

# Observing Fatty Acid Synthase as part of the *Dalotia* beetle Defense System



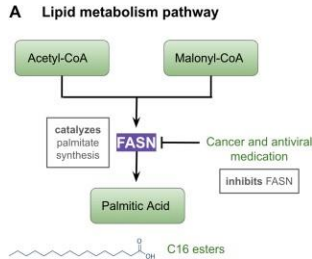
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## Introduction

Fatty acid synthase is a lipogenic catalyst in the lipid metabolism pathway. This pathway carries significance in the human body, as it modifies proteins, localizes cellular functions, and constructs cell membrane structures. While significant, this pathway can exacerbate conditions like COVID-19 and cancer.

Fig. 1. FASN utilizes acetyl-CoA and malonyl-CoA, byproducts of glycolysis, to synthesize palmitic acid. Cancer and COVID-19 can accelerate this pathway, increasing tumor proliferation and inflammation in patients [3]. Developing drugs targeted to inhibit FASN from overproduction will aid in treating these conditions.



## Evolution and Behavior

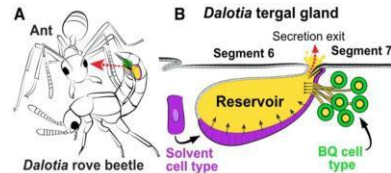
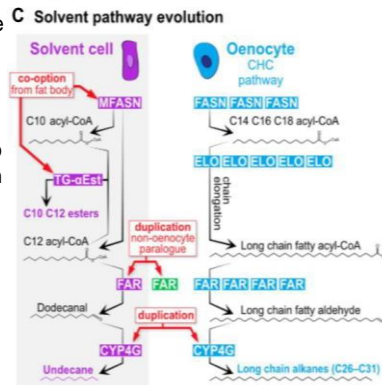


Fig. 2. One evolutionary advantage the rove beetle possesses is its tergal gland. Containing two cooperating cell types, this gland is effective in fending off attackers, like ants [1].

FASN plays a vital role in the solvent pathway, where it produces C10 and C12 esters. This pathway is integral to the glands secretion [1]. Although the mammalian lipid pathway and oenocyte pathway rely on FASN, they yield long fatty acid chains of C14, C16, and C18.



## Species Comparison

### A Multiple sequence alignment

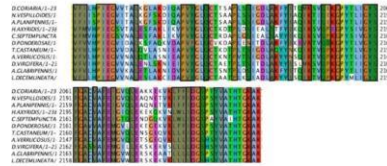
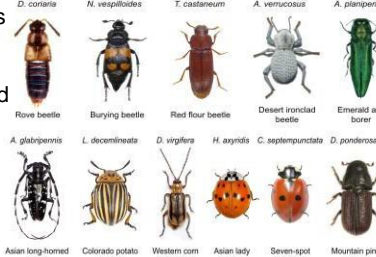


Fig. 3. A multiple sequence alignment of the 10 most similar species to *Dalotia coriaria* was made with Clustal Omega and arranged with Jalview.

### B Sequence alignment key

Boxed sequences represent conserved motifs that are also found in well-studied organisms, like humans, rats, chickens, roundworms, and fruit flies.



## Structural Overview

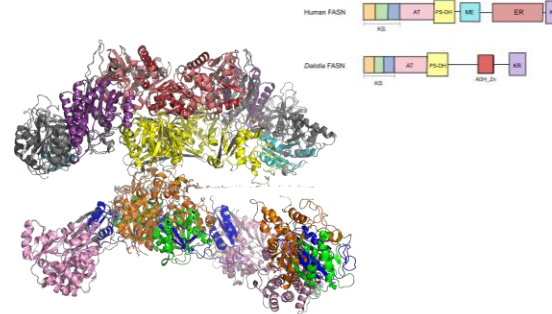


Fig. 4. The structural prediction models were made with AlphaFolds 2 and domains were found with Interpro prediction. Predicted domains were compared to confirmed protein sequences.

## Methods

### A In vitro

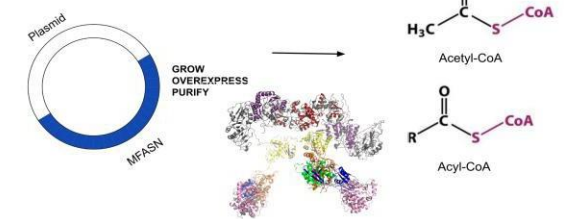


Fig. 5. By using a *Dalotia* plasmid, MFASN can be grown, overexpressed, and purified. Once purified, acetyl-CoA and acyl-CoA will be added to the purified fatty acidsynthase. Resulting products will be assessed through gas chromatography mass spectrometry to detect compounds.

### B In vivo

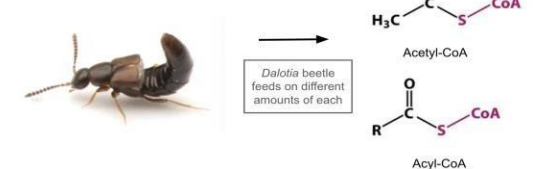


Fig. 6. To mimic the experiment done *in vitro* in a behaviorally way, the rove beetle will consume different amounts acetyl-CoA and acyl-CoA. The movement and gland secretion of the beetle will be observed to study the effects of each substance.

## References

- 1 Brückner et al. (2021). Evolutionary assembly of cooperating cell types in an animal chemical defense system. *Cell*, 184, 6138-6156. <https://doi.org/10.1016/j.cell.2021.11.014>.
- 2 Maier et al. (2008). The Crystal Structure of Mammalian Fatty Acid Synthase. *Science*, 321(1315). DOI:10.1126/science.1161269.
- 3 Tanner, J. E & Alfieri, C. (2021). The Fatty Acid Lipid Metabolism Nexus in COVID-19. *Viruses*, 13(90). <https://doi.org/10.3390/v13010090>.