

# Bioethanol Production from Solid State Fermentation (SSF) of Grape Pomace

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## Introduction

Bioethanol or alcoholic beverage production from grape pomace is usually achieved by adding a certain quantity of water followed by the fermentation of the sugary liquid produced. At the present study the use of SSF and vacuum distillation minimizes the addition of water resulting to both, the minimization of wastes and the energy consumption for bioethanol recovery.

## Materials & Methods



Fermentation vessels fitted with air-locks

### Initial composition of grape pomace

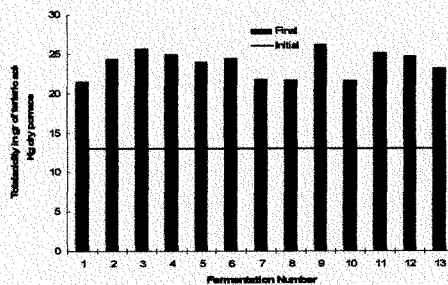
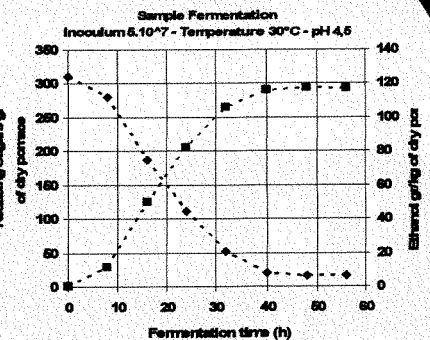
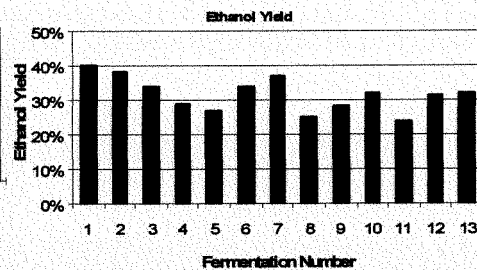
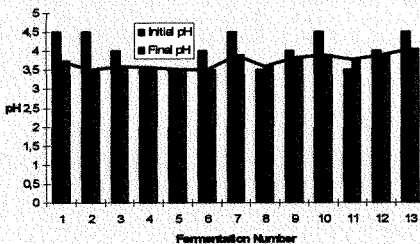
Humidity %	71,8 ± 0,5
pH	3,46 ± 0,05
Reducing sugars gr/kg wet pomace	143,6 ± 3,2
Reducing sugars gr/kg dry pomace	509 ± 11
Acetic acid gr/kg wet pomace	5,5 ± 0,3
Acetic acid gr/kg dry pomace	19,1 ± 1,1
Total acidity in tartaric acid gr/ kg dry pomace	13 ± 0,8
Ethanol gr/100 gr wet pomace	0 to 0,4
A-amino Nitrogen mg/kg wet pomace	109 ± 5
A-amino Nitrogen mg/kg dry pomace	387 ± 17
Ammonium Nitrogen mg/kg wet pomace	56 ± 2,3
Ammonium Nitrogen mg/kg dry pomace	198 ± 8

### Experimental design

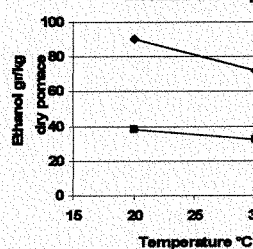
The effects of the inoculum's concentration ( $5.10^7$  and  $20.10^7$  cells/gr of dry weight), sterilization conditions, the fermentation temperature (20°C and 30°C) and the pH (3,5 - 4 - 4,5) on the production of ethanol were studied.

Fermentation Batch	Inoculum cells gr of dry pomace weight	Sterilisation	Temperature °C	pH
1	$5.10^7$	Yes	30	4,5
2	$5.10^7$	No	30	4,5
3	$5.10^7$	No	30	4
4	$5.10^7$	No	30	3,5
5	$20.10^7$	No	30	3,5
6	$20.10^7$	No	30	4
7	$20.10^7$	No	30	4,5
8	$5.10^7$	No	20	3,5
9	$5.10^7$	No	20	4
10	$5.10^7$	No	20	4,5
11	$20.10^7$	No	20	3,5
12	$20.10^7$	No	20	4
13	$20.10^7$	No	20	4,5

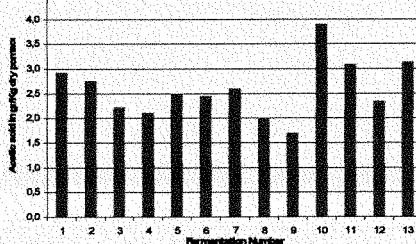
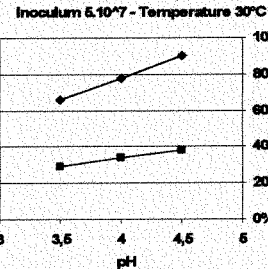
## Results & Discussion



### Fermentation 2 & 10



### Fermentation 2, 3 & 4



## RESULTS

After the completion of fermentation the final pH of the medium was always between 3,5 and 3,8. The medium total acidity increased by 65 to 100% of the initial value, while the volatile acidity increased by 0,7 to 1,6 g/Kg. Glycerol concentration found to be between 5 to 7g/Kg and the ethanol yield from 24% up to 40% under optimum conditions.

The optimum conditions for high yield bioethanol production were: pH 4,5, fermentation temperature 30°C, inoculum  $20.10^7$  cells/gr of dry weight, humidity 70%. No nitrogen or nutrient addition was necessary.

The efficiency of the ethanol recovery by vacuum distillation was between 87% to 94%.

## Conclusions

Solid state fermentation of grape pomace for ethanol production proved to be feasible and easy even without yeast inoculation. The optimum conditions for high yield bioethanol production were: pH 4,5, fermentation temperature 30°C, inoculum  $20.10^7$  cells/gr of dry weight, humidity 70%. No nitrogen or nutrient addition was necessary. The fermentation was completed after 40 hours. The efficiency of the ethanol recovery was between 87% to 94%. This method can also be used for bioethanol production using different agricultural wastes.

## POSTERS

### P53: Bioethanol Production from Solid State Fermentation (SSF) of Grape Pomace

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Grape pomace of white grapes was recovered after pressing and fermented with or without the use of industrial yeast. The pomace humidity was 72%, pH 3,46, the initial reducing sugar concentration was 144 g/Kg, and the total acidity (as tartaric acid) was 8,2g/Kg. Additionally the measured volatile acidity was 5,5g/Kg, and the ammonium nitrogen was 56mg/Kg while the a-amino nitrogen was 109 mg/Kg. All measurements were expressed in wet weight.

The effects of the inoculum concentration ( $5 \cdot 10^7$  and  $20 \cdot 10^7$  cells/gr of dry weight), sterilization conditions, the fermentation temperature (20°C and 30°C) and the pH (3,5, 4, 4,5) on the production of ethanol were studied.

After the completion of fermentation the final pH of the medium was always between 3,5 and 3,8. The medium total acidity increased by 65 to 100% while the volatile acidity increased by 0,7 to 1,6 g/Kg. Glycerol concentration found to be between 5 to 7g/Kg and the ethanol yield from 24% to 40%.

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