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Systematic Review on Respiratory Toxicology Caused by Synthetic Air Fresheners

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Abstract: ***The main objective of this comprehensive review research on the various kinds of respiratory illness caused by the synthetic air fresheners. Air fresheners are widely used in indoor built environmental settings such as businesses, schools, residences, transit, hotels, hospitals, care facilities, and a variety of private and governmental structures. In order to create a comfortable indoor atmosphere, air fresheners are made to add aroma to the air or to cover up odours. Air fresheners, however, can produce and emit a variety of potentially toxic air pollutants that can deteriorate air quality, regardless of their intended use. Volatile organic compounds (VOCs) found in air fresheners include ones that may be harmful air pollutants, carcinogens, or substances linked to adverse health consequences including asthma, COPD and so on.***
Air fresheners have been identified as a major source of volatile organic compounds in buildings from the perspective of indoor air quality. Air fresheners have been linked to negative health impacts include neonatal illness, asthma symptoms, mucosal symptoms, migraine headaches, and breathing problems. In this research review we mainly focused on synthetic air freshener, emits various kinds of VOC's that caused different types of respiratory illness.
This review also investigates a paradoxical effect that the synthetic air fresheners meant to enhance indoor environments may also present unanticipated & unidentified risk. Finally, we discussed about the International and National market size of the air freshener.
Keywords: Synthetic air freshener, VOC's, Respiratory diseases, Indoor air quality.

I. EVIDENCES OF VOC'S PRESENTED IN AIR FRESHENERS

Air fresheners are consumer products that disperse perfumes into a space to either enhance aroma or cover up odours, or both. Sprays, gels, oils, liquids, solids, plugins, hanging discs, beads, potpourri, wick diffusers, and scented candles are just a few of the numerous varieties of air fresheners that are available in the market.

They can also be active or passive, and have rapid, intermittent, or continuous release capabilities. Also included in the category of air fresheners are products marketed as air care, deodorizer, odour removal, and neutralizer (1,2). Air fresheners can include fragrant air systems, which disperse fragrance across a place in addition to site-specific units or portable products. One such method is to link a fragrance diffuser to the HVAC system.

Any kind of consumer products with fragrances, like cleaning liquid, air fresheners, and products for personal care can release a variety of air pollutants and have a negative impact on human's health. Indoor building settings like offices, schools, residences, public transit, hotels, hospitals, care facilities, and a variety of private and public buildings all of us have air fresheners. In order to create a comfortable indoor atmosphere, air fresheners are manufactured to add aroma to the air or to cover up odours. Air fresheners, however, can produce and emit a variety of potential hazardous airborne pollutants that can deteriorate air quality, despite of their intended use.

Due to regulatory safeguards for consumer product components and fragrance formulations, the majority of air freshener substances are unknown and not disclosed. Less than 10% of all volatile components, according to research, are usually listed on the labels or material safety data sheets for air fresheners (3).

More than 100 known chemicals, including ethanol, formaldehyde, benzene, toluene, and xylene, as well as semi-volatile organic compounds (terpenes like limonene, alphapinene, and beta-pinene) and terpenoids like linalool and alphaterpineol, are released by air fresheners (such as phthalates) shown in Figure 1.

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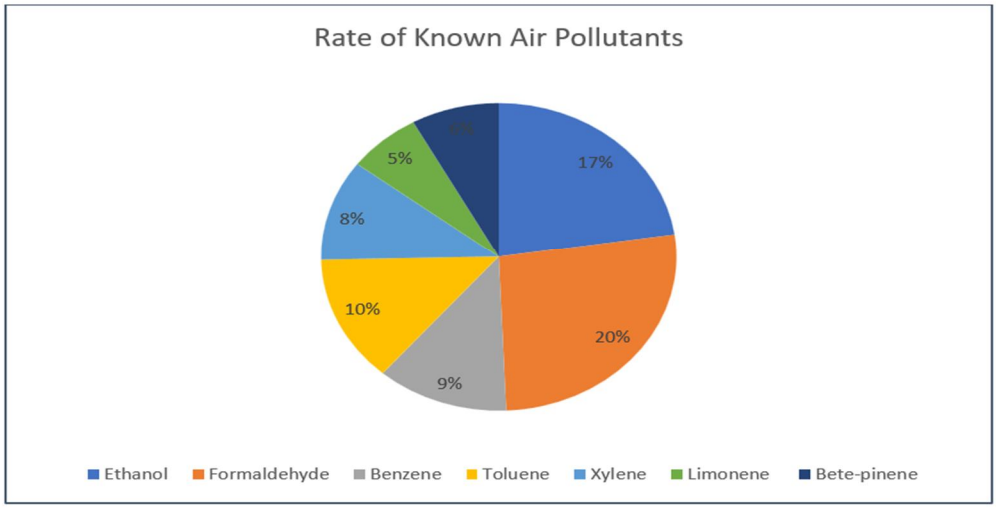


Figure 1 shows a rate of known air pollutants

Indoor oxidants such as ozone (O3), hydroxyl radicals (OH), and nitrate radicals (NO3) can also react with air freshener emissions to produce a wide range of oxidation products. For example, primary emissions like terpenes are easily converted into secondary pollutants like formaldehyde and acetaldehyde, glycol ethers, free radicals (including hydroperoxyl and alkyl peroxy radicals), and ultrafine particles when they combine with ozone. Ingredient concentrations, reactive chemistry, product use, and product composition all have an impact on secondary pollutant emissions. Researchers from all over the world have investigated air freshener product emissions (4,5). The results of the research that studied different forms of air fresheners (e.g., sprays, gels, solids, discs, oils, cartridges, diffusers, evaporators; both active and passive), Following are the categories for fragranced products: Personal care products such as soaps, hand sanitizer, lotions, deodorant, sunscreen, and shampoos; cleaning supplies such as all-purpose cleaners, disinfectants, and dishwashing soap; laundry products such as detergents, fabric softeners, and dryer sheets; household items such as scented candles, toilet paper, trash bags, and baby products; and fragrances such as perfume, and cologne show that all types of air fresheners have the ability to release significant amounts of volatile organic compounds. The fragrance mixture's composition is likely to have a greater impact on emissions than the type of delivery system. A comprehensive taxonomy of air freshener emissions would be intriguing but practically impossible given the numerous diverse air freshener types, brands, and component compositions, as well as limitations on ingredient disclosure. However, data from a few research is included to describe typical product emissions and rates. German researchers studying the effects of air fresheners in a chamber shown in figure 2 discovered that the following compounds had the highest emissions after one hour (mg/unit h): ethanol, 35,532; dipropylene glycol mono methyl ether acetate, 12,337; limonene, 9132; 2-propanol, 5690; 3-methoxy-3-methyl-1-butanol, 4763; benzyl acetate, 3920; dihydromyrcenol These include linalool and limonene, which are noted as possible allergens (6,7).

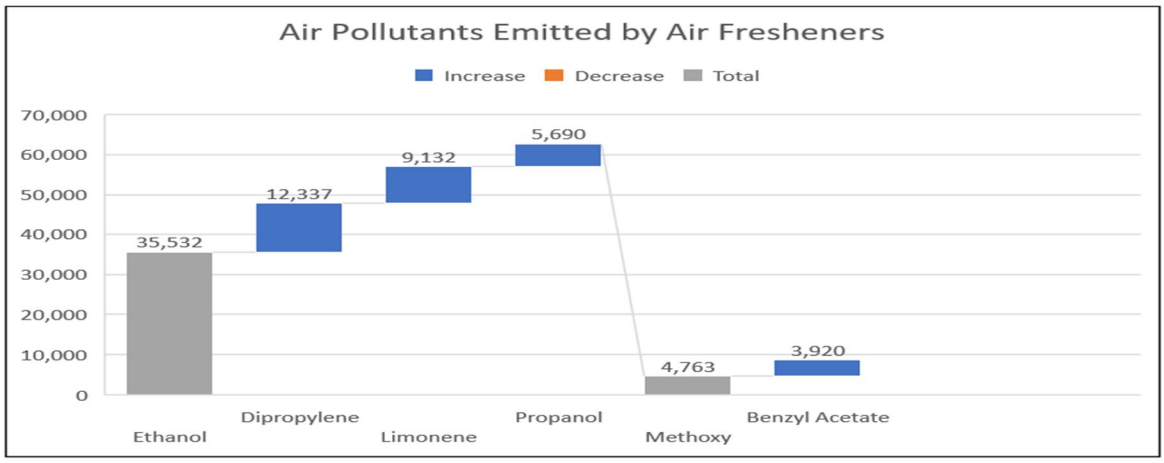


Figure 2 shows an air pollutant emitted by air fresheners

Air fresheners have been identified as a major source of volatile organic compounds in buildings from the perspective of indoor air quality. In a US research of VOC emissions from air fresheners, including sprays, gels, solids, discs, and oils, the following VOCs were found to be the most prevalent (in at least half of the products): Alpha-pinene, beta-pinene, 1-butanol, 3-methyl-, acetate, 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde (Triplal 1), limonene, acetone, and 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde (Triplalextra) beta-phellandrene, ethanol, the carene isomer, o, m, or p-cymene, and All of the air fresheners tested released one or more of the roughly one-fourth of VOCs that are categorised as potentially dangerous or harmful under one or more federal statutes in the US (8,10). Air fresheners have been linked to negative health impacts include neonatal illness, asthma symptoms, mucosal symptoms, migraine headaches, and respiratory problems (9). The following categories describe the health impacts of using air fresheners: migraine headaches, asthma attacks, neurological issues (such as tremors, convulsions, head pain, loss of coordination), respiratory issues (such as wheezing, shortness of breath), skin issues (such as rashes, hives, red skin, tingling skin, dermatitis), cognitive issues (such as difficulty thinking, concentrating, or remembering), mucosal symptoms (such as watery or red eyes, nasal congestion, sneezing), and immune system difficulties.

II. RESPIRATORY ILLNESS CAUSED BY INHALING THE AIR FRESHENER

There is growing concern about the health consequences of ambient air freshener. One of the main ambient air fresheners, are released from a variety of volatile organic compounds (VOCs) during daily routines and cause respiratory illness like asthma, COPD, sleep apnea and so on shown in figure 3. Asthma symptoms may severe and it affects upper- & lower-respiratory track symptoms and it caused by exposure of VOCs. Even though some experimental evidence suggests that oxidative stress may have an impact in VOC toxicity, the exact mechanisms still need to be determined (11). Due to the fact that it not only indicates a person's respiratory health condition but also forecasts cardiovascular morbidity and mortality in the general population, the decline of pulmonary function has emerged as one of the most crucial issues addressing the health effects of air freshener. One of the sensory functions is nose (smell) as a pathway to the rest of the respiratory system, which regulates both the air that is inhaled (by, for example, warming, humidifying, and cleaning it) and the air that is exhaled (e.g., dehumidification) (12,13). The nose also contains receptors that are essential for the trigeminal nerve, pheromone detection, and the sense of smell. Olfactory receptors are present on the olfactory receptor cells, which are responsible for detecting inhaled odorant molecules.

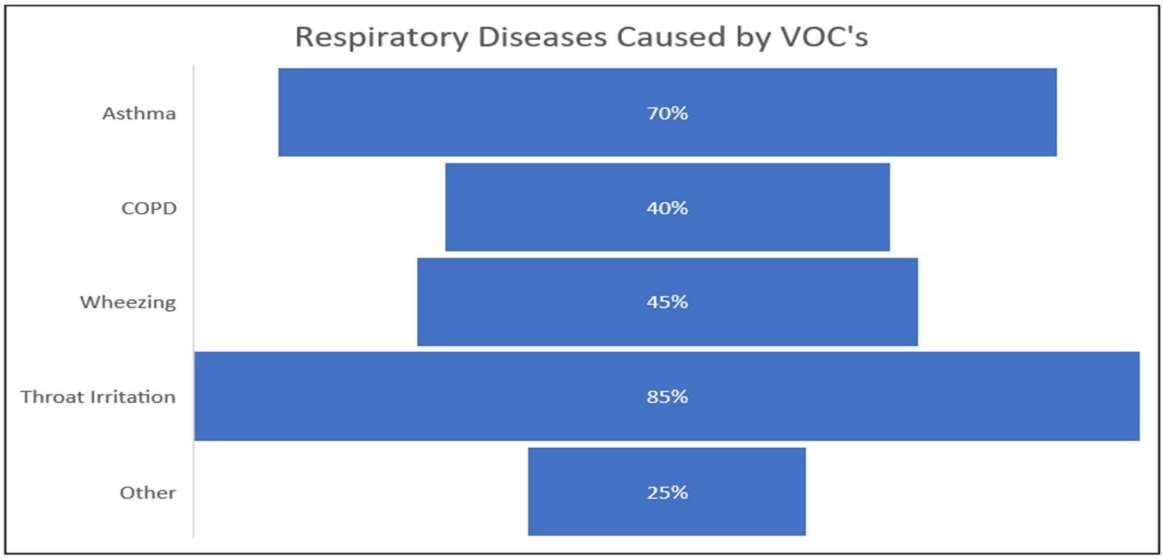


Figure 3 shows a respiratory disease caused by VOC's

Olfactory abnormalities are linked to a lower quality of life, depression, and other negative effects in people. Several respiratory investigations shows that each olfactory receptor cell has a single type of odorant receptor and that each receptor can only detect a certain set of odorant molecules. Each olfactory receptor cell is hence highly specialised for a small number of smells. The olfactory bulb then combines data from several olfactory sensors to create a pattern (14). In contrast to dyssomnia, which is more common in clinical groups but less common in general populations, epidemiological studies reveal that loss of smell sensitivity is widespread in both general and clinical populations.

The most frequent etiologist of dyssomnia include head trauma, nasal and sinus illness, and post-upper respiratory infections. Exposure to toxicants is another potential issue. Nasal immunopathology, sensory irritability, olfactory and trigeminal nerve toxicity, chemically induced nasal lesions, human and animal carcinogenesis, and olfactory and trigeminal nerve toxicity are health hazards associated with inhaled nasal toxicants (14,15). The majority of odorants as well as numerous olfactory pollutants infiltrate the inspired air and go to the olfactory mucosa. Internal nasal anatomy and inspiratory airflow rate, which is a result of the inspiratory cycle, work together to shape the nasal airflow patterns. According to research reports, odour detection thresholds in people and animals are typically in the picomolar range. By stimulating the olfactorily and trigeminal nerve systems, the nose and airways detect VOCs that resemble smells or odours; occasionally, it is difficult to tell if a VOC (or combination of VOCs) is only experienced as an odour or whether it is also detected as a sensory irritant, or both. A recent study conducted a series of events to test the respiratory rate for the people who are using an air freshener, over the weekend at the American College of Allergy Asthma and Immunology's annual conference (ACAAI). Volatile organic compounds (VOCs), which include formaldehyde, petroleum distillates, limonene, esters, and alcohols, are frequently found in indoor air fragrance product and releases a VOC, VOC's exposures can raise a child's risk of asthma and other respiratory diseases (16,18). A VOC's odour will be perceived beyond its olfaction threshold but below its sensory irritation threshold. Inducing sensations like burning, irritation, itching, pain, and stinging in the eyes, nose, and generally also olfaction, sensory irritation is a receptor-mediated process by trigeminal stimulation (chemesthesis). Irritating substances can also cause signs like eye redness, an increase in the frequency of eye blinking, edoema, and pruritus.

VOC exposure is associated with a variety of adverse health implications. VOCs have a high level of reactivity with the mucous membrane and epithelial lining of the respiratory system, including propylene glycol and glycol ethers (PG), benzene, and formaldehyde. Mucin, a polymer of glycoproteins that is rich in amine groups, makes up the mucous membrane (17,20). The C-O polar bonds that are frequently present in VOCs react with these amine-rich areas' nucleophilic sites. Since that the pattern composition of VOCs reflects cellular metabolism, activities like their adsorption, distribution, metabolism, and excretion can be altered under pathological conditions. A double-bonded C-N group is created as a result of a series of intramolecular events, which cross-links with other mucin molecules that are comparable. An antigen material produced by this chemical reaction is recognised by IgE antibodies, which in turn sets off an inflammatory response that is the main contributor to airway inflammation. Mucin compounds are frequently found in the oesophagus lining and eyes, two areas where irritation and dry skin are commonly observed. Since that the pattern composition of VOCs reflects cellular metabolism, activities like their adsorption, distribution, metabolism, and excretion can be altered under pathological conditions (19). Indeed, a number of research showed a connection between variations in VOCs and gene mutations, oxidative stress, angiogenesis, and Warburg effect. Additionally, variations in the microenvironment or an inflammatory state may have an impact on the composition of VOCs.

III. IS THERE ANY POSSIBLE ALTERATIVE OR A SOLUTION TO OVERCOME THE USE OF AIR FRESHENER?

The purpose of air fresheners is to make the indoor atmosphere more pleasantable by infusing a fragranced mixture into the air or masking an existing air quality condition. The fact that air fresheners are used by majority of the population in many countries demonstrates their popularity and desired effects. Nevertheless, using air fresheners can have unforeseen consequences and pose threats to both human health and the indoor environment. Reducing indoor pollutant levels and exposure concerns related to air freshener components can be accomplished through very simple source reduction or elimination strategies. When an indoor space has unpleasant aromas, eliminating the source, addressing the reason, or enhancing airflow may help to do so without the usage of air fresheners to cover up the smell or go with the organic based air freshener that limits the VOC and it give an organic fragrance. The use of the organic based air freshener can create a natural aroma in our indoor environment and some of the few brands of organic air freshener are reduce the VOC and the gaseous molecule in our indoor. An organic based fragrance products is intended to purify the air and reduce the indoor air pollutants. Some of the few organic based brand fragrances make claims that the organic fragrances are able to remove the disinfect in the indoor air as well as it removes the odours and reduce the allergens. Anderson et al 2010 have shown a proven results that the organic air freshener has lesser impact when compare to synthetic air freshener (8). According to the data of histopathology, the animal groups that were permitted to inhale organic air fresheners on a regular basis are less health impact than those that were not. For the animal group that was exposed to synthetic air freshener, the alveolar walls of the lungs thickened and were partially damaged, while they were slightly thicker in the case of organic ones. In the instance of the liver, the usual polygonal form of hepatocytes was distorted, their nuclei were enlarged, and tissue was also damaged due to the emergence of blood streaks among the hepatocytes in the synthetic treated group, whereas the equivalent effects in the organic treated group are extremely little.

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Chronic inhalation of air fresheners, whether they are organic or synthetic, is not always a good idea. Air fresheners should only be used when absolutely necessary, and only after following clear instructions. Anyhow, based on the most recent research, it was determined that organic air fresheners were safer than synthetic air fresheners.

IV. GLOBAL MARKET FOR AIR FRESHENER

The global market size for air fresheners was valued at $10,124.4 million in 2017 and is anticipated to reach $13,279.1 million by 2025, growing at a CAGR of 3.5% from 2018 to 2025. The biggest market is in Europe, while the fastest-growing market is in Asia. For instance, in Korea, the use of air fresheners is rising by up to 8.8% year. 72.8 percent of the general population surveyed in the US uses air fresheners and deodorizers at least once per week, and 57.9 percent is exposed to them at least once per week through the usage of others. Nearly 75% of US households, according to a previous study, use air fresheners. From 2021 to 2026, the air freshener market share in India is anticipated to rise by USD 98.33 billion, and the industry's growth speed is predicted to slow down at a CAGR of 7.61%. The data in this research study on the Indian air freshener industry will be helpful to organizations as they assess their strategic business plans. The market segmentation by type (spray, liquid, gel, electric, and others) and application is also extensively covered in this study (automotive, home, and bathroom). The air freshener market research in India also includes information on several market vendors, including Air France-KLM Group, Dabur India Ltd., Godrej Consumer Products Ltd., Mangalam Organics Ltd., MCL India, MidasCare Pharmaceuticals Pvt. Ltd., Reckitt Benckiser Group Plc, S. C. Johnson & Son Inc., The Procter and Gamble Co., and The Raymond Corp. During the projection period, the health risks related with air fresheners would be a major challenge for air freshener market vendors in India. Air fresheners are common household products whose main purpose is to add aroma to the air by covering up unwanted aromas, improving the atmosphere in enclosed spaces. However, the majority of air fresheners on the market are known to include some harmful compounds that can result in potentially contaminants and can harm people's health in a variety of ways. A primary source of numerous volatile organic compounds is thought to be air fresheners (VOCs). Long-term exposure to VOCs can worsen breathing conditions like asthma and result on headaches and nausea. The majority of air fresheners also contain phthalates, which are known to disrupt hormonal balance, impair the quality of semen, result in birth problems, and harm the reproductive system. As a result, frequent and prolonged exposure to air fresheners may have a negative influence on human health, which is likely to impede the expansion of the air freshener market in India. In-depth details on other forthcoming trends and problems that will have a significant impact on the market's expansion are also included in this analytical report on the Indian air freshener market. The companies will be able to assess and build growth strategies for 2022–2026 with the aid of the actionable information on the trends and challenges.

This statistical analysis of the Indian air freshener market takes into account the effective marketing techniques used by the major vendors. In order to compete in the fragmented air freshener market in India, vendors are using both organic and inorganic growth strategies. Market vendors should concentrate more on the growth prospects in the fast-growing segments while preserving their positions in the slow-growing segments in order to take advantage of the chances and recover from the post COVID-19 impact. In-depth insights into the major vendor profiles are included in the forecast study for the Indian air freshener market. The profiles provide details on the leading companies' production, sustainability, and future prospects. During the projected period, the spray segment will significantly increase its market share for air fresheners in India. Spray or aerosol air fresheners typically come in a completely programmable dispenser that enables users to programme it in accordance with the location, which is one of its main advantages. By controlling the precise amount of air freshener, they wish to dispense and so ensuring that they do not spray an excessive amount, aerosol air fresheners enable consumers to use them wisely. Spray or aerosol air fresheners have become more popular due to their advantages in a variety of settings, including commercial and automotive ones. Manufacturers in India's air freshener industry are producing a diverse selection of spray or aerosol air fresheners to satisfy increasing consumer demand for these products. This review shown an actionable market insight on the influence of post-COVID-19 on each segment as well as an accurate estimate of how each category would contribute to the expansion of the air freshener market size in India.

V. CONCLUSION

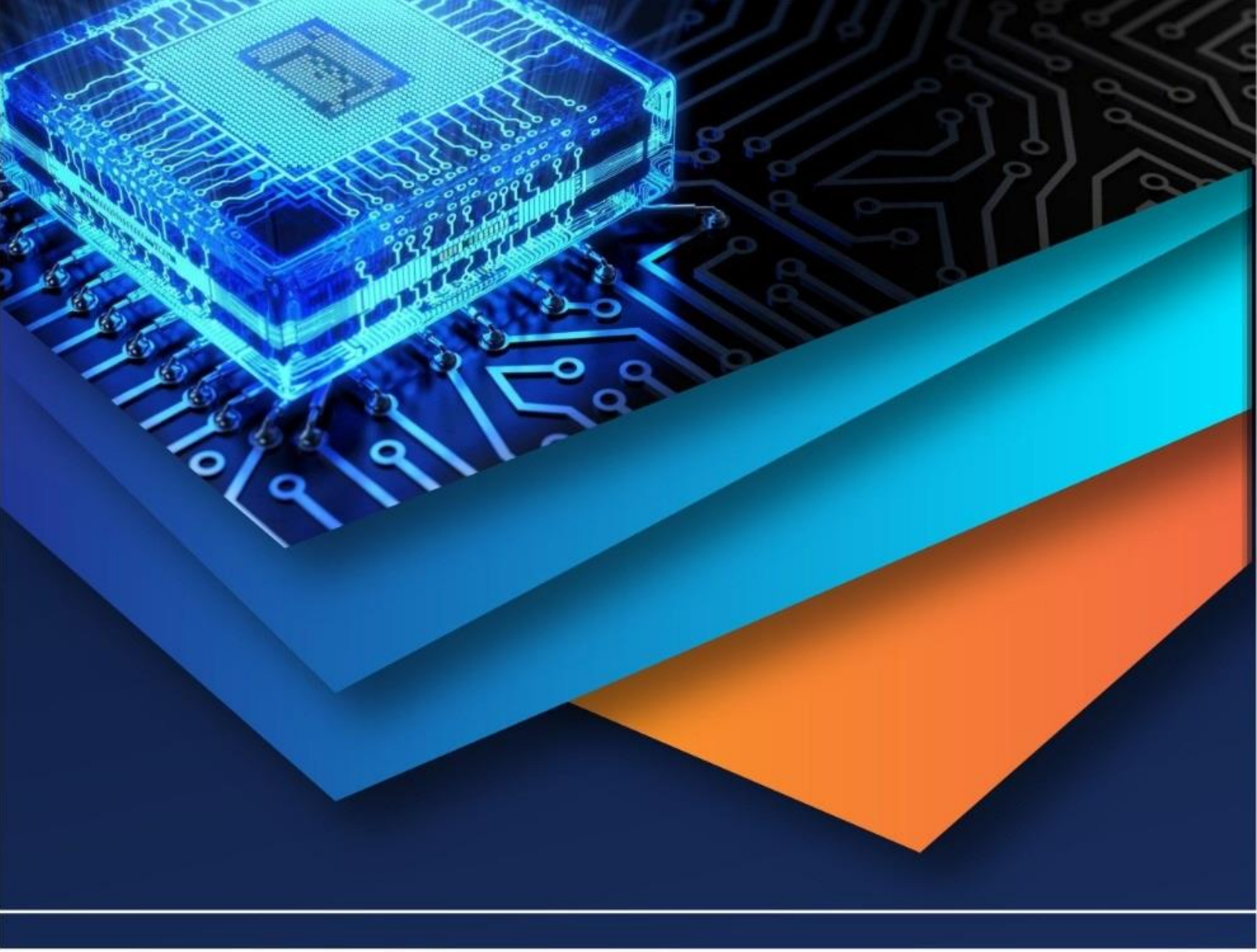
In conclusion, we have conducted a technical data investigation on pollutants emitted by the air fresheners, as well as discussed, its respiratory disorders on humans. The current study did not include any laboratory tests or evaluations of the potential respiratory health implications of air fresheners because the primary focus was on the identification of the VOC's produced from the air fresheners and their effects on respiratory health. Air fresheners are frequently used in society with the purpose of promoting a comfortable indoor environment. But it emits air pollutants, VOC’s, PM 10, PM 2.5 into the indoor environment.

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The most common pollutants released from air fresheners are volatile organic compounds and non-methane volatile organic compounds, and some of them can produce secondary elements (like ozone) and have an impact on both humans and the environment. However, air fresheners may provide unwanted and sometimes undetectable hazardous. The science, health, and policy implications of air fresheners were examined in this research review, which also provided research findings, global market and recommendations for business strategies to enhance indoor air quality and avoid significant exposure to pollutants.

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