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Nutritive Value of *Stipagrostis lanata* (Forssk.) De Winder as a Feed for Livestock

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ABSTRACT

Stipagrostis lanata (Forssk.) De Winder is a perennial plant naturally growing in the Nile Delta coastal region of Egypt. Proximate analysis and anti-nutritional factors of its aboveground parts were evaluated to determine its nutritional value as a feed for livestock. The results showed that *S. lanata* aboveground parts contained 54.63±0.39% of dry matter (DM), 7.24±0.15% of ash content (AC), 8.21±0.16% of crude protein (CP), 3.96±0.20% of ether extract (EE), 33.17±0.53% of crude fiber, 80.59±0.23% of total carbohydrate (TC), 47.42±0.63% of digestible carbohydrates (DC) and 4.11±0.15% of digestible crude protein (DCP). Total digestible nutrients (TDN), nutritive value (NV), gross energy (GE), digestible energy (DE), metabolized energy (ME), net energy (NE), nutritional ratio (NR) and caloric value (CV) were 59.16±0.22%, 7.21±0.16%, 419.79±1.22 kcal/100 g, 2.61±0.01 Mcal kg^{-1}, 2.14±0.01 Mcal kg^{-1}, 4.25±0.03 MJ kg^{-1}, 66.73±2.74 g Fu^{-1} and 258.2±1.66 kcal/100 g, respectively. Concentration of anti-nutrients recorded 0.036±0.002, 0.461±0.022, 0.292±0.01, 0.169±0.015, 0.966±0.116 and 2.917±0.178 % DM for total flavonoids, total phenolics, tannins, simple phenolics, alkaloids and saponins respectively, while cyanogenic glycosides was 2.132±0.156 mg/100 g DM. From the obtained results, it can be concluded that aboveground parts of *S. lanata* are highly nutritive and it could be utilized as a source of a feed for livestock.

Key words: *Stipagrostis lanata*, proximate analysis, anti-nutritional factors, livestock, forage crops

INTRODUCTION

Animal production in arid and semi-arid regions is facing a problem of animal feed supply due to shortage of the growth of herbaceous species and biomass yield (Boufennara *et al.*, 2012). Therefore, searching for novel alternative sources of feeding materials for possible utilization in animal diets is rapidly increasing in recent years (Hassan *et al.*, 2007).

Grasses are a major contributors in animal nutrition due to their highly nutrition value (Heneidy and Halmy, 2009). Desert vegetation in Egypt covers vast area and is formed mainly of xerophytic plants (Mossallam *et al.*, 2009). One of these plants is *Stipagrostis lanata* (Forssk.) De Winter (woolly triple-awned grass) that belongs to Family: Poaceae.

S. lanata is a perennial geophytic and coarse grass. It is up to 40 cm long with capillary or often curved leaves and woolly lower internodes. It occurs in sand dunes in Nile Delta, Oasis, Mediterranean coast and Libyan Desert of Egypt (Tackholm, 1974; Boulos, 2005). It can grow in very warm and harsh environments as it has a C_4 photosynthetic pathway (Ghasemkhani *et al*., 2008). This biochemical feature enables it to adapt to arid and semi-arid environments such as sand dunes.

The present study was conducted to analyze the aboveground parts of *S. lanata* collected from the Nile Delta coastal region of Egypt for its nutritional composition. The main objective was to verify the possible utilization of *S. lanata* aboveground parts as an alternative source of feeds for livestock.

MATERIALS AND METHODS

Plant material: *S. lanata* plants were collected at flowering stage in July 2011 from their natural habitats in the Nile Delta coastal region of Kafr El-Sheikh Governorate, Egypt. The plant was identified by the Department of Agricultural Botany, Faculty of Agriculture, Tanta University. The voucher specimen was deposited at Laboratory of the same Department. Physical and chemical characters (Ryan *et al*., 1996) of the soil where *S. lanata* plants were collected at a depth of 0 to 50 cm are shown in Table 1.

Sample preparation: Aboveground parts of *S. lanata* were separated, cut into small pieces and air dried. The dried materials were powdered and kept in the refrigerator until use.

Proximate analysis: Moisture content (MC), crude fiber (CF), ether extract (EE), total nitrogen (Kjeldahl method) and ash content (AC) were determine by using the standard procedures of AOAC (1990). Crude protein (CP) % in DM was calculated by multiplying total nitrogen by 6.25. Total carbohydrates (TC) % in DM = 100-(CP+EE+AC), while digestible carbohydrate (DC) also known as Nitrogen Free Extract (NFE) % in DM = TC-CF. Digestible Crude Protein (DCP) was calculated according to the equation of Shaltout *et al*. (2009): DCP (% in DM) = 0.929 CP-3.52.

Energy measurements: The prediction of the energy value of the aboveground parts of *S. lanata* as a feed material was estimated by using equations based on its chemical composition (Shaltout *et al*., 2008) as follows: Total Digestible Nutrients (TDN) were estimated according to the equation: TDN (% in DM) = 0.62 (100+1.25 EE)–0.72 CP. Nutritive value (NV) was calculated as: NV (% in DM) = TDN/CP. Digestible energy (DE) was estimated following this equation: DE (Mcal kg^{-1} DM) = 0.0504 CP+0.077 EE+0.02 CF+0.000377 NFE^2+0.011 NFE-0.152.

Table 1: Physical and chemical characters of the soil where *S. lanata* plants were collected

Parameters	Values	Parameters	Values
Physical characters			
Sand (%)	90.66±0.38	Moisture content (%)	1.43±0.32
Silt (%)	1.31±0.27	Porosity (%)	36.72±0.62
Clay (%)	8.03±0.23	Water-holding capacity (%)	27.33±0.69
Chemical characters			
Calcium carbonate (%)	1.71±0.14	CO_3^{--} (meq L^{-1})	0.06±0.02
Organic matter (%)	0.18±0.02	HCO_3^- (meq L^{-1})	0.85±0.10
pH	7.18±0.07	Na^+ (meq L^{-1})	0.74±0.20
Electrical conductivity (dS m^{-1})	0.19±0.03	K^+ (meq L^{-1})	0.17±0.02
Total nitrogen (%)	0.009±0.001	Ca^{++} (meq L^{-1})	0.58±0.09
Available phosphorus (ppm)	3.81±0.62	Mg^{++} (meq L^{-1})	0.34±0.06
Cl^- (meq L^{-1})	0.66±0.20	Sodium adsorption ratio	0.93±0.19
SO_4^- (meq L^{-1})	0.26±0.07	Potassium adsorption ratio	0.26±0.02

Values are Mean±SE of 3 replications

Metabolized energy (ME) as Mcal kg^{-1} = 0.82 DE and net energy (NE) was estimated as follows: NE (MJ kg^{-1} DM) = [(3.65 TDN (%)–100)/188.3]×6.9. Nutritional ratio (NR) was calculated as: NR = DCP (g kg^{-1} DM)/NE (FU kg^{-1} DM), where FU: food unit and one FU = 6.9 MJ = 1650 kcal. Gross energy (GE) was calculated as follows: GE (kcal g/DM) = DC (4.15)+CP (5.65)+CF (4.25)+EE (9.0). Caloric value (CV) was calculated using the equation of Onyeike *et al.* (1995): CV (kcal/100 g DM) = (4 CP+9 EE+4 DC).

Anti nutritional factors: The anti-nutritional factors such as alkaloids, saponins, cyanogenic glycosides, flavonoids, total and simple phenolics and tannins were estimated. Alkaloids, saponins and cyanogenic glycosides were measured following the procedures described by Clarke (1970), AOAC (1990) and Haque and Bradbury (2002), respectively. Total flavonoids were determined by the method of Zhishen *et al.* (1999). Total phenolics, simple phenolics (non-tannin phenolics) and tannins were determined according to Makkar *et al.* (2007). Amount of tannins was calculated by difference using the following formula:

Tannins = Total phenolics-Simple phenolics (non-tannin phenolics)

Statistical analysis: Values of proximate analysis and predicted energy are means of four replications±SE, while values of soil analysis and anti-nutritional factors are means of three replications±SE. Values of standard error (SE) were calculated using Microsoft Office Excel 2007.

RESULTS

Grasses are great source as forage for livestock and dairy production (Ashraf, 2006). From this view, nutritional value of the aboveground parts of *S. lanata* as a forage for livestock was evaluated in this study. High values of nutrients have been found in *S. lanata* aboveground parts (Table 2). Dry matter, ash content, crude protein, ether extract, crude fiber, total carbohydrates, digestible carbohydrates and digestible crude protein were 54.63±0.39%, 7.24±0.15%, 8.21±0.16%, 3.96±0.20%, 33.17±0.53%, 80.59±0.23%, 47.42±0.63% and 4.11±0.15% in DM, respectively.

Total digestible nutrients, nutritive value, digestible energy, metabolized energy, net energy, nutritional ratio, gross energy and caloric value accounted for 59.16±0.22% DM, 7.21±0.16% DM, 2.61±0.01 Mcal kg^{-1} DM, 2.14±0.01 Mcal kg^{-1} DM, 4.25±0.03 MJ kg^{-1} DM, 66.73±2.74 g Fu^{-1}, 419.79±1.22 kcal/100 g DM and 258.2±1.66 kcal/100 g DM, respectively (Table 3).

Table 2: Proximate analysis of the aboveground parts of *S. lanata* measured as percentage of DM

Parameters	Values
Moisture content (MC)	45.37±0.39
Dry matter (DM)	54.63±0.39
Ash content (AC)	7.24±0.15
Crude protein (CP)	8.21±0.16
Ether extract (EE)	3.96±0.20
Crude fiber (CF)	33.17±0.53
Total carbohydrates (TC)	80.59±0.23
Digestible carbohydrates (DC) or nitrogen free extract (NFE)	47.42±0.63
Digestible crude protein (DCP)	4.11±0.15

Values are Mean±SE of 4 replications

Table 3: Predicted energy value of the aboveground parts of *S. lanata* as a feed material

Parameters	Values
Total digestible nutrients (%)	59.16±0.22
Nutritive value (%)	7.21±0.16
Gross energy (kcal/100 g DM)	419.79±1.22
Digestible energy (Mcal kg^{-1})	2.61±0.01
Metabolized energy (Mcal kg^{-1})	2.14±0.01
Net energy (MJ kg^{-1})	4.25±0.03
Nutritional ratio (g Fu^{-1})	66.73±2.74
Caloric value (kcal/100 g)	258.20±1.66

Values are Mean±SE of 4 replications

Table 4: Contents of anti nutritional factors in the aboveground parts of *S. lanata*

Parameters	Values
Total flavonoids (% DM)	0.036±0.002
Total phenolics (% DM)	0.461±0.022
Tannins (% DM)	0.292±0.010
Simple phenolics (% DM)	0.169±0.015
Alkaloids (% DM)	0.966±0.116
Saponins (% DM)	2.917±0.178
Cyanogenic glycosides (mg/100 g DM)	2.132±0.156

Values are Mean±SE of 3 replications

Additionally, contents of total flavonoids, total phenolics, tannins, simple phenolics, alkaloids, saponins and cyanogenic glycosides were 0.036±0.002% DM, 0.46±0.02% DM, 0.29±0.01% DM, 0.17±0.02% DM, 0.97±0.12 % DM, 2.9±0.18% DM and 2.13±0.16 mg/100 g DM, respectively (Table 4).

DISCUSSION

The nutritional value of any forage depends largely on its contents of nutrients and energy value as well as the presence of anti-nutritional factors. Proximate composition of aboveground parts of *S. lanata* revealed that those parts contained high concentrations of the principal nutrients including minerals (ash), proteins, carbohydrates and lipids. Concentrations of protein, carbohydrates and ether extracts in any forage plant are important factors that determine its use for feed formulation, as they are responsible for caloric value of the plant (Hassan *et al.*, 2007). High amounts of crude protein, total carbohydrates and ether extract in the aboveground parts of *S. lanata* indicate its high nutritive value. Moreover, the plant is considered as a highly fibrous according to its high level of crude fiber that may be due to the environmental conditions (Boufennara *et al.*, 2012) prevailing in the Nile Delta coastal region of Egypt where the plant grows.

Nehring and Haenlein (1973) stated that gross energy (GE), digestible energy (DE), metabolized energy (ME) and net energy (NE) are the most important categories used in determination of energy value of animal feed. In this study, *S. lanata* aboveground parts showed high-energy value represented by high amounts of GE, DE, ME and NE.

Nutritional value of a feed depends on the balance between nutritional and anti-nutritional compounds found in this feed (Aberoumand, 2009). Anti-nutritional factors include flavonoids, phenolics, alkaloids, saponins, tannins, oxalates, phytates and cyanogenic glycosides and others (Akande *et al.*, 2010). They inhibit digestive enzymes, bind to proteins reducing the palatability and absorption of nutrients of the feed, and hence cause growth depression (Phale and Madibela, 2006; Sarkiyayi and Agar, 2010; Gwanzura *et al.*, 2012; Gayathri *et al.*, 2012). In addition to its adverse effects, anti-nutritional factors also have some beneficial applications in pharmaceutical, agricultural and food industries (Soetan, 2008). In this study, the results indicate that aboveground parts of *S. lanata* contain relatively high levels of anti-nutrients. This may be due to that this plant grows in very warm and harsh environments (Ghasemkhani *et al.*, 2008); therefore, these biochemical features support its adaptation and growth in arid and semi-arid environments such as sand dunes. Anti-nutritional factors were proved to play an important role in plant defense mechanisms against pathogens, herbivores and environmental stress (Gwanzura *et al.*, 2012).

Even though the soil where *S. lanata* grows was poor, it is obvious that *S. lanata* is of great value as a fodder and its aboveground parts have a tendency to accumulate high concentrations of nutrients and high-energy elements. As environmental factors including soil and climate conditions affect the chemical composition of a plant, it is possible that increasing soil nutrients can enhance the nutritional quality of forage plants (Fateh *et al.*, 2009; Ingweye *et al.*, 2010; Zulfiqar and Asim, 2002).

CONCLUSION

Grasses are widely used in animal nutrition due to their high contents of nutrients. The present study describes the nutritional value of the aboveground parts of *Stipagrostis lanata*, a wild grass growing in Egypt. The results revealed that those parts are a rich source of nutrients and have high-energy value. Therefore, our study recommends this plant to be planted and utilized on a wide range as a feed for livestock. However, further toxicological studies are needed to assess the possibility of utilization of this plant in animal diet and for feed formulations.

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