Hypothesis of regulation of active viral infection (lysis) of unicellular hosts in the hydrosphere

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Abstract

It was shown a tetranucleotide, CGCG, to inhibit infectious activities of some algal viruses by 10^2-10^4 times. This process depends on the duration of CGCG-virus contact. The results obtained seem to be interesting from the practical point of view and may be as a foundation of hypothesis of the role of DNA decay products appearing in the aquatic environment as a result of viral lysis of unicellular hosts in the smooth stop of active viral infection**.** This assumption does not contradict the conceptual model of virioplankton control of host community diversity by Wommack and Colwell, but complements it.

Key words: CGCG, algal viruses, infectious activity, infectious titer, hypothesis about stop of active viral infection in hydrosphere.

Introduction

Any water environment contains always soluble DNA molecules and 2-74 % of total soluble DNA molecules are presented by cell DNA fragments appeared as a result of lysis due often to virus activities [1]. Some our data show the contact of native DNA and viruses in water environment in vitro results in chemical interaction fixed by a microcalorimetry method demonstrating the increase of heat production and “cooperative transition” [2]. And the preliminary ultraviolet irradiation of DNA or viruses accelerated the heat production during their contact. In some our experiments the effect of the adenosine triphosphate (ATP) and interferon on DNA-virus interactions were studied. And it was shown that the addition the ATP to increase the heat production of contact virus and DNA, but the addition of interferon to conduct to decrease of heat production of this contact. These facts also described in our monograph in Russian [3].

The information and some results [4–6] shown, that the unique properties of oligonucleotides (as products of decay of DNA) were defined on the basis of which can be created antiviral and also anti-cancer drugs. However, there is no information about interaction between marine (aquatic) viruses and the products of decay of soluble DNA in marine (aquatic) environment.

Purpose

Therefore **the purpose** of this investigation is the study of a possibility change occurring in viruses (level of infectious titer) in contact with the products of soluble DNA decay (solution of DNA) with that may be not only in dynamics of experiment but also in nature (in the hydrosphere) and can to have a main role in the smooth stop of active viral infection (of viral lysis) of unicellular hosts.

Material and Methods

The isolation from 2002 of Black Sea algal viruses were carried out using liquid cultures of a microseaweed, *Tetraselmis viridis* Norris (Chlorophyta), according to an approach patented by the author [7]. Effect of CGCG tetranucleotide on the infectious titer of some variants (strains) of *Tetraselmis viridis* Virus (TvV) studied based on the patented author's method [7], also described in [3, 8]. Liquid cultures of the *Tetraselmis viridis* were obtained from the Department of Ecological Physiology of Algae (A.O. Kovalevsky Institute of Biology of Southern Seas of RAS).

In our experiments preparations of a tetranucleotide, CGCG («Sigma»), were used.

The infective activities of all viral strains, treated and nontreated by the CGCG, were determined after their titration on liquid cultures of the *Tetraselmis viridis*. Infective activities of used viral strains were 10^5-10^9 infectious units. The CGCG effect on viral infectious activities was studied after this tetranucleotide addition (0.2 ml of the 10 % CGCG aqueous solution) to purified virus suspension (1.8 ml) and virus titration using susceptible *Tetraselmis viridis* cultures, the final CGCG concentration being 1 %.

Simultaneous titrations of treated and control samples were made in 2—35 days following the CGCG addition.

Results and Discussion

Our experiments were carried out to investigate the CGCG effect on infectious activities of some strains algal viruses listed in the Table 1. Following the CGCG addition to viral suspensions, the infectious titers of both treated and control virus-containing suspensions were determined. The results obtained are given in the same Table 1. It is seen that infective activity of algal viruses following the CGCG treatment during 6 days becomes 10^2-10^4 times lower. The drop of infectious titers of viral strains depends on the time of their contact with the CGCG. In one of the experiments (with the viral isolate TvV-S19) after a day of contact with CGCG no decrease of virus titer was found. In another experiment (with the isolate TvV-S1) we observed the full elimination of virus infectivity after 35 days of such contact.

Table 1

Effect of the CGCG on infectious activities of some algal viruses

Viral isolate (viral strains of TvV)	Time of virus-CGCG contact, days	Titers of infectivity		Changes of infectivity, control/experiment
		CGCG-treated sampls	control	
TvV-S1	11	10^3	10^5	Drop by 10^2 times
	19	10^3	10^5	Drop by 10^2 times
	35	0	10^4	Drop by 10^4 times
TvV-S10	6	10^5	10^7	Drop by 10^2 times
	19	10^5	10^7	Drop by 10^2 times
TvV-S19	1	10^9	10^9	Without changes
	7	10^6	10^9	Drop by 10^3 times
	21	10^5	10^9	Drop by 10^4 times
TvV-7/2	6	10^5	10^8	Drop by 10^3 times
	19	10^5	10^8	Drop by 10^3 times

We suppose that interaction between viruses and the CGCG leading to decreased viral infectivity is caused by electrical and chemical mechanisms. In our experiment we found inhibitory effect of CGCG on the infectious titer of algal viruses.

So our results are confirmed by the data of other researchers [4–6]. It is possible that results our further researches concerning the nucleotide-virus and DNA-virus interactions might be useful for viral infection prophylaxis and in other fields.

In our opinion, the oppression of viruses under the influence of products of decay of nucleic acids plays an important role in the ecology of aquatic unicellular organisms. It is probable that there are no such high concentrations of natural viruses and tetranucleotides in natural water environment as the concentration used in our experiments. However, our study shows also the possibility of natural viruses elimination in water environment, i.e. interaction of DNA and viruses as well as viruses and nucleotides lead to a reduction in infectious titer (to a reduction of viral number).

So, in our opinion, the contact of nucleotides and viruses in natural waters can be a kind of control (brake) of the flow of active viral infection. As known, in a period of increased numbers of any group of microorganisms the number of viruses, responsible for their lysis steadily increased. During lysis in the aquatic environment DNA of cells and products of DNA decay - nucleotides are isolated (are allocated); their contact with the viruses leads to reducing their infectious activity in the dynamics. This mechanism can smoothly stop the process of destruction of the hosts – microorganisms and it reflect our hypothesis about the role of products decay of cell DNA (as product of viral lisys) in decrease of viral activity and viral number.

Thus on our opinion oppression the infectious activity of the virus in our experiment by nucleotides reflects the naturally occurring phenomenon of the ecology and evolution of biosphere.

We hope and we are shore that our hypothesis complements the conceptual model of virioplankton control of host community diversity [1].

Conclusion

Our experiments show the CGCG to inhibit infectious activities of some algal viruses by 10^2-10^4 times. This process depends on the duration of CGCG-virus contact.

We think that our results and our further researches concerning the nucleotide-virus and DNA-virus interactions might will useful for viral infection prophylaxis and in other fields.

And the main purpose of this investigation and discussion is the discovery of mechanism of the smooth stop of active viral infection of their unicellular hosts by the DNA decay products appearing in the aquatic environment as a result of viral lysis. And this fact is the main foundation of our hypothesis about the role of the DNA decay products in stop of active viral infection in hydrosphere.

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