

Biochemical Insights into Coffee Processing: Quality and Nature of Green Coffees are Interconnected with an Active Seed Metabolism

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SUMMARY

Aroma potential and thereby coffee qualities are strongly influenced by the mode of processing. In the past, we have postulated that these processing-related quality variations are due to specific differences in biochemical reactions occurring within the viable coffee beans during processing. In this paper, unequivocal evidence is presented that various biochemical processes occur within the coffee seeds and that the coffee seeds are able to respond to changes in their environment. Also, evidence is presented that germination is initiated and proceeds during coffee processing. The germination-related metabolism was monitored by both the expression of germination-specific enzymes (i.e. the isocitrate lyase) and the resumption of cell cycle activity/ cell division (estimated by β -tubulin accumulation). The extent and time course of these germination processes depend on the mode of processing. Apparently, the removal of the pulp provides the stimulus for activating the preliminary, hardly perceptible steps of the germination process. Surprisingly, also in dry process seeds, germination-related metabolism occurs, probably due to endogenous triggering. However, here the germination processes reveal a time course different from that of wet process coffees.

Apart from germination, other metabolic processes have been found to occur in coffee beans. The most significant phenomenon is the accumulation of γ -aminobutyric acid (GABA), a typical response to drought stress. However, GABA is exclusively accumulated in dry process, and not in wet process, green coffees. The reason for these differences is the different time frame for the stress-related metabolism. In dry processed beans the stress-related synthesis of GABA is likely to take place over several days, leading to a large accumulation of this non-protein amino acid. In contrast, the induced stress metabolism in wet process beans is terminated before there is a significant accumulation of GABA, as the drying procedure is much faster in wet than in dry process beans. Only in the case of a prolonged drying period, wet process coffees also reveal high levels of GABA.

The data presented in this paper demonstrate the high relevance of the fact that green coffee seeds represent vital and living organisms, in which various metabolic reactions occur during processing, e.g. a germination-related metabolism and a stress metabolism. The extent of these processes depends on the conditions during processing and thereby influences coffee quality. Consequently, specific alterations of these conditions should influence these metabolic processes and affect coffee quality.

Moreover, the new insights can be used to explain potential quality differences of coffees resulting from classical wet and new progressive processing methods with mechanical mucilage removal, e.g. the aquapulping-methods. We deliberately introduced modifications of these progressive methods by adding intermediate storage phases in which the metabolic processes associated with the fermentation stage in wet processing could proceed. Sensory analyses suggested that the introduced modifications led to perceptible changes in the flavour profile.