

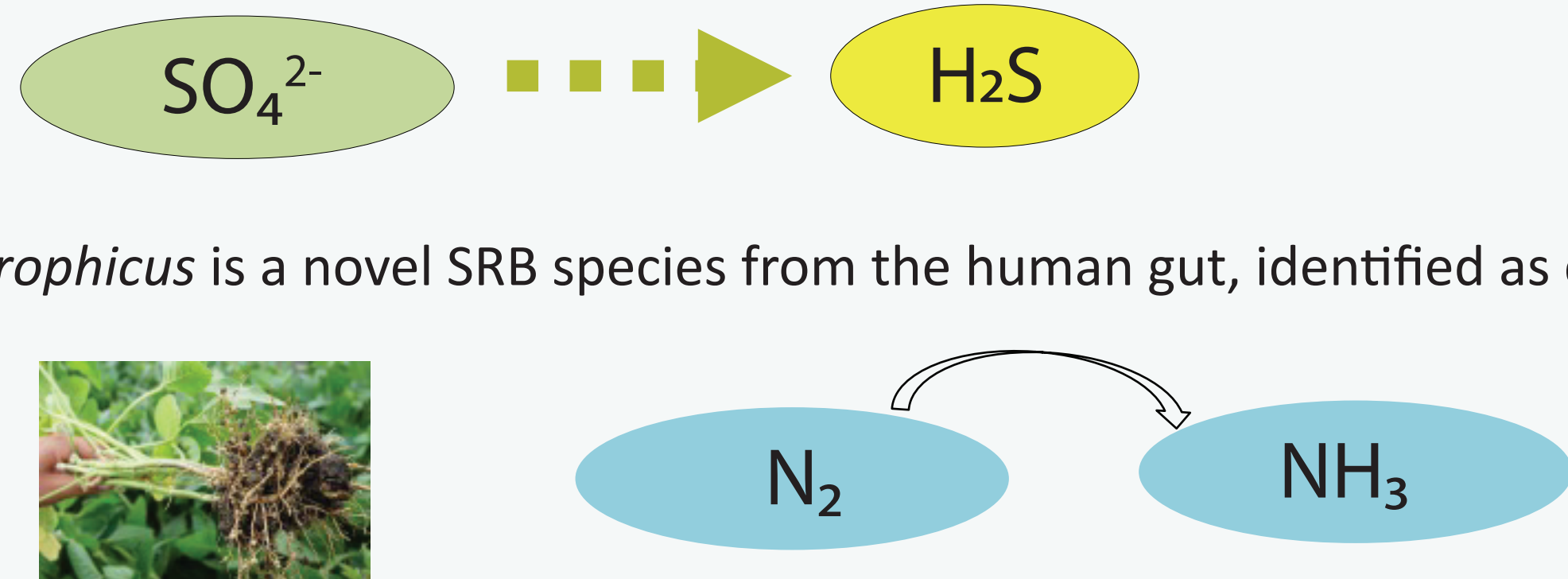
# Nitrogen fixation by sulphate-reducing bacteria: Are there implications for the gut microbiota and aging?

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## Background

- The human gut microbiota is critical for nutrient cycling and overall health.
- Sulphate-reducing bacteria (SRB) produce hydrogen sulphide (H<sub>2</sub>S), a metabolite with both protective and harmful effects.



- Desulfovibrio diazotrophicus* is a novel SRB species from the human gut, identified as capable of nitrogen fixation<sup>1</sup>.

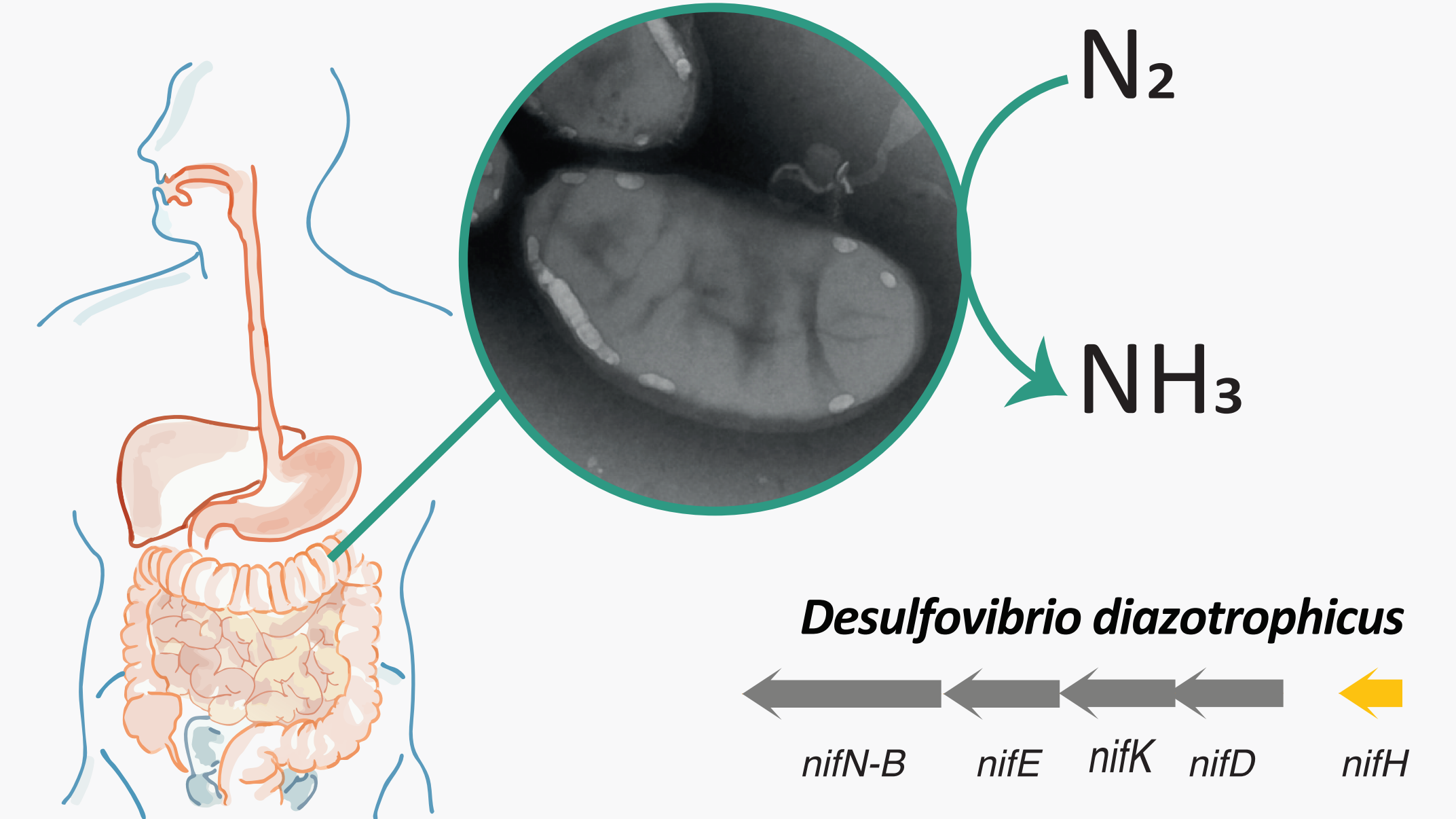


- Nitrogen fixation is likely to occur under nitrogen-limited conditions (e.g., low dietary protein intake, altered nitrogen absorption).

## Conclusions

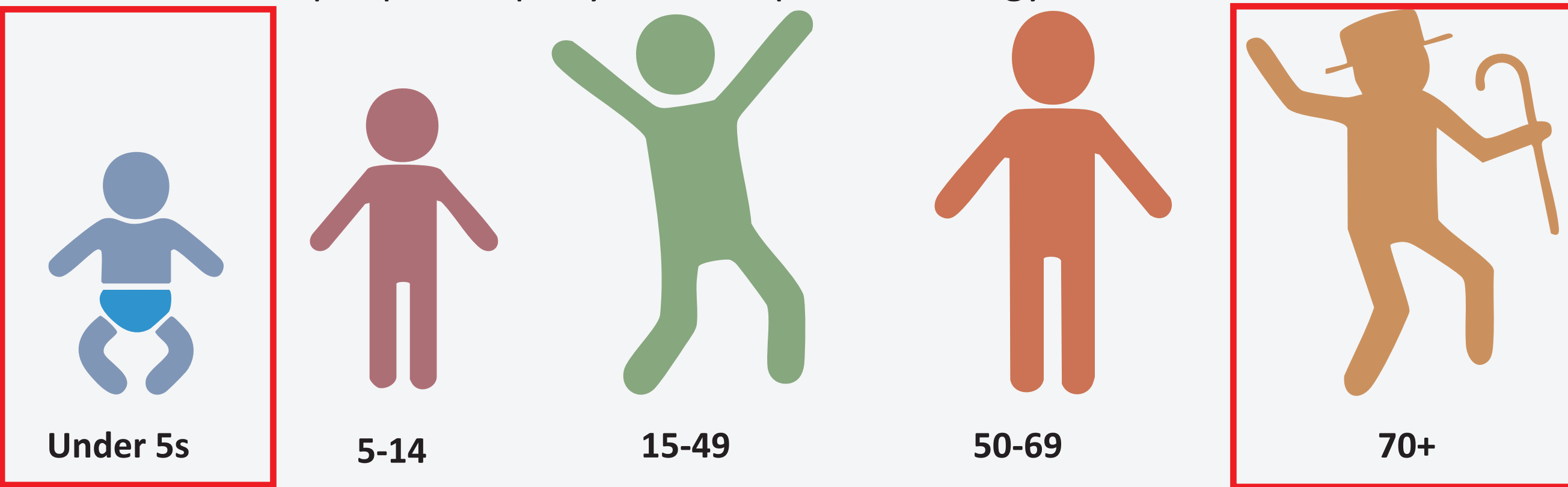


- Nitrogen fixation can occur in the gut environment
- The microbiome of vegan/vegetarians might have a higher nitrogen fixation potential compared to omnivores



## Problem

- >227 million people die per year from protein-energy malnutrition.



- On average, vegan diets have a lower protein content

## Hypotheses

- Low-protein diets might exacerbate nitrogen limitation, potentially favoring nitrogen-fixing SRB.
- Elevated H<sub>2</sub>S levels, linked to ageing-related gut inflammation and epithelial barrier disruption, may result from shifts in SRB activity.

## Methods

### Vegan/vegetarians



N=13  
(still recruiting)

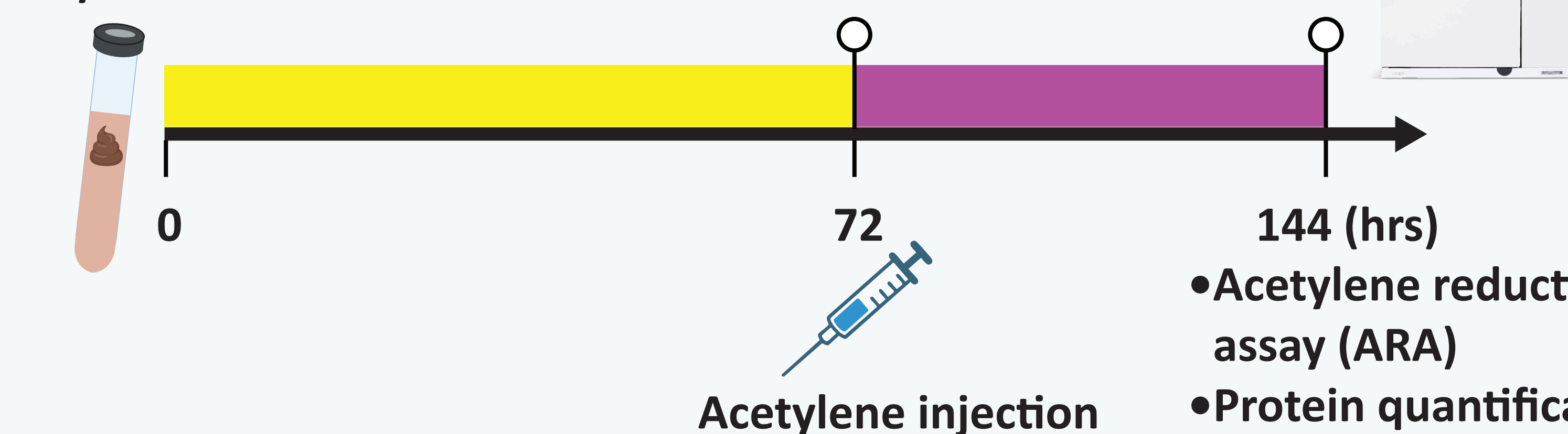
### Omnivores



N=9  
(still recruiting)

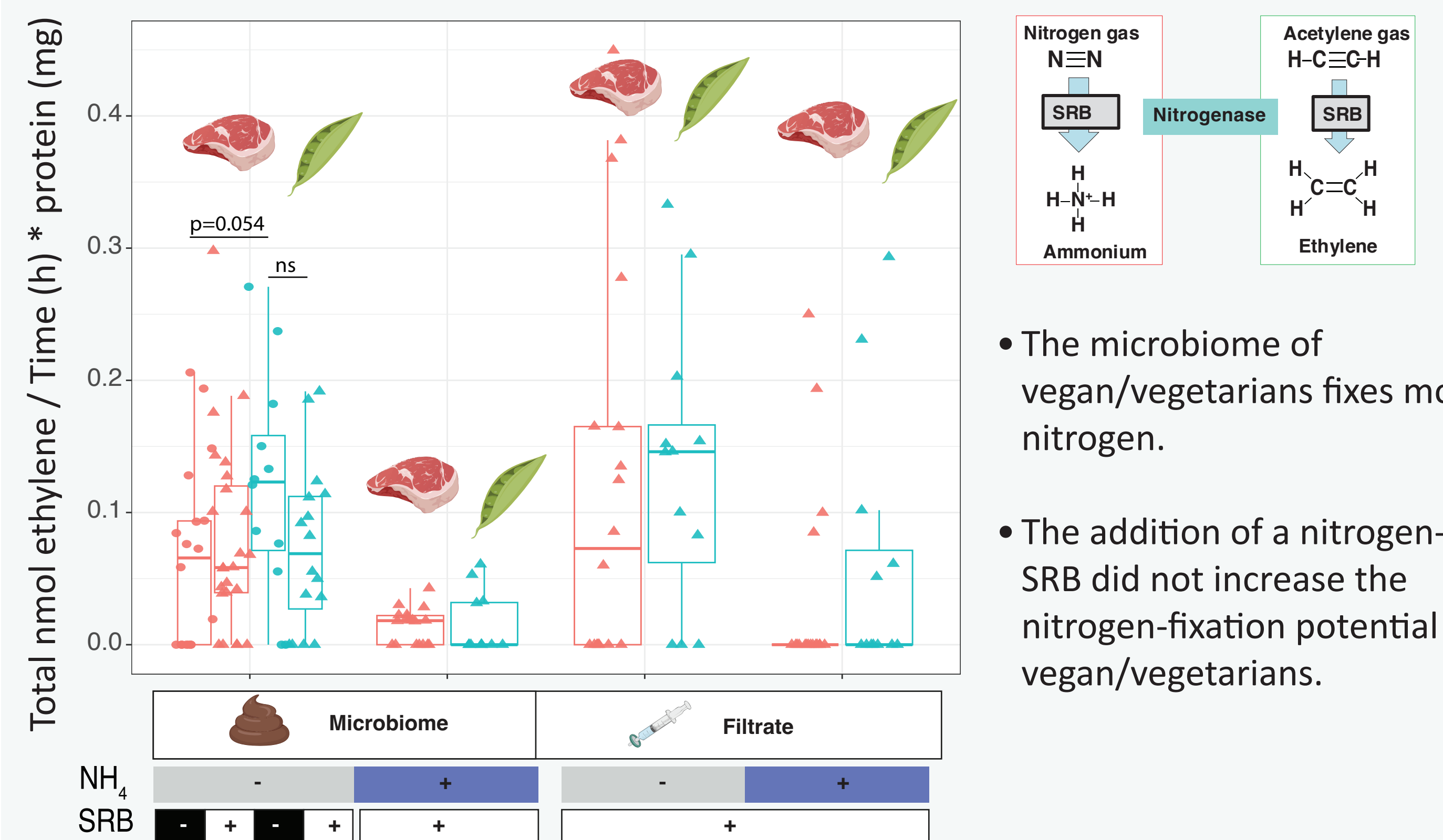
- Metaproteomics-SIP
- H<sub>2</sub>S quantification

<sup>15</sup>N<sub>2</sub>/<sup>14</sup>N<sub>2</sub>



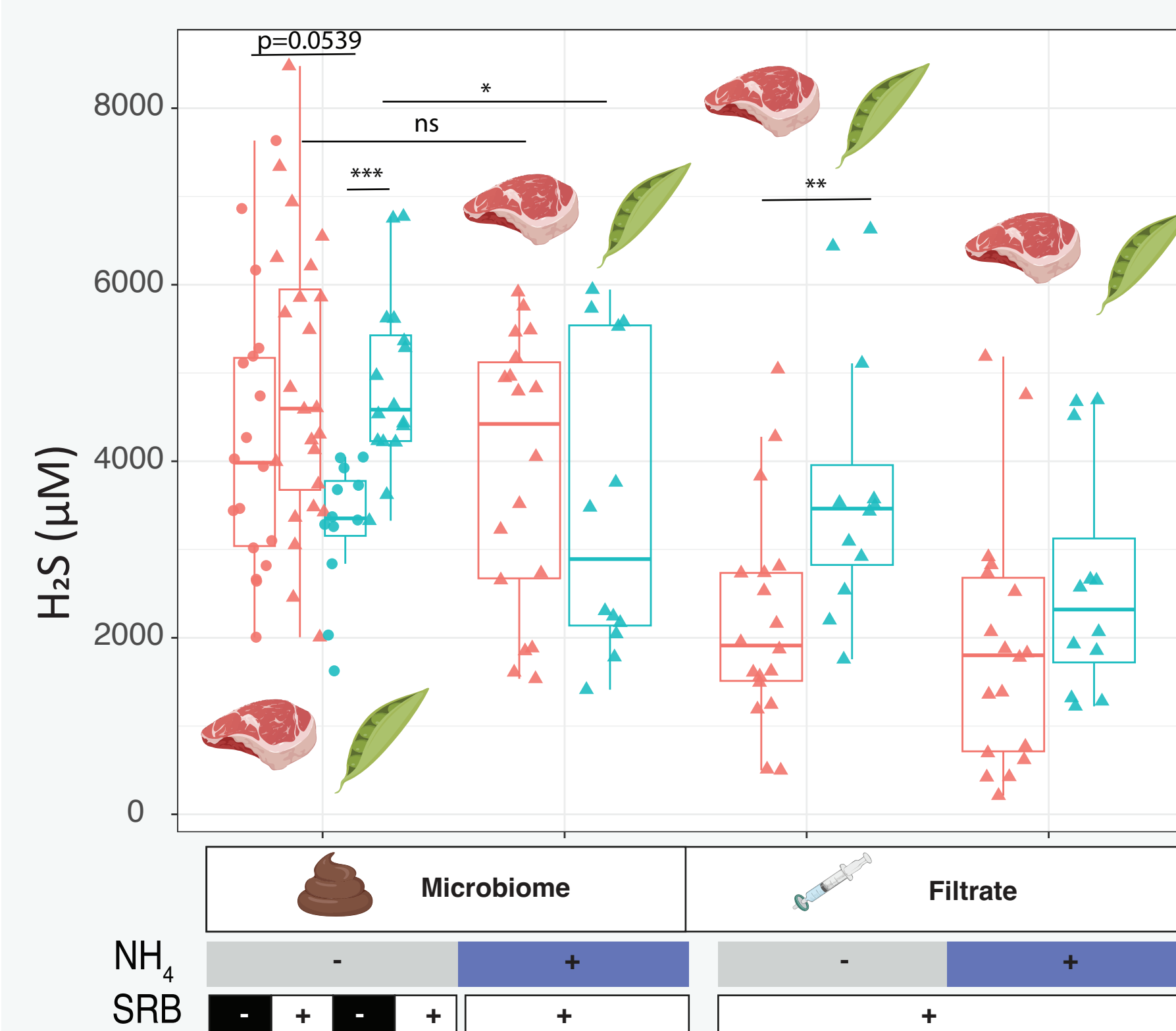
## Results

### The microbiome of vegan and vegetarians might be able to fix more nitrogen compared to omnivores



- The microbiome of vegan/vegetarians fixes more nitrogen.
- The addition of a nitrogen-fixing SRB did not increase the nitrogen-fixation potential in vegan/vegetarians.

### Impact of *D. diazotrophicus* on H<sub>2</sub>S production



- The microbiome of vegan/vegetarians produces less H<sub>2</sub>S.
- The addition of a nitrogen-fixing SRB significantly increased the H<sub>2</sub>S in vegan/vegetarians.

## Next steps

- Characterize microbial community composition to determine "who is there."
- Investigate whether nitrogen is shared with the rest of the microbiome using protein-SIP.
- Correlate nitrogen content in the gut with nitrogen fixation potential.

### Acknowledgments:

I thank the participants of the HARVEST study, the HARVEST team at Quadram Institute Bioscience, and Emad Shehata for donor recruitment. LS is funded by a BBSRC Discovery Fellowship

### Reference:

1 Sayavedra, L. et al. *Desulfovibrio diazotrophicus* sp. nov., a sulfate-reducing bacterium from the human gut capable of nitrogen fixation. *Environmental Microbiology* 23, 3164-3181 (2021). doi.org/10.1111/1462-2920.15538



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