

The domestication of *Penicillium* cheese fungi

Jeanne Ropars¹, Ricardo Rodriguez de la Vega¹, Emilie Dumas¹, Thibault Caron¹, Alodie Snirc¹, Thibault Caron¹, Bastien Bennetot¹, Antoine Branca¹, **Tatiana Giraud**^{1,*}

¹ESE, Université Paris-Saclay, CNRS, AgroParisTech

*Corresponding author, e-mail: Tatiana.Giraud@u-psud.fr

ABSTRACT:

Domestication is the process of organism evolution under selection by humans, and as such has been a model for studying adaptation since Charles Darwin. Here we review recent studies on the genomics of adaptation and domestication syndrome in two cheese-making fungal lineages, *Penicillium roqueforti* used for maturing blue cheeses, and the *Penicillium camemberti* species complex used for making soft cheeses such as Camembert and Brie. Comparative genomics have revealed horizontal gene transfers involved in convergent adaptation to cheese. Population genomics have identified differentiated populations with contrasted traits, several populations having independently been domesticated for cheese making in both *P. roqueforti* and the *Penicillium camemberti* species complex, and having undergone bottlenecks. The different cheese populations have acquired traits beneficial for cheese making in comparison to non-cheese populations, regarding color, spore production, growth rates on cheese, salt tolerance, lipolysis, proteolysis, volatile compound or toxin production and/or competitive ability. The cheese populations also show degeneration for some unused functions such as decreased ability of sexual reproduction or of growth under harsh conditions. These recent findings have fundamental importance for our understanding of adaptation and have applied interest for strain improvement.

KEYWORDS:

Fungi; domestication; cheese; adaptation; horizontal gene transfer.