

# Diversity of yeasts associated with meadow plants

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Culture Collection of Yeasts

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# Meadows are important parts of ecosystem

- Geochemical cycling
- Carbon sequestration
- Erosion control of soil (dense aboveground cover)
- Drought tolerance of plants (deep root system)
- Infiltration and filtration of rainwater
- Attract pollinators and whereby contribute to better pollination of nearby agricultural crops
- Limited or no human intervention - high plant diversity, but specific to individual area



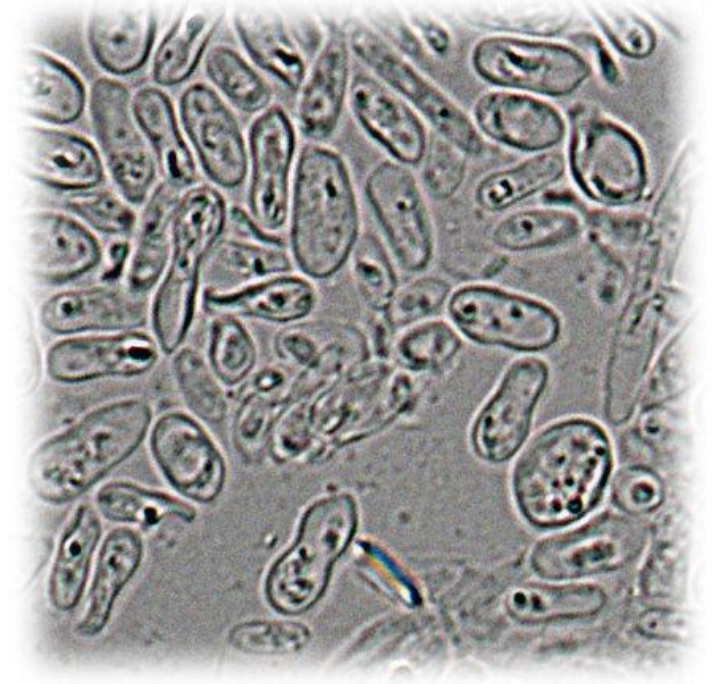
# Functions of meadow plants

- Aesthetic value (flower colours and morphology) scent → stress reduction
- Food (seeds, fruits, insects) and habitat for songbirds and small animals
- Shelter and food (nectar) for numerous bee species, butterflies, grasshoppers and other insects
- Habitat for diverse microorganisms



# Microbial inhabitants

- Important for growth, health and fitness of plants (phytohormones, pest and disease control)
- Present on the surfaces and in the inner structures of plants
- Their composition is plant-specific
- Yeasts on the phylloplane are more abundant than other types of microorganisms



# How yeasts enter aboveground parts of plants?

- via roots from the soil adjacent to plants
- air
- water
- seeds
- insects
- animals



# Phyllosphere of meadow plants

- Climate conditions (fluctuation in temperature and humidity, UV radiation, wind)
- Nutrient availability is low (carbohydrates, amino acids, fatty acids, sugars and alcohols) - via plant exudates
- Nectar - osmotic environment (20-50% of sugars), lipids, proteins and amino acids



# Importance of yeasts associated with wild plants

- Significant part of the plant microbiota (contribute to growth, health and vitality of plants)
- Elements of plant-animal mutualisms - produce VOCs, which attract pollinators to visit plants
- Food for pollinators (proteins, amino acids, vitamins) - more diverse yeast communities appear to be preferred



# Importance of yeasts associated with wild plants

- Their composition is locality- and plant species-specific
- It is possible to discover new species and strains with promising properties for bioindustry (e.g. pigments, enzymes, volatile organic compounds)



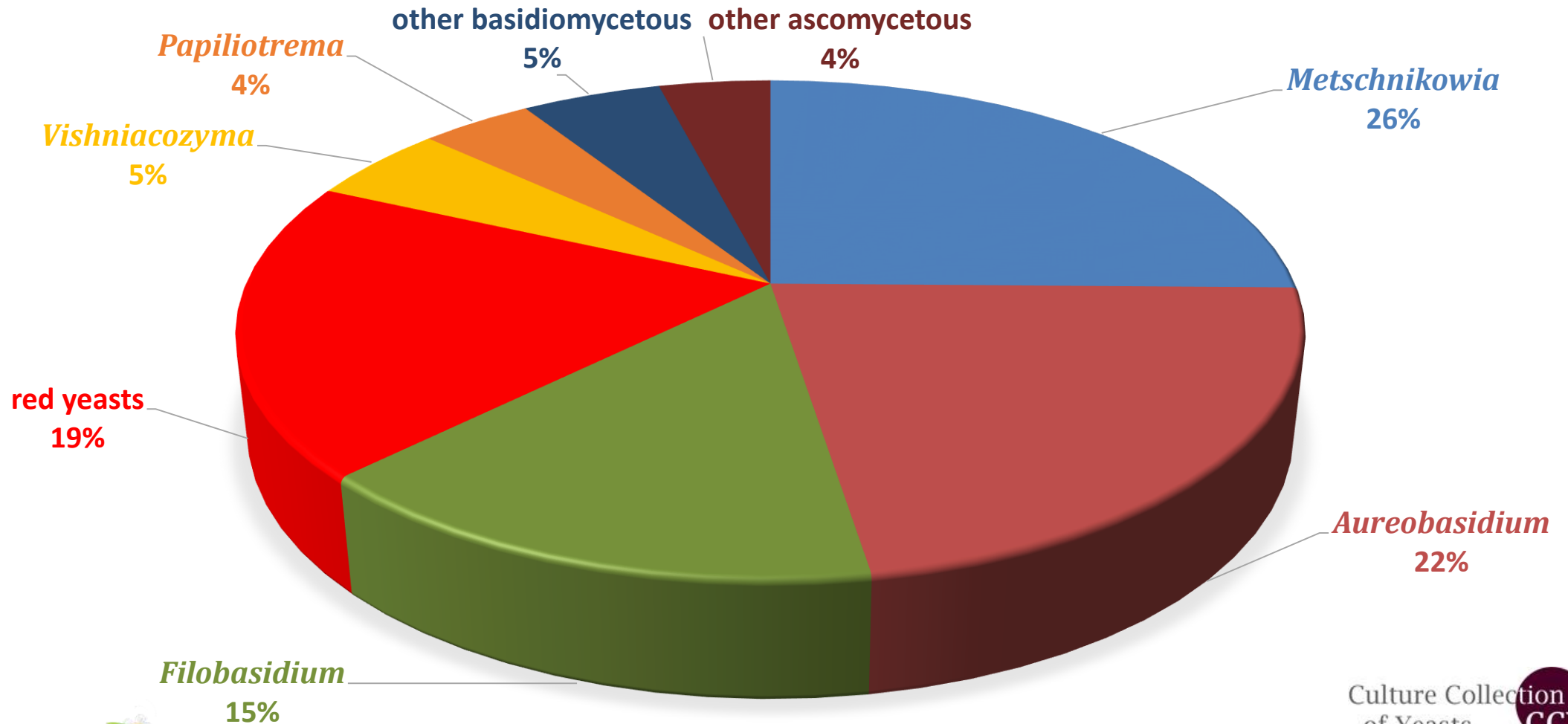


# Yeast isolation and identification

- 33 plant species belonging to 13 families (meadow in Southwest Slovakia)
- Isolation: Liquid and solid nutrient media (enriched with antibiotics) - cultivation under 20 and 15 °C, regular picking up of colonies - purification of yeast strains
- More than 280 strains
- Identification (MALDI-TOF MS and molecular methods)



# Yeast diversity on flowers



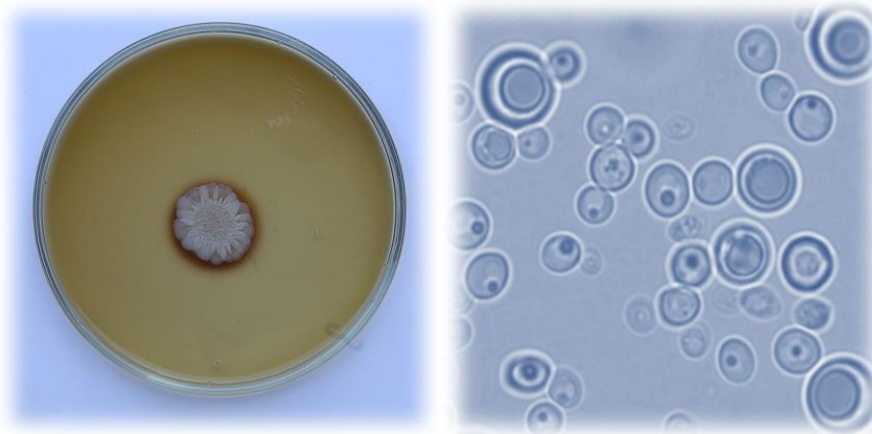
# Genus *Metschnikowia*

- Highest number of species found (6) *Metschnikowia reukafii* - almost half of plants, commonly present in nectar (nectarivorous yeast), it tolerates and utilizes high concentration of sugars, attracts bumblebees to forage nectar and alters the scent profile of plant species



# Genus *Metschnikowia*

- *Metschnikowia koreensis* (sister species *M. reukaufii*), *M. gruesii* (and sister *M. kunwiensis* and new *Metschnikowia* sp. II.), *M. viticola*
- *M. pulcherrima* - protect plants from fungal diseases - production of pulcherrimine

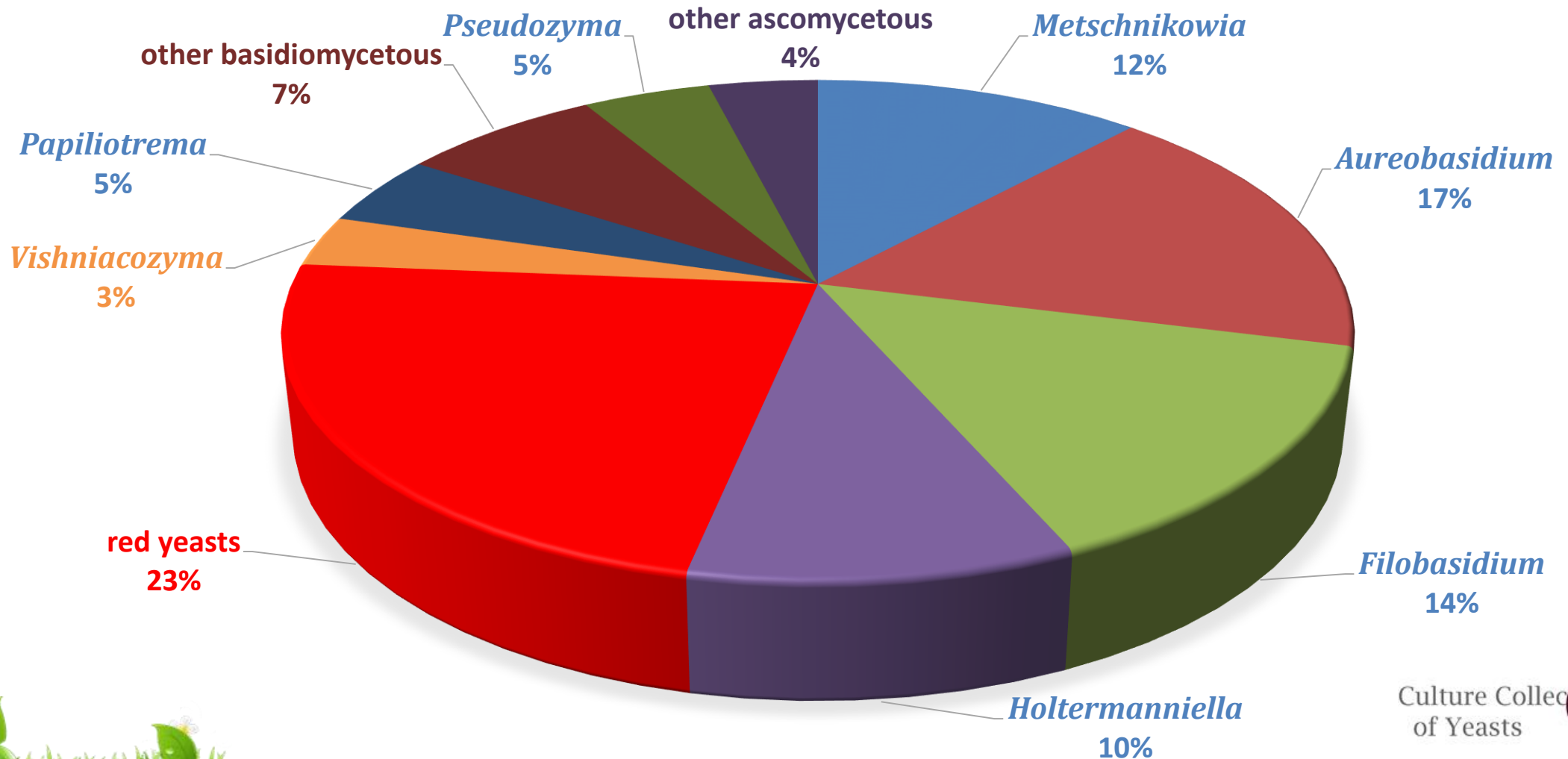


# *Aureobasidium pullulans*

- Widespread yeast species (phyllosphere - also grapevines, soil), broad spectrum of enzymatic activities - adapted to various environmental conditions
- Produces melanin pigment (protects from UV radiation, heat and oxidative stress)



# Yeast diversity on leaves



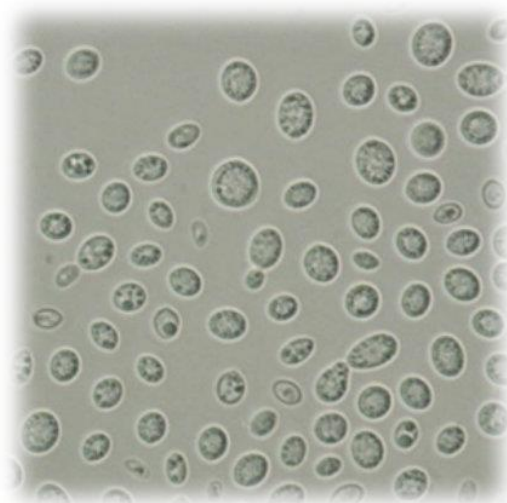
# Red yeast species

- *Cystofilobasidium macerans*, *Dioszegia hungarica*, *Rhodotorula glutinis* group, *Rhodotorula mucilaginosa*, *Sporidiobolus salmonicolor*, *Sporidiobolus roseus*
- Produce carotenoids (antioxidants)
- Resistant to desiccation (capsules)
- Other producers: *Vishnicozyma victoriae*, *Filobasidium magnum*



# Non-pigmented basidiomycetous yeasts

- Mycosporines (sunscreens): *Filobasidium magnum*, *Filobasidium wieringae*, *Filobasidium stepposum*, *Naganishia adeliensis*, *Holtermanniella festucosa*, *Papiliotrema laurentii*





# Specific yeasts isolated from flowers

- *Starmerella orientalis* (Iran, China), *Metschnikowia kunwiensis* (flowers Korea) - *Alkanna tinctoria* (Schminkwurz) - both species associated with insects
- *Metschnikowia koreensis* (Korea) - *Ranunculus polyanthemos* (Verschiedenschnabeliger Hain-Hahnenfuß)
- *Kazachstania aerobia* (corn silage, China) - *Verbascum densiflorum* (Großblütige Königskerze)



# Specific yeasts isolated from flowers and leaves

- *Papiliotrema fuscus* (Mediterranean vegetation) - *Gratiola officinalis* (Gottes-Gnadenkraut)
- *Rhodospiridiobolus platycladi* (China, leaves) - *Trifolium pratense* (Wiesenklee)
- *Naganishia albidosimilis* (Antarctic soil) - *Origanum vulgare* (Oregano)
- *Cryptococcus subarcticus* (Iceland, soil) - *Scabiosa ochroleuca* (Gelbe Skabiose)
- *Papiliotrema aurea* (flowers, Japan, Tenerife) - *Serratula tinctoria* (Färber-Scharte)



# The most diverse yeast microbiota found on plants

- *Echium vulgare* (Gewöhnlicher Natternkopf)
  - 14 yeast species
- *Vicia cracca* (Vogel-Wicke)
  - 13 yeast species
- *Crepis paludosa* (Sumpf-Pippau)
  - 12 yeast species
- *Symphytum officinale* (Echte Beinwell)
  - 12 yeast species



# Conclusions

- We isolated 283 yeast strains belonging to 53 species and 30 genera
- 35 species from flowers, 41 species from leaves
- We confirmed basidiomycetous yeasts (genera *Filobasidium*, *Rhodotorula*, *Vishniacozyma*) as common inhabitants of flowers, some of them are tolerant to 50% of glucose
- Representatives of the yeast species isolated are deposited in the Culture Collection of Yeasts ([www.ccy.sk](http://www.ccy.sk))



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