Maestría en Ingeniería en Diseño de Bioprocesos

Title

Organic waste used from fruit and vegetables to produce ethanol

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Abstract

Actually, there is a big problem of pollution and organic waste generation and is necessary to change the oil for renewable energies like biomass. The objective of this work is to obtain fermentable reducing sugars to produce bioethanol from organic solid waste as lettuce, banana, pumpkin, coriander and tomato. Acid hydrolysis was performed to different acid concentrations and obtain the best conditions. Three different methods were tested for quantitation of ethanol from fermentation (banana and tomato).

Introduction

The bioenergy is a renewable energy, It come from organic matter (biomass). The biomass is obtained from agricultural activities and livestock activities [1].

From biomass can be obtenided solid, liquids and gaseous biofuels as wood and coal, bioethanol and biomethane [2].

Biomass contains lignocellulose mainly, this provides a source of sugars to produce bioethanol, it can be consumed by microorganisms to ferment the free reducing sugars [3, 4]. The ethanol is currently used as fuel or additive to gasoline due to increase the gasoline octane [5].

Objetives

General objective

To produce bioethanol from organic waste from fruit and vegetables.

Specific objectives

To characterize the raw material from organic waste.

To standardize the acid and enzimatic hydrolysis from experimental designs.

To compare different bioethanol quantization techniques.

To produce bioethanol by Saccharomyces cerevisiae fermentation in batch culture and fed batch culture.

Results

Table 1. Organic matter characterization

Solid waste	Moisture (%)	Total solids (%)	Ash of solid fraction (%)	Volatile solids of solid fraction (%)	Soluble sugars of solid fraction (%)	Soluble prot of solid fraction (%)
Lettuce	96.32	3.628	0.276	3.352	9.45	26.06
Banana	80.3	19.705	0.041	19.664	25.41	14.82
Pumpkin	95.3	4.681	0.822	3.859	5.07	14.22
Coriander	90.2	9.784	0.917	8.867	4.01	28.04
Tomato	96.14	3.848	0.416	3.432	16	15.94

Table 2. Acid hydrolysis

Solid waste	Acid sulfuric concentraton 3 %			Acid sulfuric concentraton 5 %			Acid sulfuric concentraton 8 %		
	Initial reducing sugars (g/L)	Maximum increase (%)	Maximum increase time (h)	Initial reducing sugars (g/L)	Maximum increase (%)	Maximum increase time (h)	Initial reducing sugars (g/L)	Maximum increase (%)	Maximum increase time (h)
Lettuce	10.21	19.79	1	10.5	24.41	1	6.7	0	1
Banana	20.49	33.03	1	27.98	16.24	1	9.68	52.84	1
Pumpkin	1.616	54.11	7	2.53	49.51	1	4.465	1.43	1
Coriander	2.33	65.31	7	2.007	44.60	3	1.377	74.92	7
Tomato	9.99	10.64	3	8	23.80	3	4.319	52.48	1

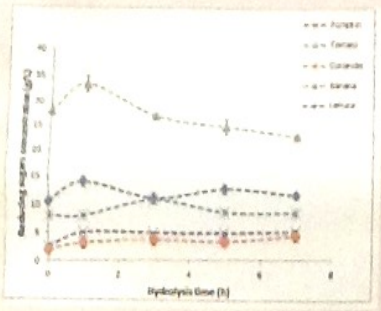

Figure 1. Acid hydrolysis kinetics to 90 °C and 5 % acid concentration.

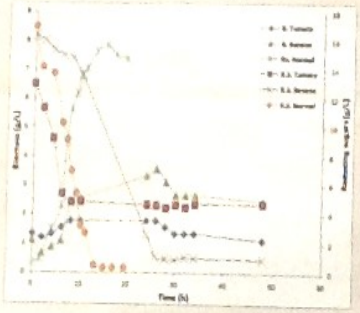

Figure 2. Alcoholic fermentation of organic waste.

Table 3. Alcoholic quantification.

Solid waste	Distilled %	Ethanol concentration		
		Method 1	Method 2	Method 3
		g/L	g/L	g/L
Banana	10	20.632	8.504	9.411
Tomato	18	11.244	1.243	2.941

Method 1 (ferrous ammonium sulfate titration)
Method 2 (sodium thiosulfate titration)
method 3 (refractometer)

Figure 3. Alcoholic destilation and titration.

Conclusions

The organic waste have more than 90% moisture, less banana having 80% moisture.

The banana, lettuce and tomato obtained a higher concentration of sugars in contrast to coriander and pumpkin.

The best acid concentration to acid hydrolysis is to 5 %.

Method 2 and 3 had similar results compared with method 1, however it is necessary to quantify the ethanol by a more sensitive method.

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