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The conversion of H_2S to sulfane sulfur

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In a recently published Review article (*H_2S signalling through protein sulfhydration and beyond. Nature Rev. Mol. Cell Biol.* **13**, 499–507 (2012))[1], Paul and Snyder use the term 'sulfhydration' to define a protein modification involving hydrogen sulfide (H_2S) in which "the sulfhydryl group of a reactive Cys is modified to an -SSH group". The implied reaction is:

protein-SH + H_2S → protein-SSH

There are two scientific problems with this presentation: the terminology does not follow the rules of chemical nomenclature; and the implied reaction cannot occur.

According to IUPAC Compendium of Chemical Terminology, 2005, 'hydration' refers to the introduction of a water molecule. Therefore, the term sulfhydration implies the introduction of a sulfur atom together with a water molecule, which is not the intended meaning. Sulfhydrylation, which refers to the introduction of a sulfhydryl (SH) group, is also not appropriate, as the SH group is already present in the protein before the modification occurs. The reaction described by the above equation involves the introduction of a sulfur atom, so the correct term for this reaction is 'sulfuration'.

The reaction described by this equation is not possible because two SH groups cannot react with each other in this way. Moreover, the system is not balanced with respect to atoms, as two hydrogen atoms are not accounted for. The realistic reaction in this case is:

protein-SH + H_2S + ½ O_2 →
protein-SSH + H_2O

This is a true sulfuration reaction because it can be considered to be the summation of two reactions: the reaction of H_2S with oxygen to give rise to sulfane sulfur; and the incorporation of the sulfane sulfur into the protein SH group by a well-documented mechanism involving a thiosulfoxide intermediate[2].

Theoretically, the SH group of a protein Cys residue could also be modified to persulfide (SSH) through the reduction of a disulfide bond:

protein-S-S-protein + H_2S →
protein-SH + protein-SSH

However, as previously discussed[2,3], this reaction is impossible *in vivo* because H_2S does not have sufficient reducing power and its concentration *in vivo* is too low to achieve this reduction.

It is clear that Paul and Snyder intended to describe the conversion of hydrogen sulfide to sulfane sulfur. However, they did not describe the likely mechanism that is provided in this correspondence.

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doi: 10.1038/nrm3391-c1

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Competing interests statement
The author declares no competing financial interests.

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IUPAC Compendium of Chemical Terminology:
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