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Comparative reviews on phytochemical components of *Andrographis paniculata*

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Abstract
Comparative study was attempted to investigate the effects of locations (Ibadan 1, India, Ibadan 2 and Malaysia as A, B, C, & D), harvesting periods (January, June and September), drying methods (air, sun and Oven dry) and solvents (Methanol, Ethanol+ Water, Ethyl-acetate, Petroleum ether, Aqeuous/water, on the quality of phytochemicals in *A. paniculata* using standard methods to determine 9 phytochemicals: Tannins, Glycosides, Saponins, Flavonoids, Phenols, Alkaloids, Terpenoids, Steroids and Carbohydrates. Sample A: had 4 (Flavonoids, Steroids, Phenols and Alkaloids, and Tannins, Carbohydrates were slightly present (2), Glycosides, Saponins and Terpenoids were absent. Sample B: all the six phytochemicals Tannins, Flavonoids, Steroids, Carbonhydrates, Alkaloids and Terpenoids were slightly present. Sample C: 6 phytochemicals were present (Tannins, Saponins, Flavonoids, Steroids, Phenols, Carbohydrates and Alkaloids), while Carbohydrates was absent Sample D: Tannins, Glycosides, Saponins, Flavonoids, Phenols, Alkaloids and Terpenoids were present while Steroids and Carbohydrates were absent. From the study, sample D (Malaysia) had the highest quality of phytochemicals, followed by C; A while B (India) had the least. *A. paniculata* likes hot humid weather (summer), in Malaysia (June to August) while autumn last from September to December. In Nigeria: April to October while autumn (dry season): November to March, India, April to October to November. All the factors in sample D were observed to be good for the preservation of phytochemicals in the plant. The solvents (Methanol and aqueous), drying methods (Oven drying) and period harvested (early autumn) were good for extraction of high quality of phytochemicals in *A. paniculata*.

Keywords: comparative studies, phytochemical, components, reviews, *Andrographis paniculata*

Introduction
Andrographis paniculata is a plant with weak stem (Plate 1a) much branched and broken easily (Plates 1 b &c). The plant is usually collected from wild sources for domestic utilization and its nurturing is restricted only to gardens especially maintained by the traditional users of medicinal plants in traditional system of medicine. Value of the remedy to the industry is contradictory due to large disparity in environmental situation at different locations of the material. This paper seeks to investigate the effects of locations (Ibadan 1, India, Ibadan 2 and Malaysia as A, B, C, & D), harvesting periods (January, June and September), drying methods (air, sun and Oven dry) and solvents (Methanol, Ethanol+ Water, Ethyl-acetate, Petroleum ether, Aqeuous/water, on the quality of phytochemicals in *A. paniculata.*

Plate 1: (a) Habit of *A. paniculata*; (b) Flowers of *A. paniculata*; (c) Stem branching of *Andrographis paniculate*

Materials and Methods
Collection of *Andrographis paniculata* was done in four different sources using different solvents to determine presence of different constituents. (a) Fresh shoots were gathered from the University of Ibadan, air dried and sun dried separately and labeled. 100g each of sample were dissolved separately in methanol+water in ratio 80:20 and the extract obtained from was screened to determine the presence of Phenols, Flavonoids, Steroids, Alkaloids, Resins, Tannins and Carbohydrates. (b)The shoots were collected in the month of January from residential garden in India. The leaves were air dried and 200g of the leaves were extracted with 2000ml of method and subjected to phytochemical screening. *Andrographis paniculata* was obtained in September by Kemaman in Terengganu, Malaysia. (c)The plant was dried at 40^0C and grinded into powdered form. 100g of powered plant was weighed and soaked in different solvent (Methanol, ethyl acetate, ethanol: water (1:1v/v) and aqueous) in a ratio of 1:10 respectively. (d) Fresh shoots of *Andrographis paniculata* were gathered from Abadina College, University of Ibadan. The shoots were air dried and grinded into fine powder. 100g of the powdered leaves weighed and 400mls of each solvent (ethanol, Methanol and water) was added in ratio. *A. paniculata* leaves extract were screened for various constituents and result

Results and Discussions
Nine phytochemicals were studied (tested): Tannins, Glycosides, Saponins, Flavonoids, Phenols, Alkaloids, Terpenoids, Steroids

and Carbohydrates. Sample A: All the 9 phytochemicals were tested. 4 were present (Flavonoids, Steroids, Phenols and Alkaloids, Tannins and Carbohydrates were slightly present (2). 3 were absent (Glycosides, Saponins and Terpenoids). Sample B: Six phytochemicals were tested:Tannins, Flavonoids, Steroids, Carbonhydrates, Alkaloids and Terpenoids. All the six phytochemicals were slightly present.Sample C: Seven phytochemicals were tested (Tannins, Saponins, Flavonoids, Steroids, Phenols, Carbohydrates and Alkaloids), 6 were present while Carbohydrates was absent while Glycosides and Terpenoids were not tested. Sample D: Seven phytochemicals were testedand found present: Tannins, Glycosides, Saponins, Flavonoids, Phenols, Alkaloids and Terpenoids while Steroids and Carbohydrates were absent. From the study above shows that, Sample D collected from Malaysia had the highest number of phytochemicals present (7), followed by sample C collected from Ibadan which has 7 phytochemicals tested, 6 present and one absent, followed by Sample A collected from Ibadan Reviews have shown that there are variability in the quality and quantity of phytochemicals in *A. paniculata.* The results obtained were presented in Table 1. The variability from the comparative study is in line with previous report of Phosphane *et al.* and Fitzloff (2004). Dhananjay *et al.* (2015) carried out phytochemical screening on the shoot of *Andrographis paniculata.* The shoots were gathered in the month of January from residential garden in India. The leaves were air dried and 200g of the leaves were extracted with 2000ml of method and subjected to phytochemical screening, the result obtained was shown in the Table 1. *Andrographis paniculata* was obtained in September by Kemaman in Terengganu, Malaysia. The plant was dried at 40^0C and grinded into powdered form. 100g of powered plant was weighed and soaked in different solvent (Methanol, ethyl acetate, ethanol: water (1:1v/v) and aqueous) in a ratio of 1:10 respectively. The result of the phytochemical screening of various extract of the plant is shown in the Table 1. Adegboyega and Oyewole (2015) [1] also carried out the phytochemical screening on the shoot extract of *A. paniculata*. Fresh shoots of *Andrographis paniculata* were collected from Albadina College, University of Ibadan. The leaves were air dried and grinded into fine powder. 100g of the powdered leaves weighed and 400mls of each solvent (ethanol, Methanol and water) was added in ratio. *A. paniculata* leaves extract were screened for various constituents and result is presented as follows Table 1. The result obtained from this research work was compared with previous works

Table 1: Comparative Studies on Phytochemical Analysis of *A. paniculata*

	Factors Phytochemicals													Author/Year
	Locations	**Harvesting periods**	**Drying methods**	**Solvents used**	**Tannins**	**Glycosides**	**Saponins**	**Flavonoid**	**Steroids**	**Phenols**	**Carbo-hydrate**	**Alkaloids**	**Terpenoid**	
A	**Ibadan 1**	September	Air dry	Methanol + Waters	-	-	-	+ +	+ +	+	+	+	_	Bello&Adesiyan (2017)
			Sun dry		+	-	-	+ +	+ +	+	-	+	_	
B	**India**	January	Air dry	Methanol	-	Not tested	Not tested	+	+	Not tested	-	-	-	Dhananjay *et al* (2015)
				Waters	-			-	_		-	+	-	
				Petroleum -ether	+			_	+		+	-	+	
C	**Ibadan 2**	June	Air dry	Aqueous	-	Not tested	+	-	-	+	-	+	Not Tested	Adegboyega &Oyewole (2015) [1]
				Methanol	+		+	+	+	+	-	+		
				Ethanol	+		+	+	+	+	-	+		
D	**Malaysia**	September	Oven dry	Methanol	-	+	-	+	Not tested	+	Not tested	+++	+	Yahaya *et al.* (2015)
				Ethyl-acetate	-	+	-	+		+		+++	-	
				Ethanol+ water	++	++	++	+		+++		++	-	
				Aqueous	++	+	+++	+		+++		+	++	

In addition, the comparative study has revealed that harvesting period has a greater noticeable effect on variability of phytochemicals in *A. paniculata*. It has also been discovered that the extraction of chemical compounds in *A. paniculata* can be carried out with methanol and water but it is advisable to extract flavonoids and saponins using pure methanol as solvent. Due to the fact that different location has different weather at different period of the year, it has been discovered that the location (most especially Countries) where the plant grows plays an important part on the phytochemical constituent of *A. paniculata*. *A. paniculata* is best planted in summer (around May-September in Nigeria) due to the fact that it grows well in hot humid weather and it should be harvested early autumn before going deeply into dry hot season and should spend up to 120 days on the field to have higher quantity of andrographolides and some other essential phytochemicals in this plant body. Comparative study was done to know the influence of locations, harvesting periods, drying methods and solvents used on the quality of phytochemicals in *A. paniculata*. It was observed from the study that sample D collected from Malaysia had the highest quality of phytochemicals, followed by sample C, sample A and sample B collected from India had the lowest phytochemicals. Floral Encounters 2016 and many other reports have shown that *A. paniculata* likes hot humid weather (Summer), it is best planted in summer and best harvested early autumn before dry season (after it has spent up to 120 days) set in fully. Summer in

Malaysia is between June to August while autumn last from September to December (Seasonyears.com, 2015-2018). Summer in Nigeria ranged from month of April to October while dry season (autumn) ranged from November until March (Nigeria Climate Weather Report). Summer in India is between April to October to November (Weather forecast India, 1999-2018). High quality of phytochemicals in sample A, C and A could be traced to the harvesting periods, September, June and September respectively while sample B with the lowest phytochemicals was collected in the month of January which was a wrong season of the year for the harvest of the plant according to the report from the paragraph above. All the factors in sample D were observed to be good for the preservation of phytochemicals in the plant. The factors of other samples (A and C) are not strongly effective. The solvents used for sample D (Methanol and aqueous), the drying methods (Oven drying) and period harvested (early autumn) are all considered good for extraction of high quality of phytochemicals in *A. paniculata* It was also observed that Tannins and Saponins were absent in methanol extract in all the samples except in sample C. This cannot be traced to the drying method because both Sample A, B and C were all air dried. It could be as a result of the solvent used. Methanol might not be a good solvent for extraction of Tannins extraction.

Conclusion

From the study above shows that, Sample D collected from Malaysia had the highest number of phytochemicals present (7), followed by sample C collected from Ibadan which has 7 phytochemicals tested, 6 present and one absent, followed by Sample A collected from Ibadan 1with all the 9 phytochemicals tested but 4 are present, 2 fairly present and 3 absent and lastly, sample B collected from India with 9 phytochemicals tested for but all are slightly present. Tannins and Saponins were absent in methanol extract in all the samples except in sample C. Methanol might not be a good solvent for extraction of Tannins extraction.

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