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ORIGINAL PAPER

5-Bromo- and 3,5-dibromo-2-hydroxy-*N*-phenylbenzamides – inhibitors of photosynthesis

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Dedicated to the memory of Professor Ľudovít Krasnec (1913–1990)

5-Bromo- (Br-PBA) and 3,5-dibromo-2-hydroxy-*N*-phenylbenzamides (Br_2-PBA) inhibited photosynthetic electron transport (PET) and their inhibitory efficiency depended on the compound lipophilicity as well as on the electronic properties of the R substituent in the *N*-phenyl moiety. Br-PBA showed higher PET inhibiting activity than Br_2-PBA with the same R substituent. The most effective inhibitors in the tested series were the derivatives with R = 3-F (Br-PBA; IC_{50} = 4.3 μmol dm^{-3}) and R = 3-Cl (Br_2-PBA; IC_{50} = 8.6 μmol dm^{-3}). Bilinear dependence of the PET inhibiting activity on the lipophilicity of the compounds as well as on the Hammett constant, σ, of the R substituent was observed for both investigated series. Using EPR spectroscopy it was found that the site of action of the tested compounds in the photosynthetic apparatus is situated on the donor side of PS 2, in $D^{\bullet}$ or in the $Z^{\bullet}/D^{\bullet}$ intermediates. Interaction of the studied compounds with chlorophyll *a* and aromatic amino acids present in the pigment–protein complexes mainly in photosystem 2 was documented by fluorescence spectroscopy.

Keywords: salicylanilides, EPR spectroscopy, fluorescence spectroscopy, photosynthetic electron transport, site of action

2-Hydroxybenzoic acid (2-HBA, salicylic acid) and related compounds exhibit a wide spectrum of biological activities. 2-HBA acts as an endogenous plant growth regulator with significant impact on the growth and development of plants (Hayat et al., 2010); plants treated with this bioactive compound are characterised by higher tolerance to abiotic stress such as chilling (Janda et al., 1999; Promyou et al., 2012), ultraviolet-B radiation (Zhang & Li, 2012), salt stress (Nazar et al., 2011) or cadmium stress (Popova et al., 2009), and by increased induced antioxidant capacity in leaves of herbicide-treated plants (Ananieva et al., 2004). On the other hand, application of higher 2-HBA concentrations resulted in swelling of the thylakoid grana in various degrees, coagulation of the stroma, increase in the chloroplast volume (Uzunova & Popova, 2000), reduced chlorophyll (Chl) content and inhibition of the stomata function, photosynthetic gas-exchange and the activity of ribulose-1,5-biphosphate carboxylase/oxygenase (Pancheva et al., 1996; Pancheva & Popova, 1998). Moreover, the uncoupler-mediated stimulation of the

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