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Unravelling the Metabolic and Hormonal Machinery During Key Steps of Somatic Embryogenesis: A Case Study in Coffee

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Nestlé Good food, Good life

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Introduction

Somatic embryogenesis (SE) is one of the most promising processes for large-scale dissemination of elite varieties. However, for many plant species, optimizing SE protocols still relies on a trial-and-error approach. Using coffee, we report here the first global analysis of metabolome and hormone dynamics aiming to unravel mechanisms regulating cell fate and totipotency [1,2].

Results

Statistical analysis performed on 104 metabolites revealed that massive re-configuration of metabolic pathways induced SE. During **initial dedifferentiation**, a sharp decrease in phenolic compounds and caffeine levels was observed while auxins, cytokinins and ethylene levels were at their highest. Totipotency reached its highest expression during **callus stages** when a shut-off in hormonal and metabolic pathways related to sugar and energetic substance hydrolysis was evidenced. Chlorogenic acids appeared as markers of **embryo redifferentiation**.

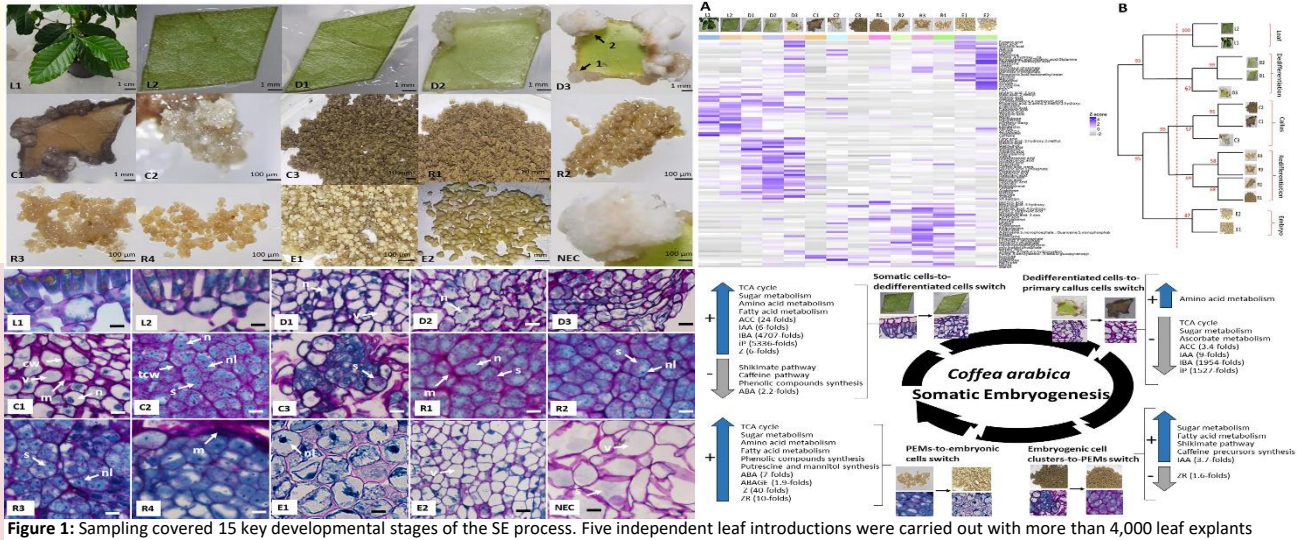

Figure 1: Sampling covered 15 key developmental stages of the SE process. Five independent leaf introductions were carried out with more than 4,000 leaf explants and a total of 25 independent cell lines. Primary metabolites, secondary metabolites and phytohormones were quantified using GC-MS, HPLC and UPLC- MS/MS respectively. A robust statistical method was used to identify metabolic pathway changes associated with the main developmental phases and phase switches. Five developmental phases and four phase switches were identified and characterized. Histological analysis was also required to characterize developmental stages.

Conclusion

This analysis showed that **metabolite fingerprints are signatures of cell fate** and represent a starting point for **optimizing SE protocols in a rational way**. Abscisic acid, leucine, maltotriose, myo-inositol, proline, tricarboxylic acid cycle metabolites and zeatin appeared as key **metabolic markers of the embryogenic capacity**.

Acknowledgments

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References

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