IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

Review of Ecological impactof increased hand soap utilization during COVID-19 pandemic

Smt. M.R. Chaya

Dept. Of Chemistry, KLES S. Nijalingappa College

Abstract:

A novel coronavirus was identified as the cause of a cluster of pneumonia cases in Wuhan, a city in the Hubei Province of China. Covid rapidly spread throughout China, resulting in a global pandemic. This Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic was partially prevented by frequent hand washing with soap as it was recommended by World Health Organisation (WHO). This made extraordinary surge in demand for hand washing products has led to environmental concerns. Therefore, the review aims to highlight the health and environmental concerns associated with the frequent use of hand washing products amid COVID-19. Synthetic petrochemical soaps are threat to the environment. Therefore the need for eco-friendly alternative hand washing productsare emphasised in this paper.In this article, several natural hand washing soaps eco-friendly alternatives to petrochemical-based soaps for hand hygiene are presented. The market for hand washing soaps is expected to grow significantly in the coming years, and hence, future research should be geared towards developing the right products.

Keywords: Coronavirus disease 2019, Biodegradable eco-friendly hand washing soap, Environmental pollution, Packaging waste, Water pollution, Sustainable solution

1. Introduction:

The epidemic coronavirus disease 2019 (COVID-19) poses severe global health challenges and adversely impacts human life quality.The World Health Organization (WHO) also declared COVID-19 as a global pandemic. This pandemic has already resulted in extreme societal, economic and political disruption worldwide[1].

Encouraging hand hygiene was one of the most cost-effective means of reducing the global burden of disease. Simple soap is one of most effective weapons against the coronavirus. Hand washing was demonstrated to reduce transmission by 45–55%[2]. The primary method of preventing infection spread in communities and healthcare facilities is washing hands with s oap and hand disinfectants..These products are most effective and affordable way to stop viruses. Hand washing with water and soap has been the "gold standard" method of eliminating most transient and resident microorganisms[3].

Synthetic soaps are also called as Syndets are substituents are natural soaps. Today Syndets dominate the market and have taken over ordinary soaps.Theyare manufactured synthetically and composed of non- biodegradable ingredients and cause the environmental contamination. They are threat to aquatic species and pollute the water of ponds and rivers to the extent that it becomes non-usable.As soaps are complex mixtures of toxic and persistent ingredients, it is prudent to promote eco-friendly replacements.This forces us to find alternative eco sustainable hand hygiene products. Solid waste associated with these products in packaging and managing the waste is also other changeling task.

2. Chemistry of Hand washes:

Mankind has been using soap for thousands of years. Soaps are sodium or potassium salt of fatty acids, which is formed via neutralization reaction.Soaps are the products of hydrolysis of oils and fats with sodium hydroxide, or lye. This process is known as saponification. The oils or fats are hydrolysed by the lye, yielding fatty acids and glycerol. The fats and oils used to make soap are made up of triglycerides. Triglycerides are esters of glycerol with three fatty acid molecules. The other major component of soap is lye, an alkali or a base. There are two major types of lye: sodium hydroxide (NaOH, caustic soda), and potassium hydroxide (KOH, or caustic potash). Sodium hydroxide is used for making solid soap bars. Whereas potassium hydroxide utilized for making liquid soaps.

A soap molecule has a tadpole shaped structure, whose ends have different polarities. The long hydrocarbon chain is non-polar and hydrophobic, i.e., insoluble in water but oil soluble at one end. By contrast, the short polar carboxylate ion is hydrophilic, i.e., soluble in water but insoluble in oil and grease. When soap is shook with water, it becomes a colloidal soap solution.The action of agitating the solution causes foaming. This allows the soap molecules to develop a unimolecular film on the surface of water and to penetrate the skin. The hydrophobic nonpolar end of the soap molecule attracts and adheres to the surface of the water [4].

Water repellent hydrophobic tails wedge themselves into the lipid envelops of microbes and viruses In trying to avoid water, the hydrophobic tails wedge themselves into the lipid envelopes of the microbes and viruses, disrupting them and destroying them.As soap molecules cluster together, they enclose microbes and viruses, forming micelles that enclose such particles and dissolve them. Mechanical action, like rubbing or tumbling, dislodges the microbes and viruses.Excess water removes these and leaves the skin clean. Soap also disrupts the chemical bonds that allow bacteria and viruses to stick to surfaces, making them easier to wash away[5].

3. Active ingredients of hand washes:

Hand sanitizers are not so activate to remove viruses that stick to surfaces compared to hand soaps. As well as its cleaning properties, an excellent soap should offer other features, such as good lathering performance, low skin irritation, physical and chemical stability, easy risibility from skin and bathtub, homogeneous and uniform structure, and reasonable erosion rates and good resistance to cracking[6].

Hand washes are formulated from fats, petroleum, and oil-based products using a mixture of sulfonation, ethoxylation, and esterification processes[7]. A wide range of ingredients may be used to design hand wash with different characteristics of quality, odour, colour, shape, and packaging design. The three major components of hand soaps are Surfactants, Builders, and Additives. The major component of hand wash is surfactants which reduces the surface tension of the water, increases the wettability, and increases the emulsification property. Dodecyl Benzene sulphate (DDBS), Linear Alkyl Benzene Sulphate (LABS), Alcohol Ethoxylate (AE), Alkyl (or Alcohol) Ethoxy Sulphate (AES), Alkyl Sulphate (AS) and Amine Oxide are used as surfactants. Builders are used to treat the water to improve surfactant performance. Sodium Lauryl Sulfate(SLS) and Sodium Tri poly phosphate(STPP**)** are used as foam booster.Liquid soaps require five times more energy to produce as they require bleaches, bleach activators, antistatic agents, fabric softeners, optical brighteners, anti-desorption agents, and fillers

.4. Comparison of natural and synthetic hand washes:

Based on the ingredients, chemical composition, hand washes are categorized into two broad groupings: natural and synthetic. Natural hand wash does not cause pollution as it can be digested by certain bacteria present in the sewage water.Natural hand wash primarily contains oils and fats which were originating from plants or animals without any additional components.Most natural hand wash are more ecofriendly and they do not produce toxic waste and byproducts, and they use less energy during production; therefore, they are more environmentally friendly.Synthetic soaps containsynthetic surfactants, plasticizers, binders, dyestuffs, fragrances, and other additives. Bacteria present in the sewage water are not able to degrade synthetic components and hence cause pollution. This is due to surfactants used in the production of Synthetic soaps.

5. Threat to Environment:

Hand washing habits increased significantly since the COVID-19 outbreak since nodrugs or vaccines available, non-pharmaceutical intervention like handwashing was recommended as the first line of protection against COVID-19[8,9].For preventing Coronavirus spread, hand washing is a vital public health measure recommended by WHO. The coronavirus outbreak has led to an unprecedented impact on hand soap markets globally. Significant increase in consumption of hand washes as cleaning products during the COVID-19.Google searches for “washing hands” have increased indicating the need for public information and guidelines related to hand hygiene[10]. The pandemic has also spurred people to stockpile and panic buy hand soaps.

Synthetic soaps containsynthetic surfactants, plasticizers, binders, dyestuffs, fragrances, and other additives. Bacteria present in the sewage water are not able to degrade synthetic components and hence cause pollution. This is due to surfactants used in the production of Synthetic soaps. Most of the residual surfactants are eliminated through sewage systems or directly into surface waters after use, and they end up dispersed in different environmental compartments such as soil, water and sediment.Chemical soaps are resistant to biological action and their elimination from sewage waste water by usual treatment presents a problem. They tend to produce stable foams in rivers, which may pose a threat to aquatic life.Theyforms an enclosing effect around organic substances present in waste water, inhibiting their oxidation.

Synthetic soapcontains approximately 35% to 75% phosphate salts. Phosphates are used as builders as they easily removed the hard water ions present in water. Phosphates can cause a variety of water pollution problems. Phosphate tends to inhibit the biodegradation of organic substances. Algae love to eat phosphates. High concentration of phosphate resulting from nitrification can lead to Eutrophication. During eutrophication is the growth of algae in the lake increases. Algae consume all the nutrients in the water and choke off the pond or stream so that no light can reach the bottom. This kills all the plants and fish in the pond or stream.

According to WHO, each person should wash hands at least five times per day, each time for almost 20–30s. If the tap is closed, a single hand washing with rubbing soap consumes almost 2 litres of water, and this amount can reach 4 litres when the tap is kept open. During use of liquid soaps the entire amount (100%) of product chemical ingredients are disposed down the drain with the wastewater. The substantial water consumption can lead to an increase in wastewater generation by 15-18%, which reduces water quality because the wastewater is contaminated with soap surfactants.

When water is discharged directly into freshwater bodies without treatment, it might contaminate the environment and harm human health. This situation poses problems during wastewater treatment.[11]. Emission of loads chemical ingredients to the aquatic environment leads to Eco toxicological impacts. Waste water purification plants operating primary and secondary treatment with subsequent phosphate elimination and sludge incineration by applying chemical-specific elimination to the freshwater environment. Waste water parameters, such as total organic carbon (TOC), total nitrogen, total phosphorous, and total sulphur also impact on environment.

The additional ingredients such as antibacterial and antifungal agents, such as triclosan (TCS), triclocarban (TCC), fragrances, and preservatives, used in hand wash products result in severe health concerns for humans and the ecosystem. Disposal of these chemical elements contaminates the aquatic environment.

Packaging disposal is another major threat to the environment.Packaging is necessary to avoid product leakage, to ensure safe use, to protect products during transport. The Central Pollution Control Board reported in 2013 that approximately eight million tonnes of plastic are consumed annually. Furthermore, nearly 70 percent of plastic packaging is transformed into waste.As a result, it becomes part of the annual plastic waste production of 5.6 million tonnes.The environmental impact of liquid soaps and their associated packaging includes carbon footprint, Eco toxicity, ozone depletion potential, and eutrophication potential. Primary packaging used for hand washes consists of PET bottles, LDPE plastic bags and bottles. Secondary and tertiary packaging materials such as corrugated board and polyethylene film required for product handling and distribution were additionally considered. The liquid soaps are additionally offered as refill products. Refill packages of liquid soap consist of plastic stand-up pouches produced from PET (15%) and LDPE (85%).From raw material production to packaging production, liquid soaps use five times more energy than bar soaps.All packaging materials, including the total amount of plastic, paper and cardboard packaging were assumed to be combusted in a solid waste plant which will incinerate or remain as landfilling. Packaging needs to be collected and disposed of properly in order to be recycled properly and to avoid adverse environmental impacts.As the COVID-19 pandemic has drastically alter waste recycling activities, eco-friendly management and handling of packaging waste can help address the challenge faced by the waste management industry[12].

Life-cycle impact assessment of these products influences on energy consumption. Cumulative fossil energy demand (CED fossil) is the total amount of power used in extracting, manufacturing, using, and disposing fossil fuels. Thus, this primary energy indicator encompasses fossil feedstock, all process energy needed within the entire production chain, and packaging supply chain, as well as grey energy embodied in plant infrastructure.

6. A sustainable solution: Biodegradable hand soap:

Soap is the most widely used surfactant during the covid-19. Increased synthetic hand washing has led to the release and accumulation of potentially toxic components into the environment. These soaps are categorized into two broad groupings: Natural and Synthetic. The difference between them is not in their washing ability but in their production either from natural oils and fats or from petrochemical[13]. Natural soap is considered to have a natural origin if its formulas comprise vegetable oils and animal fats. Synthetic soap is mainly petroleum-based hardly biodegradable, and has a high aquatic toxicity potential[14].

Considering all the above facts about synthetic soap based products there isnecessary to find alternatives for producing more sustainable and safer soaps that are made from natural materials and can decompose over time.

Since biodegradable soaps are made of natural materials, they will naturally decompose over time. need to find alternative solutions for producing more sustainable and safer soaps that entail a minimum environmental impact and can be formulated with biodegradable materials. Since biodegradable soaps are made of natural materials, they will naturally decompose over time. Therefore, these soaps are an optimal alternative to synthetic soaps for their selectivity, structural diversity, good performance in extreme conditions, mass production potential via fermentation, environmentally-friendly nature[15]. Bio surfactants are safe and obtained from plant resources, spices, vegetables, culinary herbs, and agro-industry by-products of oil seeds and fruits, containing high levels of phenolics and other active ingredients. This makes them a good option in pharmaceutical and biomedical domains[16].

7. Conclusion:

Industries should gradually move toward developing sustainable hygiene products with the focus on natural and non-synthetic chemicals, biodegradable and non-toxic ingredients, natural compounds for antimicrobial purposes, and reusable and recyclable packaging materials. For the production of soaps and soap packaging, industry and research organizations need to find eco- and economically sustainable materials that significantly reduce the environmental impacts and decrease the risk of hazardous waste entering the wastewater system.

References:

1. Zambrano-Monserrate M.A., Ruano M.A., Sanchez-Alcalde L. Indirect effects of COVID-19 on the environment. Sci. Total Environ. 2020;728
2. Teymourian T., Teymoorian T., Kowsari E., Ramakrishna S. Challenges, strategies, and recommendations for the huge surge in plastic and medical waste during the global COVID-19 pandemic with circular economy approach. Mater. Circ. Econ. 2021;3(1):1–14.
3. Jefferson T., Del Mar C., Dooley L., Ferroni E., Al-Ansary L.A., Bawazeer G.A., Van Driel M.L., Foxlee R., Rivetti A. Physical interventions to interrupt or reduce the spread of respiratory viruses: systematic review. Bmj. 2009;339
4. Foddai A.C., Grant I.R., Dean M. Efficacy of instant hand sanitizers against foodborne pathogens compared with hand washing with soap and water in food preparation settings: a systematic review. J. Food Prot. 2016;79(6):1040–1054.
5. Schmidt C.W. Lack of Handwashing access: a widespread deficiency in the age of COVID-19. Environ. Health Perspect. 2020;128(6)
6. Chemistry, formulation, and performance of Syndet and combo bars Soap Manufacturing Technology, Elsevier (2016), pp. 73-106
7. Personal cleanser technology and clinical performance Dermatol. Ther., 17 (2004), pp. 35-42
8. WHO (World Health Organization) (2020b) Basic protective measures against the new coronavirus. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public. Accessed 14 Sep 2020.
9. WHO (World Health Organization) & UNICEF (United Nations Children's Fund) (2020) Water, sanitation, hygiene and waste management for the COVID-19 virus: interim guidance, 19 March 2020. World Health Organization. https://apps.who.int/iris/handle/10665/331499 License: CC BY-NC-SA 3.0 IGO. Accessed 20 Sep 2020

10. Lin Y-H, Liu C-H, Chiu Y-C (2020) Google searches for the keywords of "wash hands" predicts the speed of national spread of COVID-19 outbreak among 21 countries. Brain BehavImmun 87:30–32. https://doi.org/10.1016/j.bbi.2020.04.020
11. D.M. JuelaQuintuña Estimated Impact of COVID-19 on Water Needs and Volume and Quality of Wastewater Available at SSRN 3651551(2020)Google Scholar
12. M. Ragazzi, E.C. Rada, M. Schiavon Municipal solid waste management during the SARS-COVID-2 outbreak and lockdown ease: lessons from ItalySci. Total Environ., 745 (2020), Article 141159
13. R. Tesser, R. Vitiello, V. Russo, R. Turco, M. Di Serio, L. Lin, C. Li Oleochemistry products, Industrial Oil Plant, Springer (2020), pp. 201-268
14. M. Deleu, M. Paquot From renewable vegetables resources to microorganisms: new trends in surfactants ComptesRendusChimie, 7 (6–7) (2004), pp. 641-646
15. K.V. Sajna, R. Höfer, R.K. Sukumaran, L.D. Gottumukkala, A. PandeyWhite biotechnology in biosurfactants Industrial Biorefineries& White Biotechnology, Elsevier (2015), pp. 499-521
16. O. Adigun, C. Manful, N. Prieto Vidal, A. Mumtaz, T.H. Pham, P. Stewart, M. Nadeem, D. Keough, R. Thomas Use of natural antioxidants from newfoundland wild berries to improve the shelf life of natural herbal soaps Antioxidants, 8 (11) (2019), p. 536