

EFFECT OF PARTIAL REPLACEMENT OF CORN BY BISCUIT WASTE (BW) ON NUTRIENTS DIGESTIBILITY, MILK PRODUCTION AND ECONOMICAL EVALUATION IN LACTATING DAMASCUS GOATS

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(Received 12/7/2021, accepted 16/9/2021)

SUMMARY

Twenty- four Damascus goats at late pregnancy period with live body weight on the average (44 ± 2 Kg). Were divided into three similar groups according to their body weight (8 goats each) for 90 days trial. The experimental concentrate feed mixture (CFM) offered to animals without or with the rate of replacement 20 (R2) and 40% (R3) Biscuits waste (BW) of corn. The basal rations composed of 60% concentrate feed mixture (CFM) and 40% clover hay. Digestibility trials were carried out at the end of experiment using acid insoluble ash (AIA) technique. Data showed that significant higher digestibility ($P < 0.05$) of DM, CP, EE and NFE for BW supplementation compared with control, while decrease digestibility ($P < 0.05$) of CF. Milk yield was higher significantly in R2 (20% replacement) than the control, there was no significant difference on fat% while decrease in protein % in the same treatment . Values of concentrations of blood plasma total protein and Albumin , cholesterol, triglycerides and total lipids of experimental goats were higher with feeding on 20 and 40% corn replacement than the control. Generally, it could be concluded that the replacement of corn by BW at level 20% in rations for dimishki goats improved digestibility, feeding values and milk yield and its composition.

Keywords : *Biscuits waste , Goats, Digestibility, Milk yield and Blood parameters.*

INTRODUCTION

The food industry produce a large amounts of by-products , which causing environmental problems. Using it as raw materials help us to formulate low cost animal feeds. In the mean time, it decrease the environmental pollution and improving value of this by- products (Deise *et al*, 2017)

Ruminants can turn unsuitable and unpalatable feeds into high-quality animal products (milk or meat). The milk production efficiency is calculated as percent between milk nutrients composition and nutrient intake. Caio *et al* (2019).

In intensive ruminant production systems the use of high amounts of energy-rich concentrates (cereal grains) is necessary. The strategy to cover the requirements of high-producing animals was reducing the food. competition between ruminants and humans is depending on energy-rich by-products in the diets. (Arosemena *et al*, 1995). Wastes from bakeries such as breads, cake and biscuits which expired also, the wastes of breaking during processing use as energetic feed because it had high concentration of carbohydrates and fat (Wing, 1965).

Biscuits wastes is high energy feed contain milk powder, flour, fats, sugar, flavor materials and salt. The cost of formulated diet with biscuits is lower than those contained maize because it is considered by product from the bakery industry. Using biscuit wastes instead of maize had potential role in decrease the competition between human and animal for traditional feed sources. Shittu *et al*, 2016)

Dairy cows fed biscuits wastes instead of corn had same milk yield and dry matter intake (DMI) compared to those fed traditional diets, also, using by-product in diet increased the conversion ratio of unsuitable food for humans into useful animal product (Ertl *et al*,, 2015). Diet of goats when the concentrate portion was replace with bakery waste exhibited improving in N utilization , feed efficiency and decrease methane production in comparison with a traditional diet (Romero-Huelva *et al*, 2017).

In developing countries up to 68% of the yielded grains fed to livestock (Elferink *et al*, 2008). According to the population growth feeding grains to animals may be not suitable. So, researchers do their best to find a lot of sustainable feed ingredients (van Zanten *et al*, 2015).

Using the most suitable raw materials and the feed formulation being factors that effect on efficiency indicators (Pinotti *et al*, 2019a). There is a trend for waste reduction. This led to increasing in using of these products in the animal feed diets (Organization, 2019).

It is well known that carbohydrates like sugars was more available in the rumen bacteria, fermented faster than fiber or starch in the rumen , the fermentation rates of monosaccharide depending on the type of sugar and rumen environments. Despite fast fermentation in the rumen it able to produce greater fermentable energy and increase microbial protein synthesis.

The objective of this study is to found the effect of partial replacing of corn by biscuit waste (BW) in CFM (20 or 40%) on digestion coefficients, blood parameters and milk production performance of the Damascus goats.

MATERIALS AND METHODS

The experiment was carried out at Sakha, Animal Production Research Station of Animal Production Research Institute, Agriculture Research Center during summer season of 2020.

Collection and preparation of concentrate feed mixture:

Biscuit waste (BW) was collected from factory in Sakha. This waste was the residues after processing and cutting biscuits , it was dry and contains chocolate and cream . Corn grains in concentrate feed mixture was replaced by biscuit waste (BW) at 20% and 40% (Table1) . Biscuit waste (BW), concentrate feed mixture (CFM), clover hay (CH) and feces were analyzed for proximate analysis according to AOAC (1995) whereas, nitrogen free extract (NFE) was calculated by difference

Table (1): ingredients (%) of the experimental concentrate feed mixture (CFM) in tested CFM.

Ingredient	CFM1 (control)	CFM2 (20% BW)	CFM3 (40% BW)
Corn	40	32	24
Biscuit waste	-	8	16
Wheat bran	32	32	32
Sun flower meal	20	20	20
Molasses	5	5	5
Lime stone	2	2	2
Salt	1	1	1
Total	100	100	100

CFM1: concentrate feed mixture(control), CFM2: concentrate feed mixture(20% BW), CFM3: concentrate feed mixture(40% BW)

Experimental rations and animals:

Twenty- four Damascus female goats at the end of pregnant period divided into 3 groups (8 each) according to live body weight (44 ± 2 Kg) for 90 days trial. Goats in first group (control) were fed concentrate feed mixture(CFM) consisted of (20% sun flower meal, 40% corn grain, 32% wheat bran, 5% molasses, 2% limestone, 1 % salt) and clover hay(CH). In the second and third group corn grain was replaced with biscuits wastes by 20 and 40%, respectively. Feed was offered at 8 am and 4 pm and the remaining amounts were measured. Water offered ad libitum. The CFM adjusted biweekly according to the body weight changes and milk production. Goats were fed the experimental diets 60 % CFM and 40% clover hay. Daily feed intakes, milk production, were recorded and feed conversion (g feed/g milk) was calculated.

Table (2): Chemical composition of CFM, CH, biscuit waste (BW), corn and experimental rations (on DM basis %).

Items (%)	DM	OM	CF	CP	EE	NFE	Ash
Tested materials:							
CH	90.85	88.40	24.13	15.20	2.43	48.95	11.60
BW	92.10	98.90	1.10	8.78	8.01	81.01	1.10
Corn	88.84	98.68	1.98	8.01	3.41	85.28	1.32
Concentrate feed mixture (CFM):							
CFM1(control)	91.77	90.97	12.03	13.85	3.01	62.08	9.03
CFM2	91.84	91.16	11.48	13.34	4.72	61.62	8.84
CFM3	91.90	91.34	11.02	14.03	5.15	61.14	8.66
Experimental rations*:							
R1(control)	91.40	89.94	16.87	14.39	2.78	56.83	10.06
R2	91.44	90.06	16.54	14.08	3.80	56.55	9.94
R3	91.48	90.16	16.26	14.50	4.06	55.34	9.84

* R1: 60% CFM1 + 40% CH : R2: 60% CFM2 + 40% CH: R3: 60% CFM3 + 40% CH

Digestibility trials:-

Nutrients digestibility and feeding values of the experimental diets were determined by using three animals from each treatment in digestibility trials by using acid insoluble ash (AIA) technique as internal marker according to Van- Keulen and young (1977). Fecal samples were collected from the rectum at 3 days as collection period. Representative samples of feed and feces from the whole collection period were prepared for proximate analysis according to A.O.A.C. (1995).

Blood and milk sample analyses:

Samples of blood were collected at the end of the experiment in sterile blood tubes and immediately centrifuged at 4000 rpm for 15 minutes. Plasma was carefully taken after treated by ethylene diamine tetra acetic acid EDTA and then stored at -20° C until analysis to obtain serum. Plasma immediately frozen for subsequent biochemical analysis. Blood parameters, including total protein, liver function, kidney function, high density lipoprotein and low-density lipoprotein, were measured by using enzymatic procedures and commercial kits.

Daily milk yield was recorded manually and milk samples were collected at first, middle and end of experiment for analysis of milk composition using Milko Scan (model 130 series – type 10900 FOSS electric – Denmark),

Statistical analysis:

Analysis of variance (one-way, ANOVA) was performed to compare between different groups. Statistical analysis was carried out using SAS (2001) and Duncan's multiple range Test (Duncan, 1955) was used to separate the means when the main effect was significant.

RESULTS AND DISCUSSION

Data in Table (2) showed the chemical composition of biscuit waste, other ingredients and tested rations. The proximate analysis of biscuit waste agreed with Giromini et al (2017) that lipid content ranged from 10% to 12%, nearly three times than wheat and corn, starch content can be up to 50%–60% on dry matter basis (DM) and DM ranged from 79% up to 93% depending on types of the bakery waste (bread, cakes, cookies, flour), and their ingredient (egg, oils, cream and sugars) during the processing before using it in animal nutrition.

Results showed that all concentrate feed mixtures (CFM) had slightly differences in all proximate analysis except EE content which increase with increasing the level of BW in CFM.

Tested ration (R2 and R3) showed the high content of fats and low content of crude fiber than control, this may be due to increase the percent of addition of (BW) instead of corn in CFM. This agrees with

finding of Humer *et al* (2017) who found an increase in fat content in ration from 2.5 to 7.1% when increase level of bakery waste instead of grains by 45% in ration.

Table (3): Digestion coefficients and nutritive values of the experimental diets.

Item	Treatment			SEM
	R1	R2	R3	
Dry matter intake(DMI) (g/ d):				
CFM	846	824	812	
Clover hay (CH)	564	558	546	
Digestion coefficients (%):				
DM	70.30 ^b	72.84 ^a	70.81 ^b	0.45
OM	69.68	68.14	67.87	0.40
CP	66.65 ^c	70.68 ^a	68.91 ^b	1.09
CF	66.91 ^a	62.96 ^b	59.52 ^c	0.60
EE	73.15 ^b	76.77 ^a	71.92 ^b	0.96
NFE	72.77 ^b	74.74 ^a	74.66 ^a	0.52
Feeding values on DM basis (%):				
TDN	66.87 ^b	69.19 ^a	67.64 ^{ab}	0.44
DCP	9.59	9.95	9.99	0.1

a,b,c : Means of different superscripts in the same row are significant (P<0.05) different.

Digestion coefficients and nutritive values were presented in table (3) Dry matter digestibility was significantly increased (P <0.05) in (R2) and this agreed with Champe and Church (1980) who found that an increase in DM apparent digestibility followed the replacement of corn by bakery waste. while, Carneiro *et al* (2006) reported no effect with replacement of the corn by bakery by products up to 80% on DM apparent digestibility in sheep, while there was no significant difference in OM digestibility between treatments.

Crude protein digestibility showed that there was significant increase (P <0.05) in R2 and R3 by 6.05 and 3.40%, respectively compared to control .This may be due to feeding sugars content in BW instead of starch in corn in ration which adjust rumen pH and improve N utilization efficiency, this agreed with the finding of Cabral *et al* (2000) who found that the decrease in ruminal NH₃-N concentration when using bakery waste in the ration may be related to the increase in energy availability for microbial protein synthesis. On the other hand digestibility of CF was decreased by increasing level of BW in rations R2 and R3 by 5.90 and 11.04%, respectively compared to control , this may be due to the high fat content and fats (oils and butter) of BW compared to the traditional ingredients used in ruminant feeding as it had adverse effect on the abundance of fibriolytic bacteria (Humer *et al*, 2018) who found a higher level of bakery by products (45%) which reduced rumen microbiota (genus *Butyrivibrio*) and impaired fiber degradation and ruminal fermentation. There was no significant difference between R1(control) and R3 but R2 was increased by 4.99% compared with control on EE digestibility , this may be due to the high energetic content of BW from fats and soluble carbohydrates. This agreed with Carneiro *et al* (2006) when using bakery by products in sheep diets with 17.7% EE and they found greater value of EED than control . Also, Champe and Church (1980) found an increased in EE digestibility when adding the bakery waste at the rate of 0, 20 and 40% being 19.4, 60.0 and 73.2%, respectively. Data of NFE showed there was significant increase with R2 and R3 compared with control ,this may be caused by its sugars content which are water-soluble carbohydrates, and include disaccharides (sucrose and lactose) and mono saccharides (glucose and fructose) which fermented quickly in the rumen. (Oba, 2011).

Results of TDN showed significant increase for R2 compared to control, while there were no significant difference between R2 and R3 and between R1 and R3, these results may be due to the increase in digestion coefficient of rations R2 and R3 by adding BW. This agreed with the finding of Almira *et al* (2012) that value of TDN of the bakery by- products was higher compared with corn meal and this increase may be related to from bakery by- products that included the energetic mixture of the concentrate . While there was no significant differences among treatments in DCP

Milk production and composition:

Table (4) observed an increased in milk production by 14.75% for R2 and decreased by 10.16% for R3 as compared with control , this agreed with the finding of (Kaltenegger *et al*, 2020) when inclusion 15 or 30% of BW in diet of dairy cows, whereas increased energy density from increasing the fat and sugar content in the ration. Replacement of 3% plant oil for equal amount of corn in a ration with 1.55 Mcal

NEI/kg DM amounts to a 7% increasing energy concentration (Andrés et al, 2011). Values of fat corrected milk (FCM) showed that R2 had significant increase compared with control and R3 could be resulted from increasing fat content in milk (60.20 g/day) in this treatment (R2).

Table (4): Daily milk yield, milk composition and milk constituent's yield of lactating goats during experimental period.

Item	Treatment			±SE
	R1	R2	R3	
Daily milk yield (Kg/day)	1.614 ^b	1.852 ^a	1.450 ^c	59.25
Daily 4%-FCM yield (K g/day)	1.375 ^b	1.646 ^a	1.267 ^b	62.03
Milk composition:				
Fat ,%	3.00	3.25	3.15	0.12
Protein , %	2.48 ^a	2.33 ^b	2.29 ^c	0.74
Lactose , %	3.94 ^{ab}	3.83 ^b	4.06 ^a	0.17
Total solids , %	10.19	9.88	10.33	0.17
Solids not fat , %	7.19	6.63	7.18	1.45
Ash , %	0.77	0.73	0.79	0.37
Milk Constituents yield (g/day):				
Fat	48.83 ^b	60.20 ^a	45.68 ^c	2.37
Protein	40.02 ^b	43.16 ^a	33.20 ^c	1.88
Lactose	63.59 ^b	70.94 ^a	58.87 ^c	1.12
Total solids yield	166.9 ^b	183.00 ^a	149.80 ^c	4.92
Solids not fat yield	116.1 ^b	122.80 ^a	104.1 ^c	2.73

*a,b,c : Means of different superscripts in the same row are significantly (P<0.05) different Fat corrected milk in sheep and goats according to (Marrogenis and papachristoforoy (1980) : FCM (4%) Kg = milk yield (Kg) * (0.411+0.147 *fat %).*

There was no significant differences in milk fat content between groups, this agreed with resulted obtained by Dhiman et al (2000) who found a quadratic increase in milk fat % (3.44%, 3.60%, 3.56%, 2.86%, and 2.93%) as result to increasing levels of soybean oil in the rations (control, 0.5%, 1%, 2%, and 4% oil), these resulted from the effect of oil that limit the growth of cellulolytic bacteria which hydrogenate the oil consumed and toxic effect of unsaturated FA on their growth. Meanwhile, there was significant decrease in protein content being 2.33 and 2.29 compared to 2.48 for control, this due to a dilution effect of increasing milk production as result of the increasing fat, as well as a shortage of available amino acids for the synthesis of protein. To maintain pace with the decreasing milk production. This agreed with the finding of Zhang et al (2006) who found that feeding ewes sunflower seeds led increasing in protein and casein being (46.5 g/kg and 35.4 g/kg) while control being (47.6 g/kg and 36.7 g/kg) and(47.1 g/kg and 36.1 g/kg) when supplemented diet with linseed oil, while there was no significant differences in lactose , total solids and solids not fat between treatments.

Blood parameters:

As shown in Table (5) the values of total proteins and albumin were 6.47, 7.14 and 7.88g/dL and 3.42, 3.87 and 4.25 g/dL for control , R2 and R3, respectively. Increased the TP and albumin were increased (P<0.05) with R2 , R3 groups compared to the control . Zeedan et al (2010) showed that the total plasma protein was increased as result of increased oil or fat in the diets in small ruminant and buffaloes, while there no significantly differences in globulin in blood.

The values of results showed no significant effects on plasma AST and ALT concentrations with different treatments , this indicates that goats were in normal health without any adverse effects of (BW)

supplementation on liver function ,this agree with Osman et al (2020) who found that values of AST and ALT in normal range when increasing molasses levels in ration.

urea and creatinine concentrations were in the normal range, urea and creatinine not affected with experimental rations compared to control

Supplemented groups had significantly increase in concentrations of cholesterol and triglycerides. These results are in agreement with those found by El-Bedawy *et al.* (2005) as increasing protected fat levels to 4% or 8% in ration.

Table (5): Blood plasma parameters as affected by feeding the experimental rations.

Parameter	Experimental group			±SE
	R1	R2	R3	
Total protein (g/dL)	6.47c	7.14b	7.88a	0.58
Albumin (g/dL)	3.42c	3.87b	4.25a	0.44
Globulin (g/dL)	3.05	3.27	3.63	0.55
ALT (IU/L)	14.44	14.37	14.41	0.89
AST (IU/L)	22.12	22.65	22.17	1.44
Urea (mg/dL)	7.13	7.84	7.87	0.83
Creatinine (g/dL)	1.18	1.12	1.58	0.95
Cho (mg/dl)	128.55c	135.28b	145.39a	0.41
HDL	72.48c	75.71b	88.53a	0.35
LDL	37.61	39.87	33.22	4.17
TG, mg/dl	92.28c	98.46b	118.21a	1.27

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

Table (6): Feed intake (as fed) and economical evaluation of dams during the suckling period (90 days).

Item	Experimental rations		
	R1	R2	R3
Average daily feed intake, g/ dam/day (as fed):			
CFM	846	824	812
Clover hay (CH)	564	558	546
Daily milk yield, g/ dam/day	1614.2 ^b	1852.3 ^a	1450.2 ^c
Economical evaluation:			
Average total feed cost, LE/dam/ day:			
CFM	3.98	3.70	3.49
Clover hay (CH)	1.58	1.56	1.53
Total feed cost, LE/dam/day	5.56	5.26	5.02
Price of average daily milk (LE/dam/day)	9.69	11.11	8.70
Feed cost / kg milk, L.E.	3.44	2.84	3.46

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

prices of concentrate feed mixture (CFM1), concentrate feed mixture (CFM2), concentrate feed mixture (CFM3) and clover hay (CH) were 4700, 4500,4300 and 2800L.E./ton, respectively based on the market price in 2020 and 6 LE/kg raw milk.

R1: control rations (60% CFM + 40% CH), R2: CFM (20 BW) + CH) R3: CFM (40 BW) + CH).

Total daily feed cost (L.E.) = (cost of CFM+ clover hay).

Economical evaluation was showed in Table (6) data reported that R3 had the lowest feed cost being 5.02 LE/dam/day but R2 had significantly increase in price of average daily milk by 14.7% compared with control and also, had lowest feed cost that mean that the cost of producing Kg of milk being 2.84 L.E

CONCLUSION

It could be concluded from the previous results that replaced corn by biscuits wastes around of 20% in concentrate feed mixture in dairy goats diets had better economic efficiency without negative effect on milk yield and its composition.

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إحلال مخلفات البسكويت كبديل للذرة في علائق الماعز الدمشقي

هيام عبد السلام سيد ، احمد محمد عبد المجيد حسين ، محمود متولي المغربي ، رضا إبراهيم مطري و محمد محمود البدوي

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أجريت هذه الدراسة لتقييم تأثير إحلال مخلفات البسكويت محل الذرة في العلف المصنع على معاملات الهضم ، بعض مكونات الدم، تركيب وإنتاج اللبن والكفاءة الاقتصادية. استخدم في الدراسة 24 ماعز دمشقي في نهاية فترة الحمل يتراوح وزنها (44 ± 2 كجم) لمدة 90 يوم تم تقسيمها لثلاثة مجاميع متماثلة تبعاً لوزن الجسم (8 لكل مجموعة). تم تغذية الحيوانات على العلف المصنع المحتوي على مخلفات البسكويت بنسبتي استبدال 20% و 40% محل الذرة في العلف المصنع . كانت العليقة الأساسية تحتوي على 60% علف مصنع و 40% دريس برسيم. تم إجراء تجريبه الهضم على ثلاثة حيوانات من كل مجموعة بطريقه الرماد غير الذائب. أظهرت النتائج ارتفاع معنوي في معامل هضم المادة الجافة ، هضم البروتين ، هضم الدهون و النتروجين غير الذائب للمجاميع المغذاه على مخلفات البسكويت مقارنة بالعليقة المقارنه بينما كان هناك انخفاض في معامل هضم اللالياف . وأيضاً هناك زيادة معنوية في إنتاج اللبن للمجموعة الثانية (لبن فعلى ولبن معدل الدهن) مقارنة بالعليقة المقارنه و لا يوجد اختلاف معنوي في نسبة الدهن بينما هناك انخفاض في نسبة البروتين. هناك ارتفاع بالنسبة للمجموعتين الثانية والثالثة في تركيز البروتين الكلى، الألبومين، الكوليسترول، الجلسريدات الثلاثيه و الدهون الكلية مقارنة بالعليقة المقارنه وعموماً يمكن القول ان استبدال مخلفات البسكويت محل الذرة بنسبه 20% في أعليقه ماعز الدمشقي يعمل على رفع معاملات الهضم والقيمة الغذائية وإنتاج اللبن و تركيبه.