CHARACTERISATION OF THE BIOLOGICAL ACTIVITY OF VIABLE YEAST ON THE BASIS OF OXYGEN CONSUMPTION IN THE RUMINAL FLUID

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Introduction

Supplementation of the ration of ruminants and especially of dairy cows with *Saccharomyces cerevisiae* live yeast culture is a widely practised method. The live yeast cell content (CFU/g) and the dose of products applied in experiments conducted *in vitro* and *in vivo* vary widely. In many cases the effect exerted by *Saccharomyces cerevisiae in vitro* was found to differ from its properties displayed under *in vivo* conditions.

One of the main areas of research is the effect exerted by *Saccharomyces cerevisiae* on ruminal fermentation, pH of the ruminal fluid, the microbial digestion of feeds, the composition and volatile fatty acid production of the rumen microflora, and on the relative proportions of volatile fatty acids (Williams et al., 1991; Brydl et al., 1994, 1995). In close association with the former, the effects of *Saccharomyces cerevisiae* on milk production, milk composition and the metabolism of animals have also been studied (Brydl et al., 1994, 1995).

Ruminal fermentation yields, among other compounds, volatile fatty acids, which are the metabolic end-products of volatile fatty acid producing bacteria. Accordingly, the concentration of volatile fatty acids depends on the growth of bacteria and the intensity of their metabolism. The growth of volatile fatty acid producing bacteria is determined primarily by the pH of the ruminal fluid which, thus, is the most important factor influencing volatile fatty acid concentration (Dirksen, 1970).

Materials and methods

Three different commercially available *Saccharomyces cerevisiae* strains were studied in the experiment: Live-Sacc® NCAIM Budapest (**A**), NCYC Sc 47 (**B**), and BCCM/MUCL 39885 (**C**). The strains were grown on a culture medium containing yeast extract, peptone and dextrose (YPD medium). Microbe count was determined by surface-streaking on YPD agar. The cell count was 1.5–2.2 × 10^{10} CFU/g. The oxygen consumption of different yeast strains

was studied *in vitro* in ruminal fluid collected from sheep. In the weeks prior to the collection of ruminal fluid, the growing lambs were fed a ration composed of alfalfa hay and a grower diet. Their daily ration contained 1.22 kg DM, 7.28 MJ NEm, 4.27 MJ NEg, 117.4 g CP, 77.1 g MP, 310.8 g CF, 575.1 g NDF and 357.5 g ADF. Ruminal fluid was collected in the third hour after the morning feeding and subsequently stored in a Braun DCU artificial rumen fermentor tower at pH 6.2 and at oxygen concentration of 1 mg/l. To ruminal fluid samples stored in this way different *Saccharomyces cerevisiae* strains were added in a concentration of 1.0, 0.3 and 0.1 g (dry matter)/l. Oxygen concentration of the ruminal fluid was determined using an Ingold oxygen electrode.

Results

The oxygen concentration of the ruminal fluid varies between 0 and 1 mg/l. In Figure 1 the dose applied is too low, as the approximately 5 mg/l oxygen level corresponding to the 100% value reached the zero level (i.e. the fully anaerobic condition) at a gradually decreasing rate, in nearly 3 hours.

Figure 2 shows the oxygen consumption curve of the same strain used in a dose of 1 g/l. The oxygen level decreased to zero in 8–10 minutes.

The curve presented in Figure 3 is considered optimal in terms of efficacy and applicability. In this case, the oxygen level decreased to zero after 40–50 minutes, and the rate of oxygen consumption was steady after transient points 3–4.

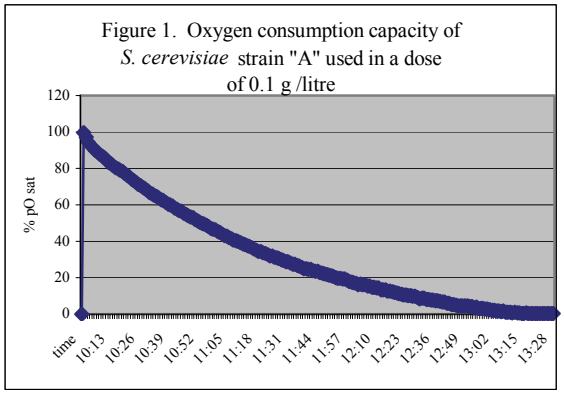


Figure 1. Oxygen consumption capacity of *S. cerevisiae* strain "A" used in a dose of 0.1 g /litre

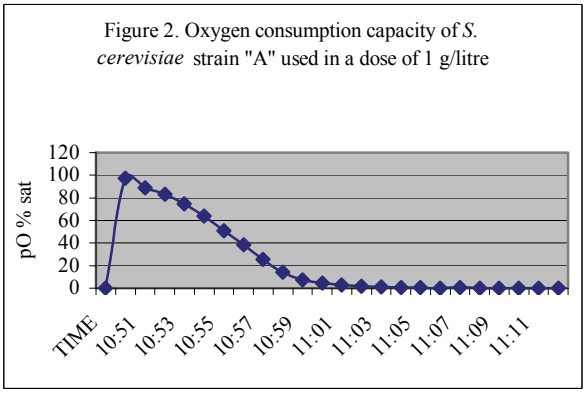
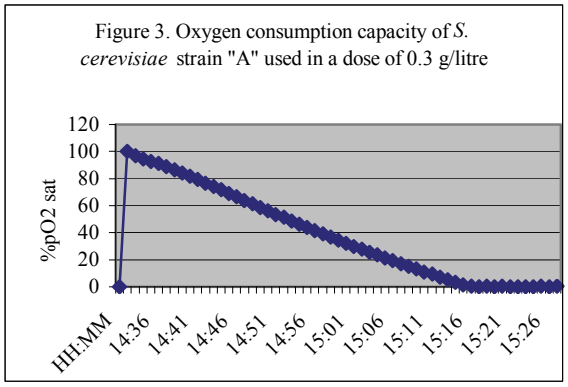


Figure 2. Oxygen consumption capacity of *S. cerevisiae* strain "A" used in a dose of 1 g/litre

Saccharomyces cerevisiae strain "B" presented in Figure 4 produced results identical with those given by strain "A" shown in Figure 4, as it consumed the entire amount of available oxygen within 40–50 minutes.



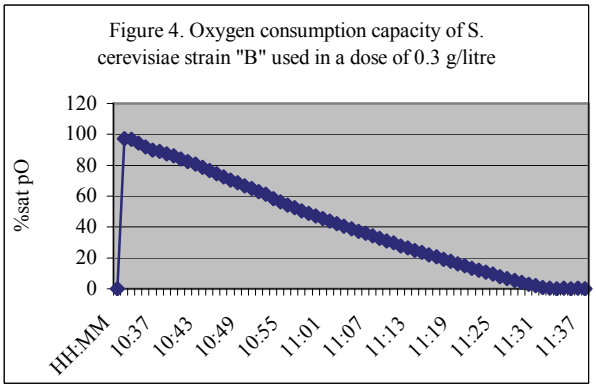
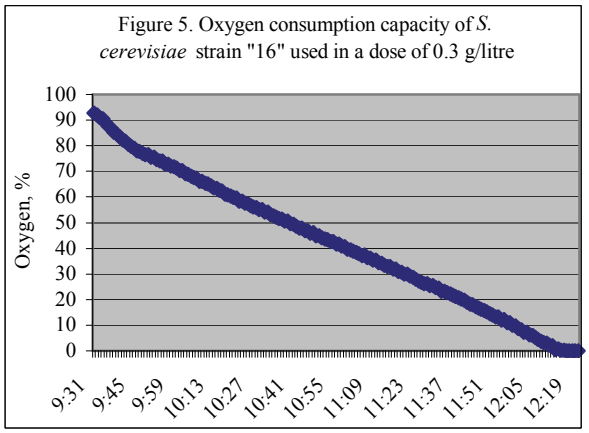
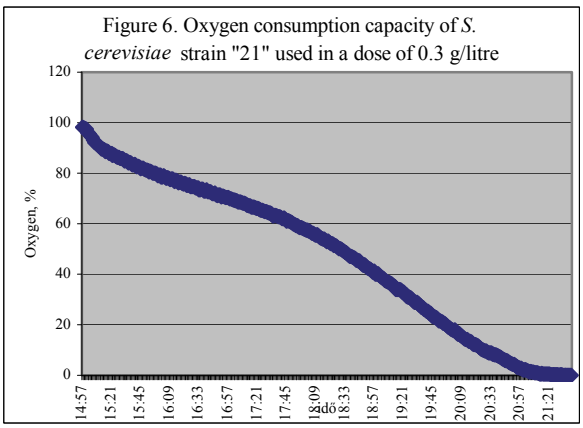


Figure 5 illustrates the oxygen consumption curve of a strain having substantially lower oxygen consumption capacity. The reduction of oxygen level to zero required about 150 minutes, i.e. much longer time than the 40–50 minutes observed in the case of strains characterised by high oxygen consumption capacity.

Figure 6 shows the results obtained for *S. cerevisiae* strain "21" having expressly poor oxygen consumption capacity. The curve shows that the oxygen level decreased to zero, i.e. fully anaerobic conditions were achieved, after approximately 350–400 minutes. Initially the rate of decrease was low, then after about 200 minutes the curve representing the rate of decrease became slightly steeper. This means that strain "21" shows exactly the opposite behaviour as compared to strain "16", i.e. at lower oxygen level it shows higher affinity to oxygen than at higher oxygen level.





Conclusions

- The different *Saccharomyces cerevisiae* strains are characterised by dissimilar oxygen consumption capacities.
- *Saccharomyces cerevisiae* strains should be used which have maximal buffer capacity and maximal oxygen consumption.

- The most important factor is whether the test strain has good or only moderate oxygen consumption capacity.
- The dose of 0.3 g/l, can lower the oxygen concentration in the rumen below the level of 0.001 mg/l in less than 50 minutes.

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