



NATURE OF ERGASTIC SUBSTANCES IN SOME NIGERIAN ASTERACEAE

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ABSTRACT

Seeds of 110 species of the Nigerian Asteraceae were examined for fats and oils, proteins and starch using standard detection procedures. All the examined species except for 8 species were herbs. Fats and oils were found in all the species investigated comprising of both herbs and shrubs (100% detection rate). Protein bodies were found in 23 species. While starch grains were found to be absent in all the investigated species. There was no correlation between life forms and the nature of ergastic substances in the family. The results from this study did not support the changes of names in the revision of the tribe Vernoniae as such this character cannot be used as a delimiting species.

Keywords: Ergastic substances, Shrubs, Herbs, Asteraceae.

INTRODUCTION

The Compositae (**Asteraceae**) family is nested high in the Angiosperm phylogeny in the Asterideae/Asterales. The family contains the largest number of described, accepted species of any plant family with 1600-1700 known genera distributed in over 24, 000 species found around the globe except for Antarctica (Funk, 2010). In Nigeria, the family is represented by 64 genera and 180 species (Adams, 1963).

The classification of the family Asteraceae is based on a combination of several specialized morphological characters e.g. capitula, highly reduced and modified florets, replacement of calyx by pappus, five epipetalous syngeneceious anthers; bicarpellary condition; syncarpous inferior and unilocular ovary with single basal anatropous ovule, fruits as a rule are achenes (seeds).

Seeds are the primary storage organs of ergastic substances. Seeds and their byproducts are major components of the diet of man and its livestock. So far, man is dependent on a few cultivated plants (less than 30 plants) out of the thousands of plants. The knowledge of the stored products in the seeds of wild plants cannot be over emphasized. This is done with the view of harnessing the resources of these wild plants.

According to Erdtman (1962), ergastic substances are secondary products of plant metabolism which are formed at certain stages of their metabolic process and are retained when the taxon in question goes through further evolution while Gill and Idu (2001) are of the opinion that they are waste products resulting from cellular activities and are usually simpler in structure than their protoplasmic bodies.

Amongst the ergastic substances, starch occupies a unique position in the nutritional requirement of man. According to Gill *et al.*, (1980) from the taxonomic point of view, starch grain characteristics are of great significance whereas protein bodies, fats and oils are of little taxonomic

value as they occur sporadically in different taxonomic groups. They further suggested that the presence of tannins which is a primitive character often gets lost with increasing phylogenetic specialization. Gill *et al.*, (1991) stated that the presence or absence of ergastic substances and their nature are of considerable importance in the evolutionary history of a taxon.

Using morphology, Robinson (1990) resurrected the genus *Baccharoides* and transferred 3 species of *Vernonia* to the genus. While Isawumi (1993) transferred 12 species from *Vernonia* to the same genus on the basis of the style base being surrounded by the nectar and involucral bracts with expanded foliose appendages which may be white or variously coloured. As a result, these have affected the Nigerian flora with change of name e.g. *Vernonia gerberiformis* = *Linzia gerberiformis*, *V. nigritiana* = *L. nigritiana*, *V. ituriensis* var. *occidental* = *L. ituriensis* var. *occidental*, *V. migeodii* = *Vernoniastrum migeodii*, *V. bamendae* = *Orbivestus bamendae* and *V. cinerea* = *Cyanthallium cinereum*.

The importance of the nature of ergastic substances in plant systematics has been stressed by various workers (Omoigui and Gill, 1988; Idu and Gill, 1998)

The present study therefore is to evaluate if this character can aid in the classification of the members of the family.

MATERIALS AND METHODS

Seeds used in this investigation were collected in nature from different parts of Nigeria. Seed material was stored in (27±2°C) in the laboratory before use. The method used for the determination of ergastic substances was outlined by Gill *et al.*, (1980). Vouchers of the specimens studied were deposited in the herbarium of the University of Benin, Nigeria.

Seeds were put in petri dishes fitted with moist paper and left at room temperature for 12 hours to soften the seeds rapidly and the following tests were done.

Test for Starch

Thin hard sections of the seeds were cut with sharp razor blades and placed on a slide. Few drops of Lugol's iodine solution were added. Starch if present reacted with iodine to give the characteristic blue-black colour.

Test for Protein

Seeds weighing (0.5g) were macerated and 2ml of 60% of Nitric acid was added. Presence of protein was indicated by a white precipitate followed by a yellow solution on boiling.

Test for Fats & Oils

Seeds weighing (0.5g) were macerated with 2 drops of alcoholic Sudan III. Presence of fats and oils was indicated if on evaporation, the colour of Sudan III (which is red) was retained.

RESULTS AND DISCUSSION

In this study 110 species of Asteraceae distributed in 46 genera were studied. All the investigated species contained fats and oils (Table 1). This result agrees with the findings of Gill *et al.*, (1984) and Gill and Idu (2001) concerning the occurrence of ergastic substances in different angiospermic families and their occurrence is sporadic and has no correlation with the habit of the plants. The presence of fats and oil in all the species in this study agrees with Omoigui and Gill (1988), Idu and Gill (1998) who worked on Southern Nigeria and West African Asteraceae respectively.

Protein was present in 23 species spread across different tribes of the family. They were found in *Ceruana pratensis*, *Lactuca capensis*, *Launaea nana*, *L.rarifolia*, *Picris xylopoda*, *Sonchus oleraceus*,

Anisopappus dalzelii, *Porphryostemma chevalieri*, *Pulicaria crispa*, *P. undulata*, *Helichrysum foetidum*, *H. globosum*, *Emilia coccinea*, *E.praetermissa*, *Gynura miniata*, *Senecio abyssinicus*, *S.baberka*, *S. hochstetteri* and *S. lelyi*. This revealed that their occurrence is sporadic. This result agrees with the findings of Gill *et al.*, (1984) and Gill and Idu (2001) concerning the occurrence of ergastic substances in different angiospermic families.

Life Form and Nature of Ergastic Substance

Several workers have established a relationship between the life form and the nature of ergastic substances. Gill *et al.*, (1980, 1984, 1991), Maheswari and Chakrabaty (1967) had earlier drawn a relationship between the presence of starch grains and the herbaceous habit. According to Hutchinson (1969), the herbaceous habit is more advanced than the shrubs and trees. In this family, majority of the species studied were herbs and there were no starch grain in any of the species studied.

There was no correlation between the habit of the plants with the occurrence of ergastic substances in this family. Starch grains are generally associated with herbaceous species. Interestingly, the result from this study agrees with the reports of Omoigui and Gill (1988), Gill and Abili (1989) and Idu and Gill (1998) which suggests that in the Asteraceae the presence of ergastic substances are sporadic and cannot be used in the delimitation of the taxa into genera or tribe. Thus, this characteristic nature of ergastic substances does not support these change of names as all the plants have fats and oils only. The results further support Drury and Watson (1965) and Ayodele and Olorode (2005) who cautioned on the use of limited characters for any reclassification.

Table 1: Summary of the Locality, Habit and Nature of Ergastic Substances in the Seeds of Some Nigerian Asteraceae

Taxon (1)	Locality (2)	Voucher Number (3)	Habit (2)	Starch (3)	Protein (4)	Fat and Oils (5)
TRIBE Asteraceae		Omoigui 168	H	-	+	+
<i>Ceruana pratensis</i> Forsk.	Bank of River Kaduna, Kaduna, Kaduna State.					
<i>Conyza aegyptiaca</i> (L.) Ait. var. <i>aegyptiaca</i> Hort.	General Hospital, Wawa Mambilla Plateau, Taraba State.	070	H	-	-	+
<i>C. attenuata</i> DC.	Market Road, Amana, Cross River State,	211	H	-	-	+
<i>C. pyrrophappa</i> Sch. Bip. ex A Rich.	Bauchi Road, by Motor Park, Jos, Plateau State.	201	H	-	-	+
<i>C. sumatrensis</i> (Retz.) Walker.	Ikvette Plateau, Obudu, Cross River State.	204	H	-	-	+
<i>Dichrocephala intergrifolia</i> (Linn. F). O. Ktze	Police Station, Gembu, Mambilla Plateau, Taraba State	203	H	-	-	+
<i>Felicia boehmii</i> O. Hoffm. subsp. <i>homochroma</i> (S. Moore) Grau.	Bauchi Ring Road, Jos, Plateau State.	205	H	-	-	+
<i>Microglossa afzelii</i> O. Hoffm. <i>afzelii</i> C.D. Adams.	School of Forestry, Jos, Plateau State.	252	H	-	+	+
TRIBE Cichorieae						
<i>Lactuca capensis</i> Thumb.	Obudu Cattle Ranch, Cross River State.	024	H	-	+	+
<i>Launaea nana</i> (Bak). Chiov.	Government Rest House, Igbetti, Oyo State.	301	H	-	+	+
<i>L. rarifolia</i> , (Oliv. & Hiern) L. Bolous)	Bauchi Ring Road, Jos, Plateau State.	303	H	-	+	+
<i>Picris xylopoda</i> Lack.	Lekitaba – Gembu Road, Gembu, Mambilla Plateau, Taraba State.	253	H	-	+	+
<i>Sonchus oleraceus</i> Linn.	Gangere Road, Kaurra Falls, Plateau State.	256	H	-	+	+
TRIBE Cynareae						
<i>Centaurea nigerica</i> Hutch.	Government Rest House, Igbetti, Oyo State.	133	H	-	-	+
<i>C. perrottetii</i> DC.	Hadeija River Basin Authority, Kaduna Kano Road, Kaduna State.	170	H	-	-	+
<i>C. praecox</i> Oliv & Hiern.	Bauchi, Ring Road, Jos, Plateau State.	104	H	-	-	+
<i>Echinops giganteus</i> A. Rich. var. <i>lelyi</i> (C. D. Adams) C.D. Adams.	Lekitaba Gembu Road, Gembu Mambilla Plateau, Taraba State.	035	H	-	-	+
<i>E. gracilis</i> O.Hoffm.	Bauchi Ring Road, Jos, Plateau State.	039	H	-	-	+
<i>E. longifolius</i> A. Rich.	Gangere Road, Kaurra Falls, Plateau State.	038	H	-	-	+

TRIBE						
Eupatorieae						
<i>Adenostemma cafferum</i> DC.	Bank of River Kaduna, Kaduna State.	040	H	-	-	+
<i>Adenostemma mauritianum</i> DC.	Obudu Cattle Ranch, Obudu, Cross River State.	045	H	-	-	+
<i>A. perrottetii</i> DC.	Bauchi Ring Road, Jos, Plateau State.	046	H	-	-	+
<i>Ageratum conyzoides</i> L.	University of Jos Campus, Plateau State.	217	H	-	-	+
<i>Chromoleana odorata</i> (L.) King & Robinson.	Ikwette Plateau, Obudu Cross River State.	136	H	-	-	+
<i>Mikania chenopodiifolia</i> Willd.	Senior Staff Quarters Unijos, Plateau State.	219	H	-	-	+
TRIBE						
Heliantheae						
<i>Achathospermum australe</i> (Loefl.) O. Kuntze.	Bauchi Road, Jos, Plateau State.	137	H	-	-	+
<i>A. hispidum</i> DC.	University of Benin, Benin City, Edo State.	200	H	-	-	+
<i>Aspilia africana</i> (Pers.) C. D. Adams var <i>africana</i> C.D Adams.	Bauchi Ring Road, Jos, Plateau State.	234	H	-	-	+
<i>A. helianthoides</i> (Schum.&Thonn.) Oliv. & Hiern. subsp. <i>helianthoides</i> O. Hoffm.	General Hospital, Igboho, Oyo State.	202	H	-	-	+
<i>A. helianthoides</i> subsp. <i>papposa</i> (O. Hoffm. & Muschl.) C. D. Adams.	Gangere Road, Kaurra Falls, Plateau State.	203	H	-	-	+
<i>A. kotschyi</i> (Sch. Bip) Oliv. var <i>kotschyi</i> O. Hoffm.	A.T.B. University, Bauchi, Bauchi State.	195	H	-	-	+
<i>Bidens biternata</i> (Lourm.) Merril & Sherff.	School of Forestry, Jos, Plateau State.	286				
<i>B. pilosa</i> L.	School of Forestry, Jos, Plateau State.	157	H	-	-	+
<i>Coreopsis asperata</i> Hutch. & Dalz.	Bauchi Ring Road, Jos, Plateau State.	157	H	-	-	+
<i>C. bateri</i> Oliv. & Hiern.	Motor Park, Barakin Ladi, Plateau State.	158	H	-	-	+
<i>C. camporum</i> Hutch.	Bauchi Ring Road, Jos, Plateau State.	119	H	-	-	+
<i>Eclipta alba</i> (L.) Hassk.	Ahmadu Bello University, Zaria, Kaduna State	144	H	-	-	+
<i>Guizotia abyssinica</i> (L.) Cass.	Texaco Petrol Station, Lafia, Nassarawa State	193	H	-	-	+
<i>G. scabra</i> (Vis) Chiov.	Obudu Cattle Ranch, Cross River State	192	H	-	-	+
<i>Melanthera elliptica</i> O. Hoffm.	School of Forestry, Jos, Plateau State	126	H	-	-	+
<i>Piloselloides hirsuta</i> (Forssk.) C. Jeffrey.	Ikwette Plateau, Obudu, Cross River State	118	H	-	-	+
<i>Scleroacarpus africanus</i> Jacq.	Lere Gembu Road, Gembu, Mambilla Plateau, Taraba State	194	H	-	-	+
<i>Synedrella nodiflora</i> Gaertn.	School of Forestry, Jos Plateau State	191	H	-	+	+
<i>Tridax procumbens</i> L.	Bayero University, Kano, Kano State	010	H	-	-	+
<i>Wedelia trilobata</i> (L.) Hiitche.	Agodi Gate, Ibadan, Oyo State.	180	H	-	+	+

TRIBE						
Inuleae						
<i>Anisopappus africanus</i> (Hook F.) Oliv. & Hiern.	Ikwette Plateau, Obudu. Cross River State	097	H	-	+	+
<i>Anisopappus dalzellii</i> Hutch.	Bauchi Ring Road, Jos Plateau State	093	H	-	-	+
<i>Gnaphalium indicum</i> L.	Bank of River Kaduna, Kaduna State	178	H	-	-	+
<i>Helichrysum albiflorum</i> Moeser.	Ikwette Plateau, Obudu Cross River State.	071	H	-	-	+
<i>H. foetidum</i> (Linn.) Moench.	Lekitaba-Gembu Road, Mambilla Plateau, Taraba State	251	H	-	+	+
<i>H. globosum</i> Sch. Bip. ex A. Rich.	Ikwette Plateau, Obudu Cross River State.	252	H	-	+	+
<i>H. mechowianum</i> Klatt.	Ikwette Plateau, Obudu Cross River State	254	H	-	+	+
<i>H. quartinianum</i> Bak.	Wawa-Gembu Road, Gembu Mambilla Plateau, Taraba State.	255	H	-	+	+
<i>H. rhodolepis</i> Bak.	Ikwette Plateau, Obudu Cross River State.	173	H	-	+	+
<i>Inula klingii</i> O. Hoffm.	Lekitaba-Gembu Road, Mambilla Plateau Taraba State	218	H	-	+	+
<i>Inula subscaposa</i> S. Moore.	Wawa-Gembu Road. Gembu Taraba State	178	H	-	+	+
<i>Laggera alata</i> (G. Don) Sch. Bip. ex Oliv. var. <i>alata</i> .	Gangere, Kaurra Falls, Plateau State.	211	H	-	+	+
<i>L. aurita</i> (Linn. F). Benth. ex C. B. Cl.	University of Jos, Plateau State.	257	H	-	+	+
<i>L. braunii</i> Vatke.	Gangere, Kaurra Falls, Plateau State.	067	H	-	+	+
<i>L. gracilis</i> (O. Hoffm. & Musch1.) C. D. Adams.	Gangere, Kaurra Falls, Plateau State.	062	H	-	+	+
<i>Mollera angolensis</i> O. Hoffm.	Bauchi Ring Road, Jos, Plateau State.	124	H	-	+	+
<i>Porphyrostemma chevalieri</i> (O. Hoffm.) Hutch. & Dalz.	School of Forestry, Jos, Plateau State.	114	H	-	+	+
<i>Pulicaria crispa</i> (Forsk.) Oliv.	Ahmadu Bello University, Zaria, Kaduna State.	141	H	-	+	+
<i>P. undulata</i> (Linn.) C.A. Mey.	Usman Dan Fodio University, Sokoto, Sokoto State.	073	H	-	+	+
<i>Sphaeranthus angustifolius</i> DC.	Hadeja River Basin Authority, Kaduwa Kano, Kano State.	223	H	-	+	+
<i>S. flexuosus</i> O. Hoffm.	Abubakar Tafawa Balewa University, Yelwa, Bauchi, Bauchi State.	081	H	-	+	+
<i>S. senegalensis</i> DC.	N.A.P.R.I. Shika, Kaduna State.	171	H	-	-	+
<i>Vicoa leptoclada</i> (Webb.) Dandy.	Government Rest House, Igbetti Oyo State	155	H	-	-	+

TRIBE Mutiseae						
<i>Dicoma tomentosa</i> Cass.	Ahmadu Bello University, Zaria, Kaduna State.	165	H	-	-	+
TRIBE Senecioneae						
<i>Crassocephalum gracile</i> (Hook. F) Milne Redhead ex Guinea.	Obudu Cattle Ranch, Cross River State.	287	H	-	-	+
<i>C. togoense</i> C. D. Adams.	Government Rest House, Igbetti, Oyo State	014	H	-	-	+
<i>Emilia coccinea</i> (Sims) G. Don.	General Hospital, Gembu, Mambilla Plateau Taraba State	301	H	-	+	+
<i>E. praetermissa</i> Milne-Redhead.	School of Forestry, Jos Plateau State	279	H	-	+	+
<i>Gynura miniata</i> Welw.	Bauchi Ring Road, Jos, Plateau State.	298	H	-	+	+
<i>Senecio abyssinicus</i> Sch. Bip. ex-A Rich.	School of Forestry, Jos, Plateau State.	138	H	-	+	+
<i>S. barberka</i> Hutch.	Gangere, Kaurra Falls, Plateau State.	283	H	-	+	+
<i>S. hochstetteri</i> Sch. Bip. ex. A Rich.	Gangere, Kaurra Plateau State.	152	H	-	+	+
<i>S. lelyi</i> Hutch.	Ikwette Plateau Obudu, Cross River State.	196	H	-	+	+
<i>S. mannii</i> Hook F.	Ranch Primary School, Obudu Cross River State	151	H	-	+	+
TRIBE Vernonieae						
<i>Elephantopus mollis</i> Kunth.	Gangere, Kaurra Falls, Plateau State.	274	H	-	-	+
<i>E. spicatus</i> B. Juss. ex. Aubl.	Gangere, Kaurra Falls, Plateau State.	148	H	-	-	+
<i>Ethulia conyzoides</i> Linn. F.	Eleyiele Water Works, Ibadan, Oyo State	290	H	-	-	+
<i>Gutenbergia nigritiana</i> (Benth.) Oliv. & Hiern.	Gangere, Kaurra Falls, Plateau State.	074	H	-	-	+
<i>G. rueppellii</i> Sch. Bip.	Abuja-Kaduna Road, Lere Junction, Kaduna State.	027	H	-	-	+
<i>Vernonia ambigua</i> Kotschy & Peyr.	School of Forestry, Jos Plateau State.	106	H	-	-	+
<i>V. biafrae</i> Oliv. & Hiern.	School of Forestry, Jos Plateau State.	129	S	-	-	+
<i>V. calvoana</i> (Hook. f.) Hook.F. var. <i>calvoana</i>	A.T.B University, Bauchi, Bauchi State.	302	H	-	-	+
<i>V. camporum</i> A. Chev.	Ahmadu Bello University, Zaria, Kaduna State.	306	S	-	-	+
<i>V. cistifolia</i> O. Hoffm.	Obudu Cattle Ranch Hotel, Cross River State.	107	H	-	-	+
<i>V. colorata</i> (Willd.) Drake.	Obudu Cattle Ranch, Obudu Cross River State.	137	H	-	-	+
<i>V. conferta</i> Benth.	Lekitaba-Gembu Road, Gembu, Taraba State.	178	H	-	-	+
<i>V. galamensis</i> (Cass.) Less.	Government Rest House, Igbetti, Oyo State.	245	H	-	-	+
<i>V. gerberiformis</i> Oliv. & Hiern.	Ahmadu Bello University, Zaria, Kaduna State.	120	H	-	-	+
<i>V. glaberimma</i> Welw ex O. Hoffm.	School of Forestry, Jos, Plateau State.	116	H	-	-	+
<i>V. guineensis</i> Benth. var. <i>cameroonica</i> C.D. Adams.	Market Road, Amana, Obudu, Cross River State.	108	S	-	-	+

Bajopas Volume 5 Number 2 December, 2012

<i>V. guineensis</i> Benth. var. <i>guineensis</i> V. Firma.	Bauchi Ring Road, Jos, Plateau State.	240	H	-	-	+
<i>V. iodocalyx</i> O. Hoffm.	Obudu Cattle Ranch, Cross River State.	242	H	-	-	+
<i>V. ituriensis</i> Muschl. var. <i>occidentalis</i> C. Jeffrey.	School of Forestry, Jos, Plateau State.	105	H	-	-	+
<i>V. nestor</i> S. Moore.	Gangere Road Kaurra Falls, Plateau State.	135	S	-	-	+
<i>V. nigriflora</i> Oliv. & Hiern.	Bauchi Ring Road, Jos, Plateau State.	131	H	-	-	+
<i>V. perrottetii</i> Sch. Bip.	Gangere Road, Kaurra Falls, Plateau State.	130	H	-	-	+
<i>V. philipsoniana</i> (Lawalree)	Bauchi Ring Road, Jos, Plateau State.	227	H	-	-	+
<i>V. richardiana</i> (O. Ktze) P. Sermolli.	Jekko Road, Kaurra Falls, Plateau State.	126	H	-	-	+
<i>V. saussureoides</i> Hutch.	Gangere Road, Kaurra Falls, Plateau State.	092	S	-	-	+
<i>V. smithiana</i> Less.	Lekitaba Gembu Road, Mambilla Plateau Taraba State.	281	H	-	-	+
<i>V. stenocephala</i> Oliv.	Bauchi Ring Road, Jos, Plateau State.	109	S	-	-	+
<i>V. stenostegia</i> (Stap F.) Hutch. & Dalz.	Bauchi Road, Unijos, Jos, Plateau State.	093	H	-	-	+
<i>V. subaphylla</i> Bak.	Ikwette Plateau, Obudu, Cross River State.	143	H	-	-	+
<i>V. tenoreana</i> Oliv.	General Hospital, Igboho, Oyo State.	042	H	-	-	+

KEY: H: Herb, S: Shrub, +: Present, - : Absent

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