SHORT COMMUNICATION

Chemical Composition of Paddy Straw as Affected by Treatment with Maize Spent Liquor

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Abstract

The experiment was conducted to study the chemical composition of untreated paddy straw and that treated with Maize spent liquor (MSL) at varying levels (10, 20 and 30 %) and incubated for one day. The DM, OM, TA, CP, EE, CF, NFE, Ca and P content of Maize spent liquor (MSL) were 16.88, 91.96, 8.04, 14.33, 4.37, 0.00, 73.26, 0.24 and 0.69%, respectively. Higher ($p < 0.01$) CP content was observed in paddy straw treated with 30% MSL compared to untreated, while non-significant differences were observed in OM and TA contents in different treatments. Higher EE and lower CF (%) values were recorded in paddy straw treated with 30% MSL compared to untreated straw. No significant differences were observed in NDF, ADF, hemicellulose, and silica (%) contents in paddy straw treated with varying levels of MSL. However, the values were significantly lower than those of untreated straw. Cellulose and ADL (%) contents were decreased significantly ($p < 0.01$), while calcium and phosphorus (%) improved ($p < 0.01$) in paddy straw treated with increased levels of MSL compared to untreated straw. The study suggests a significant effect on the chemical composition of paddy straw treated with varying levels of MSL. It is concluded that MSL can be used up to 30 % for paddy straw treatment, revealing better chemical composition than untreated straw.

Keywords: Chemical composition, Inclusion level, Maize spent liquor, Paddy straw.

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Introduction

Crop residues are the major feed resources for ruminants in India and other developing countries but have poor nutritive value (low crude protein and high lignin content), characterized by low digestibility, and hence their intake is also low. Out of the crop residues, paddy straw is a major agro-residue fed to ruminants which is of low feeding value and has high lignified material, low protein content, low fermentable carbohydrates, and mineral imbalances (Tauqir *et al*., 2013). The feeding value of crop residues is increased by the method of ammoniation by adding up nitrogen and swelling solubilization of complex carbohydrates. For ammonia fixation in fibrous carbohydrates, MSL was used successfully to enhance the nutritive value (Sarwar *et al*., 2003).

MSL, also known as steep corn water, is a by-product of the wet milling process of the maize starch industry. It is a viscous brown color liquid consisting of water-soluble extracts of corn with sweet odor and acidic pH. It is rich in crude protein, amino acids, minerals, vitamins, reducing sugars, organic acids, mainly lactic acid (20-25%), enzymes and other nutrients. This makes it an excellent nutritive source as animal feed and also as an efficient nutrient supplement for microbial fermentation (Chovatiya *et al.,* 2011). Further, MSL is an inexpensive source of nitrogen, vitamins, minerals for the cultivation of microbes such as *Enterococcus* sp. and *Lactobacillus* sp. to produce lactic acid for efficient fermentation (Saxena and Tanner, 2012). MSL was used as a liquid feed supplement for ruminants and improved body weight in lambs and body condition in beef cattle (Nascimento *et al*., 2009). On the other hand, direct feeding of corn by-products to productive animals resulted in polioencephalomalacia due to high sulfur content (Lardy and Anderson, 2014) and reproductive disorders due to mineral imbalance. Hence, it would be ideal to use MSL as a supplement to improve the nutritive value of fibrous crop residues rather than utilizing it as a liquid feed. However, very little research data is available regarding the use of MSL as a supplement. Looking to the nutritional quality of MSL and its adequate availability as a by-product of the starch industry, the present experiment was taken up to study the

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effect of MSL at varying levels on the chemical composition of paddy straw.

Materials and Methods

The study was carried out at Department of Animal Nutrition, NTR College of Veterinary Science, Gannavaram, Andhra Pradesh. In the present study, MSL was procured regularly from Paramesu Biotech Pvt. Ltd., Devarapalli (V), West Godavari District, Andhra Pradesh and paddy straw from the local market. The MSL procured at each time was used for preparation of different concentrations within 3-5 days of production, and excess, if any, was discarded. The different concentrations prepared included 10% MSL (50 mL MSL in 450 mL of water), 20% MSL (100 mL MSL in 400 mL of water) and 30% MSL (150 mL MSL in 350 ml of water).

The MSL procured was liquid and was kept in a hot air oven at 60^0C for about 48 h and analyzed for dry matter in a fresh sample. The dried MSL was ground in a Wiley mill through a medium-mesh screen (1 mm) and stored in polythene bottles for further analysis. Ground paddy straw of about 250 g each was taken into three separate trays, and diluted MSL, *i.e.,* 10, 20, and 30% MSL (@ 175 ml per 250 g paddy straw) sprayed uniformly over paddy straw in each tray. Then paddy straw was mixed with MSL solution thoroughly by hand for uniform distribution. The treated paddy straw from each tray was taken into polythene covers, sealed airtight and incubated for one day. After removal from covers, the samples of treated paddy straw were kept open for about 30 min and evaluated for dry matter. Then the samples were oven-dried for further analysis.

Samples of paddy straw treated with MSL at different levels, untreated paddy straw and MSL were analyzed for proximate constituents (AOAC, 2007), cell wall constituents, calcium, and phosphorus using the standard methods in practice. The data were analyzed statistically using SPSS 20.0 version (Snedecor and Cochran, 1994).

Results and Discussion

The chemical composition of paddy straw and MSL is presented in Table 1. Higher values of DM, CP, EE (Malumba *et al*., 2015; Ullah *et al*., 2017) and lower values of TA and NFE (Nisa *et al*., 2004; Chovatiya *et al*., 2011) were reported by several authors compared to the present study. The proximate and forage fiber constituents of paddy straw understudy corroborated with several authors' findings (Ally *et al*., 2012; Aparna *et al*., 2013; Selim *et al*., 2017).

The DM content of paddy straw treated with MSL at varying levels was significantly lower ($p < 0.01$) than untreated straw, which reflects the low DM content of MSL (Ullah *et al*., 2017). Non-significant differences in OM and TA contents (%) were observed among the various treatments. The CP content in 30 % MSL treated paddy straw (5.32 %) was significantly higher ($p < 0.01$) than other treatments. This might be due to increased ammoniation by adding nitrogen and the acidic pH due to increased lactic acid in MSL treated paddy straw, which help fix excessive ammonia (Tauqir *et al*., 2013). MSL contains soluble carbohydrates and enhances the poor fermentation of paddy straw and can help in fixing ammonia. This might be reason for the utilization of CF and NFE content in paddy straw and influenced ($p < 0.01$) by the treatment with MSL,

Table 1: Chemical composition (on % DM basis except for DM) of paddy straw and Maize spent liquor and paddy straw treated with varying levels of Maize spent liquor

Nutrient	*Untreated paddy straw*	*MSL treated paddy straw*			*Maize spent liquor*
		10 %	*20 %*	*30 %*	
DM**	$90.67^a \pm 0.48$	$48.46^a \pm 0.20$	$49.21^a \pm 0.20$	$50.92^b \pm 0.20$	16.88±0.24
OM	85.70±0.10	86.45±0.30	86.11±0.12	86.03±0.18	91.96±0.19
TA	14.30±0.10	13.55±0.14	13.89±0.21	13.97±0.19	8.04±0.17
CP**	$3.78^a \pm 0.30$	$4.55^b \pm 0.16$	$5.13^{bc} \pm 0.20$	$5.32^c \pm 0.16$	14.33±0.14
EE*	$1.57^a \pm 0.35$	$1.64^a \pm 0.20$	$1.95^{ab} \pm 0.12$	$2.21^b \pm 0.14$	4.37±0.25
CF**	$37.02^d \pm 0.14$	$36.28^c \pm 0.22$	$35.52^b \pm 0.15$	$34.36^a \pm 0.18$	0.00
NFE*	$43.11^a \pm 0.28$	$43.98^b \pm 0.17$	$43.51^{ab} \pm 0.17$	$44.14^b \pm 0.16$	73.26±0.19
NDF**	$76.08^b \pm 0.60$	$38.91^a \pm 0.18$	$38.91^a \pm 0.21$	$39.46^a \pm 0.15$	-
ADF**	$48.68^b \pm 0.51$	$24.46^a \pm 0.12$	$24.77^a \pm 0.17$	$25.15^a \pm 0.14$	-
Hemicellulose**	$27.40^b \pm 0.90$	$14.45^a \pm 0.20$	$14.14^a \pm 0.13$	$14.31^a \pm 0.10$	-
Cellulose**	$34.90^c \pm 0.22$	$19.09^b \pm 0.17$	$18.90^b \pm 0.16$	$17.11^a \pm 0.23$	-
ADL**	$6.37^c \pm 0.55$	$3.73^b \pm 0.18$	$3.50^{ab} \pm 0.19$	$2.96^a \pm 0.11$	-
Silica	4.57±0.31	4.45±0.09	4.32±0.11	4.06±0.15	-
Calcium*	$0.57^b \pm 0.06$	$0.26^a + \pm 0.03$	$0.31^a \pm 0.03$	$0.39^a \pm 0.01$	0.24±0.10
Phosphorus**	$0.16^a \pm 0.03$	$0.48^b \pm 0.03$	$0.71^c \pm 0.02$	$0.86^d \pm 0.03$	0.69±0.09

Each value is a mean of 3 observations,
Values in the rows bearing different superscripts differ significantly (*$p < 0.05$, **$p < 0.01$).

and resulted in increased protein content (Sarwar *et al*., 2004).

The NDF, ADF and hemicellulose (%) were not affected significantly in paddy straw upon treatment with different levels of MSL; however, values were significantly lower in all compared to untreated straw. This is due to the release of certain enzymes and swelling solubilization of forage fibre fractions in crop residues and might have broken linkages between lignin and cellulose or hemicellulose and increase extent and rate of cellulose and hemicellulose digestion. This is in agreement with the findings of Sarwar *et al*. (2004) in urea treated corn cobs ensiled for 5 days with steep corn liquor (CSL) at 9% level. Further, Nisa *et al.* (2006) reported no effect on NDF and ADF content of wheat straw treated with urea and CSL fed to buffalo bulls. Cellulose and ADL (%) decreased in paddy straw with an increase in MSL concentration used for treatment, but the values were lower than untreated straw, while silica remained unaffected. Cellulose is better utilized in MSL treated paddy straw because of the release of certain enzymes, lactic acid, ethanol, etc. (Agarwal *et al*., 2006) which are helpful in the fermentation process. Calcium (%) decreased ($p < 0.05$), while phosphorus (%) were improved ($p < 0.01$) significantly in the paddy straw treated with MSL with higher values at 30%, reflecting the composition in MSL.

Conclusion

The MSL could be effectively used to improve the feeding value of paddy straw by fixing nitrogen and better fermentation of soluble carbohydrates. It was concluded that MSL could be used up to 30 % level to treat paddy straw for better chemical composition. Further, *in vitro* and *in vivo* studies need to be carried out to assess the better applicability of MSL.

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References

Agarwal, L., Isar, J., Meghwanshi, G.K., & Saxena, R.K. (2006). A cost effective fermentative production of succinic acid from cane molasses and corn steep liquor by *Escherichia coli*. *Journal of Applied Microbiology*, *100,* 1348-1354.

Ally, K., Mercy, A.D., & Vishwanathan, T.V. (2012). Effect of undegradable dietary protein supplementation on early lactating crossbred dairy cows. *Indian Journal of Animal Science*, *82,* 741-744.

AOAC. (2007). *Official Methods of Analysis*. 18th ed. Association of Official Analytical Chemists, Washington, DC, USA.

Aparna, R., Raghava Rao, E., Srinivas Kumar, D., & Jagadeeswara Rao, S. (2013). Dietary inclusion of Maize spent liquor on intake and nutrient utilization in buffalo bulls. *Indian Journal of Animal Nutrition*, *30,* 224-227.

Chovatiya, S.G., Bhatt, S.S., & Shah, A.R. (2011). Evaluation of corn steep liquor as a supplementary feed for *Labeo rohita* (Ham.) fingerlings. *Aquaculture International, 19,* 1-12.

Lardy, G., & Anderson, V. (2014). Feeding co-products of the ethanol industry to beef cattle. AS1242, North Dakota State University, USA.

Malumba, P., Boudry, C., Roiseux, O., Bindelle, J., Beckers, Y., & Bera, F. (2015). Chemical characterization and *in vitro* assessment of the nutritive value of co-products yield from the corn wet-milling process. *Food Chemistry, 166,* 143-149.

Nascimento, R.P., Junior, N.A., Pereira, Jr. N., Bon, E.P.S., & Coelho, R.R.R. (2009). Brewer's spent grain and corn steep liquor as substrates for cellulolytic enzymes production by *Streptomyces malaysinensis*. *Letter for Applied Microbiology, 48,* 529-535.

Nisa, M., Sarwar, M., & Khan, M.A. (2004). Influence of *ad libitum* feeding of urea-treated wheat straw with or without corn steep liquor on intake, *in situ* digestion kinetics, nitrogen metabolism, and nutrient digestion in Nili-Ravi buffalo bulls. *Australian Journal of Agricultural Research*, *55,* 229-236.

Nisa, M.U., Khan, M.A, Sarwar, M., Lee, W.S., Lee, H.J., Ki, K.S., & Kim, H.S. (2006). Influence of corn steep liquor on feeding value of urea treated wheat straw in buffaloes fed at restricted diets. *Asian-Australasian Journal of Animal Sciences, 19,* 1610-1616.

Sarwar, M., Khan, M.A., & Nisa, M. (2004). Influence of ruminally protected fat and urea treated corncobs ensiled with or without corn steep liquor on nutrient intake, digestibility, milk yield and its composition in Nili-Ravi buffaloes. *Asian-Australasian Journal of Animal Sciences, 17,* 86-93.

Sarwar, M., Khan, M.A., & Nisa, M. (2003). Effect of urea treated wheat straw ensiled with organic acids or fermentable carbohydrates on ruminal parameters, digestion kinetics, digestibility and nitrogen metabolism in Nili-Ravi buffaloes fed restricted diets. *Asian-Australasian Journal of Animal Sciences, 18,* 93-98.

Saxena, J., & Tanner, R. (2012). Optimization of a corn steep medium for production of ethanol from synthesis gas fermentation by *Clostridium ragsdalei*. *World Journal of Microbiology and Biotechnology, 28,* 1553-1561.

Selim, A.S.M., Rahman, M.M., Jahan, M., Hoque, S.A.M., Rabbi, M.E., Hossain, M.D., & Tedeschi, L.O. (2017). Assessment of the digestibility of probiotic treated rice straw using *in vitro* gas production technique. *Indian Journal of Animal Nutrition, 34,* 389-395.

Snedecor, G.W., & Cochran, W.G. (1994). *Statistical Methods*. (6th edn). Iowa State University, Press Ames, Iowa, USA.

Tauqir, N.A., Shahzad, M.A., Mahmood, Y., Sharif, M., Mahr-un-Nisa, & Sarwar, M. (2013). Performance of Nili-Ravi buffalo calves fed urea-corn steep liqior treated corn cobs. *Buffalo Bulletin*, *32,* 918-923.

Ullah, Z., Yousaf, M., Shami, M.M., Sharif, M., & Mahrose, K. (2017). Effect of graded levels of dietary corn steep liquor on growth performance, nutrient digestibility, haematology and histopathology of broilers. *Journal of Animal Physiology and Animal Nutrition, 102,* 1-8.