

# Cell biochemical factories

producers of the beer flavour, my perfumes, warm bath oils and medicines

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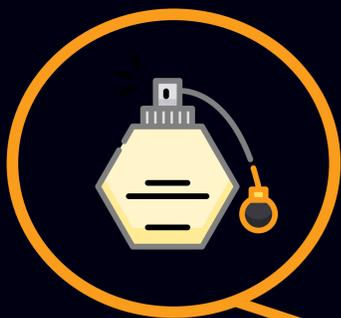


## Introduction

Trichomes are diverse epidermal structures covering the surface of a large number of plant species. Whilst some serve more as a physical and mechanical protection against environmental stress, **glandular trichomes (GTs)** are characterised by the ability to produce, secrete and store large quantities of specialised metabolites (also called secondary). Many of the produced metabolites exhibit antifungal, insecticide or pesticide properties contributing to the chemical arsenal of plants. Moreover, many of these metabolites are of a commercial importance. For instance, the **essential oils** of aromatic plants from the mint family (peppermint, basil, sage, oregano, thyme, lavender) or the agents responsible for the aroma and bitter **flavour of beer** from hop cones are all accumulated in GTs. Beyond that, some compounds due to their bioactivity have been adopted as **medicines**, such as artemisinin, an antimalarial drug precursor solely biosynthesised in the GTs of sweet wormwood *Artemisia annua*.

## Facts

1. GTs can be found in approximately **30 %** of all vascular plants.
2. Extremely high metabolic fluxes in these organs has been reported -> we estimated carbon flux to be equal to **2.5mMs<sup>-1</sup>**.
3. Production of some metabolites can reach up to **20%** of the leaf dry weight.
4. Some of the GTs have chloroplasts.



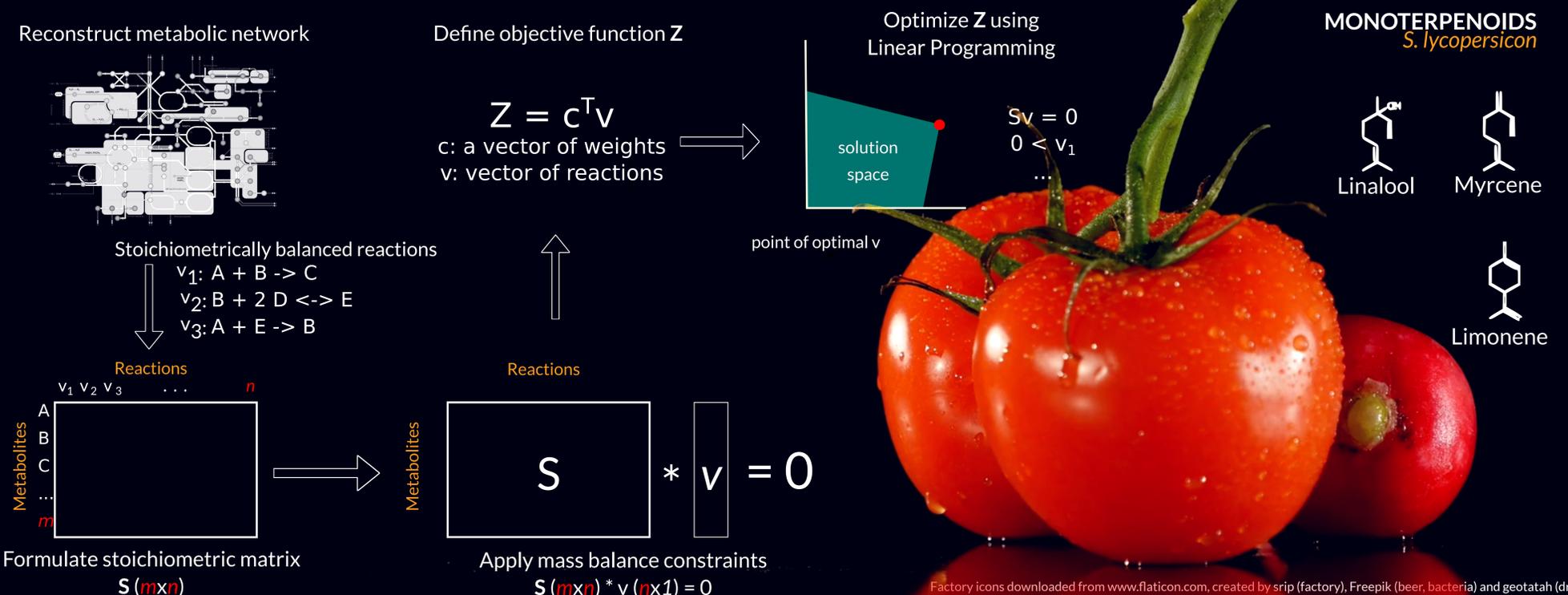
## Research Questions

1. What is the source of energy required to drive the fast biosynthesis in GTs?
2. What is the role of photosynthesis in GTs?
3. How can we modulate the metabolic network to exploit the maximal efficiency?

## Systems Biology Approach

We will integrate omics-data obtained from our experimental partner (IPB Halle) into mathematical models. We will first develop a genome-scale reconstruction of metabolism in tomato GT. Using available methods, such as **Flux Balance Analysis** we will represent metabolism in a mathematical terms and simulate the flux of metabolites through the network of photosynthetic glandular trichomes. By incorporating experimentally determined metabolite concentrations into our objective function ( $Z$ ), we ensure realistic composition of produced metabolites.

## Formulation of a FBA problem



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Visualisation of the FBA problem based on Orth et al. (2010) Nature Biotechnology, 28, pp. 245-248