ISPEC Tarım Bilimleri Dergisi
6(1): 136-143, 2022

Araştırma Makalesi

E-ISSN:2717-7238

www.ispecjournal.com

ISPEC Journal of Agr. Sciences
6(1): 136-143, 2022

Research Article

Sevilay GÜL[1a*]

[1]Tekirdağ Namık Kemal University, Vocational School of Technical Sciences Plant and Animal Production Department, Tekirdağ

[1a]**ORCID**: 0000-0002-5695-1089

[*]Corresponding author

sgul@nku.edu.tr

DOI

https://doi.org/10.46291/ISPECJASvol6iss1pp136-143

Alınış (Received): 25/10/2021

Kabul Tarihi (Accepted): 28/11/2021

Keywords
H. microcarpum, additive, silage quality, OM, digestibility

Investigations into Feed Value of *Hippomarathrum microcarpum* (Bieb) Fedtsch silages

Abstract
The aim of this study was to determine chemical composition, in vitro organic matter digestibility and energy contents of H. microcarpum silage. H. microcarpum was harvested at growing stage. Forage was chopped and divided into trial two groups for the control and 5% molasses. H. microcarpum ensiled in special 1.0 liter anaerobic jars. Chemical and in vitro cellulase method were conducted on the silage which was opened on the 60th day of storage. According to the analysis of the control, 5% mollases treatments, dry matter reached 18.97%, 23.41% and metabolisable energy reached 7.65, 9.81 MJ/kg KM; while organic matter digestibility was 55.50% and 72.35%, respectively. In conclusion, addition of molasses can increase dry matter content and organic matter digestibility of canola silage.

INTRODUCTION

H. microcarpum, which belongs to the Apiaceae family, grows naturally in the Balkans, Sicily, Caucasus, Iran and Turkey in many parts of the world. H. microcarpum, a perennial plant that grows at high altitudes of 1000-2800 m, grows from 50 to 100 cm (Davis, 1972). It is widely grown in high parts of The Eastern Anatolia region of Turkey. Since the Eastern Anatolia region has a semi-arid climate, more livestock is being produced in the region due to the long winter. In addition to the roughage (grass hay, straw, alfalfa hay) the farmers in the region use *H. microcarpum* as an alternative source of roughage. It can be fed in pasture while green in the region and after completing the vegetation, it is harvested and stored and fed to animals in winter. It is reported that the whole plant or dried leaves in Siirt, Hatay and Van region increase meat and milk yield when used as animal feed (Tuzlacı, 1985; Ozturk and Ozcelik, 1991). There is a very limited number of literature on the use of the *H. microcarpum* plant as a source of coarse feed in animal feeding. In an attempt to cultivate *H. microcarpum* and add it to the list for forage types, Ertuş et al., (2011) conducted studies and likewise Güngör (2002) conducted researches on cultivation of *H. microcarpum* to be included in the list of edible-vegetables while also conducting studies on germination biology. The aim of this study is to determine the nutritional content of H. microcarpum by making silage and to spread the use of local producers as silage in dairy cattle.

MATERIAL and METHODS

H. microcarpum grown on a farm located in Gevaş on the Van Lake of Turkey (33º 28' N, 43º, 21' E, elevation 1727 m). The annual mean temperature is 8.9 ºC. H. microcarpum was harvested at growing stage. Forage was chopped (1.0-1.5 cm theoretical length of cut). Silage material divided into two trial groups for the control, 5% molasses. The material mixed with additive was pressed in 30 (1 liter) glass jars (Weck, Wher-Oftlingen, Germany) equipped with lids that enabled gas release only. The jars were stored under constant room temperature (20±1ºC). Three jars per treatment from all groups were sampled on day 60 for analyses of chemical, cell wall contents, in vitro organic matter digestibility and energy contents of *Hippomarathrum microcarpum* silages.

Analytical procedure

Chemical analyses were performed on triplicate samples. The fresh and silage samples were dried at 60 ºC for 72 h in a fan-assisted oven. After drying, samples were ground through a 1 mm mesh screen for chemical analysis. The dry matter (DM) was determined by drying the samples at 105 ºC for 4 h. Crude protein, crude fibre and ash contents of samples were determined according to the methods of AOAC (2012). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) content determined as described by Van Soest et al. (1991). pH values fresh and silage samples were determined according to MAFF (1986). Relative feed value was determined by calculation (Van dayke and Anderson, 2000). Using the method developed by Ashbell et al. (1991), the silages opened on the 60th day of silo were subjected to aerobic stability test for 3 days. Silages were scored by three different observes in terms of color, smell and structure. The physical evaluations of the feeds were made by averaging the scores given by the three observes (Akyıldız, 1984; Kılıç, 1986).

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.).

$Y_{ij} = \mu + a_i + e_{ij}$

Y_{ij}= studied traits

μ= overall mean

$a_{i=}$ = fixed effect of the treatment

e_{ij}= random effect

For all statistical comparisons, a probability level of P<0.05 was accepted as statistically significant. When significant associations were identified, the mean values for each effect were contrasted using Duncan test.

RESULTS and DISCUSSION

Chemical composition of feeds is as illustrated in Table 1. Research findings postulate that in control group DM content of *H. microcarpum* silages is 18.97% while in molasses group the ratio is 23.41%. The difference between both applications was determined to be statistically significant (P<0.01). DM-content draws parallelism with the statement of Güngör (2002) while the ratio is higher compared to Tunçtürk and Özgökçe (2015)'s statement. The cause of the difference between literature statement and research finding is related with the diversity of harvesting periods. To obtain a high-quality silage fermentation, it is essential to degrade pH level. pH value, in general, goes down after the fermentation of lactic acid Van Soest (1994). In this research pH value was measured to be maximum (5.61) in control group and measured to be 3.06 in molasses group, hence the difference in between was found to be statistically significant (P<0.01). pH value of *H. microcarpum* plant is 6.46 and in the research pH value of silage tended to decrease. Molasses addition to the silage of *H. microcarpum* had positive effects on the fermentation of lactic acid bacteria and let the pH to be 3.06. Required range of pH is 3.5-4.0 for a high-quality silage (Filya, 2001). In this research OM value in control group was measured as 8.31%, for molasses it was 13.54% hence it was a statistically significant range (P<0.01). Ekinci et al. (2018) in the research to examine in vivo and in vitro digestibility as well as energy content of *H. microcarpum* OM content was measured as 8.31%. The reason for the difference between literature statement and research finding is that in the literature statement, research was conducted after the plant had completed its vegetation period. An analysis of the CP values in this research points to 12.37% and 13.24% (control and molasses) values respectively. In the study difference with respect to CP in both applications was insignificant. It has been reported that in edible plants raw protein ranges from 1.30% to 11.56% (Yıldırım et al., 2001; Turan et al., 2003; Şekeroğlu et al., 2006; Özer et al., 2012; Seydoşoğlu, 2019; Seydoşoğlu and Gelir, 2019; Turan and Seydoşoğlu, 2020; Görü and Seydoşoğlu, 2021). Güngör (2002) in a research that explored the means to cultivate ferula communis and morphological & biological features of the plant stated that protein ratio in dry matter is 23,78. Protein value identified in this research is higher than the values measured by Hakan et l. (2009) (8.98%), Tunçtürk and Özgökçe (2015) (5.11%) and Ekinci et al., (2018) (9.09%). Variety in statements can be attributed to the diversity in plant vegetation periods, soil structure and usage methods of *H. microcarpum*. Ash value is 10,66% for control and 9.87% for molasses group and the difference between applications is statistically significant (P<0.01). It has been suggested that in edible plants raw ash ratio is between 7.00% and 18.5% (Yıldırım et al., 2001; Şekeroğlu et al., 2006; Karaköy et al., 2013). Ash value in this research was measured to be higher than the findings in the analyses of Hakan et al. (2009) (8.53%) and Ekinci et al. (2018) (8.06%). Difference from the literature statements is bound to the vegetation period of the plant and soil structure. In the research, dry matter consumption (DMI) and dry matter digestion values were measured as 2.92%, 3.77%, 54.34%, 62.61% for control and molasses groups respectively. Difference between the treatments was measured to be statistically significant (P<0.01). Ekinci et al. (2018) computed in vivo dry matter digestion as 72.81%. Finding of this research was computed to be higher than the literature statement. Difference from literature statement stems from the procedural difference in measuring plant's vegetation period, feed content and digestibility.

Table 1. Results of the chemical analyses of the H. microcarpum silages

Treatment	DM	pH	OM	CP	Ash	DMI	DDM	RFV
0	15,22	6,46		11,22				
Control	18,97±0,45**	5,61±0,08**	8,31±0,47**	12,37±0,74	10,66±0,02**	2,92±0,03**	54,34±1,52**	122,72±2,15**
Molasses	23,41±0,19**	3,06±0,02**	13,54±0,19**	13,24±0,11	9,87±0,01**	3,77±0,01**	62,61±0,10**	183,30±0,86**

Values with different letters in the same column are statistically different (*P<0.05 and **0.01) DM: dry matter; OM: Organic matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber; ADL: acid detergent lignin; DMI: dry matter intake; RFV: relative feed values

Forage quality is measured by relative forage value (RFV). Index developed in the USA for clover and miscellaneous coarse forage. RFV value of *H. microcarpum*'s silage was identified as 122.72%, 183.30% respectively for control and molasses(P<0.01). By adding molasses to *H. microcarpum* silage, a noteworthy rise in RFV value was observed. The physical evaluations of the feeds were given in Table 2.

Table 2. The physical evaluations of the *H. microcarpum* silages

Silage	Odor	Structure	Color	Total Score	Quality class
Control	Strong sour smell	unchanged	Light yellow greenish	13	Satisfactory
Molasses	Slightly acidic	unchanged	Green	18	Honors

Cell wall composition of feeds

Cell wall components of *H. microcarpum* silage are as displayed in Table 3. In this research coarse cellulose values were measured as 25.05% in control group and 19.81% in molasses group. Molasses addition into silage positively contributed to the activities of lactic acid bacteria being the source of carbohydrate. Difference between the applications was computed to be statistically significant (P<0.01). In the research NDF contents were 37.67% in control and 28.13% in molasses group (P<0.01). Redfearn et al. (2002) reported that a negative correlation existed between high NDF content and digestibility of forage. NDF content in this research was computed to be below the NDF values reported by Hakan et al. (2009) and Ekinci et al. (2018) (45.38%, 41.93). Difference between these statements stems from plant's vegetation period, soil structure and molasses used in the research. In control group ADF value was measured as 40.59%, and in molasses group it was computed as 29.88% thus a statistically significant difference was witnessed (P<0.05). ADF content in control group was higher than the literature statements (Hakan et al., 2009; Ekinci et al., 2018) (27.91%, 26.97%). ADF content in molasses group was found to be below the values in literature statements. Difference between these statements stems from plant's vegetation period, soil structure and molasses used as additive in this study. Obtained findings about ADL-content was measured as 7.89% and 4.21% for control group and molasses group respectively in this study. Difference between applications was not found to be statistically significant.

Table 3. Cell wall contents of the *H. microcarpum* silages (% DM)

Treatment	CF	NDF	ADF	ADL
0				
Control	25,05±0,44**	37,67±0,37**	40,59±1,83*	7,89±1,55
Molasses	19,81±0,35**	28,13±0,01**	29,88±0,02*	4,21±0,28

Values with different letters in the same column are statistically different (P<0.05 and 0.01) CF: Crude fiber; NDF: neutral detergent fiber; ADF: acid detergent fiber; ADL: acid detergent lignin

In vitro organic matter digestion (OMD) and metabolic energy (ME) contents of H. microcarpum silages were determined and are given in Table 4. The highest organic matter digestibility was determined as 72.35% in the molasses group. The highest metabolic energy value was found to be 9.81 MJ/kg DM in the molasses group (P<0.05). Energy value of control and mollasses in this research was higher the value of in vivo and in vitro findings in the research of Ekinci et al., (2018). Measured differences between statements and research findings are due to the dissimilar methods applied in detecting energy values, plant feed composition, vegetation period differences and molasses used as additive in the analysis. Organic matter digestibility of control group in this research was below the value of in vivo finding in the research of Ekinci et al., (2018) For molasses group, on the other hand, organic matter digestibility was measured to be higher than the same literature statement.

Table 4. In vitro OMD and ME contents of *H. microcarpum* silage

Treatment	%	MJ/kg DM
Control	55,50±1,31*	7,65±0,16*
Molasses	72,35±2,90*	9,81±0,35*

Values with different letters in the same column are statistically different (P<0.05 and 0.01) OMD: Organic matter digestion; ME: metabolic energy

Aerobic Stability Composition of Silages

In the aerobic stability of silages; dry matter, pH and CO_2 contents are as illustrated in Table 5. As the results of analyses reveal, there is an increase in dry matter (DM) contents however differences are statistically insignificant as the analysis reveals. In control group, values are respectively 18.07%, 26.56%, 25.41% on the 1st, 2nd and 3rd days. For the molasses group DM values were computed as 19.98%, 24.23% and 27.61%. During the 3-day aerobic stability pH value in control group was measured as 5.65, 5.31, 5.71 and for molasses group the values were measured as 3.07, 2.71, 3.71 (P<0.01). Adding molasses into H. microcarpum silage lowered the pH value thereby by blocking the formation of microorganisms which lead to spoilage of silage, adding molasses contributed to preserving silage feed. During aerobic stability CO_2 value went up. In control group values were respectively 11.84, 13.62 and 34.95 while in molasses group values were measured respectively 4.28, 4.42 and 13.47 (P<0.01). Although in both applications (control and molasses) CO_2 ratio gradually increased, the ratio of CO_2 was measured to be lower in molasses group. Irrespective of the rise in CO_2 ratio not any spoilage was identified in silages. Primary cause in the spoilage of silage is the additive ingredient, molasses, because molasses allowed a rapid fall in pH value hence lactic acid bacteria fermentation in the ambiance was achieved and activities of miscellaneous microorganisms could thus be disabled.

Second cause is related to the ability of essential oleic acid compositions contained in *H. microcarpum* plant to prevent harmful microorganism activities. Karakaya et al., (2019) reported that antimicrobial activities of the oleic acid compositions contained in *H. microcarpum* plant are effective against pathogenic microorganisms.

Table 5. Aerobic stability composition of *H. microcarpum* silages

Days	Treatment	DM	pH	CO_2
1	Control	18,07±0,32	5,65±0,03**	11,84±1,17**
	Molasses	19,98±1,53	3,07±0,01**	4,28±0,34**
2	Control	26,56±1,32	5,31±0,04**	13,62±0,55**
	Molasses	24,23±0,51	2,71±0,04**	4,42±0,41**
3	Control	26,41±0,61	5,71±1,15**	34,95±0,82**
	Molasses	27,61±0,76	3,17±0,02**	13,47±0,30**

Values with different letters in the same column are statistically different (P<0.05 and 0.01)

CONCLUSION

The results of this study show that *H. microcarpum* forage has suitable nutrient composition. Therefore, it can be used for dairy cattle nutrition. It allows conservation without affecting its nutritional value. Addition of mollasses improved OM and ME content of *H. microcarpum* silage.

REFERENCES

Akyıldız, R. 1984. Yemler bilgisi laboratuvar kılavuzu. Ankara Üniversitesi Ziraat Fakültesi Yayın No:859, 236 s.

AOAC, 2012. Official methods of analysis. – 19th ed. Association of Official Analytical Chemists: International, USA.

Ashbell, G., Weinberg, Z.G., Azrieli, A., Hen, Y., Horev, B.1991. A simple system to study the aerobic deterioration of silages. Canadian Agricultural Engineering, 33: 391-393.

Davis, P.H. 1972. Flora of Turkey and East Aegean Islands, Edinburg University Press, 4.

Ekinci, M., Deniz, S., Altaçlı, S. 2018. Comparative determination of digestibility and energy contents of heliz and parzuk with traditional forages by in vivo and in vitro methods. Journal of Istanbul Veterinary Science, 2: 47-52.

Ertuş, M.M., Yergin, R., Tunçtürk, M., Tepe, I. 2011. *Hippomarathrum microcarpum* (BİEB.) Fedtsch. tohumlarının çimlenme biyolojisinin belirlenmesi. Yüzüncü yıl Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 16 (2):34-39.

Filya, İ, 2001. Silaj teknolojisi. İzmir, Türkiye. 66s.

Güngör, F. 2002. Investigations on the morphological, biological characteristics and cultivation possibilities of *Eremurus spectabilis* (BİEB). FEDTSCH, *Prangos ferulacea* (L) LİNDL and *Hippomarathrum microcarpum* (BİEB.) as growing wildly. Ph.D. Thesis. Atatürk University, Graduate School of Natural and Applied Science, Department of Horticultural. 202 p.

Görü, N., Seydoşoğlu, S. 2021. Determination of silage quality of some winter cereals (oat, barley, rye and triticale) mixed with common vetch (*Vicia sativa* L.). SDU Journal of the Faculty of Agriculture, 16(1): 26-33.

Hakan, B., Ülker, H., Demirel, M. 2009. Van ve çevresinde parzük, kerkol, helizin hayvan yemlemede kullanımı. 6. Zootekni Kongresi, Erzurum, Turkey

Karakaya, S., Göger, G., Bostanlık, D.F., Demirci, B., Duman, H., Kılıç, C.S. 2019. Comparison of the essential oils of *Ferula orientalis* L., *Ferulago sandrasica* Peşmen and Quezel and *Hippomarathrum microcarpum* Petrov and Their Antimicrobial Activity. Turk Journal of Pharmcy Science, 16 (1):69-75.

Karaköy, T., Baloch, F.S., Toklu, F., Özkan, H. 2013. Variation for selected morphological and quality-related traits among 178 faba bean landraces collected from Turkey. Plant Genetic Research Characterization and Utilization 12: 5–13.

Kılıç, A. 1986. Silo Yemi. Bilgehan Basımevi Bornova İzmir. 68-72.

Maff, 1986. Preparation of Sample of Plant Material. In: The Analaysis of Agriculture Material. A Manual Methods used by the Agricultural Development and Advisory Servicei Reference Book. 472. Ministry of Agriculture, Fisheries and Food. Her Majesty's Satationery office. London.

Özer, S., Tümer, E., Baloch, F.S., Karaköy, T., Toklu, F., Özkan, H. 2012. Variation for nutritional and cooking properties among Turkish field pea landraces. Journal of Food Agricultural Environment 10: 324–329.

Öztürk, M., Özçelik, H., 1991. Doğu Anadolunun Faydalı Bitkileri (Useful Plants of East Anatolia). SİSKAV (Siirt İlinin Spor, Kültür ve Araştırma Vakfı). s196.

Redfearn, D.D., Venuto, B.C., Pitman, W.D., Alison, M.W., Ward, J.D. 2002. Cultivar and environment effects on annual ryegrass forage yield, yield distribution, and nutritive value. Crop Science. 42:2049-2054

Statical Analysis Sistem. 2005. SAS User's Guide: Statistics. Version 6 (Cary, NC: SAS Institute).

Sekeroglu, N., Ozkutlu, F., Deveci, M., Dede, O., Yilmaz, N. 2006. Evaluation of some wild plants aspect of their nutritional values used as vegetable in Eastern Black Sea Region of Turkey. Asian Journal of Plant Sciences 5(2): 185-189.

Seydoşoğlu, S. 2019. Effects of different mixture ratios of grass pea (*Lathyrus sativus* L.) and barley (*Hordeum vulgare*) on quality of silage. Legume Research, 42(5): 666-670.

Seydoşoğlu, S., Gelir, G. 2019. A Research on the silage properties of grasspea (*Lathrus sativus* L.) and barley (*Hordeum vulgare* L.) herbages mixed at different rates. Journal of the Institute of Science and Technology, 9(1): 397-406.

Tunçtürk, M., Özgökçe, F. 2015. Chemical composition of some Apiaceae plants commonly used in herby cheese in Eastern Anatolia. Turkish Journal of Agriculture and Forestry 39: 55-62.

Turan, M., Kordali, S., Zengin, H., Dursun, A., Sezen, Y. 2003. Macro and micro mineral content of some wild edible leaves consumed in Eastern Anatolia. Acta Agric Scand B-SP 53: 129–137.

Turan, N., Seydoşoğlu, S. 2020. Evaluation the effecet of pure and various proportions of alfalfa, sainfoin and italian ryegrass on silage and feed quality. Turkish Journal of Agricultural and Natural Sciences, 7(3): 526–532.

Tuzlacı, E. 1985. Vernacular uses of plants in Turkey. Journal of Pharmacy of the University of Marmara I, 101-106.

Van Soest, P.J., Robertson, J.B., Lewis, B.A. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. Journal of Dairy Science 74: 3583-3597.

Van Soest, P.J. 1994. Nutritional ecology of the ruminant. – 2nd ed. Ithaca: Cornell University Press.

Van Dyke, N.J., Anderson, P.M. 2000. Interpreting a Forage Analysis. Alabama Cooperative Extension. Circular ANR-890.

Yıldırım, E., Dursun, A., Turan, M. 2001. Determination of the nutrition contents of the wild plants used as vegetables in upper Çoruh Valley. Turkish Journal of Botanics 25: 367–371.