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Effect of Coconut Milk and Benzyl Amino Purine on the Vegetative Growth, Nutritional and Chemical Constituent of *Amaranthus Hybridus* Linnaeus seedlings

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Abstract- Studies were carried out to investigate the effects of 10%, 15% coconut milk and 50mg/L, 100mg/L Benzyl amino purine on the vegetative growth, nutritional and photochemical constituents of *Amaranthus hybridus* Linnaeus seedlings. Plants sprayed with water were the controls. All the treatments resulted in significantly increased leaf number, stem girth, plant height, shoot/root ratio, leaf area ratio and chlorophyll content of the vegetable with highest values recorded in treatments with 15% coconut milk at 14 weeks after planting. Treatments with 15% coconut milk also resulted in greater mineral elements contents at 14 weeks after planting of the vegetable. Alkaloids (3.55), saponins (1.66), phenols (0.36) and flavonoids levels (0.85) were higher in 15% coconut milk treated plants, whereas phytic acid (1.26) and hydrocyanic acids levels (15.30) were greater in 100mg/L Benzyl amino purine and 10% coconut milk respectively at 14 weeks after planting.

Keywords: amaranthus hybridus, coconut milk, benzyl amino purine, chlorophyll content, nutritional contents, phytochemical constituents.

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Abstract- Studies were carried out to investigate the effects of 10%, 15% coconut milk and 50mg/L, 100mg/L Benzyl amino purine on the vegetative growth, nutritional and photochemical constituents of *Amaranthus hybridus* Linnaeus seedlings. Plants sprayed with water were the controls. All the treatments resulted in significantly increased leaf number, stem girth, plant height, shoot/root ratio, leaf area ratio and chlorophyll content of the vegetable with highest values recorded in treatments with 15% coconut milk at 14 weeks after planting. Treatments with 15% coconut milk also resulted in greater mineral elements contents at 14 weeks after planting of the vegetable. Alkaloids (3.55), saponins (1.66), phenols (0.36) and flavonoids levels (0.85) were higher in 15% coconut milk treated plants, whereas phytic acid (1.26) and hydrocyanic acids levels (15.30) were greater in 100mg/L Benzyl amino purine and 10% coconut milk respectively at 14 weeks after planting. The study shows that 15% coconut milk persistently had the greater potentials to increase vegetative growth, nutritional and phytochemical constituents of *Amaranthus hybridus* leading to its significance in nutrients requirements of man and usefulness in medicinal industries.

Keywords: amaranthus hybridus, coconut milk, benzyl amino purine, chlorophyll content, nutritional contents, phytochemical constituents.

I. Introduction

Vegetables are essential in the diet as they provide plant fibre, mineral elements, vitamins, carbohydrates and proteins (Hollingsworth, 1981). In Nigeria, as in most other tropical countries of Africa where the daily diet is dominated by starchy staple foods, vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acid (Okafor, 1983). Many of the local vegetable materials are under-exploited because of inadequate scientific knowledge of their nutritional potentials. Though several works reporting compositional evaluation and functional properties of various types of edible wild plants in use in the developing countries abound in literature, much still need to be done. Many workers (Lockeett *et al.,* 2000; Akindahunsi and Salawu, 2005; Edeoga *et al.,* 2006; Hassan and Umar, 2006; Ekop, 2007) have reported the compositional evaluation and functional properties of various types of edible wild plants in use in the developing countries. In Nigeria, *Amaranthus hybridus* L, popularly called 'efo tete', 'tete oyinbo' or 'tete-nla' in Yoruba land (Gbile, 2002), is an annual herbaceous plant of 1- 6 feet high. The leaves are alternate petioled, 3 – 6 inches long, dull green, and rough, hairy, ovate or rhombic with wavy margins. The flowers are small, with greenish or red terminal panicles. Taproot is long, fleshy red or pink. The seeds are small and lenticellular in shape; with each seed averaging 1 – 1.5 mm in diameter and 1000 seeds weighing 0.6 – 1.2 g. It is rather a common species in waste places, cultivated fields and barnyards. In Nigeria, *Amaranthus hybridus* leaves combined with condiments are used to prepare soup (Oke, 1983; Mepha *et al.*, 2007). In Congo, their leaves are eaten as spinach or green vegetables (Dhellot *et al.*, 2006). The growth regulators influence plant growth and development at very low concentrations while they inhibit at high concentrations (*Jules et al.*, 1981). Monthly foliar spraying of geranium (Pelergonium graveolens) resulted in increased plant height and herb production (Mohammed *et al.,* 1983). Spraying of datura plant, *Datura innoxia* planted in different salinity concentrations with chlormequat, ethephon or kinetin was found to enhance plant growth, alkaloidal and soluble sugar contents of leaves and reduce the harmful effect of salinity on the plant (Abdul-Rahman and Abdel-Aziz, 1983). Application of gibberellic acid, 4-chloroindole and 6-benzyl amino purine on to the standard petal and calyx of Vicia faba var. major was found to significantly enhance pod set (Rylott and Smith, 1990). Currently, there is no information on the effects of coconut milk (CM) (a crude

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source of cytokinin) and benzyl amino purine (BAP) on the growth, nutritional and chemical composition of *Amaranthus hybridus.* This study was therefore designed to evaluate the vegetative growth, nutritional and phytochemical chemical composition of *Amaranthus hybridus* in responses to coconut milk and benzyl amino purine treatments and to determine the optimum concentrations of the hormones that can be recommended for spraying on the vegetable for enhanced growth and quality.

II. Materials and Methods

a) Seed Collection and Planting

Seeds of *Amaranthus hybridus* was obtained from the Institute of Agricultural Research and Training (IAR&T) Ibadan, Oyo State, Nigeria ((7° 23'N and 3° 51'E). Seedlings were raised from seeds planted on sandy loam nursery seed bed (5m x 5m) at the forestry nursery unit of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria (7° 11'N and 3° 21'E), in the rainforest belt with an annual rainforest of 963.3mm (Fadimu *et al.,* 2012). Five nursery seed beds in three replicates were made. Each nursery seed bed formed a plot. Water was added to the nursery bed when necessary to keep it moist. Seedlings were thinned to 100 seedlings per bed 2 weeks after planting (WAP) putting uniformity of height into consideration and were considered matured enough to be subjected to treatments.

b) Coconut milk (CM) and Benzyl amino purine (BAP) Treatments on the Amaranthus Hybridus Seedlings

The seedlings of *Amaranthus hybridus* were sprayed foliarly in this experiment with coconut milk (CM) and benzyl amino purine (BAP). Different concentrations of the coconut milk treatments were 10% and 15% while 50mg/L and 100mg/L for benzyl amino purine. 500ml of the various concentrations of the coconut milk and benzyl amino purine were applied on the seedlings of the *Amaranthus hybridus* by foliar spraying until the leaf surfaces were properly wet and dripping at 3 weeks intervals, starting from 2 weeks after planting (WAP) while seedlings of *Amaranthus hybridus* sprayed with 500ml distilled served as the control. The treated and control vegetables were harvested for all the analyses at 14 weeks after planting (WAP). The method of Akubugwo *et al.* (2007) was used for processing the leaves of *Amaranthus hybridus* in preparation for various analyses after harvesting. The collected sample was thoroughly mixed, had their stalks removed, rinsed with de-ionized water and the residual moisture evaporated at room temperature before sun-drying for 2 - 3 days on a clean paper with constant turning over to avert fungal growth. The sun-dried sample was ground into fine powder using pestle and mortar, and sieved through a 2.0 mm mesh sieve to obtain a dried powdered sample that was used for all the analyses.

c) Vegetative Growth, Nutritional Chemical Constituent of the seedlings of Amaranthus Hybridus

Treated and control seedlings of *Amaranthus hybridus* were sampled at 14 weeks after planting. The vegetative growth (leaf number, plant height, stem girth, shoot-root ratio and leaf area ratio) were measured according to the method of Mukhtar (2008) while the chlorophyll contents of the leaves were determined using the method of Witham *et al.* (1971).

The mineral elements, comprising sodium, calcium, potassium, magnesium, iron, zinc and phosphorus were determined according to the method of Shahidi *et al.* (1999) and Nahapetian and Bassiri (1975) with some modifications. Exactly 2.0 g of each of the processed samples were weighed and subjected to dry ashing in a well-cleaned porcelain crucible at 550°C in a muffle furnace. The resultant ash was dissolved in 5.0 ml of $HNO_3/HCl/H_2O$ (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining material in each crucible, 5.0 ml of de-ionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into a 100 ml volumetric flask by filtration through whatman No.42 filter paper and the volume was made to the mark with de-ionized water. This solution was used for elemental analysis by atomic absorption spectrophotometer. A 10 cm long cell was used and concentration of each element in the sample was calculated on percentage (%) of dry matter that is mg/100 g sample. Phosphorus content of the digest was determined calorimetrically according to the method described by Nahapetian and Bassiri (1975).

Flavonoids were estimated by the method of Bohm and Kocipal (1974). Alkaloids, phenols and saponins were determined by the method of Harborne (1973) as detailed by Obadoni and Ochuko (2001). Tannin determination was determined according to Van-Burden and Robinson (1981) and determination of Hydrocyanic acid was quantified by the method of Bradbury *et al.* (1991) while Determination of Phytic acid was by the method of Wheeler and Ferrell (1971).

d) Statistical Analysis

The experimental layout was a randomized complete block design containing three replications (Steel and Torrie, 1982). Each replication contained five treatments and every treatments consisted of 100 seedling plants (5 treatments × 3 replications ×100 seedling plants = 1500 seedling plants). Data were subjected to analysis of variance (ANOVA) using Duncan Multiple Range Test (DMRT) for mean separation (Sokahl and Rholf, 1969).

III. Results and Discussion

In this study, significant ($P \leq 0.05$) increases in all the vegetative growth parameters (leaf number, stem girth, plant height, shoot/root ratio, leaf area ratio) were

observed in the *Amaranthus hybridus* seedlings treated with different concentration of coconut milk (CM) and benzyl amino purine (BAP) at 14 weeks after planting in comparison with the control. 15% Coconut milk treatment recorded the highest number of leaf number (144cm), stem girth (3.98cm), plant height (167cm), shoot/root ratio (2.14), leaf area ratio (365.5) and chlorophyll content (3.01mg/100g) (Table 1). **Ebofin *et al.* (2004)** similarly recorded enhancement in leaf number and plant height in *Prosopis africana* and *Albizia lebbeck.* Spraying of kinetin on *Datura innoxia* plant at 1mg/L, 5mg/L and 10mg/L was found to cause increased vegetative growth **(Abdel-Rahman and Abdel-Aziz, 1983).** An increase in stem circumference was likewise observed according to **Kadiri (1991)** personal communication in his studies with *Abelmoschus esculentus* and *Lycopersicum esculentus* treated with various concentration of GA_3 and 2, 4-D. Furthermore, similar results were observed by **Mukhtar (2008)** where chlorophyll content (1.08mg/g) at 9 weeks was obtained in *Hibiscus sabdariffa* treated with 15% coconut milk, followed by 100ppm GA_3 (0.93mg/g). The production of high shoot-root ratio in *Amaranthus hybridus plants* raised with hormones in this study suggests that the rate of absorption of available nutrients might have significantly been enhanced. **Akhtar *et al.* (2008)** explained that increases in shoot-root ratio by hormone treatments are due to the fact that they enhance the stem elongation plants. In addition, cytokinins such as those contained in coconut water, benzyl amino purine (BAP) also facilitate cell division and sprouting **(Pan, 2001).** GA_3 and IAA had regulatory effect to enhance the plant height, number of branches, numbers as compared to other plant growth regulators and control **(Sarkar *et al.,* 2002).** GA_3 and IAA treated plants exhibited higher values of dry weight and chlorophylls content than the control **(Abdel-Lateef, 2003; Afroz *et al.,* 2005; Abou Al-Hamd, 2007).** Enhanced germination and seedling growth by plant growth regulators may be mediated through changes in the activities of carbohydrate metabolism enzymes **(Kaur *et al.,* 2000).**

Mineral composition (Potassium, sodium, calcium, magnesium, zinc, iron and phosphorus) recorded in mg/100g in all the various treatments of coconut milk (CM) and benzyl amino purine (BAP) applied on *Amaranthus hybridus* showed significant differences in comparison with the control. Treatment of 15% CM produced the maximum K (53.70), Na (7.21), Ca (43.01), Mg (229.30), Zn (3.12), Fe (13.30) and P (34.22) (Table 2). The ratio of sodium to potassium (Na/K) and calcium to phosphorus (Ca/P) were also shown in Table 2. Magnesium content (229.30 mg /100 g) and Iron content (13.30 mg/100g) of the leaves are within the range reported in some green vegetables **(Ladan *et al.*, 1996; Ibrahim *et al.*, 2001; Antia *et al.*, 2006; Hassan and Umar, 2006).** Magnesium is a component of chlorophyll **(Akwaowo *et al.*, 2000)** while **McDonald et al., (1995)** highlighted magnesium for efficient metabolism of carbohydrates and lipids, involved in cellular respiration and general cellular biochemistry and function. It is also an important mineral element in connection with ischemic heart disease and calcium metabolism in bones according to **Ishida *et al.*, (2000).** Iron is an essential trace element for haemoglobin formation, normal functioning of the central nervous system and in the oxidation of carbohydrates, protein and fats **(Adeyeye and Otokiti, 1999).** The Zinc content (3.12 mg/100 g) compares favourably to most values reported for green leafy vegetables in literatures **(Ibrahim *et al.*, 2001; Hassan and Umar, 2006).** Zinc is involved in normal function of immune system **(Akubugwo et al., 2007)**. Also, zinc stabilizes the molecular structure of cellular components and membranes and contributes in this way to the maintenance of cell and organ integrity **(Emebu and Anyika, 2011).** The Na/K ratio in the body is of great concern for prevention of high blood pressure **(Akubugwo et al., 2007).** Na/K ratio less than one is recommended **(FND, 2002).** Therefore, high blood pressure diseases would be minimized due to constant intake of *Amaranthus hybridus* because Na/K composition is lower than one. For good Ca to P intestinal absorption, Ca/P ratio should also be close to unity **(Gull-Guerrero *et al.*, 1998)** and the ratio in this study supports this requirement, hence provides evidence of good Ca to P intestinal absorption.

Table 3 contains full details of the effects of different concentrations of coconut milk (CM) and benzyl amino purine (BAP) at 14 weeks after planting (WAP) on the phytochemical composition of the leaves of *Amaranthus hybridus* in mg/100g (DW). The result indicates that alkaloid (3.55mg/100g), saponin (1.66mg/100g), phenol (0.36mg/100g) and flavonoids (0.85mg/100g) recorded highest values from 15% Coconut milk treatment at 14 weeks after planting while 10% coconut milk treatment at 14 weeks after planting favoured highest values of tannin (0.45mg/100g) and hydrocyanic acids (15.30mg/100g). 100mg/L benzyl amino purine treatment recorded 1.26mg/100g of phytic acids at 14 weeks after planting. Result also shows that at 14 weeks after planting, all the hormonal treatments showed no significant ($P < 0.05$) differences with the controls in all the phytochemical compositions except 15% coconut milk (Table 3). This present result of the alkaloid content of 3.55mg/100g by 15% coconut milk treatment disagreed with results obtained by **Edeoga *et al.*, (2005); Okwu and Josiah, (2006); Akubugwo *et al.*, (2007)** based on the fact that it is higher than the values reported for the leafy vegetables of *Aspilia Africana*, *Bryophyllum pinnatum*, *Cleome rutidosperma* and *Emilia coccinea and Amaranthus hybridus* consumed in Nigeria. The tannin contents (0.45mg/100g) agrees with those of **Edeoga *et al.,* (2005) and Okwu and Josiah (2006).** The flavonoid content of the leaves (0.85 mg/100

g) and saponin (1.66 mg/100 g) also agreed with the result obtained for *Amaranthus hybridus* in Nigeria but was lower than values reported for *O. gratissiumum* and *Hsypits sauvelens* (Akubugwo *et al.,* 2007). The Hydrocyanic acid content (15.30mg/100 g) and phytic acid content (1.26mg/100 g) of the leaves were lower than the values reported for *A. hybridus and I. batatas* (Akubugwo *et al.*, 2007; Antia *et al.,* 2006). Phytochemical composition of *Amaranthus hybridus* shows that it may not only be useful due to its dietetic value but also medicinally and pharmacologically (Akubugwo *et al.,* 2007). Alkaloids are known to play some developmental control in living system, metabolic role and have a protective role in animals (Edeoga *et al.,* 2006; Edeoga and Eriata, 2001). The anti-nutrients, for example hydrocyanic acid have been suggested in cerebral damage and lethargy in man and animals. Tannins are capable of reducing available protein by antagonistic competition and can therefore cause protein deficiency syndrome, kwashiorkor while phytic acid has complex effect in human system including indigestion of food and flatulence (Maynard, 1997). According to Ekop *et al.* (2004), Eka and Osagie (1998) and Ekop and Eddy (2005) the anti-nutrients present in this plant is within the tolerant levels and can easily be rendered harmless by soaking, boiling or frying. The results from this research work showed that 10%, 15% coconut milk and 100mg/L benzyl amino purine treatments at 14 weeks after planting increases the vegetative growth, nutritional and phytochemical constituents of *Amaranthus hybridus.* This therefore added to its suitability as edible vegetable, nutritional and therapeutic values. These treatments could therefore be used to promote the growth and quality of *Amaranthus hybridus*.

References Références Referencias

1. Abdul-Lateef, A.A., (2003). Response of some sorghum cultivars to salts stress and hormonal treatment. M.Sc. Thesis, Fac. Agric. South Valley University Qena, Egypt.
2. Abdul-Rahman, E.A. and Abdel-Aziz, A. K. (1983). Growth regulators affecting the salt tolerance in Dutara plants. *Acta Hort.*, **132:** 273 - 283.
3. Abou Al-Hamd, M.F. (2007). The interactive effects of salinity and phytohormones on some physiological studies of two *Hibiscus sabdariffa* cultivars. M.Sc. Thesis, Fac. Science South Valley University Qena, Egypt.
4. Adeyeye, E. and Otokili, M. K. O. (1999). Proximate composition and some nutritionally valuable minerals of two varieties of *Capsicum annum* (Bell and cherry peppers). *Discov. Innov.*, **11:** 75-81.
5. Afroz, S., Mohammad, F., Hayat, S. and Sidiqui, M.H. (2005). Exogenous application of gibberellic acid counteracts the effect of sodium chloride in mustard. *Turkey Journal of Biology,* **29:** 233-236.
6. Akhtar, N., Ibrar M. and Aman, N. (2008). The effects of different soaking times and concentration of GA_3 on seed germination and growth of *Spinacia oleracea* L. *Pakistan Journal of Plant Science,* **14 (1):** 9 - 13.
7. Akindahunsi, A.A. and Salawu, S.O. (2005). Photochemical screening and nutrient-anti-nutrient composition of selected tropical green vegetables. *African Journal of Biotechnology,* **4:** 497 - 501.
8. Akubugwo, I.E., Obasi, N. A., Chinyere, G.C. and Ugbogu, A.E. (2007). Nutritional and chemical value of *Amaranthus hybridus* L. leaves from Afikpo, Nigeria. *African Journal of Biotechnology,* **6 (24):** 2833 - 2839.
9. Akwaowo, E.U., Ndon, B.A. and Etuk, E.U. (2000). Minerals and anti-nutrients in fluted pumpkin (*Telfaira occidentalis* Hook F.). *Journal of Food Chemistry,* **70:** 235 – 240.
10. Antia, B.S., Akpan, E.J., Okon, P.A. and Umoren, I.U. (2006). Nutritive and Anti-Nutritive Evaluation of sweet potatoes (*Ipomoea batatas*) leaves. *Pakistan Journal of Nutrition,* **5(2):** 166-168.
11. Atanasiu, L., Loana, S. and Lucia, P. (1983). The influence of kinetin on the growth of alga chlorella. *Rev. Roum. Biol. Ser. Biol. Veg.*, **27:**17-22.
12. Bohm, B.A. and Kocipai-Abyazan, R. (1974). Flavonoid and Condensed tannins from leaves of *vaccinum raticulation* and *vaccinum calcyimium. Pacific Sci.,* **48:**458 - 463.
13. Bradbury, J.H., Egan, S.M. and Lynch, M. J.(1991). Analysis of cyanogenic glycosides. *Journal of Science and Food Agriculture,* **55:** 277 - 290.
14. Dhellot, J.R., Matouba, E., Maloumbi, M.G., Nzikou, J.M., Safou-Ngoma, D.G., Linder, M., Desobry, S. and Parmentier, M. (2006). Extraction, chemical composition and nutritional characterization of vegetable oils: Case of *Amaranthus hybridus* (Var 1 and 2) of Congo Brazzaville. *African Journal of Biotechnology,* **5(11):** 1095 - 1101.
15. Ebofin, A.O., Agboola, D.A., Ayodele, M.S. and Aduradola, A.M. (2004). Effect of some growth hormones on seed germination and seedling growth of some savannah tree legumes. *Nigerian Journal of Botany,* **16:** 64-75.
16. Edeoga, H.O. and Eriata, D.O (2001). Alkaloid, tannin and Saponin contents of some Nigeria Medicinal plants. *J. Med. Aromatic plants Sci.*, **23:** 344-349.
17. Edeoga, H.O., Okwu, D.E. and Mbaebie, B.O. (2005). Photochemical constituents of some Nigerian Medicinal plants. *African Journal of Biotechnology,* **4(7):** 685-688.
18. Edeoga, H.O., Omosun, G. and Uche, L.C. (2006). Chemical composition of *Hyptis sauveolens* and

Ocimum gratissium hybrids from Nigeria. *African Journal of Biotechnology,* **5(10):** 892-895.
19. Eka, O.U. and Osagie, A.U. (1998). Nutritionally quality of plant food. *Post harvest publishers,* University of Benin, Nigeria pp. 38 – 54.
20. Ekop, A.S. (2007). Determination of chemical composition of *Gnetum africana* (AFANG) seeds. *Pakistan Journal of Nutrition,* **6(1):** 40-43.
21. Ekop, A.S. and Eddy, N.O (2005). Comparative Studies of the level of toxicants in the seed of Indian Almond (*Terminalia catappa)* and African walnut (*Coula edulis*). *Chem. Class J.*, **2:** 74-76
22. Ekop, A.S., N.D. Eddy, and P.G. Udofia, (2004). Effect of Processing on the elemental composition of beans. Proceedings of 28th annual Conf. of Nig. Inst. of food Sci. Tec. (NIFEST), Ibadan, pp. 217-218.
23. Emebu, P.K. and Anyika, J.U. (2011). Proximate and Mineral Composition of Kale (Brassica oleracea) Grown in Delta State, Nigeria. *Pakistan Journal of Nutrition,* **10(2):** 190-194.
24. Fadimu, O.Y., Ajiboye, A.A., Agboola, D.A., Kadiri, M. and Adedire, M.O. (2012). Effect of some combination of phytohormones on some growth parameters and Vitamin C, Carbohydrate, Protein and Chlorophyll contents of Spondias mombin Linn seedlings. *Ife Journal of Science,* **14 (2):** 397-403.
25. FND., (2002). Food and nutrition board, Institute of medicine. National Academy ofSciences Dietary reference Intake for Energy, Carbohydrate, Fibre, Fat, Fatty Acids, Cholesterol, protein and Amino acid (micro-nutrients). *www.nap.edu* (Retrieved on 14/05/2007).
26. Gbile, Z.O. and Soladoye, M.O. (2002). Vernacular names of Nigerian plants (Yoruba). 2nd Edition, Forestry Research Institute of Nigeria (FRIN) Publishers, Ibadan, Nigeria, 2002. 101pp.
27. Gull-Guerrero, J.L., Gimenez-Gimemez, A., Rodriguez-Garcia, I. and Torija-Isasa, M. E. (1998). Nutritional composition of Sonchus Species (*S. asper* L, *S. oleraceus* L, and *S. tenerrimus* L.). *Journal of Science and Food Agriculture,* **76:** 628 - 632.
28. Hassan, L.G. and Umar, K.J. (2006). Nutritional value of Balsam Apple (*Momordica balsamina* L.) leaves. *Pakistan Journal of Nutrition,* **5(6):** 522 - 529.
29. Harborne, J.B. (1973). Photochemical methods. Chapman and Hall, Ltd, London. Pp 49 - 188.
30. Hollingsworth, D.F. (1981). The place of potatoes and other vegetables in the diet in vegetable production. Spedding, C.R.W. (ed) Macmillan London. Pp 154.
31. Ibrahim, N.D.G., Abdurahhman, E. M. and Ibrahim, G. (2001). Elemental analysis of the leaves of *Vernonia amygdalina* and its biological evaluation in rats. *Niger. J. Nat. Prod. Med.*, **5:**13-16.
32. Ishida, H., HSuzuno, H., Sugiyama, N., Innami, S., Todokoro, T. and Maekawa, A. (2000) Nutritional evaluation of chemical component of leaves, stalks and stems of sweet potatoes (*Ipomea batatas* poir). *Food Chem.*, **68:**359-367.
33. Jules, J., W.S. Robert, W.N. Frank, and W.R. Varnon, 1981. Plant science: An introduction to world crops. W.H. Freeman & Co. New York p. 55-64, 162 - 192.
34. Kaur, S., Gupta, A.K. and Kaur, N. (2000). Effect of GA_3, kinetin and indole acetic acid on carbohydrate metabolism in chickpea seedlings germinating under stress. *Plant Growth Regulators,* **30:** 61-70.
35. Ladan, M.J., Bilbils, L.S. and Lawal, M. (1996). Nutrient composition of some green leafy vegetable consumed in Sokoto. *Nigerian Journal of Basic and Applied Science,* **5:** 39-44.
36. Lockeett, C.T., Calvert, C.C. and Grivetti, L.E. (2000). Energy and micronutrient Composition of dietary and Medicinal wild plants Consumed during drought: Study of Rural Fulani, Northeastern *Nigeria. Int. J. Food Sci. Nutr.*, **51:** 195 - 208.
37. Maynard, L.A., (1997). Animal Nutrition. McGraw Hill Book Company Ltd, New York, pp. 47-79.
38. McDonald, P., Edwards, R.A., Greenhalgh, J.F.D. and Morgan, C.A. (1995). Animal Nutrition. 5th Edu, Essex: Pearson Education Publishers, 49-127.
39. Mepha, H.D., Eboh, L. and Banigbo, D.E.B. (2007). Effects of processing treatments on the Nutritive Composition and consumer acceptance of some Nigerian edible leafy vegetables. *Afr. J. Food Agric. Nutr. Dev.*, **7(1):** 1 - 18.
40. Mohammed, B.R., El-Sayed, R.A. and Fawzi, A.F.A. (1983). Effect of gibberellic acid and chloromequat on yield and oil of geranium (*Pelargonium graveolens*). *Acta Hort.,* **132:** 265 - 271.
41. Mukhtar, F.B., (2008). Effect of Some Plant Growth Regulators on the Growth and Nutritional Value of *Hibiscus sabdariffa L. (Red sorrel)*. *International Journal of Pure and Applied Sciences* **2(3):**70-75. *www.ijpas.com.*
42. Nahapetian, A. and Bassiri, A. (1975). Changes in concentration and interrelationships of phytate, P. Mg, Cu, Zn in wheat during maturation. *J. Agric. Food Chem.*, **32:** 1179 - 1182.
43. Obadoni, B.O. and Ochuko, P.O. (2001). Phytochemical studies and comparative efficacy of the Crude extracts of some homeostatic plants in Edo and Delta States of Nigeria, *Global Journal of Pure Applied Sciences*, **8:**203 - 208.
44. Okafor, J.C. (1983). Horticultural Promising indigenous wild plant species of the Nigerian Forest zone. *Acta Hort.*, **123:** 165 – 176.
45. Oke, O.L. (1983). Amaranth. In: Handbook of Tropical Foods. Chan HT (ed). Marcel-Dekker, Inc., New York, pp 1 - 14.

46. Okwu, D.E. and Josiah, C. (2006). Evaluation of the chemical composition of two Nigerian Medical plants. *African J. Biotechnol.,* **5(4):** 357-361.
47. Pan, R.Z., (2001). Physiology 4th edition. Beijing, China High Educational Press, 176-186.
48. Rylott, P.D. and Smith, M. L. (1990). Effects of plant growth substances on pod set in broad beans (Vicia faba var. major) *J. Agric. Sci.*, **114:** 41 - 47.
49. Sarkar, P.K., Shahidul Haque, M. and Abdul Karim, M. (2002). Effects of GA_3 and IAA and their frequency of application on morphology, yield contributing characters and yield of soybean. **J. Agron., 1:** 119-122.
50. Shahidi, F., Chavan, U.D., Bal, A.K. and Mckenzie, D.B. (1999). Chemical Composition of Beach Pea (*Lathyrus Maritimus* L.) Plant parts. *Food Chem.*, **64:** 39 - 44.
51. Sokahl, R.R. and Rholf, F.J. (1969): Practice of Statistics in Research.Freeman, San Francisco.
52. Steel, R.G.D. and Torrie, J.H. (1982). Principles and Procedures of Statistics. 3rd Edn., McGraw-Hill International Book Co., London.
53. Wheeler, V.E. and Ferrel, F.E. (1971). A method of phytic acid determination in wheat fraction. *Cereal Chem.*, 48: 312 - 316.
54. Van-burden, T.P. and Robinson, W.C. 1981. Formation of complexes between protein and tannin acid. *J. Agric. Food Chem.*, 1: 77 - 82.
55. Witham, F.H., Blaydes, D.F. and Devlin, R.N. (1971). Observations on the morphology, *Experim. in plt physiol.* D. Van Nostrand Comp. New York. Pp. 55-56.

Table 1 : Effect of different concentrations of Coconut milk (CM) and Benzyl amino purine (BAP) at 14 weeks after planting on leaf number, stem girth (cm), plant height (cm), shoot / root ratio, leaf area ratio and chlorophyll content (mg/g) of *Amaranthus hybridus* seedlings.

	Treatments				
Parameters	10% CM	15% CM	BAP (50 mg/L)	BAP (100 mg/L)	Control
Leaf number	128^{b}	144^{a}	103^{c}	125^{b}	87^{d}
Stem girth (cm)	3.30^{b}	3.98^{a}	2.87^{c}	3.03^{bc}	1.74^{d}
Plant height (cm)	132^{b}	167^{a}	134^{b}	151^{a}	94^{c}
Shoot/root ratio	1.78^{b}	2.14^{a}	0.98^{d}	1.32^{c}	0.76^{e}
Leaf area ratio	283.1^{ab}	365.5^{a}	264.0^{bc}	228.4^{c}	171.6^{d}
Chlorophyll (mg/g)	2.63^{b}	3.01^{a}	2.60^{b}	2.62^{b}	2.27^{c}

Values followed by different letters in the same row differ significantly (P=0.05) according to Duncan's multiple comparison.

Table 2 : Effect of different concentrations of Coconut milk (CM) and Benzyl amino purine (BAP) at 14 weeks after planting (WAP) on the mineral element contents of *Amaranthus hybridus* seedlings.

	Treatments				
Composition (mg/100g)	10% CM	15% CM	BAP (50 mg/L)	BAP (100 mg/L)	Control
Potassium (K)	50.30^{ab}	53.70^{a}	48.00^{b}	48.80^{ab}	42.50^{c}
Sodium (Na)	7.01^{ab}	7.21^{a}	6.24^{c}	6.33^{bc}	5.50^{d}
Calcium (Ca)	40.30^{ab}	43.01^{a}	33.50^{c}	38.70^{b}	28.80^{d}
Magnesium (Mg)	201.40^{b}	229.30^{a}	173.80^{c}	198.30^{b}	146.40^{d}
Zinc (Zn)	2.78^{b}	3.12^{a}	2.31^{c}	2.44^{c}	1.89^{d}
Iron (Fe)	10.90^{b}	13.30^{a}	6.27^{d}	8.49^{c}	4.90^{e}
Phosphorus (P)	32.29^{a}	34.22^{a}	26.80^{b}	31.00^{a}	23.10^{c}
Na/K	0.14^{a}	0.13^{a}	0.13^{a}	0.13^{a}	0.13^{a}
Ca/P	1.25^{a}	1.26^{a}	1.25^{a}	1.25^{a}	1.25^{a}

Values followed by different letters in the same row differ significantly (P=0.05) according to Duncan's multiple comparison.

Table 3 : Effect of different concentrations of Coconut milk (CM) and Benzyl amino purine (BAP) at 14 weeks after planting (WAP) on the constituents of alkaloids, saponin, tannins, phenols, flavonoid, phytic acid and hydrocyanic acids (mg / 100g dry weight) of *Amaranthus hybridus* seedlings.

	Treatments				
Phytochemicals	10% CM	15% CM	BAP (50 mg/L)	BAP (100 mg/L)	Control
Alkaloids	3.53[ab]	3.55[a]	3.51[b]	3.50[b]	3.50[b]
Saponin	1.64[a]	1.66[a]	1.64[a]	1.63[a]	1.65[a]
Tannins	0.45[a]	0.44[a]	0.44[a]	0.44[a]	0.41[a]
Phenols	0.35[a]	0.36[a]	0.34[a]	0.35[a]	0.33[a]
Flavonoid	0.84[a]	0.85[a]	0.78[a]	0.82[a]	0.80[a]
Phytic acid	1.24[a]	1.25[a]	1.24[a]	1.26[a]	1.13[a]
Hydrocyanic acids	15.30[a]	15.20[a]	14.40[a]	15.10[a]	14.10[a]

Values followed by different letters in the same row differ significantly (P=0.05) according to Duncan's multiple comparison.

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