Enhancement effect of nonionic surfactant and enzymatic pretreatment on bio-H_2 potential from kitchen waste residues

M. M. Elsamadony[a] and A. M. Mostafa[b]*

[a]*Public work Engineering Department, Faculty of engineering, Tanta University, 31734 Tanta, Egypt*
[b]*Chemistry Department, Faculty of Science, Alexandria University, 21321Alexandria, Egypt*

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Presenting author email: ama_mostafa@ymail.com

Batch experiment trials were conducted in order to evaluate the combination effect of using nonionic surfactant such as Tween 80 and a mixture of enzymes as pretreatment tools on the performance of the fermentation process. Whereas, hydrolysis process is a limiting step along dark fermentation processes especially with the existence of organic particulates. Therefore, surfactant pretreatment during this step showed a promising approach, since it improves enzymatic hydrolysis throughout reducing the amount of enzymes needed to achieve the fermentation process. Moreover, enzymes additions play a key role in the promotion of substrate hydrolysis throughout particulate matter solubilization. By the combination of both surfactant and enzymes addition, a higher improvement of the whole fermentation process could be obtained.

The substrate used in this study was a co-digested organic fraction of municipal solid-waste with kitchen wastewater (OFMSW-KW) supplemented with mixed culture bacteria (MCB) under mesophilic condition (35 ± 2 °C). The first batch trial carried out with different Tween 80 concentrations of 0, 0.05, 0.1, 0.2, 0.4, 0.6, 0.8, and 1.0%. Results showed that pretreatment with Tween 80 alone showed a positive impact on cumulative hydrogen production (HP) and hydrogen yield (HY). Where, OFMSW-KW pretreated with 0.4% (v/v) Tween 80 increased (HP) to 412.9 mL, which was 1.61 times higher than control bottle. This corresponded to the maximum hydrogen yield of 118.2 mL H_2/g $COD_{initial}$, and was mainly due to consumption of COD (73.1%). On the other hand, second batch trials have been conducted to evaluate the hydrolysis promotion effect of enzymatic pretreatment in combined with the optimum Tween 80 pretreatment concentration. The enzymatic pretreatment conducted by using enzymes mixture of 1: 2: 1 for carbohydrase: protease: lipase, with different concentration of (0.025, 0.05, 0.1, 0.15, 0.2, and 0.3%) (v/v). 0.05% (v/v) of total enzymes dosage combined with 0.4% (v/v) Tween 80 showed the best results in terms of (HP) and COD reduction which increased to 751.6 mL (193.0% higher than control bottle) and 95.6%, respectively. Thus, the proposed combined pretreatment method is a very promising option for the promotion of (OFMSW-KW) anaerobic digestion in terms of hydrogen production and organic matter reduction.