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SHORT COMMUNICATION

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On the Possibility of a Microwave Approach for Rooms and Objects Sterilization

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Abstract

It is well known that the heat is an enemy of both virus and microbes. Starting from this consideration we discuss the possibility of using a microwave approach for a safe and cheap sterilization of closed rooms.

Keywords: Covid; Sars-cov-2; Sterilization; Microwaves

Introduction

Hyperthermia is largely used to fight both virus and microbes in many sterilization processes and it is often exploited in some therapies against some kinds of tumors [1-23]. We have proposed a new microwave approach in order to strongly reduce the virulence of Covid 19 and related virus [22]. This can be achieved by slightly heating inner tissues up to temperatures around 40°C without inducing any damage to the patient tissues. When the sterilization of either objects or closed rooms is required, most of the largely used methods take advantage on strong heating (around 100°C), ultra violet radiation exposition or the combined use of them. Here, we describe a new method for a quick and very cheap sterilization of closed rooms. It is based on the heating of the room through the use of a microwave beam at 2.15GHz, which is the operating frequency of the microwave ovens. We report a description and the feasibility analysis of the proposed approach.

Preliminary Remarks

2019-nCoV is a new coronavirus besides the other coronavirus 229E, NL63, OC43, HKU1, Respiratory syndrome-related coronavirus (MERSr-CoV) Zhao, et al. observed that angiotensin-converting enzyme 2 (ACE2) is the receptor for SARS-CoV-2 [12]. The binding of SARS-CoV-2 on ACE2 generates an enhancement of ACE2, which induce some damages on alveolar cells. Very often, it can induce further reactions leading even to the cell death. Wang et al reported that the receptor-binding ability of SARS-CoV-2 through its specific SPIKE protein can be 10 to 20 times stronger than that of SARS-CoV [5]. In most of infectious diseases and, in particular in COVID-19, major damages arise from the violent immune reaction. On this line of argument, we have proposed the idea of exploiting hyperthermia against COVID-19 to reduce the viral load and the corresponding immune reaction. We note that the idea of using heat against Covid and other disease is not new [5-22]. In particular, radiofrequency electrical hyperthermia has been investigated [19-26]. Our idea appears suitable for its ease and low cost. We have discussed the feasibility of using microwave heating in order to reduce the virulence of the Covid and related virus [22].

In a nutshell, the critical point is represented by the working temperature, which should be high to reduce the infection, but also low enough to avoid any tissue damage. After verifying if this condition is fulfilled, a very precise temperature control of the inner tissues is required in order to avoid any negative collateral effect [1, 22-33]. Taking advantage on the strong absorption from the human tissues of the microwave radiation centered around 2.15GHz, it seems reasonable to use this radiation to induce a well-controlled hyperthermia to decrease the virus strength.

Description of the Method

The idea of using microwave against Covid is a consequence of our efforts to find a cheap approach able, at least, to reduce the strength of the virus (together with its related effects). Even if it does not completely resolve the problem, the induced reduction of the virus strength induces the consequent reduction of the immunity reaction of the body. This, in turn, allows the use of many drugs which have been to show efficient but only at low virus levels [13-17]. We have chosen the frequency of 2.15GHZ because it is the working frequency of the microwave ovens, as it is strongly absorbed by the water. This mean that the technology is very well assessed, very chip and very easy to use. In addition, all the thermal parameters and physical models for biological tissues are very know when interacting with this radiation. In this paper, we analyze the feasibility of a microwave-based approach for the sterilization of closed rooms against SARS-CoV-2 virus.

Before going on, we must observe that a temperature increase is a strong enemy of the virus and of the Covid virus as well. In particular, it has been verified that the virulence of the covid starts to rapidly decrease when the temperature increase over 40°C [5-16].

Many practical configurations can be realized in the shape of a single source, a linear array or a square array. The choice is a function of the right compromise between required power, area to be illuminated and cost. This possibility led us to propose this approach for a user friendly, fast, safe and cheap sterilization of object and closed rooms. Looking at the market, sterilization involves either ultraviolet radiation or the use of liquid disinfectants (eg. Alcoholic solutions, quaternary ammonium derivatives).

If we want to sterilize a closed room the simple use of the microwave bean is not enough because the absorption coefficient of the dry air is very poor and we should need very high power to increase the temperature of the room. Many different solutions can be used to solve this problem. The simplest way to increase the efficiency of the method is to increase the humidity of the environment at a level of about 50% of relative humidity as it will be clear after the discussion of a numerical example reported later in this paper. According to the previous discussion, the effective solution we propose to sterilize a closed room is the following. We propose to use a simple nebulizer which injects in the room a mixture of simple water with sterilizing liquid. Then, a small microwave source working at 2.15GHz (the frequency of microwave ovens) is used to heat the nebulized water and, then, all the objects or the room to be sterilized.

In order to make clear the basic principle of our idea, we discuss a numerical example. A room with a surface of $30m^2$ and a height of a 3m has a volume of $90m^3$. In order to sterilize an environment like this about one liter of water would be needed. In SI units, cs=1.005+1.82H where 1.005kJ/kg°C is the heat capacity of dry air, 1.82kJ/kg°C the heat capacity of water vapor, and H is the specific humidity in kg water vapor per kg dry air in the mixture. To bring this water at a temperature of about 60°C energy is needed. If the environment temperature is of about 20°C energy of about 40.000cal equivalent to about 160.000joules should be provided. If we assume a microwave source of about 500watts (typical sources for a small microwave oven), we see that we need about 5 minutes to sterilize a room like this. The sterilization is safe because the microwave radiation is fully absorbed by the vapor and the operator is on the back of the source in a totally safe position.

We underline that the final temperature of the room depends on several factors, among which we can remind: the exact operating power of the source, the exact humidity of the room, its exact volume, the kind of furniture inside the room. All these parameters of course influence the correct exposure time required for an efficient sterilization. Indeed, the entire problem is quite simple to be solved. In fact, it is enough a thermometer in order to perform an on line and real time measurement of the temperature inside the room [20-33]. This means that the correct exposure time can be easily adapted according to specific case. The temperature sensor can be a classical infrared sensor, a semiconductor sensor or an optical sensor.

Conclusion and Future Trends

We have described a new approach which can be used to construct very simple systems for a cheap and easy sterilization of a closed room. The proposed solution is based on a new microwave method for a fast and user friendly sterilization. It is based on the well assessed technology of the microwave ovens, and its basic configuration can have a cost as low as a couple of hundreds US dollars. Starting from our basic system, many different configurations (e.g. either linear or square arrays) can be easily realized according to the specific case. Now, in the very close future, we intend to perform an experimental project aimed to characterize all the performance of the proposed technique.

Conflict of Interest Declaration

By the present, we declare that no author has any conflict of interest between his scientific and institutional activities and the results discussed in the enclosed paper An innovative high frequency hyperthermia approach against SARS-CoV-2 and related virus: feasibility analysis by Maria Alessandra Cutolo, Antimo Migliaccio, Lucia Altucci, Antonello Cutolo, Andrea Cusano, which is submitted for publication on Translation Medicine Communications.

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