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EFFECT OF RUMINAL BACTERIA (ZAD) ON CHEMICAL COMPOSITION OF ROUGHAGES

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ABSTRACT

Four common Egyptian Agricultural by products used for ruminant feeding were treated with different concentrations of Probiotic (ZAD) to study the effect of treatment on chemical composition of roughages. Roughages used were rice straw (RS), wheat straw (WS), corn stover (CS) and sugar cane bagasse (SCB). Concentrations of ZAD tested in this study were 0.05, 1.0, 1.5 and 2 ml/Kg of roughage.

Roughages were mixed with ZAD solution and incubated anaerobically for 4 weeks. Results indicated that treatments decreased crude fiber (CF) contents of all roughages by 17 % in CS to 30% in SCB and increased EE by multiplication of 1.45 times in WS to 4.9 times in SCB. Statistical analysis showed no significant interaction between roughage source and ZAD concentration on chemical composition of roughages except for crude protein where interaction was significant (P<.05).
Results also indicated that ZAD concentration over 0 ml/kg affected CF & CP contents, it was also noticed that CP of RS showed the highest response for treatment followed by SCB and CS, respectively. Crude protein of WS was not affected by different ZAD concentration. It was concluded that ZAD concentration of 1 ml/ 1 Kg of roughage is recommended for treatment to improve roughage chemical analysis.

Keywords: Chemical composition, Ruminant, ZAD, rice straw, wheat straw, corn stalls, sugar cane bagasse.

INTRODUCTION

Many agricultural by-products have been used in ruminant nutrition for a long time in Egypt. Rice straw, wheat straw, corn stover and bagasse are common agricultural by products in Egypt .They are usually used to feed ruminant animals as low quality roughages because of their low nutritive value, high fiber and legnocellulose content **(Leng 1991)**. They are also low in minerals, especially phosphorus, insufficient in crude protein and deficient in vitamins **(Tingshuang et al 2002)**. Several digestibility experiments and feeding trials have been conducted to study the effect of nutritive value of crop residues on digestibility **(Khattab et al 2008; Kholif et al 2014)**. It has been concluded that high fiber contents negatively affect voluntary intake and rate of organic matter fermentation and feeding such residues without treatment or untreatment supplementation, can just or barely cover maintenance energy requirement.

Several methods have been suggested for improving feeding value of agricultural by-products. Ensiling of many dry crop by-products have been used with addition of microorganisms and/or enzymes after chopping, reconstitution of moisture and processing then saved in an anaerobic condition **(Nahla et al 2014)**.

Objective of the present study was to investigate the effect of treating different roughages with different ZAD concentration on its chemical composition.

MATERIALS AND METHODS

The present study was performed from November 2015 to May 2018, at the Animal Production Research Institute (APRI) and Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

Raw material

Bagasse (SCB), Rice straw (RS), Corn stover(CS), wheat straw(WS), molasse, and urea were obtained from Farm of faculty of Agriculture- Ain Shams University. Strain Lactobacillus was obtained from Microbial Resources Centre - Faculty of Agriculture - Ain Shams University (MRC). media rumen fluid was obtained from Slaughterhouse..

Chemicals

All chemicals used throughout this work were biochemical grades from (APRI) Sigma, Chemicals Company.

Preparation of compost solution

Molasse and urea were added at the rate of 10% and 2% respectively, then added amount of water to raise the humidity to 60% for feed materials used.

Composting

The humidity of the bagasse, straw and corn stover was determined by drying 2 gm of each substance on 105°C for 3 hours until the stability of weight. 75 samples of each material was prepared, where the sample weighes 250 gm. Then compost solution was mixed with the Bagasse, straws and corn stover.

Composting samples was carried out well in order to enable bacteria to grow and reproduce anaerobically, leaving samples at room temperature. Then takeing a representative sample (2 gm) of each repeat for chemical analyses.

Approximate analyses were conducted according to **(AOAC 1995)**. Fiber fraction were determined according to **(Vansoest et al 1991)**.

Statistical Analyses

Data were statistically analyzed using the general linear model procedure **(SAS 2002)**. The differences among means tested using Duncan's multiple –rang test **(Duncan 1995)**.

The statistical model was as follw

$$Y_{iej} = \mu + S_i + C_e + S\,C_{ie} + e_{iej}$$

Where:

Y_{iej} = an observation
μ = overall means
S_i = effect of roughage source
C_e= effect of ZAD concentration
S C_{ie}=effect of interaction between roughage source and ZAD concentrations
e_{iej} = random error.

RESULTS AND DISCUSSION

Chemical Composition of Roughages used in the present study

Chemical Composition of Roughages used in the present study is shown in Table (1): Dry matter (DM) content of rice straw, wheat straw and corns stover were more than 95.5% with very tiny differences, however sugar cane bagasse (SCB) had the lowest DM contents (93.5%).

Crude Protein(CP) content was the highest in corn stover (5.52%) and the lowest in SCB (1.34%), while rice straw (RS) and wheat straw were intermediated (3.76, 2.85% respectively).

Ether extract values (EE) as an indicator for lipid content of roughages were the highest (1.37%) in WS followed by (RS) (0.88%) and CS (0.53%) while SCB had the lowest EE contents (0.38%) among all tested roughages.

Sugar cane bagasse contained the highest CF (45.63%) compared with (40.21%) for WS (38.58%) for RS and 38.38% for CS.

Results obtained in the present study were similar to those reported by **Mohamed et al 2016, Ibrahim et al 2017. Gomaa et al 2016 and Safa et al 2011.** Crude protein in RS ranged between 3.41% **(Ibrahim et al 2017)** and 3.9 **(Safa et al 2011)** agreeing with the present study (3.76%). Same trend of agreement was noticed for CF. However, for (WS) refrences reported a wide range for (CP); where **Salama et al 2011** reported a value of 5.7%, **Sharifi Hosseini et al 2015** recorded 1.42% and Hassan & Nisa 2011 reported 2.90. This wide range may be due to using different cultivars of wheat with different agricultural processing to raise wheat. Crude protein of CS in the present

study (5.52%) was very clause to that obtained by **Safa et al 2011** (4.95%) who reported a value of 34.97% for CF in CS compared to 38.38% in the present study. Values obtained in the present study for CP & CF of SCB (1.34, 45.63 respectively) were comparable to those obtained by several investigators **(Nahla et al 2014, Gado et al 2007 and Salama et al 2011)**.

Table 1. Chemical composition of roughages (Rice straw, Wheat straw, Corn stover, Bagasse)

Items	DM	CP	EE	CF	NFE	Ash
RS	95.5	3.76	0.88	38.58	41.46	15.32
WS	96.2	2.85	1.37	40.21	46.04	9.53
CS	96.5	5.52	0.53	38.38	45.22	10.35
SCB	93.5	1.34	0.38	45.63	41.9	10.75

RS : Rice straw. WS : Wheat straw. CS : Corn stover. SCB : Bagasse

Effect of ZAD treatments on chemical composition of experimental roughages

Data in **Table (2)** showed the effect of treatment with AZD on chemical composition of experimental roughages used in the present study. Results indicated that treatment lowered CF contents by 27% in RS, 17% in WS, 27% in CS and 30% in SCB. ZAD treatment increased EE content of RS, WS, CS and SCB by multiplications of 2.87, 1.45, 4.7 and 4.9 times, respectively.

Results obtained in the present study were in agreement with those reported by **Ibrahim et al 2017**, who stated that treating RS with ZAD decreased CF content of RS from 38.33% to 31.08% and increased EE from 1.20% up to 1.78%. Results in **Table (2)** also indicated that hemicellulose, cellulose and lignin were similar for RS & WS but they were significantly lower (P< o.o5) in CS and SCB.

Table 2. Effect of roughages sources on chemical composition (on DM basis)

Item	DM	CF	EE	NFE	ASH	Hemi	Celi	Leg
RS	40.86±0.21	27.92±0.24c	2.53±0.12a	39.78±0.32c	15.19±0.09a	30.85±0.30a	34.71±0.34a	6.03±0.23a
WS	40.89±0.24	33.35±0.37a	1.98±0.11b	41.60±0.23b	10.54±0.09c	30.36±0.23a	34.16±0.33a	6.03±0.23a
CS	40.83±0.13	27.97±0.34c	2.48±0.21a	47.08±0.48a	12.11±0.27b	28.08±0.33c	34.05±0.41a	5.59±0.26ab
SCB	41.08±0.15	31.76±0.33b	1.87±0.12b	47.87±0.40a	10.90±0.24c	29.11±0.28b	31.28±0.33b	5.27±0.17b

a, b and c: means within each column with different superscripts are significantly differ (p<0.05).
1R : Rice straw. 2R : Wheat straw. 3R : Corn Stover. 4R : Bagasse.

Effect of ZAD concentration on chemical composition of experimental roughages

Results in **Table (3)** showed the effect of ZAD concentration on chemical composition of treated roughages. Results indicated that treatment (1) (zero ZAD 0.2% Urea and 10% molasses) decreased CF contents of all roughages from 40.7% (over all mean of all tested roughages) to 31.95%. However, 0.5ml of ZAD per 1 Kg roughage did not affect CF contents significantly. On the other hand ZAD concentration of 1, 1.5 and 2 ml/kg decreased CF contents significantly compared with zero concentration with no significant differences between different concentration.

Ether extract contents were increased by all ZAD concentrations compared with over all mean of untreated roughages (0.79%), but there were no significant differences between different concentrations.

Table 3. Effect of enzyme treatment on chemical composition of roughages (on DM basis)

Enzyme concentration	DM	CF	EE	NFE	ASH	Hemi	Celi	Leg
0	41.14±0.24	31.95±0.45a	2.26±0.14	43.93±0.62ab	11.72±0.33b	30.04±0.31	33.87±0.54	6.05±0.33
0.5	41.00±0.19	30.33±0.4ab	2.42±0.19	43.61±0.56b	12.33±0.33ab	29.81±0.40	33.69±0.44	5.79±0.22
1	40.97±0.17	30.27±0.52b	2.20±0.15	43.52±0.65b	12.40±0.30a	29.38±0.36	33.32±0.39	5.71±0.23
1.5	40.62±0.22	29.39±0.49b	2.11±0.18	44.40±0.62ab	12.49±0.36a	29.64±0.38	33.78±0.39	5.72±0.24
2	40.84±0.21	29.31±0.54b	2.09±0.16	44.97±0.77a	12.00±0.36ab	29.13±0.29	33.08±0.42	5.40±0.25

a and b : means within each column with different superscripts are significantly differ (p<0.05).
Enzyme concentration: ml/kg.

Effect of interaction between roughage sources and ZAD concentration on CP contents

Results in **Table (4)** showed the effect of interaction between source of roughage and ZAD concentration on CP contents. Results indicated that CP of RS, CS and SCB increased significantly (p<0.05) by all ZAD concentrations while CP of WS was not affected by any concentration. It was noticed that RS was the highest in its response to ZAD concentration followed by SCB and CS, respectively.

Similar results were obtained using RS treated with ZAD by **Mohammed et al 2016. Safa et al 2011**, reported a CP value of 9.45 when RS was treated with fungus. However, **Gomaa et al 2012, 2016 and Ibrahim et al 2017** recorded CP values of 7.95, 6.08 and 6.08 %, respectively.

Table 4. Effect of interaction between roughage sources and enzyme concentration on CP content of treated roughage

R*E	1E	2E	3E	4E	5E
RS	8.34±0.33c	11.98±0.25a	11.96±0.25a	11.87±0.31a	12.29±0.24a
WS	9.51±0.29bc	9.85±0.17bc	9.47±0.30bc	10.17±0.33b	9.59±0.43bc
CS	8.76±0.67c	10.33±0.50b	10.55±0.69b	10.29±0.85b	10.86±0.81b
SCB	6.07±0.17d	8.76±0.16c	8.56±0.19c	8.507±0.23c	8.95±0.31c

a ,b and c : means within each column with different superscripts are significantly differ (p<0.05).
1R: Rice straw. 2R: Wheat straw. 3R: Corn stover. 4R: Bagasse.
1E: 0 enzyme. 2E: 0.5ml enzyme. 3E: 1ml enzyme. 4E: 1.5ml enzyme. 5E: 2ml enzyme.

Similar results were obtained using RS tested with ZAD by **Mohamed et al 2016. Safa et al 2011** reported a CP value of 9.45 when RS was treated with fungus. However, **Gomaa et al 2012, 2016 and Ibrahim et al 2017** recorded CP values of 7.95, 6.08 and 6.08%, respectively.

CONCLUSION

It can be concluded that treating roughages with 1mlL ZAD / 1 Kg improved chemical composition of roughages used as ruminant feeds, However, more research is needed in order to determine the effect of treatment with ZAD on digestion, rumen fermentation and animal performance.

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تأثير المعاملة ببكتريا الكرش (ZAD) على التركيب الكيميائي للأعلاف الخشنة [29]

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الموجـــــــز

تم استخدام 4 أنواع مختلفة من المخلفات الزراعية المستخدمة في تغذية المجترات بعد معاملتها بتركيزات مختلفة من مستحضر (ZAD) لدراسة تأثير المستحضر على التركيب الكيميائي للمخلفات الممثلة فى قش الأرز (RS)، تبن القمح (WS)، حطب الذرة الجافة (CS) ومصاصة القصب (SCB). وكانت التركيزات المختبرة من ال AZD (Zero, 0.5, 1, 1.5, 2 ملليلتر / 1 كجم مخلف)، وتم خلط المخلفات بمحلول ال ZAD، والتحضين تحت ظروف لاهوائية لمدة 4 أسابيع.

أظهرت النتائج أن المعاملات خفضت محتوى الألياف الخام للمخلفات بنسب تراوحت بين 17% في حطب الذرة و 30% في مصاصة القصب كما تضاعف محتوى المستخلص الايثيري بقيم تراوحت بين 1.45 مرة في تبن القمح إلى 4.9 مرة في مصاصة القصب.

أظهر التحليل الاحصائي أن التداخل بين نوع المخلف وتركيز ال ZAD لم يكن له تأثير معنوي على التركيب الكيميائي للمخلفات إلا في المحتوى البروتيني للأعلاف.

أظهرت النتائج أيضاً أن تركيزات ال ZAD فوق 0.5 كان لها تأثير إيجابي على محتوى الألياف الخام والبروتين الخام. كما لوحظ أن محتوى قش الأرز من البروتينِ الخام أظهر اعلى استجابة للمعاملة بال ZAD متبوعاً بمصاصة القصب ثم حطب الذرة على الترتيب، بينما لم يتأثر المحتوى البروتيني لتبن القمح بالتركيزات المختلفة لل ZAD.

وخلصت نتائج هذه التجربة أن المعاملة بال ZAD تحت تركيز 1 ملليلتر / 1 كجم مخلف يمكن التوصية بها لتحسين التركيب الكيميائي للمخلفات الزراعية المستخدمة في هذه التجربة.

الكلمات الدالة: التحليل الكميائى، المجترات، ZAD، قش الارز، تبن القمح، حطب الاذره، مصاصة القصب.

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