

The Art and Science of Coffee Fermentation

A Guide to
Biotransformation

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Springer

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Cover illustration: This picture was taken by Philipp Tresbach 2024 in Peru during a farm visit of the cooperative Rutas del Inca. It shows Marcel picking ripe coffee cherries.

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List of Abbreviations

AAB:	Acetic Acid Bacteria
ATP:	Adenosine Triphosphate
a_w:	Water activity
CGA:	Chlorogenic Acid
CO₂:	Carbon Dioxide
CoA:	Coenzym A
GABA:	Gamma-Aminobutyric Acid
LAB:	Lactic Acid Bacteria
OTA:	Ochratoxine A
pH:	pH-value
sp.:	(Lat. species) refers to a single, unnamed species of a genus
spp.:	(Lat. species pluralis) refers to multiple, unnamed, not further specified species of a genus

INTRODUCTION



For thousands of years, food production, processing, and preservation have been closely intertwined with microbial fermentation. When you think of fermentation, sauerkraut, yogurt, kimchi, or fresh sourdough bread with kefir butter probably comes to mind, rather than a sweet-balanced coffee.

However, the advent of elaborate, natural, and anaerobic-processed coffees has made “fermentation” a common term, especially in the specialty coffee scene. The precision in using terms and accurately describing fermentation processes often falls short. A wealth of scientific knowledge exists on coffee fermentation, but the scientific jargon makes it unapproachable.

As coffee enthusiasts who had the opportunity to receive training in biotechnology, our motivation drove us to gather expert knowledge on coffee fermentation and make it accessible to the coffee world. Don’t worry – you can understand this book without a degree in biology or chemistry.

One thing is clear: Fermentation is not an invention of humans but an essential natural process for gaining energy from the decomposition of organic matter. Without it, “the earth would be a gigantic landfill where the dead pile up, and there would be no food for the living,” as Michael Pollan aptly puts it ¹. Humans and some animal species have learned to utilize fermentation processes by controlling and stopping them immediately – controlled fermentation results in nutritious, aromatic products with often intensified taste.



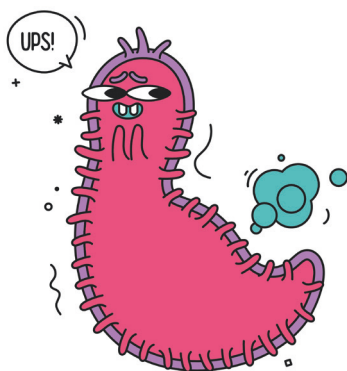
Fermentation

The conversion of organic raw materials, such as wort in brewing beer, mash in winemaking, cabbage for sauerkraut, or aroma-building blocks in coffee, through microorganisms or the addition of crucial enzymes. This conversion can occur both without oxygen (anaerobic) and with the addition of air (aerobic). The fermentation process produces organic acids, alcohols, and gases.

This book provides an overview of the fundamental impact of fermentation on coffee production. We also explore the various processes and diligent microorganisms and their influence on coffee as we know it. We hope to broaden your perspective on fermentation, green coffee processing and their effects on taste after roasting.

We dedicate this book to all the biological helpers who make coffee what it is: delicious.

So let's get nerdy.





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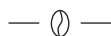
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COFFEE FLAVOR DEVELOPMENT – FINGER-LICKING GOOD



Chapter Summary

The relationship between taste and coffee is complex, influenced by a range of factors including the processing, roasting, and preparation methods used, as well as the quality of the coffee itself. Coffee books often explore the aromatic compounds and the flavors that emerge during roasting. However, fermentation plays a significant role in shaping the taste of coffee. While traditional coffee processing methods, like Washed, Honey, and Natural, focus on removing the fruit layers surrounding the coffee cherry, the exact processes of fermentation and their impact on flavor are often underexplored. Fermentation helps remove the mucilage (a gelatinous layer) from the coffee cherry, but its role goes beyond just this physical separation. The fermentation process influences the coffee's flavor profile by interacting with the compounds in the mucilage, which contains e.g. sugars, organic acids, and proteins that contribute to the overall taste.



When delving into the relationship between taste and coffee, one finds that coffee books often discuss the aromatic compounds present in green coffee and the variety of flavors that emerge during the reactions in coffee roasting. The quality of processing, roasting, and preparation can significantly influence the taste of coffee. There is already a good overview of traditional processing methods, from Washed, Honey to Natural. Ultimately, the specialty coffee scene has advanced knowledge regarding the influence of preparation methods (temperature, water quality), quality of coffee (specialty coffee), and the procedure of roasting.



Fig. 2.1: From plant to cup – coffee's lifeline.