THE CHANGE IN THE FORAGE QUALITY OF SMOOTH BROMEGRASS (*BROMUS INERMIS* L.) IN GRAZING AND NON-GRAZING PASTURES

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Abstract
This research was conducted to determine the chemical composition of smooth bromegrass in artificial pasture from the years 2010 to 2012 in Isparta Province located in the Mediterranean region of Turkey. The mixture of the pasture used were alfalfa (*Medicago sativa* L.) + sainfoin (*Onobrychis sativa* Lam.) + crested wheatgrass (*Agropyron cristatum* L.) + smooth bromegrass (*Bromus inermis* L.). Animal grazing applications were performed in the second and the third year of the study since the first year covered only the establishment of the artificial pastures. Forage samples were collected from grazing and non-grazing areas once every 15 days during the grazing seasons. The crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF) contents, total digestible nutrient (TDN) and relative feed value (RFV) were determined on the smooth bromegrass forage samples. According to results, CP, TDN and RFV values decreased throughout the grazing season, while ADF and NDF contents increased in grazing and non-grazing areas. The ADF and NDF contents of smooth bromegrass in non-grazed areas were higher than the grazed areas, while CP, TDN and RFV values of grazed areas were higher than non-grazed areas. It can be concluded that the harvesting at the late stages caused a reduction in forage quality of smooth bromegrass in grazing and non-grazing areas.
Key words: *Bromus inermis*, artificial pasture, acid detergent fibre, crude protein, relative feed value, total digestible nutrient.

Introduction

Smooth bromegrass (*Bromus inermis* Leyss.) is a high-yielding grass but requires longer recovery periods than other grasses. It is best adapted to well-drained soils and is an excellent choice for drought-prone areas (Undersander et al., 1996). Because of its highly developed root system, smooth bromegrass is resistant to temperature extremes and drought. It grows best on deep, well-drained silt or clay loam but may also establish itself in sandier soils. The forage quality of smooth bromegrass is higher than that of most other cool-season grasses such as orchardgrass (*Dactylis glomerata* L.) or tall fescue (*Festuca arundinacea*); crude protein levels in smooth bromegrass often exceed 120 g kg^{-1} if it is harvested in the boot stage. However, smooth bromegrass recovers poorly from cutting because its tiller apices, or tips, are vulnerable to removal. This leads to lower yields after a first cutting and poor seasonal distribution of yield. In addition, older stands may easily become dense and sod-bound, resulting in markedly lower productivity.

Despite its disadvantages, smooth bromegrass lends itself to a variety of purposes, especially when combined with a legume such as alfalfa (*Medicago sativa* L.) or red clover (*Trifolium pretense*). It is one of the most useful cool-season grasses throughout its range, valuable for hay, pasture, silage and green chop. Its rhizomes and tough root network also make it worthwhile for ground cover and erosion control. Therefore, in this research it was aimed to determine forage quality of the smooth bromegrass during the grazing season in the artificial pastures established in the Mediterranean Region of Turkey.

Materials and Methods

This research was conducted at Suleyman Demirel University Research Farm in Isparta Province (37°45′N, 30°33′E, elevation 1035 m) located in the Mediterranean region of Turkey on three consecutive years from 2010 to 2012. The total precipitation and average temperature data for the experimental area are given in Figures 1 and 2. The major soil characteristics of the research area were as follows: The soil texture was clay loam, the organic matter was 13 g kg^{-1} as determined using the Walkley–Black method, the lime was 71 g kg^{-1} as determined using a Scheibler calcimeter, the total salt was 2.9 g kg^{-1}, the exchangeable K was 122 mg kg^{-1} by 1 N NH_4OAc, the extractable P was 3.3 mg kg^{-1} by 0.4 N $NaHCO_3$ extraction, and the pH of a soil-saturated extract was 7.7. The soil type was *calcareous fluvisol*.

In March 2010, two artificial grazing lands, covering 1.5 ha pasture each were established at the university farm. Pasture was composed of alfalfa (*Medicago sativa* L., 15%) + sainfoin (*Onobrychis sativa* Lam., 15%) + crested wheatgrass (*Agropyron cristatum* L., 35%) + smooth bromegrass (*Bromus inermis* L., 35%). Cutting and maintenance applications were made in the first year. Immediately after sowing pasture, fertiliser was applied at rate of 50 kg ha^{-1} as phosphorus (P2O5) and 50 kg ha^{-1} of nitrogen (N). The same amount of phosphorus as triple superphosphate (46% P2O5) in the October 2010 and 2011 while in 2011 and 2012 March, 50 g ha^{-1} N as ammonium nitrate (33.5% N) was used . Pastures were harvested twice during the end of June and beginning of October in 2010. Animal grazing applications were

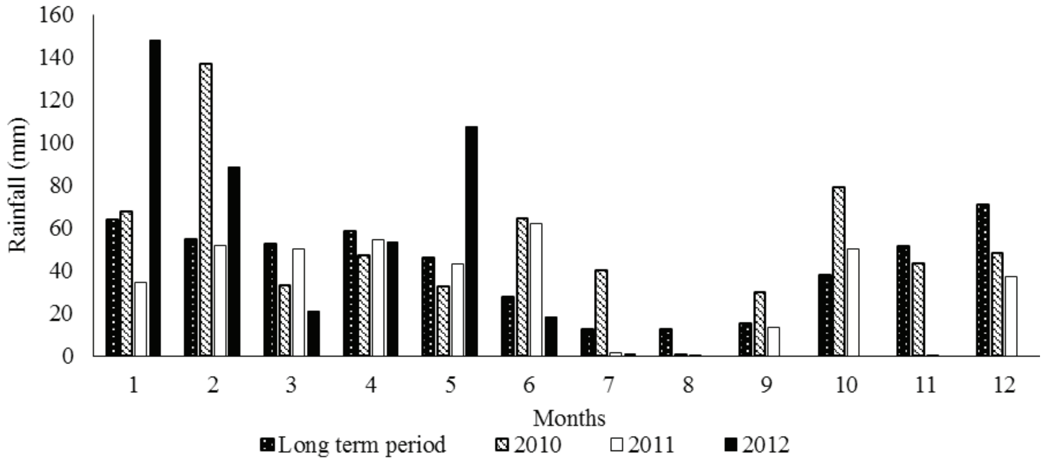

Figure 1. Rainfall values for individual experimental years and over the long term.

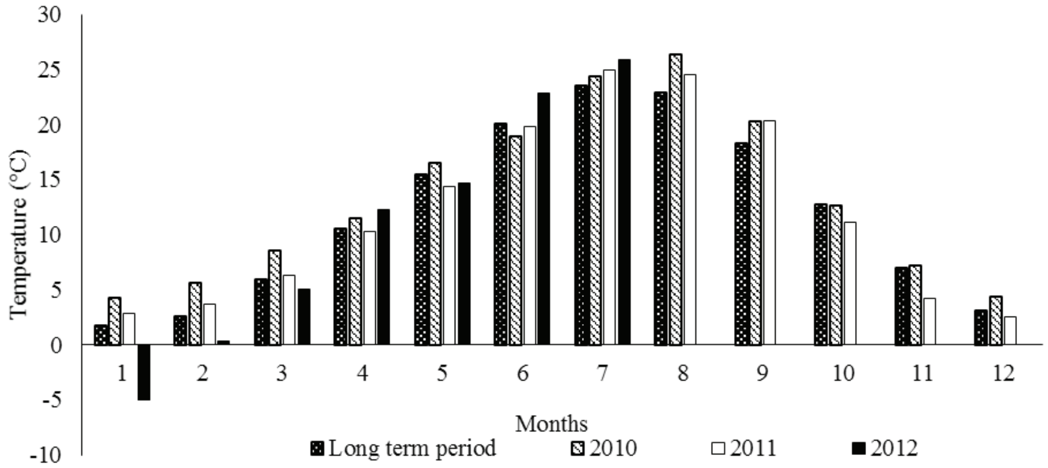

Figure 2. Temperature values for individual experimental years and over the long term.

performed in the second and the third year of the study since the first year covered only the establishment of the artificial pastures. The animals were turned out to pasture for grazing on the 1st of May and the grazing was terminated on the 1st of August each year. Animals were kept on the pasture continuously. 10 Holstein male calves with an average 6 months old were included and allocated evenly to artificially established pasture in the experiment which lasted for 90 days in 2011 and 2012. The animals had a free access to the water during all experimental periods.

Four non-grazed areas within pasture were established in order to determine forage quality changes of smooth bromegrass and fenced with wires by 4×3m size and grass samples were collected by using 0.5m^2 (0.5×1 m) quadrats fortnightly from May to August each year. The crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF) contents, total digestible nutrient (TDN) and relative feed value (RFV) were determined as well.

The collected samples (1 May, 15 May, 30 May, 15 June, 30 June, 15 July, 30 July) after the harvest were weighed and dried at 70 °C for 48 h. The dried samples were reassembled and ground to pass through a 1-mm screen. The crude protein (CP) content was calculated by multiplying the Kjeldahl nitrogen concentration by 6.25 (Kacar and Inal, 2008). The acid detergent fiber (ADF) and neutral detergent fiber (NDF) concentrations were measured according to methods from Ankom Technology. Total digestible nutrients (TDN), dry matter intake (DMI), digestible dry matter (DDM) and relative feed value (RFV) were estimated according to the following equations adapted from R.D.Horrocs and J.F.Vallentine (1999):

TDN = (-1.291 x ADF) + 101.35

DMI = 120/NDF

DDM = 88.9-(0.779 x ADF)

RFV = DDM x DMI x 0.775

The data were subjected to the analysis of variance using General Linear Models procedure (MINITAB 2010). The means were compared by pairwise comparison test by Duncan at the 5% level of significance.

Table 1

Results of analysis of variance of the traits determined

Sources of variations	df	CP	NDF	ADF	TDN	RFV
Block (year)	6	ns	*	*	*	*
Year	1	**	*	*	*	*
Grazing (G)	1	**	*	*	*	*
Sampling Times (ST)	6	**	**	**	**	**
G x ST intr	6	ns	ns	ns	ns	ns
G x Year	1	*	ns	*	ns	ns
ST x Year	6	ns	ns	ns	ns	ns
G x ST x Year intr.	6	ns	ns	ns	ns	ns
Error	78					

df: degrees of freedom, ns: not significant, *p<0.05 and **p<0.01

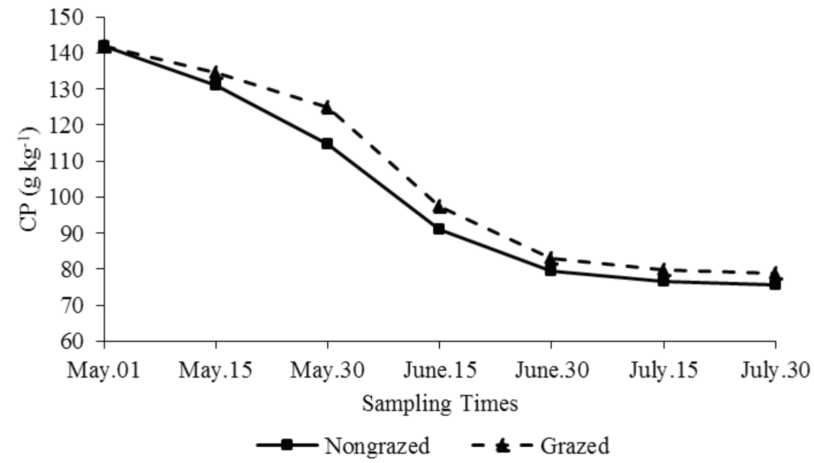

Figure 3. Seasonal variation of CP contents of smooth bromegrass according to averages of 2011 and 2012.

Results and Discussion

The effects of the grazing and sampling times on CP contents were significant (Table 1). The CP contents of smooth bromegrass were decreased throughout the grazing season in the grazed and the non-grazed areas (Figure 3). The highest CP contents were obtained from the beginning of the grazing season while the lowest CP contents were determined at the end of the grazing season. Maturity stage at harvest is the most important factor determining forage quality. Other reports also support that the CP content decreases by advancing stage of maturity (Koc et al., 2000; Rebole et al., 2004), suggesting that animals should be supplemented with protein sources, especially towards the end of the grazing season. As a result of this process, forage quality lessens substantially towards the end of growing season. The CP ratios of the grazed areas were higher than that of non-grazed areas in the present study. This could be associated with the continued re-growth of the plants in the grazed areas because young plant tissues are more nutritious than dead or mature plant (Lyons et al., 1996).

The ADF and NDF contents of smooth bromegrass were significantly affected by both grazing and sampling times (Table 1). Acid detergent fiber and NDF contents were increased during the grazing season in the grazed and non-grazed areas (Figures 4 and 5). This could be explained by the decrease in proportion of leaves and the increase of the stems proportion with advanced maturity. Because, ADF and NDF contents of stems are higher than the leaves. Similar results were reported by Karslı et al. (2003), Kaya et al. (2004), Erkovan et al. (2009), Turk et al. (2014).

The trends in ADF and NDF contents with increasing maturity are normally the reverse of protein (Rebole et al., 2004). Young plant cells has the primary cell wall, but also the secondary cell wall occurs with maturing. This causes being the more fibrous of

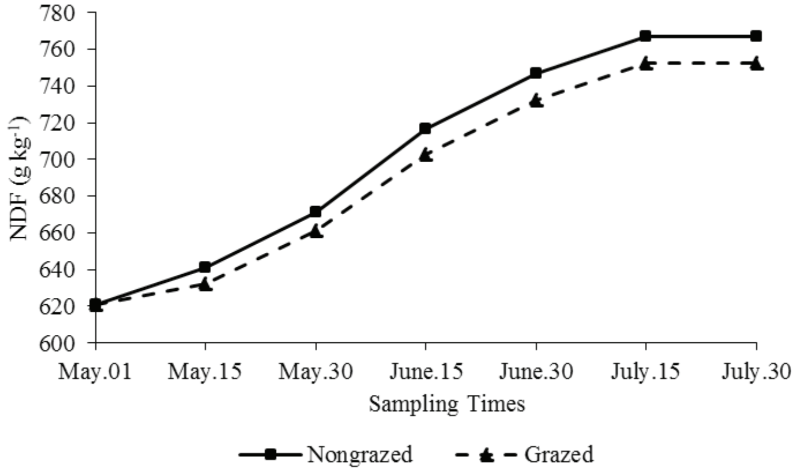

Figure 4. Seasonal variation of NDF contents of smooth bromegrass according to averages of 2011 and 2012.

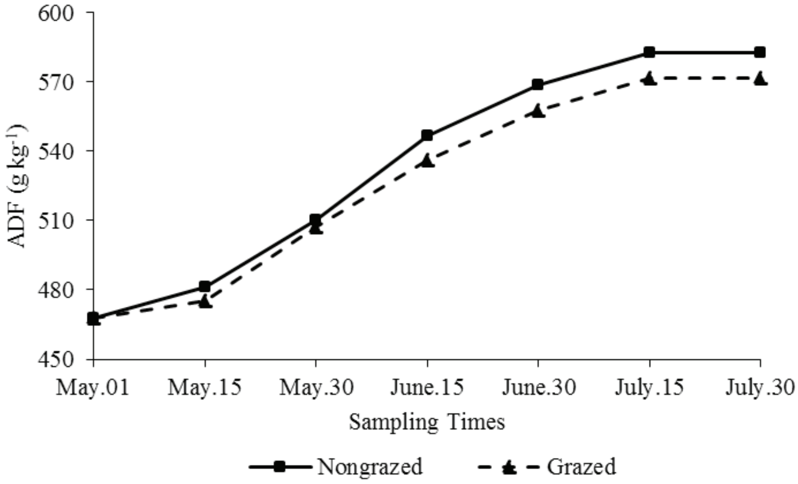

Figure 5. Seasonal variation of ADF contents of smooth bromegrass according to averages of 2011 and 2012.

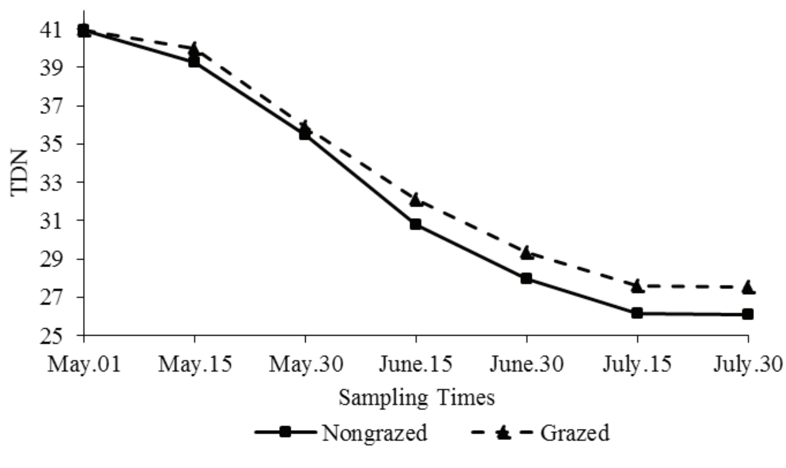

Figure 6. Seasonal variation of TDN values of smooth bromegrass according to averages of 2011 and 2012.

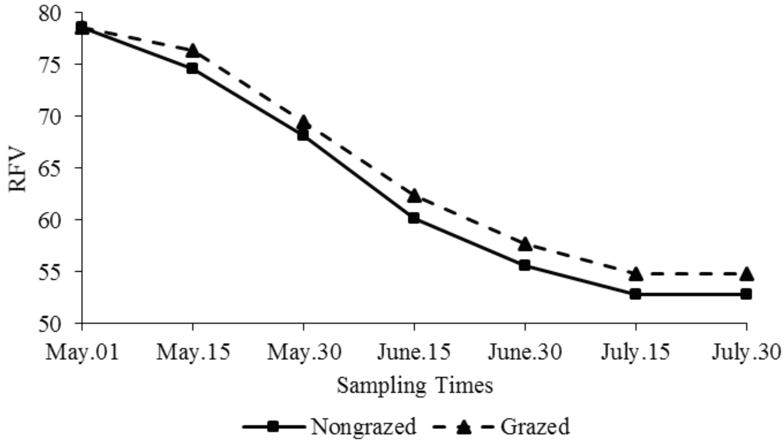

Figure 7. Seasonal variation of RFV values of smooth bromegrass according to averages of 2011 and 2012.

mature plants (Arzani et al., 2004). ADF and NDF contents of non-grazed areas were higher than those of the grazed areas in the present study. This could be explained by the continued re-growth of the plants in the grazed areas.

The highest TDN values were obtained at the beginning of the grazing season, while the lowest TDN values was obtained at the end of the grazing season in the grazed and non-grazed areas (Figure 6). The TDN refers to the nutrients that are available for livestock and are related to the ADF concentration of the forage. As ADF increases there is a decline in TDN which means that animals are not able to utilize the nutrients that are present in the forage (Aydın et al., 2010).

The RFV is an index that is used to predict the intake and energy value of the forages and it is derived from the DDM and dry matter intake (DMI). Forages with an RFV value over 151, between 150-125, 124-103, 102-87 and 86-75, and less than 75 are considered as prime, premium, good, fair, poor and reject, respectively (Lithourgidis et al., 2006). The highest RFV values were obtained on 1st May, while the lowest RFV values were obtained on 30rd July in the grazed and non-grazed areas (Figure 7). The TDN and RFV values of smooth bromegrass in the grazed areas were higher than that of non-grazed areas in this study. It may be associated with the continued re-growth of the plants in the grazed areas because young plant tissues are more nutritious than dead or mature plant (Lyons et al., 1996).

Conclusions

The results from the change in the forage quality of smooth bromegrass in grazing and non-grazing artificially established pastures in Mediterranean conditions of Turkey can be summarised as follows:

1. CP, TDN and RFV decreased throughout the grazing season, while ADF and NDF contents increased in the grazed and non-grazed areas.
2. The ADF and NDF contents of smooth bromegrass in non-grazed areas were higher than the grazed areas.
3. The CP, TDN and RFV values of smooth bromegrass in grazed areas were higher than non-grazed areas.
4. It can be concluded that the harvesting at the late stages caused a reduction in forage quality of smooth bromegrass in the grazed and non-grazing areas.

Acknowledgments

This work was financially supported by TUBITAK (Turkish Scientific and Technological Research Council, project no: 109 O 162).

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