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Comparing Digestibility of Triticale Grain, Barley Grain and Naked Barley Grain by Using *in vitro* Tilly and Terrey Technique

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Abstract: We conducted this research to determine dry matter digestibility of triticale grain, barley grain and naked barley grain by using *in vitro* Tilly and Terrey (TT) technique. A simple technique for the determination *in vitro* of digestibility of small (0.5 g) samples of dried cereal grain. It involves incubation first with rumen liquor and then with acid HCL and pepsin enzyme. *In vivo* digestibility (Y), the regression equation Y = 0.99 X-1.01 (SE±2.31) has been calculated, where X = *in vitro* digestibility. An experiment was carried out in a complete randomized design with 3 experimental groups and 9 replications per groups. The treatments were included triticale grain, barley grain and naked barley grain. Analysis of variance was performed with SAS software and the differences among means were evaluated by using the Duncan's tests. According to these results, *in vitro* and *in vivo* digestibility of triticale grain were more significantly than barley grain and grain ($p<0.01$). The result of this experiment indicate increasing digestibility as substitute triticale grain instead of barley grain.

Key words: Triticale, barley, digestibility, tilly, terrey technique

INTRODUCTION

Cereals are widely used in the ruminant livestock industries to increase digestible energy intake. Grains are also used as drought reserves and fed as survival rations in times of pasture shortage. In Iran barley, sorghum and oats are the grains most commonly fed to ruminants with triticale. Triticale is a crop species resulting from a plant breeder's cross between wheat (Triticum) and rye (Secale), The name triticale (Triticale hexaploide Lart.) combines the scientific names of the two genera involved (Brouwer, 1977). It is produced by doubling the chromosomes of the sterile hybrid that results when crossing wheat and rye.

This doubling produces what is called a polyploidy (Brouwer, 1977). Hybrids between wheat and rye date back to 1875, but until recently there was little effort to develop highyielding triticales as a field crop. Plant breeders originally wanted to include the combination of grain quality, productivity and disease resistance of wheat with the vigor and hardiness of rye.

Plant breeders working with triticale hoped it would have higher yield than other cereal grains, especially under less than ideal growing conditions and be used both as human and animal food. Table 1 describes the chemical composition of a typical triticale variety (McCloy *et al*., 1971). Feeding trials indicate that triticale has potential as a feed grain. The protein content of triticale lines has ranged from 10-20% on a dry weight basis, which is higher than wheat.

The amino acid composition of the protein is similar to wheat, but may be slightly higher in lysine (Wibberley, 2008). As triticale varieties are improved, they may compete with oats and feed barley as a home-grown feed crop, particularly if ergot, a fungus disease, can be eliminated or reduced to <0.1% in the grain (Wibberley, 2008). Higher levels of ergot have ruined the crop for feeding in some years (Wibberley, 2008).

Ergot is more severe in older than in newer varieties (McCloy *et al*., 1971). Both crude and true protein digestibilities were higher ($p<0.05$) with the triticale ration than with the barley grain ration. The Increased digestibility of the triticale reflected the Improved efficiency of feed utilization obtained in the steer finishing trial (Francois *et al*., 1998).

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Table 1: Composition of triticale grain

Components	Dry matter (%)
Protein	19.71
Fiber	3.10
Fat	1.61
Calcium	0.12
Phosphorus	0.44
Total sugars (as invert)	5.74
Starch	67.78
Threonine	0.39
Valine	0.93
Methionine	0.40
Isoleucine	0.76
Leucine	1.23
Phenylalanine	0.85
Lysine	0.57
Histidine	0.45
Arginine	0.80

MATERIALS AND METHODS

Measurement of *in vitro* DM Digestibility (IVDMD) has been used extensively to analyze feeds because of a high degree of correlation to *in vivo* digestibility (Marten and Branes, 1980). Over the years, various procedures to determine IVDMD have been developed and modified. There agents used in the procedure of Tilly and Terry (2009) have been modified to improve the precision of the IVDMD estimates, but methodologies have not permitted modifications that improve labor efficiency of assays or that incubate multiple samples in a single vessel. This procedure is a simple technique for the determination *in vitro* of the dry or organic-matter digestibility of small (0-5 g) samples of dried cereal grain.

This method called as a two staged technique. It involves incubation first with rumen liquor and then with acid HCL and pepsin enzyme (Beckers *et al*., 1996). Previous research indicates *in vitro* DM digestibility of feedstuff is highly correlated with *in vivo* DM digestibility. It has known *in vivo* digestibility allows researchers to adjust *in vitro* digestibility of feedstuff to *in vivo* values using regression equations generated from the standards. *In vivo* digestibility (Y), the regression equation Y = 0.99 X- 1.01 (SE±2.31) has been calculated, where X = *in vitro* digestibility (Tilly and Terry, 2009). Three samples of grains were dried in a forced air oven for 48 h at 60°C and ground through a 1 mm screen of a Wiley mill prior to analysis for IVDMD.

Rumen digesta was collected before the morning meal from the reticulum near the reticuloomasal orifice by vacuum pump. The digesta from each animal was filtered through eight layers of gauze cloth, mixed on a volume basis for each species, purged with CO_2 and kept in a prewar med thermos until use (within approximately, 20 min). In this trial, 0.5 g of each sample was placed in to 50 mL tubes, the incubation inoculum was prepared by diluting the digesta inoculum with the buffer and fresh rumen liquor (Tilly and Terry, 2009) in a 1:4 (v v^{-1}) ratio and stirring in a water bath at 39°C with purging CO_2 until its use (10-15 min later). Table 2 describes the chemical composition of a buffer. The tube was stoppered with a Bunsen valve and incubated for 48 h at 39°C. Tubes were gently swirled by hand four times every 12 h. Each sample was incubated in nine replicates for each source of inoculum at two different occasions. At the end of the 48 h incubation period, tube and vessel contents were acidified by adding 6CC acid HCL 20% to reach then incubation digesta inoculum with 5CC mixed acid HCL 0.1 N and pepsin enzyme a final pH of <1.2. After a few seconds, when the foam subsided, pepsin powder was added to a final concentration of 0.2% (w v^{-1}).

Table 2: Composition of artificial saliva buffer

Ingredients	Artificial saliva components (g L^{-1})
Sodium bicarbonate	9.80
Sodium chloride	0.47
Potassium chloride	0.57
Sodium di-hydrogen phosphate	2.70
Magnesium di-hydrogen chloride	0.06
Water (L)	1.00
Calcium chloride	0.04

The tubes and the vessels were reincubated for an additional 48 h. At the end of this stage, the tubes were centrifuged at 2500x g for 15 min and the supernatant was discarded. To the pellet, 50 mL of H_2O was added and the tubes were recentrifuged to wash out the residual acid. The tubes containing the pellets and the bags were dried in a forced air oven at 60°C for 48 h to determine the residual DM weights. IVDMD was calculated as the DM, which disappeared from the initial weight inserted in to the bag or tube (Tilly and Terry, 2009).

Statistical analysis: These trials were carried out in a complete randomized design with 3 experimental groups and 9 replications per groups. The treatments were included triticale grain, barley grain and naked barley grain. Data were analyzed with the general linear model procedure of SAS (2009) and the differences among means were evaluated by using the Duncan's tests ($p<0.05$).

RESULTS AND DISCUSSION

Data in Table 3 show *in vitro* and *in vivo* digestibility of triticale grain, barley grain and naked barley grain. There were significant difference between *in vitro* and

Table 3: *In vitro* and *in vivo* digestibility of triticale grain, barley grain and naked barley grain

	Triticale		Barley		Naked barley	
Repeat	*In vitro*	*In vivo*	*In vitro*	*In vivo*	*In vitro*	*In vivo*
1	84.92	83.07	73.96	72.21	82.06	80.23
2	86.42	84.55	69.58	67.88	82.32	80.49
3	84.34	82.49	72.24	70.51	80.00	78.19
4	84.56	82.71	68.90	67.21	81.10	79.28
5	86.90	85.03	71.00	69.28	79.42	77.62
6	88.10	86.21	75.00	73.24	79.48	77.68
7	87.76	85.88	76.40	74.63	81.96	80.13
8	84.50	82.65	77.68	75.90	82.50	80.67
9	88.54	86.65	75.24	73.48	80.38	78.57
Mean	86.23[a]	84.36[a]	73.34[c]	71.59[c]	81.03[b]	79.21[b]

Means within a mean row with different superscripts differ significantly ($p<0.05$)

in vivo digestibility of triticale grain, barley grain and naked barley grain. The *in vitro* digestibility values have been show higher than *in vivo* digestibility values. According to these results, the mean values obtained for IVDMD of triticale grain was significantly higher than IVDMD of barley grain and naked barley grain ($p<0.05$). In the following commentary on the results of the experiment the mean values for the IVDMD. Results obtained In the trial (Table 3) indicated that the mean values of IVDMD of triticale grain, barley grain and naked barley grain were 86.23, 73.34 and 81.03%, respectively. Also *in vivo* digestibility of triticale grain, barley grain and naked barley grain were 84.36, 71.59 and 79.21%, respectively.

These IVDMD agree with results from Umucalilar *et al.* (2002), who reported IVDMD of triticale grain and barley grain 89 and 85%, respectively. However, they stated that IVDMD of barley grain was lower than IVDMD of triticale grain. Moreover, Mabjeesh *et al.* (2000) obtained mean value of IVDMD of barley grain 68.1% by using TT method that agrees with result of the present study. The results reported here in lend further support to finding result by McCloy *et al.* (1971). They reported *in vivo* dry matter digestibility values of triticale grain 81.1 and 79.1% in sheep and cattle, respectively.

CONCLUSION

These results of present research indicate that there was difference between digestibility values of grains. The present results along with those reported by other investigators suggest that *in vivo* and *in vitro* dry matter digestibility value of triticale grain was significantly higher than barley grain and naked barley grain.

Differences between digestibility values of grains because of higher enzyme digestibility of starch and higher crude protein levels of triticale grain than other grains. Triticale is a crop species resulting from a plant breeder's cross between wheat and rye. Then, it was respected that its digestibility same wheat and better than barely. *In vitro* fermentation and enzyme digestion characteristics suggest that triticale may be grain superior to either wheat or barely. Of particular significance is the high dry matter digestibility in triticale, which is clearly superior to that of barley and naked barley grain and implies that the digestion of dry matter in rumen will be more efficient for triticale. Data from the present research suggest that triticale may potentially become an important feed grain. Further research will be required to fully evaluate triticale and develop methods to insure a more consistent acceptability by the animals.

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