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Effect of Temperature and Glucose Addition on Silage Fermentation of Lucerne (*Medicago sativa L.*) Pressed Crop Residue

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Abstract:

Green crop fractionation (GCF) produces leaf protein concentrate (LPC) from expressed leaf juice and pressed crop residue (PCR) as a fibrous fraction traditionally used for animal feed. This study evaluated the effects of temperature and glucose addition on silage fermentation of Lucerne PCR, comparing it with fresh Lucerne foliage. Silages were prepared with 0–6% glucose and stored under different temperature conditions. Results showed that glucose significantly enhanced lactic acid production and reduced pH in both fresh crop and PCR silages, improving overall fermentation quality. Temperature had little effect on silage made from fresh lucerne, but PCR exhibited higher sensitivity, producing more lactic acid and achieving lower pH at elevated temperatures. These findings indicate that Lucerne PCR is a suitable substrate for high-quality silage and that warmer climatic conditions, such as those in India, are favorable for effective ensiling.

Key words: Green crop fractionation (GCF), leaf protein concentrate (LPC), pressed crop residue (PCR), Silage, Lucerne (*Medicago sativa L.*)

Introduction:

Green crop fractionation (GCF) was proposed by Pirie (1942) as a method to produce a protein-rich, food-grade product for humans and a fiber-rich feed for animals. In this process, fresh leaves are macerated and pressed. The resulting leaf juice is used to prepare the protein-rich food product (LPC), while the pressed crop residue (PCR) serves as animal feed. During green crop fractionation (GCF), the pressed crop residue (PCR) left after extraction of juice is a major product produced in relatively large quantity. At the earlier stages of leaf protein (LP) research, the PCR was considered as a by-product of GCF system. However, Raymond and Harris (1957) demonstrated suitability of PCR as a feed for ruminant animals.

It was observed that PCR from Lucerne make better silage than fresh crop with increased lactic acid production and rapid drop in the pH (Mungikar and Joshi; 1976). In order to prepare nutritionally better quality of silage, the deficiency of fermentable sugars can be corrected by adding sugar or any other suitable substrate for promoting

lactic acid production (Ohshima and Oochi, 1979). The use of sugars before ensilaging the material enhance lactic acid production which results into rapid drop in pH and good quality of silage.

Preparation of silage in India is not much popular except in North-India and at some Government agricultural and dairy farms. On the other hand, it is a common practice in western countries where normal temperature is low. An attempt was made during present investigation to study the effect of temperature on production of lactic acid and changes in silage pH from PCR of Lucerne under the influence of 0, 1, 2, or 3 % (w/w) glucose as an additive.

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 prepare silage. The treatment of glucose was given at 0, 1, 2, 3 gm/100gm level.

For the preparation of silage, the PCR measuring about 1.2 to 1.5 kg was placed in plastic container. It was pressed to make compact and to exclude air for maintaining anaerobic condition. The lid of plastic container was then replaced, mouth screw capped, sealed with Johnsson's adhesive tape and wax to make the container air tight to create anaerobic condition. Containers were left at different temperatures until opened to collect the samples of silage.

After opening the boxes, fresh silage sample was taken for chemical analysis. Fourty gm of silage sample was mixed with 40 ml glass distilled water, placed on cotton cloth and squeezed, the extract released was collected in a clean beaker and the pH was measured using pH meter. The amount of lactic acid was estimated as described by Barker and Summerson (1941) and outlined by Oser (1979).

The data obtained was statistically analyzed following Panes and Sukhatme (1978).

Results and Discussion:

Table 1 gives an account on lactic acid content of the silages made at different temperatures under the influence of different concentration of glucose. On an average, the lactic acid production significantly increased from 1.80 to 7.04 % due to the addition of glucose, when the silage was made from fresh crop of Lucerne. However variation in temperature had very little influence on lactic acid content in the silage samples whish was statistically non-significant. As with fresh crop, the lactic acid content increased on an average from 2.52 to 4.46 % due to pretreatment with glucose. The increase in amount of lactic acid in silage was statistically significant. On an average, lactic acid content was 3.40 % when the silage was prepared from PCR at 18 ± 2^0 C. The value of lactic acid increased to 3.64 and 3.93 % when the silages were made at 20 ± 2 and 38 ± 2^0 C respectively. The effect of temperature on lactic acid production was significant in case of PCR as with the effect of glucose concentration. The data thus indicated that PCR of Lucerne was more sensitive to the change in temperature in comparison to fresh crop of Lucerne.

The results obtained on values of pH in silages prepared from fresh crop and PCR at various temperatures and glucose pretreatment are presented in Table 2. As with lactic acid, the decrease in pH from 4.73 to 4.52 under the influence of high temperature was statistically non-significant. However, on an average, the pH values

gradually decreased from 5.03 to 4.27; the decrease in pH was statistically significant as indicated by the value of F. In case of PCR, the decrease in pH from 4.44 to 4.13 due to increased temperature was statistically significant. Similarly the values for pH significantly decreased due to the treatment with glucose from 4.75 to 3.92 i. e. within permissible limits. The results are in agreement to those obtained for lactic acid, indicating PCR as a more suitable material for the preparation of silage, the quality of which may alter with the change in temperature in spite of availability of fermentable carbohydrates.

Conclusions:

Though pretreatment with glucose increased lactic acid production in the silage made from fresh and pressed foliage of Lucerne, the variation in temperature had no influence on silage fermentation in case of fresh, chopped foliage of Lucerne. The PCR of Lucerne, however, was found to be sensitive to the temperature changes producing better quality of silage at high temperature with increased lactic acid production and decrease in value of pH. The results indicate that climatic conditions in India are also favorable for the preparation of silage as the temperature is on the higher side in comparison to that in western countries.

Table 1: Lactic acid content (% of DM) in silages made from lucerne under the influence of various temperatures and levels of glucose pretreatment.

Glucose g/ 100g	Fresh Crop (FC)				Pressed Crop residue (PCR)			
	18 ± 2^0C	28 ± 2^0C	38 ± 2^0C	Mean	18 ± 2^0C	28 ± 2^0C	38 ± 2^0C	Mean
0	1.81	1.80	1.80	1.80	2.46	2.40	2.64	2.52
1	4.06	4.19	4.80	4.35	3.18	3.68	4.10	3.65
2	5.77	5.83	5.93	5.84	3.92	4.10	4.28	4.10
3	6.80	7.12	2.24	7.04	4.06	4.39	4.92	4.64
mean	4.61	4.73	4.94	-	3.40	3.64	3.93	-
F value	Temperature:		3.19^{NS}				$:10.11^{NS}$	
	Glucose conc.:		434.2**				:626.3**	
C. D. (P=0.05)	Température:		0.32				:0.32	
	Glucose conc:		0.37				:0.36	

^{NS}: Non-Significant * * : Signifiant at P=0.01

Table 2: Values of pH in silages made from lucerne under the influence of various temperatures and levels of glucose pretreatment.

Glucose g/100g	Fresh crop				Pressed crop Residue (PCR)			
	18 ± 2^0C	28 ± 2^0C	38 ± 2^0C	Mean	18 ± 2^0C	28 ± 2^0C	38 ± 2^0C	Mean
0	5.08	5.02	5.01	5.03	4.88	4.70	4.68	4.75
1	4.78	4.34	4.90	4.78	4.51	4.30	4.16	4.32
2	4.71	4.44	4.64	4.60	4.28	4.15	3.92	4.11

3	4.36	4.29	4.17	4.27	4.09	3.90	3.76	3.92
Mean	4.73	4.52	4.68	-	4.44	4.26	4.13	-

F value	Temperature:	2.15^{NS}	:58.11**
	Glucose conc.:	12.97* *	:27.00 **
C. D. (P=0.05)	Température:	0.26	:0.07
	Glucose conc.:	0.30	:0.07

^{NS}: Non-Significant **: Significant at P=0.01

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