Araştırma Makalesi https://doi.org/10.46810/tdfd.1095481 Research Article

Türk Doğa ve Fen Dergisi
Turkish Journal of Nature and Science
www.dergipark.gov.tr/tdfd

Determination of Nutritive Value and *İn vitro* Gas Production of Some Triticale Varieties

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(Received: 29.03.2022, Accepted: 09.06.2022, Online Publication: 29.06.2022)

Keywords
Chemical composition, Triticale, Varieties, *İn vitro* total gas

Abstract: The aim of this study was to determine the chemical composition, *in vitro* total gas production (TG), metabolisable energy (ME), and organic matter digestibility (OMD) of grains belonging to different triticale varieties. Variety crude ash (CA) contents range from 2.05 to 2.30%, ether extract (EE) contents range from 1.82 to 3.00%, crude protein (CP) contents range from 9.44 to 13.25%, and acid detergent fiber (ADF) and neutral detergent fiber (NDF) contents range from 2.51 to 4.50% and 15.15 to 17.65%, respectively. Total gas production *in vitro* ranged between 57.59 and 62.51 ml, with ME and OMD ranged between 11.69 and 12.55 Mj kg^{-1} DM and 78.06 and 82.24%, respectively. While Bera and Tatlıcak 97 leap out in terms of ME, the Bera variety leap out in terms of OMD. The effects of varieties on chemical composition, *in vitro* TG, ME, and OMD of triticale grains were found to be significant ($P<0.05$). According to chemical composition and fermentation parameters, the Bera variety has high values in terms of CP, ME, and OMD can be recommended for grain production.

Bazı Tritikale Çeşitlerinin Besleme Değeri ve *İn vitro* Gaz Üretiminin Belirlenmesi

Anahtar Kelimeler
Kimyasal bileşim, Tritikale, Çeşit, *İn vitro* toplam gaz

Öz: Bu çalışmada bazı tritikale çeşitlerine ait tanelerin kimyasal bileşimi, *in vitro* toplam gaz üretimi (TG), metabolik enerji (ME) ve organik madde sindirim derecelerinin (OMSD) belirlenmesi amaçlanmıştır. Çeşitlerin ham kül (HK) içerikleri %2.05-2.30, ham yağ (HY) içerikleri %1.82-3.00, ham protein (HP) içerikleri %9.44-13.25, asit çözücülerde çözünmeyen lif (ADF) ve nötr çözücülerde çözünmeyen lif (NDF) içerikleri sırasıyla %2.51-4.50, %15.15-17.65 aralığında yer almıştır. Çeşitlerin *in vitro* TG üretimleri 57.59-62.51 ml, ME ve OMSD dereceleri ise sırasıyla 11.69 - 12.55 Mj kg^{-1} KM ve %78.06 ile 82.24 arasında değişmiştir. Metabolik enerji değeri bakımından Bera ve Tatlıcak 97, OMSD bakımından Bera çeşidi ön plana çıkmıştır. Tritikale tanelerinin kimyasal bileşimleri, *in vitro* TG, ME ve OMSD değerleri üzerine çeşitlerin etkisinin önemli olduğu görülmüştür ($P<0.05$). Kimyasal bileşim ve fermentasyon parametrelerine göre HP, ME ve OMSD bakımından yüksek değerlere sahip olan Bera çeşidinin tane üretimi için tavsiye edilebileceği belirlenmiştir.

1. INTRODUCTION

Triticale, which is obtained as a result of studies to determine new product groups in order to provide balanced and adequate nutrition for the rapidly increasing world population, is becoming more and more popular nowadays [1,2]. Triticale (*xTriticosecale Wittmack*) is a one-year cool-climate cereal that can be used in both human and animal nutrition and is obtained as a result of hybridization of wheat and rye [3,4]. Because of the low flour quality of the grains, they are generally allowed to be used in animal feed [5]. It has been stated that triticale is equivalent or superior to other grains in animal nutrition in terms of its important properties such as rapid growth and development, high dry matter rate, grain, dry and green herbage yield, fiber content, degree of digestion, protein rate, and high lysine content [6,7,8]. It has been reported that the feed value of its grain is equal to wheat and better than rye and barley [9]. Denek and Deniz [10] also emphasized that triticale can be evaluated as a feed equivalent to corn in ruminant nutrition. Therefore, it has been thought that determining the animal nutrition status of high-yield and quality varieties of triticale will increase the production potential. Although the triticale varieties have been

investigated in terms of chemical composition, there are limited studies on *in vitro* gas production, metabolisable energy and organic matter digestibility of these varieties. Recently, *in vitro* gas production, metabolisable energy and organic matter digestibility can be determined together with chemical compositions of the uninvestigated raw materials by using an *in vitro* gas production technique [11,12,13]. The aim of the current experiment was to evaluate the effect of variety on chemical composition, *in vitro* TG, ME, and OMD.

2. MATERIAL AND METHOD

2.1. Collection of Triticale Grain Samples

Triticale grain samples were obtained from agronomic trials carried out in the experimental area of Muş Alparslan University between 2020 and 2021. Samples of 11 triticale varieties were randomly collected from each block in the experimental plots with 3 replications. Collected samples were prepared by grinding to pass through a 1 mm sieve for chemical analysis and *in vitro* gas production.

2.2. Chemical Analyzes

Dry matter (DM), crude ash (CA), ether extract (EE), and crude protein (CP) contents of the grains were determined according to the method reported by AOAC [14]. ADF and NDF contents were determined by Van Soest et al. [15] according to the method reported. An *in vitro* gas production technique was used to determine the TG production of triticale grain samples [16]. Rumen fluid was immediately taken from sheep slaughtered in Kahramanmaraş animal market and placed in a thermos, and brought to the laboratory quickly so that microorganism activities could continue. Feed samples (0.2 grams) mixed with buffer solution were left for fermentation at 39 °C for 24 hours with rumen fluid obtained from sheep. Gas production is arranged according to standard feed and blind measurement. Metabolizable energy and organic matter digestibility of triticale grains were determined using the equations given below [17].

$$ME\ (Mj\ kg^{-1}DM) = 1.06+0.1570GP+ 0.084CP+0.220EE-0.081CA \quad (1)$$

$$OMD\ (\%) = 28.49+ 0.7967GP+ 0.325CP \quad (2)$$

GP: Gas production of 200 mg sample at 24 h incubation (ml)
CP: Crude protein (%)
EE: Ether extract (%)
CA: Crude ash (%)

2.3. Statistical Analysis

The data obtained in the study were evaluated statistically (Tukey 5%) using one-way analysis of variance (One-way ANOVA) [26].

3. RESULT AND DISCUSSION

The chemical compositions of triticale grains are given in Table 1. It was determined that the differences in the chemical compositions of the cultivars were significant. The CA contents of triticale cultivars ranged from 2.05-2.30%, the highest values in Karma and the lowest values in Ümran Hanım. The CA content of triticale grains was determined by Denek and Deniz [10], 1.71%, Alijošius et al. [18], 1.33-1.63%, Kowieska et al. [19], 1.8%, Umucalılar et al. [20], 1.9%. The EE contents of the cultivars ranged from 1.82-3.00%, the highest values in Tatlıcak 97 and the lowest values in Bc goran. The results obtained were higher than the findings of Denek and Deniz [10] (0.96%) and are similar to the findings of Umucalılar et al. [20] (2.00%) and Chrenková et al. [21] (1.70%). The CP contents of the cultivars ranged from 9.44-13.25% the highest values in Ümran Hanım, the lowest values in Presto. Krieg et al. [22] determined the CP content of 20 triticale lines ranged from 11.6 to 13.3%. Compared to the current study, similar findings were obtained except for only one variety (Presto). In similar studies, CP contents of triticale grains were determined, 9.00-16.26% [23], 10.5-14.6% [24], and 9.45-12.51% [18]. It is thought that these differences in CP content may be related to different climatic conditions, soil types, and fertilization. The ADF and NDF contents of triticale grains ranged from 2.51-4.50% and 15.15-17.65%, respectively. The current experiment's ADF and NDF contents of triticale cultivars were consistent with the findings of Dennett et al. [24], who discovered that the ADF contents of triticale lines ranged from 3.82-5.18% and the NDF contents ranged from 13.71-16.53%. Mut and Erbaş Köse [1] found that among 24 triticale genotypes, the ADF and NDF contents ranged from 2.44-3.59% and 17.5-19.1%, respectively. Alijosius et al. [18] found that ADF content ranged from 2.5-2.9% and NDF content ranged from 10.3-13.1% respectively.

Table 1. Chemical compositions of Triticale cultivars (% DM)

Çeşitler	KM	HK	HY	HP	ADF	NDF
Alper bey	93.05	2.12^{cd}	2.72^{ab}	11.88^{d}	3.65^{abcd}	17.65^{a}
Melih bey	93.05	2.14^{bcd}	2.74^{ab}	12.91^{ab}	4.50^{a}	15.15^{e}
Karma	93.20	2.30^{a}	1.84^{c}	11.76^{de}	4.35^{ab}	15.53^{de}
Ayşe Hanım	93.21	2.15^{bcd}	2.31^{abc}	12.54^{bc}	3.54^{abcd}	17.36^{ab}
Bc goran	93.30	2.26^{ab}	1.82^{c}	11.77^{de}	2.51^{e}	15.46^{de}
Bera	93.34	2.26^{ab}	2.12^{bc}	12.16^{cd}	3.84^{abc}	15.86^{cde}
Özer	93.34	2.29^{a}	2.52^{abc}	11.34^{ef}	3.29^{cde}	16.48^{bce}
Presto	93.45	2.16^{bcd}	2.61^{abc}	9.44^{g}	3.37^{bcde}	15.46^{de}
Tatlıcak 97	93.48	2.18^{abcd}	3.00^{a}	11.19^{f}	3.60^{abcd}	17.49^{ab}
Ümran hanım	93.49	2.05^{d}	2.22^{abc}	13.25^{a}	2.83^{de}	15.39^{e}
Esin	93.56	2.25^{abc}	2.17^{bc}	11.44^{ef}	3.48^{bcde}	16.75^{abc}
SEM	0.104	0.025	0.163	0.085	0.199	0.205
Sig.	NS	**	**	**	**	**

abc Column means with common superscripts do not differ (P>0.05.) DM: Dry matter (%), CA: Crude ash (% of DM), EE: Eter extract (% of DM), CP: Crude protein (% of DM), ADF: Acid detergent fiber (% of DM), NDF: Neutral detergent fiber (% of DM), SEM: standart eror mean, Sig: Significant level, **: P<0.01, *: P<0.05, NS: Non-significant.

İn vitro TG, ME and OMD of triticale varieties were given in Table 2. The *in vitro* TG of the grains of Triticale cultivars ranged from 57.59-62.51 mL with the highest values in Bera and the lowest values in Özer.

Total gas production of triticale varieties determined in the current experiment was consistently higher than that reported by Umucalılar et al. [20] (75.5 ml) and Krieg et al. [22] (79.2 ml). The ME values of the cultivars ranged from 11.69-12.55 Mj kg^{-1} DM, the highest values in Bera and the lowest values in Karma. ME values of triticale grains are 13.70 Mj kg^{-1} DM [10], 13.3 Mj kg^{-1} DM [7], 12.4 Mj kg^{-1} DM [20], 14.0 Mj kg^{-1} DM [22]. The OMD of triticale cultivars ranged from 78.06-82.24%, the highest values in Bera and the lowest values in Özer and Karma. The OMD contents of triticale grains were 89.09% [20], 77.94% [25] in similar studies.

Table 2. *İn vitro* total gas production, metabolizable energy and organic matter digestibilty of triticale cultivars.

Çeşitler	TG (ml)	ME	OMD
Alper bey	58.54^{e}	12.01^{e}	78.99^{f}
Melih bey	60.51^{c}	12.42^{ab}	80.89^{bc}
Karma	57.63^{f}	11.69^{f}	78.22^{g}
Ayşe Hanım	59.43^{d}	12.13^{cde}	79.91^{de}
Bc goran	61.59^{b}	12.30^{bc}	81.38^{b}
Bera	62.51^{a}	12.55^{a}	82.24^{a}
Özer	57.59^{f}	11.79^{f}	78.06^{g}
Presto	60.48^{c}	12.10^{de}	79.74^{e}
Tatlıcak 97	61.75^{b}	12.53^{a}	81.32^{b}
Ümran hanım	58.80^{de}	12.06^{de}	79.64^{ef}
Esin	60.66^{c}	12.20^{cd}	80.53^{cd}
SEM	0.143	0.036	0.127
Sig.	**	**	**

abc Column means with common superscripts do not differ (P>0.05.) TG: Total gas, ME: Metabolizable energy, OMD: Organic matter digestibilty, SEM: standart eror mean, Sig: Significant level, **: P<0.01, *: P<0.05.

Cultivars have a significant effect on chemical composition, *in vitro* total gas production, ME, and OMD of grain. It has been determined that the Bera cultivar, which has high values in terms of HP, ME, and OMD according to chemical composition and fermentation parameters, can be used successfully in animal feeding. But before large implication, the grain yield of triticale grain should be tested. It is suggested that this study should be supported by in vivo studies.

ACKNOWLEDGEMENT

We thank Assoc. Prof. Dr. Mehmet KARAMAN for carrying out the agronomic trial and providing triticale grains.

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