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# INFLUENCE OF SOME NITROGEN SOURCES ON FERMENTATION AND DIGESTION OF DIFFERENT POOR QUALITY ROUGHAGES.

# 2. THE DIGESTION COEFFICIENTS, FEED INTAKE, N-BALANCE AND FEEDING VALUE OF RATIONS.

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## ABSTRACT

Three healthy Rahmany rams were used. They were fed at 90% of their *ad libitum* intake during successive metabolism trials. The experimental rations were formulated to be almost iso-nitrogenous and contain about 12% crude protein recommended by ∅rskov *et al.* (1972) to ensure maximal rate of fermentation in the rumen as follows:

1. 30% rice straw (RS) + 70 % concentrate feed mixture (CFM)
2. 30% maize stalks (MS) + 70 % CFM
3. 40% clover straw (CS) + 60 % CFM
4. 60 % RS + 30% CFM + 10% SBM
5. 60 % RS + 38.8% CFM + 1.2% U
6. 60 % MS + 30% CFM + 10% SBM
7. 60 % MS + 38.8% CFM + 1.2% U
8. 75 % CS + 17% CFM + 8% SBM
9. 75 % CS + 24 % CFM + 1.0% U

The results obtained showed that :

There were no significant effects on the digestion coefficient of DM, OM, CP, hemicellulose, N-balance and DCP% when feeding on RS or MS and CS. The CF digestibility increased significantly (P<0.05) when feeding on RS than MS or CS (64.04, 52.89 and 50.41%, respectively). The NDF digestibility increased significantly (P<0.05) when feeding on MS or RS than CS (58.69, 54.92 and 48.03%, respectively). The ADF digestibility increased significantly (P<0.05) when feeding on RS than MS or CS (60.09, 54.20 and 41.90, respectively). Cellulose digestibility increased significantly (P<0.05) when also feeding on RS than MS or CS (72.21, 65.85 and 51.31%, respectively). The dry matter intake (DMI) increased significantly (P<0.05) when feeding on CS than MS or RS (905.37, 799.64 and 761.66 g/day, respectively). The TDN% increased significantly (P<0.05) when feeding on RS or MS than CS (60.11, 60.52 and 55.53, respectively).

The DM digestibility increased significantly (P<0.05) when added CFM than with SBM or urea (64.4, 58.52 and 55.54, respectively) and the OM digestibility was as the same trend (68.40, 61.68 and 58.41%, respectively). The ADF digestibility increased significantly (P<0.05) when added CFM or with SBM than added urea (53.49, 53.89 and 48.82%, respectively) but cellulose digestibility increased when added CFM than with SBM or urea (68.09, 63.09 and 58.19%, respectively). The DMI increased (P<0.05) when added CFM than with SBM or urea (919.20, 737.61 and 809.87 g/day, respectively). The TDN % values were higher (P<0.05) when added CFM than with SBM or urea (63.02, 56.43 and 57.61, respectively).

In general, there were positive effects on cell wall digestion with N-sources when feeding on RS but there were negative effects on the feeding with MS and there were no significant effect in feeding with CS.
**Keywords:** sheep, rice straw, maize stalks, clover straw, digestion coefficient.

## INTRODUCTION

In Egypt, there are about 14 million tons of agriculture by-products produced annually (El-Shinnawy, 1998), unfortunately there are not properly fully used. The right policy will be therefore to direct the attention and efforts towards maximizing the use of roughaes and untraditional feeds.

Most crop residues alone can not meet total animal nutrient requirements. If crop residues are to be used in animal diets successfully, the nutrient deficiencies should be corrected by adding protein supplements, energy and any other defficient nutrients. Otherwise, such animal will lose weight and condition, may experience difficulty in calving and recovery and hence will be low producers.

Because most cereal straws contain only 3-5% crude protein (on dry matter basis) which is poorly digested, extra supplemental protein must be fed.

So, the present research aimed to study the influence of some nitrogen sources on the digestion of different poor quality roughages by using the common crop residues such as rice straw, maize stalks and clover straw.

## MATERIALS AND METHODS

The experimental work of the present study was conducted at the Agricultural Experimental Station and the Laboratories of Animal Production Department, Faculty of Agriculture Mansoura University

### Experimental design

Nine experimental rations were formulated to investigate the influence of supplementing three tested roughages (rice straw (RS), maize stalks (MS) and clover straw (CS)) with different combinations of concentrate feed mixture, CFM (traditional supplement), SBM (good source of amino acids) and urea on digestion coefficients, feed intake, N-balance and feeding values of the rations. The experimental rations were formulated to be almost iso-nitrogenous and to certain slightly more than 12% crude protein recommended by ∅rskov *et al.* (1972) to ensure maximal rate of fermentation in the rumen.

The formulation of the nine experimental rations were given in Table (1a).

The rice straw, maize stalks and clover straw were chopped to length of about 5 cm. The CFM contained about 15.81% CP and consisted of undecorticated cotton seed, wheat bran, yellow corn, salt and limestone.

**Table (1a): The formulation of the experimental rations.**

| Ingred.% | Formulation rations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **(1)-** | **(2)*** | **(3)*** | **(4)-** | **(5)*** | **(6)*** | **(7)-** | **(8)*** | **(9)*** |
| **RS** | 30 | 60 | 60 | - | - | - | - | - | - |
| **MS** | - | - | - | 30 | 60 | 60 | - | - | - |
| **CS** | - | - | - | - | - | - | 40 | 75 | 75 |
| **CFM** | 70 | 30 | 38.8 | 70 | 30 | 38.8 | 60 | 17 | 24 |
| **SBM** | - | 10 | - | - | 10 | - | - | 8 | - |
| **U** | - | - | 1.2 | - | - | 1.2 | - | - | 1.0 |

**- Control rations** *** tested rations**

**Experimental animals and their management**

Nine digestibility and metabolism trials were carried out on sheep. Three healthy Rahmany rams of about 1.5-2.0 years old, with an average live body weight of 45 kg were used. During each digestibility trial, the animal were kept in individual pens for 21 days. Each animal was then kept in metabolic cage for another 15 days. Faces and urine were collected separately and quantitatively for the last 7 days.

Each experimental diet was offered *ad lib* at 8.00 am to the experimental animals. During the collection period, 90% of *ad lib* intake was offered.

**Chemicals analysis**

The chemical analysis of tested materials, faces and urinary nitrogen were determined according to A.O.A.C. (1984) procedures. The NDF, ADF and ADL were determined by the method of Goering and Van Soset (1970). While, cellulose and hemicellulose were accordingly calculated.

**Statistical analysis**

The data collected for each parameter was analyzed by Factorial Design in order to ascertain whether. The observed treatment effects were real and discernible from chance effects. The null hypothesis was tested by F-test of significance (Gomez and Gomez, 1984). The differences between treatment means were tested by Duncan's Multiple Range Test (Duncan, 1955).

## RESULTS

The chemical composition of rice straw, maize stalks, clover straw, feed concentrate mixture, soybean meal and urea are detailed in Table 1b. The chemical composition of the total mixed rations are detailed in Table 2. As the trial proceeded, the CF, NDF, ADF and cellulose of the rations offered tended to increase as the level of roughage increased.

**Table (1): The chemical composition of rice straw, maize stalks, clover straw, feed concentrate mixture, soybean meal and urea.**

| Item | RS | MS | CS | CFM | SBM | Urea |
|---|---|---|---|---|---|---|
| DM% | 91.93 | 90.81 | 87.48 | 88.90 | 89.17 | - |
| Composition of DM%: | | | | | | |
| OM | 83.68 | 92.52 | 87.35 | 90.16 | 92.66 | - |
| CP | 4.89 | 4.33 | 8.80 | 15.81 | 52.68 | 280 |
| EE | 1.70 | 2.02 | 1.06 | 2.35 | 2.51 | - |
| CF | 36.30 | 32.86 | 42.37 | 11.37 | 3.45 | - |
| NFE | 41.07 | 53.31 | 35.12 | 60.53 | 34.02 | - |
| Ash | 16.32 | 7.48 | 12.65 | 9.84 | 7.34 | - |
| NDF | 74.66 | 75.01 | 65.21 | 35.34 | 28.46 | - |
| ADF | 51.67 | 45.25 | 50.15 | 12.79 | 3.31 | - |
| Hemicellulose | 22.99 | 29.76 | 15.06 | 22.55 | 25.15 | - |
| Cellulose | 38.67 | 34.64 | 36.62 | 10.57 | 1.77 | - |
| ADL | 13.00 | 10.61 | 13.53 | 2.22 | 1.54 | - |

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

| Item | RS | | | MS | | | CS | | |
|---|---|---|---|---|---|---|---|---|---|
| Roughage% | 30 | 60 | 60 | 30 | 60 | 60 | 40 | 75 | 75 |
| CFM% | 70 | 30 | 38.8 | 70 | 30 | 38.8 | 60 | 17 | 24 |
| SBM% | - | 10 | - | - | 10 | - | - | 8.0 | - |
| Urea% | - | - | 1.2 | - | - | 1.2 | - | - | 1.0 |
| DM | 89.80 | 90.73 | 89.64 | 89.47 | 90.06 | 88.97 | 88.33 | 87.85 | 86.94 |
| Composition of DM%: | | | | | | | | | |
| OM | 88.34 | 86.69 | 88.72 | 90.92 | 91.81 | 93.84 | 89.65 | 88.24 | 89.93 |
| CP | 12.57 | 12.95 | 12.44 | 12.40 | 12.60 | 12.10 | 13.03 | 13.51 | 13.20 |
| EE | 2.16 | 1.98 | 1.93 | 2.29 | 2.17 | 2.12 | 1.83 | 1.39 | 1.35 |
| CF | 18.91 | 25.56 | 26.23 | 17.87 | 23.50 | 24.16 | 23.83 | 33.98 | 34.52 |
| NFE | 54.70 | 46.20 | 48.12 | 58.36 | 53.54 | 55.46 | 50.35 | 39.36 | 40.86 |
| Ash | 11.66 | 13.31 | 11.28 | 9.08 | 8.19 | 6.16 | 10.35 | 11.76 | 10.07 |
| NDF | 47.12 | 58.23 | 58.50 | 47.23 | 58.44 | 58.71 | 47.28 | 57.17 | 57.38 |
| ADF | 24.45 | 35.16 | 35.96 | 22.52 | 31.31 | 32.11 | 27.73 | 40.04 | 40.67 |
| Hemicellulose | 22.67 | 23.07 | 22.54 | 24.71 | 27.13 | 26.60 | 19.55 | 17.13 | 16.71 |
| Cellulose | 19.00 | 26.55 | 27.30 | 17.79 | 24.14 | 24.89 | 20.99 | 29.41 | 30.00 |
| ADL | 5.45 | 8.61 | 8.66 | 4.73 | 7.17 | 7.22 | 6.74 | 10.63 | 10.67 |

## 1. Interaction between low quality roughages type and N-sources on the digestion coefficients, feed intake, N-balance and feeding values of the rations:

### 1.1. Rice straw:

Table (3) shows the main effects of CFM, CFM+SBM and CFM+U which were supplemented to rice straw.

There were no significant effect of adding either CFM, CFM+SBM or CFM+U to rice straw on its DM, OM, CP, EE, NFE, ADF and cellulose digestibilities. The apparent digestibilities of CF, NDF and hemicellulose were significantly ($P<0.05$) higher with added CFM+SBM or CFM+U to rice straw. The ADL digestibility was significantly ($P<0.05$) higher with added CFM+SBM than added CFM or CFM+U and was higher ($P<0.05$) with added CFM+U than added CFM alone.

The feed intake was significantly ($P<0.05$) higher with added CFM than added CFM+SBM or CFM+U, but there was no significant difference between CFM+SBM and CFM+U. All supplements had no significant effect on the TDN%, ME (MJ/Kg feed) and N-balance (g/day).

### 1.2. Maize stalks:

As shown in table (3) the digestibility of OM, CF, ADF and cellulose of MS were significantly (P<0.05) decreased with added CFM+SBM or CFM+U than added CFM, and the decrease in digestibilities were significantly (P<0.05) more with added CFM+U than added CFM+SBM. The NDF digestibility was significantly (P<0.05) increased with added CFM or CFM+SBM than added CFM+U, but there were no significant effect of added CFM, CFM+SBM or CFM+U on the hemicellulose digestibility. The ADL digestibility was significantly (P<0.05) higher with added CFM+SBM than added CFM or CFM+U.

**Table (3): Interaction between roughages and N-sources on digestion coefficients, dry matter feed intake, N-balance and feeding value of rations.**

| Item | RS | | | MS | | | CS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CFM | CFM+ SBM | CFM+ Urea | CFM | CFM+ SBM | CFM+ Urea | CFM | CFM+ SBM | CFM+ Urea | SEM* |
| **Nutrient digestibility (%):** | | | | | | | | | | |
| DM | 61.79 | 58.91 | 60.87 | 66.50 | 59.60 | 49.87 | 63.71 | 57.06 | 55.81 | 2.38 |
| OM | $66.62^{ab}$ | $64.43^{b}$ | $65.23^{ab}$ | $72.67^{a}$ | $61.97b^{c}$ | $53.48^{d}$ | $65.93a^{b}$ | $58.84^{bcd}$ | $56.53^{cd}$ | 2.33 |
| CP | 67.84 | 69.51 | 72.62 | 69.68 | 69.30 | 61.03 | 60.44 | 69.18 | 63.16 | 2.94 |
| EE | $78.46^{a}$ | $65.74^{ab}$ | $69.30^{ab}$ | $71.05^{ab}$ | $75.44^{a}$ | $73.14a^{b}$ | $67.40^{ab}$ | $60.50^{b}$ | $33.66^{c}$ | 3.86 |
| CF | $58.35^{bcd}$ | $65.33^{ab}$ | $68.46^{a}$ | $60.10^{abc}$ | $55.67^{cde}$ | $42.89^{f}$ | $49.13^{def}$ | $48.30^{ef}$ | $53.81^{cde}$ | 2.96 |
| NFE | 68.83 | 62.46 | 64.36 | 76.81 | 62.49 | 58.77 | 75.13 | 64.15 | 60.73 | 2.54 |
| NDF | $51.83^{b}$ | $60.82^{a}$ | $63.43^{a}$ | $59.90^{a}$ | $58.98^{a}$ | $45.89^{b}$ | $49.99^{b}$ | $44.74^{b}$ | $49.38^{b}$ | 2.38 |
| ADF | $55.74^{b}$ | $62.07^{ab}$ | $62.47^{ab}$ | $65.35^{a}$ | $57.48^{b}$ | $39.77^{c}$ | $39.36^{c}$ | $42.13^{c}$ | $44.21^{c}$ | 2.20 |
| Hemicellulose | $47.40^{c}$ | $58.91^{ab}$ | $64.96^{a}$ | $62.60^{a}$ | $60.73^{a}$ | $60.13^{a}$ | $65.00^{a}$ | $51.13b^{c}$ | $61.90^{a}$ | 2.65 |
| Cellulose | $72.08^{b}$ | $70.44^{b}$ | $74.11^{ab}$ | $81.41^{a}$ | $66.90^{b}$ | $49.26^{c}$ | $50.79^{c}$ | $51.94^{c}$ | $50.95^{c}$ | 2.80 |
| ADL | $1.50^{d}$ | $36.28^{a}$ | $25.67^{b}$ | $3.23^{d}$ | $25.86^{b}$ | $7.59c^{d}$ | $3.76^{d}$ | $14.28^{c}$ | $24.52^{b}$ | 2.37 |
| DM feed intake g/day | $936.80^{a}$ | $612.43^{d}$ | $705.06^{cd}$ | $868.60^{ab}$ | $712.93^{cd}$ | $817.40^{bc}$ | $921.50^{ab}$ | $887.46^{ab}$ | $907.16^{ab}$ | 43.27 |
| N-balance g/day | 6.09 | 3.18 | 3.42 | 5.21 | 5.19 | 4.11 | 4.64 | 5.00 | 4.91 | 1.01 |
| **Feeding value as DM (%):** | | | | | | | | | | |
| TDN | 60.89 | 57.35 | 62.10 | 67.95 | 58.95 | 54.66 | 60.21 | 53.01 | 53.38 | 2.15 |
| TDN intake (g/day) | 570.4 | 351.2 | 437.8 | 590.2 | 420.3 | 446.8 | 554.8 | 470.4 | 484.2 | 52.07 |
| ME (Mj/Kg) | 9.05 | 8.19 | 9.23 | 10.10 | 8.77 | 8.15 | 8.95 | 7.88 | 7.93 | 0.31 |
| DCP | $8.46^{abc}$ | $8.89^{abc}$ | $9.61^{a}$ | $9.05^{ab}$ | $8.67^{abc}$ | $7.67^{c}$ | $7.87b^{c}$ | $9.49^{a}$ | $8.66^{abc}$ | 0.40 |

**a, b, c, d: Means within the same raw with different superscripts are significantly different (P<0.05).**
*** SEM= standard error of means, n= 3.**

The feed intake was significantly (P<0.05) higher with added CFM or CFM+U than added CFM+SBM to MS. The DCP% was significantly higher (P<0.05) with added CFM than added CFM+U, but there were no significant effect between added CFM or CFM+SBM and between CFM+SBM or CFM+U. All supplements had no significant effect on the TDN%, ME (MJ/Kg feed) and N-balance (g/day).

### 1.3. Clover straw:

As shown in table (3) the digestibility coefficients of OM was significantly (P<0.05) higher with added CFM than CFM+U, but there were no significant effect of added CFM or CFM+SBM and between CFM+SBM or CFM+U. The same trend was obtained for EE digestibility. There was no significant effect on CF, NDF, ADF and cellulose digestibilities when CFM,

CFM+SBM or CFM+U were added to clover straw. On the other hand hemicellulose digestibility was significantly (P<0.05) higher with added CFM or CFM+U than added CFM+SBM.

All supplements had no significant effect on feed intake, TDN, ME (MJ/kg feed) and N-balance (g/day). The DCP% was significantly (P<0.05) higher with added CFM+SBM than added CFM, but there were no significant effect when added CFM or CFM+U and CFM+SBM or CFM+U to the clover straw.

**2. Effect of low quality roughages type on digestion coefficients, dry matter feed intake, N-balance and feeding value of the rations (irrespective to N-sources):**

Table (4) shows the main effects of roughage type on digestibility coefficients, feed intake, N-balance and feeding value of the rations.

The EE and NDF digestibilities were higher (P<0.05) with RS and MS (71.17 and 73.14%, respectively) than with CS (53.63%).

The CF, ADF, cellulose and ADL digestibilities of RS rations were higher than those of MS and CS (P<0.05).

The feed intake (g/day) was the highest (P<0.05) with CS ration than RS and MS rations, but there were no significant effect of RS and MS rations.

On the contrary, the TDN% and ME (MJ/kg feed) of CS ration were less (P<0.05) than RS and MS rations.

There were no significant effects among roughage types on N-balance and DCP%

**Table (4): Effect of roughage type on digestion coefficients, dry matter feed intake, N-balance and feeding value of the rations irrespective to N-sources.**

| Item | RS | MS | CS | SEM* |
|---|---|---|---|---|
| **Nutrient digestibility (%):** | | | | |
| **DM** | 60.96 | 58.65 | 58.88 | 1.37 |
| **OM** | 65.42 | 62.71 | 60.54 | 1.35 |
| **CP** | 69.99 | 65.55 | 64.26 | 1.70 |
| **EE** | 71.17[a] | 73.14[a] | 53.63[b] | 2.23 |
| **CF** | 64.04[a] | 52.89[b] | 50.41[b] | 1.71 |
| **NFE** | 65.22 | 66.02 | 66.67 | 1.47 |
| **NDF** | 58.69[a] | 54.92[a] | 48.03[b] | 1.37 |
| **ADF** | 60.09[a] | 54.20[b] | 41.90[c] | 1.27 |
| **Hemicellulose** | 57.09 | 61.15 | 59.34 | 1.53 |
| **Cellulose** | 72.21[a] | 65.85[b] | 51.31[c] | 1.62 |
| **ADL** | 21.16[a] | 12.22[b] | 14.19[b] | 1.37 |
| **DM feed intake g/day** | 751.45[b] | 799.64[b] | 905.37[a] | 24.98 |
| **N-balance g/day** | 3.89 | 4.82 | 4.84 | 0.58 |
| **Feeding value as DM (%):** | | | | |
| **TDN** | 60.11[a] | 60.52[a] | 55.53[b] | 1.24 |
| **TDN intake (g/day)** | 452.30 | 477.04 | 503.93 | 30.06 |
| **ME (Mj/Kg)** | 8.94[a] | 9.01[a] | 8.25[b] | 0.18 |
| **DCP** | 8.98 | 8.46 | 8.67 | 0.23 |

**a, b, c: Means within the same raw with different superscripts are significantly different (P<0.05).**
*** SEM= standard error of means, n= 9.**

**3. Effect of N-sources on digestion coefficients, feed intake, N-balance and feeding value of rations (irrespective to low quality roughage type):**

Table (5) shows the main effects of CFM, CFM+SBM and CFM+U which were supplemented to roughages on digestion coefficients, feed intake, N-balance and feeding value of the tested rations.

The apparent digestibilities of DM, OM, NFE and cellulose increased (P<0.05) with added CFM than CFM+SBM or CFM+U.

The apparent digestibility of ADF and EE were significantly (P<0.05) higher with added CFM or CFM+SBM to rations than adding CFM+U.

The ADL digestibility was higher (P<0.05) with adding CFM+SBM than when either CFM or CFM+U were added.

The feed intake, TDN% and ME (Mj/Kg DM feed) were significantly (P<0.05) higher with added CFM than adding CFM+SBM or CFM+U to the rations.

**Table (5): Effect of N-sources on digestion coefficients, dry matter feed intake, N-balance and feeding value of rations (irrespective to roughage type).**

| Item | CFM | CFM+SBM | CFM+Urea | SEM |
|---|---|---|---|---|
| **Nutrient digestibility (%):** | | | | |
| **DM** | 64.44[a] | 58.52[b] | 55.54[b] | 1.37 |
| **OM** | 68.40[a] | 61.86[b] | 58.41[b] | 1.35 |
| **CP** | 65.98 | 68.22 | 65.60 | 1.70 |
| **EE** | 72.30[a] | 67.23[a] | 58.63[b] | 2.23 |
| **CF** | 55.86 | 56.43 | 55.05 | 1.71 |
| **NFE** | 73.59[a] | 63.03[b] | 61.29[b] | 1.47 |
| **NDF** | 53.91 | 54.84 | 52.90 | 1.37 |
| **ADF** | 53.49[a] | 53.89[a] | 48.82[b] | 1.27 |
| **Hemicellulose** | 58.33 | 56.92 | 62.33 | 1.53 |
| **Cellulose** | 68.09[a] | 63.09[b] | 58.19[c] | 1.62 |
| **ADL** | 2.83c | 25.47[a] | 19.27[b] | 1.37 |
| **DM feed intake g/day** | 908.98[a] | 737.61[b] | 809.87[b] | 24.98 |
| **N-balance g/day** | 4.97 | 4.45 | 4.13 | 0.58 |
| **Feeding value as DM (%):** | | | | |
| **TDN** | 63.02[a] | 56.43[b] | 56.71[b] | 1.24 |
| **TDN intake (g/day)** | 560.56[a] | 414.56[b] | 458.14[b] | 30.06 |
| **ME (MJ/Kg)** | 9.37[a] | 8.39[b] | 8.44[b] | 0.18 |
| **DCP** | 8.46 | 9.02 | 8.64 | 0.23 |

**a, b, c: Means within the same raw with different superscripts are significantly different (P<0.05).**
*** SEM= standard error of means, n= 9.**

As shown in Table (3) the CF digestibility of MS ration was differed significantly (P<0.05) when supplemented with CFM than CS ration, but there was no significant effect between RS and MS rations with the same supplement. The CF digestibility of MS and CS rations decreased significantly (P<0.05) when supplemented with CFM+SBM compared to RS ration.

The CF digestibility of MS ration was decreased ($P<0.05$) when supplemented with CFM+U than RS or CS rations, but the CF digestibility of RS ration was higher ($P<0.05$) than that of CS ration.

The NDF digestibility of MS ration was higher ($P<0.05$) when supplemented with CFM than RS and CS containing rations, but there was no significant effect on NDF digestibility between RS and CS rations. The NDF digestibility of RS or MS rations were higher ($P<0.05$) than CS ration when supplemented with CFM+SBM, but NDF digestibility of RS ration increased ($P<0.05$) than MS or CS rations when supplemented with CFM+U and there was no significant effect on NDF digestibility between MS or CS rations.

The ADF digestibility was higher ($P<0.05$) when MS ration was supplemented with CFM than RS or CS rations and also ADF digestibility of RS ration was higher ($P<0.05$) than ADF digestibility of CS ration. The ADF digestibility of RS or MS ration were higher ($P<0.05$) than CS ration when supplemented with CFM+SBM, but ADF digestibility of RS ration increased significantly ($P<0.05$) than MS or CS rations when supplemented with CFM+U.

The hemicellulose digestibility of MS or CS rations were higher ($P<0.05$) than RS ration when supplemented with CFM, and there was no significant effect on hemicellulose digestibility of MS or CS rations. The hemicellulose digestibility of RS or MS rations were higher ($P<0.05$) than CS ration when supplemented with CFM+SBM, but there was no significant effect on hemicellulose digestibility between RS or MS or CS rations when supplemented with CFM+U.

The CFM supplement resulted in higher cellulose digestibility ($P<0.05$) with MS ration than RS or CS rations, but the cellulose digestibility of RS ration was higher ($P<0.05$) than CS ration. Cellulose digestibility was higher ($P<0.05$) when RS or MS rations were supplemented with CFM+SBM than CS ration. The cellulose digestibility of RS ration increased significantly ($P<0.05$) than MS or CS rations when supplemented with CFM+U, but there were no significant effect between MS or CS rations.

There was no significant effect on ADL digestibility between RS, MS and CS rations when supplemented with CFM. The ADL digestibility of RS ration increased significantly ($P<0.05$) than MS or CS rations when supplemented with CFM+SBM, and on the other hand, ADL digestibility of MS ration was higher ($P<0.05$) than CS ration. The ADL digestibility of MS ration decreased significantly ($P<0.05$) than RS or CS rations when supplemented with CFM+U, and there was no significant effect between RS and CS rations.

It is clear that DCP% was higher ($P<0.05$) when RS or MS supplemented with CFM than CS ration, but there were no significant effect between the three tested low quality roughages when CFM+SBM or CFM+U were added.

## DISCUSSION AND CONCLUSION

Several attempts were made to upgrade the nutritive value of low quality feeds either by physical, chemical or biological treatments. Such methods are to a large extent successful, however there are warnings regarding pollution of the environment and hazards to human health.

The alternative safer ways to benefit from low quality feeds is either including them in complete rations or to fortify them with the defficient nutrient mainly protein or NPN sources to increase their fermentability in the rumen yielding more microbial protein synthesis and hence better feeding value and animal performance.

The objectives of the present study were therefore directed towards studying the use of three common roughages available in Egypt, mainly rice straw, maize stalks and clover straw. Three proteins and/or NPN supplements were tested in a 3 x 3 factorial design in an attempt to establish any possible interaction between type of roughage and the protein supplement nature. The three tested roughages were chosen to represent legumes (Clover straw, CS), and graminasae (Rice straw, RS & maize stalks, MS) which vary in the fiber fractions and the supplements to represent medium quality plant protein (Concentrate feed mixture, CFM), high quality plant protein (Soy bean meal, SBM) and/or urea (NPN).

The summative analysis of the ingredients (Table 1) used to formulate the experimental rations (Table 2) were within the normal published ranges (El-Ayouty, 1991; Maklad, 1996 and El-Ayek, 1996). The ash content of rice straw was higher than that of the other two roughages. This could be a false indication since it may be partly due to the possibility of its contamination with soil during storage or transportation. However, this was inversely reflected on their OM contents. Clover straw contained the highest CF (42%) followed by rice straw (36%) and then maize stalks (32%).

Ibrahim (1987) and Maklad (1988) showed that the nutritive values as DM% of rice straw was low in terms of energy and protein. The mean values of TDN% and DCP% were 43.2 and 1.92, respectively, and as such is of limited use in animal nutrition.

The CP of maize stalks was marginal to deficient and not adequate for ruminal microbial breakdown of ingested forage while the CF content as for other forages is high being 39.4% on average (Sundstøl, 1988).

With the objective of increasing the use of rougahges, six tested diets were formulated (two from each roughage) by almost doubling their ratio as in the respective control diets and reducing the traditional CFM as a protein supplement to less than one half by either high quality SBM (10%) or equivalent urea (1.2%).

These proportions were chosen to achieve isonitrogenous diets containing about 12% CP necessary for optimal utilization and fermentation of roughages in the rumen (Ørskov *et al.*, 1972). The target of 12% CP in each experimental diets was achieved in all diets since the ingredients were analysed before formulating the experimental diets.

Willms *et al.* (1991) studied the effect of I ncreasing CP level with SBM on nitrogen retention in lambs fed diets based on alkaline hydrogen peroxide treated wheat straw. These data are interpreted to indicate that maximal nitrogen retention and fiber digestibility in diets are obtained at 12% CP.

There were no significant effect between different tested roughages when supplemented with CFM, CFM+SBM and CFM+U on N-balance and TDN%.

As previously mentioned, the three control diets contained 60-75% CFM + 25-40% of the tested roughage. Such proportions were reversed in the two tested diets for each roughage plus altering the source of N. However, it was observed that the feeding values in terms of TDN were slightly reduced as summarized as follows:

| **Items** | **TDN %** | **Relative change from control %** |
|---|---|---|
| RS + CFM | 60.89 | 100 |
| RS + CFM + SBM | 57.35 | 94.20 |
| RS + CFM + U | 62.10 | 102.0 |
| MS + CFM | 67.95 | 100 |
| MS+ CFM + SBM | 58.95 | 86.80 |
| MS + CFM + U | 54.66 | 80.40 |
| CS + CFM | 60.21 | 100 |
| CS + CFM + SBM | 53.01 | 88.00 |
| CS + CFM + U | 53.38 | 88.70 |

The present results showed that the lower digestibility with higher DMI of rations containing CS than RS or MS as follows:

| **Items** | **RS** | | | **MS** | | | **CS** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **CFM** | **CFM + SBM** | **CFM + U** | **CFM** | **CFM + SBM** | **CFM + U** | **CFM** | **CFM + SBM** | **CFM + U** |
| NDF dig.% | 51.83 | 60.82 | 63.43 | 59.90 | 58.98 | 45.89 | 49.99 | 44.74 | 49.38 |
| ADF dig./% | 55.74 | 62.07 | 62.47 | 65.35 | 57.48 | 39.77 | 39.36 | 42.13 | 44.21 |
| DMI (g/day) | 967.50 | 612.43 | 705.06 | 868.60 | 712.93 | 817.40 | 921.50 | 887.46 | 907.16 |
| TDN% | 60.89 | 57.35 | 62.10 | 67.95 | 58.95 | 54.66 | 60.21 | 53.01 | 53.38 |

This shows clearly that for tested RS diets, the fermentable NDF of RS was appreciably increased with CFM + SBM supplement which might explain the slight reduction in the TDN of the whole diet. It was surprising to record that the TDN of the diet containing CFM+U was even slightly higher than the control despite the small improvement in the fermentable NDF and the appreciable reduction in the fermentable ADF. However, it was observed that the rate of ADF disappearance of such diet was much faster than when CFM+SBM was used allowing faster cell wall breakdown and possibly longer retention time in the rumen (Nandra *et al.*, 1993), which might partly explain the slight improvement in the TDN value (see Mehrez *et al.,* 2001).

Regarding MS diets, the fermentable amounts of DM, NDF and ADF were all increased by either CFM+SBM or specially with CFM+U.

Clover straw diets responded differently since the fermentable DM was not affected by either supplements, while those of NDF and ADF were slightly reduced with CFM+U, but were not affected when CFM+SBM was used.

This would clear the interaction between roughage type and type of supplement to be used. It is necessary and recommended therefore that in future studies in similar area, retention times of solid and liquid phases should be determined to enable clear explanation of such interactions.

Hagemeister *et al.* (1981) reported that the greatest utilization of energy for microbial protein synthesis has been suggested when diets contained 30 roughage and 70% concentrate. Mixture of forage and concentrate fed to cows should result in greater and more efficient microbial growth than either concentrate or forage alone, possibly because of optimization of availability of fermentable substrate and increased rate of passage of digesta from the rumen. The decrease in efficiency of microbial protein passage to the small intestine when diets containing more than 70% concentrate are fed may occur because of a rapid rate of NSC degradation which could result in an uncoupled fermentation. The uncoupled fermentation occurs because energy is released much faster than it can be trapped and utilized for growth by ruminal bacteria. Adding forage to diet that is high in concentrate may allow ruminal bacteria to utilized the energy for growth more efficiency because the energy is released in more uniform pattern throughout the day.

On the other hand, Evans (1981 a&b) showed that when high forage diets are fed it may decrease the quantity and efficiency of passage of microbial protein to the small intestine which may be attributed to at least two factors: (1) A deficiency of available energy (NSC) will cause slow growth of microbes and greater lysis of microbes in the rumen as a result of slower rate of passage of microbes from the rumen. (2) Rate of passage of microbes from the rumen was slower because microbes attach to larger particles and this increase recycling of energy and nitrogen in the rumen. These conditions in the rumen cause a larger quantity of energy and N to be utilized for maintenance rather than for growth of the bacteria.

Clark *et al.* (1992) reported that factors other than the amount of OM fermented in the rumen affect efficiency of microbial protein synthesis. These factors are probably the amount and proportion of other nutrients provided in the diets. The synchronization of degradation of feed ingredients to provide nutrients at all time to meet the requirement for growth of rumen bacteria and environmental conditions in the rumen. Among the ester-linked cell wall components, acetyl groups and *P*-coumaric acid generally have lower disappearances than ferulic acid (Titgemeyer *et al.,* 1991).

With regard to the feeding value of the experimental rations, it should be pointed out that the rations were initially formulating relying on the publishing feeding values of the constituents. They were then evaluated *in vivo* during the experiments.

Both calculated* and actually determined values could be summarized as follows:

| Formula | TDN% | | DCP% | |
|---|---|---|---|---|
| | Calculated | Determined | Calculated | Determined |
| RS+CFM | 55.98 | 60.89 | 7.48 | 8.46 |
| RS+CFM+SBM | 51.51 | 57.35 | 8.26 | 8.89 |
| RS+CFM+U | 48.80 | 62.10 | 8.15 | 9.61 |
| MS+CFM | 57.47 | 67.95 | 7.30 | 9.05 |
| MS+CFM+SBM | 54.13 | 58.95 | 7.90 | 8.67 |
| MS+CFM+U | 51.78 | 54.66 | 7.79 | 7.67 |
| CS+CFM | 59.62 | 60.21 | 7.64 | 7.87 |
| CS+CFM+SBM | 58.47 | 53.01 | 8.21 | 9.49 |
| CS+CFM+U | 52.47 | 53.38 | 8.27 | 8.66 |

***(RS= 1.61% DCP, 41.7% TDN), (MS=1.0% DCP, 46.66% TDN),**
**(CS= 4.1% DCP, 55.9% TDN), (SBM= 43% DCP, 75% TDN),**
**(CFM= 10% DCP, 62.1% TDN) & (Urea= 280% CP).**

These values indicate that the determined DCP values were very close to those based on calculation for almost all the rations.

On the other hand, the determined TDN values were appreciably higher than the corresponding calculated values for all RS and MS containing rations indicating positive associative effects. The calculated and determined values of CS rations were almost similar except in case of CS+CFM+SBM where the determined value was lower indicating negative associative effect which is difficult to explain.

Associative effects related to varying roughage to concentrate ratio was studied in detail and reviewed in a previous study (Ead, 1982) during which it was also possible to quantitively predict the associative effect. It was not possible to apply such approach during the present study because it was not possible to feed each ingredient as a sole feed.

The influence of protein supplements varied with the type of the roughage used to formulate the ration even at the same proportion, i.e. CFM+U was better for RS while CFM+SBM was better for MS while there were no particular trend with CS.

This was statistially proved by the significant interaction such trends could be partly explained by the synchronization of availability of energy (VFA) and $NH_3$ release during fermentation in the rumen which is the site of 90% of fiber digestion (Petit and Veira, 1994).

Another possible reason is the supply of certain performed amino acids from concentrates by certain species of rumen microbes (Hungate, 1966). Urea, on the other hand, would only supply $NH_3$ at a fast rate and declines quickly before energy is available especially when low quality roughages are used at high proportions.

Although the feeding values of the proposed rations in which the roughage constituents between 60 to 75% of the ration and the protein supplement (CFM, CFM+SBM and CFM+U) between 25 and 40% were lower than those commonly applied (60-70% concentrate + 30-40% roughage) mainly because the increased roughage contribution having lower feeding value, yet the feeding values of the proposed rations were not less than 52% TDN.

Such value is recommended and sufficient for local dairy cows and beef cattle during the first stages of growth and generally for ruminants of medium production level (Ministry of Agriculture, 1996).

In addition, increasing the proportion of roughage and reducing concentrates did not adversely affect voluntary feed intake, a faster which has a great bearing on the value of roughage since the roughage index is a function of nutritive value and voluntary feed intake.

From an economical point of view, it should be pointed out that although the feeding values of the proposed rations were decreased by almost 10 to 12 percentage TDN units, without appreciably affecting DCP values, yet the price of one unit of TDN from the proposed rations using any supplement was much less from those commonly used by producers (control). This could be illustrated as follows:

| Formula | The cost (LE/ton) | TDN (Kg/ton) | LE/Kg TDN | Benefit rate (%) |
|---|---|---|---|---|
| 30% RS+70% CFM | 555 | 608.9 | 0.91 | - |
| 60% RS+30% CFM+10% SBM | 365 | 573.5 | 0.63 | 30.7 |
| 60% RS+38.8% CFM+1.2% U | 351 | 621.0 | 0.56 | 38.5 |
| 30% MS+70% CFM | 555 | 679.5 | 0.81 | - |
| 60% MS+30% CFM+10% SBM | 365 | 589.5 | 0.61 | 24.69 |
| 60% MS+38.8% CFM+1.2% U | 351 | 546.6 | 0.64 | 20.98 |
| 4% CS+60% CFM | 490 | 602.1 | 0.81 | - |
| 75% CS+17% CFM+8% SBM | 266 | 530.1 | 0.50 | 38.27 |
| 75% CS+24% CFM+1.0% U | 255 | 533.8 | 0.47 | 41.97 |

*** Price of one ton "LE" of: CFM = 750; Roughage = 100 and SBM = 800).**

On a national scale, the replacement of 33.5% of the concentrates in ruminant rations by roughages as applied in the present study during the proper protein supplements could save up to 500.000 tons of the 2 million tons annualy produced in Egypt (25%). The saved amounts of CFM could be used to formulate untraditional complete diets which could participate in narrowing the gap in feed shortage. Alternatively, they can be used to raise more animals to increase the per capita from animal protein sources in Egypt.

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## تأثير بعض المصادر الأزوتية على تخمر وهضم بعض الأعلاف الخشنة الفقيرة
## ٢. معاملات هضم وكمية المأكول وميزان الآزوت والقيمة الغذائية للعلائق.

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أجرى هذا البحث بهدف دراسة تأثير مصادر آزوتية على تخمر وهضم العلائق التى تحتوى على مواد علف خشنة فقيرة بالإضافة إلى بعض مقاييس التخمر فى كرش الأغنام.أجريت هذه الدراسة بمحطة البحوث والتجارب التابعة لقسم الإنتاج الحيوانى بكلية الزراعة جامعة المنصورة.

وخلال الدراسة تم إختيار ثلاثة أعلاف خشنة فقيرة شائعة الإستعمال وهى:

١- قش الأرز. ٢- حطب الأذرة. ٣- تبن البرسيم.

وقد تم تكوين العلائق التالية كعلائق مقارنة فى الحدود التالية:

٣٠% قش أرز + ٧٠% علف مصنع.

٣٠% حطب أذرة + ٧٠% علف مصنع.

٤٠% تبن برسيم + ٦٠% علف مصنع.

وقد تم مضاعفة إستخدام الأعلاف الخشنة وتقليل إستخدام المركزات (مرتفعة الثمن) كهدف للدراسة مع دراسة تأثير بعض الإضافات البروتينية الحقيقية "كسب فول الصويا" أو غير الحقيقية "يوريا" لعمل خلطات علفية عالية القيمة الغذائية ، وكانت الخلطات المختبرة متساوية فى محتواها البروتينى (١٢%) وكانت على النحو التالى:

١- ٦٠% قش أرز + ٣٠% علف مصنع + ١٠% كسب فول صويا.

٢- ٦٠% قش أرز + ٣٨,٨% علف مصنع + ١,٢% يوريا.

٣- ٦٠% حطب أذرة + ٣٠% علف مصنع + ١٠% كسب فول صويا.

٤- ٦٠% حطب أذرة + ٣٨,٨% علف مصنع + ١,٢% يوريا.

٥- ٧٥% تبن برسيم + ١٧% علف مصنع + ٨% كسب فول صويا.

٦- ٧٥% تبن برسيم + ٢٤% علف مصنع + ١% يوريا.

وقد إستخدم ٣ كباش تامة النمو متوسط وزنها حوالى ٤٥ كجم فى إجراء ٩ تجارب هضم وإتزان أزوتى لهذه العلائق.

**وقد كانت النتائج المتحصل عليها كما يلى:**

**أولاً: تأثير المعاملات على هضم قش الأرز:**

١- لم تظهر المعاملات تأثيراً معنوياً على هضم كل من المادة الجافة، المادة العضوية، البروتين الخام ، مستخلص خالى الأزوت ، ميزان الأزوت، المركبات المهضومة الكلية والطاقة الممثلة.

٢- كان هناك تحسن فى هضم الألياف نتيجة إضافة كل من كسب فول أو اليوريا للخلطات وخاصة عند إضافة الاليوريا حيث كان التأثير معنوياً على مستوى ١% مقارنة بالخلطات التى بها العلف المصنع فقط. كانت معاملات هضم الألياف عند إضافة كل من العلف المصنع أو العلف المصنع + كسب فول الصويا أو العلف المصنع + اليوريا هى ٥٨,٣٥ ، ٦٥,٣٣ ، ٦٨,٤٦% على التوالى.
كما أشارت النتائج إلى أن هضم NDF كان بنفس التأثير فى هضم الألياف .

٣- كان هناك تأثير معنوى عند إضافة كل من كسب فول الصويا أو اليوريا على هضم الهيميسليولوز. لم يكن هناك تأثير معنوى على هضم السليولوز نتيجة الإضافات.

٤- تحسن هضم اللجنين بإضافة الكسب فول الصويا معنوياً عن الخلطات التى بها العلف المصنع فقط أو اليوريا .

٥- زادت كمية المأكول معنوياً (٥%) بالخلطات التى بها العلف المصنع فقط

٦- كانت كمية النتروجين المحتجز بمعدل أكبر بالخلطات التى بها العلف المصنع فقط .

٧- كانت نسبة المركبات المهضومة (TDN%) والبروتين الخام المهضوم (DCP)عند إضافة اليوريا أعلى من الخلطات التى بها العلف المصنع فقط أو الخلطات التى بها كسب فول الصويا

**ثانياً: تأثير المعاملات على هضم حطب الأذرة:**

١- لم تظهر المعاملات تأثيراً معنوياً على هضم كل من المادة الجافة ، البروتين الخام ، ميزان الأزوت والمركبات الكلية المهضومة والطاقة الممثلة.

٢- إنخفضت معنوياً (P<0.05) معاملات هضم المادة العضوية بإضافة الكسب فول الصويا أو اليوريا مقارنة بالخلطات التى بها العلف المصنع فقط .

٣- إنخفض أيضاً معامل هضم الألياف ADF (P<0.05)عند إضافة اليوريا .

٤- تحسن (P<0.05)هضم اللجنين بالخلطات المضاف إليها كسب فول الصويا .

٥- تشير النتائج إلى زيادة كمية المأكول معنوياً (٠,٠٥%) مع إضافة العلف المصنع فقط .

٦- لم تظهر النتائج فروقاً معنوية فى كمية النتروجين المحتجز بين مصادر الإضافات الآزوتية المدروسة

٧- لم تكن هناك فروقاً معنوية على TDN% بين الإضافات المدروسة وإن كانت نسبة DCP أعلى معنوياً على مستوى ٠,٠٥% عند إضافة العلف المصنع فقط أو مع إضافة كسب فول الصويا.

**ثالثاً: تأثير المعاملات على تخمر وهضم تبن البرسيم:**

١- أظهرت النتائج أن هناك تأثيراً معنوياً (٠,٠٥%) عند التغذية مع الخلطات التى بها العلف المصنع فقط والخلطات المضاف إليها اليوريا

٢- لم يكن هناك تأثير معنوى نتيجة الإضافات على هضم كل من المادة الجافة ، مستخلص خالى الازوت ، ميزان الأزوت ، المركبات الكلية المهضومة والطاقة الممثلة.

٣- تحسن هضم اللجنين مع إضافة العلف المصنع + اليوريا مقارنة بالخلطات التى بها العلف المصنع فقط أو العلف المصنع + كسب فول الكسب فول الصويا (٢٤,٥٢ ، ٣,٧٩ ، ١٤,٢٨% على التوالى).

٤- لم تتأثر كمية المأكول بالإضافات مع كل من العلف المصنع فقط أو العلف المصنع + كسب فول الكسب فول الصويا أو العلف المصنع + اليوريا.

٥- لم تظهر فروق معنوية على معدل النتروجين المحتجز مع الإضافات السابقة .

٦- كذلك لم يكن لنفس الإضافات السابقة تأثير معنوى على قيم الـ TDN% وإن أظهرت الإضافات تحسناً ملحوظاً معنوياً فى قيم البروتين الخام المهضوم DCP% للخلطات التى بها العلف المصنع + كسب فول الصويا عن الخلطات المضاف إليها العلف المصنع فقط ، بينما لم يكن هناك تأثير معنوى بينها وبين العلف المصنع + اليوريا (٩,٤٩ ، ٧,٨٧ ، ٨,٦٦% على التوالى).

تبين النتائج أن القيمة الغذائية للخلطات العلفية المقترحة (٦٠-٧٥% خشن + ٢٥-٤٠% مركز) بدلاً من الخلطات التقليدية (٦٠-٧٠% مركز + ٣٠-٤٠% خشن) التى تستخدم عادة لدى المربين (علائق المقارنة) تختلف فيما بينها بإختلاف نوع مادة العلف الخشنة ،ولكن تلك العلائق لم تقل قيمتها الغذائية عن ٥٢-٥٥% فى صورة مركبات غذائية مهضومة (TDN) وهذا الموصى به فى الأعلاف المقدمة

لحيوانات اللبن المصرية والمرحلة الأولى من التسمين والتى تعتبر قيمة غذائية جيدة خاصة للحيوانات ذات الإنتاجية المتوسطة سواء لإنتاج اللحم أو اللبن.

وبالرغم من إنخفاض القيمة الغذائية نتيجة لزيادة نسبة العلف الخشن فى الخلطة العلفية بمقدار ١٠-١٢% وحدة مئوية TDN دون تأثير على DCP فإن تكلفة وحدة TDN من الخلطات المقترحة أقل بكثير من وحدة TDN فى علائق المقارنة حوالى (٤٠%) مما يؤدى إلى خفض تكلفة التغذية مع توفر الإحتياجات اللازمة للإنتاج.

هذا بالإضافة إلى أن إحلال مواد العلف الخشنة الفقيرة محل حوالى ٣٣,٥% من العلف المصنع مع إستخدام إضافات من المصادر الآزوتية يؤدى إلى توفير حوالى (٥٠٠ ألف طن) من العلف المصنع المنتج سنوياً والذى يقدر بحوالى ٢,٠ مليون طن. وبذلك يمكن إستخدام هذه الكمية المتوفرة لتصنيع أعلاف متكاملة غير تقليدية لسد جزء من العجز فى الموازنة العلفية أو التوسع فى تربية أعداد من الحيوانات لتساهم فى زيادة نصيب الفرد من البروتين الحيوانى فى مصر.