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RESEARCH ARTICLE

EVALUATION OF NUTRITIVE VALUE OF TARO (*Colacasia esculenta Linn*) AS A SUBSTITUTE FOR MAIZE IN WEANER PIG DIET

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ABSTRACT

The nutritive value of Taro (*Colocasia esculenta*) as a substitute for maize in weaner pig diets was evaluated using (1) chemical analysis (proximate, gross energy, and anti-nutritional factors). (2) Animal trial (growth performance, carcass characteristics and organ weight expressed as percentage dressed weights and feed cost estimate of the diets). Diet 1 was maize based while diets 2, 3, and 4 had maize being replaced at 13.7% (5%), 27.24% (10%), and 41.13% (15%) by taro respectively. A total of 24 weaner pigs were used and randomly allotted to four dietary treatments having three replicates and two weaner pigs per replicate in a completely randomized design. The experiment lasted for 56 days, feed and water were given *ad libitum*. The proximate and gross energy showed CP (5.342%), GE (3.851kcal/kg). Phytate (0.29%), Oxalate (0.54%), HCN (4.45%) and Tannin (0.063%). The growth performance favoured diet 4, followed by 3, 2 and 1 with feed conversion ratio of 0.1826, 0.1953, 0.1951 and 0.2057 respectively. The carcass characteristics and organ weight favoured T_3. The feed cost estimate of diets also favoured T_3 (with cost/kg weight gain of ₦277.43 as opposed to others in T_1 (₦290.40), T_2 (₦292.01) and T_4 (₦281.99). Judging from the growth performance especially feed conversion ratio (0.1953), carcass characteristics (% dressed weight, ham %, shoulder % and belly %), comparable organ weight and highest value of economic viability especially for cost/kg weight gain ₦277.43 as opposed to others, T1 = ₦290.40, T2 = ₦292.07 and T4 = ₦287.99. T3 is therefore recommended.

INTRODUCTION

Population and economic growths in developing countries like Nigeria often increases the demand for food, particularly meat and milk (Rosegrant and Thornton, 2008). Nwokocha *et al* (2009), Damisa and Bawa (2007), Onyimoyi and Okeke (2008) reported that, in Nigeria, the single most important factor militating against rapid development of swine industry has been the increasing unavailability and consequent high cost of feeds. This has been blamed on the competition between man livestock and industry for conventional feedstuffs. The resultant effect is high cost of ingredients making feed to account for about 70% total cost of production of pigs (Umesiobi, 2000; Ogu, 2008). Among the conventional feedstuffs, energy source e.g. maize, sorghum is the costliest (Akimutimi *et al.,* 2009). Cereal grains e.g. maize form the bulk of energy in monogastric animal feed especially pig (Nsa *et al*, 2009). Several workers have emphasized the need for utilizing alternative feed ingredients (Nsa *et al*, 2007; Fanimo *et al,* 2007). Researches have been conducted to replace the conventional feedstuffs for livestock like maize with cassava tuber, sweet potato, biscuit waste, citrus waste and mango seed kernel as energy sources in livestock diets (Oke *et al*, 2007). These by-products are cheap, available, less competed for and represent a suitable strategy at reducing the total cost of feed.

One of the envisaged alternative feedstuffs of energy source is taro. Taro (*Colocasia esculenta*) is a starch producing tropical root crop that belongs to the family *Areceae*. It is widely distributed throughout the tropics (Tindall, 1995; Anibogu, 1995). The yield of up to 15t/ha of tubers have been obtained (Tindall, 1986; Anibogu, 1996). It contains crude protein of about 5.36% and Metabolizable energy of 3,575 Kcal//kg. It has high potentials as energy feedstuffs (Bette, 2005). Information on the use of Taro (*Colocasia esculenta*) as a substitute for maize in weaner pig's diet is yet to be reported. This forms the objective of this paper.

MATERIALS AND METHODS

Experiment site

The experiment was conducted at Chukwuemeka multi-purpose farms in Mbaise Local Government Area in Imo State.

Collection and processing of the test ingredient

Taro tubers were purchased in Ore-ikpa market in Mbaise Local Government Area in Imo State, washed to remove mud and sand, sliced or chopped into thin pieces, (chips) sun-dried and milled. This was then used for chemical analysis and for the formulation of experimental diets.

Experimental animals and management

A total of 24 weaner pigs (Large White) were purchased for the investigation. They were randomly assigned to four (4) dietary treatment groups T1, T2, T3 and T4. Each treatment had three replicates with two Weaner pigs per replicate in a completely randomized design. Four diets were formulated. Diet 1 was control. The test ingredient (taro) replaced maize at 13.7% (5%), 27.42% (10%) and 41.13% (15)% in diets 2, 3 and 4 respectively (Table 1). The experiment lasted for 56 days. Feed and water were given *ad-libitum* throughout the experimental period.

Growth Performance

Initial live weights of the pigs were taken before introducing them to the experimental diets. The weights of the pigs were recorded weekly there after. The quantity of feed given and the refusal were also measured Mortality was recorded daily. Data obtained were used to calculate the feed intake/pig/day(g), daily weight gain/pig/day (g), feed conversion ratio and % mortality Carcass was evaluated by the method reported by Fashina-Bombata and Tewe, (1995). Pigs were selected, starved overnight, weighed and slaughtered by severing the jugular vein. They were bled thoroughly, scalded in hot water and the hair removed by using razor blade. The head, forelegs, rear legs and the tail were removed, and belly was cut open to remove the intestine. The animals were weighed to get the dressed weight. The carcass was cut into parts such as ham, shoulder etc. and organs such as heart, liver, intestine etc. were collected and expressed as percentage dressed weight.
Feed cost estimate of the diets – as described by Ekwu (2008).

$$\text{Cost / kg of feed} = \frac{\text{Total cost of producing 100kg of feed}}{100}$$

Cost of feed consumed (₦) = cost / kg of feed x total feed consumed

$$\text{Cost / kg weight gain} = \frac{\text{Cost of feed consumed}}{\text{Weight gain}}$$

Chemical Analysis

The proximate composition of the experimental diets and the test ingredient were determined using the procedure of (AOAC, 1990).

Anti-nutritional factors analysis

The test ingredient was also analyzed for anti nutritional factors such as Tannin, Phytin, oxalate and HCN as described by Maga (1982), Lucas and Markaka (1975), Fasset (1996) and Knowles and Montgomery (1980) respectively..

Statistical analysis

Data collected were subjected to Analysis of Variance (ANOVA) as describer by Steel and Torrie (1980) and mean were separations using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Table 2 reveals the proximate composition of the test feed stuff - Taro. The crude protein of 5.23 % was in agreement with the report of (Anigbogu, 1997) who reported 5.36 crude protein content of taro. The gross energy of 3.85Kcal/g for the test ingredient shows its potential as alternative energy source. Table 3 shows the proximate composition of the experimental diets. The table reveals the crude protein content range of 17.49 – 18.39 % and Crude fibre content range of 5.01-5.79%. These ranges fall within the nutrient requirements of weaner pigs (Fapohunda *et al.*, 2008). Table 4 reveals the anti-nutritional factors in chopped sun-dried taro. The presence of oxalate, tannin, phytate and HCN is confirmed (Okon *et al.*, 2008; Betta, 2005).

Table 5 shows the growth performance of weaner pigs fed with graded levels of taro. There were significant ($P<0.05$) differences for all the parameters considered, with the exception of the initial weight. The final weight and weight-gain per pig per day followed similar pattern. Also total weight gain, total feed intake and feed intake per pig per day followed similar pattern in that the highest values occurred in treatment 1 and the lowest value occurred in treatment 4. The feed conversion ratio showed that treatment 1 was significantly ($P<0.05$) higher than all the treatments containing the test feed stuff (taro). Treatments 2 ,3, and 4 were statistically different from one another with treatment 4 having the least value. The downward decrease as the quantity of test ingredient increases in the diets for final weight and total weight gain per pig/ per day in which the control diet (T1) became significantly higher than treatment 4 only could be attributed to the effect of anti-nutritional factors. Also the above trend occurred in total weight gain, total feed intake and feed intake per pig/ per day with the

Table 1. Percentage composition of experimental diets fed to weaner pigs

Ingredient	Diet 1	Diet 2	Diet 3	Diet 4
Maize	*36.47*	*31.47*	*26.47*	*21.47*
Taro	*0*	*5.00*	*10.00*	*15.00*
Palm kernel meal	*36.47*	*36.47*	*36.47*	*36.47*
Soya bean meal	*23.31*	*23.31*	*23.31*	*23.31*
Bone meal	*3.00*	*3.00*	*3.00*	*3.00*
Salt	*0.50*	*0.50*	*0.50*	*0.50*
Vitamin Premix	*0.25*	*0.25*	*0.25*	*0.25*
Total	*100*	*100*	*100*	*100*
CP (%)	*20.00*	*19.46*	*19.27*	*19.09*
ME (Kcal/Kg)	*2801.17*	*2805.23*	*2809.29*	*2813.35*

Table 2. Proximate composition of the test Ingredient

Parameters	*Values*
Crude protein (%)	5.24
Crude fat (%)	0
Crude fiber (%)	0.85
Ash (%)	2.16
Dry matter (%)	89.54
G.E (kcal/kg)	3.85 kcal/g

Table 3. Determined composition of the experimental diets fed to weaner pigs

Composition	Diet 1	Diet 2	Diet 3	Diet 4
Crude protein (%)	18.37	18.19	17.57	17.4
Crude fat (%)	3.64	3.71	3.83	3.77
Crude fiber (%)	5.01	5.18	5.59	5.79
Ash (%)	7.27	7.19	7.42	7.53
Dry matter (%)	89.11	89.31	89.24	89.33
G.E (kcal/kg)	3.08	3.09	3.11	3.11

Table 4. Anti-nutritional factors in the test ingredient (%)

Parameters	Values (%)
Phytate	0.29
Oxalate	0.54
Tannin	0.06
HCN	4.43

Table 5. Growth performance of weaner pig fed graded levels of taro

	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	SEM
Initial weight (kg)	9.4100	9.4600	9.6900	9.5900	0.17
Final weight (kg)	30.4300^{a}	29.1300^{ab}	29.2700^{ab}	27.7200^{b}	0.53
Total weight gain (kg)	21.0200^{a}	19.6900^{b}	19.5800^{b}	18.1300^{b}	0.46
Weight gain/pig/day (g)	01907^{a}	0.1756^{ab}	0.1746^{ab}	0.1617^{b}	0.00
Total feed intake (kg)	117.6^{a}	108.13^{ab}	107.98^{ab}	99.37^{b}	0.18
Feed intake /pig/day{kg}	1.05^{a}	0.9654^{b}	0.9641^{b}	0.8872c	0.00
Feed conversion ratio	5.506^{a}	5.4977^{c}	5.5218^{b}	5.4867^{d}	0.00

a-c means along the same row with different superscripts are significantly ($P<0.05$) different.

Table 6. Carcass characteristics for pigs fed with graded levels of Taro

	T_1	T_2	T_3	T_4	SEM
Fasted weight(Kg)	27.70	24.40	26.80	23.90	0.17
% Dressed weight	80.69^{ab}	82.38^{a}	77.69^{c}	78.25^{bc}	0.76
Cut parts (PDW) Expressed as percentage dressed weight					
Ham (%)	22.82^{a}	22.88^{b}	23.67^{ab}	24.68^{a}	0.36
Shoulder (%)	20.58^{b}	22.89^{a}	23.05^{a}	19.32^{c}	0.32
Loin (%)	4.47^{b}	4.36^{b}	3.96^{c}	4.97^{a}	0.07
Belly (%)	6.26^{a}	5.85^{ab}	5.90^{ab}	5.22^{b}	6.20
Loin eye area (cm)	5.75^{a}	5.75^{a}	5.15^{a}	3.55^{b}	0.07
Back fat thickness (cm)	0.05^{a}	0.05^{a}	0.05^{a}	0.33^{c}	0.01

Table 7. Organ weights (%DW) of weaner pigs fed graded levels of taro

	T_1	T_2	T_3	T_4	SEM
Heart (%)	0.45^{c}	0.50^{b}	0.48^{b}	0.81^{a}	0.00
Kidney (%)	0.45^{c}	0.50^{b}	0.49^{b}	0.54^{a}	0.00
Spleen (%)	0.23^{c}	0.25^{b}	0.24^{bc}	0.54^{a}	0.00
Liver (%)	3.30^{c}	3.52^{b}	3.49^{b}	3.76^{a}	0.03
Lung (%)	1.34^{b}	2.00^{a}	1.45^{b}	1.47^{b}	0.15
Empty stomach (%)	1.34^{c}	1.50^{b}	1.45^{b}	1.64^{a}	0.02

a-c means along the same row with different superscripts are significantly different ($P < 0.05$).

Table 8,Feed cost of f weaner pigs fed graded levels of taro

	T_1	T_2	T_3	T_4	SEM
Cost/kg feed (₦)	59.68^{a}	56.91^{b}	54.15^{c}	51.38^{d}	0.00
Cost of feed consumed (₦)	7018.36.^{a}	6153.68^{b}	5847.12^{c}	5105.63^{d}	8771.66
Cost/kg weight gain (₦)	328.58	312.85	298.93	281.92	0.00

a-c means along the same row with different superscripts are significantly difference ($P < 0.05$).

exception that the control diet became significantly($P<0.05$) higher than others from treatment 2 and above. This also could be attributed to the effect of anti nutritional factors. Tannin for example has been reported to cause poor growth in the diet containing high content of it by forming complexes with dietary protein and the inhibition of the activities of proteolytic enzymes (Grifiths and Thomas, 1981; Akinmutimi, 2004). Hydrogen Cyanide (HCN) also in Table 4 has been reported to cause poor growth by its detoxification that requires methionine leading to the formation of thiocyanate. This methionine is supposed to have been used for growth (Akinmutimi, 2004;Aletor and Fasuyi, 1997). Phytate also (Table 4.) has been reported to form compounds with ions and proteins, this makes the proteins unavailable for enzymatic activities leading to poor growth (Akinmutimi, 2004; Akinmutimi, 2006). The feed conversion ratio favoured treatment 4 with 5.4867 that was significantly lower than others (T1 5.5060, T2 5.4977 and T3 5.5218). The lower value for treatment 4 could be attributed to moderate feed intake and moderate weight gain. Since the lower the fed conversion ratio, the superior the diet

(Ogbonna *et al.,* 2000) making treatment 4 a choice treatment. Carcass characteristics of pigs fed graded levels of taro are as shown in Table 6. There were significant (P<0.05) differences in all parameters except for live weight. The dressed weight and the belly followed the same pattern in that the highest value occurred in the control diet while the lowest value occurred in treatment 4. The percentage dressed weight for treatments 1, 2 and 4 are statistically similar while treatments 3, 4 and 1 were also statistically similar. Generally, for percentage dressed weight, the values were high enough to imply that values of live weight were not due to inedible offals (Oluyemi and Roberts, 2006). The value for the Ham in treatments 4 and 3 were statistically similar and significantly (P<0.05) higher than that of Treatment 2. Treatments 2 and 3 were statistically similar. It implies that treatment 4 favoured tissue deposition in terms of Ham (Abeke, 1999) Ham is a prime part and hence it will increase the economic benefits. For shoulder, treatment 3 and treatment 2 were statistically similar and significantly (P<0.05) higher than treatment 1 and 4 while treatment 1 is significantly (P<0.05) higher than treatment 4. Treatments 3 becomes a choice diet for shoulder deposition.

The loins value for treatments 1 and 2 were statistically (P>0.05) similar but significantly (P<0.05) higher than treatment 3 and lower (P<0.05) than treatment 4 making diet 4 a choice diet for loin deposition. In terms of weight of belly, treatments 2, 3 and 4 were statistically (P>0.05) similar while treatment 1 was significantly (P<0.05) higher than treatment 4 making treatment 1 a choice diet in terms of belly deposition. For loin eye area values in treatments 1, 2 and 3 were statistically (P>0.05) similar and significantly higher than treatment 4. It numerically favours treatments 1 and 2 making them a choice diet for loin eye area production. Back fat thickness reveals that treatment 4 had the lowest value followed by treatment 3 and 2 and 1 making treatment 4 a choice diet since the lower the value of back fat thickness the more acceptable the pork to consumers and the more price it commands. The result generally shows different ability of tissue deposition for various cut parts (Abeke, 1999). Table 7 presents the organ weights expressed as % dressed weight of weaner pigs fed graded levels of taro. There were significant (P<0.05) differences for all the parameters considered. The heart, kidney, liver and empty stomarch values followed similar trend in that the T1 (control diet) was significantly (P < 0.05) lower than diets containing the test ingredient. The spleen value for control diet was significantly (P < 0.05) difference for all other treatments except for T3. The lung values for T1, T2 and T4 were statistically similar but significantly (P < 0.05) lower than T2. Generally, the values of test diets were higher than the control diets for all parameters measured. This probably may be due to the effect of some anti-nutritional factors probably present in the test ingredient which may have led to much activity by the organs, resulting to enlargement and increase in weight (Akinmutimi, 2004).

The economics of the diet is as shown in Table 8. There were significant (P < 0.05) differences for all the parameters considered except cost /kg weight gain. The cost/kg feed and cost of feed consumed followed similar pattern in that the control diet had the highest values. The downward decrease in their values could be attributed to low price of the test ingredient as compared to maize for cost/kg feed. This, coupled with moderate feed intake for cost of feed consumed. Although the values obtained for cost/kg weight gain were statistically similar, it numerically favoured T4 followed by T3, T2 and T1. T4 is preferred to be more economically viable than others.

Conclusion and applications

Judging from growth performance especially feed conversion ratio, (5.4867) carcass characteristics (%, dressed weight, ham%, shoulder%, belly %), comparable organ weight and highest value of economic viabilities especially for cost/kg weight gain (₦ 281.92) as opposed to others T1-₦ 328.58., T2-₦ 312.85 and T3-₦ 298.93., T4 (15% dietary level of inclusion of taro) is recommended.

REFERENCES

AOAC. 1990. Association of Official Analytical Chemists. Methods of Analysis. (15 edition). Published by the association of official chemists, Washington D. C.

Abeke, F.O. 1999. Effects of cooking duration of Lablab (Lablab purpureus) organ weight and blood parameters of pullet chicks. NSAP Proc. IAR and T, Ibadan. Pp. 240-242.

Akinmutimi A.H, H.O. Uzegbu and S.F. Abasiekong, 2009. Anti-nutritional factors and true metbolization energy of raw and variously processed velvet bean (*Mucuna sloanei*) proceedings the 34th Annual Conference of the Nigeria Society for Animal Production pp> 375-377.

Akinmutimi, A. H. 2004. Evaluation of Sword Bean (*Canavalia gladiata*) as an Alternative Feed Resource for broiler chicken PhD Dissertation College of Animal Science and Health, Michael Okpara University of Agriculture, Umudike

Akinmutimi, A.H. 2006. Nutritive value of raw and processed jack fruits seeds, (Artocarpus hetrophyllus). Chemical Analysis. Agric. J., I: 266-271..

Aletor, V. A. and Fasuyi, A. O.1997. Nutrient composition and processing effects on cassava leaf (*Manihot esculenta*, Cranzt) anti-nutrients. A paper presented at the 2nd Annual Conference of Animal Science Association of Nigeria, Lagos. Pp 231 – 242

Anigbogu, N. M. 1995. Taro (*Colocasia esculenta* Linn.) as a substitute for corn in broiler rations. *Tropical Root and Tuber Crops Bulletin,* 8(2): 8-9.

Anigbogu, N. M. 1996. Economic Costs of Using Taro (*Colocasia esculenta* Linn.) in broiler rations Tropical Root and Tuber Crops Bulletin. Pp. 8.

Anigbogu, N. M. 1997. Taro (*Colocasia esculenta* Linn.) tuber processing for animal feed and its economic cost. Tropical Root and Tuber Crops Bulletin. Pp. 13

Bette, O. M. O. 2005. Performance and Carcass Characteristics of Quails (*Corturnix corturnix japonica*) fed graded levels of boiled sun-drued taro cocoyam (*Colocasia esculenta*) as a replacement for maize. University of Calarbar – Calabar Cross River State.

Damisa, M. A. and Bawa, G. S. 2007. An Appraisal of Weaner Pigs fed different levels of cassava peal meal diets. AUST. J. of basic and applied Sci. 1(4): 403 – 406.

Duncan, D. B 1995). Multiple range test: Biometrics 11:1-42

Ekwu, (2008): The effect of forage to concentrate ratios on the performance of weaner rabbits . B. Agric. Project, Micheal Okpara University of Agriculture, Umudike.

Fanimo, A. O., Adebayo, A. J., Oduguwa, O. O. and Biobaku, W. O. 2007. Feeding value of cashew testa for broiler chickens. Nig. J. Anim. Prod. 34(1) 83 – 93.

Fapohunda, J. B., Ayodeji, I. O., Omole, A. J., Iji, O. T. 2008. Back to Agric. Series (8) small and medium scale pig farming.pp-7.

Fashina-Bombata, H. A. and Tewe, O. O. 1995. Performance of Carcass Characteristics of Finishing pigs fed raw or extruded full-fat soya beans rations. Nigerian Journal of Animal Production. 22(1): 64 – 67.

Fasset, D. W., (1996). Oxalates: toxicants occurring naturally in foods. National Academy of Science/Natural Resources Council. Washington D.C.

Grifiths , D.W. and Thomas, A.T. 1981. Phytate and total phosphorus content of field beans (*Viciafaba*). *J. Sci. Food Agric.,* 34:187-192.

Knowles W. and Montgomery, R. D. 1980. Toxic constituent of plant food stuffs. 2 ed. Academic Press, New York. Pp. 10 – 15

Lucas, G. M. and P. Markakas, 1975. Phytic acid and other phosphorus compounds of bean (*Phaseolus vulgeris*). *J. Agric. Ed. Chem.,* 23:13-15.

Maga, J. A, 1982. Phytate, its chemistry, occurrence food interaction nutritional significance and method of analysis. J. Sci. Food and Agric., pp 30-31.

Nkwocha, G.A should be Nwokocha, G.A. 2009. Growth response and carcass characteristics of broiler finisher chickens fed varying dietary levels of sun-dried animal plasma. Proceedings Animal Science Association of Nigeria (ASan). : 375-378.

Nsa, E. E., Okereke, C. O. and Okon, B. 2007. Effects of supplementary green feedstuffs on growth performance, internal organs development and abdominal fat deposition in finisher broilers. 32nd annual conference of NSAP. Proceedings.

Nsa, E. E., Okon, B., Akpan, I. A., Anya, M. I., Wogar, G. S. I., Edet, G. D., Okereke, C. O. and

Juobi, V. I. 2009. Growth Performance and Economy of maize offal as a replacement for maize in broiler finisher. Proceedings of 14th Annual Conference of Animal Science Association of Nigeria, (ASAN). Pp. 418 – 421

Ogbonna, I. U., A. O. Oredem and A. O. K. Adesehinwa, 2000. Effect of replacing groundnut cake with raw soybean residue in diet on performance and nutrient digestibility of cockerel chicks: A preliminary study Nig. Poultry Sci. J. 1:23-31

Ogu, E. K. 2008. Nutritional Evaluation of Toasted *Mucuna sloanei* in the diet of grower pigs. A thesis Michael Okpara University of Agriculture, Umudike.

Oke, D. B., Adeyemi, O. A., Oke, M. O. and Alanpeln, M. I. 2007. Utilization of citrus wastes in broiler diets. 32nd Annual Conference of NSAP Proceedings

Okon, B. I., Obi, M. B. and Ayak, A. A. 2008. Performance of quails (*Cotunix cotunix saponica*) fed graded levels of boiled sun-dried taro cocoyam *Colocasia esculenta* as a replacement of maize. *Medwell Online Agric. J.*, 2(6) 654 – 657.

Oluyemi, J.A. and Roberts, F.A. 2000. Poultry production in warm wet climates. Spectrum books Ltd. Ibadan. Pp 244

Onyimonyi, A. E. and Okeke, G. C. 2008. Nutritional evaluation of cassava (*Manihot esculenta crantz*) peel in the diet of weaner pigs. Nig. J. Anim. Prod. 35(1): 82-89

Rosegrant, M. W. and Thornton, P. K. 2008. The growing demand for food: In: Jd 21 Jnsights, 72. F.

Steel, R. G. and J. H. Torrie, 1980. Principle and procedures of Statistics. A Biometric Approach and Edition McGraw Hill Book Co.

Tindall, M. D. 1986. Vegetables in the tropics. ELSB edition. Hong Kong. Pp 52 – 56

Tindall, M.D. 1995. In Commercial Vegetable growing. Oxford University press. Ely House, London, UK.

Umesiobi, D. O. 2000. Animal Production Ruminant and Non-Ruminant Practicium. Pp 269 – 271.

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