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PREBIOTIC CHEMISTRY

Survivability and Abiotic Reactions of Selected Amino Acids in Different Hydrothermal System Simulators

Kuhan Chandru · Eiichi Imai · Takeo Kaneko · Yumiko Obayashi · Kensei Kobayashi

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Abstract We tested the stability and reaction of several amino acids using hydrothermal system simulators: an autoclave and two kinds of flow reactors at 200–250 °C. This study generally showed that there is a variation in the individual amino acids survivability in the simulators. This is mainly attributed to the following factors; heat time, cold quenching exposure, metal ions and also silica. We observed that, in a rapid heating flow reactor, high aggregation and/or condensation of amino acids could occur even during a heat exposure of 2 min. We also monitored their stability in a reflow-type of simulator for 120 min at 20 min intervals. The non-hydrolyzed and hydrolyzed samples for this system showed a similar degradation only in the absence of metal ions.

Keywords Hydrothermal systems · Origin of life · Flow reactor · Amino acids · Autoclave

Introduction

Hydrothermal systems could well be a spot where the origin of life had occurred on Earth (Corliss et al. 1981) due to its high energy, reducing environment and the availability of various starting chemicals (i.e. CH_4, C_2H_6, H_2S, CO, and H_2). The emergence of many biomolecules subsequently propagated to life as we know it now (Holm 1982; Wächtershäuser 1990; Shock 1992). Many experiments have been done since, to simulate this kind of prebiotic environment to produce biomolecules and/or test their survivability (Miller and Bada 1988; Kobayashi et al. 1995; Imai et al. 1999; Islam et al. 2001).

Previously, autoclaves were used as a common apparatus to perform experiments involving hydrothermal systems (e.g. Kobayashi et al. 1995; Kohara et al. 1997; Miller and Bada 1988) which was more of a closed system. A flow-type simulator was also suggested by Corliss

K. Chandru (✉) · T. Kaneko · Y. Obayashi · K. Kobayashi
Department of Chemistry and Biotechnology, Faculty of Engineering, Yokohama National University, 79-5 Tokiwadai, Hodogaya-ku, Yokohama 240-8501, Japan
e-mail: kuhan-chandru-nw@ynu.ac.jp

E. Imai
Department of Bioengineering, Nagaoka University of Technology, Nagaoka 940-2188, Japan