Using Molasses and Protein Supplements for Grazing Beef Cattle

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Introduction

An estimated 500,000 tons of blackstrap molasses is produced annually as a by-product of the sugar industry in Florida. This molasses is one of our lowest cost sources of supplemental energy for cattle production and is used extensively as a supplemental feed for beef cattle. Much of the molasses used as a supplement is blended with urea, minerals and vitamins to produce liquid feed designed to provide the needed supplemental nutrients for cattle grazing pasture.

During the 1980's, an interest developed in mixing dry feed ingredients in molasses to make "molasses slurries". The initial interest and support for this research was from Dr. Jim Hentges (Department of Animal Science, University of Florida) and John Black (U.S. Sugar Corporation). During the past 8 years, research at the University of Florida has focused on the effects of various levels and sources of dry ingredients and drugs mixed in molasses on the supplement intake and cattle performance. During these trials, it was found that the performance of cattle was improved by protein supplementation during the late summer and fall when protein supplementation has not traditionally been used. A summary of research during the past 8 years is presented in this paper.

Protein Supplements

Research with protein supplements has focused on growing cattle supplemented during the summer and fall. Most of this research has used natural protein supplements such as soybean or cottonseed meal and cattle were grazed on bahiagrass or limpograss pastures (Table 1).

Nursing Calves. Trials with nursing calves were conducted on commercial ranches in Florida in cooperation with the ranches, county extension agents and Lakeland Cash Feed. Cottonseed meal was fed in creep feeders and 8 to 10% white salt was added to the cottonseed meal to limit intake to 1 lb/head/day or less after the calves were eating the cottonseed meal. Supplement consumption has been a problem in some situations and 3 additional trials were unsuccessful because the cottonseed meal was not consumed. Three of four trials conducted showed a .48 pound increase in gain per pound of cottonseed meal consumed (Table 1). In one trial, the response to supplemental protein was .17 pound added gain per pound protein fed and this may be

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explained by the conditions where calves were younger and their dams appeared to have excellent milking ability. Research in Oklahoma has also shown .35 lb increase in gain per pound of protein supplement fed. Additional research trials under different conditions are needed but these studies indicate that limit feeding a protein supplement to nursing calves for 60 to 90 days in late summer may result in 15 to 30 lb more gain and $5 to $8 per head more profit.

Calves After Weaning. Protein supplemented to calves grazing bahiagrass after weaning in the summer or fall has also resulted in .26 to .43 lb increase in gain per pound of supplemental protein consumed (Table 1). The actual gains of unsupplemented cattle varied widely from -.08 to 1.33 lb/head/day in these trials but the protein supplement consistently gave a response averaging .32 lb increase in gain per pound of supplement consumed. The variation in gains from year to year in these trials where the same pasture, stocking rates and cattle type were utilized indicates the wide variations in the quality of bahiagrass in different years and seasons.

Yearlings. Two trials with yearling heifers grazing bahiagrass during the summer did not show an increase in gain from protein supplementation (Table 1). However, the gains of unsupplemented heifers were above 1.6 lb/head/day which is considerably above gains reported for yearling cattle grazing bahiagrass in other available research. Possible explanations include the yearling cattle compared to calves and year to year variation in pasture quality. We are planning other studies with forage samples collected over the years that may help explain the variation in animal performance and response to supplemental protein across years. Limpograss (Hemarthria) is a forage characterized by higher digestibility and lower crude protein compared to bahiagrass. Supplemental protein from urea doubled gains from .65 lb/head/day to 1.30 lb/head/day in yearling cattle grazing limpograss during the summer. The dramatic response of cattle grazing limpograss to the non-protein nitrogen supplement needs further evaluation with beef cows to see if they will show a response.

Protein Source. Most of the protein supplementation studies have utilized soybean or cottonseed meal. These are sources of natural protein with an estimated 60 to 80% of the protein degraded in the rumen. One study utilized a supplement containing 34.2% hydrolyzed feather meal, 60.5% corn and 5.3% urea which has a similar protein content, lower cost and a higher proportion of protein escaping rumen degradation compared to soybean meal. Neither protein supplement improved performance of yearling heifers grazing bahiagrass but the unsupplemented heifers gained 1.86 lb/head/day. Two of the 3 groups fed the supplement containing feather meal did not consume the 1 lb/head/day offered during the first month (May-June) but consumed all the supplement for the rest of the trial indicating it was less palatable than soybean meal. In another trial, a corn-urea supplement with a similar level of energy, protein and major minerals compared to soybean meal improved gains of calves grazing bahiagrass during the summer. The daily gains were slightly lower for corn-urea compared to soybean meal (.79 vs. 85 lb/hd/day), however, the gains for corn-urea supplemented heifers were notably lower than soybean meal during August when gains were the lowest. Few conclusions can be made about source of supplemental protein from these studies. A general understanding of non-protein nitrogen (NPN) utilization indicates that NPN would be utilized better when the cattle were consuming the higher quality forage and gaining weight similar to the situation with limpograss pasture.

Forage Protein Levels. Crude protein levels have been determined in bahiagrass forage collected at monthly intervals during the summer trials. Crude protein levels ranged from 8.3 to 16.9% with an average of 10.8%, 9.5% and 11.8% for years 1984, 1985 and 1986, respectively. During 1985 and 1986, supplemental protein improved gains. A response to crude protein supplementation would not be expected by comparing the levels of crude protein in the forage with the levels required for the sex, weight and growth rate of cattle as listed in the Nutrient Requirements of Beef Cattle (NRC, 1984).

Blood Urea Nitrogen. Levels of blood urea nitrogen (BUN) can be utilized to help evaluate the potential response of cattle to supplemental protein. In cooperation with Dr. Andy Hammond at the Subtropical Agriculture Research Center, Brooksville, FL., we have been monitoring the BUN levels of cattle in protein supplementation trials. Levels of BUN below 8 indicate that supplemental protein may improve performance, those above 10 indicate no response to rumen degraded supplemental protein would be expected and levels between 8 and 10 are considered marginal in healthy beef cattle.

A summary of results from 5 trials using this technique shows encouraging results (Table 2). When BUN levels were below 8, supplemental protein improved gains over .6 lb/head/day but when BUN levels were over 9, very little response was found. In the limpograss study, two levels of supplemental protein were used. During the first year, the higher level gave an added improvement in gain from 1.17 to 1.41 lb/head/day and BUN levels were 6.8 and 11.9 indicating a response was expected. During the second year, the intermediate and high level gave similar gains (1.17 and 1.19 lb/head/day) and the BUN levels were 9.6 and 10.9 indicating a response was not expected.

We are extremely encouraged with these results and hope BUN level can be utilized to project the timing and quantity of protein supplementation. The response of cattle grazing bahiagrass to supplemental protein has been variable over the years. The variation in forage species, cattle type and environment create an overwhelming number of possible situations and a technique such as this will be needed if we ever hope to fine time our recommendations on feeding supplemental protein to grazing beef cattle in Florida.

Molasses Supplements

Research on adding dry ingredients to molasses was started in 1983 and has focused on the effects of several types and levels of dry ingredients added to blackstrap molasses. Experience indicates that up to 20% of finely ground corn or soybean meal can be added to blackstrap molasses and still maintain a flowable product. The addition of bulky and fibrous ingredients will need to be under 15% to maintain flowability.

Consumption. The free choice consumption of blackstrap molasses is self limiting and may be below the level needed to get desired performance. The addition of 15 to 20% of corn or soybean meal to molasses was found to nearly double consumption in some situations. Consumption of molasses slurries has been as high as 2% of body weight. In many applications, molasses slurries will need to be limit fed to get the desired level of supplemental nutrient intake.

Energy Utilization. A concern with molasses was the utilization of the energy to improve gains in growing calves. Two trials were conducted comparing molasses-soybean meal slurries with corn-soybean meal in the efficiency of converting TDN into added gain (Table 3). The added gain per supplemental TDN consumed was .2 for both molasses-soybean meal and corn-soybean meal supplements when comparative supplements were fed to calves grazing bahiagrass during the summer. The conversion of TDN to gain has been reasonably consistent when gains were less than 1 lb/head/day. The added gain per unit supplemental TDN was lower when gains were over 1.5 lb/head/day as expected. The trials conducted during the fall were shorter in length and used newly weaned calves. They also showed more variation in actual gains and the response to supplemental energy from molasses slurries. From the results of these trials, we feel comfortable the supplemental energy from molasses is efficiently converted into gain. The calculations in our studies used 65% TDN for blackstrap molasses.

Type of Additive. Much of the research has focused on the response when different types of dry ingredients were added to molasses. Corn added to molasses was effective in increasing consumption but the added gain per supplemental TDN was only .12 compared to .18 for molasses-soybean. Molasses fed alone with no additives was consumed at lower levels but the added gain per supplemental TDN averaged .11 in 2 trials which also was below molasses-soybean meal. Blood urea nitrogen levels of cattle supplemented with molasses were below 6 also indicating a need for supplemental protein. All three results support the need for supplemental nitrogen for efficient utilization of molasses supplements fed to growing calves grazing bahiagrass during the summer.

Two trials evaluated corn and urea added to molasses at levels providing energy and protein levels similar to soybean meal. The molasses-corn-urea slurries had consumption levels and efficiency of energy utilization comparable to molasses-soybean meal slurries in 2 trials conducted during the summer and 1 trial in the fall. In our research situation, molasses-corn urea gave results comparable to molasses-soybean meal slurries.

Three different protein supplements with high levels of undegraded protein were evaluated as dry ingredients in molasses slurries. These included brewers grains, distillers dried grains and feather meal. Their utilization was similar to molasses-soybean meal slurries.

Level of Additive. The level of grains or protein supplement will impact consumption. Initial studies with molasses-soybean meal slurries utilized 16% soybean meal added to the slurry which resulted in a slurry containing 13% crude protein. Levels of BUN in one study were below 8 during part of the study indicating the level of added protein may have been marginal. The level of soybean meal in slurries was increased to 20% in later studies resulting in 15% crude protein in the slurry.

Beef Cows. A 4 year study evaluating the protein level and source in a molasses supplement for beef cows was recently completed at the Ona Research Center (Table 4). Supplements included molasses, molasses-urea and molasses-cottonseed meal-urea. All supplements were limit-fed to give similar levels of supplemental energy.

Cows fed molasses with urea weaned approximately 7 more calves per 100 cows and their calves weighed 12 pounds more at weaning compared to cows fed molasses only. Cows fed molasses-cottonseed meal-urea weaned approximately 12 more calves per 100 cows and their calves were 12 pounds heavier at weaning compared to cows fed only molasses. Calf production per cow in the breeding herd was increased 40 and 62 pounds, respectively, by adding urea and cottonseed meal-urea to the molasses mixture. Cow weight differences were not large across treatments, but cows fed the molasses-cottonseed meal-urea supplement were slightly heavier than cows fed molasses or molasses-urea.

Younger cows exhibited a greater response to the addition of crude protein to molasses than older cows. Three-year-old first-calf heifers fed molasses-urea had a 22.5 percentage point higher conception rate than heifers fed only molasses. First-calf heifers fed molasses-cottonseed meal-urea had a 32 percentage point higher conception rate than first calf heifers fed only molasses. Even 4 to 6-year-old cows fed either molasses-urea or molasses-cottonseed meal-urea had a 10 and 13 percentage point higher conception rate, respectively, than cows fed molasses only. Seven to 13 year old cows exhibited no response in conception rate to the addition of urea to molasses, and a slight response to the addition of cottonseed meal-urea to molasses (weaned about 4 more calves/100). A similar response to the addition of urea and cottonseed meal to molasses was observed in the weaning weight of calves from first-calf heifers. These responses show the importance of feeding young cows molasses fortified with crude protein, part of which should be a natural protein.

Ionophores

Ionophores are widely used in the feedlot industry and their improvement in gain is well documented in grazing cattle. The challenge for grazing cattle has been to find an effective and economical delivery system. Adding these to dry or liquid feeds provides a natural delivery system and should enhance the response to the supplement.

Several studies with ionophores added to grain or protein supplements are summarized in Table 5. Five studies with ionophores added to protein or grain supplements show increases in gain from .18 to .33 lb/head/day. One study (Fall 1989) shows a .4 lb/head/day decrease in gain which may have been caused by feeding too high a level of rumensin (200 mg/head/day) for the low quality forage available. The recent studies with Rumensin added to molasses-soybean meal slurries were initiated to evaluate the response of Rumensin in a molasses supplement. Ionophores are sensitive to high levels of sodium and potassium and molasses contains approximately 4% potassium. Neither trial with Rumensin added to molasses-soybean meal slurries has shown a positive response but the gains were near 2 lb/head/day in both trials. The response of ionophores added to molasses supplements fed at 4 to 5 lb/head/day needs additional evaluation.

Molasses Slurries

Molasses slurries as supplements for beef cattle are being utilized by many ranchers. Although we have approached our research studies by evaluating one ingredient or nutrient at a time, this approach is not suggested for the rancher. A molasses slurry should be formulated to supplement energy, protein, minerals and vitamins needed for the forage available to meet the nutrients requirements for the desired performance. Most molasses slurries will probably be mixed on the ranch in the foreseeable future. Several ranchers have modified molasses hauling tanks to mix molasses slurries and plans are available for those interested.

Most ranches do not have storage for dry ingredients and are limited to one type of molasses storage. At least two approaches are available to make molasses slurries utilizing one dry feed and one liquid feed. One approach is to use blackstrap or standard molasses and a dry mixture containing the desired level and source of protein, minerals, vitamins and additives. A second approach is to use a liquid feed containing desired levels of protein, minerals, vitamins and additives and mix a dry ingredient such as cottonseed meal with the liquid feed. Availability of ingredients, storage, costs and other factors will determine which system is more desirable.

Molasses slurries provide a level of flexibility in supplementing cattle that was not previously available. Each herd can be evaluated to determine the optimum level of supplementation and the amount and composition of the slurry can be changed easily and quickly. It seems reasonable that a ranch might have two or more molasses slurries that might use different dry ingredients or different levels of one dry ingredient. These two feeds (or more) could be fed at different levels in each herd and this could be adjusted during the year depending on the forage, weather and other factors. The increased flexibility will require more management planning and will be a challenge to the feed industry, university faculty, consultants and others to assist ranchers in determining economically optimum supplementation programs for each herd on their ranch.

Table 1. Summary of Research with Supplemental Protein on the Performance of Growing Cattle on Pasture[a]

Cattle		Pasture		Supplement		Daily Gain		Added	Gain/
Sex[b]	Weight	Species[c]	Date	Type[d]	Level	Control	Supp.	Gain	Feed
	lb				lb/h/d	lb	lb	lb	
Nursing Calves-Summer									
S&H	340	Bahia	Jul-Aug 86	CSM	.40	1.95	2.14	.19	.48
S&H	340	Bahia	Jul-Sep 87	CSM	.84	1.61	1.75	.14	.17
S&H	520	BP	Jul-Sep 88	CSM	.75	1.58	1.94	.36	.48
H	440	Bahia	Jul-Aug 88	CSM	.95	1.20	1.66	.46	.48
Post Wean Calves-Summer									
H	410	Bahia	Jun-Sep 85	SBM	1.0	.46	.89	.43	.43
S&H	470	Bahia	Jun-Sep 86	SBM	1.0	.64	.85	.21	.21
S&H	460	Bahia	Jun-Sep 87	SBM	1.0	.71	1.13	.42	.42
Post Wean Calves-Fall									
S&H	360	Bahia	Aug-Dec 86	CS	1.0	.41	.74	.33	.33
H	520	Bahia	Sep-Nov 88	SBM	1.0	1.33	1.55	.22	.22
H	530	Bahia	Sep-Nov 89	SBM	1.0	-.08	.22	.30	.30
Yearlings-Summer									
H	670	Bahia	May-Sep 88	SBM	1.0	1.68	1.56	-.12	-.12
H	620	Bahia	May-Sep 89	SBM	1.0	1.86	2.00	.14	.14
S	690	Limpo	Jul-Sep 87	CU	1.6	.79	1.41	.62	.39
S	800	Limpo	Jul-Sep 88	CU	1.6	.51	1.19	.68	.43

[a]Data from several research trials conducted in Florida.
[b]S - steers, H - heifers.
[c]Bahia - bahiagrass, BP - bahiagrass-pangolagrass, Limpo - limpograss.
[d]CSM - cottonseed meal, SBM - soybean meal, CS - cottonseed and soybean meal, CU - corn-urea (50% crude protein).

Table 2. Summary of Research with Supplemental Protein on the Performance and Blood Urea Nitrogen Levels of Growing Cattle on Pasture[a]

Pasture		Supplement		Daily Gain		Added	Blood Urea Nitrogen	
Species[b]	Date	Type[c]	Level	Control	Supp	Gain	Control	Supp
		lb/h/d	lb	lb	lb	mg/dl	mg/l	
Bahia	Jun-Sep 86	SBM	1.0	.64	.85	.21	9.1	14.7
Bahia	May-Sep 88	SBM	1.0	1.68	1.56	-.15	15.3	17.4
Bahia	May-Sep 89	SBM	1.0	1.86	2.00	.14	13.0	16.0
Limpo	Jul-Sep 87	CU	1.6	.79	1.41	.62	6.2	11.9
Limpo	Jul-Sep 88	CU	1.6	.51	1.19	.68	5.8	10.9

[a]Data from several research trials conducted in Florida.
[b]Bahia - bahiagrass, Limpo - limpograss.
[c]SBM - soybean meal, CU - corn-urea (50% crude protein).

Table 3. Summary of Research with Molasses and Grain Supplements on the Performance of Growing Cattle on Pasture[a]

Cattle		Pasture		Supplement			Daily Gain		Added	Gain/
Sex[b]	Weight	Species[c]	Date	Type[d]	As Fed	TDN	Control	Supp.	Gain	TDN
	lb				lb/h/d	lb/h/d	lb	lb	lb	
Calves-Summer										
H	410	Bahia	Jun-Sep 84	MS	4.7	3.1	.89	1.52	.63	.20
H	410	Bahia	Jun-Sep 85	MS	5.2	3.4	.46	1.09	.63	.19
S&H	470	Bahia	Jun-Sep 86	MS	5.1	3.4	.64	1.32	.68	.20
H	410	Bahia	Jun-Sep 84	CS	5.1	4.1	.89	1.71	.82	.20
H	410	Bahia	Jun-Sep 85	CS	5.3	4.2	.46	1.31	.85	.20
Calves-Fall										
H	470	Bahia	Sep-Nov 87	MS	5.7	3.8	.64	.89	.25	.07
H	520	Bahia	Sep-Nov 88	MS	5.4	3.6	1.33	1.99	.66	.18
H	520	Bahia	Sep-Nov 89	MS	4.8	3.2	-.08	.42	.50	.16
Calves-Winter										
S	480	Bahia	Dec-Apr 86	MS	6.0	4.1	.47	1.04	.57	.14
S	480	Bahia	Dec-Apr 87	CS	5.2	4.2	.14	1.11	.97	.23
H	370	Bahia	Dec-Apr 89	CS	5.1	4.1	.54	1.47	.93	.23
Yearlings-Summer										
H	670	Bahia	May-Sep 88	MS	6.5	4.4	1.68	1.84	.16	.04
H	620	Bahia	May-Sep 89	MS	5.8	3.9	1.86	2.17	.31	.08

[a]Data from several research trials conducted in Florida.
[b]S = steers, H = heifers.
[c]Bahia = bahiagrass.
[d]MS = molasses-soybean meal, CS = corn-soybean meal.

Table 4. Performance of crossbred brood cows fed different molasses-based mixtures during the winter while grazing bahiagrass pasture and fed low-quality hay (1984-1988)[a]

Item	Molasses[b]	Molasses urea[c]	Molasses-cottonseed meal-urea[d]
Weaning rate, %	63.8	70.9	75.7
Calf weaning weight, lb	443	455	455
Calf produced/cow in breeding herd, lb	283	323	345
Increased calve production/cow over molasses along, lb	--	40	62
Molasses mixture fed/cow, lb[e]	368	406	356
Hay fed/cow, lb	1816	1753	1856
Conception rate for different age cows, %			
3 year olds	37.5	60.0	69.6
4, 5 and 6 year olds	66.1	76.1	79.3
7 to 13 year olds	78.1	78.7	82.7
Weaning weight of calves from different age cows, lb			
3 year olds	392	405	423
4, 5 and 6 year olds	437	454	440
7 to 13 year olds	460	464	465

[a]F. M. Pate, Proc. Winter Feeding Field Day, Ona Report RC 89-3, 1989, 4 years data

[b]Standard blackstrap molasses, 79.5° Brix; 6% crude protein (2.9 lb/cow/day).

[c]Standard molasses, 90%; urea, 5%; water, 5%; 20% crude protein (3.2 lb/cow/day).

[d]Standard molasses, 73%; cottonseed meal, 25%; urea, 1%; water, 1%; 16% crude protein.

[e]Molasses mixtures were fed for 127 days with an average starting date of December 16 and average ending date of April 22.

Table 5. Summary of Research with Ionophores on the Performance of Growing Cattle on Pasture[a]

Cattle		Pasture		Supplement		Ionophore		Daily Gain		Added
Age[b]	Wt	Species[c]	Date	Type[d]	Level	Type[e]	Level	Control	Supp	Gain
	lb				lb/h/d		mg/h/d	lb	lb	lb
C	570	BC	Jan-Apr 82	G	7	R	175	1.21	1.51	.30
C	400	Star	Nov-Mar 81	G	1	B	100	1.14	1.32	.18
C	460	Bahia	Jun-Sep 87	P	1	L	100	1.13	1.46	.33
C	520	Bahia	Sep-Nov 88	P	1	R	200	1.55	1.80	.25
C	530	Bahia	Sep-Nov 89	P	1	R	200	.22	-.16	-.40
Y	670	Bahia	May-Sep 88	P	1	R	200	1.56	1.86	.30
Y	620	Bahia	May-Sep 89	P	1	R	200	2.00	1.82	-.18
Y	670	Bahia	May-Sep 88	MS	6	R	200	1.84	1.90	.06
Y	620	Bahia	May-Sep 89	MS	6	R	200	2.17	2.02	-.15

[a]Data from several research trials conducted in Florida
[b]C - calf, Y - yearling
[c]Bahia - bahiagrass, Star - stargrass, BC - bahiagrass-clover
[d]G - grain, P - protein, MS - blackstrap molasses-soybean meal slurry
[e]R - Rumensin, B - Bovatec, L - Lysocellin