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Single-walled carbon nanotubes as a delivery vehicles enhance the immunoprotective effect of a DNA vaccine against spring viremia of carp virus in common carp

Chen Zhang, Zhao Zhao, Ji-Wei Zha, Gao-Xue Wang, Bin Zhu



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1 **Single-walled carbon nanotubes as a delivery vehicles enhance the**
2 **immunoprotective effect of a DNA vaccine against spring viremia of carp virus in**
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4 Chen Zhang, Zhao Zhao, Ji-Wei Zha, Gao-Xue Wang, Bin Zhu*

5 *College of Animal Science and Technology, Northwest A&F University, Yangling 712100, China*

6
7 *Corresponding author at: Northwest A&F University, Xinong Road 22nd, Yangling, Shaanxi 712100,
8 China. Tel./fax: +86 29 87092102.

9 *E-mail address: zhubin1227@126.com (B. Zhu)*

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11 **Abstract** Spring viremia of carp virus (SVCV) is highly contagious and pathogenic to cyprinid fish,
12 causing enormous economic losses in aquaculture. Efficient and economic prophylactic measure
13 against is the most pressing desired for the common carp farming industry. In this research,
14 single-walled carbon nanotubes (SWCNTs) as a candidate DNA vaccine carrier was administrated via
15 bath (1, 5, 10, 20, 40 mg L⁻¹) or injection (1, 4, 8, 12, 20 µg) in common carp juvenile, and the different
16 immune treatments to induce immunoprotective effect was analyzed. The results showed that higher
17 levels of transcription and expression of *G* gene could be detected in muscle, spleen and kidney tissues
18 via bath administration or intramuscular injection in SWCNTs-pEGFP-*G* treatment groups compared
19 with naked pEGFP-*G* treatment groups. Meanwhile, complement activity, superoxide dismutase
20 activity, alkaline phosphatase activity, immune-related genes (especially the TNF- α) and antibody
21 levels were significantly enhanced in fish immunized with DNA vaccine combined with SWCNTs. The
22 relative percentage survival were significantly enhanced in fish bathed with SWCNTs-pEGFP-*G*
23 vaccine and the relative percentage survival reached to 57.5% in SWCNTs-pEGFP-*G* group than that of

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