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Inspection on Three Plant Spices as an Animal Forage Source in Mazandran Wetland

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Abstract: In order to evaluation of wetland plant spices as a forage source in animal nutrition, three species, *Paspalum distichum, Sparganium erectum* and *Aeloropus litoralis* that has vast cover in Mazandaran wetland was chosen. At the 30% of flowering, randomly, 3 kg of feed samples were taken and kept on –20ºC, until that defreeze before chemical analysis. Chemical composition including crud protein (CP), crud fiber (CF), neutral detergent fiber (NDF), acid detergent fiber (ADF), total digestible nutrients (TDN), digestible dry matter (DDM),predicted dry matter intake, relative forage value (RFV) and relative forage quality (RFQ) of feeds were calculated. Using two ruminal fistulated mature Zel sheep, NDF digestibility (% of NDF) were measured via *in situ* techniques. Dry matter, CP, CF, NDF, ADF, and ash content of three spices were significantly different. *Aeloropus litoralis* had the highest dry matter, CP, ADF, and ash, but *Sparganium erectum* had the highest CF, NDF. There were not significant different between NFC and ether extract content of three plant spices. Digestibility of NDF after 48-h ruminal incubation was significantly different and the values were 0.65, 0.63, and 0.66 % of NDF in *Paspalum distichu*m, *Sparganium erectu*m, and *Aeloropus litorali*s, respectively. However, digestible NDF (NDFD; % of NDF) had no difference in *Paspalumdistichu*m, *Sparganium erectu*m, and *Aeloropus litoralis* (45.68, 45.51 and 44.10% of NDF, respectively). TDN, DDM content of three spices and predicted DMI (% of BW) had not significant differences. The values of RFV and RFQ were significantly different in *Paspalumdistichu*m, *Sparganium erectu*m, and *Aeloropus litoralis* (118.08, 114.73 and 124.23; 143.26,116.32 and 136.27, respectively. It can be concluded that wetland grasses are high in NDF, but that fiber typically is highly digestible; therefore, wetland grasses may be evaluated more accurately when tested for RFQ instead of RFV.

Key word: Feed evaluation, relative feed value, relative forage quality, wetland plant

Introduction

Wetlands are relatively common in tropical and temperate lowlands. Wetlands not only supply nutritious forage for wildlife, but this forage can be beneficial to livestock as well (Kirby *et al*., 1989). However, nutritional value of the forage provided by wetlands can vary depending on the type of plant community, which is determined by the brackishness and permanence of water. Smaller, fresh water wetlands provide some of the highest quality forage of any prairie pothole wetland. In addition, nutritional value varies considerably depending on the time of the growing season. Most wetland plant species are most nutritious in the spring and early summer, where CP levels and digestibility drop rapidly by mid- to late summer.

Paspalum distichum L. is a littoral species occurring in sands and muds near the seashore, and in saline soils and swamps (Duncan and Carrow, 2000). A perennial with long creeping rhizomes and stolons; culms erect, from 15 to 60 cm. Leaves stiff, narrow, about 15 cm long; racemes usually two; spikelets elliptical, 3.5-4 mm long. It differs from *P. paspaloides* in that the upper glume is glabrous with the mid-nerve sometimes suppressed; the leaf-blades are usually narrower, up to 4 mm wide, often less, folded and with in rolled margins; racemes upto 4 cm long, often less, usually spreading horizontally or deflexed; lower glume absent. It is quite palatable and an important forage grass. Dirven (1963) found that in Suriname, the nutritional value of the grass is low and cattle grazing it are in poor condition (Duncan and Carrow, 2000).

Sparganium erectum is a very common plant of wet ditches, canals, fens, lake sides, river sides, ponds, and similar wet habitats. Easily recognized, with its tall shoots reaching four feet or so, long, narrow keeled leaves, and a stem, which carries a branched inflorescence of globular heads of male and female flowers (Piquot *et al*., 1992).

Grasses such as *Aeluropus littoralis* are 50 - 80 cm tall and produce fresh yields generally amounting to 3.0 - 6.3 tons per hectare. In some cases, yields can reach 10.0 - 22.5 tons per hectare, but are only 0.75 tons per hectare in heavily saline soil. Saline and bog meadows are also used as summer pasture (OIA, 1992).

Nutritive value is a term used to quantify the presence and availability in a feed of nutrients that are required by the animal and to predict the productive output from the animal to which it is fed. It depends on the following: 1)

The concentration of nutrients in the feed, 2) The availability of these nutrients to the animal, 3) The efficiency with which the absorbed nutrients are used by the animal, and 4) The effect of feed composition on the voluntary intake of the feed. Nutritive value must be expressed in standard units that can be applied also to the nutrient requirements of the animal. RFV and RFQ are indexes used to measure the quality of forage and are determined by its content of ADF and NDF. ADF evaluates the content on cellulose and lignin in forage and is closely related to digestibility. ADF is also used to calculate the energy (NE_m, NE_l and NE_g) content of forage. NDF is an evaluation of the total fiber content that includes hemicellulose in addition to the cellulose and lignin content. The NDF content is related to intake because it evaluates the bulkiness of forage. Nowadays, development of a new index provides the opportunity for flexibility in choice of equations for predicting DMI and TDN; these equations should be specific for different types of forage. With the introduction of the new approaches to determining animal requirements in National Research Council (NRC, 2001), there is an opportunity to improve upon this quality index through use of newer analyses and equations. Therefore, this experiment designed to evaluate three wetland plant spices including *Paspalum distichum, Sparganium erectum,* and *Aeloropus litoralis* as a forage source in animal nutrition that has vast cover in Mazandaran wetland.

Materials and Methods

In order to evaluation of wetland plant spices as a forage source in animal nutrition, three species, *Paspalum distichum, Sparganium erectum* and *Aeloropus litoralis* that has vast cover in Mazandaran wetland was chosen. This experiment was conducted in Said-Mahaleh wetland region is at 52°41' to 53°08' N and receives up to 584/3 mm of rain yearly. Based on Köppen (1931) and Ackerman (1941), this region has humid continental climate. At the 30% of flowering, randomly, 3 kg of feed samples were taken and kept on –20°C, until that defreeze before chemical analysis. CP (AOAC, 2002), CF (AOAC, 2002), NDF (Van Soest *et al*., 1991), ADF (Van Soest *et al*., 1991) were measured. TDN (NRC, 2001), DDM (Oba and Allen, 1999), predicted DMI (Mertens, 1987; Weiss *et al*., 1992) and RFV of feeds were calculated based on Moore and Undersander (2002b) as follows:

DDM (% of DM) = 88.9 - (0.779 × %ADF); (Equ. 1)

DMI (% of body weight) = 120 / %NDF; (Equ. 2)

RFV = (DMI, % of BW)×(DDM, % of DM)/1.29 (Equ. 3)

In addition, RFQ of feeds were calculated as follow:

RFQ=(DMI, % of BW)×(TDN, % of DM)/1.23 (Equ. 4, Moore and Undersander, 2002b). Using two ruminally fistulated mature Zel sheep, NDF digestibility (% of NDF) were measured. Samples of three wetland plant spices dried at 55°C over 24 h and were ground topass a 2-mm screen in a Wiley mill. Using the *in situ* techniques, nylon bags (5 × 10 cm; poresize 50 µm) were filled with 3 g dry, ground samples, incubated in two replicate in the rumen for 48h. After incubation, samples were washed manually until the rinse water remained clear. The NDF content of residual were determined and NDFD; % of NDF) was calculated. The following equations were used for calculation of TDN:

TDN = (NFC×0.98) + (CP×0.87) + (FA×0.97×2.25) + (NDFn×NDFDp/100) - 10 (Equ. 5; Moore and Undersander, 2002b).

Where, NFC is non fibrous carbohydrate (% of DM) or 100 – (NDFn + CP + EE + ash); CP is CP (% of DM); EE is ether extract (% of DM), FA is fatty acids (% of DM) or ether extract –1; NDFCP is CP of NDF, NDFn is nitrogen free NDF or NDF – NDFCP, else estimated as

NDFn = NDF×0.93; NDFD is 48-hour NDF digestibility (% of NDF) and NDFDp is = 22.7 +0.664×NDFD. DMI calculations for grasses will be:

DMI = -2.318 + 0.442×CP -0.0100×CP 2 - 0.0638×TDN + 0.000922×TDN 2 + 0.180×ADF -0.00196×ADF 2 - 0.00529×CP×ADF (Equ 6; Moore and Kunkle, 1999).

Where, DMI is expressed as % of BW, and CP, ADF, and TDN are expressed as % of DM. Using PROC GLM of SAS (2002), all data were analyzed and differences between means were separated with LSD at alpha = 0.05.

Results and Discussion

Species chosen for nutrient analysis are considered primary or secondary emergent wetland species in Mazandaran that can be easily grazed or hayed. Three wetland grasses species including *Paspalum distichu*m, *Sparganium erectu*m, and *Aeloropus litoralis* selected and analyzed in this study provide data that generally agree with previously published information for these species (Fulton, 1979). However, complete comparisons are difficult due to lack of information on collection methodology in earlier studies. The nutrient composition of wetland species examined was similar to that of widely used regional hays. Dry matter, CP, CF, NDF, ADF, and ash content of three spices were significantly different (Table 1). *Aeloropus litoralis* had the highest dry matter, CP, ADF, and ash, but *Sparganium erectum* had the highest CF and NDF. There were not significant different between NFC and ether extract content of three plant spices (Table 1). The higher NDF in these grasses will make RFQ a better predictor of quality than RFV (Moore and Kunkle, 1999). Digestibility of NDF after 48-h ruminal incubation was significantly different and the values were 0.65, 0.63, and 0.66 % of NDF in *Paspalum distichu*m, *Sparganium erectu*m, and *Aeloropus litorali*s, respectively. However, NDFD (% of NDF) had no difference in *Paspalum distichu*m, *Sparganium erectu*m, and *Aeloropus litorali*s.

Table 1: Chemical composition of as animal forage source in Mazandran wetland.

	Paspalumdistichum	*Sparganiumerectum*	*Aeloropuslitoralis*	SEM
Spices				
Dry matter (%)	14.24[b]	13.24[c]	15.46[a]	0.32
Crud protein (% of DM)	8.00[a]	6.57[b]	8.16[a]	0.42
Crud fiber (% of DM)	39.25[a]	40.06[a]	37.24[b]	0.65
Acid detergent fiber (% of DM)	38.52[b]	25.23[c]	43.06[a]	0.93
Neutral detergent fiber (% of DM)	70.27[b]	72.24[a]	66.82[c]	0.67
Non fibrous carbohydrate (% ofDM)	11.29	12.96	12.88	0.68
Ash (% of DM)	8.23[ab]	7.25[b]	9.74[a]	0.56
Ether extract (% of DM)	2.31	2.32	2.40	0.56

Means within a row with different subscripts differ (P < 0.05).

Table 2: Nutritive value of three plant spices as animal forage source in Mazandran wetland

Spices	*Paspalumdistichum*	*Sparganiumerectum*	*Aeloropuslitoralis*	SEM
48 –h NDF digestibility (% of NDF)[1]	0.65[a]	0.63[b]	0.66[a]	0.08
NDFD (% ofNDF) [2]	45.68	45.51	44.10	0.95
NDFDp[3]	53.03	52.92	51.98	0.75
NDFn [4]	65.35[b]	67.18[a]	62.14[c]	0.86
TDN [5]	45.32	46.85	45.08	0.98
DDM [6]	89.20	89.10	89.24	0.66
DMI [7]	1.98[a]	1.61[c]	1.88b	1.23
DMI [8]	1.71	1.66	1.79	0.22
RFV [9]	118.08[b]	114.73[c]	124.23[a]	1.21
RFQ [10]	143.26[a]	116.32[c]	136.27[b]	1.06

Means within a row with different subscripts differ (P < 0.05).

1- 48–h NDF digestibility (% of NDF) that measured using the *in situ* techniques

2- NDFD = digestible NDF (% of NDF).

3- NDFn = NDF×0.93.

4- NDFDp = 22.7 + 0.664×NDFD.

5- TDN = (NFC×0.98) + (CP×0.87) + (FA×0.97×2.25) + (NDFn×NDFDp/100) – 10 (Moore and Undersander, 2002a).

6- DDM (% of DM) = 88.9 - (0.779 ×%ADF).

7- DMI = -2.318 + 0.442×CP -0.0100×CP 2 - 0.0638×TDN + 0.000922×TDN 2 + 0.180×ADF -0.00196×ADF 2 - 0.00529×CP×ADF (Moore and Kunkle, 1999).

8- DMI (% of body weight) = 120 / %NDF.

9- RFV = (DMI, % of BW) × (DDM, % of DM) / 1.29.

10- RFQ = (DMI, % of BW) × (TDN, % of DM) / 1.23 (Moore and Undersander, 2002a).

Although *Paspalumdistichum* and *Sparganium erectum* had the higher NDF, their NDFD was higher, too. In contrast, *Aeloropus litoralis* had the highest ADF and its NDFD was lower than other spices. However, these results were similar to Moor *et al*. (1996). Analyzing more than 50 grasseshay, Moor *et al*. (1996) found that they had percentage of CP and NDF, *in vivo* dry matter and NDF digestibility 11.9, 70.7, 57.8 and 62.5, respectively. Digestible fiber is an important component of forage energy and intake and is quite variable. A number of factors result in changes in fiber digestibility. Some of these include: the plant species, the varieties within the plant species, the stage of maturity at harvest, the climatic conditions under which the crop was grown and harvested, and then interactions between these factors. While *in vitro* and *in situ* estimates of digestibility have long been recognized as being more closely related to animal performance than chemical extractions. Digestibility of forages is a function of its ADF content and intake of forages is a function of its NDF content (Allen, 2000). ADF has been used to estimate DDM for the last 25 years even though it was never designed for this purpose. When using any fiber determination to estimate digestibility the assumption is made that there is a close relationship between fiber concentration and digestibility (Weiss, 1994). Use of *in vitro* NDF digestion may improve the accuracy of both DMI and TDN prediction. Routine use of *in vitro* NDF digestion will, however, require the standardization of methodology, comparisons with *in vivo* NDF digestibility for various types of forages (Moore and Undersander, 2005). However, in current experiment, we used *in situ* NDF digestion coefficients for measuring NDFD that seems has more reliability than *in vitro* NDF digestion.

TDN, DDM content of three spices and predicted DMI (% of BW) had not significant differences. Accurate prediction of DMI is the greatest challenge in developing accurate RFQ predictions. Moore and Kunkle (1999) developed and evaluated multiple regression equations that included ADF fit the data better than did those that included NDF. Intake prediction equations that include a measure of digestibility may have the potential to provide more acceptable predictions than equations based on chemical analyses alone. Therefore, *in vitro* NDF digestibility has been suggested for estimation of DMI (Oba and Allen, 1999). In current experiment, we used both equations (Equ. 2 and 6) for estimation of DMI (% of BW).The values that obtained from equation 6 were significantly different between three plant species, but the values that obtained from equation 2 were similar between them. In this study, we used the Weiss *et al.* (1992) equation to prediction of three plant spices that is being used successfully to estimate TDN concentrations in feeds, forages, and mixed diets. It includes estimates of truly digestible NFC, truly digestible CP, truly digestible fatty acids, truly digestible NDF, and metabolic fecal excretion. The Weiss equation requires an estimate ofNDF digestibility and has adopted by the NRC Dairy committee (NRC, 2001).

The values of RFV and RFQ were significantly different (Table 2). The RFQ emphasizes fiber digestibility while RFV uses digestible dry matter intake. The difference is that the digestibility of the NDF is included in the equation. Therefore, the digestibility may be the reason cows produce differently on hays of similar RFV. The digestibility of alfalfa hay NDFcan vary significantly and this will change the RFQ, where it does not change the RFV. Fiber from grass and legumes naturally differs in digestibility, as it also does when grown under different ambient temperatures. However, fiber fraction digestibility from each cutting will be different, as ambient temperatures influence this at the time of growth and development. Therefore, differences in fiber digestibility are not taken into account in the RFV calculation and cows may perform differently when fed forages from different cuttings. Therefore, RFV should be used to compare forages within the same species. In current experiment, the samples were taken from the one region at similar condition at the 30 % of flowering. Therefore, it seems that differences in DDM, NDFD, RVF, and RFQ are result of differences in nature of fiber fractions. To calculate RFV it is necessary to have a forage analysis for ADF and NDF. Protein is not considered but higher RFV values are usually associated with higher protein. *Paspalum distichu*m, *Sparganium erectu*m, and *Aeloropus litoralis* typically had high ADF and NDF concentrations and consequently had low RFV. When using RFV or RFQ it is best to compare hays that are within a similar classification. RFQ gives more credit for digestible fiber in grasses and grasses will typically have higher RFQ than RFV but will still be less than many legumes. Type, quality, and price should be taken into consideration when purchasing hays. Undersander and Moor (2004) reported that RFQ will become the standard test for evaluating forages throughout the country and that it eventually will be used even more widely than RFV is today. Grasses are high in NDF, but that fiber typically is highly digestible. So, grasses should be evaluated more accurately when tested for RFQ instead of RFV.

Conclusion: Nutritive value quantifies the presence and availability in a feed of nutrients that are required by the animal and It depends on feed nutrients concentration, availability of these nutrients to the animal, efficiency nutrients utilization by the animal, and the effect of feed composition on the voluntary intake of the feed. Nutritive value must be expressed in standard units that can be applied also to the nutrient requirements of the animal. RFV and RFQ are indexes used to measure the quality of forage and are determined by its content of ADF and NDF. Wetland grasses are high in NDF, but that fiber typically is highly digestible; therefore, Wetland grasses may be evaluated more accurately when tested for RFQ instead of RFV.

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