SIGNIFICANCE OF INDUCED MUTATIONS IN SOME YEASTS AND THEIR PROTEIN AND BAKERS' PRODUCTABILITIES

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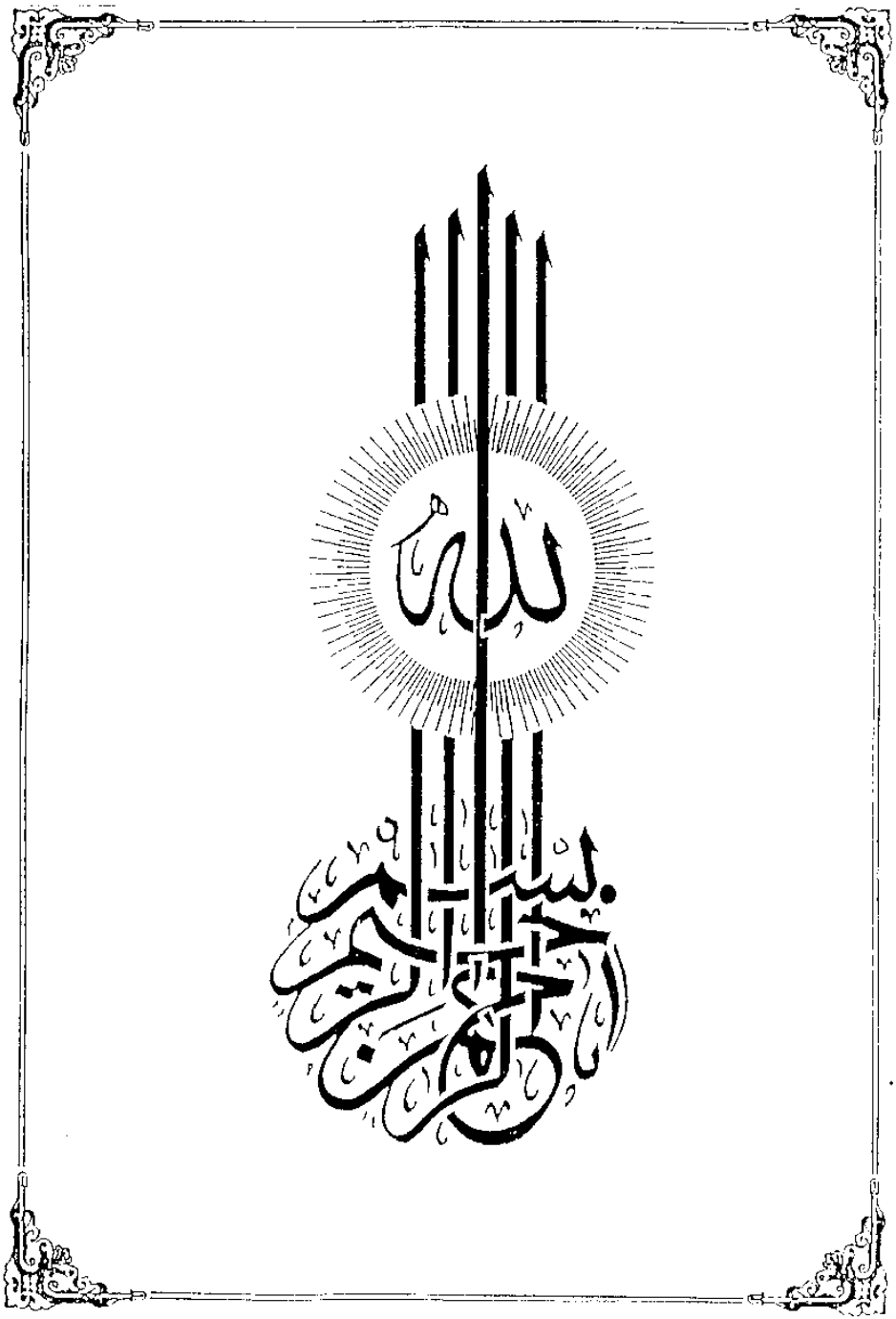

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C O N T E N T S

INTRODUCTION

It is well known that yeasts participate in the elucidation of the basic metabolic processes of living cells. On the other hand, the existence of a definite life cycle in yeasts, involving a sexual process linking a haplophase with a dipophase has been established a long time ago. In a typical strain of Sacch.cerevisiae the vegetative cells are diploid, and upon transfer to a sporulation medium they become transformed into asci each of which contains four or fewer haploid spores. However, under suitable nutrient conditions, spores may fuse in pairs forming zygotes in which the diploid conditions are restored.

It is of interest to mention that a mutagen is an agent which induces mutation and the latter is a heritable alternation of the genetic information. However, induction of mutation has to be tested in a biological system. This may not be as easy and straight forward as it appears at a first glance.

Assessment of genetic risks is complicated by mainly two factors, one is the fact that the mutagenic potential of direct acting mutagents is not expressed in all cell types of a given organism. The other complication is caused by the fact that indirect acting chemicals (which all by themselves have no mutagenic potential) are metabolized in the biosphere to mutagenic derivatives. This latter complication is particularly grave because it is not established how a given chemical disperses into the biosphere, and when as well as what kind of metabolic conversion could occur.

The problem at hand deals with the main following points:-

1. The possibility of having haploid strains out of diploid strain of Sacch.cerevisiae G104.

2. Carrying out mutation technique (either physical or chemical) on the most suitable haploid strain in order to achieve higher levels of reserved carbohydrates in the produced mutants.

3. Protein level should be within the recommende range in yeast.

4. The produced mutants will be screened to use the best fit one in bread making according to the normal parameters, i.e. growth density, protein content, consumed sugars, yield coefficient and reserved carbohydrates.

5. Organoleptic evaluation of the produced bread.

REVIEW OF LITERATURE

I. Mechanism of Induced Mutants:

A- Induced mutants mechanism as a function of UV; (Ultraviolet light):

Respiratory-deficient cells of yeast were photo-reactivated with continuous light more-rapidly than respiratory sufficient cells;(Pihman and Pedigo, 1959). Tagger and Stafford (1965) realized that the UV-irradiated cells lacking photoreactivating enzyme showed greater survival when exposed to near-UV light. There was an increasing indirect evidence mentioned by Game and Cox (1969), that UV inactivation of yeasts may result from damage of non genetic cellular components as well as from DNA damage.

Drake (1970) compared the effects of temperature and caffeine on survival and mutation of cell treated with UV or the chemical mutagens, ethyl methan-sulfonate (EMS) or nitrous acid (NA). Each of these agents affects DNA. However, UV induced dimerization of pyrimidines.

Ionizing radiation type effect may, indeed account for the recombinagenic effectiveness of UV-B in

diploid yeast; (Lawrence and Christensen 1974). Game and Mortimer (1974) suggested that ionizing radiation is known to induce a variety of lesions such as double-strand breaks, single strand breaks, and base damage. The repair of these lesions is an important factor that determines cell survival. The yeast Sacch.cerevisiae possess at least 8 genes which are involved in repairing one or more types of lesions induced by x-rays.

Eckardt and Haynes (1977) mentioned that UV-induced mutation frequency in a forward non-selective assay system (scoring white ADEX ADE2 double auxotroph mutants among the red pigmented ADE2 clones) increased linearly with UV dose, and declined in both RAD excision competent wild-type and RAD 2 excision deficient strains of Saccharomyces cerevisiae. Mutation frequencies of the RAD and the RAD2 strains plotted against survival were nearly identical over the entire survival range. Unexcised pyrimidine dimers were the predominant type of pre-mutational lesions in both strains. In the RAD wild-type strain pure mutant colonies outnumbered sectors in a 10:1 ratio at all the used doses.

In RAD2, this ratio varied from 1:1 at low doses up to 10:1 at high doses. For wild-type strains and in the RAD2 strain pure colony formation was not accounted for quantitatively by lethal sectoring events alone. Heteroduplex repair was a crucial step in pure mutant colony formation.

There was a plausibility of certain macromolecular mechanisms according to which heteroduplex repair was coupled with replication, repair and sister strand exchange in yeast mutagenesis.

Hannan and Nasin (1978) demonstrated the effectiveness of UV-B irradiation in inducing mitotic crossing over, mitotic gene conversion and reverse mutations in the eukaryotic organism (Sacch.cerevisiae).

The mutant UVS.RHO.72 of Sacch.cerevisiae UV-sensitive for Rho-production displays slower growth on media containing non-fermentable carbon sources such as glycerol or lactate; (Crosby et al., 1978). The slower growth on glycerol is not due to deficiency in glycerol catabolism or mitochondrial oxidative phosphorylation.

No modifications of the sensitivity to ethidium bromide of the mitochondrial ATPase activity was detected. A mathematical model is presented which accounts and elevated Rho-production in the mutant strain. This model, which estimates the rate of mutation from the rate of growth and vice versa, was verified experimentally in the case of UVS.RHO.72. The model was generalized, so that it can be used for any microbial populations subject to constant and high rates of any type of mutation.

Lawrence and Christensen (1978) studied reversions in radiation-sensitive strains of the yeast Sacch. cerevisiae using the REV 1-3 as well as the REV 1-1 mutation; 4 new cyc 1 alleles out of 15 examined were identified. While the REV 1 Gene function is required for the production of many mutational alterations at this locus, it is not for the production of certain specific events. This apparently depends on the genetic nature of these events rather than the kind of premutational lesion. Since complete informations on the base-pair changes and surrounding nucleotide sequences at these sites have not yet been possible to define their special nature precisely, the mutational process is complex. The REV 1 gene function is not required for the production