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# USE OF BANANA WASTES AS HAY OR SILAGE FOR FEEDING RUMINANTS:

## 1- INFLUENCE OF DIFFERENT ADDITIVES ON THE QUALITY AND FEEDING VALUE OF SILAGE MADE FROM BANANA WASTES, COMPARED WITH BANANA HAY.

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## ABSTRACT

This work was designed to process banana wastes as hay and trying to improve its utilization by ensiling either untreated or supplemented with one of two kinds of bacteria inoculants . Determination of silage quality and anti – nutritional factors were studied .The effect of replacing clover hay by banana wastes as hay or untreated or treated silage on DM intakes , digestion coefficients , nutritive values and nitrogen balance. About 650 Kg banana hay were prepared and three tested silages in sixty plastic barrels (20 for each treatment ) with a capacity of 7.5 tons ( 2.5 tons each ) were used for ensiling the untreated silage , silage inoculated by H/MF inoculants ( homo fermentative acidophilic bacteria ) or inoculated by 11C33 inoculants ( Dual purpose contains homofermentative and hetrofermentative lactic acid bacteria ) .

The results indicated that all banana silages were excellent have a firm texture , good smell , free from signs of molds , dust smells , caramelized and tobacco or vinegar . All silages had a normal of pH ( 3.70 to 4.03) with the superiority of those treated by 11C33 inoculants . The overall means of TVFA's ranged between 7.15 to 7.85 ml mol / 100 ml , being higher for treated silages . Silage treated by (11C33 ) inoculants recorded the least concentration of $NH_3$ – N (2.12 % ) . The fast rate of pH decline with inoculants silages imply a quick establishment of anaerobic in the silo and minimizing time of ensiling by two weeks . Silage treated with dual purpose bacteria inoculants (11C33) remained unspoiled and markedly improved aerobic stability of silage . The ensiling of banana wastes either with or without additives depressed the presence of some anti – nutritional factors . The results showed that fed rams with ensiled banana wastes either untreated or inoculated increased significantly ( $P<0.05$) the digestibility of OM , CP , CF , NDF and ADL and improved significantly ( $P< 0.05$ ) TDN and DCP values. Ensiling banana wastes with dual purpose bacterial inoculants had big advantages , improved the aerobic stability of silage and participate in feeding animals and minimize such problems of disposal pollution .

**Keywords** : Bacteria inoculants , silage , disposal pollution , aerobic stability

## INTRODUCTION

Animal feeds are expensive and due to its continuously increasing prices, it become necessary to use the agricultural by – product as compensatory feeds for feeding animals . In Egypt , many million tons of agricultural cellulose wastes are produced annually, only few amounts of these crop – residues are used for ruminant feeding . The remain of the crop

– residues are burned or wasted hence contributing to environmental pollution and subsequent health hazards .

Banana wastes is available in Egypt all year round and can be used to replace clover hay in animal feeds in Egypt ( Abd EL – Gawad *et al* ., 1994). The major costs of the use of this material are transportation , processing and storage since these residues can be obtained at almost no cost .

The annual cultivated area from banana plants in Egypt was about 45,000 feddans (Ministry of Agriculture and Reclaiming Land, 2005 ). The wet material (Leaves and pseudostems ) is about 40 tons per feddan. The total wet material is about 1,800.000 tons which is estimated to be about 130.000 tons dry matter . These amounts are usually burned causing environmental pollution. The potential use of the banana plants wastes in ruminant rations has been investigated before ( Horn *et al* . , 1988 , EL – Shewy , 1998 , Shoukry *et al* . , 1999 , Khattab *et al . ,* 2000, EL – Ashry *et al* . , 2003 and Hassan *et al* . , 2005 ) .

Some problems such as containing of anti-nutritional compounds could be found in these wastes as animal feed . Using different treatments to breakdown linkages among cellulose and tannins compounds could improve digestibility of banana wastes ( Reichert *et al* . , 1980 , Mc Grath *et al* . , 1982 and Russell and Lolley . , 1989 ) .One of several efficient extensive researches to solve such problems is ensiling process , which aimed to process a cheap , high quality and fresh feed in silage form .

Silage additives can be a helpful management tool in aiding and improving silage fermentation . Since inoculants has been introduced in the Egyptian market in commercial scale , Thus one of the main objectives of the present study was to compare between two kinds of bacteria inoculants. The first contained numerous homofermentative acidophilic bacteria . This inoculants improved the efficiency of the fermentation process and enhanced the quality of silage.

The main objectives of this work were to study the possibility of utilizing banana wastes as unconventional feed source for ruminants and trying to improve its nutritive value by hay and silage making . A comparison between untreated and treated silages was also investigated. The parameters studied were silage quality , aerobic stability , anti-nutritional factors , nutrients digestibility , digestion coefficients , nutritive values and nitrogen balance .

## MATERIALS AND METHODS

This study was conducted at Regional Center for Food and Feed, Agric Rec. Center, Ministry of Agriculture and Animal Production Department, Faculty of Agric, Cairo University during the period from 2005 to 2008.

The experiment was designed to process banana plant wastes as hay and trying to improve its utilization by ensiling either untreated or treated with bacterial inoculants. Determination of silage quality and anti – nutritional factors were studied. The effect of replacing clover hay by banana plant wastes as hay or untreated or treated silage on DM intakes, digestion coefficients and nutritive values were also investigated .

**Processing as hay:**

Fresh plant wastes (leaves and stems) were collected from EL. Knater and some villages 30 Km around Giza. The plants were manually harvested and immediately were transported to the lab. The stock of about four tons allowed to be dried in sun after being chopped (about 10-15 cm length). The plants were sun dried and shuffled upside – down and mixed well every day for 25 days to become acceptable for animals. After the moisture content reached 12%, the stock was carried out to ground up to (3-5 cm length). A representative samples were taken and kept in tight plastic container for chemical analysis, the rests were stored for running the digestibility trials.

**Processing as silage :**

Fresh plant wastes were harvested immediately and chopped (10 – 15 cm / length) and left to dry in the sun for a period of about 4-7 days to reach and average moisture content of about70%, The silages were made in hard plastic barrels with a capacity of about 120Kg , each. Sixty plastic barrels were filled with the three tested silages (20 for each treatment) .The three different silage forms were : 1) without any additives , 2) inoculated by 1.4 Kg H/MF inoculants /liter water /ton fresh material {producing bacteria not less than 5 billion CFU·s /g (content dried *pediococcus acidilactics* fermentation product, dried *lactobacillus plantarm* fermentation product)} and 3) inoculated by 1g 11C33 inoculants / liter water / ton fresh material ( dual purpose containing total viable lactic acid producing 110 billion ($1.1X10^{11}$) colony forming unites (CFU)/g from multiple strains of *lactobacillus buchneri*, *lactobacillus plantarum* and *entrococcus faecium*.).The content of barrels were pressed by hand and stocked by trampling to exclude the air condition. Finally, each barrel had a tight sealed cover with heavy stones to ensure anaerobe conditions. Silage barrels were kept in closed room during, the ensiling period which lasted for 56 days , then the samples were taken to test the physical and fermentative characteristics . Color and oder of silages were examined to test the physical and fermentative characteristics. Samples were taken after eight weeks for chemical analysis. Silage samples were extracted using20g homogenized wet material with 100 ml distilled water in warm blender for 10 minutes (Waldo and Schulty, 1956). Each homogenized sample was filtrated through a double layer of cheese cloth and then the solution was refiltrate through filter paper until it becomes perfectly clear , then the filtrate was used to determine silage pH by using Orion 680 digital pH meter. The concentration of total VFA·s was determined according to the method of Warner (1964). Ammonia nitrogen was determined using saturated solution of magnesium oxide distillation according to the method of AOAC (1990). The DM in fresh samples was determined by drying samples in oven at $85C^0$ for 48 h. Dry matter losses were estimated by measuring differences in silo weights before and after ensiling. Aerobic stability was determined in all silages after silo opening. Three replicate 800 g silage samples from each treatment were placed in a suitable container. Silages were exposed to air at room temperature (25 $C^0$) and a thermometer was placed in the geometric center of the silage mass. A double layers of cheesecloth was placed over

each container , to prevent drying and contamination, but allowing penetration of air. Ambient temperature and the temperature of were recorded each silage every 6 h. Aerobic deterioration was denoted by a 1 $C^0$ rise above ambient temperature changes. With time temperature were monitored for 144 h. Aerobic stability was defined as the number of hours the silage remained stable before rising more than 2 $C^0$ above the ambient temperature (Morane *et al.,* 1996).

In order to determinate silage quality during periods, fifteen polyethylene bags (500g) were filled with chopped materials of three tested silages (5 for each treatment).The bags were pressed by hand to exclude the air condition and then sealed to reach an ideal anaerobic. One bag from the treatments were opened at 4,5,6,7 and 8 weeks of ensilage. The previous analyses procedures were followed for pH, NH3-N and total VFA's determinations.

Photochemical screening were carried out on the different forms of banana plant wastes and clover hay for the sake of comparison to predict and roughly estimate the presence of anti-nutritional components, which might negatively affect banana wastes as feed recourses for animal (Glycosides was estimated according to the method of Vogel ( 1956 ) . Tannins and Alkaloids were determined as described by Wall et al ( 1954 ) . Estimation of Flavonoids was done by Shinoda test and Anthra Quinone was detected according to Ramstod ( 1959 ) .

Five metabolism trails were carried out with three mature rams to determine digestibilities, nitrogen balance and nutritive values of the different forms of banana plant wastes when given in rations with sheep as hay or silage compared with ration contains clover hay ,using three mature Rahmany rams aged 24 months with 62 Kg live weight. Each trial continued for 31 days in which the collection period lasted ten days .

Five experimental rations were formulated to cover maintenance requirements of mature sheep according to NRC (1985) as follows:

Ration 1- 500g CFM + 500g CH (clover hay )
Ration 2- 500g CFM + 500g BWH (banana wastes hay)
Ration 3- 500g CFM + 1500g UBWS (untreated silage)
Ration 4- 500g CFM + 1500g TBWS (H / MF) (silage treated with H/MF)
Ration 5- 500g CFM + 1500g TBWS (11C33) (silage treated with 11C33)

Ensuring to cover maintenance requirements minerals and vitamins mixture supplement 20g /h/d was mixed with the CFM before offering. Fresh water was available at all times. The chemical analysis of feed ingredients of the experimental rations used in feeding rams in metabolism trials were presented in Table (1).

The collection feces (10 days collection) of each animal was well mixed and then dried at 60$c^0$ for 48 hours. Samples were taken for determination of dry matter. The remaining feces were finally ground for proximate chemical analyses. The representative samples of the different ingredients, experimental rations and faces were chemically analyzed for DM, CP, CF, EE, and ash determinations according to the official of AOAC (1990) methods. Fiber constituents, neutral detergent fiber (NDF) was determined

according to Van Soest and Marcus (1964).While acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by Robertson and Van Soest procedures (1981). Metabolisable energy (ME) was calculated as 3.56 M cal per 1Kg TDN (Mc Donald *et al* ,. 1973) .

**Table (1): Chemical analysis of feed ingredients used for formulation the experimental rations used in feeding rams.**

| Item | | On DM basis (%) | | | | | |
|---|---|---|---|---|---|---|---|
| **Ingredients** | **DM** | **OM** | **CP** | **CF** | **EE** | **NFE** | **Ash** |
| CFM* | 89.56 | 94.77 | 15.88 | 9.45 | 2.55 | 66.89 | 5.23 |
| Clover hay (2nd cut) | 90.00 | 91.80 | 13.10 | 29.10 | 2.20 | 47.40 | 8.20 |
| Fresh banana wastes (BCW) | 12.80 | 82.12 | 11.94 | 35.10 | 2.15 | 33.13 | 17.68 |
| Banana wastes hay (BWH) | 88.19 | 81.48 | 10.27 | 36.15 | 3.11 | 31.95 | 18.52 |
| Banana wastes silage (BWS) | 29.85 | 83.11 | 12.58 | 27.11 | 3.12 | 40.30 | 16.89 |
| Banana wastes silage inoculated by (H/MF) inoculants | 30.55 | 85.72 | 13.69 | 25.11 | 3.15 | 43.77 | 14.28 |
| Banana wastes silage inoculated by (11C33) inoculants | 31.12 | 86.82 | 14.85 | 22.15 | 3.11 | 46.71 | 13.18 |
| N D F | 24.92 | 51.24 | 53.15 | 54.11 | 52.15 | 51.61 | 50.33 |
| A D F | 12.33 | 39.87 | 43.15 | 44.20 | 42.11 | 40.15 | 39.20 |
| A D L | 9.56 | 3.12 | 8.04 | 5.02 | 1.78 | 1.04 | 1.09 |
| Hemi cellulose | 12.59 | 11.37 | 10.00 | 9.91 | 10.04 | 10.46 | 11.13 |
| Cellulose | 2.77 | 36.75 | 40.11 | 39.18 | 40.33 | 39.11 | 38.11 |

At the end of metabolism trials animals were group fed on the experimental rations according to treatments to determine dry matter intake . The feeding system followed during this period which lasted for 30 days was based on offering restricted amount of concentrate feed mixture at 8.00 am to provide animals with 40% of their requirements from TDN, while clover hay, banana wastes hay or untreated or treated silages were added ad-lib to the animals at 12.00 am to cover the rest (60%) of their requirements Feed offered and feed refusals were weighted daily in each pen prior to feeding at 8.00 am.

Data were analyzed using the general linear model procedure of SAS (1996). The differences among means were carried out according to Duncan's New Multiple Range Test (Duncan, 1955).

## RESULTS AND DISCUSSION

**Evaluation of ( banana wastes residue) as hay and silages :**

In order to make animal feeds from the huge quantities of banana plant wastes, methods for reducing the moisture content for hay making must be used. The results showed that a period of about 20 – 25 days was enough for drying banana plant wastes to be used as hay (from 15/3/2005 to 10/4/2005).

Proximate chemical composition of feed ingredients used is presented in Table (2) .The results showed that the chemical composition of concentrate feed mixture (CFM) and clover hay were in agreement with that obtained by EL – Shinnawy (2003) and Ali (2005). The data indicated that the

values of DM , CP , CF , EE , NFE and ash of banana wastes hay ( BWH ) full within the corresponding ranges reported by FAO (1975 ) . The DM , CP , CF , EE , NFE and ash content of untreated banana silage were in line with those obtained by Shoukry *et al* ., (1999) and Hassan *et al .,* (2005 )

It could be observed that silage making resulted in decreasing CF , NDF , ADF and ash ,contents but increasing NFE compared with that of banana wastes hay . The organic matter and CP contents of treated silages were higher than those of untreated silage and banana wastes hay . The DM contents were nearly similar for UBWS, TBWS ( H / MF ) or TBWS ( 11C33 ) , respectively . Reduction in cell wall components was observed with banana silage either untreated or treated with inoculants . However , NDF was reduced by about 1. 88 , 2. 90 and 5. 36 % , respectively compared with that of banana wastes hay. These could be due to the effect of the enzymes produced by the anaerobic bacteria in silage . These results were agreed with that reported by , Shoukry *et al .* (1999 ) , EL – Shewy ( 1998 ) and Hassan *et al* . , (2005) .

Results concerning the silage quality of the three forms of silages during different ensilage periods, up to 8 weeks are presented in Table (2).

**Table (2) : Characteristics of untreated and treated banana silages during the ensilage periods .**

| Period | pH | | | Total VFA's ml (mol / 100 ml) | | | NH3 – N as % of total N | | |
|---|---|---|---|---|---|---|---|---|---|
| | Untreated silage (UBWS) | TBWS (H/MF) | TBWS (11C33) | UBWS | TBWS (H/MF) | TBWS (11C33) | UBWS | TBWS (H/MF) | TBWS (11C33) |
| 4weeks | 5.11 | 4.75 | 4.39 | 2.25 | 2.74 | 2.81 | 5.15 | 4.81 | 4.51 |
| 5weeks | 4.82 | 4.56 | 4.38 | 2.61 | 2.95 | 3.10 | 4.81 | 4.51 | 4.12 |
| 6weeks | 4.62 | 4.05 | 4.05 | 3.22 | 3.65 | 3.95 | 3.71 | 3.45 | 3.20 |
| 7weeks | 4.20 | 3.95 | 3.85 | 3.31 | 3.75 | 4.10 | 3.10 | 3.15 | 2.81 |
| 8weeks | 4.08 | 3.81 | 3.75 | 3.61 | 3.92 | 4.41 | 2.75 | 2.61 | 2.03 |

The pH value is an important criteria of the chemical characteristics which reflects the changes occurred during ensiling . At the same time , it is considered the simple method to predict the silage quality. At 5 weeks , inoculants treatments of silage , resulted in much lower pH than untreated silage . The fast rate of pH decline with inoculants silages imply a quick establishment of anaerobic conditions in the silo , which in turn promote a growth of lactic acid and minimize time of ensiling by about two weeks . These results are in agreement with those obtained by Yacout (2001) and EL – Shinnawy (2003) . Similar result was obtained by Shoukry *et al*., ( 1999) they found that pH value of banana wastes silages ranged from 3.8 to 4.2 . At week 7 of ensiling , pH value of all silages reached a plateau between 3.85 and 4.20 with a trends lower pH value with treated silages which indicates good silage fermentation .

The content of TVFA's are used for judging silage quality. Results in Table (2) indicated that TVFA's concentration of silages ranged between 3.61 – 4.41 ml mol / 100 ml by week 8 . The total VFA's values tended to be higher

with inoculated silages . The high quality silage is characterized by high total VFA's concentration (Langston *et al* . , 1958 , and Etman *et al* ., 1994 ) .

Results in Table (2) showed that by week 8 of ensiling NH3 – N concentrations of the three silages ranged between 2. 75 to 2. 05 % of DM with a tendency to be lower with treated silages than untreated one . The protein breakdown is almost inhibited with decreasing pH value, this might be due to that lactic acid organisms help to reduce the breakdown of protein to ammonia ( Virtanen , 1934 ) . These results are in agreement with the finding of Hieu (1969 ) and Abd EL – Malik ( 1972)

Silage quality used in metabolism trials :

Physical properties were used to judge silage quality as they were practical and require no reference to a laboratory . The results showed that all experimental silages at the end of ensilage period ( 8 weeks ) were yellowish green , having good smell , free from signs of molds , dust smells , caramelized and tobacco or vinegar . The silages were excellent and have a firm texture .

Results in Table ( 4 ) showed that the overall mean of pH values of all silages a appeared to be within normal range ( 3.7 to 4.03 ) , with the superiority of TBWS ( 11C33 ) followed by TBWS ( H / MF ) and then untreated one . Generally , a good quality silage should have a pH value of 4.2 or less (Mc Donald *et al* . , 1995 ) . The obtained results indicated a good quality silage and were within the values obtained by Shoukry *et al* . , (1999) .

**Table (3) : Characteristics of untreated and treated banana wastes silages used in metabolism trials .**

| Item | Untreated silage (UBWS) | TBWS (H / MF) | TBWS (11C33) |
|---|---|---|---|
| Dry matter (DM) % | 29.85 | 30.55 | 31.12 |
| Crude protein, % DM | 12.58 | 13.69 | 14.85 |
| Ash , % DM | 16.89 | 14.28 | 13.18 |
| pH | 4.03 | 3.86 | 3.70 |
| Lactic acid % | 4.98 | 5.33 | 5.19 |
| Total VFA's % | 7.15 | 7.85 | 9.82 |
| Acitic acid % | 1.11 | 1.51 | 3.85 |
| $NH_3$ – N as % DM | 2.71 | 2.55 | 2.12 |

Results in Table (3) indicated that the overall means of TVFA's concentrations were higher for treated silages . These results are more close to the values obtained by Shaver *et al* . , (1985 ) and Etman *et al* . , (1994 ) with corn silage and related to the pH values results.

The $NH_3$ -N concentrations were within the normal range given by Longston *et al* . , (1958 ) being 1.02 to 3.62 % of DM . Untreated silage recorded the highest concentration of $NH_3$ – N as % DM (2.71 % ) , while TBWS (11C33 ) recorded the least value ( 2.12 % ) . These results indicated a good quality silages as stated by Flyn (1981 ) and Mc Donald *et al* . , ( 1995) . Amonia -N $NH_3N$ concentration was lower in banana wastes silage treated with 11C33 inoculants than in those treated with H/MF inoculants and untreated silage .

**Aerobic stability :**

Irrespective of treatment , all of the silages were stable for 84h after the silos were opened ( Figure 1 ) after wards , they all deteriorated, although at different rates. Untreated silage deteriorated at the fastest rate , followed by silage treated with/MF inoculants .

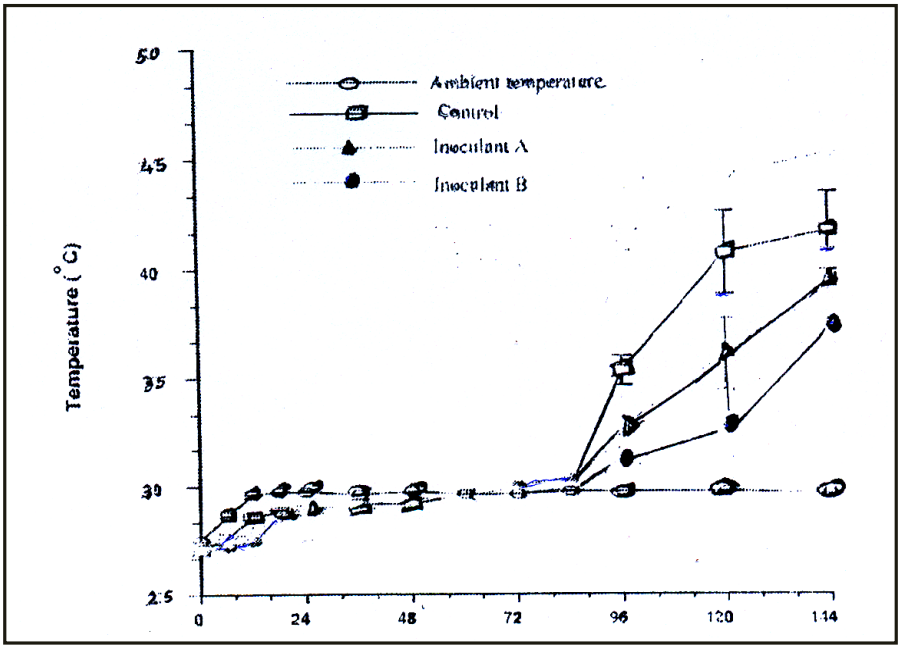


**Figure 1 . Effect of additive treatment on aerobic stability of untreated and treated banana wastes silage .**

Improvements in aerobic stability during prolonged storage and feeding may be beneficial , thus making small losses of DM incurred during an initial fermentation less important . Compared with the other inoculants , the slower deterioration rate conferred by 11C33 inoculants which contained *L.buchneri* agrees with previous findings in corn , wheat and grass silages ( Weinberg *et al* ., 1999; Ranjit and Kung , 2000 ; Kung and Ranjit , 2001 and Adesogan *et al* ., 2003 ). Such silages has higher concentration of acetic acid relative to untreated silage. Acetic acid has strong antifungal properties (Woolford ., 1975 ) , and its high concentration were probably the primary reason for improvements in the aerobic stability of silages treated with L-buchneri Silages treated with L-buchneri to achieve and markedly improved the aerobic stability of at least $5x10^5$ cfu / g remained unspoiled and markedly improved the aerobic stability of the silage when exposed to air for longer periods of time than treated with H/MF inoculants or untreated silage. Treating silages with L-buchneri produced the most stable silage and is an

effective method of improving the aerobic stability of banana silage and may be an alternative to other antifungal additives .

The results concerning phytochemical careening of clover hay, banana wastes hay and banana wastes silages with or without additives are shown in Table (4) . Phytochemical screening showed that banana wastes silages contained slightly detected of glycoside, tannins, Alkaloids and Flavenoids and non detected saponins and anthraquinone . The silages with or without additives showed nearly similar results for anti – nutritional factors to those of clover hay . The highest levels of tannins and alkaloids were found in banana wastes hay .

**Table (4): Phytochemical screening of different forms of banana wastes hay or its silages either untreated or inoculated by bacteria inoculants compared with clover hay**

| Items | Phytochemical Screening | | | | | |
|---|---|---|---|---|---|---|
| | Glycosides | Tannins | Alkaloids | Flavenoids | Saponins | Anthraquinone |
| Clover hay | + | - | - | - | - | - |
| Banana wastes hay | + | + + | + + | + | - | - |
| Banana wastes silage | + | + | + | + | - | - |
| Banana wastes silage inoculated by H/MF | + | + | + | + | - | - |
| Banana wastes silage inoculated by KEMLACR dry | + | + | + | + | - | - |

The chemical composition of the five experimental rations used in metabolism trials is shown in Table ( 5 ) . The results showed that DM % ranged from 41.90 to 89. 80 being higher for ration containing clover hay followed by ration containing banana wastes hay . The decreased dry matter content in rations 3 , 4 and 5 have been due to the high moisture content in silage ( about 70 % ) .

Ensiling treatments slightly decreased CF content compared with the rations containing banana hay ( 22.81 , 20.24 , 18.96 and 18 . 08 , respectively) . The NDF and ADF fractions of rations containing banana wastes silages were decreased by 6.40 , 8.80 and 9.90 , 3.41 , 9.96 and 11.22 , respectively compared with the ration containing banana wastes hay . As expected , the CP contents with rations containing treated silages were somewhat higher than that containing untreated silages ( 7.0 and 13.0 % , respectively ) .The non fiber carbohydrates ( NFC ) were ranged from 33.73 to 37.11 % in the presented experimental rations . Rations formulated for 35 to 37 % NFC (DM basis) , should avoid metabolic disturbances related to feeding high levels of starches in grains .

Results in table (6) showed that no significant differences were found among rations for the digestion coefficients of DM and EE . It was notice that ensiling either untreated or inoculated resulted in higher ( $P< 0.05$ ) digestion coefficients of OM , CP , CF , NDF , ADF , Hemi cellulose , cellulose and ADL

compared to ration containing banana wastes hay . These could be related to the microbial inoculants which cause rolubilization of carbohydrate esters of phenolic monomers in the cell wall Jung *et al* ,. 1983 a and b .Rooke *et al* ,. 1988 , Smith *et al,.* 1993 and Yan *et al,* . (1996 ). They reported improvements in nutrients digestibility coefficients as a the result of inoculants treatment .

It is observed that the group fed ration 5 was significantly (P<0.05) higher in OM , CF and NFE digestibilities than the other three groups fed rations 2 , 3 and 4 . Recent research demonstrated that digestibility may be greater in silages treated with microbial inoculants as silage additives (Cleale *et al*., 1990; Harrison *et al*., 1989 and Phillip *et al* ., 1990 )

**Table (5): Chemical composition of the experimental rations fed to sheep containing banana wastes hay or its silages either untreated or inoculated by bacteria inoculants .**

| Items | Experimental rations | | | | |
|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | R5 |
| **DM** | **89.80** | **88.70** | **41.90** | **42.37** | **43.75** |
| **Composition on DM % :** | | | | | |
| OM | 93.28 | 88.13 | 88.80 | 90.28 | 90.59 |
| CP | 14.49 | 13.08 | 14.72 | 15.75 | 16.45 |
| CF | 19.32 | 22.81 | 20.24 | 18.96 | 18.08 |
| EE | 2.37 | 2.67 | 2.40 | 2.39 | 2.48 |
| NFE | 57.10 | 49.57 | 51.44 | 53.18 | 53.58 |
| Ash | 6.72 | 11.87 | 11.20 | 9.72 | 9.41 |
| **Fiber fractions %** | | | | | |
| NDF | 39.31 | 38.65 | 36.11 | 35.22 | 35.10 |
| ADF | 25.11 | 26.11 | 25.22 | 23.51 | 23.18 |
| Hemicell | 14.20 | 12.54 | 10.89 | 11.71 | 11.92 |
| Cellulose | 19.61 | 21.31 | 20.00 | 18.40 | 18.38 |
| ADL | 5.50 | 4.80 | 5.22 | 5.11 | 4.80 |
| NFC | 37.11 | 33.73 | 35.57 | 36.92 | 36.56 |
| NFC/NDF | 0.94 | 0.87 | 0.98 | 1.05 | 1.04 |
| Cell./ADF | 0.78 | 0.82 | 0.79 | 0.78 | 0.75 |
| Cell./NDF | 0.50 | 0.55 | 0.50 | 0.52 | 0.49 |
| NFC/hemi. | 2.61 | 2.69 | 3.27 | 3.15 | 3.07 |

**R1 = CFM + clover hay . R2 = CFM + Banana wastes hay .**
**R3 = CFM + Banana wastes silage R4 = CFM + Banana wastes silage inoculated by H/MF**
**R5 = CFM + Banana wastes silage inoculated by 11C33 .**

The effects of inoculants on digestibility may be a consequence of improved nutrient preservation during the fermentation process and conservation of a greater proportion of digestibility nutrients (Mc Donald, 1981) .

Regarding the nutritive values , the results in Table (6) showed that the values in of TDN and DCP were significantly higher ( P< 0.05 ) in rations 3 , 4 and 5 (containing silage) compared with ration 2 (containing banana waste hay . These improvements were associated with the increased digestion in fibrous materials particularly hemicelluloses in addition to the increased

bacterial degradation of cell wall content (Hassan *et al*., 2005 and Hoton ,1981) . The highest value of TDN was recorded when using the ration containing silage banana waste inoculated by inoculants (11C33). This result was due to the high values of digestibility coefficients of ( OM ) and NFE of this ration..

**Table (6): Effect of feeding experimental rations on digestion coefficients, dry matter intake and feeding values with sheep.**

| Ite6m | experimental rations | | | | | |
|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | R5 | SE |
| **Nutrient digestibility (%):** | | | | | | |
| DM | 66.12 | 64.81 | 65.11 | 65.81 | 66.38 | ± 0.787 |
| OM | 63.7$^{b}$ | 60.53$^{c}$ | 63.36$^{b}$ | 63.58$^{b}$ | 65.95$^{a}$ | ± 0.345 |
| CP | 67.19$^{a}$ | 62.43$^{c}$ | 63.82$^{bc}$ | 64.33$^{b}$ | 65.31$^{b}$ | ± 0.551 |
| CF | 42.50$^{e}$ | 51.12$^{d}$ | 53.15$^{c}$ | 55.11$^{b}$ | 57.81$^{a}$ | ± 0.426 |
| EE | 66.11 | 65.11 | 66.10 | 65.81 | 66.15 | ± 0.771 |
| NFE | 69.88$^{a}$ | 64.11$^{e}$ | 65.20$^{d}$ | 66.28$^{c}$ | 68.88$^{b}$ | ± 0.253 |
| NDF | 67.79$^{a}$ | 62.70$^{b}$ | 66.20$^{a}$ | 67.76$^{a}$ | 69.45$^{a}$ | +1.030 |
| ADF | 63.12$^{b}$ | 62.90$^{b}$ | 62.30$^{b}$ | 64.10$^{ab}$ | 66.20$^{a}$ | +0.750 |
| Hemicell | 76.01$^{a}$ | 62.28$^{b}$ | 75.20$^{a}$ | 75.12$^{a}$ | 75.75$^{a}$ | +3.750 |
| Cellulose | 71.12$^{a}$ | 67.45$^{b}$ | 68.82$^{ab}$ | 71.02$^{a}$ | 70.60$^{a}$ | +0.864 |
| ADL | 34.64$^{c}$ | 30.18$^{d}$ | 37.55$^{bc}$ | 39.17$^{ab}$ | 41.15$^{a}$ | +1.04 |
| **Dry matter intake and feeding values as DM (%):** | | | | | | |
| DM intake (g/d) | 996.33$^{b}$ | 922.33$^{b}$ | 979.33$^{b}$ | 1004.67$^{b}$ | 1029.67$^{a}$ | ± 32.55 |
| TDN , % | 61.39 $^{a}$ | 55.52 $^{d}$ | 57.26 $^{c}$ | 59.37 $^{b}$ | 61.63 $^{a}$ | ± 0.231 |
| TDN intake g/h/day | 611.73$^{ab}$ | 512.07$^{c}$ | 560.77$^{bc}$ | 596.50$^{ab}$ | 636.27$^{a}$ | ± 21.29 |
| DCP, % | 9.74$^{c}$ | 8.17$^{d}$ | 9.40$^{c}$ | 10.13$^{b}$ | 10.74$^{a}$ | ± 0.085 |
| TDN :DCP | 6.30$^{b}$ | 6.80$^{a}$ | 6.09$^{c}$ | 5.86$^{d}$ | 5.74$^{d}$ | ± 0.41 |
| CP intake (g/d ) | 144.37$^{b}$ | 120.64$^{c}$ | 143.86$^{b}$ | 158.24$^{ab}$ | 169.38$^{a}$ | ± 4.98 |
| ME (Mcal/Kg ) | 2.185$^{a}$ | 1.976$^{d}$ | 2.039$^{c}$ | 2.114$^{b}$ | 2.200$^{a}$ | ± 0.08 |
| M E intake (Mcal/d) | 2.178$^{ab}$ | 1.820$^{c}$ | 1.996$^{bc}$ | 2.124$^{ab}$ | 2.267$^{a}$ | ± 0.08 |
| ME intake (Cal/Kg $w^{0.75}$) | 86.87$^{a}$ | 73.53$^{c}$ | 75.80$^{bc}$ | 85.43$^{ab}$ | 91.67$^{a}$ | ± 3.07 |

**A,b,c,d,e Means within the same raw with different superscripts are significantly different($p<0.05$).**

Results concerning nitrogen intake , excretion and balance are presented in Table (8) . Nitrogen balance ( g / h / d ) was positive in all tested groups fed the experimental rations indicating that the animals were in normal N metabolism status , a condition necessary for accurate evaluation of the tested rations. The highest value of NB was found in R5 and R4 (inoculated ones ) . This may be attributed to the presence of treated silage in the rations ( EL – Kady *et al* . , 1999 ) . Therefore, it is suggested that lambs can utilize N of the rations containing different silages either treated or inoculated more efficiency by about 29.8 , 46.6 and 72.6 % than ration containing banana waste hay , respectively . In this respect , Gunter *et al* . , (1998 ) and Ghanem *et al* . , (2000) had the same conclusion with lambs and goats fed silage with feed mixture .Sheep given ration containing banana silage inoculated by inoculants retained more nitrogen than those received other rations.

At the end of metabolism trials, animals of each group were fed the experimental rations according to treatments. Data concerning average dry matter intake are presented in Table (7) The results were within the values obtained by EL – Shinnawy (2003) who found that DM intake of rations containing corn silage by sheep ranged from 1.604 to 1.828 Kg / day and somewhat higher than that obtained by Stalting *et al .* , (1982) and Wittenberg *et al .* , (1983) they found that DM intake ranged from 0. 770 and 1.440 Kg / day . The lowest DM1 was recorded for lambs given R2. The decreases were 5.4 , 4.6 , 10.6 and 19.0 % compared with R1 , R3 , R4 and R5 , respectively .This result may be due to silage process which makes roughage more softness and more palatable than clover hay or banana waste hay The results indicated that there were higher intakes of DM for animals fed R4 and 5 comparing with those fed control , R2 and R3 .The results showed also that average DM1 from R5 was significantly, ($P< 0.05$ ) higher than R1 , R2 , R3 and R4 .The TDN intakes followed similar trend except with control ration . These results led to conclude that banana waste silage treated with bacteria inoculants are more palatable than untreated silage and banana hay. These results introduce a novel technique towards making best use of agricultural residues . More research is need on making silage from other residues and on other kinds of animals and on various types of production .

**Table (7) : Nitrogen utilization with rams fed the experimental rations.**

| Items | Rations | | | | | ±SE |
|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | R5 | |
| Nitrogen intake (g/h/d) | $23.10^{c}$ | $19.30^{d}$ | $23.07^{c}$ | $25.32^{b}$ | $27.10^{a}$ | 0.353 |
| Nitrogen excretion (g/h/d) Fecal N | $7.57^{c}$ | $7.26^{c}$ | $8.34^{b}$ | $9.03^{b}$ | $9.39^{a}$ | 0.153 |
| Digested N | $15.53^{bc}$ | $12.04^{d}$ | $14.73^{c}$ | $16.29^{b}$ | $17.71^{a}$ | 0.309 |
| Urinary N(g/h/d) | $11.35^{ab}$ | $8.67^{c}$ | $10.33^{b}$ | $11.32^{ab}$ | $11.85^{a}$ | 0.356 |
| Nitrogen retention (g/h/d) | $4.17^{bc}$ | $3.39^{c}$ | $4.40^{bc}$ | $4.97^{ab}$ | $5.85^{a}$ | 0.350 |
| %of N – intake | 18.06 | 17.51 | 19.11 | 19.63 | 21.56 | 1.42 |
| %of N digested | 26.88 | 28.06 | 29.92 | 30.50 | 32.94 | 2.05 |

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# إستخدام مخلفات الموز كدريس أو سيلاج لتغذية المجترات:
# ١ـ تأثير الإضافات المختلفة على النوعيه والقيمة الغذائية لسيلاج مخلفات الموز مقارنة بدريس الموز

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**٢ـ المركز الاقليمى للأغذيه والاعلاف ـ مركز البحوث الزراعيه**

أجريت هذه الدراسه خلال الفتره من ٢٠٠٥ ألى ٢٠٠٨ بالمركز الأقليمى للأغذيه و ألاعلاف ـ مركز البحوث الزراعيه ـ وزاره الزراعه وقسم الأنتاج الحيوانى بكليه الزراعه جامعه القاهره وذلك بهدف تصنيع مخلفات الموز كدريس ومحاوله تحسين إستخدامها بالسيلجه سواء بدون معامله أو بعد معاملتها بملقح بكتيرى وقد تم تقدير نوعيه السيلاج ودراسه العوامل المثبطه للتغذيه ومدى ثبات جوده السيلاج و دراسه تأثير إستبدال دريس البرسيم بمخلفات الموز سواء على هيئه دريس أو سيلاج غير معامل أو معامل على المتناول من الماده الجافه ، معاملات الهضم والقيم الغذائيه و ميزان الازوت وقد تم تجهيز حوالى ٦٥٠كجم دريس مخلفات الموز وكذلك ثلاثه أنواع من السيلاج فى ٦٠ برميل بلاستيك ( ٢٠ لكل معامله ) بكميه قدرها ٧,٥ طن ( ٢,٥ طن لكل معامله ) ، احداها غير معامل والثانيه بملقح بكتيرى MF/H بكتيريا أحاديه النواتج محبه للحموضه أما الثالثه فقد عوملت بملقح بكتيرى ٣٣C١١ ( ثنائى الغرض يحتوى على بكتيريا حمض اللاكتيك أحاديه النواتج وأخرى متعدده . ولتقدير المواصفات الكيميائيه والحسيه للسيلاج فى فترات السيلجه المختلفه ثم ملأ خمسه عشر حقيبه بلاستيكيه بالثلاث معاملات ( ٥ لكل معامله ) ثم فتحها على فترات زمنيه أسبوعيا كما تم الكشف عن العوامل المثبطه للتغذيه وكذلك قياس مدى ثبات مواصفات السيلاج بعد تعرضه للهواء لمدد زمنيه مختلفه . كما تم إجراء خمس تجارب هضم . وقد أظهرت النتائج أن جميع عينات السيلاج كانت ممتازه ذات ملمس متماسك ، ذات رائحه جيده ، خاليه من العفن ورائحه التراب والكرمله والتوباكو أو الخل ـ كما كانت جميع أنواع السيلاج ذات درجه حموضه طبيعيه ( ٣,٧٠ ـ ٤,٠٣ ) مع تمييز المجموعه المعامله بالملقح ٣٣C١١ ـ كما كان المتوسط العام لتركيز الأحماض الدهنيه الطياره لجميع أنواع السيلاج يقع ما بين ٧,١٥ ـ ٧,٨٥ ، وكان مرتفعا مع السيلاج المعامل ـ وقد أظهر الإنخفاض السريع فى درجه الحموضه للسيلاج المعامل بالملقح الإستقرار السريع للظروف غير الهوائيه داخل السيلو ، وتقليل الوقت اللازم للسيلجه بأسبوعيين . وأن السيلاج المعامل بالملقح ثنائى الغرض ٣٣C١١ظل غير متعفن مما يبين قدرته على تحسين ثبات السيلاج فى الظروف الهوائيه كما أن السيلجه قد أدت إلى تخفيض وجود بعض العوامل المثبطه للتغذيه .كما أن تغذيه الحملان على السيلاج المعامل وغير المعامل أدت إلى زياده معنويه على مستوى ٥% فى معاملات هضم الماده العضويه ، البروتين الخام ، الالياف الخام ، الألياف المتعادلة ، الألياف الحامضة كما أدت إلى تحسين معنوى فى المركبات الكليه المهضومه والبروتين الخام المهضوم .

والسيلاج المعامل بالملقح البكتيرى ثنائى الغرض له مميزات كبيره حيث أدى إلى تحسين ثبات جوده السيلاج عند تعرضه للهواء ، فضلا عن الإسهام فى تغذيه الحيوان وتقليص مشاكل البيئه .

وتقدم الدراسه تقنيه حديثه للاستخدام الأمثل للمخلفات الزراعية . وتوصى الدراسه بإستمرار الأبحاث على السيلاج من مخلفات زراعيه أخرى وعلى أنواع مختلفه من الحيوانات وأغراض إنتاجيه متعدده .

**قام بتحكيم البحث**

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