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Determination of Silage Quality, Herbage and Hay Yield of Different Triticale Cultivars

[1]B. Kara, [2]V. Ayhan, [1]Z. Akman and [2]E. Adiyaman
[1]Deparment of Field Crops,
[2]Deparment of Animal Science, Faculty of Agriculture, Suleyman Demirel University,
32260 Isparta, Turkey

Abstract: This study was carried out to determine silage quality, herbage and hay yield of different triticale cultivars (Tacettinbey, Tatlicak-97 and Karma-2000). In the research, besides herbage and hay yield of triticale cultivars, dry matter, organic matter, crude protein, crude lipid, crude fiber, nitrogen-free extract and crude ash, silage pH, flieg point, metabolizable energy and physical quality of triticale silage were examined. Among the cultivars, while the highest herbage yield (22860 kg ha^{-1}), hay yield (14270 kg ha^{-1}), dry matter (43.4%), crude protein content (8.3%), crude lipid (2.91%), crude fiber (27.1%), flieg point (127.8) and the best pH value (4.1) were observed in Karma-2000 cultivar, physical characteristics such as smell, structure and color of the cultivars were similar among cultivars.

Key words: Triticale, cultivar, silage, chemical composition, physical characteristics, herbage yield

INTRODUCTION

Silage is a very important animal feed especially in dairy cattle feeding for economical, balanced and sufficient feeding (Soya *et al*., 1998), therefore silage quality can have a major influence on milk production. Ecological conditions of Turkey are suitable for growing forage crops that are used to make silage. Recently, silage production in Turkey has rapidly increased; however, maize silage constitutes over 80% of the silage production (Alcicek and Karaavaz, 2003), however, this amount is not enough to meet roughage requirement of ruminants. The reason for not meeting roughage requirement of ruminants is that, in Turkey ratio of cultivated forage crops in total cultivated area is low (4-5%). Triticale (xTriticosecale Wittmack), a species resulting from the intergenetic crossing of wheat and rye, has the potential to introduce valuable economic benefits to both grain and herbage production systems (Igne *et al*., 2007). Triticale is a very important alternative forage crop to increase cultivated forage crop area, due to its great adaptation capacity. Since, triticale has adaptation capacity, it is grown in all regions of Turkey. There are several triticale cultivars and genotypes in Turkey, but there is not sufficient research regarding roughage and silage qnality of these cultivars.

The purpose of this study was to determine silage qnality, herbage and hay yield of different triticale cultivars along with chemical composition and quality characteristics of different triticale cultivars.

MATERIALS AND METHODS

Study was carried out in research farm of Suleyman Demirel University during 2007-08 growing season. The experiment was arranged as randomized complete block design with three replications.

Corresponding Author: Burhan Kara, Deparment of Field Crops, Faculty of Agriculture, Suleyman Demirel University, 32260 Isparta, Turkey Tel: +902462114639 Fax: +902462371693

Seeds were sown in the second week of October in plots (6×1.2 m). Prior to sowing, half of the nitrogen fertilizer (40 kg N ha^{-1}) was applied as ammonium sulphate. The other half (40 kg N ha^{-1}) was applied during stalk development (stem formation) as ammonium nitrate. All the phosphorus fertilizer (60 kg P_2O_5 ha^{-1}) was given as triple super phosphate before sowing. In the study, winter/alternative triticale cultivars: Tacettinbey, Tatlicak-97 and Karma-2000 cultivars were used. Characters of cultivars are as follows:

- **Tacettinbey:** The variety is an alternative cultivar, with 1000 grain weight equaling to 35-45 g and resistant to lodging, drought, disease, pests and could be used for feeding and silage
- **Tatlicak-97:** The variety is a winter cultivar, with 1000 grain weight equaling to 33-42 g and resistant to lodging, drought, disease, pests and could be used for feeding, blending flour and silage
- **Karma-2000:** The variety is a brown-seeded, winter cultivar, with 1000 grain weight equaling to 35-40 g and resistant to lodging, drought, cold, stress conditions, disease, pests and could be used for feeding and silage

All cultural practices were kept regular and uniform for all treatments. When plants reached dough stage, a sampling quadron of 1×1 m was created by using wooden slats. Herbage yield was calculated as converted from parcel herbage yield to hectare. The herbages were dried at 20°C room temperature and hay yield was converted from parcel to hectare.

Triticale cultivars were harvested at the dough stage for silage and brought to the laboratory. The samples were chopped at a length of 3-4 cm using a BLACK δ DECKER-GS1400 type mechanical forage cutter. Cut materials were placed in 5 L plastic bags and each group was prepared with three replications. All the bags were carefully closed. The bags were opened after a fermentation of 70 day and silages were analyzed for physical and chemical properties. In the study; dry matter, organic matter, crude protein, crude lipid, crude fiber, nitrogen-free extract, crude ash, pH, silage quality characteristics of triticale cultivars and metabolizable energy were determined in the following ways.

In order to determine the chemical composition of triticale silage, 5 samples obtained from each bags were mixed and pooled, then were taken to analysis laboratory. Firstly, pH values of silages were measured by electronic pH meter and the physical characteristics of silages were evaluated by silage evaluation scale (DLG, 1987). Later, dry matter was identified for samples. For this purpose samples were dried in an air-forced oven at 65°C for 48 h to determine the primary moisture content. Then experimental samples were ground through a 1 mm screen. Crude ash was determined by incineration at 550°C in muffle furnace for 12 h (Naumann and Bassler, 1997). Crude protein was determined by using Kjeldahl method (AOAC, 1990). Crude lipid content was obtained through the Soxholet extraction method using anhydrous diethyl ether. Crude fiber content was determined by using 12.5% H_2SO_4 and 12.5% NaOH solutions (Naumann and Bassler, 1997). Flieg point was calculated using the following formula (Denek *et al*., 2004):

$$\text{Flieg point} = 220 + (2\times\%\ \text{dry matter}-15)-40\times \text{pH}$$

Metabolizable energy was calculated using the following formula (TSE, 2008):

$$\text{ME (kcal kg}^{-1}) = 3260+[0.455\times \text{CP\%}]+[3.517\times \text{CL\%}] - [4.037\times \text{CF\%}]$$

where, ME is metabolizable energy, CP is crude protein, CL is crude lipid, CF is crude fiber. All the data were analyzed with analysis of variance (ANOVA) using SAS statistical package program. Mean values were compared using the Least Significant Difference (LSD) test.

Climatic and Soil Data of the Experimental Area

Isparta has continental climate (cold winters and dry hot summers) with an annual mean rainfall of 500 mm. The long-term average temperature from October to June is 9.5°C. Precipitation is 453.4 mm for the same period. The vegetative periods (from October to June) in 2007-08 had average temperatures of 8.8°C, with total precipitation of 496.6 mm, respectively (Anonymous, 2008).

Soil in a depth of 60 cm was sampled before the start of the experiment and was subjected to physicochemical analysis. The soil texture was loamy, low in nitrogen (0.14 N%) and phosphorus (199 mg kg^{-1} P_2O_5) and organic matter (13.4 g kg^{-1}).

RESULTS

Variance analysis of data regarding herbage yield, hay yield, dry matter, organic matter, crude protein, crude lipid, crude fiber, nitrogen-free extract, crude ash, metabolizable energy, fleig point, pH and physical quality of triticale cultivars were conducted. Means were compared using the Least Significant Difference (LSD) test.

Results showed that highest herbage (22860 kg ha^{-1}) and hay yield (14270 kg ha^{-1}) were obtained from Karma-2000 cultivar compared to other cultivars. Tacettinbey and Tatlicak-97 cultivars had similar herbage and hay yield ($p>0.05$) (Table 1).

Results indicated that there were significant differences in terms of dry matter, crude protein, crude lipid and crude fiber ($p<0.05$) among cultivar silage and no significant differences in terms of organic matter, crude ash and metabolizable energy ($p>0.05$). Among triticale cultivars, the highest dry matter (43.4%), crude protein (8.3%), crude lipid (2.91%) and crude fiber (27.1%) were obtained from Karma-2000 and highest nitrogen-free extract (53.8%) was determined from Tatlicak-97. The lowest dry matter (41.0%), crude protein (7.1%), crude lipid (2.50%) and crude fiber (24.5%) were determined from Tatlicak-97 and nitrogen-free extract (49.5%) was obtained from Karma-2000 (Table 2).

Results given in Table 3 indicated that the highest flieg point (127.8) and the best pH value (4.1) were obtained from Karma-2000 cultivar compared to other cultivars ($p<0.05$). The lowest flieg point (111.0) and the highest pH value (4.4) were determined from Tatlicak-97 cultivar ($p<0.05$). Physical characteristics such as smell, structure and color of triticale cultivars were similar among cultivars ($p>0.05$).

Table 1: Herbage and hay yield of triticale cultivars

Triticale cultivars	Herbage yield (kg ha^{-1})	Hay yield (kg ha^{-1})
Tacettinbey	21670b	13350b
Tatlicak-97	21500b	13550b
Karma-2000	22860a	14270a
Mean	22010	13720
Significant level	*	*
LSD	660.6	709.4
CV	4.82	8.33

Mean values in the same column followed by the same letter(s) are not significantly different; *$p<0.05$

Table 2: Chemical composition of triticale cultivars silage

		Dry matter basis (%)						
Triticale cultivars	Moisture basis, dry matter (%)	Organic matter	Crude protein	Crude lipid	Crude fiber	Nitrogen-free extract	Crude ash	ME (kcal kg^{-1})
Tacettinbey	43.3a	87.7	8.2a	2.90a	24.8b	51.7ab	12.2	3173.8
Tatlicak-97	41.0b	88.0	7.1b	2.50b	24.5b	53.8a	12	3172.6
Karma-2000	43.4a	87.8	8.3a	2.91a	27.1a	49.5b	12.1	3164.4
Mean	42.6	87.8	7.9	2.8	25.5	51.6	12.1	3169.6
Significant level	*	NS	*	*	*	*	NS	NS
LSD	1.583	-	0.972	0.086	1.614	2.56	-	-
CV	0.99	0.56	5.44	0.82	2.79	1.66	1.06	0.071

Mean values in the same column followed by the same letter(s) are not significantly different; *$p<0.05$; NS: Non Signification; ME: Metabolizable Energy

Table 3: Silage quality characteristics of triticale cultivars

Triticale cultivars	Flieg point	pH value	Physical characteristics				Quality classification
			Smell	Structure	Color	Score	
Tacettinbey	123,6 a	4.2 b	14	4	2	20	Very good
Tatlicak-97	111.0 b	4.4 a	14	4	2	20	Very good
Karma-2000	127.8 a	4.1 b	14	4	2	20	Very good
Mean	120.8	4.2	14	4	2	20	Very good
Significant level	*	*					
LSD	5.56	0.173					
CV	5.6	2.53					

Mean values in the same column followed by the same letter(s) are not significantly different; * $p<0.05$

DISCUSSION

In the study, variations occurred among triticale cultivars regarding herbage and hay yield. The highest herbage and hay yield was obtained from Karma-2000 cultivar compared to other cultivars. It is thought that differences in herbage and hay yield among cultivars resulted from genetic traits of the cultivars and environmental factors (Terzioglu *et al*., 2008; Terzioglu and Yildirim, 2008).

In the study, variations were observed among triticale cultivars regarding dry matter, crude protein, crude lipid, crude fiber and nitrogen-free extract, fleig point and pH value. While the highest chemical composition and silage quality characteristics were obtained from Karma-2000 cultivar, the lowest chemical composition and silage quality characteristics of were observed from Tatlicak-97. In the research, dry matter, organic matter, crude protein, crude lipid, crude fiber, nitrogen free extract, crude ash, metabolizable energy, fleig point and pH varied between 41.0-43.4, 87.7-88.0, 7.1-8.3, 2.50-2.91, 24.5-27.1, 49.5-53.8 and 12.0-12.2%, 3164.4-3173.8 kcal kg^{-1}, 111-127.8 and 4.1-4.4, respectively.

Physical characteristics such as smell, structure and color of the cultivars were similar among treatments. Similar results were also obtained by Messman *et al*. (1992), Demirel and Yildiz (2001) and Konca *et al*. (2005). Silage quality characteristics such as pH, physical characteristics and fleig point showed that the triticale cultivars posses all traits of quality silage (Alcicek and Ozkan, 1997; Ergul, 1997).

CONCLUSION

In this research, among the cultivars the highest herbage and hay yield were obtained from Karma-2000 cultivar. Chemical composition of Karma-2000 cultivar silage was better than that of other cultivars. As a result, it is possible to say that a good quality silage can be produced from triticale. For silage makers we could advise Karma-2000 cultivar because of its higher silage quality.

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