African Journal of Biotechnology Vol. 10(48), pp. 9800-9803, 29 August, 2011
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2011 Academic Journals

*Full Length Research Paper*

# Nature of ergastic substances in some Poaceae seeds

**Idu, M.[1]* and Onyibe, H. I.[2]**

[1]Department of Botany, University of Benin, PMB 1154, Benin City, Edo State, Nigeria.
[2]Department of Botany, Ambrose Alli University, PMB. 14, Ekpoma, Edo State, Nigeria.

Accepted 6 May, 2011

**Seeds of 48 species of Poaceae were examined for the presence of alkaloid, protein, fats and oil, inulin, starch and tannins. All taxa investigated indicated the presence of starch, fats and oils and protein and were devoid of tannins and inulin. Only 12 seed samples indicated the presence of alkaloids. The Positively indicated taxa are suggested for further investigation.**

**Key words:** Poaceae, starch, fats and oils, alkaloid, protein, tannins, inulin.

## INTRODUCTION

Ergastic substances are products of metabolism. These substances may appear or disappear at different times in the life of the cell. They are reserve or waste products resulting from cellular activities. Some well-known ergastic substances are carbohydrates, cellulose and starch, protein bodies, fats and related substances (Eckey, 1954; Pritchard, 1997; Arahira et al., 1998; Christina et al., 2001; Gómez-Sosa and Castro, 2004; Wolf, 2006). They include also many other organic substances such as tannins, resins, gums (Howes, 1949), rubber and alkaloids, whose nature or function or both are not fully understood (Paech, 1950).

Since seed is the storage organs of ergastic materials such as alurine grains and starch grains, these stored materials are of taxonomic value. Gill et al. (1980) suggested that the stored food products show positive correlation with other morphological characteristics and is proved to be of significance in making a natural classification. Of all the stored food products, starch occupies unique position in nutritional requirements of man.

According to Gill and Ayodele (1986), the number of cultivated crops is relatively insufficient to provide for the world food supply and thus, the knowledge of stored products in the seeds of wild plants cannot be over-emphasized, and this can be done with a view to harness the resources of the wild plants. Also, the future energy needs of man will rely heavily on renewable plant resources to replace the present decreasing fossil fuel reserve (Abelson, 1978).

From the beginning, seeds have been and still are the main source of man's diet. The Poaceae (large seeded grasses) contribute more food seeds than any other plant family; it contributes about 50% per capita energy intake (FAD, 1977).

The importance of the nature of ergastic substances in plant taxonomy has been stressed by various authors such as Earle and Jones (1962), Maheshwari and Chakrabarty (1967), Calvin (1983), Gill et al. (1984, 1991), Gill and Ayodele (1986), Omoigui and Gill, (1988), Gill and Abili (1989) and Idu and Gill (1997). The result of the survey of 48 Poaceae seeds for ergastic substances are reported here.

## MATERIALS AND METHODS

Seeds of 20 species were obtained from the Botanischer Garten and Botanisches Museum, Berlin-Dahiem, Germany and seven were from the South-East Asia Weed Information Centre, Indonesia through seed exchange programme. Seeds of 20 species were collected from the northern part of Nigeria. Vouchers of the seeds examined were kept in the Botany Department of the University of Benin, Benin City, Edo State, Nigeria. Chemical tests for various ergastic substances were carried out following the procedures described by Gill et al. (1991).

## RESULTS AND DISCUSSION

The results of the taxa studied for their ergastic substances along with their habit are summarized in Table 1. The taxonomic arrangement of the taxa in this family was alphabetical. According to Erdtman (1956),

*Corresponding author. E-mail: macdonaldidu@hotmail.com.

**Table 1.** Nature of ergastic substances in taxa studied.

| GRAMINIEAE/POACEAE | Life form* | Alkaloid | Fats and oil | Inulin | Protein | Starch | Tannin |
|---|---|---|---|---|---|---|---|
| *Agrostis stolonifera* L. | H | - | + | - | + | + | - |
| *Alopecurus pratensis* L. | H | + | + | - | + | + | - |
| *Apera spica-venti* (L.) P Beauv. | H | - | + | - | + | + | - |
| *Beckmannia eruciformis* (L.) Host. | H | - | + | - | + | + | - |
| *Brachypodium sylvaticum* (Hudson) P. Beauv | H | - | + | - | + | + | - |
| *Bromus alopecuros* Poinret | H | - | + | - | + | + | - |
| *Bromus hordeaceus* L. | H | | + | - | + | + | - |
| *Bromus secalinus* L. | H | - | + | - | + | + | - |
| *Bromus sterilis* L. | H | | + | - | + | + | - |
| *Chioris argentina* (Hackel) Lillo and Parodi | H | - | + | - | + | + | - |
| *Cynosurus echinatus* L. | H | - | + | - | + | + | - |
| *Dactylis glomerata* L. | H | + | + | - | + | + | - |
| *Digitaria exilis* L. | H | - | + | - | + | + | - |
| *Diplachne dubia* (Kunth) Scnbner | H | - | + | - | + | + | - |
| *Elymus barbulatus* (Schur) Meld. | H | - | . | + | + | + | - |
| *Elymus hispidus* (Opiz) Meld. | H | - | + | - | + | + | - |
| *Eragrotis minor* Host. | H | - | + | - | + | + | - |
| *Festuca amethystina* L. | H | - | + | - | + | + | - |
| *Festuca arundinacea* Schreber. | H | - | + | - | + | + | - |
| *Festuca indigesta* Bioss | H | - | + | - | + | + | - |
| *Festuca paniculata* (L.) Schinz and Thell subsp. Durandoi (Clauson) Emb - and Maire. | H | - | + | - | + | + | - |
| *Festuca trachpyhylla* (Hackel) Kraj. | H | - | + | - | + | + | - |
| *Helictotrichon filiforluim* (Lagasca Henrard. | H | + | + | - | + | + | - |
| *Holcus lanatus* L. | H | + | + | - | + | + | - |
| *Imperata cylindrica* (Anderss.) C.E.Hubbard. | H | - | + | - | + | + | - |
| *Lamarckia aurea* (L.) Moench. | H | + | + | - | + | + | - |
| *Leymus racemosus* (Lain) Trvelev subsp. Sabulosus (M. Bier) | H | + | + | - | + | + | - |
| *Lolium remotum* Schrank. | H | - | + | - | + | + | - |
| *Melica ciliata* L. | H | - | + | - | + | + | - |

**Table 1**. Contd

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Melica transsilvanica* Schur. | H | + | + | - | + | + | - |
| *Nardus stricta* L. | H | - | + | - | + | + | - |
| *Oryza sativa* L. | H | - | + | - | + | + | - |
| *Panicum capillare* L. | H | - | + | - | + | + | - |
| *Pennisetum americanum* L. | H | + | + | - | + | + | - |
| *Phalaris arundinacea* L. | H | - | + | - | + | + | - |
| *Phalaris paradoxa* L. | H | + | + | - | + | + | - |
| *Piptatherum miliaceum* (L.) Coss | H | - | + | - | + | + | - |
| *Poa chaixii* Villars. | H | - | + | - | + | + | - |
| *Poa stiriaca* Hayek and Fritsch. | H | - | + | - | + | + | - |
| *Polypogon monspeliensis* (L.) Desf. | H | - | + | - | + | + | - |
| *Roastratia cristata* (L.) Tzvelev. | H | - | + | - | + | + | - |
| *Sesleria nitida* Ten. | H | - | + | - | + | + | - |
| *Sorghum bicolor* L. | H | + | + | - | + | + | - |
| *Sporobolus indicus* (L.) R. Br. | H | + | + | - | + | + | - |
| *Trisetum paniceum* (Lam.) Pers. | H | + | + | - | + | + | - |
| *Triticum aestivum* L. | H | - | + | - | + | + | - |
| *Zea may* L. | H | - | + | - | + | + | - |
| *Zea mexicana* (Schrader) Reeves and Mangelsd | H | - | + | - | + | + | - |

* H: Herb.

the information on ergastic substances could be of considerable importance in the evolutionary history of plant taxa as knowledge of principles and directions of chemical evolution might contribute to the understanding of the evolution of the present day plant groups.

From this survey, ergastic substances present in the various taxa included fats and oils, protein and starch. However, the taxa were devoid of tannin, inulin and only 12 seeds samples indicated the presence of alkaloids. Gill and Ayodele (1986) observed predominantly presence of starch, fats and oils and protein in all 11 taxa of Poaceae investigated. It is apparent that the taxa that showed the presence of protein, fats and oil and alkaloid could be quantitatively analysed and this needs further investigation. Those that showed suitable quantities of fats and oils could be commercially exploited as source of edible oil. The taxa, which gave positive test for alkaloids, need further investigation for possible exploitation in the pharmaceutical industries.

The predominant presence of starch in the seeds of these families tends to confirm the suggestions of Erdtman (1956) and Gill and Idu (2001), that certain compounds or chemically related substances may be characteristic of particular genera or family. Tatteoka (1955, 1962), studied the structure and properties of starch granules in the family Gramineae and was the first to emphasis the importance of starch granules in systematics of grasses and separated the tribe Hordeae on the basis of starch characteristics.

These taxa that showed the presence of starch could be commercially exploited for the form of gel, retrogression and staling in the confectionery

industry. The properties of starch can be modified by chemical treatments which result in products suitable for specific purposes in the food and pharmaceutical industry such as emulsion stabilisers, thickeners, forms of pastes and gel for capsule making.

From the discussion, it is evident that plant seeds that showed the presence of protein, fats and oils and starch could be commercially exploited and this type of survey will go a long way in solving the problem of food shortage and shortage of industrial raw materials.

## ACKNOWLEDGEMENTS

The authors are grateful to the Directors of Botanischer Garten and Botanisches Museum, Berlin-Dahiem and Biotropo, Indonesia for providing the seeds.

### REFERENCES

Abelson PH (1978). Bio-energy. Science. 204: p. 1161.

Arahira M, Van Hai Nong , Kadokura K , Kimura K , Udaka K, Fukazawa C (1998). Molecular cloning and expression patterns of Cu/Zn-superoxide dismutases in developing soybean seeds. Tokyo, Japan. Jpn. Soc. Biosci. Biotechnol. Agrochem., pp. 1018-1021

Calvin M (1983). New Sources of Fuel and Materials. Science, 219: 21-26.

Christina JP, Paula JR, Mary G (2001). Taxonomic Distribution, Ultrastructure and Development of Silica Bodies in Monocotyledons. The third biennial meeting of The Systematics Association, took place from the 3rd to the 7th of September at Imperial College, London.

Earle RR, Jones Q (1962). Analysis of seed samples from 113 plant families. Econ. Bot., 16: 221-250.

Eckey EW (1954). Vegetable fats and oils. ACS Monograph Series. New York. Reinhold.

Erdtman H (1956). Flavonoid Heartwood constituents of Conifers. Sci. Proc. Royal. Soc. Dublin., 27: 127-138.

Faech K (1950). Biochemie Und Physiologie de Sekunddren pflanzenstoffe. Lehrbuch der pflanzenphysiologie. Band I. Teil 2. Berlin, Springer-Verlag.

.

FAO (1977). The Forth World Food Survey, Food and Nutrition Series NolO, FAD, Rome Gill LS, Abili MA (1989). Nature of Ergastic substances in some angiospermic seeds -V. Feddes. Repert., 100: 71-79.

Gill LS. and Ayodele JR (1986). On the nature of ergastic substances in the seeds of some tropical and temperate angiosperms III J. Plant Anat. Morphol., 3: 35-47.

Gill LS, Idu M (2001). On the Nature of ergastic substances in some Caryophyllaceae seeds -9. Nig. J. Appl. Sci., 19:10-1633.

Gill LS, Olabanji GO, Husaini SWH (1980). On the nature of stored food material in the seeds of some Nigerian Legumes. Legume. Res., 3: 67-70.

Gill LS, Olabanji GO, Husaini SWH (1984). On the nature of ergastic substances in the seeds of some Nigerian Leguminosae II. Feddes. Repert., 95: 659-6633.

Gill LS, Nyawuarne HG, Aibangbee MJ. and Agho DA. (1991). Nature of ergastic substances in some mediterranean angiosperms seeds - VI. Feddes. Repert., 102: 613-628.

Gómez-Sosa E, Castro MA (2004). A new species of *Astragalus* (Leguminosae- Papilionoideae) from Bolivia with peculiar xerophytic adaptation. Arnaldoa., 11(1): 29-44.

Howes FN (1949). Vegetable gums and resins. Waltham, Mass. Chronica Botanica Co.

Idu M, Gill LS (1997). Nature of ergastic substances in some West African Asteraceae seeds - VIII. Comp. Newsl., 30: 50-56.

Maheshwari JK, Chakrabarty B (1967). Starch grains of Leguminous seeds (Austria). Phyton., 12: 191-199.

Omoigui ID, Gill LS (1988). Nature of ergastic substances in some West African Compositae. Feddes. Repert., 99: 143-145.

Peterson C, Brett RG, Prior S, Rogers H (1997). Atmospheric CO[2] concentration, N availability, and water status affect patterns of ergastic substance deposition in longleaf pine (Pinus palustris MiII.) foliage. Springer, Berlin, Allemagne., pp. 494-503

Tateoka T (1955). Further studies in starch grains of seeds in poaceae from the view point of systematics. Jpn. J. Botany., 30: 109-208.

Tateoka T (1962). Starch grains of endosperm in grass systematics. Bot. Mag., 75: 377-383.

Wolf SJ (2006). Introduction to Botany. California State University Stanislaus.