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EFFECT OF FEEDING DIFFERENT LEVELS OF CORN SILAGE ON MILK COMPOSITION OF FRIESIAN COWS.

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ABSTRACT

Eighteen lactating Friesian cows at different lactation seasons were taken one month pre-partum and divided into 3 similar groups. (G1) control was fed 25% corn silage (CS) on DM basis, (G2) was fed 50% corn silage and (G3) was fed 75% corn silage. Results showed that silage fermentation characteristics (pH, TFVA, ammonia nitrogen (NH_3-N) and fractions of VFAs) were almost within the normal ranges reported for good quality silage. Also, it was indicated that increasing level of CS in rations significantly ($P<0.05$) increased pH and decreased VFAs and NH3-N in rumen liquor. Cows in G3 showed the highest average daily milk yield (ADMY) *followed by G2 and G1 at all lactation periods. Maximum ADMY was observed* between 30 and 60 days of lactation period in all groups. Milk fat content showed inconsistent trend in all groups and showed the maximum fat content at 60 days of lactation period. Protein content showed the highest values at the beginning of lactation, thereafter decreased in all groups. Lactose content was almost higher in G3 and G2, than G1 at all lactation times. As a results of increasing fat, protein and lactose contents in milk in G2 and G3 total, solids content was higher in G3 and G2, respectively at all lactation times. Total concentrations of TVFA, NCN, NPN were significantly not affected by feeding treatments.

Keywords: Friesian cows, corn silage, rumen function, milk composition.

INTRODUCTION

Corn plant is one of the main crops in Egypt. About 1.5 to 2 millions feddan (Zedan, 1998) are cultivated annually with corn plant. Recently, use of maize silage has rapidly increased as forage for dairy cattle in Egypt. This increase can be related to the relatively high energy yield of maize crop and ease of mechanization with which the whole plant can be ensiled to provide highly palatable source of energy and high quality forage (Mohamed *et al.*, 1999). Several studies used corn silage and corn stalks without and with additives, El-Mufeed, protein sources and enzymes (Zedan, 1998; Sheperd and Kung, 1996; Overton *et al.*, 1998 and Noftsger *et al.*, 2000) were carried out to study effects on milk production and composition.

The present work was conducted to study the effect of using corn silage at different levels in rations of lactating cows on gross chemical composition and nitrogen distribution of the milk.

MATERIALS AND METHODS

This experiment was carried out at Sakha Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center.

Eighteen lactating Friesian cows at different lactation seasons were taken one month pre-partum and were divided into 3 similar groups. All groups were fed according to NRC (1989). The first group (G1) was fed 11.65 kg concentrate feed mixture (CFM), 1.5 kg berseem hay (BH) and 11.4 kg corn silage (CS, about 25% on DM basis) and was considered as a control. Cows in the 2nd group were fed 7.3 kg CFM, 1.5 kg BH and 22.8 kg CS (50% on DM basis), while the 3rd one was fed 4.18 kg CFM and 32.3 kg CS (75% on DM basis).

Calculated chemical composition of different rations fed to lactating cows is presented in Table (1).

Table (1): Calculated chemical composition of different experimental rations.

Item	DM%	Chemical composition (%)on DM basis					
		OM	CP	EE	CF	NFE	Ash
G1 (25% CS)	65.09	92.05	14.21	3.25	15.83	58.76	7.95
G2 (50% CS)	50.79	92.02	12.46	3.05	19.25	57.26	7.98
G3 (75% CS)	41.56	92.41	11.09	2.84	21.50	56.96	7.59

Rations were offered twice daily at 8.0 a.m. and 3.0 p.m. and water was offered all day times. Cows were milked twice daily at 6.00 and 18.00 h by milking machine and milk production was daily recorded. Monthly milk samples were taken for determining approximate chemical analysis, using Milkoscan (Model 133 B). Total nitrogen content (TN) was determined using semi-micro Kjeldahl method, meanwhile total solids (TS) and ash contents were measured according to Ling (1963). The method of Kosikowski (1978) was used for determination of total volatile fatty acids (TFVA). The N distribution was done as recommended by Rowland (1938). Non-casein nitrogen (NCN) was determined in the collected filtrate after precipitation of casein by means of acetic acid and sodium acetate at pH 4.6. Non-protein nitrogen (NPN) was measured in clear filtrate after precipitation of protein by TCA (15%). Non-Protein nitrogen and albumin (NPN + AL) was measured by adding Na_2So_4 (20 g/100 ml) to precipitate the casein, albumin and protease peptone. Concentration of NPN+AL was determined in filtrate. Casein nitrogen (CN), whey protein nitrogen (WPN) and albumin nitrogen (ALN) were quantified by the difference as reported by Rowland (1938) as follows:

CN = Total N-NCN
WPN = NCN - NPN
ALN = [NPN+AL] - NPN

Chemical analysis using methods of A.O.A.C. (1980) was performed on representative samples from all experimental feedstuffs. Values of pH in silage were determined using digital pH-meter. Concentration of total VFAs and individual VFAs including lactic, acetic and butyric acids were determined using high performance liquid chromatography (Model Knauer).

Rumen liquor samples were collected from 3 animals in each group, 4 hours post feeding. Rumen pH values were determined immediately after samples collection using digital pH-meter. Concentration of ammonia-nitrogen was determined by the method described by Conway (1957), whereas, TVFA were determined by steam distillation method as described by Warner (1964).

Statistical analysis was carried out using general linear procedure of SAS (1996) according to Stell and Torrie (1984). Group mean differences were tested using least significant differences (Duncan, 1955).

RESULTS AND DISCUSSION

Silage characteristics:

Different fermentation characteristics of corn silage shown in Table (2) revealed that pH value, concentrations of lactic, acetic, butyric and propionic acids as well as concentration of TVFA and NH_3-N in silage juice were almost within the normal ranges reported for good quality silage as reported in the literature as shown in Table (2). Good quality silage is characterized by high lactic acid concentration. Soluble carbohydrates are the major source of lactic acid in the silage (Zedan, 1998).

Table (2): Fermentation characteristics of corn silage compared to those reported by different authors.

Item	CS	Good quality silage	
		Range	Reference
VFAs (%) on DM basis:			
Lactic	5.63	2.8-8.57	Buttrey *et al.* (1986) McDonald *et al.* (1995)
Acetic	2.86	0.93-3.67	Chen *et al.* (1994)
Butyric	0.43	0.07-1.45	Stokes and Chen (1994)
Propionic	0.17	0.03-0.48	Etman *et al.* (1994)
Total	3.52	1.22-3.54	Etman *et al.* (1994)
NH_3-N (%)	0.19	0.08-0.22	Sheperd and Kung (1996)
PH value	4.3	%4.5	Hellberg (1963) Flynn (1981) and Pitt (1990)

The volatile substances in the good silage must be comparatively less than lactic acid concentration (Ranjhan, 1980). The poor quality silage is generally associated with high level of ammonia, which may indicate considerable breakdown of amino acids into more soluble products (Bakr, 1995).

Rumen function:

Rumen parameters including pH, concentration of VFAs and NH_3-N of lactating cow fed experimental rations are shown in Table (3).

Results indicated that increasing level of CS in the rations significantly ($P<0.05$) increased pH value and decreased concentration of VFAs and NH_3-

N in rumen liquor. The differences between rations containing 50 and 75% CS were almost significant ($P<0.05$), being higher in 50% than 75% for concentration of VFAs and NH_3-N, however, pH values showed the opposite trend.

The significant reduction in VFAs concentration by increasing CS level might be due to the increase of lactic acid production. This was observed in rumen liquor of cows fed rations containing different levels of CS (Etman *et al.*, 1986; Hussein and Berger, 1995; Taie *et al.*, 1998 and Mehany, 1999). Also, this was in relation to increasing level of roughages and decreasing level of CFM (Taie *et al.*, 1998 and Mehany, 1999).

Table (3): Average values of rumen parameters of lactating cows fed different levels of corn silage.

Rumen parameter	Experimental group		
	G1	G2	G3
pH value	6.21^{b}	6.33^{b}	6.65^{a}
NH3-N mg/100 ml	13.45^{a}	10.14^{b}	7.24^{c}
Total VFAs mEq/100 ml	16.68^{a}	14.76^{b}	10.75^{c}

a, b and c: Group means with different superscripts are significantly different at $P<0.05$.

On the other hand, the significant reduction in NH_3-N concentration may be due to the higher degradability of dietary protein in CFM than in CS. This was associated with the lower concentration of NH3-N in CS (Table 2).

Concentration of VFAs in rumen liquor of cows in all groups was associated with reversible trend of ruminal pH value (Table 3). Russell and Dombrowski (1980) reported that ruminal VFAs production was closely related to ruminal pH which can be an important regulator of microbial yield.

Milk yield:

Table (4) shows that the differences in average daily milk yield (ADMY) among experimental groups were significant ($P<0.05$), being higher by about 112.7 and 115% in G2 and G3, respectively, than in the control group.

Table (4): Milk production and milk composition of cows fed different levels of corn silage.

Item	Experimental group		
	G1	G2	G3
Average daily milk yield (kg)	16.94[b]	18.59[a]	18.98[a]
Milk composition (%):			
Fat	3.78	3.91	4.00
Protein	3.09	3.02	3.03
Lactose	4.86[b]	5.08[ab]	5.27[a]
TS	13.82[b]	13.90[b]	14.04[a]
SNF	10.05	9.98	10.10
Ash	0.74	0.75	0.77
Concentration (mg/100 ml):			
Total volatile fatty acid	3.53	3.75	3.93
Non-casein nitrogen	130.65	153.35	153.99
Non-protein nitrogen	71.7	79.6	78.14

a and b, Group means with different superscripts are significantly different at P<0.05.

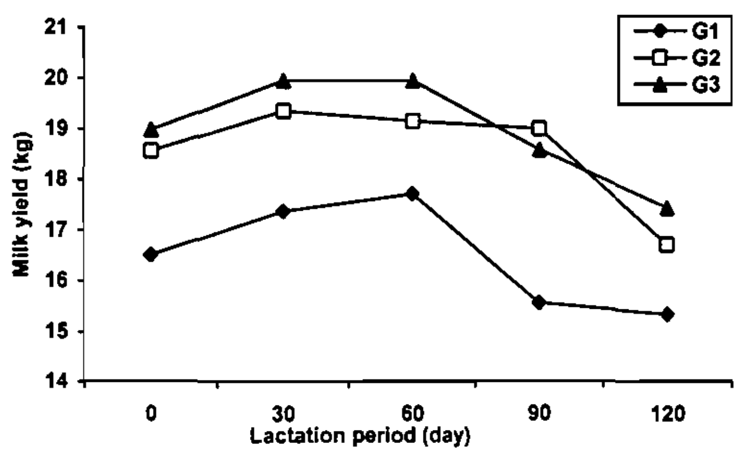

Fig. (1): Changes in daily milk yield of cows in experimental groups at different lactation days.

Concerning the changes in ADMY at different lactation periods in all experimental groups, it was observed that cows in G3 showed almost the highest ADMY, followed by those in G2. Meanwhile, cows in the control group showed the lowest ADMY at all lactation periods. Maximum ADMY was observed between 30 and 60 days of lactation period in all groups (Fig. 1).
Superiority of cows fed CS rations than the control group is in agreement with the results of Keys *et al.* (1984); Bakr *et al.* (1998); Overton *et al.* (1998) and Noftsger *et al.* (2000).

Milk composition:

Percentages of milk fat showed marked increase by increasing level of CS in the rations of lactating cows, but the differences among groups did not reach significant level ($P<0.05$, Table 4). At different lactation periods, milk fat content showed inconsistent trend in all groups, although all groups showed the minimum values on 30 days lactation (Fig. 2).

Percentage of milk protein did not differ significantly among experimental groups ranging between 3.02-3.09% (Table 4). In all experimental groups, protein content showed the highest values at 0 day, thereafter decreased to the lowest values at 30 days of lactation period, but was always higher in control group than G2 and G3 during the 1st month of lactation period. The opposite was observed during late lactation period (90-120 days) (Fig. 2).

Percentage of lactose was significantly ($P<0.05$) different among experimental groups, being higher in G3, followed by G2 and G1, respectively. The differences were significant only between G1 and G3. (Table 4) At all lactation times, lactose content was the highest in G3, followed by G2, while those in G1 showed the lowest values, the highest lactose values were observed at 60 days of lactation period in all groups (Fig. 2).

As a results of increasing fat, protein and lactose contents in milk of cows in G2 and G3, total solids (TS) contents were significantly ($P<0.05$) higher in G3 than in G1 and G2 (Table 4). It is of interest to note that TS content showed similar trend of changes at all lactation times to those occurred in fat and protein contents in all groups (Fig. 2). The observed variation in TS content due to feeding treatments agrees with the results given by Overton *et al.* (1998) and Noftsger *et al.* (2000).

According to the changes in fat and TS contents in all groups, solids not fat (SNF) content did not differ significantly among experimental groups (Table 4). Content of SNF showed opposite trend to that occurred in fat and TS contents in all groups (Fig. 2).

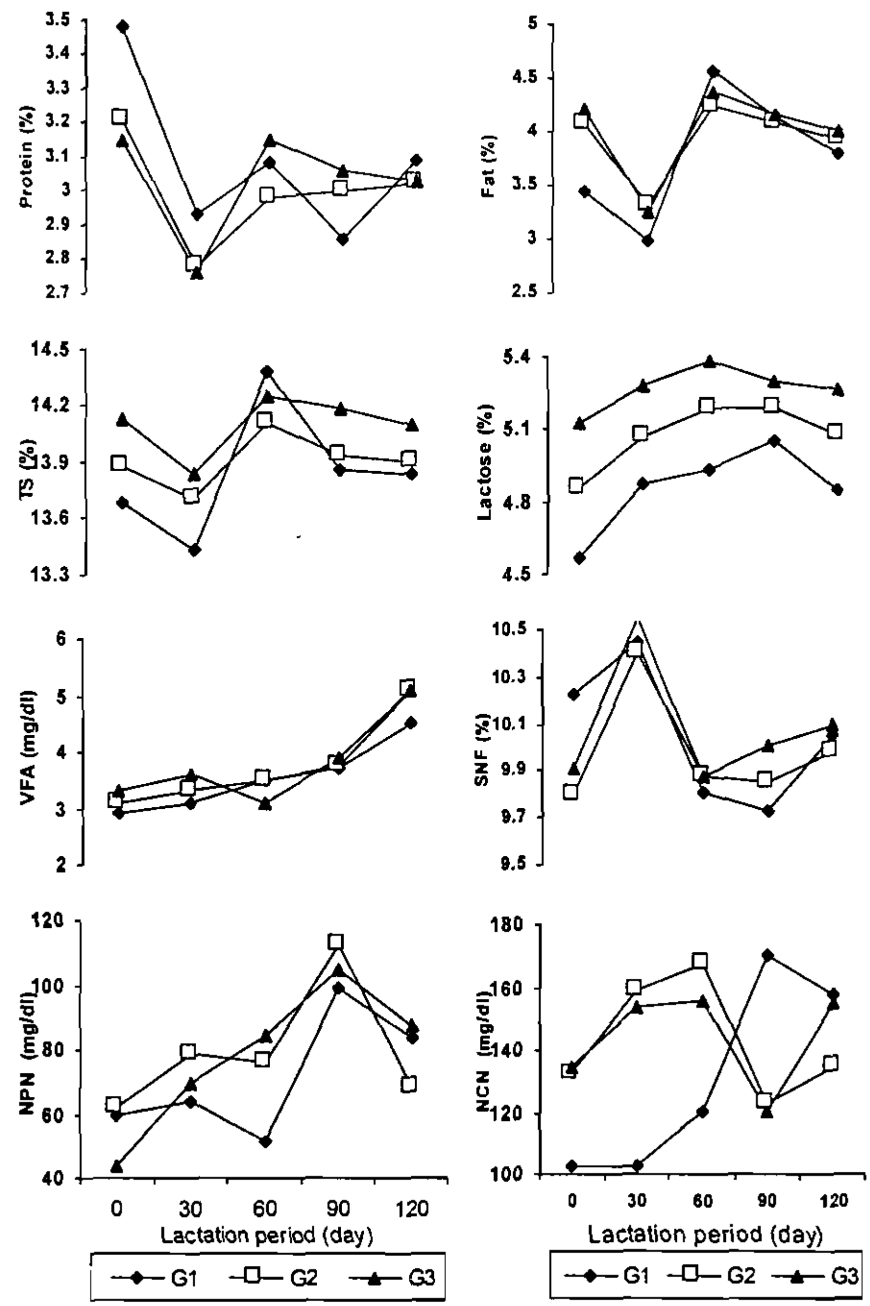

Figure (2): Changes in milk composition of cows in different experimental groups at successive lactation days

Overall means of total concentration of volatile fatty acids (TVFAs), non-casein nitrogen (NCN) and non-protein nitrogen (NPN) were not affected significantly by feeding treatments (Table 4).

All experimental groups showed nearly similar trends of TVFA and NPN concentration at all lactation times. However, increasing level of CS to 50 and 75% resulted in marked increase at early stage (0-60 days) and pronounced decrease at late stage of lactation (60-120 days) in NCN concentration as compared to the control group (Fig. 2).

In general, the effect of interaction of treatment with lactation time on concentration of fat, protein, lactose, TS, SNF, TVFA, NPN and NCN was not significant.

Nitrogen distribution:

Results presented in Table (5) revealed that different fractions of nitrogen and total content of nitrogen were not affected significantly by CS in rations of the experimental groups.

In spite the insignificant differences among lactating, cows fed on 50% (G2) and 75% (G3) resulted in tendency of lower casein nitrogen concentration and higher concentration of whey protein nitrogen and albumin nitrogen than those in the control group (G1). However casein nitrogen content, in turn total nitrogen content tended to be higher in control milk than those in G2 and G3 (Table 5).

The recorded nitrogen distribution agrees with the finding of several authors (Keys *et al.*, 1984; Bakr *et al.*, 1998 and Noftsger *et al.*, 2000) observed the same trend of results when they used different feeding treatments for lactating cows.

Table (5): Effect of feeding treatments on nitrogen distribution (mg/100 ml) in milk.

Properties	Treatments		
	G1	G2	G3
Casein nitrogen	353.68	320.0	320.93
Whey protein nitrogen	58.95	73.75	75.85
Albumin nitrogen	55.03	61.05	61.85
Total nitrogen	484.33	473.35	474.92

Generally, the influences of diet composition on milk protein is small relative to other environmental and genetic influences, and diet mainly induces changes in milk yield and protein content that are often different in direction depending on stage of lactation (Depeters and Cont, 1992).

It could be concluded that replacement of CFM by different levels of CS in rations of lactating cows at a rate of 50 or 75% could be increase average daily milk yield without any reversible effects on milk composition, especially nitrogen distribution.

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تأثير التغذية بمستويات مختلفة من سيلاج الأذرة على تركيب لبن الأبقار الفريزيان

عبد الحليم محمد عبد السلام محى الدين و منال على نعيم
معهد بحوث الإنتاج الحيوانى – مركز البحوث الزراعية – وزارة الزراعة

- أستخدم فى هذه الدراسة ١٨ بقرة فريزيان حلابة فى مواسم حلب مختلفة ، وقسمت إلى ثلاث مجموعات تحتوى علائقها على سيلاج الأذرة بالكيزان ، وذلك على أساس المادة الجافة ، الأولى غذيت على عليقة تحتوى على ٢٥% سيلاج أذرة ، والثانية غذيت على عليقة تحتوى على ٥٠% سيلاج أذرة ، والثالثة غذيت على عليقة تحتوى على ٧٥% سيلاج أذرة ، وأظهرت النتائج أن :
- السيلاج المستخدم ذات صفات جيدة حيث أن قيم الرقم الهيدروجينى PH وتركيز الأحماض الدهنية الطيارة الكلية أو منفردة وكذلك تركيز الأمونيا جميعها كانت فى المعدلات الطبيعية للسيلاج الجيد
- إرتفاع مستوى سيلاج الأذرة فى العليقة أدى إلى إرتفاع الرقم الهيدروجينى PH معنويا ، بينما إنخفض تركيز كل من الأحماض الدهنية الطيارة والأمونيا فى سائل الكرش
- أظهرت المعاملة الثالثة (٧٥% سيلاج أذرة) أعلى متوسط لمحصول اللبن اليومى ، تلتها المجموعتان الثانية والأولى ، وكان أعلى متوسط لمحصول اللبن خلال ٣٠ : ٦٠ يوما من الحلابة فى كل المجموعات.
- سجل محتوى اللبن من الدهن فى كل المعاملات أعلى محتوى عند اليوم ٦٠ من الحلابة ، وكذلك محتوى اللبن من البروتين كان مرتفعا فى بداية الحلب وتناقص بتقدم المدة.
- أظهر محتوى اللبن من اللاكتوز إرتفاعا فى المجموعة الثالثة ثم تلتها الثانية والأولى وذلك فى كل فترات الحلب ، وكنتيجة لإرتفاع الدهن والبروتين واللاكتوز فى المجموعة الثالثة والثانية عن الأولى إرتفعت المادة الصلبة الكلية خلال فترات الحلب المختلفة.
- لم يتأثر كل من تركيز الأحماض الدهنية الطيارة والبروتين غير الكازينى والنيتروجين غير البروتينى فى اللبن معنويا نتيجة المعاملات الغذائية المختلفة.

– من ذلك يمكن القول أن إستخدام ٥٠% أو ٧٥% سيلاج الأذرة على أساس المادة الجافة فى علائق حيوانات اللبن يزيد محصول اللبن اليومى دون أى تغيير فى تركيب اللبن الكيماوى.