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Measures against Infection in Facilities Using Air Catalysts

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Background: The global outbreak of COVID-19 has affected the operations of healthcare field and various infection control measures are being carried out at each hospital and clinic.
Aim: We have administered infection control measures using air catalysts which is a new antiviral and antibacterial technology being employed at our healthcare center.
Methodology: We used a product called Health Bright® and this liquid substance was sprayed to coat every part of the facility. After that, we measured the amount of adenosine triphosphate (ATP) in coated places, including the waiting room, examination room and endoscopy room.
Results: The amount of ATP decreased the day after the treatment in each room, and of note is that the amount of ATP was still low after 6 months and 12 months.

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Conclusion: Our current data showed the possible efficacy of air catalysts against bacteria and virus in the healthcare facility.

Keywords: Air; catalyst; bacteria; virus; COVID-19.

1. INTRODUCTION

The global outbreak of COVID-19, which began in late 2019 [1,2,3], has affected the operations of our health checkup facilities in various ways. In Japan, the declaration of a state of emergency issued in April of the same year urged temporary self-restraint from conducting health checkup services. Our healthcare center also suspended operations for about a month and a half, and after reopening, we have been conducting medical care while taking measures such as limiting the number of patients seen, taking temperature measurements and disinfecting with alcohol when entering a room, installing ventilation and acrylic boards, and implementation of COVID-19 antibody tests for our staff over time [4,5].

The above are essential measures now that the COVID-19 crisis continues, and are now being carried out at every hospital and clinic. This time, in addition to these measures, our corporation has taken its own infection control measures. That is an air catalyst [6] which is a chemical reaction that exerts antibacterial, antiviral, and antifungal effects, and is a technology developed in our country. The substance used for the air catalyst is a colorless and transparent liquid of 100% natural minerals. Most of the components (99.95%) are water, including a small amount of iron (Fe; 0.02%), aluminum (Al; 0.02%), potassium (K)-40 (0.0002 %), and titanium (Ti; 0.00004 %) [6]. When the coated Fe, Al, K40, and Ti come into contact with air, they react with water and oxygen in the air, causing a catalytic reaction that converts them into hydroxyl radicals and superoxide anions [6]. Their oxidizing potential contributes to decomposition reactions of bacteria, viruses, formaldehyde, etc. The detailed process of reaction by air catalyst is shown in Fig. 1. Several laboratory data have already showed its effect however, it is unclear whether they are actually effective in the healthcare facility. Therefore, the purpose of this study was to evaluate the effect of air catalyst in our working area of healthcare institution by using a product called Health Bright® [6] from Comany Inc.

2. MATERIALS AND METHODS

2.1 Setting by Health Bright® Coating

On May 3 and 4 2021, Health Bright® which is liquid substance was sprayed to coat every part of our health care facility that people came into contact with (Fig. 2(a-b)).

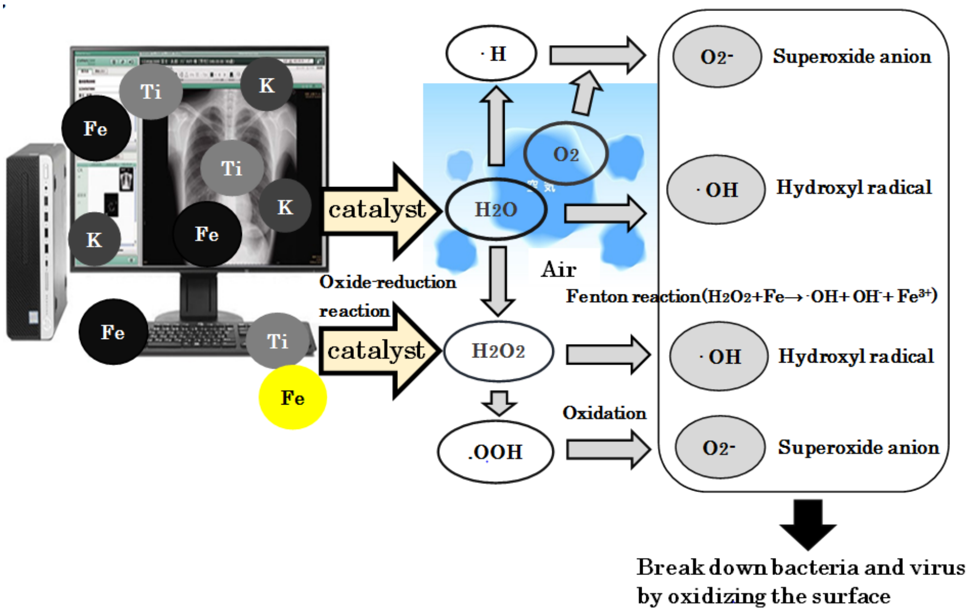

Fig. 1. Reaction process by air catalyst

(2a)

(2b)

Fig. 2(a-b). Coating work of the inside of facility with Health Bright®

2.2 Monitoring Contamination of the Working Environment

For monitoring contamination of the working environment of our institution, we used the adenosine triphosphate (ATP) bioluminescence assay using a device called Lumitester.

2.3 Measurement of ATP

We investigated the amount of ATP in the 5 coated area, which are the waiting room, examination room, endoscopy room, lung function room and staff room. The amount of ATP was expressed as relative light unit (RLU). Measurements were taken four times in total, the day before Health Bright® coating was applied, the day after application, 6 months, and 12 months later respectively. All data were taken during the same time of the day (16:00). In total, we monitored the ATP amount for a-year period after the Health Bright® coating.

2.4 Data Analysis

The ATP amount after coating were compared with that of before coating measured as a control. We also evaluated the fluctuation of ATP, especially we evaluate whether the amount reached to under 500 RLU, because this amount is recommended as a standard value in healthcare institution [7].

3. RESULTS

The amount of ATP in each room are shown in Fig. 3. The ATP amount decreased immediately the day after the treatment in all room and it declined less than half in 3 rooms (waiting, lung function and staff room). Of note is that the ATP amount was still low after 6 months and 12 months compared to that of before treatment, and it showed less than 500 RLU in endoscopy room. It declined remarkably from 8682 RLU (before application) to 533 RLU (12 months after) in staff room which was near 500 RLU.

4. DISCUSSION

As a result of experiments conducted by the Japan Food Research Laboratories on the antiviral effect of the air catalyst by Median tissue culture infectious dose (TCID50/ml), it was announced that the influenza virus could be inactivated in about 5 minutes (the Japan Food Research Laboratories Experimental No. 0501623001-001). On the other hand, a demonstration experiment conducted by the Nara Medical University as contract research on the antiviral effect of the air catalyst on the SARS-CoV-2 (TCID50/ml), 97% of the SARS-CoV-2 was inactivated in 1 hour and 99% of it was inactivated in 2 hours [8], while joint experiments conducted by the Gifu University and Gunma University similarly showed that infectivity titer of SARS-CoV-2 decreased by approx. 89% after 1 hour and 95% after 2 hours [9].

However, these are all laboratory data, and it is unclear whether they are actually effective in the facility setup. Therefore, on this occasion, we introduced this air catalyst for the first time at a health checkup facility in Japan and verified its effect. We measured the amount of ATP in the coated area using a device by Lumitester [10]. Although this machine does not directly measure the amount of viruses and bacteria, it is used by public health centers in Japan as an indicator of microbial contamination [11]. In this study, we demonstrated that lower amount of ATP was maintained at least 12 months in our facility and also showed that its RLU was sufficiently low [12] in some area. According to the company selling the air catalyst, its effect lasts for a long time after coating. In fact, it seems that it is still effective in the Osaka subway car to which it was introduced eight years ago [6]. In addition, it has already been introduced in many hospitals, public facilities, universities, offices, airports, etc., including JR West and Hotel Monterey Group [6]. It has also been introduced at our healthcare center in May 2021, and it has been displayed as such within each room [13]. As a result, this led to a sense of security for the patients who consulted our facility and the staff as well.

One important point is that air catalysts are effective against contact infections mainly at the coated site, but not against droplet or airborne infections. Therefore, it is still important to take measures such as masks and face shields to prevent droplet infection.

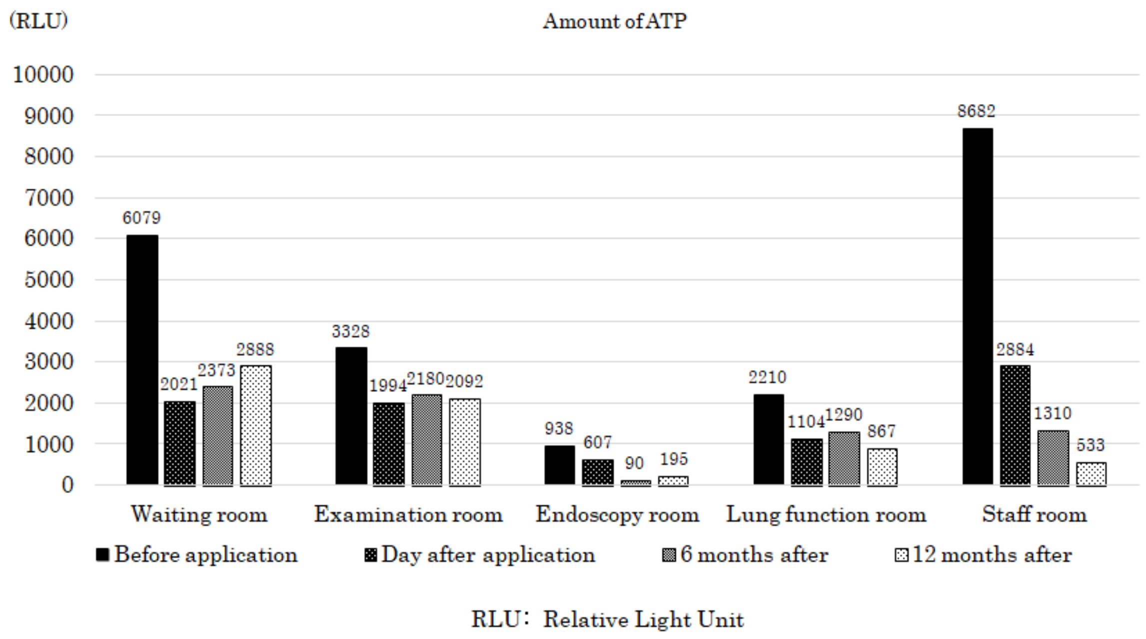

Fig. 3. Amount of ATP measurements in each room

In general, photocatalysts are catalysts that are known in Japan [14]. With those catalysts, a catalytic reaction takes place as light hits titanium oxide (TiO_2). Universities and research institutes have been studying photocatalysts for about 50 years, and products applying this technology have already been developed in many fields [15,16,17]. On the other hand, there have been few scientific reports on air catalysts so far, and their effects are still unknown. Here, we measured the ATP levels before and after coating with the air catalyst and presented the results, and we would like to emphasize that no clusters of COVID-19 have occurred in our facility since the introduction of the air catalyst.

The facility plans to continue to verify the effects over time, and we would like to wait for the results of future research at other institutions.

5. CONCLUSION

We have described infection control measures using air catalysts, which is a new antiviral and antibacterial technology being employed at our facility. Since this infection situation is likely to continue for some time, we plan to continue to verify the effects over time.

6. STUDY LIMITATIONS

Some limitations of this study require consideration. Firstly, the present 1-year follow-up study is insufficient to evaluate the efficacy of air catalyst. It will be necessary to monitor for a long period. Secondly, the ATP measurement did not reflect the amount of viruses and bacteria directly. Therefore, another assay will be needed to confirm our result.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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