CHEMICAL COMPOSITION OF MILK AS AFFECTED BY FEEDING LACTATING COWS VEGETABLE AND FRUIT MARKET WASTE SILAGE

By

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ABSTRACT

Chemical composition of Friesian milk as affected by using vegetables and fruits market waste (VFMW) in feeding lactating cows was tested over a period of 12 weeks. The use of VFMW in a silage form (Treatment I) to replace 15 % of the control ration (ammonia -treated rice straw and concentrate) resulted in an increase in fat, lactose, protein, casein and whey protein content of milk. Non-protein N and non-casein N were lower. In treatment (II), VMW(vegetable market waste) and El-Mufeed was used to replace 15% of the control ration, whereas in treatment (III), VMW and ground yellow corn was used to replace 15% of the control ration. Results showed that treatment (II) gave the highest fat and lactose content followed by treatment (I), whereas treatment (I) gave the highest protein and casein content followed by treatment (II). In all cases, the control milk samples had the lowest values of fat, protein, casein and whey protein content.
Key words: milk composition, cows feeding , Silage

INTRODUCTION

In Egypt especially in the long summer days, it is well known that farm animals suffer from an extreme shortage of green forages and supplying the animals with sufficient uantity of nutrients is the most critical problem. Only straw, maize stover and other fibrous materials are available and considered as poor and inadequate sources for protein and minerals.

Recently, search for unconventional sources for animal feeds is the target for many studies; El-Shinnawy (1974) and Tag El-Din (1979) used some by-products in feed mixture for feeding farm animals, Osman (1980) used poultry waste in ruminant nutrition, Anis and El-Abd(1991) supplemented rice straw and maize stover with El-Mufeed (a molasses liquid supplement) and mentioned that such treatment increased milk yield and its nutritional value, Abo El-Nor et al., (1995) used date seeds as a new component in diet for dairy animals, whereas El-Feel et al., (1995) followed the trace elements and composition of milk as affected by feeding cows on poultry manure, Khattab et al., (1998) and El-Alamy et al., (1999) used feather and offal meals and other protein sources in feeding buffaloes.

Concerning vegetables and fruits market waste (VFMW), Abaza et al., (1987) and Gabr et al., (1995) evaluated the nutritive value of VFMW and concluded that it can participate in solving the feed shortage problem. Recently , Khattab et al . (2000) used same agro – industrial by-product cambination in rations of lactating goats , wheneas Al-Shanti (2003) and El-Nahas et al . (2004) carried out studies on using orange wastes for feeding lactating cows . On the other hand , Shitta and Gaafar (2003) repanted that dry matter intake by lactating cows was significantly lower with feeding vegetable marketing waste silage campared with feeding control ration .

The present work was conducted to study effect of using VFMW in feeding the lactating cows on gross chemical composition and nitrogen distribution of milk.

MATERIALS AND METHODS

1- Material

- **Vegetables and fruits marketing wastes (VFMW) were collected from the Egyptian market for vegetables and fruits (Al-Aopour market) and preserved into silage as described by Gabr et al., (1995). The VFMW contained a mixture of unhomogenious materials such as cabbage and cauliflower leaves, leek, lettuce, onion, radish, tomatoes, potato, peas....etc. This mixture of materials contained about 85% moisture.**

- **El-Mufeed is a commercial name for a molasses-based liquid supplement rich in urea, minerals and vitamins**

2- Experimental animals

In the present Study, 20 Friesian lactating cows weighted 400-500 Kg were divided randomly into 4 dietary treatments. Treatments were arranged to be one control and the other three for the tested rations (5 cows for each treatment). The feeding trials were lasted for 3 months.

3- Experimental rations

The cows were individually fed according to the allowances for dairy cows (NRC,1996). The control group was fed on traditional summer ration which was composed of 3% ammonia-treated rice straw and concentrate. In treatment (I), the ration of this group was the same as in the control group with substitution of 15% by VFMW in a silage form. In treatment (II), the ration was the same as in the control group with substitution of 15% by vegetables marketing waste (VMW) and El-Mufeed. The ration of treatment (III) was the same as the control ration but with substitution on of 15% by VMW and ground yellow corn.

4- Analytical procedures

The weekly milk samples from evening and morning milking were collected over a period of 12 weeks and chemically analysed for fat and lactose using Milko-scan (133 B. Foss Electric), whereas the total protein content was determined using semi-micro Kjeldahl method as given by LING (1963). The N distribution was done as recommended by Rowland (1938). Non-casein nitrogen (NCN) was determined in the resultant filtrate after precipitation of casein by means of acetic acid and sodium acetate at pH 4.6. Non-protein nitrogen (NPN) was measured in the clear filtrate after precipitation of protein by TCA (15%). Casein nitrogen (CN) and whey protein nitrogen (WPN) were quantified by difference specified by Rowland (1938) as follows:

CN = Total N – NCN .

WPN = NCN - NPN.

Statistical methods

The collected data were statistically analysed for range, average and standard error (SE) as well as for the analysis of variance using a SAS computer program as given in the user's guide (SAS, 1987).

RESULTS AND DISCUSSION

Table (1) shows chemical composition of milk as affected by the feeding treatments applied. Fat content ranged from 1.09 to 3.42% in control milk, whereas the corresponding values for treatment (I) were 1.91-4.90%, for treatment (II) were 1.44-4.43% and for treatment (III) were 1.57-4.78%. The maximum average fat content of 2.99±0.07% was given for treatment (II) followed by milk from treatment (I), whereas the minimum average value of 2.48±0.08% was recorded for the control milk.

Table (I): Effect of feeding treatments on the chemical composition (%) of milk *

Property	Treatments			
	Control	I	II	III
Fat content				
Range	1.09-3.42	1.91-4.90	1.44-4.43	1.57-4.78
AV±SE	2.48±0.08	2.94±0.07	2.99±0.07	2.82±0.08
Lactose content				
Range	4.18-5.37	4.20-5.37	4.69-5.25	4.17-5.08
AV±SE	4.69±0.04	4.87±0.03	4.91±0.02	4.64±0.03
Protein content				
Range	1.85-4.72	1.98-4.15	2.55-4.59	1.85-5.23
AV±SE	3.02±0.07	3.36±0.06	3.28±0.05	3.23±0.09
Casein content				
Range	1.08-2.93	1.21-3.38	1.79-3.13	1.08-3.89
AV±SE	2.14±0.07	2.52±0.06	2.45±0.04	2.41± 0.08
Whey protein content				
Range	0.06-1.15	0.25-0.83	0.13-0.89	0.19-1.08
AV±SE	0.45±0.05	0.50±0.04	0.51±0.04	0.51 ±0.04

*** Range, average and standardi error (SE) of 60 eterminations.**

The increase in milk fat content in samples from the different treatments compared to the control may be due to the higher energy and the increased digestible crude protein for the supplemented rations. Anis et al., (1991) observed the same trend of results when they used El-Mufeed in feeding lactating cows.In this respect, Church (1991) demanstrated that aceticc acid is the major end product of the fermentation of cell wall carbohydrates by rumen microorganisms and revealed the importance of acetic acid in dairy cows nutrition as a major source of energy and a precursor for fat synthesis

Lactose content (Table 1) shows the same trend of fat with except that the lowest average lactose content was recorded for treatment (III). However, lactose content ranged from 4.18 to 5.37% in control milk, whereas those for treatments I, II and III were 4.20-5.37, 4.69-5.25 and 4.17-5.08% in order. The corresponding averages±SE were 4.69±0.04, 4.87±0.03, 4.91 ±0.02 and 4.64±0.03% respectively. Such variations in lactose content due to feeding treatments (FT) were highly significant and those due to feeding period ((FP) were only significant (Table 2).

The trends of fat and lactose are in accordance with those given by Khattab et al.(2000). They found an increase in fat and lactose contents as affected by feeding lactating goats some agro-andustrial by – products.

Protein content (Table 1) in milk from each group of cows showed a wide range of variations. Thus, in control milk, the min. and max. values were 1,85 and 4.72% in order. The corresponding values in case of treatment (I) were 1.98 and 4.15% and in treatment (II) were 2.55 and 4.59% and in treatment (III) were 1.85 and 5.32% in order. The maximum average value of 3.36±0.06% was given for treatment (I). This was followed by values of 3.28±0.05, 3.23±0.09 and 3.02±0.07% for treatments II, III and the control respectively.

Statistical analysis (Table 2) showed that the differences in protein content due to FT, FP and FT x FP were highly significant.

Table (2): Analysis of variance for the effect of feeding treatments (FT) and feeding period (FP) on chemical composition of milk.

SOV	DF	SS	MS	F	Significance <
Fat content					
FT	3	8.559	2.853	10.17	0.01
FP	11	7.879	0.716	2.55	0.01
FTxFP	33	15.205	0.460	1.64	0.05
Lactose content					
FT	3	2.523	0.841	14.88	0.01
FP	11	1.280	0.116	2.06	0.05
FTxFP	33	2.737	0.083	1.47	NS*
Protein content					
FT	3	3.408	1.136	6.67	0.01
FP	11	15.086	1.371	8.05	0.01
FTxFP	33	17.862	0.541	3.18	0.01
Casein content					
FT	3	6.404	2.135	12.61	0.01
FP	11	13.031	1.185	7.00	0.01
FTxFP	33	15.293	0.463	2.74	0.01
Whey protein content					
FT	3	0.169	0.056	3.06	0.05
FP	11	2.124	0.193	10.47	0.05
FTxFP	33	2.374	0.072	3.90	0.05

* NS = not significant

Similar results were given by Anis et al., (1991) when they used El-Mufeed and could be attributed to the effect of presence of sufficient digestible protein and starch value of the ration to satisfy all or some requirements of lactating cows. Gabr et al., (1995) demonstrated that the VFMW hay contained crude protein as 11-36% and when VFMW silage was added to maize stover at the rate of 1:1 and 2:1, it caused an increase in its crude protein from 5.20 to 8.76% and 11.66% respectively.

The pattern of casein content was the same as that observed, for protein content. Table (1) reveals that the maximum average in this respect (2.52±0.06%) was recorded for treatment (I) with the range of 1.21-3.38%, whereas the minimum average (2.14±0.07%) was given for the control milk with the range of 1.08-2.93%. Treatment (II) had the average of 2.45±0.04% with the range of 1.79-3.13%, whereas those for treatment (III) were 2.41± 0.08% and 1.08-3.89% in order.

The same highly significant effect of FT, FP and FTxFP was recorded in Table (2) as that mentioned for protein content.

In spite of the same average value (0.51±0.04%) was record for whey protein content of milk from treatments (II) and (III), the minimum and maximum given values were completely different. However, a wider range of variation was observed with respect to whey protein of the control milk. The values ranged from 0.06 to 1.15% with the minimum average value of 0.45 ± 0.03%. However, the differences in whey protein due to FT, FP and FTxFP were significant at $P<0.05$. As given in Table (3), TN followed the same pattern of protein content being the highest average value of 0.51 % was recorded in milk from treatment (I), whereas the control milk had the minimum value of 0.47%. This was true with respect to CN. Their values had the same trend of casein content. The maximum average value of 0.40±0.02% was recorded for treatment (I). This was followed by the values of 0.39 ±0.02, 0.36 ±0.01 and 0.34±0.01% for milk samples from treatment II, III and the control respectively

Table (3): Effect of feeding treatments on nitrogen distribution (%) in milk*.

Property	Treatments			
	Control	I	II	III
TN content				
Range	0.31-0.58	0.31-0.65	0.41-0.65	0.29-0.82
AV±SE	0.47± 0.01	0.51±0.02	0.50±0.02	0.50± 0.01
CN content				
Range	0.19-0.59	0.19-0.53	0.30-0.57	0.14-0.62
AV±SE	0.34±0.01	0.40±0.02	0.39±0.02	0.36±0.01
NPN content				
Range	0.03-0.15	0.02-0.06	0.03-0.08	0.01-0.11
AV±SE	0.06±0.004	0.04±0.002	0.05±0.002	0.07±0.003
NCN content				
Range	0.09-0.21	0.08-0.16	0.08-0.19	0.11-0.23
AV±SE	0.14±0.004	0.12±0.002	0.13±0.002	0.15±0.004
WPN content				
Range	0.01-0.18	0.04-0.13	0.02-0.14	0.03-0.13
AV±SE	0.07±0.005	0.08± 0.004	0.08± 0.004	0.084± 0.004

* Range, average and standard error (SE) of 60 determinations.

Statistical analysis (Table 4) revealed that FT, FP and FTxFP had highly significant effects on TN and CN content.

It may be of interest to point out that the maximum Average values of 0.07±0.003% and 0.15±0.004% for NPN and NCN in order were recorded for milk from treatment (III), whereas the minimum values of 0.04±0.002% and 0.12±0.002% in order were given for treatment (I) as shown in Table (3). However, Table (4) shows that the differences in NPN and NCN due to FT, FP and FTxFP were highly significant, *Table (4): Analysis of variance for the effect of feeding treatments (FT) and feeding period (FP) on nitrogen distribution in milk.*

sov	DF	SS	MS	F	Significance <
TN content					
FT	3	0.074	0.024	5.28	0.01
FP	11	0.352	0.032	6.85	0.01
FTxFP	33	0.452	0.013	2.93	0.01
CN content					
FT	3	0.171	0.056	12.48	0.01
FP	11	0.349	0.031	6.98	0.01
FTxFP	33	0.343	0.011	2.28	0.01
NPN content					
FT	3	0.042	0.014	14.23	0.01
FP	11	0.032	0.002	2.96	0.01
FTxFP	33	0.073	0.002	2.23	0.01
NCN content					
FT	3	0.027	0.009	27.20	0.05
FP	11	0.020	0.002	5.60	0.05
FTxFP	33	0.055	0.002	5.03	0.05
WPN content					
FT	3	0.589	0.196	1.31	NS*
FP	11	1.428	0.130	< 1	NS
FTxFP	33	4.911	0.149	< 1	NS

* NS = not significant

Table (3) reveals that the average WPN value of 0.08±0.004%was recorded for milk samples from treatments I, II and III, whereas a slight lower value of 0.07±0.005% was given for the control milk. Such differences in WPN as affected by FT, FP and FTxFP were insignificant. In general, such change in chemical composition of milk as 'affected by using the market wastes might be due to the chemical composition of the given wastes. Gabr et al., (1995) gave the values of 8.76, 2.18, 20.30, 44.80 and 23.96% on dry matter basis for crude protein, ether extract, crude fiber, nitrogen-free extract and ash respectively for the mixture containing VFMW and maize stover as 1:1. The corresponding values in the mixture of 2:1 was 11.66, 2.47, 21.02, 44.10 and 20.75% in order.

Generally , such improvement in milk cemposition may be due to the increase in feed conversion of cows as affected by the applied treatments . In this respect, Shitta and Gaafar (2003) found that replacing berseem hay by vegetable marketing waste improved feed efficiency of lactating cows, whereas EL-Nahas et al . (2004) reported that lactating cows fed ration containing orange waste silage showed significantly higher feed utilization . On the other hand, the economic benefit for such treatments should be taken into consideration .

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الملخص العربي

تأثير استخدام سيلاج مخلفات أسواق الخضروات والفاكهة في تغذية الأبقار الحلابة علي التركيب الكيماوي للبن

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أهتم البحث بدراسة تأثير استخدام مخلفات أسواق الفاكهة والخضروات كغذاء للأبقار علي التركيب الكيماوي للبن حيث استخدمت هذه المخلفات في صورة سيلاج لمدة ١٢ أسبوعا وفقا للمعاملات الآتية :-

١- عليقه المقارنة (الكنترول) كانت عبارة عن قش معامل بالأمونيا والعليقة المركزة

٢- في المعاملة الأولي تم استبدال ١٥% من مخلوط عليقه الكنترول بمخلفات خضروات وفاكهة كمصدر للطاقة

٣- في المعاملة الثانية تم استبدال ١٥% من مخلوط عليقه الكنترول بمخلفات خضروات مع مفيد

٤- في المعاملة الثالثة تم استبدال ١٥% من مخلوط عليقه الكنترول بمخلفات خضروات + ذرة أصفر

وقد دلت النتائج علي أن التغذية وفقاً للمعاملة الأولي أدت لزيادة محتوي اللبن من الدهن واللاكتوز والبروتين الكلي والكازين وبروتينات الشرش بينما انخفض النتروجين غير البروتيني والنتروجين غير الكازيني

وقد لوحظ أن تأثير المعاملة الثانية كان أكبر عن المعاملة الأولي في زيادة نسبة الدهن واللاكتوز وتأثيرا أقل علي زيادة نسبة البروتين والكازين وبصفة عامة فقد اتصف اللبن الناتج من التغذية علي عليقه المقارنة بمحتويات أقل من الدهن والبروتين والكازين وبروتينات الشرش ٠