



## Review : Microbial Volatile Organic Compounds (mVOCs) emissions by soil

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# REVIEW: MICROBIAL VOLATILE ORGANIC COMPOUNDS (MVOCs) EMISSIONS BY SOIL

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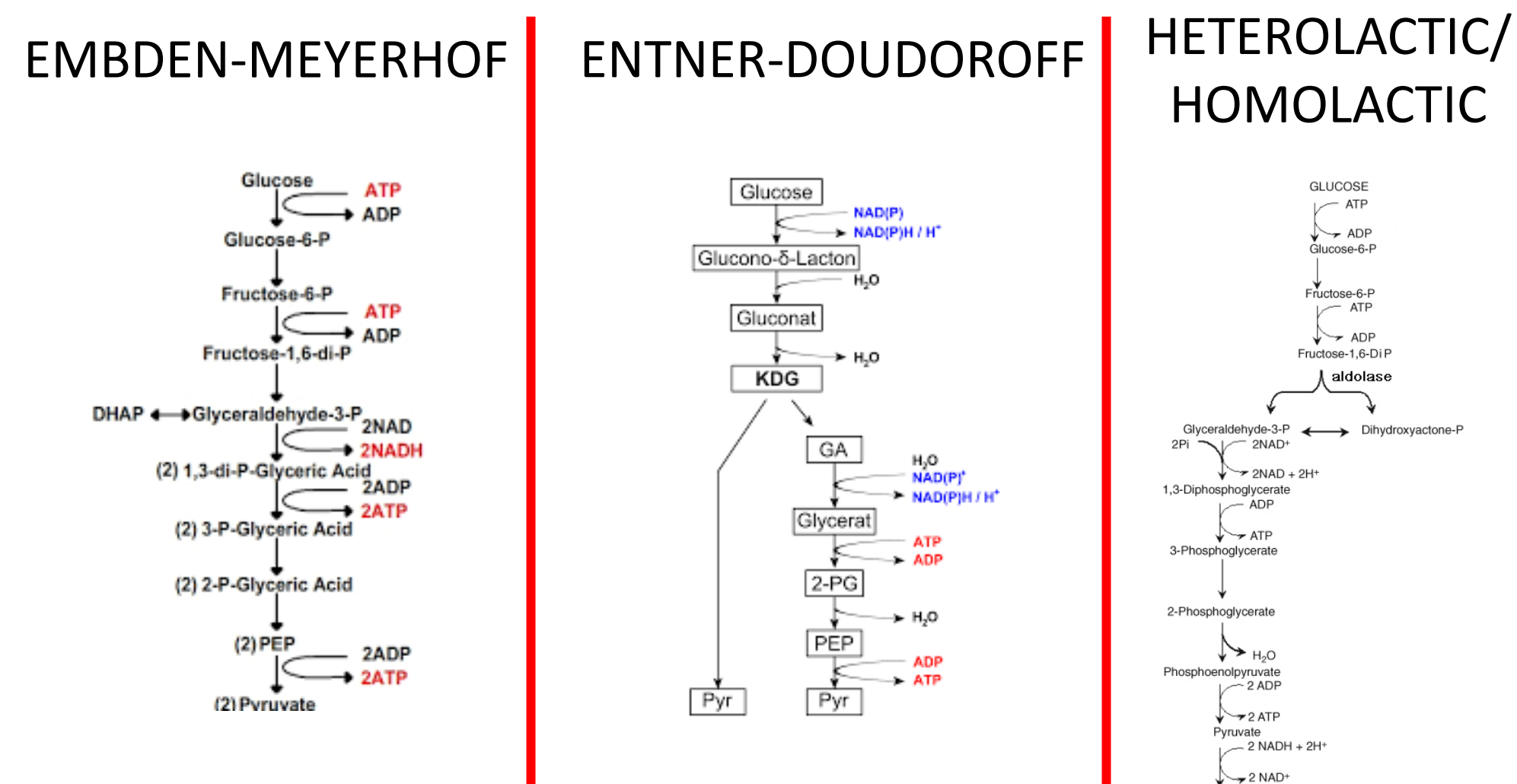
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## ABSTRACT

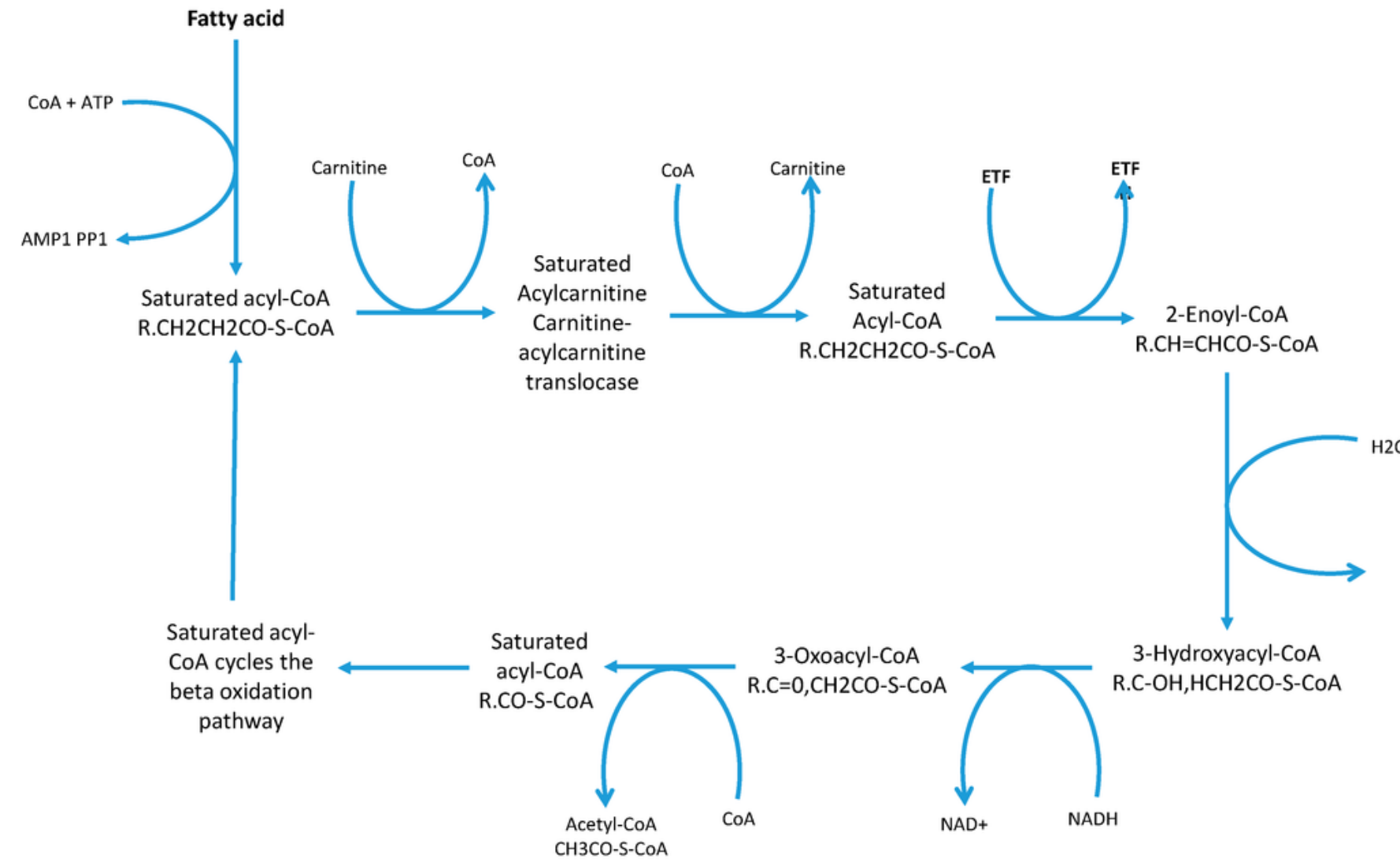
Volatile Organic Compounds (VOCs) have a central role in the chemistry and composition of the troposphere. VOCs are precursors of atmospheric aerosols (PM 2.5) and tropospheric ozone (O<sub>3</sub>). Biogenic VOCs (bVOCs) are estimated to contribute up to 90% of the total VOCs emissions globally. One of the sources of bVOC is soil microorganisms, especially through sugar degradation but also through secondary metabolism processes. Microbial VOCs production in soils depends also on: nutrients, physiological state of the microorganisms, pH, temperature and oxygen availability. The aim of this poster shows an overview of the existing knowledge on VOC emissions by microorganisms in soil, the reasons why VOCs are emitted and which are the metabolic pathway involved. A focus on the most used techniques to detect VOCs in soils is given and in particular advantages of PTR-MS technique are shown.

## METABOLIC PATHWAY FOR THE VOCs PRODUCTION

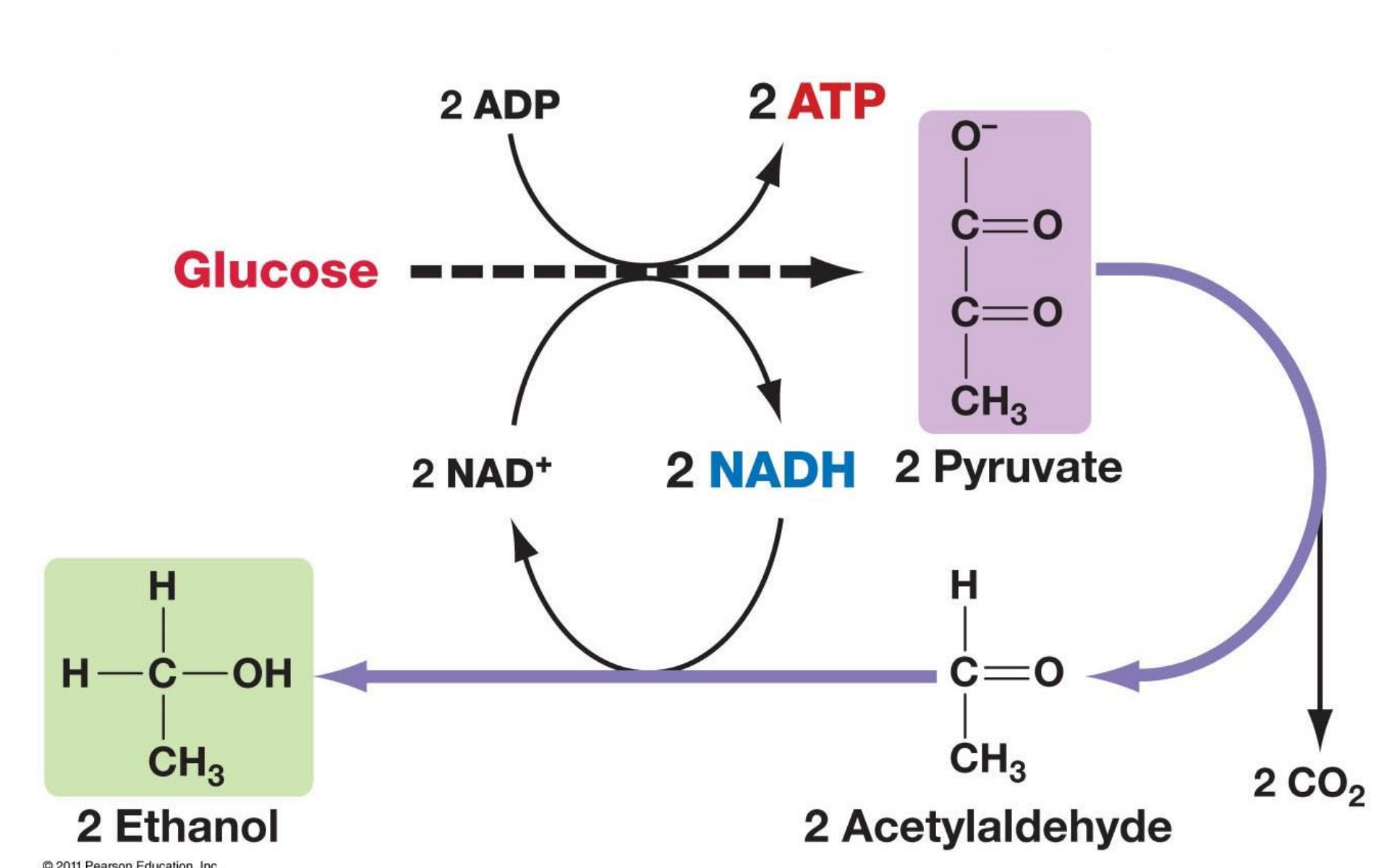
### SUGAR DEGRADATION



### FATTY ACID DEGRADATION



### ALCOHOLIC FERMENTATION

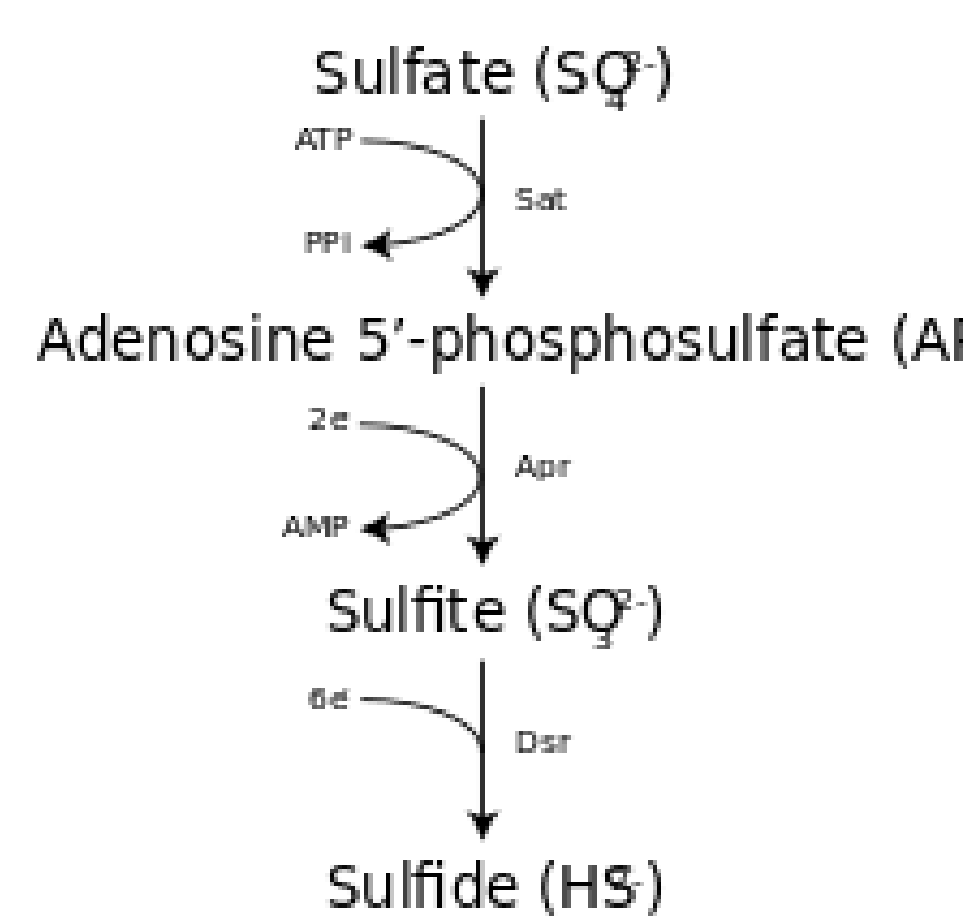


PYRUVATE, GLYCERALDEHYDE-3-PHOSPHATE, LACTATE, ACETATE

PRECURSORS OF THE VOCs FORMATION

**SECONDARY METABOLITES:** play a central role in inter-organismic interactions. Innumerous cases volatile and non-volatile secondary metabolites have been implicated in defense and communication among organisms.

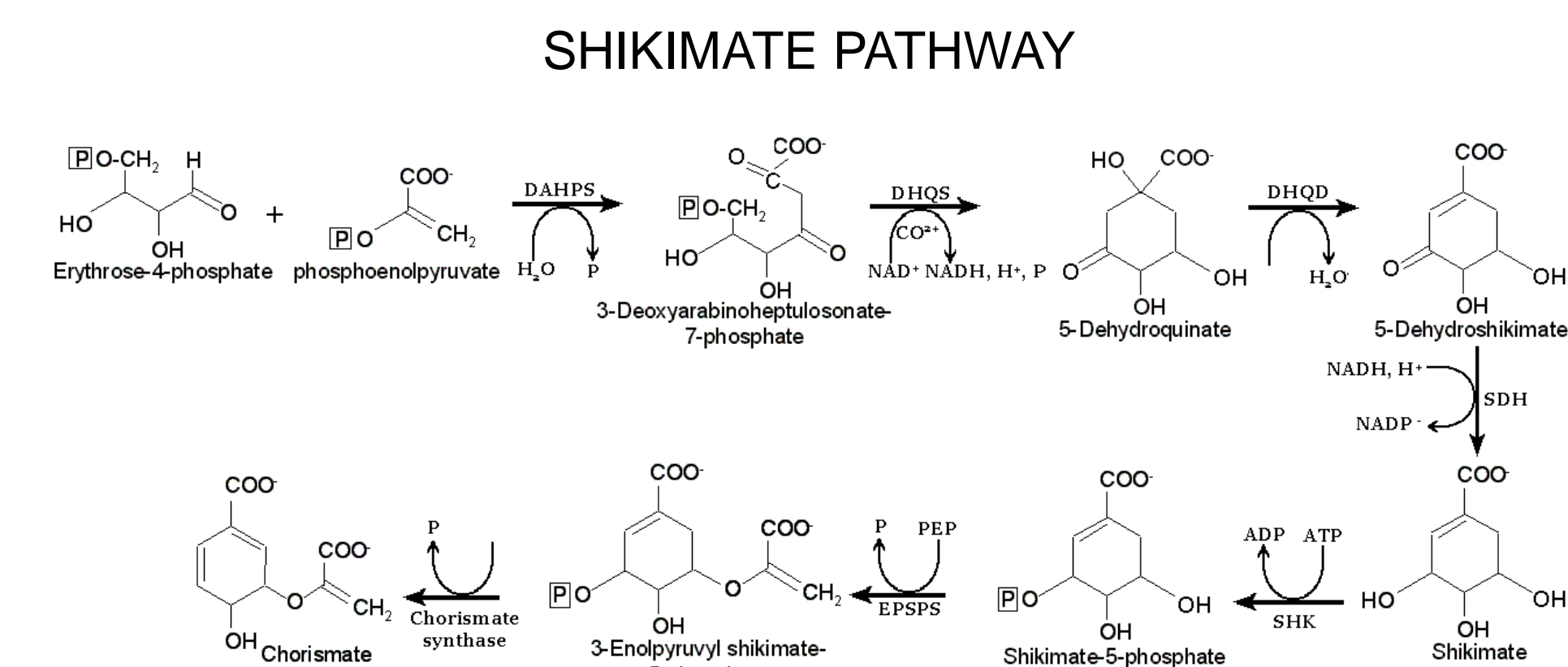
### SULPHUR REDUCTION



**MOST IMPORTANT VOLATILE SULPHUR COMPOUNDS**

- H<sub>2</sub>S,
- methanethiol,
- dimethyl sulphide (DMS),
- dimethyl disulphide (DMDS)
- dimethyl trisulphide (DMTS)

### AMINOACID BIOSYNTHESIS



2-PHENYLETHANOL: ONE OF THE MOST WIDESPREAD VOLATILE AROMATIC COMPOUNDS (synthesized by phenolopyruvate)

## WHAT CAN AFFECT MICROBIAL VOCs PRODUCTION

Microbial VOCs production in soils is strongly depending on:

1. NUTRIENTS
2. OXYGEN AVAILABILITY
3. PHYSIOLOGICAL STATE OF THE MICROORGANISMS

they also depend on

- SOIL MOISTURE
- SOIL TEXTURE
- MICROBIAL ACTIVITY
- pH
- TEMPERATURE

**MOST INFLUENT PARAMETER** — **O<sub>2</sub> HIGHLY EFFECTIVE RESPIRATION**

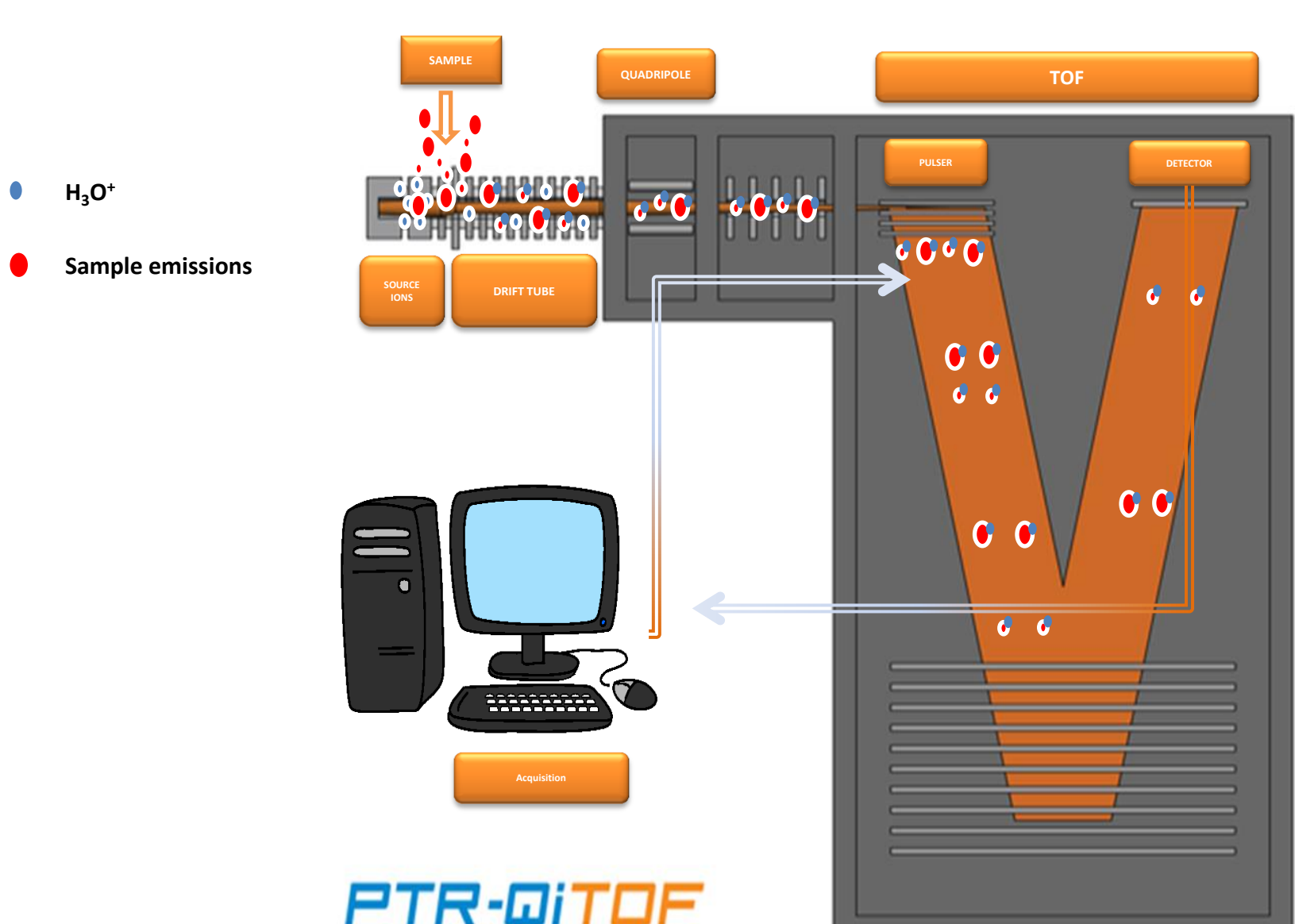
MICRO- AEROBIC OR ANAEROBIC CONDITION:

- I. C-org ARE THE END PRODUCT OF HETERO AND HOMO FERMENTATIVE PROCESS;
- II. DIVERSITY AND AMOUNT OF VOCs EMITTED INCREASE

## VOCs DETECTION TECHNIQUES

### PTR-MS

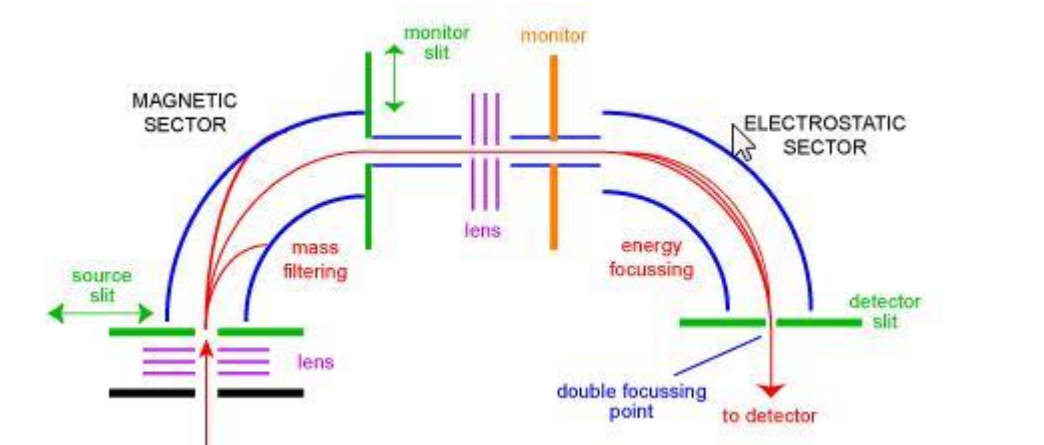
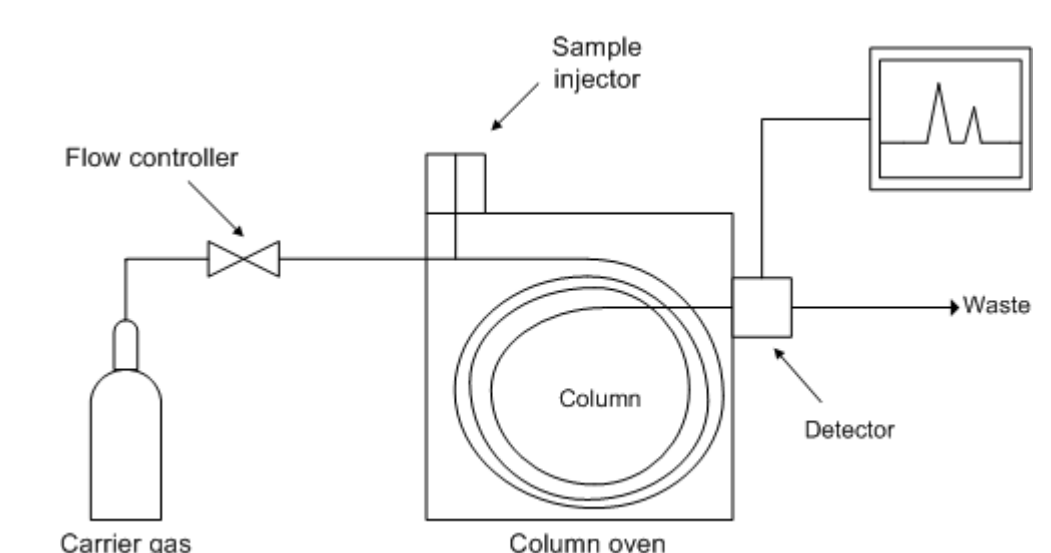
#### HOW IT WORKS



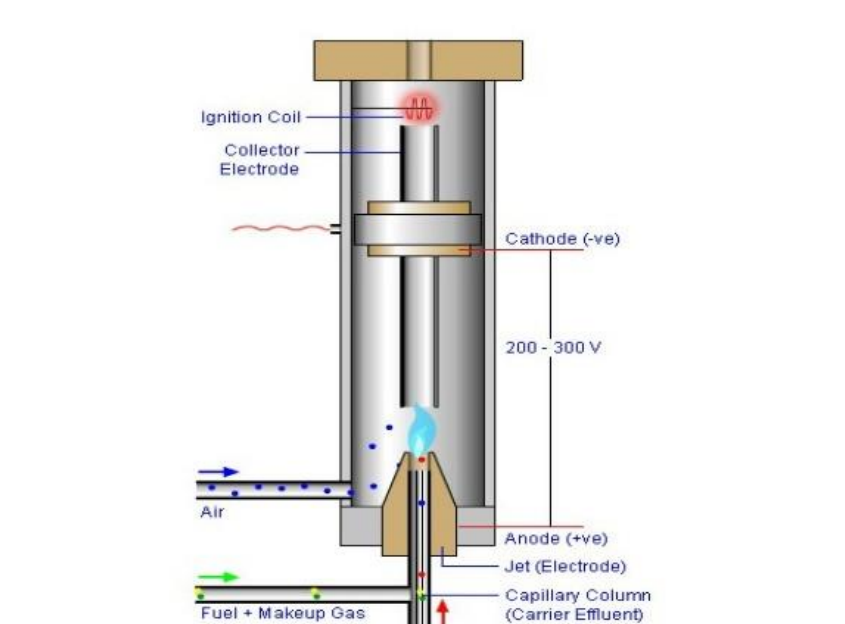
#### ADVANTAGES

- SIMULTANEOUS **ON-LINE MONITORING** OF VOLATILE ORGANIC COMPOUNDS;
- LIMIT OF DETECTION <10 pptv
- TIME OF FLIGHT DETECTOR:**
- SPEED
- HIGH RESOLUTION

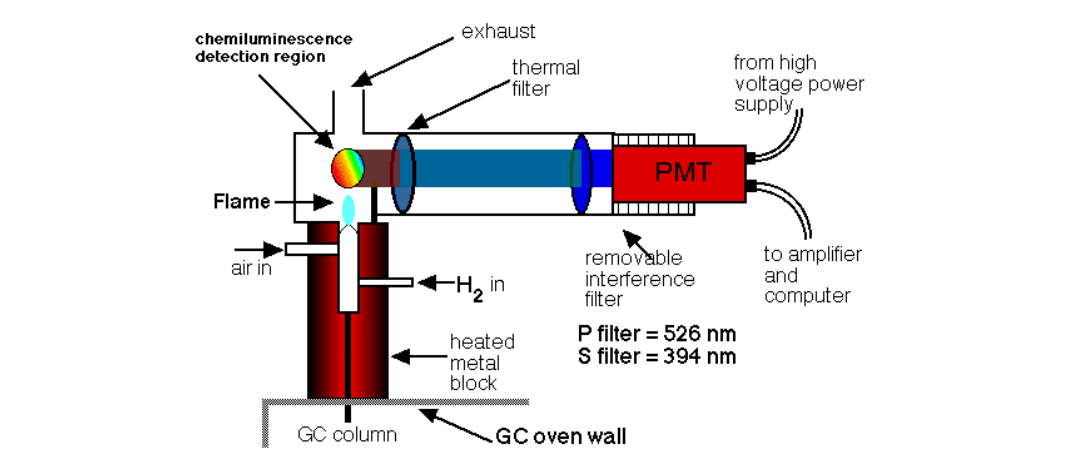
### GAS CHROMATOGRAPHY



### MASS SPECTROMETRY



### FLAME IONIZATION DETECTOR



### FLAME PHOTOMETRIC DETECTOR

THESE TECHNIQUES NEED A METHOD FOR THE VOCs EXTRACTION FROM SAMPLES (e.g. SOLID PHASE MICRO-EXTRACTION (SPME))

## REFERENCES

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- A. Guenther, "Biological and Chemical Diversity of Biogenic Volatile Organic Emissions into the Atmosphere," *ISRN Atmospheric Sci.*, vol. 2013, pp. 1–27, 2013.
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