Van Vet J, 2019, 30 (1) 53-55

Van Veterinary Journal

http://dergipark.gov.tr/vanvetj

ISSN: 2149-3359 **Original Article** e-ISSN: 2149-8644

Determination of Nutrient Composition and Energy Content of Seven Different Malting Barley Varieties

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Received: 04.12.2018 Accepted: 15.03.2019

ABSTRACT The nutrient composition, in vitro Dry matter (DM), Organic matter (OM) digestion and Metabolic energy (ME) levels of seven different malt barley varieties were determined in this study. In the study, seven different malt barley varieties (Zeynelaga, Erciyes, Yildiz, Aydanhanım, Basgül, Efes-98, Durusu) were used. Based on the results of this study, all barley varieties can be used successfully in animal nutrition in terms of both nutrient composition and metabolic energy results by in vitro DM digestion (IVTDMD) and in vitro OM digestion (IVOMD). Durusu variety was better than other varieties in terms of in vitro digestion and ME values. Transfer to the field of these results of the barley which has an indispensable place in the animal feeding and malt industry is important.

Keywords: *Chemical composition, Malt barley varieties, Energy, In vitro digestibility*

ÖZ

Yedi Farklı Maltlık Arpa Çeşidinin Besin Madde Kompozisyonu ve Enerji İçeriklerinin Belirlenmesi

Bu çalışmada, yedi farklı maltlık arpa çeşidinin, besin madde kompozisyonu, in vitro Kuru madde (KM), Organik madde (OM) sindirimi ve Metabolik enerji (ME) düzeyleri belirlenmiştir. Çalışmada yedi farklı malt arpa çeşidi (Zeynelağa, Erciyes, Yıldız, Aydanhanım, Başgül, Efes-98, Durusu) kullanılmıştır. Çalışmanın sonucunda, tüm arpa çeşitlerinin hem besin madde kompozisyonu hem de in vitro gerçek KM (İVGKMS) ve OM sindirimi (İVOMS) ile belirlenen metabolik enerji (ME) sonuçları açısından hayvan beslemede başarılı bir şekilde kullanabilir. Durusu çeşidi, in vitro sindirim ve ME değerleri bakımından diğer çeşitlerden daha iyi bulunmuştur. Hayvan besleme ve malt endüstrisinde vazgeçilmez bir yere sahip olan arpanın bu sonuçlarının sahaya aktarılması önemlidir.

Anahtar Kelimeler: *Kimyasal kompozisyon, Maltlık arpa çeşitleri, Enerji, In vitro sindirilebilirlik*

INTRODUCTION

Barley (*Hordeum vulgare* L.) has an important place in the field of cultivation and production in Turkey and the World (Kun 1988). In the past, it was only used as human nutrition and today, is most important source of nutrients in the consumption area. Animal feed and malt industry constitutes an important part of the consumption area (Aydogan et al. 2017). Barley is an indispensable source of feed for producers because of its high nutritional value and fast availability in the feeding of livestock (Sayim and Balabanli 2006). On the other hand, the portion of barley which is considered as raw material in the malt industry remains very low in total barley production and it is stated that culcivation field of barley has decreased by about 44% according to the data of 2016 (Tasci and Bayramoglu 2017). Barley is more grown as grain. The nutrient density and energy levels in the contents vary according to the cultivated ecological regions (Akman and Kara 2007). There are also important differences between varieties. It is stated that the difference between varieties is considered as an important criterion in malt industry (Tasciand Bayramoğlu 2017).

It is important to determine the energy values and nutrient digestibilities of these varieties as well as the differences in the content of malt type barley varieties in term of nutrient composition. Therefore, the aim of this study was to determine the nutrient composition, the in vitro DM and OM digestibilities, and energy levels of seven different malt barley varieties.

MATERIALS and METHODS

Feed material

Seven different malt barley varieties (Zeynelaga, Erciyes, Yildiz, Aydanhanım, Basgül, Efes-98, Durusu) were obtained from Ankara Field Crops Central Research Institute. Approximately 500 g samples were taken from

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each variety and brought to the laboratory.

Chemical Analysis

Malt type barley samples were ground in 1 mm sieve. Samples were analysed to determine DM, ash, CP, and CF contents based on the methods descripted by AOAC (1990), NDF and ADF contents according to Van Soest et al. (1991).

Determination of in vitro DM, OM Digestibility and Energy Contents

ANCOM Daisy II incubator devise which provides artificial rumen environment was used in order to determine in vitro DM and OM digestibilities of malting barley varieties. The rumen fluid used in in vitro incubation was taken from four-year-old cattle fed barley based on diet. In the study, seven different malt barley varieties were transferred to F57 filter bag and incubated in DAISY incubator for 24 hours. At this stage, a total of 36 filter bags; 4 replicates for each barley type and 8 blinds were soaked in acetone for 3-5 minutes before incubation and then stored at 105 ºC for 4 hours in the oven. Twenty-eight samples, excluding the blinds, 0.5 g of each barley sample were weighed and closed tightly. Samples taken after incubation were washed in tap water until clear water was removed and stored at 105 ^{0}C for 3 hours until constant weight and weighed. Then, using the ANCOM method determined in vitro the true DM, OM digestion and ME (Mcal/kg DM) levels by Van Soest et al. (1991) using strainer bag technique (ANCOM 2002 Technology Corp., Fairport, NY) were determined. The following equalities were used for in vitro true DM and OM.

Digestibilities;

$$\text{In vitro true DM digestibility (\%)} = \frac{100-(T3-(T1xC1))}{(T2xD)x100}$$

$$\text{In vitro true OM digestibility (\%)} = \frac{100x(T2xQ)-((T3-T1)xZ}{(T2xQ)}$$

T1 : F57 weight of bags

T2 : Weight of feed sample

T3 : Weight of bag and feed sample after in vitro incubation

C1 : Bag weight change correction coefficient due to incubation

Q : Feed organic matter before incubation, %

Z : Feed organic matter after incubation, %

Statistical Analysis

The data obtained from the study were analysed using general linear model (GLM) of SAS 9.4 package program (SAS 2014). The differences between the averages of malt barley varieties were determined by Duncan test.

RESULTS

The chemical composition of malt type barley varieties is given in Table 1. When Table 1 is examined, there was a significant difference between malt barley varieties in term of all nutrient contents, except for CF content (Table 1; $p<0.001$). DM and OM contents of Zeynelaga, Erciyes and Aydanhanım varieties were higher than other varieties. The DM content of the Efes-98 variety was higher than that of the Aydanhanım and the DM content of the varieties ranged from 94.73 to 96.88%. Sevim et al. (2017) noted that Durusu variety which is a malt type barley variety had 93.53-94.39% DM content, 2.31-2.80% ash content, Imik et al. (2003) have reported that DM and ash contents were 88.30% and 2.34%, respectively for barley. Similarly, Guney and Demirel (2016) reported the 91.16% DM and 2.39%ash contents for barley. The DM values reported in studies mentioned above were be lower than the values obtained in this study, but were similar to the values of ash contents. It is stated that malt type barley is difficult to germinate at low DM levels and should be stored in storehouses with good air circulation (MacLeod 2018). DM content of barley grains can vary depending on type, cultivation conditions, soil structure and weather conditions in the harvesting period and storage conditions (Sevim et al. 2017).

Table 1 shows CP content of barley. CP content of Durusu variety were higher than (16.02%) those of Zeynelaga (14.24%), Aydanhanım (14.23%), Basgül (14.96%) and Efes-98 (14.30%) varieties but similar to other varieties ($p<0.001$). In the studies at which examined the quality characteristics of barley varieties in different regions, CP contents were determined 12.03-14.46% (Aydogan et al. 2017), 11.29% (Aldemir and Karsli (2012), 12% (Imik et al. 2003), 11.22% (Cerci et al. 2004). In current study, CP contents of malt types barley varieties ranged from 14.23% to 16.02% DM, which were significantly higher than the values reported by the researchers mentioned above. Kun et al. (1992) reported that the amount of protein in the grain barley is related to malt and fodder characters, because low in CP content in malt types and high CP content in fodder varieties is desired. It was considered that these barley varieties used in this study could not be suitable for malt industry due to high CP contents but it is appropriate to use as animal feed.

When the NDF contents were examined, Aydanhanım variety (40.99%) had the lowest, Durusu varieties (22.07%) had the lowest NDF contents among barley varieties. In term of ADF contents of varieties; Zeynelaga (6.10%), Erciyes (6.09%) and Efes-98 (5.81%) were higher than Yildiz (4.85%), Aydanhanım (4.53%) and Durusu (4.69%) (Tablo 1; $p<0.001$). In the literature, NDF and ADF values were 35.55% and 8.64% (Güney and Demirel 2016); 27.73% and 6.62% (Sevim et al. 2017), respectively. In current study, it was noted that the range of NDF contents of malt type varieties were very wide. It is stated that the nutrient consumption of the plants is affected by many factors, including vegetation period (Kılıc 1986). As a matter of fact, Tekce and Gül (2014) reported that NDF and ADF content in feeds caused rumen pH to remain within normal limits by promoting saliva secretion in ruminants.

In vitro DM, OM digestibility and metabolized energy levels of 7 malt barley varieties are given in Table 2. DM digestibilities of malt type varieties ranged from 57.72-88.75%; whereas OM digestion varied between 68.02-83.92%. DM and OM digestion of Durusu variety was higher than other varieties. It can be stated that the increasing cell wall levels in feed causes a decrease in the total digestibility of feeds (Lithourgidis et al. 2006). Thus, it has been observed that Durusu has a lower NDF content than the other varieties (Table 2; $p<0.0001$). ME contents of malt varieties were between 2.24-3.24 Mcal/kg and Durusu variety had the highest ME value and no difference was observed between the other varieties. Higher ME levels in Durusu variety are thought to be caused by a higher in vitro OM digestion.

Table 1. Chemical composition of malting barley varieties, DM%

Variety	Zeynelaga	Erciyes	Yildiz	Aydanhanım	Basgül	Efes-98	Durusu	P<
DM	96.88±0.11^{a}	96.58±0.02^{a}	95.31±0.42^{b}	96.48±0.06^{a}	94.73±0.01^{c}	95.19±0.11^{bc}	94.78±0.06^{bc}	0.0001
OM	94.64±0.10^{a}	94.49±0.10^{a}	93.11±0.43^{b}	94.54±0.02^{a}	92.36±0.08^{c}	92.60±0.06^{bc}	92,34±0.13^{c}	0.0001
Ash	2.07±0.05^{bc}	2.09±0.08^{bc}	2.21±0.01^{bc}	1.94±0.08^{c}	2.37±0.09^{ab}	2.59±0.17^{a}	2.43±0.19^{ab}	0.0114
CP	14.24±0.15^{b}	15.14±0.18^{ab}	15.16±0.25^{ab}	14.23±0.20^{b}	14.96±0.27^{b}	14.30±0.32^{b}	16.02±0.58^{a}	0.0010
CF	0.69±0.01^{ab}	0.57±0.01^{ab}	0.43±0.05^{ab}	0.88±0.20^{a}	0.38±0.17^{b}	0.64±0.18^{ab}	0.64±0.17^{ab}	0.2539
NDF	29.80±0.60^{bcd}	35.13±3.45^{ab}	24.82±0.82^{cd}	40.99±4.39^{a}	32.58±4.30^{abc}	29.42±1.10^{bcd}	22.07±0.62^{d}	0.0050
ADF	6.10±0.32^{a}	6.09±0.52^{a}	4.85±0.15^{b}	4.53±0.14^{b}	5.25±0.18^{ab}	5.81±0.26^{a}	4.69±0.13^{b}	0.0031

DM: Dry matter, OM: Organic matter, CP: Crude protein, CF: Crude fat, NDF: Neutral detergent fiber, ADF: Acid detergent fiber (ADF); P<0.001: Means with different superscripts within a row are significantly different; a, b, c, d: Means with the same superscript(s) within each row are significantly different

Table 2. In vitro DM, OM digestibility and ME contents of Barley varieties

Variety	IVTDMD, %	IVOMD, %	ME, kcal
Zeynelaga	65.57±1.68^{bc}	70.27±2.22^{b}	2.54±0.08^{bc}
Erciyes	64.21±0.40^{bc}	69.91±0.64^{b}	2.53±0.02^{bc}
Yildiz	68.55±2.27^{b}	74.31±1.91^{b}	2.69±0.07^{b}
Aydanhanım	61.95±0.91^{bc}	68.02±0.31^{b}	2.46±0.01^{bc}
Basgül	57.72±3.44^{c}	69.12±5.29^{b}	2.24±0.12^{c}
Efes-98	68.34±2.68^{b}	73.53±2.61^{b}	2.66±0.09^{b}
Durusu	88.75±5.86^{a}	83.92±4.21^{a}	3.24±0.17^{a}

IVTDMD: in vitro true dry matter digestibility, IVOMD: in vitro organic matter digestibility, ME: Metabolic energy

DISCUSSION and CONCLUSION

In the study, high DM and CP contents of malt type barley varieties have been obtained. It is thought that all varieties have high CP content and high CP content is an undesirable feature in malt industry. Thus, it is thought that it would be better if these varieties are used as animal feed. Seven different malt barley varieties can be used successfully in animal nutrition based on both nutrient composition and in vitro DM, OM digestibility, metabolic energy results. Durusu varieties were found to be superior in term of in vitro digestion and ME levels. Barley has an important place in the malt industry and animal nutrition. Therefore, it is important that these results of barley varieties are important to reveal and transfer to the field.

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