# REPLACEMENT CORN SILAGE BY ORANGE WASTE SILAGE IN BARKI RAM LAMBS RATIONS

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## SUMMARY

The present work was conducted to study the effect of replacement corn silage (CS) by orange waste silage (OR) improved the performance of Barki lambs using one of the following rations: 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. Two experimental trials were conducted: Results showed the silages had good smell and were free from any signs of molds in all groups. Digestibility trial was conducted using nine mature local Barki breed rams were divided in three groups (3 animals each) weighting with average body weight 57 kg ± 1.5 kg and 3 years old. R3 recorded ($P<0.05$) the highest digestibility coefficients for all nutrients and nutritive value than others and the results showed a significant improvement ($P<0.05$) in digestibility coefficients of NDF, ADF and cellulose in R3 than others. Results showed insignificant differences ($P>0.05$) among the three tested groups in all blood parameters. Eighteen Barki lambs with average body weight 21.00 ± 0.20 kg/head were used. Lambs were divided into three groups (6 animals each) and fed the three respective rations with the same regime of feeding the experimental lasted for month. R3 recorded the highest value of average daily gain compared with R2 and R1. Also, R3 recorded the best value of feed conversion (6.24) followed by the R2 (6.52) than the control (7.03). It was concluded that corn silage by orange waste silage to rations of growing Barki lambs could improve their performance especially replacement of 100% corn silage by orange waste silage (R3).

***Keywords****: corn silage, orange waste silage, digestibility, blood parameters, Barki lambs, growth*.

## INTRODUCTION

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 (Qelurem *et al*., 2007). The utilization of agricultural by-products and industrial residues in ruminant feed, looking to attenuate troubles of forage shortage and the reduction of the cost of animal feed during critical season. Citrus pulp is a by-product derived from the citrus juice industry and includes a mixture of citrus peel, pulp and seeds (Lanza, 1984). There are a lot of agro- industrial by- products which could be using potentially to replace corn grains and the other traditional feedstuffs (Shoukry *et al.,* 1986). Dried orange pulp (DOP) or citrus pulp could be used effectively as an alternative energy source in replacement of some grains as corn, barley and other concentrated ingredients (Gado *et al*., 2011). The use of by-products for livestock feeding allows us to convert material that has limited application for use as human food into animal protein; ruminants are fundamental elements in that process. Citrus pulp is a by-product feed obtained during the manufacture of orange juice and processing of other citrus fruits (Grasse *et al.*, 1995). The aim of this study is to find out the influence of feeding Barki lambs on different levels of replacement corn silage by orange waste silage on their nutrients digestibility, feeding value, rumen fermentation, sheep performance and their feed 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 Barki lambs at four months of age with an average live body weight 21±0.2 kg were assigned to three groups according to live body weight (6 lambs for each) in growth feeding trial (60 days) and received the following 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 | 38.9 | 89.22 | 88.7 |
| OM | 86.90 | 83.95 | 83.75 | 92.82 |
| CP | 9.15 | 8.72 | 3.86 | 14.16 |
| CF | 24.67 | 28.56 | 36.70 | 11.05 |
| EE | 2.56 | 3.08 | 1.75 | 2.30 |
| NFE | 50.52 | 43.59 | 41.44 | 65.31 |
| Ash | 13.10 | 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.*

**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 |

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 fill 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, $\mu$ 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 of fermentation characteristics are in agreement with previous studies reported by Sun *et al.*, (2009). The differences in the concentrations of total organic acids among the two types 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 0.05% 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 soluble protein (SP) content, solubilization of true protein occurs in the silo due to the action of plant proteases enzymes.

**Table (3): Chemical characteristics of different 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] | 0.05[a] | 0.34 |

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

***Digestibility coefficients and nutritive values:***

Data of Table (4) clearly indicated that animals fed R3 recorded the highest digestibility values of DM, OM, CP, CF, EE, NFE and nutritive values as (TDN and DCP) compared with other rations. Results indicated that replacement corn silage by orange waste silage at 100% in ration R3 had significant (P<0.05) effect on all nutrient digestibility coefficients compared with control ration (R!). These results are in agreement with those obtained by Gholizadeh and Naserian. (2010) and Shdaifat *et al*. ( 2013) who reported that DM and OM digestibilities tended to remain affected, CP digestibility was increased and crude fiber fractions (NDF and ADF) digestibility were increased when dried citrus pulp substitute for starchy feeds. Also on earlier study, Ben-Ghedalia *et al*. (1989) noticed that CP was more digestible in the starch- rich diet (barely) and NDF was more digestible in the pectin -rich diet (dry citrus pulp) in the concentrate diet, while OM equally digested in both diets. Recently Gawad *et al*. (2013) reported that DM, OM and CP digestibilities remained affected by various levels of dried citrus pulp. The high values of TDN and DCP of ration R3 contained orange waste silage may be attributed to the mutual associative effect of highest nutrients digestibility. These results are in accordance with those obtained by Taie *et al.*, (1998); Etman *et al.* (2007) and Mostafa *et al.*, (2010).

**Table (4): Nutrients digestibility and nutritive values of experimental rations by Barki lambs.**

| Item | Experimental ration | | | |
|---|---|---|---|---|
| | R1 | R2 | R3 | ±SE |
| Digestibility coefficients%: | | | | |
| DM | 63.82[b] | 63.78[b] | 65.98[a] | 0.50 |
| OM | 60.73[b] | 60.53[b] | 64.77[a] | 0.02 |
| CP | 66.43[b] | 66.60[b] | 69.04[a] | 0.78 |
| CF | 62.82[b] | 63.00[b] | 65.96[a] | 0.54 |
| EE | 73.40[b] | 73.04[b] | 76.40[a] | 0.60 |
| NFE | 65.08[b] | 65.00[b] | 67.70[a] | 0.34 |
| Cell wall constituents %: | | | | |
| NDF | 60.98[b] | 60.40[b] | 63.70[a] | 0.44 |
| ADF | 52.33[b] | 52.43[b] | 54.60[a] | 0.87 |
| ADL | 40.62[b] | 40.82[b] | 44.75[a] | 0.67 |
| Cellulose | 20.48[b] | 20.55[b] | 22.62[a] | 0.54 |
| Hemicellulose | 50.93[b] | 50.89[b] | 55.72[a] | |
| Nutritive value %: | | | | |
| TDN | 60.06[b] | 60.09[b] | 62.52[a] | 0.43 |
| DCP | 6.73[b] | 6.65[b] | 8.20[a] | 0.02 |

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

***Total fungal counts and microbial protein:***

As shown in Table (5), R2 and R3 were found to achieve (P<0.05) higher total fugal count compared with R1. Significance increase in microbial protein was noticed in favor of groups fed orange waste silage being (0.94 and 0.74 ($x10^3$ cfu/ml) for R3 and R2, respectively, compared with the control ($0.54x10^3$ cfu/m1). The microorganisms used most of the fermentable sugars from the protein for protein synthesis. Whereas the white rot fungi-exhibited promising ability for the decomposition of lignin-cellulose containing

materials and for increasing the availability of carbohydrates and production of fungal protein Iconomou *et al.*, (1997) and Philip *et al.*, (2014).

**Table (5): Total fungal counts and microbial protein for animals fed the experimental rations.**

| Item | Experimental ration | | | ±SE |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| Total fungus Counts (x$10^3$cfu/ml) | 1.60[c] | 1.83[b] | 1.99[a] | 0.30 |
| Microbial protein (g/100ml) | 0.54[c] | 0.74[b] | 0.94[a] | 0.40 |

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

***Blood serum parameters:***

The data of Table (6) sho as an antioxidant (Kleczkowski *et al*., 2004). wed insignificant (P>0.05) differences among the different experimental rations for blood serum 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 with lambs. All blood serum 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 0.59, 0.76 and 0.97 (mmol/l) for R1, R2 and R3, respectively. Peroxidase is the most important enzymatic mechanisms which protect an organism against oxidative stress which safely interact with free radicals

**Table (6): Effect of biological and chemical treatments on blood serum parameters for lambs.**

| Item | Experimental ration | | | ±SE |
|---|---|---|---|---|
| | R1 | R2 | R3 | |
| Total protein (g/dl) | 6.74 | 6.97 | 6.83 | 0.33 |
| Albumin (g/dl) | 3.89 | 3.97 | 3.91 | 0.07 |
| Globulin (g/dl) | 2.86 | 3 | 2.92 | 0.29 |
| Creatinine (mg/dl) | 0.86 | 0.86 | 0.82 | 0.15 |
| Urea (mg/dl) | 44.24 | 39.24 | 40.46 | 3.67 |
| ALT (U/ml) | 20.8 | 20 | 18 | 3.11 |
| AST (U/ml) | 37.2 | 34 | 35 | 4.26 |
| Total antioxidants capacity (mmol/l) | 0.59[c] | 0.76[b] | 0.97[a] | 0.05 |
| Cholesterol (mg/dl) | 128.2 | 135.4 | 133.6 | 5.25 |
| Triglycerides (mg/dl) | 111.8 | 107.4 | 104 | 3.45 |

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

***Growth performance and economic efficiency:***

The average values of feed intake, daily gain, feed conversion and economic efficiency are shown in Table (7). Data revealed that total body gain and daily gain were increased for lambs fed rations containing orange waste silage. These results may be related the increasing digestibility coefficients for R3 and R2. The highest value of DMI was observed in R3 followed by R2. Bueno *et al.* (2002) replaced corn with dehydrated citrus pulp (DCP) at levels 0, 33, 66, 100% in Saanen kid diets. They noted that, feed intake showed a quadratic effect (P<0.05) with the increasing levels of replacement. These results are in agreement with those obtained by Allam *et al.* (2011) who decided that using dried orange pulp as alternative energy source by 50%replecment corn grains with soybean meal as a protein source to obtained higher performance with lowest cost of feeding. The best feed conversion (Table 7) was that for lambs fed R3. The improvement of feed conversion may be due to improvement in both nutrient digestibilities and nutritive value. In agreement with present results Omer and Tawila (2009) concluded that replacements of corn grains by citrus by-production in goat ration improved feed efficiency and decreased daily feeding cost and consequently improved relative economic efficiency. similarly, Allam *et al.* (2011) found that all rations contented dried orange pulp

**(**DOP) recorded the best feed conversion values in compression with control one that free from DOP with growing lambs.

**Table (7): Effect of experimental rations on growth performance of lambs**

| Item | Experimental ration | | |
|---|---|---|---|
| | R1 | R2 | R3 |
| Initial live body weight (I.B.W), Kg | 20.2 | 20.5 | 20.3 |
| Final live body weight (F.B.W), Kg | 42 | 45 | 47 |
| Total body gain, Kg | 22.2 | 24.5 | 26.7 |
| Daily gain, g | 185 | 204 | 222 |
| Feed intake/day (DMI), g: | | | |
| CFM | 650 | 675 | 700 |
| CS | 525 | 270 | - |
| OS | - | 275 | 550 |
| RS | 125 | 130 | 135 |
| Total DM, g | 1300 | 1350 | 1385 |
| Feed conversion (DMI Kg/Kg gain) | 7.03 | 6.61 | 6.24 |
| Economic Efficiency | | | |
| Price of daily gain, LE | 11.1 | 12.24 | 13.32 |
| Daily feed cost, LE:* | | | |
| CFM | 3.29 | 3.42 | 3.51 |
| CS | 1.33 | 0.68 | - |
| OS | - | 0.38 | 0.70 |
| RS | 0.05 | 0.05 | 0.06 |
| Total daily feed cost, LE | 4.68 | 4.55 | 4.31 |
| Feed cost/kg gain, LE | 42.16 | 37.17 | 32.35 |
| Daily profit, LE | 11.10 | 12.24 | 13.32 |
| Economic feed efficiency, %** | 237.2 | 269.0 | 309.0 |
| Relative feed cost, %*** | 100 | 88.16 | 76.73 |
| Relative daily profit, %**** | 100 | 110.27 | 120.00 |

*Price of 1 ton CFM= 4500 LE Price of 1 ton CS = 900 LE; Price of 1 ton OS = 500 LE and Price of 1 ton RS = 400 LE;. Market price of 1 kg live body weight in (2019) = 60 LE.*
** Daily feed cost calculated as fresh feed (as fed).*
*** Economic feed efficiency% = daily profit/daily feed cost X 100*
****Relative feed cost, %=Feed cost, LE/kg gain (R2 and R3)/R1*
*****Relative daily profit, % =Daily profit LE (R2and R3)/R1.*

## CONCLUSION

It could be concluded that incorporation of replacement corn silage by orange waste silage in lambs rations improve digestibility, nutritive value and performance of growing lambs meanwhile, solving the problem of environmental pollution ofreplacement 100% corn silage by orange waste silage (R3) showed the best results.

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# احلال سيلاج الذرة بسيلاج مخلفات البرتقال فى علائق حملان الاغنام البرقى

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اجريت هذة الدراسة لتقييم احلال سيلاج مخلفات البرتقال محل سيلاج الذرة على الاداء الانتاجي للحملان البرقى وتم اجراء تجربتين: الأولى تجربة هضم واستخدام بها 9 كباش برقى وزن 57 ± 1.5كجم عمر (3 سنوات) وتم اجراء التحليلات الكيميائية للعلائق المختبرة ومعاملات الهضم والقيمة الغذائية. التجربة الثانية تجربة تغذية لمدة 4 اشهر باستخدام 18 من الحملان البرقى تزن فى بداية التجربة 21 ±0.2 كجم كمتوسط وزن حيث قسمت الحيوانات الى ثلاث مجموعات (كل مجموعة ستة حيوانات) وغذيت على العلائق التجريبية. وتم تقدير أداء الاغنام كل اسبوعين من خلال تقدير معدل الزيادة اليومية والمأكول من المادة الجافة والكفاءة الغذائية. غذيت الاغنام على النحو التالى:

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

المجموعة الثانية: 50% مخلوط علف مركز + 20% سيلاج ذرة + 20% سيلاج مخلفات البرتقال+ 10% قش ارز.

المجموعة الثالثة: 50% مخلوط علف مركز + 40% سيلاج مخلفات البرتقال + 10% قش ارز.

أشارت النتائج ان السيلاج المصنوع من كلا من الذرة والبرتقال كان جيد فى صفاته ولونه ورائحته كما اشارت نتائج التجربة الأولى الى أن احلال سيلاج الذرة بسيلاج البرتقال خاصة فى المجموعة الثالثة ادى الى تحسين معاملات الهضم خاصة البروتين والاليياف والكربوهيدرات والسيلولوز والهيمسيلولوز وكان هناك تحسين فى القيمة الغذائية كمركبات غذائية مهضومة وبروتين خام مهضوم. اما التجربة الثانية فقد اشارت الى ان احلال سيلاج الذرة بسيلاج مخلفات البرتقال قد ادى الى ارتفاع معدل النمو اليومى بالمقارنة بمجموعة المقارنة وكذلك ارتفاع الكفاءة الغذائية. وايضا زيادة فى معدلات التحويل الغذائى للمجموعة الثالثة عن بقية المجموعات مع اعلى كفاءة اقتصادية .

يستنتج من هذه الدراسة انة يمكن احلال سيلاج مخلفات البرتقال محل سيلاج الذرة فى علائق الاغنام البرقى بما يقلل من تكلفة التغذية مع تحسن معدل النمو اليومى وكفاءة تحويل الغذاء والكفاءة الاقتصادية وكانت افضل النتائج مع نتيجة احلال 100% من سيلاج مخلفات البرتقال بسيلاج الذرة تحت الظروف المصرية.