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Relationship between the cypsela of *Echinacea* and its endophyte symbionts

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Cypselas are fruits derived from an inferior ovary, forming a further layer (perianth) outside the fruit pericarp. We investigated the three most frequently cultivated *Echinacea* species (*Asteraceae*) to observe the presence and localization of endophytic microorganisms. Bacteria were observed exclusively within cells of the cotyledons parenchyma. The bacteria were enclosed in membrane structure similarly to the situation observed in other endocellular bacteria such as mycobacteria.

Moreover, the presence of fungi was recorded in the perianth, that is the most external component of the cypsela. This modified residual of the flower is woody and porous in the cypsela and hosts numerous hyphae, that are able to cross the walls between one cell to the other. This presence was never recorded before. The presence of fungi in the cypsela is apparently arrested at the level of the pericarp, containing phytomelanin.

A last microorganisms component is that represented by bacteria strictly adhering to the external side of the perianth.

In conclusion, the observation of the cypselas of three different species of *Echinacea* showed that three different components of microorganisms are carried by the fruit during dispersal. One endocellular bacterial component in the cotyledon; another more generic component adhering to the external side of the perianth, and a fungal component contained inside the porous layer of the perianth, whose remarkable structure may be considered as an adaptation for fungal transport. The endophytic bacteria are reported as possible producers of substances of pharmaceutical interest, while the fungi in the perianth may be important to block the entrance of pathogenic fungi by production of alkaloids. The presence of endophytic bac-

teria was observed also in the shoot, leaves and roots of the adult plant and we may suggest that these endosymbiont bacteria are carried also at the seed stage.

The cypselae can therefore be described as a unit of dispersal composed by more symbionts.

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