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CHEMICAL COMPOSITION, DEGRADABILITY AND NUTRITIVE VALUES OF EGGPLANT BUSHES HAY AS SHEEP DIET.

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SUMMARY

Three rumen cannulated Rahmani rams were used to determine of DM, OM and CP degradability for eggplant bushes hay (EGBH). Another three Ossimi rams were used to determine feed intake, digestion coefficient and nutritive values.

The chemical composition of EGBH was 88.76, 14.37, 32.24, 1.68, 40.47 and 11.24 % for OM, CP, CF EE, NFE and ash, respectively. The respective cell wall constituents (CWC %) of EGBH were 62.29, 45.37, 11.74, 33.63 and 16.92% for NDF, ADF, ADL, cellulose and hemicellulose. Major minerals content (Ca, P, Na and S) in EGBH were 1.93, 0.85, 0.04 and 0.52 (%), while trace element content (K%, Cu, Mn, Zn and Se ppm) were 1.37 %, 6.00, 30, 19 and 0.01, respectively. Condensed tannin was 2450 ppm. The values of ruminally degraded fraction (b), calculated potential (PD), effective degradability (ED) and undegradable fraction (UND) were 54.94, 62.48, 40.62 and 37.52% for DM; 58.30, 64.44, 44.13 and 35.56% for OM and 62.39, 65.13, 40.13 and 34.87% for CP. The overall mean of DM, OM and CP disappearance for EGBH were 46.06, 49.97 and 46.27%, respectively. Respective values of feed intake (g/h/d), refusals as % of amount offered and relative palatability (%) were, 1161.68, 6.76 and 96.92. Digestibilities of OM, CP, CF, EE and NFE for EGBH were 55.76, 54.71, 49.39 and 66.52%, respectively, while digestibilities of NDF, ADF, cellulose and hemi-cellulose were 59.74, 54.48, 73.84 and 72.04%, respectively. The respective values of total digestible nutrient (TDN) and DCP for EGBH were 50.89 and 7.86%. Sheep fed EGBH were shown positive nitrogen balance (0.57 g/h/d). The concentration of NH_3-N (mg/dl), TVFA's (meq/dl) and acetic (%) were 9.54, 12.08 and 57.83, respectively. Blood serum analysis of total protein, albumin and globulin were 6.20, 3.02 and 3.18 (g/dl) and NH_3-N was 0.46 (mg/dl). It could be concluded that EGBH as farming waste could be efficiently utilized as animal feed which could be successfully incorporated in animals rations

Keywords: *Eggplant bushes hay (EGBH), feed intake, palatability, chemical composition, degradability and nutritive values.*

INTRODUCTION

The total cultivated area in Egypt of eggplant was about 44,000 feddans (feddan = 4200m^2) producing 495.758 ton by-product annually (Agriculture Economics and Statistics, Egypt, 2000). These large quantities resulting from the cultivation eggplant spread nationwide and could be used by small holder as animal feed. Using egg plant bush hay (EGBH) may help to reduce feeding cost. Feeding eggplant by-product (EGBH) to ruminants could reduce amount of concentrate and hay in their rations, and helps to avoid its environmental pollution hazardous. Little information had been found about the chemical composition, feeding value and the digestible nutrients of eggplant residues.

This study aimed to evaluate the feeding value of eggplant bush hay using *in sacco* and *in vivo* methods.

MATERIALS AND METHODS

The studies were carried out at experimental animal house, Animal Production Research Institute (APRI), Dokki, Giza, Egypt.. Chemical composition was determined in the laboratory of By-products Utilization Department in APRI.

In sacco study:

Three male Rahmani sheep weighing 50-55 kg fitted with permanent rumen cannula (50 mm inner diameter) were used to determine DM and OM degradability by incubating about two grams of sample in nylon bags (50 × 150 mm, 55μm pore size) into the rumen. Other sample was incubating for protein degradability. The rams were fed berseem hay as basal diet. All bags were incubated 1 h after the rams offered the feed. Two of the bags were withdrawn after 6, 12, 24, 36, 48, 60 and 72 hrs. of incubation. After removal from the rumen, bags were washed under running cold water until the rinse water was clear. Bags were then dried at 70°C for 48 hrs. and washing losses were estimated by soaking two bags per sample in warm water (39°C) for 1 hrs. followed by washing and drying as before. The data were subjected to the model of McDonald (1981)

$$Y = a + b\,(1-e^{-c\,(t-L)})$$

Where: Y = degradability at time (t),
a = the zero time intercept,
b = potentially degradable fraction
c = rate of degradation
L = log time.

The potential degradability (PD = a + b) and the effective degradabilities (ED = a + (bc)/(c+k)) of DM, OM or CP were calculated according to Ørskov (1985), where ruminal solid outflow rate was assumed to be 0.03 per hour according to Ørskov *et al.* (1988).

In vivo study:

Tested material:

Green eggplant bushes (EGBH) were collected, sun dried and chopped at 3-5cm length.

Test of feed intake and palatability:

Feed intake and relative palatability (RP) were determined using three Ossimi rams about 64 kg. Rams fed EGBH for 30 days where intakes being measured and feed refused were collected at final two weeks. Other three rams were feed berseem hay to calculate RP. Diets were offered at two times daily in equal portions at 08:00 and 17:00 and the residuals of tested materials were collected to determine the actual feed intake. Intake was expressed as a ratio of the quantity offered (FI/FO). Relative palatability indices were calculated as RP = (FI/FO) for EGBH / (FI/FO) for BH where FI= quantity of feed intake and FO= quantity of feed offered.

Digestibility trial:

Three rams were individually housed in metabolic cages for eight days for total collection of feces and urine. Drinking water and EGBH were offered *ad-libitum*.

Samples and chemical analysis:

Samples from feeds or residuals, feces and urine were subjected for proximate analysis (A. O. A. C., 1995) procedure. Fiber fractions as neutral detergent-fiber (NDF), acid detergent-fiber (ADF) and acid detergent-lignin (ADL) were determined according to Goring and Van Soest (1970). Hemi-cellulose and cellulose were calculated as the difference between NDF and ADF, ADL. Gross energy (GE) of feed and faces were determined by using Gollen Kump ballistic bomb calorimeter, (catalogue No CCBB: 33-0101). Minerals were determined by atomic absorption according to A.O.A.C. (1995). Condensed tannins were determined according to description of Harinder *et al.* (1994).

Concerning to rumen sampling, the values of pH were determined by the HNNA pH meter, mode [HI8424]. Total VFA's concentration was determined as mentioned by Eadie *et al.* (1967) and VFA's fractions were analyzed according to Erwin *et al.* (1961). Ammonia-N concentration was determined according to Conway (1978) method.

Serum total protein (TP), albumin and ammonia nitrogen were determined by using commercial kits (Bio Merieux 69280 Marcy-1, Etoile/France). Serum globulin was obtained by difference and Albumin/Globulin ratio was calculated. Mean values and standard error within group were calculated by SAS (1999).

RESULTS AND DISCUSSION

Chemical composition:

Chemical composition of EGBH (Table 1) is comparable to the average values of berseem hay (BH) found by El-Masooudi (1998); El-Waziry and Kamel (2001) and Sallam (2005), which was 80.80, 13.36, 30.29, 1.72, 35.43 and 11.82, for OM, CP, CF, EE, NFE and ash%, respectively. The cell wall constituents (CWC%) showed almost similar values to those found by El-Masooudi (1998) for BH, except ADL which was higher in EGBH than that in BH (11.74 vs. 8.7%).

Table (1): Chemical composition, cell wall constituents, minerals and tannin of egg plant bush hay on DM bases.

Item	EGBH
Chemical compassion %	
DM	89.89
OM	88.76
CP	14.37
CF	32.24
EE	1.68
NFE	40.47
Ash	11.24
Gross Energy Mcal/kg	4.167
Cell wall constituent (%)	
NDF	62.29
ADF	45.37
ADL	11.74
Cellulose	33.63
Hemicellulose	16.92
Minerals	
Ca%	1.93
P%	0.85
Na%	0.04
Cl%	0.01
Mg%	0.20
S%	0.52
K%	1.37
Cu ppm	6.00
Fe ppm	750.00
Mn ppm	30.00
Zn ppm	19.00
Se ppm	0.01
Condensed tannin ppm	2450

EGBH= Egg plant bush

Minerals content especially major elements (Ca, P, Na and S %) in EGBH were slightly higher than that in BH according to NRC (1989), while Cl, Mg and K (%) were slightly lower in EGBH than BH. On the other hand, trace element content being Cu, Mn and Zn (ppm) in EGBH were slightly lowered comparable to BH according to NRC (1989), while Fe ppm in EGBH was twice that in BH.

Degradability kinetics:

Soluble fraction (a) of DM for EGBH was 4.77%. The corresponding value of berseem hay (BH) was 4.29% (El Waziry and Kamel, 2001), but was 8.11% for acacia (Hassan, 2006). The values of, ruminally degraded fraction (b) and degradation rate (c) for EGBH were comparable for DM, OM and CP that found by El-Waziry and Kamel (2001) for BH. These values for acacia (Hassan, 2006) were 45.25 and 0.045 for DM, 41.37 and

0.046 for OM and 24.21 and 0.029 for CP. This lower value of acacia compared to EGBH might be due to high tannins content as 10.3% (Hassan, 2006).

The calculated potential (PD) and effective degradability (ED) of DM, OM and CP for EGBH were higher than that recorded for acacia by Hassan (2006) while undegradable fraction (UND) was lower, as for DM (50.01, 24.85 and 49.75%), OM (48.15, 24.17 and 53.63%) and CP (29.40, 8.29 and 70.80%) for PD, ED and UND, respectively. While, the values of OM and CP for EGBH were lower by 9.95% and 7.39% than BH in study of El-Waziry and Kamel (2001). Lower protein breakdown in EGBH than that BH due to presence on tannins where, (Waghorn *et al.*, 1999) noticed that tannins were decrease protein degradability. The EGBH showed intermediate values between BH and acacia.

Table (2): Ruminal degradation kinetics of egg plant bush defined by the equation $Y = a + b\,(1-e^{-c\,(t-L)})$.

Item	W (%)	a (%)	b (%)	c (%/h)	PD (%)	ED (3% h-1)	UD (%)
DM(%)	4.77 ±0.116	7.54 ±1.509	54.94 ±0.384	0.046 ±0.003	62.48 ±1.609	40.62 ±0.724	37.52 ±1.609
OM(%)	4.90 ±0.480	6.14 ±0.110	58.30 ±1.240	0.056 ±0.002	64.44 ±1.350	44.13 ±1.357	35.56 ±1.350
CP(%)	4.04 ±0.319	2.74 ±1.934	62.39 ±5.114	0.046 ±0.046	65.13 ±3.715	40.13 ±0.735	34.87 ±3.715

W= washing loss, Undegradable fraction (UD) = 100-(a + b), PD= potential degradability and ED= effective degradability.

Table (3): Dry matter, OM and CP disappearance for egg plant bush hay at different times.

Item	Incubation time (hrs.)						
	6	12	24	36	48	60	72
DM (%)	19.33 ±0.632	32.44 ±0.973	45.55 ±0.628	49.69 ±0.366	55.21 ±2.498	57.13 ±0.467	63.09 ±0.873
OM (%)	22.06 ±1.300	35.60 ±0.788	50.88 ±1.406	54.80 ±2.806	58.80 ±1.249	62.47 ±1.607	65.17 ±1.302
CP (%)	17.80 ±0.131	28.44 ±2.178	44.57 ±1.412	52.19 ±3.430	57.21 ±2.607	60.87 ±2.567	62.83 ±2.082

The DM, OM and CP disappearance for EGBH in the rumen were shown in Table 3. Similar results were obtained with the incubated BH in rumen of sheep (El-Waziry and Kamel 2001) where the overall values were 46.31, 54.35 and 49.32% for DM, OM and CP disappearance, respectively. The low CP disappearance of EGBH in comparison with BH might be due to the high tannins content of EGBH. Condensed tannins are reported to decrease protein degradation in the rumen and increase flow of protein to the intestine (Waghorn *et al.*, 1999 and McNabb *et al.*, 1996).

Feed intake, nutrient digestibility and nutritive value of EGBH:

Feed intake, relative palatability in Table (4) showed that, the DM intake of EGBH was comparable to that reported by El-Masooudi (1998) where sheep consumed 1154.21 (g/h/d) on DM basis. Percentage of residues referred to total offered supports the

findings of Konimba (1996), who fed sheep lablab hay contending 12.2 % CP and proposed that feed intake is not exclusively related to nitrogen content of the diet, but also to fiber content and its quality. Relative palatability had very accepted in related to BH and this small difference might be due to content of tannins in EGBH.

Table (4): Feed intake, relative palatability for egg plant bush hay.

Item	EGBH
Feed intake, g/h/d	1161.68±67.240
Refusals as % of amount offered	6.76±1.508
Feed intake / feed offered	0.93±0.013
g feed intake / kg live body weight	18.15±0.834
g DM/kg $W^{0.75}$	51.17±2.427
Relative palatability	96.92±1.764

Nutrient digestibility, cell Wall constituent and nutritive value (%) for egg plant bush hay are present in Table (5). The digestibilities of DM, OM and CF for EGBH were lower than that of BH reported by El-Waziry and Kamel (2001); Mehrez and Maklad (1999) and El-Masooudi (1998) where their average values were 60.01, 61.30 and 53.06% for DM, OM and CF, respectively. On the other hand, our data of DM, OM and CF digestibility were higher than that obtained by Hassan (2006) for acacia, where digestion coefficient of DM, OM and CF were 45.17, 48.10 and 38.05%, respectively. Digestion coefficient of CP for EGBH was lower in comparison with BH in the study of El-Masooudi (1998) 54.71% for EGBH vs. 66.45% for BH.

Table (5): Nutrient digestibility, cell wall constituent and nutritive value (%) for egg plant bush hay.

Item	EGBH
Nutrient digestibility, (%)	
DM	53.73±2.334
OM	55.76±2.180
CP	54.71±1.802
CF	49.39±2.523
EE	66.52±1.961
NFE	62.42±3.722
Energy	54.34±0.236
Cell wall constituent (%)	
NDF	59.74±0.690
ADF	54.48±2.091
ADL	4.17±0.636
Cellulose	73.84±4.061
Hemicellulose	72.04±2.725
Nutritive value, (%)	
TDN	50.89±1.874
DCP	7.86±0.287

The lower digestibility of CP could be related o the lower degradability in EGBH as affected by the higher condensed tannins in EGBH. McNabb *et al.* (1996) found that tannins decrease protein degradability and its digestibility as well. No differences between digestion coefficients of EE, NFE, energy and cell wall constituents for EGBH and BH in the study of El-Masooudi (1998) and acacia studied by Hassan (2006)

The values of total digestible nutrient (TDN) and DCP for EGBH was slightly lower than that recorded by El-Masooudi (1998) for BH (58.44% for TDN and 10.91% for DCP), but it was higher than values of acacia (46.53% for TDN and 5.57% for DCP) as reported by Hassan (2006).

Nitrogen utilization:

Feeding 100% EGBH diet did not resulted in negative nitrogen balance (NB). Data in Table 6 showed a positive NB by 0.57 (g/h/d). Positively N balance with feeding on sheep EGBH might be related to lower rumen ammonia, because EGBH protein was slowly degradable as result for presence of tannins (Fassler and Lascano, 1995).

Table (6): Nitrogen utilization by sheep fed egg plant bush hay.

Item	EGBH
Nitrogen intake, (g/h/d)	26.71±1.720
Urine nitrogen, (g/h/d)	11.53±0.766
N. Balance, (g/h/d)	0.57±0.100
N. Balance/ N intake	2.13±0.822
N. absorption (g/h/d)	12.1±1.802
N. absorption / N. intake	45.30±0.203

Basic pattern of rumen parameters:

Feeding whole EGBH diet showed a normal pattern of rumen fermentation as shown in Table 7. The rumen pH values were comparable to those found by El-Masooudi (1998) for berseem hay (6.95) and acacia (6.90) by Hassan (2006). Concentration of NH_3-N with feed EBGH was lower in comparison with BH in the study of El-Waziry and Kamel (2001) (9.58 for EGBH vs. 16.10 mg/dl for BH). Feeding EGBH to sheep had not an adverse effect on rumen pH and NH_3-N concentration at different time. Total volatile fatty acids (TVFA's) and VFA's fractionation (acetic, Ac; propionic, Pr and butyric acid, Bu) with feed EGBH was comparable to that reported by El-Waziry and Kamel (2001) for BH, where the values were 12.08 (meq/dl) for TVFA's and 59.42, 23.68 and 13.92 % for Ac Pr and Bu, respectively. These data seemed to be in accepted with the obtained results from degradability and digestion coefficient of NDF, ADF and CP. End products of ruminal fermentation and digesta kinetics (i.e., rates of digestion and passage) affect production rate from a given diet (Singh and Gupta, 1993). Mehrez (1992) reported that the optimal ruminal NH_3 concentration for maximal rate of rumen fermentation is associated with dietary source and level of energy to be fermented in the rumen.

Table (7): Basic pattern of rumen fermentation of sheep fed egg plant bush.

Item	Time			Overall mean
	0	4	8	
pH	6.55±0.121	6.60±0.254	6.60±0.143	6.58±0.133
NH_3-N (mg/ dl)	9.13±0.182	10.46±0.320	9.14±0.074	9.58±0.721
TVFA's (meq./dl)	10.89±0.212	17.55±0.56	11.29±0.865	13.25±0.408
VFA's fractionation (%)				
Acetic	57.00±0.395	58.51±0.137	57.97±0.304	57.83±0.845
Propionic	23.28±0.294	24.74±0.109	24.08±0.029	24.04±0.357
Ac/Pr	2.45±0.040	2.37±0.003	2.40±0.015	2.41±0.030
Butyric	10.59±0.306	13.80±0.094	11.60±0.105	12.00±0.050

Blood parameters:

The blood parameters were given in Table (8). It was noticed that the values of total protein (TP), albumin, globulin, albumin/globulin and NH_3-N are within the normal range according to El-Sayed (1991). Feeding EGBH did not affect blood serum analysis compared to feed BH as basic diet for sheep in the study of (Salem, 1976), where the values were 6.00, 3.01 and 2.99 (g/dl) for TP, albumin and globulin, respectively.

Table (8): Blood proteins of sheep fed egg plant bush hay.

Item	EGBH
Total protein (g/dl)	6.20±0.056
Albumin (g/dl)	3.02±0.124
Globulin (g/dl)	3.18±0.076
Albumin / Globulin	0.95±0.062
NH_3-N (mg/dl)	0.46±0.006

Economic evaluation:

Data of economical efficiency of feeding egg plant bush was presented in Table (9). The results showed that the price (LE) of TDN and DCP unite were lower comparable with calculated values of BH (1.37 LE/ TDN unit and 6.28 LE/ DCP unite on price basis 650 LE/ton) and acacia (0.54 LE/ TDN unit and 4.49 LE/ DCP unite on price basis 250 LE/ton). These values on basis of market price during the time of our present study, which refer to lower cost of animal nutrition and this will reflect on cost of milk and meat production.

Table (9): Economical efficiency of feeding egg plant bush hay.

Item	EGBH
Price of ton (LE)	100
Price of treatment /ton (LE)	50
Total cost	150
Amount of TDN (kg/ ton)	503.4
Amount of DCP (kg/ton)	85.6
Price of TDN unit (LE)	0.30
Price of DCP unit (LE)	1.75

Price of ton = Labors for cutting, collection and transfer.
Price of treatment = price of chopping machine and labors

CONCLUSION

It could be concluded that, feeding EGBH to sheep couldn't have an adverse effect on rumen pH, NH_3-N, VFA concentration or degradation rates and digestibility. EGBH as farm waste could be used by ruminants on nutritional and economical pointed of view

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التركيب الكيماوى ومعدل التكسر فى الكرش والقيمة الهضمية لدريس شجيرات الباذنجان كغذاء للاغنام

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ثلاث كباش رحمانى مزودة بفستيولا على الكرش استخدمت لتقدير معدل تكسر المادة الجافة والعضوية والبروتين فى دريس شجيرات الباذنجان. ثلاث كباش اخرى اوسيمى متوسط وزنها ٦٤ كجم استخدمت فى اجراء تجارب الماكول والاستساغة وتقدير معاملات الهضم والقيمة الغذائية لدريس شجيرات الباذنجان. من التحليل الكيماوى لدريس شجيرات الباذنجان كانت قيم المادة العضوية والبروتين الخام والالياف الخام ومستخلص الاثير والمستخلص الخالى من الازوت والرماد على التوالى كالاتى ٨٨.٧٦و ١٤.٣٧ و ٣٢.٢٤و ١.٦٨ و ٤٠.٤٧ و ١١.٢٤. كما كان محتوى جدر الخلايا يحتوى على ٦٢.٢٩و ٤٥.٣٧ و ١١.٧٤ و ٣٣.٦٣ و ١٦.٩٢٪ لكل من محتوى الألياف الذائب فى المحلول المتعادل ومحتوى الألياف الذائب فى المحلول الحامضى واللجنين والسليلوز والهمى سليلوز على التوالى. سجل محتوى العناصر المعدنية الكبرى مثل الكالسيوم والفوسفور والصوديوم والكبريت ٪ القيم التالية على التوالى فى دريس شجيرات الباذنجان ١.٩٣و٠.٨٥ و ٠.٠٤ و ٠.٥٢ ٪ بينما العناصر الصغرى مثل البوتاسيوم ٪ والنحاس – المنجنيز – الزنك – السلينيوم جزء فى المليون – القيم التالية على التوالى ١.٣٧ ٪ (٦.٠ و ١٩ و ٣٠ و ٠.٠١). وكان محتواه من التنينات ٢٤٥٠ جزء فى المليون.

كانت قيم الجزء المتكسر فى الكرش (b) والجزء المحسوب توقع تكسره(PD) وكفائة التكسر(ED) والجزء غير المتكسر فى الكرش(UND) المتحصل عليها كالتالى (٥٤.٩٤و ٦٢.٤٨ و٤٠.٦٢ و٣٧.٥٢ ٪) للمادة الجافة و (٥٨.٣٠ و٦٤.٤٤ و ٤٤.١٣ و ٣٥.٥٦٪) للمادة العضوية و (٦٢.٣٠ و ٦٥.١٣ و ٤٠.١٣ و ٣٤.٨٧ ٪) للبروتين الخام. وكانت متوسط قيم معدل تكسر المادة الجافة والعضوية والبروتين الخام لدريس شجيرات الباذنجان فى الكرش كالاتى٤٦.٠٦ و ٤٩.٩٧ و ٤٦.٢٧ ٪ على التوالى.

كانت قيم الماكول جم / راس/ يوم والمرفوض كنسبة مئوية من الغذاء المقدم وكذا الاستساغة النسبية كالتالى ١١٦١.٦٨ و ٦.٧٦ و ٦٩.٩٢ على التوالى . كما اشارت نتائج معاملات هضم دريس شجيرات الباذنجان الى ان معاملات هضم المادة العضوية والبروتين والالياف و مستخلص الاثير والمستخلص الخالى من الازوت كانت ٥٥.٧٦ و ٥٤.٧١ و ٤٩.٣٩ و ٦٦.٥٢ ٪ على التوالى. فى حين سجلت قيم معاملات هضم محتوى الألياف الذائب فى المحلول المتعادل ومحتوى الألياف الذائب فى المحلول الحامضى والسليلوز والهمى سليلوز على التوالى ٥٩.٧٤و ٥٤.٤٨ و ٧٣.٨٤ و ٧٢.٠٤٪. كما

سجلت نتائج القيمة الغذئية مقدرة كمركبات غذائية مهضومة أوبروتين مهضوم لدريس الباذنجان القيم التالية على التوالى ٥٠.٨٩ و ٧.٨٦ ٪. وسجل ميزن الازت الايجابى ٠.٥٧ جم / راس/ يوم.

سجلت تقديرات سائل الكرش لكل من نتروجين الامونيا مجم/ ١٠٠ مل والاحماض الدهنية الطيارة الكلية ملى مكافىء / ١٠٠ ملى وحمض الخليك ٪ القيم التالية على التوالى ٩.٥٤و ١٢.٠٨و ٥٧.٨٣ .

كما سجلت قيم عينات سيرم الدم لكل من البروتين الكلى والالبيومين والجلوبيولين القيم التالية ٦.٢٠و ٣.٠٢و ٣.١٨جم/ ١٠٠ مل وكانت قيمة الامونيا ٠.٤٦ ملجم/ ١٠٠ مل.

من النتائج المشار اليها سابقا مقارنة بدريس البرسيم والاكاسيا من دراسات اخرى مماثلة يتضح ان دريس شجيرات الباذنجان كمخلف يمكن استخدامها بكفائة فى تغذية الحيوان لما لها من مردود غذائى واقتصادى.