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SHORT COMMUNICATIONS

A New Phenotypic Manifestation of Deletion of the *BGL2* Gene Encoding the Cell-Wall Glucanotransferase Bgl2p in the Yeast *Saccharomyces cerevisiae*

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Abstract—Deletion of the gene encoding the cell-wall glucanotransferase Bgl2p in *Saccharomyces cerevisiae* decreases the number of dead cells in the yeast culture incubated in a liquid nutrient medium for more than two days. After storage for three months, only 32% of the wild-type cells were found to be able to produce colonies, whereas all cells with the inactivated *BGL2* gene retained this ability. It is suggested that the glucanotransferase Bgl2p plays an important role in the limitation of the reproductive life span of aging yeast cells.

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It is believed that the loss of reproductive ability in old cells followed by their death is a favorable factor for biological species [1] and that a limited reproductive lifespan of cells in populations is biologically reasonable [2]. However, our experiments on inactivation of the *BGL2* gene that encodes the cell-wall glucanotransferase Bgl2p of *Saccharomyces cerevisiae* questions this belief.

Bgl2p is one of the major proteins of the cell wall of yeasts; it possesses glucanotransferase and, under certain conditions, endoglucanase activities [3]. This protein was first described in 1989 [4]; however, up to now its physiological role has been poorly understood because mutations in the *BGL2* gene do not produce any notable phenotypic changes in the yeast cells grown under standard cultivation conditions (30°C, YPD medium with 2% each peptone, yeast extract, and glucose), except that the content of chitin in the cell wall slightly increases [3, 5, 6].

A comparative study of the short-term growth (for less than a day) of wild-type and mutant (bgl2) strains with the inactivated *BGL2* gene [5] showed that both strains reached the stationary growth phase at the same time and accumulated the same amount of biomass (Fig. 1).

However, in older cultures (more than two days old), the number of cells in the wild-type culture became considerably lower than in the mutant culture (Fig. 2). This observation suggests that the deletion of the *BGL2* gene encoding the glucanotransferase Bgl2p may diminish the death rate of cells in aging yeast cultures.

To verify this suggestion, we studied the effect of the *BGL2* gene deletion on the reproductive life span of yeast cells. For this purpose, colonies of the wild-type and the bgl2 mutant strains were grown at 30°C on YPD agar for one day followed by their incubation at 20°C for three months. Then, old wild-type and mutant cells were plated in equal numbers onto fresh YPD agar and the plates were incubated at 30°C for a day. The enumeration of the number of grown colonies showed that only 32% of the wild-type cells produced new colonies,

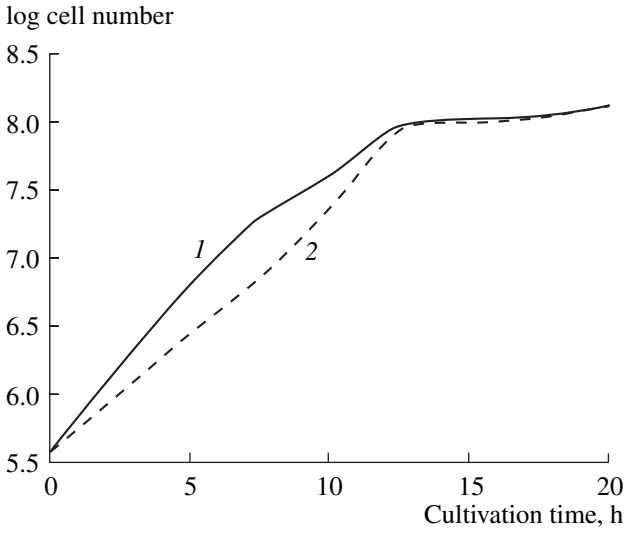

Fig. 1. Short-term growth (for 20 h) of (*1*) the wild-type and (*2*) bgl2 mutant yeast cultures at 30°C in liquid YPD medium. Cells were counted using a Gorayev chamber.

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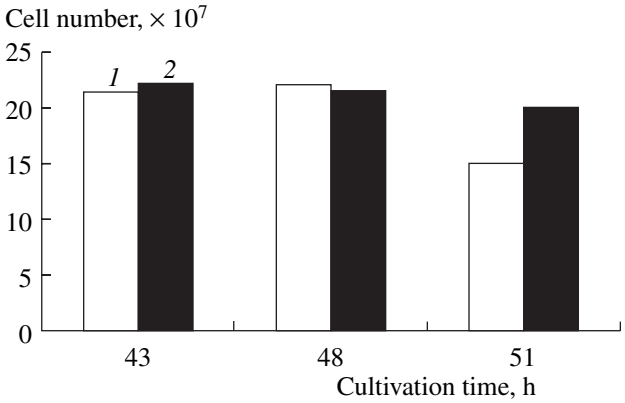

Fig. 2. Number of cells in (*1*) the wild-type and (*2*) bgl2 mutant yeast cultures grown at 30°C in liquid YPD medium for more than two days. Cells were counted using a Gorayev chamber. The standard error of cell count was ±0.3 × 10^7 cells.

whereas all cells with the inactivated *BGL2* gene were able to produce new colonies (Fig. 3). These data suggest that the glucanotransferase Bgl2p may play an important role in the limitation of the reproductive lifespan of aging yeast cells.

According to our experiments in vitro (unpublished data), the glucanotransferase Bgl2p can form fibrils of the amyloid type. This fact suggests that Bgl2P forms a fibrillar network in the cell wall of yeast cells during their life. As soon as cell death becomes necessary, the expression of the *BGL2* gene is activated and the fibrillar network becomes very dense, isolating old cells from the environment, blocking their metabolism, and eventually causing their death.

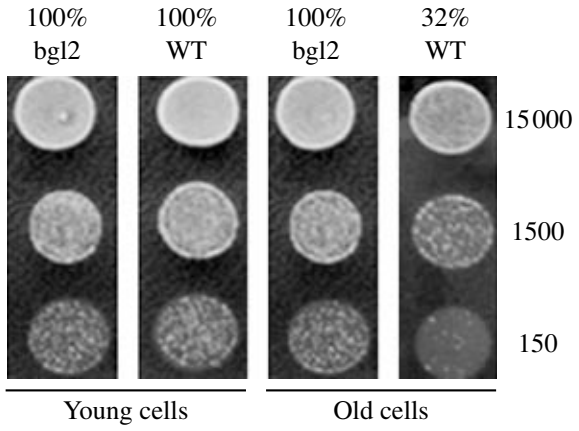

Fig. 3. The ability of the young and old cells of (*1*) the wild-type (WT) and (*2*) bgl2 mutant yeast cultures to produce new colonies. Young cells were taken from the cultures grown to the early stationary phase. Old cells were taken from colonies kept at 20°C for three months. To produce colonies, inoculated agar plates were incubated at 30°C for a day. Numbers on the right indicate the number of plated cells. The percentage of cells capable of producing colonies is given on the top.

It should be noted that Mrsa et al. showed that the overproduction of Bgl2p drastically reduces the viability of yeast cells [3]. In contrast, the deletion of the *BGL2* gene can largely compensate for the detrimental effect of deletion of the genes encoding other cell-wall glucanases, such as scw4 and scw10 [7, 8]. Taken together, these data may indicate that the cell-wall protein Bgl2p is involved in the sequence of events leading to the death of yeast cells. The study of the mechanism through which the cell-wall glucanotransferase can stimulate (and/or initiate) the death of old yeast cells is in progress in our laboratory.

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