ENZYMATIC HYDROLYSIS OF FIBERS OF GENETICALLY DIFFERENT LINES OF COTTON

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ABSTRACT

Recently, the processes of bioconversion of renewable lignocellulosic raw materials into various products (alcohols, organic acids, amino acids, etc.) have reached an industrial scale [1, 2]. The main component of such raw materials is cellulose; its content in the starting material can reach 40–50% and higher [3]. The stage of enzymatic hydrolysis of cellulose to glucose in these processes is the key and most laborious. For the effective hydrolysis of cellulose, it is necessary to have a well-balanced cellulase complex, including endoglucanases (EG) and cellobiohydrolases (CBH), which cleave the polymer substrate to cellobiose and other oligosaccharides, as well as exoglucosidases that catalyze the hydrolysis of oligosaccharides to glucose [4]. Currently, the search for new, more active cellulases remains an urgent task. Intensive research is also underway to increase the specific activity of enzymes and improve their other properties by protein engineering methods [5–7]. To optimize the composition of the cellulase complex, approaches are often used based on the creation of model mixtures of purified enzymes and testing their hydrolytic ability with respect to various cellulose-containing substrates [7–9].

The obtained data on the enzymatic destruction of cellulose fibers in 25 genetically different lines showed that there are significant differences in the rate of biodegradation between the studied lines of the cotton genetic collection. The order of reactions during the enzymatic catalysis of fiber samples was diverse, apparently due to the different effect of the accumulation of cellulose in their fiber during their growing season. From the data of table 1

it can be seen that in each particular fiber the degree of its destruction is different, although the degradation of the fiber begins in the early stages of fermentolysis. So, for example, after 2 hours of fiber hydrolysis, the glucose yield of all samples was not high, but a difference was observed in the rate of hydrolysis between the fibers. In the samples of cotton fibers of lines L-601, L-602 and L-525 at the beginning of hydrolysis, the glucose yield is 0.37, 0.32 and 0.36 g / l, while in other fiber samples, lines L-12, L -12-1 and L-654 hydrolysates had a glucose content of 1.08, 1.02 and 0.71 g / l, respectively. According to our data, we can assume that cellulolysis of fibers at the beginning of the process is slow, since at this time the polymer chain of cellulose is still resistant to the action of enzymes. After 24 hours of the enzymatic process, a different glucose output could be observed. So, for example, at the end of the process, at the L-468 and L-469 lines, it is 7.77 g / l and 7.56 g / l (Fig. 1 a), while for some lines, such as L-501, L -525, at the end of the enzymatic process, the glucose yield decreased by 25-30% than in the previous lines.

Table 1. Glucose yield (g / l) during enzymatic hydrolysis of fibers of genetically different cotton lines

№	Lines	In 2 hours	After 24 hours	After 48 hours
K.	F-108	0,119	1,367	2,27 ±0,095
1	L-467	0,43	5,9	6,89± 0,106
2.	L-468	0,40	3,8	7,69+0,095
3.	L-469	0,56	3,15	7,66+ 0,052
4.	L-459	0,56	3,15	6,75+0.071
5.	L-490	0,37	3,7	4,69± 0,070
6.	L-458	0,47	3,2	4,83± 0,072
7.	L-463	0,42	2	3,29± 0,040
8.	L-501	0,71	2,05	3,82± 0,050
9.	L-525	0,36	2,6	3,41± 0,060
10.	L-532	0,51	2,25	3,073± 0,043
11.	L-601	0,37	1,0	1,63± 0,084
12.	L-602	0,32	3,65	5,59± 0,043
13.	L-650	0,46	3,25	4,21± 0,052
14.	L-654	0,71	3,05	5,34± 0,070
15.	L-655	0,40	3,1	5,34± 0,093
16.	L-681	0,57	4,8	5,98± 0,066

17.	L-12	1,08	3,75	7,66± 0,053
18.	L-12-1	1,02	2,8	7,31± 0,055
19.	L-466	0,132	1,445	2,51 ± 0,061
20.	L-37	0,127	0,652	2,24 ± 0.072
21.	L-22	0,110	0,720	1,93±0.058
22.	L-627	0,125	0,923	1,88±0,038
23.	L-653	0,116	0,631	1,82±0,067
24	L-26	0,106	1,581	2,34 ±0,057
25.	L-36	0,026	0,412	1,15± 0,073

Note: the underlined value significantly differ from the indicators of the control variant. A high degree of fiber hydrolysis between the cotton lines was distributed as follows: L-467> L-12> L-12-1> L-654> L-501.

It was revealed that some cotton lines, such as L - 36, L - 501, L - 525, L - 602 were resistant to cellulases. The fibers of the lines L - 12, L - 12-1, L - 654 had medium resistance (strength), while L - 468, L - 469 had low resistance. According to the glucose yield of resistant fibers, 0.32 - 0.37 g / l were separated, while the average resistance was 0.71 - 1.08 g / l, respectively, having low strength to cellulase enzymes - 4.9 - 7, 77 g / l

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