Bicarbonate solutions activated by hydrogen peroxide convert into photon emitting dissipative systems sustaining in a highly non-equilibrium state for a very long time.

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Aqueous bicarbonate solutions (ABS) are the material basis of all biological liquids and of most natural waters. They represent far from equilibrium entities because high density energy generating processes with reactive oxygen species (ROS) participation continuously proceed in them. Addition of H_2O_2 at low concentrations to ABS increases the intensity of these processes, and in the presence of a fluorescent probe luminol such a solution becomes a long-lasting source of ultra-weak photon emission (PE). One of the non-trivial features of activated ABS is that after its preparation PE from it gradually increases indicating that the energy generating processes in ABS "flare up" rather than extinguish as it could be expected if the reagents participating in the reactions were consumed. Another peculiarity of these systems is that after distribution of the activated ABS from a common "pool" into separate test tubes individual portions of the original solution demonstrate individual dynamics of PE. Immediately after filling a set of test tubes with ABS relative standard deviation (RSD) of PE intensities from these test tubes is about 5-10% of the mean, but several days later RSD reaches 50-80%. Later on the variability between PE from different samples decreases and RSD drops to 10-20% of the mean. The maximal variability in PE intensity from different samples coincides with the period of the maximal rate of growth of PE intensity rather than with the maximal absolute PE intensity. This dynamical system demonstrates many features of "deterministic chaos", because initially the properties of the individual components belonging to it diverge and then begin to converge approaching a certain attractor value.

The dynamics of PE from a set of individual test-tubes has a complex pattern. Absolute values of PE intensity from different test tubes may differ from each other by 10 or more times, but in most cases they change in time in parallel. In general increase and decrease of PE intensity from test tubes correlate with the ambient temperature changes. However, this correlation is not absolute. Episodes can be seen when PE intensity in all or some samples change in the direction opposite to the changes in temperature indicating that activated ABS may react to some subtle factors unrelated to temperature changes. Besides there are episodes when in some samples PE intensity increases while in other samples it decreases, though before and after this episode all the samples behave in a similar manner. It can also be seen that distribution of PE intensities is far from "normal". Rather two or three groups of "allowed" intensities could be distinguished while other intensities seem to be "forbidden".

Peculiar dynamical properties of the processes developing in activated bicarbonate solutions seem to be related to fundamental properties of water as an intrinsically non-equilibrium system. Further research of the regularities in the behavior of ABS and understanding the mechanisms underlying this behavior may help to ascertain the mechanisms of development of living things since aqueous bicarbonate system is an inherent component of all living systems.