THE YEASTS, THEIR ECONOMIC, TECHNOLOGICAL AND DIVERSIFICATION POTENTIAL—PRESENT AND FUTURE

By

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Abstract

A BRIEF look at the way yeasts and human beings met in ancient times, as well as an analysis of the primary and marginal yeasts such as baker's yeast, fodder yeast from different agro-industrial residues, beer production, etc., with the possible alternatives for upgrading, are presented. The analysis of the yeasts propagation, as an established technology for the dramatic reduction of the polluting potential of distillery slops, with the simultaneous synthesis of a high quality fodder protein concentrate, as well as the evaluation of yeasts as a source of human nutrition complements, flavour enhancers, specific proteins and amino acids, organic pigments, plus the evaluation of the uses of the functional and thermal properties of yeasts, will complete the scope of this paper.

Introduction

Yeasts existed and influenced, from very early times. It is well known that there are no fossil yeasts. However, it is possible that they will be discovered soon (Poinnar *et al*., 1993).

Yeasts can be found in the most diverse environments, from the deserts (cactofic yeasts) to the Antarctic (criptococus), as well as associated with insects, flowers, fruits, soils, plankton, etc.

Their unlimited ability to metabolise from hexose, pentose, and organic acids to hydrocarbons and their possibilities to synthesise from alcohols and fats to heterologous proteins gave the yeasts a distinguished active share in the 'jump' of life from the aqueous media toward superior forms.

About the history up to now

The yeasts and their ties with human beings are shown, from the very beginning, as faithful servants of the pleasure and the subsistence of our race (wine and bread).

The first to inform and systematise about it were the Egyptians who were in contact with yeasts but did not know their identity.

Sugarcane, in its long journey of 30 centuries from its origin in the Far East to the Caribbean was accompanied by the practice of fermenting its juices to obtain beverages of various characteristics and alcoholic content.

It was in America where the paradigmatic co-product of sugarcane was institutionalised: the Rum (Blanco, 1989).

In 1818, Erxleben established that the yeasts were living organisms, responsible for the fermentation. Finally, in 1857, Louis Pasteur demonstrated that their presence was essential for the fermentation process, giving the 'final blow' to the idea of the spontaneous generation. Hansen, in 1896, presented the first comprehensible taxonomic system for yeasts.

A landmark was when, at the end of the XVIII Century, fermentations were carried out to obtain solely yeasts. Between 1850 and 1870, an accelerated growth of baker's yeast factories took place and, in 1867, A.L.G. Dehne invented and developed the well known 'filter press' for yeasts recovery, which is still in use.

The first producer of aerated yeasts was K.W.Howman, in England, in 1896. The first patent to backup the use of molasses as a substrate for yeasts production appeared in Austria in 1895, at the same time as the works of Delbrúrck started the use of the yeasts as a protein source in fodders, but also as a reliable option in human nutrition.

A solid development of aeration systems, with higher oxygen transfer rates and lower energy inputs, opened a new way for the genus *Saccharomyces*.

The food crisis during the World War I made it almost unavoidable to call on to the *Torulopsis* and *Saccharomyces* as alternative sources of food for the population in Europe and also in the Caribbean. That stopped in 1918. Such experiences of massive production and use of SCP for human use favoured the come back in Germany in 1934–1936.

A new landmark in the evolution of biotechnology, that impacted on the massive production of yeasts, happened at the end of the World War II, with the required industrial production of penicillin. This forced the design and construction of big scale, highly aerated fermenters, for very pure cultures, which required efficient methods of agitation and aeration, accurate temperature measurement and control systems.

This was the milestone that marked the birth of the true biotechnology.

Residual yeasts

The *Saccharomyces* are used in an active form in the bakery industry, in the ethanol fermentation and other fermenting processes like the soya sauce (Luh, 1995).

Its inactive form, mainly in animal feeding and in human nutrition, is basically through its derivatives like the yeast extracts and autolisates.

The high oil cost, plus the banning of oxygenating additives in gasoline, has driven an explosive expansion of ethanol production.

The residual slops of the distillation stage in the ethanol distillery is a hi*g*hly contaminating stream. However, a technology has been developed that allows the aerobic fermentation of those slops, using a strain of *Candida* that metabolise the remaining organic matter to synthesise biomass. This depletes the BOD of the slops by 84% or more, and a highly valuable SCP dry concentrate of 45% protein content is obtained for fodder use.

The yeasts as food

The interest in the use of the yeasts as human and animal food corresponds basically to the following factors;

- The technological development reached about the baker's yeasts that allows a deep knowledge of the biological mechanisms of their multiplication, as well as the necessary technological equipment for mass production. (Bergander, 1959)
- The availability of residual yeasts from other processes, mainly the production of ethanol.
- Abundant sources of raw materials of low cost, like the molasses from the production of cane sugar, vinasse from alcohol manufacture, starch, sulfite liquor, n-alkenes (Otero, 1989).
- The low availability or high prices of food, due to droughts, fuel shortages, etc.

Today, the protection of the environment has been added .to the problems mentioned before. Yeasts production became a proved way to reduce the environmental contamination by some industries such as the ethanol industry.

The value of the yeasts as food

Foods must cover a series of requisites that make them acceptable.

The FAO Organisation has established the pre and clinical tests that any food must undergo to be recognised as Gras (Generally Recognised as Safe).

Digestion and absortion

To be able to use the nutritive components of a food, they must be available at the digestion and during the absorption.

Any additive like yeasts are forced to show, not only to be safe and nutritive, but also to have physical and chemical-physical properties that facilitate their use and ensure an attractive aspect of the final product. Among them are humidity, particle size, bulk density, palatability, and oxidation.

The yeasts are not only an ideal, safe, plastic source of high quality proteins, but also of badly required vitamins, oligoelements and essential amino acids

The yeasts as a complement of human foods

The yeasts as a complement in the human diet satisfy the concept of ‘functional food’, being able to produce beneficial metabolic and physiological effects, like the reduction of glycaemia, prevention of prostate cancer, etc

In addition to the basic nutritional functions, the yeast cells could be considered as nutraceutics, as is the case of the different chromium and selenium complexes, etc. (Roberfroid, 1999).

The dry *Saccharomyces* cells are used as an optimum source of dietetic fibre and vitamins of the B complex. They also have eight essential amino acids required for healthy adults and arginine and histidine basic for children. Additionally, they supply essential minerals, especially chromium and selenium (Dziezak,1987; Peixoto, 1996).

The essential amino acid composition of the yeasts has no difference in comparison with the FAO/WHO standard, except for the chemical score of the yeasts autolisate that reached 84% in relation to the sulfurous amino acids.

The state of the art and some recent tendencies

The last years of the 20th century and the beginning of the 21st show really interesting tendencies of special significance in the relation of yeasts with mankind.

Yeasts show even more abilities that, wisely used, have an indisputable space in health, nutrition and industrial production (Leimer and Finguerut, 2005).

An example is the possibility of accumulating significant amounts of minerals present in the culture media. It is the case of organic selenium used successfully because it resembles the way this mineral is present in nature.

A similar situation happens with chromium, a very active constituent of the glucose tolerance factor (GTF) that becomes a necessary cofactor to enhance the activity of insulin to transport the glucose from the circulatory tissues to the peripheral ones.

The strengthening of the immune system in animals is a new science and here also the yeasts are getting a special share.

Hydrogen, as an option to establish an ecologically friendly energetic alternative, is a place where yeasts will play a decisive role.

The impact of the yeasts in the solution of the basic problems that mankind is facing today: food, energy and the protection of the environment, is clear and evident; Yeasts will be surprising us every day.

REFERENCES

Bergander, E. (1959). Biochemie und Technologie der Hefe, Leipzg, Theodor Steinkopff Verlag.

Blanco, G. (1989). 'Evaluación Económica Integral de Alternativas de usos para las Melazas de Caña', Tesis Doctoral, Universidad Central Marta Abreus, Villa Clara, Cuba.

Dziezak, J. (1987). Yeast and yeast derivatives; definitions, characteristics and prossessing. Food Technology, 41: 104–121.

Leimer, K.H. and Finguerut, J. (2005). Alternatives for the use of dried yeast and its products. Proc. Int. Soc. Sugar Cane Technol. 25: 418–424.

Luh, B.S. (1995). Industrial production of soy sauce. Journal of Industrial Microbiology, 14: 467-471.

Otero, M.A. (1989). 'Proteína Unicelular para el Consume Humano', Gálvez, L.O. (ed), La Habana, Editorial Científico técnica.

Peixoto, N. (1996). Processamento de productos de biomasa de levadura para alimentacao humana; potencial, mercado interno y externo. En Workshop sobre Productos de Biomasa de Levadura: Utilizacao em Alimentacao Humana e Animal, Campinas, campinas, Ital, 90–98.

Poinar, G.O., Waggooner, B.M. and Bauer, U.C. (1993). Terrestrial sofá-bodied protest and other micro organisms in Triasic amber, Science, 259: 222–224.

Roberfroid, M. (1999). Scientific concepts of functional foods in Europe. British Journal of Nutrition, 81: S1–S27.

LES LEVURES: POTENTIEL ÉCONOMIQUE, TECHNOLOGIQUE ET DE DIVERSIFICATION - PRÉSENT ET AVENIR

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MOTS-CLÉS: Levures, Technologies, Alimentation, Arôme, Promoteurs, Protéines, Pollution.

Résumé

CETTE COMMUNICATION comporte un bref coup de œil sur la façon dont les levures et les êtres humains se sont rencontrés dans l'Antiquité, ainsi qu'une analyse des levures principales et marginales telles que la levure boulangère, fourragère et celle émanant de résidus agro-industriel et de la production de bière, etc., qui sont susceptibles d'être améliorées. L'analyse de la propagation de levures, comme une technologie établie pour la réduction considérable du potentiel polluant de la vinasse de distillerie, avec la synthèse simultanée d'un concentré de protéine de haute qualité fourragère, ainsi que l'évaluation des levures comme une source complémentaire d'alimentation humaine, d'amélioration de saveur, de production de protéines et d'acides aminés spécifiques, des pigments organiques et l'évaluation de l'utilisation des propriétés fonctionnelles et thermiques des levures, complèteront le contenu de ce document.

LAS LEVADURAS. SU POTENCIAL ECONÓMICO, TECNOLÓGICOY DIVERSIFICADOR. PRESENTE Y FUTURO

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PALABRAS CLAVE: Levaduras, Tecnologías de Nutrición, Acentuadores de Sabor, Proteína, Contaminación.

Resumen

SE PRESENTA una breve visión del modo en que las levaduras y los seres humanos se encontraron en la antigüedad, así como un análisis de cómo las levaduras marginales y primarias, como las de panificación, forrajeras obtenidas de diferentes residuos agroindustriales, de la producción de cerveza, etc. pueden ser revalorizadas. La visión total de este trabajo se completa con el estudio de la propagación de las levaduras, como una tecnología establecida, para una dramática reducción del potencial contaminante de los residuos de las destilerías, con la síntesis simultánea de un concentrado proteico de alta calidad, así como la evaluación de las levaduras como fuente de complemento para la alimentación humana, potenciadores de sabor, proteínas específicas y aminoácidos, pigmentos orgánicos, a más de la consideración de los usos de las propiedades funcionales y térmicas de las levaduras.