

SELECTION OF YEAST STRAINS WITH A VIEW
TO THE PRODUCTION OF PROTEIN ON INULIN

by

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SUMMARY

Various yeast strains have a good protein yield and a high growth rate on inulin. *Kluyveromyces marxianus* seems to be particularly suitable for the production of protein on this substrate.

INTRODUCTION

The purpose of this work was to select yeasts which grow well on inulin and which have a good protein yield.

Inulin was chosen as carbon substrate since the tubers of some plants, and in particular the Jerusalem artichoke *Helianthus tuberosus*, are very rich in this carbohydrate.

The Jerusalem artichoke has the merits of being hardy, easy to rear and of giving high yields; the tubers contain 12 to 20 % inulin (weight of undried matter). At present the Jerusalem artichoke is used only as animal feed.

MATERIAL AND METHODS

Biological material

We used 16 strains from the Centraalbureau voor Schimmelcultures, Delft, Holland (CBS) and from our laboratory's collection (LG).

Strains were chosen according to their ability to assimilate inulin according to Barnett and Pankhurst (1974).

Method of cultivation

Cultivation was carried out at 28° C on a medium consisting of Difco Yeast Nitrogen Base (YNB) with Merck inulin added in agitated Erlenmeyer flasks (70 oscillations/min., amplitude 7.5 cm) filled to 1/10 of their volume.

The cultures were in all cases inoculated with preliminary cultures on the same medium. The medium was sterilized by filtration.

Analytical methods

The dry matter was determined by weighing washed cells after 24 hours of drying at 108° C.

Protein was dosed using Strickland's biuret method (1951).

Nitrogen was dosed using the Kjeldahl method (Bradstreet 1965).

RESULTS OF THE EXPERIMENTS

I. STUDY OF GROWTH ON INULIN

The growth rates were determined on YNB medium with 0.5 % inulin per nephelometric measurement at 400 nm.

The growth yields were determined after cultivation on YNB medium with 0.1 to 2 % inulin. Curves were plotted showing the production of dry matter and the production of protein in function of the concentration of substrate in the medium. The slope of the right-hand part of the curve gives the yields.

The results of these experiments are assembled in Table 1.

Strain	Napierian growth rate	Yield mg Dry matter/mg inulin	Yield mg Protein mg/inulin
<i>Candida kefyr</i> CBS 834	0.12	25.5	11
<i>Candida macedoniensis</i> CBS 2079	0.12	32	11
<i>Candida pseudotropicalis</i> LG	0.22	21	10
<i>Candida salmenticensis</i> CBS 5121	0.12	48	20
<i>Debaryomyces cantarellii</i> CBS 4349	0.13	49	15.5
<i>Debaryomyces phaffii</i> CBS 4346	0.11	35	14.5
<i>Kluyveromyces fragilis</i> CBS 1555	0.30	40	14
<i>Kluyveromyces marxianus</i> LG	0.27	45	20
<i>Lipomyces starkeyi</i> LG	0.10	50	17
<i>Pichia guilliermondii</i> LG	0.10	31.5	14
<i>Pichia polymorpha</i> CBS 186	0.16	38	16
<i>Saccharomyces fermentati</i> CBS 818	0.12	21	9.5
<i>Saccharomyces rosei</i> LG	0.05	21.5	8
<i>Schwanniomyces alluvius</i> CBS 4516	0.16	50	12
<i>Schwanniomyces castellii</i> CBS 2863	0.20	34	14.5
<i>Torulopsis colliculosa</i> CBS 133	0.10	39	11

Table 1 - Rates and yields of growth on YNB inulin.

The two *Kluyveromyces* had the best growth rate. The best protein/sugar yields were obtained with *Candida salmenticensis* and *Kluyveromyces marxianus*.

II. OBSERVATION CONCERNING THE COMPOSITION OF THE STRAINS

The Kjeldahl nitrogen content and the real protein as a percentage of dry matter were determined after cultivation on YNB medium with 0.5 % inulin.

The results of these experiments are assembled in Table 2.

The best protein ratios were obtained with *Candida pseudotropicalis*, *Saccharomyces fermentati*, *Kluyveromyces marxianus* and *Pichia guilliermondii*.

Strain	% Prot./dry matter	% N/dry matter
<i>Candida kefyri</i> CBS 834	42	6.0
<i>Candida macedoniensis</i> CBS 2079	34	5.9
<i>Candida pseudotropicalis</i> LG	48	8.1
<i>Candida salmunticensis</i> CBS 5121	42	7.8
<i>Debaryomyces cantarellii</i> CBS 4349	31	5.3
<i>Debaryomyces phaffii</i> CBS 4346	40	6.7
<i>Kluyveromyces fragilis</i> CBS 1555	34	6.0
<i>Kluyveromyces marxianus</i> LG	45	7.5
<i>Lipomyces starkeyi</i> LG	33	5.5
<i>Pichia guilliermondii</i> LG	45	7.5
<i>Pichia polymorpha</i> CBS 186	40	7.2
<i>Saccharomyces fermentati</i> CBS 818	45.5	7.5
<i>Saccharomyces rosei</i> LG	34	6.5
<i>Schwanniomyces alluvius</i> CBS 4516	26.5	4.7
<i>Schwanniomyces castellii</i> CBS 2863	42	7.1
<i>Torulopsis colliculosa</i> CBS 133	27.5	4.7

Table 2 - Protein and nitrogen content of the cells after cultivation on YNB with 0.5 % inulin.

CONCLUSION

Among those strains with a good protein yield on inulin, *Kluyveromyces marxianus* seems particularly suitable for the production of protein. This strain has a very good protein/dry matter ratio (45 %) and a high growth rate (0.4). However, this strain is able to ferment inulin: since *Kluyveromyces marxianus* has no glucose effect and it is possible to cultivate it continuously this disadvantage remains negligible.

Other strains could also be usable: *Candida salmunticensis* or *Pichia polymorpha*, in spite of their relatively lower growth rates.

The use of such strains enable protein to be produced from Jérusalem artichokes, cultivation of which is tended to dwindle in spite of the merits of this plant as regards farming.

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