J. Agric. Sci. Mansoura Univ., 26 (11): 6797 - 6812, 2001.

بسم الله الرحمن الرحيم

INFLUENCE OF UREA TREATMENT AND SUPPLEMENTATION OF PROTEIN AND ENERGY SOURCES ON CELL WALL STRUCTURE AND ITS DIGESTIBILITY OF RICE OR SOYBEAN STRAW BASED DIETS.

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ABSTRACT

This experiment was carried out to investigate the effects of urea treatment, amount and source of energy and protein supplementation on the intake, fiber fractions digestibility of rice or soybean straw based diets with sheep. Two supplemental energy sources (maize or molasses + maize) and three sources of protein (fish meal, soybean meal and urea) were used.

Sixteen metabolism trials were conducted to evaluate the nutritive values of the following rations:

1. Untreated rice straw (URS) + Maize (M) + Fish meal (FM) + Urea (U).
2. URS+ M + Soybean meal (SBM) + FM + U
3. URS + Molasses (MO) + M + FM + U
4. URS+ MO + M + SBM + U
5. Treated rice straw (TRS) + M + FM.
6. TRS+ MO + FM.
7. TRS+ MO+ M + fish meal FM.
8. TRS+ MO+ M + SBM
9. Untretaed soybean straw (USBS) + M + FM + U
10. USBS + M+ SBM + FM + U
11. USBS + MO + M + FM + U
12. USBS + MO+ M + SBM+ U
13. Treated soybean straw (TSBS) + M + FM.
14. TSBS + MO + FM.
15. TSBS + MO+ M + FM.
16. TSBS + MO+ M + SBM

The experimental rations were formulated to contain about 80 g/kg DMI or higher in CP content when ruminants are given roughage *ad lib.* in order to maximizing the rumen microbial growth and activity (Van Soest, 1982).

The results showed that, there were pronounced effect of urea treatment on the chemical composition of RS and SBS. The digestibility of DM, OM, CF, NDF, ADF, hemicelluloise, cellulose and ADL of TRS rations were higher (P<0.01) than URS rations. The digestibility of CF was higher (P<0.05) when adding FM (76.9) than adding SBM (75.0%) in TRS rations. Also, digestibility of CF, NDF and hemicellulose were higher (P<0.05) when feeding on molasses and maize than feeding on maize in TRS roughage. The effect of urea treatment on dry matter intake (DMI) and TDN value were higher (P<0.01) than untreated materials. The TDN value (%) of ration containing TRS with FM and maize was (59.87%) higher than the other RS rations. The TDN value (%) of TSBS with SBM and maize plus molasses was (54.01%)higher than the other SBS rations.

The results showed that there were significant differences as the effect of the type of the roughage. The urea treatment with adding protein and carbohydrate source improved RS digestion more than SBS.

INTRODUCTION

When straw is used as the basal feed for ruminant animals their diets may be improved either by offering supplements to correct its nutrient deficiency and/or by treating the straw to increase the availability of nutrients. Ruminant diets in most developing countries are based on fibrous feeds mainly nature pastures (particularly at the end of the dry season) and crop residue (e.g. rice straw and maize stovers). Hoover and Miller (1991) reported that optimum feed utilization by ruminants is dependent on achieving maximum rumen fermentation and flow of microbila protein to the duodenum. It is clear that the major nutrients required by the microbial population include both fiberous and non-fiberous sources of carbohydrates and nitrogen in the form of ammonia, amino acids and peptides. The exact quantities and sources of these nutrients that achieve optimum rumen fermentation rates and microbial yields are only particularly known.

The present study was designed to investigate the effectiveness of amount and source of supplementation energy and protein on the intake cell wall degradability of tested roughages either untreated or treated with urea.

MATERIALS AND METHODS

The experimental work of the present study was carried out at the Experimental Station of Animal Production Department, Faculty of Agriculture, Mansoura University.

Sixteen digestibility trials were carried out with twelve healthy Rahmany rams with an average live body weight of 45 kg. The animals were divided into four groups, three in each group to receive either untreated or urea treated tested roughages plus supplemental protein and energy sources which were used in this investigation.

The two tested roughages used in this study were rice straw and soybean straw without treatment or after being treated with 3% urea. In the treatment it was found that 400 ml of water/kg straw were sufficient to ensure adequate distribution of the liquid in the straws. This level was used to prepare the 3% urea solution to only spraying the straws and ensiling for three weeks. For preparing urea solution 9 kg urea were dissolved in 120 litres of water. The solution was then sprayed on 300 kg within which tested chopped materials were covered by a plastic sheet. Two supplemental energy sources were used maize and sugarcane molasses. Also three supplemental protein sources were used fish meal, soybean meal and urea.

The urea was dissolved in about 100 ml of water. Liquid supplement was often mixed with untreated straw prior to feeding.

The classical metabolism trial procedures was carried out as described by Schnider and Flatt, 1975. Each experimental period consist of 28 days, the first 21 days were considered as a preliminary period followed by 7 days for quantitative collection and separation feces and urine. Each treated material was evaluated at 90% of the *ad lib* intake to cover the maintenance requirements of CP as recommended by (NRC, 1975), which was determined before the commencement of the trials. All animals were given their daily feed allowance in two equal meals at 9. A.m. and 15.0 p.m

The mineral vitamin mixture (20 g/h/d) was added to cover the requirement of sheep according to NRC (1975) recommendation.

The experimental rations were as follows:

1. URS + M + SBM + U.
2. URS+ + M + FM + U
3. URS + M+ MO + SBM + U
4. URS + M+ MO + FM +U
5. TRS + M+ SBM.
6. TRS + M + FM.
7. TRS + M+ MO + SBM.
8. TRS + M+ MO + FM.
9. USBS + M + SBM + U.
10. USBS + + M + FM + U
11. USBS + M+ MO + SBM + U
12. USBS + M+ MO + FM +U
13. TSBS + M+ SBM.
14. TSBS + M + FM.
15. TSBS + M+ MO + SBM.
16. TSBS + M+ MO + FM.

Where:

URS: Untreated rice straw ; M: Maize
TRS: Treated rice straw; FM: Fish meal
Mo: Molasses ; SBM: Soybean meal
U: Urea; USBS: untretaed soybean straw
TSBS: treated soybean straw

The chemical analysis of tested materials feces and urine were determined according to the standard methods by AOAC (1984). Determination of fiber fractions (NDF, ADF and ADL) of tested materials were carried out according to the methods suggested by Robertson and Van Soest (1981).

The obtained data were statistically analysed according to a fractional model being (2x2x2) as described by Gomez and Gomez (1984) utilizing MSTATC package of computer program. The differences between treatment means were tested by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The chemical composition of the rice straw, soybean straw and total mixed rations offered to sheep during trials:

As shown in Table (1) roughages are mainly characterized by their high content of crude fiber and low N content. El-Ayouty (1991) reported that the poor quality roughages are divided on cereal by-products and legumes. The CF% of legumes were higher than cereal by-products.

Leslie and Fahey (1994) showed that the chemical of cell wall of straw fraction for legumes and cereal by-products on 100% DM basis were as follows:

Items	Alfalfa	Orchard grass	Wheat straw
CP	10.7	3.5	2.8
NDF	64.1	80.3	83.5
ADF	55.7	52.4	58.9
ADL	11.2	6.9	8.9

Easters of P-cumaric acid to lignin seem to be present in all forages with higher concentrations in grasses than in legumes (Aman, 1993).

Several attempts were made to upgrade the nutritive value of low quality feeds by including them in complete rations or to fortify them with the deficient nutrient mainly protein or NPN sources to increase their fermentability in the rumen yielding more microbial protein synthesis and hence feeding value and animal performance.

The results in Table (1) shows that treatment of rice straw and soybean straw with 3% urea led to an increased CP contents of tested materials by about 71.8% and 49% for RS and SBS, respectively, while CF content was decreased by about 18.8% and 8.8%, respectively, compared with untreated straw diets plus urea. These results agree with those reported by Ibrahim (1987) and El-Ayouty (1991) who found that crude protein content was increased in ammoniated materials compared with untreated ones while, it reduced CF content. However, Horton and Steacy (1979) stated that NH_3-treatment (3.5%) of wheat and oat straw had no marked effect on their CF contents.

Also, it decreased the NDF, ADF and cellulose contents in the urea treated RS by about 3.9, 8.6 and 9.8%, respectively, compared with those of untreated materials plus urea. In this respect, the NDF, ADF and hemicellulose, cellulose in SBS were decreased by about 8.6, 4.1, 18.4 and 5.2% on the average, respectively. The ADL content was not markedly affected by urea treatment as shown in Table (1).

From these results, it can note that, the NDF content was higher in cereal straw (RS) than legume (SBS) but the opposite was true for lignin. Urea treatment improved the characteristics of the cell wall contents in SBS by reducing the hemicellulose and cellulose. The decreasing of CF content was associated with the reduction in NDF, ADF, hemicellulose and ADL after treating of urea. These results agree with those obtained by Ibrahim (1987), El-Serafy *et al.* (1989) and El-Ayouty (1991).

Cheng *et al.* (1991) showed that essentially digestion in the rumen involves a sequential attack of ruminal microorganisms on feeds. To optimize feed digestion, this attack must be expedited on low quality feeds (e.g. straw) and slow it with highly digestible feeds (e.g. cereal grains) to prevent digestive disturbances.

Van Soest (1982) suggested that when ruminants are given roughage *ad libitum,* CP content is recommended to be 80 g /kg or higher in order to effect negatively the rumen microbial growth and activity. Jackson (1977) suggested also that urea is needed to be added to the straw fed animals to maintain their live weight.

Table (1): The chemical composition of rice straw, ureated rice straw, soybean straw, ureated soybean straw, feed concentrate mixture, soybean meal, fish meal and urea.

Items	URS	TRS	USBS	TSBS	M	SBM	FM	MO	U
DM%	91.17	90.45	89.96	88.53	88.90	90.39	90.07	75.0	-
Composition of DM%									
OM	82.63	80.72	92.30	86.69	98.39	93.22	85.68	86.91	-
CP	4.15	7.13	7.84	11.68	8.41	49.25	73.74	5.80	280
EE	1.44	1.43	0.94	1.15	5.49	1.46	10.13	-	-
CF	39.85	32.38	45.43	41.68	3.24	5.45	0.60	-	-
NFE	37.19	39.78	38.07	32.18	81.25	37.06	1.21	81.11	-
Ash	17.37	19.28	7.70	13.31	1.61	6.78	14.32	13.09	-
NDF	82.60	79.37	76.04	69.48	25.62	28.83	-	-	-
ADF	56.92	52.05	52.08	49.93	3.78	11.49	-	-	-
Hemic.	25.68	27.30	23.97	19.55	21.84	17.37	-	-	-
Cell.	49.50	44.65	37.07	35.15	3.34	9.91	-	-	-
ADL	7.43	7.40	15.01	14.77	0.44	1.58	-	-	-

So, with the objective of increasing the use of roughaes, the tested diets were formulated as shown in Table (2).

Table (2): Formulation and calculated chemical composition of total mixed rations offered to sheep during the trials

Item	URS				TRS				USBS				TSBS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Roughage%	86.3	87	84.3	85.0	88	88.5	87	88	85	86	84	86.5	88	89	89.5	90
M	11	11	3.0	3.0	10.5	10.5	2.6	2.5	12.5	12.5	3.0	2.7	10.5	10.0	2.0	2.0
Mo	-	-	10	10	-	-	8.8	8.5	-	-	10.5	9.3	-	-	7.0	7.0
SBM	1.7	-	1.7	-	1.5	-	1.6	-	2.0	-	2.0	-	1.5	-	1.5	-
FM	-	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-	1.0
U	1.0	1.0	1.0	1.0	-	-	-	-	0.5	0.5	0.5	0.5	-	-	-	-
Calculated chemical composition of the experimental ration																
DM	90.0	90.0	88.56	88.56	90.29	90.28	89.05	89.09	89.39	89.38	87.92	88.09	88.60	88.58	87.62	87.60
Composition of DM%																
OM	83.72	83.57	82.88	82.45	82.76	82.62	81.92	81.74	92.62	92.53	91.47	91.44	88.02	87.85	87.04	86.93
CP	8.14	8.07	7.97	7.90	7.90	7.93	7.72	7.72	10.10	9.93	9.83	9.69	11.90	11.97	11.77	11.82
EE	1.87	1.96	1.40	1.49	1.86	1.94	1.41	1.50	1.51	1.60	0.98	1.06	1.61	1.67	1.16	1.24
CF	34.84	35.03	33.78	33.98	28.92	29.0	28.34	28.58	39.13	39.48	38.37	39.39	37.10	37.43	37.45	37.59
NFE	41.66	41.30	42.53	42.17	44.09	43.75	44.45	43.94	43.26	42.91	43.67	42.68	37.41	36.78	36.66	36.44
Ash	16.28	16.43	17.12	17.55	17.24	17.38	18.08	18.26	7.38	7.47	8.53	8.56	11.98	12.15	12.96	13.07
NDF	74.59	74.68	70.89	70.98	72.95	72.91	70.16	70.74	68.41	68.60	65.22	66.47	64.26	64.40	63.12	63.10
ADF	49.73	49.94	48.29	48.50	46.37	46.46	45.56	45.90	44.97	45.26	44.09	45.15	44.51	44.82	44.92	45.02
Hemcell.	24.86	24.74	22.60	22.48	26.58	26.45	24.60	24.84	23.44	23.34	21.13	21.32	19.75	19.58	18.30	18.08
Cell.	43.25	43.43	42.0	42.18	39.79	39.87	39.10	39.38	32.13	32.30	31.44	32.16	31.43	31.62	31.66	31.71
ADL	6.48	6.51	6.29	6.32	6.58	6.59	6.46	6.52	12.84	12.96	12.65	12.99	13.08	13.20	13.26	13.31

1. Effect of urea treatment, protein and of carbohydrate sources on digestion coefficients, dry matter intake, feeding values, N-balance of rations containing rice straw diets (RS):

The effect of urea treatment, protein and carbohydrate sources on digestibility coefficients is presented in Table (3). The only significant interactions are those for CP and CF digestibilities. The CP digestibility for the URS diets containing FM was significantly lower with maize plus molasses than with maize. With TRS containing SBM, maize plus molasses resulted in a lower CP digestibility than maize.

For CF digestibility, neither nor carbohydrate sources had effect on CF digestibility of the URS diets. But for TRS diets containing maize plus molasses increased CF digestibility especially when combined with SBM.

Table (3): Effect of urea treatment, protein and carbohydrate sources on digestion coefficients of rice straw diets.

Item	URS				TRS			
	SBM		FM		SBM		FM	
	M	M+MO	M	M+MO	M	M+MO	M	M+MO
DM	61.0	60.8	61.5	59.7	64.5	66.2	65.5	64.2
OM	61.5	61.3	62.2	59.1	68.6	70.0	70.2	68.7
CP	38.0d	38.8d	41.2c	33.8e	53.2a	50.5b	51.3ab	52.8a
EE	68.9	59.2	70.3	57.7	75.3	72.2	78.3	70.5
CF	66.9f	66.6ef	67.0e	66.8ef	71.6d	78.3a	76.3c	77.5d
NFE	59.6	59.6	60.6	66.2	69.1	68.1	69.1	65.8
NDF	62.8	59.3	63.7	59.6	67.2	70.6	68.6	68.8
ADF	59.4	54.9	59.0	55.2	61.6	62.9	62.0	60.7
Hemicellulose	59.5	68.9	73.1	69.3	76.9	85.0	80.2	84.0
Cellulose	67.0	61.3	65.8	61.3	69.3	70.2	69.9	68.1
ADL	10.2	12.2	13.6	14.2	15.1	18.5	14.6	16.4
DM feed intake g/day	944	908	938	847	1009	1019	1004	1046
TDN%	53.40	52.20	54.33	50.60	58.67	58.67	59.87	57.47
ME (Mj/Kg)	7.94	7.77	8.08	7.52	8.71	8.73	8.90	8.52
DCP%*	5.71b	5.84ab	5.82a	5.50c	4.23d	3.90e	4.09d	4.08d
NB g/day	6.32b	5.66c	6.84a	4.92d	5.08d	4.23f	3.75g	4.56e

a, b, c, d…. : Means within the same raw with different superscripts are significantly different (P<0.05).

*** Urea nitrogen which was added to untreated straw is consider to be completely degraded in the reticulo-rumen (Chruch, 1980).**

1.1. The digestion coefficients of rice straw rations as affected by urea treatment, type of protein and source of carbohydrate:

The results in Table (4) shows that urea treatment increased (P<0.01), the digestibility of DM, OM, CF, CP, NDF, ADF, hemicellulose, cellulose and ADL by about 7.1, 15.2, 13.9, 36.8, 12.3, 8.3, 16.2, 8.8 and 30.6%, respectively. These results agree with those obtained by Horton and Steacy (1979) who found that NH_3-treatment with (3.5%) increased (P<0.01) the digestibility of DM, OM, CF and energy in nine straw varieties. Hossain and Rahman (1981) also showed that the urea treatment of paddy straw increased the digestibility of DM, OM, CP and CF by about 30.0, 30.0; 20.0 and 10.0 percentage units than the untreated ones.

As for the effect of protein source the apparent digestibility of DM and ADF appeared to be higher when added SBM than FM but the differences among the rations was not significant. The CF digestibility was increased (P<0.01) from 70.9 to 71.9 when added FM than SBM. These results agree with Delcurto *et al.* (1990) who reported that the increases in digestibility of tallgrass prairie forage was associated with increased supply of protein to the rumen. Church and Santos (1981) reported that DM digestion increased when at least 1 g of CP/kgw$^{0.75}$ was fed as SBM to steers consuming wheat-straw compared with unsupplemented straw. In this respect, decreasing ruminal CP degradation of diet by replacing SBM with FM increased ruminal fiber digestion (McCarthy *et al.,* 1989 and Hussein *et al.,* 1991a). This may be due to supplementing low ruminal degradable protein.

Table (4): Means of digestion coefficient of rice straw as affected by urea treatment, protein and carbohydrate source.

Items	DM	OM	CP	EE	CF	NFE	NDF	ADF	Hemi.	Cell.	ADL
Urea treatment											
Untreated	60.7B	61.1B	38.0B	64.0B	66.8B	59.0B	61.4B	57.1B	70.2B	63.9B	12.6B
Treated	65.1A	69.4A	52.0A	74.1A	75.9A	68.0A	68.8A	61.8A	81.5A	69.4A	16.2A
Protein source											
Soybean	63.1	65.4	45.1	68.9	70.9B	64.1a	64.1b	64.9	59.7	66.9	14.0
Fish meal	62.7	65.1	44.8	69.2	71.9A	62.9b	65.2a	59.2	67.7	66.3	14.7
Carbohydrate source											
Maize	63.1	65.6a	45.9A	73.2A	70.5B	65.6a	65.6A	60.5A	74.9B	68.00A	13.4B
Maize +molasses	62.7	64.8b	44.0B	64.9B	72.3A	62.4b	64.6B	58.4B	76.8A	65.2B	15.3A

A, B means within the same column for each capital letters are significantly different (P<0.01).
a, b means within the same column for each small letters are significantly different (P<0.05).

Regarding the effect of carbohydrate sources, the results indicated that the digestibility of NDF, ADF and cellulose increased (P<0.01) with maize supplemented rations from 64.6, 58.4 and 65.2% to 65.6, 60.5 and 68%, respectively than with the rations containing molasses plus maize. The digestibility of CF increased (P<0.01), as well as hemicellulose and ADL were increased (P<0.01) from 70.5, 75 and 13.4% to 72.3; 76.8 and 15.3%, respectively with supplementation molasess and maize than maize only. These results agree with Sanson (1993) and Matejovsky and Sanson (1995) who found that corn replacing molasses has improved (P<0.05) digestibility of rice straw for DM, OM, CP and CF content. Adding small amounts of soluble carbohydrate to a forage diet may enhance fiber digestion by enhancing bacterial attachment to digesta particles, perhaps by aiding microbial formation of extra cellular polysaccaride glycocel. The glycocel serve in attachment of microbes to particles and provide protection for extra cellular enzymes (Cheng *et al.,* 1980).

As shown in Table (5) the interaction in untreated materials between urea treatment and protein source was only significant for CF in the treated straw diets digestibility and ADL digestibility in untreated ones. Whilst, the interaction between urea treatment and carbohydrate source was significant for OM, NDF, ADF, hemicellulose and cellulose.

The carbohydrate source had no effect on CF digestibility in the untreated diets, but maize plus molasses increased it compared with maize in the treated diets.

The interaction of protein with carbohydrate source on most digestibility of nutrients coefficients was not effects due to carbohydrate source with SBM, but with FM it was found that maize in most cases improved nutrients digestibilities by the rate higher than maize plus molasses.

Rook and Armstrong (1989) have shown that microbial CP synthesis is improved to a greater extent when protein is supplied in addition to sugars rather than when they are fed separately.

Also, Gabr (1988) showed that there were significant interactions (P<0.01) between ammoniated rice straw and the form of additional N and source of carbohydrate on CP and CF digestibility.

Table (5): Interactions between urea treatments and protein sources, urea treatment and carbohydrate sources and protein and carbohydrate sources on digestion coefficients (%) of rice straw diets.

Items	DM	OM	CP	EE	CF	NFE	NDF	ADF	Hemi.	Cell.	ADL
Interaction between treatment and protein sources											
Untreated											
Soya	60.9	61.4	38.4	64.1	66.8c	59.6	61.0	57.1	69.2	64.2	11.2c
Fish	60.6	60.7	37.5	64.0	66.9c	58.4	61.7	57.1	71.2	63.6	13.9b
Treated											
Soya meal	65.4	69.3	51.9	73.7	75.0b	68.6	68.9	62.2	80.9	69.8	16.8a
Fish meal	64.8	69.4	52.1	74.4	76.9a	67.5	68.7	61.4	82.1	69.0	15.5a
Interaction between treatment and carbohydrate sources											
Untreated											
Maize	61.2	61.9b	39.6	69.6b	67.0c	60.1	63.3c	59.2b	71.3c	66.4b	11.9
Maize +molasses	60.2	60.2c	36.3	58.5c	66.7c	57.9	59.5d	55.0c	69.1d	61.3c	13.2
Treated											
Maize	65.0	69.4a	52.3	76.8a	52.3b	69.1	67.9b	61.8a	78.6b	69.6a	14.8
Maize +molasses	65.2	69.4a	51.6	71.4b	77.9a	66.9	69.7a	61.8a	84.5a	69.2a	17.5
Interactions between protein and carbohydrate sources											
Soybean meal											
Maize	62.8ab	65.0ab	45.6	72.1	69.3b	64.4a	65.0b	60.5	73.2b	68.1	12.7
Maize + molasses	63.5a	65.7a	44.6	65.7	72.5a	63.8a	64.9b	58.9	76.9a	65.8	15.4
Fish meal											
Maize	84.5a	69.2	46.3	74.3	17.5a	64.9a	66.2a	60.5	76.7a	67.9	14.1
Maize + molasses	61.9b	63.9b	43.3	64.1	72.1a	61.0b	64.2b	58.0	76.7a	64.7	15.3

a, b ……. means within the same column for each experimental factor are significantly different (P<0.05).

1.2. Dry matter intake, feeding values and N-utilization of rice straw diets:

The results in Table (6) show that dry matter intake (DMI) was higher due to urea treatment by 12.2% than the untreated diet, the differences between the two diets was significant (P<0.01). There were no significant differences between either SBM or FM addition in the DM intake. Also, it was found that DM intake did not differ significantly as a result of carbohydrate addition.

The TDN of the urea treated diets was higher than those of untreated one by about 11.4%. The protein source had no effect on TDN of the diets. While, diets supplemented with maize was higher (P<0.01) than those of supplemented with maize plus molasses by 3.3% (Table 6).

The DCP content was higher (P<0.01) for the untreated diets plus urea than urea treated by about 39%. The protein sources had no effect on DCP, whereas, maize raised DCP slightly but significantly (P<0.05) than maize plus molasses.

Table (6): Means of DM intake, feeding values and N-balance of rice straw diets as affected by urea treatment, protein and carbohydrate sources

Items	Untreated	Treated	SBM	FM	Maize	Molasses+ maize
DMI g/h/d	909B	1020A	970	959	974	955
TDN%	52.6B	58.6A	55.7	55.6	56.5A	54.7B
ME, Mj/kg*	7.84B	8.71A	8.29	8.25	8.41A	8.13B
DCP, %	5.7A	4.1B	4.9	4.9	5.0a	4.8b
NB g/day	5.9A	4.4B	5.3	5.0	5.5A	4.8B

Interactions between urea treatment and carbohydrate sources on:

Items	Untreated		Treated	
	Maize	Maize + Molasses	Maize	Maize + Molasses
DMI g/day	941b	877c	1006a	1032a
TDN%	53.9c	51.4d	52.9a	58.1b
ME, Mj/kg	8.01c	7.64d	8.81a	8.62b
DCP, %	5.8	5.7	4.0	4.0
NB g/day	6.6a	5.3b	4.4c	4.4c

A,B Means within the same raw with different superscript are significantly different (P<0.01).
a,b Means within the same raw with different superscript are significantly different (P<0.05).
*** ME (Mj/kg DM) = TDN % x 3.56 x 4.182 (McDonald *et al.,* 1978)**

Poor *et al.* (1990) concluded that the digestibility of potentially digested NDF (PDF) should be evaluated in studies of concentrate effects on fiber digestion and has more influence on passage rate of low quality than on passage rate of grain or high-quality forage.

On the other hand, the optimum ratio of NPN to AA-N for microbial growth was 75% urea-N and 25% AA-N. Kaur *et al.* (1992) showed that under glucose fermentation, the bacterial content of the incubation mixture was increased to 3.91, 6.31 and 5.08 times the control value (urea alone) when 25, 50 and 75% of urea-N was replaced with amino acid, respectively.

2. Effect of urea treatment, protein and of carbohydrate sources on digestion coefficients, dry matter intake, feeding values, N-balance of rations containing soybean straw diets (SBS):

Data showing the effects of urea treatment of SBS, protein and carbohydrate sources on the digestion coefficient of nutrients are presented in Table (7). Crude protein digestibility was lowest with maize supplied with SBM to the USBS diets, but with TSBS diets, maize with SBM improved the digestibility of crude protein. The NFE and cellulose digestibility of the USBS diets were higher with maize supplied with SBM, but they were lower with the TSBS diets received the same supplements.

Table (7): Effect of urea treatment, protein and carbohydrate sources on digestion coefficients of soybean straw diets.

Item	USBS				TSBS			
	SBM		FM		SBM		FM	
	M	M+MO	M	M+MO	M	M+MO	M	M+MO
DM	54.9	53.6	51.4	52.5	56.9	59.3	56.7	58.2
OM	55.9	56.8	54.8	55.0	59.2	61.3	58.8	59.8
CP	44.2e	49.1d	50.5d	49.7d	62.8a	58.1c	62.0a	60.1b
EE	57.8	49.6	41.6	38.3	55.2	48.9	62.0	51.7
CF	45.6	48.8	41.9	44.1	50.8	52.1	51.0	54.3
NFE	67.6b	65.6c	65.8c	66.6bc	66.6bc	71.8a	65.6c	65.5c
NDF	51.0	52.2	47.6	49.1	54.8	56.6	54.7	56.4
ADF	42.9	41.8	41.0	39.2	46.5	50.1	48.1	51.6
Hemicellulose	66.6	74.0	60.5	70.6	74.6	72.7	69.9	68.4
Cellulose	54.9e	53.7f	53.3f	53.4f	60.2c	63.1a	61.8b	58.9d
ADL	12.9c	12.5c	10.8d	18.8a	13.3c	18.8a	15.1b	15.4b
DM feed intake g/day	843	770	826	806	1053	1128	1048	1252
TDN%	53.14	52.80	50.83	51.16	53.15	54.01	53.00	52.73
ME (Mj/Kg)	7.91	7.85	7.57	7.61	7.91	8.04	7.89	7.85
DCP%*	7.94	7.82	8.54	8.06	7.94	6.79	7.43	7.05
NB g/day	6.63d	5.20c	7.96e	5.63e	9.22b	9.29b	9.24b	10.8a

a, b, c, d…. : Means within the same raw with different superscripts are significantly different (P<0.05).

*** Urea nitrogen which was added to untreated straw is consider to be completely degraded in the reticulo-rumen (Chruch, 1980).**

2.1. Effect of urea treatment, protein and of carbohydrate source on digestion coefficients of soybean straw diets:

The results in Table (8) show that the effect of urea treatment of SBS increased (P<0.01) digestibility coefficients of DM and OM by about 7.6 and 7.4%, respectively than untreated diets.

The increase in fiber fractions digestibility of treated SBS reached to 11.4, 19.2, 5.2, 13.4 and 13.7% for NDF, ADF, heicellulose, cellulose and ADL, respectively compared with those contained USBS+urea.

Table (8): Means of digestion coefficient of bean straw as affected by urea treatment, protein and carbohydrate sources.

Items	DM	OM	CP	EE	CF	NFE	NDF	ADF	Hemi.	Cell.	ADL
Urea treatment											
Untreated	53.6B	55.6B	48.4B	46.8B	45.1B	66.4b	49.9B	41.2B	67.9B	53.8B	13.7B
Treated	57.7A	59.7A	60.8A	54.5A	52.0A	67.4a	55.6A	49.1A	71.4A	61.0A	15.7A
Protein source											
Soybean	56.2	58.3a	53.6B	52.9A	49.3A	67.9A	53.7A	45.3	71.9A	58.0a	14.4
Fish meal	54.7	57.1b	55.6A	48.4B	47.8B	65.9B	52.0B	45.0	67.4B	56.8b	15.0
Carbohydrate source											
Maize	55.0B	57.2b	54.9	54.2A	47.3B	66.4	52.0B	44.7	67.9B	57.6	13.0B
Maize +molasses	55.8A	58.2a	54.3	47.1B	49.8A	67.4	53.6A	45.7	71.4A	57.3	16.4A

A, B means within the same column for each experimental factor are significantly different (P<0.01).

a, b means within the same column for each experimental factor are significantly different (P<0.05).

These results agree with those obtained by Horton and Steacy (1979) and El-Ayouty (1991) who found that NH_3-treatment with (3.5% NH_3) compared with those of untreated one increased (P<0.01). The digestibility of DM, OM, CP, CF and energy in nine straw varieties. Also, similar trend was recorded by Hossain and Rahman (1981).

The digestibility of CF, NDF, hemicellulose and cellulose, was significantly affected by the protein source. However, the effect of protein source was lower in most cases than the effect of urea treatment. Hussein *et al.* (1995b) indicated that to the known advantage of supplementing ruminant diets with low ruminally degradable protein supplements i.e. increasing the quantity and/or improving the profile of the amino acids reaching the duodenum they seem to have an important role in ruminal fiber digestion.

The digestibility coefficient was significantly affected by carbohydrate sources since they were improved by higher rates with maize grains than with maize plus molasses supplementation. However, digestibility of hemicellulose was improved with maize plus molasses compared with maize only.

The effect of the interactions between urea treatment, protein and carbohydrate sources on the digestion coefficients of SBS diets are presented in Table (9).

As shown in Table (9) the effect of the interactions between urea treatment and protein sources on digestibility coefficients in most cases was lower with FM supplementation to the untreated straw diets plus urea.

Fish meal also decreased (P<0.05) the digestibility of CF when it was supplemented to the untreated straw diets plus urea. The digestibility of NDF and ADF were significantly higher (P<0.05) with SBM than FM with untreated diets but not affected significantly with the treated diets straw. These results agree with those obtained by Nelson *et al.* (1985) who found that the ruminants are to utilize fibrous residuals, ammoniation of these materials generally improves digestibility. Thus, feedstuffs containing both fiber bound and free N but low in amino acids content, feeding system might supply rumen NH_3-N from the ammoniated roughage and major protein of the animals protein requirements from protein sources that escape rumen degradation.

The interaction between urea treated and carbohydrate source shows that the addition of maize plus molasses did not affect the digestibility of NDF in the untreated diets but increased it in the treated diets.

Supplementation of forage based diets with readily available carbohydrate such as starch from corn (Andreson *et al.,* 1988 and Zorilla-Rois *et al.,* 1991) or sugars from molasses (Brown and Johanson, 1991) has increased apparent DM or OM digestibility. Responses to energy supplementation of ammoniated also have been positive (Brown and Johnson, 1991).

Table (9): Interaction between urea treatment and, protein sources, urea treatment and carbohydrate sources and protein and carbohydrate sources on digestion coefficients of soybean straw based diets.

Items	DM	OM	CP	EE	CF	NFE	NDF	ADF	Hemi.	Cell.	ADL
Interaction between treatment and protein sources											
Untreated											
Soya	54.3	56.4	46.7	53.7a	47.2b	66.6b	51.6b	42.3b	70.3	54.3	12.7b
Fish	51.9	54.9	50.1	39.9b	43.0c	66.2b	48.4c	40.1c	56.6	53.3	14.8a
Treated											
SBM	58.1	60.2	60.5	52.1a	51.4a	69.2a	55.7a	48.4a	73.6	61.7	16.1a
FM	57.5	59.3	61.1	56.9a	52.6a	65.6b	55.6a	49.9a	69.2	60.4	15.2a
Interaction between treatment and carbohydrate sources											
Untreated											
Maize	53.2	55.4	47.3c	49.7	43.8	66.7b	49.3	41.9c	63.5c	54.1	11.9
Maize +molasses	53.1	55.9	49.4c	43.9	46.6	66.1b	50.7	40.5c	72.3a	53.6	15.6
Treated											
Maize	56.8	59.0	62.4a	58.6	50.9	66.1b	54.8	47.4b	72.2a	61.0	14.2
Maize +molasses	58.8	60.5	59.1b	50.3	53.2	66.7a	56.5	50.8a	70.5b	61.0	17.1
Interactions between protein and carbohydrate sources											
SBM											
Maize	55.9	57.6	53.5	56.5	48.2	67.6	52.9	44.8	70.6	57.6ab	13.1
Maize + molasses	56.3	59.0	53.6	49.2	50.4	65.6	54.4	45.9	73.3	58.4a	15.7
FM											
Maize	54.1	56.8	56.3	51.8	46.5	65.8	51.2	44.5	65.2	57.6ab	13.0
Maize + molasses	55.3	57.4	54.9	45.0	49.2	66.1	52.8	45.4	69.5	56.1b	17.1

a, b means within the same column for each experimental factor are significantly different (P<0.05).

2.2. Dry matter intake, feeding values and N-utilization of soybean straw diets.

As shown in Table (10) the TDN content of the diet was improved significantly (P<0.01) by urea treatment of tested material and by SBM supplementation.

The carbohydrate sources had no effect on TDN content of the tested diets. Fish meal supplementation tended to improve the DCP content of the diet but this effect was not statistically significant. Maize grain supplementation improved DCP content (P<0.01).

Also, Matejovsky and Sanson (1995) studied the supplementation of corn to low, medium and high quality grass hays and found that dry matter intake increased quadratically with feeding on low quality grass hay with increasing the level of corn as a source of carbohydrate. On the other hand, Hussien *et al.* (1995a) found that DMI was not affected (P<0.01) by dietary forage level or canola seeds supplementation when fed to steers.

The results of N-utilization was presented in Table (10), it was improved by urea treatment (P<0.01) by 51.6% compared with untreated SBS.

The interaction of urea treatment with carbohydrate sources on the DM intake, TDN and DCP are presented in Table (10). Maize supplementation to the untreated diets elevated DM intake than maize plus molasses, but the opposite happened with treated diets.

Table (10): Means of DM intake, feeding values and N-balance of rice straw diets as affected by urea treatment, protein and carbohydrate sources and its interactions

Items	Untreated	Treated	SBM	FM	Maize	Molasses+ maize
DMI g/day	811B	1120A	948	983	943	989
TDN%	52.0B	53.2A	53.3A	51.9B	52.5	52.7
DCP, %	8.1A	7.2B	7.5	7.8	7.8A	7.4B
NB g/day	6.4B	9.6A	7.6B	8.4A	8.3	7.7

Interactions between urea treatment and carbohydrate sources on:

Items	Untreated		Treated	
	Maize	Maize + Molasses	Maize	Maize + Molasses
DMI g/day	835c	788d	1051b	1190a
TDN%	52.0	52.0	53.1	53.4
DCP, %	8.2	7.9	7.5	6.9
NB g/day	7.3c	5.40d	9.2b	10.1a

*** Means within the same raw with different capital letters are significantly different (P<0.01).**

*** Means within the same raw with different small letters are significantly different (P<0.05).**

Buxton and Redfearn (1997) showed that the energy availability from forage is limited by fiber concentration because fiber is slowly and incompletely digested, whereas, cell soluble is almost completely digested. Thus the proportion of fiber to cell soluble is a major determined of energy availability of forages. Grasses normally have more fiber than the legumes.

Poor *et al.* (1991) suggested that the ratio of forage NDF to ruminally degradable starch be maintained greater than or equal to 1: 1 when diets basal on low quality forage (wheat straw) are fed to cows in early lactating.

On the other hand, Sudana and Leng (1986) showed that the poor quality forages low in protein, protein nutrition is increased by providing a persistent source of protein and giving the animal some escape protein.

Generally, From the foregoing results it could be concluded that the urea treatment with adding protein and carbohydrate sources improved rice straw based diets digestion than the untreated straw with adding urea.

The formula which give the highest improvement as TDN% were TRS+FM+ M and TSBS + SBM+ M+ MO.

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تأثير المعاملة باليوريا وإضافة مصادر بروتينية وكربوهيدراتية على التركيب الكيماوى للجدار الخلوى ومعاملات الهضم للعلائق المحتوية على قش الأرز وتبن فول الصويا

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أجريت هذه الدراسة بهدف تحسين القيمة الغذائية لمواد العلف الخشنة سواء من مصدر نجيلى " قش الأرز " أو بقولى "تبن فول الصويا" عن طريق معاملتها باليوريا ٣% (سيلجة) ثم إستخدامها فى تغذية الأغنام سواء معاملة أو غير معاملة مع مصادر بروتين "مسحوق فول الصويا أومسحوق السمك" ومصادر طاقة "الذرة أو المولاس + الذرة" وذلك بهدف :

1. معرفة تأثير المعاملة على التحليل الكيماوى للجدار الخلوى لمواد العلف المختبرة وبالتالى تأثيرها على معاملات الهضم والقيمة الغذائية.
2. أيهما افضل فى الإستخدام كمصدر بروتين "مسحوق فول الصويا ام مسحوق السمك" وكذلك مصدر الطاقة الأذرة أم المولاس + الأذرة.

ولذلك تم إجراء ١٦ تجربة هضم بإستخدام ١٢ كبش رحمانى لبيان أهداف هذه الدراسة ن ولقد اوضحت النتائج مايلى:

1. أظهرت النتائج ان هناك فرق معنوى على مستوى معنوية ٥% نتيجة تأثير المعاملة على طبيعة التركيب الكيماوى لمواد العلف المختبرة لكل من المادة العضوية والألياف الخام ، NDF ، ADF والهيمسليلوز والسيليلوز وأوضحت النتائج أن المعاملة بالأمونيا أدت إلى إنخفاض محتوى السليلوز ، ADF فى كل من قش الأرز وتبن الصويا.
2. أدت المعاملة إلى رفع معاملات الهضم للمركبات الغذائية المختلفة معنوياً على مستوى ١% مقارنة بالتغذية على المواد الخشنة غير المعاملة وكان هناك تأثير معنوى على مستوى ٥% على هضم الألياف وكان التحسن فى هضم الألياف الأفضل عند التغذية على قش الأرز المعامل مع إضافة مسحوق الصويا و ذرة ومولاس مقارنة بالعلائق الأخرى المختبرة.
3. أظهرت النتائج أن المعاملة زادت من المادة الجافة المأكولة والمركبات الكلية المهضومة معنوياً على مستوى ٥% بالمقارنة بالتغذية على المواد غير المعاملة.
4. تشير النتائج أن ميزان الأزوت كان موجباً فى جميع الحيوانات المغذاه على العلائق المختبرة.

يتضح من هذه الدراسة أن هناك درجات متفاوتة للإستجابة للمعاملة باليوريا مع إضافة مصدر بروتين وطاقة بين انواع مواد العلف الخشنة.

ولذا فقد كانت أنسب خلطة لكل مادة علف خشنة أعطت اعلى درجة تحسن لقيمة المركبات المهضومة الكلية وهى :

1. قش ارز معامل + مسحوق سمك + ذرة
2. تبن فول صويا معامل + مسحوق كسب فول الصويا + ذرة + مولاس