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*Original Citation:*

*Availability:*

This version is available <http://hdl.handle.net/2318/1707289> since 2019-07-22T17:00:08Z

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# **A matter of chocolate aroma: what microbial communities can do on the formation of sensorial attributes in the early stages of the cocoa fermentation**

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## **Abstract**

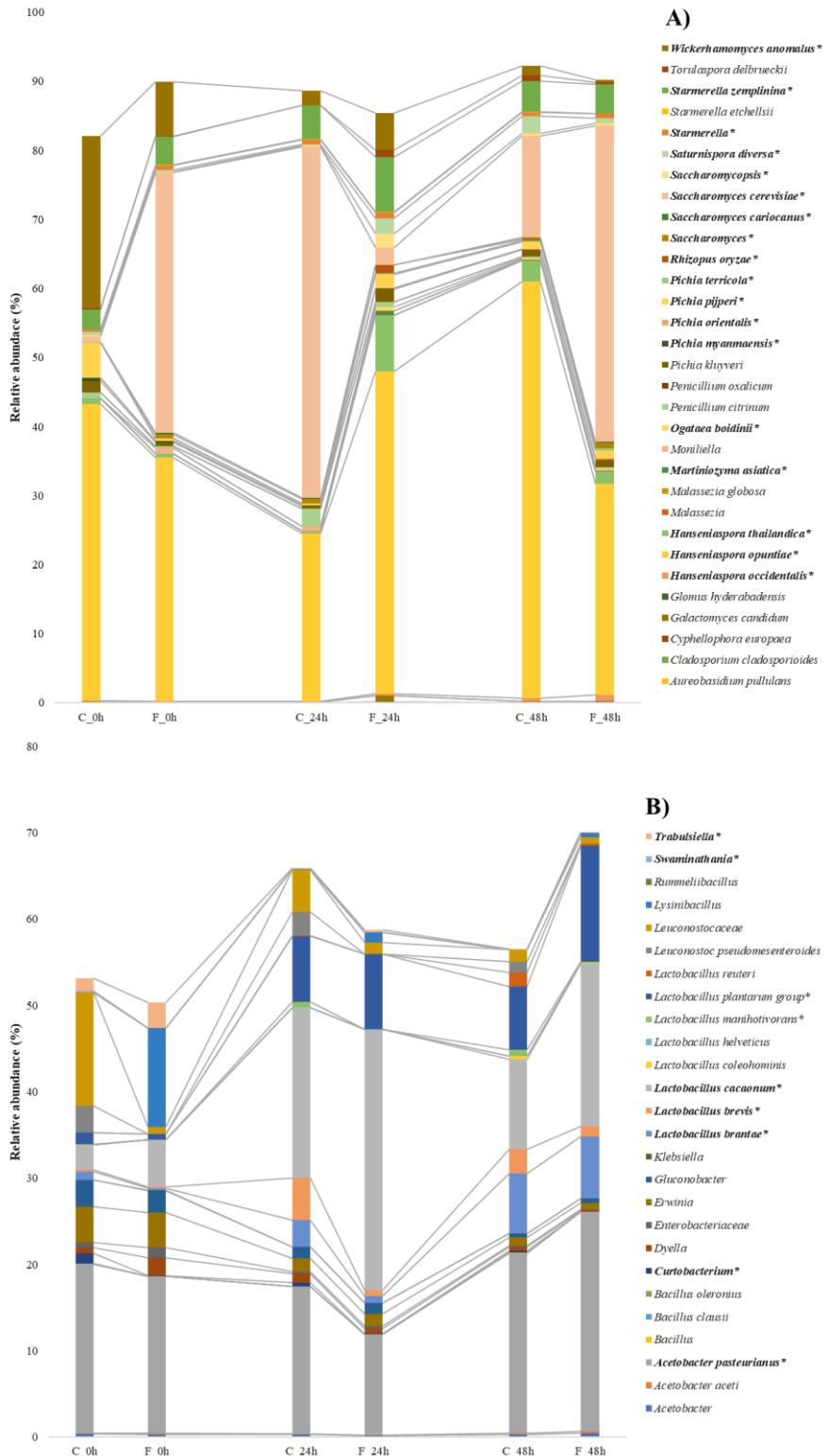
A desirable chocolate aroma is considered a marker for high quality. However, the flavor characteristics depend on the variety's genetics and post-harvesting methods. The aroma development starts during fermentation where the microbiota plays an important role in the generation of the cocoa flavor. This work aimed to identify the dominant microbes that can contribute to the aroma generation in two different Mexican cocoa varieties (*Criollo* and *Forastero*) during the first two days of spontaneous fermentation. To evaluate the microbial communities of fermented cocoa beans we performed an amplicon-based sequencing on the microbiota and mycobiota by targeting 16S and the 26S rRNA respectively using the Illumina MiSeq platform. Microbial richness analysis indicated a higher level of complexity across fermentation time for fungi ( $P < 0.05$ ), while the bacterial community remarkably indicated a higher level of complexity in *Criollo* varieties compared to *Forastero* ( $P < 0.05$ ). In general, we observed that the fermentation was driven by *Hanseniaspora opuntiae*, *Saccharomyces cerevisiae*, *Acetobacter pasteurianus*, *Lactobacillus cacaonum*, and *Lactobacillus plantarum* group (Fig. 1)

#IMG:Fig1#. A quantitative descriptive analysis was also performed using a trained panel and the frequency data obtained was subjected to correspondence analysis. Figure 2 showed that the sensorial perception of fermented cocoa beans changes over fermentation time as a function of the microbial metabolic activity and development, while no influences were observed between cocoa varieties. However, the roasting process had a positive influence on the sensorial profile of the cocoa beans. #IMG:Fig2#. These results provide useful information on the microbial composition and aroma compounds of fermented cocoa beans that can be used to improve the aroma and flavor characteristics of chocolate.

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**Figure 1.** Relative abundance of fungi (A) and bacterial (B) communities in fermented cocoa beans.  
**Abbreviations:** Criollo (C) and Forastero (F).



**Figure 2.** Correspondence analysis factor (CA) map showing the position of the taste and aroma attributes of fermented and roasted cocoa beans obtained from two different cocoa varieties. The CA loading and scores for dimension 1 and 2 are represented based on the type of cocoa process, including roasting (blue circles) and fermentation (orange triangles). **Abbreviations:** Criollo (C) and Forastero (F).

