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ANTIOXIDANT AND PHYTOCHEMICAL DYNAMICS IN EREMOMASTAX POLYSPERMA LEAF EXTRACTS: A SEASONAL PERSPECTIVE

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Abstract:
Eremomastax polysperma is a medicinal plant widely used in traditional remedies among the Efik/Ibibio communities in southeastern Nigeria. This study investigated the seasonal variations in phytochemical composition, antioxidant content, and physicochemical properties of its leaf and aqueous leaf extract to validate its ethnomedicinal use and identify the optimal harvest season. Standard analytical methods were employed. Results revealed notable seasonal differences in chemical constituents. Alkaloids, flavonoids, and saponins were more abundant during the wet season, while tannins and hydrogen cyanide (HCN) peaked in the dry season. Vitamin C content was higher in the wet season, whereas vitamin A was more concentrated in the dry season. Physicochemical parameters also varied; pH, titratable acidity, alkalinity, biochemical oxygen demand (BOD), and nitrates were higher in the wet season, while temperature, conductivity, suspended solids, dissolved oxygen (DO), total hardness, sulphate, and chloride were elevated during the dry season. These findings suggest that seasonal changes significantly influence the chemical profile of E. polysperma, and strategic harvesting based on desired bioactive constituents may enhance its therapeutic efficacy.

Keywords: *Eremomastax polysperma, Seasonal variation, Phytochemicals, Traditional medicine.*

Introduction

In nature, numerous medicinal plant species abound and ultimately constitute the primary source of important lifesaving drugs for humanity (Khan et al., 2009). Two third of the population in the developing countries rely solely on herbals as their primary form of health care. Thus according to Elujoba *et al*, (2005), the use of ethnomaterials cannot fade out in the treatment and management of an array of diseases in the African continent (llesanmi *et al*, 2018) reported that the world Health Organization estimated that 80 percent of the population of some Asian and African countries presently uses herbal medicine for some aspect of primary health care (WHO, 2011) and that the annual Global export value of pharmaceutical plant in 2011 accounted for over 2.2 billion USD

Eremomastax polyeperma is one of such understudied medicinal plant commonly available in some part of West Africa and form part of the natural herbal remedy base (Uyoh *et al*, 2014).

The plant belongs to the family of tropical plant called Acanthaceae. It is a perennial herb commonly grown on forest farmland (Heine, 1996). In Nigeria, the plant is commonly known as “Blood tonic”

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plant, the Ibibio people of Akwa Ibom Identify it as Edemididuote or ndadad edem meaning pinkish back, (Iba *et al*., 2015) stated that enquiries from herbalist revealed that this plant is used to treat anemia, the root extract is taken as enema in the management of spleen problem, the leaf juice when mixed with egg can treat diabetes. Decoction of the leaf can treat internal heat especially in pregnant women. The plant has been found to have shown significant benefit in the use of its extract to manage female Infertility and also inhibits suckling activities (Mboso *et al*., 2014). Iba *et al,* (2015), reported improvement in key parameter indicative of anaemic such as increased RBC, PCV, MCH and MCV in the leaf extract treated rats, While llesnami *et al,* (2018) reported inflammation inhibition property of the hind paw edema of albino rat induced by caraganan by the ethanolic extract of the leaf.

It has also been establish that a number of factors such as climate, altitudes, rainfall and other conditions may affect growth of plant which in turn affect the quality of herbal ingredient present in the particular specie even when it is produced in the same country. These conditions may produce major variations in the bioactive compound present in the plant. (Geetha and Geetha, 2014). This will also determine the seasons of the year when the herbs are at peak maturity and contain high concentration of it chemical components. (Singh, 2008; Jayanthy *et al., 2013*). The aim of this research therefore is to assess the phytochemical, antioxidants and the physiochemical properties of this herb, in order to verify some of its medicinal acclamation and establish their seasonal responses

Material and method

Sample Collection and preparation: Samples of the leaves of Eremomastax polysperma were harvested in February and August 2018 from three experimental sample garden within Akwa Ibom State Nigeria (Ikot Ekpene, Eket and Uyo). The three sourced sample were combined for each season, air dried for about two weeks, pounded with mortar and pestle into finer powder, homogenized and stored for analysis

Phytochemical Analysis

Alkaloids and saponnins were screened according to method described by soforowa (2008), feavaroids and Tannins by Trease and Evans (2007) while cardiac glycoside by Salkowsky test. Evaluation of Alkaloids, vonoids saponnins and Tannins were as Harbone (1973) and cyanide by methods described by Onwuka, (2005.)

Vitamins: Vitamins A was estimated as described by AOAC (2005) and vitamin C by Henry (1964.)

Physiochemical properties: these were estimated as described by Ademoroti (1996.). They include Temperature, PH, Appearance and colour, conductivity, suspended solid, dissolved solid, Titratable acidity and Alkalinity, Dissolved Oxygen, Biochemical Oxygen demand, Chloride ion and Total hardness of solution these procedures were, carried out for both the wet season and dry season. Each result were obtained in triplicate to validate the accuracy of the method. The T multiple test analysis was employed to determine the significant difference of the results for the two seasons.

Results and Discussion.

The results obtained in this research were presented in table 1- 4tables below.

Table 1: Result of phytochemical screening of the leaves of Eremomastax polysperma for wet and dry seasons.

Parameter	wet season	Dry season	Observation

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Flavonoids	+++	+++	Orange coloration
Spanning	++	+++	observed Frothing persist
Tannins	++	+++	for more than 10 minutes
Alkaloids	+	+	Blue green coloration observed, deeper in dry season
Cardiac glycosides (Keller kilian's test)	++	+++	Orange coloration with precipitate observed. Brown coloration at the interface

Key: (+++) Abundantly present (++) Moderately present (+) Tracey present.

Table 2: Result of the quantitative phytochemical in *Eremomoastax polysperma* for wet and dry season

	Wet season	Dry season
Alkaloids	2.52±0.35	2.38± 0.43
Flavoroids	3.55±0.07	2.81±0.21
Tannins	2.38.38±0.22	3.21±0.04
Saponnins	3.00±0.07	2.84±0.11
HCN	1.87±0.02	2.74±0.13

Values = Mean ± standard deviation of Triplicate record

Table 3: Vitamins A and C composition of Eremomastzx polysperma.

	wet season	Dry season	RDA (WHO)
Vit A mg/100g	0.51±0.02	0.82±0.06	400-900mg/day
Vit C. mg/100g	231.22±0.	164.26±0.10	200mg/day

Values = mean ± standard dev. of triplicate recording

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Table 4: physiochemical parameters of the water extract of the leaf of Eremomastax polysperma

Parameter	Wet season Extract	Dry season Extract	Water use for extraction	WHO
Temperature	25.50	27.20	30.00	40
PH	8.00	7.60	6.5	6.5-9.2
Appearance	Purple	Deep purple	Colours	
Electrical S/m	33.14	35.52	2.00	1000 conductivity
Suspended solid(mg/L)	3.600	3.80	0.01	Dissolved
solid(mg/L)	12.00	11.62	0.12	1500
Titratable acidly (as Ca CO_3 mg/L)	40.44	40.20		
Tiitratable alkalinity (as $CaCO_3$ mg/L)	65.31	62.00	5.00	120
Dissolved Oxygen (DO)	1.85	2.63	2.20	
Biochemical oxygen demand (BOD)	360.00	273.65	10.00	0.2-0.5
Total hardness (as $CaCO_3$mg/L)	42.30	40.60	0.81	1.0-5.0
Sulphate (mg/L)	24.20	25.00	3.56	42.0-45.00
Nitrate (mg/L)	2.81	2.50	1.66	10.00
Chloride mg/L	188.00	188.73	21.65	2.50

Discussion

Photochemical Screening

The ethanolic extract of E-polysperma revealed the presences of the screened photochemical as follows. Alkaloids (+), Saponnins, Tannins and Glycosides (++) and Flavonoids (+++) in the wet season, while Alkaloids (+), Saponns (++) and Tannins, Glycosides and Flavonoids were (+++) in the dry season. Quantitatively, HCN (1.87+0.02) < Tannins (2.38+0.22) < Alkaloids (2.52+ 0.35) < Saponnins (3.00+0.07) < Flavonoids (3.55+0.07) in the wet eason and Alkaloids (2.38+0.43)< HCN (2.74+0.13) < Flavonoids (2.81+0.21) < Saponnins (2.84+0.11) < Tannins (3.21+0.04). These results were in contrast with that reported by (Shiva and Jung Ho, 2014) for Broccoli cultivars were they reported that all phytochemicals were higher in spring than in the falls. It confirmed the statement of Geetha and Geetha (2014) that factors such as climate, attitudes, rainfall etc affect growth of plant and this its herbal ingredients. However considering the significant difference in these values using the multiple student T test analysis, at ($P<0.05$) at a df of 4, the T test experiment (0.606) << T tab (2.132). Thus

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there is no significant difference between the results of the two season. These phytochemical were also obtained in the same leaf as screened by llesanmi and Okon, (2017), and their values were fairly higher than the results obtained in this research. Ncube and Van staden (2011) reported that phytochemicals very between leaves and bulbs and where higher in spring and winter than in other season.

Antioxidants

The Vitamin A obtained revealed that dry season value (0.82±0.06) > wet season value (0.51± 02) while in Vitamin C, wet season value (231.220.05)> dry season value (164.26 ±0.10) mg/100g. This variation agrees with Shiva and Jung Ho (2014) who reported that levels of phytochemical and anti-oxidant were significantly influenced by cultivars, plant parts and growing season. The values of vitamins reported here were much lower than vitamin A (313.45) mg/kg but higher than Vitamin C (264.70) mg/kg for *E. polysperma* leaf. However both were higher here than values Vitamin A (0.29) and Vitamin C (14.67) mg/kg reported for *Aspila africana* leaf (llesanmi and Okon, 2017). This is in consent with Villa-Ruano *et al*, (2017) who reported organic acid slightly higher in falls and winter than in spring and summer which are period characterized by more sunlight

Physiochemical parameters

Results of the physiochemical properties as seen in Table 4, revealed a high variation among the parameters for the two seasons. This also was in consent with that of, Singh (2008) that the efficacy of the constituent and active principles of medicinal plant varies quantitatively at different season. Which implies that everything that is responsible for the bioactivity in plant is determined by a number of factor, important among which was climate (Nacif de Abreu and Mazzafera, 2005). The values for physiochemical parameters obtained: Here were all within safe limit when compared with WHO limit, except for BOD, total hardness and chloride content which were above the WHO limit for these chemicals in drinking or safe water. Therefore consuming this extract could pose some severe danger with respect to these chemicals, particularly to pregnant women. Therefore, further processing may be required to further reduce the levels of such chemical in the extract before consumption. Understanding that this is a known herbal remedy for internal heat. Statistically, employing the multiple T test at $P<0.05$ and 12 degree, of freedom the T experiment (0.045) < T tabulated (1.782). Therefore there is no significant difference between the values during the wet and dry season.

Conclusion

From the results of this research, it can be concluded that seasons have great impact on the quality and quantity of medicinal principle of this plant. More of these components are higher in the wet season than the dry season. This could be associated with the fact that wet season allows for faster and robust plant growth thus reaching full maturing that may result in full concentration of its chemical properties. Though some of these may pose some risk, and thus requires some processing as may be necessary.

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