Inhibition of methane production through anaerobic digestion by diluted solution of Preventol

Experimental protocol

The automatic methane potential test system (AMPTS) nowadays routinely employed in evaluating the biodegradability or biochemical methane potential of a substrate [1-2] was used as an experimental tool in the present assay. The application of the AMPTS and experimental protocol is well documented [1].

To evaluate the effect of a specially prepared diluted solution of preventol (2-Bromo-2-nitropropane-1, 3-diol) on methane generation from microcrystalline cellulose, four different tests, all in triplicates under mesophilic conditions were adopted and evaluated with the aid of the AMPTS. The tests were;

1) Addition of 40 µl of preventol solution to 300 ml of pre-incubated inoculum, to which 1.6 g of pre-dried cellulose was introduced as substrate.

2) In test number two, 40 µl was diluted 10 times and added to 300 ml of pre-incubated inoculum, to which 1.6 g of pre-dried cellulose was introduced as substrate.

3) Same as in '2' with the exception that the 40-µl preventol was diluted 100 times

4) Same as in '2' with the exception that the 40-µl preventol was diluted 500 times.

Another line of experiments, conducted also in triplicates consisted of 300 ml the pre-incubation inoculums only, acting as a negative control.

The methane yields reported below are the net methane yields from which the methane production from the inoculums were subtracted from those of the substrate and thereafter divided by the amount of substrate (cellulose) added.

Results

Figure 1 shows the cumulative methane yield from all tests. There was no noticeable difference between methane productions from cellulose in the present experiment, though all the tests seemed to show an initial lag phase of up to three days. The apparition of a lag phase during anaerobic of crystalline cellulose is not uncommon [3].

However, the test with addition of 40 µl -preventol showed a two-stage (diauxic) methane production curve with production levelling up on day 6, commencing again on day 11, and finally levelling off on day 16 in the same range as the other tests. This result is in line with

findings that microbes in the presence of 2-bromo-2-nitropropane-1,3-diol indicate a period of biocide-induced bacteriostasis followed by growth at an inhibited rate [4].

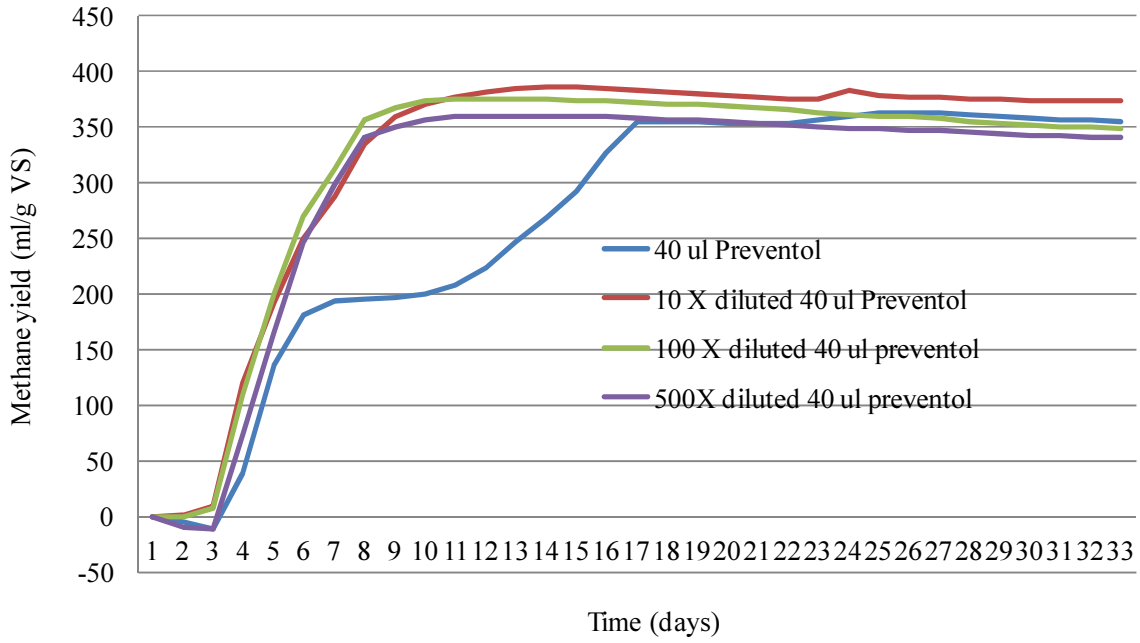

Figure 1. Cumulative methane production from microcrystalline cellulose and inoculums with and with addition of preventol.

It is plausible to state therefore that the concentration of the bacteriocidal or bacteriostatic ingredient in 40 µl of preventol and further dilutions thereof were not enough to elicit a total inhibition of the anaerobic microorganism involve in methane production.

Figure 2 shows the ultimate methane yield of cellulose from the all tests. The ultimate methane yields were not significantly different. In fact, the yields are in the same range as experimental methane yields of cellulose reported in literature [2-3, 5].

The yields achieved in this study were on average 81 to 87 of the theoretical methane yield of cellulose

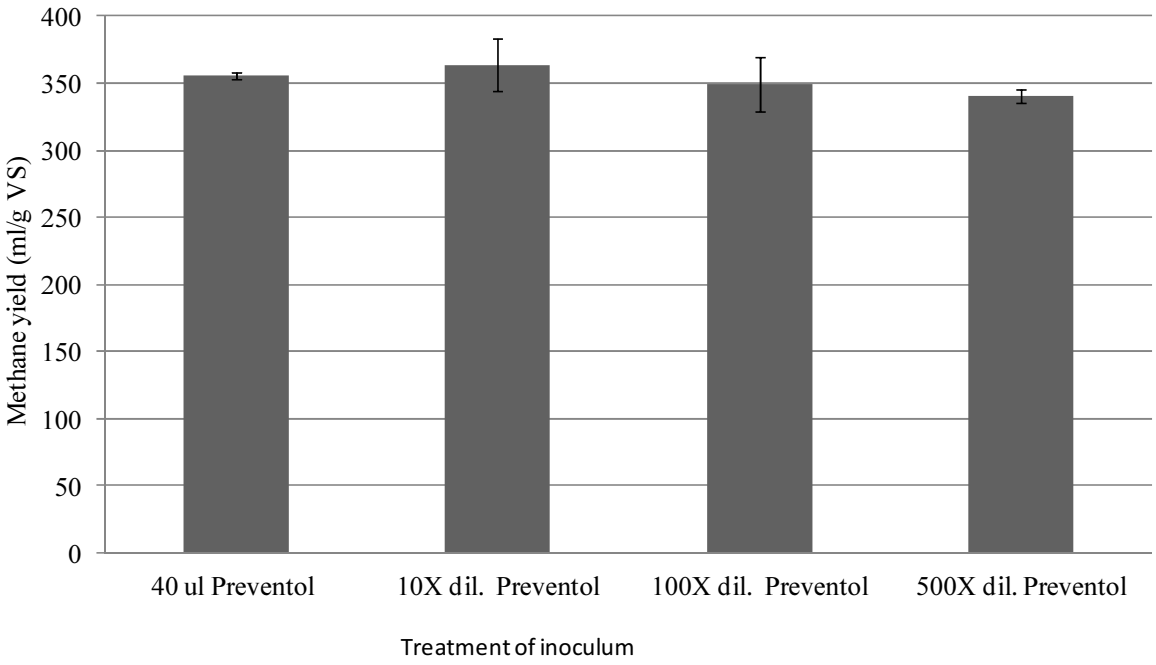

Figure 2. Ultimate methane yields of cellulose with addition of diluted solution of preventol.

The inhibitory mechanism of preventol on the anaerobic microorganisms is not clear. However, one can liken the inhibition to that of another bromo-molecular called 2-bromoethane sulfonic acid (BESA). BESA, which is a closely related analog of Coenzyme M or CoM (2-mercaptoethane sulfonic acid) is known to inactivate methanogensis through the inhibition of the methylreducdase-F_{430} enzyme complex [6]. This premise may be supported by another thesis which state that the antimicrobial activity of preventol relates to the interaction with essential thiols (e.g. CoM and HS-CoM which is formed during the reduction of the methyl by hydrogen) within the cell [4].

References

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