



## **Waste materials derived bio-effectors used as growth promoters for strawberry plants. An agronomic and metabolomic study**

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Recently, a novel concept of bio-effectors has emerged to describe a group of products that are able to improve plant performance more than fertilizers. In this study, three different agro-industrial residues, i.e. brewers' spent grain (BSG), fennel processing residues (FPR) and lemon processing residues (LPR) were chosen as potential bio-effectors. A greenhouse soilless pot experiment was conducted on strawberry plants (*Fragaria x ananassa* var. Festival) in order to study the effect of BSG, FPR and LPR water extracts, at different concentrations, on plant growth and fruit quality. Their effect was compared with humic-like substances as a positive/reference control (Ctrl+) and with Hoagland solution as a negative control (Ctrl-). Agronomic parameters and the nutrient uptake were measured on shoots, roots and fruits. Metabolomic profiling tests were carried out on leaves, roots and fruit juices through the NMR technique. Plants treated with the FPR extract showed better vegetative growth, while plants treated with the BSG extract gave higher yield and better fruit size. Metabolomic profiling showed that fruits and roots of plants treated with FPR and LPR extracts had higher concentrations of sucrose, malate and acetate, while BSG treated plants had higher concentrations of citrate and  $\beta$ -glucose. In conclusion, according to the results achieved, the bio-effectors used in this study promote plant growth and fruit quality regardless of their nutritional content.

**Keywords:** bio-effectors, agro-industrial waste, nuclear magnetic resonance (NMR), strawberry, growth promotion, fruit quality.