Effects of Forage Sampling Method on Nutritive Value of Bahiagrass During the Winter and Spring

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This study suggest that when adequate forage is available for grazing, steers will selectively graze bahiagrass forage with greater nutritive value than hand-collected forage during the winter and spring.

Summary

A six-mo trial was conducted from December 2006 to May 2007 to evaluate the differences between forage and masticate samples of bahiagrass pastures at four research stations across Florida (Ona, Brooksville, Santa Fe, and Marianna) during the winter and spring. Eight ruminally cannulated steers were used for collection of masticate samples. Forage samples were collected by cutting the grass within a 0.8-ft^{2}quadrat to approximately 1-in from the soil surface. High and low forage availabilities were designated to represent differences in forage quantities at each location. Forage mass, in vitro digestible organic matter, and crude protein concentrations were determined for each sample type. There were differences in forage mass, digestible organic matter, and crude protein between locations, as well as the state mean.. Selection indices indicated the opportunity for selection of forage that was greater in digestibility and crude protein compared to hand-collected forage samples. The selection indices for digestibility were similar at the four locations varying from 0 to 62%, while the selection indices for CP differed more by location ranging from -4 to 68%. Overall, during the winter and spring, steers were able to select a diet that was 31% greater in digestibility and 21% greater in crude protein compared to hand-collected forage samples.

Introduction

Florida pastures are comprised primarily of tropical and subtropical grasses, which are typically high yielding, but low in quality. Bahiagrass (*Paspalum notatum)* is the most commonly utilized forage in pasture grazing systems in Florida occupying approximately 2.5 million ac (Chambliss and Sollenberger, 1991), but also extends into the Gulf Coast Region. Currently, there is little published data dedicated to classifying subtropical forages on a year-round basis, whether by hand-sampling or collection of masticate samples, with even less data devoted to studying diet selection by cattle grazing subtropical pastures.

Studies have shown that when adequate forage is available for grazing, ruminants will selectively graze within those situations (Weir and Torell, 1959; Schlegel et al., 2000). When attempting to represent the diet of a grazing animal, research has illustrated how hand-collected forage samples are inaccurate in their estimations of selected material (Coleman and Barth, 1973; Russell et al., 2004). The objective of this study was to characterize the nutritive value of bahiagrass from four locations across the state of Florida during the winter and spring comparing sampling techniques, either by hand-sampling or collection of masticate sample, within pastures of varying levels of forage availability (FA) with the ultimate goal of better predicting available forage nutritive value and subsequent supplementation needs to meet Florida grazing cattle nutritional requirements.

Materials and Methods

Four locations were utilized for this project to represent the variation in the Florida pasture landscape, the locations included: Range Cattle Research and Education Center, Ona; USDA-Subtropical Agricultural Research Station, Brooksville; Santa Fe River Ranch Beef Unit, Alachua; and North Florida Research and Education Center, Marianna. The pasture sizes at each location were: 2.5 ac (Ona), 2.5 ac (Brooksville), 2.0 ac (Alachua), and 3.7 ac (Marianna). Bahiagrass (*Paspalum notatum)* was the primary forage of interest for this trial. However, there were different cultivars at each location. At the Ona research site, the bahiagrass cultivar used for the trial was Pensacola (*Paspalum notatum* cv. Suarae Parodi), while the cultivar found in Brooksville was primarily Argentine bahiagrass, which is similar to Pensacola, but may be more palatable. At the Alachua research site, the bahiagrass cultivar was Pensacola, while Marianna contained Pensacola bahiagrass. The selected pastures were managed at each location either by grazing or mowing to allow for differences in available forage mass. Pastures were not fertilized prior to or during the trial.

Forage and masticate samples were collected monthly (approximately every 30 d) from December 2006 to May 2007. Eight ruminally cannulated Angus or Brangus steers were used for this experiment with two steers at each location (one Angus and one Brangus) for collection of masticate samples. Forage availabilities were visually assigned to the selected pastures, as either HIGH or LOW, at each location to represent differences in forage quantity. Within each pasture, two individuals hand-clipped three forage samples each for a total of six samples per pasture. Hand shears were used to cut the forage within a 0.8-ft^2 quadrat to an approximate height of 1-in from the soil surface. Simultaneously, masticate samples were collected from the fistulated steers by initially emptying the rumen, allowing the steers to graze either the HIGH or LOW FA pasture for approximately one h, then removing the selected material from the rumen. Forage and masticate samples were analyzed for forage mass, in vitro digestible organic matter (IVDOM), and crude protein (CP). The selection index (SI) for chemical composition was also calculated using the following equation, SI = {[(Masticate concentration – hand-collected forage concentration) / hand-collected forage concentration] * 100} + 100.

Data were analyzed as a split plot design with the whole plot completely randomized using the MIXED procedure of SAS. The experimental unit was steer or person for sample collection. Fixed effects in the model included FA, month, sampling type (masticate or hand-collection), and their interactions. Repetition (steer or person) within each FA was used for the repeated measures and random effect. The least squares means were determined. Means were separated using the P-diff option when protected by a significant F-value ($P<0.05$).

Results

Ona

At Ona, there was a month effect (Table 1; $P<0.001$), whereas there was only a tendency for a FA effect ($P=0.09$). Ona had significantly greater forage mass in comparison to the other locations. The high FA decreased steadily during the winter months until a 4,500 lb/ac increase in May, whereas the low FA remained fairly similar during the winter until a 4,000 lb/ac increase in May. The IVDOM concentration of masticate samples (Table 2) were greater ($P<0.001$) than hand-collected forage samples during the winter and spring. Month also affected IVDOM concentration ($P<0.001$) of forage and masticate samples, as both sample types steadily increased in IVDOM concentration during the winter. Likewise, the CP concentration of masticate samples (Table 3) was greater ($P<0.001$) compared to hand-collected forage samples with exception of March, which likely caused the type x month effect ($P<0.001$). The mean SI at Ona (Table 4) indicated that the steers were selecting forage 31% greater in IVDOM concentration and 21% greater in CP concentration compared to hand-collected forage samples during the winter and spring months.

Brooksville

There were no differences in forage mass at Brooksville (Table 1) between FA (P=0.23) or month (P=0.15) during the winter and spring. While the IVDOM concentration of both sample types (Table 2) increased from December to May (P<0.001), masticate samples averaged 13% greater IVDOM concentration (P<0.001) compared to hand-collected forage samples. Similarly, the CP concentration of masticate samples (Table 3) was greater (P<0.001) than the hand-collected samples during the winter and spring. The similarity of the forage and masticate CP concentrations in March led to a type x month (P<0.001) effect. At Brooksville, the steers were able to select forage that was 32% greater in IVDOM and CP compared to hand-collected forage samples (Table 4).

Santa Fe

There was no LOW FA sample taken at Santa Fe during January due to sampling difficulty, thus forage and masticate samples were not analyzed for IVDOM and CP during January. There was a month effect (P=0.04) for forage mass from December to May, which was likely due to the sharp increase in forage mass in May with only a tendency (P=0.09) for a difference between FA (Table 1). Throughout the winter and spring, IVDOM concentration (Table 2) was greater (P<0.001) for masticate compared to hand-collected samples. Month also affected IVDOM concentration of both sample types (P<0.001) from December to May. The variation between sample type and month led to type x month (P=0.01) interaction for IVDOM concentration. During the winter and spring, CP concentration (Table 3) varied between month (P<0.001). While there was no sample type effect (P=0.18) on CP concentration, masticate samples had greater CP concentration than hand-collected forage samples with the exception of March. February had the greatest SI (Table 4) for IVDOM concentration (P<0.05) indicating the opportunity for steer selection of forage 62% greater in IVDOM concentration compared to hand-collected forage samples with other months eliciting less of a selection response (mean= 14%). During January and February, the steers were able to select forage that was greater in CP concentration (36% and 22%, respectively) with other months eliciting less of a selection response.

Marianna

Marianna had the lowest forage mass (Table 1) compared with other locations, with variation between months (P=0.04), but not between FA (P=0.12). Masticate sample IVDOM concentration (Table 2) was greater (P<0.001) compared to hand-collected forage samples with variation between months (P<0.001). With the exception of January (35.0% IVDOM concentration), hand-collected forage samples varied by less than 5% IVDOM (mean= 53.0%). Similarly, IVDOM concentration of masticate samples only varied by 9% during the winter and spring (mean= 64.3%) with the exception of January (54.5%). The differences between sample type and month resulted in a type x month (P=0.03) effect for IVDOM concentration during the winter and spring. Masticate sample CP concentrations (Table 3) were greater (P<0.001) than hand-collected forage samples from December to May. CP concentrations were also affected by month (P<0.001) with only a tendency for a type x month interaction (P=0.08), which was likely due to the similarity in value between masticate and hand-collected forage samples during March. The greatest opportunity for selection of forage with greater IVDOM concentration compared to hand-collected forage (Table 4; P<0.05) was in January (55.4%) and February (37.3%). The mean SI for CP concentration indicated the opportunity for selection of forage material that was 17% greater in CP concentration compared to hand-collected forage during the winter and spring.

State Mean

Month affected the overall state mean forage mass (Table 1; P<0.001), while there only tended to be a difference between FA (P=0.10) at all locations. The forage mass of the HIGH FA decreased from December to April until increasing in May, while the LOW FA remained fairly constant during the winter until increasing by approximately 1,400 lb/ac in May. Masticate samples were consistently greater (mean= 59.2%) in IVDOM concentration (Table 2*;* *P*<0.001) compared to hand-collected forage samples (mean= 45.8%). Month also affected IVDOM concentration of masticate and hand-collected forage samples (*P*<0.001) during the winter and spring likely due to changing environmental factors at each location. The sample type and month effects led to a type x month interaction (*P*<0.001) for IVDOM concentration. Similarly, CP concentrations (Table 3) were affected by month (*P*<0.001) with masticate samples consistently greater than the hand-collected forage samples with the exception of March, thus influencing a type x month interaction (*P*=0.02). The SI for IVDOM concentration (Table 4) varied by month (*P*<0.05) with the greatest opportunity for selection in January and February (51%), while the remaining months indicated the steers selected forage that was 19% greater in IVDOM concentration compared to hand-collected forage samples. The SI for the overall mean CP concentration (*P*<0.05) was greatest in December (37%), followed by January and February (30%), and least in March, April and May (10%) indicating less of an opportunity for selection of forage as the winter and spring seasons progressed.

Conclusions and Implications

The results of this study indicate that during the winter and spring when bahiagrass forage mass is most limiting and nutritive value is low, grazing steers will select forage material with greater IVDOM and CP concentrations compared to hand-collected forage values, which are normally gathered for estimation of available forage quality. The data collected in this study imply that forage samples collected by hand may under-estimate the nutritive value of the actual selected forage by cattle. The implications of this study indicate the opportunity to more closely match cow requirements with forage resources, based on available bahiagrass nutritive value and cow selection within those forage opportunities. If energy and protein supplementation can be more closely matched to cow requirements, then less N and other nutrient inputs would be added to the environment thus improving land and water quality, which is an important concern for Florida cattle producers.

Literature Cited

Chambliss, C. G. and L. E. Sollenberger. 1991. Proc. 40th Annual Florida Beef Cattle Short Course, pp 74-80.

Coleman, S. W. and K. M. Barth. 1973. J. Anim. Sci. 36: 754-761.

Russell, J. R. et al. 2004. J. Anim. Sci. 82(Suppl 2): 93.

Schlegel, M. L. et al. 2000. J. Anim. Sci. 78: 2202-2208.

Weir, W. C. and D. T. Torell. 1959. J. Anim. Sci. 18:641-649.

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Table 1. Effect of forage availability and month on overall mean forage mass (lb/ac)

		Month							P-value		
Location	FA[a]	Dec	Jan	Feb	Mar	Apr	May	SEM[d]	FA	Month	FA*Month
Ona	H[b]	5,184	3,429	3,156	2,653	1,840	6,258	592	0.09	<0.001	0.17
	L[c]	1,858	1,195	1,257	1,341	978	4,017				
Brooksville	H	2,093	1,277	2,251	1,974	1,329	1,788	356	0.23	0.15	0.50
	L	1,431	833	951	1,366	1,114	1,259				
Santa Fe	H	1,626	1,000	1,345	1,311	1,170	3,549	383	0.09	0.02	0.19
	L	939	na	867	930	946	1,466				
Marianna	H	1,128	1,616	889	730	927	1,872	275	0.12	0.04	0.42
	L	406	478	672	703	519	1,386				
St. Mean	H	2,508	2,832	1,911	1,085	889	2,032	414	0.10	0.001	0.73
	L	1,159	836	937	1,376	1,316	2,700				

[a]FA= Forage availability.

[b]H = High forage availability.

[c]L= Low forage availability.

[d]SEM= Standard error of the mean.

Table 2. Effect of sampling type and month on in vitro digestible organic matter (IVDOM, %)

		Month							P-value		
Location	Type[a]	Dec	Jan	Feb	Mar	Apr	May	SEM[d]	Type	Month	Type*Month
Ona	F[b]	38.56	34.94	39.09	42.83	43.70	51.29	2.05	<0.001	<0.001	<0.001
	M[c]	47.80	51.17	58.41	56.45	65.25	58.72				
Brooksville	F	40.43	39.69	38.73	44.36	50.26	50.10	1.42	<0.001	<0.001	<0.001
	M	52.44	60.08	58.78	56.62	57.89	57.78				
Santa Fe	F	43.66	na	39.32	55.84	51.81	50.42	2.62	<0.001	<0.001	0.01
	M	51.46	na	63.27	63.63	57.08	61.57				
Marianna	F	54.68	35.04	50.80	54.88	54.49	50.19	2.23	<0.001	<0.001	0.06
	M	66.34	54.56	69.51	61.99	60.15	63.65				
St. Mean	F	44.21	37.51	42.24	49.62	50.81	50.52	1.98	<0.001	<0.001	<0.001
	M	55.63	56.32	62.62	60.63	59.84	60.53				

[a]Type= Forage sampling type.

[b]F= Hand-collected forage.

[c]M= Masticate.

[d]SEM= Standard error of the mean, n=48.

Table 3. Effect of sampling type and month on crude protein (CP, %)

		Month							P-value		
Location	Type[a]	Dec	Jan	Feb	Mar	Apr	May	SEM[d]	Type	Month	Type*Month
Ona	F[b]	7.57	9.22	10.93	12.05	11.70	10.84	0.62	<0.001	<0.001	<0.001
	M[c]	9.57	10.56	13.49	11.92	15.72	12.24				
Brooksville	F	6.78	8.02	8.06	10.20	10.06	10.89	0.49	<0.001	<0.001	<0.001
	M	10.19	12.90	11.47	10.39	11.63	11.63				
Santa Fe	F	7.70	na	11.91	15.20	13.75	13.27	0.89	0.18	<0.001	0.43
	M	9.83	na	14.56	14.72	15.07	13.55				
Marianna	F	9.03	9.75	12.16	10.36	11.47	9.83	0.56	<0.001	<0.001	0.08
	M	12.00	11.70	14.24	10.57	11.89	12.61				
St. Mean	F	7.81	9.53	10.82	11.92	11.72	11.31	0.58	<0.001	<0.001	0.02
	M	10.62	11.94	13.44	11.93	13.64	12.52				

[a]Type= Forage sampling type.

[b]F= Hand-collected forage.

[c]M= Masticate.

[d]SEM= Standard error of the mean, n=48.

Table 4. Effect of month on steer selection index[a] of bahiagrass forage.

Location	Analysis	Month							
		Dec	Jan	Feb	Mar	Apr	May	SEM[d]	P-value
Ona	IVDOM[b]	122.73	146.45	153.78	129.85	149.22	115.12	18.96	0.65
	CP[c]	124.98	118.66	134.53	99.91	136.43	112.88	24.93	0.89
Brooksville	IVDOM	129.68	151.72	151.79	127.67	115.74	116.70	6.72	0.04
	CP	150.24	167.84	147.56	101.84	115.55	106.71	19.55	0.24
Santa Fe	IVDOM	108.78	na	161.63	114.36	110.47	122.25	6.18	0.02
	CP	136.06	na	122.17	96.84	109.80	102.08	21.34	0.79
Marianna	IVDOM	121.72	155.43	137.30	112.87	104.30	126.98	8.11	0.05
	CP	134.69	118.00	116.28	102.07	103.91	129.38	8.96	0.21
St. Mean	IVDOM	120.71[g]	151.82[ef]	151.11[e]	121.23[g]	119.92[g]	120.34[g]	5.73	<0.001
	CP	136.52[f]	131.03[f]	130.12[f]	100.24[e]	116.44[ef]	112.82[ef]	8.59	0.03

[a]{[(Masticate concentration – forage concentration) / forage concentration] * 100} + 100.

[b]IVDOM= In vitro digestible organic matter.

[c]CP= Crude protein.

[d]SEM= Standard error of the mean, n=12.

[e,f,g]Within a row, means with a different superscript differ, *P*<0.05