Metagenomic, metabolomic and sensorial characteristics of fermented *Coffea arabica* L. var. Castillo beans inoculated with microbial starter cultures

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Coffee is one of the most important, and most widely consumed drinks around the world. Fermentation is a key step in determining the quality of the final cup of coffee. Although this process was initially done to simply remove the mucilage from the coffee beans, coffee producers have begun to use microbial starter cultures to improve cup sensory profiles. In the present study, freshly harvested Arabica coffee beans were processed through two different fermentation methods in which one of these processes was inoculated and supplemented with microbial starter cultures and natural flavors, to determine the microbial communities involved in the fermentation process and the metabolomic and sensorial profiles of the resulting green and roasted coffee beans. The bacterial and fungal composition were followed throughout the fermentation process of the beans using metagenomic DNA extraction and high-throughput sequencing of the bacterial *16S rRNA* gene V4 region and fungal *ITS1* region. Moreover, the metabolomic profiles of the resulting green and roasted coffee beans were studied with non-targeted metabolite profiling analysis, using reverse-phase and hydrophilic interaction chromatography modes of high performance liquid chromatography in quadrupole time of flight mass spectrometer. These metabolites were manually annotated with the CEU Mass Mediator annotation tool. Additionally, a quantitative descriptive analysis was applied to measure certain sensory attributes, including aroma, flavor, acidity, and sweetness, among others, to describe the sensorial profiles of the roasted and brewed coffee beans. A total of 220 possible metabolic compounds of variable experimental masses were identified for the green coffee beans using both metabolomics platforms. The metabolic compositions differed between both fermentation methods, given that the standard fermentation had more metabolites associated with a higher acidity, caramel and almond notes, such as neochlorogenic acid, 2-benzofuran carboxaldehyde and ethyl maltol, respectively, and the inoculated fermentation had a higher abundance of metabolites associated with sweeter, and winey notes, such as vanillin and piceatannol 4’glucoside. Furthermore, the coffee beverage resulting from the inoculated fermentation method had an overall higher cupping score and more notes that were preferred by certified Q-Grader coffee cuppers in contrast to the coffee processed with standard methods, which was characterized by a noticeable defect in the form of a phenol. As a consequence, coffee producers should be aware of the potential and safety of utilizing starter cultures to improve the final quality of the brewed and consumed coffee. Future studies should focus on microbial identification at a deeper level and the correlation between certain species and their resulting metabolic compounds, where specific bacterial and fungal groups could be isolated and grown to be used as commercially available starter cultures for wet processed coffee fermentation.