EFFECT OF UREA SUPPLEMENTATION ON THE NUTRITIVE VALUE OF OAT SILAGE

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Summary

Silages were prepared with different ratios of oat and wheat straw 100 : 0, 80 : 20, 60 : 40, 40 : 60, 20 : 80, and 0 : 100 with or without urea supplementation and were ensiled for 60 days in air tight polyethylene bags and kept at room temperature. Results showed that dry matter loss was maximum in 100% oat silage and it decreased as the ratio of wheat straw increased. There was a significant difference in crude protein value of the silages prepared by different ratios of oat and wheat straw. Addition of urea significantly increased the crude protein and decreased the crude fibre value. Silage made with urea supplementation were well fermented as indicated by higher value of volatile fatty acids (VFA) and lower value of residual carbohydrates. Maximum VFA concentrations were observed in 60 : 40 oat-wheat straw silages. The value of enzyme soluble organic matter (ESOM) was high in all the urea supplemented silages as compared to without urea and maximum value was found in 60 : 40 oat wheat straw combination.

(**Key Words**: Oat-Wheat Straw Silage, Volatile Fatty Acids, Fermentation, Water Soluble Carbohydrate)

Introduction

Oat crops (*Avena sativa*) are commonly cultivated for fodder production in rain fed areas of Pakistan. Generally oat crop is used as fodder and oat straw or hay after grain harvest, however may be used for silage making. Disadvantages of oat-crop silage are low dry matter and protein contents at the milk stage (Nandra et al., 1982), However, when the oat crop is harvested with desirable moisture content for silage, it becomes more lignified and consequently less digestible. Chenost et al. (1970) and Azim et al. (1989) reported that the digestibility of the fodder and forage declined as the crop became mature. Marsh (1979) also observed that crops containing low dry matter are fermented more extensively and produce large amounts of acids and also suffer higher losses of nutrients. Different methods have been devised to minimize nutrient losses and increase the dry matter content of the ensiled material. These include i) wilting, ii) inclusion of high dry matter additives and iii) allowing further maturation of crop (Gordon, 1967 and Lopez et al., 1976). The addition of high dry matter containing ingredients such as dry pulps, feed grains and crop residue may be employed for increasing the dry matter content of the ensiled material. Wheat straw is a potential crop residue, available throughout the year in Pakistan. Wheat straw might be used to increase the dry matter content of oat crop for silage.

The present study was conducted to evaluate the effect of different ratios of oat fodder and wheat straw without or with supplementation of urea on the quality of silage at laboratory scale.

Materials and Methods

Whole oat fodder was manually harvested at early bloom stage from the experimental Field of Animal Sciences Institute, NARC, Islamabad, Pakistan. The plants were chopped to 2-3 inches in size and mixed with chopped wheat straw in the ratios of 100 : 0, 80 : 20, 60 : 40, 40 : 60, 20 : 80 and 0 : 100 respectively on dry basis. Dry matter was 22 and 90%; crude protein, 8.14 and 4.25% and crude fibre 35 and 45% for oat fodder and wheat straw respectively. Three replicates of 5 kg each mixture were ensiled without and with 5% urea in polyethylene bags. Ensiled

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Received July 3, 1990
Accepted December 3, 1991

materials were kept at room temperature for 60 days. After ensiling the bags were opened and representative samples were analysed for total volatile fatty acids (VFA), water soluble carbohydrate (WSC) and proximate chemical composition (AOAC, 1984). The pH was determined electrometrically. Organic matter digestibility was determined using enzyme soluble organic matter (ESOM) by technique described by Rexen (1977). The data was statistically evaluated by two way analysis of variance (Steel and Torrie, 1980).

Results and Discussion

Proximate analysis was carried out to determine the overall nutrient contents of silage and to note any changes as a result of fermentation and supplementation with urea. Results of chemical composition of oat-wheat straw silages with or without urea are given in table 1. Results showed that percent dry matter losses decreased as the ratio of wheat straw increased in the ensiled material and there was a significant difference with different ratios of oat and wheat straw silage. The minimum loss (3.27%) was found in 100% wheat straw silage. No significant difference ($p > 0.05$) was found between with or without urea supplemented silages. This showed that the losses of dry matter depended on the initial water content of oat fodder and wheat straw mixture. Bolsen et al. (1983) reported that the dry matter content of the original crop is the factor which most influences the extent of dry matter loss and the pattern of fermentation during the ensiling of whole crop cereals.

There was a significant difference in the crude protein value of silages prepared by different ratios of oat fodder and wheat straw. The crude protein values were significantly ($p < 0.05$) increased in urea treated silages as compared to without urea treated silages. Henderson et al. (1971), Smith et al. (1982), and Moore et al. (1986) reported similar results for fodder and grasses silages treated with different concentrations of ammonia.

Results indicated that as the wheat straw ratio increased in the silages the crude fibre value was also increased. Addition of urea significantly decreased the crude fibre value in all types of prepared silages. The maximum decrease (about 15%) in crude fibre value was found in the silage prepared by the combination of 60 : 40 oat and wheat straw respectively. Paterson et al. (1979) reported that fibre digestibility of corn plant residue ammoniated at 3.0% of dry matter before ensiling was increased 14.5% units. Moore et al. (1986) also noted that ammoniation of orchard grass clover silages at 3.0% of dry matter resulted in large increase in digestibility of dry matter and fibre constituents.

The characteristics of fermentation i.e. pH, volatile fatty acids (VFA), water soluble carbohydrate (WSC) and enzyme soluble organic matter

TABLE 1. COMPOSITION OF OAT-WHEAT STRAW SILAGES WITH OR WITHOUT UREA SUPPLEMENTATION (% DM)

Parameters	Urea	Wheat straw content (%)						Mean	LSD
		0	20	40	60	80	100		
Dry matter	−	24.6	27.4	27.6	28.2	27.8	28.9	27.4	0.9669
	+	25.3	27.0	27.4	28.4	28.5	29.1	27.6	
DM loss	−	18.1	8.8	8.0	6.0	4.3	3.4	8.1	0.5697
	+	15.8	10.0	8.7	5.5	5.2	3.3	8.1	
Crude protein	−	8.3	7.1	6.0	5.6	4.7	4.1	5.9	0.7529
	+	21.1	22.0	19.4	18.8	18.3	16.9	19.4	
Crude fibre	−	34.6	36.7	38.0	40.0	41.7	44.5	34.6	0.9234
	+	34.1	35.3	32.3	37.8	29.2	39.8	36.4	
Ash	−	10.7	11.8	10.1	10.1	11.4	13.6	11.3	0.1705
	+	10.6	13.3	10.7	11.6	12.2	11.6	11.7	

values are given in table 2. Results showed that without urea supplementation silages had a low pH (4.3). On the other hand, urea treated silages had a high pH (5.1). Johnson et al. (1982) and Bolsen et al. (1983) reported that addition of ammonia or alkali artificially increased the pH and improved the digestibility of the silages.

Silages made with urea supplementation contained higher concentrations of VFA and lower levels of residual carbohydrates. Baintner et al. (1985) observed that silage treated at the high urea rate maintained a consistently higher pH, along with higher lactic acid and other acids and observed that addition of urea favoured the growth of lactic acid bacteria over the moulds and yeasts. Present results demonstrated that 100% wheat straw silage had minimum VFA values (2.90%) it consistent with the low water soluble carbohydrate concentration in wheat straw. Water soluble carbohydrate (WSC) in the crop are fermented by anaerobic bacteria to give VFA. Non volatile organic acid and structural carbohydrate also made some contribution to fermentation.

The value of enzyme soluble organic matter

TABLE 2. FERMENTATION CHARACTERISTIC AND ORGANIC MATTER DIGESTIBILITY (ESOM) OF OAT-WHEAT STRAW SILAGES

Parameters	Urea	Wheat straw content (%)						Mean	LSD
		0	20	40	60	80	100		
pH		3.8	3.9	4.1	4.3	5.0	4.8	3.5	0.2870
	+	5.9	4.7	4.6	5.2	5.1	5.2	5.1	
Residual WSC	−	1.6	1.4	0.9	0.8	0.5	0.5	1.0	0.1206
(% DM)	+	1.5	1.3	0.9	0.9	0.3	0.2	1.1	
VFA (% DM)	−	9.6	4.0	5.4	3.7	3.6	2.9	4.9	0.3338
	+	7.9	7.2	8.8	6.7	4.8	4.9	6.7	
ESOM (% DM)	−	63.6	61.5	66.4	63.2	54.5	52.3	60.3	0.9843
	+	64.5	63.3	73.3	65.5	59.2	55.8	63.6	

WSC = Water Soluble Carbohydrate
VFA = Total Volatile Fattyacids
ESOM = Enzyme Soluble Organic Matter

(ESOM) was increased in all the urea supplemented silages as compared to without urea supplemented. The maximum value of ESOM was observed in 60 : 40, Oat: wheat straw, urea supplemented silage (73.3%). The value of ESOM was associated with the CF value i.e. a 15% decrease in CF and 10% increase in ESOM. The present results are comparable with alkali treated barley and whole crop wheat silages reported by Wilkinson Santillane (1978) and Bolsen et al. (1983) that increased in the organic matter digestibility about 13 and 18% units respectively. From the results of the present study, it may be concluded that wheat straw can be used efficiently up to 40% in low dry matter containing oat fodder with or without urea supplementation.

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