The α-proteobacterium *Rhodospirillum rubrum* has been chosen by the European Space Agency to colonize the second compartment of the MELiSSA loop, its life support system envisaged to autonomously sustain a crew for a long-term space mission. Indeed, under anaerobic condition, *Rs. rubrum* is able to grow photoheterotrophically with light as energy source and the volatile fatty acids (VFA) produced in the first compartment of the loop as carbon sources. The assimilation metabolism of these VFAs in *Rs. rubrum* under photoheterotrophic condition is the subject of this thesis.

The ethylmalonyl-CoA pathway, a recently demonstrated anaplerotic pathway, is shown to have a central role in the VFAs assimilation metabolism, while a new anaplerotic route based on the L-valine biosynthesis and degradation pathways is proposed for the assimilation of butyrate.

A surprising adaptation phenomenon involving genetic plasticity and characterized by the duplication and amplification of key genes of the ethylmalonyl-CoA pathway is also shown to confer protective effects against light stress when acetate is used as carbon source.

Finally, the assimilation of mixtures of VFA is explored. An inhibition of the assimilation of butyrate by acetate and propionate is observed and could be due to cross-inhibition in assimilation metabolisms. Despite this inhibition, a surprising synergy effect is also highlighted to arise from the combination of the different VFAs.

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**Ph. D. Thesis Defense**

*Rhodospirillum rubrum* S1H

Unravelling the volatile fatty acids assimilation in the MELiSSA loop

A Ph. D. thesis presented by QUENTIN DE MEUR in fulfilment of the requirement for the degree of Doctor of Philosophy in Biological Sciences.

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