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Original Article

Effect of using unconventional an energy source in silage possessing on silage quality and performance of lactating cows

F.M. Abo-Donia, G.E. El-Emam, M.A. El-Shora, M.A. Fayed Amal, A. Elsheikh Hanim and T.H. El-Sawah

Animal Production Research Institute, Agriculture Research Center (ARC), Giza, Egypt

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Corresponding Author
Fawzy Abo-Donia
framsis2nd@gmail.com

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ABSTRACT

The aim of this study was to investigate the effect of partial substitution of corn grains with culling dates as a source of energy at making sailage from corn stalk on silage quality and performance of lactating dairy cows. Sixteen crossbreeds (Balady X Friesian) lactating cows were assigned to four balanced groups and fed individually for 90 days on experimental rations whereas all the groups were received a basal diet with one of four kinds of silage as follows: 100 % GC (R1), 75 % GC + 25% CD (R2), 50 % GC + 50 % CD (R3) and 25 % GC + 75 % CD (R4) on gross energy-based, respectively. The NH_3 concentration slightly decreased with an increased CD level. There was a slight tendency to increase silage DM content by increasing the entry-level of CD. Silage with CD appeared identical contents of OM and ash nearly to those of the control diet. DM and OM digestibility were significantly ($P<0.05$) higher in the diets containing CD than in the control diet. Nevertheless, there was insignificant ($P>0.05$) increases in the CP, CF, α-NDF, and ADF digestibility for dietary treatment T2, T3 and T4 compared to T1. Also, no significantly different ($P>0.05$) was found in dry matter intake among all dietary treatments. The highest yield of actual milk and 4% fat corrected milk was recorded with T4 (10.87 and 10.24, respectively), while the lowest values for these items were existing in T1 (10.06 and 8.56, respectively) with no significant differences. Regarding milk pH value, milk protein and ash contents have the same trend with no significant ($P>0.05$) difference among groups. There were significant differences in the milk fat, SNF, lactose and TS percentages between T1 (the lowest one) and each of T2, T3, and T4. Using CD to 75% as a source of energy alternative of corn grains in silage did not show any negative effect on silage quality, animal performance. It could be an optimal alternative to overcome the price increase of corn or shortage of markets.

Keywords: cull dates, silage, digestibility, milk yield, and composition, dairy cows.

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INTRODUCTION

The prevalence of silage in the tropics is a means of increasing the efficiency of the use of natural resources, especially land and water (Cowan *et al*., 1993). Ensiling is a conservation method under anaerobic conditions depending on natural fermentation whereas, water-soluble carbohydrates (WSC) convert by lactic acid bacteria to organic acids which leading to decrease pH value and preserve the forage. Various additives, whether chemical and biological have been used Adesogan *et al*., (2007) to improve the ensiling process.

Fermentation patterns (extent and profile) affect the nutritional value of ensiled forage, palatability and dry matter intake (Huhtanen *et al*., 2007). Dayani *et al*., (2012) found CD considered more beneficial as nutrient components and nutritional values than their pits. Dates are very rich in saccharides (their total sugars may reach up to 87%, monosaccharides 44%, glucose 50%) (Abd El-Rahman *et al*., 2012). And for that, dates considered as a high source of energy (1 kg of dates provides over 3000 kcal/kg gross energy) (Yousif *et al*., 1996). At the same time, CD containing reasonable quantities of the phenolic profiles (Mansouri *et al*., 2005) volatile compounds (Harrak *et al*., 2005) flavonoid glycosides (Hong *et al*., 2006) and antioxidant properties of the aqueous extracts of the date fruit (Vayalil, 2002).

In Egypt, the annual date's production is estimated by 1.113.270 tons where CD represented about 20% of all dates produced (Ministry of Agriculture, 2002). Therefore, huge amounts of CD (which are inappropriate for human consumption) are available which can be utilized as a cheap non-conventional ingredient in ruminant's diets. The provision of corn grains will have an economic impact on farmers and stakeholders, especially smallholders, as well as will be important especially on the national level to reduce the imports of corn. The main objective of this study was to evaluate the effect of using CD as a partial substitution of corn grain in silage preparation and its effect on the performance of dairy cows.

MATERIALS AND METHODS

Animal care

The experimental procedure was approved by the Institutional Animal Care and Use Committee (IACUC) at APRI, ARC(AA2019)

Materials and Silage preparation

Corn-stalks hybrid (CSH) was assembled after harvesting from farmers by wholesalers with approximately 30% DM. Corn stalks chopped by chopper machine to two: five cm length. The cull date (CD) collected from palm date's factory in the New Valley (El Wadi El Gedid) Governorate, then mechanically crushed by a grinder machine into little pieces to 3-5mm. Silage material from CSH (30% DM) included 30 kg per ton of ground corn (GC) as a source of energy for control silage, while the CD was added as an alternative to corn at 25, 50 and, 75% on gross energy-based, respectively. The distribution of ground corn grains or cull dates was sown sequentially between the silage layers with a depth of 20 cm and sprayed with urea solution as a source of nitrogen by 0.5% of chopped corn stalk for each kind of silage according to (Abo-Donia *et al*., 2009). At the end of the ensiling period (45 days), 1000 g of each homogenized silage sample from each pile was taken for the physical, fermentation characteristics and chemical analysis of the respective sampling days and frozen immediately (−18 °C). The pH was determined in the juice extract obtained from a 1:1 (Wet silage: distilled water), stored overnight at 4 °C after homogenizing for 10 min in a blender, using (a digital handheld pH electrode (Hanna, model HI 8424). A portion of the water extract was filtered through Whatman 54 filter paper (Whatman, Clifton, NJ), acidified with 50% H_2SO_4, and frozen for analysis ammonia-N by the method described earlier by (Weatherburn, 1967). Another portion of the water extract was filtered through sterile double-layer cheesecloth into sterile test tubes, and the liquid fraction was centrifuged at 2000 g for 20 min and stored frozen at -20 °C for determining SCFAs according to (Warner, 1964) and organic acid analysis. The lactic acid concentration was determined by methods of Analytical Chemistry of Foods methods (James, 1995). Silage samples were dried in a 58°C forced air oven for 72 h until constant weight half of these samples were ground by mill (5 mm screen) to determine DM, remaining available for the determination of ruminal *in vitro* degradability. The other portion was ground with a 1-mm screen to be used for chemical analyses.

The aerobic exposure trials

Aerobic stability of the silages was determined at the end of the storage period by measuring the temperature increase. The number of days it took for silage to increase in temperature by 2°C was used to express aerobic stability (Hönig, 1990). Silage temperature was measured in 1,300-mL PVC tubes covered at the bottom with polyurethane fiber using a digital probe thermometer (Hanna, model HI 8424). Packing density was decided in relation to DM concentration according to the equation: filling weight (g fresh material) = (-205.57 x ln (% DM)) + 1061), based on (DLG. 2006). recommendations. Tubes were placed in an insulating Styrofoam block and kept at room temperature for 5-7 days. The number of days it took for silage to increase 3 °C was used to express aerobic stability (Hönig, 1990).

***In-vitro* gas production and degradability**

Rumen fluid was collected by stomach tube from two Ossimi rams before morning feed into a Thermo flask. The procedure for the *in vitro* gas production was as established by (Navarro-Villa *et al*., 2011). The rumen liquor collected was properly mixed and filtered through a metallic sieve (1 mm sieve). A stream of carbon dioxide (CO2) was made to pass through the sieved rumen liquor until the completion of inoculation. The liquor was then diluted four-fold (rumen fluid to buffer, v/v) with the buffered mineral solution (Menke and Steingass 1988). Briefly, a 0.6 g silage sample was transferred into a 100-ml glass bottle containing 60 ml of diluted rumen fluid. All the bottles closed with rubber stoppers, crimped with aluminum seals, shaken and placed in the incubator maintained at 39 °C. The gas production (GP) measured intermittently throughout the incubation using the Reading Pressure Technique (RPT) (Hangzhou Runchen Electron Com., Hangzhou, China). Headspace gas pressure measured at 4, 6, 12, 24, 48, 60 and 72 hrs. Gas production was calculated by the following equation: GV = 7.365 × p (n = 500; r2 = 0.99; data not reported), where: GV = gas volume (ml); p = measured pressure (psi). After reading, at each time, total gas withdrawn by syringe with 4 ml NaOH (10 M) to estimate methane concentration following the method by (Fievez *et al*., 2005).

Results of kinetic parameters of GP or CH_4 (ml/g OM) were fitted using the NLIN option according to (France *et al*., 2000) as $P = b \times (1 - e^{-c(t - L)})$, where P is the volume of GP or CH_4 at time t, b is the asymptotic P (mL/g OM), c is the rate of P (ml/h), and L (h) is the discrete lag time prior to initiation of P. The metabolizable energy (ME; MJ /kg DM) of samples was calculated using the equation of (Menke *et al*., 1979). as follows: ME (MJ/kg DM) = 2.20 + 0.136GP + 0.057CP (R2= 0.94), where, GP is 24 h net gas production and CP is crude protein (%).

Feeding trails

Sixteen crossbreed Friesian (Balady X Friesian) cows in the 2nd and 3rd season of lactation with average body weight 450 Kg in their early lactation stage were used. The experimental cows were assigned to four balanced groups according to body weight (four animals each). Animals were housed indoors and fed individually with adapting (after parturition directly) on their experimental rations for 10 days before starting the feeding trial that lasted for 90 days. The animals were assigned to one of four tested diets where the concentrate feed mixture (CFM) were offered to animals at two times daily just before milking at 5:00 am, and before the second milking at 5.00 p.m. The amount of silage, berseem, and rice straw was combined and divided into two equal parts separately of each daily. The diets were formulated to be iso-caloric and iso-nitrogenous according to and adjusted biweekly according to body weight, milk production, and fat percentage. The first group was received a basal diet contained CFM + silage containing GC + berseem + rice straw, 2nd group received a diet containing CFM + silage with (25% CD+75% GC) + berseem + rice straw, the 3rd group received a diet containing CFM + silage with (50% CD+50% GC) + berseem + rice straw and the 4th group received a diet containing CFM + silage with (75% CD+25% GC) + berseem + rice straw. Animals were machined individually milked twice daily at 5.00 a.m. and 5.00 p.m. and evening milk yield were daily recorded. Every two weeks, evening and morning milk samples were taken and stored at -20 °C for analysis. Milk samples were analyzed for fat, protein, lactose; solid not fat (SNF), total solids (TS) and ash contents by Milko Scan 133 BN Foss. Electric, Hillerod, Denmark.

Digestibility experiment

At the end of the feeding trial which lasted for 10 days, four cows of each group were chosen in a complete randomized design to carry out digestibility experiments (Mean BW 450 ± 9 kg.). All cows were housed in individual tie stalls with rubber mats and allowed 10 days collection periods, during which separate collections of total feces were made. They had access to freshwater tow time daily at 8.30 pm and 5.30 am, respectively. Cows were offered the same experimental diets as described above. They were fed diets in two equal meals at 8:00 and 16:00 h. Fecal samples were collected for each cow twice daily at 600 am and 1800 pm and kept frozen until chemical analysis. Nutrient digestibility was estimated by acid insoluble ash (AIA) method (Van Keulen *et al*., (1977).

Chemical analysis

Composite feed, silages, and feces samples were chemically analyzed according to (AOAC, 2012). Neutral detergent fiber and acid detergent fiber procedures were performed according to (Van Soest *et al*., 1991). The neutral detergent fiber was assayed with the addition of a heat-stable amylase but without sodium sulfate. Neutral Detergent-Soluble Fiber (NDS) was determined by using ethanol/water (v/v) according to (Mary *et al*., 1997) while Nonfibrous carbohydrates (NFC) was calculated by difference, where: NFC = 100 – (%Neutral Detergent Fiber + %Crude Protein + %Fat + %Ash). Total heating value (gross energy; GE) was measured according to (Weiss, 2007) using the following values for each carbohydrate, crude fiber, protein and fat (4.3, 4.3, 5.6 and 9.2 Kcal/g, respectively). Chemical composition of corn silage types and the experimental rations are presented in Table (2). The silage organic acids (acetic, Propionic, and Butyric concentrations were measured using gas chromatography as described by (Jayaprakasha and Sakariah, 2002).

Statistical analysis

All data were subjected to analysis of variance using a general linear model (GLM) (SAS, 2009). Mean treatment differences were obtained by Duncan's multiple range tests (Duncan, 1955) with a level of statistical significance of 5%.

RESULTS

Table 1 shows the physicochemical properties of the ensiled corn-stalks hybrid (CSH) with different levels of CD as a source of energy instead of GC. In this study, the kinds of silage were similar in their properties having an olive-green color, pleasant alcoholic odor, firm texture, and temperature of 20°C. Data in Table (1) showed that the pH values of the tested silage samples after 45 days of ensiling ranged from 3.89 (S1) to 3.72 (S4). Data in the same table showed that there was a slight decrease in the NH_3-N concentration with an increased level of CD. The highest NH3-N value observed in the control silage (S1) followed by S2, S3, and S4, being 0.454, 0.446, 0.439 and 0.434 % of DM, respectively. There were no obvious differences in the SCFAs among different types of silage. The highest values of lactic acid (5.28% of DM), lactic acid/acetic acid ratio (3.11) and the total count of lactic acid bacteria (6.28 log cfu g-1 fresh silage) recorded in the silage containing a higher level of CD (S4) compared to all other treatments. Aerobic stability; the number of h before a 2°C rise in temperature of the silage mass above baseline ambient temperature.

1- Aerobic Stability.

Data in Table (1) reported that S4 had a marked improvement in aerobic stability compared to other tested silages.

Nutrient Content of tested silages and rations

The chemical compositions of the experimental silages are presented in Table 2. Dry matter (DM) content of different tested silages was similar (34.69 to 34.83%) and fall in the ideal average ranges 30 and 35% for silage DM content. Silages containing CD displayed OM and ash contents nearly identical to those of the control diet.

Table 1: Fermentation profiles of tested silages after 45 days of ensiling

Item	S1	S2	S3	S4
Physical characteristics				
Color	Olive green	Olive green	Olive green	Olive green
Aroma	PA	PA	PA	PA
Texture	Firm	Firm	Firm	Firm
Temperature (°C)	20.0	20.0	20.1	20.1
Chemical characteristics				
pH	3.89	3.83	3.76	3.72
NH_3-N (% of DM)	0.454	0.446	0.439	0.434
SCFAs (meq/dl)	7.86	8.06	8.16	8.47
Lactic acid (% of DM)	5.12	5.20	5.24	5.28
Acetic acid (% of DM)	1.73	1.71	1.71	1.70
Propionic acid (% of DM)	0.24	0.24	0.23	0.23
Butyric (% of DM)	0.23	0.23	0.22	0.22
Lactic acid/Acetic acid	2.96	3.04	3.06	3.11
Lactic acid bacteria (log cfu g-1 fresh silage)	6.19	6.22	6.26	6.28
Aerobic stability (AS)	96	98	110	112

S1 = 100% GC of GE, S2 = 75% GC and 25% CD of GE, S3= 50% GC and 50% CD of GE, S4 = 25% GC and 75% CD of GE. PA: Pleasantly alcoholic

Table 2: Chemical composition and GE (Mcal/Kg DM) of corn silage types and experimental rations.

Item	Silage Types				Experimental Rations			
	S1	S2	S3	S4	R1	R2	R3	R4
DM	34.69	34.73	34.78	34.83	68.61	68.62	68.63	68.64
OM	91.19	91.14	91.12	91.01	88.40	88.39	88.38	88.36
CP	10.31	10.19	10.03	9.88	11.55	11.52	11.49	11.46
CF	31.34	31.49	31.59	31.68	25.46	25.49	25.51	25.52
EE	2.08	1.97	1.90	1.81	2.02	1.99	1.98	1.96
Ash	8.82	8.86	8.88	8.99	11.61	11.61	11.62	11.64
NFE	47.47	47.49	47.60	47.64	49.38	49.39	49.41	49.42
αNDF	49.22	49.42	49.56	49.67	46.72	46.72	46.72	46.72
NDS	48.54	48.47	48.41	48.35	52.36	52.30	52.24	51.41
NFC	27.64	27.73	27.83	27.92	27.26	27.23	27.20	26.40
GE (Mcal/Kg DM)	4.158	4.148	4.142	4.131	4.050	4.048	4.047	4.045

S1 = 100% GC of GE, S2 = 75% GC and 25% CD of GE, S3= 50% GC and 50% CD of GE, S4 = 25% GC and 75% CD of GE. GE (Mcal/Kg DM).

Table 3:umulative gas production, CH_4, NDFD and ME of different silages kind and tested rations

Item	Silages				±SE	Rations				±SE
	S1	S2	S3	S4		R1	R2	R3	R4	
Gas production characteristics of different silages kind										
b	57.55^{a}	50.52^{b}	49.35^{b}	46.63^{b}	2.198	51.22^{a}	44.96^{b}	43.92^{b}	41.50^{b}	1.957
c (h^{-1})	0.098	0.089	0.101	0.126	0.026	0.098	0.089	0.101	0.126	0.026
Methane characteristics of different tested rations										
b	23.94	20.21	24.55	19.03	8.455	32.15	25.50	24.16	25.44	9.912
c (h^{-1})	0.010	0.015	0.013	0.011	0.006	0.007	0.009	0.010	0.007	0.004
Degradability of NDF and ME										
NDFD	41.49	40.00	39.32	38.72	1.432	47.20	45.50	44.73	44.04	1.629
ME	8.41^{a}	8.19^{a}	7.99^{ab}	7.66^{b}	0.150	7.86^{a}	7.68^{a}	7.50^{ab}	7.21^{b}	0.134

Means within rows with unlike superscript differ significantly ($p<0.05$).
±SE = Standard error mean.
b = the gas or CH_4 production from the insoluble fraction (ml/g OM).
c = the gas or CH_4 production rate constant for the insoluble fraction b (h).
NDFD= neutral detergent fiber degradability (%).
ME =metabolizable energy (MJ/kg DM).

Table 4: Digestibility and nutritive value of experimental diets.

Item	R_1	R_2	R_3	R_4	±SE
Digestion coefficients (%)					
Dry matter, DM	68.02^{b}	69.67^{a}	69.94a	70.23^{a}	0.290
Organic matter, OM	71.53^{b}	72.07^{ab}	72.97a	73.35^{a}	0.422
Crude protein, CP	72.65	72.96	73.73	73.97	0.508
Ether extract, EE	80.84^{c}	81.53^{bc}	82.66^{ab}	83.48^{a}	0.527
Crude fiber, CF	61.98	62.09	62.26	62.54	0.425
Nitrogen free extract, NFE	59.76	59.54	59.06	58.93	0.474
Neutral detergent fiber, α-NDF	58.86	58.91	58.97	59.58	0.399
Acid detergent fiber, ADF	52.53	53.19	53.26	53.58	0.374
Nutritive value					
TDN (%)	66.21^{b}	66.70^{ab}	67.53^{ab}	67.78^{a}	0.417
DCP (%)	7.99	8.06	8.17	8.08	0.118

^{a,b} and ^{c}: Means denoted within the same row with different superscripts are significantly different at ($P<0.05$).

Moreover, the CP content of silage ranged from 10.31 to 9.88% with the tendency to decrease in silage contained cull dates compared to the control. The experimental silages with CD contained slightly low contents of EE and gross energy and slightly high values of CF, NFC, and NDF. Low variability was observed for the other chemical nutrients all among groups.. Based on the results from the calculated chemical composition of the experimental rations (Table 2), the experimental rations were almost iso-caloric and iso-nitrogenous. The values of EE, OM, CP, and GE contents were slightly reduced by CD inoculation in silages but the opposite happened to CF and NFE contents.

In vitro degradability and gas production kinetics

The curves at 72 hours after incubation of cumulative gas production are given in Fig 1 and the exponential model parameters are presented in Table (3). There was a significant (P<0.05) decrease in cumulative gas production (ml/g OM) by 12.22, 14.25 and 18.97% for S2, S3 and S4, respectively compared with control (S1). However, there are no significant differences (P>0.05) among different types of silages containing CD.

The same trend was shown with various experimental ratios. Results of the rate constant (c) indicated that, no significantly (P>0.05) differences among different types of silages. Despite the maximum rate of CH_4 production (b) (ml/g OM) was recorded with silage containing GC than these containing CD, the difference was not significant (P>0.05). The NDF degradability of tested silages and rations ranged insignificantly (P>0.05) from 41.49 to 38.72 % and from 47.20 to 44.04%, respectively. The metabolizable energy (ME) was similar for all types of silages and rations except silage S4 and ration R4 which appeared significant differences (P<0.05) compared to control silage (S1) and ration (R1).

Nutritive value and Nutrient digestibility

The digestibility coefficients and nutritive value of the experimental diets are depicted in Table (4). Apparent digestibility coefficients of DM and OM were significantly higher (P<0.05) in the diets containing silage with CD compared to the control diet containing GC. However, there were insignificant (P>0.05) increases in CP, CF, α-NDF and ADF digestibility of rations R2, R3, and R4 compared to control (R1). On the other hand, R1 ration had a significantly lower digestion coefficient of EE (80.84%) followed by R2 (81.53%) and R3 (82.66%), while the R4 ration had a significantly higher value (83.48%). On the contrary, the digestion coefficient of NFE improved from 58.93% with R4 ration to 59.76% with a control ration. The nutritive values of the experimental diets expressed as the percent total digestible nutrients (TDN) and digestible crude protein (DCP) presented in Table 4. The DCP values were similar (P>0.05) across all tested diets. Total digestible nutrients (TDN) were highest (P<0.01) in cows fed ration R4 (67.78%) in comparison to the control group (66.21%), while, no difference observed between R2, R3 and R4 rations.

Dry matter intake, milk yield and its composition

Dry matter intake (DMI), milk yield and its composition and feed conversion parameters showed in Table (5). There was no statistically significant (P>0.05) difference in DMI among all the experimental rations. There was no significant effect of rations containing silage with CD on either actual milk yield, or fat corrected milk (4 % fat). Regarding milk pH value, milk protein and ash percentage have the same trend which did not significant (P>0.05) differ among groups. The opposite appeared with the total solids (TS), milk fat, solid not fat (SNF), lactose and percentages, where, feeding rations containing CD were higher (P<0.05) significant compared to that feed control ration containing GC, while the other milk constituents were not different. For the feed efficiency expressed as the amounts of DM, TDN and N intake required to produce one kg FCM (4%), there were no significant differences by the substitution levels of GC by CD compared to the control group. However, the feed efficiency values of R2, R3, and R4 were almost close and had higher values compared with the control group. This probably explained by the increases in the yield of actual and 4% FCM since.

Table 5: Dry matter intake, feed conversion, milk production and composition of dairy cows fed the experimental rations.

Item	R1	R2	R3	R4	±SE
Total dry matter intake, kg/h/d.	13.69	13.73	13.72	14.23	0.211
Milk yield (kg/h/d)					
Actual milk, kg/h/d	10.06	10.41	10.74	10.87	0.596
FCM (4 % fat), kg/h/d.	8.56	9.65	9.95	10.24	0.577
Milk composition, (%)					
Fat	3.00[b]	3.51[a]	3.51[a]	3.60[a]	0.052
Protein	2.97	3.17	3.12	3.09	0.065
Lactose	4.47[c]	4.57[b]	4.60[b]	4.69[a]	0.018
SNF	8.07[b]	8.39[a]	8.37[a]	8.44[a]	0.070
TS	11.07[b]	11.90[a]	11.88[a]	12.04[a]	0.057
Ash	0.63	0.65	0.65	0.65	0.015
pH	6.60	6.62	6.61	6.63	0.027
Feed conversion					
Kg DM intake /Kg FCM	1.620	1.435	1.388	1.413	0.088
Kg TDN intake/ Kg FCM	1.072	0.958	0.938	0.955	0.059
Kg N intake / Kg FCM	0.030	0.025	0.022	0.028	0.002

[a,b] and [c] : Means denoted within the same row with different superscripts are significantly different at ($P<0.05$).

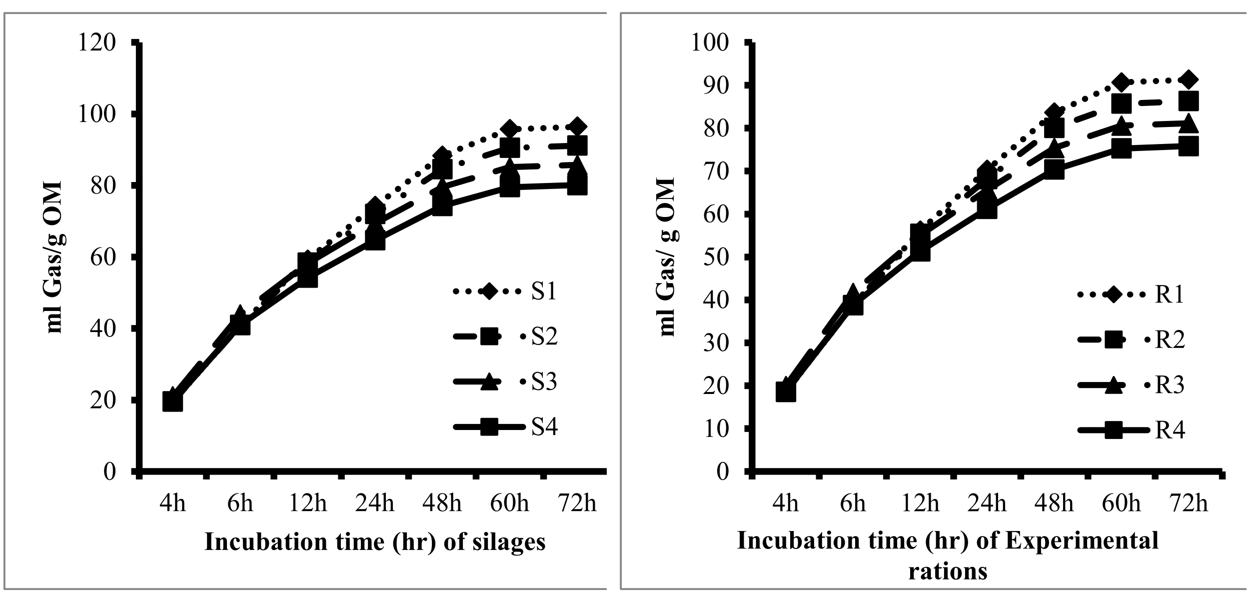

Figure 1: *In-vitro* gas production (ml/600mg DM) of different silages kinds and tested rations

DISCUSSIONS

Good silage usually preserves the original color of the pasture or any forage (Oduguwa *et al*., 2007). The silage with CD showed pleasant alcoholic aroma which indicates good or well-made silage (Kung and Shaver 2001). The temperature of fermenting forage very closely from 20: 20.1°C was presumed to produce excellent silage (Arbabi and Ghoorchi 2008) in Foxtail Millet and (Falola *et al*., 2013) in silage of vetiver grass. The values of pH obtained were fell within the normal range of good quality silage by (Kung *et al*., 2001). These results may due to favorable conditions of good growth of lactobacillus bacteria (such as the higher content of NFC and NFE in CD) and inhibit the growth of undesirable anaerobic microorganisms, thus increased the production of lactic acid, which is the main acid responsible for reducing silage pH. The pH of inoculated silage after 45 days of ensiling tended to be below 4.5, which considered acceptable for good silage (Falola *et al*., 2013). Extensive proteolysis occurs during the first few days of ensiling and if the pH can be reduced rapidly to 4.3 the proteolytic activity will be decreased (Abo-Donia *et al*., 2009). In the present study, the DM content of herbage materials was sufficiently high to avoid seeping and additive silage pH went down quickly to prevent the loss of silage protein. Well-preserved silage is considered to be good with less than 100 g NH_3-N/kg total nitrogen (Khattab, 2013). In all silage containing CD, NH_3 content and NH_3-N/total nitrogen ratio were in good. This can be explained by the fact that increasing CD additive reduced pH in silage products rapidly, resulting in decreasing NH_3 production. NH_3 content and NH_3-N/total nitrogen ratio increased with longer storage time, as occurred in the treatment without CD because of continued deamination. This result which obtained are in a agrees with the finding by (Henderson, 1993) reported the lactic acid bacteria population increased during ensiling with cull dates, where the values closed to 7 log cfu/g. According to the fermentation profile parameters obtained, which indicated that all values of tested silages were within the normal range of good silage characteristics (Kaiser and Piltz 2009). The success of silage conservation and fermentation quality is mainly judged by aerobic stability (Hönig, 1990). Similar results were found by (Arbabi, and Ghoorchi 2008) who noticed that silages treated with water-soluble carbohydrates had a clear improvement in their aerobic stability.

Increasing of CD level increased silage DM content because the DM content of CD is higher than that of GC. Previously observed DM content in silage was similar to that obtained by (McDonald *et al*., 1991) In the present study, the OM and CP content of Silage was as that collected by Abd El-Rahman *et al*., (2012) who reported that dates had lower CP contents which the main limitation of dates in the ruminant diet. Other contents of CF, NFC, and NDF in the current study was agreed with those reported by others (Allam, e. al. 2013) and also in accordance with the report by (El-Hag *et al*., 1993) and (Al-Dobaib, 2005). The curves at 72 hours after incubation of cumulative gas production were consistent with that obtained by (Abo-Donia *et al*., 2009) who showed a similar tendency of GP when compared to reeds and corn silage. In our study, similar results of cumulative gas production were found by (Deutschmann *et al*., 2017) who reported that conserved pangola grass did not affect cumulative gas production.

High degradable feedstuff has been known to be enhanced in high ME (Babayemi *et al*., 2006) whereas, the measurement of IVNDFD has been widely used to express the quality of the nutritional feeds, due to its high correlation with in vivo digestibility (Getachew *et al*., 2004). Generally, in the present study ME values measured were in harmony with those obtained for some silage (8 MJ/kg DM) by

Abo Donia *et al.,* (2009) but that was more than observed (6 MJ/kg DM) by (Kanber Kara 2015). As recorded by many authors, (Al-Dobaib, and Ahmed 2002) and Abd El-Rahman *et al*., (2012) who found that the digestion coefficient of CP and CF was not different from the inclusion of dates in the ration. However, Al-Kinani and Al-Wash 1975) indicated that the presence of CD improved the digestibility coefficients of fiber, while the value of EE was higher than that obtained by (Al-Dobaib, and Ahmed 2002). Apparent digestibilities of nutrients are in a good agreement with the findings of (Al-Yousef *et al*., 1993), (Javidan and Khezri, 2013). and (Ahmed and Al-Dobaib 2000) who indicated that date supplemented diets may improve the digestibility coefficients of animals. These results revealed that the improvement of nutrients digestibility in the rations containing silage with CD may regard as the improvement in rumen characteristics as a result of growth-promoting compounds' presence in dates (Ismail, 2000). Nutritive values of tested rations where in the same trend was observed by Abd El-Rahman *et al*., (2012), who found that the TDN value of total cull instead of corn grains was insignificantly higher than that of other levels of replacement. These results of DMI, milk yield and its composition and feed conversion parameters among all the experimental rations are matching with (Hmeidan *et al*., 1993) who found adding CD up to 33% did not negatively affect the feed intake of Najdi lambs. These results might be due to improved nutrients digestibility and the presence of the growth-promoting compounds in CD (Ismail, 2000). Similarly, Khattab, (2013) found no difference observed in milk yield between the lactating Barki ewes which fed diets containing 0, 50 or 100% dates in replacing corn grains. Besides, (Hmeidan *et al*., 1993), (Al-Yousef *et al*., 1993) and (Al-Dobaib, 2005) found replacing a part of the concentrate with 11% to 35% cull dates did not harm lamb performance. Similar results obtained by Al-Dobaib, 2009) who reported the cull dates addition to Aradi goats ration associated with significantly higher milk protein and SNF contents. The same trend of FCM was observed by Abd El-Rahman *et al*., (2012) who reported with the replacement of yellow corn by cull dates, the TDN value was insignificantly higher than that free from cull dates.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

CONCLUSION

We certify that there is no conflict of interest with using cull dates till 75% as an alternative of corn grains as a source of energy in silage did not show any negative effect on silage quality, dry matter intake, digestibility, feed efficiency, milk yield, and composition. It could even be an optimal alternative in the event of rising corn prices or a shortage of markets.

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