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Research Article
Using an Unconventional Energy Source to Make Silages and their Impact on Silage Quality and Performance of Lactating Cows

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Abstract
Background and Objective: Using corn grains in silage leads to a relentless decrease in the availability of corn grains and high prices, causing high nutrition costs. This study aimed to use Date Pits (DP) as an available and cheap source of energy instead of Corn Grains (CG) to make silage during suffering from a shortage of quantities or high prices. **Materials and Methods:** Ground DP (3-5 mm) as a source of energy was added at 25 (DPS_1), 50 (DPS_2) and 75% (DPS_3) Instead of corn grains in silage (CGS). Tested silage offered with concentrated feed mixture and rice straw in four diets T_0, T_1, T_2 and T_3, respectively. Twenty cows distributed for 4×4 Latin squares. **Results:** Using DP as an energy source in silage making did not adversely affect the color, odor and texture. Lactic acid, NH_3-N, butyric acid and aerobic bacteria are within the desirable range. Components of silage not affected, while gas production and digestibility of Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were reduced. The values of digestible protein and energy not significant ($p>0.05$) alterations with an added 25 and 50% DP, but decreased with added 75%. No significant difference found in actual milk, fat corrected milk and milk components among all groups. Feed conversion of experimental groups not affected. Blood biochemical constituents (total protein, albumin, globulin, urea and creatinine) not significantly affected. **Conclusion:** Utilize DP as an alternative to CG at silage making, up to 75%, maybe no effect of feed consumption, palatability, rumen fermentation, digestion factors or blood measurements.

Key words: Date pits, silage, digestibility, milk yield and composition, dairy cows

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Egypt suffers from a gap equivalent to 60% of its needs of corn. This problem is also found in many subtropical countries that produce dates. In spite of Egypt is ranked in first place among the top five date-producing countries in the world (with a production of 1,465,030 tons in 2014) but despite the growth in the international demand, its export contribution to the international dates market is low[1]. At the same time, the large quantities of date pits available, it did not exploit the optimum exploitation in animal feeding, it can be used as a substitute for corn kernels in the silage. The Date Pits (DP) are mainly produced from dates production factories and date paste production units at the farm level[1]. DP contained high and variable quantities of fiber, with a high level of lignification (on DM basis): CF 16-51%, NDF 58-90%, ADF 41-46% and ADL 4-18%[2] and contain appreciable amounts of K followed by P, Mg and Ca, with a little content of Na. The nutritive value of DP has been quite extensively studied due to its widespread availability in the countries where date production is important. Ground DP can be used up to 75% of the ruminant diets provided a good protein supplement. DP, as a major by-product remains after consumption of date flesh proved to be a valuable source of energy in animals and poultry rations[3]. The energy level and source in the diet affect animal performance and feed utilization[4]. The energy level supplementation in the animal diet depends on species, productive performance and climatic conditions[5]. The DP is traditionally used for ruminant animal feed as a source of energy[6] and usually can be fed at any time of the year[7]. Dates can be used as a source of energy in partial substitution of the concentrates in the animal rations[8]. Since DP is rich in soluble sugars, vitamins and minerals and so has been used as a fermentation substrate of microbial activity for processing silage. The DP is containing (23% to 26.86%) total carbohydrates[9], while the total carbohydrate content[10] of DP is about up to 65.5%. However, good quality silage depends on moisture content, buffering capacity, sugar content and types of organisms[11] DP has been used to supply energy source that can fast ferment into lactic acid by lactic acid bacteria. This study was aimed to appreciate the effects of partially replacing corn by crushing DP on silage quality and performance of lactating cows.

MATERIALS AND METHODS

This study was conducted at El-Serw Experimental Station (from March 2018 to December 2018) belonging to the Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture. Egypt.

Silage preparation: The date pits (DP) were collected from the palm date's manufacture in the New Valley (El Wadi El Gedid Governorate). Hybrid corn-stalks (HCS) was assembled at the picked season of farmers by wholesalers with about 30% DM. Green corn stalks chopped by chopper machine to 2-5 cm length. Date pits were moistened with water for 72 hours, then ground to 3-5 mm. Silage material from HCS (30% DM) specifically included 30 kg per ton of ground corn as a source of energy for control silage (CGS). While the DP was added as an alternative to corn on metabolizable energy (ME) at 0, 25, 50 and 75% silage with corn grain (CGS), silage with 25% DP (DPS_1), silage with 50% DP (DPS_2) and silage with 75% DP (DPS_3), respectively. The metabolizable energy content of the ingredient, silage and rations was calculated according to National Research Council[12]. The ground CG or DP distributed sequentially among the silage layers at a depth of 25 cm and sprayed with urea solution, with maintaining the optimum humidity of silage. Urea was added as a nitrogen source by 0.5% of chopped corn stalks for each kind of silage. Relative Feeds Value (RFV) was calculated according to Moore and Undersander[13] and Fleig Points (FP) calculated from determined pH values and DM content of silage samples as the physical analysis according to the specified formula of Kamarloiy and Yansari[14] as follows:

$$\text{Fleig point} = 220+(2\times\text{Dry Matter (\%)}-15)-40\times\text{pH}$$

***In vitro* gas production determination:** Rumen fluid inoculum was collected from three Ossimi rams (56$\pm$ 2.0 kg body weight) which were fed ad-libitum a total mixed ration containing 1:1 concentrate feed mixture (CFM 14% CP) and rice straw to covering their nutrient requirements of maintenance. The well-mixed of rumen fluid and buffer at a ratio (1:4 vol/vol) as described by Goering and Van[15] to reproduce a buffered ruminal solution. Nearly, 0.6 g of ground silage samples were weighed in 100 mL serum bottles of 60 mL buffered ruminal fluid under CO_2 flushing. Three blanks contained only buffered ruminal fluid. The pressure of GP was recorded according to Theodorou *et al.*[16] at 3, 6, 12, 24, 48 and 72 hrs of incubation using the GP technique (Hangzhou Runchen Electron Com., Hangzhou, China). After 72 hrs of incubation, all the content of each bottle filtered through four layers of a nylon bag (100 μm pore size) and the pH value of each bottle was immediately measured with a pH meter

(Hanna, model HI 8424). Then the residue was collected and oven-dried at 60°C to constant weight to find neutral detergent fiber degradability (dNDF). A 10 mL sample of each filtered fermentation fluid was collected for analysis of ammonia nitrogen (NH_3-N) and short-chain fatty acids (SCFA's).

Metabolizable energy (ME, MJ/kg DM) determined according to the following equation of Menke[17]:

$$\text{ME (MJ kg}^{-1}\text{ DM)} = 14.51 - (0.143 \times \text{ADF})$$

where, ME is Metabolisable energy, DM is Dry matter and ADF is acid detergent fiber (g kg^{-1} DM)

Feeding trial and management: Crossbreeding Friesian cows (n = 20) in the 2nd-3rd season of average weight 464±1.06 kg (mean, 134 days postpartum) were randomly distributed through five completed simultaneous 4×4 Latin Squares. Twelve Holstein cows were separated from the rest of the herd and housed in individual tie stalls. The cows were the diet consists of concentrated feed mixture (CFM), Rice Straw (RS) and tested silage, where, T_0 (fed silage CGS), T_1 (fed silage DPS_1), T_2 (fed silage DPS_2) and T_3 (fed silage DPS_3), respectively. The experiment consisted of four periods lasting 17 days each (the first 10 days were for adaptation and the last 7 days were used for data collection). The concentrate feed mixture (CFM) was offered 2% based on live body weight (LBW) before the morning and the afternoon milking, while 4 kg/h/days of rice straw offered during feeding trail two times daily after milking directly. The silage was offered *ad libtum* daily from 7:00 am to 4:00 pm, then refusals were collected to find the real feed intake of tested silage. Relative palatability was expressed as the ratio of the quantity of the actual silage consumed (ASC)/silage offered (SO). Animals were machines milked twice daily at 5.00 am and 5.00 pm and individual the morning and evening-milk yield was daily recorded. Every two weeks, composite milk samples were taken from composed evening and morning samples and were stored at -20°C for analysis. Milk samples were analyzed for the percentage of fat, protein, lactose; solid not fat (SNF), Total Solids (TS) and ash by milk SCAN 133 BN Foss Electric, Denmark. However, Fat corrected milk (4% FCM) was calculated by using the following equation: 4% FCM = 0.4× actual milk yield in kg/day+15×milk fat in kg/day. Also, Relative Feeds Value (RFV) is calculated by Rohweder *et al.*[18] using the following equations as follows:

$$\text{RFV} = \frac{((\text{DMI, body weight (\%)}) \times (\text{DDM, DM (\%)}))}{1.29}$$

where: Dry matter intake (DMI, body weight (%)) = 120/(NDF, DM (%)) and Digestible dry matter (DDM, %) = 88.9-(0.779×ADF, DM (%)).

Digestibility trials: Fecal samples were collected at the end period (6 am and 6 pm). Composite feeds and fecal samples were analyzed according to AOAC.[19]. The nutrients digestibility was estimated using acid insoluble ash (AIA) method described by Keulen and Young[20].

Laboratory analysis: At the end of the ensiling period (60 days), color and odor were examined and samples were taken from each silage kind for chemical analysis. Silage samples were extracted using twenty grams homogenized the wet sample with 100 mL distilled water for 10 min in the blender[21]. The homogenous were filtered through double layers of cheesecloth and then the filtrate was used to determine silage pH directly by using HANNA pH-meter (model HI 8424). Ammonia-N (NH_3-N) concentration was estimated according to the descriptions of Weatherburn[22] and short-chain fatty acids (SCFA's) fractions were analyzed according to Erwin *et al.*[23]. The lactic acid concentration was determined by methods of Analytical Chemistry of Foods[24]. Ground samples of feeds or residuals and feces were subjected for proximate analysis procedure AOAC.[19]. Neutral detergent fiber and acid detergent fiber procedures were performed as described by Van Soest *et al.*[25]. The neutral detergent fiber was assayed with the addition of a heat-stable amylase, but without sodium sulfite. Water-soluble carbohydrate (WSC) concentration was measured colorimetrically as a method by DuBois *et al.*[26].

Serum Total Protein (TP), albumin (Alb), urea, creatinine, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined by using commercial kits, (Bio Merieux 69280 Marcy-1, Etoile/France). Serum globulin (Glb) was obtained by difference.

Statistical analysis: All statistical analyses were performed using PROC GLM of SAS (Statistical Analysis System, version 9.4). Animals were allocated to four 4×4 Latin square[27], containing five animals, four experimental periods and four treatments. Each animal within a period was the experimental unit. The statistical model is as follows:

$$y_{ijkl} = \mu + \alpha_i + \beta_j + c(\alpha)_{ki} + t_l + \epsilon_{ijkl},$$

where, y_{ijkl} represents the observation of cow k in square i at period j subjected to treatment l, α_i represents the fixed effect of square i (i = 1, 2, 3,4), β_j represents the fixed effect of period j (j = 1, 2, 3, 4); $c(\alpha)_{ki}$ represents the fixed effect of cow k within square i and ϵ_{ijkl} represents the random error.

The results for intake, feed efficiency, variation in body weight, milk production, milk composition and digestibility were subjected to analysis of variance and test of means, with Tukey's test applied at 0.05 probability for comparison of the means. All statistical procedures were carried out using SAS software (Statistical Analysis System, version 9.4).

RESULTS

Chemical compositions of silage and diets: Chemical compositions of the experimental silages, corn grains (CG) and date pits (DP) are presented in Table 1. Corn grains (CG) composed 89.68% DM, 9.82% CP, 4.21% EE, 1.59% Ash, 10.12% NDF and 3.48% ADF. In opposite, DP contained 91.76% DM, 5.89% CP, 7.69% EE, 1.47% Ash, 63.65% NDF and 44.56% ADF. Also, DP had high levels of total phenolic. Added DP as an alternative energy source to CG at different levels during making corn silage showed no differences in terms of DM content which fall in the normal corn silage DM range. Also, the content of CP and ash in DPS_1, DPS_2 and DPS_3, respectively

Table 1: Composition of the tested silages and ingredients (% on DM basis)

Items	Corn grains (CG)	Date pits (DP)	Experimental silages (%) CGS	DPS_1	DPS_2	DPS_3
Corn gains	-	-	7.79	5.84	3.89	1.94
Date pits	-	-	0.00	2.08	4.15	6.22
Cornstalk	-	-	90.91	90.79	90.66	90.54
Urea	-	-	1.30	1.30	1.30	1.29
Proximate analysis of the experimental silages (% on DM basis)						
Dry matter	89.68	91.76	30.32	30.44	30.56	30.63
Crude protein	9.82	5.89	10.37	10.28	10.20	10.12
Ether extract	4.21	7.69	2.10	2.18	2.25	2.33
Ash	1.59	1.47	7.27	7.26	7.25	7.24
Neutral detergent fiber	10.12	63.65	51.72	52.91	54.09	55.26
Acid detergent fiber	3.48	44.56	32.81	33.73	34.64	35.56
TPC (g GAE/100 g DW)	2.743	4.12	-	-	-	-
ME (Mcal/kg DM)	-	-	2.420	2.417	2.413	2.410
Flieg score	-	-	98.04	97.48	96.91	98.27
RFV (%)	-	-	113.92	110.11	106.48	103.02

CG: Corn grains, DP: Date pits, CGS: Corn silage with CG, DPS_1: Corn silage with DP(25%), DPS_2: Corn silage with DP(50%) and DPS_3: Corn silage with DP (75%), TPC: Total phenolic content (g GAE/100g DW), ME: Metabolizable energy and RFV: Relative feed value

Table 2: Fermentation characteristics of corn silage stored for 60 days

Items	Experimental silages (%) CGS	DPS_1	DPS_2	DPS_3
The physical characteristic of the tested silage				
Colour	Olive-green	Olive-green	Olive-green	Olive-green
Aroma	pleasant alcoholic	pleasant alcoholic	pleasant alcoholic	pleasant alcoholic
Texture	Firm and separable	Firm and separable	Firm and separable	Firm and separable
Fermentation patterns				
pH	4.19	4.21	4.23	4.24
NH_3-N (%DM)	0.055	0.051	0.048	0.046
La (g/100 g DM)	5.37	5.34	5.32	5.28
Ac (g/100 g DM)	2.19	2.15	2.14	2.1
Bu (g/100 g DM)	0.04	0.04	0.05	0.05
WSC (DM%)	5.49	5.51	5.5	5.51
La/Ac	2.45	2.48	2.49	2.51
Microbial counts, (log10 cfu g^{-1}) after 60 days (fresh matter)				
Aerobic bacteria	7.35	7.39	7.42	7.37
Lactic acid bacteria	6.89	6.87	6.85	6.81

CGS: Corn silage with CG, DPS_1: Corn silage with DP(25%), DPS_2: Corn silage with DP (50%) and DPS_3: Corn silage with DP (75%), La: Lactic acid, Ac: Acetic acid, Bu: Butyric acid and WSC: water-soluble carbohydrate were at the same level compared to CGS. The contents of EE, NDF and ADF were slightly increased with the different levels of DP. The RFV value of tested silages ranged from 113.92 to 103.02, where reduced slightly when the ratio of DP increased in silages. The best Fleig points value that indicates good quality silage show with adding corn grains compared to adding DP.

The values of the different fermentation characteristics of tested silage are shown in Table 2. Tested silages were similar in their properties having olive green color, pleasant alcoholic odor, firm texture. The tested silage exhibit pleasant alcoholic aroma stated pleasant smell is accepted for good or well-made silage. The fermented silage increased pH values slightly as DP when substituted of CG in the silage making were ranged between 4.19 (CGS): 4.24 (DPS_3) which indeed showed effective preservation. The values of Ammonia nitrogen (NH_3-N), lactate, propionate proportion and lactic acid bacteria (LAB) reduced unimportant with the increasing substituting level of DP in silage. The different parameter's value of all tested silage was within the desirable range of optimal. Lactic acid bacteria populations slightly decrease to DPS_3 (6.81 log CFU/g fresh matter) compared to S_1 (6.89 log CFU/g fresh matter) and this has led to a decrease in the amount of lactic acid produced in DPS_3 compared to CGS.

Proximate analysis of the experimental diets, concentrate feed mixtures (CFM) and rice straw (RC) (% on DM basis) is shown in Table 3. The percent of DM, OM, CP, EE, ash and NFE of the tested diets were relatively close among all the dietary treatments. While the NDF and ADF concentrations of the control diet (T_0) were the lowest of all experimental diets that contain DP (T_1, T_2 and T_3). An opposite trend was observed for Non-fiber carbohydrates (NFC) values which were related to higher NDF and ADF contents of the DP than that of CG.

Table 3: Proximate analysis of the experimental diets (% on DM basis)

	Experimental diets (%)				
Items	T_0	T_1	T_2	T_3	±SE
Dry matter	73.31	73.31	73.28	73.37	0.012
Organic matter	88.83	88.83	88.85	88.84	0.004
Crude protein	12.85	12.81	12.79	12.76	0.005
Ether extract	2.33	2.35	2.37	2.39	0.001
Ash	11.17	11.17	11.15	11.16	0.004
Neutral detergent fiber	34.39^{b}	34.77^{ab}	35.08^{a}	35.41^{a}	0.024
Acid detergent fiber	21.67^{b}	21.96^{ab}	22.19^{a}	22.44^{a}	0.017
Non-fiber carbohydrates	39.26^{a}	38.89^{a}	38.60^{ab}	38.28^{b}	0.021

^{a,b,c}Within a raw, means bearing different superscript are statistically different, p<0.05

Effect of tested silage on gas production and degradability: The data of *in vitro* fermentation kinetics are shown in Table 4. The lowest values of the gas potential extent of gas production (50.75 ml/g DM) were observed with DPS_3, while the highest value was shown with CGS (57.19 ml/g DM). No significant (p>0.05) difference in gas production rate (h^{-1}) was found among all tested silage kinds. The ME values of silage containing DP significantly (p<0.05) decreased with increasing DP level in the silage, so this finding due to reducing fermentation and fiber degradability of silage. *In-vitro* gas production rates concerning tested silage indicate a decrease in the release of GP with a higher level of addition of DP in silage as a source of energy instead of corn.

Effect of experimental diets on cow's nutrient digestibility: The total apparent digestibility of DM, CP and EE as shown in Table 5 had the same trend (p>0.05) for the control treatment (T_0) compared with those treatments incorporated silage with DP. However, total tract apparent digestibility of OM, NDF and ADF nutrients decreased (p<0.05) significantly with the inclusion of the DP in the diet T_3 compared to the control (T_0). There were no significant (p>0.05) differences between all treatments of DCP (%) since there was a significant (p<0.05) decrease in the values of TDN (%) and calculated metabolizable energy (Mcal/Kg DM) with diet T_3, compared to control diet T_0.

Effect of experimental diets on DMI and animal performance: The results of dry matter intake (DMI), feed conversion, milk production and milk composition are

Table 4: Gas production and degradability of different tested silages

	Incubation time (hours)						Gas kinetics			
Items	3	6	12	24	48	72	GP	c	dNDF	ME
CGS	3.98	9.03^{a}	19.40^{a}	41.40^{a}	49.52^{a}	55.84^{a}	57.19^{a}	0.050	42.95	8.41^{b}
DPS_1	3.96	8.66^{ab}	18.59^{ab}	39.67^{ab}	47.46^{ab}	53.51^{ab}	54.84^{ab}	0.049	42.71	8.18^{ab}
DPS_2	3.94	8.12^{b}	17.43^{ab}	37.20^{ab}	44.50^{b}	50.17^{bc}	51.48^{bc}	0.049	42.42	7.84^{ab}
DPS_3	3.83	7.46^{c}	16.45^{b}	35.42^{b}	43.02^{b}	49.02^{c}	50.75^{c}	0.046	42.29	7.61^{b}
±SE	0.100	0.180	0.721	1.541	1.306	1.132	1.040	0.002	0.830	0.209

CGS: Corn silage with CG, DPS_1: Corn silage with DP(25%), DPS_2: Corn silage with DP(50%) and DPS_3: Corn silage with DP (75%), GP: Gas production (ml/g DM), C: rate of gas production (hr), dNDF: NDF degradability (%) and ME: Metabolizable energy (Mj/kg), ^{a,b,c} Within a column, means bearing different superscript are statistically different, p<0.05

Table 5: Nutrients digestibility coefficients and nutritive values of experimental rations

	Experimental diets (%)				
Parameters	T_0	T_1	T_2	T_3	±SE
Digestibility coefficients (%)					
Dry matter	64.87	65.61	65.58	65.46	0.351
Organic matter	68.14^{a}	67.63^{a}	66.82^{ab}	66.01^{b}	0.438
Crude protein	68.25	68.04	67.91	67.72	0.316
Ether extract	75.32	74.93	74.84	74.54	0.357
NDF	58.42^{a}	58.18^{ab}	57.71^{ab}	57.25^{b}	0.349
ADF	53.89^{a}	53.66^{a}	53.43^{a}	52.15^{b}	0.401
Nutritive values (%)					
TDN (%)	63.64^{a}	63.37^{ab}	63.13^{ab}	62.97^{b}	0.197
Calculated metabolizable energy (Mcal/kg DM)	2.30^{a}	2.29^{ab}	2.28^{ab}	2.28^{b}	0.007
Digestible Crude Protein (DCP), (%)	8.77	8.72	8.69	8.64	0.042

^{a,b,c} Within a raw, means bearing different superscript are statistically different, p<0.05, TDN: Total digestible nutrients, NDF: Neutral detergent fiber and ADF: Acid detergent fiber

Table 6: Feed intake, feed conversion, milk production and composition of dairy cows fed the experimental rations

	Experimental diets				
Parameters	T_0	T_1	T_2	T_3	±SE
Total DMI (kg/h/d)	15.99	15.81	15.97	15.91	0.061
Offered silage (kg/h/d)	7.008	6.918	6.976	6.946	0.031
Residual silage (kg/h/d)	2.352^{a}	2.322^{b}	2.304^{b}	2.296^{b}	0.010
Actual silage consumed (kg/h/d)	4.65^{ab}	4.59^{b}	4.65^{ab}	4.67^{a}	0.020
Relative palatability silage intake (kg/h/d)	66.40^{b}	66.40^{b}	66.94^{a}	66.96^{a}	0.017
Milk yield					
Actual milk (kg/h/d)	12.48	12.40	12.36	12.34	0.194
FCM (4 % fat), (kg/h/d)	11.49	11.30	11.16	10.94	0.312
Milk composition (%)					
Fat	3.47	3.41	3.35	3.24	0.099
Protein	3.47	3.44	3.41	3.38	0.095
Lactose	4.31	4.28	4.27	4.23	0.132
MSNF	9.24	9.07	9.01	8.89	0.175
TS	12.71	12.48	12.36	12.13	0.202
Ash	1.46^{a}	1.35^{ab}	1.33^{ab}	1.28^{b}	0.055
Feed conversion					
kg DM intake/kg FCM	1.39	1.40	1.44	1.46	0.043
kg TDN intake/kg FCM	0.890	0.888	0.910	0.920	0.027
kg N intake/kg FCM	0.028	0.030	0.028	0.028	0.028

^{a,b,c} Within a raw, means bearing different superscript are statistically different, p<0.05, MSNF: Milk solids-not-fat TS: Total solid, TDN: Total digestible nutrients and FCM: Fat corrected milk

presented in Table 6. There was no significant (p>0.05) alter of consumed silage or total DMI for all experimental groups. Residual silage of the control group was better than of all groups fed silage incorporated with DP. However, relative palatability silages intake of DPS_2 and DPS_3 was significantly (p<0.05) higher than of the CGS silage (T_0). Cows displayed no significant difference (p>0.05) in terms of actual milk and fat corrected milk among all groups which indicated the all experimental diets covered both the maintenance and production requirements of cows. Concerning the all milk components of cows except ash content, no significant (p>0.05) differences were observed among experimental groups. Ash content was significantly (p<0.5) higher for the T_0 group (1.46%) compared to the T_3 group (1.28%). No significant (p>0.05) differences appeared between the tested groups with regard to the feed conversion factors, whether the consumer was from dry matter, digested compounds, or the nitrogen consumer per kg of fat corrected milk.

Effect of experimental diets on blood biochemical parameters: Blood biochemical parameters are shown in Table 7. Experimental diets did not significantly (p>0.05) affect the different blood biochemical constituents represented by the total protein, albumin, globulin, urea and creatinine

Table 7: Blood serum biochemical parameters in lactating cows

	Experimental diets				
Parameters	T_0	T_1	T_2	T_3	±SE
Total protein (g dL^{-1})	7.82	7.57	7.49	7.39	0.1547
Albumin (g dL^{-1})	3.43	3.38	3.35	3.27	0.1645
Globulin (g dL^{-1})	4.39	4.19	4.14	4.12	0.1921
Urea (mg dL^{-1})	24.34	23.89	23.74	23.56	0.3967
Creatinine (mg dL^{-1})	0.88	0.87	0.85	0.79	0.0540
ALT (U L^{-1})	27.38	27.42	27.49	27.56	0.2453
AST (U L^{-1})	87.78	87.83	87.95	87.02	0.3349

AST: Aspartate aminotransferase and ALT: Alanine aminotransferase

concentrations in the cow serum. Concerning liver enzymes including both ALT and AST concentrations, no significant ($p>0.05$) differences were observed among dietary treatments.

DISCUSSION

There was no eminent alteration in the quality or chemical composition of produced silage when replacing corn grains with the date pits. The components of silage were very comparable as well in energy content and relative feed value, all changes were slight. Good silage usually preserves the original color of the pasture or any forages[11]. The olive green color obtained in the present study was close to the original color of the grass which was an indication of good quality silage[28]. The pleasant alcoholic aroma in tested silage considered an indication of well-made silage[29]. Values of pH in the tested silage were in the optimal range and closer observed by Binuomote *et al.*[30] who concluded that high-quality silages to have pH values 3.5-4.5. The lowered values of NH_3-N and lactic acid may be influenced by the high level of total phenolic content as antibacterial activity in DP (4.12 g gallic acid equivalents GAE /100 g DW) compared to that in CG (2.71 g GAE/100 g DW). According to many studies, low content of NH_3-N in silage may be due to two main reasons, the first could be due to the ability of phenolic content to be an insoluble complex with proteins[31-33] which lead to the inhibition of bacterial proteolytic activities with silage[34] and thus protect the protein from degradation in silage[35,36]. The second reason is a decrease in NH_3-N level with a shrinkage of the protein contents of DP (5.89% on DM) compared to CG (9.82% on DM) as shown in Table 2.

The chemical analysis of CG and DP used in silage making corresponded to earlier studies of Benmeddour *et al.*[36] they found that CG was higher contenting of CP compared to DP, while DP was containing higher fiber than that in CG. Thus, it could be used as feed additives or functional feeds[36] DM content of all tested silage was consistent with what stated in the study by Kung and Shaver[37], who reported that the dry matter range between 30 to 35%. The replacement CG led to an increase in the content of EE, NDF and ADF in silage, which may be due to higher it in DP. The reducing values of RFV might be due to the high NDF and ADF contents in DP compared to corn grains and high pH values (4.24) of DPS_3 the 60th day where Dunham[38] concluded that, Flieg point of the silage was acceptable (super or better class) at 60 days of the ensiling period. Fleig points value for silages in the present study are closer to those observed by Saricicek *et al.*[28] with corn silage (103.02) on the 90th day.

In spite of the slight rise of NDF and ADF content in silage with date pits, the consumer and the palatability did not change. The increased content of NDF and ADF in produced silage is due to the increased level of dates, especially with the high replacement ratio of 50 and 75%. As a result of the quiet palatability of silage containing date pits, there has been no change in the total feed intake of experimental animals. Fiber digestibility and forage fragility are critical factors that should be considered in forage evaluation and diet formulation for ruminants[11]. Traditionally, nutritionists have focused primarily on fiber digestibility parameters measures and kinetics of ruminal Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) degradations[39]. However, recent studies have suggested including indigestible fiber measures as a necessary type of fiber that had unique ability to influence the turnover rate of ruminal fiber pools and eventually set the rate and final extent of rumen fiber digestion[37]. Despite higher content of the NDF and ADF with an increased level of DP in silage, except that it is within the recommended defining an upper limit for dietary NDF in the high production of dairy cows[30].

When feedstuffs are incubated *in vitro* gas is produced mainly from the fermentation of carbohydrates[40] with a small contribution to the fermentation of protein or fat[41]. Our results suggest that DP would be also highly fermentable feedstuffs in the silage that could represent a substantial supply of energy to the microorganism. The same trends of lower values of asymptotic gas production were observed with studies of Boufennara *et al.*[42] who observed that the in vitro fermentation kinetics estimated from the gas production curves were significantly lower values. A possible explanation for higher gas volumes from NDF may stay in the efficiency with which fermentable material is allowed into microbial cells. There is a possible contrary relationship between gas production (i.e. short-chain fatty acid production) and LAB cell yield when both were related to a given unit of substrate truly fermented[40,41]. Correspondingly less microbial yield and higher SCFA assembly from NDF would, therefore, mean higher gas volumes from NDF.

Regarding data of total apparent digestibility, might be the reason for these results can be simply attributed to the fact that as cell wall increases, digestibility and energy content decrease[43]. As a result of the inadequacy of change in the feed intake, this was reversed on the digestibility coefficient of the experimental diets. These results were comparable to digestibility values by Kung and Shaver[37], Ferraretto and Shaver[44], Al-Suwaiegh[45] and Suliman and Mustafa[46] they reported that inclusion levels from 5 to 28% of palm kernel meal in the diet of lactating dairy cows did not affect digestibility coefficient of the experimental diets. Similar results were reported by Al-Shanti[47] who observed no effect of CP digestibility with the level of 30% DP of the goat's rations. Similar DMI among all tested groups may be attributed to the close contents of dietary NDF (51.72 : 55.26%), ADF (32.81 : 35.56%) and acetic acid (2.1-2.19 g/100 g DM) of silage. Replacing either corn or barley with crushed DP at 50, 75 and 100% on DM basis, no change was observed in average daily feed intake[46]. In the same context, DMI has much increased with the increase in the percentage of ground DP up to 15.57% in lamb diets[47]. Incidentally, milk yield and milk composition study by Sharifi *et al.*[48] who shows no effect on milk yield and milk composition of Saanen dairy goats with different levels of DP (0, 6, 12 and 18%) of the diet (on DM basis). There is no significant difference in the feed conversion ratio of experimental groups that were agreed with Al-Shanti[47] who found the DP inclusion up to 20% of the CG in lamb diets had no adverse effect on the nutritive value of feed intake which indicated cows on the different diets fed similar diets of its TDN content and so produced a similar feed conversion ratio.

The inadequacy of change in the feed intake, as well as the digestibility coefficient, was reversed on the blood constituents as no significant modifications appeared between the tested groups. The values of blood biochemical constituents were within the normal ranges reported by Sharifi *et al.*[48] and Kaneko *et al.*[49] they stated that replacing yellow corn by date seed didn't affect blood parameters. This may be explained that, the increased total phenols levels of DP which was associated without alteration of the protein utilization.

These findings are in good agreement with those obtained by Azzaz *et al.*[50] who reported no significant ($p>0.05$) effect of feeding sheep on DP at the level of 50% replacing concentrate feed mixture of blood total protein, albumin, globulin, urea-N and creatinine. The values observed in this study might explain that DP has adequate amounts of protein for maintenance and production, especially since serum urea level is a good display of malnutrition[51]. These data concluded that, the use of date pits as an energy source was reasonably positive and the results obtained from the above indicate the possibility of using it as an alternative to corn grains. The importance of date pits is because it contains an acceptable percentage of energy in addition to the possibility of storing it for long periods and therefore it can be used in critical periods. In addition to that, the percentage of substitution can reach 75% of corn grains without any effect on the quality of silage or the consumer of food, as well as the digestibility factors or the production of milk and its ingredients.

CONCLUSION

In conclusion, the results of this study indicate the possibility of using dates pits as an alternative to corn, up to 75%, without any adverse impact on feed consumption, palatability, rumen fermentation, digestion factors or blood measurements.

SIGNIFICANCE STATEMENT

This study discovers that uses of dates as one of the unconventional sources rich in energy and not well exploited will have can be beneficial for impact on the costs of manufacturing silage. On the other hand, it is possible to use date pits to address the problems caused by the shortage of corn grains or their high prices during the critical periods, especially in countries located in the subtropical region, where it is considered one of the proposed solutions in this regard. The novel discoveries of many energy sources will add multiple options in front of livestock owners to choose the most appropriate and least expensive, especially in many regions of the world that have a problem in the availability of corn grain, high prices, or the impact of climate changes on productivity.

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