

Green Coffee is ALIVE !

A Review on the Metabolic Processes taking Place in Coffee Beans during Processing and their Implication for Modern Coffee Research

D. SELMAR AND G. BYTOF

Institute for Plant Biology, Technical University Braunschweig, Mendelssohnstr. 4,
38106 Braunschweig, Germany

SUMMARY

Within the last few years, substantial progress has been made in the understanding of the metabolic processes occurring within the coffee seeds during the course of post harvest treatments. It was shown that seed germination is initiated during processing and, especially whilst drying, a stress metabolism is executed in the coffee beans and that the metabolic reactions involved strongly are determined by the mode of post harvest treatment and thereby influencing the coffee quality. These insights lead to a paradigm shift in coffee research: today, the green coffee beans are not longer considered just as an inanimate commodity, but rather as viable organisms, whose physiological capacity could be used for quality improvement. This however, requires the comprehensive knowledge of the related metabolic processes, especially that of their time courses and their successions. Using modern techniques of plant biochemistry and molecular biology, it became possible to analyze reliably the extent and amplitude of these processes. Based on competitive RT-PCR techniques, the time course of germination processes during the course of processing was analyzed by the expression pattern of the germination specific isocitrate lyase. In wet processed green coffees, maximal gene expression occurs about 2 two days after the onset of post harvest treatment, whereas the maximal activity in dry process coffees is abundant about one week after the start of processing. The progression of germination was also monitored by quantification of the cell cycle activity and cell division via Western blot analyses of β -tubulin and by flow cytometry. As monitored for the gene expression, also the maximal cell division occurs in wet processed coffees already two day after the onset of processing, whereas the maximum in dry process ones is achieved about one week after the start of drying. A direct comparison of all time courses reveal that the processes analyzed do not run simultaneously, but that there are some minor shifts in the time courses. This is due to the fact that germination corresponds to an entire metabolic syndrome, where some events run in parallel, some delayed and others consecutively. Like germination, also a stress related metabolism proceeds in differentially processed green coffees seeds to a quite different extent. This is expressed by a massive accumulation of the stress metabolite γ -amino butyric acid (GABA) in dry processed beans, whereas in wet processed ones the GABA concentration is far lower; although also in the course of wet processing drought stress is induced when the parchment coffee is dried. The explanation for these differences in the extent of GABA accumulation is given by the quite different time frames for the related metabolism which can be deliberately altered by changing the drying conditions. As specified for germination, also stress metabolism corresponds to a metabolic syndrome. Hitherto, it is not known, if further complex metabolic events are also executed in green coffee during processing. Yet, we must be aware that numerous metabolic reactions are running in parallel or consecutively, altogether a complex and sophisticated intermixture of metabolic reactions, which only could be comprehended by using new and powerful methods like the new and promising approaches

of genomics and metabolomics. Up to now, the causal coherences between the various physiological events and the generation of flavour precursors and aroma relevant compounds are not elaborated. The clarification of this subject corresponds to one of the most intriguing and promising field of modern coffee research. The overall analyses of the substantial composition of green coffee in relation to physiological fundamentals, will provide powerful tools for the understanding and comprehension of influencing the coffee quality by modifying processing conditions.