

# 28.12.2020

## 1 Measurement of germ content before and after CleanAir use

### 1.1 Material

- agar plates (Servoplate C3 10413 Nährböden (agars), Sabouraud 2% Glucose Agar (20-er Pack))
  - pepton: 10g/l
  - D(+) glucose: 20g/l
  - agar: 17g/l
- Kreppband

### 1.2 Baseline

- office room - measurements?
- meeting room table
- 6 chairs around table
- 4 chairs at short wall
- 1 pot plant
- window façade at the opposite the wall where CleanAir device was placed

### 1.3 Experimental setup

- 4 different distances
- duplicates
- incubation time: 47-48min

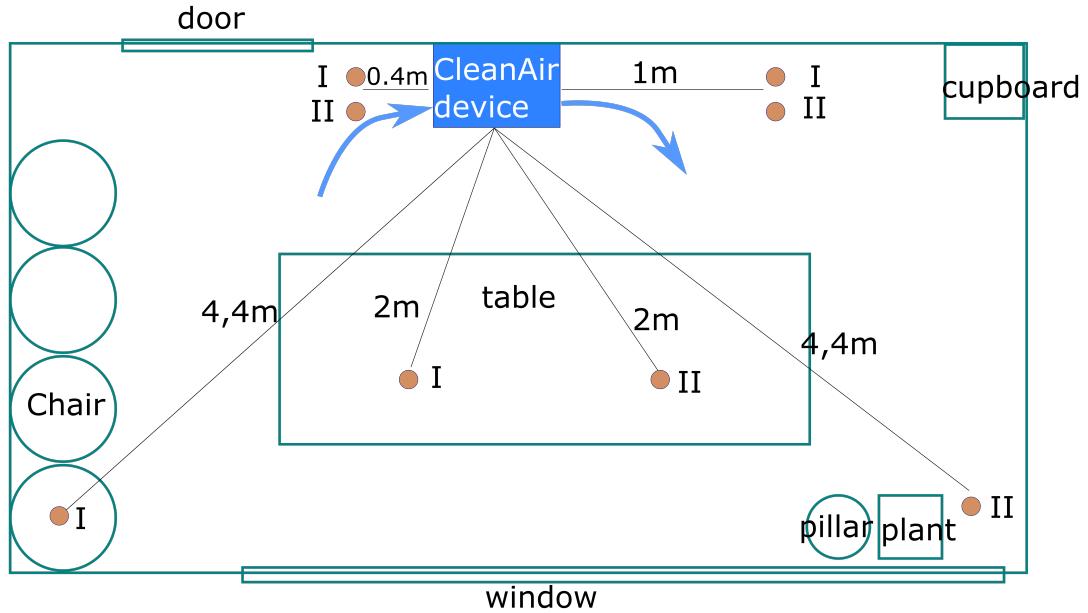


Figure 1: Schema of office room with the approximate placing of the table, chairs and plant as well as the placing of the CleanAir device. Air flow direction is indicated by the arrows. Agar plates are depicted as brown circles.

Distance from CleanAir	height from ground	labelling
0,4m from suction area	0m	28.12., 0,4m, front, before, 1
0,4m from suction area	0m	28.12., 0,4m, before, 2
1m from emitting area	0m	28.12., 1m, before, back, 1
1m from emitting area	0m	28.12., 1m, before, back, 2
2m	0,76m	28.12., 2m, before, 1
2m	0,76m	28.12., 2m, before, 2
4,4m	0,49m	28.12., 4,4m, before, 1
4,4m	0m	28.12., 4,4m, before, 2
0,4m from suction area	0m	28.12., 0,4m, front, after, 1
0,4m from suction area	0m	28.12., 0,4m, after, 2
1m from emitting area	0m	28.12., 1m, after, back, 1
1m from emitting area	0m	28.12., 1m, after, back, 2
2m	0,76m	28.12., 2m, after, 1
2m	0,76m	28.12., 2m, after, 2
4,4m	0,49m	28.12., 4,4m, after, 1
4,4m	0m	28.12., 4,4m, after, 2

Table 1: plates identifiers

## 1.4 Description

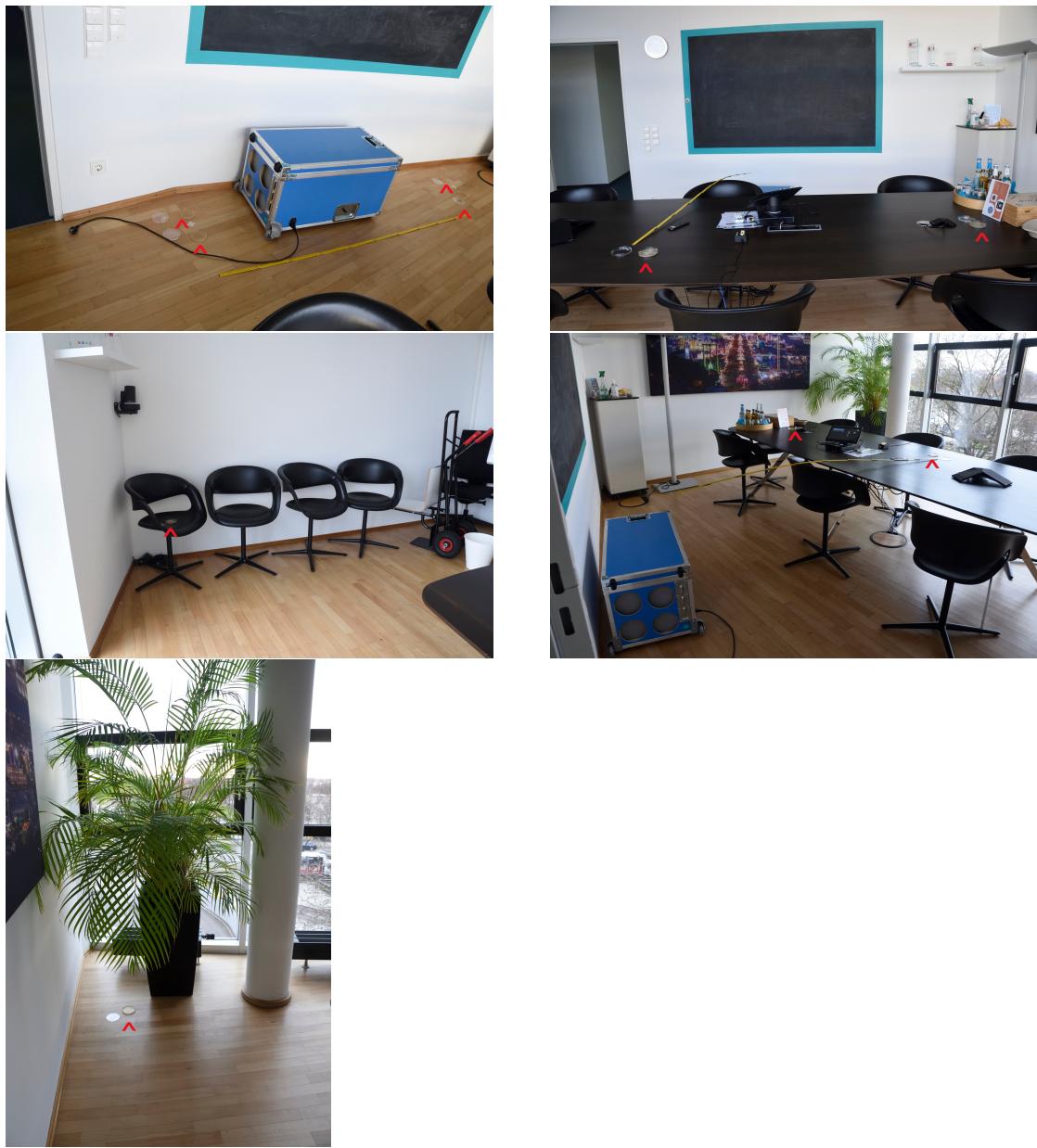


Figure 2: photos showing the office and the placement of the CleanAir device and agar plates (red arrows)

The office was out of use for one day before starting the experiment. The door was open beforehand. The CleanAir device was placed in the middle of the long wall of

the office but was not turned on. Distances were marked using a tape to ensure that before and after measurements are taken from the same location. Plates were placed at the indicated distances from the CleanAir device. Plates were opened without touching the inside (optimally only touch the rims), not breathing into the open plates and not holding the hand across the open agar. The lids of the plates were positioned so that the inside looks down on the ground so that no germs would be on the inside of the lids. Plates were left open for the time of incubation (48min, room temperature). The door was closed during incubation. Starting time of the incubation was 9:56 am, incubation was finished at 10:43 am. The plates were then sealed with tape.

The CleanAir device was turned on for 38min at maximum power. The door was closed during air cleaning. (Estimated air turn over rate?)

Plates were placed at the indicated distances, the ClearAir device was turned off and plates were left open (see above). The door was opened only shortly and closed immediately before device was turned off and plates were setup. Incubation was at room temperature and started at 11:21 am and ended at 12:09 pm. Plates were sealed with tape (optimally parafilm). Agar plates are turned upside down for incubation at room temperature to ensure round colony growth. Growth was observed for 15 days since then fungi cultures started to "re-infect" the plates and it was not possible to distinguish original from new fungi CFUs.

## 1.5 Photograph culture plates

- tripod
- (good) camera
- good artificial lighting (room lights + flashlight, no camera flash!)
- white paper (non reflecting)
- table or alike as flat plane
- remote release (optional)

Before taking pictures it is necessary to count the CFUs visually against a lamp because sometimes CFUs are hard to see on a picture or there is a difficulty distinguishing them from condensation drops in the picture. Sometimes plates can contain artefacts due to manufacturing that might be mistaken for CFUs. If the supposed CFUs are at the rim and very small check the outside of the plates for artefacts. If unsure for any CFU maybe take a note for this plate and decide after 1-2 days. If CFUs are growing into each other memorize and note the original number of CFUs. Put camera on tripod and position it so that it has a 90° angle to the plane (table). Put a white paper on the plane. Position one culture plate top up on the paper. Try to make the culture plate image filling (no digital zoom) but with the whole plate in the picture. Lighten the image as best you

can with the flashlight but try to not get reflections in the plate. Do not use camera flash: it will bring in reflections in the picture. Take the picture with remote release if available. If not available, use the shutter release delay to make the pictures optimally sharp. After taking the picture turn plates upside down again. Be careful, if you notice that some CFUs loose their round shape over the days and look more ellipsoid or look like they are sliding along: do not let those plates rest at an uneven angle longer than necessary. These CFUs might slide across others.

## 1.6 Observations

Date	day	0,4m front I	0,4m front II	1m back I	1m back II	2m I	2m II	4,4m I	4,4m II	Sum
28.12.2020	0									0
29.12.2020	1									0
30.12.2020	2									0
31.12.2020	3									0
1.1.2021	4			2	1			1	1	5
2.1.2021	5	1	2	1		2	1	1	1	8
3.1.2021	6	1	2	2	2	2	1	1	1	11
4.1.2021	7	1	2	2	3	1	2	1	1	13
5.1.2021	8	5	2	2	3	2	3	1	1	19
6.1.2021	9	13	2	6	3	2	3	1	1	31
7.1.2021	10	14	2	10	3	3	4	1	1	38
8.1.2021	11	14	2	10	3	3	4	1	1	38
6.1.2021	9	13	2	10	3	2	3	1	1	31
7.1.2021	10	14	2	10	3	3	4	1	1	38
8.1.2021	11	14	2	10	3	3	4	1	1	38
9.1.2021	12	14	2	12	3	3	4	1	1	40
10.1.2021	13	15	2	13	3	3	4	1	1	41
11.1.2021	14	15	2	13	3	3	4	1	1	41
12.1.2021	15	15	2	13	3	11	4	1	1	49

Table 2: Daily counting of CFUs for agar plates placed before CleanAir device was run

Date	day	0,4m front I	0,4m front II	1m back I	1m back II	2m I	2m II	4,4m I	4,4m II	Sum
28.12.2020	0									0
29.12.2020	1									0
30.12.2020	2									0
31.12.2020	3									0
1.1.2021	4			1						1
2.1.2021	5			1	1					2
3.1.2021	6	1	1	1						3
4.1.2021	7	2	1	1			1			5
5.1.2021	8	3	2	1			1			7
6.1.2021	9	3	3	1			1			8
7.1.2021	10	4	3	2			4			13
8.1.2021	11	4	3	2	2	1	4			15
6.1.2021	9	3	3	1			1			8
7.1.2021	10	4	3	2			4			13
8.1.2021	11	4	3	2	2	1	4			15
9.1.2021	12	4	3	2	2	1	5			16
10.1.2021	13	4	3	2	4	1	6			19
11.1.2021	14	4	3	2	5	1	6			19
12.1.2021	15	4	3	2	5	1	8			22

Table 3: Daily counting of CFUs for agar plates placed after CleanAir device was run

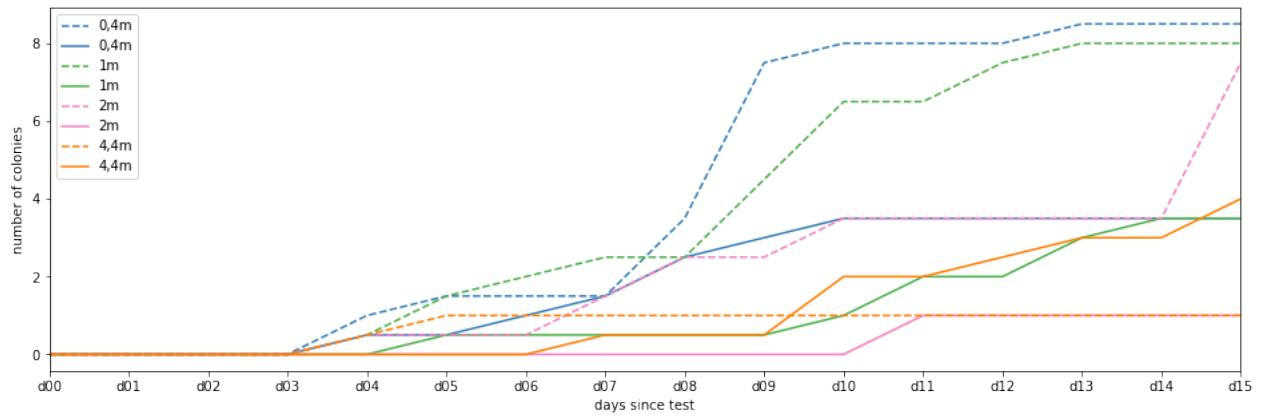
- first CFUs were found at day 4 for both experimental setups
- fungi are nearly only found in the setup before clean air device was run
- CFUs in the post clean air experiment are smaller and slower growing
- possible reasons:

- these are more resilient bacteria, perhaps spore forming bacteria
- bacteria are weakened
- CFUs in post clean air experiment are found predominantly in plates that were located near the doors
  - could be brought in through door when device was turned off and plates were placed
  - bacteria were "on the way" to get to the device when air flow was stopped

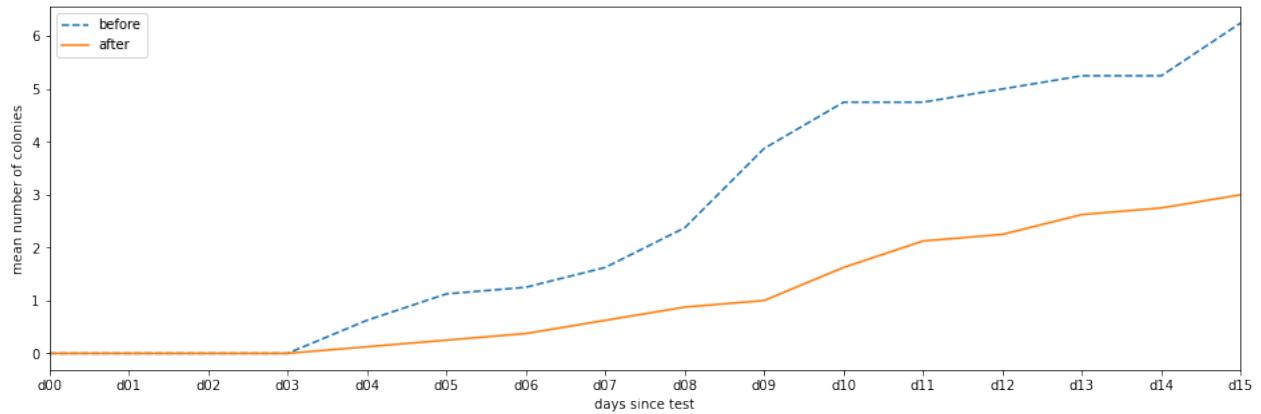
possible species in agar plates:

- *Staphylococcus aureus* root-like structure, yellow, also on human skin, thus can be also air-borne
- *Micrococcus luteus* yellow, round colonies, typical air-borne bacteria, also on human skin
- *Penicillium spec.* fungi colonies, very common

Except for the plates placed the farthest away from the CleanAir device, all comparable distances show higher CFU numbers in the pre condition. There is a gradient of CFUs from door to window in the pre condition. Except for the plates at 4.4m there is a reduction of CFUs of about one third to one half. The overall number of CFUs after the clean air run is about half as much as that before the device was run. However numbers are small for stable results.



(a) Median number of CFUs per distance per day



(b) Mean number of CFUs per condition per day

Figure 3: number of colonies over course of observation

possible shortcomings:

- agar plates are for dermatophytic microbes, so some microbes might not grow on this medium that might be able to colonize other human organs
- CFUs cannot be unambiguously classified
- only qualitative outcome (quantitative results could be obtained through air samplers)
- no direct measurement of virus possible

advantages:

- can be done easily in any room and setup
- does show if spores are efficiently inactivated

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- bacteria and viruses are inactivated by same wavelengths but most bacteria need higher dosages so viruses should be inactivated more efficiently (papers)
- in contrast to aerosol measurements, this also takes care of free dry spores