INDISIM-YEAST: an individual-based simulator accessible from a website for experimenting and investigating diverse dynamics of yeast populations in liquid media

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ABSTRACT

Simulation modelling can be used to capture and mimic real-world microbial systems which, unlike real-world systems, can then be experimented upon. Some researchers are realizing that simulation models are a new kind of experimental system.

Individual-based models, in which individuals interact dynamically with each other as structural elements in the model world, exemplify this view of simulation modelling [1].

The individual-based simulator INDISIM-YEAST, developed to deal with yeast populations, models the evolution of a set of yeasts by setting up rules of behaviour for each individual cell according to its own biological rules and characteristics. It takes into account the uptake, metabolism, budding reproduction (with two differentiated phases and unequal division) and viability of the yeast cells, over a period of time in the bulk of a liquid medium, occupying a three dimensional spatial grid with two kinds of particles (glucose and ethanol). Each microorganism is characterized by its biomass, genealogical age, state in the cellular reproduction cycle and viability among other individual properties [2,3].

When we have constructed INDISIM-YEAST, we have created a vritual world in which we have access to all of the laws and components of that world, and the relationships among those abiotic and biotic components, so we are also able to manipulate them.

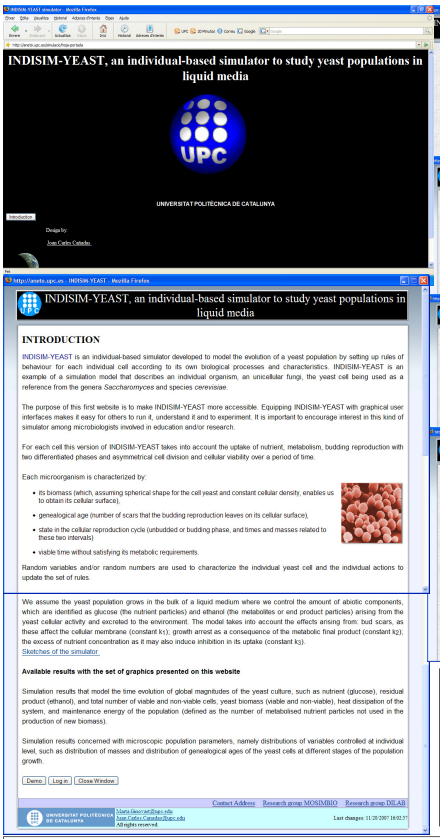
The aim of this work is to present the website from which INDISIM-YEAST is accessible, and the way to carry out yeast simulations to promote the skills associated with the use of this individual-based simulator.

The application is simple and intuitive, resulting in a very versatile program to be used in controlled simulation experiments from the designed website. An interesting and useful way to analyze this yeast simulator it is to explore the way in which it reacts to changes in parameter values, initial conditions or assumptions. Equipping INDISIM-YEAST with graphical user interfaces in this website makes easy for others to run it, understand it and to experiment.

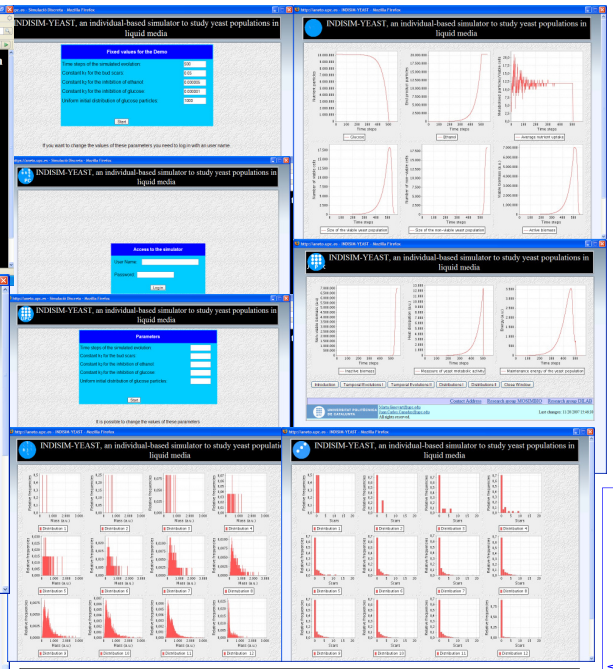
With this new scientific approach to the study of yeast systems, it is important to encourage interest in the simulator among microbiologists involved in education and/or research.

Graphical representations of global properties of the system and individual properties (as temporal evolutions or distributions) of the cell variables provide information on the development of the virtual yeast culture. Graphical screens allow observers to see and change parameter values, not only for the characterization of the yeast cells but also for parameters that control execution.

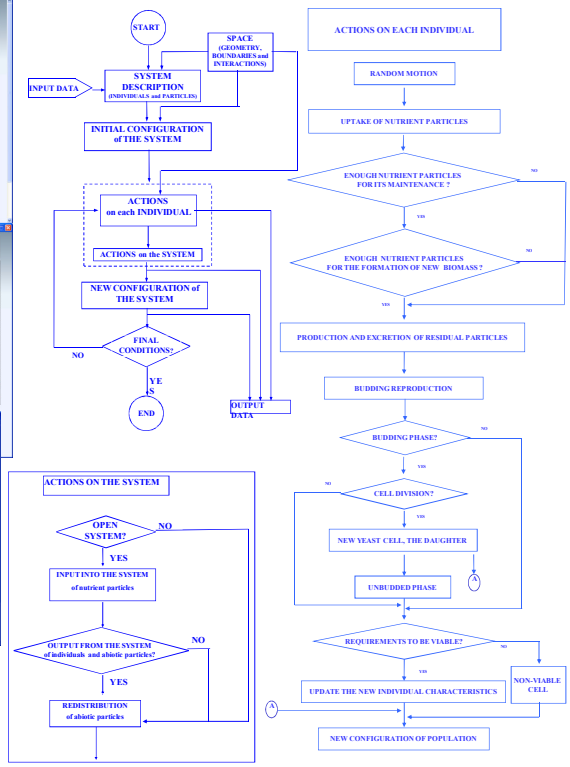
The website: http//aneto.upc.es/simulacio/hoja-portada



Screenshots of INDISIM-YEAST in action



Flow charts of the INDISIM-YEAST simulator



CONCLUSION

The software platform for this yeast individual-based simulator is designed to support a visual communication tool for microbiologists interested in dealing with the study of yeast population dynamics of diverse cultivation strategies in liquid media.
The option of the batch culture has been prepared and it is running.

FUTURE WORK

Adaptations of INDISIM-YEAST to this website to deal with fed-batch cultures and continous cultures.

REFERENCES

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