Impact of Organic Wastes Utilization in Cultivating Sorghum Vulgare as Goat Fodders in Sinai

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Impact of organic wastes utilization in cultivating *Sorghum vulgare* as goat fodders in Sinai

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SUMMARY - Great interest has been placed on utilizing organic wastes as fertilizers. A study was conducted on four groups of goats for 45 days to evaluate the nutritive value and utilization of sorghum manured with one of four fertilizers: (i) inorganic (NPK); (ii) garbage (G); (iii) a mixture of garbage and animal excreta (GAE); and (iv) a mixture of garbage and sludge (GS). Nutrients, IVDMD and yields of sorghum were influenced by advancing maturity and types of manures. The sorghum manured with GS attained greater CP and lower NDF and ADL contents. Significant higher intake of sorghum was recorded for goats in GS followed by the NPK groups (71.2 and 68.7 gm DM/kgW$^{0.75}$, respectively). All goats obtained sufficient amounts of TDN and DCP which slightly exceeded the recommended requirements for maintenance. Animals did not show any digestive disturbance and enzymes of liver function were in normal ranges.

Key words: Organic wastes, grasses, goats, nutritive value.

RESUME - *"Impact de l'utilisation des résidus agricoles de la culture de* Sorghum vulgare *en tant que fourrage pour caprins dans le Sinaï". Un grand intérêt a été porté à l'utilisation de résidus organiques en tant que fertilisants. Une étude a été menée sur quatre groupes de chèvres pendant 45 jours pour évaluer la valeur nutritive et l'utilisation de sorgho mélangé à l'un des quatre fertilisants : (i) inorganique (NPK) ; (ii) compost (G) ; (iii) un mélange de compost et d'excréments d'animaux (GAE) ; et (iv) un mélange de compost et de boues résiduelles (GS). Les nutriments, l'IVDMD et les rendements du sorgho ont été influencés par les stades de maturité et les types d'engrais. Le sorgho mélangé avec GS a atteint un plus grand CP et des teneurs plus faibles en NDF et ADL. Une ingestion significativement plus grande de sorgho a été enregistrée pour les chèvres recevant GS suivies par les groupes NPK (71,2 et 68,7 gm MS/kgW^{0,75}, respectivement). Toutes les chèvres ont obtenu des quantités de TDN et DCP qui dépassaient légèrement les besoins recommandés pour l'entretien. Les animaux n'ont montré aucun trouble digestif et les enzymes liées au fonctionnement du foie étaient dans un intervalle normal.*

Mots-clés : *Résidus organiques, herbes, chèvres, valeur nutritionnelle.*

Introduction

Approximately 25 and 3 million tons/year of town refuses and sludge, respectively have a great impact on environmental pollution in Egypt. Recycling and reutilization of these organic wastes, as fertilizers for producing animal fodders, is a growing interest for many reasons:

(i) The chemical fertilizers are costly and dependent on effective precipitation whereas organic amendments are relatively inexpensive and environmently acceptable (Khalil *et al.,* 1991).

(ii) The fringes and desert soils are generally poor in their organic content.

(iii) The shortage of animal feeds and their improper availability, especially in summer season, is the main obstacle in improving animal productivity (El Shaer, 1995). Therefore, producing summer grasses, such as sorghum, fertilized with organic wastes could have great potentialities to eliminate environmental problems and to provide a promising summer forage. This study aimed to evaluate the utilization of sorghum fertilized with different types of organic wastes; in addition to the impact of sorghum feeding on goats performance.

Materials and methods

The study was conducted on *Sorghum vulgare* L. manured with different organic wastes fertilizers, in Ras Sudr Research Station (DRC), Southern Sinai in 1994. The soil was highly calcareous loamy sand with high salt content. It was manured before cultivation with four types of fertilizers recommended by Khalil *et al.* (1991): (i) NPK (ammonium sulphate, superphosphate and potassium sulphate: 80, 150 and 50 kg/feddan, respectively); (ii) G, garbage (town refuses, 15 tons/fed.); (iii) GAE, a mixture of garbage (10 tons/fed.) and animal (sheep and goats) excreta (5 tons/fed.); and (iv) GS, a mixture of garbage (10 tons/fed.) and dried sludge (5 tons/fed.). Biofertilization as foliar application was conducted two times after 30 and 45 days from planting using enriched special biofertilizers. Three cuts were harvested at ages of 60, 90 and 120 days. Forage yield was determined and representative samples (4 samples/cut) were collected for chemical composition analysis and *in vitro* dry matter digestibility (IVDMD, %) was determined (Tilly and Terry, 1963). Twelve mature male goats averaged 27±0.45 kg body weight, were used in a 30-day feeding trial followed by a 14-day digestibility trial. The bucks, were randomly assigned to four groups (3 animals each) and were offered sorghum manured with one of the four fertilizers as a sole diet. Animals into each group were placed in separate pens and were fed the 2nd cut, fresh chopped sorghum grass *ad libitum* (e.g., at 125% of the grass intake of the previous day) during the feeding trial and the adjustment period; then 90% of the *ad libitum* intake was given during the collection period. Fresh drinking water was available at all times. Live body weight changes were measured. Each animal was individually housed in a metabolic cage during the digestibility trial. Forages, orts and feces samples were collected, dried at 65°C for 72 h, then ground and kept for analysis. Urine was also collected and sampled for chemical analysis. Proximate analysis was conducted (AOAC, 1984). Neutral detergent fiber, NDF and acid detergent lignin, ADL were determined (Goering and van Soest, 1970). Blood samples were collected weekly (3 h post feeding) during the entire experiment; analysed for plasma glucose (GL), urea-N (BUN), total protein (TP), non-esterified fatty acids (NEFA), alanine aminotransferase (ALT, SGPT) and aspartate aminotransferase (AST, SGOT) using commercial kits (Sigma diagnostic kits). Statistical analyses was by one way doc analysis of variance; differences among the means were tested (SAS, 1990).

Results and discussion

Data on chemical composition, *in vitro* dry matter digestibility (IVDMD, %) and yield of sorghum (Table 1) were influenced with various degrees by harvesting date. A progressive increase in dry matter (DM) and fiber contents (NDF and ADL) with advancing maturity of sorghum was observed regardless the type of fertilization. On the other hand, crude protein (CP) and IVDMD values were the highest at the 1st cut then declined with grass maturity. These observations are similar of those reported on various grasses (El Aasser, 1980; El Shaer *et al.,* 1987). This is quite possible for two reasons: (i) the growing grasses accumulate and translocates photosynthates; and (ii) leaf to stem ratio decreased with age of the grass, since the leaf fractions were found to contain a higher proportion of CP and lower levels of NDF and ADL (El Aasser, 1980). *Sorghum vulgare* of the first cut appeared to be more nutritious since it attained high levels of CP and IVDMD with less levels of NDF and ADL. The progressive lignification could be responsible for the reduction of CP content and digestibility of the grass with advancing maturity (El Shaer *et al.*, 1987). The sorghum manured with GS was nutritious as compared to the other grasses since it contained highest values of CP and IVDMD with lowest values of fibrous components (Table 1). Increasing N fertilization using organic manures to forage grasses exerted an increase in CP content and digestibility whereas the total structural carbohydrates was decreased. That was attributed to the physical soil properties improvement, nutrient presence and organic matter status in the soil (Saida, 1994). The dry matter and organic matter yields of sorghum declined by age of sorghum (Table 1). The greatest yield was recorded for sorghum manured with GS followed by GAE which could be explained by their high N content and narrow C/N ratio, i.e., 2.33 and 1.62% N and 11 and 16 C/N for sludge and gardage, rep. The superiority of all amended treatments with organic manures over the control (NPK) could be explained as biofertilization engaged with organic manuring enlarge the positive effect of such manures since it activates the residual amounts of these manure (Khalil *et al.,* 1991). The sorghum manured with GS was found to have the highest estimated carrying capacity compared with those manured with GAE, G and NPK (123 *vs* 111, 87 and 82 heads/fed., respectively) during 120 days. The total costs of sorghum production in NPK, G, GAE and GS groups were 160, 112, 147 and 122 *LE*/ton DM, respectively. Organic wastes as manures added further advantage since it decreased the costs of grass production, thus increase the net return to the farmer.

Table 1. Mean values of chemical constituents *in vitro* DMD (%, on DM basis) and yield (ton/fed.) of sorghum of the 3 cuts

Cut	Group	DM	CP	NDF	ADL	IVDMD	DM yield	OM yield
1	NPK	26.4	9.46	60.2	5.16	61.7	2.67	2.42
	G	27.2	9.15	60.4	6.80	60.3	3.24	2.94
	GAE	27.9	9.09	61.0	5.41	62.5	3.76	3.39
	GS	26.7	10.8	57.6	4.81	65.3	3.87	3.49
	± SEM	0.34	0.41	0.82	0.44	1.22	0.32	0.25
2	NPK	30.0	8.79	64.8	6.01	55.2	2.42	2.16
	G	31.0	8.59	66.6	7.09	54.8	2.93	2.63
	GAE	31.0	8.26	66.4	5.86	57.7	3.39	3.02
	GS	31.4	10.2	62.9	5.21	61.2	3.53	3.15
	± SEM	0.31	0.40	0.87	0.40	1.44	0.26	0.23
3	NPK	34.5	8.14	67.3	6.42	51.7	1.02	0.90
	G	34.6	7.89	69.6	7.39	51.3	1.23	1.09
	GAE	35.1	7.85	69.4	6.23	53.9	1.43	1.26
	GS	34.2	9.59	64.2	5.82	57.1	1.49	1.31
	± SEM	0.22	0.39	1.26	0.34	1.33	0.12	0.11

During the feeding trail, amounts of voluntary intake of the 2nd cut fresh sorghum grass in NPK, G, GAE and GS groups were increased gradually then became stable at the 3 rd week of starting feeding, when maximum values were recorded (being 68.7, 64.5, 67.1 and 71.2 g DM/kgW$^{0.75}$, respectively). The intake of DM and CP were significantly (P<0.01) affected by the manured sorghum groups. DMI and CPI were highest (P<0.01) for goats fed sorghum of GS group (71.2 and 6.68 g/kg W$^{0.75}$, respectively) due mainly to high CP content (10.2%) of the manured sorghum with GS. There was a trend that DMI increased with increasing CP levels of goats diets since CP content was highly associated with sorghum intake (Sahlu *et al.*, 1992). The lowest DMI recorded for goats in G group (57.5 g/kg W$^{0.75}$) could be attributed to higher proportions of fibrous constituents since the lignificiation constraints forage intake (van Soest, 1982). The pattern of intakes was reflected on body weight changes of the mature goats. Animals fed sorghum in GS and NPK groups gained remarkable weights (3.4 and 2.4 kg, respectively), whereas the lowest gain was recorded in G group (1.7 kg). Digestibilities of DM, CP and NDF and consequently nutritive value of sorghum were significantly (P<0.01) varied (Table 2). Goats in GS and NPK groups tended to digest these nutrients more efficiently than those did in G and GAE groups. This was reflected on highest nutritive values (TDN and DCP) recorded for goats in GS and NPK groups. Such findings could be expected since the high contents of structural carbohydrates (Table 1) were reported to affect negatively the digestibilities of nutrients and nutritive values (van Soest, 1982; El Shaer, 1995). All animals were able to cover their maintenance of energy (TDN) and digested protein (DCP) requirements (Kearl, 1982) and exceeded by 34, 18, 29.8 and 53.7% of TDN; 17, 3, 5 and 45% of DCP for animals in NPK, G, GAE and GS groups, respectively. Data on nitrogen (N) utilization (Table 2) revealed that both N intake and retention were varied significantly among the groups. The highest N intake (1069 mg/kgW$^{0.75}$) was recorded in GS group (the highest N manure content) as the forage contained higher CP content and animals consumed the highest DMI (71.2 g/kg$^{0.75}$). All animals were in positive N balance. The greatest N retention was observed also for goats in GS group followed by those in NPK group (189 and 157 mg/kgW$^{0.75}$ respectively). Values of the blood metabolites were in normal ranges of goats (Sahlu *et al.*, 1992). Values of GOT and GPT were in the high normal ranges, particularly in goats fed sorghum in GS during the last 2 weeks of the experiment. It seems that BUN and TP concentrations were higher in goats fed sorghum manured with GS since it contained higher CP content (10.2%) compared to other grasses (Sahlu *et al.*, 1992). NEFA concentration were inversely related to the level of both DMI and glucose concentrations (El Assar, 1980). All goats were healthy and in normal conditions, no digestive disorders were observed during the whole study.

In conclusion, It is important to note the relative success of GS treatment without hazards from the heavy metals in sludge is mainly due be buffering action of high organic content in chelating these metals away from affecting the growing plants.

It is safe to conclude that *Sorghum vulgare* manured with organic fertilizers produced more yields and attained reasonable nutritive value as good quality fodders. It is warrant, therefore, further studies, particularly minerals (major and heavy metals) accumulation and utilization.

Table 2. Daily intakes and nutritive value of sorghum grass by goats

Parameters		NPK	G	GAE	GS	SEM
Initial body weight (kg)		25.3	28.7	26.7	27.3	0.45
Body weight changes (kg)		2.4	1.7	2.1	3.4	0.36
Voluntary intake (gDM/kg$W^{0.75}$)		68.7^{ab}	64.5^{b}	67.1^{b}	71.2^{a}	1.36
Crude protein intake (g/kg$W^{0.75}$)		5.41^{ab}	4.94^{b}	4.99^{b}	6.68^{a}	0.41
Digestibilites						
DM (%)		63.5^{ab}	60.9^{b}	61.2^{b}	65.8^{a}	1.16
CP (%)		64.0^{ab}	63.8^{b}	62.9^{b}	65.5^{a}	0.54
NDF (%)		65.1^{a}	58.0^{c}	61.0^{b}	66.3^{a}	1.26
N. utilization						
Intake (mg/kg $W^{0.75}$)		866^{b}	790^{b}	799^{b}	1069^{a}	61.1
Retained (mg/kg$W^{0.75}$)		157^{a}	106^{b}	144^{ab}	189^{a}	17.4
TDN (g/kg$W^{0.75}$)		38.6^{ab}	34.9^{b}	37.8^{b}	45.0^{a}	2.02
DCP (g/kg$W^{0.75}$)		3.47^{b}	3.16^{b}	3.15^{b}	4.37^{a}	0.26
Blood metabolites						
GL (mg/dl)	1^{st} wk	61.2^{b}	62.2^{ab}	63.6^{ab}	64.8^{a}	0.81
	6^{th} wk	66.6^{b}	65.6^{b}	65.7^{b}	68.7^{a}	0.73
NEFA (m.eq/l)	1^{st} wk	305^{ab}	325^{a}	300^{b}	289^{b}	7.63
	6^{th} wk	289^{ab}	306^{a}	285^{ab}	273^{b}	6.84
BUN (mg/dl)	1^{st} wk	10.6^{a}	9.45^{b}	10.9^{a}	10.6^{a}	0.32
	6^{th} wk	11.9^{b}	11.9^{b}	11.6^{b}	13.7^{a}	0.49
SGOT (U/L)	1^{st} wk	44.5^{ab}	43.9^{b}	44.9^{b}	45.6^{a}	0.36
	6^{th} wk	47.4^{b}	46.0^{b}	48.8^{ab}	55.9^{a}	2.22
SGPT (IU/L)	1^{st} wk	11.0^{a}	10.9^{a}	11.0^{a}	11.1^{a}	0.04
	6^{th} wk	12.1^{b}	11.4^{b}	12.7^{b}	15.2^{a}	0.85

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