RESEARCH ARTICLE

IMPACT OF DRYING METHODS ON CHEMICAL COMPOSITION OF PRESSED FOLIAGE OF LUCERNE (*MEDICAGO SATIVA L.*)

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Abstract:

This study evaluated the effects of various drying methods on the chemical composition and nutrient retention of pressed foliage from lucerne obtained through green crop fractionation. Results showed that sun drying achieved the highest dry matter content (96.6%), but significantly reduced crude protein and β-carotene levels. In contrast, shade drying—especially with cover—better preserved β-carotene (up to 6.08 mg/100g) and protein (up to 20.83%), though it was slower and risked fermentation. Nutrient composition, including fat, sugars, ash, calcium, and phosphorus, showed varying degrees of sensitivity to drying conditions. Overall, while sun drying was efficient, shade drying was more effective in retaining essential nutrients, notably β-carotene, critical for animal health. These findings support pressed foliage of Lucerne as a valuable feed resource, with drying method significantly influencing its nutritional quality.

Keywords: Lucerne (*Medicago sativa L.*), Pressed Foliage, Green Crop Fractionation (GCF), Drying Methods, Animal Nutrition.

Introduction:

Mechanical fractionation of green leaves has been advocated by Pirie (1942) for producing protein rich food-grade product for human being and fiber-rich feed product for animal nutrition. For this green leaves macerated and pressed. The leaf juice released due to the pressing is employed for preparation of protein-rich food product. While pressed foliage is used for animal nutrition. Earlier, pressed foliage was considered as a by-product of Green Crop fractionation (GCF) system. However, Raymond and Harris (1957) demonstrated its suitability as a feed for ruminant animals. Several plants have been found suitable for this purpose. Out of these, Lucerne (*Medicago sativa L.*) is being highly recommended (Mungikar, 1999a). An attempt was made during present study to investigate the chemical composition of pressed foliage of Lucerne dried by different methods.

Materials and Methods:

Fresh green foliage of Lucerne was harvested early in the morning at a preflowering stage. A sample of foliage was immediately brought into the laboratory, pulped (Davys and Pirie, 1969) and subsequently pressed (Davys *et al*., 1669). The juice released due to the pressing was employed for the preparation of LPC while pressed crop residue (PCR) was employed to undertake the experiments.

About 7 kg of PCR was mixed uniformly and divided into seven parts in steel trays comprising of 1 kg PCR in each tray. The PCR samples kept in all the trays were dried by employing following methods:

1) drying in oven at 60^0 C
2) drying in sunlight
3) initial drying in sunlight for 6-8 hours followed by drying in shade
4) covering the PCR with sun-glass and drying in sun
5) drying in shade
6) initial drying in shade for 6-8 hours followed by sun drying
7) Covering the PCR with sun-glass and drying in shade.

The dry matter content of the PCR was simultaneously determined by drying a sample in oven at 95^0 C till constant weight. The completely dried samples of PCR were ground to a fine powder and taken for analysis. The chromic acid oxidation method of O'shea and Maguire as described by Mungikar (1999b) was followed to determine gross energy (GE). The nitrogen (N) content in the dry matter was estimated by microKjeldahl method (Bailey, 1967) and the crude protein content was expressed as N x 6.25. The crude fiber (CF), ash and calcium (Ca) contents were determined following A. O. A. C. (1970) methods. The crude fat content was determined using chloroform-methonol (1:3) as a solvent using soxhlet extractor. A method of Fiske and Subba Rau (1925) outlined by Oser (1979) was followed for the estimation of phosporus (P). Two gm dry silage sample was mixed with 100 ml water, boiled, filtered through whatman filter paper and the amount of water soluble reducing sugar (WSRS) was measured in terms of glucose using folin-wu tubes (Oser, 1979). The amount of β-carotene (Pro-vitamin A) was estimated following Knuckles *et al*. (1970). The data were statistically analysed following Panse and Sukhatme (1985) and Mungikar (1997, 2003).

Results and Discussion:

The chemical composition of dry PCR from lucerne is given in Table 1 and 2. The % dry matter in the material ranges from 72.2 with shade drying, while 96.6 when sun-drying was employed. There was very little variation in the values of gross energy (C. V. 4.39) and it ranged from 3.92 to 4.49 %. Variation in crude protein content was observed when the material was dried by various methods (C. V. 10.43). The crude protein content was least (15.62 %) when the PCR was dried in sun, while it was highest (20.83 %) when drying in shade with a cover was employed. The fat content in dry PCR showed little variation (C. V. 11.25) and fluctuated between 7.1 and 9.9 in various samples dried under different condition. The total sugar content was highest (2.76 % of DM) when the material was dried in oven; or otherwise, it ranged from 1.69 to 2.22 % with a coefficient of variation up to 14.28 %.

Table 1: Chemical composition of pressed crop residue (PCR) of lucerne dried by various methods

Sr. No.	Drying Method	% Dry Matter (DM)	Gross energy Kcal/g DM	% of Dry Matter (DM)				
				Nitrogen (N)	Crude Protein (CP)	Crude Fat (CF)	Total Sugar	WSRS
1	Oven (60^0 C)	100.00	4.24	3.25	20.31	9.9	2.76	2.62
2	Sun	96.16	4.49	2.50	15.62	8.1	2.11	1.89
3	Sun (6-8h) followed by shade	91.22	4.18	3.08	19.27	7.1	2.08	1.72
4	Sun + cover (Colour glass)	92.20	4.24	2.75	17.18	7.5	2.16	1.68
5	Shade	80.63	3.92	2.75	17.18	7.7	2.19	2.12
6	Shade (6-8h) followed by Sun	98.84	4.42	3.16	19.79	7.3	1.69	1.63
7	Shade +cover (colour glass)	72.70	4.16	3.33	20.83	8.7	2.22	2.13
Mean		90.25	4.23	2.97	18.59	8.0	2.17	1.97
S.D.		10.07	0.18	0.30	1.94	0.9	0.31	0.35
C.V.		11.15	4.39	10.10	10.43	11.2	14.28	17.76

Table 2: Chemical composition of pressed crop residue (PCR) of lucerne dried by various methods

Sr. No.	Drying Method	% of Dry Matter (DM)					
		Total Ash	ASA	AIA	Ca	P	β-carotene mg/100gm
1	Oven (60^0 C)	7.60	7.15	0.45	1.29	0.16	3.56
2	Sun	9.20	8.90	0.30	1.69	0.36	2.92
3	Sun (6-8h) followed by shade	10.20	9.65	0.55	1.70	0.20	2.36
4	Sun + cover (Colour glass)	6.75	6.40	0.35	1.61	0.31	2.64
5	Shade	11.25	10.80	0.45	2.10	0.27	4.80
6	Shade (6-8h) followed by Sun	9.20	8.80	0.40	1.94	0.22	6.08
7	Shade +cover (colour glass)	11.65	11.25	0.40	2.33	0.26	3.60
Mean		9.40	8.99	0.41	1.80	0.25	3.70
S.D.		1.80	1.77	0.08	0.34	0.06	1.31
C.V.		19.14	19.68	19.51	18.18	24.00	35.40

Almost similar trend was observed in respect to the content of water soluble reducing sugars. The values for total, acid soluble and acid insoluble ash contents ranged from 7.60 to 11.65 %, 7.51 to 11.25 % and 0.30 to 0.45 % respectively. The maximum ash content was reported in the samples which were dried in shade, particularly under the cover. The oven dried samples, however, were with lower values of ash content. The C. V. for all these parameters was almost similar i. e. 19.14 to 19.68 %. The calcium content was highest in the PCR samples which were dried in shade while least when dried in an oven. In general the calcium content ranged from 1.29 to 2.33 % of dry matter. Large variation in the content of phosphorus was observed (C. V. 24.00 %) and in dried PCR samples it ranged from 0.16 to 0.36 %.

β-carotene is a photosynthetic pigment associated with chlorophyll and it is present in almost all green plants (Devlin and Witham, 1986). It is often considered as pro-vitamin A, as its one molecule gets converted into two molecules of vitamin A after consumption by human beings. (Mertz, 1967). Thus the amount of β-carotene gives an indication of vitamin A content in a feed product derived from plant origin. During present investigation, the β-carotene content was maximum (6.08 mg/100g) when the PCR was dried initially in shade following sun drying. When the PCR was dried completely under shade, the β-carotene content was reduced to 4.80 mg/100g PCR. On an average, it was 3.6 mg/100g when the PCR was dried either in oven or shade with cover, while, fluctuated between 2.36 to 2.92 mg/ 100g when dried in sun either partly or completely. The overall results obtained on the preparation of dry PCR indicate that drying in sun was most suitable for fast drying while shade drying was slow. However, it was observed that the material dried in sun loses its colour while the same is retained considerably during shade drying.

The sun dried PCR samples were bleached and lost its original green colour. Such residues lose carotene pigment due to exposure to sun-light (Tekale, 1975). With regards to the chemical composition of the PCR, it can be stated that, the product contains almost all nutrients in sufficient quantity to fulfil the requirement of farm animals. However, slight changes in the contents of some nutrients were observed due to the method of drying. Cattle need diet containing carotenoids and its deficiency may lead to infertility (Cooke, 1978). Arkcoll and Holden (1973) reported that, there is a rapid loss of carotenes during conservation of fodder, it is therefore advocated that the process of conservation should be initiated at the earliest (Pirie, 1987).

Vitamin-A is supplied to the animals through green feed in the form of β-carotene. A number of factors affect the content of β-carotene in green leaves. Tekale and Joshi (1977) observed that β - carotene content in the lucerne foliage was maximum in the morning with a decline in the afternoon. During present investigation, it was further observed that the carotene content differs with the method of drying and sunlight showed more negative effect on the carotene content.

Conclusions:

The results obtained indicated suitability of PCR in animal nutrition and that of drying in shade to retain nutrients in the PCR of lucerne. However, it is necessary to undertake shade drying carefully as the delay in the drying under shade may result into fermentation at the bottom of layer resulting in nutrient loss (Kasture, 1982). Frequent turnings during drying may improve the quality of product (Bhande, 1989).

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