

# MICROBIOLOGICAL QUALITY OF MEDICAL AND FOOD GASES REVIEW

## SCIENTIFIC REPORT

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# MICROBIOLOGICAL QUALITY OF MEDICAL AND FOOD GASES-REVIEW

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## 1 Introduction

For the assessment of the microbiological quality of food and medical gases there are no specific normative references, either for parameters to detect and for the analytical aspects, or for limits to be respected. However, there is a reference in the European Pharmacopoeia with parameters and limits for non-sterile products for inhalation use, that fit well with the topic [1]. This reference is also reported in EIGA Technical Bulletin TB02, Microbiological Quality of Medical, Pharmaceutical and Food Grade Gases [2]. Therefore, the choice of parameters to be investigated is based on the acceptance criteria of the microbiological quality of non-sterile products for pharmaceutical use of the European Pharmacopoeia 10.0 in chapter 5.1.4, where the following maximum criteria are indicated for products for inhalation use [1]:

Total Aerobic Microbial Count: ( $10^2$ ) 200 CFU/ml or CFU/g

Total Yeasts Microbial Count: ( $10^1$ ) 20 CFU/ml or CFU/g

*Staphylococcus aureus*: absent in 1 g or 1 ml

*Pseudomonas aeruginosa*: absent in 1 g or 1 ml

Bile-tolerant gram-negative: absent in 1 g or 1 ml

It should be noted that the units of measurement, CFU/ml or CFU/g, are not representative of the matrix in study, which is a gas. For example, for oxygen breathing use, the dose is of hundreds of litres per hour.

Another useful reference is the criteria used for ambient air in cleanroom class D (clean areas for carrying out less critical stages in the manufacture of sterile products), where the microbiological quality specifies a maximum Total Bacterial Count (TBC) value of 200 CFU/m<sup>3</sup> [3].

Gases are manufactured in completely closed systems, supplied under pressure, and with no contact with ambient air, humans or animals. Where gas is exposed to process water as part of the manufacturing process, the water quality is controlled (as defined in the EC Guide to Good Manufacturing Practice) using validated methods [4]. Either drinking water quality or specially treated water is used to assure microbiological contamination is controlled and minimised. For medical and food gases supplied in cylinders or cryogenic containers, the valve outlets are required to be covered after filling to ensure no contamination enters the valve. For cryogenic and liquefied gases supplied by tanker, the transfer hose is purged with gas prior to filling the tanker and prior to making the delivery to ensure that any contamination inside the hose is removed prior to the product being transferred.

In gas production processes there are no sterilisation treatments, however the conditions in which gases are produced, including temperature, pressure, and lack of humidity and nutrients, does not allow microorganism to proliferate [5]. Moreover, the decompression step when the gas is used significantly deteriorates the microbial cells, possibly by shear forces, and affect their ability to generate colony forming units (CFU) [6].

In particular, several researchers reported the microbial inactivation effects of compressed carbon dioxide (CO<sub>2</sub>) on different types of microorganisms in different experimental conditions of temperature, pressure and moisture. This inhibitory action has been increasingly applied to improve the hygiene of both liquid and solid foodstuffs by protecting them from bacterial spoilage [7]. However, there are some rare microorganisms able to thrive in extreme environments. These extremophiles include, for example, pressure-phile, anhydrobiotic and low pH-phile microbes [8].

It is clear that an experimental approach is important. In the bibliography there are some specific studies, article and technical papers reporting activities of sampling, analysis on different gases with related results. The present paper reports this data by references and supports the EIGA Technical Bulletin TB02 [2].