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Comparative Study of the Effects of Organic and Inorganic Fertilizer on Nutritional Composition of *Amaranthus spinosus* L.

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ABSTRACT

The application of organic and inorganic fertilizer to the soil is considered as good agricultural practice because it improves the fertility of the soil and plant quality. The objective of this study is to compare the effect of organic (saw dust, poultry droppings and cow dung: 500 kg ha^{-1}) and inorganic fertilizer (NPK: 500 kg ha^{-1}) on the mineral composition of *Amaranthus spinosus* on a plot of land in Akparabong, Ikom Local government Area of Cross River State. The experiment was arranged in a randomized block design in three replicates. Parameters assessed include proximate, mineral, anti nutrient, vitamins A and C. Data were analyzed using student t-test. Results were also expressed as percentage difference and differences between mean values were determined at 5% probability. Phytochemicals (percentage crude alkaloids, tannins, saponins, flavonoids and reducing compounds) were higher in organic leaf samples with mean values of 0.84±0.02, 0.96±0.2, 2.90±0.02, 15.20±0.2 and 1.50±0.02 mg/100 g, respectively compare to values of 0.68±0.02, 0.85±0.01, 2.80±0.01, 14.80±0.02 and 1.32±0.01 mg/100 g. Organic fertilizer resulted in significantly ($p<0.05$) higher crude protein (7.90±0.01) fibre (3.20±0.2), ash (3.10±0.2) and fat (0.48±0.2) in leaf sample compared to values of 5.60±0.01, 2.60±0.02, 2.80±0.1 and 0.43±0.1 g/100 g, respectively for inorganic fertilizer. Mean values recorded for Mg, Cu, Zn, K, Fe, Ca, Na and P for organic fertilizer in leaf sample were 4.45±0.3, 0.03±0.2, 0.03±0.1, 7.60±0.1, 0.12±0.02, 2.94±0.2, 6.50±0.03 and 2.20±0.03 mg/100 g, respectively as against values of 3.41±0.1, 0.02±0.01, 0.02±0.01, 5.30±0.01, 0.09±0.02, 2.80±0.2, 5.70±0.01 and 1.90±0.01 mg/100 g for inorganic fertilizer. Tannins were present in leaf samples but absent in all other plant parts. Mean values for Cu and Zn were the same in all the plant parts studied for organic and inorganic fertilizer. Results obtained for anti-nutrients and vitamins followed similar trends. The experimental results of this study have showed that organic fertilizer produced higher nutritional values on *A. spinosus* whole plant (leaf, stem, inflorescence and root) when compared with inorganic fertilizer.

Key words: *Amaranthus spinosus*, mineral composition, organic and inorganic fertilizer

INTRODUCTION

Amarranthus spinosus L. (Family Amaranthaceae) is commonly known as the spiny, prickly or thorny amaranth. It is an annual vegetable that is widely distributed in the humid zone of the tropics including Nigerian (Assiak *et al*., 2001). *Amaranthus spinosus* is a coarse herb with sharp spines and tiny greenish flowers (Costea and DeMason, 2001). In Nigeria, this species of *Amaranthus* is eaten as a vegetable in some parts of Delta, Edo and Akwa Ibom States. It is also a very good fodder for cattle and goats. The vegetable has been reported to possess both nutritional and pharmacological properties (Ayethan *et al*., 1995; Baral *et al*., 2011; Alegbejo, 2013).

Organic and inorganic fertilizers are essential for plant growth. Both fertilizers supply plants with the nutrients needed for optimum performance. Organic fertilizers have been used for many centuries whereas chemically synthesized inorganic fertilizers were only widely developed during the industrial revolution. Inorganic fertilizer has significantly supported global population growth, it has been estimated that almost half the people on the earth are currently fed as a result of artificial nitrogen fertilizer use (Erisman *et al*., 2008). Commercial and subsistence farming has been and is still relying on the use of inorganic fertilizers for growing crops (Masarirambi *et al*., 2010). This is because they are easy to use, quickly absorbed and utilized by crops. The continued dependence of developing countries on inorganic fertilizers has made prices of man agricultural commodities to skyrock. The chemical fertilizers used in conventional agriculture contain just a few minerals which dissolve quickly in damp soil and give the plants large doses of minerals (Masarirambi *et al*., 2010). Most vegetable farmers in tropical Africa are small holders who cannot afford cost of inorganic fertilizers, although soil fertility limits yield of vegetables especially in urban and periurban centres (Makinde *et al*., 2010). In Nigeria, fertilizer being costly and sometimes scare can make farmers not apply enough for good growth (Alonge *et al*., 2007). Fertilizer application rates in intensive agricultural systems have increased drastically during recent years in Nigeria. Farmers depend largely on locally sourced organic fertilizers (Makinde *et al*., 2010). Organic wastes are rich plant nutrients (Mahmoud *et al*., 2009). Organic material such as farming and manure improves soil physical chemical properties that are important for plant growth (Snyman *et al*., 1998). Organic fertilizers have positive effect on root growth by improving the root rizoster conditions (structure, humidity etc.) and also plant growth is encouraged by increasing the population of microorganisms (Fatma *et al*., 2007). Organic acids which occur in decomposition increases the benefits of nutrients.

The effect of organic, organomineral and NPK have been studied on the nutritional quality of *Amaranthus* (Makinde *et al*., 2010) who reported that organic material alone or in combination with NPK significantly increased CP, ash and EE while CF was reduced. The NKP gave least values of CP, CF ash and EE compared with organic material. Organic material alone or integrated with NPK increased nutritive quality. Funda *et al*. (2011) studied the effect of organic and inorganic fertilizers on yield and mineral content of onion and reported in the year, that treatments influenced K content, but did not influence N, P, Ca, Na, Mg, Fe, Zn, Cu and Mn contents of the onion bulb. In the second year, the treatments influenced Na content, but did not influence the others. Coolong *et al*. (2005) reported that N, P, Mn, Fe and Zn content of bulb were increased by N treatments but the content of N was decreased by N doses. Potassium, Cu and Mo contents were not affected by the treatments.

Abdelrazzag (2002) found that increasing the rate of sheep and chicken manure increased N content of onion significantly, while P and K contents had low level. Mixture of chicken manure and biofertilizer increases the yield of onion and enriched nutrient content in tuber (Fatma *et al*., 2007). Application of organic manures significantly increased levels of organic C and N and the formation of water stable aggregates, as compared with application of chemical fertilizers (N'Dayegamiye, 2006). Several studies have centered on the effect of organic, inorganic fertilizer or used in combination on soil properties, nutrients uptake, growth, yield and some minerals contents. However, there is scarce research information on the effect of organic and inorganic fertilizer on nutritional composition (Phytochemicals, proximate, minerals, antioxidants and vitamins A and C) in *Amaranthus spinosus*. The objective of the present study is to compare the effect of organic and inorganic fertilizer on the nutritional composition of *A. spinosus*.

MATERIALS AND METHODS

Study site: The research was carried out on a farmland in Akparabong Town, Ikom Local Government Area of Cross River State, Nigeria. Pre-cropping chemical analysis of the experimental soil was not conducted before the land was cleared for planting. The experiment was laid out in a randomized block design with three replicates.

Planting procedure: The land was cleared manually after which West African hoe was used to make beds with a space of 50 cm between beds. The organic (saw dust, poultry droppings and cow dung: 500 kg ha^{-1}) and inorganic (NPK: 500 kg ha^{-1}) fertilizer used were applied to the soil and mixed thoroughly two weeks before seedlings were transplanted. Seeds of *Amaranthus spinosus* were connected from local farmlands in Akparabong Town. *Amaranthus spinosus* seedlings were raised and transplanted to seedbeds at a spacing of 10 cm by 20 cm and depth of 3 m, one seedling per hole. The seedlings were allowed to grow for three months before harvesting. At the end of the experiment, 20 matured plants were randomly uprooted. The leaf, stem, root and inflorescence were separated with knife. Leaf and inflorescence were dried at temperature at 70°C for 24 h. Stem and root were cut to smaller pieces and oven-dried at 74°C for 24 h to a constant weight and milled into powder in an electric mill. One hundred grams were taken from pulverized samples for the determination of phytochemicals, proximate, minerals, antioxidants and vitamins A and C contents.

Determination of phytochemicals: The whole plant (leaf, stem, root and inflorescence) samples were defatted. The preparation of fat free sample was carried out by adding 2 mL of defatted sample with 100 mL of diethyl either suing a soxhlet apparatus for 2 h. Alkaloids and reducing compounds were determined using Harborne (1973) method, tannins by Van Buren and Robinson (1981), saponins by Obadoni and Ochuko (2002), flavonoids by Bohm and Koupai-Abyazani (1994).

Determination of the proximate composition: The proximate composition (Crude protein, ash, fibre, carbohydrate and moisture) were determined by the method of the Association of Official Analytical Chemists (AOAC., 1995). Vitamin A was determined spectrophotometrically using the hexane method and vitamin C by modified method of Bessey (1994).

Determination of minerals and antioxidant: The mineral composition (Mg, Fe, Ca, Cu, Zn) were determined using atomic absorption spectrophotometer as outlined in AOAC (1995). Sodium and K were estimated by flame photometry. Phosphorus was determined as described by AOAC (1995). Antioxidants:Hydrocyanate (HCN) was determined according to AOAC (1995), phytic acid was determined as described by Abara *et al*. (2000), oxalate by method of Dye (1956) as described by Abara *et al*. (2000).

Date analysis: Data were analyzed using student t-test. Results were also expressed as percentage difference and differences between mean values were determined at 5% probability.

RESULTS

Data on comparative effect of organic and inorganic fertilizer on phytochemical of *Amaranthus spinosus* is given in Table 1. Effect of organic fertilizer in all the plant parts studied was higher than that of inorganic fertilizer. Mean values obtained for alkaloids, tannins, saponins, flavonoids and reducing compounds in leaf samples were 0.84±0.02, 0.96±0.2, 2.90±0.02, 15.20±0.2, 1.50±0.02 mg/100 g, respectively as against values of 0.68±0.02, 0.85±0.01, 2.80±0.01, 14.80±0.02 and 1.45±0.01 mg/100 g for inorganic fertilizer. Tannins were absent in the stem, root and inflorescence. Flavonoids were present in all the plant parts with exception of inflorescence. Saponins were higher in stem and root samples than in the leaf and inflorescence.

Result as presented in Table 2 revealed that organic fertilizer produced significantly ($p<0.05$) higher effect on crude fibre, protein, ash, fat, vitamin C and A in all the plant parts when compared with inorganic fertilizer. Mean values recorded for the above parameters in leaf sample were 3.20±0.2, 7.90±0.01, 3.10±0.2, 0.48±0.2, 7.80±0.02 and 46.19±0.02 g/100 g, respectively compared with values of 2.60±0.02, 5.60±0.01, 2.80±0.1, 0.43±0.1, 6.50±0.02 and 42.40±0.1 g/100 g, respectively for inorganic fertilizer. Mean values for ash, fibre and vitamin C were higher in the root and inflorescence.

Comparative effect of organic and in organic fertilizer on mineral composition of *Amaranthus spinosus* is presented in Table 3. Results showed that organic fertilizer produced significantly ($p<0.05$) higher Zn, Cu, Mg, K, Fe, Ca, Na and P than in organic fertilizer in all the plant samples studied.

Table 1: Comparative study of the effect of organic and inorganic fertilizer on phytochemicals of *Amaranthus spinosus*

	Phytochemicals (mg/100 g dry matter)				
Plant part and soil type	Alkaloids	Tannins	Saponins	Flavonoids	Reducing compounds
Leaf					
Organic	0.84±0.02	0.96±0.2	2.90±0.02	15.20±0.2	1.50±0.02
Difference (%)	95.3	92.0	5.5	11.8	13.6
Inorganic	0.68±0.02	0.85±0.01	2.80±0.01	14.80±0.02	1.45±0.01
Difference (%)	58.1	70.0	1.8	8.8	9.8
Control	0.43±0.01	0.50±0.01	2.75±01	13.60±0.02	1.32±0.01
Stem					
Organic	0.81±0.01		3.40±0.01	16.40±0.02	1.42±0.02
Difference (%)	97.6		57.4	10.4	10.1
Inorganic	0.66±0.01	-	2.30±0.02	15.05±0.02	1.33±0.01
Difference (%)	61.0		6.5	1.3	3.1
Control	0.41±0.02		2.16±0.02	14.86±0.02	1.29±0.1
Root					
Organic	0.86±0.01		3.10±0.02	11.80±0.01	1.49±0.02
Difference (%)	72.0		34.8	16.8	8.0
Inorganic	0.60±0.02	-	2.70±0.01	10.78±0.02	1.41±0.01
Difference (%)	20.0		17.4	6.7	2.2
Control	0.50±0.01		2.30±0.1	10.10±0.01	1.38±0.02
Inflorescence					
Organic	0.31±0.1		2.20±0.02		1.48±0.01
Difference (%)	10.7		15.2	-	3.5
Inorganic	0.30±0.1	-	2.0±0.1		1.44±0.02
Difference (%)	7.1		4.7		0.7
Control	0.28±0.1		1.91±0.02		1.43±0.02

Values are Mean±SD, n = 3 replicates, $p<0.05$. Percentage difference was obtained by expressing the difference between the value for control and organic/inorganic fertilizer as a percentage of the control

Table 2: Comparative study of the effect of organic and inorganic fertilizer on proximate composition of *Amaranthus spinosus* L.

Plant part and soil type	Moisture	Ash	Protein	Fat	Fibre	Carbohydrate	Vitamin A	Vitamin C
	(g/100 g dry matter)						(µg/100 g)	
Leaf								
Organic	86.40±0.2	3.10±0.2	7.90±0.01	0.48±0.2	3.20±0.2	89.27±0.02	46.19±0.02	7.80±0.02
Difference (%)	2.5	29.2	64.3	23.1	88.2	0.5	15.9	71.4
Inorganic	85.60±0.2	2.80±0.1	5.60±0.01	0.43±0.1	2.60±0.02	89.06±0.01	42.40±0.1	6.50±0.02
Difference (%)	1.5	16.7	33.3	10.3	52.9	0.2	5.9	42
Control	84.30±0.02	2.40±0.01	4.20±0.01	0.39±0.01	1.70±0.01	88.84±0.02	40.05±0.02	4.55±0.01
Stem								
Organic	79.43±0.1	3.20±0.1	3.40±0.1	0.30±0.1	3.10±0.01	90.82±0.01	45.17±0.02	7.78±0.2
Difference (%)	1.3	28.0	54.5	50.0	10.7	0.5	12.1	54.0
Inorganic	78.50±0.02	2.81±0.1	2.80±0.1	0.24±0.01	2.90±0.2	90.82±0.01	45.17±0.02	7.78±0.2
Difference (%)	0.1	12.4	27.2	20.0	3.6	0.4	9.4	20.8
Control	78.40±0.01	2.50±0.01	2.20±0.2	0.20±0.2	2.80±0.01	90.39±0.01	40.30±0.2	5.05±0.1
Root								
Organic	76.60±0.01	3.30±0.2	3.70±0.02	0.34±0.2	4.50±0.02	89.54±0.02	30.11±0.02	10.40±0.03
Difference (%)	4.4	50.0	27.6	36.0	12.5	1.1	5.6	60.0
Inorganic	75.10±0.2	2.74±0.1	3.20±0.01	0.29±0.1	4.20±0.01	89.54±0.02	29.87±0.02	8.43±0.2
Difference (%)	2.3	24.5	10.3	16.0	5.0	1.0	4.8	29.7
Control	73.40±0.02	2.20±0.01	2.90±0.1	0.25±0.01	4.0±0.1	88.50±0.01	28.50±0.2	6.50±0.2
Inflorescence								
Organic	82.30±0.01	3.40±0.01	1.90±0.02	0.15±0.2	3.20±0.1	91.85±0.02	46.05±0.2	11.08±0.1
Difference (%)	2.8	13.3	26.7	50.0	6.7	1.1	37.5	55.0
Inorganic	80.25±0.01	3.30±0.1	1.60±0.02	0.13±0.2	3.10±0.2	91.54±0.01	41.90±0.2	8.45±0.01
Difference (%)	0.2	10.0	6.7	30.0	3.3	0.8	25.1	18.2
Control	80.05±0.1	3.0±0.01	1.50±0.02	0.10±0.2	3.0±0.2	90.81±0.02	33.50±0.2	7.15±0.02

Values are Mean±SD, n = 3 replicates, p<0.05. Percentage was obtained by expressing the difference between the values for control and organic/inorganic fertilizer as a percentage of the control

Table 3: Comparative study of the effect of organic and inorganic fertilizer on mineral composition of *Amaranthus spinosus* L.

	Mineral composition (mg/100 g dry matter)							
Plant part and soil type	Na	K	Ca	Mg	Fe	Zn	Cu	P
Leaf								
Organic	6.50±0.03	7.60±0.1	2.90±0.4	4.45±0.3	0.12±0.02	0.03±0.2	0.03±0.02	2.10±0.03
Difference (%)	44.2	77.2	45.0	93.5	50.0	100.0	100.0	16.7
Inorganic	5.70±0.01	5.30±0.01	2.80±0.2	3.41±0.1	0.09±0.02	0.02±0.1	0.02±0.01	1.90±0.01
Difference (%)	26.4	23.5	40.0	48.3	12.5	100.0	100.0	5.6
Control	4.30±0.02	4.29±0.1	2.0±0.01	2.30±0.01	0.08±0.1	0.01±0.01	0.01±0.02	1.80±0.01
Stem								
Organic	6.40±0.01	4.20±0.2	2.90±0.1	3.50±0.2	0.07±0.01	0.02±0.01	0.02±0.1	1.90±0.02
Difference (%)	25.5	3.7	29.5	52.8	40.0	100.0	100.0	75.9
Inorganic	5.30±0.01	4.10±0.2	2.50±0.01	2.85±0.01	0.06±0.01	0.02±0.1	0.02±0.01	1.20±0.3
Difference (%)	3.9	1.2	11.6	24.5	20.0	100.0	100.0	11.1
Control	5.10±0.1	4.05±0.1	2.24±0.01	2.29±0.1	0.05±0.1	0.01±0.2	0.01±0.01	1.08±0.01
Root								
Organic	8.62±0.3	4.48±0.3	3.0±0.2	2.25±0.01	0.04±0.01	0.02±0.1	0.04±0.02	1.41±0.02
Difference (%)	51.2	12.0	20.0	12.5	100.0	100.0	100.0	4.4
Inorganic	7.80±0.2	4.45±0.3	2.60±0.1	2.10±0.01	0.03±0.2	0.01±0.01	0.03±0.02	1.36±0.07
Difference (%)	36.8	11.3	4.0	5.0	50.0	-	100.0	0.7
Control	5.70±0.1	4.0±0.1	2.50±0.1	2.0±0.01	0.02±0.1	0.01±0.01	0.02±0.01	1.35±0.01
Inflorescence								
Organic	6.31±0.1	3.90±0.1	2.70±0.01	2.70±0.03	0.09±0.03	0.03±0.01	0.03±0.02	1.70±0.02
Difference (%)	38.4	18.0	17.4	11.1	88.0	100.0	50.0	6.3
Inorganic	5.70±0.2	3.45±0.1	2.61±0.02	2.60±0.03	0.07±0.2	0.02±0.01	0.03±0.02	1.70±0.01
Difference (%)	25.0	4.5	13.4	6.7	40.0	-	50.0	6.3
Control	4.56±0.1	3.30±0.2	2.30	2.43±0.01	0.05±0.01	0.02±0.01	0.02±0.01	1.60±0.01

Values are Mean±SD, n = 3 replicates, p<0.05. Percentage difference was obtained by expressing the difference between the value for control and organic/inorganic fertilizer as a percentage of the control

Mean values obtained for leaf sample in the above minerals for organic fertilizer were 0.03±0.2, 0.03±0.02, 4.45±0.3, 7.60±0.1, 0.12±0.02, 2.90±0.04, 6.50±0.03 and 2.10±0.03 mg/100 g, respectively. Corresponding mean values for inorganic fertilizer in leaf sample were 0.02±0.1, 0.02±0.01, 3.41±0.1, 5.30±0.01, 0.09±0.02, 2.80±0.2, 5.70±0.01 and 1.90±0.01 mg/100 g. Zinc and Cu had the same values in all the plant parts studied for both organic and inorganic fertilizer. Sodium was highest in the root sample.

Effect of organic and inorganic fertilizer on antioxidants of *Amaranthus spinosus* is shown on Table 4. Results revealed a similar trend of higher mean values for organic fertilizer in all the plant samples when compared with inorganic fertilizer. Mean values recorded for leaf sample in inorganic

Table 4: Comparative study of the effect of organic and inorganic fertilizer on antioxidants (mg/100 g dry matter) of *Amaranthus spinosus* L.

Plant part and soil type	Total oxalate	Soluble oxalate	Cyanic acid	Phytic acid
Leaf				
Organic	28.20±0.02	17.38±0.01	2.38±0.03	0.63±0.02
Difference (%)	16.0	50.5	0.41	34.0
Inorganic	26.40±0.03	13.53±0.1	2.27±0.01	0.58±0.1
Difference (%)	8.5	17.1	4.2	23.4
Control	24.30±0.2	11.55±0.02	2.37±0.03	0.47±0.01
Stem				
Organic	30.40±0.2	18.37±0.02	2.45±0.02	0.61±0.02
Difference (%)	35.7	60.4	10.9	35.6
Inorganic	29.30±0.02	16.94±0.03	2.30±0.02	0.55±0.2
Difference (%)	30.8	48.0	4.1	22.2
Control	22.40±0.02	11.45±0.2	2.21±0.01	0.45±0.02
Root				
Organic	31.70±0.02	16.83±0.2	3.61±0.01	0.73±0.01
Difference (%)	56.1	86.6	18.0	21.7
Inorganic	26.40±0.2	14.63±0.02	3.20±0.1	0.65±0.01
Difference (%)	30.0	62.2	4.6	8.3
Control	20.30±0.1	9.02±0.01	3.06±0.02	0.60±0.1
Inflorescence				
Organic	25.80±0.2	12.65±0.02	1.76±0.01	0.37±0.2
Difference (%)	20.6	71.6	13.5	42.3
Inorganic	24.80±0.02	10.37±0.02	1.57±0.02	0.27±0.01
Difference (%)	15.9	40.7	1.3	3.8
Control	21.40±0.2	7.37±0.02	1.55±0.01	0.26±0.2

Value are Mean±SD, n = 3 replicates, $p<0.05$. Percentage difference was obtained by expressing the difference between the value for control and organic/inorganic fertilizer as a percentage of the control

fertilizer were 17.38±0.01, 0.63±0.02, 28.20±0.02 and 2.38±0.03 mg/100 g, respectively for soluble oxalate, phytic acid, total oxalate and cyanic acid. Corresponding mean values for inorganic leaf sample were 13.53±0.1, 0.58±0.1, 26.40±0.03 and 2.27±0.01 mg/100 g. Values for percentage difference followed similar trends with higher values recorded for organic than inorganic.

Results of comparative study of the effect of organic and inorganic fertilizer on phytochemicals, proximate/mineral composition and antioxidants of *Amaranthus spinosus* followed a similar trend. Organic fertilizer significantly ($p<0.5$) higher effect on all the parameters studied. Values for percentage difference obtained for organic fertilizer were also considerably higher for all the pant samples when compared with inorganic fertilizer.

DISCUSSION

This study on comparative effect of organic and inorganic fertilizers on phytochemicals, proximate, mineral, antioxidants, vitamins A and C composition of *Amaranthus spinosus* revealed that organic fertilizer produced higher effects on all the parameters investigated when compared with inorganic fertilizer. The results of this research are in agreement with previous researchers who have reported increases with organic fertilizers on some proximate, mineral contents (Abdelrazzag, 2002; Arisha *et al*., 2003; Coolong *et al*., 2005; Adekayode, 2004; Katherine, 2007; Fatma *et al*., 2007; Funda *et al*., 2011; Makinde *et al*., 2010). These increases could be due to the ease with which nutrients such as N, P and K in NPK fertilizers are lost by leaching. Nutrients in organic material are less easily available since the materials have to be decomposed and organic nutrients mineralized (Makinde *et al*., 2010). Organic manures activate many species of living organisms which release phytohormones and may stimulate the plant growth and nutrients (Arisha *et al*., 2003) and such organisms need nitrogen for multiplication (Ouda and Mahadeen, 2008).

Results of this study are also in consonance with results of the biggest and most extensive scientific study and research into the benefits of organic food by Katherine (2007) who reported that organic food is more nutritious than non organic (ordinary produce) food and may in fact lengthen peoples lives. She also found that they contain higher levels of antioxidants and flavonoids which help ward off heart disease and cancer as well as iron and zinc. Research that was carried out in the Newcastle University also showed that organic food contain more antioxidants and less unhealthy fatty acids. They found that levels of antioxidants in milk from organic cattle were between 50 and 80% higher than normal milk. Organic wheat, tomatoes, potatoes, cabbage, onions and lettuce had between 20 and 47% more nutrients than non-organic foods. The project coordinator Professor Carlo Leifert said they were yet to find out the difference (Katherine, 2007).

People eat vegetables not just because they like vegetable but also for the nutritional benefits derived from them. High amounts of phytochemicals, minerals and antioxidants recorded in this research gives preference to the use of organic than inorganic fertilizer. The results of this study therefore, encourage the used of organic fertilizer in growing *A. spinosus* for better nutritional quality.

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