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SUNFLOWER PLANT RESIDUES AS A FEEDSTUFF IN RUMINANT DIETS

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SUMMARY

Three silage mixtures of sunflower plant residues (SFPR) were formulated with urea, ammonia or poultry manure. Molasses and water were added to promot silage fermentation. Chemical changes in silage mixtures during the fermentation period (90 days) were determined. Tweleve direct digestion trials on Ossimi rams were carried out to evaluate nutrients digestibility and nutritive value of silage mixtures. In a feeding trial, an experimental diet (40% concentrate mixture + 60% ureated silage) was compared with the control diet (80% concentrate mixture + 20% rice straw).

Silages pH, NH_3-N: total N, total VFA's (ml mol/100 ml) and lactic acid concentrations (% of DM) were 4.19, 26.63, 3.61 and 3.52 for ureated silage; 4.60, 24.93, 3.41 and 3.18 for ammoniated silage and 5.10, 25.80, 3.67 and 2.73 for poultry manure silage. Digestibilities of DM and OM were 58.33 and 59.46; 53.49 and 55.62 and 45.92 and 56.40 for ureated, ammoniated and poultry manure silages, respectively. The TDN, SE and DCP values were 54.90, 36.91 and 8.32; 50.50, 35.00 and 8.37 and 52.30, 36.08 and 7.07 for ureated, ammoniated and poultry manure silages, respectively. The average daily feed intake (kg. SE/$w^{0.75}$), daily body gain (gm) and feed conversion (kg SE/kg. gain) were 0.029, 48 and 5.77 and 0.034, 118 and 3.25 for lambs fed the experimental diet which contained ureated silage and the control diet, respectively.

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Sunflower plant residues could be used in ruminant diets especially after ensiling and enriching it with a suitable source of NPN.

Keywords: Sunflower by-products, silage, poultry manure, urea, ammonia

INTRODUCTION

The shortage in animal feedstuffs, particulary during summer season and early autumn appears to be the most important and critical problem which faces animal production development in Egypt. Recently appreciable area is cultivated with sunflower for oil extraction for human consumption. The meal so produced is mainly used for poultry feeding. Therefore, using farm residues as sunflower plant residues (SFPR) in ruminants feeding may participate in increasing feed resources, decreasing feed costs and alleviating the environmental pollution.

It is well known that most crop residues have low protein, digestible nutrients and mineral contents, while they contain high percent of fiber and lignin (Church, 1980). Improving poor quality feedstuffs utilization by ruminants has received considerable attention by researchers.

Vandersall (1976), Marx (1977); Schaeffer et al, (1977); Sneddon et al. (1979) and McGuffey and Schingoethe, (1980) were used ensiled whole sunflower plant in ruminants feeding.

This study aimed to: a) use the residues of sunflower plant in animal diets, b) compare the effect of ensiling and enriching by different sources of NPN (urea-ammonia and poultry manure) on the chemical composition, silage quality, digestion coefficients and nutritive value of sunflower plant residues and c) investigate lambs performance when fed a diet containing 60% ureated sunflower residues silage + 40% concentrate compared to the traditional summer diet (80% concentrates + 20% rice straw).

MATERIALS AND METHODS

Silage mixtures

After collection of sunflower ears at the high moisture stage of maturity, the whole plant residues were

harvested immediatly and chopped into 0.5-2.0 cm. pieces. Urea, aqueous ammonia (25%) or poultry manure obtained from cage layers were used as a various additives to formulate three mixtures as shown in Table (1). Molasses and water (1:1) were added to the mixtures to encourage silage fermentation. Mixtures were mixed carefully and put in wide-mouthed bottles (0.5 L.), 20 bottles for each mixture, to evaluate silage quality at different stages of fermentation. Moreover, 4 open barrels (250 L.) for each mixture were used to determine its feeding value. Bunker silo (6 x 1 x 1/2 m.) of ureated mixture only was used to investigate lambs performance. All silos were tightly packed and closed completely by using plastic sheets and a thick layer of mud for barrels and bunker silo or paraffin wax for bottles. Silages were kept for a period lasted 90 days before being evaluated.

Silage quality

Two bottles were opened for each mixture after 0, 2, 4, 8, 16, 30, 45, 60, 75 and 90 days of ensiling. The fermented material was extracted as discribed by McDonald 1981 to measure pH, NH_3-N (A.O.A.C., 1980), VFA's (Markham, 1942) and lactic acid (Barker and Summerson, 1941).

Digestion trials

Four Ossimi rams (9 months and 33-37 kg body weight) were used in tweleve direct digestion trials to evaluate the silage mixtures. A preliminary period of at least 21 days was used to permit full adaptation of the animals to the tested mixtures then it was followed by 7 days collection period. Proximate analysis according to A.O.A.C., 1980 was conducted on feed and fecal samples.

Feeding trial

Ten Ossimi lambs (6 months) were randomly divided into 2 groups of similar mean body weight. Animals were housed in individual pens and adapted for the experimental ration for two weeks. Only half of the concentrate mixture allowance of the control group (I) was offered to the animals of the experimental group (II) to cover 80% and 40%, respectively of the total energy requirements (maintenance + 150 gm daily gain) based on NRC (1985) for sheep. Rice straw and ureated

sunflower residues silage were offered ad lib for groups I and II, respectively. The maintenance requirements were adjusted every 4 weeks intervals according to body weight changes during the feeding trial period which lasted for 126 days. Vitamins-minerals blocks were used to fulfill lambs requirements. Rice straw or ureated silage mixture were offered firstly at 8 a.m, while the concentrate mixture was offered at 4 p.m. to make sure that animals consumed maximum amounts of the ensiled material. The feed intake was determined daily. Animals were allowed free access of water.

Statistical analysis

Data obtained were statistically analysed according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1. Silage quality

Values of pH; NH_3-N; total N; total VFA's and lactic acid were used for judging silage quality. Their changes throughout the ensiling period for all mixtures are summurized in Fig. 1 (a, b, c and d).

Changes in pH values were fast during the first 15 days, slow during the middle period (15-45 days) and limited at the last period (45-90 days) of fermentation. The final pH values were 4.60, 4.19 and 5.10 for ammoniated, ureated and poultry manure silages, respectively. The high pH values of all silages might be due to the difficulty of rapid exclusion of air from the mass as a result of the hard nature of the sunflower plant residues. This result is in a harmony with that reported by Langston et al. (1962). Who detected that rapid exclusion of air has been recognized as one of the most important factor governing the production of high quality silage.

At the begining of ensiling period, the NH_3-N: total N ratios varied for all silages. It was high in ammoniated silage and low in ureated one. Thenafter it decreased slowly in ammoniated silage until the end of ensiling period. While, it markedly increased markedly in ureated silage at the first week as a result of urea hydrolysis, then it decreased. Poultry manure silage showed a slight increase in NH_3-N: total N ratio until the end of ensiling period. All silages had nearly

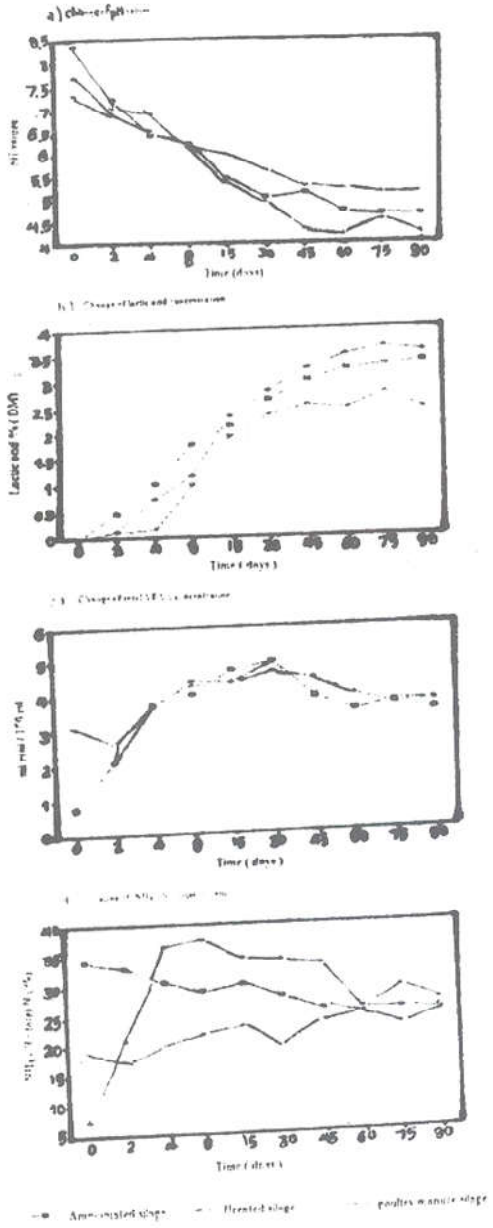

Fig. 1. Changes of silage mixtures characteristics during the ensiling period.

similar final values of NH_3-N: total N, which ranged from 24.93 to 26.63%. Increasing NH_3-N: total N ratios for all silages might be related to a) using NPN compounds at ensiling time and/or b) high pH values in silage (Boman, 1979 and Huber et al., 1980).

The total VFA's for all silages increased during the first period (0-30 days), thenafter it decreased until the end of ensiling (30-90 days). All silages had nearly similar final content of total VFA's which ranged from 3.41 to 3.68 ml mol/100 ml.

Lactic acid concentration increased markedly up to 45 days of the ensiling period for all silages. Thenafter, there was a slight increase until the end of ensiling period. The final lactic acid concentrations were 3.18, 3.52 and 2.73% of DM for ammoniated, ureated and poultry manure silages, respectively. Increasing lactic acid concentration in ammoniated and ureated silages might be due to their higher content of molasses (5%), Table 1. Results indicated that lactic acid concentration had an inverse trend to pH values. This result is in agreement with that reported by McDonald (1981).

The chemical characteristics data of all silages indicated that: a) All silages had medium quality b) There was no marked difference in silage quality between ammonia and urea treatments and c) all silages needed 30-45 days of ensiling period to reach a suitable quality degree.

2. Nutritional evaluation of silages:

Silage mixtures and thier ingredients analyses (Table 1) indicated that urea, ammonia and poultry manure addition increased CP content from 5.69% in sunflower plant residues to 12.46, 12.93 and 11.31% in silage mixtures, respectively. Moreover, no appreciable differences were noticed in the chemical composition among all silage mixtures except poultry manure silage which showed slightly higher DM and NFE than those of other silages.

Digestibilities of DM and OM were higher ($P<0.05$) in ureated silage than the other silages which showed insignificant difference (Table 1). No significant ($P<0.05$) differences were reported in CP and CF digestibilities between ureated and ammoniated silages. While, CF digestibility was lower ($P<0.05$) in poultry manure silage.

Table 1. Silage mixtures formulation and their nutritional evaluation

Item	Silage		
	Urea	Ammonia	Poultry manure
a) Silage ingredients			
SFPR, Kg	100.00	100.00	100.00
Urea (46.5% N), Kg	0.86	----	----
Ammonia (25%), Kg	----	1.95	----
Poultry manure (45% DM), Kg	----	----	30.00
Molasses, Kg	5.00	5.00	2.50
b) Chemical composition, %			
DM	37.11	36.75	39.13
	Composition of DM, %		
OM	86.64	85.27	86.79
CP	12.46	12.39	11.31
CF	32.11	30.01	31.24
EE	3.14	3.34	3.19
NFE	38.93	38.90	41.05
Ash	13.36	14.73	13.21
c) Digestion coefficient, %			
DM	58.33 ^{a}	53.49 ^{b}	54.92 ^{b}
OM	59.46 ^{a}	55.62 ^{b}	56.40 ^{b}
CP	66.76 ^{a}	64.70 ^{ab}	62.50 ^{b}
CF	51.66 ^{a}	50.13 ^{a}	45.45 ^{b}
EE	82.77 ^{a}	81.20 ^{a}	79.66 ^{a}
NFE	59.57 ^{a}	54.52 ^{b}	62.80 ^{a}
d) Nutritive value, (DM basis), %			
TDN	54.90 ^{a}	50.50 ^{c}	52.30 ^{b}
SE	36.91 ^{a}	35.00 ^{c}	36.08 ^{b}
DCP	8.32 ^{a}	8.37 ^{a}	7.07 ^{b}

^{a,b,c} Means on the same row having unlike superscripts differ significantly ($P \leq 0.05$).

There were significant ($P<0.05$) differences among all silage mixtures of sunflower plant residues in their nutritive value as TDN and starch equivelant, SE (Table 1). Ureated silage had the highest values of TDN and SE as a result of its higher nutritents digestibilities than the other silage mixtures. The digestable crude protein (DCP) did not differ significantly between ammonia and urea silage mixtures, but it was the lowest ($P<0.05$) in poultry manure silage mixture.

3. Lambs performance:

The average daily feed intake expresed as DM, TDN, SE and DCP gm/kg $w^{0.75}$ (Table 2) were higher ($P<0.05$) in the control group than those in the experimental group which contained ureated silage mixture. The reduction rate was 19, 19, 17 and 21% for DM, TDN, SE and DCP, resp. This might be attributed to the hard nature of sunflower residues which decreased its palatability.

Lambs in the control group had the highest daily body weight gain, being 119 gm. The corresponding value for the experimental group was 48 gm. In other words, lambs fed sunflower silage gained 59% less than the control group. This might be due to the low intake from sunflower silage (236 g/day) and hence the animals on the silage treatment could not compensate the reduced intake from concentrate by increasing their intake from the silage which was offered ad lib.

Average feed conversion (Kg DM, TDN, SE or DCP/Kg gain) was better ($P<0.05$) for lambs fed the control ration compared with those fed the urea silage ration.

Lambs performance was poor when fed the ration which contained sunflower silage as a result of its low palatability and concequentely less SE and CP intakes. However, feeding growing lambs on a diet contained only 319 gm concentrate mixture and 230 gm ureated silage produced 48 gm daily body gain.

Therefore, sunflower silage could be used as a medium quality roughage for ruminants in summer season to save part of the scarse and expensive concentrate feed mixture.

Table 2. Performance of lambs fed ration contained ureated sunflower residues silage

Item	Control ration	Experimental ration
Initial body weight, Kg	18.40	16.90
final body weight, Kg	33.30	22.90
Daily body gain, gm	118.00	48.00
Daily feed intake (DM basis):		
Silage, gm/head	----	236.00
rice straw, gm/head	81.00	----
Concentrate, gm/head	756.00 [a]	319.00 [b]
Total, gm/head	837.00 [a]	555.00 [b]
TDN, gm/head	487.00 [a]	320.00 [b]
SE, gm/head	384.00 [a]	275.00 [b]
DCP, gm feed	84.00 [a]	55.00 [b]
DM, gm/kg $w^{0.75}$	73.00 [a]	59.00 [b]
TDN, gm/kg $w^{0.75}$	42.00 [a]	34.00 [b]
SE, gm/kg $w^{0.75}$	34.00 [a]	29.00 [b]
DCP, gm/kg $w^{0.75}$	7.30 [a]	5.80 [b]
Feed conversion:		
DM, kg/kg gain	7.09 [b]	11.56 [a]
TDN, kg/kg gain	4.13 [b]	6.67 [a]
SE, kg/kg gain	3.25 [b]	5.77 [a]
DCP, kg/kg gain	0.71 [b]	1.15 [a]

[a,b] means on the same row having unlike superscripts, differ significantly ($P \leq 0.05$).

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مخلفات نبات عباد الشمس كمادة علف فى علائق المجترات

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تم تكوين ثلاث مخاليط سيلاج من مخلفات نبات عباد الشمس مع اليوريا او الامونيا او زرق الدواجن مع اضافة المولاس والماء لتشجيع تخمر السيلاج واثناء فترة التخمر (٩٠يوم) قدرت التغيرات الكمياوية فى مخاليط السيلاج ٠ كما اجريت اثنى عشر تجربة هضم مباشرة على كباش اوسيمى لتقييم معامل هضم المركبات والقيمة الغذائية لمخاليط السيلاج ٠ كما اجريت تجربة تغذية تطبيقية لمقارنة العلقية المختبرة (٤٠٪ مخلوط + ٦٠٪ سيلاج مخلفات نبات عباد الشمس المعامل باليوريا) مع العليقة الكنترول (٨٠٪ مخلوط مركز + ٢٠٪ قش ارز)٠

كانت درجة الحموضة نسبة ازوت الامونيا : الاوزت الكلى وتركيز الاحماض الدهنية الطيارة (مل مول/١٠٠ مل) وتركيز حمض اللاكتيك (٪من المادة الجافة) هى ٤,١٩ - ٢٦,٦٣ - ٣,٦١ - ٣,٥٢ لسيلاج اليوريا ٤,٦٠ - ٢٤,٩٣ - ٣,٤١ - ٣,١٨ لسيلاج الامونيا ٥,١٠ - ٢٥,٨٠ - ٣,٦٧ - ٢,٧٣ لسيلاج زرق الدواجن٠

كانت معاملات هضم المادة الجفة والمادة العضوية ٥٨,٣٣ ، ٥٩,٤٦ لسيلاج اليوريا ٥٣,٤٩ ، ٥٥,٦٢ لسيلاج الامونيا ٤٥,٩٢ ، ٥٦,٤٠ لسيلاج زرق الدواجن، وكانت قيم مجموع المركبات الغذئية المهضومة ومعادل النشا والبروتين الخام المهضومة ٥٤,٦٠ ، ٣٦,٩١ ، ٨,٣٢ لسيلاج اليوريا ٥٠,٥٠ ، ٣٥,٠ ، ٨,٣٧ لسيلاج الامونيا ٥٢,٣٠ ، ٣٦,٠٨ ، ٧,٠٧ لسيلاج زرق الدواجن٠

كان متوسط المأكول اليومى (كجم معادل نشا / الوزن ٣/٤) والزيادة اليومية فى وزن الجسم (جم) وكفاءة التحويل الغذئى (كجم معادل نشا/ كجم زيادة فى وزن الجسم) ٠,٠٢٩ ، ٤٨ ، ٥,٧٧ للحملان المغذاه على العليقة المختبرة المحتوية على سيلاج اليوريا بينما كانت ٠,٠٣٤ ، ١١٨ ، ٣,٢٥ للحملان المغذاه على العليقة الكنترول ٠

من ذلك يتضح امكانية الاستفادة من مخلفات نبات عباد الشمس فى تغذية المجترات خاصة بعد تسليجها واغنائها باى من المركبات الازوتية الغير بروتنية٠