



Glycerin Replacement Of Corn In Beef Finishing Rations

Glycerin, a co-product of biodiesel production, may offer another opportunity to remain competitive in the cattle feeding industry, even in the face of expensive grain. Investigation into glycerin's nutritive value is certainly in its infancy as biodiesel manufacture is a relatively new alternative to conventional petrochemistry. Biodiesel production tripled in 2005 compared to 2004 and more than tripled in 2006 compared to 2005. As of the fall of 2007, biodiesel capacity in the United States was at 900 million gallons in operational plants with another 1.7 billion gallons expected from plants under construction. Glycerin production is approximately 10% of biodiesel production, by weight, so as much as 1 million tons could be available in the relatively near future.

Biodiesel can be made from virtually any naturally-occurring vegetable oil or fat. Those most commonly used include soybean oil, cottonseed oil, used cooking oil, tallow, and poultry fat. Clarity of the resulting glycerin ranges from nearly crystal clear to amber, depending upon the oil or fat of origin.

The process of converting soybean oil to biodiesel and glycerin, using 100 lb as an example, consists of treating 100 lb of degummed oil with 10 lb of methanol (wood alcohol). Transesterification, which is the conversion of oil to methyl esters to increase its volatility, is enhanced by the addition of alkaline sodium and potassium salts (namely potassium phosphates) and a catalyst, at elevated temperatures. Once this reaction is complete, the excess methanol is recovered by distillation. Resulting products are 100 lb of biodiesel and 10 lb of glycerin and water, known as crude glycerin. Some plants evaporate crude glycerin to drive off the water, getting a purified (99%) product.

Industrial uses for glycerin include explosives, glues, inks, lubricants, antifreeze, and hydraulics. More refined applications include cosmetics and soaps, sweeteners (60% as sweet as cane sugar), thickeners for liqueurs, substrates (similar to cane molasses) in antibiotic and citric acid fermentations, and, most recently, as a feed ingredient. A more specialized application in animal feeding may be as a ketosis preventive, similar to the use of propylene glycol.

Glycerin As A Feed Ingredient

Pure glycerin, also known as glycerol which is a "sugar" alcohol like sorbitol and mannitol, is a colorless, odorless, water-soluble, sweet-tasting, viscous liquid. Purified grades, containing not more than 150 ppm of residual methanol, are regulated by FDA's Center for Veterinary Medicine as substances that are Generally Recognized As Safe (GRAS) for general purpose use in animal feed when employed in accordance with good manufacturing or feeding practices. These materials reportedly enjoy a market in the \$360 to 400 per ton range. Crude glycerin has been found to contain as much as 1% methanol (10,000 ppm), with the potential of being even higher, and should be monitored. Practical feeding rates will dictate the maximum tolerable level for methanol in these crude grades, reportedly being marketed for anywhere from free for the transportation to approximately 40% of pure glycerin.

The composition of crude glycerin is shown on page 2 (dry matter basis). Research with sheep and cattle has shown the net energy value of glycerin to be equal to or greater than that of corn. Net energy values were approximately 13% lower in high starch rations than in low starch rations,

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attributable to decreased fiber digestibility when glycerin was added to the high starch diets (the substitution effect). The economic value of energy from glycerin can be compared directly to that of corn after correcting for the glycerol content (analogous to the “dry matter” content of the glycerin).

Dry matter (glycerol content), %	61 – 81
Moisture, %	12 – 27
Alkaline Na & K salts, %	7 – 12
Potassium, %	2.2 – 2.3
Phosphorus, %	1.1 – 2.4
NE maint, low starch, mcal/lb	1.02
NE gain, low starch, mcal/lb	0.70
NE maint, high starch, mcal/lb	0.89
NE gain, high starch, mcal/lb	0.61

Several tests with early lactation dairy cows, conducted in Indiana, South Dakota, and Pennsylvania in 2007, indicated no difference in milk production, milk composition, and body condition scores when glycerin replaced corn to provide up to 15% of the ration dry matter. Dry matter intake was not different among treatments in two of the three tests. European studies found glycerin at up to 10% of dietary dry matter to result in comparable starch and organic matter digestibility. There, glycerin’s net energy available for lactation ranged from 0.90 to 1.05 mcal per pound of dry matter.

Another European study evaluated glycerin in high-starch pelleted feeds. There, 5% glycerin was effective in suppressing fungal growth over different conditions for extended periods of time. Also, pellet durability was improved and methanol content was reduced.

Glycerin For Finishing Cattle

Two tests were conducted at the University of Missouri in 2007-08 with glycerin replacing corn at levels up to 20% of the ration dry matter. Rate of gain was increased by inclusion of glycerin at 5 or 10%. Feed intake was depressed at higher levels. The crude glycerin used in this study contained 12% moisture and 7% alkaline salts.

In an Illinois study in 2007, glycerin replaced corn in either grain or co-product based (DDGS and soy hulls) finishing rations for steers weighing 853 lb initially. The grain ration consisted of 70% cracked corn, 15% corn silage, 10% DDGS, and 5% supplement. The co-product diet contained 35% cracked corn, 30% DDGS, 15% corn silage, 15% soy hulls, and 5% supplement (all percentages DM basis). Glycerin was substituted for 0 or 10% of the corn in both diet types. Rate of gain was 11.4% greater in cattle fed the grain ration with glycerin and 2.5% greater for steers fed the co-product based ration with glycerin. Glycerin decreased dry matter intake by 8.1% for the grain diet and 11.8% for the co-product diet, resulting in improved feed efficiency for both diet types.

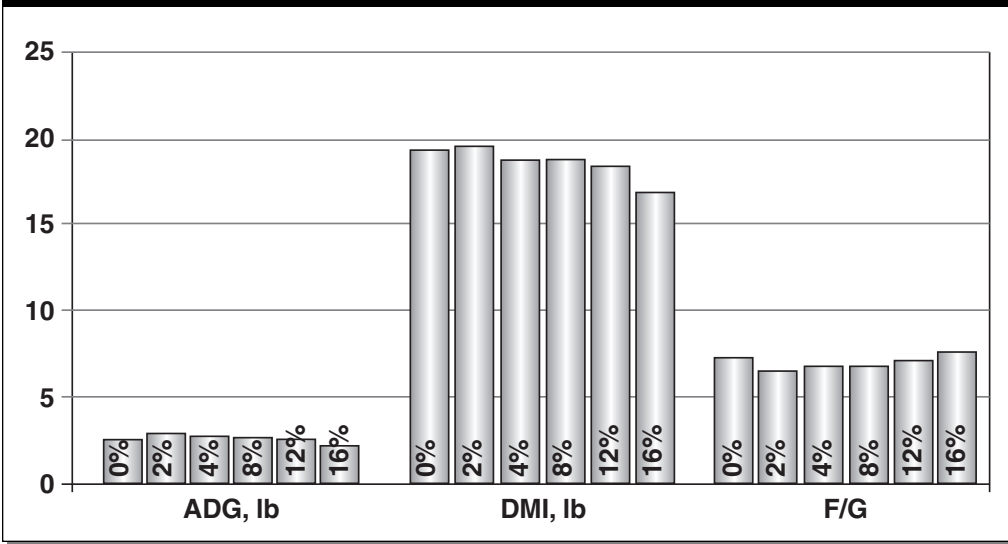
In Kansas (2008) glycerin was fed at 0, 2, 4, 8, 12, or 16% of the ration dry matter as a replacement for corn to a total of 373 finishing heifers averaging 930 lb initially. There were six to seven heifers per pen and nine pens per treatment. Rations contained 63 to 83% steam-flaked corn, 0 to 16% glycerin, approximately 6% each of condensed distillers solubles (CDS) and alfalfa hay, a protein supplement, Rumensin® (300 mg/day), Tylan® (90 mg/day), and MGA (0.5 mg/day). Test duration was 85 days.

Glycerin increased rate of gain when fed at levels less than 8% of the ration dry matter. Dry matter intake was reduced by glycerin levels above 8%. Feeding glycerin at 2, 4, 8, and 12% improved feed conversion by 10.8, 10.0, 7.2, and 3.1% respectively. See the bar graph on page 3 labeled Feedlot Performance.

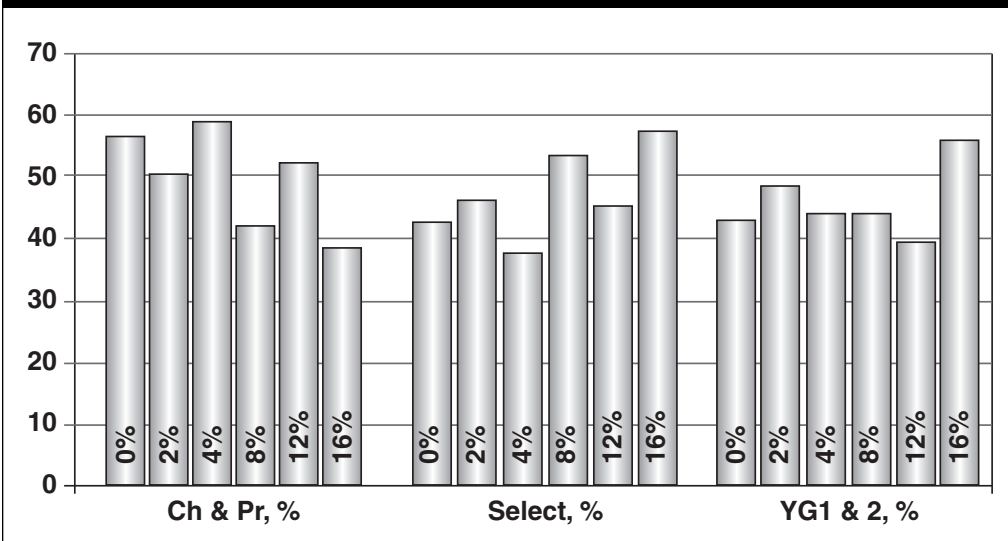
Feeding glycerin resulted in reduced fat cover over the 12th rib and lower marbling scores. Lower marbling scores caused 1.3 to 16.4% fewer of the glycerin-fed cattle to grade USDA Choice and more of the glycerin-fed cattle to grade USDA Select. Refer to the bar graph on page 3 entitled Quality and Yield Grades. Dietary treatment had no effect on percentage of kidney, pelvic, and heart fat or the percentage of liver abscesses.

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Graph 1. Feedlot Performance



Graph 2. Quality And Yield Grades



Summary

Current knowledge about feeding glycerin to finishing cattle is limited, but it appears that up to 10% of the corn can be replaced if economically favorable. Contributions to mineral intake by glycerin might be a factor in dry matter intake and/or phosphorus management and need to be

considered in ration formulation. Glycerin may contain objectionable levels of methanol and should be monitored. Methods for feeding glycerin in rations other than a TMR-type program have not been published.

Key words: glycerin, corn, finishing beef cattle