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Phytochemistry of *Andrographis paniculata* (Burm F.) Wall. ex Nees

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Abstract

The practice of modern-day medicines is on the increase, which results in the replacement of traditional methods. Medical research which has been conducted recently started delving into the complete chemical characterization of many medicinal plants available and analyzing the different classes of phytochemicals such as alkaloids, steroids, flavonoids, phenols, tannins, and terpenoids. *Andrographis paniculata* (Burm F.) have been known extensively for pharmacological activities, such as analgesic, anticancer, antidiabetic, antifertility, anti-inflammatory, antimalarial, antimicrobial, antioxidant, antipyretic, antiretroviral, antivenom, cardioprotective, hepatoprotective and immunomodulatory, etc. In this study, phytochemical analysis was quantitatively carried out on the leaves of *A. paniculata* to determine the chemical constituents of the plant. Results of the study indicate that the plant contains a very high percentage of Alkaloids (63.75%), high percentage of flavonoids (23.01%), moderate percentage of tannin (4.57%). Phenol (0.51%), saponin (2.87%), glycoside (0.45%), steroids (0.50%), terpenoids (0.30%), anthracyanin (3.32%), carotenoids (1.72%) were in trace amount. The presence of the metabolites observed in this study confirms the usefulness of *Andrographis paniculata* to treat various diseases in ethnobotany, use as food, and as a potential source of raw materials for drug production.

Keywords: Andrographis paniculata, photochemical, ethnobotany.

Introduction

INTRODUCTION

The practice of ethnobotany requires the correlation between humans and plants; however, the tendency of the term entails the study of native or traditional knowledge of plants. It involves the natural knowledge of plant classification, cultivation, likewise food, medicine, and shelter. The introduction of medicinal practices and modern-day plant medicines is considered to increase, which leads to the gradual substitution of traditional methods (Yuan *et al.*, 2016). Additionally, treatment with indigenous folk medicines focused on the implementation of plants by the local communities and has been proficient for centuries. It goes down from generation to generation, especially among those who live in isolated areas where health services and health practitioners are unavailable (Aziz *et al*., 2018 Suba *et al.*, 2019).

Recently, there are medical explorations into the chemical characterization of a wide range of medicinal plants available. Yearly a wide range of secondary metabolites are obtained from approximately 50,000 plant species and also, 4,000 new secondary metabolites are isolated from a broad selection of plant species. These phytochemicals have been allowed in human healthcare (as antioxidants, drugs) and used for agricultural purposes (as insecticides) (Bunty *et al.,* 2019).

Plants have always been known as a very good source of antiviral drugs in traditional medicine to treat viral infections. One of such medicinal plants with numerous profitable attributes is *Andrographis paniculata* (Burm.f.). It is a herbal medicine belonging to the family Acanthaceae and is commonly identified as 'Kalmegh' in India and 'King of Bitters' in Asia. It is widely grown or farmed across Europe, Asia, Africa, and is useful in managing diverse diseases (Kumar *et al.,* 2020; Jiashu *et al.,* 2019; Lalitha et al. 2015). *A. paniculata* is indigenous to India and Sri Lanka, extensively dispersed in China, Cambodia, the Caribbean, Indonesia, Laos, Malaysia, Thailand, Taiwan, and Vietnam (Sithara et al. 2016; Jiao *et al.,* 2019). Also, very useful in treating snakebite and poisonous stings of insects, fevers (like malaria, dengue), diarrhea, flu, skin diseases, upper respiratory infections, using traditional means (Jiao *et al.,* 2019; Nayak *et al.,* 2020). The function of andrographolide having a biological effect of *A. paniculata* was emphasized in a study to be a reduction of acute brain injury in Wistar rats (Tao *et al.,* 2018), reduction of neurological fiscal in mice, and good antiviral potency (Daneman and Prat., 2015). The unprocessed state of *A. paniculata* has been notified for its vast nature of pharmacological activities, such as analgesic, anticancer, antidiabetic, antifertility, anti-inflammatory, antimalarial, antimicrobial, antioxidant, antipyretic, antiretroviral, antivenom, cardioprotective, hepatoprotective and immunomodulatory, etc. Different groups have also evaluated the artificial environment and within the antineoplastic and immunomodulatory activity of *A. paniculata* (Suzuki *et al.,* 2016; Li *et al.,* 2017). In correspondence to studies, terpenoid lactones and flavonoids are the important classes of compounds reported in different parts of the plant (Matsuura and Fett-Neto 2015 Chandra *et a*l., 2016). Thus, this study is aimed at evaluating the ethnobotanical, phytochemistry, and pharmacological uses of *Andrographis paniculata.*

MATERIALS AND METHODS

Sample source

Plant samples were obtained from Mbiaso village, Ikot-Ekpene LGA, Akwa Ibom State. Situated at 5.18º North latitude, 7.71º East longitude, and 159 meters elevation above the sea level. The leaves were washed under running tap water to remove the surface pollutants, then cut into small pieces and sun-dried for 14 days. Samples were then macerated using an electric blender and stored in a transpirable container before analysis.

Phytochemical screening

The qualitative and quantitative phytochemical analysis of the plant extract was examined using the parameters that were tested for including; Tannins, Saponins, Flavonoids, Cardiac, Glycosides, Alkaloids, Steroids, etc. Glucosides were determined with 1ml of the test solution and 2drops of Concentrated Sulphuric acid added to a glass tube and placed in a water bath for about 15mins. 20% KOH was added to make the solution Alkaline. To this solution, little drops of $FeCl_2$ were added. The formation of a brick-red precipitate indicates the presence of glucosides. Alkaloids were determined with 1mg of dried extract dissolved in 6 drops of 2%

hydrochloric acid. The solution was divided into 3 aliquots, to the first position which acted as a reference, 2ml of distilled water was added. To the second test tube, 2 drops of drangendorff's reagent with basic Bismuth nitrate was added. A precipitate was formed indicating the presence of alkaloids. Flavonoids were determined with the Shinoda test, while standard methods were employed in the determination of tannins,saponins, steroids, phenols, carotenoids, oxalates, phytates Anthocyanine and terpenoids AOAC (2012); Ikpeama et al. (2015).

Results

Qualitative Determination of Phytochemical Constituents of *Andrographis paniculata.*

The qualitative phytochemical analysis carried out on leaves of *Andrographis paniculata* showed the number of chemical constituents in the plant and is determined that the plants contain a very high amount of Alkaloids and Flavonoids, a moderate amount of tannin, and a trace amount of phenol, saponin, glycosides, steroids, terpenoids, anthracyanins and carotenoids as seen in Table 1

TABLE 1: Qualitative results for pythochemical analysis for *Andrographis paniculata*

S/N	PARAMETERS	INTERFERENCE
1	Alkaloids	+++
2	Phenol	+
3	Tannin	++
4	Flavonoids	+++
5	Saponin	+
6	Glycoside	+
7	Steriods	+
8	Terpenoids	+
9	Anthracyanin	+
10	Carotenoids	+

Results are expressed as mean of three replicates where: + = present in trace amount, ++ = moderately high, +++ = present in high amount.

Quantitative Determination of Phytochemical Constituents of *Andrographis paniculata*

The quantitative phytochemical analysis carried out on the leaves of *Andrographis paniculata* showed the number of chemical constituents in the plant and determined that the plant contains a very high percentage of Alkaloids (63.75%), a high percentage of flavonoids (23.01%), moderate percentage of tannin (4.57%). Phenol (0.51%), saponin (2.87%), glycoside (0.45%), steroids (0.50%), terpenoids (0.30%), anthracyanin (3.32%), carotenoids (1.72%) were in trace amount as shown in table 2.

S/N	PARAMETERS	PERCENTAGE (%)
1	Alkaloids	63.75
2	Phenols	0.51
3	Tannin	4.57
4	Flavonoids	25.01
5	Saponin	2.87
6	Glycoside	0.45
7	Steriods	0.50
8	Terpenoids	0.30
9	Anthracyanin	3.32
10	Carotenoids	1.72

Results are expressed as mean of three replicates.

Phytochemical Content (%) *Andrographis paniculata* Leaves

The qualitative and quantitative phytochemical analysis carried out on the leaves of *A. panuculata* shows that itcontains a very high amount of Alkaloids and Flavonoids, a moderate amount of tannin, and a trace amount of phenol, saponin, glycoside, steroids, terpenoids, anthracyanin and carotenoids as graphica

TABLE 2: QUANTITATIVE RESULT FOR PHYTOCHEMICAL ANALYSIS OF *Andrographis paniculate.*

lly shown in fig 1.

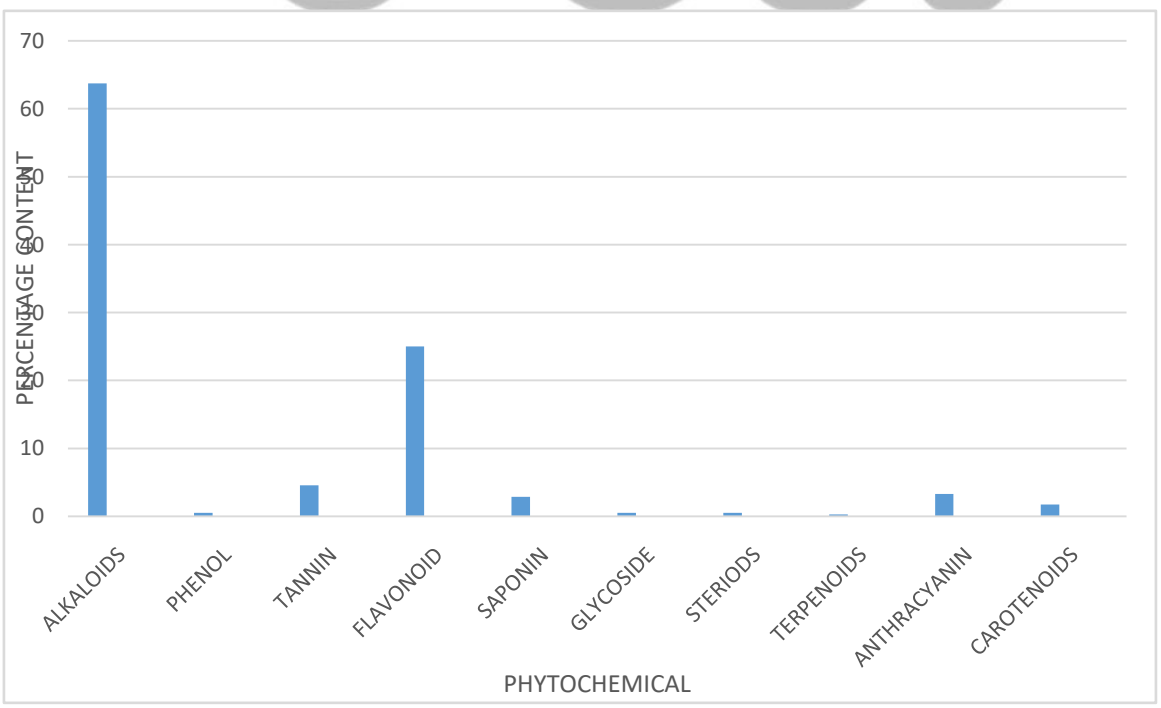

Fig 1: Phytochemical content (%) in *Andrographis paniculate*

DISCUSSION

This study identified a number of phytoactive compounds such as flavonoids, alkaloids, tannin, saponin, glycoside, phenol, etc, which have been previously known as antimicrobial compounds (Othman et al., 2019, Umar et al., 2019). They have been extensively used in disinfection and remained the standard with which other bactericides are compared (Ogbunugafor et al., 2017). Also, alkaloids and flavonoids are used as basic medicinal agents for their bactericidal, analgesic, and antispasmodic effects (Jigam et al., 2017, Umar et al 2019). These phytochemicals may be acting singly or synergistically with each other to bring about a cidal, or static effect on microorganisms, while anti-inflammatory and analgesic properties on man (Dhananjay and Manyuri 2015; Ikpeama *et al.,* 2015; Karuna *et al.,* 2018a; Karuna *et al.,* 2018b; Kundu *et al.,* 2019 Yusuf et al., 2018).

Medicinal properties of *A. paniculata* was confirmed in this study, previous studies suggest it could be used in curing headache associated with hypertension, management of cold, chronic catarrh, and migraine (Ikpeama *et al.,* 2015).

Alkaloids recorded from extracts in this study was high (63%) they acts as an anti-cancer agent by stopping cell progression and actively kill dividing cells (Abduyeva-Ismayilova, 2016; Nomura and Shiina, 2016; Arbab et al. 2017; Nada *et al.,* 2017). Alkaloids can also be used in the production of drugs as they have shown extensive therapeutic effect on diabetics (Hassan *et al.,* 2020).

Phenol is known for its sour and bitter properties in plant which is recommended and considered healthy for consumption (Pagliarini *et al.,* 2021). The state of a specific ecosystem might cause variation in the concentration of phenol in plants (Dragovic *et al.,* 2020). Nagajothi *et al.,* (2018), in their results, states that phenol was lower in the leaves of *Andrographis paniculata* which is also equivalent to these findings which might also be a result of environmental conditions including temperature and precipitation. Tannin was found to be moderately high in this study which may be related to the results of (Priyoatmojo *et al.,* 2021) than that of (Nagajothi *et al.,*2018; Yusuf *et al.,* 2018). The major biological activity of tannin is the binding of proteins by plants which may also depend on the plant's nutrients.

Flavonoids, in this study were found to be in high quantity which is in agreement with the findings of (Panche et al. 2016; Sharika *et al.,* 2019). It is known to have anti-inflammatory, antiviral, antimicrobial pharmological activities. Saponin, glycoside, steroids, terpenoids, anthracyanin, and carotenoids in this study were found in trace amounts which is related to the findings of (Olatunji *et al.,* 2018). Yatoo *et al., (*2018) reported a high amount of natural concentration of steroids in *A. paniculata.* This may be due to ability of the plant species to biosynthesize them and availability of required substrates for their production from the environment.

CONCLUSION

Andrographis paniculata, as a well-known Asian herbal medicine, is widely used around the world. This study evaluated the ethnobotanical, ethnopharmacological, phytochemical and antiviral properties and toxicological uses of *A. paniculata*. The bioactive compounds and chemical components from *A. paniculata* have been known. The results obtained from this study suggest that *A. paniculata* has a wide range of phytochemical components that may be beneficial in managing a range of ailments.

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