

AMERICAN STUDY CONFIRMS THE EFFECTIVENESS OF VISIBLE SPECTRUM FREQUENCIES ON SARS-CoV-2

Independent research from Mount Sinai Icahn School of Medicine has confirmed the efficacy of Biovitae's spectrum frequencies on SARS-CoV-2 and other viruses.

The [study published in preprint on BioRxiv](#) titled "Lighting a better future: the virucidal effects of 405 nm visible light on SARS-CoV-2 and influenza A virus" reports test results carried out using the entire visible spectrum between 380 and 780nm, with a maximum peak in the 400-420nm range which, as seen in the figures below, coincides with that of BIOVITAE.

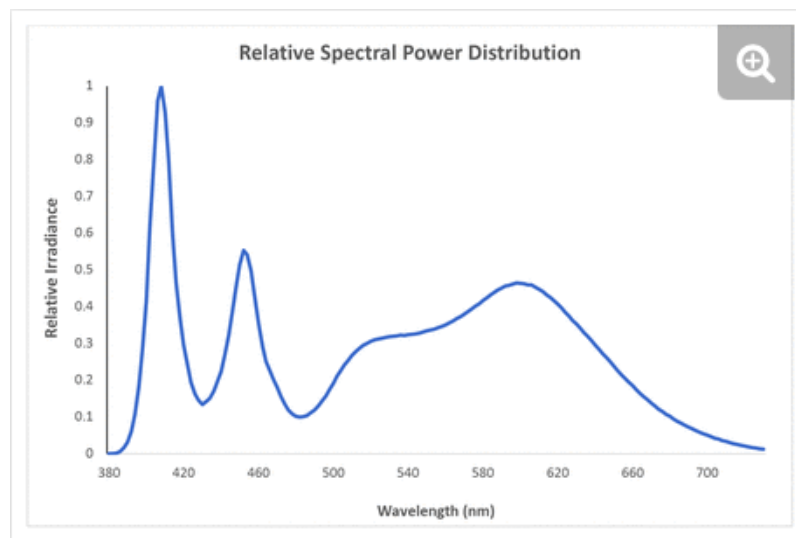


Fig. 1 - Normalized spectral distribution from the study of the Icahn School of Medicine, posted on BioRxiv on April 20, 2021

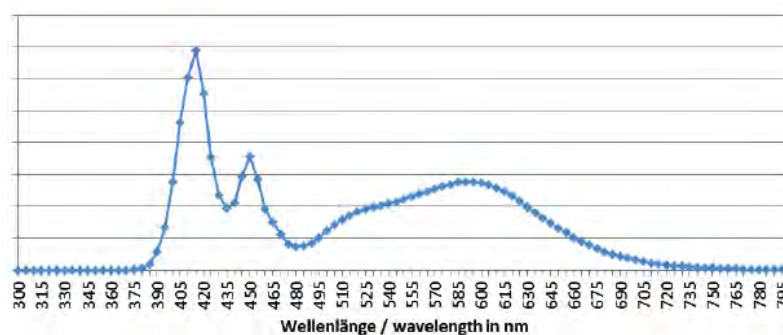


Fig. 2 - BIOVITAE® Normalized spectral distribution from the TÜV Rhineland test report of January 22, 2021, as made available to the public on the BIOVITAE® website (<https://www.biovitae.it/en/la-tecnologia/>)

This is an important recognition for the Scientific Department of the Celio Military Polyclinic in Rome, which was the first in the world to make this discovery - thanks to a study conducted with a device provided by Nextsense based on BIOVITAE® technology patented in 2016 - and publish the results of their research in June 2020 on [MedRxiv](#).

Following the announcement of Mount Sinai, [LEDs Magazine](#) - the most influential magazine in the lighting sector, considered a reference point for the market - published an article in which it listed all

the sanitizing lighting technologies that use only visible spectrum frequencies available on the market, with the relative manufacturers, including:

1. **BIOVITAE®** of Nextsense cited together with licensee Molex;
2. **STRATHCLYDE** licensed to Kenall Industries which markets under the Indigo Clean brand;
3. **VITALVIO**, which it markets under the VYV brand.

The three technologies have significant differences both in terms of effectiveness and in terms of operation which are summarized in the following table:

	BIOVITAE	VYV	KENALL-INDIGO
PATENT 400-420nm	YES	NO (only 405nm)	NO (only 405nm)
TESTED EFFECTIVENESS ON SARS-CoV2	YES	NO*	YES **
CONTINUOUS SANITIZATION	YES	YES	YES

** There are currently no tests carried out on SARS-CoV-2 available*

*** published test results refer to the frequency range of BIOVITAE® technology*

Currently only BIOVITAE has two patents relating to a technology that uses a spectrum that covers the 400-780nm band and includes maximum peaks in the 400-420nm range; while the other two technologies could refer, based on their filed patents, either to the use of only the 405nm frequency.

All three technologies claim the ability to separately control the light components (white and blue).

But while the other two technologies offer the DUAL MODE function for the use of the sanitizing function only (without white light) when the rooms are unoccupied to increase the microbicidal efficacy, BIOVITAE can work in both sanitation mode with white light, where all wavelengths in the range between 400nm and 780nm are recruited to maximize microbicidal efficiency in populated environments, that is when the risk of contagion between individuals is higher, both in sanitization mode with only "blue- violet", when there is no need for lighting. And, in the latter case, the microbicidal capacity is calibrated so as to be adequate for situations with a lower level of risk (for example, when the presence of people is not expected in the environment),

All three devices use the claim of continuous sanitation (Continuous Environmental Disinfection - CED) as they can also be used in the presence of living beings, as they do not emit UV frequencies. Independent searches ([Oxford University Press](#), [Maury Regional Health Center](#), [Fiumicino - Aeroporti di Roma](#)) have shown that continuous sanitization using LED light, used in conjunction with traditional intermittent cleaning systems in hospitals, homes, public spaces and workplaces, drastically reduces contamination and the risk of infection.

THE PRINCIPLES BEHIND THE BIOVITAE® TECHNOLOGY

BIOVITAE technology has been designed following some key principles necessary to obtain a controlled environmental sanitation:

1. Avoid the risk of sterilizing the environments, since the complete elimination of populations of microorganisms involves the cancellation of the immune system.
2. Avoid the risk of recontamination, which is what happens when a potentially pathogenic microbial population reactivates in environments previously treated with UV-C decontamination systems or with chemical disinfectants.
3. Respect the conditions of competitive antagonism between microorganisms, which is achieved not by eliminating all microorganisms in an uncontrolled way, but by targeting mainly pathogenic microorganisms while protecting the creation of stable colonies of "probiotics".
4. Countering the phenomenon of the "resistance", ie blocking the spread of those groups of genes which, through the exchange between microorganisms, allow the acquisition of genetic information capable of developing resistance to antibiotics and chemical disinfectants in the microorganisms themselves.
5. Being "customizable", that is, creating a scalable technology and, therefore, adaptable to different environments with different levels of microbiological risk.
6. Be environmentally friendly: with lower consumption and higher performance, BIOVITAE® devices are on average between 30% and 50% more efficient than other competitors.

BIOVITAE EFFECTIVENESS TESTS ON SARS-CoV-2

The first tests on SARS-CoV-2 with BIOVITAE® technology were carried out by the Italian Military Scientific Department and the results were published in preprint on numerous other tests that have been carried out on SARS-CoV-2 by other independent laboratories in recent months:

- Scientific Department of the Celio Military Polyclinic, in Italy.
- Bundeswehr Institute of Microbiology, Viral and Intracellular Pathogens Section, Germany.
- CBRN Department of Protection and Security, of the Research and Defence Agency (FOI), in Sweden.
- International Centre for Genetic Engineering and Biotechnology (ICGEB), in Italy.
- Commissariat for Atomic Energy and Alternative Energy (CEA), in France.

	Organism	Medium	Irrad. (mW / cm2)	Time (hours)	Time (minutes)	Results
Mt. Sinai	SARS-CoV-2	PBS (Saline)	0.035	4	N / A	55.08%
				24		90.17%
Mt. Sinai	SARS-CoV-2	Artificial Saliva	0.076	24	N / A	98.22%
Mt. Sinai	SARS-CoV-2	PBS (Saline)	0.15	4	N / A	63.64%
				24		96.21%
Mt. Sinai	SARS-CoV-2	PBS (Saline)	0.6	1	N / A	71.52%
				8		99.74%
CELIO / BIOVITAE	SARS-CoV-2	gMEM	4.67	N / A	15	93.25
CELIO / BIOVITAE	SARS-CoV-2	gMEM	4.67	N / A	30	97.94
CELIO / BIOVITAE	SARS-CoV-2	gMEM	4.67	N / A	45	99.31
CELIO / BIOVITAE	SARS-CoV-2	gMEM	4.67	N / A	60	99.64
CEA / BIOVITAE	SARS-CoV-2	TNE buffer + 0.3g / L BSA	1.04	N / A	30	57.34
CEA / BIOVITAE	SARS-CoV-2	TNE buffer + 0.3g / L BSA	1.04	N / A	60	98.30
CEA / BIOVITAE	SARS-CoV-2	TNE buffer + 0.3g / L BSA	1.04	N / A	90	98.65

By elaborating the results obtained during the experiments conducted over the years, a mathematical model has been developed which allows to identify the expected abatements of each product; by way of example, the following table shows those relating to a BIOVITAE 600x600 32W panel (mod. BP-F6060P33-EU) installed at 2.70m (about 1.60m from the surfaces):

BIOVITAE 600x600 panel - mod. BP-F6060P33-EU
Expected abatements in real conditions (TCID50 <100) *

Time (minutes)	mW / cm2	Log	%
5	0.0316	0.45	64.48
15	0.0316	0.55	71.66
30	0.0316	0.69	79.79

45	0.0316	0.84	85.58
60	0.0316	0.99	89.70
Time (hours)	mW / cm2	Log	%
1.5	0.0316	1.28	94.74
3.0	0.0316	2.15	99.29
6.0	0.0316	3.85	99.99

* Data processed on the basis of Nextsense mathematical model with BP-F6060P33-EU panel

Based on the data processed with this mathematical model, based on the operational characteristics of the BIOVITAE® devices, it is also possible to determine the number of devices to be installed in an environment, based on the level of associated infectious risk. These simulations are to be considered indicative as the optimal installations, especially for medium and high-risk environments, must be determined on the basis of the specific environmental characteristics.

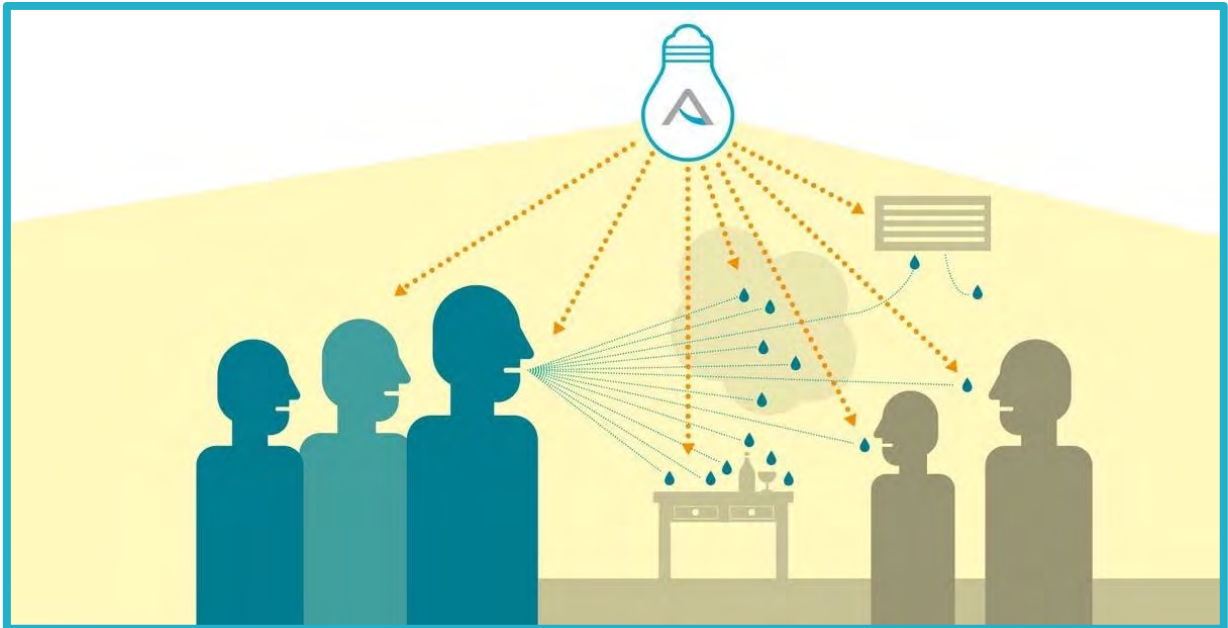
The following table shows a simulation of the number of BIOVITAE® devices necessary to adequately sanitize an area of 20 square meters in the following three hypotheses of microbiological risk, also taking into account the minimum levels of illumination (LX) required by the laws / regulations in force, for:

- **LOW RISK:** Homes (depending on the environments, 150-300 Lux)
- **MEDIUM RISK (MID):** Classrooms (300 LX), Offices (500 LX), Supermarkets (750 LX)
- **HIGH RISK:** Operating rooms (1000 LX)

Model/units	LOW	MID	HIGH
DOWNLIGHT 180	4	9	12
PANEL 6060	2	5	7
BATTEN 120	2	5	6

* The numbers refer to the coverage of an area of 20 m2, regardless of the total size of the environment considered. For example, for a room of 40 m2 it will be necessary to double the number of devices indicated.

BIOVITAE® INTRODUCES THE CONCEPT OF PASSIVE CONTINUOUS SANITISATION



The BIOVITAE LEDs are monochromatic light sources with a very narrow emission interval, that have been designed both to reach a peak of 413 nm when correctly superposed as well as to exponentially increase their microbicidal efficacy when white light components are added. In this way, performing similarly to a standard illuminating device, the BIOVITAE® powered luminaires are especially of use when its most needed: when people attend the room and become both vectors and victims of a possible microbial infection.

BIOVITAE controls the proliferation continuously even in the presence of living beings by helping to maintain human friendly bacteria. BIOVITAE® sanitizes environments without making them sterile (which is dangerous). Human beings live in symbiosis with viruses and bacteria and without them, humans would not survive. However, the uncontrolled proliferation of pathogens can cause imbalances in the ecosystem and mutations that lead them to become dangerous. By sanitising the environment, you safely reduce the pathogens below their infectious dose, thus reducing the risk of infection whilst stimulating the natural resilience of your immune system.

BIOVITAE emits both the microbicidal light and brilliant white LED light, thus making it a direct replacement for normal LED luminaires: both illuminating and sanitizing, simply by switching on the light.

IPC Solutions Compared (Chemical Disinfection-UV-Biovitae)

AREA	CRITERIA	CHEMICAL DISINFECTION	UV	BIOVITAE
TECHNOLOGY	What is the disinfection technology?	Chemicals	Single frequency UV LED	Multi-frequency Visible Light LED
TRAINING	Does the IPC solution require special training for EHS staff?	YES	YES	NO
SARS-COV-2 EFFICACY	Has the IPC solution's efficacy on SARS-CoV-2 been validated?	NO	NO	YES
CONSUMABLES	Does the IPC solution require any consumables/replaceable parts?	YES	NO	NO
SURFACE COMPATIBILITY	Is the IPC solution compatible with all indoor surface types?	NO	NO	YES
MANAGEMENT	Does the IPC solution require a dedicated EHS management system?	YES	YES	NO
PATHOGEN RESISTANCE	Is the IPC solution effective against resistant pathogens?	NO	YES	YES
RESISTANCE DEVELOPMENT	Does the IPC solution support the development of resistant pathogens?	YES	YES	NO
BIOFILM	Is the IPC solution effective against biofilm?	NO	NO	YES
HEATH RISK	Does the IPC solution produce any health risks?	YES	YES	NO
ENVIRONMENT RISK	Does the IPC solution produce any environmental risks?	YES	YES	NO
ODOR	Does the IPC solution produce an odor/smell?	YES	YES	NO
COST	How does the cost of the IPC solution compare?	HIGH	VERY HIGH	MEDIUM