**Production of lactic acid from the organic fraction of municipal solid wastes using *B. coagulans*.**

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**Highlights**

* OFMSW hydrolysate contains more than 50 g/L of fermentable sugars.
* *B. coagulans* was able to grow without the addition of any extra nutrients
* Glucose is completely consumed and LA final concentration reached 60 g/L.
* The conversion yield for the process was 0.79 gLA/gsugars

**1. Introduction**

Investigations into new substrates for the production of chemicals and energy have become more demanding in recent years; not only looking for renewable sources but also for those that are cheap residues. This study focuses on the valorization of the organic fraction of municipal solid waste (OFMSW) also known as biowaste. On average, 40% of this abundant residue, with an estimated yearly production of 88 million tonnes, is landfilled in the EU. Besides posing an environmental risk, landfilling also disregards the potential of the material for being utilized as the substrate in other processes. The OFMSW, is rich in both carbon and nitrogen sources, which makes it an interesting material for the production of value added chemicals through fermentation. This study evaluates a hydrolysate produced from the OFMSW for the production of l-lactic acid. Besides the numerous applications of this versatile platform chemical, its utilization for polylactic acid (a biodegradable plastic) synthesis has recently raised interest on its production. *B. coagulans* are homofermentative l-lactic acid producers, with low nutritional requirements and the ability of growing at 52°C (reducing risks of contamination) which make them of interest for the valorization of waste streams. A *B. coagulans* isolate was used for the fermentations.

**2. Methods**

The substrate for the fermentation was a hydrolysate of the OFMSW. It was obtained from IMECAL SA (Valencia, Spain). Chemical compositional analysis of the substrate was performed for the determination of sugars, organic acids, minerals and nitrogen content. *Bacillus coagulans* A160 (Leibniz Institute for Agricultural Engineering and Bioeconomy, Germany) was employed for the fermentation of the OFMSW hydrolysate. The inoculum for the 1 L scale bioreactor was prepared in MRS broth (Merck, Germany) with dolomite EVERZIT Dol 0.5-2.5 mm (Evers, Germany) as buffer, at an orbital shaker set at 100 rpm, 42 °C for 13 h. Following preliminary lab scale fermentations a technical scale fermentation was carried out in a 72 L BIOSTAT UD bioreactor (B-Braun Biotech, Germany) containing 30 L of OFMSW hydrolysate. Fermentation was carried out at 52 °C and pH 6. Stirring occurred at 300 rpm using a double Rushton turbine. Regulation of pH was carried out by adding 20% (w/w) NaOH. The inoculum, 5% (v/v), was prepared in a 2 L fermentation vessel containing 1 L of OFMSW hydrolysate. Samples were taken regularly for the quantification of sugars and lactic acid.

**3. Results and discussion**

Results for the compositional analysis of the OFMSW hydrolysate show that, in most cases, the hydrolysate has a concentration of glucose higher than 50 g/L. Results for the variation in concentrations of sugars and lactic acid throughout the fermentation are shown in Figure 1.

**Figure 1.** Variation in the concentrations of sugars and lactic acid during a fermentation of OMSW hydrolysate in a technical scale bioreactor (30 L working volumen). The strain used was B coagulans A166 and the fermentation was performed at 52°C and pH was controlled at 6.

LA had a concentration of 7.25 g/L at the start of the fermentation reaching a maximum value of 60.71 g/L by the end of the fermentation. Analysis of enantiomeric purity gave a result of 93.85% for L-LA. As shown in the figure above, the initial concentration of total sugars was around 83 g/L. From that, 50 g/L was glucose, 24.5 g/L xylose, 9 g/L disaccharides and 1.25 g/L arabinose. The fermentation was stopped when the production of LA ceased, by that point the remaining concentration of total sugars was 15.80 g/L. That represents a consumption of approximately 81 % of the initial amount of sugars. The conversion yield for the process was 0.79 gLA/gsugars (79 % conversion).

**4. Conclusions**

The hydrolysate from OFMSW is a good substrate for the production of lactic acid with a total sugars concentration in the hydrolysate exceeding 70 g/L (50g/L for glucose). Furthermore, the hydrolysate is able to support the growth of the bacteria without the addition of any other nutrients and without any apparent inhibitory effects. After fermentation using *B. coagulans* conversion yield for the process was 0.79 gLA/gsugars  and a LA final concentration of 60.71 g/L were achieved.