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EFFECT OF DRYING AND DIFFERENT METHODS OF ENSILING ON THE FEEDING VALUE OF ALFALFA

El-Deeb, M.M.[1]; A.Z. Mehrez[2] and H.M. El-Shabrawy[1]
[1] Animal Production Research Institute, Agricultural Research Center., Ministry of Agriculture, Dokki, Giza, Egypt.
[2] Animal Production Department, Faculty of Agriculture, Mansoura University, Mansoura, Egypt.

ABSTRACT

Third and fourth cuts of alfalfa forage were conserved as green, hay or ensiled either untreated or treated with 0.31 g HCHO/100g DM or 2.8 g formic acid/100 g DM and fed to Zaraibi buks weighed 50 kg on average.

The obtained results indicated that treated silages either with HCHO or HCOOH contained higher values of OM, EE, NFE and NSC than those of green and hay alfalfa forms. The treated ensiled alfalfa contained higher values of OM, CP, EE and NSC, while it contained lower values of NFE, ash and NDF compared to the untreated silage. Treaded alfalfa silages tended to have higher desirable fermentation represented in low pH, butyric acid and higher lactic acid content compared to the untreated silage. Protein solubility decreased with the reduction of NPN and NH_3 in the treated silages as well.

Feed intake in terms of DM, TDN and DOM significantly ($P<0.05$) improved in the ensiled forage compared to the green and hey ones. The relative feeding value (RFV) and both of digestible energy (DE) and metabolizable energy (ME) of ensiled alfalfa increased than those of green and hey alfalfa. This accompanied with a reduction in effective neutral detergent fiber (eNDF) values, specially with increased NSC content of HCOOH-treated silages. The alfalfa silages diets contained the highest ($P<0.05$) values of digestibility coefficients for all nutrients, except for EE in green alfalfa which recorded the highest but without significant difference with HCOOH-treated silage.

Rumen liquor pH and total VFA recorded the highest ($P<0.05$) values with green alfalfa diet and significantly decreased with HCOOH and HCHO-treaded diets. The NH_3-N concentration was impaired ($P<0.05$) with untreated silage and the lowest with alfalfa hey. All animals were in positive N-balance and percentage of N-balance to N-intake or digested were the heights ($P<0.05$) with HCHO- and HCOOH-treated silages.

It could be concluded the formaldehyde treatment for alfalfa silage is more effective in reducing its NDF content and increasing its NSC content which reflected positively on fermentation in the rumen and improving feed utilization compared to the other tested forms of alfalfa.

Keywords: Alfalfa, green, hay, silage, NDF, NSC, intake, digestibility, fermentation in the rumen.

INTRODUCTION

Forages, e.g. alfalfa, are usually the major source of fiber in dairy rations. However, several research works focused on fibers related factors such as its particle size, quality and sources as important and limiting factors in ration formulation for ruminants.

In the developed countries, e.g. Egypt, the diverse in fiber sources usage depends on either different sources of forages or roughages in animal feeding lead researchers to speculate the adequacy of fibers to balance rations for ruminants. The difficulty in detecting the precise amount of fiber especially for dairy animals referred back to several reasons, e.g. low energy content of these forages and roughages which is needed to be sufficiently provided with fibers in rations of high genetic potential dairy animals. Hence, the fermentation of diets based on neutral detergent fiber (NDF) as a percentage of the ration dry matter (DM) has been recommended because of the positive relationship between NDF and rumen fill and the negative relationship between NDF and energy density (Mertens, 1994).

In feeding strategies of dairy animals, the dietary forage fiber content, starch amount and source may interact to affect animal performance, since the NDF content of diets has a direct relation with nonstructural carbohydrate "NSC" (Harmison *et al.*, 1997).

Alfalfa is one of the important forages widely used in animal nutrition. However, ensiling alfalfa was followed to conserve it to be used as a major component of rations for dairy animals. Although, 75 to 78% of alfalfa silage-total nitrogen may be found as non protein nitrogen "NPN" (Muck, 1987 and Broderick *et al.*, 1990), Merchen and Satter (1983) and Hristov *et al.* (2001) reported that alfalfa silage (AS) protein is poorly utilized because its extensive degradation in the rumen. Extensive production of ammonia (NH_3) in the rumen was also reported with feeding AS to dairy animals (Vagnoni and Broderick, 1997). This leads to envisaging that conserving alfalfa as silage may reduce animal escaped protein, synthesis of ruminal microbial protein, or both, compared to conserving alfálfa as hay (AH). To overcome such degradation problem in alfalfa silage protein, scientists treated it with either formalin (HCHO) or formic acid (HCOOH) in order to increase rumen undegradable protein (RUP) which is needed by lactating animals (Nagel and Broderick, 1992). They found that these treatments increased milk yield by 3.3 and 0.06 Kg/day, respectively. Formaldehyde reduces protein degradability by forming cross-links between protein chains and has antimicrobial properties that may alter the bacterial population and fermentation pattern of silage (Woolford, 1975). Dhiman *et al.* (1993) stated that protein, but not energy, was the first limiting nutrient for milk yield in cows fed diets high in AS. In this connection, poor performance on diets high in AS might result from inadequate capture of dietary N as absorbable protein. Also, increased dry matter intake and N retention have been reported in dairy cows fed treated-AS (Nagel and Broderick, 1992).

While formulating rations for dairy animals, the attention must be paid towards the importance of synchronization between ruminal degradability of NSC and rumen degradable protein (RDP) to maximize microbial protein synthesis which support animals' growth and milk production. Since Clark *et al.* (1992); Hoover and Stokes (1991); Nocek and Russell (1988) and Nocek and Tamminga (1991) reported that bacterial-N and microbial protein synthesis have been altered by varying NSC sources and its ratio to RDP for lactating cows.

The objective of the present investigation was to study the relationship among N-source, NSC, eNDF and relative feeding value of different forms of alfalfa (green, hay, untreated silage, formaldehyde and/or formic acid treated silage).

MATERIALS AND METHODS

The present study was carried out at El-Serw Experimental Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt.

1. Preparation of experimental diets:

Alfalfa was grown at El-Serw Agricultural Research Station. Third and fourth cuts of alfalfa in the first year before bloom were used in the forms of either green fodder (AG), hay (AH) or silage (AS). The green alfalfa was chopped to a length of 5 cm before being offered to animals. The AH was wilted, then sun dried to approximately 85% DM, chopped to a length of 5 cm, conserved in a stack and stored under shelter. The third cut of alfalfa was allowed to wilt to approximately 28% DM and then chopped (about 5 cm lengths) and about 7 Kg ground yellow corn grain per 100 Kg wilted alfalfa was added and mixed to improve fermentation conditions. Alfalfa was ensiled untreated, treated with formaldehyde (0.31 g formaldehyde 40% conc. / 100 g DM; 1.3 g of HCHO / 100 g of CP) and treated with formic acid (2.8 g formic acid 90% conc. /100 g DM). The mixtures were ensiled in double plastic bags (130 x 80 cm) by firmly packing by trampling to remove as much air as possible and the bags were individually sealed. The mixture was allowed to ferment for minimum 40 days before feeding.

2. Metabolism trials:

Five digestion trials were conducted to evaluate the alfalfa as green, hay, untreated silage, formaldehyde treated silage and formic acid treated silage. Three mature Zaraibi buks weighed 50 Kg on average were used for these trials. Each digestibility trials lasted for 28 days in which the first 21 days considered as a preliminary period and the last 7 days represented the collection period. Animals were kept in metabolic crates and diets were offered for *ad libitum* intake once daily and drinking water was available freely. Offered diets and orts were weighed once daily and samples were taken from it during the collection period.

Samples of AG, AS and orts, after drying at 60°C for 24 hours in forced air oven, as well as AH and feces samples were dried at 105°C for 3 hours and ground through a 1 mm screen hammer mill. The samples were analyzed for crude protein (CP), crude fiber (CF), ether extract (EE) and ash according to the official methods of AOAC (1990). The NDF percentage was determined according to the method outlined by Robertson and Van Soest (1981). Total urine was collected, acidified with 100 ml of 10% H_2SO_4 and 10% daily sub-sample was taken and kept until nitrogen analysis.

3. Silage quality determination:

Samples of alfalfa silage were taken during the experimental period (4 samples within 12 weeks) and kept frozen at -20°C until analysis. Silage samples were thawed, then extracted with distilled water and pH was measured immediately using battery operated pH meter. Water extracts were analyzed for organic acids fractions by gas liquid chromatograph (GLC). Extract (20 ml) was deproteinized using 5 ml of 25% trichloro acetic acid (wt/vol). The TCA extracts were analyzed for NH_3-N (Conway and O'Mally, 1957) and NPN (Muck, 1987).

4. Rumen liquor parameters:

Rumen liquor samples (RL) were taken after each collection period of the digestibility trials at 0, 3, 6, 9, 12, 15 hrs post feeding using stomach tube. Rumen liquor was strained through three layers of cheesecloth and pH was immediately measured using a digital pH meter, followed by the addition of 2.0 ml H_2SO_4 (50% v/v) to retard ammonia loss. Samples were frozen and kept at -20°C for subsequent NH_3-N determination according to the method described by Conway and O'Mally (1942) and total volatile fatty acids as described by Warner (1964).

5. Statistical analysis:

Data were statistically analyzed by the computer program of SAS (1996) using the General Linear Model (GLM). Means were compared according to Duncan's Multiple Range Test at significance level of 0.05 (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition:

The chemical composition of the used alfalfa is presented in Table (1). The results revealed that chemical composition of different forms of alfalfa was within the published ranges (Abu-Raya, 1967, Broderick, 1995 and El-Shabrawy *et al.*, 2004). However, it seems that treated silages contained higher values of OM, EE, NFE and NSC compared to those recorded for the other two forms of alfalfa (green and hay). On the other hand, ensilaging alfalfa decreased CP, CF, ash and NDF percentages than those of both green and hay forms.

Table (1): The chemical composition of green, hay, untreated, formaldehyde treated and formic acid treated alfalfa silage.

Items	DM (%)	Chemical composition (on DM basis, %)							
		OM	CP	EE	CF	NFE	Ash	NDF	NSC***
Green	23.93	87.56	17.97	2.25	21.83	45.51	12.44	37.81	29.53
Hay	89.33	86.09	17.59	2.12	23.72	42.66	13.91	43.16	23.22
Untreated silage	27.95	87.77	17.20	3.11	20.45	47.01	12.23	33.03	34.43
HCHO-treated silage*	27.78	87.81	17.51	3.30	20.12	46.88	12.19	30.97	36.03
HCOOH-treated silage**	28.42	87.94	17.35	3.25	21.12	46.22	12.06	32.03	35.31

* HCHO = Formaldehyde
** HCOOH = formic acid
*** NSC % = 100 – [% NDF + % CP + % fat + % ash]   Calsemiglia *et al.* (1995)

It also appeared that ensiled alfalfa contained higher value of OM, CP, EE and NSC when treated with formaldehyde and formic acid, while it contained lower values of NFE, ash and NDF compared to the untreated silage. Meanwhile, CF showed a slight reduction when silage was treated with formaldehyde and a relative increase in the silage treated with formic acid.

Fermentation characteristics and N solubility:

The results in Table (2) indicated that formaldehyde and formic acid treated alfalfa silages, as well as added ground yellow corn grains, tended to have higher desirable fermentation characteristics indicated in lower pH and butyric acid and higher lactic acid content compared to the untreated silage. In thisa concern, Sibanda *et al.* (1997) found that ground maize (5 and 10% w/w) mixed with legume (*Desmodium uncinatum*) improved fermentation of star grass silage (*Cynodn nlemfluensis*). These results are in agreement with those reported by McDonald and Edwards (1976); Nagel and Broderick (1992) and El-Shabrawy *et al.* (2004). The formaldehyde treatment was most effective in reducing protein solubility of alfalfa silage probably by rapidly decreasing pH and inhibiting plant proteases. Reduced protein solubility was demonstrated by the lower NPN, NH_3 in the formaldehyde or formic acid treated AS versus the untreated one. Similar results were reported by Broderick (1996).

Table (2): Fermentation characteristics and *in vitro* nitrogen solubility of alfalfa silage.

Item	Silage		
	Untreated	HCHO-treated	HCOOH-treated
No. of sample	4	4	4
DM (%)	27.95	27.78	28.42
pH	4.20	4.00	3.85
Total N (TN), % DM	2.75	2.80	2.78
NPN, % TN	45.65	36.25	30.12
NH_3-N, % TN	8.35	5.70	4.02
Organic acids (%):			
Lactic	40.33	44.82	52.12
Acetic	35.37	36.78	34.38
Propionic	14.13	14.83	8.76
Isobutyric	2.36	0.26	1.05
Butyric	6.56	2.61	2.84
Isovaleric	0.66	0.16	0.25
Valeric	0.59	0.54	0.60
Soluble N (% Total N*)	74.05	35.20	30.55

*** In borate phosphate buffer solution (El-Shabrawy, 1996).**

Messman *et al.* (1994) observed that drying fresh alfalfa to AH reduced the amount of total soluble protein that was identifiable electrophoretically by about 25% and ensiling reduced it by more than 90%. In addition, Charmley and Veira (1990) stated that the inhibition of proteolysis by heat treatment at ensiling can increase utilization of silage-N within the rumen, increases voluntary intake and results in higher rate of gain by lambs fed alfalfa silage.

Formaldehyde treatment of silage decreased NPN as % of TN by about 20% and NH_3-N as % of TN by about 30%, while the corresponding decreasing values as a result of formic acid treatment were >30% and >50%, respectively compared with those of untreated silage. Broderick *et al.* (1990) reported that alfalfa ensiled with 30 to 55% DM contained 62 to 76% NPN, mean NPN in the present trial was 39% of total N. On the same line with the obtained trends of pH, NPN and NH_3-N, Broderick (1996) stated that adding formic acid and formaldehyde to silage dropped the pH and reduced (but does not stop) NPN formation; and hence formaldehyde increases ruminal protein bypass. Moreover, McDonald *et al.* (1991) reported that reducing NPN alone appeared more useful than increasing protein bypass with a smaller reduction in NPN. These findings are interesting because European recommended that formic acid can be applied only to direct-cut silage, but that it is ineffective when applied to wilted silage.

Feed intake and energy density:

Intake from dry matter as well as OM (g/day) significantly (P<0.05) increased with HCHO-treated silage by about 5% than the other forms, while such difference was not significant among green, untreated and HCOOH-treated alfalfa silage (Table 3). Accordingly, TDN and DOM intakes were maximum with HCHO-treated silage followed by green, untreated silage and hay for the first criterion, and by HCOOH-treated, untreated silage, green and hay for the second criterion, respectively. The difference among the 5 tested forms of alfalfa were significant (P<0.05) in this respect.

Table (3): Feed intake and energy density of alfalfa in different forms.

Items	Green	Hay	Silage			SE
			Untreated	HCHO-treated	HCOOH-treated	
Fresh intake (g/day)	4912	1190	4354	4572	4302	93.52
DM intake (DMI, g/day)	1209^{b}	1063^{c}	1217^{b}	1270^{a}	1222^{b}	14.28
OM intake (OMI, g/day)	1058^{b}	915^{c}	1068^{b}	1115^{a}	1075^{b}	12.59
TDN intake (g/day)	702^{d}	579^{e}	745^{c}	812^{a}	784^{b}	8.68
DCP intake (g/day)	151^{b}	133^{d}	144^{c}	163^{a}	161^{a}	2.03
DOM intake (g/day)	657^{d}	562^{e}	714^{c}	786^{a}	768^{b}	9.81
DE (MJ/Kg DM)	12.48^{c}	10.68^{d}	13.57^{b}	14.93^{a}	14.59^{a}	0.19
ME (MJ/Kg DM)	10.23^{c}	8.75^{d}	11.12^{b}	12.24^{a}	11.96^{a}	0.15
eNDF*	26.60^{a}	19.98^{b}	13.83^{c}	17.85^{cd}	7.45^{e}	-
RFV**	112.65^{bc}	98.64^{d}	120.78^{b}	132.51^{a}	131.08^{a}	-

* eNDF (Effective NDF) = (pH - 5.425) / 0.04229 Fox *et al.* (2000)

** RFV (Relative feeding value) = DMI x DDM / 1.29 Moore and Coleman (2001)

a, b, c...: Values in the same row having different superscripts are significantly different (P<0.05).

The results in Table (3) indicated that the effective NDF (eNDF) significantly (P<0.05) decreased when green alfalfa was dried to hay and this reduction was more pronounced with ensiled alfalfa. It seems that DE and ME contents of different forms of alfalfa followed similar trend to that of the eNDF. In this concern, Waldo *et al.* (1990) mentioned that the higher NDF of orchardgrass or other fiber components seemed to be the most probable cause of its somewhat lower potential energetic efficiency relative to alfalfa. In addition, the relative feeding value (RFV) varied significantly (P<0.05) when alfalfa was ensiled with the superiority of HCHO treatment to give the highest (132.51) value, while alfalfa hay recorded the lowest (98.64) value among the tested forms. It is also clearly appeared that the eNDF content and energy density were positively reflected on the intakes of different nutrients. These results are confirmed by those obtained by Mertens (1983) who stated that a diet of 35% NDF would stimulate maximum NDF intake, since higher concentrations of NDF limited the intake through rumen fill, and the intake from diets with low NDF level were limited by the energy requirements of the animal which was negatively related to NDF content (Mertens, 1994). Nagel and Broderick (1992) found that DM intake and body weight gain of dairy cows fed on formic acid and formaldehyde-treated silage diets were higher than those of untreated silage.

Regarding the effect of NSC on DMI it is clear that with increased level of NSC, DMI increased, but this was accompanied by a reduction in NDF content (HCHO and HCOOH treated silages compared to untreated one) which may refferd back to the addition of maize grains with silage making. An opposite trend was observed with alfalfa hay, since DMI and NSC decreased with the increased level of NDF% in comparison to the green alfalfa and its silages. In this connection Yokota *et al.* (1998) concluded that combination of molasses/rice bran improved the fermentation quality and enhanced the utilization of Napeir grass silage by goats. These results came online with those of Sievert and Shaver (1993) who found higher NDF intake and lower DMI with 35 and 42% NFC (non-fiber carbohydrate) diets of lactating dairy cows.

Digestion coefficients and nutritive values:

The results of digestion coefficients and feeding values are presented in Table (4). It was clear that there were significant differences ($P< 0.05$) among means of nutrients digestibility with superiority of ensiled forms of alfalfa, since they recorded the highest values for all nutrients digestibility coefficients, with few exceptions, e.g. the reduction of CP digestibility of untreated silage. The AS diets recorded the highest values of digestibility coefficients for all nutrients ($P<0.05$), except for EE in the green alfalfa which recoded the highest but without significant difference with HCOOH-treated silage. El-Shabrawy *et al.* (2004) found that CP digestibility improved when alfalfa silage was treated with formaldehyde with lactating goats.

Table (4): Effect of feeding alfalfa in different forms on apparent digestibilities and nutritive values by Zaraibi buks.

Items	Green	Hay	Silage			SE
			Untreated	HCHO-treated	HCOOH-treated	
Digestion coefficient, %:						
DM	60.05^{d}	59.85^{d}	64.01^{c}	67.30^{b}	69.36^{a}	0.50
OM	62.14^{c}	61.43^{c}	66.85^{b}	70.54^{a}	71.49^{a}	0.57
CP	69.55^{d}	71.46^{c}	68.82^{d}	73.53^{b}	75.95^{a}	0.57
CF	47.15^{b}	46.67^{b}	49.35^{a}	50.20^{a}	49.64^{a}	0.44
EE	59.77^{a}	47.44^{c}	53.64^{b}	55.53^{b}	62.31^{a}	0.81
NFE	70.94^{c}	67.02^{d}	75.63^{b}	78.57^{a}	77.85^{a}	0.42
Feeding values, %:						
TDN	58.09^{c}	54.49^{d}	61.23^{b}	63.93^{a}	64.18^{a}	0.22
DCP	12.50^{c}	12.57^{b}	11.83^{d}	12.87^{b}	13.18^{a}	0.11

a, b, c...: Means within the same row having different superscripts are significantly different ($P< 0.05$).

It appears also that ensiling alfalfa increased the digestibility of nutrients with increased NSC and decreased NDF levels compared to the other two forms of alfalfa (green or hay). Sievert and Shaver (1993) found that DM and OM digestibilities were higher for diets contained 42% NFC than others contained 35% NFC, while CP as well as NDF digestibility improved with 35% NFC than with 42% NFC. They added that possible associative effects of fiber on ruminal fermentation may contribute to these increases in fiber digestibility when dietary NFC is lowered. Moreover, although greater intake compensate for lower digestibility, nutrients apparent digestibility along the whole alimentary tract is reflection of fermentation in the rumen in terms of N-availability for rumen microbes as a result of RUP and the synergy between NSC and NDF contents in the diet (Thomson *et al.*, 1991).

Ruminal parameters:

The results in Table (5) indicate that the ruminal pH and total VFA's recorded the highest ($P<0.05$) values with green alfalfa diet, while the lowest ($P<0.05$) corresponding values were recorded with HCOOH and HCHO-treated alfalfa silages, respectively. Generally, the pH values seems to be lower with the three alfalfa silage forms than those of green or hay, while NH_3-N and total VFA concentrations decreased in both treated silages compared to the untreated one and were still lower than the green alfalfa.

Table (5): Mean values of some rumen liquor (RL) parameters of Zaraibi buks fed the alfalfa different forms.

Items	pH	NH_3-N (mg/100 ml RL)	TVFA (meq./100 ml RL)
Green	6.55^{a}	18.17^{b}	6.83^{a}
Hay	7.27^{b}	14.24^{c}	5.68^{c}
Untreated silage	6.01^{c}	20.21^{a}	6.61^{ab}
HCHO-treated silage	6.18^{b}	15.60^{c}	6.39^{b}
HCOOH-treated silage	5.74^{d}	14.32^{c}	6.46^{ab}
± SE	0.06	0.55	0.14
Sampling times (hrs):			
Before feeding, 0	6.54^{a}	8.90^{d}	5.39^{d}
After feeding:			
3	6.14^{b}	23.88^{a}	6.89^{a}
6	6.01^{c}	18.73^{b}	7.13^{a}
9	5.91^{c}	17.99^{b}	6.81^{a}
12	6.02^{c}	15.44^{c}	6.29^{b}
15	6.26^{b}	14.12^{c}	5.85^{c}
±SE	0.06	0.60	0.15

a, b, c...: Means within the same column having different superscripts are significantly different ($P< 0.05$).

Meanwhile, NH_3-N concentration gave the highest ($P<0.05$) value with untreated alfalfa silage. Lower concentration of ruminal NH_3-N on hay diet reflected the greater microbial capture of degraded protein, while on the alfalfa untreated alfalfa silage diet reflected the NPN as a percentage of total

N (Table 2). The extensive conversion of protein to NPN that occurs during silage fermentation, resulting in excessive production of NH_3-N in the rumen, suggested that conservation of alfalfa as silage reduced ruminal escape protein, microbial protein synthesis, or both, by about 29% compared to conservation of alfalfa as hay (Peltekova and Broderick, 1996 and Vagnoni and Broderick, 1997). Thus, for better protein utilization dietary rumen undegradable protein (RUP) needed to be increased without affecting microbial fermentation in the rumen to synchronize with energy digestion (Broderick, 1996, Baker *et al.*, 1996 and El-Fadaly *et al.*, 2003).

The highest pH value (6.54) was before feeding, and significantly ($P< 0.05$) decreased to 5.91 after 9 hours post-feeding. El-Shabrawy *et al.* (2004) observed a similar reduction in pH after feeding, which might have been due to increasing availability of fermentable substrate after feeding. In contrast, the highest ($P< 0.05$) NH_3-N and VFA's values (23.88 mg/100 ml and 7.13 meq./100 ml) were obtained at 3 and 6 hours after feeding. Although, diets which contained high NDF and low NSC levels (green and hay) recorded the highest pH ($P<0.05$) values compared to the other three silage forms, hay fermentation in the rumen produced the lowest ($P<0.05$) value of total VFA. Sievert and Shaver (1993) found that ruminal pH and ammonia were higher with low than high NFC diets and the reverse was true with total VFA levels.

Nitrogen balance:

The results presented in Table (6) focused on N balance and indicate that all buck were in positive N balance especially with HCHO and HCOOH-treated silages which significantly differed ($P<0.05$) than the other three tested forms of alfalfa (green, hay and/or untreated silage). This may be due to the increase in digested N which was higher ($P<0.05$) with both treated silage forms compared to the untreated, green and/or hay ones, since the % of N balance to N-intake and /or digested nitrogen were the highest ($P<0.05$) with both HCHO and HCOOH-treated silages.

Table (6): Nitrogen balance (g/head/day) of Zaraibi buks fed different forms of alfalfa.

Items	Green	Hay	Silage			SE
			Untreated	HCHO-treated	HCOOH-treated	
N-intake (NI)	34.76^{a}	29.91^{c}	33.49^{b}	35.59^{a}	33.94^{b}	0.39
Fecal-N	11.04^{a}	9.32^{c}	10.26^{c}	11.64^{a}	9.73^{c}	0.30
Urinary-N	18.86^{a}	15.24^{c}	18.76^{a}	17.30^{b}	16.76^{b}	0.35
N-balance (NB)	4.86^{c}	5.35^{c}	4.47^{d}	6.65^{b}	7.45^{a}	0.22
N-digested (ND)	24.18^{b}	21.37^{d}	23.04^{c}	26.16^{a}	25.77^{a}	0.33
NB/NI x 100	13.98^{c}	17.88^{b}	13.34^{c}	18.68^{b}	21.95^{a}	0.75
NB/ND x 100	20.09^{c}	25.03^{b}	19.40^{c}	25.42^{a}	28.91^{a}	1.13
NB/100 g TDN intake	0.69	0.92	0.60	0.82	0.95	0.34
NB/100 g digestible OM	0.74^{c}	0.95^{a}	0.63^{d}	0.85^{b}	0.97^{a}	0.36

a, b, c...: Means within the same row having different superscripts are significantly different ($P< 0.05$).

As shown in Table (6), although nitrogen balance per 100 g TDN intake did not record any significant difference among the five tested alfalfa forms, it was significantly ($P<0.05$) more in case of hay and HCOOH-treated silage compared to the other tested forms. In this concern Nagel and Broderick (1992) discussed and reviewed formaldehyde treatment effect on the direct cut of alfalfa herbage and silage and stated that proteolysis and apparent digestibility decreased, although it increased the N retention in the animal body.

On the light of the above discussed results, it is clear that conserving alfalfa in the form of silage or using it as green is much better for animal utilization compared to using it as hay. To overcome the problem of NPN formation, formaldehyde and/or formic acid showed to be effective in reducing NPN in the silage throughout decreasing the breakdown of alfalfa protein during preservation. and the results favor formaldehyde treatment for alfalfa silage compared to formic acid because of the high cost (not economical) and corrosiveness of the latter. This is confirmed by the results of El-Shabrawy *et al*, (2004) who found that when the three tested forms of alfalfa (hay, untreated and HCHO-treated silages) were fed to lactating Zaraibi , yields of milk, 4% FCM and its component were higher with HCHO-treated silage. It could be concluded that formaldehyde treatment reduced the NDF level and increased the NFC concentrations, thus effectively improved utilization of nutrients in alfalfa silage through better fermentation characteristics during ensiling and in the rumen and improved its feeding values.

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تاثير التجفيف وطرق مختلفة للسيلجةعلي القيمة الغذائية للبرسيم الحجازي

محمد محمد الديب[1] - أحمد زكى محرز[2] - حامد محمد الشبراوى[1]

١- معهد بحوث الإنتاج الحيوانى - مركز البحوث الزراعية - وزارة الزراعة - الدقى - الجيزة - مصر.

٢- قسم إنتاج الحيوانى - كلية الزراعة - جامعة المنصورة - مصر.

استخدمت الحشة الثالثة والرابعة من البرسيم الحجازي إما خضراء أو في صورة دريس أو مسيلجة أو معاملة بـ ٠,٣١ جرام فورمالين لكل ١٠٠ جرام مادة جافة أو ٢,٨ جرام حمض فورميك لكل ١٠٠ جرام مادة جافة ، في تغذية ذكور الماعز الزرايبي زنة ٥٠ كجم في المتوسط.

أوضحت النتائج المتحصل عليها أن السيلاج المعامل بالفورمالدهيد أو حمض الفورميك يحتوى على قيم أعلى من المادة العضوية ومستخلص الإثير والمستخلص خالي الأزوت والألياف غير التركيبية مقارنة بمثيلها في البرسيم الأخضر ودريسه. وبينما احتوى سيلاج البرسيم الحجازي المعامل على قيم مرتفعة من المادة العضوية والبروتين الخام ومستخلص الإثير والكربوهيدرات غير التركيبية فقد احتوى على نسب منخفضة من مستخلص خالي الأزوت والرماد ومستخلص الألياف المتعادل مقارنة بالسيلاج غير المعامل. وقد أظهر السيلاج المعامل دليلا على حدوث التخمرات المرغوبة ممثلا في انخفاض قيم الأس الهيدروجيني وحمض البيوتريك وارتفاع محتواه من حمض اللاكتيك مقارنة بالسيلاج غير المعامل. كما انخفض ذوبان البروتين مع النقص في المواد الأزوتية غير البروتينية والأمونيا في السيلاج المعامل.

تحسن المأكول في صورة مادة جافة ومواد كلية مهضومة ومادة عضوية مهضومة معنويا (<٠,٠٥) من السيلاج المعامل مقارنة بالصورة الخضراء أو الدريس. كما ازدادت القيمة الغذائية النسبية ومحتوى العلف من الطاقة المهضومة والممثلة في الصورة المسيلجة عن الخضراء أو الدريس ، وقد اصطحب ذلك حدوث نقص في مستخلص الألياف المعادل الفعال (eNDF) وخاصة بزيادة محتوى الكربوهيدرات غير التركيبية في السيلاج المعامل بحمض الفورميك. وقد سجلت علائق السيلاج أعلى (<٠,٠٥) معاملات هضم لكل المركبات الغذائية ، فيما عدا مستخلص الإثير في البرسيم الحجازي الأخضر التي سجلت أعلى القيم ولكن بدون فرق معنوي مع نظيره للسيلاج المعامل بحمض الفورميك.

وقد كانت أفضل القيم (<٠,٠٥) للأس الهيدروجيني والأحماض الدهنية الطيارة مسجلة مع البرسيم الحجازي الأخضر وانخفضت معنويا في سيلاجه المعامل بحمض الفورميك والفورمالدهيد. وتعظمت (<٠,٠٥) تركيزات نتروجين الأمونيا في السيلاج غير المعامل وكانت أقل قيمة مع دريس البرسيم الحجازي. وكانت كل الحيوانات في حالة ميزان أزوتي موجب ، وكانت نسبة ميزان الأزوت للنتروجين المأكول والمهضوم الأعلى (<٠,٠٥) في حالة السيلاج المعامل بالفورمالدهيد ثم حمض الفورميك.

مما سبق يمكن استنتاج أن معاملة سيلاج البرسيم الحجازي بالفورمالدهيد أكثر فعالية في تقليل محتواه من مستخلص الألياف المتعادل (NDF) وزيادة محتواه من الكربوهيدرات غير التركيبية التي انعكست إيجابيا على التخمرات في الكرش وتحسين الاستفادة من الغذاء مقارنة بالصور الأخرى المختبرة من البرسيم الحجازي.