Comparison of nutritional status of green forage, hay and silage of sudan grass (*Sorghum sudanense* (Piper) Stapf)

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ABSTRACT

A study was conducted to determine the nutritional status of sudan grass (*Sorghum sudanense* (Piper) Stapf.) in the form of silage and hay as compared to its green forage. Green forage gave the highest percentage of crude protein, moisture and ether extract and lowest percentage of crude fibre, whereas hay gave the lowest percentage of moisture and crude protein and highest percentage of crude fibre, mineral matter and phosphorus, respectively. The percentage of calcium was in the same magnitude in green forage and hay of sudan grass. Silage gave more percentage of crude protein and less crude fibre as compared to hay. There was more crude fibre in silage than green forage. Therefore silage was found less nutritive than green forage but more nutritive than hay of sudan grass.

INTRODUCTION

The importance of ensiling as a means of conserving forage has progressively increased during recent times and its use has now become an important component of policies for promoting the greatest possible use of grassland products in the feeding of ruminants. Experience has shown that climatic conditions of the country are very suitable for hay and silage making which is of vital importance to overcome the problem of acute shortage of forage (4). Graves (7), Hein (8) and Shepel (15) reported that a good quality silage and hay may be prepared from sorghum crop, which is relished by cattle, horses and sheep due to its palatability and feeding value. Crowder (4) considered sudan grass a most suitable crop to be ensiled and cured as hay. Many workers analysed the green forage, silage and hay of sorghum to determine their feeding value. Crampton and Harris (3) reported moisture as 78.2%, 76.7% and 11.1%, crude fribre 32.2%, 34.4% and 28.9%, mineral matter 8.9%, 8.9% and 9.6%, and phosphorus as 0.09%, 0.05% and 0.28%, whereas McDonland *et. al.* (10) reported moisture as 89.0%, 75.0% and 15.0%, ether extract 3.8%, 0.7% and 1.5% and mineral matter as 2.4%, 2.7% and 6.4% in the green forage silage and hay of sorghum crop, respectively. Similary Cullison (6) reported crude protein as 14.1%, 9.6% and 7.6%, crude fibre 27.5%, 23.8% and 33.1%, mineral matter 7.8%, 7.3% and 9.6%, calcium 0.09%, 0.06%, and 0.27% and phosphorus 0.44%, 0.18% and 0.30%, whereas Martin *et. al.* (9) reported crude fibre as 6.2%, 6.9% and 27.9%, ether extract 1.0%, 1.0% and 1.7%, mineral matter 1.3%, 1.4% and 8.1% in green forage, silage and hay of sorghum crop, respectively. The same workers (9) further added that phosphorus percentages of 0.04 and 0.24 were found in silage and hay of sorghum, respectively. Seiffort (13) and Setala (14) reported the crude protein as 2.0% and 1.2% and DM as 50% and 18.9% for the silage

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of sorghum, respectively. Adam found DM as 31.1% and 88.9%, protein 8.5% and 4.4% and fibre 27.8% and 45.3% in silage and hay of sudan grass, respectively.

No attempt was made to prepare the silage from sudan grass and compare its nutritive value to hay and green forage of the crop under the prevailing climatic conditions of this country. Therefore, studies of preparation of silage from sudan grass and comparison of its nutritional status with its hay and green forage crop were undertaken.

MATERIALS AND METHODS

Sudan grass was grown at Punjab Agricultural Research Institute, Faisalabad, Pakistan on an area of half a hectare divided into four blocks. The sowing was done in the mid of May and the harvesting of the crop was carried out at milk stage in the third week of July. Seed was sown at the rate of 20 Kg. per hectare.

In order to get representative samples for the evaluation of green forage, the crop was harvested from various places of each block. The fresh samples collected in polyethelene bags, were immediately analysed for their moisture content whereas other chemical content, were made on oven dry basis.

At the same time, the crop was harvested from four blocks at certain places randomly for ensiling. For the preparation of silage, six silo pits were made and lined internally with plastic sheets. Each silo pit was 90 cm. deep with a diameter of 105 cm. at top and 60cm. at bottom, respectively. Before ensiling, the crop was chopped after subsequent wilting for two hours. The chopped fodder was filled in the silo pits compressingly and pit were closed for two months. After the completion of fermentation, the silo pits were opened and samples from different depths of each silo pit were taken and mixed toge ther thoroughly. For moisture determination, the fresh samples were analysed immediately, whereas for other chemical determinations, the samples were oven dried and grinded.

For hay making, the harvesting of the crop was delayed for a short period. For obtaining representative samples for hay evaluation, again the crop was harvested randomly from certain places of each of four blocks. The crop was air dried in the field. After making the crop completely air dried, the crop was bulked together and samples were analyzed for their moisture content, whereas for other chemical determinations, the samples were oven dried and ground.

The proximate chemical analysis for all chemical determinations except calcium and phosphorus were carried out by the methods described in A.O.A.C. (2). Moisture was determined by oven drying the samples whereas the samples were ignited in muffle furance for determining their mineral contents. For crude protein contents, nitrogen was determined by Kjeldahl apparatus which then was multiplied by 6.25 to calculate protein contents. For ether extract determination, the samples were extracted with anhydrous ether in soxhlet apparatus whereas the residue of ether extractions was boiled with 2.5 N H_2SO_4 followed by 2 N NaOH, respectively to find out the crude fibre contents. Calcium and phosphorus contents were determined by flame photometer and photo electronic calorimeter methods, respectively as given in the Agriculture Hand Book No. 60 U.S. Dept. of Agriculture (12).

The data were analyzed statistically by the techniques of the analysis of variance as outlined by Steel and Torrie (16).

RESULTS AND DISCUSSION

The data on chemical composition of various forms of sudan grass i.e. green forage, silage and hay in terms of moisture, crude protein, crude fibre, ether extract, mineral matter, calcium and phosphorus contents expressed on a percentage basis are given in Table 1.

The various forms of sudan grass tested for their moisture contents showed signifi-

Table 1 — Mean values of percentages of moistute, crude protein, crude fibre, ether extract, mineral contents, calcium and phosphorus of various forms of Sudan grass.

Form of Sudan grass	Moisture	Crude protein	Crude fibre	Ether extract	Mineral content	Calcium	Phosphorous
Green forage	73.80 ± 0.800	3.77 ± 0.022	30.86 ± 0.325	1.50 ± 0.094	2.80 ± 0.228	0.02 ± 0.020	0.144 ± 0.114
Silage	70.00 ± 0.632	2.80 ± 0.171	32.26 ± 0.192	1.29 ± 0.104	2.40 ± 0.063	0.01 ± 0.001	0.03 ± 0.059
Hay	11.00 ± 0.447	1.91 ± 0.067	38.79 ± 0.620	1.34 ± 0.323	9.00 ± 0.316	0.02 ± 0.001	0.25 ± 0.008
P	3009.40**	43.40**	105.51**	2.87^{ns}	74.40**	0.243^{ns}	41.66**
L.S.D. (0.05)	0.630	0.139	0.402	—	0.421	—	0.031

^{ns} Non Significant
* Significant
** Highly significant

cant ($P < 0.01$) differences. Green forage and hay had the highest (73.80%) and lowest (11.00%) mean percentage of moisture contents, respectively, whereas moisture in silage was found to be 70%. These results agree with the findings obtained by Crampton and Harris (3), McDonland *et. al.* (10), and Setala (14) who found the highest and lowest moisture percentage in the green forage and hay of the sorghum crop, respectively. Green forage followed by silage was considered more digestible than hay. This fact is in conformity with the conclusion made by Forhoodmond (5) and Morrison (11).

The various forms of the sudan grass tested for their crude protein contents also showed significant ($P < 0.01$) differences. The mean percentage of crude protein was found to be the highest in green forage (3.77%) and lowest in hay (1.91%), respectively, while these were found intermediate (2.80%) in silage. These were also observed in the same trend in green forage, silage and hay by Cullison (6). Seiffort (13), Setala (14) and Adam (1) also found higher percentage of crude protein content in silage than hay of sorghum which confirmed the results presented in Table 1.

The crude fibre differences of green forage, silage and hay of sudan grass were also found significant ($P < 0.01$). Hay and green forage contained the highest (38.79%) and lowest (30.86%) mean percentage of crude fibre, respectively, whereas silage gave 32.26% as mean percentage of crude fibre. Results of the same nature were reported by Crampton and Harrison (3), Cullison (6), Martin *et. al.* (9) and Adam (1) who also found highest and lowest percentage of crude fibre in hay and green forage of the sorghum crop, respectively.

The ether extract contents of green forage, silage and hay did not differ with each other ($P < 0.05$). The mean percentage of ether extract was found to be highest in green forage (1.50%) and lowest (1.29%) in silage, respectively, whereas hay gave 1.34% of ether extract. McDonland *et. al.* (10) also found the highest and lowest percentage of ether extract in green forage and silage, respectively, whereas Martin *et. al.* (9) also reported the lowest percentage of ether extract in the silage of sorghum. These findings agree with the results given in Table 1.

The variours forms of sudan grass tested for their mineral content showed significant differences ($P < 0.01$). The hay and silage gave the highest (9.00%) and lowest (2.40%) mean percentage of mineral contents, respectively, whereas green forage gave 2.80 mean percentage of mineral contents. The mineral matter differences of green forage and silage were found non significant whereas they differed from green forage and silage significantly for their mineral matter contents. Crampton and Harris (3), and Cullison (6) also found the lowest mineral contents in silage whereas McDonland (10) and Cullison (6) also found the highest percentage of mineral matter contents in hay of sudan grass which supported the results of Table 1.

The calcium contents of green forage, silage and hay of sudan grass did not differ significantly ($P < 0.05$). The calcium contents were in the same (0.02%) magnitude in green forage and hay, whereas silage was found to contain the least (0.01%) content of calcium. Results of the same nature were reported by Cullison (6) who also found the least (0.06%) amount of calcium in the silage of sudan grass.

The various forms of sudan grass tested for their phosphorus content showed significant ($P < 0.01$) differences. The mean percentage of phosphorus content was found to be the highest (0.25%) in hay and lowest (0.03%) in silage, respectively, whereas green forage gave 0.14 mean percentage of phosphorus. The findings of Crampton and Harris (3), Cullison (6) and Martin *et. al.* (9) were in conformity with the results given in Table 1.

It is a well established fact that the forage crop with more protein and less fibre along with higher content of moisture for digestibility is considered more nutritive (3, 6, 10, & 11). Keeping this criteria in view, it can safely be concluded from this trial that green forage followed by silage is more nutritive than hay of the sudan grass. Thus it may be recommended that maximum efforts should be made for continuous supply of green forage. In case of surplus, the extra green forage should be preserved in the form of silage as it is far better than hay in its feeding value and will be very effective in overcoming the problem of acute shortages.

LITERATURE CITED

1. Adam, R.S. 1979. *Feeding forages to dairy cattle special circular.* Agricultural Experiment Station Pennsylvania State University No. 256.
2. Association of Official Agricultural Chemists. 1965. *Official methods of analysis. 10th* ed. Washinton D.C.
3. Crampton, E.W., and L.E. Harris. 1969. *Applied animal nutrition.* W.H. Freeman and Company San Francisco. 2th ed. p. 700 - 702.
4. Crowder, L.V. 1969. *Recommendation for an accelerated fodder improvement and production programme in West Pakistan.* Dept. of Agr. Pakistan.
5. Forhoodmond, M.B. and W.F. Weiden. 1968. *Changes in composition of sudan grass and forage sorghum with maturity.* Agron. J. 60: 459 - 463.
6. Cullison, A.E. 1975. *Feeds and Feeding.* Reston Publishing Company, Inc., Reston, Virginia 22090 pp. 436 - 437.
7. Graves, C.R; M.J. Montgomery, J.R. Owsen and H. Morgan. 1979. *Silage yield and composition of sweet sorghum grain sorghum crosses.* Tennessee Farm and Home Science Progress Report No. 111: 18 - 20.
8. Hein, M.A. 1957. *Sudan grass.* Farmers' Bulletin No. 1126 U.S. Dept. of Agri.
9. Martin, J.H.; W.H. Leonard and D.L. Stamp. 1976. *Principles of field crop production.* Macmillan Publishing Co., Inc. New York, pp. 1118.
10. McDonland, P.; R.A. Edwards and F.D. Greenhalgh, 1973. *Animal nutrition.* Oliver and Boyd, Edinburg. 2nd ed. p. 432 - 436.
11. Morrison, F.B. 1949. *Feed and feeding.* The Morrison Publishing Company. Ithaca, U.S.A.
12. Richard, L.A. 1969. *Diagnosis and improvement of saline and alkaline soils.* Agricultural Hand Book No. 60. U.S. Deptt. of Agri.
13. Seiffort, N.F. and E.R. Prates. 1978. *Forage species for silage. 2. Nutritive value and quality of silage of cultivars of maiz (Zea mays L.) sorghum (Sorghum spp.) and pearl millet (Pennisetum americanum Schum).* Herb. Abst. 50: 3212.
14. State, J.; J. Seppalla, S. Pulli and E. Poutiainen. 1979. *Preliminary studies on the conservation of whole sorghum and corn plant and sugar corn stover for silage.* Journal of the Scientific Agricultural Society of Finland. 51: 222 - 228.
15. Shepel, N.A. 1976. *Prospects of cultivation of sorghum in the Kuban River area.* Herb. Abst. 48: 3117.
16. Steel, R.F.D. and J.H. Torrie. 1960. *Principles and procedures of statistics.* McGraw Hill, New York, U.S.A.

مقارنة بين الوضع الغذائى للأعلاف الخضراء والخرطان (الأعلاف الجافة) والسيلاج لعشبة السودان

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المستخلص

اجريت دراسة لتحديد الوضع الغذائى لعشبة السودان فى صور سيلاج وخرطان لمقارنتها بالاعلاف الخضراء لنفس العشبة. . ولوحظ الآتى :-

الأعلاف الخضراء أعطت أعلى نسبة مئوية من البروتين الخام والرطوبة ومستخلص الأيثير وأقل نسبة مئوية من الألياف الخام، بينما اعطى الخرطان (الأعشاب المجففة) أدنى نسبة مئوية من الرطوبة والبروتين الخام واعلى نسبة مئوية من الألياف الخام والمواد المعدنية والفوسفور على التوالى وكانت النسبة المئوية للكالسيوم فى نفس المرتبة بالنسبة للأعلاف الخضراء والخرطان.

السيلاج اعطى أعلى نسبة مئوية من البروتين الخام وأقل نسبة من الألياف الخام وذلك بمقارنته مع الخرطان.

وكانت نسبة الألياف الخام فى السيلاج اكثر من تلك المتواجدة فى الأعلاف الخضراء ولهذا وجد أن القيمة الغذائية للسيلاج اقل من الأعلاف الخضراء ولكنها اكثر من الخرطان.