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Nitrogen Gas Plasma Sterilization and Its Contribution

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Abstract

The study of gas plasma sterilisation methods and mechanisms necessitates a combination of chemistry, engineering, and microbiology expertise. The combined efforts of experts in these areas to investigate the efficacy and function of gas plasma sterilisation have resulted in technological advancements.

Introduction

The aim of this research is to learn more about the processes of nitrogen gas plasma sterilisation. Because of the efforts of microbiologists and chemists to engineering researchers, progress toward discovering the process of gas plasma sterilisation is approaching a conclusion. It should be remembered that current knowledge of the process of gas plasma sterilisation is restricted to nitrogen gas plasma sterilisation. Other gas plasma pathways, such as helium, are yet to be discovered. With a 40 to 150 mm distance between the cathode and anode, the low pressure nitrogen gas plasma apparatus can be used at about 60 o C under half atmospheric pressure. The sterility assurance standard (SAL) of 100 was reached in 7 minutes from an initial population of 106 CFU (Colony Forming Unit), meaning that the D value (decimal reduction value, time or dose to decease) was exceeded. Different gas plasmas, for example, have very different effects on spores: Although oxygen gas plasma shrinks significantly, hydrogen, argon, or helium gases do not. While hydrogen, argon, and helium gases do not. As a result, the mechanism of gas plasma sterilisation must be studied separately for each kind of gas plasma. Only the mechanism of nitrogen gas plasma sterilisation can be speculated about at this time, and this hypothesis may be right. Hydration of dipicolinic acid (DPA), which is contained inside the heart, has been shown to be beneficial. Scanning electron microscopy revealed tiny particles on spore surfaces during exposure to gas plasma (SEM). This small particles may be hydrated dipicolinc acid that migrated from the spore nucleus, according to our theory. We used HPLC with UV and MS detection to see whether the tiny particles were made up of DPA or not.

Conclusion

The energy of the N2 metastables and photons caused pinholes to form on the spores' surface. As a consequence, water from inside and around the spore hydrated DPA in the spore nucleus. The hydrated DPA was carried to the surface layer, where it remained as white particles after drying. The death of spores by metastables and photons is thought to be caused by this process. Since the killing process took place mostly inside the nucleus, the spore's recognisable form remained intact after death. Ion-suppression reversed phase C-18 was used to analyse DPA at the spore surface, followed by UV spectroscopy at 235 nm and MS. At pH 5, the mobile process consisted of acetonitrile/water (1/4, v/v) including the use of acetic acid Since the hydrated compound's retention time and MS fragmentation were similar to those of normal DPA, the hydrated compound tended to be DPA. However, at this point, the role of metastables and photons in spore killing is only a guess. Other causes, such as OONO radicals, can sterilise spores, but although DPA hydration was clearly shown, the process of spore death by metastables and photons has yet to be verified.

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