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NUTRITIVE EVALUATION OF CASSAVA ALONE OR INTERCROPPED WITH MILLET OR DARAWA IN RECLAIMED SANDY SOIL BY SHEEP

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ABSTRACT

Cassava was cultivated alone or intercropped with millet or darawa at Ismailia Research Station and Animal Nutrition Unit of Ismailia (Animal Production Research Institute). Five treatments were used: 1) cassava foliage alone (Two cuts), 2) cassava+millet (Two cuts), 3) Millet alone (Two cuts), 4) cassava+darawa (one cut) and 5) Darawa alone (one cut). The DM, CP and EE in cassava foliage were higher, while CF and NFE were lower than those in millet or darawa. The DM intake from cassava alone or cassava-millet mixture was significantly ($P<0.05$) higher than other treatments. The digestion coefficients of all nutrients and TDN of cassava-millet mixture were significantly ($P<0.05$) higher than other treatments. The DCP percent and N-balance with cassava alone were significantly ($P<0.05$) higher than other treatments. Ruminal ammonia-N and pH of cassava and its mixtures were significantly ($P<0.05$) higher than millet or darawa while VFAs of cassava alone were significantly ($P<0.05$) lower than other treatments. The DM yields per feddan were 3.363, 4.768, 5.564, 4.205, 4.907 ton. for cassava (C), cassava+millet (CM), millet (M), cassava+darawa (CD) and Darawa (D), respectively. Cassava roots without cutting produced 3.985 ton/feddan of DM. It could be concluded that intercropping cassava with millet or darawa in reclaimed sandy soil could complement each other to balance the nutrients for sheep.

Keywords: cassava, millet, darawa, intercrop, digestibility, feeding value, sheep.

INTRODUCTION

Shortage of feed supply during summer especially green forages is one of the main constraints for development in animal production. Most available summer green forages are of low protein content. Cassava is a good crop in sandy soil (Abd El-Baki *et al.*, 1990 and Attalla *et al.*, 2001)and its roots are good source of energy. Meanwhile, its foliage or leaves contain high crude protein (Devendra, 1979; Lutaladio and Ezumah,1980; Mathius *et al.*,1983; Soliman,1990 and Abd El-Baki *et al.*, 1990). Therefore, cassava foliage is efficiently utilized as a protein supplement for forage diets marginal or deficient in crude protein (CP). Recent experimental findings on the use of cassava foliage as a protein supplement for animals are encouraging and lay the basis for future research and development activities that promise to have a major impact in farming systems (Preston and rodriguez, 2004). In addition, millet produce the best green and dry forage yields in sandy soil when compared with other summer grasses (Mousa *et al.*, 1995; Geweifel, 1997 and Khinizy *et al.*, 1997) Forethermore, cassava could be intercropped with some other crops (Mason *et al.* 1986 and Sherief, 2000). This study was

conducted to evaluate productivity, digestibility and nutritive values of cassava alone and its mixtures with millet or darawa by sheep in reclaimed sandy soil.

MATERIALS AND METHODS

The experimental work was carried out at Ismailia Research Station and Animal Nutrition Unit of Ismailia (Animal Production Research Institute). Cultivation was practisted in reclaimed sandy soil. Physical properties and chemical analysis of the sandy soil is presented in Table (1).

Table (1): Physical properties and chemical analysis of the sandy soil

Physical properties	value	Chemical analysis	Value
Coarse sand	76.3%	pH	8.20%
Fine sand	17.4%	Organic matter	0.20%
Silt	2.1%	Total nitrogen	0.02%
Clay	4.2%	Ec(dsm-1 at 25c)	0.40%
Texture	Sandy	**Cation (meg/L)**	
Ca Co_3	1.5%	Ca^{++}	1.00
		Mg^{++}	1.40
		Na^{+}	0.70
		K^{+}	
		Anions (meg/L)	0.08
		$Co3^{--}$	0.00
		$So4^{--}$	0.48
		Cl^{-}	1.70

Planting:

Indonesian variety of cassava (*Manihot esculenta*) was planted during March (875 m^2/ treatment) using stem cuttings of 25 cm length and approximately 2.5 cm diameter (from one year old plants). Cuttings were planted vertically by inserting into the soil keeping 3-4 nods over ground. Cuttings were irrigated after planting directly. The distance between ridges and spaces between plants were one meter (El-Fieshawy ,1986). Millet (*Pennisetum americanum*) or darawa (*Zea maize*) were sown by intercropping with cassava (after 2 months from planting cassava) with seeding rate of 15 kg/feddan for millet and 25kg/feddan for darawa. The distances between millet and darawa rows were 50 cm between cassava ridges.

Irrigation was practiced every 3-4 days under sprinkler irrigation system. The fertilization was by 150kg super phosphate (15.5% P_2O_5) and 100kg potassium sulphate (48% K_2O) per feddan before planting. Nitrogen fertilization in the form of ammonium nitrate (33.5% N) was used at rate 90kg N in three equal doses of 1.5 months intervals starts after cassava plantation.

Cuttings of green forages:

According to the plnting design, it was possible to obtain the 1st cut from the green foliage after 4 months from planting cassava (2months from

sowning grasses) in five cutting treatments: 1) cassava alone (C), 2) cassava+millet (CM), 3) millet alone (M), 4) cassava+darawa (CD) and 5) darawa alone (D). The 2nd cuts at 1.5 months from the 1st cuts for C, CM and M treatments. The foliage was chopped and wilted for 18-20 h. before feeding.

Harvesting of cassava roots:

The roots of all cassava were harvested after 8 months of cultivation, then chopped and sun dried.

Digestibility trials and rumen parameters of sheep:

Five digestibility trials with 3 rams each were carried out to evaluate the 1st cuts of cassava foliage alone, cassava+millet, millet alone, cassava+darawa and darawa alone. Three digestibility trials with 3 rams each were carried out to evaluate the the 2nd cuts from cassava foliage alone, cassava+millet and millet alone. The wilted foliage was fed as 90% from *ad libitum* intake of the preliminary period in two equal amounts at 8 a.m. and 4 p.m.. Drinking water was available for choice. Rumen fluid samples were taken from three in each treatment rams using a stomach rubber tube 3h. post feeding. These samples were filtered through three layers of surgical gauze without squeezing. Ruminal pH was immediately estimated by pH meter. Rumen ammonia-N was determined according to Conway (1957), and total volatile fatty acids (VFAs) were measured according to Warner (1964). Each trial lasted 29 days of which the 21 days were a preliminary period, 5 days for quantitative feces and urine collection and three days for rumen parameters. Samples of feed and feces were dried at 60°C for 48h, then ground for chemical analysis. Urinary nitrogen was determined. Chemical analysis of representative samples were carried out according to AOAC methods (1996).

Determination of the yield:

The yield per feddan was estimated as fresh green foliage for the different treatments. Cassava roots production per feddan was also estimated.

Statistical analysis:

The collected data were statistically analysed according to Snedecor and Cochran (1982). Significance for mean differences were tested according to Duncan's New Multiple Range Test (1955). The following model was used:

$Y_{ij} = \mu + T_i + e_{ij}$

Where: Y_{ij} = observed trait, μ = overall mean, T_i = effect of treatment, e_{ij} = random error.

RESULTS AND DISCUSSION

Chemical composition of foliage:

The chemical analysis revealed that dry matter (DM), crude protein (CP) and ether extract (EE) cotents of cassava foliage were higher, while the crude fiber (CF) and nitrogen free extract (NFE) were lower than those of

millet or darawa (Table2). The chemical composition of cassava foliage lie within the normal range determined by Devendra (1979), Soliman (1990), Abd El-Baki *et al.* (1990) and Alli- Balogun *et al.* (2003). However, Hong *et al.* (2003) found that CP content in cassava plant ranged from 20.8 to 28.5% The chemical composition of millet and darawa in this study were within the ranges found by Mousa *et al.* (1995), Geweifel (1997), and Khinizy *et al.* (1997) with millet and Soliman (1990) and Khinizy *et al.* (1997) with darawa with little differences. Such differences might be due to soil type, fertilization, management, weather, age of cut and varieties used. Generally, the mixtures of cassava with millet or with darawa had high contents of DM, CP and EE and low cotent of NFE than millet or darawa.

Table(2): Foliage composition of cassava, millet, darawa and mixtures of millet or darawa with cassava.

Items	DM	DM composition percent					
		OM	CP	CF	EE	NFE	Ash
1st cut							
Cassava(C)	21.69	88.94	15.94	27.53	4.84	40.63	11.06
Millet (M)	14.80	88.06	10.57	29.52	2.09	45.88	11.94
Darawa (D)	14.55	92.24	9.01	29.12	1.34	52.77	7.76
Mixture of C+M	15.76	88.23	11.60	29.14	2.62	44.87	11.77
Mixture of C+D	15.59	91.57	10.42	28.80	2.05	50.30	8.43
2nd cut							
Cassava(C)	21.97	88.91	19.60	21.55	5.11	42.65	11.09
Millet (M)	15.36	88.55	10.32	26.80	2.42	49.01	11.45
Mixture of C+M	16.00	88.60	11.56	26.10	2.78	48.16	11.40

Feed intake, digestibility and nutritive values:

Cassava alone or cassava+millet showed significantly ($P<0.05$) higher DM intake than other foliages (Table 3). Abd El-Baki *et al.* (1990) found that foliage intakes of cassava alone and cassava+sorghum were nearly equal. However, Mathius *et al.* (1983) found that supplementation of cassava leaves to napier grass had no effect on DM intake by sheep but increased intake by goats. Alli- Balogun *et al.* (2003) noticed that feed intake by sheep was not significantly affected by cassava foliage supplemented with gamba hay.

The digestion coefficients (Table 3) of all nutrients of cassava+millet mixture were significantly ($P<0.05$) higher than other treatments. Similar trend was recorded by Abd El-Baki *et al.* (1990) who showed that DM, OM and CF digestibility coefficients of cassava-sorghum mixture were higher than cassava alone. The same authers found that the *in vitro* and *in situ* DM and OM disappearances of cassava foliage mixed with some grasses were higher than cassava alone or grasses alone. However, Mathius *et al.* (1983) found that DM digestibility was not affected by the amount of cassava leaves to Napier grass, but CP digestibility increasd. Alli- Balogun *et al.* (2003) showed that DM digestibility by sheep significantly increased by cassava foliage supplement with gamba hay.

The TDN value of cassava+millet was significantly ($P<0.05$) higher than other treatments, while the highest value of DCP was recorded with cassava followed by CM mixture (Table 3).

Table (3): Foliage and dry matter intakes, digestion coefficients and nutritive values of cassava (C), cassava+millet (CM), millet (M), cassava+darawa (CD) and darawa (D) by sheep.

Items	C	CM	M	CD	D	±SE
1st cut						
Intake						
Foliage, kg/h/d	4.38^{c}	5.79^{a}	5.83^{a}	5.10^{b}	5.29^{b}	0.27
DM, kg/h/d	0.951^{a}	0.912^{a}	0.863^{b}	0.795^{c}	0.770^{c}	0.03
DM, kg/100kg wt	2.38^{a}	2.28^{a}	2.16^{b}	1.99^{c}	1.93^{c}	0.08
DM,g/kg $W^{0.75}$	59.81^{a}	57.36^{a}	54.28^{b}	50.00^{c}	48.43^{c}	2.16
Digestion coefficients						
(%)	66.38^{b}	72.26^{a}	67.97^{b}	62.44^{c}	58.81^{d}	2.31
DM	69.11^{b}	73.46^{a}	69.13^{b}	64.75^{c}	60.46^{d}	2.21
OM	72.78^{a}	74.92^{a}	68.65^{b}	59.88^{c}	51.17^{d}	4.41
CP	63.00^{c}	71.94^{a}	68.68^{b}	63.15^{c}	60.15^{d}	2.14
CF	45.19^{c}	67.40^{a}	62.46^{b}	43.62^{c}	46.77^{c}	4.92
EE	74.68^{a}	74.39^{a}	69.83^{b}	67.55^{b}	62.58^{c}	2.26
NFE						
Nutritive values (%)	64.21^{b}	66.99^{a}	62.51^{b}	60.41^{c}	56.56^{d}	1.76
TDN	11.60^{a}	8.68^{b}	7.26^{c}	6.24^{d}	4.61^{e}	1.18
DCP						
2nd cut						
Intake	3.53^{b}	4.98^{a}	5.14a	-	-	0.51
Foliage, kg/h/d	0.775^{a}	0.797^{a}	0.789	-	-	0.01
DM, kg/h/d	1.94^{a}	1.99^{a}	a	-	-	0.02
DM, kg/100kg wt	48.74^{a}	50.13^{a}	1.97a	-	-	0.41
g DM/kg $W^{0.75}$			49.62			
Digestion coefficients	67.53^{b}	72.37^{a}	a	-	-	1.44
(%)	71.16^{b}	74.80^{a}		-	-	1.07
DM	74.01^{a}	70.88^{b}	71.02^{a}	-	-	1.66
OM	58.40^{b}	71.63^{a}	72.44^{b}	-	-	4.19
CP	50.38^{b}	75.18^{a}	68.27^{c}	-	-	8.70
CF	78.71^{a}	77.44^{a}	70.16^{a}	-	-	1.31
EE			77.62^{a}			
NFE	66.45^{b}	68.76^{a}	74.31^{b}	-	-	0.76
Nutritive values (%)	14.51^{a}	8.20^{b}		-	-	2.32
TDN			66.49^{b}			
DCP			7.04^{c}			

a, b, c, d and e means in the same line with different superscripts differ (P<0.05) significantly

N-balance:

The N-balance by sheep fed cassava foliage was significantly (P<0.05) higher than that fed other forages (Table 4), while the N-balance as percent from N-intake of cassava + millet was significantly (P<0.05) higher than other forages These results agreed with those of Alli- Balogun *et al.* (2003). Abd El-Baki *et al.* (1990) found no significant differences in N-balance between cassava foliage alone or mixed with sorghum.

Rumen fluid parameters:

Ammonia-N concentrations in rumen fluid of sheep fed cassava foliage alone or mixed with millet or darawa were significantly (P<0.05) higher than in those fed millet or darawa as shown in table 5.

The increase in ruminal ammonia-N may be due to the high content of CP in cassava foliage as showen by Abd El-Baki *et al.* (1990), Hong *et al.* (2003) and Alli- Balogun *et al.* (2003). The same trend was shown in pH values which increased with the increase of ruminal ammonia-N. The ruminal VFAs of sheep fed cassava alone were significantly lower than those fed other forages alone or mixed with cassava. Similar results was noticed by Soliman (1990).

Table (4): Nitrogen balance of sheep fed cassava (C), cassava+millet (CM), millet (M), cassava+darawa (CD) and darawa (D).

Items	C	CM	M	CD	D	±SE
1st cut						
Nitrogen-intake, g/day	24.29^{a}	16.92^{b}	14.60^{bc}	13.26^{bc}	11.10^{c}	2.27
Fecal-N, g/day	6.61	4.25	4.57	5.31	5.40	0.41
Urinary-N, g/day	14.45	9.96	8.47	6.31	4.92	1.65
N-balance, g/day	3.23^{a}	2.71^{b}	1.56^{c}	1.64^{c}	0.78^{d}	0.44
% of intake	13.30^{b}	16.02^{a}	12.37^{b}	10.68^{c}	7.03^{d}	1.49
2nd cut						
Nitrogen-intake, g/day	24.30^{a}	14.74^{b}	13.03^{b}	-	-	5.51
Fecal-N, g/day	6.35	4.06	4.13	-	-	0.75
Urinary-N, g/day	14.87	8.29	7.01	-	-	2.43
N-balance, g/day	3.08^{a}	2.39^{b}	1.89^{c}	-	-	0.34
% of intake	12.68^{b}	16.21^{a}	14.50^{ab}	-	-	1.02

a, b, c and d means in the same line with different superscripts differ (P<0.05) significantly

Table (5): Rumen fluid parameters of sheep fed cassava (C), cassava+millet (CM), millet (M), cassava+darawa (CD) and darawa (D).

Items	C	CM	M	CD	D	±SE
1st cut						
Ammonia-N(mg/100ml)	28.23^{a}	22.42^{b}	18.72^{c}	21.66^{b}	17.33^{c}	1.89
pH	6.94^{a}	6.63^{b}	6.42^{bc}	6.54^{bc}	6.32^{c}	0.11
Total VFAs (mequ./100ml.)	8.12^{b}	9.62^{a}	9.64^{a}	9.61^{a}	9.57^{a}	0.30
2nd cut						
Ammonia-N(mg/100ml)	32.42^{a}	23.72^{b}	18.94^{c}	-	-	1.02
pH	7.06^{a}	6.72^{b}	6.61^{b}	-	-	0.13
Total VFAs (mequ./100ml.)	8.09^{b}	9.71^{a}	9.78^{a}	-	-	0.55

a, b and c means in the same line with different superscripts differ (P<0.05) significantly.

Yield:

Cuttings of cassava foliage generally decreased the yield of cassava roots. This reduction varied with the number of cuts as showen in Table 6. Decrease in the yield of cassava roots may be ascribed to the reduction of effective photosynthetic area. These results agreed with those of Dahniya (1980), Lutaladio and Ezumah (1980) and Soliman (1990). On the other hand, fresh and dried yield of roots/feddan of cassava grown alone were higher than the intercropped cassava (Table 6). The herein results agreed with the fendings of Mason *et al.* (1986) and Sherief (2000) with Cassava intercropped with cowpea. The total yield/feddan (foliage + roots) of cassava

mixed with other forages was higher than cassava alone. The total yield of cassava + millet was higher than cassava + darawa. The TDN and DCP/ feddan as foliage of Cassava + millet or darawa were higher than cassava alone as showen in Table 7. Abd El-Baki *et al.* (1990) and Soliman (1990) showed Similar TDN and DCP/ feddan with Nigerian variety of cassava applying two cuts. The DM yields of cassava roots per feddan were 3.985, 1.217, 0.937, 2.373, 2.090 and 2.922 ton for cassava without cuttings, C, CM, M, CD and D, respectively (Table 6). The root yield was similar with the yield obtained by Attalla *et al.* (2001) and Hong *et al.* (2003). In addition the TDN value of cassava roots was reported to be 84.3% (Soliman, 1990). It could be postulated that each feddan of cassava roots would produce 3.36, 1.03, 0.79, 2.00, 1.76 and 2.46 ton TDN/feddan for cassava without cuttings, C, CM, M, CD and D respectively.

It could be concluded that intercropping cassava with millet or darawa in reclaimed sandy soil could complement each other to balance the nutrients for sheep.

Table (6): Average fresh and dry matter yields of cassava alone or cassava intercropped with millet or darawa. (ton/ fed.

Items	Cassava without cuttings	Treatments				
		C	CM	M	CD	D
Fresh yield						
Foliage						
1st cut	-	5.36	11.06	10.01	10.79	9.57
2nd cut	-	2.84	7.99	5.50	-	-
Roots	12.30	3.78	2.83	7.34	6.41	8.75
Totai	12.30	11.98	21.88	22.85	17.20	18.32
Dry yield						
Foliage						
1st cut	-	1.436	2.207	2.096	2.115	1.985
2nd cut	-	0.710	1.624	1.095	-	-
Roots	3.985	1.217	0.937	2.373	2.090	2.922
Total	3.985	3.363	4.768	5.564	4.205	4.907

Table (7): Foliage TDN and DCP (Ton/feddan) for cassava (C), cassava+millet (CM), millet (M), cassava+darawa (CD) and darawa (D).

Items	Treatments				
	C	MC	M	DC	D
TDN					
1st cut	0.922	1.380	1.404	1.196	1.199
2nd cut	0.472	1.080	0.728	-	-
DCP					
1st cut	0.167	0.160	0.183	0.098	0.124
2nd cut	0.103	0.114	0.077	-	-

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التقييم الغذائى لنباتات الكاسافا منفردة أو محملة بنباتات الدخن أو الدراوة بواسطة الأغنام فى الأراضي الرملية

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٢ معهد بحوث الأراضي والمياه والبيئة - مركز البحوث الزراعية - مصر

أجريت هذه التجربة فى محطة البحوث الزراعية ووحدة تغذية الحيوان - الإسماعيلية. وقد زرعت الكاسافا فى ثلاثة نظم زراعية هي زراعة كاسافا منفردة بدون تحميل ودخن محمل على الكاسافا ودراوة محملة على الكاسافا وقد أجريت ٥ معاملات تقييم غذائي بواسطة الأغنام لتقييم المعاملات التالية:١- كاسافا منفردة (حشتين) ٢- مخلوط الدخن والكاسافا (حشتين) ٣- دخن فقط بدون الكاسافا (حشتين) ، ٤- مخلوط الدراوة والكاسافا (حشة واحدة) ٥- دراوة فقط بدون الكاسافا (حشة واحدة). وقد قيم العلف الأخضر(بعد تذبيله لمدة ١٨- ٢٠ ساعة) بواسطة الأغنام فى تجارب هضم، وقد تم تقييم المحصول للمعاملات المختلفة.

أظهرت النتائج المتحصل عليها ان نسب المادة الجافة والبروتين الخام ومستخلص الاثير كانت مرتفعة بينما كانت نسب الألياف الخام والمستخلص الخالى من الأزوت منخفضة فى الكاسافا الخضراء عن كل من الدخن أو الدراوة. كان المأكول من الكاسافا المنفردة أو الكاسافا مع الدخن مرتفعا معنويا عن باقى المعاملات، كما كانت معاملات الهضم لكل العناصر الغذائية وكذلك المركبات الكلية المهضومة لمخلوط الكاسافا والدخن مرتفعة معنويا عن باقى المعاملات بينما كان البروتين المهضوم وكذلك ميزان الأزوت مرتفعا معنويا لنباتات الكاسافا المنفردة عن باقى المعاملات. كانت الأمونيا وال pH مرتفعة معنويا فى سائل كرش الأغنام التى غذيت على الكاسافا أو مخاليطها عن كل من الدخن أو الدراوة المنفردة بينما كانت الأحماض الدهنية الطيارة منخفضة معنويا فى سائل كرش الأغنام المغذاة على الكاسافا بمفردها عن باقى المعاملات.

كان انتاج الفدان من المادة الجافة للمعاملات المختلفة ٣,٣٦٣ و٤,٧٦٨ و٥,٥٦٤ و ٤,٢٠٥ و٤,٩٠٧ طن/ فدان لكل من الكاسافا منفردة و مخلوط الدخن والكاسافا و دخن فقط بدون الكاسافا و مخلوط الدراوة والكاسافا و دراوة فقط بدون الكاسافا على التوالى بينما كان محصول الكاسافا المنفردة بدون حش هو ٣,٩٨٥ طن/ فدان من المادة الجافة. ومن النتائج المتحصل عليها نستخلص أنه يمكن زراعة الدخن أو الدراوة محملا على الكاسافا فى الأراضي الرملية المستصلحة مع أخذ حشتين من مخلوط الدخن والكاسافا أو حشة واحدة من مخلوط الدراوة والكاسافا لتغذية الأغنام ثم ترك الكاسافا لإعطاء محصول الجذور الدرنية.