# Three essential collection elements: Microbes, data, and expertise

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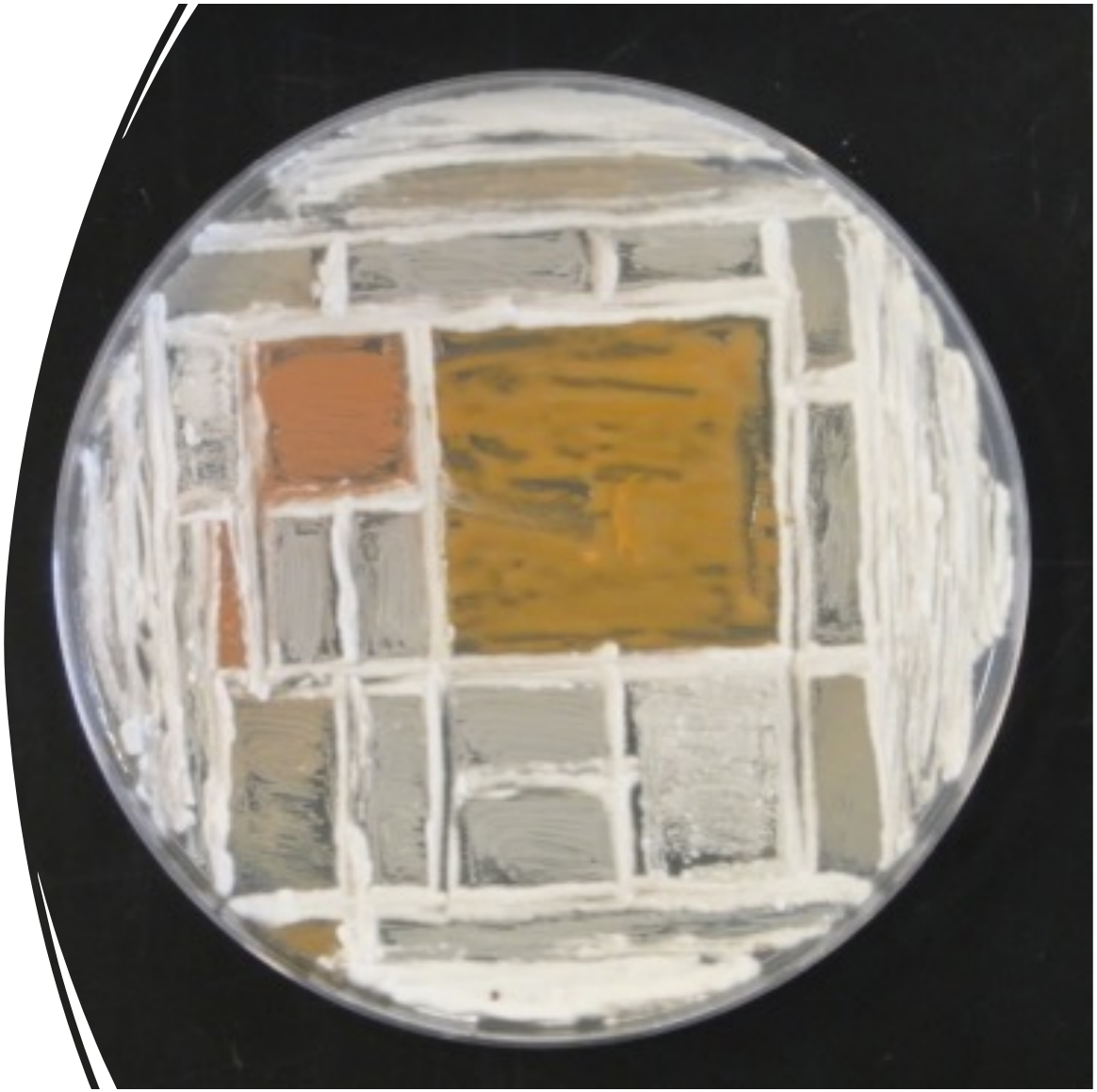


# Phaff Yeast Culture Collection

- 9,000 strains; over 1,500 species
- Ecology research
  - Food, plants, animals, other
- 1 to 800 strains per species (independent isolates)
- Wild, non-GMO
- Phenotype database
- In GCM, and our own catalog: https://phaffcollection.ucdavis.edu

# 1. MICROBES

*Adapted from: Flattau, P. E., M. Boeckmann, R. d. l. Cruz, P. Lagasse, N. Mitchell, M. Patterson, and D. Singpurwalla. 2007. Scientific collections: Mission-critical infrastructure for federal scientific agencies. Science and Technology Policy Institute.*

**Currently adding 5,000 yeast strains from Dr. Marc-André Lachance**

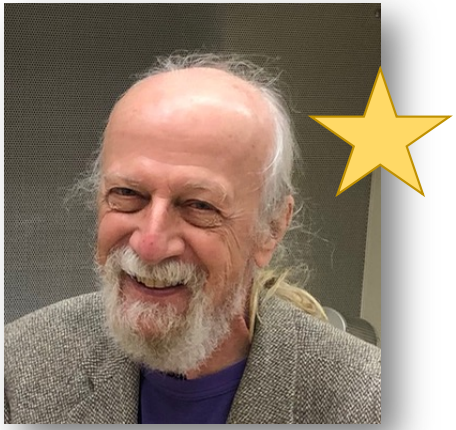
**Criteria for selecting:**

- Important discoveries
  - Cited in publications
  - Type strain of new species
- Investment in data
  - Genome sequenced; Phenotype data
- Immediate access needed
- Costly or impossible to replace
  - “Moon rocks”
  - Classical mutations, habitat destroyed
- Complements holdings
  - Genetic, geographic, temporal, phenotype diversity
- Few or no limitations on use

# Tips for researchers

2019 publication by USCCN

- Organize specimens
  - Cull duplicates; assign unique ID
- Database
  - Source, genotype, phenotype, documentation
  - Share database
- Preserve
- Long-term plan
  - Future home; funding



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REVIEW ARTICLE

## Preserving US microbe collections sparks future discoveries

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**Keywords**
algae, biotechnology, diversity, environmental mycology, fungi.

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**Summary**
Collections of micro-organisms are a crucial element of life science research infrastructure but are vulnerable to loss and damage caused by natural or man-made disasters, the untimely death or retirement of personnel, or the loss of research funding. Preservation of biological collections has risen in priority due to a new appreciation for discoveries linked to preserved specimens, emerging hurdles to international collecting and decreased funding for new collecting. While many historic collections have been lost, several have been preserved, some with dramatic rescue stories. Rescued microbes have been used for discoveries in areas of health, biotechnology and basic life science. Suggestions for long-term planning for microbial stocks are listed, as well as inducements for long-term preservation.

**Introduction**

Repositories of our culture can be endangered by massive disturbances such as floods, wildfires or civil unrest. Recent examples: the Audubon Aquarium of the Americas in New Orleans lost most of their fish in the aftermath of Hurricane Katrina (Kaplan and Zarembo 2005), many priceless items were damaged or destroyed in the Notre Dame Cathedral fire of April 2019 (Wu *et al.* 2019), and over 200 years of artefacts were lost in the fall 2018 fire at the National Museum in Rio de Janeiro in Brazil (Gorman 2018). Another type of vulnerable 'culture' is particularly relevant to readers of this article microbial cultures, which are often preserved in either public culture collections or in research collections. For instance in March 2019, there was a transformer explosion and fire in the Kline Biology Tower housing the *Escherichia coli* Genetic Stock Center (CGSC) at Yale University. Fortunately, all the freezers





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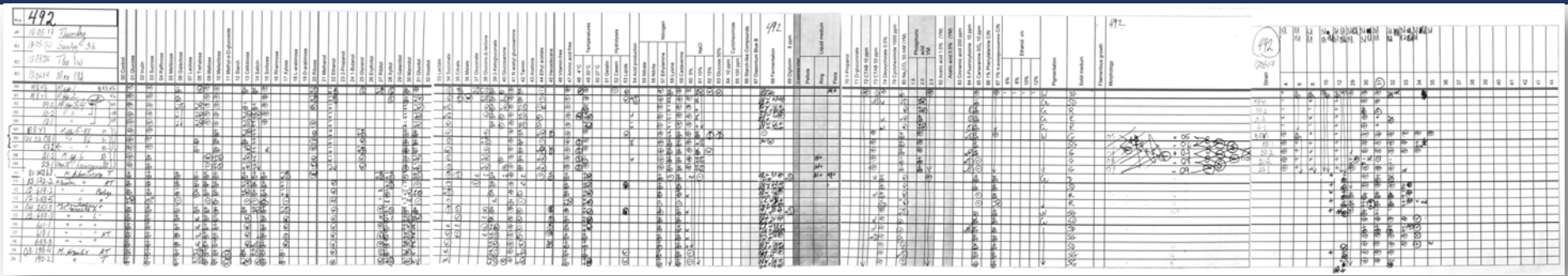
# 2. DATA:
# Lachance data sheets



Over 5,000 strains

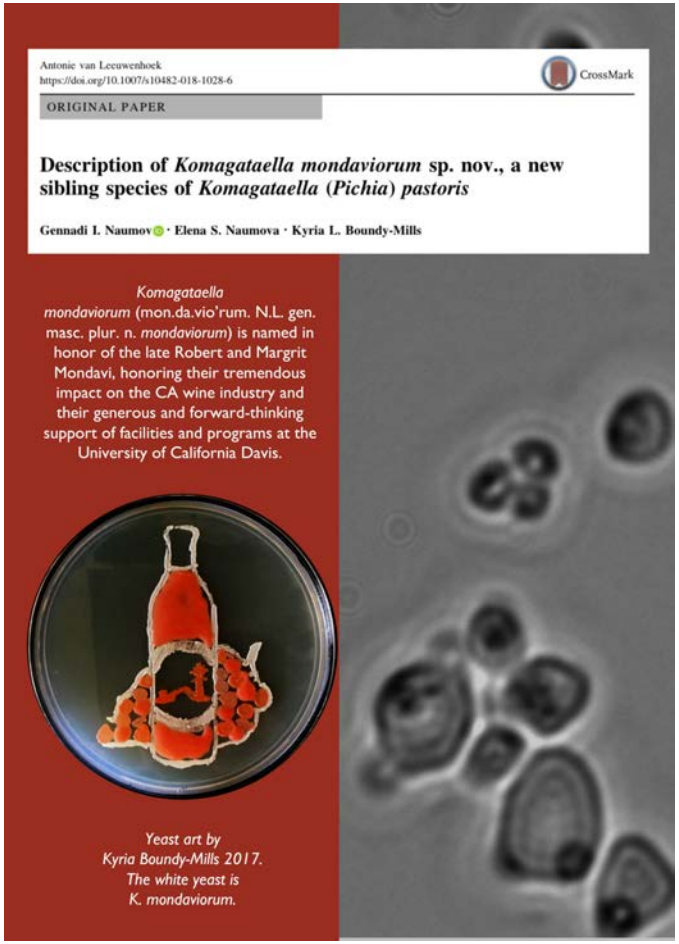
- Assimilation of C, N compounds
- Fermentation of C compounds
- Killer activity
- Enzymes
- Morphology

**Stress tolerance:**

- High, low temperatures
- High, low pH
- High sugar, salt; ethanol tolerance
- Growth inhibitors

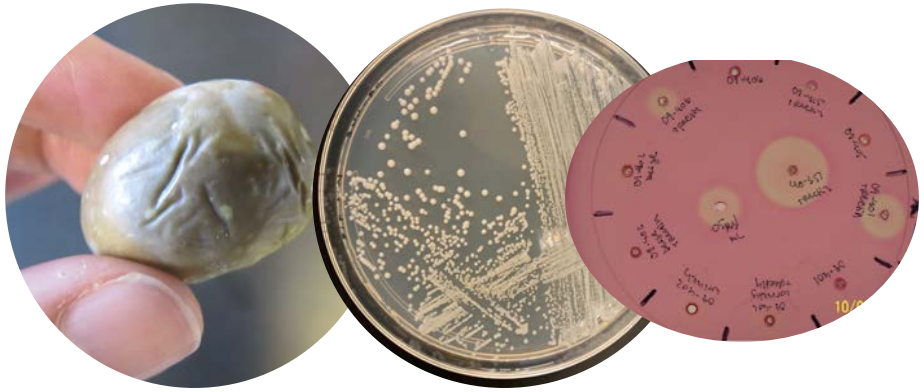
# 3. EXPERTISE of collection personnel

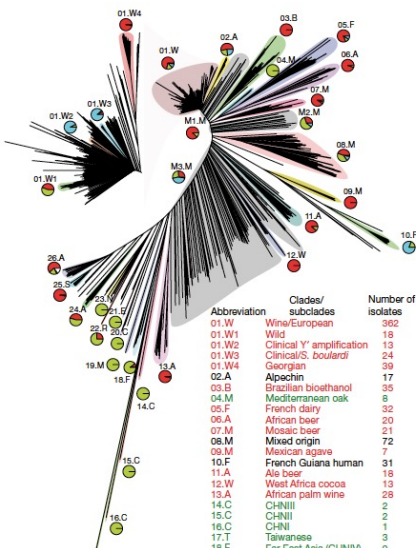
- SOURCE:
  - Acid tolerance study →isolated from low pH substrates
- TRADITIONAL PHENOTYPE DATA:
  - Ethanol tolerance study → ethanol tolerance data
- RECENT DATA:
  - New species descriptions → ribosomal sequences
    - *Komagataella mondaviorum*
    - *Rasporella dianae*
- CONNECTING RESEARCHERS:
  - Asparaginase, acrylamide story



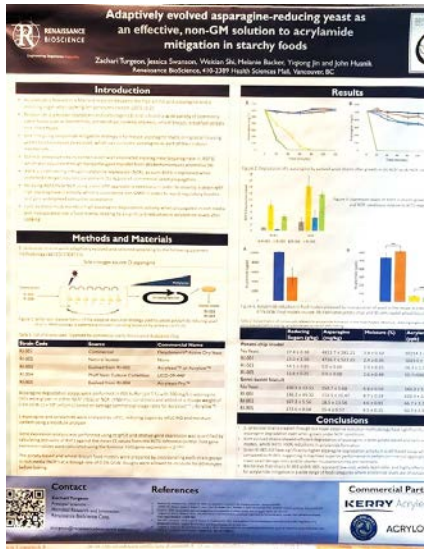
# Many uses of one yeast strain: *Saccharomyces cerevisiae* UCDFST 09-448

- 2009: Caused spoilage of olives – excessive pectinase activity
- 2011: Sent to researchers in France who sequenced genomes of 1,011 *S. cerevisiae* strains
  - Published in Nature in 2018
- 2020: Renaissance Biosciences found interesting asparaginase gene in a few *S. cerevisiae* strains including 09-448
  - Asparagine in foods can become acrylamide; Asparaginase before cooking reduces acrylamide in product
  - Renaissance used adaptive evolution to improve the strain
  - In 2022, Renaissance produced 2,200 kg of dried yeast for food companies to put into baked and fried foods to reduce acrylamide






| Abbreviation | Clades/ subclades | Number of isolates |
|---|---|---|
| 01.W | Wine/European | 362 |
| 01.W1 | Wild | 18 |
| 01.W2 | Clinical Y* amplification | 13 |
| 01.W3 | Clinical/*S. boulardi* | 24 |
| 01.W4 | Georgian | 39 |
| 02.A | Alpechin | 17 |
| 03.B | Brazilian bioethanol | 35 |
| 04.M | Mediterranean oak | 8 |
| 05.F | French dairy | 32 |
| 06.A | African beer | 20 |
| 07.M | Mosaic beer | 21 |
| 08.M | Mixed origin | 72 |
| 09.M | Mexican agave | 7 |
| 10.F | French Guiana human | 31 |
| 11.A | Ale beer | 18 |
| 12.W | West Africa cocoa | 13 |
| 13.A | African palm wine | 28 |
| 14.C | CHNIII | 2 |
| 15.C | CHNII | 2 |
| 16.C | CHNI | 1 |
| 17.T | Taiwanese | 3 |



# REQUEST: Can I see your collection's Disaster Plan?

**MICROBES, DATA:**

- Fire, flood, earthquake
- War
- Pandemic
- Freezer malfunction
- Computer crash

**PERSONNEL:**

- Illness, death
- Retirement
- Funding cuts

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