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Stability of SARS Corona Virus in Humans and Environment

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Abstract:

Severe acute respiratory syndrome (SARS) is a single stranded RNA virus, it infects the epithelial cells within the lungs. . Moreover, these infections can be successfully inactivated by

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lipid solvents including ether (75%), ethanol, chlorine-containing disinfectant, peroxyacetic corrosive and chloroform with the exception of chlorhexidine. The viability of a few povidone-iodine (PVP-I) items, various other synthetic operators, and different states of being were assessed for their capacity to inactivate the extreme intense respiratory condition coronavirus (SARS-CoV). The stability of SARS coronavirus in human specimens and in environments was studied. The survival abilities on the surfaces of eight different materials and in water were quite comparable, revealing reduction of infectivity after 72 to 96 h exposure. Viruses stayed stable at 4°C.The survival of the virus seems to be relatively strong in humans and environment. Heating and UV irradiation can eliminate the viral infectivity.SARS,to be transmitted through respiratory droplets, fomites or tainted sewage frameworks. Presence of different strains of coronavirus has led to complications in the field of vaccine and medicine.Hence, this study sheds light on the stability of the different strains of virus (SARS CoV) in humans and environment. And also this study emphasizes on the physical and chemical methods of inactivation of SARS CoV. Thus, The necessity and aim of this study is to understand the knowledge about stability of SARS CoV in order to predict the future antiviral treatment and coping methodologies.

Keywords: SARS, Temperature; Stability; Viral infectivity; Antiviral methodology.

INTRODUCTION:

Severe acute respiratory syndrome(SARS) is a strain of virus that causes severe acute respiratory disease. It is an enveloped, positive-sense, single-stranded RNA virus which infects the epithelial cells within the lungs. The virus enters the host cell by binding to the ACE2 receptor. It infects humans, bats. A pandemic of coronavirus disease 2019 (COVID-19) in 2019–20 showed many similarities to the SARS outbreak, with the viral agent identified as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), yet another strain of the Severe acute respiratory syndrome-related coronavirus (SARSr-CoV). SARS-CoV-1 is one of seven known coronaviruses to infect humans, including Human coronavirus 229E (HCoV-229E), Human coronavirus NL63 (HCoV-NL63), human coronavirus OC43 (HCoV-OC43), Human coronavirus HKU1 (HCoV-HKU1), Middle East respiratory syndrome-related coronavirus (MERS-CoV), and SARS-CoV-2. These reasons are plagued with variable clinical seriousness highlighting respiratory and extra-respiratory indications. Concerning SARS-CoV, MERS-CoV, the death rates are up to 10% and 35%, respectively (Aydin, Al- Khooly and Lee, 2014). Thus, SARS-CoV-2 has a place with the betaCoVs class. It has round or elliptic and regularly pleomorphic structure, and a distance of around 60–140 nm. Like different CoVs, it is delicate to bright beams and warmth. Moreover, these infections can be successfully inactivated by lipid solvents including ether (75%), ethanol, chlorine-containing disinfectant, peroxyacetic corrosive and chloroform with the exception of chlorhexidine. The stability of SARS coronavirus in human specimens and in environments was studied. Using a SARS coronavirus strain CoV-P9, which was isolated from pharyngeal swab of a probable SARS case in Beijing, its stability in mimic human specimens and in mimic environment including surfaces of commonly used materials or in household conditions, as well

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as its resistance to temperature and UV irradiation were analyzed (Chan *et al.*, 2012) . The survival abilities on the surfaces of eight different materials and in water were quite comparable, revealing reduction of infectivity after 72 to 96 h exposure. Viruses stayed stable at 4 degrees C, at room temperature (20 degrees C) and at 37 degrees C for at least 2 h without remarkable change in the infectious ability in cells, but were converted to be non-infectious after 90-, 60- and 30-min exposure at 56 degrees C, at 67 degrees C and at 75 degrees C, respectively. Irradiation of UV for 60 min on the virus in culture medium resulted in the destruction of viral infectivity at an undetectable level.The survival ability of SARS coronavirus in human specimens and in environments seems to be relatively strong. Heating and UV irradiation can efficiently eliminate viral infectivity (van Doremalen *et al.*, 2020). The aim of this study is to understand the knowledge about stability of SARS CoV in order to predict the future antiviral treatment and coping methodologies.Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Ariga *et al.*, 2018; Basha, Ganapathy and Venugopalan, 2018; Hannah *et al.*, 2018; Hussainy *et al.*, 2018; Jeevanandan and Govindaraju, 2018; Kannan and Venugopalan, 2018; Kumar and Antony, 2018; Manohar and Sharma, 2018; Menon, Ks, R, *et al.*, 2018; Nandakumar and Nasim, 2018; Nandhini, Babu and Mohanraj, 2018; Ravinthar and Jayalakshmi, 2018; Seppan *et al.*, 2018; Teja, Ramesh and Priya, 2018; Duraisamy *et al.*, 2019; Gheena and Ezhilarasan, 2019; Hema Shree *et al.*, 2019; Rajakeerthi and Ms, 2019; Rajendran *et al.*, 2019; Sekar *et al.*, 2019; Sharma *et al.*, 2019; Siddique *et al.*, 2019; Janani, Palanivelu and Sandhya, 2020; Johnson *et al.*, 2020; Jose, Ajitha and Subbaiyan, 2020).

SARS-COVID:

Coronaviruses are a gathering of related RNA infections that cause illnesses in well evolved creatures and flying creatures. In people, these infections cause respiratory tract contaminants that can run from mellow to deadly. Gentle sicknesses incorporate a few instances of the regular cold (which is caused likewise by certain different infections, prevalently rhinoviruses), while progressively deadly assortments can cause SARS, MERS, and COVID-19. Side effects in different species fluctuate: in chickens, they cause an upper respiratory tract illness, while in cows and pigs they cause loose bowels. There are until now no antibodies or antiviral medications to forestall or treat human coronavirus infections.Coronaviruses establish the subfamily Orthocoronavirinae, in the family Coronaviridae, request Nidovirales, and domain Ribovirus. They are encompassed infections with a positive-sense single-abandoned RNA genome and a nucleocapsid of helical symmetry. This is enclosed by an icosahedral protein shell.The genome size of coronaviruses ranges from roughly 26 to 32 kilobases, one of the biggest among RNA infections(Eckerle *et al.*, 2010). The coronavirus surface spikes are homotrimers of the S protein, which is made out of a S1 and S2 subunit. The homotrimeric S protein is a class I combination protein which intervenes the receptor official and layer combination between the infection and host cell. The S1 subunit shapes the leader of the spike and has the receptor restricting area (RBD). The S2 subunit frames the stem which stays the spike in the viral envelope and on protease actuation empowers combination (Rajeshkumar, Kumar, *et al.*, 2018). Inside the envelope, there is the nucleocapsid, which is framed from

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different duplicates of the nucleocapsid (N) protein, which are bound to the positive-sense single-abandoned RNA genome in a nonstop globules on-a-string type conformation (Geller, Varbanov and Duval, 2012). The lipid bilayer envelope, film proteins, and nucleocapsid ensure the infection when it is outside the host cell (Hach *et al.*, 2013).The autoimmune haemolytic anaemia is associated with COVID 19 infection (Gheena and Ezhilarasan, 2019).Individuals with underlying chronic liver disease,or even dangers for liver disease,should be dealt with also to other highly risk groups (Ezhilarasan, 2018),(Ezhilarasan, Sokal and Najimi, 2018).Utilizing electron magnifying lens ,they found that the coronavirus contaminated both develop mature and progenitor enterocytes ,which are intestinal absorptive epithelial cells that line the inward surface of the intestines (Ashwini, Ezhilarasan and Anitha, 2017).In general, pre-existing chronic respiratory conditions (including bronchial asthma, COPD, bronchiectasis) are reported only in a small proportion of patients. This is interestingly with the other respiratory viral infections(e.g. flu, rhinovirus), which are normally influencing unfavorably susceptible patients and those with chronic respiratory diseases (Mehta *et al.*, 2019).Mortality unexpectedly high among individuals with lung malignant growth and COVID 19 disease (Sharma *et al.*, 2019).COVID 19 attacks the 1-beta chain of hemoglobin and catches the porphyrin to restrain human heme metabolism (Lakshmi *et al.*, 2015).

SARS-CoV:

Extreme intense respiratory condition (SARS) is the ailment brought about by SARS-CoV. It causes regularly extreme sickness and is checked at first by foundational indications of muscle torment, cerebral pain, and fever, followed in 2–14 days by the beginning of respiratory manifestations, for the most part hack, dyspnea, and pneumonia. Another basic finding in SARS patients is a lessening in the quantity of lymphocytes circling in the blood (Henwood, 2020).In the SARS flare-up of 2003, about 9% of patients with affirmed SARS-CoV contamination kicked the bucket. The death rate was a lot higher for those more than 60 years of age, with death rates moving toward half for this subset of patients (Hilgenfeld and Peiris, 2013). Human SARS-CoV seems to have a mind boggling history of recombination between hereditary coronaviruses that were facilitated in a few distinctive creature groups.In request for recombination to occur at any rate two SARS-CoV genomes must be available in a similar host cell (Otter *et al.*, 2016). Recombination may happen during genome replication when the RNA polymerase changes starting with one format then onto the another(Ma *et al.*, 2015). SARS seems, by all accounts, to be transmitted through respiratory droplets, fomites or tainted sewage frameworks .In more seasoned individuals, clinical sequelae of the sickness will in general be more awful (Morawska and Cao, 2020). Many will in general present with vague indications which may later form into optional inconveniences requiring concentrated unit care and mechanical ventilation.Hospital workers are at the front line of the coronavirus flare-up reaction and as such are presented to danger that put them in danger of infection.Hazards include pathogen presentation ,long working hours,psychological distress,fatigue,occupational burnout and mental violence (Rajeshkumar, Agarwal, *et al.*, 2018).Individuals with immune system issues, for example, rheumatoid joint inflammation (RA), might be bound to encounter contaminations. Along these lines, those with

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RA who create coronavirus might be at higher hazard for creating extreme side effects and additional complications(Menon, Ks, Santhiya, *et al.*, 2018).Smokers are more likely to develop severe disease with coronavirus compared to non smokers (Warnakulasuriya and Muthukrishnan, 2018).Individuals who have developed advanced liver diseases and disintegrating health because of hepatitis B or C should to be vigilant in shielding themselves from contracting coronavirus as they are at risk of more serious illness (Karthiga, Rajeshkumar and Annadurai, 2018).Dietary supplement vitamin C acts as an intervention on the coronavirus infection (Lakshmi, Ezhilarasan, Vijayaragavan, *et al.*, 2017). Cancer patients ,their families and parental figures are disproportionately affected by the COVID pandemic.Cancer patients are twice as prone to get infected than the general population and significantly more likely to die from coronavirus once infected (Ashwini and Anitha, 2017).Coronavirus-Early antiplatelet treatment, particularly P2Y12 rivals, might be gainful because of their inhibitory consequences for platelet enactment and age of neutrophil-platelet totals, key instruments in both blood clot arrangement and aspiratory neutrophil enlistment (Lakshmi, Ezhilarasan, Nagaich, *et al.*, 2017).Cytokine storm blockers and safe host modulators are as of now being applied in seriously ill coronavirus patients,suggesting that more consideration ought to be taken before immunosuppressive treatment by cytokine blockers in coronavirus(Perumalsamy *et al.*, 2018).Patent herbal drugs can effectively relieve symptoms such as fever,cough and reduce the probability of patients developing severe conditions (Swetha, Priya and Gayathri, 2018).

STABILITY AND INACTIVATION OF SARS:

The SARS-coronavirus (SARS-CoV) is a profoundly pathogenic agent . While direct individual to-individual transmission through respiratory beads represented most cases, different modes have not been precluded. Fecal shedding is normal and drawn out and has caused a flare-up in Hong Kong. We considered the strength of SARS-CoV under various conditions, both in suspension and dried on surfaces, in correlation with other human-pathogenic infections, including human coronavirus HCoV-229E (Morens and Fauci, 2013). In suspension, HCoV-229E step by step lost its infectivity totally while SARS-CoV held its infectivity for as long as 9 days; in the dried state, endurance times were 24 h versus 6 days. Warm inactivation at 56 degrees C was exceptionally powerful without protein, decreasing the infection titre to beneath perceptibility; notwithstanding, the expansion of 20% protein applied a defensive impact bringing about lingering infectivity(van Doremalen *et al.*, 2020). On the off chance that protein-containing arrangements are to be inactivated, heat treatment at 60 degrees C for at any rate 30 min must be utilized. It is conceivable to think about SARS patients and to direct research center logical investigations on SARS-CoV securely (Rabenau *et al.*, 2005). By the by, the specialists' persistence is significantly higher than that of HCoV-229E, and should SARS reappear, expanded endeavors should be committed to inquiries of ecological cleanliness (Ou *et al.*, 2020)(Eckerle *et al.*, 2010).

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COMPARISON BETWEEN SARS CoV-1 AND SARS CoV-2:

The half-existences of SARS-CoV-2 and SARS-CoV-1 were comparable in mist concentrates, with middle evaluations of around 1.1 to 1.2 hours and 95% trustworthy interims of 0.64 to 2.64 for SARS-CoV-2 and 0.78 to 2.43 for SARS-CoV-1. The half-existences of the two infections were additionally comparative on copper. On cardboard, the half-existence of SARS-CoV-2 was longer than that of SARS-CoV-1. The longest reasonability of both infections was on tempered steel and plastic. Evaluated contrasts in the half-existences of the two infections were little with the exception of those on cardboard (Denison *et al.*, 2011).

To look at SARS-CoV-1, which caused a multicountry episode in 2002 to 2003, and SARS-CoV-2, which causes COVID-19 (presently a pandemic), analysts assessed security of the two infections in mist concentrates and on different surfaces and evaluated rot rates. After aerosolization, reasonable SARS-CoV-2 infection was discernible all through the 3-hour try; irresistible titter dropping from 103.5 to 102.7 TCID50 (half tissue-culture irresistible portion) per liter of air. SARS-CoV-2 was noticeable following 72 hours after application to plastic and following 48 hours on hardened steel, in spite of the fact that titers dropped. Endurance was shorter on cardboard (no reasonable SARS-CoV-2 following 24 hours) and copper surfaces (no feasible SARS-CoV-2 following 4 hours). The half-existence of the two infections vaporized were comparable (1.1–1.2 hours). Endurance of both infections was comparable with the exception of SARS-CoV-2 endure longer than SARS-CoV-1 on cardboard (Pica and Bouvier, 2012).

EFFECT OF TEMPERATURE ON THE VIABILITY OF SARS:

SARS CoV can be made in any event fourteen days in the wake of drying at temperature and moist conditions found in a cooled domain. The infection is steady for 3 weeks at room temperature in a fluid domain yet it is effectively killed by heat at 56°C for 15 minutes (Chan *et al.*, 2011). This shows SARS CoV is a steady infection that may possibly be transmitted by aberrant contact or fomites. These outcomes may demonstrate that defiled surfaces may assume a significant job in transmission of contamination in the emergency clinic and the community.Our examines show that SCoV is moderately more steady than the human coronaviruses 229E or OC43 and some other viral respiratory pathogens. These discoveries recommend that, while direct bead transmission is a significant course of transmission , the job of fomites and ecological tainting in infection transmission may assume a noteworthy job in infection transmission (Naddeo and Liu, 2020). Specifically, fomites may add to the proceeded with transmission of disease in the nosocomial setting that keeps on happening regardless of the extraordinary consideration and severe precautionary measures taken to forestall bead spread.Faecal sullying of SCoV coronavirus may in this way be a powerful course of transmission of the ailment. The solidness of the infection on ecological surfaces and its essence in defecation shows the potential that fecal defilement of new food creation may represent a danger for infection transmission; particularly in nations with poor sanitation and sewage removal frameworks and that reviews to

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address this chance are required (Nkengasong, 2020).

CHEMICAL INACTIVATION OF SARS CoV:

The viability of a few povidone-iodine (PVP-I) items, various other synthetic operators, and different states of being were assessed for their capacity to inactivate the extreme intense respiratory condition coronavirus (SARS-CoV). Treatment of SARS-CoV with PVP-I items for 2 min diminished the infection infectivity from 1. 17 x 106 TCID 5o/ml underneath the distinguishable level. The adequacy of 70% ethanol was equal to that of PVP-I items. Obsession of SARS-CoV-tainted Vero E6 cells with a fixative including formalin, glutaraldehyde, methanol, and CH3)2CO for 5 min or longer wiped out all infectivity. Warming the infection at 56°C for 5 min significantly decreased the infectivity of the infection from 2.6 x 107 to 40 TCID 5o/ml, though warming the infection for 60 min or longer dispensed with all infectivity(Yi *et al.*, 2020).

Intense Respiratory Syndrome (SARS) coronavirus, Middle East Respiratory Syndrome (MERS) coronavirus or endemic human coronaviruses (HCoV) can endure on lifeless surfaces like metal, glass or plastic for as long as 9 days, however can be proficiently inactivated by surface sanitization strategies with 62–71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite inside 1 moment(Tollefson, Cox and Williams, 2010). The principle proteinase (Mpro) of the extreme intense respi-ratory condition (SARS) coronavirus is a principal target for the structure of anti coronavirus compounds.Benzotriazole esters have been accounted for as potent non peptidic inhibitors of the chemical (Pica and Bouvier, 2012).Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Vijayashree Priyadharsini, Smiline Girija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020; R *et al.*, 2020; Samuel, 2021)

TREATMENT:

The treatment is indicative, and oxygen treatment speaks to the significant treatment mediation for patients with extreme disease. Mechanical ventilation might be important in instances of respiratory disappointment unmanageable to oxygen treatment, though hemodynamic help is fundamental for overseeing septic stun (Ren *et al.*, 2020).

Intubation and defensive mechanical ventilation ,The system ought to be executed by a specialist administrator who utilizes individual defensive gear (PPE, for example, FFP3 or N95 veil, defensive goggles, expendable outfit long sleeve parka, dispensable twofold socks, and gloves(Muralidharan *et al.*, 2020).

Mechanical ventilation ought to be with lower flowing volumes (4 to 6 ml/kg anticipated body

weight, PBW) and lower inspiratory weights, arriving at a level weight (Pplat) < 28 to 30 cm H2O.

Different treatments - Among other restorative procedures, foundational corticosteroids for the treatment of viral pneumonia or intense respiratory pain condition (ARDS) are not suggested.. a few medications have been proposed, for example, lopinavir/ritonavir (400/100 mg like clockwork), chloroquine (500 mg at regular intervals), and hydroxychloroquine (200 mg like clockwork). Alpha-interferon (e.g., 5 million units by airborne inward breath two times a day) is additionally utilized. It has been proposed that patients with poor outcomes have to be given position ventilation (Song *et al.*, 2013).

CONCLUSION:

Presence of different strains of coronavirus has led to complications in the field of vaccine and medicine. Hence, this study sheds light on the stability of the different strains of virus (SARS CoV) in humans and environment. And also this study emphasizes on the physical and chemical methods of inactivation of SARS CoV, which would further give knowledge about the sterilisation and disinfection methods forCoronavirus, hence preventing its spread , transmission and infection.

References:

1. Ariga, P. *et al.* (2018) 'Determination of correlation of width of Maxillary Anterior Teeth using Extraoral and Intraoral Factors in Indian Population: A systematic review', *World journal of dentistry*, 9(1), pp. 68–75. doi: 10.5005/jp-journals-10015-1509.

2. Ashwini, S. and Anitha, R. (2017) 'Antihyperglycemic Activity of Caralluma fimbriata: An In vitro Approach', *Pharmacognosy magazine*, 13(Suppl 3), pp. S499–S504. doi: 10.4103/pm.pm_59_17.

3. Ashwini, S., Ezhilarasan, D. and Anitha, R. (2017) 'Cytotoxic effect of Caralluma fimbriata against human colon cancer cells', *Pharmacognosy Journal*, 9(2). Available at: https://www.phcogj.com/article/252.

4. Aydin, H., Al- Khooly, D. and Lee, J. E. (2014) 'Influence of hydrophobic and electrostatic residues on SARS- coronavirus S2 protein stability: Insights into mechanisms of general viral fusion and inhibitor design', *Protein science: a publication of the Protein Society*. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/pro.2442.

5. Basha, F. Y. S., Ganapathy, D. and Venugopalan, S. (2018) 'Oral hygiene status among pregnant women', *Journal of advanced pharmaceutical technology & research*, 11(7), p. 3099. doi: 10.5958/0974-360x.2018.00569.3.

6. Chandrasekar, R. *et al.* (2020) 'Development and validation of a formula for objective assessment of cervical vertebral bone age', *Progress in orthodontics*, 21(1), p. 38. doi:

10.1186/s40510-020-00338-0.

7. Chan, J. F. W. *et al.* (2012) 'Is the discovery of the novel human betacoronavirus 2c EMC/2012 (HCoV-EMC) the beginning of another SARS-like pandemic?', *The Journal of infection*, 65(6), pp. 477–489. doi: 10.1016/j.jinf.2012.10.002.

8. Chan, K. H. *et al.* (2011) 'The Effects of Temperature and Relative Humidity on the Viability of the SARS Coronavirus', *Advances in virology*, 2011, p. 734690. doi: 10.1155/2011/734690.

9. Denison, M. R. *et al.* (2011) 'Coronaviruses: an RNA proofreading machine regulates replication fidelity and diversity', *RNA biology*, 8(2), pp. 270–279. doi: 10.4161/rna.8.2.15013.

10. van Doremalen, N. *et al.* (2020) 'Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1', *The New England journal of medicine*, 382(16), pp. 1564–1567. doi: 10.1056/NEJMc2004973.

11. Duraisamy, R. *et al.* (2019) 'Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments', *Implant dentistry*, 28(3), pp. 289–295. doi: 10.1097/ID.0000000000000885.

12. Eckerle, L. D. *et al.* (2010) 'Infidelity of SARS-CoV Nsp14-exonuclease mutant virus replication is revealed by complete genome sequencing', *PLoS pathogens*, 6(5), p. e1000896. doi: 10.1371/journal.ppat.1000896.

13. Ezhilarasan, D. (2018) 'Oxidative stress is bane in chronic liver diseases: Clinical and experimental perspective', *Arab journal of gastroenterology: the official publication of the Pan-Arab Association of Gastroenterology*, 19(2), pp. 56–64. doi: 10.1016/j.ajg.2018.03.002.

14. Ezhilarasan, D., Apoorva, V. S. and Ashok Vardhan, N. (2019) 'Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(2), pp. 115–121. doi: 10.1111/jop.12806.

15. Ezhilarasan, D., Sokal, E. and Najimi, M. (2018) 'Hepatic fibrosis: It is time to go with hepatic stellate cell-specific therapeutic targets', *Hepatobiliary & pancreatic diseases international: HBPD INT*, 17(3), pp. 192–197. doi: 10.1016/j.hbpd.2018.04.003.

16. Geller, C., Varbanov, M. and Duval, R. E. (2012) 'Human coronaviruses: insights into environmental resistance and its influence on the development of new antiseptic strategies', *Viruses*, 4(11), pp. 3044–3068. doi: 10.3390/v4113044.

17. Gheena, S. and Ezhilarasan, D. (2019) 'Syringic acid triggers reactive oxygen species–mediated cytotoxicity in HepG2 cells', *Human & experimental toxicology*, 38(6), pp. 694–702. doi: 10.1177/0960327119839173.

18. Hach, J. C. *et al.* (2013) 'Palmitoylation on conserved and nonconserved cysteines of murine IFITM1 regulates its stability and anti-influenza A virus activity', *Journal of virology*, 87(17), pp. 9923–9927. doi: 10.1128/JVI.00621-13.

19. Hannah, R. *et al.* (2018) 'Awareness about the use, ethics and scope of dental photography among undergraduate dental students dentist behind the lens', *Journal of advanced pharmaceutical technology & research*, 11(3), p. 1012. doi: 10.5958/0974-360x.2018.00189.0.

20. Hema Shree, K. *et al.* (2019) 'Saliva as a Diagnostic Tool in Oral Squamous Cell Carcinoma - a Systematic Review with Meta Analysis', *Pathology oncology research: POR*, 25(2), pp. 447–453. doi: 10.1007/s12253-019-00588-2.

21. Henwood, A. F. (2020) 'Coronavirus disinfection in histopathology', *Journal of histotechnology*, pp. 1–3. doi: 10.1080/01478885.2020.1734718.

22. Hilgenfeld, R. and Peiris, M. (2013) 'From SARS to MERS: 10 years of research on highly pathogenic human coronaviruses', *Antiviral research*, 100(1), pp. 286–295. doi: 10.1016/j.antiviral.2013.08.015.

23. Hussainy, S. N. *et al.* (2018) 'Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up', *Journal of conservative dentistry: JCD*, 21(5), pp. 510–515. doi: 10.4103/JCD.JCD_51_18.

24. Janani, K., Palanivelu, A. and Sandhya, R. (2020) 'Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality: an in vivo study', *Brazilian dental science*, 23(1). doi: 10.14295/bds.2020.v23i1.1805.

25. Jeevanandan, G. and Govindaraju, L. (2018) 'Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: a double blinded randomised clinical trial', *European archives of paediatric dentistry: official journal of the European Academy of Paediatric Dentistry*, 19(4), pp. 273–278. doi: 10.1007/s40368-018-0356-6.

26. Johnson, J. *et al.* (2020) 'Computational identification of MiRNA-7110 from pulmonary arterial hypertension (PAH) ESTs: a new microRNA that links diabetes and PAH', *Hypertension research: official journal of the Japanese Society of Hypertension*, 43(4), pp. 360–362. doi: 10.1038/s41440-019-0369-5.

27. Jose, J., Ajitha and Subbaiyan, H. (2020) 'Different treatment modalities followed by dental practitioners for Ellis class 2 fracture – A questionnaire-based survey', *The open dentistry journal*, 14(1), pp. 59–65. doi: 10.2174/1874210602014010059.

28. Kannan, A. and Venugopalan, S. (2018) 'A systematic review on the effect of use of impregnated retraction cords on gingiva', *Journal of advanced pharmaceutical technology & research*, 11(5), p. 2121. doi: 10.5958/0974-360x.2018.00393.1.

29. Karthiga, P., Rajeshkumar, S. and Annadurai, G. (2018) 'Mechanism of Larvicidal Activity of Antimicrobial Silver Nanoparticles Synthesized Using Garcinia mangostana Bark Extract', *Journal of Cluster Science*, pp. 1233–1241. doi: 10.1007/s10876-018-1441-z.

30. Kumar, D. and Antony, S. D. P. (2018) 'Calcified canal and negotiation-A review', *Journal of advanced pharmaceutical technology & research*, 11(8), p. 3727. doi: 10.5958/0974-360x.2018.00683.2.

31. Lakshmi, T. *et al.* (2015) 'Azadirachta indica: A herbal panacea in dentistry - An update', *Pharmacognosy reviews*, 9(17), pp. 41–44. doi: 10.4103/0973-7847.156337.

32. Lakshmi, T., Ezhilarasan, D., Vijayaragavan, R., *et al.* (2017) 'Acacia catechu ethanolic bark extract induces apoptosis in human oral squamous carcinoma cells', *Journal of advanced pharmaceutical technology & research*, 8(4), pp. 143–149. doi: 10.4103/japtr.JAPTR_73_17.

33. Lakshmi, T., Ezhilarasan, D., Nagaich, U., *et al.* (2017) 'Acacia catechu Ethanolic Seed Extract Triggers Apoptosis of SCC-25 Cells', *Pharmacognosy magazine*, 13(Suppl 3), pp. S405–S411. doi: 10.4103/pm.pm_458_16.

34. Manohar, M. P. and Sharma, S. (2018) 'A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists', *Indian journal of dental research: official publication of Indian Society for Dental Research*, 29(6), pp. 716–720. doi: 10.4103/ijdr.IJDR_716_16.

35. Mathew, M. G. *et al.* (2020) 'Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial', *Clinical oral investigations*, pp. 1–6. Available at: https://link.springer.com/article/10.1007/s00784-020-03204-9.

36. Ma, Y. *et al.* (2015) 'Structural basis and functional analysis of the SARS coronavirus nsp14–nsp10 complex', *Proceedings of the National Academy of Sciences of the United States of America*, 112(30), pp. 9436–9441. doi: 10.1073/pnas.1508686112.

37. Mehta, M. *et al.* (2019) 'Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases', *Chemico-biological interactions*, 308, pp. 206–215. doi: 10.1016/j.cbi.2019.05.028.

38. Menon, S., Ks, S. D., R, S., *et al.* (2018) 'Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism', *Colloids and surfaces. B, Biointerfaces*, 170, pp. 280–292. doi: 10.1016/j.colsurfb.2018.06.006.

39. Menon, S., Ks, S. D., Santhiya, R., *et al.* (2018) 'Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism', *Colloids and Surfaces B: Biointerfaces*, pp. 280–292. doi: 10.1016/j.colsurfb.2018.06.006.

40. Morawska, L. and Cao, J. (2020) 'Airborne transmission of SARS-CoV-2: The world should face the reality', *Environment international*, 139, p. 105730. doi: 10.1016/j.envint.2020.105730.

41. Morens, D. M. and Fauci, A. S. (2013) 'Emerging infectious diseases: threats to human health and global stability', *PLoS pathogens*, 9(7), p. e1003467. doi: 10.1371/journal.ppat.1003467.

42. Muralidharan, N. *et al.* (2020) 'Computational studies of drug repurposing and synergism of lopinavir, oseltamivir and ritonavir binding with SARS-CoV-2 protease against COVID-19', *Journal of biomolecular structure & dynamics*, pp. 1–6. doi: 10.1080/07391102.2020.1752802.

43. Naddeo, V. and Liu, H. (2020) 'Editorial Perspectives: 2019 novel coronavirus (SARS-CoV-2): what is its fate in urban water cycle and how can the water research community respond?', *Environmental Science: Water Research & Technology*, 6(5), pp. 1213–1216. doi: 10.1039/D0EW90015J.

44. Nandakumar, M. and Nasim, I. (2018) 'Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis', *Journal of conservative dentistry: JCD*, 21(5), pp. 516–520. doi: 10.4103/JCD.JCD_110_18.

45. Nandhini, J. S. T., Babu, K. Y. and Mohanraj, K. G. (2018) 'Size, shape, prominence and localization of gerdy's tubercle in dry human tibial bones', *Journal of advanced pharmaceutical technology & research*, 11(8), p. 3604. doi: 10.5958/0974-360x.2018.00663.7.

46. Nkengasong, J. (2020) 'Author Correction: China's response to a novel coronavirus stands in stark contrast to the 2002 SARS outbreak response', *Nature medicine*, 26(3), p. 441. doi: 10.1038/s41591-020-0816-5.

47. Otter, J. A. *et al.* (2016) 'Transmission of SARS and MERS coronaviruses and influenza virus in healthcare settings: the possible role of dry surface contamination', *The Journal of hospital infection*, 92(3), pp. 235–250. doi: 10.1016/j.jhin.2015.08.027.

48. Ou, J. *et al.* (2020) 'RBD mutations from circulating SARS-CoV-2 strains enhance the structural stability and human ACE2 affinity of the spike protein', *bioRxiv*. Available at: https://www.biorxiv.org/content/10.1101/2020.03.15.991844v2.abstract.

49. Pc, J., Marimuthu, T. and Devadoss, P. (2018) 'Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study', *Clinical implant dentistry and related research*. Available at: https://europepmc.org/article/med/29624863.

50. Perumalsamy, H. *et al.* (2018) 'In silico and in vitro analysis of coumarin derivative induced anticancer effects by undergoing intrinsic pathway mediated apoptosis in human stomach cancer', *Phytomedicine: international journal of phytotherapy and phytopharmacology*, 46, pp. 119–130. doi:

10.1016/j.phymed.2018.04.021.

51. Pica, N. and Bouvier, N. M. (2012) 'Environmental factors affecting the transmission of respiratory viruses', *Current opinion in virology*, 2(1), pp. 90–95. doi: 10.1016/j.coviro.2011.12.003.

52. Rabenau, H. F. *et al.* (2005) 'Stability and inactivation of SARS coronavirus', *Medical microbiology and immunology*, 194(1-2), pp. 1–6. doi: 10.1007/s00430-004-0219-0.

53. Rajakeerthi and Ms, N. (2019) 'Natural Product as the Storage medium for an avulsed tooth – A Systematic Review', *Cumhuriyet Üniversitesi Diş Hekimliği Fakültesi dergisi*, 22(2), pp. 249–256. doi: 10.7126/cumudj.525182.

54. Rajendran, R. *et al.* (2019) 'Comparative evaluation of remineralizing potential of a paste containing bioactive glass and a topical cream containing casein phosphopeptide-amorphous calcium phosphate: An in vitro study', *Pesquisa brasileira em odontopediatria e clinica integrada*, 19(1), pp. 1–10. doi: 10.4034/pboci.2019.191.61.

55. Rajeshkumar, S., Kumar, S. V., *et al.* (2018) 'Biosynthesis of zinc oxide nanoparticles usingMangifera indica leaves and evaluation of their antioxidant and cytotoxic properties in lung cancer (A549) cells', *Enzyme and microbial technology*, 117, pp. 91–95. doi: 10.1016/j.enzmictec.2018.06.009.

56. Rajeshkumar, S., Agarwal, H., *et al.* (2018) 'Brassica oleracea mediated synthesis of zinc oxide nanoparticles and its antibacterial activity against pathogenic bacteria', *Asian Journal of Chemistry*, 30(12), pp. 2711–2715.

57. Ramadurai, N. *et al.* (2019) 'Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial', *Clinical oral investigations*, 23(9), pp. 3543–3550. doi: 10.1007/s00784-018-2775-5.

58. Ramesh, A. *et al.* (2018) 'Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study', *Journal of periodontology*, 89(10), pp. 1241–1248. doi: 10.1002/JPER.17-0445.

59. Ravinthar, K. and Jayalakshmi (2018) 'Recent advancements in laminates and veneers in dentistry', *Journal of advanced pharmaceutical technology & research*, 11(2), p. 785. doi: 10.5958/0974-360x.2018.00148.8.

60. Ren, S.-Y. *et al.* (2020) 'Stability and infectivity of coronaviruses in inanimate environments', *World journal of clinical cases*, 8(8), pp. 1391–1399. doi: 10.12998/wjcc.v8.i8.1391.

61. R, H. *et al.* (2020) 'CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene', *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, pp. 306–312. doi: 10.1016/j.oooo.2020.06.021.

62. Samuel, S. R. (2021) 'Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life?', *International*

journal of paediatric dentistry / the British Paedodontic Society [and] the International Association of Dentistry for Children, 31(2), pp. 285–286. doi: 10.1111/ipd.12662.

63. Sekar, D. *et al.* (2019) 'Methylation-dependent circulating microRNA 510 in preeclampsia patients', *Hypertension research: official journal of the Japanese Society of Hypertension*, 42(10), pp. 1647–1648. doi: 10.1038/s41440-019-0269-8.

64. Seppan, P. *et al.* (2018) 'Therapeutic potential of Mucuna pruriens (Linn.) on ageing induced damage in dorsal nerve of the penis and its implication on erectile function: an experimental study using albino rats', *The aging male: the official journal of the International Society for the Study of the Aging Male*, pp. 1–14. doi: 10.1080/13685538.2018.1439005.

65. Sharma, P. *et al.* (2019) 'Emerging trends in the novel drug delivery approaches for the treatment of lung cancer', *Chemico-biological interactions*, 309, p. 108720. doi: 10.1016/j.cbi.2019.06.033.

66. Siddique, R. *et al.* (2019) 'Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi', *Journal of conservative dentistry: JCD*, 22(1), pp. 40–47. doi: 10.4103/JCD.JCD_284_18.

67. Song, F. *et al.* (2013) 'Middle East respiratory syndrome coronavirus spike protein delivered by modified vaccinia virus Ankara efficiently induces virus-neutralizing antibodies', *Journal of virology*, 87(21), pp. 11950–11954. doi: 10.1128/JVI.01672-13.

68. Sridharan, G. *et al.* (2019) 'Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(4), pp. 299–306. doi: 10.1111/jop.12835.

69. Swetha, I., Priya, V. V. and Gayathri, R. (2018) 'Benefits of herbal medicine in oral care', *Drug Invention Today*. Available at: http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=130629140&h=7AqkyaGzTFe1mmIu7TQKyoDQZAfdOyEfqOv%2FtJrThwQbgcX4nkr9bfz1S%2B1EbIwzHH4UsI1oq1ZvU0TRaybPeQ%3D%3D&crl=c.

70. Teja, K. V., Ramesh, S. and Priya, V. (2018) 'Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study', *Journal of conservative dentistry: JCD*, 21(6), pp. 592–596. doi: 10.4103/JCD.JCD_154_18.

71. Tollefson, S. J., Cox, R. G. and Williams, J. V. (2010) 'Studies of culture conditions and environmental stability of human metapneumovirus', *Virus research*, 151(1), pp. 54–59. doi: 10.1016/j.virusres.2010.03.018.

72. Vijayashree Priyadharsini, J. (2019) 'In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens', *Journal of periodontology*, 90(12), pp. 1441–1448. doi:

10.1002/JPER.18-0673.

73. Vijayashree Priyadharsini, J., Smiline Girija, A. S. and Paramasivam, A. (2018) 'In silico analysis of virulence genes in an emerging dental pathogen A. baumannii and related species', *Archives of oral biology*, 94, pp. 93–98. doi: 10.1016/j.archoralbio.2018.07.001.

74. Warnakulasuriya, S. and Muthukrishnan, A. (2018) 'Oral health consequences of smokeless tobacco use', *Indian Journal of Medical Research*, p. 35. doi: 10.4103/ijmr.ijmr_1793_17.

75. Yi, Y. *et al.* (2020) 'COVID-19: what has been learned and to be learned about the novel coronavirus disease', *International journal of biological sciences*, 16(10), pp. 1753–1766. doi: 10.7150/ijbs.45134.