DOI: 10.46991/JISEES.2025.SI1.045

Hydrogen Production by *Clostridium beijerinckii* DSM791 and *Clostridium pasteurianum* DSM525 During the Utilization of Coffee Silverskin

Anna Galstyan[1,2*], Liana Vanyan[1,2], Nare Patvakanyan[2,3], Anait Vassilian[1,4], Karen Trchounian[1,2,3]

[1] Research Institute of Biology, Yerevan State University, Yerevan, Armenia
[2] Microbial Biotechnologies and Biofuel Innovation Center, Yerevan State University, Yerevan, Armenia
[3] Department of Biochemistry, Microbiology and Biotechnology, Faculty of Biology, Yerevan State University, Yerevan, Armenia
[4] Department of Ecology and Nature Protection, Faculty of Biology, Yerevan State University, Yerevan, Armenia

ABSTRACT

Molecular hydrogen (H_2) is considered a fuel of the future, as carbon-based energy reserves are gradually being depleted and are non-renewable. Research has shown that representatives of the *Clostridium* genus produce molecular H_2 through dark fermentation by utilizing various carbon sources. Coffee silverskin (CS) produced as a result of coffee roasting process represents low-cost substrate for H_2 production. In this study H_2 production was investigated using *Clostridium beijerinckii* DSM791 and *Clostridium pasteurianum* DSM525 strains, with crude CS as the carbon source with final concentrations of 20-80 g L^{-1}, as well as a combination of waste-with glucose (8 g L^{-1}). Glucose was used as the sole carbon source in the positive control. H_2 production was observed in all samples starting from the 24th hour. It was shown that the maximum H_2 production occurred when the waste-glucose combination was used as the carbon source. In the control samples, the maximum H_2 production was observed at the 72nd hour, with *C. pasteurianum* producing ~30 mM, and *C. beijerinckii* producing ~22 mM. In the waste-glucose combination, the maximum H_2 production was observed at the 48th hour in the 60 g L^{-1} sample of *C. pasteurianum*, which exceeded the control by 2.5 fold. In *C. beijerinckii*, the maximum production was observed at the 72nd hour in the 40 g L^{-1}sample, which exceeded the control by approximately 1.2 times. When only waste was used as the carbon source, the maximum production was observed at the 72nd hour in the 80 g L^{-1} CS containing sample of *C. pasteurianum*, with ~18 mM, and in the 60 g L^{-1} sample of *C.beijerinckii*, with ~7 mM. Thus, it can be concluded that untreated CS can be used as a carbon source for bacterial hydrogen production, although optimal concentrations should be chosen to maximize industrial hydrogen yields.

Keywords: coffee silverskin (CS), *Clostridium beijerinckii* DSM791, *Clostridium pasteurianum* DSM525, hydrogen (H_2) production

References:

1. Gottstein, V.; Bernhardt, M.; Dilger, E.; Keller, J.; Breitling-Utzmann, C.M.; Schwarz, S.; Kuballa, T.; Lachenmeier, D.W.; Bunzel, M. Coffee Silver Skin: Chemical Characterization with Special Consideration of Dietary Fiber and Heat-Induced Contaminants. *Foods* **2021,** *10*, 1705. DOI:10.3390/foods10081705
2. Wang, J.; Yin, Y. Clostridium species for fermentative hydrogen production: An overview. *Int. J. Hydrogen Energy* **2021,** *46*, 34599–625. DOI:10.1016/j.ijhydene.2021.08.052

[*]Corresponding Author:

Anna Galstyan Research Institute of Biology, Faculty of Biology, Yerevan State University, 1 Alex Manoogian str., Yerevan, 0025, Armenia.
Email: anna.galstyan@ysu.am