Laudatio: Wilhelm Pfeffer Prize 2024

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In his Ph.D. thesis, Dr. Henryk Straube investigated the metabolism of nucleotides in plants. As the building blocks of DNA and RNA, nucleotides store and convey genetic information. Nucleotides also have a number of other important functions in the metabolism of all organisms. For example, cells use ATP and GTP to transfer energy, and nucleotide sugars such as ADP-glucose provide sugar building blocks for glycosylations and the biosynthesis of starch and other polysaccharides. Furthermore, several coenzymes and vitamins such as NADH, FAD or thiamin are derived from nucleotide precursors. Unfortunately, the complex chemical composition of plant cells makes the quantification of nucleotides very challenging. Other obstacles for the quantification by liquid chromatography-mass spectrometry (LC-MS) are the charged nature of nucleotides, their low cellular concentration, and the presence of stable phosphatases that must be quickly inactivated during cell lysis.

In his Ph.D. thesis, Dr. Straube addressed these challenges to develop a sensitive and reproducible method for the purification and quantification of nucleotides. He systematically and meticulously optimised the steps for lysis, quenching, purification and analysis, resulting in a protocol that allows the detection of deoxyribonucleotides, ribonucleotides, deoxyribonucleosides, and ribonucleosides. He further demonstrated that the method is applicable to a wide range of plant species, including monocots, dicots, mosses, and algae.

The application of the new method led to the discovery of hitherto unknown connections between groups of metabolites. For example, Dr. Straube found that the GC content of the deoxynucleotide pool in different plant species is correlated with the genomic GC content, revealing a link between the genetic and metabolic levels. Furthermore, he found that ribonucleoside-degrading enzymes also degrade deoxyribonucleosides *in vivo*. In another example, Dr. Straube discovered that the rare base inosine is not only incorporated into tRNAs, but also into other RNAs and DNA in the model plant *Arabidopsis*. Inosine is formed by the uncatalysed deamination of adenosine, and this work culminated in the characterisation of inosine triphosphate pyrophosphatase, an enzyme that degrades deoxyinosine triphosphate (dITP) and inosine triphosphate (ITP) to protect plants from these damaged metabolites.

In summary, Dr. Straube's new method for the absolute quantification of nucleotides makes it possible to answer questions that were previously almost inaccessible. His work paves the way to study the roles of nucleotides and nucleosides in various biological processes, ranging from DNA replication and transcriptional fidelity to the response to biotic and abiotic stress and immune signalling. Plant biologists can now use the new method to study these processes in different plant species and mutants, and also in different developmental stages and tissues. In addition, the method will hopefully contribute to a better consideration of nucleotides in metabolomics studies.

Prof. Dr. Severin Sasso, president of DBG’s Wilhelm Pfeffer Foundation