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Combined therapy of far infrared radiation, heat and castor oil, an alternative remedy against Covid-19 infection: A perspective

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Abstract

COVID-19 virus causes mass death worldwide which is facing an unending battle that needs unconventional evidence in complementary and alternative medicine. This review aims to elucidate the possible health benefit of far infrared from Nuga Bed/Mat® along with its heat produced and the application of castor oil pack that has antiviral property in the management of coronavirus infection. Far infrared radiation from Nuga Bed/Mat® has low wavelength and is perceived as heat by the thermoreceptors of the human body. The presence of heat from the Nuga Bed/Mat® coming from the far infrared radiation gives sufficient health benefits including detoxification, pain relief, reduction of muscle tension, relaxation, improved circulation, boosting of the immune system and lowering of blood pressure. SARS-CoV-2 infection manifests inflammation of the vascular endothelium which prevents proper circulation of the blood and can further progress to blood clotting. Treatment with Far infrared radiation for 40 minutes to 2 hours causes the stimulation of HO-1 protein that induces anti-inflammatory activity on the vascular endothelium and other sites of inflammation. Hence, improved blood flow can be expected after an exposure with far infrared radiation. With the added castor oil, spread on the specific site which has a corresponding antiviral property, the possibility of alleviation from the symptoms associated with coronavirus infection can give a light of hope as an alternative remedy.

Keywords: SARS-CoV-2; Far Infrared Radiation; Nuga Best Bed/Mat; Castor Oil; Antiviral; Heat

1. Introduction

In the current pandemic situation, many are maximizing complementary and alternative medicine approaches to fight against the Covid-19 infection. Every country is finding a conclusive therapy of several forms including antiviral and antibacterial agents, steroids, plasma therapy and nanovaccines. Although, no definitive evidence to support its reduction of viral load and alleviating the symptoms, most Asian countries like China and India conducted clinical trials to assess the possible health benefits against Covid-19 infection [1]. Considering the employment of CAM, infrared radiation can be felt in the form of heat that further halt proliferation and eventually death of the virus. SARS-CoV-2 as a form of spike enveloped virus are sensitive to heat. According to the study of Darnell, *et. al*., it was concluded that viruses are heat-sensitive. Heat at temperatures of 55 to 65°C within the span of 15 to 30 minutes can inactivate a wide variety of viruses, specifically enveloped viruses like coronaviruses [2]. Heat therefore, can be an inexpensive, highly useful and broadly available mode of therapeutic treatment for Covid-19 infection. Heat-based therapies can present a good option for integrating natural, conventional and traditional remedies [3].

Among the complementary and alternative treatments which utilizes far-infrared radiation is the Nuga Best Bed/Mat® which elicits far-infrared radiation from natural jade and tourmaline materials. The mat is capable of producing 3.6 to

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1 micron's wavelength and heat radiation of 2-15 mW/cm through the carbon fiber conductive heating system. This wavelength activates the jade and tourmaline to release huge volumes of negative ions that will enter down into the deepest cells promoting better blood circulation and improving immune function of the body. Untoward danger may not be an issue since the type of radiation delivers low energy of light. In fact, human body utilize it every day in order for the natural physiological functions to perform well including treatment of several vascular-related disorders. While the FIR technology has been extensively used in health improvement [4-6] and food preservation, the precise and concrete mechanisms of producing hyperthermic activity and other biological functions remains unclear [7-9].

Far-infrared (FIR) is a division of the infrared radiation (IR) which belongs to the invisible region of the electromagnetic continuum with a wavelength measured in mm or μm. It is divided into three categories: far-infrared (FIR) radiation with a wavelength between 5.6-1000 mm, middle-infrared (MIR) radiation with a wavelength between 1.5-5.6 mm and near-infrared (NIR) radiation with a wavelength between 0.8-1.5 mm. The particular wavelength of FIR can be perceived as heat by thermoreceptors in the surrounding skin. FIR as a form of medical therapy is a safe, noninvasive and convenient therapeutic modality, which is known to improve both blood flow and endothelial function. It can be further considered as a type of physiotherapy since it can penetrate up to 4 cm (~1.5 inches) beneath the skin and generates effects in the human body either thermal or non-thermal [7, 10-12].

FIR produces biological effects in the tissues through energy transfer that produce heat and put forth stimulation on the target tissues and its surrounding tissue environment. As a form of noninvasive therapy, there has been so many studies which shows that FIR therapy can be fully beneficial to human health in terms of the following: (a) it promotes wound healing (b) improves the prognosis of cardiovascular diseases (c) guards the cells from the various inflammatory attacks (d) helps produce open and free blood flow system which is beneficial for patients undergoing a dialysis sessions through both thermal and non-thermal effects (e) plays a good benefit for the protection of the entire blood vessels (f) has sleep inducing activity and prevent abnormal growth of cells like tumors (g) increases blood flow and improves peripheral circulation (h) improves endothelial health and functions (i) reduces blood sugar and insulin levels (j) induces accelerated recovery of skeletal muscle function after exercise (k) increases arterial and peripheral blood flow in the lymphatic vessels (l) improving endothelial function and decreasing pain, inflammation, and oxidative stress. FIR has an abundant health benefits and non-invasive and proven harmless form of therapy [12, 13-16]. In the study of Shi-Yau Yu, *et. al.,* on the biological effect of far-infrared therapy on increasing skin microcirculation in rats, it was seen that after direct contact to FIR, the blood flow in the skin has increased. This can be possibly due to the synthesis, utilization and enhancement of the natural physiological factors induced by the FIR which led to the increase in blood flow. This mechanism is seen to be processed by the nitric oxide action of the autonomic nervous system [7].

Another alternative medicine commonly practiced among elderly and patients with chronic inflammation is the use of castor oil pack with the application of heat. Castor oil plant has a wide array of traditional and medicinal values for the treatment of various health conditions including liver infections; illnesses of the gastrointestinal tract like constipation, indigestion, enteritis, colic and flatulence; inflammation especially of chronic state, removal of warts and also helps improve blood circulation to the area of application through nitric oxide stimulation. Considering the phytochemical components, castor oil is rich, hence, castor oil has a very extensive range of highly medicinal activities including hepatoprotective, anti-nociceptive, antioxidant, antiulcer, anticancer, anti-inflammatory, central analgesic, antidiabetic, antimicrobial, antiviral, and wound healing activity [17, 18].

The main aim of this review is to establish the possible health benefit of FIR radiation released from the Nuga Best Bed/Mat® with an added castor oil pack which may have potential antiviral activity that can probably alleviate or treat any viral infection including coronavirus as both of these therapies enhance blood circulation which may hasten the combat against the coronavirus infection.

2. Methods

This article review uses recovered studies and peer-reviewed articles from the different journals in Pubmed, ResearchGate and Google Scholar. Also, the Chinese National Knowledge Infrastructure Database, Chinese Science and Technique Journals Database, and Chinese Biomedical Literature Database were also considered for the search of the articles. The article search started on June to August 2021. Topics searched were all focusing on far infrared radiation, heat, castor oil and Nuga bed/mat®. All journals reviewed were systemically filed in one folder for easy access and for prevention of any documentary discrepancies. All articles were reviewed and synthesized. Articles that mention complementary and alternative medicine for possible treatment of Covid-19 infections were highly prioritized [19]. The review was done comprehensively in order to establish possible correlation of far infrared, heat, castor oil and nuga bed/mat®.

2.1. Symptomatic Indicators of COVID-19 Infection

With the recent news and events of mass death associated with this deadly coronavirus, the world is now facing a true case of a global terror. True enough, coronavirus is something we should be taking seriously with great caution. At the start of this disease at Wuhan, China – we all thought that clinical manifestations of the disease involve the pulmonary tract. In fact, we know that coronavirus associated ailment is produced by a peculiar severe acute respiratory syndrome following the contact of the virus to specific receptors in the body. However, when autopsies were carried out to establish further the extent of the pathologic damages, it was found out that the pathologic mechanisms leading to the death of the victims include respiratory failure due to surfactant deficiency and alveolar collapse, cardiac syncope from direct damage to cardiac muscles, peripheral paralysis, cytokine storm and excessive haemorrhage from impaired coagulation [20]. At the outset, what originally was thought about the cause of the expiration of the patient as purely acute respiratory syndrome has now been blown out of proportion as the cause of the death of the patients now involves multiple organs including heart, kidneys, bone marrow, lymph nodes and brain. The contributory pathologic infection is somehow related to vascular endothelium of multiple organs [21, 22].

2.2. Far Infrared Radiation Mechanism

With consideration to the whole electromagnetic radiation continuum, the infrared radiation (IR) band occupies the wavelength range of 750 nm–100 μm, frequency range of 400 THz–3 THz, and photon energy range of 12.4 meV– 1.7 eV. It is situated in between the long wavelength red edge of the visible and the short edge of the terahertz (starting at 3 THz) spectral bands (Figure 1) [23].

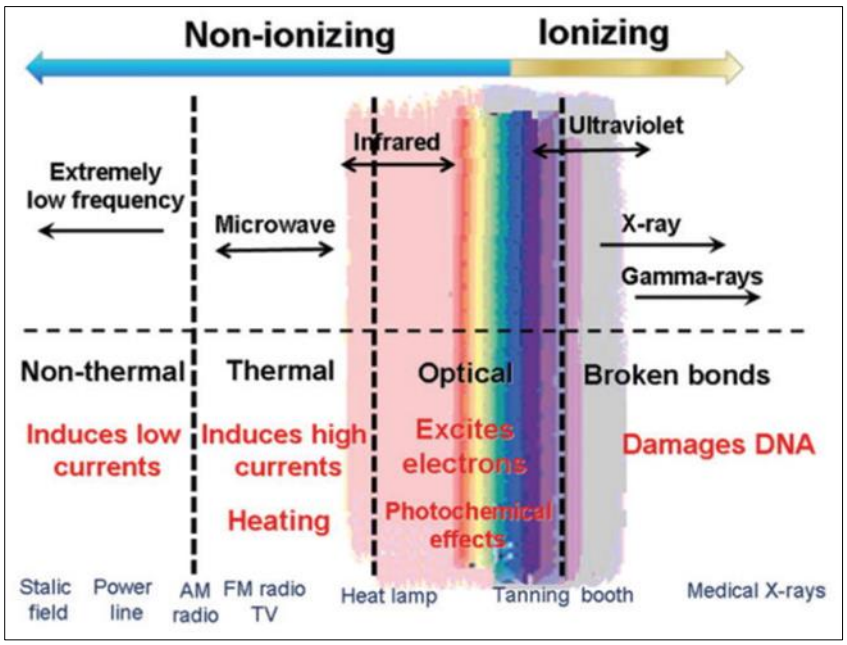

Figure 1 Electromagnetic radiation spectrum and its induced biological modification processes. Adapted from Vatansever and Hamblin (2012) [23]

All living matters has the ability to absorb and transfer energy to some extent or degree. Hence, the discovery of the infrared radiation that is capable of emitting electromagnetic radiation at low wavelengths and frequencies has shown to be of significant potential health benefit. Of the entire infrared radiation continuum, only the FIR spectrum has the capability to transfer energy that is absorbed in the form of heat and are sensed by the skin's thermoreceptors as a radiant heat. The mechanism of transfer of energy from the black body (the object/body part that absorbs infrared radiation) is said to be at a uniform state of temperature. At this state, the black body radiates back the absorbed energy, known as black body radiation [24-25].

2.2.1. Inhibition of vascular endothelial inflammation

The endothelium is the cell that lines the walls of all the blood vessels of the circulatory system. This endothelium serves an important aspect in the regulation of blood flow. The regulatory action of the endothelium is governed by the contractile state of the vasculature. This state helps regulate the interactions between the blood circulating in the vessels and the walls of the vessel. Furthermore, endothelial cells act as a significant barrier that separates the plasma and

blood-formed elements from the neighboring tissues. Endothelial dysfunction is a vital trademark of several pathologic conditions like atherosclerosis and acute coronary syndromes (Figure 2) [26].

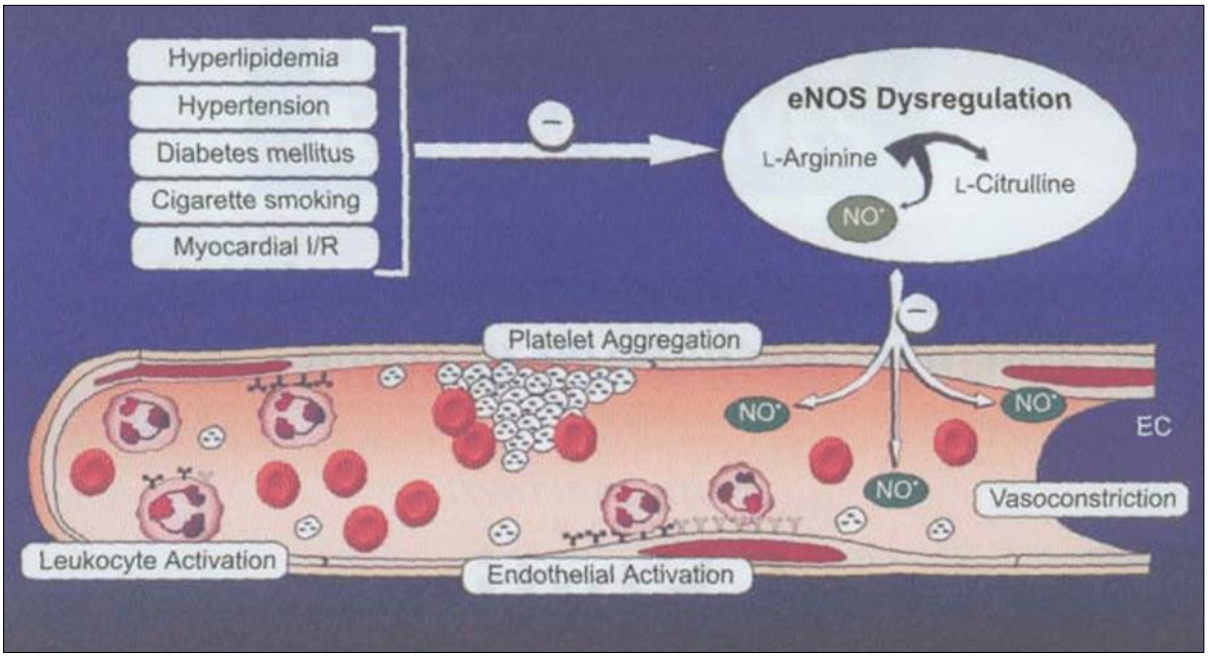

Figure 2 Mechanism of Vascular Endothelial Dysfunction. Adapted from Elrod and Lefer (2005) [26]

Vascular homeostasis is therefore very important in keeping a healthy body. The principal factor which will lead to endothelial dysfunction is the decrease in nitric oxide (NO) bioavailability [27]. Nitric oxide helps in the mechanism of vessel relaxation and in maintaining vascular homeostasis. Any instances of lack in nitric oxide level in the body have been shown to induce reductions in blood flow, platelet accumulation, vascular smooth muscle propagation, and to develop leukocyte linkage and successive extravasation of the tissue [28-31]. Such a corresponding scenario may lead to vascular endothelial inflammation. This condition involves amplified permeability of the vascular endothelial cells (VECs) from one or multiple organs that form the lining of blood vessels, which will result in overstated extravasation of the components of the blood and inflation of extravascular fluid. Vascular endothelial inflammation can occur simultaneously in multiple organs. But commonly affected organs for Covid-19 patients are the lungs and heart.

Far infrared (FIR) radiation at its wavelength is recognized by the body's skin thermoreceptors in the form of heat [32, 33]. New studies have been conducted showing the therapeutic benefits of the FIR radiation in the cardiovascular system. These studies have shown that FIR radiation helps in improving ventricular arrhythmias and endothelial function of patients with cardiovascular conditions [34, 35]. Moreover, FIR radiation allows blood flow at microvascular level and angiogenesis in numerous animal models [36, 37]. In addition, research studies have shown that the use of FIR as a treatment in patients undergoing hemodialysis increases access flow of the arteriovenous fistula (AVF) [38].

In vitro studies by Ching Lin, *et. al.,* showed in cultured human umbilical vein endothelial cells (ECs) were subjected for 40 minutes with FIR radiation, it resulted in the stimulation of Heme oxygenenase-1 (HO-1) protein and such stimulation is time-dependent. HO-1 is a Nrf2-regulated gene that plays a critical role in the prevention of vascular infection. The results showed that far infrared therapy elicits a strong and powerful anti-inflammatory activity through the induction of HO-1. The ability of FIR therapy to inhibit inflammation may play a critical role in preserving blood flow and patency of arteriovenous fistulas in hemodialysis patients [39].

2.3. Influence of Heat on Skin Absorption

Skin absorption is difficult for two reasons: first, the outer layer of the skin which is the epidermis is a non-vascular part. Vascularization of the skin begins at the dermis layer, hence skin absorption is difficult. Second, at cold temperatures the pores of the skin are usually closed making entry of drug molecules difficult. Hence, any drug treatment administered topically must be lipophilic so that it will adhere to the skin and allow longer duration of exposure of the skin with the drug. The lipophilic characteristic of the drug caters for deep penetration even on non-vascularized epidermis layers of the skin because the treatment allows direct contact on the pores of the skin which will

increase chances of absorption. With these two reasons, skin absorption can be enhanced at a rapid rate if heat is applied because it allows the pores of the skin to open up resulting in faster absorption. There are several studies which have proved that heat can enhance absorption into the skin with an increase in temperature [40-42]. Application of heat in therapeutic aspect has initiated a lot health benefits including (a) fast wound healing (b) anti-ageing effects using lasers in the treatment (c) increased blood flow in the skin by vasodilation which will allow oxygenation and hasten transport of drugs across the skin barrier [43, 44]. Figure 3 shows the influence of temperature on skin absorption [45].

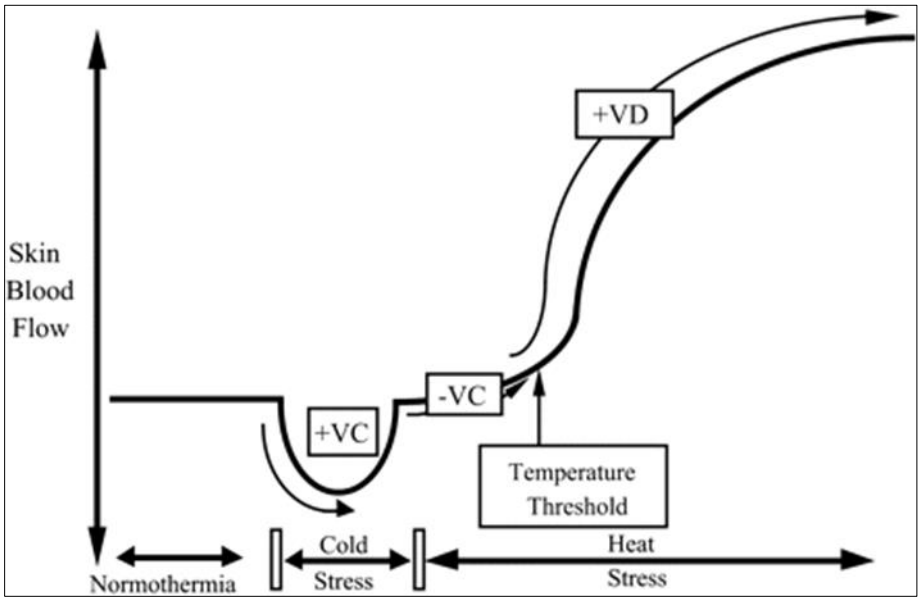

Figure 3 Effects of cold stress and hot stress on skin blood flow [45]

Earlier studies have shown the effects of heat and its exposure to the skin. Among these include the study of Shomaker *et al*.(2000) which shows the comparison of exposure to 40°C for 4 hours and 80^0C for 15 seconds. At 40°C for 4 hours, there was an increase in the skin permeability which allows hydrophobic drug (fentayl) to permeate the skin by 4-fold. On the other hand, exposure to 80°C for 15 seconds presented a 12-fold surge in skin permeability of porcine with hydrophobic drug, butanol. This rise in the permeability of the skin is credited greatly to the disordering of *Stratum corneum* lipid bilayer structures of the skin. With this, it can be noted that skin permeability can be greatly enhanced upon the application of heat. As such, there are many innovative developments in employing heat to the skin in increasing permeability for better absorption of drugs, this include: (a) application of microheaters to increase insulin and vaccine delivery [46- 47]; (b) Radio-frequency heating of the skin allows an intensification in the distribution of minute drug molecules, human growth hormone and DNA [42, 48-49]; (c) Laser treatment to increase skin permeability of large molecules, like dextrans [50-53].

Truly, the length of exposure and the degree of temperature plays a big role in the extent of skin permeability and absorption. In the study of Hao, et. al., on the effects of heat on drug delivery across human skin, he cited that for a little use of heat (43°C for 60 s) it causes a substantial cutaneous hyperemia resulting to a twofold rise in the perfusion of the skin as well as a 5°C rise in its temperature, which lasted for 15 min [54]. Further studies showed that an essentially ninefold rise in local blood flow was noted after an increase of 9–13°C in skin temperature [55, 56].

In the course of locally heating the skin, there are a lot of factors that may contribute strikingly to the flow of the blood in the skin which arises through the sympathetic vasodilator nerves and other contributory factors like the production of nitric oxide [57]. The local sensory nerves are temperature-sensitive and it has been established that at temperatures between 29°C to 40°C, local nerves will be activated causing local vasodilation [58, 59]. Charkoudian in his study also described a certain pattern of the typical cutaneous vasodilation during 30 min of locally inducing heat at 42°C skin temperature, in which he found out that the blood flow of the skin quickly escalated in the first 3–5 min, and then gradually decreases, and then after 25-30 minutes it gradually rises to a maximum [58, 60-62]. The predominant contributory factors for the initial (fast) and slow increase in the skin blood flow subsequently are due to the local sensory nerves activation and nitric oxide, respectively. Another recent study was established and showed vasodilation in the vessels of the skin at a maximum state when the temperature of the skin was retained at 42°C [60].

2.4. Castor Plant: Ethnomedicinal uses and Pharmacological Activities

Ricinus communis L. (Castor oil plant) is a very vital and precious alternative medicine around the world for it has shown significant health benefits throughout the past years (Figure 4) [65]. It belongs to the family of *Euphorbiaceae* and possesses great traditional and medicinal benefits for infections in the liver, pain in the stomach including flatulence and can also relieved from constipation, arthritis and rheumatism, muscle aches including chronic back aches and sciatica for it has anti-inflammatory activity and a property to remove warts and heal the person from colic and other gastrointestinal diseases, menstrual cramps and insomnia. With regards to the phytochemistry of the plant it contains flavonoids, phenolic compounds, fatty acids, amino acids, terpenoids, phytosterol and other valuable components. There have been a lot of studies conducted with castor plant and among of them are anti-contraceptive, anti-ulcer, anti-diabetic, anti-cancer, anti-fertility, central analgesic, anti-inflammatory, antimicrobial, anti-viral, antioxidant, hepatoprotective, insecticidal and wound-healing activities. Indeed, the castor plant has proven its significant therapeutic activity. In addition, castor plant also possesses scavenging on free radicals and most specially the strong metal mercury. While castor plant has shown abundant therapeutic health benefits, it has a comparatively toxic component which is ricin (protein) and ricinine (alkaloid). But the advancement of technology has allowed the removal of the toxic ricin during the process of the oil extraction [63-65].

Figure 4 Castor Plant (A. Shoot, B. Flower, C. Fruit and D. Seeds) [65]

According to the study of Elkousky, *et al*., found out that the leaves of a castor plant exhibit antiviral activity. In his experiment, four extracting solvents were used, namely: Methanol, Methylene Chloride, Butanol and Ethyl acetate. Assessment of the anti-replicative activity revealed that the castor plant extract coming from the four different solvents showed a relatively impressive anti-replicative activity against hepatitis A virus particularly the methanolic and methylene chloride fractions while it showed a moderate activity against Coxsackie B4 virus. The sequence of the highest antiviral activity of these four solvents begins first with butanol > methylene chloride > ethyl acetate > methanol. The butanol extract however, showed the best protective activity against hepatitis A virus while methanol extracts exhibited greater non-significant antiviral protective activity against herpes simplex virus-1 vs Acyclovir. The varied effects of castor plant extract against each virus – HAV, HSV and COXB4 suggests that other possible components present in the extract like the alkaloids and phenolic compounds may have contributed to the enhancement of the antiviral activity of the castor plant extract [64].

2.5. The Chemistry of Castor Oil and Its Potential Antiviral Activity

Castor seeds yield a viscous, characteristic pale yellow color and is nonvolatile and non-drying type of oil - Castor Oil [66]. The distinctive structure of castor oil shows excellent properties, in the making of several industrial products as

well as therapeutic applications. Chemically, castor oil which is known as the Palm of Christ in some regions commonly consists of several healthful benefits like ricinoleic acid - 90%, linoleic acid - 4%, oleic acid - 3%, stearic acid - 1% and less than 1% of linolenic fatty acids [67, 68]. It is the ricinoleic acid which exhibits most of the physicochemical properties of castor oil along with the presence of the three hydroxyl groups in the structure [69]. Moreover, the processing of castor oil is easy because the target component (ricinoleic acid) has highest concentration (85.1%). Antiviral activity of castor oil is greatly attributed to the palmitic acid and oleic acid present [70-75].

In the study of Sands, he discussed two aspects of antiviral mechanisms demonstrated by numerous fatty acids against bacteriophage. These two fatty acids are oleic acid (18:1) and palmitoleic acid (16:1) which have shown a very strong deactivating effect against the virus. Administering either of these two fatty acids at 50 µg/ml at 25 or 0°C for 30 min lowered the virus titer to about 0.1% of the initial titer. On the other hand, administering oleic acid at low concentration of 3 µg/ml lowered the virus titer to <1% of the initial titer within 30 min. There are a lot of other fatty acids which have been proven to have an inactivation activity against the virus. Hence, fatty acids are a good potential for exhibiting antiviral activity by preventing the replication. The mechanism by which these two fatty acids prevent attack into the host cell is by inhibiting entry of the viral genome [71]. In another study conducted by Hilmarsson, he has observed parallel antiviral action of preventing entry into the host cells of these six medium chain fatty acids, namely; capric, lauric and myristic and long chain unsaturated fatty acids - oleic, linoleic and linolenic acids. Fortunately, this oleic acid is also present in the castor oil which may somehow contribute to the antiviral property of castor oil. The alcohol and mono-glyceride derivatives of these six fatty acids exhibits antiviral activity against herpes simplex viruses 1 and 2 and all other enveloped viruses including human immunodeficiency virus, bovine viral diarrhoea virus, Sindbis virus and pseudorabies virus [72-75].

With the above studies, it can be safely concluded that fatty acids from castor oil may be a very good potential for delivering antiviral activity and possibly can be a good alternative medicine against Covid-19 infection.

2.6. Combined Effects of the Far Infrared Radiation, Nuga Bed/Mat® and Castor Oil Pack

Acupuncture is somewhat a discomfort to the patients. It can be hazardous as well if the patient has a bleeding disorder or is on blood thinning medications like Aspirin. The possibility of bleeding, bruising, and soreness may occur at the insertion sites. Also, the risk of infection is high if the needles are unsterilized. To prevent this scenario, Nuga bed/mat® has become a very popular alternative for acupuncture. Nuga bed/mat® is of great advantage over the use of acupuncture with regards to the distress attributed upon the insertion of needles. Together with the combined effect of far-infrared light and heat therapy of Nuga Bed/Mat® (Figure 5), a unique form of acupressure can be felt. Such function of Nuga Bed/Mat® works in the same manner but have demonstrated a better therapeutic health benefit compared to the acupuncture or acupressure alone [76]. So, the principle of Nuga bed/mat is grounded on the following:

Figure 5 Infra-red Radiation and Heat of Nuga Bed® [76]

2.7. Acupressure

Acupressure is based on the theory that when a body is in the state of illness, the energy travels can be disoriented in the body and possibly become stuck. This blocked state can be improved and eventually eliminated with the help of stimulating the focal points pathways, yielding restoration of energy balance, body's homeostasis and improvement of the health status [77].

2.8. Moxibustion and Utilization of Castor Oil Pack

Moxibustion is a type of traditional Chinese medicine (TCM), which involves the use of burning moxa (*Folium artemisiae argyi* or mugwort) herb over acupuncture points. In China, it is commonly applied in order to enable cephalic version of breech presentation [78]. The Nuga Best's jade ball and tourmanium ceramic® component allows a similar mechanism of moxibustion. This will be done by excitation of the blood flow which elicits proper blood circulation through the far infra-red heat transfer mechanism of the Nuga Bed/Mat® [77]. In addition, with the application of castor oil pack instead of moxa using the Nuga mat® as the heating pad, can be a possible added therapeutic medicine to further alleviate the symptoms of Covid-19 since castor oil has a proven antiviral activity. The heat will allow easy penetration of the castor oil into the skin since the pores are open resulting in better absorption and faster therapeutic activity.

2.9. Far Infrared Radiation

The Far Infrared Radiation from the Nuga bed/mat® plays a significant influence on stimulating the body's cellular metabolism. As such, the body's regenerative capability rises which can produce restoration of the nervous system to its normal and proper function. Together with the added heat, the entry of far infrared energy can be easily facilitated inside the body as heat increases chances of absorption. With these, restoration of bodily functions to a normal state will be facilitated. Also, far infrared radiation stimulates the repair responses and healing processes [79, 80].

3. Conclusion

According to the different studies presented and after carefully expounding on the possible alternative remedy for Covid-19 infection, it is safe enough to conclude that the combination of far infrared radiation, heat and castor oil pack can be a good potential in the alleviation of symptoms and treatment of Covid-19 infection. This alternative therapy shows ample and valid claims on its efficacy on increasing blood flow and producing antiviral activity.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest from the authors.

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