Effect of *Spirulina* (*S. Platensis*) on the Toxicity Induced by Inorganic Mercury, *p*-Aminophenol and Cisplatin

HIDEKI FUKINO, YUKARI TAKAGI and YASUHIRO YAMANE

Faculty of Pharmaceutical Sciences, Chiba University,
1-33 Yayoi-cho, Chiba 260, Japan

As we reported [108th(1988), 109th(1989), 110th(1990) Annual Meeting of the Pharmaceutical Society of Japan and the Second Meeting of the International Society for Trace Element Research in Humans (ISTERH in 1989)], the toxicity of mercuric chloride in rats was lowered by feeding a CE-2 powder diet (CLEA Japan Inc., Tokyo) containing 30% *Spirulina* platensis.

All rats given mercury alone died by the 4th day. When *Spirulina* and mercury were administered, however, all animals were alive on the 3rd day and two were still alive on the 10th day. These results show that the toxicity of mercury is suppressed by the feeding of *Spirulina*.

It has long been recognized that mercuric chloride induces acute renal failure in rats. Thus, we examined the blood urea nitrogen (BUN) and serum creatinine as indicators of renal function. Both showed higher values in Hg group as compared with the control group, while they were significantly reduced in the Sp-Hg group as compared with the Hg group. Thus, *Spirulina* inhibits mercuric chloride-induced renal failure.

We also examined the urinary excretion of alkaline phosphatase (ALP) and glutamic-oxaloacetic transaminase (GOT) as further indicators of renal function. The activities of both enzymes in urine were higher in the Hg group than in the control group. On the other hand, they were significantly reduced in the Sp-Hg group as compared with the Hg group. This again indicates that *Spirulina* might reduce the renal toxicity of mercuric chloride.

p-Aminophenol (PAP) is well known to induce renal toxicity. Therefore, we examined the protective effect of *Spirulina* on renal toxicity

induced by this substance. BUN and creatinine showed high values in the PAP group as compared with the control group. In control, they were significantly reduced in the Sp-PAP group as compared with the PAP group. These results indicate that *Spirulina* generally suppresses renal toxicity.

Cisplatin and Gentamicin are also known to induce renal toxicity; therefore, we next examined the protective effect of *Spirulina* on the renal toxicity induced by these substances. These results indicated that *Spirulina* generally might suppress renal toxicity.

We examined what effective components might be contained in *Spirulina*. *Spirulina* powder was fractionated by extraction, giving Sp(W) as the water-soluble fraction and Sp(N.W) as the residue fraction. The protective effects of Sp(W) and Sp(N.W) against mercury toxicity in the rat kidney were examined and the results indicated that Sp(W) had the best protective effect against renal failure induced by mercury.

We next fractionated Sp(W) and found that the materials with a molecular weight of more than 100000 in the water-soluble fraction in *Spirulina* were responsible for this protective effect.

Spirulina contains phycocyanin, which is a pigment and generally exists as a trimer. As the monomer molecular weight is about 40000, the *Spirulina* phycocyanin is expected to have a molecular weight of more than 100000. Thus, we examined the effect of phycocyanin on the toxicity of mercury and found that phycocyanin might inhibit renal failure.

On the other hand, we examined the effect of phycocyanin on the toxicity of PAP and found that the substance probably does not inhibit the renal failure. Thus, we consider that *Spirulina* plays some roles in the protective effect against general renal dysfunction.

These results were also confirmed by the histological examination under a microscope and found to correspond with the biochemical results.