INVESTIGATION OF BOTANICAL COMPOSITION, FEED VALUE, ORGANIC MATTER DIGESTIBILITY AND NET ENERGY LACTATION OF GRASS SILAGE AT EARLY MATURITY STAGE BY IN VIVO AND IN VITRO METHODS

GÜL, S.

Namık Kemal University, Vocational School of Technical Sciences Plant and Animal Production Department, TR-59030 Tekirdağ, Turkey
(e-mail: sgul@nku.edu.tr; phone: +90-282-250-4014; fax: +90-282-250-9934)

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Abstract. This study was carried out to determine botanical composition, nutritive value, organic matter digestibility (OMD) and net energy lactation (NEL) of grass ensiled at early (early maturity, first cut) stage of maturity. In vivo and in vitro (gas test) methods were both used. The feed material of the study was taken from the producers in three different regions of (Arisu, Edremit, Kurubas) Van province at the first cutting period (1 June). Approximately 1000 kg of grass was cut from each pasture with a mower. It was kept in plastic bins, closed tightly and turned upside down until the day the silos were opened. In addition, 0.25-m^2 areas were cut, divided into species when wet, and the rate of participation of species in yield was calculated. Chemical analyses and in vivo and in vitro (gas test) experiments were conducted on the silage which was opended on the 60th day after it had been ensiled. According to the analysis; silages obtained from Edremit, Kurubas and Arisu pastures contained 27.38%, 22.30%, 24.78%, of dry matter 9.51%, 14.76%, 14.27% of crude protein, respectively; in vivo OMD was found 70.70%, 79,17%, 55.85%, and in vitro OMD_{48} h was found 66.79%, 61.65%, 61.15%, respectively. At the same time, the correlation between in vivo OMD and in vitro OMD_{48} hour was found R^2 0.99. It has been determined that Gramineae family is the dominant plant population in the pastures of Van province. In conclusion, it has been evaluated that grass ensiled at early maturity (first cut) stage increased organic matter digestibility of silages.
Keywords: *digestibility, grass, silage, maturity, gas test, lactic acid*

Introduction

Grass silages are important ruminant rations in Western Europe and in other region of the world. Their nutritive value can highly affect animal performance and the need for supplemental concentrates (Holtshausen et al., 2012; Weiby et al., 2022). The nutritive value of grass silage is affected by the stage of maturity of grass (at the time of) harvest (Nousiainen et al., 2003; Holtshausen et al., 2012; Weiby et al., 2022). Harvesting grasses for silage at early maturity stages is known to increase the organic matter digestibility and promotes high milk production of dairy cows (Randby et al., 2012; Nadeau et al., 2019). The most accurate determination of feeds nutritive value can be done through in vivo studies. But their labouriousness, need for large quantities of feed and high cost make it unsuitable for routine feed evaluation systems. Hence, prediction of digestibility of feeds using reliable, simple and inexpensive techniques is important (Rodriguez et al., 2005). As an alternative to in vivo studies, in vitro gas production (GP) techniques has been developed by Menke at al. (1979). The in vitro gas production (GP) technique is cheap, well standardized and widely used to evaluate the nutritive value of ruminant feeds by incubating substrate in buffered rumen fluid. In vitro gas production method used to estimate digestion of feeds is based on measured relationships between the in vivo digestibility of feeds and in vitro gas production, in combination with the feed's chemical composition (Menke at al., 1979; Getachew at al., 1998; Hatew et al., 2015; Macome et

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al., 2017). The objective of this study was to use in vivo and in vitro (gas test) methods to determine organic matter digestibility and NEL contents of grass ensiled at early (first cut) stage of maturity.

Material and Methods

Grass sample

The feed material of the study was from pastures of producers in three different regions of (Arisu, Edremit, Kurubas) Van province at the first cutting period (1 June). Van province is located between 42° 40' and 44° 30' east longitudes and 37° 43' and 39° 26' north latitudes in Turkey. Arisu, Edremit and Kurubas pastures are located between east longitudes and northern latitudes 38° 37' 12.9720' - 43° 13' 43.9608', 38° 25' 23.524 - 43°16' 13,842, 38° 27´ 18.2124" - 43° 24´ 37.8540", respectively. The map showing the location of Arisu, Edremit and Kurubas pastures in Van is given in *Figure 1*. Van has a continental climate. The annual mean temperature is 9.4° and total rainfall is 387 mm. Snowfall occurs from November to the end of April. Chestnut colored soils constitute the largest soil group in Van province with a rate of 49.21%. This group is followed by calcareous brown soils with a ratio of 15.62% and brown soils with a ratio of 13.00%, respectively. Alluvial soils with high yields have a rate of 3.22%. Van Lake, which is a soda lake with high pH, has a great effect on the formation and characterization of the soils of the pastures in the study area (Karaca et al., 2019). In order to determine the grass yield of the pastures, the weeds in a 1-m^2 frame from each of the three pastures were harvested from the bottom and weighed and the grass yield of the pastures was determined. With these samples, natural dry matter analysis was carried out, and the hay yields of the pastures were calculated. In addition, 0.25-m^2 areas were cut, divided into species when wet, and the rate of participation of species in yield was calculated (Tosun and Altin, 1981). The floristic composition of the pastures was determined according to the herbarium rules, using the images in the Van flora virtual book and the flora of Turkey (Davis, 1965-1988). Approximately 1000 kg of grass was cut from each pasture with a mower for silage. It was kept in plastic bins, closed tightly and turned upside down until the day the silos were opened.

Figure 1. *Location of Arisu, Edremit and Kurubas pastures*

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In vivo methods

In vivo digestibility of silages was performed with Akkaraman rams (mean LW 60-70 kg) kept individually in cages. Latin square designs with 21 days periods and the last 7 days were used for the fecal collection. Akkaraman rams were fed with grass silages at approximately maintenance level (35g $DMkg^{-1}$ $LW^{0.75}$). Rams had free access to feed mineral vitamin blocks. Diet samples, refusals and feces were collected and put in the freezer for later chemical analyses (Bulgurlu and Ergul, 1978).

In vitro gas production test

Gas production was measured using glass syringes as described by Menke et al. (1979). At least eight replicates per silage groups distributed across 4 independent incubation periods were done. Fistullated animals were fed grass hay for adlibitum intake, 250 g of a concentrate mix and 10 g of vitamin mineral mix daily. Rumen liquid was taken from ruminally fistulated Akkaraman rams before the morning feeds. Rumen fluid was transferred into a pre-warmed (39°) insulated flask to the laboratory. The silage groups were formed in 4 repetitive designs of each silage. Determination of the gas production values at the 24, 48, 96th hours was measured with the in vitro gas production technique which was described by Menke and Steingass (1988). Approximately 200 mg of the silage samples were weighed in glass syringes. Rumen fluid was filtered through two layers of linen cloth and mixed with buffered medium at ratio of 1:2 and dosed at a volume of 30 ml with each syringe. The correction factors for hay and concentrate were calculated based on the two standard feedstuffs.

Chemical analyses

Chemical analyses were performed with triplicate measurements. Three jars per treatment from all groups were sampled for analysis of chemical, cell wall contents, in vitro organic matter digestibility and NEL contents of grass silages. The silage and faeces samples were dried at 60° for 72 h in a fan assisted oven. After drying samples were ground through a 1-mm screen for chemical analyses. The dry matter (DM) was determined by drying the samples at 105 ºC for 4 h. DM, Ash, crude protein (CP), ether extracts (EE) contents of silage and faeces samples were determined according AOAC (1990). Crude fiber (CF) contents of silages and faeces were determined in accordance with Van Soest et al. (1991). pH values of samples were determined according to Bulgurlu and Ergul (1978). Butyric acid (BA), lactic acid (LA) and acetic acid (AA) contents of silages were determined according to the analysis method of Lepper (Bulgurlu and Ergul, 1978).

Equations used to calculate in vivo digestible nutrients and NEL contents (Bulgurlu and Ergul, 1978):

$$\text{DDN\%} = \frac{\text{Consumed Nutrient - Nutrient Excreted With Manure}}{\text{Consumed Nutrient}} \times 100 \qquad \text{(Eq.1)}$$

$$\text{NEL MJ/kg} = 0.6\ [1+0.004\ (q-57)]\ \text{CE} \qquad \text{(Eq.2)}$$

$$Q = \text{CE} \times 100/\text{GE}$$

Equations for calculating in vitro organic matter digestion degree and NEL content:

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$$NEL\ MJ/kg = 0.101\ GP + 0.051\ CP + 0.112\ EE \text{ (Menke at al., 1979)} \quad (Eq.3)$$

$$OMD\% = 0.7602\ GP + 0.5365\ CP + 22.53 \text{ (DLG, 1991)} \quad (Eq.4)$$

Statistical analysis

Statistical analyses were performed with the general linear model (GLM) procedure of Duncan's multiple range test performed with the Statistical Analysis System (2005) Software (SAS, Cary, N.C.).

$$Yij = \mu + ai + ei \quad (Eq.5)$$

where
Yij = studied traits; μ = overall mean; ai = fixed effect of the treatment; eij = random effect.

Results and Discussion

The distribution of botanical and floristic compositions of Arisu, Kurubas and Edremit pastures are given in *Table 1, Table 2*. The results show that, the plants belonging to the Gramimineae family are the highest in the Arisu (41.81%), the plants belonging to the Leguminoseae family are the highest in the Edremit (36.14%) and the plants belonging to the other families are the highest in Kurubas pastures (37.77%) ($P<0.01$). Proportion of gramineas in Turkey are between 19.3%-57.0% (Bozkurt and Kaya, 2010; Sen and Hatipoglu, 2010; Agin and Kokten, 2013; Cınar et al., 2015; Oten et al., 2016; Babalik et al., 2018). Proportion of legumes in similar studies in Turkey were between 1.3%-31.0% (Oten et al., 2016; Babalik et al., 2018). Proportion of species of other families in similar studies in Turkey were between 25.4%-64.5% (Agin and Kokten, 2013; Oten et al., 2016; Seydosoglu et al., 2019). There are numerous factors affecting botanical composition: nutritive value of grasslands including water avability, effects of climate, type of soil and local geographical location (Andueza et al., 2010).

Table 1. *Botanical composition of pasture %*

Pasture	Gramineae	Leguminoseae	Other Families	Sem	P
Arısu	41,81±5,37a	25.32±3.98c	32.87±5.97b	1.57	0.01
Edremit	34.57±6.88b	36.14±6.02a	29.29±5.59c	1.56	0.01
Kurubaş	31.19±5.42c	31.05±9.67b	37.77±8.95a	0.83	0.01

P<0.01

Green grass and hay yields of pastures are determined and given in *Table 3*. It was determined that the green grass yield and hay yield ranged between 1521-2650 kg/ha, and 417-531 kg/ha relatively ($P<0.05$). Previous studies findings in Turkey showed that green yield ranged between 1781-6072 kg/ha (Cacan and Kokten, 2014; Babalik et al., 2017; Yildiz and Ozyazici, 2017). The results of this study and the results of previous studies

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were similar. Seydosoglu et al. (2019) found green grass yield as 1600 kg/ha. In this study green grass findings were higher than previous study findings of Seydosoglu et al. (2019). The hay yields ranged between 465-2208 kg/ha (Sen and Hatipoglu, 2010; Cacan and Kokten, 2014; Babalik et al., 2017; Yildiz and Ozyazici, 2017). The hay yield of Arisu pastures was found to be compatible with the previous study findings while the hay yield of Kurubas and Edremit pastures were lower than the literature reports. The difference with the literature reports is due to the grazing regime of the pastures, and to topographic and ecological differences.

Nutrient content of silages is presented in *Table 4*. Dry matter contents of the silages were ranged from 22.30 and 27.38% and were significantly differing among the pastures ($P<0.001$). The highest dry matter content was found in Edremit pasture (27.38%) and the lowest dry matter content was found in Kurubas pasture (22.30%). Dry matter contents of silages were similar to those reported by Bureenok et al. (2012), Randby et al. (2015), Khota et al. (2016) and Tomaz et al. (2018) while lower than those reported Warner et al. (2015), Warner et al. (2016), Macome et al. (2018) and Arslan et al. (2020). Klicher (1981) reported that plant type, season, climate, soil moisture, fertility, leaf steam ratio, soil type, physiological, morphological factors may vary with annual versus perennials grasses and legumes affecting the rate of change in nutrient composition with advancing plant development.

The organic matter content of silages was determined as 85.97%, 87.45% and 86.37% for Arisu, Edremit and Kurubas pastures, respectively ($P<0.005$). OM contents of silages was similar to those reported by Metler-Zebeli et al. (2012); Macome et al. (2018); Arslan et al. (2020) while lower than reported by Holtshausen et al. (2012); Warner et al. (2015); Khota et al. (2016); Kaya et al. (2009) stated that OM concentration is inversely related to ash concentration. Differences between previous studies stem from plant type, season, climate, soil moisture, fertility, leaf steam ratio, soil type, physiological, morphological factors and may vary with annual versus perennials grasses and legumes affecting the rate of change in nutrient composition.

Crude protein (CP) contents of the silages were ranged between 9.51-14.76% and they were significantly differing among the pastures ($P<0.001$). Crude protein contents of Kurubas (14.76%), Arisu pastures (14.27%) were higher than that of Edremit pasture (9.51%). The findings on CP contents of silages are consistent with those found by Warner et al. (2015) and Rinne et al. (2020). CP contents of silages were higher than those reported by Metler-Zebeli et al. (2012), Randby et al. (2015), Khota et al. (2016) and Arslan et al. (2020) while lower than the findings of Holtshausen et al. (2012); Macome et al. (2018) and Rinne et al. (2020). Differences in nutrient composition of the silages are also likely due to differences in the stage of growth and plant part (leaves, soft steam). Elghandour et al. (2013) stated that the stage of maturity is the most important factor on crude protein content of grass. Differences in CP contents between the grasses were probably due to stage of maturity, the N profile of the soils where they were grown and differences in efficiency of protein accumulation in them during growth.

In the study ash contents of silages ranged between 12.55-14.03% and they were significantly differing among the pastures ($P<0.05$). Ash content of Arisu (14.03%) was higher than that of Kurubas (13.63%) and Edremit (12.55%) pastures. Ash content of silages were higher than those reported by Nouisiainen et al. (2003), Jančik et al. (2011), Särkijarvi et al. (2012) and Nadeau et al. (2019). Differences between the previous studies might be related to dilution and translocation of minerals from vegetative portion of the plant to roots at stage of maturity.

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***Table 2.** Floristic composition of the pastures*

Pasture	*Gramineae*	*Leguminoseae*	*Other Families*
Arisu	*Alopecurus myosuroides* *Bromus scoparius L.* *Bromus sterilis L..* *Cynosurus cristatus L* *Hordeum geniculatum ALL.* *Poa angustifolia L.* *Poa pratensis L.* *Poa bulbosa L.* *Poa sterilis BIEB.* *Secale cereale L.* *Poa bulbosa L.*	*Astragalus odoratus LAM.* *Lotus corniculatus L.var. corniculatus (BIEB) ARC.* *Medicago sativa L.subsp. sativa L.* *Medicago sativa L.subsp. coreulea* *Trifolium hybridum L.var. hybridum L.* *Trifoium pratense L. var. pratense BOISS. ET BAl* *Trifolium repens L. var.repens L.*	*Carex distans L.* *Carex divulsa STOKES subsp.* *Cirsium arvense L. SCOP subsp .arvense* *Cirsium arvense SCOP subsp.vesitum* *Crepis sancta L. BABCOK* *Taraxacum androssovi SCHISCKIN* *Anchusa arvensis L. BIEB. SUBSP. VESTİTUM (WIMMER ET GRAB.) PETRAK* *Erodium circutarium L.* *Convolvulus arvensis L.* *Veronica pusilla KOTSCHY var.* *Cardaria draba L.* *Silene vulgaris GARCKE var* *Stellaria kotschyana FENZL* *Polygonum cognatum* *Rumex cripus L.* *Salvia verticiliataL.* *Plantago lancelota l.* *Potentilla anatolica*
Edremit	*Bromus japonicus THUNB* *Bromus lanceolatus ROTH* *Elymus nodosus subsp. Gypsicolus* *Glyceria plicata* *Hordeum bulbosum L.* *Poa angustifolia L.* *Poa pratensis L.*	*Lathyrus tuberosus L.* *Lotus corniculatus L. var. corniculatus (BIEB) ARC.* *Medicago lupulina L.* *Medicago sativa L.subsp. sativa L.* *Trifolium pratense L.var. pratense BOISS. ET BAL* *Trifolium repens L. var repens L.* *Vicia sativa L. subsp. Nigra (L) EHRH. Var.segetalis (THUILL.) SER. EX DC.*	*Carex dilluta BIEB.* *Carex divulsa STOKES subsp. Coriogyne* *Colchicum szovitsii FISCH* *Tarxacum purpurespetiolatum* *Tragopogon longirostis BISCH.* *Convolvulus arvensis L.* *Pedicularis comosa L. var. acmondonta (BOISS.)* *Rhynchocorys odontophylla* *Plantago lancelota L.* *Potentilla speciosa WILD.* *Ranunculus kotschyi BOISS* *Ranunculus oxyspermus WILD* *Chellathas marantae L. DOMIN*
Kurubaş	*Elymus nodosus MELDERIS subsp.* *Poa angustifolia L.*	*Lotus corniculatus L.* *Medicago lupulina L.* *Medicago sativa L.* *Onobrychis.altissima GROSSH* *Trifolium pratense L.* *Trifolium repens L.*	*Carex diluta BIEB* *Carex distans L.* *Cirsium arvense L.* *Taraxacum androssovii* *Taraxacum purpureipetiolatum* *Convolvulus arvensis L.* *Pedicularis comosa L.* *Cardaria draba L.* *Polygonum cognatum MEISSN* *Salvia verticillate L.* *Plantago lanceolata L.*

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Table 3. *Green grass and hay yields of pasture kg/dec*

	Arisu	Edremit	Kurubas	Sem	P
Green grass	2650,00±150,00a	1521,00±789,00c	2180,00±870,00b	163.72	0.000
Hay yield	531,00±51,00a	417,00±244,50a	471,50±248,50a	16.52	0.000

P<0.01

Table 4. *Results of the chemical analyses of the grass silages (% DM)*

	Arisu	Edremit	Kurubas	Sem	P
DM	24.78b	27.38a	22.30c	0.747	0.000
OM	85.97b	87.45a	86.37b	0.261	0.020
CP	14.27a	9.51b	14.76a	0.84	0.000
EE	2.10	2.24	1.63	0.29	NS
Ash	14.03a	12.55b	13.63c	0.26	0.027
CF	43.34a	34.14b	31.02c	0.28	0.000
NFE	26.26c	41.57a	38.89b	2.36	0.000
pH	5.65	5.37	5.75	0.15	NS
LA	41.37b	67.25a	42.12b	4.25	0.000
AA	15.73b	29.00a	10.10c	2.80	0.000
BA	42.90b	3.74c	47.77a	6.96	0.000

P<0.05, P<0.01. DM: dry matter, OM: organic matter, CP:crude protein, EE: ether extract, CF: crude fiber, NFE: nitrogen free extract, LA: lactic acid, AA: asetic acid, BA: butyric acid

CF (crude fiber) contents of silages were determined in the range 31.02-43.34% in all pastures. CF content of Arisu pastures (43.34%) were higher than that of Edremit (34.14%) and Kurubas (31.02%) pastures. The differences between the pastures were found to be statistically significant (P<0.01). Study CF findings were higher than those reported by Metler-Zebeli et al. (2012), Macome et al. (2018), Särkijarvi et al. (2012) and Rinne et al. (2020) while they were similar with the findings of Kaya et al. (2009). The differences between previous study findings are due to plant variety, physiological, morphological factors and soil structure.

In the study LA contents of silages ranged between 41.37%-67.25%. The highest LA value was found in Edremit pasture (67.25%) followed by Kurubas (42.12%), and Arisu pasture (41.37%) and they were significantly differing among the pastures (P<0.01). The LA contents of silages were higher than in the previous studies of Warner et al. (2015), Särkijarvi et al. (2012), Burenok et al. (2019), Gul et al. (2008), Khota et al. (2016), Tomaz et al. (2018) while lower than the findings of Randby et al. (2015), Nadeau et al. (2019). LA contents were similar with findings of Adesogan et al. (2002). In the study pH values were higher and LA contents of grass silages were lower than it is generally accepted for a good quality grass silage. LA levels of quality silages are reported as 50-70 g/kg of silage DM (Lorenzo and O’Kiley, 2008). LA level could be attributed to the pH range which might be contributed to acetobacters activity. LA is transformed to acetic acid by acetobacter at certain pH values causing the increase of silage pH (Kayembe et al., 2013). Baytok et al. (2005) and Kayembe et al. (2013) emphasized that higher pH and lower LA content didn’t adversely affect nutritive value of silage. High LA level is essential of fermentation quality. It’s not effective on animal performance.

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AA contents of silages ranged between 10.10-29.00% and they were significantly differing among the pastures (P<0.01). AA contents were lower than those reported by Aksu et al. (2017); Tomaz et al. (2018) while higher than Särkijarvi et al. (2012) and Randby et al. (2015). AA contents were similar with findings of Khota et al. (2016) and Warner et al. (2016). AA content of grass silage is also important as much as content of LA for protection of DM and cell wall components of grass silage (Kayembe et al., 2013; Aksu et al., 2017). High level AA caused by the buffering capacity in the silages with dry matter lower than 25% was expected fermentation pattern alfalfa silages (Kung and Shaver, 2001). Grass silages usually contain 10 to 30 g/kg of DM acetic acid (Mc Donald et al., 1991).

In the study BA contents of silages ranged between 3.74-47.77% and they were significantly differing among the pastures (P<0.01). BA findings were similar with findings of Nousiainen et al. (2003) and Bureenok et al. (2019). BA contents of silages were similar with findings of Khota et al. (2016) and Warner et al. (2016) while lower than those of Jančık et al. (2011) and Randby et al. (2015). BA contents of silages were higher than in the previous study of Khota et al. (2016).

In vivo and in vitro organic matter digestibility (OMD) and net energy lactation (NEL) contents of grass silages were determined and given in *Table 5*. In the study in vivo OMD value ranged between 55.85-79.17%, respectively. The highest in vivo OMD was determined as 79.17% in the Kurubas pastures (P<0.01). Silage OMD finding is similar to the findings of Nadeau et al. (2019), Särkijarvi et al. (2012); Macome et al. (2018), Burenook et al. (2012), Warner et al. (2016), Rinne et al. (2020). It was found to be lower than the findings of Dønnem et al. (2011). Jalali et al. (2012) emphasized that grass maturity is one of the most important factors affecting forage quality. In this study grass silage at an early maturity stage showed greater in vivo organic matter digestibility. Norgaard and Kornfelt (2006) emphasized that higher proportion of small particles can be observed in the feces of cattle when it was fed early cut silage with greater digestibility compared with barley straw with lower fiber quality. The CF and nötral detergen fiber (NDF) digestibilities were mostly affected by grass species and therefore also had the greatest effect on DM and OM digestibility (Särkijarvi et al., 2012).

Table 5. *Results of the chemical analyses of the grass silages (% DM)*

In vivo	**Arisu**	**Edremit**	**Kurubas**	**Sem**	**P**
OMD	55.85c	70.70b	79.17a	3.85	0.000
NEL	4.35	4.78	4.78	0.16	NS
In vitro					
OMD_{24}	52.07c	56.66a	54.81b	0.68	0.00
OMD_{48}	61.15b	66.79a	61.65b	0.91	0.00
OMD_{96}	68.24b	72.15a	65.52c	0.97	0.00
NEL_{24}	3.87	4.59	4.18	0.17	NS
NEL_{48}	5.07	5.93	5.08	0.20	NS
NEL_{96}	6.02	6.65	5.60	0.21	NS
GP_{24}	28.78c	38.19a	32.04b	1.38	0.00
GP_{48}	40.73b	51.51a	41.04b	1.77	0.00
GP_{96}	50.06b	58.56a	46.14c	1.83	0.00

P<0.01, OMD: organic matter digestibility, NEL: net energy lactation, GP: gas production

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In vitro (gas test) OMD value of silages at 24, 48, 96 hours were determined as 52.07-56.66%, 61.15-66.79%, 65.52-72.15% relatively ($P<0.01$). The highest OMD value was determined in Edremit pastures at 24, 48, 96 hours. OMD values were similar with the findings of Jančık et al. (2011), Särkijarvi et al. (2012), Nadeau et al. (2019), Rinne et al. (2020). OMD findings of this study was lower than the findings of Nousiainen et al. (2003), Dønnem et al. (2011); Warner et al. (2015); Macome et al. (2017). More efficient ruminal bacteria digest DM and cell wall fractions of forage and also passage rate may be responsible for the more efficient digestion in ruminants (Särkijarvi et al., 2012).

Correlation between in vivo OMD and in vitro OMD_{48}

Correlation between in vivo OMD and in vitro OMD_{48} hour was R^2 0.99 found. Gas production (GP) were found for the 24, 48 and 96th hour, 28.78-38.19, 40.73-51.51 and 46.14-58.56 respectively ($P<0.01$). GP values of study were lower than the findings of Ribereo et al. (2014); Metler-Zebeli et al. (2012). It is reported that high cell wall components and lignin content reduce the rate and extent of gas production (Getachew et al., 2000). This supressing effect results from the reduction of attachment of microbes in rumen to the feed particles. Differences are between gas production values stem from chemical composition of feeds.

Conclusion

The results of the study showed that the Gramineae are the dominant plant population in pastures of Van district and grass ensiled at maturity stage increased the in vivo and in vitro OMD digestibility. The crude protein contents of pastures (at early stage) met needs of ruminants in lactation.

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