Journal of Medicinal Plants Studies
www.PlantsJournal.com

ISSN (E): 2320-3862
ISSN (P): 2394-0530
NAAS Rating: 3.53
www.plantsjournal.com
JMPS 2020; 8(4): 257-261

Received: 01-05-2020
Accepted: 03-06-2020

Uka Chiedozie Joel
Department of Botany, Nnamdi Azikiwe University, Awka, Anambra, Nigeria

Okeke Clement Uwabunkeonye
Department of Science Laboratory Technology, Federal Polytechnic, Oko, Anambra State, Nigeria

Muoka Rufina Ogechukwu
Department of Science Laboratory Technology, Federal Polytechnic, Oko, Anambra State, Nigeria

Anukwuorji Chidozie Azubuike
Department of Botany, Nnamdi Azikiwe University, Awka, Anambra, Nigeria

Corresponding Author:
Uka Chiedozie Joel
Department of Botany, Nnamdi Azikiwe University, Awka, Anambra, Nigeria

Comparative phytochemical study of the parts of *Ipomoea* species

Uka Chiedozie Joel, Okeke Clement Uwabunkeonye

Abstract
The present study was aimed to evaluate the phytochemicals present in the different parts of some *Ipomoea* species which are *Ipomoea aquatica, I. asarifolia, I. quamoclit, I. involucrata, I. triloba, I. acanthocarpa,* and *I. hederifolia* (Family-Convolvulaceae). The alkaloids, flavonoids, saponins, phenols and tannins contents of the vegetative parts of these plants viz. the leaves, stems and roots were screened and compared. Result from the phytochemical analyses showed that Alkaloids, Tannins and Steroids were present in all the parts of the seven *Ipomoea* species except in *I. quamoclit* which lacked steroids in all the parts investigated. All the species investigated contained appreciable amount of alkaloids, tannins, flavonoids and saponins ranging from (14.21±0.00% - 23.28±0.13%), (1.02±0.01% - 24.15±0.14%), (0.10±0.00% - 24.02±0.01%) and (0.17±0.01% - 25.05±0.01%) respectively. The result of this research which showed the close affinity of these plants also verify that the parts of the *Ipomoea* species studied possessed bioactive compounds which could be exploited for medicinal purposes.

Keywords: *Ipomoea* species, phytochemistry, medicinal properties, ornamental properties

1. Introduction
Ipomoea is one of the dominant genera within the family Convolvulaceae with approximately 650 species, mainly distributed in tropical and warm temperate regions of the world and known as "morning glories" [1]. Most of the species within this genus are twining climbing plants and include annual and perennial herbs, lianas, shrubs and small trees [1].
The genus *Ipomoea* since time immemorial have been in continuous use for different purposes, such as, nutritional, medicinal, ritual and agricultural. The knowledge constitutes a rich source of ethnomedical information for effective selection of plants to be evaluated by chemical studies [2]. The genus hence has attracted the attention not only of horticulturists but also of several botanists and chemists because of its economic importance and medicinal values [3].
Nigeria is one country rich in raw and useful herbs from which important drugs could be prepared or agents which serve as starting products for the potential synthesis of drugs [4]. Most of these plants used for traditional medicine are equally consumed by humans in Nigeria, but their medicinal values are not determined. According to the review of genus *Ipomoea* by Meira [5] *Ipomoea* species are used in different parts of the world for the treatment of several diseases, such as diabetes, hypertension, dysentery, constipation, fatigue, arthritis, rheumatism, hydrocephaly, meningitis, kidney ailments and inflammations. The phytochemistry of the *Ipomoea* genus has been studied since 1950. Some species of *Ipomoea* showed antimicrobial, analgesic, spasmolitic, spasmogenic, hypotensive, psychotomimetic and anticancer activities. [5].
Phytochemistry is a systematic line of evidence and is so used in combination with other systematic lines of evidence to produce a natural classification. The system of chemotaxonomic classification relies on the chemical similarity of taxon [6, 7].
Flavonoids and saponins are present in a variety of plants utilized as important components of both human and animal diets. These include fruits, seeds, herbs and vegetables [8]. The phenolics, alkaloids, terpenoids and non-protein amino acids, are the four important and widely exploited groups of compounds utilized for chemotaxonomic classification [9]. These groups of compounds exhibit a wide variation in chemical diversity, distribution and function [9, 10].

2. They can be used at all taxonomic levels in most groups of plants
Their most important role may be in plant defence against pathogens and herbivore predators, and thus are applied in the control of human pathogenc infections [11].

They are beneficial to man as powerful anti-oxidants, stress modifiers, anti-allergic agents, anti-viral compounds, stimulant of protein synthesis, anti-inflammatory agents, vaso-propertive activity, diuretic, anti-spasmodic, anti-bacterial and anti-fungal [12].

In Nigeria *Ipomoea* species are often found mostly in the wild while a few are grown for food and for their ornamental properties. However, their medicinal value is yet to be fully exploited. Hence the more reason this study is of utmost importance. Therefore, the present study was conducted to evaluate the phytochemical composition of the parts of *Ipomoea* species and their taxonomic significance within the species.

3. Material and methods

3.1 Collection of Samples

Seven species of the genus *Ipomoea* were collected from the wild; from different locations in Anambra State, Nigeria. They were taxonomically identified and authenticated by comparing the collection with the available specimens deposited in the herbarium of Botany Department, Nnamdi Azikiwe University, Awka and voucher specimens were deposited at the same herbarium.

3.2 Preliminary phytochemical analysis

The species of *Ipomoea* were collected at flowering stage and subjected to different phytochemical tests. The tests carried out were based on standard procedures outlined by [13] and modified by [14] Table 1.

3.3 Preparation of plant extracts for phytochemical analysis

The fresh plant parts, leaves, stems and roots were oven dried for 2 days each for specific hours of 6hrs, 10hrs and 12hrs. The dried samples were ground to fine powder using corona grinding machine. The dried powdered samples were extracted with 95% ethanol. After which the extract was concentrated to dryness and eventually used for the various analyses.

Table 1: Qualitative screening of different phytochemicals

S. No	Name of Phytochemical	Test	Observation
1	Alkaloids	2 ml ethanolic extract + 3 drops of Pirovic acid + mix	Light green colouration.
2	Flavonoids	2 ml ethanolic extract + Conc. Hcl 2 drops + yellow solution	Yellow colouration Turned colourless
3	Tannins	2 ml aqueous extract + 3 ml dist. H_2O + shaken + 2 drops of dilute $FeCl_3$	Very dark ppt.
4	Saponins	2 ml of aqueous extract + 6 ml dist. H_2O + shaken well Aqueous extract + 3 drops of vegetable oil + shaken	Formation of froth Formation of persistent emulsion
5	Glycosides	Aqueous extract + 2 ml of acetic acid + 2 ml chloroform + cooled + Conc. H_2SO_4	Green color
6	Terpenoids	0.5 g extract + 2 ml chloroform + 3 ml conc. H_2SO_4	A reddish brown colouration
7	Phenols	5 mg ethanolic extract+5ml dist. H_2O + 3 drops of neutral 5% $FeCl_3$	Dark green colour
8	Steroids	5 ml ethanolic extract + 2 ml acetic anhydride + 2 ml H_2SO_4	Colour change from Violet to blue or green

The following rankings were be used:
+= Present
-= Absent

3.4 Statistical Analysis

All values were subjected to statistical analysis using SPSS software, 2001 version. F-Test was then used to analyze the data at $p< 0.05$ Duncan's multiple range test (DMRT) was used to separate the means and data were expressed as mean ± standard deviation of triplicate determinations.

3.5 Quantitative determination of the phytochemical constituents of the plants studied

Investigation of the secondary metabolites accumulated in the plants was carried out. The concentration of alkaloids, flavonoids, tannin, saponins and cardiac glycosides, phenols, terpenoids and steroids were determined using the standard methods of [13, 15, 16].

Table 2: Qualitative phytochemical constituents

Taxa		Alkaloids	Tannins	Flavonoids	Saponins	Phenols	Cardica Glycoside	Terpenoids	Steroids
I. aquatica	Leaf	+	+	+	+	-	+	-	+
	Stem	+	+	+	+	-	+	-	+
	Root	+	+	+	+	-	+	-	+
I. asarifolia	Leaf	+	+	+	-	+	-	+	+
	Stem	+	+	+	-	+	-	+	+
	Root	+	+	+	-	+	-	+	+
I. quamoclit	Leaf	+	+	+	-	+	+	+	-
	Stem	+	+	+	-	+	+	+	-
	Root	+	+	+	-	+	+	+	-
I. involucrata	Leaf	+	+	-	+	-	+	-	+
	Stem	+	+	-	+	-	+	-	+
	Root	+	+	-	+	-	+	-	+
I. triloba	Leaf	+	+	+	+	-	-	-	+
	Stem	+	+	+	+	-	-	-	+
	Root	+	+	+	+	-	-	-	+
I. acanthocarpa	Leaf	+	+	+	+	+	-	+	+
	Stem	+	+	+	+	+	-	+	+
	Root	+	+	+	+	+	-	+	+
I. hederifolia	Leaf	+	+	-	+	+	+	-	+
	Stem	+	+	-	+	+	+	-	+
	Root	+	+	-	+	+	+	-	+

KEY
+ = Present
- = Absent

3.6 Quantitative phytochemical constituents

Table 3 showed the quantitative phytochemical composition of the leaves of the seven *Ipomoea* species. It showed that *I. aquatica* contained the highest amount in alkaloids (23.28 ±0. 13[a]), Tannins (24.15 ±0. 14[a]) these values are significantly higher than the values gotten from the other species while *I. quamoclit* contained the highest amount in both Flavonoid (24.01 ±0. 01[a]) and Cardiac glycosides (47.01 ±0. 01[a]) The *Ipomoea* species all had Alkaloids in large amount compared to other chemical components. *I. quamoclit*, *I. involucrata* and *I. triloba* showed low values in Saponins, Phenols, with the values from both *I. aquatica* and *I. involucrata* being significantly lower than others. *I. involucrata* had the lowest Terpenoids content (0.06 ±0.00[g]), while *I. acanthocarpa* had the highest Steroids content (18.2 ±0. 2[a]) which is not significantly higher than that of *I. asarifolia* (18.01 ±0.00[a])

Table 3: Quantitative phytochemical constituents of the leaves of *Ipomoea* spp (%).

Taxa	%Alkaloids	%Tannins	%Flavonoids	%Saponins	%Phenols	%C. Glycosides	%Terpenoids	%Steroids
I. aquatica	23.28 ±0. 13[a]	24.15 ±0. 14[a]	14.51 ±0.00[c]	12.63 ±0.01[d]	0.00 ±0.00[e]	0.48 ±0. 11[d]	0.12 ±0.00[f]	10.1 ±0.00[b]
I. aarifolia	14.80 ±0.00[f]	20.01 ±0. 01[b]	13.02 ±0. 01[d]	0.20 ±0.00[e]	7.51 ±0.00[b]	0.00 ±0.00[f]	10.11 ±0.05[a]	18.01 ±0.00[a]
I. quamoclit	21.20 ±0.00[c]	20.01 ±0.00[b]	24.01 ±0. 01[a]	0.20 ±0.00[e]	7.50 ±0.00[b]	47.01 ±0. 01[a]	9.81 ±0.00[b]	1.21 ±0.00[e]
I. involucrata	20.60 ±0.00[d]	13.04 ±0. 02[d]	1.20 ±0.00[e]	25.06 ±0. 03[a]	0.00 ±0.00[e]	6.73 ±0. 02[b]	0.06 ±0.00[g]	1.63 ±0. 02[d]
I. triloba	20.61 ±0. 01[d]	20.01 ±0. 01[b]	23.02 ±0. 01[b]	20.05 ±0. 01[b]	1.24 ±0. 01[d]	0.26 ±0. 01[e]	0.80 ±0.00[d]	1.53 ±0. 02[d]
I. acanthocarpa	22.81 ±0. 01[b]	13.23 ±0. 07[e]	14.50 ±0. 04[c]	18.01 ±0. 01[c]	20.05 ±0. 03[a]	0.26 ±0.00[e]	7.81 ±0.01[c]	18.2 ±0. 2[a]
I. hederifolia	19.63 ±0. 04[e]	16.00 ±0.00[c]	0.10 ±0.00[f]	18.04 ±0. 03[c]	6.00 ±0.00[c]	6.91 ±0.00[c]	0.40 ±0.00[e]	2.32 ±0. 01[c]

Values are in mean ± Standard deviation of triplicate determinations. Columns with the same letter are not significantly different. *Significant difference is at (p<0.05);

The phytochemical study of the stem of *Ipomoea* as shown in Table 4 showed that all the *Ipomoea* species contained high amount of Alkaloids, tannins and other components in varying amount. *I hederifolia* contained the highest amount of Saponins (23.05 ± 0.00[a]) and Steroids (25.01 ± 0.01[a]) which are both significantly different from the values of the other species. Phenols was absent in *I. triloba* while Cardiac glycosides was absent in *I. involucrata*. *I. involucrata* and *I. triloba* also showed small amount of Terpenoids (0.03 ± 0.00[f]) and (0.02 ± 0.00[f]) which are not significantly different.

Table 4: Quantitative constituents of the stems of *Ipomoea* spp (%).

Taxa	%Alkaloids	%Tannins	%Flavonoids	%Saponins	%Phenols	%C. Glycosides	%Terpenoids	%Steroids
I. aquatica	21.52 ± 0.01[c]	22.12 ± 0.02[a]	15.81 ± 0.01[c]	10.11 ± 0.01[e]	0.11 ± 0.00[e]	7.33 ± 0.00[ab]	0.11 ± 0.00[e]	10.10 ± 0.00[e]
I. aarifolia	15.30 ± 0.00[g]	18.80 ± 0.00[c]	11.81 ± 0.00[e]	0.17 ± 0.00[g]	7.02 ± 0.01[b]	0.06 ± 0.00[c]	10.40 ± 0.00[a]	17.10 ± 0.00[c]
I. quamoclit	19.01 ± 0.01[f]	20.00 ± 0.00[b]	24.02 ± 0.01[a]	0.20 ± 0.00[f]	1.32 ± 0.01[c]	4.81 ± 0.00[b]	8.40 ± 0.00[b]	19.02 ± 0.00[b]
I. involucrata	21.50 ± 0.0[d]	1.02 ± 0.01[g]	20.00 ± 0.00[b]	13.89 ± 0.01[d]	1.00 ± 0.00[d]	0.00 ± 0.00[c]	0.03 ± 0.00[f]	8.52 ± 0.01[f]
I. triloba	19.90 ± 0.00[e]	14.00 ± 0.00[e]	0.93 ± 0.02[f]	23.01 ± 0.01[b]	0.00 ± 0.00[f]	5.21 ± 2.24[b]	0.02 ± 0.00[f]	1.31 ± 0.00[g]
I. acanthocarpa	21.92 ± 0.01[b]	12.93 ± 0.00[f]	13.62 ± 0.02[d]	18.71 ± 0.01[c]	21.07 ± 0.03[a]	0.23 ± 0.00[c]	6.31 ± 0.01[c]	16.91 ± 0.01[d]
I. hederifolia	22.03 ± 0.01[a]	17.00 ± 0.00[d]	0.75 ± 0.00[g]	23.05 ± 0.00[a]	7.04 ± 0.01[b]	8.10 ± 0.00[a]	0.64 ± 0.01[d]	25.01 ± 0.01[a]

Values are in mean ± Standard deviation of triplicate determinations. Columns with the same letter are not significantly different. *Significant difference is at (p<0.05);

All the species contained the phytochemical components tested except *I. involucrata*, *I. triloba* and *I. aquatica* which showed absence of phenols, Table 5. Alkaloids and Tannins were in high concentration in all the species. *I hederifolia* contained the highest amount of alkaloids (21.50 ± 0.00[a]) and Steroids (26.01 ± 0.00[a]) which were significantly different from others, while *I. quamoclit* contained the highest in Flavonoids (20.02 ± 0.00[b]). *I. involucrata* and *I. triloba* showed same amount in Cardiac glycosides (5.21 ± 2.24[a]), Terpenoids (0.02 ± 0.00[f]) and Steroids (1.31 ± 0.00[f])

Table 5: Quantitative phytochemical constituents of the roots of *Ipomoea* spp (%).

Taxa	%Alkaloids	%Tannins	%Flavonoids	%Saponins	%Phenols	%C. Glycosides	%Terpenoids	%Steroids
I. aquatica	20.47 ± 0.36[b]	23.01 ± 0.01[a]	16.31 ± 0.01[b]	11.44 ± 0.02[d]	0.00 ± 0.00[e]	8.31 ± 0.01[a]	0.16 ± 0.00[e]	11.17 ± 0.03[d]
I. aarifolia	14.21 ± 0.00[e]	19.21 ± 0.01[c]	12.71 ± 0.01[d]	0.20 ± 0.00[f]	7.21 ± 0.00[d]	0.14 ± 0.03[b]	9.30 ± 0.00[a]	16.92 ± 0.01[c]
I. quamoclit	18.03 ± 0.00[d]	20.02 ± 0.00[b]	22.00 ± 0.00[a]	0.42 ± 0.01[e]	9.01 ± 0.00[b]	5.00 ± 0.00[a]	8.01 ± 0.01[b]	1.50 ± 0.00[e]
I. involucrata	19.90 ± 0.00[c]	14.00 ± 0.00[e]	0.93 ± 0.02[e]	23.01 ± 0.01[a]	0.00 ± 0.00[e]	5.21 ± 2.24[a]	0.02 ± 0.00[f]	1.31 ± 0.00[f]
I. triloba	19.90 ± 0.00[c]	14.00 ± 0.00[e]	0.93 ± 0.02[e]	23.01 ± 0.01[a]	0.00 ± 0.00[e]	5.21 ± 2.24[a]	0.02 ± 0.00[f]	1.31 ± 0.00[f]
I. acanthocarpa	20.73 ± 0.02[b]	12.14 ± 0.01[f]	15.31 ± 0.01[c]	16.18 ± 0.13[c]	18.25 ± 0.03[a]	0.16 ± 0.00[b]	5.91 ± 0.00[c]	17.52 ± 0.02[b]
I. hederifolia	21.50 ± 0.00[a]	15.08 ± 0.01[d]	0.81 ± 0.00[f]	20.02 ± 0.02[b]	8.02 ± 0.01[c]	7.30 ± 0.00[a]	0.45 ± 0.00[d]	26.01 ± 0.00[a]

Values are in mean ± Standard deviation of triplicate determinations. Columns with the same letter are not significantly different. *Significant difference is at (p<0.05)

4. Discussion

Phytochemical screening of the leaves, roots and stems of these seven *Ipomoea* species showed the presence of alkaloids and tannins in the three different parts of *I. aquatica* and *I. asarifolia* while *I. quamoclit*, *I. involucrata*, *I. triloba*, *I. acanthocarpa* and *I. hederifolia* showed presence and absence of these phytochemicals. Terpenoids were absent in all the species except in *I. asarifolia*, *I. quamoclit* and *I. acanthocarpa* (Table 2). This study agrees with the work of Essiett and Obioboho [17] and Mascarenhas *et al.* [18] who reported the presence of these phytochemicals in *Ipomoea* species**.** The presence of secondary metabolites shows the resourcefulness of a plant for medicinal use. The presence and absence of the same phytochemicals in the different plant parts authenticates the use of the whole plant ethno botanically in Nigeria. The antimicrobial effect of plant extracts could be due to the presence of some of these phyto-constituents [19, 20, 21]. According to Ebana [21] Plants used in

the treatment of diseases are said to contain active principles which are phytochemicals with biological activity, some of which are responsible for the characteristic odours, pungencies and colours of plants while others give a particular plant its culinary, medicinal or poisonous virtues [12].

The species showed an appreciable amount of Alkaloids (21. 20.47 ± 0.36^{b}), (14.21 ± 0.00^{e}), (18.03 ± 0.00^{d}), (19.90 ± 0.00^{c}), (19.90 ± 0.00^{c}), (20.73 ± 0.02^{b}), (21.50 ± 0.00^{a}) in the leaves, stem and roots. This is not a surprise as the genus is well known for the content of ergot type alkaloids. This is also in agreement with Meira [5] who said that some members of this genus (*Ipomoea*) contain alkaloids. Several species of *Ipomoea* are used as hallucinogenics. Some of them were used in pre-Columbian times by ancient people to attain a state of mind suitable for divination during religious ceremonies and magical healing practices [22, 23]. The presence of alkaloids and tannins in all the parts of the *Ipomoea* species studied shows their relatedness.

Many herbivores avoid morning glories like *Ipomoea*, as the high alkaloid content makes these plants unpalatable, if not toxic [24].

Alkaloids present in these taxa however contradicts the work of Essiett and Ukpong [25], who said that alkaloids were absent in the stem of *I. involucrata* and *I. triloba.*

The leaf and root of *I. aquatica* contained the highest amount of Tannins (24.15 ±0. 14^{a}, 23.01 ± 0.01^{a} and 22.12 ± 0.02^{a} %), followed by the root of *I. quamoclit* (20.02 ± 0.00^{b} %). The presence of tannins in these plants may also be the reason why most animals do not graze on the plant. This supports the opinion of [13], who pointed out that tannins have anti-herbivore function in plants and inhibit pathogenic fungi [26] Tannins also have the potential to bind to complex divalent ions such as Zinc, Iron and Copper, resulting in their unavailability [27] and have been reported to form complexes with digestive enzymes, thus reducing the digestibility of proteins in the food.

Flavonoids, steroids and saponins showed varied amount in these plants with *I. quamoclit* containing the highest amount (24.02 ± 0.01^{a}) in the stem. Flavonoids have been reported to be water soluble antioxidant and are free radical scavengers. They prevent oxidative cell damage and are anti-carcinogenic [28].

Okwu [27] also opined that its presence in the intestinal tract reduces the risk of heart diseases while preventing inflammation. These therapeutic activities of flavonoids had been confirmed by [29]. The presence of flavonoids in the present study could be attributed to its use in treating migraine headaches, tumor, aneamia [30].

The Saponins content of these species is in line with the opinion of Houghton *et al.*, [31] who noted that saponin is in trace quantity in the plant species. Saponins are often referred to as natural detergent because of their foamy nature and have anti-carcinogenic properties, immune modulation activities and regulation of cell proliferation as well as health benefit such as inhibition of the growth of cancer cells and cholesterol lowering activity [32].

Generally *Ipomoea* species have none or low Terpenoid content with the highest found in the stem of *I. asarifolia* (10.40 ± 0.00^{a} %). Cardiac glycoside was also generally present in these species.

The role of Cardiac glycosides in the correction of heart disorders as well as the slowing and strengthening effect it possesses on failing hearts has been well documented [14]. This phytochemical was abundant in the leaf of *I. quamoclit*, trace or absent in others. The presence of this compound in *I. quamoclit* leaf could be useful in the treatment of diseases associated with the heart [14, 33].

The presence of phenolic compound in the plants proves they have anti-microbial and anti-fungal effect [34]. Also plants that contain phenols could be used as anti-inflammatory, immune enhancers and hormone modulators [35].

4.1 Conclusion

According to the result of this study, the extracts of these species contained the majority of the phytochemicals tested and quantified. Especially alkaloid, tannins and steroid which are found in almost all the parts of the plants. The presence of these phytochemicals shows their affinity and potential as medicinal plants. Despite their medicinal potentials care should be taken in their use due to their hallucinogenic and toxic properties. To get the best out of these *Ipomoea* species there is need for further studies in order to isolate, identify, characterize and elucidate the structures of these bioactive principles, this will increase their value and use by native people in Nigeria and pharmaceutical companies as raw material in the production of drugs.

5. References

1. Marbberley DJ. The Plant-Book. A portable dictionary of plants, their classification and uses, Third Edition, Cambridge University Press, India, 2008, 1021 pp.
2. Pereda-Miranda R, Bah M. Biodynamic constituents in the Mexican morning glories: purgative remedies transcending boundaries. Current Topics in Medical Chemistry. 2003; 3:111-131.
3. Patel BB, Rane VA, George. Karyotype Analysis of Ten Species of Ipomoea. *Cytologia*. 2012; 77(2):239-249.
4. Sofowora A. Medicinal Plants and Traditional Medicine in Africa, 2nd Edition, Spectrum Books Limited (Publisher), Ibadan, Nigeria, 1993, 134-156.
5. Meira M, Pereira E, Jorge M, David P, Jucent P. Review of the genus *Ipomoea*: Traditional Uses, Chemistry and Biological Activities. Brazilian Journal of Pharmacy. 2012; 22:682-713.
6. Atal CK. Cultivation and Utilization of Aromatic Plants, 1st ed, Council of Scientific and Industrial Research, New Delhi, 1982, 15-21.
7. Rasool R, Ganai BA, Akbar S, Kamili AN, Masood A. Phytochemical screening of *Prunella vulgaris* l. – an important medicinal plant of Kashmir. Pakistan Journal of Pharmaceutical Science. 2010, 23:399-40.
8. Okwu DE. Phytochemical, vitamins and mineral contents of two Nigerian medicinal plants. Journal of Molecular Medicine and Advance Science. 2005, 1:378-381.
9. Smith PM. The Chemotaxonomy of plants London, Edward Arnold, 1976, 313.
10. Hegnauer R. Phytochemistry and Plant taxonomy-an essay on the Chemotaxonomy of higher plants. Photochemistry. 1986; 25:1519-1535.
11. Pwupponen-Pimia R, Nohynek L, Amman S, Oksman-Caldentey K, Buchert J. Enzyme Assisted Proccessing Increases Anti-microbial and Anti-oxidadant Activities of Billberry. Journal of Agricultural Food Chemistry. 2008; 56:681-688.
12. Evans WC. Trease and Evan's Pharmacognosy. 5th edition, Haarcourt Brace and Company, 2002, 336p.
13. Harborne JB. Phytochemical Methods. A Guide to Modern Techniques of Plant Analysis. 3rd Edn., Chapman and Hall publishing, London, United Kingdom, 1998,

67pp.
14. Trease and Evans. Pharmacognosy 16th edition, W.B. Saunders company Ltd. Landon, 1996, 256-276.
15. Indumathi C, Durgadevi G, Nithyavani S, Gayathri PK. Estimation of Terpenoid content and its antimicrobial property in *Enicostemma litorale*. International Journal of ChemTech Research. 2014; (9):4264-4267
16. Pearson D. Laboratory Techniques in Food Analysis: the Butterworth Group. London, 1976, 22-25.
17. Essiett UA, Obioboho GE. Phytochemical, Nutrients and Antinutrients of the *Ipomoea triloba*, *Ipomoea batatas* and *Ipomoea involucrata* leaves. International Journal of Research. 2014; 1(11):1412-1418.
18. Mascarenhas ME, Cibani Ramesh Mandrekar, Pratiksha Bharat Marathe, Luena Joey Morais. Phytochemical screening of selected species from Convolvulaceae. International Journal of Current Pharmaceutical Research. 2017; 9(6):94-97
19. Sofowora A. Medicinal Plant and Traditional Medicine in Africa II. John Wiley Chiechester, 1986, 178 pp.
20. Cushnie TP, Lamb AJ. Antimicrobial activities of flavonoids. International Journal of Antimicrobial Agents. 2005; 26:343.
21. Ebana RUB, Madunagu BE, Ekpe ED. Microbiological exploitation of cardiac glycosides and alkaloids from *Garcinia kola*, *Borreli ocymoides*, *Kola nitida Citrus aurantifolia* Journal Applied Bacteriology. 2005; 71:398-401.
22. Taber WA, Vinig LC, Heacock RA. Clavine and lysergic acid alkaloids in varieties of morning glory. Phytochemistry. 1963; 2:65-70.
23. Daló N, Moussatché H. Acción tóxica de las plantas del género *Ipomoeas*. Tarea Común. Rev Universidad Centro Occidental. 1978; 6:25-39.
24. Pandurangan A, Kavita R. A mini review on chemistry and biology of *Ipomoea hederifolia* linn. (Convolvulaceae) Global Journal of Pharmaceutical Education and Research. 2015; 4:1-2.
25. Essiett UA, Ukpong UJ. Comparative Phytochemical, Nutrient and Anti-Nutrient of Stems of *Ipomoea Involucrata* Beauv, *Ipomoea. triloba* L. and *Ipomoea batatas* Lam. American Journal of Food and Nutrition. 2014; 2(4):71-76.
26. Edeoga HO, Eriata DO. Alkaloid, Tannin and Saponins contents of some medicinal Plants. Journal of Medicinal Aromatic Plant Sciences. 2001; 3:344-349.
27. Okwu DE. Phytochemicals and vitamins content of indigenous spices of SouthEastern Nigeria. Journal of Sustainable Agriculture and Environment. 2004; 6:30-34.
28. Pietta PG. Flavonoids as Antioxidants. Journal of Natural Product. 2000, 63 (7):1035-1042.
29. Essiett UA, Bala DN, Agbakahi JA. Pharmacognotic studies of the leaves and stem of *Diodia scandens* SW in Nigeria. Archives of Applied Science Research. 2010; 2(5):124-198.
30. Burkill HM. The Useful Plants of West Tropical Africa. Families A-D. Royal Botanical Garden, Kew, 1985, 2:960pp
31. Houghton PJ, Woldermarian TZ, O'Shea S, Thyagarajan SP. Two *securinega* type alkaloids from *Phyllanthus amarus*, Photochemistry. 1996; 43:715-717.
32. Jimoh FO, Oladji AT. Preliminary studies on *Pilostigma thonningii* seed: proximate analysis, medicinal composition and phytochemical screening, African Journal of Biotechnology. 2005; 4(12):1439-1442.
33. Anyasor GN, Aina DA, Olushola M, Aniyikaye AF. Phytochemical constituent, proximate analysis, antioxidant, antibacterial and wound healing properties of leaf extracts of Chromolaena odorata. Available online at www.scholarsrearchlibrary.com, 2011.
34. Huang MT, Ferraro T. Phenolic compounds in food and cancer prevention in phenolic compounds in food in the effects of health II. In: Huang, M. T., H.O.C.T., C. T. (Eds): Acs Symposium Series 507; American Chemical Society, Washington, 1992.
35. Okwu DE, Omodamiro OD. Effect of hexane extract and phytochemical content of *Xylopia aethiopica* and *Ocimum gratissimum* in uterus of guinea pig. Biological Research. 2005; 3:40-44.