much smaller in size than normal, cracking or grinding may be necessary to improve total tract digestibility. The unsaturated fat content of beans increases the risk of rancidity after processing during warm weather and lengthy storage of ground

Figure 1. Double-crop soybeans during a drought year may be immature at harvest being smaller in size and having a greenish hue to them. Photo by Jeff Lehmkuhler

soybeans is not recommended. It has been reported that immature green soybeans may contain approximately 10% less energy than mature soybeans due to a 23% lower oil content.

Flood-damaged Beans

When crop fields are flooded, harvested soybeans may not be accepted by elevators. Producers may consider salvaging the crop as livestock feed. Extreme caution is warranted when dealing with all feedstuffs from flooded areas, including soybeans. Crops can be contaminated from storm and sanitary sewers during flooding. Dirt and mud can cover the crop and be a source of pathogens such as *C. botulinum*. Grains may begin to sprout before harvesting can occur which often leads to increased risk of mycotoxins. In general, flood damaged crops are best composted and not fed to livestock. Before considering feeding flood-damaged soybeans, be sure to test for contaminants and consult your Extension agent and/or nutritionist.

General Considerations

Valuing alternative feedstuffs based on their nutrient content using readily available feedstuffs and their prices as references for energy and protein is a widely accepted. Wisconsin developed a computer spreadsheet, FeedVal, which calculated values for feedstuffs based on reference feeds. University of Missouri personnel adapted this sheet for beef, FeedVal III. The example below illustrates an output using reference feeds and known nutrient content of alternative feedstuffs with FeedVal III. No value for calcium or phosphorus was used in this example. Using this approach, the value of soybeans is estimated to be $332/ton or $9.98/bu when corn is valued at $5.25/bu and soybean meal is $405/ton. In many instances, the elevator bid price for whole soybeans often exceeds the calculated feed value making it more economical to sell soybeans than feed them. Keep in mind that there may be opportunities to feed soybeans that may be severely discounted due to small size or other discounts.

When considering replacing a commercial protein supplement that supplies the macro- and micro-minerals, vitamins, and feed additives, one will have to provide these nutrients from a balancer pellet or some other form. The cost of transporting and storing whole soybeans should be considered as well. If on-farm storage already exists, these costs are minimal. There are multiple approaches that can be used to value soybeans for feeding, and valuing alternatives based on the nutrient content should be considered. Consult with your nutritionist to gather more information on the economics of feeding soybeans.

Conclusion

Soybeans can be incorporated into beef rations as a source of protein and energy. As with any supplementation program, it is important to identify what nutrients are deficient and then identify feedstuffs that can be sourced to provide these nutrients. Consider the economics by looking at feedstuffs on a nutrient basis when comparing multiple sources. Additionally, consider the logistics of delivery, storage and handling, and labor required for different supplements.

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