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Review

On the antioxidant, neuroprotective and anti-inflammatory properties of S-allyl cysteine: An update

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ABSTRACT

Therapeutic approaches based on isolated compounds obtained from natural products to handle central and peripheral disorders involving oxidative stress and inflammation are more common nowadays. The validation of nutraceutics vs. pharmaceutics as tools to induce preventive and protective profiles in human health alterations is still far of complete acceptance, but the basis to start more solid experimental and clinical protocols with natural products has already begun. S-allyl cysteine (SAC) is a promising garlic-derived organosulfur compound exhibiting a considerable number of positive actions in cell models and living systems. An update, in the form of review, is needed from time to time to get access to the state-of-the-art on this topic. In this review we visited recent and refreshing evidence of new already proven and potential targets to explain the benefits of using SAC against toxic and pathological conditions. The broad spectrum of protective actions covered by this molecule comprises antioxidant, redox modulatory and anti-inflammatory activities, accompanied by anti-apoptotic, pro-energetic and signaling capacities. Herein, we detail the evidence on these aspects to provide the reader a more complete overview on the promising aspects of SAC in research.

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1. SAC metabolism and excretion

S-allyl cysteine (SAC) is the most abundant organosulfur compound in aged garlic extracts (AGE). The chemical structure of this compound is highly suggestive of antioxidant and redox activity, as it has been established in our previous review (Colín-González et al., 2012).

Information about SAC metabolism, excretion and pharmacokinetics is of major relevance for monitoring dynamics of this compound in living organisms. Some SAC pharmacokinetics was described in our last review (Colín-González et al., 2012). A new study of Amano and coworkers (2015) recently investigated all these parameters in rats and dogs receiving single oral doses of SAC (5 and 2 mg/kg), revealing new key information about this compound. SAC exhibited a bioavailability above 90%, suggesting good adsorption. Specifically, long elimination half-life was justified by its high renal re-absorption. In addition, the main SAC metabolite N-acetyl-S-allyl-L-cysteine (NAc-SAC), and other like N-acetyl-S-allyl-L-cysteine sulfoxide (NAc-SACS), S-allyl-L-cysteine sulfoxide (SACS), and L-γ-glutamyl-S-allyl-L-cysteine, were all found in plasma and urine. It was also found that liver and kidney of both dogs and rats catalyzed SAC N-acetylation and NAc-SAC deacetylation. Noteworthy, following i.v. administration of NAc-SAC, SAC was detected in plasma, not only emphasizing the relevance of N-acetylation and deacetylation to stablish the levels of NAc-SAC and of other metabolites like NAc-SACS and SACS, but also the reversibility of the metabolic process inherent to SAC. Since some of these metabolites could also exert beneficial effects at physiological levels, SAC metabolism and re-absorption might help to understand the many positive properties of this garlic-derived compound. Fig. 1 depicts the chemical structures of SAC and related garlic-derived compounds.

2. Oxidative stress and SAC

"Oxidative stress" refers to the complex of harmful responses evoked by reactive oxygen species (ROS) in cells, tissues, organs and living systems. The CNS is more vulnerable than other organs to oxidative stress due its high content of lipids, lower levels of antioxidants and increased metabolism and redox activity. Indeed, oxidative stress has been postulated as a causative factor involved in different neurodegenerative disorders, including Parkinson's disease (PD), amyotrophic lateral sclerosis (ALS), Alzheimer's disease (AD), etc. (reviewed by Andersen, 2004).

In our previous review (Colín-González et al., 2012) we revised in a detailed manner the many antioxidant properties of SAC and its role as a neuroprotective molecule in different experimental models and paradigms. Since the main interest of this review is not revisiting the already revised information, in this section we will just make a brief update on this topic.

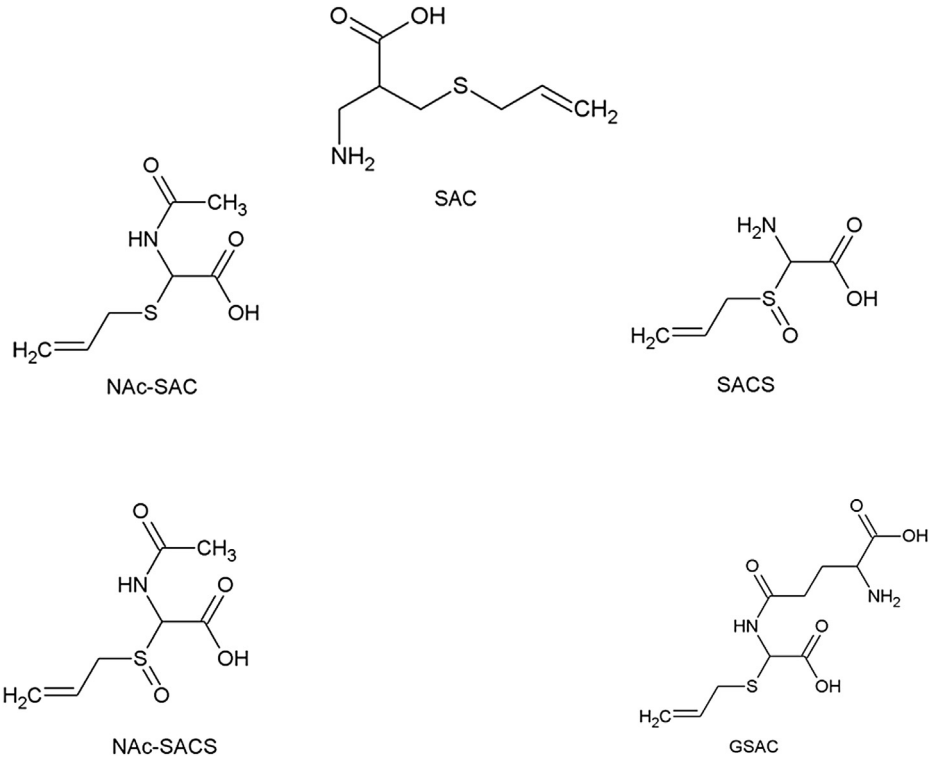

Fig. 1. Chemical structures of S-allyl cysteine (SAC) and metabolically related compounds, including N-acetyl-S-allyl-L-cysteine (NAc-SAC), S-allyl-L-cysteine sulfoxide (SACS), N-acetyl-S-allyl-L-cysteine sulfoxide (NAc-SACS), L-γ-glutamyl-S-allyl-L-cysteine (GSAC). The structures were built up using the program ACD/ChemSketch Freeware (http://www.acdlabs.com/resources/freeware/chemsketch/).