THE RETAINING OF MICROORGANISMS ON SILICAGEL IN ELECTRICAL FIELD

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Soil and glass particles, ion-exchange resins, active carbon, calcium phosphate, and many other hard particles adsorb microorganisms in a varying degree (1).

The nature of this interaction is not fully clarified as yet. It is presumed that a basic role in the process outlined is to be attributed to the electrostatic forces of attraction. They depend on the character of the hard body surface, on the magnitude and type of its electric charges, as well as on the electrokinetic properties of microorganisms.

To our knowledge the particles of the mentioned above origin, placed in an electric field, acquire the quality to retain microorganisms in a quantity exceeding many times the adsorptional capacity of the same material outside the electrical field. The efficacy of the process of separating microorganisms from the suspension depends on the intensity of electrical field, on the type of hard particles, speed of flowing suspension, its electrolyte content, type of microorganisms and temperature. After switching off the current in the electrical chain, the retained microorganisms are readily liberated through liquid rinsing. On secondary electrical field induction, the process of microorganism retention over the particles is restarted. Moreover the effectiveness of the so-called electrofiltration is by no means reduced (2)1.

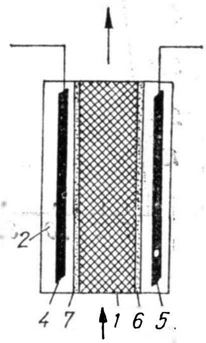

Fig. 1: Scheme of a chamber for retaining microorganisms

1 — working chamber; *2* — electrode chamber; *4* and *5* — electrodes; *6* and *7* — membranes. The arrows indicate the direction of suspension movement.

The experiments were conducted in a closed plexiglass chamber, consisting of three subchambers: a middle, working one, and two electrode ones. The middle chamber was filled with silicagel-merck, and was separated from the electrode chambers by means of cuprofan membranes (Fig. 1). Separation is mandatory in order to rule out the influence exerted by electrode reaction products on the process of retaining the microorganisms. Distilled water or electrolyte solution circulated continuously in the electrode subchambers so that in the electrical chain the same force of current (3 mA) was maintained regardless of the different voltage applied.

In the experiment a 24-hour culture of Saccharomyces cerevisiae in distilled water was used; the velocities of the suspension flow through the working chamber, filled with silicagel, were the following: 1) 1.5 ml/min, 2) 3.0 ml/min and 3) 5.0 ml/min; the curves in the graphs enclosed are numbered with the same figures. To study the effect of the suspension pH upon the retained amount of microorganisms, a citrate-phosphate buffer (MacIlven) was used. The starting suspension contained about 1 million yeasts per 1 ml, and its temperature on entering and leaving the chamber did not show noteworthy variations — never exceeding tenths of a degree. The yeast concentration was determined with the aid of FEK-56PM apparatus set. The obtained results are submitted in Fig. 2-a b c d.

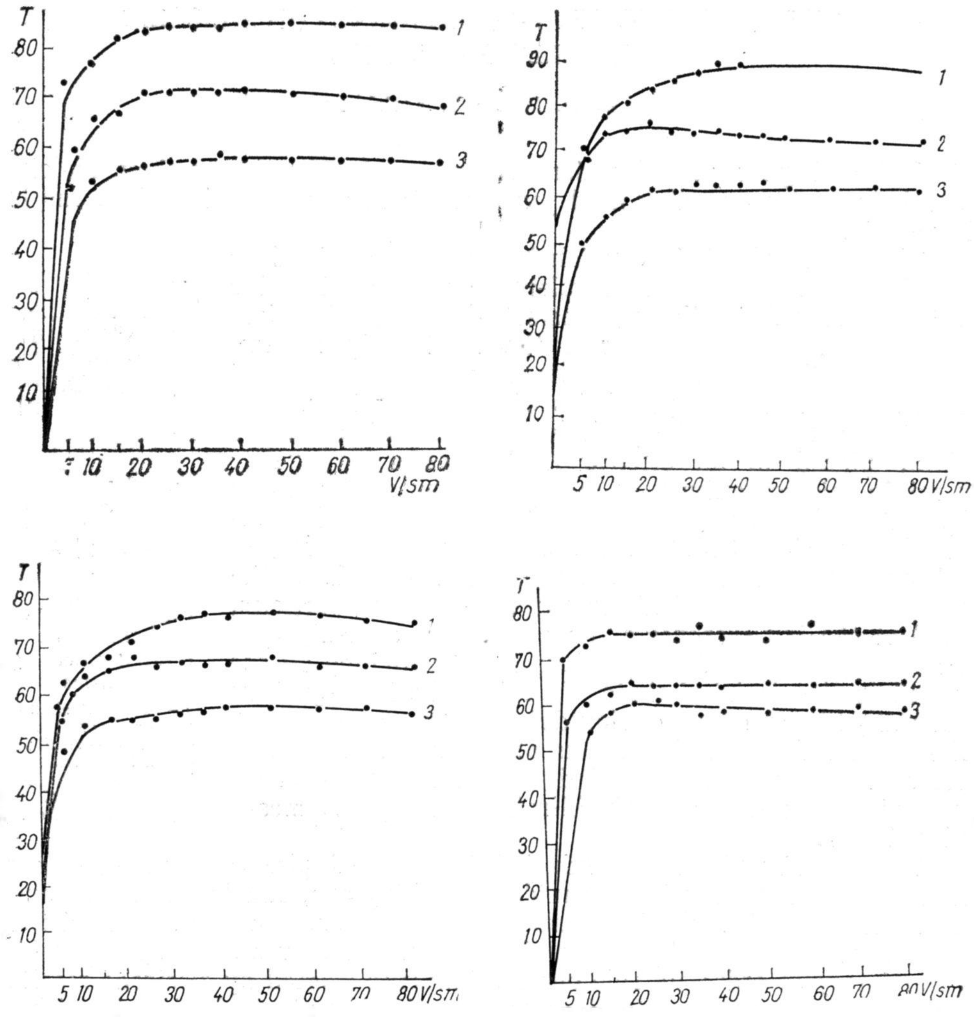

Fig. 2-abcd: The influence of the electrical field intensity, flowing velocity of the suspension, and its pH on Saccharomyces cerevisiae retention over silicagel.

The analysis of the above data shows that the efficacy of yeast retaining over silicagel increases with augmenting the voltage applied, and with decreasing the speed of suspension flow. The character of curves in all experimental setups, regardless of the suspension pH, exhibit analogical patterns. The most strongly pronounced is the retaining effect for the suspension in the acid zone (pH=5.0 and pH=6.0), whereas at pH=7.0 it is the least expressed. In all likelihood, the obtained results are conditioned by the following factors: a) flow of yeasts towards the silicagel surface as the result of electrophoresis; b) the proper retention of yeasts over silicagel thanks to electrostatic interaction.

Electrophoresis and electrostatic retention are realized by the external electrical field applied and by the multitude of local fields, arising in the system upon polarization of silicagel and yeast cells (3). Also, the assumption is warranted that yeast cells, endowed with a definite dipole moment, under the electrical field effect are associated in chained aggregates, which in turn contributes to their retention in huge amounts, considerably exceeding the adsorption capacity of silicagel.

The described experiments could be employed in the separation and concentration of microorganisms, and for rendering innocuous and sterilizing liquids.

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ЗАДЕРЖКА МИКРООРГАНИЗМОВ НА СИЛИКАГЕЛЕ В ЭЛЕКТРИЧЕСКОМ ПОЛЕ

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РЕЗЮМЕ

Приводятся результаты задержки Saccharomyces cerevisiae на силикагеле «Мерк» подвергнутом воздействию постоянного электрического поля.

Эффективность задержки дрожжей повышается с увеличением примененного напряжения и с уменьшением скорости протекающей суспенсии. Сильнее всего этот эффект выражен для суспенсии в кислотной области (pH=6,0 и pH=5,0), а при нейтральной среде он выражен слабее всего.

Проведенные исследования могли бы быть использованы для определения концентрации микроорганизмов, для обезвреживания и стерилизации жидкостей.