Yeast adaption on the substrate straw

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Introduction

As the availability of fossil fuels is limited and their combustion responsible for vast CO_2 emissions, the interest in the production and usage of biofuels has increased enormously. One of the most important aspects for bioethanol production is an ideal yeast strain for the fermentation process. This yeast strain should possess the ability of a stable conversion of C5- and C6-sugars, resistance against inhibitory compounds, tolerance concerning high temperatures, high ethanol and sugar yields and industrial stability. Furthermore, to answer public's attitude against genetic engineering and to avoid judicial restrictions and extensive costs due to enormous safeguards, this yeast strains should not be generated by genetic engineering, but isolated by specific adaptation and systematic selection. Such a strain is not available at present.

Methods

Adaption of yeast strains to C5-sugars: Selected yeast strains have been adapted to grow on xylose agar. Finally, fermentation analyses of a possible increase in conversion of xylose have been conducted (125 g/l xylose ; 30 °C; 168 h; 110 rpm).

Resistance against inhibitory compounds: Selected yeast strains have been cultivated in ascending concentrated hydrolysate adaption media. Analyses of increased inhibitor resistance have been conducted by fermentations (140 g/l glucose; 30 °C; 168 h; 110 rpm).

Adaption to increased temperatures: Several yeast strains have been streaked on YGC agar plates and incubated at increasing temperatures. Accordingly, fermentative capacity (40 °C; 168 h; 110 rpm) has been tested.

Adaption to increased alcohol concentrations: Selected yeast strains have been cultivated at 30 °C in YGC-media containing ascending concentrations of ethanol.

Conclusions

The ideal yeast strain has not been produced yet, because the mentioned requirements could not have been combined completely into one ideal yeast strain. Nevertheless, some significant improvements with regard to the ideal yeast strain have been reached, e.g. yeast growth in ascending hydrolysate medium (15 % dry substance) at increased temperatures (40 °C). These improvements offer new possibilities for further optimization.

Results

The following tables show the results of the conducted adaption and selection procedures:

Table 1: Ethanol and xylose yields of xylose adapted yeasts; not all data shown.

Yeast strain	Adapted yeast		Non adapted yeast	
	EtOH [% vol.]	Xylose [g/l]	EtOH [% vol.]	Xylose [g/l]
Pichia stipitis	4,0	19,1	2,1	73,4
Pachysolen tannophilus	1,6	28,1	0,2	112,6
Candida utilis	4,5	-	0,1	-

Table 2: Ethanol and glucose yields of inhibitor adapted yeasts; not all data shown.

Yeast strain	Adapted yeast		Non adapted yeast	
	EtOH [% vol.]	Glucose [g/l]	EtOH [% vol.]	Glucose [g/l]
Sherry yeast	4,8	60,4	0,7	124,1
Portwine yeast	4,6	56,5	0,7	125,6
Turbo yeast	4,2	67,9	2,9	86,9

Table 3: Ethanol yield after fermentation at 30 °C and 40 °C; not all data shown.

Yeast strain	EtOH yield at 30 °C [% vol.]	EtOH yield at 40 °C [% vol.]
Osmophilic yeast	5,9	5,4
Malaga yeast	5,5	5,8
White wine yeast	5,5	5,6

After constantly increasing the ethanol yield, some of the tested yeast strains became tolerant up to 12 % vol. ethanol.

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