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Influence of Treated Wheat Bran, with Effective Microorganisms- on an *In vitro* Digestibility and *In sacco* Degradability of a Mixed Ration

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Abstract

This study assessed the impacts of including a treated wheat bran, with effective microorganisms (EMWB), in a mixed diet on the chemical composition, in vitro digestibility, and in sacco degradability of the dry matter (DM) and crude protein (CP). The treatment consisted of 70% native pasture hay (NPH) and 30% concentrate mixtures (wheat bran (35%), maize (20%), rice bran (21%), molasses (3%), niger seedcake (4%), sunflower cake (11%), salt (3%), and limestone (3%)). This concentrate mixture was substituted with different levels (0, 33, 66 and 100%) of treated wheat bran for T_1, T_2, T_3 and T_4, respectively. The CP content was increased (7.2, 9.1, 9.2 and 12.2% DM (SEM = 0.214), while the neutral detergent fiber (NDF) content was decreased with an increasing level of EMWB (66.2, 64.3, 63.7 and 62.1 % DM (SEM = 0.117) for T_1, T_2, T_3 and T_4 respectively). Similarly, the contents of both acid detergent fiber (ADF) and acid detergent lignin (ADL) showed a declining trend with an increasing EMWB in the diet. The in vitro DM digestibility (IVDMD) was in the order of $T_4 > T_3 > T_2 > T_1$ (54.9, 56.2, 59.7 and 74.4% (SEM = 0.169), respectively. An inclusion of EMWB, in the diet enabled to improve the rapidly degradable (a) and insoluble but potentially soluble (b) fractions of the diets. Furthermore, the in sacco potential (PD) and effective degradability (ED) of DM and CP increased with increasing levels of EMWB in the diet. The PD and ED for DM ranged from 55 to 70% and 37 to 48%, respectively. Similarly, the PD and ED for CP ranged 25 to 48% and 16 to 22%, respectively. The treatments with EMWB for example T_4 showed the most significant impact on enhancing the nutritive values and degradability. Consequently, EMWB can completely substitute a commercial concentrate mixture used in the current study, yielding better results.

Keywords: *In sacco* degradability, *in-vitro* digestibility, crude protein, dry matter

Introduction

The livestock sector of Ethiopia plays a crucial role in the country's economy and the livelihoods of the majority of its people, with significant potential for meat and milk production (CSA 2017/18). However, feed supply (in quantity and quality) have been a major hindrance to livestock production and productivity in the country (FAO, 2019). The primary sources of livestock feed in Ethiopia are natural pasture and crop residues, which are characterized by poor nutritional quality and insufficient year-round supply (Seyoum et al., 2007). Dried forages

and roughages are deficient in crude protein (CP), minerals, and vitamins and their high-lignin content restricts their use as sole feed for ruminants (ILRI, 1999).

To enhance the utilization of low-quality roughages, various strategies, including supplementation, biological treatment, and manipulation of the rumen ecosystem, are well-known and widely used in the sector (Lettat et al., 2012; FAO, 2019; Bimrew et al., 2020). Microorganisms have been effectively employed as biological treatments in ruminant production to increase productivity, prevent digestive disorders like acidosis, and reduce pathogenic load (Lettat et al., 2012). Generally, the use of combinations of microbial strains in ruminants has shown synergetic beneficial effects (Collado et al., 2007), leading to improved animal performance (Krehbiel *et al.*, 2003).

Effective Microorganisms (EM) are a mixed culture of aerobic and anaerobic microbes that live symbiotically with each other. These microorganisms are beneficial, natural, free-living, and safe. EM comprises selected species of microorganisms, including predominant populations of lactic acid bacteria and yeasts, as well as smaller numbers of photosynthetic bacteria, actinomycetes, and other types of organisms (Higa, 1994).

The use of EM in animal husbandry is widely accepted in many parts of the world. In a study conducted in Russia by Alexey et al. (2019), EM was successfully used as a feed supplement in cattle rations to increase the productivity and meat quality of calves. Similarly, studies conducted in Egypt by Yacout et al. (2021) showed that the use of EM as a feed supplement improved digestibility in sheep. Likewise, several studies have been conducted in Ethiopia to investigate the effect of EM on enhancing the nutritive value of crop residues. For instance, research findings of Bimrew et al. (2020) and Daniel et al. (2017) indicated that treating rice straw and sorghum stover with EM improved their quality by reducing fiber content and enhancing CP. However, to date, the effects of a mixed ration containing different proportions of EM- treated wheat brans on chemical composition, *in-vitro* digestibility, and *in sacco* degradability of a mixed ration have not been investigated. Therefore, the objective of this study was to assess the effects of different levels of EM-treated wheat bran on the chemical composition, *in vitro* digestibility, and *in sacco* degradability of DM and CP of a mixed ration.

Materials and Methods

Study Site and Treating the Wheat Bran, with Effective Microorganisms

The study was conducted at the Holetta Agricultural Research Center of the Ethiopian Institute of Agricultural Research (EIAR).

A sufficient quantity of activated EM packed in plastic bottles was purchased from Weljeji PLC (Bishoftu, Ethiopia) and molasses was purchased from Ethiopian Sugar Corporation Wenji branch. EM was diluted by mixing 1 liter of EM, 1 liter of molasses and 18 liter of water in a ratio of 1:1:18. Then, 20 liters of the diluted EM solution was poured gradually onto a 50 kg of wheat bran and then thoroughly mixed. The mixture was placed in a concrete hole/silo-type that was prevented from air entry, maintaining anaerobic conditions, and it was protected from direct sunlight. Finally, it was left to ferment for 21 days. After 21 days, the treated wheat bran was ready for use when it emitted a sweet fermented smell.

Experimental Treatments

In a companion feeding trial with lactation dairy cows, the animals were fed a mixture of 70% native pasture hay and 30% concentrate mixture (consisting of wheat bran 35%, maize 20%, rice bran 21%, molasses 3%, niger seed cake 4%, sunflower cake 11%, salt 3%, and limestone 3%). The composition and proportions of the concentrate mixture were provided by the formulating company. The aim of this study was to determine the effects of EM-treated wheat bran on performance parameters of lactating dairy cows. The concentrate mixture was replaced by 0, 33, 66 and 100% EM-treated wheat bran for T_1, T_2, T_3 and T_4, respectively. A mixed ration with that of proportionally similar to the feeding trial was also prepared and used to evaluate the chemical composition, *in vitro* digestibility and *in sacco* degradability of the experimental feeds. Thus, a 200 g mixed ration was prepared by mixing 140 g of native pasture hay plus 60 g concentrate mixture for T_1. The same amount of native pasture hay was combined with 33 % (20 g), 66% (40 g) and 100 (60 g) of the concentrate mixtures being replaced by an EM-treated wheat bran for T_2, T_3 and T_4, respectively. Samples of these feeds were dried at 65 °C for 48 hours. Then, these samples were divided into two halves, with one half was ground using a Wiley mill to pass through a 1 mm screen for chemical analysis and *in vitro* digestibility determination. The other half was ground to pass through a 2 mm screen for *in sacco* degradability measurement.

Experimental Measurements

Chemical Composition

The DM, ash and CP contents in the treatment samples were analyzed following the AOAC (1990) method. The organic matter (OM) content was calculated as 100 − ash content. The CP content was calculated by multiplying nitrogen content by a factor of 6.25. The acid detergent fiber (ADF), acid detergent lignin (ADL) and neutral detergent fiber (NDF) of the samples were determined using the method of Van Soest and Robertson (1985).

In vitro Digestibility

The *in-vitro* dry matter digestibility (IVDMD) of the treatments was determined as described by Van Soest and Robertson (1985). Rumen fluid was obtained from

three rumen fistulated Boran × Holstein Frisian crossbred steers, fed on a basal diet of natural pasture hay and supplemented with 2 kg of concentrate mixture (wheat bran 35%, maize 20%, rice bran 21%, molasses 3%, niger seed cake 4%, sunflower cake 11%, salt 3%, limestone 3%). This fluid was used for *in vitro* incubation of the treatment samples. The same natural pasture hay used in this study served as the source of hay fed to the rumen content of the donor animals.

In sacco Degradability

The *in sacco* DM and CP degradability were determined by incubating about 3 g of each treatment sample in a nylon bag (40 to 60 µ pore size and 4.5 × 18 cm dimension) in three rumen fistulated Boran × Friesian crossbred steers. Duplicated samples were incubated for 0, 6, 12, 24, 48, 72, and 96 hours. The bags were inserted sequentially and removed at the same time (Osuji et al., 1993). After removal from the rumen, the bags were washed in running tap water while rubbing gently between thumb and fingers until the water became clear. Zero-time disappearances (washing losses) were obtained by washing un-incubated bags in the same manner. The washed bags were then dried in an oven at 100 °C for 24 hours. After cooling in desiccators, the bags were weighed immediately to determine the dry weight of the incubation residues. The residues were also analyzed for CP contents. Dry matter and CP disappearances were estimated using the following equations:

$$Dry\ Matter\ Disappearance\ (DMD) = \frac{((BW+S1)-(BW+RW))}{S1}\ X\ 100$$

$$Crude\ Protein\ Disapperance\ (CPD) = \frac{((S1\ X\ CP1)-(RW\ X\ CP2))}{S1\ X\ CP1}\ X\ 100$$

Where; BW = bag weight; RW = residue weight; S1 = sample weight; CP1 = crude protein content of the original sample; CP2 = crude protein content of the residue.

The DMD and CPD data were fitted to the equation $Y = a + b\ (1 - e^{-ct})$ described by Ørskov and McDonald (1979) using the Naway Excel program (Chen, 1995), where; Y = the potential disappearance of DM at time t; a = the rapidly degradable fraction; b = the potentially, but slowly degradable fraction; c = the rate of degradation of b; e = the natural logarithm; t = time after incubation. The potential degradability was determined by the equation PD = a + b. Effective degradability (ED) was calculated assuming a passage rate of 4%/h using the equation described by Ørskov and McDonald (1979) as $ED = \frac{a+bc}{k+c}$; where k = passage rate.

Statistical Analysis

The data were analyzed using analysis of variance (ANOVA) following the general linear model (GLM) procedure of SAS statistical program (2010). Means were separated using LSD. The model used for analysis was $Y_{ij} = \mu + T_i + ß_j + e_{ij,}$

where; Y_{ij} = response variable; μ = overall mean; T_i = treatment effect; $ß_j$ = replication effect; and e_{ij} = the random error.

Results and Discussion

Chemical composition and *in-vitro* digestibility

The chemical composition and IVDMD of treatment rations used in this study are given in Table 1. The OM content of T_4 was greater ($P < 0.05$) compared to the other treatments. The diets in T_4 had the greatest CP content, while T_1 had the lowest, and the other two treatments showed intermediate values. Generally, there was an increasing trend in CP content as the level of EM-treated wheat bran inclusion increased. This increase in CP content with rising levels of EM-treated wheat bran may be attributed to enhanced microbial growth and proliferation during the treatment process, which is consistent with the findings of Bimrew et al. (2020) and Daniel et al. (2017) regarding greater CP values in EM-treated rice straw and sorghum stover compared to untreated ones.

The NDF contents of treatment diets followed the order of $T_1 > T_2 > T_3 > T_4$ ($P < 0.05$). The ADF and ADL contents were higher for T_1 and T_2 compared to T_3 and T_4. These findings align with previous studies that have reported deceased levels of structural carbohydrates such as NDF, ADF and lignin with EM inoculation on fibrous feedstuffs (Yonatan et al., 2014; Daniel et al., 2017; Bimrew et al., 2020).

The IVDMD in the current study ranged from 54.9 to 74.4%. There was a significant increase ($P < 0.05$) in IVDMD with increasing levels of EM-treated wheat bran inclusion in the diet. Previous research has shown a negative correlation between digestibility and NDF, ADF and ADL contents, as well as a positive correlation with CP content (Solomon et al., 2010; Bimrew et al., 2020). Therefore, the observed increase in CP and decrease in NDF and other fiber contents of the treatment diets with increasing levels of EM-treated wheat bran inclusion likely contributed to an improved value of IVDMD. Similar improvements in IVDMD have been reported by Yonatan et al. (2014) for EM-treated coffee husk silages and Yacout et al. (2021) for different sheep feeds treated with EM. Based on the results of this study, the inclusion of EM in animal feeds appears to improve feed quality by reducing structural carbohydrates and increasing CP content and IVDMD.

Table 1. Chemical composition and *in-vitro* dry matter digestibility (IVDMD) of mixed diets containing different levels of EM-treated wheat bran replacing concentrate mixture

Treatments	DM (%)	Ash (% DM)	OM (% DM)	CP (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	IVDMD (%)
T1	92.9	9.9^{a}	90.0^{b}	7.1^{c}	66.1^{a}	21.2^{a}	4.9^{a}	54.9^{d}
T2	93.2	9.9^{a}	90.0^{b}	9.1^{b}	64.3^{b}	21.1^{a}	4.9^{a}	56.2^{c}
T3	92.8	9.7^{a}	90.3^{b}	9.2^{b}	63.6^{c}	20.2^{b}	4.4^{b}	59.7^{b}
T4	92.5	8.4^{b}	91.6^{a}	12.2^{a}	62.1^{d}	20.1^{b}	4.3^{b}	74.4^{a}
SEM	0.182	0.108	0.108	0.214	0.117	0.126	0.099	0.169
p-value	0.13	< .0001	< .0001	< .0001	< .0001	0.0004	0.004	< .0001

DM = dry matter; CP = crude protein; OM = organic matter; NDF = neutral detergent fiber; ADF = Acid detergent fiber; ADL = acid detergent lignin; Concentrate mixture (CM) = (wheat bran 35%, maize 20%, rice bran 21%, molasses 3%, niger seedcake 4%, sunflower cake 11%, salt 3%, limestone 3%); T_1 = 70% native pasture hay (NPH) plus 30% CM; T_2 = 70% NPH plus 33% of the 30% CM replaced by EM-treated wheat bran; T_3 = 70% NPH plus 66% of the 30% CM replaced by EM-treated wheat bran; T_4 = 70% NPH plus 100% of the 30% CM replaced by EM-treated wheat bran; SEM = standard error of mean

In sacco Dry Matter and Crude Protein Degradability

The *in sacco* degradation of DM and CP at different incubation hours are presented in Table 2 and Table 3, respectively. Generally, the degradation of DM and CP increased with the incubation time. Differences in the degradability of DM and CP were observed at all incubation periods. In most incubation hours, the degradability of DM and CP increased with increasing levels of EM-treated wheat bran inclusion in the diet. Therefore, the inclusion of EM-treated wheat bran in the diet has improved the ruminal degradation of the mixed diet, indicating an improvement in nutritional value of feeds with EM treatment. Consistent with the current results, other studies have noted that treating feed with EM increased ruminal DM degradability and improved the nutritive value of feeds (Syomiti et al., 2010; Daniel et al., 2017).

The improved CP content and reduced content of structural carbohydrates with increasing levels of EM-treated wheat bran noted in this study might have contributed, in part, to the improvements in the ruminal degradability of DM and CP (Solomom et al., 2010; Bizelew et al., 2021). Moreover, Syomiti et al. (2010) reported that EM treatment increased *in sacco* DM degradability of cellulose and highly fibrous feeds and suggested that this could be due to the yeasts and bacterial species in EM.

It has been suggested that the microbes in EM may stimulate the activity of beneficial microbes, especially cellulolytic organisms and their associated enzymes in ruminants (Aramble and Kent, 1990; Yoon and Stern, 1995). Maurya (1993) highlighted that the yeast cells remain active in the rumen and have a stimulatory effect on cellulose-degrading bacteria. Yeasts in the rumen also convert available oxygen and sugar into carbon dioxide and usable energy for efficient bacterial cell growth, thereby maintaining the rumen environment anaerobic and favorable to ruminal cellulolytic microbes (Knapp et al., 2014). Thus, the effect of including dietary probiotics in enhancing ruminal degradation

of nutrients could be a consequence of multiple factors, such as improvements in chemical composition of the diet, enhanced degradation of structural carbohydrates, changes in the profile of ruminal microbes that stimulate degradation of fibrous feeds, and the maintenance of favorable anaerobic ruminal environment for the microbes, among others. These positive attributes of EM on the chemical composition and ruminal degradability of nutrients can increase animal productivity and feed efficiency.

Table 2. *In-sacco* dry matter degradability at different incubation hours of mixed diets containing different levels of EM-treated wheat bran replacing concentrate mixture

Treatments	Incubation hours						
	0	6	12	24	48	72	96
T1	12.7^{c}	26.3^{d}	33.1^{c}	36.1^{d}	42.7^{d}	51.2^{c}	55.6^{d}
T2	14.3^{c}	30.9^{c}	35.9^{b}	39.5^{c}	47.2^{c}	55.6^{b}	58.4^{c}
T3	17.6^{b}	33.5^{b}	39.2^{a}	43.4^{b}	52.9^{b}	58.2^{b}	65.6^{b}
T4	19.8^{a}	36.1^{a}	41.1^{a}	47.2^{a}	59.8^{a}	64.4^{a}	70.4^{a}
SEM	0.537	0.496	0.655	0.834	0.483	0.794	0.656
p-value	< .0001	< .0001	< .0001	< .0001	< .0001	< .0001	< .0001

$^{a-d}$Mean values in a column without common superscripts differ (P < 0.05); Concentrate mixture (CM) = (wheat bran 35%, maize 20%, rice bran 21%, molasses 3%, niger seedcake 4%, sunflower cake 11%, salt 3%, limestone 3%); T1 = 70% native pasture hay (NPH) plus 30% CM; T2 = 70% NPH plus 33% of the 30% CM replaced by EM-treated wheat bran; T3 = 70% NPH plus 66% of the 30% CM replaced by EM-treated wheat bran; T4 = 70% NPH plus 100% of the 30% CM replaced by EM-treated wheat bran; SEM standard error of mean

Table 3. *In-sacco* crude protein degradability at different incubation hours of mixed diets containing different levels of EM-treated wheat bran replacing concentrate mixture

Treatments	Incubation hours						
	0	6	12	24	48	72	96
T1	6.4^{d}	10.4^{b}	13.6^{c}	17.2^{d}	20.4^{c}	21.3^{d}	26.3^{d}
T2	8.1^{c}	13.0^{ab}	14.3^{c}	19.3^{c}	23.2^{b}	24.2^{c}	29.1^{c}
T3	10.9^{b}	13.4^{a}	16.6^{b}	20.1^{b}	23.0^{b}	25.5^{b}	31.8^{b}
T4	12.5^{a}	14.7^{a}	19.1^{a}	23.3^{a}	24.3^{a}	29.6^{a}	35.5^{a}
SEM	0.247	0.822	0.248	0.205	0.275	0.189	0.342
p-value	< .0001	0.032	< .0001	< .0001	< .0001	< .0001	< .0001

$^{a-d}$Mean values in a column without common superscripts differ (P < 0.05); SEM standard error of mean; Concentrate mixture (CM) = (wheat bran 35%, maize 20%, rice bran 21%, molasses 3%, niger seedcake 4%, sunflower cake 11%, salt 3%, limestone 3%); T1 = 70% native pasture hay (NPH) plus 30% CM; T2 = 70% NPH plus 33% of the 30% CM replaced by EM-treated wheat bran; T3 = 70% NPH plus 66% of the 30% CM replaced by EM-treated wheat bran; T4 = 70% NPH plus 100% of the 30% CM replaced by EM-treated wheat bran; SEM = standard error of mean

Degradability Parameters of Dry Matter and Crude Protein

The parameters for *in sacco* degradation of DM and CP in the treatment diets are presented in Tables 4 and 5, respectively. Except for parameter c/rate of degradation for DM, all degradation parameters differed among the treatments ($P < 0.05$). The rapidly degradable fraction (a) for DM was greater for T_3 and T_4 compared with T_1 and T_2. The insoluble but potentially degradable DM fraction (b) tended to increase with an increasing inclusion of EM-treated wheat bran in the diet. The PD followed the order of $T_1 = T_2 < T_3 < T4$ and the ED followed the

order of $T_1 < T_2 < T_3 < T_4$ ($P < 0.05$). The fraction a for CP increased with an increasing level of EM-treated wheat bran inclusion in the diet. The fraction b for CP was greater in T_3 and T_4 compared to T_1 and T_2. The rate of degradation of CP decreased with an increasing level of EM-treated wheat bran in the diet. The PD and ED of CP showed a similar trend to that observed for DM, and both increased with increasing levels of EM-treated wheat bran in the diet.

In general, the inclusion of EM-treated wheat bran in the diet improved the degradability parameters. The improvement in the fraction a for both DM and CP with the inclusion of EM-treated wheat bran was apparently associated with changes in chemical composition of the treatment diets noted in this study. Other researchers also noted that the increase in CP and decrease in structural carbohydrate content with EM treatment increased the rapidly degradable fraction of the diets (Solomon et al., 2010; Syomiti et al., 2010). Similarly, the values of fraction b, PD and ED were greater with the inclusion of EM-treated wheat bran in the diet, which is supported by previous finding of Daniel et al. (2017) and Syomiti et al. (2010) who showed the use of EM as a feed additive increases the DM degradability parameters of sorghum stover and forages. The values for PD and ED parameters also align with the *in vitro* digestibility values noted in this study. Solomon et al. (2010) also observed that *in sacco* DM and CP degradation parameters have a positive correlation with IVDMD and a negative correlation with NDF, ADF and ADL contents. Similarly, Bezelew et al. (2021) indicated that greater levels of NDF and lignin could lead to lower levels of PD and ED. Based on the *in sacco* PD and ED parameters of DM and CP in the treatment diets, the treatments can be ranked as $T_4 > T_3 > T_2 > T_1$.

Table 4. *In-sacco* dry matter degradability parameters of mixed diets containing different levels of EM-treated wheat bran replacing concentrate mixture

Treatments	a (g/kg DM)	b (g/kg DM)	c (%/h)	PD (g/kg DM)	ED (g/kg DM)
T1	16.4^{b}	38.5^{c}	0.03	54.9^{c}	36.6^{d}
T2	18.2^{b}	38.9^{bc}	0.04	57.2^{c}	40.3^{c}
T3	21.5^{a}	42.1^{b}	0.03	63.6^{b}	44.2^{b}
T4	23.3^{a}	46.8^{a}	0.03	70.1^{a}	48.2^{a}
SEM	0.552	0.954	0.003	1.316	0.269
p-value	0.0004	0.003	0.64	0.0007	< .0001

$^{a-d}$Mean values in a column without common superscripts differ ($P < 0.05$); a = rapidly degradable fraction; b = slowly, but potentially degradable fraction; c = rate of degradation; DM = dry matter; ED = effective degradability; PD = potential degradability; Concentrate mixture (CM) = (wheat bran 35%, maize 20%, rice bran 21%, molasses 3%, niger seed cake 4%, sunflower cake 11%, salt 3%, limestone 3%); T1 = 70% native pasture hay (NPH) plus 30% CM; T2 = 70% NPH plus 33% of the 30% CM replaced by EM-treated wheat bran; T3 = 70% NPH plus 66% of the 30% CM replaced by EM-treated wheat bran; T4 = 70% NPH plus 100% of the 30% CM replaced by EM-treated wheat bran; SEM = standard error of mean

Table 5. *In-sacco* crude protein degradability parameters of mixed diets containing different levels of EM-treated wheat bran replacing concentrate mixture

Treatments	a (g/kg DM)	b (g/kg DM)	c (%/h)	PD (g/kg DM)	ED (g/kg DM)
T1	7.1[d]	18.1[b]	0.03[a]	25.29[c]	16.36[d]
T2	9.0[c]	20.1[b]	0.02[b]	29.07[c]	18.48[c]
T3	11.9[b]	29.3[a]	0.01[c]	41.27[b]	19.61[b]
T4	13.7[a]	34.4[a]	0.01[c]	48.14[a]	22.02[a]
SEM	0.375	1.865	0.001	1.808	0.191
p-value	< .0001	0.0024	< .0001	0.0004	< .0001

[a-d]Mean values in a column without common superscripts differ (P < 0.05); a = rapidly degradable fraction; b = slowly, but potentially degradable fraction; c = rate of degradation; DM = dry matter; ED = effective degradability; PD = potential degradability; SEM standard error of mean; Concentrate mixture (CM) = (wheat bran 35%, maize 20%, rice bran 21%, molasses 3%, niger seed cake 4%, sunflower cake 11%, salt 3%, limestone 3%); T1 = 70% native pasture hay (NPH) plus 30% CM; T2 = 70% NPH plus 33% of the 30% CM replaced by EM-treated wheat bran; T3 = 70% NPH plus 66% of the 30% CM replaced by EM-treated wheat bran; T4 = 70% NPH plus 100% of the 30% CM replaced by EM-treated wheat bran; SEM = standard error of mean

Conclusion

Treating feed with EM, as used in the present study, showed improvements in the chemical composition through an increased CP and reduced structural carbohydrates. It also increased the degradability of DM and CP, indicating the high potential of EM treatment for enhancing the nutritive values of the feeds. The current results suggested that EM-treated wheat bran can fully replace the concentrate mixture used in the current study with better animal performance results.

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