EFFECT OF FEEDING MASH OR PELLETIZED SUGARCANE BAGASSE BASED DIET ON NUTRIENTS DIGESTIBILITY, SOME BLOOD CONSTITUENTS AND GROWTH PERFORMANCE OF GROWING CROSSBRED GOATS

A.M. Singer

Animal and Poultry Production Department, Faculty of Agriculture and Natural Resources, Aswan University, Aswan, Egypt.

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SUMMARY

This study aimed to determine the effect of feeding mash or pelletized sugarcane bagasse based diet to growing crossbred Boer male goats (Boer X Damascus) on feed intake, growth performance, nutrients digestibility, some rumen parameters, serum parameters and the economic outcome. Twenty of growing crossbred Boer goats (averaged 7 months of age and weighted 19.72 ±0.87 kg) were divided into two equal groups (10 animals each), the first group received mash form bagasse while the second group received pelleted form bagasse diet. The results showed that pelleted group diet was significantly (P< 0.005) higher in nutrients digestibility, and dry matter intake compared to the other group. Ruminal ammonia nitrogen (NH_3-N), TVFA and total nitrogen were increased (P<0.05) for goats fed pelted form diet compared with this fed the mash form diet. Average daily gain, total weight gain and feed conversion were significantly higher (P<0.05) for goat's consumption diet in pelleted form compared with mash form diet. Dry matter intake, TDNI, CPI were significantly higher (P<0.05) in pelleted form group compared with mash group diet. Serum concentrations of total protein, albumin, globulin, cholesterol, GOT, GPT and urea were higher (P<0.05) for group fed pelleted diet compared with another group. The results indicated that using sugarcane bagasse in pelleted form in growing crossbred Boer goats improved nutritional digestion, growth performance and reduced feed costs without any negative effect on performance.

***Keywords*:** Growing crossbred Boer goats, nutrients digestibility, growth performance, pelleting, mash and rumen and blood serum parameters.

INTRODUCTION

In Egypt, residue crops are significant important to smallholder farmers. Thirty million tons of bagasse and crop wastes are produced annually in Egypt (Abou Hussein and Sawan, 2010). Although Egypt's production of crop residues reaches 30 million tons annually, only 20% is used in animal feed (FAO, 2017). Three million tons of these leftovers are from sugarcane bagasse (Agriculture Economic and Statistics Institute, 2009).

Small holders and animal nutrition experts began looking for less expensive feed substitutes that might be utilized to feed farm animals due to financial constraints, the scarcity of conventional feed, and its high cost. Numerous researchers have turned to chemical, biological, or physical methods to boost the nutritional value of agricultural waste (Ben Salem *et al.,* 2005c; Silverstein *et al.,* 2007; Mahesh and Mohini, 2013).

Crop wastes are treated at the farm level, but there are also chances for biological treatments and the treatment of certain wastes, such bagasse, with urea or ammonia to boost their nitrogen content and nutritional value (Ahmed *et al.,* 2013).

Pellets, as a mechanical treatment approach, have been discovered to reduce component separation and feed wastes; they can be simply blended with grain or processed through a feed mill, according to NRC (2001)

Reddy *et al.* (2011) found that the treating crop residue by physical methods (mash or pellet forms) improved their nutritional value, reducing shortages animal feedstuff and utilizing various new feed resources such as bagasse. As a result, this study aims to identify appropriate physical form for efficient utilization of sugarcane bagasse-based complete rations in growing crossbred Boer goat diets, as well as the effects on nutritive value, feed intake, and growth performance of growing crossbred Boer goats.

MATERIALS AND METHODS

Ethical approval:

All experimental procedures (animal care, sampling) were conducted in accordance with the standards established by Faculty of Research Ethics Committee at Faculty of Agriculture, Ain Shams University. Animals experimentation in the study was approved by Faculty of Agriculture Research Broad **(Approved A 4-2023-01**).

Animals and management:

Twenty growing crossbred Boer goats (Boer x Damascus) weighing 19.72 ± 0.87 kg mean initial body weight were divided into two groups, each with 10 animals. The goats were then treated against external and internal parasites before beginning the experiment. The trial lasted 120 days, and all animals were ear-tagged. The initial and final body weights were recorded before morning meal.

Experimental diet and feeding:

Animals were group fed in pens throughout the experimental feeding, but were fed individually during the digestibility trial. Each group received diet consists of 50% bagasse plus 45% alfalfa hay (Table 1). The experimental diets T1 and T2 consisted of mash diet (50% bagasse+45% alfalfa hay) and pelleted diet (50%bagasse + 45%alfalfa hay) respectively. The animals of the two groups were fed on T1 and T2, respectively. Each group received their daily requirements twice a day (700 and 1500 h) in accordance with NRC guidelines (NRC, 1985). Refusals were gathered and quantified on a daily basis to continuously alter the feed allowance. At least 10% refusal was tolerated in order to accomplish ad libitum feeding. Water was always available. Table (1) shows the experimental ratios' ingredients and chemical compositions. The two diets had different physical forms, but they had similar chemical compositions. Salt and minerals were combined.

The proximate chemical analysis of experimental ration, residues and feces were carried out according to the methods of AOAC (2002).

Digestibility trail:

Digestibility trails were carried out using five animals from each group at the end of the experimental period. A bag was placed on each animal to collect the feces. Feed provided, refusal, and faeces were quantified daily during the 7-day sample collection period. Feed samples (100 g) were collected each day and pooled for each dietary treatment. Refusals were kept, pooled for each animal and subsampled at the end of the experiment.

Rumen and blood sampling:

Five animals were selected from each group to collect blood and rumen fluid. Ten milliliters of blood were drawn from the jugular vein. Blood serum was separated by centrifugation at 4000 rpm for15 minutes. The collected serum was stored at -20C until analysis. Values of total protein, albumin, GPT, GOT, creatinine, urea, and glucose, were estimated by using commercial kits. The serum globulin was calculated by subtracting the values of albumin from the corresponding values serum of total protein. At the end of the digestibility trail rumen liquor was obtained through a stomach tube. The pH of the rumen samples was measured immediately after sampling with a pH meter. Subsamples were kept at -20◦C for total volatile fatty acid, total nitrogen, and ammonia-nitrogen assays according AOAC (2002).

Economic efficiency:

The economic analysis was calculated by subtracting production costs from the income generated by the sale of growing crossbred goats. The costs of manufacturing were determined using market prices at the time of the experiment.

Table (1): Ingredients and chemical composition of experimental diets (on dry matter basis %).

Items	Mash	Pellet	Bagasse	Alfalfa hay
Ingredients %				
Bagasse	50	50		
Alfalfa hay	45	45		
Yeast	0.5	0.5		
Molasses	2.5	2.5		
Urea	0.5	0.5		
Minerals	1	1		
Salt	0.5	0.5		
Total	100	100		
Chemical Composition %				
DM	86.46	86.46	92.12	90.35
OM	93.3	93.3	95.68	92.07
CP	10.85	10.85	2.86	17.19
EE	1.63	1.63	0.8	2.77
CF	26.96	26.96	31.76	28.12
ASH	6.70	6.70	4.32	7.93
NFE	53.86	53.86	60.26	43.99

Statistical analysis:

All data collected were statistically analyzed using GLM procedure of SAS (2004) software (version 9.0). Significant differences between means of treatments were separated by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Feed intake:

Data of Table (2) clearly indicated that the introduction of bagasse in the pelleted form significant ($p < 0.0001$) increased dry matter intake (DM (g)/kg$W^{0.75}$, TDN intake (g), and CPI (g).

Growing crossbred Boer goats consumed 34% more pellets ($P < 0.01$) than mash-based diets (Table 2). These findings are consistent with research published by Malik *et al.* (2020) which shown that goats given pelleted total mixture rations (TMR) consumed more dry matter ($p<0.05$) than goats fed chopped TMR. Growth performance is mainly determined by total feed intake and the total quantity of nutrients that animals can utilize per unit of ingested feed. In this trial, growing crossbred Boer goats consumed more pelleted feed. This finding is consistent with Zhong *et al.* (2018) and Zhang *et al.* (2019). The increase in DM intake is mostly owing to a reduction in rumen fill in response to pellets, which allows for more feed intake to satisfy satiety (Li *et al.*, 2021).

Table (2): Impact of ration's physical form on growing crossbred Boer goats' feed intake head/ day.

Item	Experimental rations		SEM	p value
	Mash	Pelleted		
Feed intake /head/d				
DMI, kg	1.39^{b}	1.74^{a}	0.08	<0.0001
DM(g)/kg$W^{0.75}$	120.32^{b}	134.32^{a}	3.14	<0.0001
TDN intake, g	675.42^{b}	914.65^{a}	53.53	<0.0001
CPI, g	151.03^{b}	188.46^{a}	8.38	<0.0001

^{a,b} Means with different superscripts in the same row differ significantly ($P < 0.05$).
SEM ± standard error of means.

Nutrients digestibility:

Table (3) demonstrates the impact of form diets on the digestion of nutrients. The goats fed the pelleted form diet had significantly higher ($p<0.01$) DM, OM, CP, CF, EE and NFE than those fed the mash form diet. The highest levels of dry matter, organic matter, and crude protein found in the pelleted diet indicate that it had the highest level of intensive digestibility. These findings are consistent with the findings of Kamra *et al.* (1993) and Kamra and Zadrazil (1986).

Pelleting has the added benefit of partially gelatinizing starch and denaturizing proteins and other nutritious components of the feed due to the heating process. This may have a favorable effect on digestion (Soltani *et al.,* 2020). Additionally, pelleting facilitates the inclusion of some less appetizing by-products (Beigh *et al.,* 2017).

Table (3): Impact of physical ration forms on the digestion of nutrients in growing crossbred Boer goats.

Items	Mash	Pelleted	SEM	P value
Digestibility, %				
DM%	64.45[b]	66.854[a]	0.41	<.0001
OM%	73.168[b]	73.838[a]	0.12	0.0003
CP%	61.324[b]	65.18[a]	0.64	<.0001
CF%	60.15[b]	63.90[a]	0.65	<.0001
EE%	77.06[b]	78.448[a]	0.27	0.0013
NFE%	48.68[b]	54.34[a]	0.96	0.0002

[a,b] Means with different superscripts in the same row differ significantly ($P < 0.05$).
SEM ± standard error of means.

Zhong *et al.* (2018) discovered that pelleting slightly increased the digestibility of CP, ADF, OM, ether extract, and starch. Karimizadeh *et al.* (2017) who showed that pelleting diet resulted in an increase in digestible of crude fiber and digestible of dry matter. Feed pelleting has an impact on nutrient digestibility since processing parameters including temperature, time, and water content influence nutrient breakdown (Bertipagli *et al.,* 2010; Ran *et al.,* 202149). One possible explanation for the variation in digestibility response amongst studies could be different pelleting conditions (Nolan, 2007; Soltani *et al.,* 2020). Variations in animal age, sex, and breed between studies may also be the cause (Choct and Hughes, 1999).

Rumen fermentation:

Data in Table (4) showed that the addition of bagasse in the pelleted form had an influence on ruminal pH, ruminal ammonia nitrogen concentration, total nitrogen, and total volatile fatty acids. Growing crossbred Boer goats on pelleted diets had significantly ($P < 0.01$) lower rumen pH compared to mash diets. The pH dropped by 0.3 units compared to the mash form diet. These findings are consistent with those of Li *et al.* (2021), who found that feeding pelleted TMR raised total short-chain fatty acid concentration while decreasing rumen pH.

Table (4): The effect of physical diet forms on rumen fermentation parameters in growing crossbred Boer goats.

Items	Mash	Pelleted	SEM	P value
pH	7.08[a]	6.78[b]	0.027	<.001
NH_3-N mg/100ml	15.84[b]	18.16[a]	0.169	<.001
Total nitrogen mg/100ml.N	82.89[b]	96.73[a]	1.356	<.001
TVFA's meq/100ml	7.00[b]	9.32[a]	0.168	<.001

[a,b] Means with different superscripts in the same row differ significantly ($P < 0.05$).
SEM ± standard error of means.

Rumen pH is an important fermentation parameter that is influenced by a variety of factors, including feed processing (Plaizier *et al.,* 2018). The lower pH value in growing crossbred Boer goats fed pellet diets may be associated to aster eating observed in this study and by Karimizadeh *et al.* (2017), as well as increased feed intake (Table 2) (Zhong *et al.,* 2018; Zhang *et al.,* 2019 and Karimizade *et al.,* 2017). More feed consumed over a short period of time gives rumen microorganisms with more substrates to ferment. This is demonstrated by the increased amounts of ammonia and total VFA found in this current study (Table 2). Ammonia-nitrogen concentrations in the rumen differed between pelleted and mash diets. Growing crossbred Boer goats fed

pelleted diets had considerably greater ruminal ammonia and VFA concentration (P < 0.01) than those fed mash diets. The current findings are agreed with those published by Voelker *et al.* (2003), who found that cattle received pelleted ration had lower rumen pH and greater overall VFA levels.In addition, Zhang *et al.* (2019) reported that the concentrations of total VFAs were greater in lambs given pelleted TMR compared to un-pelleted TMR, rumen pH remained unaffected. As a result, in order to completely understand how feeding pelleted TMR affects rumen pH, future studies will require long-term and dynamic monitoring.

This could stabilize the rumen environment, lowering the risk of acute and subacute rumen acidosis. However, the stability of rumen pH could be counteracted by the lowering of the physical efficacy of fiber caused by pelleting. The higher rumen NH3-N concentrations in pellet form diet may be attributed to the higher consumption of protein (Karimizadeh *et al.,* 2017).

Blood serum parameters:

Serum metabolites are evaluated to assess animals' nutritional status and immunological function.

Table (5) showed that growing crossbred Boer goats fed pelleted diet had considerably greater blood total protein albumin and globulin contents (P<0.001) compared to mash-based diets. According to Pi *et al.* (2005), Boer goats given a rice straw-based total mixed ration in pelletized form had significantly higher serum total protein, albumin, globulin, and glucose values (P<0.05), whereas urea and creatinine levels fell.

These results corroborate those of Dhore *et al.* (2007), who found that the blood biochemical profile showed high levels of both glucose and total protein (P<0.01). The current findings (Table 5) show that the serum glucose level was increased in pelted form compared to mash form (70.37 vs 54.32). According to Bensadoun *et al.* (1962), animals fed hay pellets had significantly greater plasma glucose concentrations (P < 0.01) than sheep fed chopped hay at medium and high levels of intake.

Table (5): Impact of ration form on blood metabolites in growing crossbred Boer goats.

Items	Mash	Pelleted	SEM	P value
Total protein/dl	7.03^{b}	7.44^{a}	0.38	<.0001
Albumin, g/dl	2.64^{b}	2.81^{a}	0.17	<.0001
Globulin, g/dl	4.38^{b}	4.62^{a}	0.31	<.0001
GPT,IU/L	126.25^{a}	112.17^{b}	1.24	<.0001
GOT,IU/L	14.58^{a}	12.73^{b}	0.21	<.0001
Creatinine, mg/dl	1.18^{a}	0.88^{b}	2.20	<.0001
Urea, mg/dl	72.04^{b}	94.37^{a}	0.18	<.0001
Glucose, mg/dl	54.32^{b}	70.37^{a}	0.16	<.0001

^{a,b} *Means with different superscripts in the same row differ significantly (P < 0.05)*

Blood serum urea nitrogen is an indicator of nitrogen status in ruminant bodies that is influenced by dietary intake and crude protein degrade (Martin *et al.,* 2005). Blood urea nitrogen levels are positively correlated (Table 4) with rumen ammonia concentrations (Xu *et al.,* 2019; Mahmoudi 2020). The increased of ammonia concentration in the rumen caused by feed pelleting in this study, that agree with the findings of Karimizadeh *et al.* (2017); Zhang *et al.* (2019) and Zhong *et al.* (2018), resulted in a numerically higher blood urea nitrogen concentration in growing crossbred Boer goats fed pelleted diets (Table 5).

Growth performance:

Table (6) shows how physical form affects the growth performance of growing crossbred Boer goats. Animals in the pellet and mash groups had an average initial BW of 19.85 kg and 19.79 kg, respectively, and an average final BW of 40.86 kg and 32.53 kg. The pellet group significantly raised the final BW, ADG, and feed conversion ratio (p <.05) of growing crossbred Boer goats.

The average daily gains of growing crossbred Boer goats were influenced by their physical form feeding. These results are positively correlated with those of nutrients digestibility (Table 3). The pelleted group gained an average of 138 g/d, whereas the mash group gained 84 g/d. These values of ADG are greater than those found by numerous researches, such as Coufal-Majewski *et al.* (2017) 60 g/d and Zhang *et al.* (2019) 76 g/d on TMR pellets when compared to mash form diet. Furthermore, these findings are consistent with those reported by Li *et al.* (2021), who reported that feeding pelleted TMR increased growth performance of fattening lambs mostly due to an increase in feed intake.

Table (6): The impact of physical rationing forms on the performance of growing crossbred Boer goats.

Items	Mash	Pelleted	SEM	P value
Initial Weight ,kg	19.79	19.85	0.056	0.639
Final weight ,kg	32.53[b]	40.86[a]	0.959	<.0001
Total gain, kg	12.74 [b]	21.01[a]	0.951	<.0001
AVDG, kg	0.084[b]	0.138[a]	0.006	<.0001
FCR	16.39[b]	12.40[a]		

[a,b] Means with different superscripts in the same row differ significantly (P < 0.05).
SEM ± standard error of means.

The growing crossbred Boer goats fed a pelleted feed showed the highest weight growth (P < 0.05), these findings corroborate those of Thomson and Cammmell (1979), who showed that lambs fed pelleted ration grew more quickly than lambs fed chopped form. Also. Pi *et al.* (2005) found that feeding pelletized rice straw-based total mixed diet resulted in higher intake, daily weight growth, and feed efficiency in Boer goats than ryegrass hay-based rations. In addition, Raju *et al.* (2021) reported that the higher weight gain and average daily gain in pelleted diets are reflected by increased digestibility of OM, CP and NDF.

Increased feed intake can contribute to increased growth performance. As demonstrated in this study, pelleting does not necessarily improve feed conversion efficiency. This agrees with Coufal-Majewski *et al.* (2017).

Economic efficiency:

Input and output analysis was carried out to estimate the economic efficiency of the dietary treatment (Table 7). The cost of the experimental rations was estimated assuming that the market prices were as follows:

Table (7): The effects of physical forms of ration on Economic efficiency.

Item	Experimental rations	
	T1	T2
Total weight gain / head (kg)	12.74	21.01
Total DMI (kg)/ head	208.8	260.55
Feed cost (LE)for Total weight gain	536.62	721.72
Total revenue*(LE)	2037.92	3361.92
Net revenue** (LE)	1501.78	2639.88
Economic efficiency***	2.80	3.66
Relative Economic efficiency****	100.00	130.76

** Total revenue = Total weight gain * price of kg live weight gain (160 LE)*
*** Net revenue = Total revenue – Feed cost for total weight gain.*
Market prices were as follow: Grinded bagasse was 1100 LE / Ton,
grinded alfalfa hay was 3000 LE /Ton, yeast was 75 LE /kg, molasses was 25000LE /Ton, urea was 8000 LE /Ton, Minerals was 75LE /kg, salt was 10LE /kg.
*** Economic efficiency = Net revenue /Total feed cost*
*****Relative Economic efficiency = (Economic efficiency of treatment/ Economic efficiency of control) ×100*

The results showed that the economic efficiency values of pelleted form were better than of mash form although pelletizing form increased the cost production by 200 L.E, but it also improved animal growth performance in growing crossbred Boer goats fed pelleted form. Results revealed that economic efficiency was higher with pelleted diet and recorded the best relative economic efficiency when than with mash diet.

Data in Table (2) showed that using pelleted sugarcane bagasse in growing crossbred Boer goats diet increased the net revenue and consequently improved the economic efficiency compared to mash sugarcane bagasse. The results showed that the net revenue values were1501.78 and 2639. 88 L. E, for mash and pelleted form, respectively. These results are in a good agreement with Kumari (2011) who reported the feeding pelleted sweet sorghum bagasse based complete diet achieved more economic efficiency compared to mash form in sheep rations. Using pelleted diet improved animal performance as reported by several researchers (Reddy *et al.*, 2002; Anandan *et al.*, 2012 and Raju *et al.*, 2021).

The economic efficiency values were 2.80 and 3.66 for mash diet and pelletized diet, respectively. The relative economic efficiency was improved by 130.76 in pelletized diet compared with mash diet.

CONCLUSION

This study demonstrates that pelleting bagasse as a compared with mash bagasse is workable method for growing crossbred Boer goats and improved growth performance.

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تأثير التغذية علي مصاصة قصب السكر المطحونة أو المصبعة على هضم العناصر الغذائية وبعض مكونات الدم وأداء النمو في المعزالنامية الخليطة.

عبدالله منصور سليم سنجر

قسم الانتاج الحيواني والداجني – كلية الزراعة والموارد الطبيعية – جامعة أسوان - أسوان - مصر

تم إجراء هذه التجربة لدراسة تأثيراستخدام صور مختلفة من مصاصة القصب في علائق هجين معزالبور(بورXدمشقي) علي استهلاك العلف، وأداء النمو، وهضم العناصر الغذائية، وبعض معايير الكرش، ومؤشرات الدم والعائد الاقتصادي. تم تقسيم عدد 20 من ذكور معز البور الهجين (بورXدمشقي) (متوسط عمر 7 أشهر ووزن 19.72 ± 0.87 كجم) إلى مجموعتين متساويتين (10 حيوانًات لكل منهما) في تجربة تغذية استمرت 120 يومً. تلقت حيوانات المجموعة الاولي مصاصة القصب في صورة مطحونة وتلقت المجموعة الثانية مصاصة القصب في صورة مصبعات . أظهرت النتائج أن النظام الغذائي لمجموعة المصبعات كان أعلى معنويا عند مستوي معنوية 5% في هضم العناصر الغذائية واستهلاك المادة الجافة مقارنة بالمجموعة الأخرى. لوحظ زيادة الامونيا نيتروجين في الكرش والاحماض الدهنية الطيارة الكلية والنيتروجين الكلي عند مستوي معنوية 5% للماعز التي تغذت على مصاصة القصب في صورة مصبعات مقارنة مع تلك التي تغذت على المصاصة في صورة مطحونة. كان متوسط الزيادة اليومية وزيادة الوزن الكلي وكفاءة التحويل الغذائي أعلى عند مستوي معنوية اكبر من 5% للمجموعة المستهلكة للمصاصة في صورة مصبعات مقارنة مع المجموعة المستهلكة للمصاصة المطحونة. كان تناول المادة الجافة المأكولة والمركبات الكلية المهضومة المأكولة والبروتين الخام الكلي المأكول أعلى عند مستوي معنوية 5% في المجموعة المستهلكة للمصاصة في صورة مصبعات مقارنة مع مجموعة المصاصة المطحونة . كانت تركيزات البروتين الكلي، الألبيومين، الجلوبيولين، واليوريا في سيرم الدم أعلى عند مستوي معنوية 5% للمجموعة المستهلكة للمصاصة في صورة مصبعات مقارنة مع مجموعة المصاصة المطحونة بينما اخفضت قيم كلا من GOT، GPT والكرياتينين في المجموعة المغذاة علي المصاصة في صورة مصبعات. تفوقت مجموعة مصاصة القصب في صورة مصبعات أقتصاديا علي مجموعة مصاصة القصب في صورة مطحونة .

الكلمات المفتاحية: *معز البور الهجين، هضم العناصر الغذائية، أداء النمو، الصورة المصبعة ، المطحونة وقياسات الكرش وسيرم الدم.*