Exploring the impact of spontaneous fermentation during wet processing on microbiota and coffee quality

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Introduction

Coffee (*Coffea arabica*) grows in tropical regions where its fruit, *i.e.* the coffee cherries, undergoes a series of processing steps until the dried green coffee beans are ready for roasting. The quality of the resulting product is influenced by several factors such as coffee variety, climate, post-harvest processing, and storage. In the wet process, spontaneous fermentation of depulped coffee beans has a significant impact on quality of the green beans. Hence, fine-tuning parameters of post-harvest processing can lead to improved quality via alteration of microbial diversity (Zhang et al., 2019). The aim of this study was to monitor and compare two wet processes, Reposo and Tradicional, on the farm Finca Santa Rita in Nicaragua.

Material and Method

After selective picking and removal of floaters, coffee cherries (*Coffea arabica* var. *Catuaí Rojo*) were processed in two ways with three independent replications each (see process schematics Fig. 1). In the Reposo process (R) cherries were rested for 40 h in a closed barrel, followed by 10 h of fermentation (Fig. 2). In the Tradicional process (T) cherries were directly depulped and fermented for 15 h. Afterwards, fermented coffee beans were washed and sun dried for 10 d to reduce moisture content to 11%. At different steps during the two processes, lactic acid bacteria (LAB) and yeasts were determined using RYM and LAB petrifilms (3M). Further, pH was measured according to Jackels and Jackels (2005) and samples for liquid chromatography were frozen. Organic acids were analysed and quantified in green coffee from both processes by ultra performance liquid chromatography (UPLC) using a HSS T3 column (2.1 mm x 100 mm, 1.8 µm) coupled to TripleQuad mass spectrometry (Waters cooperation).

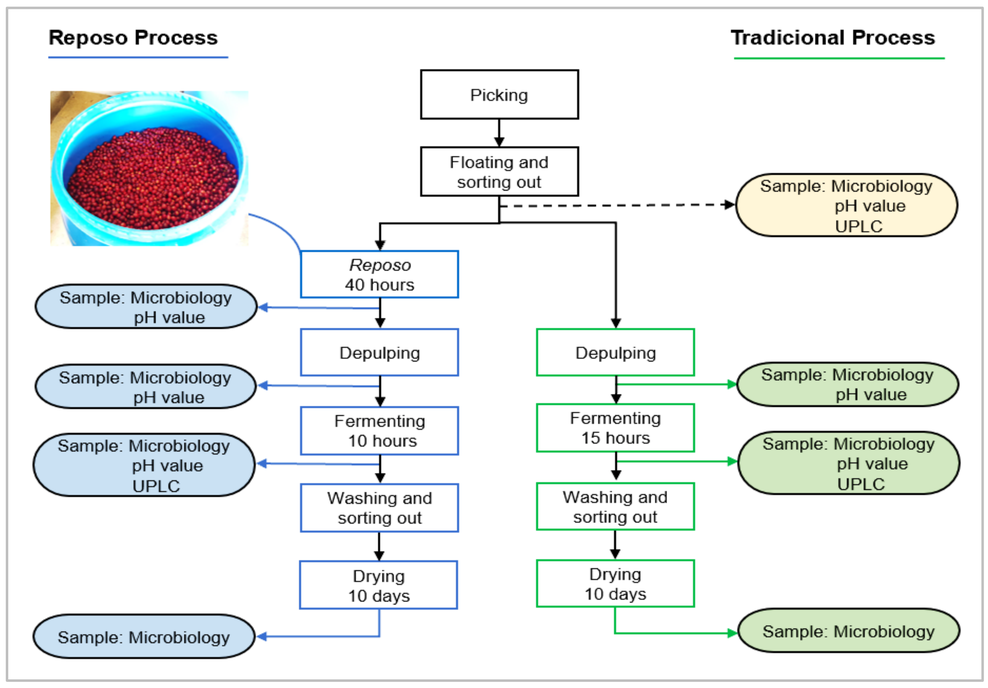

Fig. 1. Overview of the coffee post-harvest processes Reposo (left side) and Tradicional with sampling plan (right side) (n=3)

Fig. 2. Fermentation of depulped coffee beans in a barrel

Results and Discussion

The microbiota represented through yeast and LAB showed almost identical initial counts (Fig. 3) at a starting pH of 5.4. After 40 h *Reposo*, the number of LAB and yeasts increased while the pH decreased to 5.0. During the subsequent fermentation, LAB and yeasts counts remained high in Reposo process, whereas it increased in Tradicional process with respective fermentation endpoints at pH 4.8 (R) and 5.2 (T). Other studies showed similar LAB and yeast counts after fermentation (Avallone et al., 2001; Velmourougane, 2013). According to Jackels and Jackels (2005) a pH of 4.6 indicates complete fermentation. Therefore, Reposo coffee beans were nearly optimal fermented, whereas Tradicional coffee beans remained rather under-fermented.

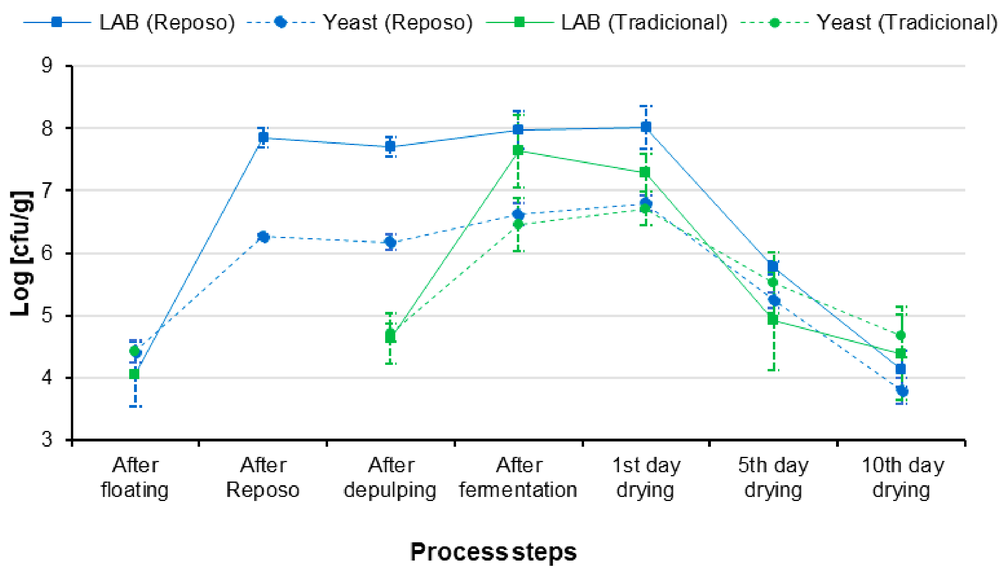

Fig. 3. Cell counts of LAB and yeast during Reposo process (blue) and Tradicional process (green) (n=3) with standard deviation

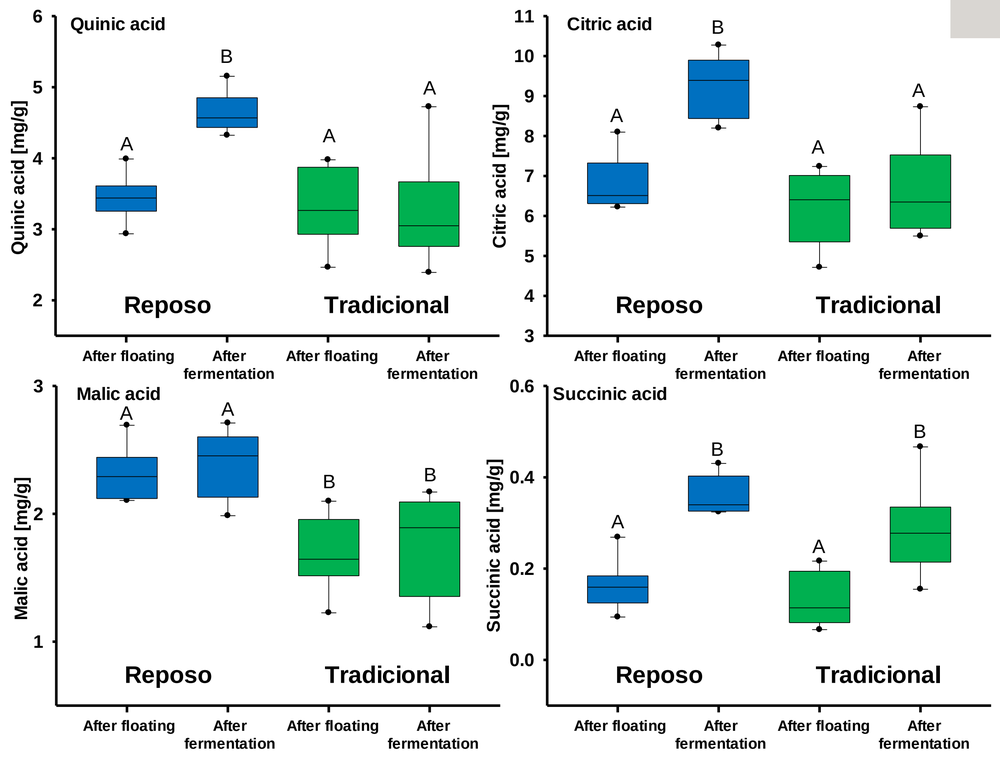

Fig. 4. Quantification of four organic acids in fresh green coffee, before and after fermentation for Reposo process (blue) and Tradicional process (green) (n=9). Different letters indicate significant differences (ANOVA, Holm post hoc test).

The main organic acids in green beans were identified as citric and quinic acid, followed by malic and minor amounts of succinic acid (Fig. 4). No lactic, oxalic or tartaric acids were present in green beans, while phosphoric and acetic acid were not analyzed. The decrease in pH during fermentation corresponded to an increase of citric as well as quinic acid only for the Reposo process, whereas these two acids did not change in coffee from the Tradicional process. Also for malic as well as succinic acid there were differences in quantity, but due to the low amounts present in coffee these should not impact coffee taste.

Conclusion

This study showed that different fermentation processes, also due to the longer microbiological activity during the Reposo process, lead to a reproducibly different composition of green coffee. Since acidity is a preferred attribute in coffee, controlled fermentation seems to produce a higher coffee quality.

References

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