THE CATALASE TEST FOR STAPHYLOCOCCUS AUREUS

Raluca POPOVICI, Corina BALDEA

University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania

REVIEW, RESEARCH ARTICLE –

Abstract
The bacteria are microorganisms with a wide spread in the nature as a result of their adapting in the process of evolution. The natural collector of the bacteria is the soil in which the concentration of cells can reach values of 107-109 g-1 in the superficial layers (aerobe bacteria) but also in the depth layers (anaerobe bacteria). From the soil the bacteria has adapted to live in the waters, where the concentration of cells can be from 10 x cm -3 in the spring water, to values of 1012 x cm -3, for example, in the fecal-waste waters. The bacteria can be met in large depths of the sea and ocean waters, in the thermal waters. The existence in the air of the bacteria is temporary and by the help of the air currents they are spread to large distances. From the air they are carried again in the soil, through the atmospheric precipitations. In natural conditions, the bacteria have a huge role in the transformation of the macromolecular compounds in simple compounds, by the mineralization of the non-living organic matter, thus contributing to the natural accomplishing of the circuit of some elements of vital importance: carbon, nitrogen, sulphur, phosphorus, iron.

Keywords: bacteria, micromolecular compounds, nitrogen, sulphur.

INTRODUCTION

The cellular wall of S. aureus includes the basal layer of murein, characteristic to the Gram-positive bacteria, to which are connected in the exterior the teichoic acids. The majority of S. aureus strains have on their surface an enzyme connected to the cellular wall called ”clumping factor” or connected coagulase that transforms the fibrinogen in fibrin. It should not be confused with ”free coagulase”, secreted in the exterior of the bacterial cell and which is characteristic to the S. aureus species. Through the clumping factor S. aureus is fixed to the fibrinogen from injured tissues, to medical implants and to catheters on which the fibrinogen was previously laid. In the majority of the S. aureus strains the peptidoglycan is covered with protein A. It has the property to connect in a non-specific way the antibodies by the Fc fragment, which confers anti-opsonizing properties to the staphylococci.

Staphylococcus aureus secrets in the media a series of enzymes and toxins, in part responsible for the clinical manifestations of the staphylococci infections.

The coagulase is the marker of virulence of *S. aureus*. 96% of the Staphylococcus aureus strains builds a free coagulase which, following the reaction with a globulin factor from the plasma forms staphylothrombin, which in its turn catalyzes the conversion of the fibrinogen in insoluble fibrin.

The fibrinolysin lyses the fibrin layer that is created around a staphylococci abscess, being a factor of diffusion in the tissues.

The deoxiribonuclease hydrolyses the DNA and is a factor of diffusion. It has a value of diagnosis for Staphylococcus aureus because it is present only in very few strains of SCN.

Hemolysin or hemotoxins. There are 4 hemolysins known: α, β, γ and δ. More important in the human pathology are alpha-toxin (hemolysin), that produces a lysis of the erythrocytes and injures the thrombocytes and beta-toxin, which, degrading the sphingomyelin, is toxic for the erythrocytes but also for other types of cells.

Leukocidin, secreted especially by the isolated strains from furuncles, lyses the neutrophil polymorphonuclear leucocytes and macrophages and thus confers an increase resistance to phagocytosis.

MATERIAL AND METHODS

For the performing of the study we used also the archive, registered in the specific program of the computer from the laboratory of S.C. Diaser, Oradea, in the computerized data base of the unit, respectively.

- A recipient of collection (coprosampler with collecting spoon) with transport medium
- Wooden spatula
- Latex gloves

In regard to the collection, it has to be done as close to the beginning of the diseases as possible and before the beginning of any antimicrobial treatment.

• Collection from a spontaneous stool – it is preferred and is indicated in all forms of acute diarrhea when the emission of fecal matters is frequent.

• For bacterial and parasital examinations the collection is made with the "spoon" of the coprosampler, aiming at the liquid and, especially the mucous and/or bloody parts, if they exist. The volume of the collection has to be minimum of 5 ml or 3-5 cm^3, if the stool is formed.

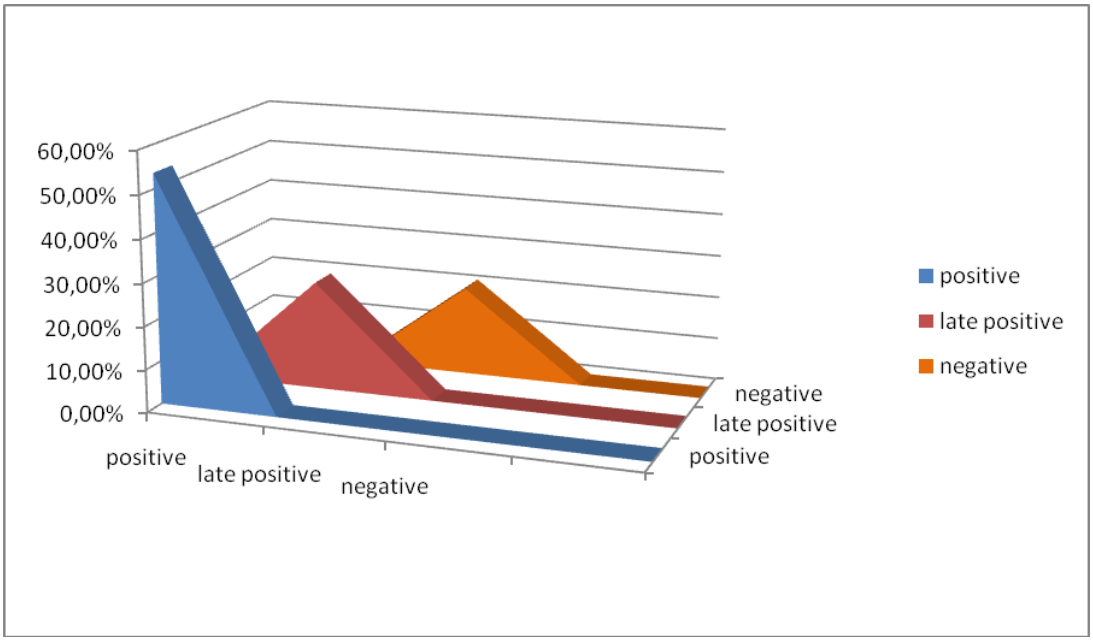
• For isolations or virologic exams there are 5-10 cm^3 of fecal matters collected or minimum 5 ml, if the stool is not formed.

RESULTS AND DISCUSSIONS

The test of coagulase on the blade is a technique that is based on the deposit of a drop of plasma on a blade, with the inoculation loop, and then the loop is loaded with 18-20 hours old culture from agar slants and is mixed in the plasma drop. The action of coagulase can be quickly observed by the appearance of small coagula that pileup because of the precipitation of the plasmatic fibrinogen in the fibrin under the action of the enzyme.

On the same blade it will be accomplished a control with physiological water and culture. The technique is reliable if it is executed with precision, the blade has to be new, well washed and degreased.

Fig.1. Test of catalase positive for *S. aureus*



In the study batch, the frequency of catalase production, the predominant is the catalase positive, with 53,66%, being followed by catalase late positive, a bit significantly larger 25,45%, compared to the negative catalase, being represented in percentage of 20,89%.

KEVIN K. and WALDEMAR A. PALUTKE, in the published paper "Isolation and characterization of a catalase-negative strain of Staphylococcus aureus", affirms the following aspects, like the fact that in the classical description the staphylococci are gram-positive, catalase positive, fermenters of glucose. The production of coagulase and the anaerobe fermentation of mannitol are the minimal characteristics that differentiate Staphylococcus aureus from other staphylococci. Due to the genetic variation, some strains of coagulase-positive staphylococci can't ferment the

mannitol but are still considered S. aureus. Catalase-negative S. aureus was isolated previously from a human source (8) and from an animal source. On this note it is described a strain of S. aureus that is catalase-negative and can't ferment anaerobe the mannitol in the Baird-Parker medium.

CONCLUSIONS

The test of catalase is used more frequently in the usual microbiological studies.

The conventional technique of the drop on the culture plate, although easy to be performed, is not reliable when it is used on plates that contain mixed cultures unless the colonies are well separated.

In order to survive, the organisms have to rely on defense mechanisms that allow them to repair or to the escape from the oxidant harms of the hydrogen peroxide (H2O2). Some bacteria produce the catalase enzyme that facilitates the cellular detoxification. The catalase neutralizes the bactericide effects of the hydrogen peroxide and its concentration in bacteria was correlated with the pathogenicity.
For the identification of the anaerobe bacteria it is necessary a solution of H2O2 of 15%. In this context the test of catalase is used to differentiate the aerotolerant strains of Clostridium, which are catalase-negative, from the Bacillus species that are positive.

The test of catalase Superoxol used for the presumptive identification of some Nuisseria organisms needs a different concentration of H2O2.

REFERENCES

1. ARUP Laboratories. Test Directory: Hemosiderin, Urine. www.aruplab.com 2010. Ref Type: Internet Communication.

2. Buiuc D., Neguţ M. 2009 – Treaty of Clinical Microbiology – 3rd edition, Ed. Medicală, Bucharest.

3. BENNETT J.B., DOLIN R., BLASER M. J. 2019 - Principles and Practice of Infectious Diseases, vol 2, Ninth edition, Churchill Livingstone Elsevier.

4. Buiuc D. 2003 – Medical Microbiology: Guide for the study and practice of medicine, Ed. "Gr. T. Popa" Iasi.

5. Cepoi V., Azoicăi D. 2012 – Guide of Nosocomial Infections Management. Ed. Arte, Bucharest.

6. Constantiniu S., Ionescu G. 2005 – Acinetobacter Genre in Human Pathology. Bacteriology, Virology, Parasitology, Epidemiology, pp. 50:1-2, 157-173.

7. Crisan A., Nicoara E. 2015 - Course of Infectious Diseases, Ed. de Vest, Timisoara.

8. CORNELISSEN C. N. HOBBS M. M. 2020 – Microbiology, fourth edition, Lippincott Illustrated reviews.

9. Campfield T, Braden G, 2010. Urinary Oxalate Excretion by Very Low Birth Weight Infants Receiving Parenteral Nutrition. In Pediatrics, pp. 84(5):860-3.

10. CAROLL K.C., PFALLER M.A., LANDRY M.L., McADAM A.J., PATEL R. RICHTER S.S., WAENOCK D.W, 2019 - Manual of Clinical Microbiology, 2 volumes, (ASM Books), 12th edition.

11. Dumitraşcu V., Laboratory Medicine. Biochemistry of urine, Publishing house Orizonturi Universitare, Timisoara, 2002.

12. Earnest DL. Enteric Hyperoxaluria. In Adv Intern Med, 1979.LaboratorSynevo. Specific references to the work technology used in 2015. Ref Type: Catalogue. pp.24:407-27 (review).

13. Dumitraşcu V. and collab. 2007 – Pharmacology – Antimicrobial medicine, Ed. de Vest, Timisoara,. 96

14. Dumitraşcu V. and collab. 2007 – Pharmacology in the Clinical Laboratory, Ed. de Vest, Timisoara.

15. Garrity G.M., Bell J.A., and Timothy G.I., 2004 – Taxonomic outline of the Prokaryotes, Bergey`s Manual of Systematic Bacteriology – II-ndedn. Bergey Manual Trust, Springer, New York.

16. Heymann D.L., 2012 - Manual of Transmissible Diseases management, Ed. Amaltea, Bucharest.