International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 1622-1624

Received: 07-10-2020
Accepted: 13-11-2020

S Senthilkumar
Department of Animal Nutrition, College of Veterinary and Animal Sciences (COVAS), Mannuthy, Thrissur, Kerala, India

Corresponding Author:
S Senthilkumar
Department of Animal Nutrition, College of Veterinary and Animal Sciences (COVAS), Mannuthy, Thrissur, Kerala, India

In vitro acid detergent fibre (ADF) disappearance of brewery waste incorporated paddy straw in RUSITEC

S Senthilkumar

DOI: https://doi.org/10.22271/chemi.2020.v8.i6w.10997

Abstract
An *in vitro* experiment was conducted to study the *in vitro* ADF disappearance of the following seven experimental feeds such as 1) Control feed; 2) Experimental feed (75%) + Fresh brewery waste (25%) (EFFBW); 3) Experimental feed (75%) + Dried brewery waste (25%) (EFDBW); 4) Fresh brewery waste (FBW); 5) Dried brewery waste (DBW); 6) Paddy straw (PS) and 7) Brewery waste incorporated paddy straw (BWIPS) incubated for 2, 6, 12, 24, 48 and 72 hours in Rumen Simulation Technique (RUSITEC). During initial incubation periods (2, 6, 12 and 24 hours), the control feed, EFFBW, EFDBW and FBW showed higher *in vitro* ADF disappearance than other experimental feeds, whereas, during later incubation periods (48 and 72 hours), the DBW, paddy straw and BWIPS showed higher *in vitro* ADF disappearance than other experimental feeds incubated in RUSITEC. Among the feeds experimented in RUSITEC, disappearance was more in the control feed, EFFBW and EFDBW when compared to other experimental feeds. Similarly, the disappearance was more in BWIPS compared to paddy straw. The *in vitro* ADF disappearance rates at all incubation periods were higher for FBW than those for DBW.

Keywords: Brewery waste, paddy straw, ADF disappearance, *in vitro*, RUSITEC

Introduction
Brewery waste is a by product of ethanol industry which uses cereal grains as feed stock. Distiller's grain has a moderate content of protein and high level of crude fibre which make it an attractive ingredient to be used in ruminant feed (Rasco *et al*., 1989) [11]. Among the various cereal crop residues, paddy straw (*Oryza sativa*) is the main roughage source for majority of cattle and buffaloes reared in Indian small holdings. However, the nutrient digestibility of straw is very poor. Knowledge on disappearance / degradability of brewery waste incorporated with paddy straw would throw more light on its usefulness and would help to formulate complete feed for dairy cattle. The present study was undertaken to evaluate the *in vitro* ADF disappearance of brewery waste incorporated paddy straw based feeds using Rumen Simulation Technique (RUSITEC).

Materials and methods
Per cent ingredient composition of the control and experimental concentrate mixtures used are presented in Table 1. The Dry matter (DM) composition of Control feed, Experimental feed, Brewery waste, Paddy straw and Brewery waste incorporated paddy straw were carried out as per standard procedure (AOAC, 1990) [1] and was 95.15 ± 0.56, 94.76 ± 0.26, 29.15 ± 0.43, 90.35 ± 0.81 and 78.11 ± 0.63 per cent, respectively. The ADF content of Control feed, Experimental feed, Brewery waste, Paddy straw and Brewery waste incorporated paddy straw was carried out as per AOAC (1990) [1].
The *in vitro* ADF disappearance of seven experimental feeds such as control feed, experimental feed with fresh brewery waste (EFFBW), experimental feed with dried brewery waste (EFDBW), fresh brewery waste (FBW), dried brewery waste (DBW), paddy straw (PS) and brewery waste incorporated paddy straw for 3 days (BWIPS) was determined using the rumen simulation technique (RUSITEC) described by Czerkawski and Breckenridge (1977) [3]. The *in vitro* ADF disappearance of experimental feeds was studied at 0, 2, 6, 12, 24, 48 and 72 hours of incubation in RUSITEC and the experiment was replicated. Each RUSITEC experiment totally consisted of 7 days adaptation period followed by collection period.

Loss in weight of nylon bag after 0, 2, 6, 12, 24, 48 and 72 hours of incubation in RUSITEC followed by washing and drying was recorded to calculate *in vitro* ADF disappearance.

$$\text{In vitro ADF disappearance} = \frac{\text{(weight of bag with ADF before incubation) – (weight of bag with ADF after incubation)}}{\text{weight of sample}} \times 100$$

The data were analyzed statistically as per the standard statistical methods given by Snedecor and Cochran (1994) [15].

Table 1: Per cent ingredient composition of the control and experimental concentrate mixtures used

Ingredient	Concentrate mixture (%)	
	Control	Experimental
Yellow Maize	37.00	40.00
Groundnut Cake	29.00	21.50
Wheat bran	30.50	10.00
Brewery waste	0.00	25.00
Mineral Mixture*	1.00	1.00
Salt	1.00	1.00
Shell Grit	1.50	1.50

To every 100 kg of concentrate mixture 20 grams of Nicomix AB_2D_3K (Nicholas Piramal India Ltd, Mumbai) containing Vitamin A-82500 I.U, Vitamin D_3-12000 I.U, Vitamin B_2-50 mg, Vitamin K-10 mg per gram was added.

*Mineral mixture supplied by Kerala Feeds Ltd. Kerala, containing Calcium (minimum) 20 per cent, Phosphorus (minimum) 12 per cent, Magnesium (minimum) 5 per cent, Iron (minimum) 0.4 per cent, Copper (minimum) 0.1 per cent, Zinc (minimum) 0.8 per cent, Manganese (minimum) 0.12 per cent, Cobalt (minimum) 0.012 per cent, Iodine (minimum) 0.026 per cent, Sulphur 1.8-3 per cent, Arsenic (maximum) 7 ppm, Lead (maximum) 20 ppm and Flourine (maximum) 0.07 per cent.

Results and discussion

The ADF content of paddy straw, brewery waste and brewery waste incorporated paddy straw was 48.57 ± 0.87, 24.68 ± 0.92 and 42.60 ± 0.84 per cent, respectively on DM basis. The ADF content of brewery waste obtained in the present study is higher when compared to an average of 20 per cent as reported by Murdock *et al.* (1981), Davis *et al.* (1983), Rogers *et al.* (1986) and Depeters *et al.* (1997) [9, 4, 12, 5]. However, Dhiman *et al.* (2003) [6] reported higher ADF value of 27.7 per cent and Dong and Ogle (2003) [7] reported lower value of 17.5 per cent in brewery waste. The ADF content of Control feed, Experimental feed, Brewery waste, Paddy straw and Brewery waste incorporated paddy straw was 10.52 ± 0.23, 13.68 ± 0.57, 24.68 ± 0.92, 48.57 ± 0.87 and 42.60 ± 0.84 per cent, respectively on dry matter basis.

Table 2: *In vitro* Acid Detergent Fibre (ADF) disappearance of experimental feeds at different incubation periods (h) in Rusitec, %

Treatments	ADF Disappearance, %						
	0h	2h	6h	12h	24h	48h	72h
Control feed	12.56	20.34	28.97	37.18	41.76	48.29	53.02
Experimental feed with fresh brewery waste (25%)	10.81	15.46	22.39	29.06	35.55	48.99	51.87
Experimental feed with dried brewery waste (25%)	9.70	14.81	20.71	27.82	32.89	48.31	51.09
Brewery waste (fresh)	9.43	13.95	20.54	27.85	34.43	43.72	45.52
Brewery waste (dried)	8.57	12.67	18.45	24.95	31.42	41.54	43.76
Paddy straw	8.27	11.45	16.34	20.56	26.75	32.92	35.28
Brewery waste incorporated paddy straw	9.16	13.24	19.00	25.40	33.28	37.97	39.69

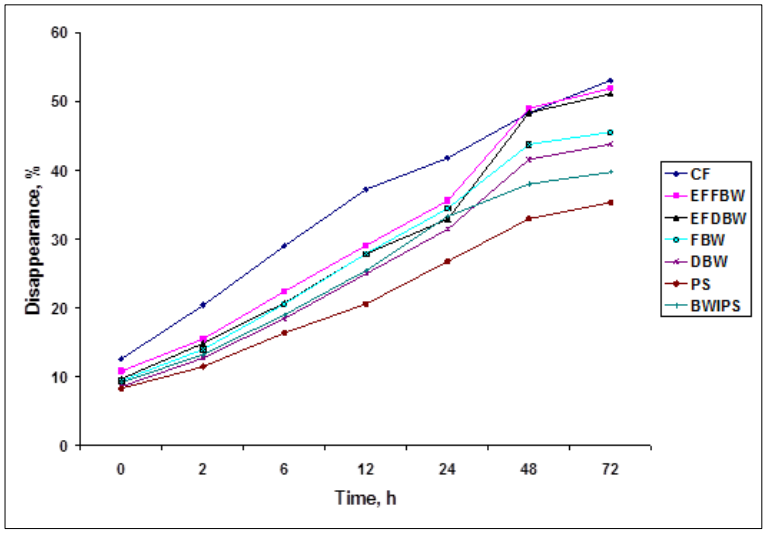

Fig 1: *In vitro* Acid Detergent Fibre (ADF) disappearance of experimental feeds at different incubation periods (h) in RUSITEC, %

In vitro ADF Disappearance

The percentage *in vitro* disappearance of ADF of control feed, experimental feed with fresh brewery waste (EFFBW), experimental feed with dried brewery waste (EFDBW), fresh brewery waste (FBW), dried brewery waste (DBW), paddy straw (PS) and brewery waste incorporated paddy straw (BWIPS) incubated for 0, 2, 6, 12, 24, 48 and 72 hours in RUSITEC are given in Table 2 and is illustrated in Fig.1. The *in vitro* ADF disappearance of experimental feeds such as control feed, EFFBW, EFDBW, FBW, DBW, PS and BWIPS at 2 hours of incubation in RUSITEC was 20.34, 15.46, 14.81, 13.95, 12.67, 11.45 and 13.24 per cent, respectively. The ADF disappearance at 24 hours incubation period was 41.76, 35.55, 32.89, 34.43, 31.42, 26.75 and 33.28 per cent for

control feed, EFFBW, EFDBW, FBW, DBW, PS and BWIPS, respectively.

During 72 hours of incubation, 53.02, 51.87, 51.09, 45.52, 43.76, 35.28 and 39.69 per cent ADF disappeared from control feed, EFFBW, EFDBW, FBW, DBW, PS and BWIPS, respectively. Ojowi *et al.* (1997) [10] reported *in situ* effective degradability of ADF for wet brewer's grain and wet distiller's grain distiller's grain as 27.5 and 31.9 per cent, respectively. Addition of cationomycin (Ionophore) to fescue hay based pelleted diet showed increased *in vitro* (RUSITEC) NDF, ADF, hemicellulose and cellulose degradability (Bogaert *et al.*, 1989) [2]. Significant improvement was observed in the *in vitro* (RUSITEC) NDF and ADF degradability of *Vigna unguiculata* when mixed with a tropical grass *Brachiaria humidicola*, compared to those with *Leucaena leucocephala* (Hess *et al.*, 2007) [8]. Sliwinski *et al.* (2002) [14] found no significant difference in the 48 hour *in vitro* (RUSITEC) NDF, ADF and hemicellulose degradability of basal diet (containing grass silage, barley grain and grass hay) compared to those with soyabean meal based diet. The *in vitro* ADF disappearance values of paddy straw obtained in the present RUSITEC experiment (35.28 per cent) is in agreement with Senthilkumar *et al.* (2007) [13] who reported the *in vitro* ADF disappearance of 35.61 per cent.

Summary

Among the feeds experimented in RUSITEC, disappearance of ADF was more in the control feed, EFFBW and EFDBW when compared to other experimental feeds. Similarly, the ADF disappearance was more in BWIPS compared to paddy straw. The *in vitro* ADF disappearance at all incubation periods was higher for FBW than the DBW. The FBW had more ADF disappearance compared to DBW. A low *in vitro* ADF disappearance of 35.28 per cent was recorded at 72 hours of incubation for paddy straw, whereas the BWIPS had improved *in vitro* ADF disappearance of 39.69 per cent at 72 hours of incubation.

Acknowledgement

The Author is thankful to the Dean, College of Veterinary and Animal Sciences, Mannuthy, Kerala Agricultural University, Thrissur, Kerala, India for the facilities and financial support provided to carry out this research.

References

1. AOAC. Official Methods of Analysis, Fifteenth edition. Association of Official Analytical Chemists. Washington D.C., 1990, 587.
2. Bogaert C, Gomez L, Jouany JP, Jeminet G. Effects of the ionophore antibiotics lasalocid and cationomycin on ruminal fermentation *in vitro* (RUSITEC). Animal Feed Science and Technology 1989;27:1-15.
3. Czerkawski JW, Breckenridge G. Design and development of a long term rumen simulation technique (RUSITEC). British Journal of Nutrition 1977;38:371-384.
4. Davis CL, Grenawalt DA, McCoy G. Feeding value of pressed brewers' grains for lactating dairy cows. Journal of Dairy Science 1983;66:73-79.
5. Depeters EJ, Fadel JG, Arosemena A. Digestion kinetics of neutral detergent fibre and chemical composition within some selected by-product feed stuffs. Animal Feed Science and Technology 1997;67:126-140.
6. Dhiman TR, Bingham HR, Radloff HD. Production response of lactating cows fed dried versus wet brewer's grain in diets with similar dry matter content. Journal of Dairy Science 2003;86:2914-2921.
7. Dong NTK, Ogle RB. Effect of brewery waste replacement of concentrate on the performance of local and crossbred Muscovy ducks. Asian-Australian Journal of Animal Sciences 2003;16:1510-1517.
8. Hess HD, Mera ML, Tiemann TT, Lascano CE, Kreuzer M. *In vitro* assessment of the suitability of replacing the low tannin legume *Vigna unguiculata* with the tanniniferous legumes *Leucaena leucocephala, Flemingia macrophylla or Calliandra calothyrsus* in a tropical grass diet. Animal Feed Science and Technology 2007, 1-11.
9. Murdock FR, Hodgson AS, Robert E, Riley JR. Nutritive value of wet brewers grains for lactating dairy cows. Journal of Dairy Science 1981;64:1826-1832.
10. Ojowi M, McKinnon JJ, Mustafa A, Christensen DA. Evaluation of wheat based wet distiller's grains for feedlot cattle. Canadian. Journal of Animal Sciences 1997;77:447-454.
11. Rasco BA, Borhan MY, Owusu-Ansah. Effects of drying techniques and incorporation of soluble solids on the chemical composition and color of distiller's grain products. Cereal Foods World 1989;34:346-349.
12. Rogers JA, Conrad HH, Dehority BA, Grubb JA. Microbial numbers rumen fermentation, and nitrogen utilization of steers fed wet or dried brewer's grains. Journal of Dairy Science 1986;69:745-753.
13. Senthilkumar S, Valli C, Balakrishnan V. Evolving specific non starch polysaccharide enzyme mix to paddy straw for enhancing its nutritive value. Livestock Research for Rural Development 2007;19(12):Article No. 178.
14. http://www.cipav.org.co/lrrd/lrrd19/12/sent19178.htm
15. Sliwinski BJ, Soliva CR, Machmüller A, Kreuzer M. Efficacy of plant extracts rich in secondary constituents to modify rumen fermentation. Animal Feed Science and Technology 2002;101:101-114.
16. Snedecor GW, Cochran WG. Statistical Methods. Eighth edition. The Iowa state University press, Ames, Iowa 1994, 313.