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EFFECT OF SCENEDESMUS ACUMINATUS GREEN ALGAE
EXTRACTS ON THE DEVELOPMENT OF CANDIDA LIPOLYTICA
YEAST IN GAS-CONDENSATE-CONTAINING MEDIA

by

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Cultivation of yeast on a hydrocarbon base is promising for the production /12**
of an inexpensive nutrient protein. One of the paths for accelerating growth and
development of nutrient yeast on a medium with hydrocarbons is to use biostimu-
lants.

Extracts made of higher and certain (blue-green algae) lower plants have been
suggested as such stimulants [1-3]. We have not encountered any information on the
effect of green algae on the intensity of hydrocarbon yeast development in the
literature. We will cite the results from culturing the *C. lipolytica* yeast
strain in a mineral medium with gas-condensate as the hydrocarbon substrate, and
with aqueous and alcohol extracts from green algae *Scenedesmus acuminatus* as the
yeast growth stimulants.

Studies were made with the *C. lipolytica* yeast culture (strain No. 3) that
grows well when the gas condensate is used. The culturing took place in a mineral
medium [4] with de-aromatized gas-condensate in a quantity of 4% (volumetric) of
the Fergana Oil Refinery (FNZ). Aqueous and alcohol extracts from the *S. acuminatus*

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**Numbers in margin indicate pagination in original foreign text.

biomass presented to us by our colleagues in the laboratory of aqueous cultures were tested as the biostimulants. A study was made of the aqueous extract obtained with multiple freezing and unfreezing of the aqueous algal suspension and the decoction of algae obtained during boiling in a water bath for 30 min. The alcohol extract of algae was tested in the liquid state and condensed to a paste.

The concentration of aqueous extracts in one gas-condensate-containing medium was 1%, of alcohol--0.5%.

Culturing was carried out at a 28°C temperature under conditions of rocking and a five-liter fermenter. The intensity of development was judged by the yield of biomass that was computed by the weight method [5]. The content of residual hydrocarbons and lipids in the yeast was determined by the method of alcohol-ether extraction [6], quantity of vitamins B₁ and B₈--by the microbiological method [7], raw protein--according to total nitrogen (N x 6.25), true protein--by the method suggested by R. M. Fedorovich et al. [8].

For a control the tested strain was grown in a medium without additives and with the additives that are traditional for yeast--yeast autolysate in sum with corn extract. The reliability of the results was established by the variational statistics method.

During the cultivation of *C. lipolytica* in media with gas-condensate under rocking conditions it was established that the aqueous extracts of *Scenedesmus acuminatus* can replace the expensive yeast autolysate with the corn extract. The aqueous extract of *Scenedesmus* biomass possessed greater stimulating action than the alcohol. With development in media with aqueous extract of green algae the yeast culture developed faster and after 2-day growth the cells began to die off. On the media with yeast autolysate and corn extract a longer stationary phase of development was noted, 96 h. /13

We will cite data on the accumulation of biomass of *C. lipolytica* on the gas-condensate-containing medium with different additives (g/l):

Additive	Growth time, h					
	6	18	24	48	72	96
control--without additive	1.14	1.4	1.92	2.9	2.87	2.82
Yeast autolysate+corn extract	1.58	3.47	4.8	5.88	5.92	6.0

	6	18	24	48	72	96
Alcohol extract made of Scenedesmus	1.12	2.94	4.3	5.59	4.96	4.28
Aqueous extract made of Scenedesmus	1.6	4.01	5.2	7.6	6.8	6.37

Note: The average error m is from ± 0.12 to ± 0.35 .

A comparative study of the effect of additives obtained by different methods from the Scenedesmus biomass indicated that the most intensive stimulating effect on the yeast growth was found in the decoction and aqueous extract (7.5-8.7 g/l of biomass on second day of growth), and the least--alcohol extract and the chlorophyll-carotene paste. This is apparently explained by the fact that the aqueous extracts have a greater quantity of substances that actively affect yeast growth: vitamins, hormone-like compounds, etc. [9].

The effect of different additives obtained from the *S. acuminatus* biomass on the *C. lipolytica* growth in the gas-condensate-containing medium (2-day growth) is:

Additive	Biomass yield, g/l
Control without additive	2.9 \pm 0.12
Aqueous extract	7.5 \pm 0.18
Decoction	8.7 \pm 0.27
Alcohol extract	5.59 \pm 0.35
Chlorophyll-carotene paste	5.58 \pm 0.22

In order to study the hydrocarbon and lipid compositions of the *C. lipolytica* biomass the cultures were grown in a five-liter fermenter with aqueous extract made of Scenedesmus and with yeast autolysate in sum with corn extract. When the decoction made of algae was introduced into the gas-condensate-containing medium the content of residual hydrocarbons in the yeast was reduced by 4%, and the content of lipids was almost not altered (8.2-8.9%).

Data on the content of residual hydrocarbons and lipids in the *C. lipolytica* biomass during growth in a gas-condensate-containing medium with biostimulants in a five-liter fermenter (2 days of growth) are given below.

Additive	Biomass, g/l	Residual hydrocarbons, %	Lipids, %
Yeast autolysate + corn extract	6.0 \pm 1.3	13.1 \pm 0.2	8.9 \pm 0.8
The same + decoction of algae	9.09 \pm 0.7	9.0 \pm 0.27	8.2 \pm 0.66

The replacement of the yeast autolysate with corn extract by the aqueous extract made of green algae had an insignificant effect on the content in the biomass of yeast of raw protein, true protein and certain vitamins in the B group. Thus, there was 53.8-55% raw protein in these variants, 44.2-45.2% true protein, 28.2-34 γ/g thiamine, and 36.1-36.2 γ/g inositol.

The content of protein and vitamins B₁ and B₈ in the *C. lipolytica* biomass during growth in gas-condensate-containing media with different additives (2 day growth) is as follows.

Additive	Output of biomass, g/l	Raw protein, (Nx6.25), %	True protein, %	Vitamin, γ/g	
				B ₁	B ₈
Corn extract + yeast autolysate	5.88	55.0	45.23	34.0	36.1
Decoction of green algae	8.7	53.75	44.2	28.2	36.2

Note: Average error m does not exceed $\pm 2-3.3\%$.

Thus, the *C. lipolytica* yeast in gas-condensate-containing media with aqueous extracts of green algae *Scenedesmus acuminatus* grow better than on media with the traditional biostimulants for yeast--yeast autolysate and corn extract. The aqueous extracts of the biomass of this type of algae can be used in the gas-condensate-containing media as growth stimulants for *C. lipolytica* yeast.

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