Response of Replacement of Yellow Corn with Cull Dates as a Source of Energy on Productive Performance of Goats Kids

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Abstract: This study was conducted to evaluate the effect of replacing corn grains with cull dates (CD) on the performance of growing goats kids. Twelve male kids aged 6 months with an average body weight 16.5 kg ± 0.25 kg were placed in individual pens and fed with four levels of replacement of corn grains by CD (0, 50, 75 and 100%) during 90 days. Daily live-weight gain, dry matter intake and feed conversion were evaluated. Amino acids of corn grains and cull dates were determined. A digestibility trial was conducted to determine the digestibility coefficients and nutritive value of the tested ration. Rumen parameters were also measured. Results obtained showed that CP, CF and EE contents in four rations were nearly similar. The DM intake of group 4 was higher than the other tested rations. Results of digestibility trial indicated that the difference between all tested rations were not significant, except for NDF and ADF. The TDN of 100% cull dates showed insignificant higher than that of the three other groups, concerning the DCP, the control ration showed the highest value ($p<0.05$) compared with the other tested rations. Concerning weight gain, animal fed ration (4) recorded highest gain (105 g) followed by control group (102 g). The group (2) recorded the lowest value (90 g). Ruminal total volatile fatty acids values were significantly higher for goats fed 100% cull dates than control group. Ammonia-nitrogen of treatment 3 (75% cull dates) was higher than values of other groups. In conclusion, group 4 (100% cull dates) could be used to improve animal performance of goats kids without any adverse effect.

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1. Introduction

Feed is the most important cost items for livestock production. **Tayler and Field (1998)** reported that the feed cost represented 50 to 70% of the total cost of beef cow production. Grains, i.e. corn, barley, sorghum and oats are the primary courses of high energy feed for livestock. Yellow corn grains are the most important sources as carbohydrates for rations of ruminants. Because of the shortage and high price of yellow corn grains, one of the alternatives to solve this problem is using non-conventional ingredients as a partial replacement of corn grains in rations of ruminants.

Dates (*Phoenix dactylifera L.*) are very popular in most of the Middle Eastern countries. Over 70% of the total world production are produced in this area and are considered an important national crop in some Arabian countries. A considerable amount (20%) of produced dates is inedible and is not beneficial for human consumption due to their poor quality. Besides, the average weight of dates pits is 10% of the date's weights.

In developing countries, the demand for importing corn grains as an ingredient for animal and poultry industry has been increasing under the intensive production systems, leading to an increase in its price in the world market. Alternate sources for feed energy have been investigated in many developing countries. Dates are very rich in saccharides, their total sugars may reach up to 87% in the Tamr stage and the monosaccharides are mainly 44% glucose and 50% fructose and some sucrose **(Sawaya *et al.*, 1983).** Therefore, dates are considered the highest in energy content among all fruits, for example 1 kg of dates provides over 3000 kcal/kg gross energy, while 1 kg of orange provides 500 Kcal/kg **(Yousif *et al.*, 1996).** For this reason, dates that are not suitable for human consumption are considered a good source of energy for animals and poultry.

In addition, significant amounts of cull dates (which are unstable for human consumption) are available in Egypt which can be utilized as a cheap non-conventional ingredient in ruminants diets. The annual production of dates in Egypt is estimated by 1.113.270 ton **(Ministry of Agriculture, 2002).** Moreover, the quantity of cull dates is estimated by about 20% of all dates produced **(Al-Yousef *et al.*, 1994).**

The objective of this study is to estimate the value of cull dried dates as an energy substitute for yellow corn in diets for growing kid goats performance.

2. Materials and Methods

This study was carried out at the Nubaria Experimental Station and on the Laboratories of Animal Production Department, National Research Center. Dokki, Giza, Egypt.

Feeding trials:

Twelve growing male goats weighed in average 19.3 kg were randomly allocated into four similar groups (3 animals in each). Ground cull date was incorporated into of the experimental feed mixtures (FM) to replace 0, 50, 75 and 100% of the ground yellow corn grains as a source of energy. The formulation and the chemical composition of the corn grains, cull dates and feed mixtures were shown in Tables (1 and 2).

All ingredients of each ration were well mixed and ground before feeding. The experimental feed mixtures were fed individually *ad libitum* two times daily, at 8 a.m. and 4 p.m., while feed residues were removed and weighed once daily before morning feeding to estimate daily feed intake. Fresh water was freely available all time. Kids weights were recorded at the beginning of the experiment and thereafter at biweekly intervals till the end of the experiment after water and feed were withdrawn for 12 hrs. The feeding trials lasted for 90 days.

Digestibility trials:

At the middle of the feeding trial (45 days), using a grab sample method from each group to determine the nutrients digestibility and feeding value of the experimental rations using acid insoluble ash (AIA) as a internal marker as described by **Van Keulen and Young (1977).**

Rumen liquor parameters:

During the digestibility trials rumen liquor samples were taken before given the morning rations and at 2 hrs after feeding using stomach tube and strained through four layers of cheesecloth. Samples were separated into two portions, the first was used for immediate determination of pH values by Orion Research Digital pH-meter, model 201. Ammonia-nitrogen (NH_3-N) concentration was determined according to **Conway (1962)**, while the 2nd portion was stored at -20 ^{O}C after adding few drops of toluene and a thin layer of parafin oil till analyzed for total VFA's according to **Warner (1964).**

Proximate analysis:

The moisture content of the samples (feeds and feces) was determined by oven-drying to a constant weight at 105 ^{o}C. Crude protein, ether extract, crude fiber and ash content were determined in accordance with the standard methods of **AOAC (1995).** Carbohydrates (nitrogen free extract) were determined by difference.

Amino acids analysis:

Amino acids content for cull dates and yellow corn grains was determined as described by **Spackman *et al*. (1958) and Moore *et al.* (1958).** The analysis was performed in Central Service Unit, National Research Center, Egypt, using LC3000 amino acids analyzer (Eppendorf-Biotronik, Germany). The technique was based on the separation of the amino acids using strong cation exchange chromatography followed by the ninhydrine colour reaction and photometric detection at 570 nm. Samples were hydrolyzed with 6 N HCl at 110 ^{O}C in teflon capped vials for 24 h. After vacuum removal of HCl, the residues were dissolved in a lithium citrate buffer, pH 2.2. Twenty µl of the solution were loaded onto the cation exchange column (pre-equilibrated with the same buffer), then four lithium citrate buffers with pH values of 2.2, 2.8, 3.3 and 3.7, respectively, were successively applied to the column at flow rate 0.2 ml/min. The ninhydrine flow rate was 0.2 ml/min and pressure of 0-150 bar. The pressure of buffer was from 0 to 50 bar and reaction temperature was 130 ^{O}C.

Statistical analysis:

The data of feeding and digestibility trials were statistically analyzed using General linear method of statistical analysis system **(SAS, 1998).** Duncan multiple range test **(Duncan, 1955)** was used to separate among means.

3. Results and Discussion

The proximate chemical analyses of the tested ingredients and experimental rations are shown in Table (2). The results indicated that rations containing dates were nearly similar in DM, CP, EE, CF and NFE contents relative to the control ration. These results are in agreement with those reported by **Al-Dabeeb (2005).** The experimental data showed that yellow corn was the highest in crude protein (9.85%), while CD was the lowest (4.89%). **(Herms and Al-Homidan, 2004).**The results showed that cull dried dates has lower value of crude protein (4.89%) as compared with yellow corn grains (9.85%), but this value was higher than that obtained by **Awadalla *et al.* (2002),** who found that CP of cull dates was 3.62%

and the cull dates has nearly similar value of NFE (77.94%) compare to yellow corn grains (77.71%).

The amino acids composition of cull dates and yellow corn grains are presented in Table (3). The results showed that cull dates contains higher amounts of aspartic, threonin, serine, glutamic, glycine, alanine, valine, methionine, isoleucine, leucine, lysine, histidine and arginine acids compared with yellow corn grains. These results agreed well with those reported by **El-Sohaimy and Hafez (2010)**.

Results of the digestibility trials are shown in Table (4). The digestibility of all nutrients increased as dates in the rations increased up to 100% CD. Total digestible nutrients (TDN) was higher for animals receiving the diets containing 100% CD compared with the other three rations without any significant. **Ahmed and Al-Dabeeb (2000)** indicated that date supplemented diets may improve the digestibility coefficients of animals. This finding is contrary to the findings of **El-Hag *et al.* (1993),** who reported that high concentrate dates in ration caused a sharp drop in digestion coefficients of CP and CF. The same trend was observed by **Al-Yousef *et al.* (1994).**

Rumen fluid parameters of goat kids fed different rations are given in Table (5). Rumen pH decreased as the level of CD increased in the ration. Different between the control and 100% CD is significant, this result agree with that obtained by **Awadalla *et al.* (2002),** who reported that rumen pH decrease ($P<0.05$) tended to increase the levels of CD in the rations. **Kholif *et al.* (1996),** reported significant decreases in rumen pH with CD inclusion in goat rations. The lower ruminal pH associated with CD feeding was partially a result of higher concentration of total VFA's. Moreover, the increase in rumen NH_3 N due to CD feeding may indicate high ruminal activity, which was reflected on higher digestibility. There are no interaction between experimental rations and sampling time.

Results of growth performance for growing kids fed different rations are shown in Table (6). The average daily feed intake of the four rations differed significantly ($P<0.05$). Kids in group (4) consumed more feed (735 g/day) than other three groups. There were no significant differences in daily gain in weight for kids fed the four diets. The kids receiving 100% cull dates recorded the highest value of average daily gain (105 g/head/day). The results of the present study indicated that incorporation of cull dates at 100% of yellow corn show an improvement in growth rate when compared with the control group. This finding was agree with the findings of **El-Hag *et al.* (1993),** who reported that addition of dates to the whole ration was associated with an increase in growth rate of Awassi lambs, while **Al-Dabeeb (2005)** indicated that incorporation of dates in ration did not show an improvement in growth rate when compared with the control group. Values recorded for feed conversion (kg feed intake / kg gain) were nearly the same for the four treatments in terms of DM, TDN or DCP intake / gain. The control group recorded the highest values for the feed cost and lowest values for economic feed efficiency compared with the other treatments. The best economical feed efficiency and relative economical efficiency values were detected with group 4 (Table 7).

Table (1): Ingredients proportion (%) used in feed mixture.

Ingredients	Treatment			
	0%	50%	75%	100%
Ground corn	40	20	10	-
Ground dried cull dates	-	20	30	40
Undecorticated cotton seed meal	20	20	20	22
Wheat bran	12	12	12	12
Berseem straw	25	25	25	23
Limestone	2	2	2	2
Sodium chloride	0.7	0.7	0.7	0.7
Vitamins and minerals mixture[a]	0.3	0.3	0.3	0.3

[a]Each 3 kg vitamins and minerals mixture contains: Vitamin A 12.000.000 IU, vitamin D_3 2.200.000 IU, vitamin E 10.000 mg, vitamin K3 2.000 mg, vitamin B_1 1.000 mg, vitamin B_2 5.000 mg, vitamin B_6 1.500 mg, vitamin B_{12} 10 mg, pantothenic acid 10 mg, niacin 30.000 mg, follic acid, 1.000 mg, biotin 50 mg, choline 300.000 mg, manganese 60.000 mg, zinc 50.000 mg, copper 10.000 mg, iron 30.000 mg, iodine 100 mg, selenium 100 mg, cobalt 100 mg, $CaCO_3$ 3.000g.

Table (2): Chemical composition of the ingredients and experimental rations.

Feed	% DM	Composition (%DM)						
		CP	CF	EE	Ash	NFE	NDF	ADF
Ground corn	89.87	9.85	2.75	4.44	5.25	77.71	9.30	2.1
Ground cull dates	87.15	4.89	3.60	3.34	10.23	77.94	29.10	13.25
Concentrate 0	88.25	12.25	18.10	2.13	7.99	60.03	51.25	32.10
Concentrate50	86.68	11.72	18.32	2.10	8.21	59.65	52.54	33.25
Concentrate75	86.39	11.31	18.43	2.19	8.21	59.34	54.25	34.57
Concentrate100	86.11	11.10	18.54	2.13	9.14	59.09	56.77	36.00

Table (3): Amino acids composition of cull dates and corn grains.

Amino acids (%)	Ground cull dates	Ground corn grains
*Aspartic acid	10.94	8.10
**Threonine	4.09	3.34
*Serine	4.93	4.32
*Glutamic acid	24.48	21.13
*Glycine	2.90	2.47
*Alanine	9.28	7.50
**Valine	3.91	3.56
**Methionine	1.19	1.08
*Isoleucine	4.10	3.89
**Leucine	14.76	10.02
*Tyrosine	5.72	7.37
**Phenylalanine	5.96	8.36
**Histidine	3.95	3.17
**Lysine	3.59	2.86
*Arginine	5.13	4.82

*Non-Essential amino acids ** Essential amino acids

Table (4): Feed intake, nutrients digestibilities and feeding value recorded for kids fed the four rations.

Item	Experimental rations				SE	Sig.
	R1	R2	R3	R4		
No. of animals	3	3	3	3		
Body weight, kg	21.26^{b}	22.38^{a}	25.61^{a}	25.66^{a}	0.75	*
Feed intake, g DM/h/day	715.66^{a}	629.84^{b}	665.00^{b}	735.00^{a}	20.86	*
DM intake, g/kg body weight	33.70	28.47	26.22	28.74	1.31	NS
Nutrients digestibility, %						
DM	65.33	66.55	68.33	68.43	0.93	NS
OM	68.45	66.49	66.53	69.88	1.01	NS
CP	67.73	63.55	64.51	69.62	1.16	NS
CF	54.67	53.63	56.63	59.31	1.31	NS
EE	68.38	66.29	68.04	69.06	1.06	NS
NFE	72.11	71.02	72.91	73.43	1.09	NS
NDF	53.90^{b}	59.58^{ab}	62.75^{a}	65.75^{a}	1.65	*
ADF	52.81^{b}	60.25^{ab}	64.35^{a}	66.45^{a}	1.91	*
Nutritive values, %						
TDN	64.76	62.76	64.35	65.44	0.15	NS
DCP	8.29	7.44	7.29	7.72	1.65	NS

NS : Not significant. * : Significant differences at ($P<0.05$).

Table (5): Rumen liquor parameters recorded for kids fed the four rations.

Item	Experimental rations				SE	Sampling time		SE
	R_1	R_2	R_3	R_4		0 hr.	2 hrs.	
pH	4.83[a]	4.68[ab]	4.71[a]	4.45[b]	0.17*	5.05	4.29	0.09**
Ammonia-N, mg/dl	28.35[a]	25.55[b]	32.30[c]	28.56[a]	0.94**	32.00	25.37	0.94**
Total VFA's, meq/dl	9.70[a]	11.83[b]	12.66[b]	16.18[c]	0.66**	10.62	14.56	0.66**

* Significant differences at (P<0.05).
** Significant differences at (P<0.01).

Table (6): Growth performance and feed conversion for kids given the different experimental rations.

Item	Experimental rations				SE	Sig.
	R1	R2	R3	R4		
No. of animals	3	3	3	3		
Body weight, kg						
Initial	16.67	18.33	21.33	20.93	0.78	NS
Final	25.85[b]	26.43[b]	29.88[a]	30.38[a]	0.74	*
Gain	9.18	8.10	8.55	9.45	0.26	NS
Average body weight gain, g/h/day	102.00	90.00	95.000	105.00	2.98	NS
Feed intake, g/h/day						
DM	715.66[a]	629.84[b]	665.00[b]	735.00[a]	20.86	NS
TDN	461.05[a]	394.15[b]	426.94[ab]	480.14[a]	12.78	*
DCP	55.73	46.71	48.67	55.89	1.95	NS
Feed conversion, kg feed / kg gain						
DM	7.01	7.00	7.00	7.00	0.04	NS
TDN	4.53	4.39	4.50	4.58	0.06	NS
DCP	0.54	0.52	0.51	0.53	0.09	NS

NS : Not significant.
* : Significant differences at (P<0.05).

Table (7): Effect of incorporation of cull dates in rations on economical efficiency of growing goats.

Item	Experimental rations			
	R_1	R_2	R_3	R_4
Total DM intake, g	715.66	629.84	665.00	735.00
Feed conversions	7.01	7.00	7.00	7.00
Av. daily gain (g/h/day)	102.00	90.00	95.00	105.00
Av. feed cost (h/day, LE*) [1]	1.18	0.98	1.07	1.12
Av. Revenue of daily gain (h/d, LE) **	3.06	2.7	2.85	3.15
Net feed revenue (h/d/LE)[2]	1.88	1.72	1.78	2.03
Economic Feed efficiency (%)[3]	159.3	175.5	166.3	181.3
Relative economic efficiency (%)[4]	100	110.2	104.4	113.8

*LE=Egyptian pound = 0.164$ approximately.
** Market price of the 1 kg live body weight in 2011 is 30 LE.
1: Calculated according to the local price at 2011 (1900, 1500, 2400, 1500 and 700 LE for ground corn, ground cull dates, undecorticated cotton seed meal, wheat bran and berseem straw, respectively.
2: Revenue of daily gain – daily feed cost.
3: Net feed revenue/daily feed cost x 100.
4: Economic efficiency for treatment/economic efficiency for control, as assuming that relative economical efficiency of the control group equal 100.

Conclusion

Based on results of the present study, it could be safely concluded that cull dates could efficiently be used as useful ingredients in the ration of small ruminants taking into account the right proportion of dates added. Therefore, using cull dates in feeding small ruminants could be economically sound in hot climate countries.

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