REPLACING CORN SILAGE BY ORANGE WASTE SILAGE IN LACTATING DAMASCUS GOATS RATION

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SUMMARY

The present work was conducted to study the effect of replacement corn silage (CS) by orange waste silage (OR) milk yield and milk composition, feed efficiency and some blood serum parameters. Eighteen dairy lactating Damascus goats, aged 3 – 4 years, weighed 30.60±0.2 kg and were in 2nd - 3rd season of lactation were divided randomly to three similar groups (6 goats each) to receive the experimental rations those contained: R1: 50% concentrate feed mixture (CFM) + 40% corn silage (CS) + 10% rice straw (RS) (control). R2: 50% CFM + 20% CS + 20% orange waste silage (OS) + 10% RS and R3: 50% CFM + 40% OS + 10% RS. The experimental lasted for 120 days showed significant (P<0.05) fermentation characteristics of all silages during the ensiling period non-significant differences (P>0.05) were found among the three tested groups in all blood parameters but significantly (P<0.05) total antioxidants capacity in all rations. Averages daily milk yield were (1170.00g) for R3 compared (1110.90g) for R2, while (1090.80g) for R1. The same trend was noticed for the improvement in economic evaluation as result replacement corn silage by orange waste silage. It was concluded that replacement corn silage by orange waste silage to rations of lactating Damascus goats could improve their performance especially replacement of 100% corn silage by orange waste silage (R3) and without any adverse effect on productive performance and health.

***Keywords**: corn silage, orange waste silage, lactating Damascus goats milk production, milk composition.*

INTRODUCTION

Animal rations formulations depending on corn grain as a main source of energy, while corn grain is expensive that increases the costs of animal rations. So, it must search for cheap sources of energy to be alternative for grains. Increase disposal costs in many parts of the world have increased interest in utilization of by-product feedstuffs as alternative feeds for ruminants. Citrus pulp can also be fed fresh or as silage (Bampidis and Robinson, 2006). By-products from the citrus industry can make an important addition to the amount of locally produced feed for animals. In countries where the quantity of peel and rag from canning industries is large, drying is in most cases the preferred way of conservation because dried citrus pulp is easy to handle, to transport and to mix into compound feeds Gohl (1999). Feeding by-products of the crop and food processing industries to livestock is a practice a sold as the domestication of animals by humans. It has two important advantages (Grasser *et al.*, 1995), these being to diminish dependence of livestock on grains that can be consumed by humans (which was almost certainly the primary original reason), and to eliminate the need for costly waste management programs (which has become very important in recent years as the world human population has increased and the amount of crop and food by-product has increased, particularly in developed countries). Ruminant feeding systems based on locally available by-product feedstuffs (BPF) are often a practical alternative because the rumen microbial ecosystem can utilize BPF, which often contain high levels of structural fiber, to meet their nutrient requirements for maintenance, growth, reproduction and production. The term 'citrus by-product' includes numerous BPF, which vary according to the originating crop and method of production, that are an important component of ruminant feeding systems in many areas of the world (Bampidis and Robinson, 2006).

In Egypt, the key limiting factor in animal production is considerably due to the high cost of formulating livestock rations along the year as there is a kind of completion between human and livestock for the conventional feedstuffs like corn grains as a main source of energy, therefore it is necessary to being search currently for feed resources that are inexpensive and available and does not directly required as component

of human diet and can economically considering as a vital ingredients in the rations of farm animals without adverse effects on the rumen microbial fermentation and performance of the animals (Qelurem *et al*.,2007).

The aim of this study was to evaluate the effect of replacement corn silage by orange waste as a source of energy in rations of lactating Damascus goats on nutrient digestibility feeding value, some parameters of blood, feed intake, milk yield and composition, feed conversion and economic efficiency.

MATERIALS AND METHODS

The experimental work of this study was carried out at El-Gemeza Experimental Station, Animal Production Research Institute, Agriculture Research Center. Eighteen dairy lactating Damascus goats aged 3 – 4 years, weighed 30.60±0.2 kg and at the 2nd - 3rd season of lactation were selected from El-Gemeza Station herd. The selected goats were distributed according to their live body weight and milk production into three equal groups (6 goats each). The animals of each group were kept in a separate shaded pen. The experiment lasted for 120 days after weaning offspring. The animals were fed for two weeks as a transitional period on the same experimental rations before the start of collecting results of the experimental work. The experimental groups were assigned at random to the three experimental rations (Table, 2)

R1: 50% CFM + 40% CS + 10% RS (control).

R2: 50% CFM + 20% CS + 20% OS + 10% RS

R3: 50% CFM + 40% OS + 10% RS.

Animals were groups fed according to NRC (1985). The chemical analyses of all feedstuffs were shown in Table (1).

Table (1): Chemical composition (% on DM basis) of corn silage (CS), orange waste silage (OS), rice straw (RS) and concentrate feed mixture (CFM).

Item	CS	OS	RS	CFM*
DM	36.24	38.90	89.22	88.70
OM	86.90	83.95	83.75	92.82
CP	9.15	8.72	3.86	14.16
CF	24.67	28.56	36.7	11.05
EE	2.56	3.08	1.75	2.3
NFE	50.52	43.59	41.44	65.31
Ash	13.1	16.05	16.25	7.18
NDF	35.62	33.96	74.2	27.79
ADF	26.14	23.81	40.31	8.86
ADL	5.02	4.77	8.5	2.89
Cellulose	21.21	19.04	31.81	5.88
Hemicelluloses	9.48	10.15	33.89	18.89

** Concentrate feed mixture (CFM) consisted of: 38% ground yellow corn, 22% undecorticated cotton seed meal, 7% soybean meal, 12% wheat bran, 13% rice bran, 5% cane molasses, 2% lime stone and 1% common salt.*

Orange waste silage was prepared by collection of the orange (orange waste unfit for human consumption) from Edffina canning factory in Alexandria Governorate. One underground trenches (6 ton each) were filled with the chopped materials (4:1 orange waste::rice straw, on DM basis) and added 2% El-mofeed in the orange waste silage layer by layer and covered tightly with plastic sheet after oppressing the mixture by a tractor. The corn plants were cultivated in El-Gemeza Experimental Station and harvested at the dough stage of maturity (after 60 days from cultivation). The plants were wilted for 24 hours before ensiling to diminish the moisture content to about 65-70%, then chopped (1- 2cm length) and ensiled using cement pits. The mixture (corn or orange) was also covered with 20 cm of soil layer to guarantee anaerobic conditions and left for 60 days then samples were taken to test fermentative characteristics. In order to

determine the silage quality, polyethylene bags (three were used for each kind of silage) were packed by 500g of the chopped materials at the same mixed ratio pressed well and kept closed and left at room temperature for 60 days. When bags were opened, color and odor were directly examined. Values of pH, ammonia –N (NH_3-N), and TVFA's were determined in the extraction of silage. The biomass was mixed well and pressed in large concert up-right silos holding about 6 tons of the fresh materials and after 60 days, silos were opened for feeding and sampled for chemical analysis. Silage pH was directly determined using pH meter (Orion Research, model 201/digital pH meter). While TVFA's and ammonia nitrogen concentrations were determined according to the method that recorded by Warner (1964) and Bergen *et al*. (1974).

Table (2): Calculated chemical composition of the experimental rations.

Item	Experimental rations		
	R1	R2	R3
DM	67.77	68.30	68.83
OM	89.55	88.95	88.37
CP	11.13	11.04	10.95
CF	19.06	19.84	20.62
EE	2.35	2.45	2.56
NFE	57.01	55.62	54.24
Ash	10.45	11.05	11.63
NDF	35.56	35.23	34.90
ADF	18.92	18.45	17.99
ADL	4.30	4.25	4.20
Cellulose	14.61	14.17	13.74
Hemicelluloses	16.63	16.76	16.89

A digestibility trial was conducted using nine adult Barki rams divided into three similar groups (3 animals for each) diet averaged (57±1.50 kg, a live body weight) and 3 years old. Animals were housed in individual metabolic cages for 21 days (14 days as a preliminary period followed by 7 days as collection period) to determine the digestibility coefficients and nutritive values of the three respective tested rations. Feces were collected quantitatively every day and 10% daily sample was taken and sprayed with 10% sulfuric acid and dried during the collection period. At the end of the collection period, feces samples for each ram were ground mixed well and kept in the refrigerator for chemical analysis. Rumen liquor samples were taken from each animal at the end of collection period by stomach tube at 4 hrs. post-feeding. The Ruminal pH values were measured immediately by pH meter. Ammonia nitrogen (NH_3-N) concentration was measured according to Conway and O'Mally (1957). Total VFA's concentration was determined by the steam distillation method according to Abou-Akkada and Osman (1967). Total fungal counts were determined according to (Difco, 1984) and microbial protein was measured by sodium tangistate methods according to Shultz and Shultz (1970). Chemical analyses of feedstuffs and feces were carried out according to the A.O.A.C (1995). The nitrogen free extract (NFE) was calculated by subtracting the summation percentages of CP, CF, EE and Ash contents from one hundred. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by the methods of Van Soest *et al.* (1991). Blood samples were taken at the end of the experimental period. Blood samples were taken from the Jugular vein of three animals in each group at 8.00 am into vacationer tubes, and then allow the coagulated blood samples were centrifuged at 3000 rpm for 20 min to obtain blood serum. The supernatant was frozen and stored at -20^{o}C for subsequent analysis. Blood serum was analyzed for total protein (Armstrong and Carr 1964), albumin (Doumas *et al*., 1971), globulin calculated by subtracting concentration of serum albumin from the corresponding concentration of total protein, creatinine (Folin, 1994), urea (Siest *et al*., 1981), cholesterol (Fassati and Prenciple, 1982) and triglycerides (Richmond, 1973) as well as activity of asprtate (AST) and alanine (ALT) aminotransaminases (Reitman and Frankel, 1957) and total antioxidant capacity (Sies, 1997) was estimated using commercial kits by calorimetric determination.

Collected data of silage characteristics, nutrients digestibilities, rumen fermentation and blood biochemical parameters were subjected to statistical analysis using one-way-analysis of variance according to Snedecor and Cochran (1980) was using the following mathematical model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where: Y_{ij} is the parameter under analysis, μ is the overall mean, T_i is the effect due to treatment and e_{ij} is the experimental error. The general linear model of SAS (2004) program was used in processing measured parameters. The difference between means was statistically measured for significance at ($P<0.05$) according to Duncan's test (1955).

RESULTS AND DUSCUSSION

Silage characteristics:

Fermentation characteristics of all silages during the ensiling period indicated a successful processing (Table, 3). Silages had good smell and were free from any signs of molds. Values of pH indicated good preserved silage as it decreased with advancing ensilaging period where it reached 3.79 and 4.20 at 8 weeks for corn silage and orange waste silage, respectively, which seems to be within the normal range for good quality silage as reported by McDonald *et al*., (1995). Data fermentations characteristics are in agreement with previous studies reported by (Sun *et al.*, 2009). The differences in the concentrations of total organic acids among the type of silages were significant ($P<0.05$) and ranged between 5.84 to 7.94% in all type of silage. These results are in agreement with those obtained by Shaver *et al*., (1985). Total VFA's concentration in two kinds of silages appeared to be within the normal range (1.45 to 1.67) for good quality silage which indicated acceptable silage fermentation. Also, low values for NH_3–N concentration (0.03 to 0.08% of DM) over the two kinds of silage were obtained in present study and these results are matched with those recorded by Sheperd and Kung (1996). The changes in NH_3-N values indicated less rate of SP content, solubilization of true protein occurs in the silo due to the action of plant proteases enzymes.

Table (3): Chemical characteristics of corn silage and orange waste silage.

Item	CS	OS	±SE
pH	3.79[b]	4.20 [a]	0.25
Total organic acids% of DM	5.84[b]	7.94[a]	0.87
TVFA's % of DM	1.45[b]	1.67[a]	0.65
NH_3-N% of DM	0.03[b]	0.08[a]	0.34

[a,] and [b] Means in the same row with different superscript are significantly (P<0.05).

Blood serum parameters

The data of Table (4) showed insignificant ($P>0.05$) differences among the different experimental rations for blood plasma urea, total protein, albumin, globulin, creatinine, urea, AST, ALT, cholesterol and triglyceride. Similar results were recognized by Allam *et al*. (2011) who showed that no significant differences in respect all blood parameters among rations contained different levels of dried orange pulp (DOP) with lambs. All parameters were found to be within normal range as reported by Gholizadeh and Naserian (2010). Otherwise total antioxidants capacity concentration were the highest significantly ($P<0.05$) in R3 compared with others rations being 0.65, 0.70 and 0.88 (mmol/l) for R1, R2 and R3, respectively

Milk yield and composition:

Milk yield (g) and composition (%) for lactating does fed the experimental rations are presented Table (5). Average daily milk yield was higher ($P>0.05$) for R3 (1170g) compared with R2 (1110.90g), R1 (1090.80 g). These results are in agreement with the findings obtained by Fegeros *et al.* (1995) who revealed conceited that dried orange pulp is a valuable high energy by- product that can partly replace cereal grains in ewes ration without adverse effect on milk yield and composition. .On very recent study, Valencia (2014) found that when replacing the concentrate (corn grains) with fibrous by product (citrus pulp) in the diet of dairy goats no significant differences were observed for milk production, while milk fat percentage was significantly greater than the un replacing ration. In support to the present results Afaf and Khattab

(2017) reported milk constituents and yields, the date indicated that significant differences among the dietary treatments respecting the most milk constituents of all milk composition expect fat, total solid and solid not fat (%) when fed replacement by 50 and 100% dried orange pulp by corn silage.

Table (4): Effect of treatments on some biochemical and enzyme activity in blood serum of lactating Damascus goats.

Item	Experimental ration			±SE
	R1	R2	R3	
Total protein (g/dl)	6.93	7.30	7.2	0.46
Albumin (g/dl)	3.78	3.98	3.93	0.17
Globulin (g/dl)	3.16	3.32	3.27	0.46
Creatinine (mg/dl)	1.21	0.95	0.74	0.17
Urea (mg/dl)	49.61	41.28	40.99	4.56
ALT (U/ml)	21.67	20.33	21.67	4.57
AST (U/ml)	44.33	42.66	40.33	5.60
Total antioxidants capacity (mmol/l)	0.65^{c}	0.70^{b}	0.88^{a}	0.05
Cholesterol (mg/dl)	150.67	140.33	143	5.41
Triglycerides (mg/dl)	104.33	100	100.33	3.34

[a ,b] and [c] Means within the same row with different superscripts differ (P<0.05).

Table (5): Effect of treatments on average body weight, milk yield, milk composition and milk constituents yield of lactating Damascus goats.

Item	Experimental ration			±SE
	R1	R2	R3	
Body weight (kg)	30.60	30.40	30.20	
Av. Milk yield (g/day)	1090.80	1110.90	1170.00	
Milk composition, %:				
Fat	3.48^{c}	3.50^{b}	3.55^{a}	0.04
Protein	3.08^{c}	3.15^{b}	3.18^{a}	1.12
Lactose	4.41^{c}	4.45^{b}	4.53^{a}	0.50
Total solid (TS)	11.72^{c}	11.82^{b}	11.99^{a}	0.60
Solid not fat (SNF)	8.24^{c}	8.32^{b}	8.44^{a}	0.04
Ash	0.75^{a}	0.73^{b}	0.70^{c}	0.12
Milk constituents yield (g/day)				
Fat	33.58^{c}	34.65^{b}	42.60^{a}	1.01
Protein	29.72^{c}	31.19^{b}	38.16^{a}	0.58
Lactose	42.56^{c}	44.06^{b}	54.36^{a}	0.40
Total solids	113.10^{c}	117.02^{b}	143.88^{a}	0.60
Solid not fat	79.52^{c}	82.37^{b}	101.28^{a}	0.05
Ash	7.24^{c}	7.13^{b}	8.76^{a}	0.70

[a, b,] and [c] Means within the same row with different superscripts differ (P<0.05).

Economic evaluation

The economic evaluation of lactating Damascus goats fed rations containing corn silage and orange waste silage are shown in Table (6). Damascus goats fed on ration contained 100% OC (R3) in replacing corn silage recorded the best economic efficiency compared to that of rations contained 50% (R2) or control one (R1). The same trend was noticed for the improvement in economic evaluation. These results are in agreement with those obtained by Afaf and Khattab (2017) reported that goats fed on ration contained 50% DOP in replacing corn grains had recorded the best economic efficiency compared to that of rations contained 75% or 100% DOP or control one. The lowest value was recorded with the ration contained 75%. The same trend was noticed for the improvement in economic evaluation as result replacement corn grains by dried orange pulp. Also comparable results were obtained by Omer and Tawila (2009) who demonstrated

that replacement of corn grains by citrus by-product in goat rations improved ADG, feed efficiency and decreased daily feeding cost and consequently improved economic efficiency.

Table (6): Effect of treatments on economic parameters of lactating Damascus goats.

Item	Experimental rations		
	R1	R2	R3
Feed intake (g/day):			
CFM	900	900	900
CS	1500	750	-
OS	-	1100	2100
Total feed intake (g/day)	2100	2750	3000
Daily milk yield (g/day)	1090.80	1110.90	1170.00
Price of feed intake (LE. h/d)			
CFM	4.05	4.05	4.05
CS	1.35	0.67	-
OS	-	0.60	1.50
Price of total feed intake (LE. h/d)	5.40	5.32	5.55
Price milk yield(LE. h/d)	6.54	6.66	7.02
Net profile (LE./h/d)	1.14	1.34	1.47
Economic efficiency %	0.21	0.25	0.26
Relative improvement	100	119.04	123.80

Price of 1 ton CFM= 4500 LE Price of 1 ton CS = 900 LE and. Price of 1 ton OS = 500 LE. Market price of 1 kg and 1 kg of milk = 6 L.E.

Net profile= price of milk yield LE.- total feeding cost, LE.
Economic efficiency, EE = net profile / total feeding cost, LE.
Relative improvement of the control, assuming that the EE of the control (R_1)=100

CONCLUSION

It could be concluded that inclusion of orange waste silage at the level of 100% replacing corn silage where as a daily ration for Damascus goats ration gave the best productive performance improved milk yield, milk composition and economic efficiency.

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استبدال سيلاج الذرة محل سيلاج مخلفات البرتقال فى علائق المعز الدمشقى الحلاب

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اجريت هذة الدراسة لتقييم استبدال سيلاج مخلفات البرتقال بسيلاج الذرة على المعز الدمشقى الحلاب و استخدام ثمانية عشرعنزة قسمت بعد الولادة الى ثلاث مجاميع متساوية بمتوسط وزن 0.20±30.60 كجم (6 حيوانات فى كل مجموعة) وتأثير ذلك علي جودة السيلاج ومحصول اللبن ومكوناته والكفاءة الاقتصادية وغذيت علي العلائق الآتية:

المجموعة الاولى: 50% علف مركز + 40% سيلاج ذرة + 10% قش ارز (مجموعة المقارنة).

المجموعة الثانية: 50% علف مركز + 20% سيلاج ذرة + 20% سيلاج برتقال+ 10% قش ارز.

المجموعة الثالثة: 50% علف مركز + 40% سيلاج برتقال + 10% قش ارز.

سجلت المجموعة الثالثة التى غذيت على احلال سيلاج الذرة بسيلاج البرتقال بنسبة 100% والمجموعة الثانية التى غذية على استبدال سيلاج الذرة بسيلاج مخلفات البرتقال بنسبة 50% أفضل النتائج بالنسبة لإنتاج اللبن ومكوناته من البروتين والدهن بالمقارنة بمجموعة المقارنة. وبالنسبة لقياسات الدم لم تكن هناك اى فروق معنوية بين المجاميع الثلاثة فى تركيز كل من البروتين الكلى و الألبيومين و الجلوبيولين و اللبيدات الكلية والجلوكوز والجلسيريدات الثلاثية والكوليستيرول واليوريا وتركيزات أنزيمات الكبد ALT and AST بينما كانت هناك فروق معنوية فى مضادات الاكسدة الخاصة بالمجموعة الثالثة والثانية عن محموعة المقارنة. يستخلص من هذه الدراسة ان استبدال سيلاج الذرة بسيلاج مخلفات البرتقال بنسبة 50 و 100% كان له تأثيراً معنوياً على تحسين الإستفادة من الغذاء للمعز الدمشقى الحلاب كما زاد محصول اللبن ومكوناته مع نسبة استبدال 100% دون اى تاثير سلبى على انتاج حليب المعز الدمشقى.