Recent Research on Liquid Supplements for Beef Cattle

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Introduction

A recent survey (Williams, 1995) indicated that over 1.7 million tons of liquid feed were manufactured in the 1994-95 production year. An estimated 45% (708,000 tons) of this liquid feed was used in feedlot diets and 55% (960,000 tons) was specified as non-feedlot and presumably most of this was fed to cattle on forage based diets. Past estimates of liquid feed tonnage indicate it has grown an average of 9.7% annually over the last 20 years. The advantages of self-fed liquid feeds in reducing labor and feeding equipment costs has been a contributing factor in their use for grazing cattle.

Molasses has been used in livestock feeds for several decades with reports on the feeding value of molasses in North America dating back to 1890. Several excellent reviews on feeding molasses to livestock and poultry have been published (Scott, 1953; Curtin, 1983; Pate, 1983; Harris and Van Horn, 1983; Combs et al., 1983) and provide comprehensive summaries and discussion of the feeding value of molasses in livestock and poultry diets. Liquid feeds are manufactured by blending molasses and other ingredients and many of these products are self-fed to grazing livestock. Several reviews have been written concerning liquid supplements (Loosli and McDonald, 1968; Coppock, 1969; Wornick, 1969; Rhodes, 1970; Britzman, 1971; Huber, 1972; Eng, 1992; Bowman et al., 1994). This paper will focus on feeding sugarcane molasses-based products and formulation of liquid feeds that improve performance of forage-fed cattle (Kunkle et al., 1996).

Energy in Sugarcane Molasses

Molasses is noted for its sugar content and sugars usually contribute 60-65% of the solids in sugarcane molasses. Sucrose usually comprises 65-70% of the total sugars with glucose and fructose contributing the highest proportion of the other sugars in molasses (Curtin, 1983; Binkley and Wolfrom, 1953; Chen, 1985, Stateler, 1993). Other carbohydrates usually comprise 10-16% of the solids with pectic compounds and reaction products present in significant quantities. Non-nitrogenous acids contribute 4-9% of the solids with aconitic acid present in significant quantities. Protein and amino acids usually represent only 1-2% of molasses solids. Minerals contribute most (8-17%) of the other solids in molasses.

The TDN concentration in molasses is listed as 72% (DM) in the NRC (1984) which is 83% of the organic matter. The sugars in molasses would be expected to be fermented rapidly but the rate and extent of digestion of the non-sugar carbohydrates is poorly understood. Quantitative approaches to estimating TDN concentrations in molasses based liquid feeds have been proposed (Harris, 1995; Pate and Kunkle, 1993). These approaches attempt to quantify the various fractions of proximate analysis from information available on the feed tag, estimate a digestibility of each fraction, correct for non-additive fractions (fat and urea) then sum the digestible fractions to calculate the estimated TDN of the liquid feed. The accuracy of this approach has not been tested but the primary use has been to evaluate the TDN concentration in different liquid feeds.

Nofziger (1995) reviewed differences in the composition of cane and beet molasses and proposed that the TDN could be estimated as .98 times the organic matter. The rational of using organic matter to estimate the TDN in molasses is sound but an apparent digestion coefficient of .8 to .9 seems more realistic. A similar approach using organic matter could also be applied to liquid feeds by adjusting for added urea and fat.

Early studies suggested that the feeding value of molasses decreased when added at more than 10% of the diet. Lofgreen and Otagaki (1960) evaluated the net energy of molasses at various levels in the beef finishing diets and reported that in diets containing 25 and 40% molasses the net energy value was reduced by 49% compared to feeding at 10% of the diet. Morrison (1967) suggested that molasses had a feeding value of 75 to 95% of the value of grain when added to the diet in smaller amounts but this was reduced to 40 to 50% of the grain feeding value when added at higher levels. However, additional studies (Preston et al., 1969) suggested that the net energy value for fattening did not decrease when molasses was added at levels above 10% of the diet. Pate (1983) also concluded that most of the feeding data suggests the feeding value of molasses does not decline when added at 10% to 40% of the diet.

The feeding value of molasses supplements compared to corn-based supplements in cattle fed forage based diets has been evaluated in several trials. Pitzer et al. (1986) evaluated molasses-soybean meal and corn-soybean meal supplements fed at 1.1% body weight of supplement dry matter to newly weaned heifers grazing bahiagrass pastures during the summer. Results over two years (Table 1) showed that both molasses-soybean meal and corn-soybean meal supplements increased gains .21 lb for each lb of supplement TDN consumed. A recent study compared a molasses-corn gluten meal supplement with a corn-urea supplement formulated to provide similar levels of rumen degraded (DIP) and rumen undegraded protein (UIP) from similar protein sources to growing cattle fed bermudagrass hay. When the TDN of molasses was assumed to be 72% (DM), supplements providing similar quantities of TDN to cattle with adlibitum access to hay resulted in similar increases in gain (Table 2). Hay intake was depressed to a similar degree by both molasses and corn-based supplements. Each pound of supplemental TDN improved gains by .24 pounds. These studies indicate that 72% TDN (NRC, 1984) is a realistic value for molasses when evaluating supplementation programs for forage fed cattle.

In contrast to the studies reported above, Brown and Weigel (1993) compared the feeding value of molasses, corn, and soybean hulls supplements at two levels for growing steers fed ammoniated stargrass hay (Table 3). Molasses supplemented at both levels had lower increases in gain/unit supplemental TDN consumed compared to the corn supplement. The soybean hull supplement increased gains more/unit supplemental TDN than did molasses or corn supplements which is consistent with other studies. The cattle fed the molasses supplement had considerably lower performance than the cattle fed the corn supplement at the low level of supplementation presumably due to the reduced consumption of hay compared to the corn supplement. All treatments groups received similar amounts of cottonseed meal which would be expected to provide adequate protein.

Stateler (1993) reviewed several studies and concluded that molasses and corn supplements had comparable improvements in gain/unit supplemental TDN when plant sources of protein were fed but the results were often poorer when non-protein nitrogen was fed. Brown (1993) also demonstrated the importance of a natural protein supplement. Cottonseed meal fed at 1 lb (DM) improved performance of growing steers fed ammoniated stargrass hay more than did 3.3 or 5.9 lb (DM) of molasses but feeding both cottonseed meal and molasses resulted in additional improvements in gains and added gain/unit supplemental TDN was improved to .22 and .31 in the two studies. A significant amount of research indicates that natural protein needs to be provided in adequate quantities for the molasses energy to efficiently improve the gains of growing cattle fed forage-based diets.

Protein Additions to Molasses Supplements

The crude protein concentration of sugarcane molasses is low with concentrations ranging from 4 to 9% (DM). Molasses from sugarcane grown on organic soils has higher crude protein concentrations than does molasses from sugarcane grown on soils low in organic matter. Protein and amino acids usually comprise less than 25% of the total nitrogen in molasses (Curtin, 1983; Binkley and Wolfrom, 1953; Chen, 1985, Stateler, 1993). The availability of the nitrogen in molasses for microbial fermentation may be in question. The conditions seem ideal (sugar concentration and temperature are high during sugar crystallization) for proteins to react with sugars to form Malliard reaction products. Stateler (1993) evaluated the availability of nitrogen in sugarcane molasses using a semi-continuous fermentation system where nitrogen limited microbial growth. The yield of microbial protein indicated that 75-85% of the nitrogen in molasses was available to the microorganisms.

Liquid feeds are often fed to cattle grazing poorer quality standing pasture, range, or crop residues. Nitrogen supplied by urea and other non-protein nitrogen (NPN) sources is usually added to increase the low nitrogen concentrations in the many molasses-based liquid feeds. Urea additions to increase crude protein in liquid supplements is cost effective and the urea reduces the consumption of the liquid supplement when added at higher concentrations. The reduction in consumption found from urea addition to a self-fed liquid supplements is usually desirable. In many situations the consumption-limiting aspects of urea dictate that the level be higher than efficacious for NPN utilization by grazing cattle.

The potential for improved cattle performance with high NPN supplements exists when ruminally available nitrogen limits forage intake and digestibility. These situations occur when TDN to crude protein ratio (TDN:CP) is above 7 (Moore and Kunkle, 1995). In many situations low quality forage has both low protein and low TDN and the response to protein supplementation is limited by lack of digestible energy to support microbial growth and synthesis of microbial protein from nitrogen supplied by the supplement. A complicating factor in evaluating the potential response to nitrogen supplements in grazing situations is knowing the composition of the forage being consumed. Selective grazing of the available forage makes it difficult to evaluate the nitrogen adequacy of the consumed forage. Monitoring blood urea nitrogen (Hammond et al., 1994) and fecal composition (Lyons et al., 1995) appear to be promising real time techniques to evaluate the potential response to nitrogen supplementation in grazing cattle.

Sources and levels of protein added to sugarcane molasses-based liquid supplements fed to growing cattle has been a focus of research in Florida for several years. Eight different experiments have evaluated different levels, sources (soybean meal, cottonseed meal, feather meal, blood meal) and combinations of protein in molasses-based supplements for growing steers and heifers fed warm season tropical forages (Kunkle et al., 1994; Stateler et al., 1995; Pate et al., 1995; Brown, 1993). The approach was to meet the microbial nitrogen requirements with NPN or ruminal degradable intake protein (DIP) and to evaluate responses to additional protein from sources that provided ruminal undegraded intake protein (UIP). Blood urea nitrogen concentrations were monitored in most of these trials to evaluate the nitrogen adequacy of the diet and were helpful in interpreting the response or lack of response to NPN supplements in several instances. A summary of 24 evaluations (Figure 1) shows an increase in gain ranging from .02 to .90 lb/day and with an average of .31 lb/day across several sources and levels of supplemental protein in situations where ruminal nitrogen requirements were met. When increases in gain were high, the supplemental protein usually increased forage intake but when smaller increases in gain were reported, forage intakes were usually similar and an improved efficiency in the use of diet consumed was apparent. In 12 comparisons with .20 to .37 lb/day of supplemental undegraded protein from feather, blood, and/or corn gluten meals, the increased gains ranged from .18 to .66 lb/day and averaged .33 lb/day. We concluded that feeding sources of ruminally undegraded protein to growing beef cattle improved performance and may be profitable in selected beef production systems in Florida.

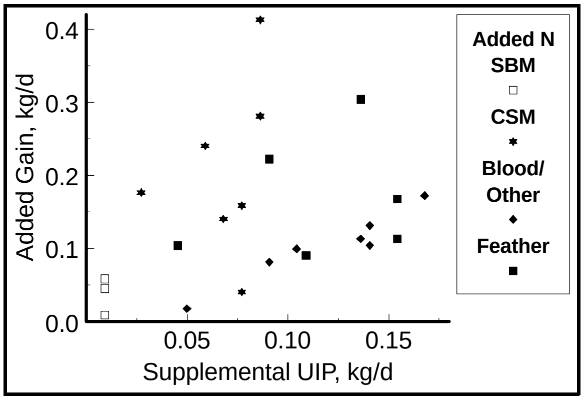

Figure 1. Effects of undegraded intake protein (UIP) on added gain in growing cattle fed molasses-supplemented forage diets in Florida.

Protein supplementation utilizing a liquid supplement is desirable in many situations where protein is limiting forage intake and beef cow performance. The response of beef cows to protein in liquid supplements does not appear to be different from that of protein in dry supplements. In a review of nutrition on rebreeding in cattle, Randel (1990) summarized research that showed a natural protein supplement fed prior to calving where protein in the basal diet was inadequate increased pregnancy rate from 7 to 72 percentage units in 9 different trials with an average increase of 25 percentage units (55 to 80% pregnancy rate). In trials evaluating protein supplements after calving, the higher level of a natural protein supplement where protein in the basal diet was inadequate increased pregnancy rate from 4 to 50 percentage units in eight different trials with an average increase of 21 percentage units (69 to 90% pregnancy rate). Calves from protein supplemented groups also averaged 15 lb heavier weaning weights (11 to 22 lb range over 6 trials) compared to groups fed protein inadequate diets. Protein supplemented mature beef cows grazing range had less weight and condition loss and differences in pregnancy rate appeared to be related to the body condition score (BCS) of the cows.

The effects of protein supplements on cow weight, body condition, and pregnancy rate are well documented and the heifers and young cows appear to be more responsive to protein supplementation than mature cows. Pate et al. (1990) evaluated molasses, molasses-urea and molasses-cottonseed meal-urea supplements (limit-fed for similar supplemental energy) for wintering beef cows fed 4-6% crude protein stargrass hay. Cows (all ages) supplemented with a molasses-cottonseed meal-urea supplement had a pregnancy rate of 80% compared to 68% for the molasses-supplemented cows. An evaluation of the response in 3 year old first calving cows showed that pregnancy rate was increased from 38% for cows fed the molasses supplement to 70% in cows fed the molasses-cottonseed meal-urea supplement. The molasses-urea supplemented 3 year old cows had a 60% pregnancy rate. In 3 year old cows the protein supplement dramatically improved pregnancy rate but had small effects on the differences in weight loss or the body condition loss. The 3 year old cows in all treatments had an average BCS of 4.0 to 4.4 at the beginning of the breeding season.

Other researchers have also shown that the young cow has dramatic increases in pregnancy when a protein deficient diet is supplemented with protein. Sasser et al. (1988) reported that heifers fed a 7% protein diet before and after calving had a rebreeding rate of 32% compared to 74% in heifers fed a protein adequate diet. Heifers fed both the 7% protein diet and the protein adequate diet were limit-fed similar levels of feed and had slightly lower weight gains prior to calving but the dramatic reduction in pregnancy rate was more than expected based on the reduction in weight. Hennessy (1986) also evaluated the effects of protein (cottonseed meal) and a molasses-based energy supplement on the weight and pregnancy rates of cows with their first calves. Both protein and energy supplements improved cow weights but the pregnancy rates were higher (60%) in the protein supplemented treatments compared to the energy supplemented (20%) and unsupplemented (10%) treatments. Both of these studies indicate that young beef cows had dramatic increases in pregnancy rate when a protein supplement was fed with a low protein diet.

Minerals and Vitamins

Sugarcane molasses has high concentrations (NRC, 1984; Stateler, 1993) of calcium (1.0-1.1%), magnesium (.4-.5%) potassium (3-4%), chlorine (2-3%), and sulfur (.45-.60%) but it is low in phosphorus (.1%). Sugarcane molasses based liquid supplements with up to 30% crude protein from NPN should have adequate sulfur and still maintain a 12 to 1 ratio of nitrogen to sulfur essential for efficient NPN utilization. Many range forages have potassium concentrations below requirements and the high levels of potassium in molasses-based liquid supplements overcome one of the nutrient limitations for cattle grazing these forages. The phosphorus concentration in molasses is low and phosphoric acid is usually added to liquid supplements. Phosphoric acid is a highly available source of phosphorus, a liquid that mixes well with molasses, and an acid that lowers the pH of the liquid supplement thus helping to limit consumption.

Trace minerals are present in sugarcane molasses but most are not present in high concentrations relative to cattle requirements. Trace minerals are usually added as needed for the product from sources that are soluble in the molasses to avoid separation. Fat soluble vitamins are usually added to liquid supplements to meet the specifications needed for each product.

Forage Intake and Gain Responses

Most liquid feed marketed in the U.S. as a supplement for grazing beef cattle has urea added to increase crude protein concentration. Numerous research trials have been conducted evaluating molasses-urea supplements with mixed results. Bowman et al. (1994) reviewed 43 studies involving cattle and sheep fed low-quality forages where the animal performance, forage intake, and supplement consumption were reported. In five of seven studies where hay or straw was fed, molasses-urea supplements did not increase forage intake or animal performance. In seven of 13 grazing studies, molasses-urea supplements improved weight change. In five of six studies reviewed that compared both molasses-urea and dry supplements, forage intake and animal weight change were not increased by molasses-urea supplements over dry supplements.

Moore et al. (1995) developed a database from 21 publications reporting effects of liquid supplements on performance of cattle grazing or fed on 53 forages. Studies included in the database were limited to those that included a non-supplemented control treatment and at least one treatment where a molasses-based supplement was fed. There were a total of 151 comparisons between a control treatment and a liquid supplement treatment. Daily gains were reported for 148 comparisons, and forage intakes were reported for an additional three comparisons. All studies were conducted with non-lactating cattle, and most were growing calves or yearlings.

In the 151 comparisons, 107 were conducted on pasture or range, and 44 with harvested forages or roughages. Native mixed species (mostly warm season grasses) were used in 106 comparisons, improved warm-season grasses in 30 comparisons, cool-season grasses or grass-legume mixtures in nine comparisons, and rice straw in six comparisons. Molasses alone was used in 35 comparisons, molasses plus NPN in 95 comparisons, molasses plus a dry meal in 11 comparisons, and molasses plus both NPN and meal in 10 comparisons. The NPN sources were mostly urea but included biuret and several ammonium salts.

Analysis of the liquid supplement database (Moore et al., 1995) resulted in identifying several relationships or responses that define the interactions or situation-specific responses. Voluntary forage intake was found to either increase or decrease due to feeding of liquid supplements and four factors were identified: 1) Forages with different TDN:CP ratios showed different responses. When TDN:CP ratio was < 7, supplements almost always decreased forage intake. When TDN:CP ratio was between 7 and 12, intake was both increased and decreased by liquid supplements. When TDN:CP ratio was > 12 (excess TDN and/or deficient in protein), all types and levels of supplements increased forage intake; 2) When forage intake (fed alone) was > 1.75 % of BW, supplements decreased forage intake but when forage intake (fed alone) was < 1.75 % of BW, supplements increased forage intake; 3) Forage intakes were decreased by liquid supplements when supplement intake was > .8 % of BW; 4) Forage intake was increased when liquid supplement CP was > 25% of OM. The data examined in this study suggest that there is no obvious inherent difference between liquid and dry supplements (Moore and Kunkle, 1995) in their effects on forage intake.

Additional analysis of the liquid supplement database indicated that daily gains were generally, but not always, increased by feeding liquid supplements. Adding a source of N increased gains compared to animals fed molasses alone. When supplemental CP concentrations were above 15% of OM, gains were almost always increased. When supplemental CP intake was greater than .1% of BW, gains were always increased. When forage quality was low (i.e., low voluntary intake when fed alone, and TDN:CP ratio >7), liquid supplements increased both intake and gain, but gains were still low or even negative; in contrast, when forage quality was high (i.e., high voluntary intake, and TDN:CP ratio < 7), liquid supplements decreased intake generally, but increased gains if the supplement contained meal or a combination of meal and NPN.

Fat and Antibiotic Additives to Liquid Feeds

Nutrient and non-nutrient additives that improve cattle performance have been the focus of many research projects. Both fat and antibiotic additives appear to be beneficial in some production systems and delivery in self-fed liquid supplements has advantages over other feeding methods if effective.

An easy way to increase the TDN concentration in liquid supplements is to add fat. Fats blend well in molasses-based feeds and are palatable to cattle. Pate (1996) reported that 5 or 10% tallow or restaurant grease could be mixed in a molasses-feather meal-urea slurry and fat separation was not a problem even without using suspending agents. Fats are usually priced above the cost of TDN from molasses therefore they have not been widely used in liquid supplements. Recent research indicates that fats may have beneficial effects on reproduction in cattle above their caloric value. Williams (1989) reported that fat in the diet of postpartum beef cows increased blood cholesterol and progesterone concentrations. Staples et al. (1991) reviewed research indicating that fat additions to the diets of beef and dairy cows had beneficial effects on pregnancy rate and services/conception in some trials but not in others.

Pate (1996) reported results of adding fat to liquid supplements fed to beef cows and heifers. Brahman crossbred heifers were supplemented with 5.1 lb/day of a molasses-feather meal (87:13 ratio) slurry with or without 5% added catfish oil from weaning (550 lb) through the 60 day breeding season. Pregnancy rates tended to be improved from 31 to 48% in the first year and from 69 to 80% in the second year. Daily gains (.09 vs .24 lb/day in Year 1; .70 vs .81 lb/day in Year 2) and serum cholesterol concentrations (97 vs 133 mg/dl in Year 1; 92 vs 143 mg/dl in Year 2) were higher for heifers fed the liquid supplement with 5% added catfish oil compared to supplements without added catfish oil in both years. Additional trials evaluated 10% animal fat or restaurant grease added to a molasses based liquid supplement limit fed at 5.1 lb/day from December to April to beef cows wintered on stargrass hay. Pregnancy rates were not different (91 vs 82% in Year 1; 81 vs 81% in Year 2) when the fats were added but the cows fed liquid supplements with added fat compared to cows fed supplements without added fat had a shorter calving interval in the first year and higher blood cholesterol concentrations in both years. Fat added to the diets of cows and heifers appears to enhance reproductive performance in some situations but additional research is needed on the length of feeding, levels, and types of fat that will enhance reproductive performance.

The ionophore antibiotics are used widely to improve efficiency of gain in the feedlot industry and have been shown to increase gain and feed efficiency in forage-fed cattle. Recently another antibiotic (bambermycins, Gainpro™) has been shown to increase gain in forage-fed cattle. Many cattle on pasture are not fed supplements daily and the inability to deliver these antibiotics at effective levels in free choice supplements has limited their use in grazing cattle. Liquid supplements with added ionophores are marketed but research evaluating the efficacy of these antibiotics in liquid supplements is limited in the scientific literature. Monensin added to a molasses-soybean meal supplement was evaluated in yearling heifers grazing bahiagrass pasture during the summer (Kunkle et al., 1990). Heifers limit-fed 5.9 lb/day of the molasses-soybean meal supplement gained 1.85 lb/day in the first year and 2.18 lb/day in the second year and gains were not improved (+.04 lb/day in Year 1, -.15 lb/day in Year 2) when 200 mg/day of monensin was added to the supplement. Pate (1995) also has evaluated lasalocid in molasses supplements and reported that gains were not improved when added to the supplement. High dietary mineral concentrations of sodium and potassium have been shown to reduce the efficacy of ionophores (Bergen and Bates, 1984; Gay et al., 1985; Schwingel et al., 1989) and the high concentrations of potassium in molasses supplements consumed in high quantities (over 5.5 lb/day) may be the mechanism that makes the ionophore antibiotics ineffective in improving gains.

We recently completed a trial (2 years data) evaluating Rumensin™ and Gainpro™ in both corn- and molasses-based supplements (Balbuena et al., 1996). Rumensin™ increased gains .09 lb/day when fed in a corn-based supplement but did not improve gains when fed in a molasses-based supplement (Table 2). Gainpro™ improved gains .25 lb/day when fed in a corn-based supplement and gains were improved .09 lb/day when fed in a molasses based supplement. Rumensin™ appeared to be an effective coccidiastat in both corn and molasses supplements and Gainpro™ did not appear to have efficacy against coccidia in either supplement. Evaluation of the effects of the antibiotics on the relationship of gain to ME intake indicated that Rumensin™

improved the efficiency of energy utilization. Gainpro™ improved gains by stimulating more energy consumption through decreased substitution of supplement for forage in the first year but had no effect on forage consumption but increased efficiency of ME consumed in the second year.

Self -Fed Liquid Supplements

Consumption-limiting supplements that can be self-fed to grazing cattle are preferred by many ranchers. Labor savings from the reduced frequency of feeding is important in many situations. Hand feeding has also been suggested to alter grazing behavior (cattle wait for supplement to be fed) that may reduce forage intake. Liquid supplements are designed to be homogenous mixtures that are not sorted by cattle allowing the addition of micro-nutrient and drugs with increased efficacy and reduced risk of overdosing. Most liquid supplements can be self-fed avoiding the cost of intake limiters such as salt that are often used in self-fed dry supplements.

Consumption of both liquid or dry self-fed supplements is variable and situation dependent. Intake depends on the cattle, forage, weather, water, and other factors. Many of these factors are changing constantly therefore the consumption keeps changing. Average consumption of the herd can be measured but research indicates there is a considerable variation in individual animal consumption within the herd. Bowman and Sowell (1996) reviewed research where individual supplement consumption was measured. In three experiments, 17 to 38% of the cattle did not consume the supplement. In four experiments, the coefficient of variation of liquid supplement consumed by cattle ranged from 23 to 107% with an average of 53%. A recent study (Bowman and Sowell, 1995) evaluated liquid supplement (28.5% crude protein as fed) consumption in beef cows grazing native range. Supplement consumption varied from 0 to 5.6 lb/day and 30% of the cows consumed only trace amounts of the supplement. The average coefficient of variation of supplement intake was 85%. These studies suggest that consumption of liquid supplements varies considerably across individuals in the herd and this can be a concern when delivering drugs or nutrients needed to improve performance, as well as energy and protein.

Experiences with Molasses Slurries

Molasses slurries have been fed by Florida ranchers for over 10 years. Sugarcane molasses is mixed with dry ingredients (10-20%) on the ranch or in commercial liquid feed manufacturing facilities. Molasses slurries may become more viscous depending on the dry material added but will flow and are handled in gravity flow tanks similar to conventional liquid feeds. Several ranches have built mixing systems using a transport tank equipped with a boat propeller (10-14 inches in diameter) powered by a hydraulic motor to mix the slurry before delivering into open troughs or lick tanks. Separation of the dry ingredients from the molasses is not usually a problem since the slurry is usually consumed in a few days and the molasses used has very little water added (it is viscous).

Feather meal, blood meal and cottonseed meal are the most common dry ingredients added to molasses slurries but many other feeds have been used. Consumption of molasses is increased by adding dry ingredients and in many situations the slurries are limit fed to the cattle. Typically a 3 or 4 day supply of slurry will be fed to a herd twice a week. The cattle may clean up the slurry before the next feeding, but the rate of consumption is moderate and all cattle have access to the troughs so digestive upsets are usually not a problem. Molasses slurries are usually fed to heifers, thin cows and bulls. Ranchers have reported higher gains and body condition in heifers and bulls, and improved pregnancy rates in young cows and thin cows, when feeding molasses slurries compared to urea-based liquid feeds. For several years most molasses slurries were mixed on the ranches but 3 years ago the largest liquid feed supplier in Florida built a new liquid feed manufacturing plant and has marketed several molasses slurry products. In the first year they marketed over 2000 tons of molasses slurries and tonnage of these products is continuing to increase. An estimated 10% of the molasses supplements (12000-14000 tons/year of molasses slurries mixed on the ranch or purchased) fed to beef cattle on Florida ranches are molasses slurries.

Conclusions

Sugarcane molasses based supplements have been shown to efficiently improve gains in cattle fed forages if properly balanced with protein, minerals and vitamins. Liquid supplements with protein added as NPN have been shown to be effectively utilized in some situations but in growing cattle and young cows adding natural protein has been shown to enhance both growth rate and reproductive performance. Fat additions to liquid supplements appear to enhance reproduction more than expected from its caloric value in some trials but additional research is needed to further define when fat is effective. Ionophores and other antibiotics have been shown to improve gains of cattle on pasture but the ionophores do not appear to improve gains when fed in molasses based- supplements consumed at higher quantities (5 lb/day). Self-fed liquid supplements offer efficiencies in feeding but variation in consumption across different herds and by individual cattle in the herd may result in some reduced efficiency of utilization of the nutrients and drugs in the supplements. Supplementation using molasses slurries has improved the performance of cattle in some production systems by providing more natural protein.

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Table 1. A Comparison of Corn- and Molasses-Based Supplements Fed to Growing Calves Grazing Bahiagrass Pasture[a]

	Supplement		
	None	Molasses-soybean meal[b]	Corn-soybean meal[c]
1984			
Daily gain, lb	.90	1.52	1.72
Added gain[d]	-	.62	.82
Supplement intake,			
As fed, lb/day	-	4.66	5.10
TDN, lb/day	-	2.77	3.89
Added gain/TDN[e]	-	.22	.21
1985			
Daily gain, lb	.46	1.10	1.32
Added gain[d]	-	.64	.86
Supplement intake,			
As fed, lb/day	-	5.19	5.30
TDN, lb/day	-	3.10	4.03
Added gain/TDN[e]	-	.21	.21

[a]Pitzer et al., 1986; 2 pens (4 newly weaned heifers/pen, 414 lb initial weight) were assigned to each treatment.
[b]Supplement contained 83.3% blackstrap molasses and 16.7% soybean meal, 59.6% TDN as fed.
[c]Supplement contained 81.5% ground corn, 17.5% soybean meal, and 1% limestone; 76.1% TDN as fed.
[d] Added gain compared to calves grazing bahiagrass pasture with no supplement.
[e]Added gain of calves above pasture only divided by supplement TDN.

Table 2. Effects of Rumensin™ and Gainpro™ in Corn- and Molasses-Based Supplements Fed to Growing Calves Fed Bermudagrass Hay (2 years data)[a].

	Hay Only	Corn based supplement[b]			Molasses based supplement[c]			SEM
		CON	RUM[d]	GP[e]	CON	RUM[d]	GP[e]	
Daily gain, lb								
0-110 days	.55	1.36	1.45	1.61	1.36	1.30	1.45	.068
Added gain[f]	-	.81	.90	1.06	.81	.75	.90	.044
Initial BCS[g]	5.4	5.4	5.4	5.3	5.4	5.3	5.4	.113
BCS change	-.37	.28	.40	.47	.30	.26	.38	.102
Height change, in.	1.83	2.43	2.62	2.56	2.32	2.52	2.44	.255
Hay intake, % BW[h]	2.10	1.54	1.40	1.63	1.64	1.50	1.58	.094
Supplement intake,								
Dry matter, lb/day	-	4.09	4.09	4.09	4.66	4.60	4.66	.015
TDN, lb/day	-	3.45	3.45	3.45	3.42	3.39	3.43	.011
Added gain/TDN[i]	-	.24	.26	.31	.24	.22	.26	.013
Fecal coccidia, n/5 g								
Year 1[J]	827	626	6	1057	881	6	805	-
Year 2[k]	.78	.78	.25	1.03	.78	.23	.72	-

[a]Balbuena et al.,1996; 4 pens with calves/pen (537 lb initial weight) were assigned to each treatment each year.
[b]Supplement contained 93.8% corn meal, 2.8% urea, 1.0% limestone, 1.8% dicalcium phosphate, and .57% dynamate; 71% TDN, 16.1% crude protein as fed, supplements fed daily.
[c]Supplement contained 89.6% standard molasses, 10% corn gluten meal, and .4% urea; 56.4% TDN, 12.9% crude protein as fed, supplements fed 3 times/week.
[d]Rumensin™ provided in supplements at 200 mg/day.
[e]Gainpro™ provided in supplements at 20 mg/day.
[f]Added gain compared to gain of calves fed hay only.
[g]Body condition score: 1 (thin) to 9 (fat).
[h]Percent body weight, as fed.
[i]Added gain of calves above hay only divided by supplemental TDN.
[J]Counts/5 gram of sample.
[k]Quantitatively scored; 0=none, 4=heavy infestation.

Table 3. Effects of Molasses, Corn and Soybean Hull Supplements Fed at Two Levels on the Performance of Growing Calves Fed Ammoniated Stargrass Hay[a]

	Hay Only	Supplement-low level[b]			Supplement-high level[c]		
		MOL[d]	Corn[e]	SH[f]	MOL[d]	Corn[e]	SH[f]
Year 1							
Daily gain, lb	1.21	1.69	2.00	2.00	1.89	2.29	2.40
Added gain, lb[g]	-	.48	.79	.79	.68	1.08	1.19
Daily intake, lb							
Hay	15.18	12.98	14.98	15.77	13.57	12.08	13.20
Cottonseed meal	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Supplement							
DM	-	3.00	3.00	3.00	6.00	6.00	6.00
TDN	-	2.16	2.68	1.91	4.31	5.39	3.83
Added gain/TDN[h]	-	.22	.30	.41	.16	.20	.31
Year 2							
Daily gain, lb	.79	1.00	1.41	1.21	1.50	1.69	1.69
Added gain, lb[g]	-	.21	.62	.42	.71	.90	.90
Daily intake, lb							
Hay	16.15	13.79	15.69	17.07	15.49	13.18	12.08
Cottonseed meal	.90	.90	.90	.90	.90	.90	.90
Supplement							
DM	-	3.00	3.00	3.00	6.00	6.00	6.00
TDN	-	2.16	2.68	1.91	4.31	5.39	3.83
Added gain/TDN[h]	-	.11	.23	.22	.17	.17	.24
Average-2 years							
Added gain/TDN[h]	-	.17	.27	.32	.17	.19	.28

[a]Brown and Weigel, 1993.
[b]Each supplement fed at 3.0 lb dry matter/day.
[c]Each supplement fed at 6.0 lb dry matter/day.
[d]Sugarcane molasses, 72% TDN (NRC,1984).
[e]Ground shelled corn, 90% TDN (NRC,1984).
[f]Soybean hulls, 64% TDN (NRC,1984).
[g]Added gain of calves compared to hay only.
[h]Added gain of calves above hay only divided by supplement TDN.