Study on the germicidal efficacy of ultra violet devices.
Model UV FAN M1/25

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Introduction

Microbiological laboratories are, by definition, a place where the risk of coming in contact with infections is high. Such risks are due to the exposure of personnel to practically all types of infectious agents, such as bacteria, viruses, fungi, protozoans and helminths. It is therefore of the utmost importance, especially in this type of environment, to protect the health of the operators. In addition to the normal safety measures of wearing gloves, goggles, masks, coats etc to reduce these risks, technological advances are always proposing new devices to improve the quality of the environment. From this point of view the major concerns are ambient air where formation of aerosol may occur and surface areas where biological products are continuously prepared.
The aim of this study is to test the microbial and mycotic charge reduction in our Environmental Hygiene Laboratory, Microbiology Department, when using ultraviolet ray devices currently available on the market.

Materials and Method

Test was carried out in an Environmental Microbiology Laboratory.
The laboratory characteristics are as follows
Room Size (m) – 3W x 6Lx 4H
Window surface area – 3.6 m^2
Two benches each 3 x 1 m were positioned on either side of the room entrance
Other equipment consisted of a biohazard cabinet, a ventilated reagent cabinet, a sink and various other laboratory apparatus.
The laboratory's main activity consists of bacteriological and microbiological analytic analysis in water, sewage and air samples.
Three devices, type UV FAN M1/25 manufactured by Light Progress were used in the study. Each was placed at a height of 2.5 m and approximately 2 m from each other.
Device specification UV FAN M1/25
Wave length 253.7 nm
One irradiation source.
The screened system consist of a sterilisation chamber with dimensions to give a 30 mm clearance around the UV tube, air is aspirated through the chamber at a rate of 70 m. cu/Hr. The special screening makes it possible for this device to be used in the presence of personnel without the problem of exposure to UV rays (Bistolfi, 1983).
Study protocol was based on available literature (Block, 1986) and investigation was carried out for total counts of microbes, moulds, yeast, staphylococci, coliforms and sulfite reducer clostidia spores using the following media:
Plate Count Agar Difco (Total microbial count)
Sabouraud dextrose agar Difco (Moulds and yeasts)
Agar sale mannite Difco (Staphylococci)
Levine EMB Agar Difco (Coliforms)
SPS Agar Oxoid (sulfite-reducer clostridia)
The media was prepared according to the manufacturers instruction - autoclaved for 15 minutes at 121°C and then 10 ml was placed in each Contact-type plate, which had an area of 24 cm^2.
Air sampling was carried out using a SAS (Surface Air System) sampler by PBI, mounted on a stand placed at 1.5 meters from the ground (Carducci 1993, Schivo 1994, Rebagliati, 1995).
The plates containing the media were positioned under the pierced cover of the SAS sampler (properly disinfected with sodium hypochlorite). 180 litres of air were passed over the samples and monitored at 1 m^3. Other samples were positioned near the door entrance, in centre of laboratory and near the window. An initial reading of the microbial charge in the environment was taken so as to give a base prior to the devices being operated.
Only the screened option with the forced air ventilation of the UV FAN M1/25 was operated. After operating the unit for 10 minutes to stabilise the UV ray emission, reading were taken at intervals of

10, 20, 30, 40, 50, 60, 120, 180, 240, 360 minutes. Air samples were taken at the inlet and outlet points of the device located in the centre of the lab to ascertain the reduction level in microbial activity by the device.
All Contact-type plates were incubated in an oven at a temperature of 36° C, with the exception of plates containing Sabouraud dextrose agar used to identify and count moulds and yeasts. These were incubated at a temperature of 22° C.
SPS Agar plates, used to identify and count sulfite-reducer clostridia spores were incubated in jars for anaerobiosis at a temperature of 36° C.

RESULTS

The test results for the Screened UV tube of the UV FAN M1/25 is summarised in Table 1. and shows the UFC/m^3 and the percentage reduction of microbial parameters from air samples taken in the laboratory. These devices use circulating air, producing air currents that evenly distribute disinfected air and avoid leaving pockets of contaminated areas in the environment. Air is evenly contaminated and the contamination rate progressively decreases with the increase of the exposure time to UV radiation, as noticed by some other scientists (Block, 1986).
The overall reduction for the total amount of microbes was ranged at 21% for the first 20 minute irradiation and achieved an overall reduction of 99% after 240 minutes with a 66% reduction after only 30 minutes. The reduction trend for moulds and yeast was similar to the above: the UFC/ m^3 was considerably reduced after 30 minutes, but the lowest percentage reduction is achieved after 240 minutes exposure. The total amount of Staphylococci decreases considerably after 50 minutes and is completely eliminated (100%) after 120 minutes of irradiation, whereas the number of Coliforms decreased by 85% after only 20 minutes of irradiation and were completely eliminated (100%) after 40 minutes.
The small quantity of Sulfite-reducer clostridia spores present in the air were completely eliminated after 60 minutes, in accordance with the outcome of other researches (Bayliss et al. 1979).
Table 2 shows UFC/m^3 of the incoming and outgoing air of the central device during the various stages of the experiment. The figures show that, in all cases, the total amount of UFC/m^3 in the outgoing air of the device was considerably decreased.

Conclusions

The basal samples taken in the air and on the surfaces of Microbiological Department of the Laboratory of Environmental Health show that contamination of its environment is caused by virtually all the tested micro-organisms and are of environmental and human origin
The difference between the air samples taken at the inlet and outlet points of the device shows that the UV FAN E 80 BD, with an air flow of 70 m^3 of air per hour, has a high efficiency disinfecting performance which eliminates all the germs present in the environment with the exception of molds and yeast. Even with a very high initial concentration of molds and yeast, the reduction rate was greater than 95%.
The results show that within 30-60 minutes of operation the UV FAN M1/25 devices are capable of exterminate almost all the microbes present in the air eliminating staphylococci, coliforms and sulfite-reducer clostridia spores. Therefore, the continuous use of these types of devices represents a protective measure for the personnel working for many hours with air contaminating agents.
Therefore, the devices that underwent examination showed to be extremely useful, above all in consideration of the fact that there is no need to use chemical products.

TAB. 1 - Number of UFC/m3 in the air during the different steps of the test and their respective percentage of reduction.

	Total amount of microbes		Molds and Yeast count		Staphylococci		Coliforms		Sulfite-reducer clostridia spores	
	UFC/m^3	Reduction %	UFC/m^3	Reduction %	UFC/m^3	Reduction %	UFC/m^3	Reduction %	UFC/m^3	Reduction %
With devices off	2130	0	1203	0	98	0	433	0	29	0
After 10 minutes	2050	4	1120	7	91	8	190	57	25	14
After 20 minutes	1680	21	922	23	88	11	66	85	23	21
After 30 minutes	720	66	367	69	71	28	18	96	16	45
After 40 minutes	233	89	123	90	57	42	3	99	11	62
After 50 minutes	133	94	98	92	19	81	0	100	5	83
After 60 minutes	122	95	88	93	8	92	0	100	2	93
After 120 minutes	78	96	69	94	0	100	0	100	0	100
After 180 minutes	44	98	54	95	0	100	0	100	0	100
After 240 minutes	30	99	45	96	0	100	0	100	0	100
After 360 minutes	24	99	19	98	0	100	0	100	0	100

TAB. 2 – Number of UFC/m3 in the air at the intake and outlet points of the devices, during the various stages of the test.

	Total amount of microbes UFC/m^3			Molds and Yeast count UFC/m^3			Staphylococci UFC/m^3			Coliforms UFC/m^3			Sulfite-reducer clostridia spores UFC/m^3		
	Intake	Outlet	Reduc. %	Intake	Outlet	Reduc. %	Intake	Outlet	Reduc. %	Intake	Outlet	Reduc. %	Intake	Outlet	Reduc. %
With devices off	2180	2202	0	1422	1432	0	188	194	0	377	370	0	30	35	0
After 10 minutes	1821	151	92	1334	398	70	174	20	88	363	15	96	28	14	50
After 20 minutes	1620	130	92	1209	340	72	144	15	90	345	10	97	25	11	56
After 30 minutes	544	79	86	310	90	71	84	9	89	20	2	90	15	7	53
After 40 minutes	298	30	90	121	47	61	45	2	96	5	0	100	7	2	72
After 50 minutes	125	14	89	90	16	82	19	0	100	0	0	100	5	0	100
After 60 minutes	95	5	95	74	12	84	4	0	100	0	0	100	0	0	100
After 120 minutes	75	5	93	68	11	84	0	0	100	0	0	100	0	0	100
After 180 minutes	33	5	85	49	6	87	0	0	100	0	0	100	0	0	100
After 240 minutes	27	5	82	45	5	89	0	0	100	0	0	100	0	0	100
After 360 minutes	24	5	79	20	5	75	0	0	100	0	0	100	0	0	100