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Effect on *In vitro* protein degradability of decorticated cottonseed cake, cottonseed cake, soybean meal, groundnut cake and other ingredients of the concentrate mixture

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Abstract

To observe the effects of partial replacement of soybean (de-oiled) meal with cottonseed expeller or decorticated solvent extracted cottonseed cake digestibility of nutrients, nutritive evaluation of the feeds. 18 Karan fries female calves of similar age (8-9 months) and body weight (114-115 kg) were randomly divided into three groups of each and allotted diets 'C', 'T-1' or 'T-2'. The diet 'C' having 15% soybean meal, which was replaced by 10 parts with cottonseed cake expeller in 'T-1' diet or 10 parts by decorticated cottonseed cake solvent extracted in 'T-2' diet. An *in vitro* rumen degradability study of different diets was undertaken to determine the rumen degradability of DM, OM and CP. The *in vitro* rumen dry matter degradability (IVDMD_R) higher ($P \leq 0.05$) in 'C' (71.41±1.26) followed by 'T-1' (67.92±1.10) and 'T-2' (65.05±0.93) group. The IVOMD_R (%) was significantly higher ($P \leq 0.05$) in 'C' (67.03±0.85) and lowest in 'T-2' (55.03±0.91) group. IVCPD_R was significantly lower ($P \leq 0.05$) in 'T-2' (56.54±1.25) followed by 'T-1' (59.04±1.41) and 'C' (65.74±1.73).

Keywords: cottonseed cake, decorticated cottonseed cake, *in vitro* rumen degradability

Introduction

Cottonseed cake contains 36.15% protein, 19.96% fibre, 14.42% fat, while biological value was 51.0% compared to 61.0 and 73.0% for defatted and full-fat extruded soybean meal [1]. Cottonseed meal can replace other oilseed meals (soybean, rapeseed, sunflower and groundnut) without affecting milk yield and composition. [2] Reported a lower protein degradability of cottonseed cake (60.5%) compared to GNC (76.3%). The cottonseed cake (expeller) used was having 25.55% crude protein and 7.7% ether extract and thus was observed to be a quality protein supplement. It has also got higher undegradable protein compared to groundnut cake and mustard oil cake [2]. Cottonseed cake is considered to be a natural source of higher rumen undegradable protein [2] i.e. 39 percent known to be rumen by pass protein. Thus this will be a better protein supplement for higher growth and milk production in ruminants. When supplementing highly digestible forages such as maize silage, cottonseed meal (expeller) can replace soybean meal without any detrimental effect on DM intake and milk yield [3].

[4] Found no change in the apparent digestibility coefficient of the nutrients ($P > 0.05$) with the replacement of soybean meal by cottonseed cake while [5] reported lower digestibility values for DM, OM, EE, CP and NDF when analysing the use of cottonseed meal compared to soybean meal.

Material and Methods

An *in vitro* rumen degradability study of different diets was also undertaken to determine the rumen degradability of DM, OM and CP [6].

a) McDougall's buffer solution

S.No	Reagents	Quantity
1	NaHCO ₃	49.0 g
2	Na ₂ HPO ₄	18.6 g
3	KCl	28.5 g
4	NaCl	23.5 g
5	CaCl ₂	2.0 g
6	MgCl ₂ .7H ₂ O	6.0 g

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- i) Forty nine(49.0) g of NaHCO₃,18.6 g Na₂HPO₄ were dissolved in approximately 800 ml of water,100 ml of chloride solution containing 28.5 g KCl,23.5 g NaCl,6.0 g MgCl₂.7H₂O and 2.0 g CaCl₂ per litre were added and the mixture made to 1 litre. The solution was thoroughly saturated with CO₂ at 38°C until it became clear.
- ii) Strained rumen liquor: Rumen liquor was collected from fistulated animal maintained on standard diet using plastic tube attached through a filter flask to a vacuum pump.
- iii) Immediately after removal, the rumen fluid was strained through four layers of muslin cloth into a flask. CO₂ was passed into the flask to displace air from above the rumen liquor and it was kept at 38-39°C until required.

Procedure

0.5 g of mill ground sample passed through 0.8 mm sieve and oven dried at 100°C was placed into already numbered centrifuge tube.40 ml of buffer solution was added, followed by 10 ml of the strained rumen liquor in each tube. The mixture was stirred, gassed with CO₂, kept at 39°C. CO₂ was passed through each tube for maintaining anaerobic condition for 48 hrs. The tube was sealed with a rubber cork fitted with Bunsen gas release valve and then placed in an incubator at 39°C for 48hr.The tubes were shaken gently 3 or 4 times, a day. One blank tube, containing only rumen liquor and buffer, and at least two tubes containing standard samples of known digestibility were included in each batch of experimental tubes. The pH was maintained during incubation within the limits 6.7-6.9. Appropriate adjustments were made with 1N Na₂CO₃. After 48 hrs of first incubation period, the bacterial activity was stopped by adding 1 ml of 5% HgCl₂ and 2ml of 1N Na₂CO₃ are also added to improve sedimentation. The tubes were centrifuged at 1800 × g at 1°C.

The supernatant from the centrifuge tube was poured off and residue was transferred to a pre-weighed crucible with minimum amount of water. The crucibles plus the residues were dried at 100°C, cooled in a desiccator and weighed. The organic matter residues were obtained after ashing the crucible plus the residues. Crude protein contents were also estimated in the residues to find out the percent protein degradability.

Less protein degradability in rumen indicates the higher bypass protein which helps in faster growth rate.

Results and Discussion

For *in vitro* studies 1st stage of [6] was used to measure the rumen dry matter, organic matter and crude protein degradability of concentrate mixtures 'C', 'T-1' and 'T-2' respectively. The data in table 3 and 4 clearly showed that decorticated cottonseed cake solvent extracted protein supplement had higher rumen undegradable protein. Cottonseed cake (expeller) also had more undegradable protein than soybean meal de-oiled. Thus decorticated cottonseed cake solvent extracted can be fed to the growing animals requiring rapid rate of growth with advantage compared to soybean meal de-oiled as the more crude protein will be available at the site of absorption [7]. Reported that RDP: UDP ratio of 52:48 in undecorticated cottonseed cake stimulated higher growth rate in crossbred calves because of higher rumen undegradable protein availability from this cake. However, in the present study the cottonseed cake expeller had RDP: UDP ratio of 59:41 compared to 65:35 in soybean meal and 56:44 in decorticated cottonseed cake solvent extracted. [2] Reported a RDP: UDP ratio of 61:39 in

cottonseed cake (expeller) which was quite comparable to the RDP: UDP ratio of 59:41 in the present study.

Table 1: Percent chemical composition of concentrate mixtures SBM 'C', 'T-1' (replacing 10 parts of soybean meal with cottonseed cake expeller), 'T-2' (replacing 10 parts of soybean meal with decorticated cottonseed cake), green oats and wheat straw (on DM basis)

Parameters	Groups			Oat fodder	Wheat straw
	SBM 'C'	CSC 'T-1'	DCSC 'T-2'		
Dry matter	90.2	90.3	91.1	16.0	90.6
Organic matter	90.4	90.9	90.2	88.5	91.6
Crude Protein	19.8	20.0	19.9	8.5	2.6
Crude fibre	10.8	10.4	9.4	42.3	33.1
Ether extract	4.2	6.2	4.8	2.7	0.9
Nitrogen free extract	56.3	52.0	55.8	44.2	45.8
Total ash	9.6	9.1	9.8	11.5	8.4
Acid insoluble ash	1.8	1.4	1.1	3.6	4.0
Neutral detergent fibre	36.2	31.7	33.8	63.2	81.6
Acid detergent fibre	15.1	15.2	12.7	43.0	57.1
Hemicellulose	21.1	16.5	21.1	20.2	24.5

Table 2: *In vitro* degradability of different cakes after incubation at 48 hrs

Ingredient	<i>In vitro</i> degradability		
	Dry matter*	Organic matter*	Crude protein*
Soybean meal	64.41 ^a ±1.61	64.49 ^a ±0.58	64.46 ^b ±0.60
Cottonseed cake (Expeller)	59.58 ^b ±1.02	52.86 ^a ±1.58	58.96 ^a ±1.98
Decorticated Cottonseed cake	55.70 ^a ±0.45	53.31 ^a ±0.70	55.92 ^a ±0.87
Sem	1.38	1.97	1.41

Values bearing different superscripts^{a, b, c} in a column differ significantly (P < 0.05) *Significant (P < 0.05)

Table 3: *In vitro* degradability of different Concentrate mixtures after incubation at 48 hrs.

Conc. Mixtures	<i>In vitro</i> degradability		
	Dry matter*	Organic matter*	Crude protein*
C	71.41 ^b ±1.26	67.03 ^c ±0.85	65.74 ^b ±1.73
T-1	67.92 ^a ±1.10	58.28 ^b ±0.94	59.04 ^a ±1.41
T-2	65.05 ^a ±0.93	55.03 ^a ±0.91	56.54 ^a ±1.25
Sem	1.07	1.84	1.56

Values bearing different superscripts^{a, b, c} in a column differ Significantly (P < 0.05) *Significant (P < 0.05)

SBM: Soybean Meal CSC: Cotton Seed Cake (Expeller) DCSC: Decorticated Cotton Seed Cake (Solv. ext.)

The data showed that the soybean meal and concentrate mixture 'C' had higher (P≤0.05) DM (64.41±1.61, 71.41±0.26), OM (64.49±0.58, 67.03±0.85) and CP(64.46±0.60, 65.74 ±1.73) degradability followed by cottonseed cake (expeller) and conc. mixture (T-1) i.e. DM (59.58±1.02, 67.92±1.10), OM (52.86±1.58, 58.28±0.94) and CP (58.96±1.98, 59.04±1.41) and decorticated cottonseed cake solvent extracted and concentrate mixture 'T-2' had lowest (P≤0.05) DM (55.70±0.45, 65.05±0.93), OM (53.31±0.70, 55.03±0.91) and CP (55.92±0.87, 56.54±1.25) degradability. The data clearly showed that decorticated cottonseed cake solvent extracted protein supplement had higher rumen undegradable protein.

Conclusion

During *in vitro* study 'T-2' concentrate mixture having significantly lower *In vitro* crude protein degradability (56.54±1.25), organic matter degradability (59.04±1.41) and

dry matter degradability ($65.05^a \pm 0.93$) so more nutrients available to intestine for growth.

It can be concluded that incorporation of decorticated cotton seed cake as a partial replacement (10 parts) of soybean meal in a concentrate mixture fed as a complete feed mixture without any adverse effect on digestibility of nutrient.

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