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Review Article

A GENERAL IDEA ABOUT PHYTOMELANIN LAYER IN SOME COMPOSITAE

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ABSTRACT
The present paper deals with the general idea about the phytomelanin layer, on the surface of cypsela of some Compositae, with the help of both compound light microscope and scanning electrone microscope. Phytomelanin layer is made up of hard, black, water resistant resinous or tanniniferous or polyvinyl alcohol containing disputed substance, usually found in the cypselar wall of some members of the family Compositae belonging to the tribes-Coreopsideae, Helenieae, Heliantheae, Eupatorieae, Millerieae, Perityleae etc.

Key Words: *Phytomelanin Layer; Cypselar Surface; Compositae*

INTRODUCTION
The Compositae are regarded as a fairly advanced family of the dicotyledons (Takhtajan, 1997) and are one of the largest family of angiosperms, consisting of 43 tribes, 1600- 1700 genera and 24000 species (Funk *et al.*, 2009). Many members of the Compositae are cosmopolitan, found specially in temperate or tropical montane regions and open and / or dry habitats.

Phytomelanin layer is made up of a type of hard, black, water resistant resinous or tanniniferous or polyvinyl alcohol containing disputed phytomelanin substance, usually found in the cypselar wall of some members of the family Compositae belonging to the tribes Coreopsideae (Jana and Mukherjee, 2012), Heliantheae, Eupatorieae (Pandey and Dakhal, 2001) etc. It act as a protective layer of the pericarp, which protect the developing embryo from external invasion of insects, pests and other macro- micro-organisms. Since a payer of dominant genes or allele control the deposition of phytomelanin layer, so it has some significant importance in the tribal and subtribal classification as well as evolutionary significance in Compositae (Pandey and Dakhal, 2001).

Distribution of Phytomelanin Layer

Phytomelanin layer is an unique type of hard, opaque, brittle, black, charcoal like, water and acid resistant layer usually develops in schizogenous space in the cypselar wall, specially in mesocarpic region of cypsela after fertilization and is usually found in the major members of the tribe- Heliantheae (Basak and Mukerjee, 2001), Eupatorieae (Pandey and Dhakal, 2001), Millerieae (Jana and Mukherjee, 2012), perityleae (Jana and Mukherjee, 2013) etc., but lacks in other some tribes of Compositae (Bremer, 1996). Morphologically, this layer is also found from the surface (Figures 1, 3, 4, 5, 6).

Phytomelanin has also been reported in other groups of dicotyledons- Campanulaceae, Umbelliferae (Bohlmann *et al.*, 1973) and monocotyledons Asperagales, Zingiberales and Haemodorales (Huber, 1969). In majority of the taxa (Figure 2) (*Tridax, Melampodium, Acanthospermum* etc.), distribution of this layer is noticed just below the epicarpic region. In some other taxa, where it has been noticed in different depth of the mesocarpic region of pericarp (*Bidens, Villanova*, etc.). Pandey has reported the seed coat anatomy of the family Compositae and according to his observation, phytomelanin layer is alwase present in the seed coat of the tribes Eupatorieae, Heliantheae etc. Since a pair of dominant genes or allele (Mosjidis, 1982) control the distribution of phytomelanin layer, so it has significant importance

in tribal and subtribal classification as well as evolutionary significance in Compositae (Pandey and Dakhal, 2001).

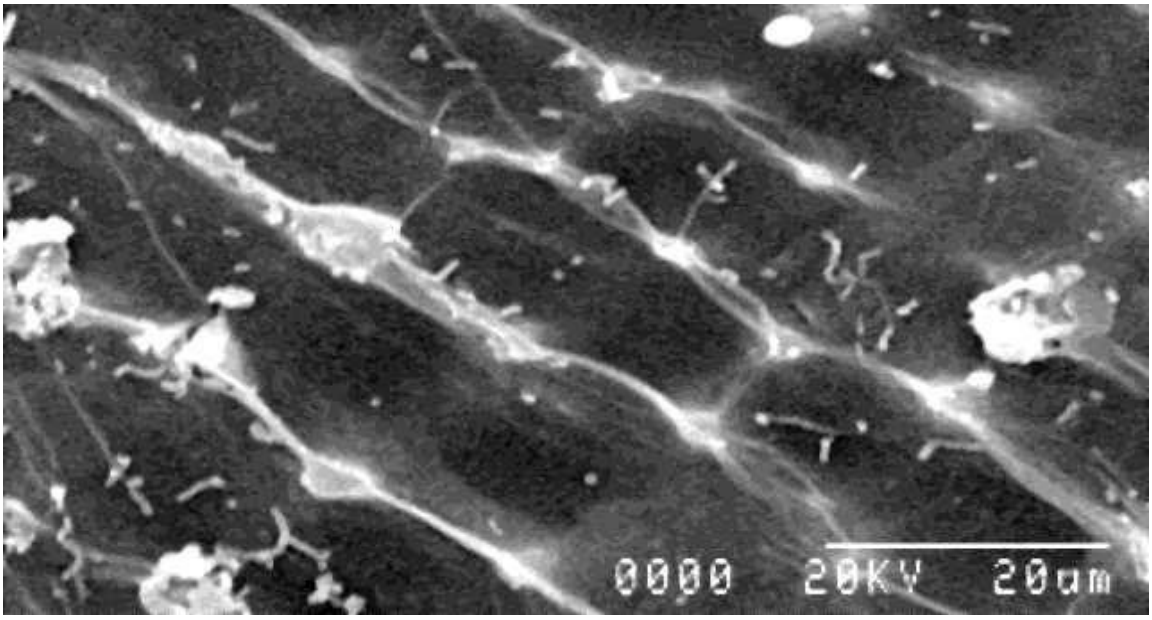

Figure 1: Phytomelanin layer on the surface of the cypsela of – *Acmella oleracea*

Structural Features of Phytomelanin Layer

The structural features of phytomelanin layer is not clearly known till now. This layer in mature pericarpic zone exists as a continuous bundle (*Villanova*, *Tridax* etc.) or usually found as a discrete bundles (*Melampodium* etc.) with variable thickness, depending on the maturity of cypselar wall as well as its genetic constitution. According to Huber (1969), primitive taxa have a thick phytomelanin layer than the advanced one. Phytomelanin layer has no physical structure but has a definite chemical structure.

Chemical Structure

Chemical nature of this layer is not clearly reported, till now. There are various openion, regarding its chemical nature.

1. According to Pandey and Kumari (1987), this layer is rich in carbone compound.
2. Phytomelanin layer is very rich in polyvinyl alcohol, reported by Pandey and Dhakal (2001).
3. According to Pandey and Dhakal (2001), this layer is insoluable in chromic acid, Potassium hydroxide and even sulphuric acid etc.
4. This layer is composed of about 70% Carbon containing compound (Kiewnick, 1964) or resinous substances (Putt, 1944).
5. According to Hanausek (1902); this layer is made up of tanniniferous and amorphous substance.

Although, tha structure of phytomelanin layer is not clearly known yet.

Mode of Development of Phytomelanin Layer

The mode of development of phytomelanin layer in different taxa (*Tagetes*, *Ageratum* etc.) has been studied in details by Pandey (1998). According to Hanausek (1902), this layer is formed by the transportation of the middle lamella and that the substance for its formation is supplied by sclerenchyma cell wall. This view was rejected by some workers and according to their view, this layer is always develops from the hypodermal cells of the pericarp. According to Jana and Mukherjee (2012), this layer is also formed below the epicarpic region (Figure 2). According to Pandey *et al.*, (1989), this layer is secreted by the glandular activity of hypodermal cells.

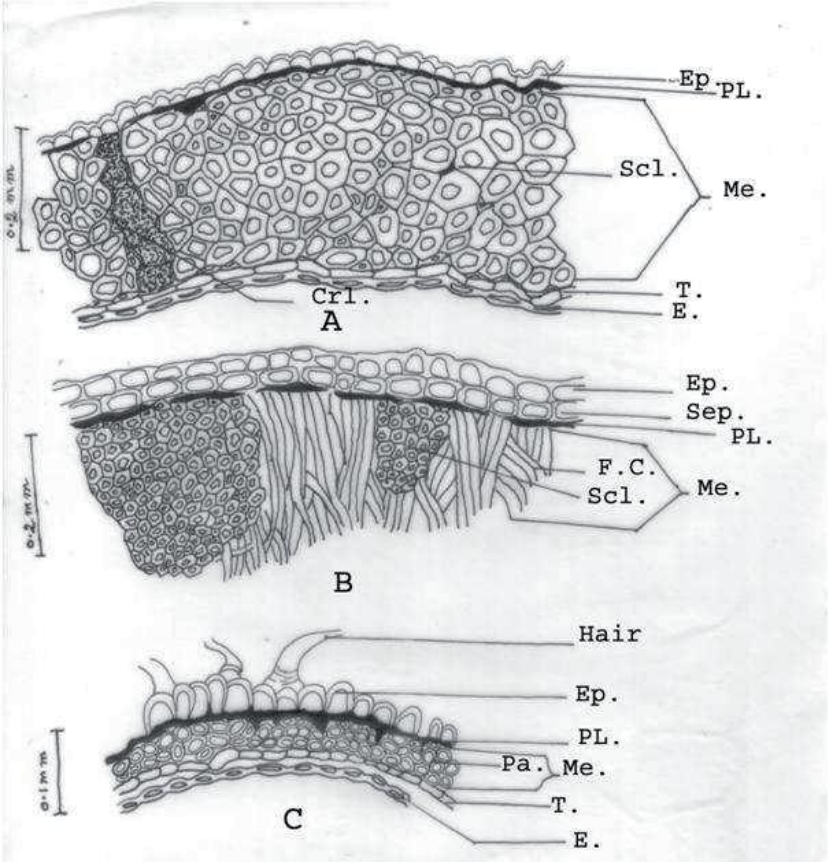

Figure 2: Cross sections of cypselas, showing phytomelanin layer.
A- *Acanthospermum hispidum,* B- Melampodium perfoliatum, C- *Tridax procumbens*

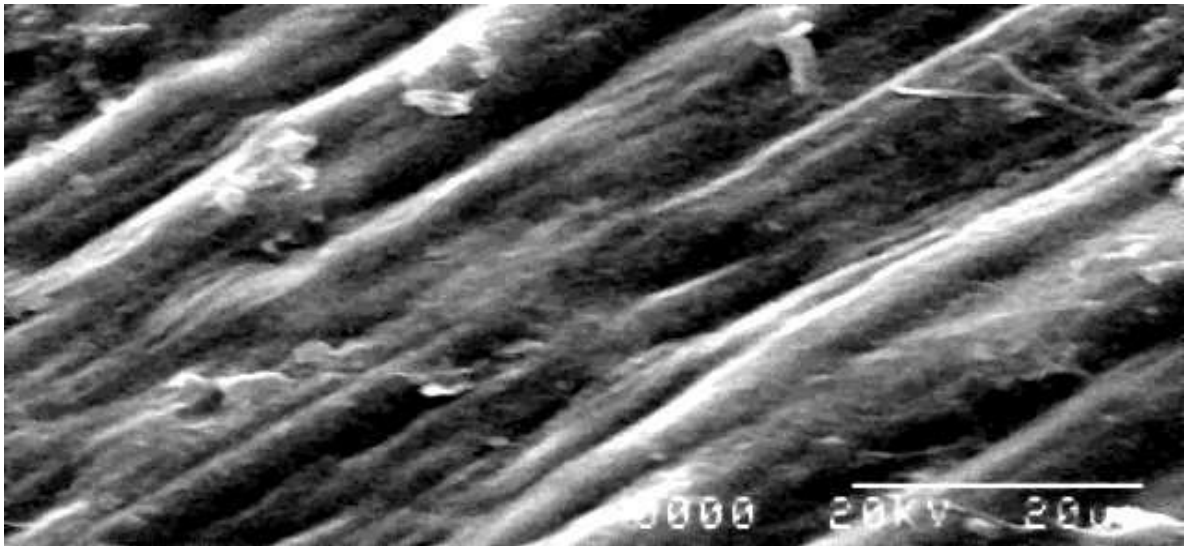

Figure 3: Phytomelanin layer in the surface of the cypsela of *Helianthus nuttallii*

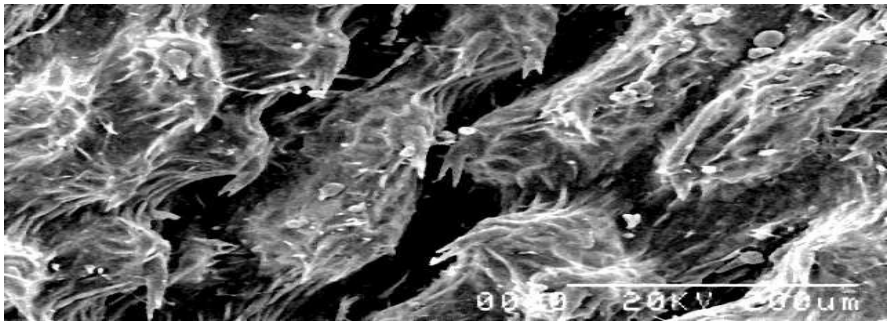

Figure 4: Phytomelanin layer on the surface of the cypsela of *Synedrella nodiflora*

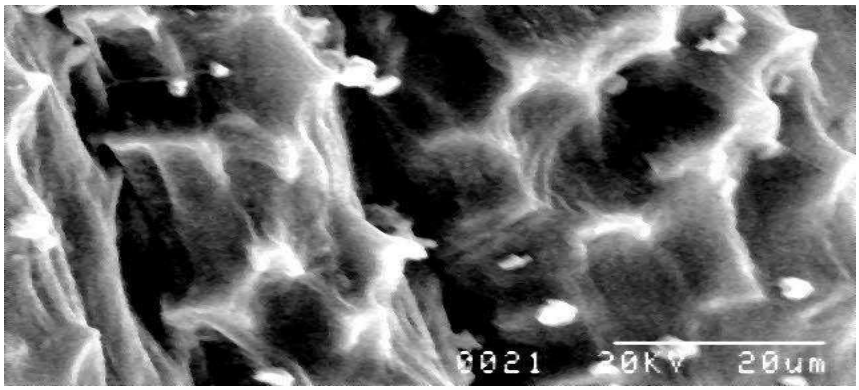

Figure 5: Phytomelanin layer on the surface of the cypsela of *Tagetes lucido*

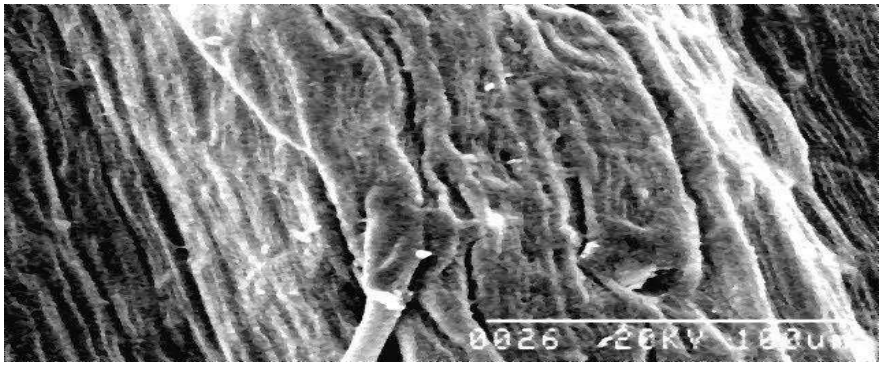

Figure 6: Phytomelanin layer on the surface of the cypsela of *Bidens frondosa*

Other Function of Phytomelanin Layer

Primarily, Phytomelanin layer act as a protective layer of the pericarp, but has some other activities.

1. Discontinuous phytomelanin layer may facilitate the cypsela to allow free exchange of water and gases (Pandey and Dakhal, 2001) from inside to outside or vice-varse.
2. Continuous phytomelanin layer inhibits the germination but it is also suitable for mechanical protection against the invation of insects and pests (Pandey and Dakhal, 2001).

Evolutionary Significance

According to Bremer (1996), phytomelanin bearing tribes are in a sister group and form a common highly advanced clade in his classification of Compositae, on the basis of both morphological and

anatomical data (Karis, 1993). According to his observation, the tribe Helenieae is the most primitive whereas Eupatorieae is highly advanced and Heliantheae is intermediate between these two tribes. Phytomelanin layer may be found as a continuous ring in some taxa or found as a discrete bundle in some other taxa. Discontinuous layer may facilitate the cypsela to allow free exchange of water and gases, which is essential for germination of cypsela. On the other hand continuous layer inhibit the germination but it is suitable for mechanical protection against the invation of insects and pests or to protect the cypsela from external unfavourable environments (Pandey and Dakhal, 2001). On this ground, any one type can not be coined as advanced one. Phytomelanin layer may be antagonistic to the formation of crystal structure. In this connection, Robinson and King (1977), have mentioned that in Eupatorieae, pericarp and testa are always devoid of calcium oxalate crystals. This statement is probably correct if we look into the histological features of cypselas in Helenieae and Heliantheae as well. Similar type of statement has been advocated in the work of Pandey and Dhakal (2001), Basak and Mukherjee (2001), Jana and Mukherjee (2012) etc.

REFERENCES

Basak N and Mukherjee SK (2001). The Morphology and Anatomy of the Cypselas of Some Species of *Helianthus* L. (Asteraceae- Heliantheae) and its Taxonomic Significance. *National Botnical Society* **55** 111 – 124

Bohlmann F, Burkhardt T and Zdero C (1973). Naturally Occuring Acetylenes (eds.). Academic Press, London, New York.

Bremer K (1996). Major clades and grades of the Asteraceae. In: Compositae: Systematics, edited by HIND DJN and HJ Beentje, *Proceedings of the International Compositae Conference* **1** 1-7. Royel Botanic Garden, Kew.

Funk VA, Susanna A, Stuessy TF and Bayer RJ (2009). *Systematics, Evolution, and Biogeography of Compositae*. International Association for Plant Taxonomy,Vienna,Austria.

Hanausek TF and Ber D (1902). *Verhandlungen der Kaiserlich-Koniglichen Zoologisch-Botanischen Gesellschaft* **20** 449-454.

Huber H (1969). Die Samenmerkmale und Verwandtschafts- verhadtnisse der liliiflorae. *Mitteilungen der Botanischen Staatssammlung Munchen* **8** 219-538.

Jana BK and Mukherjee SK (2012). Comparative morphological and anatomical studies of cypselas of some members of the tribe Millerieae (Asteraceae). *IJPRBS* **1**(5) 317-330.

Jana BK and Mukherjee SK (2012). Morphological and anatomical studies of cypselae of 3 species of the family compositae. *International Journal of Science Innovations and Discoveries* **2**(3) 386-393.

Jana BK and Mukherjee SK (2013). Study of fruit structure of *villanova oppositifolia* of the tribe perityleae (Compositae). *International Journal of Chemical and Pharmaceutical Research* **2**(9) 204-209.

Karis PO (1993). Morphological phylogenetics of the Asteraceae- Asteroideae, with notes on character evolution. *Plant Systematics and Evolutio* **186** 69-93.

Kiewnick L (1964). *Pflanzenkrankh Pflanzenschutz* **71** 294-301.

Mosjidis JA (1982). *Journal of Heredity* **73** 461-464.

Pandey AK and Kumari A (1987). Development and structure of seeds and fruits in Compositae: *Zinnia species. Journal of Japanese Botany* **62** 168-176.

Pandey AK (1998). Develpoment of phytomelanin layer in the fruit wall of *Tagetes patula* L. (Asteraceae). *Journal of the Indian Botanical Society* **77** 35-38.

Pandey AK and Dhakal MR (2001). Phytomelanin in Compositae. *Current Science* **80**(8) 933-940.

Robinson H and King RM (1977). Eupatorieaesystematic review. In: *The Biology and Chemistry of the Compositae* **1** 437-485, edited by Heywood VH, Harborne JB and BL Turner, Academic Press, London.

Takhtajan A (1997). Diversity and classification of flowering plants. Columbia University Press, New York.