5Ca04

過酸化水素添加によるラジカル処理水中の殺菌効果の増強

Enhancement of bactericidal efficacy in radical-activated water through the addition of hydrogen peroxide

岩田直幸^1^, ウラディスラフ　ガマリェエフ^1^, 呉準席^2^,
太田貴之^1^, 石川健治^3^, 堀勝^3^, 伊藤昌文^1^
Naoyuki Iwata^1^, Vladislav Gamaleev^1^, Jun-Seok Oh^2^,
Takayuki Ohta^1^, Kenji Ishikawa^3^, Masaru Hori^3^, Masafumi Ito^1^

^1^ 名城大学, ^2^ 大阪市立大学, ^3^ 名古屋大学
^1^ Meijo Univesity, ^2^ Osaka City University, ^3^ Nagoya University

Recently, non-equilibrium atmospheric-pressure plasmas are receiving a lot of attention owing to its great applicability to various agricultural and medical fields. In particular, plasma-activated water (PAW) is one of the most common plasma topics in this decade and it is considered that strong and short-lived oxidants such as hydroxyl radical (OH·) and hydroperoxyl radical (HOO·) are generated through reaction (R1-2) and (R1, 3-4), respectively, and kill the bacteria in PAW. [1,2] However, there are few reports, performing a quantitative measurement of radicals to prove that neutral radicals actually involve in the generation of bactericidal efficacy.

$$HNO_2 + H_2O_2 \rightarrow ONOOH + H_2O \quad (R1)$$
$$ONOOH \rightarrow OH\cdot + NO_2 \quad (R2)$$
$$ONOOH + H_2O_2 \rightarrow O_2NOOH + H_2O \quad (R3)$$
$$O_2NOOH \leftrightarrow HOO\cdot + NO_2\cdot \quad (R4)$$

In the previous study, an atmospheric-pressure radical source was employed which selectively supplies electrically-neutral radicals without charged species or optical radiation by extracting them from plasma, to produce radical-activated water (RAW) and the bactericidal efficacy was evaluated using colony forming unit (CFU) of *Escherichia coli* (*E. coli*). As a result, RAW also showed strong bactericidal efficacy and therefore it was proven that neutral radicals are highly likely to be keys of the efficacy in PAW too.

In the present study, the importance of hydrogen peroxide (H_2O_2) on the bactericidal efficacy of RAW was investigated by adding H_2O_2 reagent to DI water and the radical treatment.

E. coli (10^8/mL) was prepared and suspended into deionized waters (DI water), containing H_2O_2 of 0, 200, 400, 600, 800, 1000 μM. The suspension was treated using the atmospheric-pressure oxygen radical source (Tough Plasma, Fuji Machine) [3] for 5 min. Colony counting method was used to investigate the number of survivors in the samples.

Figure 1 shows the bactericidal efficacy of RAW as a function of added H_2O_2 concentrations. Clearly, the bactericidal efficacy of RAW did not show any significant changes even when the solution contained 1000μM of H_2O_2.

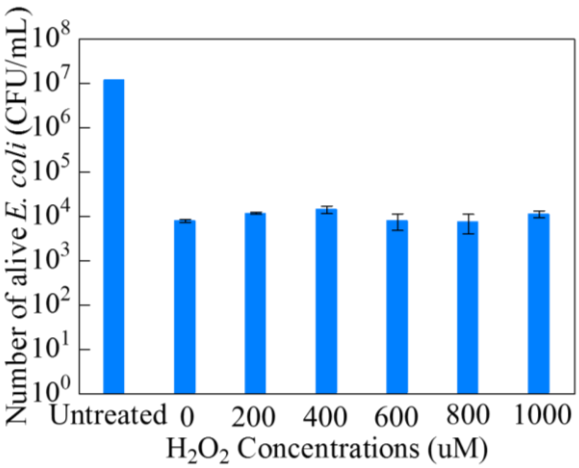

Fig. 1. Bactericidal efficacy in RAW depending on added H_2O_2 concentration.

In summary, the importance of H_2O_2 on the bactericidal efficacy has been investigated and it doesn't seem that the additional H_2O_2 has a significant effect on the killing of *E. coli* in our case.

This work was supported by the MEXT-Supported Program for the Strategic Research Foundation at Private Universities (S1511021) and a JSPS KAKENHI Grant Number JP17K05099.

References

[1] S. Ikawa, *et al*., Plasma Processes Polym. **7**, 33 (2010).
[2] S. Ikawa, *et al*., J. Phys. D: Appl. Phys. **49**, 425401 (2016).
[3] H. Hashizume, *et al*., Jpn. J. Appl. Phys. **52**, 056202 (2013).