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Chemical composition and CNCPS protein fractions of some feed ingredients used in livestock

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Abstract

The present study was conducted to evaluate proximate composition, cell wall fractions (%DM) and CNCPS protein fractions (%CP) of various feed ingredients used in ruminant nutrition. Total ten different feed ingredients were taken and analysed for proximate composition, detergent analysis (cell wall fractions) and CNCPS protein fractions by AOAC (2005), Van Soest *et al.* (1991) and Sniffen *et al.* (1992), respectively. The crude protein content (%DM) ranges from 9.80 in oat fodder to 40.39 in GNC. The NDF and ADF content (%DM) ranges from 18.84 to 64.41 and 6.29 to 40.61 in pearl millet grain and oat fodder, respectively. P_A fraction (%CP) ranges from 5.68 in GNC to 25.37 in MOC whereas P_C fraction (%CP) ranges from 2.83 in GNC to 12.96 in DORB, respectively. CNCPS protein fractions consider instantaneously degradable and non degradable parts of protein based on degradation kinetics occurring in ruminants to provide better status of actual feed protein available and estimate requirements accordingly.

Keywords: Cell wall fractions, CNCPS, feed ingredients, proximate composition

1. Introduction

In India, the shortage of feeds and forages is the major problem in accelerating the growth of livestock sector. Further, these feedstuffs are of poor quality, less digestible, have lower quantities of crude protein and energy and, thus poorly utilized by the animals. It is well known that along with energy, protein content of animal's diet play very important role in growth, production and reproduction. Crude protein of the feedstuffs doesn't take account of the actual quantity of true protein or amino acids that gets absorbed by the animal, therefore being considered as obsolete in ration balancing of ruminants due to immense activities of microorganisms resulting in degradation of feed protein and synthesis of microbial protein in rumen. Traditional methods like proximate analysis and detergent analysis of feed don't consider degradation processes in rumen by microbes and take feed protein as single unit. NRC (2001) ^[1] and ARC (1984) ^[2] consider three feed protein fractions i.e. A, B and C assuming A fraction as instantly degradable, B fraction as potentially degradable and C fraction as undegradable. Cornell net carbohydrate and protein system (CNCPS) (Sniffen *et al.*, 1992) ^[3] divides feed protein into five fractions according to their degradation rate in rumen and post ruminal degradability.

Fraction P_A: NPN compounds -NH₃, AA, peptides (instantaneously degradable).

Fraction P_{B1}: Globulins, some albumins (rapidly degradable).

Fraction P_{B2}: Mostly albumins, glutelins (intermediately degradable).

Fraction P_{B3}: Prolamine, cell wall protein, denatured protein (slowly degradable).

Fraction P_C: Maillard protein, lignin and tannin bound protein (not degradable).

This system also generates metabolisable protein (MP) value of feeds which is potentially more accurate than crude protein system and is based on their protein fractions, ruminal degradation and passage rate (Burroughs 1974) ^[4]. Limited information is available on detailed protein fractions of feeds of Indian origin as per CNCPS, therefore this study is aimed at evaluating detailed chemical composition of test feeds so that a database regarding the protein fractions of common indigenous ruminant feeds could be developed.

2. Materials and Methods

The sample of feeds and fodders were collected from forage sections of NDRI, Karnal and from local market of Karnal (Haryana). Feed and fodder samples were collected from atleast five different areas and localities to get a representative sample. DM, CP, EE and Total Ash

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(Proximate composition) in test feed samples were estimated as per AOAC (2005) [5]. The cell wall fractions i.e. NDF, ADF were estimated as per Van Soest *et al.* (1991) [6]. The methods adopted for fibre fractions and lignin were the modifications of original procedures described by Goering and Van Soest (1970) [7]. CNCPS protein fractions were estimated as per equations given by Sniffen *et al.* (1992) [3].

3. Results and Discussion

The chemical composition (%DM) and CNCPS protein fractions (%CP) of different feedstuffs are presented in Table 1. The crude protein (CP), ether extract (EE), total ash of maize and pearl millet grain are found to be 9.83, 4.78, 2.43 and 11.45, 4.37, 2.19 percent, respectively. Among oil seeds cakes, CP and total ash content was observed highest in ground nut cake (GNC) as 40.39 and 6.11 percent while ether extract doesn't vary much. Highest fat percentage was found in full fat soya (20.12) while its CP (%) value estimated to be 38.58. The neutral detergent fibre (NDF) and acid detergent

fibre (ADF) (%DM) of oat and sorghum fodder were found to be 64.41, 40.61 and 59.57, 36.95 respectively. Among cakes, NDF, ADF and lignin content were found to be on higher side in cotton seed cake (CSC), on the other hand in agro-industrial by products, NDF, hemicelluloses (HC) and lignin content were estimated as 35.77, 25.49 and 5.26 respectively for wheat bran. The results of chemical composition of the test feedstuffs corroborates to earlier reported values of Bisitha (2013) [8], Prusty *et al.*, (2013) [9] and Das *et al.*, (2014) [10]. In CNCPS protein fractions, P_A (%CP) of mustard oil cake (MOC) was observed highest (25.37) among all feedstuffs while P_{B1} (%CP) value was found to be highest for full fat soya (49.56) and lowest for MOC (12.73). P_{B2} and P_{B3} content (%CP) was observed highest for pearl millet grain (59.92) and deoiled rice bran (DORB) (21.77), respectively whereas P_C content was found to be lowest for GNC (2.83). Earlier works by several workers (Mondal *et al.*, 2008 [11]; Prusty *et al.*, 2013 [9]; Das *et al.*, 2015 [12]) suggested a wide variation in the protein fractions of concentrate feedstuffs.

Table 1: Chemical composition (%DM) and CNCPS protein fractions (%CP) of various feedstuffs

Feedstuffs	Maize grain	Pearl millet grain	MOC	CSC	GNC	Full fat soya	Oat fodder	Sorghum (Sugar graze fodder)	Wheat bran	DORB
DM	91.89	90.92	91.11	92.01	92.72	88.50	24.29	26.32	89.30	90.83
CP	9.83	11.45	36.13	24.97	40.39	38.58	9.80	11.10	14.96	13.35
EE	4.78	4.37	7.52	7.73	7.47	20.12	1.43	2.12	2.88	1.24
TA	2.43	2.19	4.85	4.51	6.11	7.01	9.13	9.35	5.03	9.26
NDF	23.27	18.84	21.22	38.47	20.46	32.27	64.41	59.57	35.77	32.43
ADF	7.19	6.29	17.74	24.81	16.63	23.75	40.61	36.95	10.28	13.92
HC	16.08	12.55	3.48	13.66	3.83	8.52	23.80	22.62	25.49	18.51
LIGNIN	1.63	1.99	3.98	8.35	4.95	3.25	4.77	4.58	5.26	4.18
CNCPS Protein fractions										
P _A	8.13	7.24	25.37	21.85	5.68	9.81	17.90	17.19	11.22	10.79
P _{B1}	19.86	17.49	12.73	15.19	42.54	49.56	31.57	24.37	13.79	15.48
P _{B2}	54.54	59.92	55.87	54.59	41.49	28.85	20.81	30.56	48.81	39.00
P _{B3}	13.42	9.19	2.94	3.66	7.46	7.68	17.65	17.38	18.86	21.77
P _C	4.05	6.36	3.09	4.71	2.83	4.10	12.08	10.49	7.32	12.96

4. Conclusion

Among all test feed samples, CP content (%DM) was observed to be highest for GNC (40.39) and lowest for oat fodder (9.80). Instantaneously degradable protein fraction was found to be highest in MOC (25.37%) while least degradable protein fraction (%CP) was estimated as 2.83 and 12.96 in GNC and DORB respectively. Nowadays, along with chemical composition, detailed knowledge on CNCPS protein fractions of various of feed ingredients has gained importance considering its protagonist significance in integrating both ruminal degradability and intestinal digestibility, which can be further extended to determine the RDP, UDP, MP values in ruminant nutrition for better productivity.

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