

# Effects of microcystin-LR on the partial reactions of the Na<sup>+</sup>-K<sup>+</sup> pump of the gill of carp (*Cyprinus carpio* Linneo)

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Several partial reactions of the Na<sup>+</sup>-K<sup>+</sup> pump enzyme were studied in a microsomal fraction derived from the gill of carp (*Cyprinus carpio* Linneo). We tested the effect of three toxins [(i) microcystin-LR (ii) microcystin-LR-like toxin component isolated from *Microcystis aeruginosa* culture and (iii) okadaic acid] on the phosphorylation, ouabain binding and ATPase activity of the Na<sup>+</sup>-K<sup>+</sup> pump. The K<sup>+</sup>-dependent hydrolysis of the Na<sup>+</sup>-dependent phosphorylation of Na<sup>+</sup>-K<sup>+</sup> pump, as well the release of bound ouabain were inactivated in direct proportion to the amount of each toxin treatment. These results indicate that these toxins not only block the hydrolysis of phosphorylated protein at serine and threonine residues, but also inhibit the aspartic dephosphorylation step of the sodium pump enzymes. This inactivation could disrupt the ion homeostasis of the internal medium by blocking the gill function. The blockage of gill activity could be the cause of the massive fish death during blooms of M.