Acta Scientific Microbiology (ISSN: 2581-3226)

Volume 7 Issue 7 July 2024

Research Article

# Antimicrobial Effect Using Air Catalyst Called Health Bright in Healthcare Facility: A 3-Year Analyzing Report

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**DOI:** 10.31080/ASMI.2024.07.1388

**Received:** May 17, 2024

**Published:** June 11, 2024



## Abstract

**Background:** Air catalyst is a new antiviral, antibacterial and antifungal technology and has recently been used widely in our country. However, it is unclear whether they are actually effective in the facility and is also unclear the duration of its effect.

**Material and Methodology:** In our healthcare facility, we used a product called Health Bright® and this liquid substance was sprayed to coat every part of the facility. After that, we measured and monitored the amount of adenosine triphosphate (ATP) in each coated place for a 3-year period.

**Results:** The ATP amount in each room before Health Bright® coating showed approximately 2000 – 8000 relative light unit (RLU). However, its amount decreased the day after the coating in all room. The ATP amount still keep low after 6 months, 1 year, 2 year and 3 year compared to that of before treatment. Of note is it showed less than 500 RLU in endoscopy room.

**Conclusion:** Our current data demonstrated the possible efficacy of air catalyst against virus, bacteria and fungus in the healthcare facility. We also showed its effect to maintain at least 3 years after coating.

**Recommendation:** Another assay for the measurement of microbial amount will be recommended to confirm our current result.

**Keywords:** Air; Catalyst; Adenosine Triphosphate (ATP); Virus; Bacteria

## Introduction

Recently, we administered various anti-microbial countermeasures after the global outbreak of COVID-19, which began in late 2019 [1-4]. For example, our healthcare center suspended operations for about a month and a half after the declaration of a state of emergency issued in April of 2020 urged temporary self-resistant from conducting health checkup services. 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 and hypochlorous acid when entering a room, installing ventilation and acrylic boards, and implementation of COVID-19 antibody tests for our staff over time [5,6].

In addition to these measures, our corporation has taken its own infection control measures. That is an air catalyst [7] which is a chemical reaction that exerts antibacterial, antiviral, antifungal and anti-volatile organic compounds 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%) [7]. 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 temporarily [7]. Their oxidizing potential contributes to decomposition reactions of bacteria, viruses, fungus, formaldehyde, etc. The detailed process of reaction by air catalyst was shown in Figure 1. Several laboratory data have already showed its effect however, it is unclear whether they are actually effective in the facility. It is also unclear the duration of its effect. Therefore, the purpose of this study was to evaluate the effect and duration of air catalyst in our working area of healthcare institution [7].

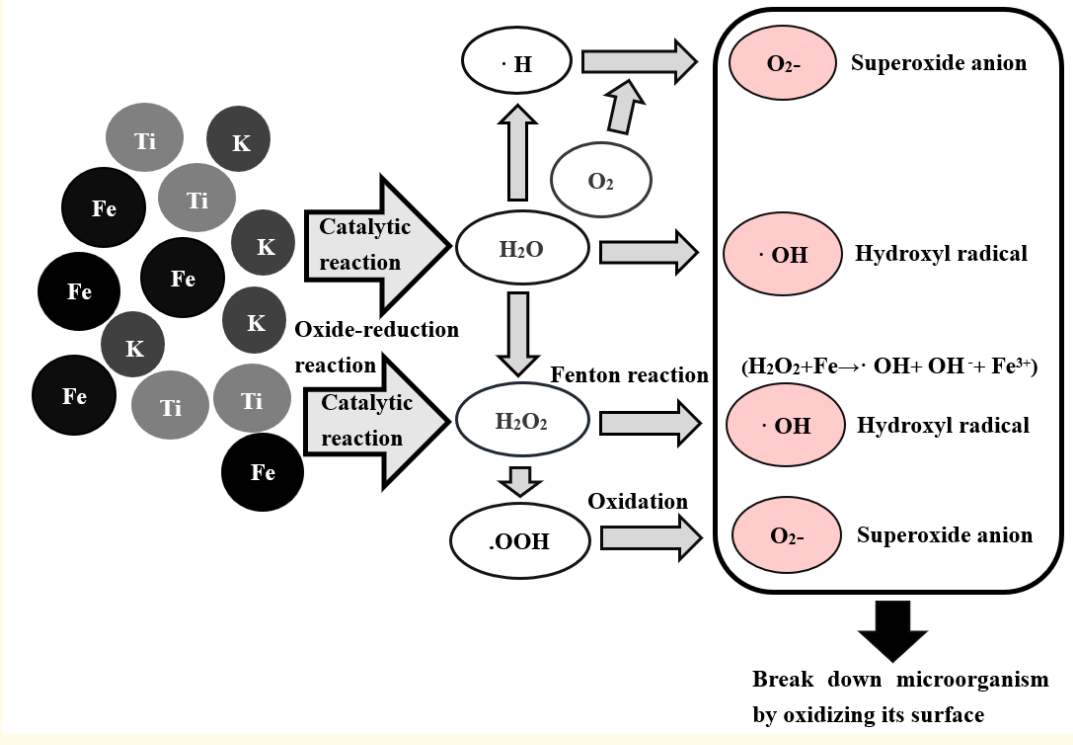



**Figure 1:** Detailed process of catalytic reaction by Health Bright®.

## Materials and Methodology

### Sample coating

On May 3 and 4, 2021, air catalyst called Health Bright which is liquid substance was sprayed to coat every part of our healthcare facility that people came into contact, which were locker room (Figure 2a), X-ray room (Figure 2b), blood collection room (Figure 2c), waiting room, examination room, endoscopy room and lung function room. Our facility has 2 floors which are main floor (7th floor) and ladies only floor (6th floor), and every part of each floor was sprayed respectively.

### 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.

### Measurement of ATP amount

In this study, we investigated the amount of ATP in the important coated areas of each floor, which were the waiting room, examination room, endoscopy room, lung function room and locker

Figure 2a

Figure 2b

Figure 2c

**Figure 2a:** Coating work in the locker room with Health Bright®. **Figure 2b:** Coating work in the X-ray room with Health Bright®. **Figure 2c:** Coating work in the blood collection room with Health Bright®.

room (7th floor only). The amount of ATP was expressed as relative light unit (RLU). Measurements of ATP were taken six times in total, the day before air catalyst coating was applied, the day after application, 6 months later, 1 year later, 2 years later and 3 years later respectively. All data were taken during the same time of the day (16:00). In total, we monitored the ATP amount for 3-year period after the air catalyst coating.

### Data comparison

The ATP amount after air catalyst coating was compared with that of before coating measured as a control in each room of both floors. We also evaluated the fluctuation of ATP, especially we evaluate whether the amount reached to under 2000 RLU, because this amount is recommended as a standard value in the facilities as clean environment [8].

## Results

### The ATP amount of main floor before and after air catalyst coating

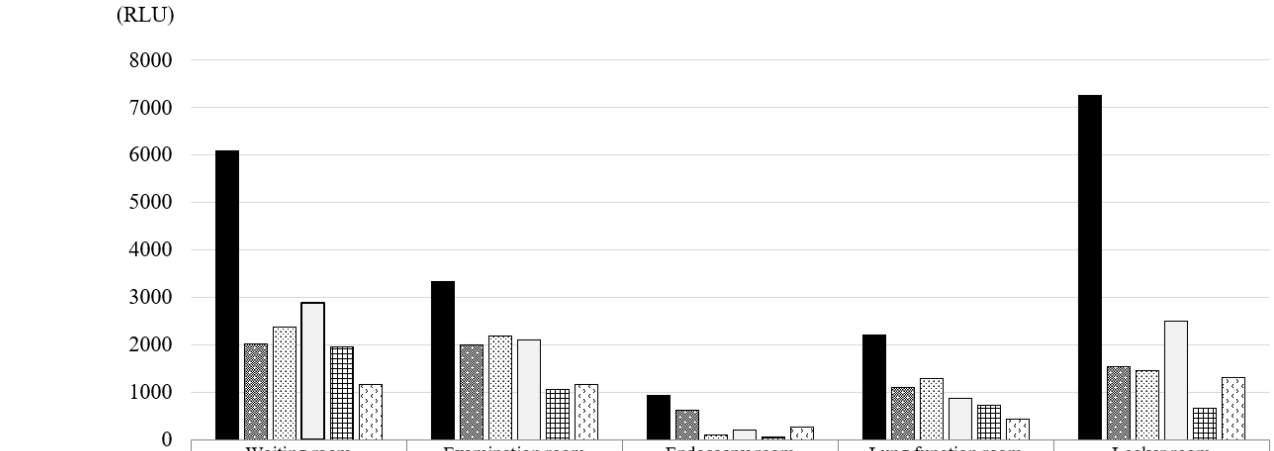
The amount of ATP in each room of main floor (7th floor) was shown in Figure 3. The ATP amount in each room before air catalyst coating showed 2000 – 8000 RLU except endoscopy room This amount was almost equivalent to that of swap test obtained from palm of the hand. However, its amount decreased almost under 2000 RLU immediately the day after the treatment in each room and it declined less than half in 3 rooms (waiting, lung function and locker room). The ATP amount still keep low 6 months later, 1 year later, 2 years later and 3 years later respectively compared to that of before treatment. Of note is it showed less than 500 RLU in endoscopy and lung function room.

### The ATP amount of ladies only floor before and after air catalyst coating

The amount of ATP in each room of ladies only floor (6th floor) was shown in Figure 4. The ATP amount in each room before air catalyst coating showed approximately 2000 – 5000 RLU. However, its amount also decreased almost under 2000 RLU immediately the day after the treatment in all room. The ATP amount still keep low 6 months later, 1 year later, 2 years later and 3 years later respectively compared to that of before treatment except examination room. Of note is it showed less than 500 RLU in endoscopy room.

## Discussion

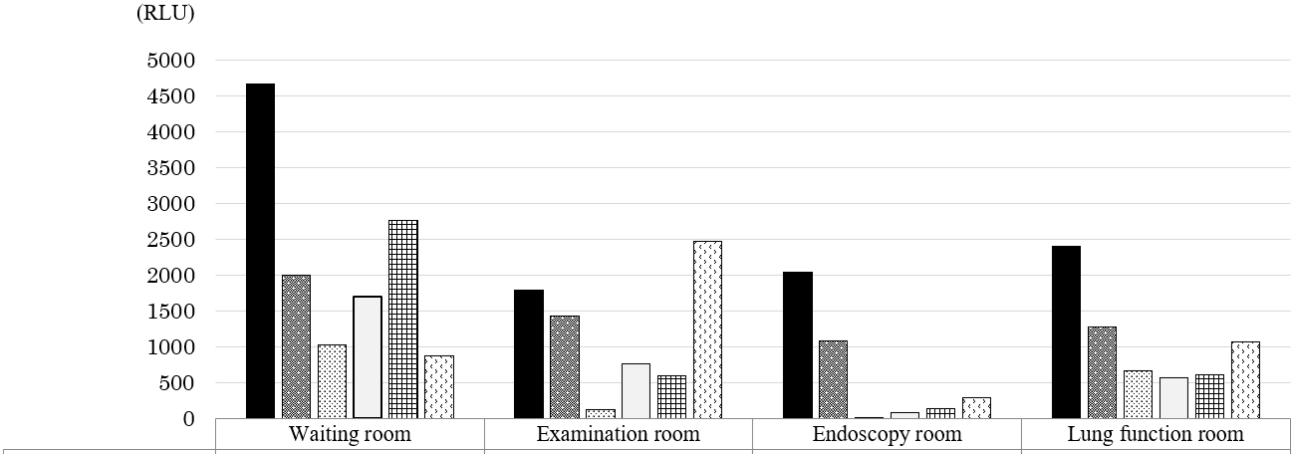
Air catalyst is a new antiviral, antibacterial and antifungal technology, and recently it has been widely used in our country. However, its efficacy and duration still remain obscure. In our preliminary study, we showed antimicrobial effect of air catalyst for a year after coating at our facility [9]. In this extensive study, we also demonstrated the effect lasted for at least 3 years.




| | Waiting room | Examination room | Endoscopy room | Lung function room | Locker room |
|---|---|---|---|---|---|
| Before application | 6079 | 3328 | 938 | 2210 | 7240 |
| Day after application | 2021 | 1994 | 607 | 1104 | 1527 |
| 6 months later | 2373 | 2180 | 90 | 1290 | 1451 |
| 1 year later | 2888 | 2092 | 195 | 867 | 2486 |
| 2 years later | 1950 | 1054 | 45 | 716 | 664 |
| 3 years later | 1162 | 1159 | 258 | 427 | 1308 |

(RLU: Relative light unit)

**Figure 3:** Amount of ATP measurements inside the facility on main floor.




| | Waiting room | Examination room | Endoscopy room | Lung function room |
|---|---|---|---|---|
| Before application | 4659 | 1783 | 2042 | 2397 |
| Day after application | 2004 | 1434 | 1084 | 1272 |
| 6 months later | 1022 | 128 | 18 | 659 |
| 1 year later | 1695 | 764 | 76 | 573 |
| 2 years later | 2760 | 589 | 142 | 604 |
| 3 years later | 870 | 2469 | 292 | 1067 |

(RLU: Relative light unit)

**Figure 4:** Amount of ATP measurements inside the facility on ladies only floor.

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 [10], while joint experiments conducted by the Gifu University and Gunma University similarly showed that infectivity titer of SARS-CoV-2 decreased by approximately. 89% after 1 hour and 95% after 2 hours [11]. However, these are all laboratory data, and it is unclear whether they are actually effective in the facility setup.

On this occasion, we introduced this air catalyst for the first time at a health checkup facility and verified its effect. We measured the amount of ATP in the coated area using a device by Lumitester [12]. Although this machine does not directly measure the amounts of viruses and bacteria, it is used by public health centers in Japan as an indicator of microbial contamination [13-15]. In this study, we demonstrated that lower amount of ATP was maintained at least 3 years after coating in our facility and also showed that its RLU was remarkably low especially in endoscopy room. We consider that this result is meaningful because the clean environment is especially required such a place [16]. 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 [7]. In addition, it has already been introduced in many hospitals, public facilities, universities, offices, airports, etc., including JR West and Hotel Monterey Group [7]. It has also been introduced at our healthcare center in May 2021, and it has been displayed as such within each room [17]. 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.

In general, photocatalysts are catalysts that are well known in Japan [18-22]. With those catalysts, a catalytic reaction takes place as light hits titanium oxide ($TiO_2$) [23-27]. Universities and research institutes have been studying photocatalysts for more than 50 years, and products applying this technology have already been developed in many fields [28-30]. On the other hand, there have been no scientific reports on air catalysts except our data [9,17] so far, and their effects are still unknown. Here, we measured the ATP levels before and after 3 years coating with the air catalyst and presented the results. We would also 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 as well. Finally, we believe that our current data is sufficiently compelling to elicit further examination by investigators with access to similar research.

## Recommendation

The ATP measurement using a Lumitester did not reflect the amounts of virus, bacteria and fungus directly. Therefore, another assay for the measurement of microbial amount will be recommended to confirm our current result.

## Conclusion

We have described infection control measures using air catalyst, which is a new antiviral, antibacterial and antifungal technology being employed at our facility. Our current result demonstrated that the ATP amount in each room before air catalyst coating showed 2000 – 8000 RLU, however, its amount decreased under 2000 RLU immediately the day after the treatment, and lower amount of ATP was maintained at least 3 years after coating. These results suggest that the possible efficacy of air catalyst against microorganism in the healthcare facility for a long period.

## Acknowledgements

The authors would like to thank all the staff of Seikokai Group and Medical four clover Co., Ltd. for their providing technical assistance in this research. The authors would also like to thank Dr. Keisuke Toyama, Professor Emeritus of Tokyo Medical University, for his valuable advice.

The preliminary data of this study was presented at a symposium of the 50th Annual Meeting of Japan Society of Health Evaluation and Promotion via live on January 28 and on-demand web streaming from February 7 to February 28, 2022. A 2-year follow up data of this study was also presented at the 52$^{th}$ Annual Meeting of Japan Society of Health Evaluation and Promotion at Kurashiki, Japan on January 26, 2024.

## Author Contributions

- Methodology: This study was designed and conducted by Ikuma Kasuga.
- Investigation: Main research was performed by Ikuma Kasuga, Yoshimi Yokoe, Sanae Gamo, Tomoko Sugiyama, Maiko Noguchi, Michiyo Tokura, Mayumi Okayama and Nariko Ohmori.
- Original draft writing and data curation were performed by Ikuma Kasuga.
- This study was supervised by Yoshitsugu Takeda, Takeshi Sato, Itto Nakashima and Kazuyo Wakabayashi.
- This study was resourced by Shigeru Yamamoto and Osamu Ohtsubo.
- All authors scrutinized and confirmed the final manuscript.

## Conflict of Interest

All authors declare that they have no conflict of interest.

## Funding

All authors declare that they have nothing to disclose regarding funding.

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