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IMPROVING NUTRITIVE VALUE OF SOME ROUGHAGE WITH MUFEED LIQUID SUPPLEMENT

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SUMMARY

Several straws (corn stalks, rice straw, bean straw, wheat straw and barley straw) were used as basic feedstuffs for sheep, along with different levels (0, 100 and 200 ml/h/d) of Mufeed liquid supplement(MLS). Rahmani (an Egyptian local breed)X Finnish crossbred rams were grouped according to body weight and age and used repeatedly in metabolism trials. Amount of hemicellulose varied with the lignin content of each straw and each straw also had different levels of cellulose. Both cellulose and acid detergent Lignin (ADL) digestion coefficients decreased as the level of MLS increased (45.7, 42.8 and 42.5% for cellulose) and (22.1, 18.2 and 17.4% for ADL) for 0, 100 and 200 ml MLS respectively). This may have been due, in part, to the fluctuations that have occurred to rumen pH as a result od adding MLS that contained 91% molasses. Digestion coefficients of DM (54.6, 57.2 and 59.8%), CP (53.5, 56.3 and 57.7%) and hemicellulose (74.8, 76.05 and 76.7%) increased as the level of MLS was increased from 0 to 200 ml/h/d in order. Total Digestible nutrients also increased with increasing levels of MLS. Straws showed variable digestibilities as they have variable degrees of lignification and ash contents. Urea included in MLS (2.5%) may have exerted an effect on cellulose dissociation from lignin, and this could be an additional reason for the variability in nutrient digestibilities of straws. In conclusion, the addition of MLS improved the nutritive values of roughages and

corn stalks had higher nutritive value than other tested roughages; either supplemented or not.

Keywords: Mufeed liquid supplement, roughage, feed value, sheep

INTRODUCTION

In most developing countries the ruminant diets consists of low quality fibrous feeds such as crop residues (straws, stovers etc.) and dried grass(Jayasurya, 1987). However, these feeds are deficient in protein and other essential nutrients. Furthermore, due to excessive lignification, digestion and intake of crop residues is rather low resulting in limited productivity by the animals. It has been established that supplementation of fermentable N. in the diet stimulates the rumen fermentation and improves the utilization of crop residues. Because urea is a cheap source of fermentable N., a liquid urea molasses supplement has been proposed for use as a spray solution low quality roughages (Pathak and Rayhan, 1973; Phillips and Varva, 1979; Chahil and Rathee, 1983; Johri and Ranjan, 1983 and Preston and Leng,1984). Several workers have found feed intake to be increased as a result of urea molasses supplementation (Ernest et al., 1975; Losada et al., 1979 and Sudana, 1985). Others, however, observed no increase in feed intake of basal diets (Chicco et al., 1972; Church and Santos, 1981; Dixon, 1984 and Neric et al., 1985).

Mufeed liquid Supplement (MLS) consists of 91% molasses, 2.5% urea, 1.5% mineral premix and 5% water. It is used as a spray solution mixture. Results obtained when using this supplement varied as the contents of MLS varied during periods of development (Yakout, 1987 and Etman et al., 1989). Although limited research has been conducted in Egypt, MLS is distributed on commercial basis to farmers. This study was designed to study the effect of MLS on the nutritive value of some roughages that are typically used as feedstuffs in Egypt.

MATERIALS AND METHODS

1- Animals and management

Fifteen mature Rahmani (an Egyptian local breed) X

Finnish crossbred rams were divided into five groups of three animals each according to body weight and age, then used repeatedly in 15 metabolism trials with three animals/treatment. Animals were kept in separate metabolic cages fitted with stainless steel separators. Animals weights were recorded at the beginning and at the end of the experiments. Each experimental period consisted of three weeks as a preliminary period and seven days for collection. Between experiments the animals were allowed to rest and adapt to treatment for two weeks. Samples of feed, water, feces and urine were taken daily at 0700h.

2- Experimental Rations

Five different kinds of low quality roughages (corn stalks, rice straw, bean straw, wheat straw and barley straw) were used in this experiment. Each roughage was chopped to a length of 3 cm except for barley and wheat straws, which were usually less than or equal to 1 cm in length and used as a basic feedstuff component at 90% of the *ad. lib.* intake recovered during the adaptation period (about 500 gm/h/d). The level of concentrate feed mixture (CFM) was fixed at 569.3 gm/h/d (Table 1). The MLS was added at two levels(100 or 200 ml/h/d) as well as no supplementation. The density of MLS was 1.38. Fifteen different experimental rations were assessed in metabolism trials. Animals were fed twice daily at 0800h and 1500h.

Table 1. Diet ingredients (DMI) in grams fed to mature rams in metabolism trials

Ration	Bean straw	Barley straw	Wheat straw	Corn stalks	Rice straw
Basal ration (g/h/d)	432.50	499.85	410.60	391.10	388.20
Concentrate (g/h/d)	569.27	569.27	569.27	569.27	569.27
Mufeed Liquid					
0 ml/h/d	0	0	0	0	0
100 ml/h/d	96.8	96.8	96.8	96.8	96.8
200 ml/h/d	193.5	193.5	193.5	193.5	193.5

Mufeed liquid supplement consisted of cane molassses (91%), urea (2.5%) and premix (1.5%)

3- Analytical Methods

Samples of feed, feces and urine, as well as mineral contents were analyzed according to A.O.A.C. (1980). Fractional fiber was analyzed according to the procedures of Goering and Van Soest (1970). Table 2 shows the chemical compositions of feed ingredients. Statistical analysis was carried out according to Snedecor and Cochran (1980). Significance of treatment means was estimated by Duncan's multiple test (1955).

RESULTS AND DISCUSSION

1- Chemical compositions

In general, straws have a high crude fiber content. Classification of fiber contents to hemicellulose and lignin has been very important in recognizing the limiting factors in the nutritive value of roughages. Manipulation (e.g. chopping) is an important method of modifying the quality of roughage and,hence, altering the digestion of its nutrients by animals. According to Van Soest (1982), the amount of cellulose in a roughage, in addition to its content of lignin and proportion of plant cell wall, determines the availability of feed nutrients. Therefore, the discussion of this paper concentrates on such components.

Cellulose content (Table 2) of the different straws was similar except for rice straw, which had a higher cellulose content(52.38%). Hemicellulose content of roughages varied with type of roughage. While hemicellulose content was similar for corn stalks (28.33%) and rice straw (27.28%), it was low for bean straw (23.85%), high for barley straw (30.11%) and even higher for wheat straw 34.25%). The variation in lignin content may be responsible for the variability in hemicellulose content, which increased as lignin contents decreased. No obvious relationship between hemicellulose and cellulose contents appear to exist, since cellulose contents were almost constant while hemicellulose varied for all roughages. This kind of relationship, especially within the same variety of roughage especially at different stem/leaf ratios, warrants further study. Bean straw had the highest lignin content (8.66%), perhaps because it is the hardest of roughages tested. Barley and wheat straws had the lowest lignin content (3.34% and 4.92%, respectively). This is probably because they are shorter in length and softer than other straws. The impact of lignification on nutrient digestibility is well known (Van Soest, 1964; Mertens, 1973 and Gillard and Richards, 1975). Ash content also affects digestibility and these values were noticeably high in all of the roughages, ranging from 9.35% for barley to 16.54% for rice straw. The chemical composition of rice, bean, barley and wheat straw and corn stalks were within the range of composition previously reported in the literature (Abou-El-Hassan, 1963; Ministry of Agriculture of Egypt, 1968; El-Talty, 1973; Coxworth et al., 1981; McDonald et al., 1982; Abdel-Aziz, 1986; Talha, 1990; Abdou, 1990; Fahmy, 1990 and Fouad,1991).

The MLS chemical analysis differed somewhat from that obtained by Yakout, 1987 (15.97% CP and 63.89% NFE) and Etman et al., 1989 (4.27% CP and 81.92% NFE) but was similar to the results of Lashin et al., 1993 (11.54% CP and 76.56% NFE). Mineral contents of all the straws were within the range reported before (Yakout, 1987; Etman et al., 1989 and Lashin et al., 1993). Gross energy contents (Table 1) did not show much variations among different kinds of roughages; they varied from 3.74 Mcal/Kg for rice straw to 4.06 Mcal/Kg for barley straw.

2- Nutritive value (NV)

a) Nutrient digestibilities

The effects of MLS on the nutrient digestibility coefficients are shown in Table 3. There seem to be a trend that digestibility of nutrients increases as the level of MLS increases. A marked difference was apparent between the control treatment and both levels of supplement ($P<0.05$). Dry matter digestibility (DMD) was significantly higher ($P<0.05$) for the two levels of MLS supplementation. This increase was seen in the organic matter digestibility (OMD) although there was no difference between the two levels of supplement. The superiority of the supplement over control continued with crude protein digestion (CPD), hemicellulose, ADL, N. balance and TDN.

Table 3 also shows a reverse situation in cellulose digestibility and crude fiber digestibility (CAD); the control was higher than the two levels of MILS in these areas. Cellulose digestibility coefficients of 45.66, 42.82 and 42.53% were obtained for control, 100 and 200 ml of MILS, respectively. This effect may be traced to the fact that molasses constituted 91% of the MILS that may have increased lactate production in the rumen and, hence, reducing ruminal pH.

Table 4 shows that barley straw had the lowest DMD (55.42%) in spite of not being different significantly from that of wheat straw (56.14%). Corn stalks exhibited the highest (P<0.05) mean value of DMD (58.95%), whereas bean and rice straws had almost identical values (57.81 and 57.56%), respectively). The same observation also applied to OMD (table 4). Both levels of MILS did not differ significantly in CPD with the 200 ml level being higher (57.68%) than the 100 ml level (56.25%) and both were significantly (P<0.05) different from control (53.53%). The CPD of different roughages (Table 4) showed non differing mean values for bean straw and corn stalks (56.17 and 58.89% in order). Yet, both were higher significantly (P<0.05) than the rest of straws. With fiber fractions the situation was reversed except for hemicellulose fraction which followed DMD, OMD and CPD in that control was lower (74.82%) significantly (P<0.05) than both levels of supplement. Cellulose and ADL fraction digestibilities were higher for control than other treatments (Table 3). Molasses fermentation occurs at a much faster rate than cellulose (Matry et al., 1970; Owens et al., 1971; Bryant, 1973; Church, 1988 and Wiedmeir et al 1992) and can lead to an accumulation of lactate in the rumen and decrease pH. The decrease in rumen pH decreases rate of cellulose digestion (Annison and Lewis, 1959 and Ørskov, 1987). Therefore, with control treatment the digestion of cellulose progressed perhaps at a normal rate while with MLS it proceeded at lower rate and consequently decreased cellulose digestion value. Yet, this reversed situation as might be expected, did not affect the total digestible nutrients (TDN). The TDN percentages increased as the level of MLS increased and this might provide an evidence that MLS could have improved rumen fermentation in general although no rumen parameters were taken into consideration when conducting this study. Bean and barley straws had identical TDN values (55.06% for each) and wheat and rice straws did not differ significantly (53.35 and 54.12%. respectively). Corn stalks had the highest (P<0.05) TDN value (58.0%). Nitrogen balance was positive for all treatments and all

Table 2. Chemical Compositions of ingredients Fed to Sheep in Metabolism Trials.

Ingredient	DM	OM	CP	CF	EE	NFE	Ash	NDF	ADF	ADL	Hemi	Cellu.	Gross energy KCal/kg	Ca	P	Zn	Mn
		DM basis												mg %			
Corn stalks	79.22	90.33	5.40	35.77	1.63	47.48	9.67	76.46	8.13	5.70	28.33	42.43	4038	162.41	90.48	12.11	7.08
Rice straw	77.64	93.46	4.86	39.70	1.90	37.00	16.54	87.27	59.99	7.61	27.28	52.38	3741	158.62	99.10	9.11	15.12
Bean straw	86.50	87.06	5.82	37.34	1.78	42.12	12.94	76.57	52.72	8.66	23.85	44.06	3928	193.19	86.54	11.29	18.91
Wheat straw	82.42	84.37	4.42	34.38	1.90	43.67	15.63	83.80	49.55	4.92	34.25	44.63	3799	142.93	80.34	9.33	14.09
Barley straw	89.97	90.65	4.32	34.47	1.25	50.61	9.35	78.20	48.09	3.84	30.11	44.25	4062	151.18	94.01	8.43	17.39
Concentrate	87.58	84.55	15.00	7.08	2.99	59.51	15.42	78.90	16.23	3.82	62.67	12.41	4120	999.41	343.14	35.90	103.19
Mufeed	70.12	86.17	10.71	1.17	1.25	73.04	13.33	2.10	1.23	0.10	0.87	1.13	4084	432.00	251.14	33.68	91.19

Table 3. The overall means (±SD) of nutrient digestion coefficients as affected by mufeed liquid supplement

Treatment(ml/h/d)	DM	OM	CP	Hemi	Cell	ADL	NB*	TDN
Zero	54.61^{c}	59.96^{b}	53.53^{b}	74.82^{a}	45.66^{a}	22.09^{a}	2.66^{c}	53.00^{c}
100	54.17^{b}	62.30^{a}	56.25^{a}	76.05^{b}	42.82^{b}	18.20^{b}	2.87^{b}	55.20^{b}
200	59.75^{a}	62.29^{a}	7.68^{a}	76.67^{b}	42.53^{b}	17.39^{b}	3.05^{a}	57.27^{a}
±SD	2.61	2.27	2.51	1.12	2.13	2.22	0.29	2.43

^{a,b,c}Values in the same column bearing different super scripts differ (P<0.05), * Nitrogen balance.

Table 4. The overall means (±SD) of nutrient digestion coefficients of five roughages by sheep

Treatment(ml/h/d)	DM	OM	CP	Hemi	Cell	ADL	NB*	TDN
Bean straw	57.81^{b}	62.29^{b}	56.17^{a}	75.45	44.12^{b}	19.32	3.26^{a}	55.06^{c}
Barley straw	55.42^{c}	60.98^{c}	54.33^{b}	75.52	42.60^{c}	19.53	2.74^{c}	55.06^{b}
Wheat straw	56.14^{c}	60.88^{c}	54.22^{b}	75.72	41.66^{d}	19.09	2.64^{d}	53.53^{c}
Corn stalks	58.75^{a}	64.44^{a}	58.09^{a}	76.37	46.00^{a}	20.56	2.95^{b}	58.00^{a}
Rice straw	58.95^{a}	61.81^{b}	55.47^{b}	76.11	43.96^{b}	18.63	2.71^{c}	54.12^{c}
±SD	2.545	2.270	2.610	1.110	2.130	2.022	0.287	2.42

^{a,b,c}Values in the same column bearing different super scripts differ (P<0.05), * Nitrogen balance.

kinds of straws. Tables 5 and 6 show some selected mineral (Ca, P, and Zn) balances (mg/h/d). There was no negative balances perhaps because of the presence of mineral premix (1.5%) in MLS. The positivity of mineral balances increased as the level of MLS increased from 0 to 100 to 200 ml/h/d. There should be no worry about these mineral supplementation therefore.

Implications

The bulky feeds especially those of low quality for the nutrition of ruminant animals are mostly present in developing countries. These feeds need to be nutritionally improved in order to improve animal performance and to relief the malnutrition they suffer from. One of the ways of improvement is to spray urea and molasses on these roughages. The Mufeed Liquid Supplement is a urea molasses-mineral premix. In this study the MLS significantly improved nutrient digestibilities of roughages. There was no significant differences between the two levels of MLS although the higher level of supplement (200 ml/h/d) exhibited higher values of nutrient digestibilities than the 100 ml/h/d level. All roughages had better nutritive values when fortified with MLS than the non-fortified ones. The best of them seemed to be corn stalks. It responded better to the treatment of mufeed where it had significantly higher digestibility values of DM, OM, CP and cellulose. It had also higher positive nitrogen balance and greater total digestible nutrients. The MLS can, therefore, be recommended for use by farmers to improve the nutritive values of their roughages.

Table 5. The overall means (±SD) of mineral balance (mg/h/d) of sheep as affected by mufeed liquid supplement

Treatment (ml/h/d)	Ca	P	Mn	Zn
Zero	1087.79^{c}	650.17^{c}	141.06^{c}	82.38^{c}
100	1514.33^{b}	743.97^{b}	173.48^{b}	107.60^{b}
200	1774.56^{a}	797.37^{a}	209.14^{a}	133.35^{a}
± SD	307.12	72.21	35.32	25.02

^{a,b,c}Values in the same column bearing different superscripts differ (P<0.05)

Table 6. The overall means (±SD) of mineral balance (mg/h/d) of five roughages by sheep

Kind of straw (ml/h/d)	Ca	P	Mn	Zn
Bean straw	1468.12[b]	727.37[b]	163.16[bc]	104.11[b]
Barley	415.51[b]	698.85[b]	151.52[c]	98.58[b]
Wheat straw	1394.75[b]	708.67[b]	162.26[bc]	94.66[b]
Corn stalks	1606.78[a]	788.82[a]	203.91[a]	123.16[a]
Rice straw	1414.64[b]	728.80[b]	185.94[ab]	118.38[a]
±SD	307.06	72.49	35.32	25.02

[a,b,c]Values in the same column bearing different superscripts differ ($P<0.05$)

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تحسين القيمة الغذائية لبعض المواد الخشنة باستخدام سائل المفيد

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فى هذه الدراسة تم استخدام عدة مواد خشنة (حطب – الذرة – قش الارز – تبن الفول وتبن القمح – تبن الشعير) كعلقية اساسية للاغنام وذلك مع عدة مستويات مختلفة من سائل المفيد (صفر– ١٠٠ – ٢٠٠ مل/ راس/يوم) .

تم اجراء ١٥ تجربة هضم باستخدام كباش رحمانى مهجنة بفنلندى حيث تم توزيعها فى مجموعات حسب وزن الجسم والعمر . لوحظ اختلاف محتوى الهيميسيليولوز لكل نوع من المواد الخشنة باختلاف محتوى اللجنين مع ملاحظة ان لكل مادة خشنة مستوى مختلف من السيليولوز .

اوضحت النتائج انخفاض معامل هضم السيليولوز بزياد مستوى سائل المفيد (٤٥,٧٪ و ٤٢,٨٪ – ٤٢,٥٪ للسليولوز ، ٢٢,١٪ – ١٨,٢٪ – ١٧,٤ ٪ للجنين) وذلك عند المستوى صفر–١٠٠–٢٠٠مل /راس/ يوم سائل مفيد . كما لوحظ انه بزيادة مستوى سائل المفيد من الصفر الى ١٠٠ ملل الى ٢٠٠ملل/ راس /يوم يزداد معامل هضم المادة الجافة (٥٤,٦٪ – ٥٧,٢٪ – ٥٩,٨٪) والبروتين الخام (٥٣,٥٪ – ٥٦,٣٪ – ٥٧,٧٪) والهيميسيليولوز (٧٤,٨٪ – ٧٦,٠٥٪ – ٧٦,٧٪).

لوحظ زيادة المركبات الكلية المهضومة مع بزيادة مستوى سائل المفيد . وقد اختلفت النسب الهضمية بالنسبة للمواد الخشنة المختلفة نتيجة إختلاف محتوى اللجنين بها وكذلك محتوى الرماد وقد استنتج ان اليوريا الموجودة فى سائل المفيد (٢,٥٪) قد يكون لها تاثير على انفصال السيليولوز من اللجنين مما قد يكون سببا اضافيا للاختلافات فى النسب الهضمية للعناصر الغذئية للمواد الخشنة.