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Feeding *Celosia argentea* as Fodder Block to Ruminants

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ABSTRACT

Background: *Celosia argentea*, commonly known as plumed cockscomb, is a herbaceous plant of tropical origin and has 19.78% crude protein and is equal to leguminous fodder. It is highly palatable by animals. The study was designed to find out the chemical composition of the plant at summer and monsoon season and also to conserve it as fodder block for feeding ruminants during feed shortage.

Methods: Fodder block was prepared by using paddy straw (60%), *Celosia argentea* plant (30%), 7.5% refined wheat flour, 2% mineral mixture and 1% salt. The fodder blocks were assessed for physical, chemical and IVDMD tests. Three treatments such as paddy straw and *Desmanthus* fodder (T1), paddy straw and *Celosia argentea* fodder (T2), paddy straw and *Celosia argentea* block (T3) were used for palatability trial in eighteen cross bred heifers. Trial was conducted for a period of one month. Daily feed intake (kg/day), initial and final body weight was measured. Data was analysed by using SPS software.

Result: Significant variations (P<0.01) were observed in the proximate composition of *Celosia argentea* fodder between monsoon and summer season. The prepared fodder blocks with *Celosia argentea* had bulk density of 70.15 kg/m^3, relative hardness of 12.36 mm and durability of 89.22%. The chemical composition of fodder blocks (dry matter - 90.3%, crude protein - 10.28%, ether extract - 1.6%, crude fibre - 16.25%, total ash -13.26%, nitrogen free extract - 58.35%, Ca - 1.05% and P - 0.53%) were found to lie in the normal range. The IVDMD of fodder block is 48.52%. Average daily dry matter intake of heifers fed with T3 was higher (P<0.01) compared to heifers fed with T1 and T2. The body weight of heifers fed with all treatments did not change during trial period. *Celosia argentea* can be utilized as alternate to *Desmanthus* fodder and can be preserved as fodder block along with paddy straw for use during fodder deficit seasons.

Key words: *Celosia*, Fodder block, Palatability, Ruminants.

INTRODUCTION

Feeding of ruminants in India involves providing them with a ration having concentrate and roughage in the ratio of 60:40 to 40:60 according to their dry matter requirement. The shortage of feed and fodder is a chronic ailment that afflicts the livestock industry (Arti *et al.,* 2018). In roughage feeding, green fodder plays a major role in livestock and supplies very good energy and is also a source of vitamins and trace elements. Leguminous green fodders supply one third of crude protein required by ruminant livestock and this is approximately equal to the crude protein content provided by oil cakes. In general, leguminous green fodder is included at one third of the total green fodder supplemented to ruminant livestock and serves as a valuable source of protein. *Celosia argentea*, commonly known as plumed cockscomb or the silver cock's comb, is an herbaceous plant of tropical origin and is known for its very bright colors. In India and China, it is known as a troublesome weed at the end of monsoon season found in cultivating and fallow land (William, 1954). It blooms in mid-spring to summer and it is propagated by seeds. The seeds are extremely small up to 43,000 seeds per ounce. The leaves and flowers are edible and are grown for such use in Africa and Southeast Asia (Grubben and Denton, 2004). Few ruminants especially sheep graze this plant. When the land is not irrigated and there is no rain the plant dries up and sheds all its leaves. Thus, there exists a possibility that the plants could be harvested post monsoon and conserved suitably for feeding ruminants during the lean season. Feed block making is a suitable processing technology to utilize such type of unconventional feed resources more effectively. This technology helps to densify low density feed resources and thus reduces transportation cost (Karangiya *et al.,* 2016). In this background, a study was designed to evaluate the chemical composition of *Celosia argentea* during summer and monsoon season and harvest and conserve it as fodder block for feeding ruminants during feed shortage.

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MATERIALS AND METHODS

Location

The study was conducted at Institute of Animal Nutrition, Tamil Nadu Veterinary and Animal Sciences University,

Tamil Nadu, India, which is located at 13.03′N latitude and 80.12′E longitude at an altitude of 28 m above mean sea level. The study took place during the years 2015 to 2016.

Soil and climate

The soil of the experimental site was red soil, having a pH of 7.1. The soil available nitrogen, phosphorus and potassium were 426.0 kg ha^{-1}, 6.2 kg $ha^{-1}$and 165 kg ha^{-1}, respectively and the organic carbon content was 0.42%. The annual rainfall of the region during the experimental period was 1050 mm and more than 80 per cent of this rainfall was received between the months September to December. The mean annual maximum and minimum temperature recorded during the study period was 36.6°C and 22.6°C, respectively.

Biomass yield and proximate composition

The biomass yield of *Celosia argentea* was recorded during summer (May) and post monsoon season (December) in the fallow land identified as the experimental site. During the respective seasons plant samples were collected from six different locations at the experimental site. The samples for the respective seasons were pooled, shade dried and ground to pass through 1 mm sieve in Willey mill. The ground samples were preserved in an airtight container for further chemical analysis. Proximate composition of collected samples were determined as per AOAC (2012).

Fodder blocks preparation

Around 100 kg of *Celosia argentea* was collected post monsoon from the experimental site to prepare the fodder blocks. The paddy straw required for preparing the fodder blocks was collected from a local farm after machine harvesting. The ingredient composition of the fodder blocks is presented in Table 1.

Both paddy straw and *Celosia argentea* were chaffed to 2-3 inch size, mixed with binding material (refined wheat flour), mineral mixture and salt for preparing the fodder blocks. After adequate mixing, the mix was compacted in an iron mould having dimensions of 30×30×10 cm, using a specially designed semi-automatic hydraulic press fitted with a manual ejection system. The standard pressure of 2000 psi and dwell time of 5 minutes was adopted (Murugeswari *et al.*, 2013) during the compaction process in the hydraulic press. After compression the blocks were removed from the mould and sun dried. Each block weighed one kilogram. The blocks were packed and stored in a cool and dry storage conditions for conducting palatability trial in dairy cattle.

Evaluation of fodder blocks

The blocks were assessed for their physical properties: bulk density, relative hardness (Singh and Chahal, 1993), durability (Butler and Mccoly, 1959) and post compression expansion (Berwal *et al*., 1993). The chemical composition of fodder blocks (AOAC 2012) and their *in vitro* dry matter degradability (IVDMD) (Tilly and Terry, 1963) was studied.

Palatability trial

Eighteen crossbred growing heifers, 9 months old, having initial mean body weight of 96.6±4.25 kg were randomly distributed into three groups of six animals each. The animals were housed individually providing adequate floor, feed, water space as per standards. Other management practices adopted were as per standards and were uniform for all animals. The palatability trial was conducted for one month.

Each group of animals was fed with one of the following experimental feeds.

T1 - Paddy straw and *Desmanthus* fodder.
T2 - Paddy straw and *Celosia argentea* fodder.
T3 - Paddy straw and *Celosia argentea* block.

Animals were fed at 3% dry matter intake and were also allowed 5% of extra feed according to their body weight every day. The animal had access to clean potable water throughout the day. Records were maintained on feed offered and left over for each individual animal every day to document actual dry matter intake. The body weight of the animal was measured at the end of trial.

Statistical analysis

The data were subjected to descriptive statistics (Snedeor and Cochran, 1994). The one-way ANOVA of CRD was used for comparison of daily dry matter intake and for body weight effect between groups through SPS software. A p-value of 0.05 was considered statistically significant and 0.01 was considered as highly significant.

Results and Discussion

Biomass yield and proximate composition

The biomass yield of *C. argentea* was 8.05±0.33 MT during summer season and 12.11±0.42 MT during the monsoon season in fallow experimental site.

Table 1: Ingredient composition of fodder block.

Ingredients	%DMB
Paddy straw	60
Celosia argentea	30
Binding material (maida)	7
Mineral mixture	2
Salt	1
Total	100

Table 2: Proximate composition (%DMB) of *Celosia argentea* (Mean*±SE).

Proximate principles	Monsoon season	Summer season
Dry matter	31.51±1.41[a]	42.12±1.63[b]
Crude protein	19.57±0.26[b]	10.78±0.24[a]
Ether extract	3.23±0.04[b]	2.05±0.07[a]
Crude fibre	19.87±0.11[a]	21.91±0.28[b]
Total ash	17.01±0.05	17.44±0.07
NFE	40.32±1.01[a]	47.82±1.22[b]

*Mean of six samples; Means bearing different alphabets as superscripts differ significantly (P<0.01).

The proximate composition of *C. argentea* documented for both the seasons is presented in Table 2.

The proximate composition of *C. argentea* is within the normal range as reported by Adegbaju *et al.* (2019). The crude protein of *C. argentea* was significantly (P<0.01) higher during monsoon season, whereas the dry matter, crude fibre and NFE was significantly (P<0.01) higher during summer season. The variability in proximate principles between seasons could be because *C. argentea* grow during June-July with the onset of first monsoon shower, remain green up to August-September, then wither off with the onset of winter. The crude protein content of *C. argentea* was found lower in summer season than in monsoon season due to shattering of leaves in the plant. It was observed during collection of the plan samples in summer season. It is due to the reduction of water evaporation from leaves to survive the plant life (Ravindra *et al.,* 2008).

The short life cycle *C.argentea* often impose restriction on its availability to grazing ruminants during late winter and summer season. This necessitates the need for their conservation as fodder blocks.

Table 3: Physical properties, chemical composition and *in vitro* dry matter degradability fodder blocks with *C. argentea* (Mean±SE)*.

Parameter	Physical properties
Physical properties of fodder block	
Bulk density (kg/m^3)	70.15±1.05
Relative hardness (mm)	12.36±0.51
Durability (%)	89.22±1.49
Chemical composition of fodder block	
Parameters	% DMB
Dry matter	90.3±1.47
Crude protein	10.28±0.25
Ether extract	1.86±0.05
Crude fibre	16.25±1.06
Total ash	13.26±1.14
Nitrogen free extract	58.35±1.92
Ca	1.05±0.02
P	0.53±0.01
IVDMD	48.52±2.51

*Mean of six samples.

Table 4: Dry matter intake and body weight changes of heifers fed with different experimental feed.

Treatments	Dry matter intake (kg/day)	Initial body weight (kg)	Final body weight (kg)
T1	3.12±0.14^b	94.52±3.26	97.26±3.89
T2	2.84±0.11^a	98.37±3.89	100.54±3.29
T3	3.26±0.15^c	99.12±4.15	103.08±3.72

*Mean of six samples; Means bearin different alphabets as superscripts differ significantly (P<0.01).

The physical properties, proximate composition and *in vitro* dry matter degradability fodder blocks with *C. argentea* is given in Table 3.

The physical properties of the fodder block indicates a bulk density of 70.15 kg/m^3 which shows that the bulkiness of paddy straw and *C. argentea* plant was reduced and their density increased by blocking, which concurs with that reported by Singh *et al.* (2016). The relative hardness of the block was reduced to 12.36 mm since refined wheat flour was used as binder. The durability of the block also increased up to 89.2%. If the blocks are more durable it will be easier to handle them both during storage and transportation (Munasik *et al*., 2013). Fodder block made with paddy straw is the best technology to improve the paddy straw nutritive value and effective utilization when combined with other green fodders as reported by Sheikh, *et al.,* 2018.

The dry matter percentage of complete feed block was 90.3% which is in agreement with the values (87-91%) reported by Kulathunga *et al.,* (2015) for different feed blocks. The crude protein content of fodder block is higher (10.78%) because *C. argentea* has high level of crude protein similar to leguminous fodder. This is the recommended level of crude protein in blocks (Walli *et al.,* 2012). The ash content of the block was 13.26% which was higher compared to other blocks due to the addition of mineral mixture in the block preparation. The crude fiber content was high (16.25%) due to the inclusion of 70% paddy straw. The crude fibre values are in accordance with the values reported for different crop residue based complete rations (28-31%) by Kulathunga *et al.* (2015). The calcium and phosphorous content was less in the fodder block since paddy straw and *C. argentea* have lower level of calcium and phosphorous. Kulathunga *et al.* (2015) also reported a range of 0.74 to 1.45% of calcium and 0.5 to 1% of phosphorous in complete feed block with different fodder and concentrate mixture. Hence, measures should be taken to increase the calcium and phosphorous content of the blocks. The IVDMD of fodder block is 48.52% indicating better digestibility than paddy straw, due to inclusion of *C. argentea* which improved the degradation. The results of the palatability trial are presented in Table 4.

The dry matter intake is significantly different (P<0.01) among all treatments. The highest dry matter intake was recorded in the treatment 3. Feeding of paddy straw and *C. argentea* as fodder block had increased palatability, as both the fodders were inseparable it resulted in provision of balanced nutrients (Chaudhary *et al.*, 2017). The initial body weight was maintained during the palatability trial which indicates that the treatments did not produce any ill effect on health. It also confirms that the *C. argentea* can be fed as fodder and as fodder block along with paddy straw in the place of *Desmanthus* as leguminous fodder.

CONCLUSION

C. argentea is available as fodder from fallow land without any cultivation. It can be used as very good source of green

fodder during monsoon season and as dry fodder at summer season for ruminants. It can be utilized as an alternate to *Desmanthus* fodder. *C. argentea* can be preserved as fodder block along with paddy straw for use during summer season.

Conflict of interest

All authors declare that they have no conflict of interest.

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