THE EFFECT OF WHEAT BRAN ADDED TO CANOLA SILAGE ON FEED VALUE AND IN VITRO ORGANIC MATTER DIGESTIBILITY

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Abstract. This study was carried out to determine the effect of wheat bran as added to canola silage on the fermentation and in vitro organic matter digestibility. Canola was harvested and ensiled with 5% and 10% wheat bran in glass silos. With each treatment three parallel investigations were performed. Chemical, microbiological analyses 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% and 10% wheat bran treatments, crude protein reached 14.31%, 14.71% and 15.66%; ammonia-nitrogen reached 91.53, 85.43 and 85.34 g/kg TN; metabolisable energy reached 7.94, 8.27 and 8.51 MJ/kg KM; while organic matter digestibility was 61.45%, 63.93% and 62.92%, respectively. In conclusion, addition of wheat bran can increase dry matter content of canola silage.
Keywords: *canola, additive, silage quality, OM, digestibility*

Introduction

Canola seeds are mentioned frequently because of their contribution to the biodisel production. Canola is one of the oilseed plants that belong to brassica sp. Canola has tolerance to low temperatures and salinity (Sovero, 1993; Francois, 1994). Canola may be used as silage, straws, stubble and stover for roughage source in ruminant nutrition because of its palatability, and low levels of rejection (Sovero, 1993; Francois, 1994; Kincaid et al., 2012; Reta et al., 2015). Brassicas have metabolisable energy from 2.8 to 3.3 mcal/kg DM and dry matter digestibility of 81 to 89% before blooming (Hall and Jung, 2008; Barry, 2013). However, there are very restricted research studies about nutrient composition of canola forages. Sånchez-Duarte et al. (2011) reported a slight increase in feed consumption of eight month elder heifers fed with a 21% canola silage ratio, compared with heifers in the control group. Silage process is a method that contributes to diminish anti-nutritional effects concerning Brassicas and allows conservation without affecting nutritional value (Fales et al., 1987). But it requires an additive for proper conservation. Brassica forage contains 80-95% water (Lambert et al., 1987; Guillard and Alison, 1988). High moisture forages tend to lose their nutrients during ensiling. Canola forage must be wilted to 60-65% moisture before ensiling (Balakhial et al., 2008). A little scientific literature investigates the effect of wheat bran addition on the feed value and in vitro OM digestibility of canola silage. Addition of wheat bran can increase dry matter content of canola silage thanks to its relatively high dry matter content. The main objective of this study was to determine the effects of

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different level of wheat bran addition on feed value and in vitro OM digestibility of canola silage.

Materials and methods

The study was conducted in 2016 in Tekirdağ (41.0 ºN, 27.5 ºE), western Turkey located at about 5 m altitude above sea level and with a total precipitation of 482 mm on average and an annual mean temperature of 10.5ºC. Caravel which is a kind of winter canola was sowed in October 2016. Canola forage was harvested when 2/3 of the were blooming. Forage was chopped 1.0-1.5 cm theoretical length of cut. Silage materials were divided into three trial groups for the control, 5% wheat bran and 10% wheat bran. The material mixed with additive was pressed in 36 (1.0-1 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 pH, dry matter, water soluble carbohydrates, lactic acid (DM, WSC, LA) content measurement and LAB, mold and yeast enumeration.

Analytical procedure

Chemical analyses were performed on triplicate samples. The fresh and silage samples were dried at 60ºC 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 105ºC for 16 h. Crude protein and ash contents of samples were determined according to the methods of AOAC (2012). Hemicellulase, cellulase, dry matter digestibility and relative feed value was determined by calculation. Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) content determined as described by Van Soest et al. (1991). Metabolisable energy (ME) content of fresh and silage samples were calculated from the chemical composition TSE (1991). In vitro organic matter digestibility of samples was determined according to the methods of Aufrère and Michalet-Doreau (1988). Ammonia nitrogen (NH_3-N) and pH values fresh and silage samples were determined according to MAFF (1986). Lactic acid (LA) was determined by the spectrophotometric method of Barker and Summerson (1941). Water soluble carbohydrate (WSC) contents of experiment were determined by spectrophotometer (Shimadzu UV-12ol, Kyoto Japan) after reaction with the Anthrone reagent (MAFF, 1986). Microbiological analyses were performed according to the methods reported by Seale et al. (1990). Accordingly as the incubation medium; MRS agar was used for LAB and malt extract was used for yeast and mold. LAB, mould and yeast counts of samples were obtained at 30 °C following 3 days incubation period. Lactic acid bacteria (LAB), yeast and mold counts of the samples were converted into logaritmic coloni forming unit (cfu/g).

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.).

$$Y_{ij} = \mu + a_i + e_{ij} \quad \text{(Eq.1)}$$

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where
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

The results of the chemical analysis of fresh and ensiled canola are given in *Table 1*. In the study, dry matter and crude protein contents of canola silages ranged between 21.79-28.82% and 14.31-15.66%, respectively, and the dry matter and crude protein contents of canola silages increased significantly with the increase of wheat bran usage rate ($P < 0.01$). The reason for this increase in silage dry matter and crude protein content is that the dry matter and crude protein content of wheat bran is higher than that of canola. DM content was higher compared with that reported by Balakhial et al. (2008), Kincaid et al. (2012) and Limón-Hernández et al. (2019). Limón-Hernández et al. (2019), reported a CP of 145 g/KM DM that is slightly lower than our mean content of 148 g/kg DM. The CP content of canola silages was higher than that provided by most of conserved cereals that have 60 to 100 g/kg DM. For that reason silage could meet the requirements of ruminants (Van Soest, 1994; NRC, 2000). Besides, the addition of wheat bran to the canola significantly decreased the crude ash and ammonia nitrogen of the silages ($P < 0.05$). The pH value of silages, water-soluble carbohydrates and lactic acid contents were not affected by the addition of additives ($P > 0.05$). The pH value (4.5) was higher than (3.9) reported by Limón-Hernández et al. (2019). Balakhial et al. (2008) reported pH value 4.8 that is higher than our mean value (4.5). In the study conducted by Balakhial et al. (2008), it was reported that the addition of urea to the canola silage increased pH and ammonia concentration of the silage and thus the silage quality was adversely affected. The research findings show that wheat bran supplement has a positive effect on silage quality.

Table 1. *Chemical analysis of canola silages*

Treatment	DM %	pH	CP %	Ash %	WSC g/kg KM	NH_3-N g/kg TN	LA %
0	23.66	5.87	14.65	11.39	49.42	98.95	-
Control	21.79±0.48[c]	4.63±0.02	14.31±0.02[c]	13.85±0.89[a]	13.97±0.17	91.53±1.18[a]	36.15±5.05
WB 5%	24.72±0.57[b]	4.61±0.04	14.71±0.06[b]	13.74±0.40[a]	16.75 ±2.28	85.43±4.71[b]	32.21±7.02
WB 10%	28.82±1.23[a]	4.55±0.16	15.66±0.19[a]	11.40±0.50[b]	15.08±1.33	85.34±2.87[b]	33.10±6.59
P	0.001	0.550	0.001	0,005	0.160	0.001	0.730

Values with different letters in the same column are statistically different (P<0.05 and 0.01). WB: wheat bran; DM: dry matter; CP: crude protein; WSC: water soluble carbohydrate; NH_3-N: ammonia nitrogen; LA: Lactic acid

The microbiological composition of the canola silage is given in *Table 2*. The number of lactic acid bacteria increased as the amount of wheat bran decreased, while the number of yeast and mold increased. Silage fermentation is a complex process

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which depends on many factors. The silage characteristics that contribute to a good fermentation are: dry matter content, physiological properties of epiphytic bacteria and, most importantly, the quantity of soluble carbohydrates (Zanine et al. 2010). The decline in pH values inhibit the spoilage microorganism proliferation, which allows the silage nutritive values to be preserved. Thus, the best silage forages are the ones with high water soluble carbohydrate content, which should be sufficient to promote the fermentation and produce enough acid to preserve the silage. In the present experiment, content of WSC in all ensiled canola forages (4.2% DM, *Table 1*) was lower than the 6 to 7% content which is recommended for theoretical requirement to achieve well preserved fermentation (Wang et al. 2009). Thus the canola without additives was adequate for producing good quality silages.

Table 2. *Microbiological analysis of canola silages*

Treatment	LAB log_{10}cfu/g	YEAST log_{10}cfu/g	MOLD log_{10}cfu/g
0	4.77	4.76	3.57
Control	3.12±0.25[a]	3.28±0.04[b]	2.53±0.04[b]
WB 5%	2.52±0.07[b]	3.15±0.07[b]	2.56±0.05[b]
WB 10%	2.48±0.04[b]	4.59±0.11[a]	4.50±0.09[a]
p	0.001	0.001	0.001

Values with different letters in the same column are statistically different (P<0.01). WB: wheat bran

NDF, ADF, ADL, hemicellulose, digestible dry matter (DDM), dry matter intake (DMI) and relative feed values (RFV) of canola silages are given in *Table 3*. In parallel with the increase in wheat bran ratio added to the canola, the NDF and ADF contents of the silages significantly reduced (P < 0.01).

Table 3. *The results of the analysis of the cell wall of canola silages*

Treatment	NDF %	ADF %	ADL %	HEM.CEL %	DDM	DMI	RFV
0	55.33	44.80	10.16	10.52	54.00	2.17	90.77
Control	54.32±0.22[a]	41.20±1.43[a]	19.37±1.70[ab]	13.12±1.65	56.80±1.11[b]	2.21±0.01[b]	97.24±1.52[b]
WB 5%	51.28±0.65[b]	34.43±0.57[b]	15.06±2.37[b]	16.85±0.92	62.08±0.44[a]	2.34±0.03[a]	112.59±1.54[a]
WB 10%	50.51±0.79[b]	37.08±2.73[b]	19.90±2.68[a]	13.43±3.43	60.01±2.13[a]	2.38±0.04[a]	110.47±2.61[a]
p	0.001	0.01	0.08	0.16	0.01	0.001	0.001

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

The degradation of the cell wall components in silages is thought to be resulted from the fact that the wheat bran has low NDF and ADF content and accelerates the activity of lactic acid bacteria in the environment, being a source of carbohydrates. The NDF and ADF findings were similar with Balakhial et al. (2008); and higher than Limón-Hernández et al. (2019) findings. Kincaid et al. (2012) reported a lower value of NDF

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(29.82%) which can be attributed to an early harvest (60-70 days after sowing). Feeding behavior of animals, feed consumption, feed digestibility and feed conversion to animal products vary depending on the quality of feed (Van Soest, 1994).

Feed quality is determined by the relative feed value (RFV) index developed for clover in the USA and used in other roughages (Bozkurt, 2011; Canbolat, 2013). Neely et al. (2009) reported that RFV of canola silage was double that of corn, alfaalfa silage and more than three times higher than triticale silage. The lowest RFV was found as 97.24 in control group canola silage, whereas the RFV significantly increased with the addition of wheat ($P < 0.05$). The highest DDM ratio of silages was found as 62.08% and 5% in wheat bran group and the lowest DDM ratio was found as 56.80% in lean canola silage. DMI ratios of silages ranged between 2.21-2.38% and DMI ratio was found to be significantly higher in the groups with the addition of wheat bran than in the control group of canola silage. It is reported that increase in NDF, ADF and ADL levels, which are found in the structure of feeds and slow down the digestion, causes satiety and limits the feed consumption of animals (Canbolat and Karaman, 2009; Canbolat, 2013). The findings of this research also support this. The DDM and DMI values determined in the study were found to be similar with the findings of Canbolat and Karaman (2009) and Bozkurt (2011), who studied different legume feeds. In a study investigating the effects of urea and molasses on the quality of feed as an additive to canola silage, it was determined that the addition of molasses improved the quality of silage decreasing the content of ADF and NDF, but lowered the DDM value (Balakhail et al. 2008). DMI findings were slightly lower than Paula et al. (2017) findings. In the study, the addition of wheat bran to canola silage was found to increase the DMI value.

Organic matter digestion (OMD), metabolic energy (ME) contents of canola silages were determined and given in *Table 4*. Organic matter digestibility and metabolic energy values of canola silages increased with the addition of wheat bran. The highest organic matter digestibility was determined as 63.93% in canola silages with the addition of 5% wheat bran, while the highest metabolic energy value was found in the group with the addition of 10% wheat bran ($P < 0.05$). OMD findings were slightly lower than reported by Balakhial et al. (2008), Kincaid et al. (2012), Paula et al. (2017) and Limón-Hernández et al. (2019).

Table 4. *Organic matter digestion (OMD), metabolic energy (ME) content of canola silages*

Treatment	OMD %	ME MJ/kg KM
0	60.79	8.23
Control	61.45 ± 0.67^{b}	7.94 ± 0.20^{b}
WB 5%	63.93 ± 0.02^{a}	8.27 ± 0.06^{a}
WB 10%	62.92 ± 0.72^{a}	8.51 ± 0.07^{a}
p	0.01	0.00

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

Conclusion

The results of this study show that canola forage has suitable nutrient composition. Therefore, it can be used for dairy cattle nutrition. It allows conservation without

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affecting its nutritional value. High moisture content of canola forage is one of the dangerous factors concerning canola silage quality. It requires an additive for proper conservation. Addition of wheat bran improved DM and DDM content of canola silage.

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