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Air-Fresheners Can Affect Respiratory Parameters In Both Acute And Chronic Exposures

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Author for Correspondence*: kemzi89@gmail.com. <https://dx.doi.org/10.4314/sokjmls.v10i4.22>**Abstract**

The use of air fresheners has been reported to cause some unpleasant health effects, especially on the respiratory tract. This study evaluated the levels of surfactant-D, TNF-alpha and IL-1beta in Albino rats exposed to selected air fresheners in both acute and chronic exposures. Forty-two (42) albino rats were divided into seven groups of six rats each (1, 2, 3, 4, 5, 6, 7). Group 1 rats were not exposed to any air freshener and served as the negative control group. Groups 2, 3, and 4 were exposed to three different air fresheners (A, B and C) respectively for 30 days, while groups 5, 6 and 7 were exposed to the three air fresheners for 60 days. The rats were sacrificed at the end of the study, and blood collected via cardiac puncture. The blood samples were collected into plain bottles for the analysis of surfactant-D, IL-1beta and TNF-alpha using ELISA technique. The results showed that the levels of these parameters in the rats exposed at both the acute and chronic exposures were significantly higher than the levels in the negative control group. It is concluded that the negative effects of air fresheners occur in both acute and chronic exposures respectively.

Keywords: Air fresheners, acute exposure, chronic exposure, respiratory parameters

Introduction

Air fresheners generally are consumer products that emit pleasant fragrances that serve to provide an aroma to a space, or to mask an odor in a space, or both. As consumer products, air fresheners come in numerous versions, including sprays, gels, oils, liquids, solids, plug-ins,

hanging disks, beads, potpourri, wick diffusers, and scented candles; in active or passive forms; and with instant, intermittent, or continuous release. Air fresheners also include so-called air care, deodorizer, odour control, and neutralizer products (Steinemann, 2017). In other words, air fresheners provide pleasant aromas that make a space (rooms, halls, cars, etc), comfortable for humans to stay in.

Air fresheners, when in use, release scented compounds into the air, which overpowers odours (Pino-Delgado *et al.*,2021). These air fresheners contain some compounds that may have effects on human health. Some of the identified compounds and substances contained in air fresheners include benzene derivatives, pinene and limonene, aldehydes, phenol, and cresol. Other chemicals that are commonly reported in air fresheners include volatile organic compounds (VOCs) such as benzyl alcohol, toluene, myrcene, phthalates, artificial musks, lilial, and linalool (Steinemann, 2016). Terpenes and terpenoids are a large class of VOCs that are found in nature, in plants and fruits. Because of their fragrance properties, they are prevalent in air fresheners and cleaning products [2]. VOCs are organic compounds and have high volatility and low boiling points. Because of these chemical properties of VOCs, they easily generate ozone or odour (Kim *et al.*,2014).

Despite their pleasant effects, air fresheners have been associated with certain adverse health effects, such as asthma attack, mucosal symptoms, infant illness, breathing difficulties, and migraine headaches from a health perspective

(Steinemann, 2017). The respiratory tract is the most common route of entry for inhaled particles from air fresheners. The components emitted from air fresheners are directly inhaled by the respiratory system through the nose to the alveoli. Other organs such as the eyes, nose, and skin are also directly affected during the usage of air freshener (Kim *et al.*, 2014).

This study investigated the effects of some commonly used air fresheners on the respiratory parameters, when used in acute and chronic exposures in albino rats.

Materials and Methods

Experimental Animals

Forty-two albino rats (male and female) weighing 200-220g were used for this study. They were allowed for two weeks to acclimatize in the cage, before the commencement of the study.

Air fresheners

A market survey was done to determine the most commonly used air fresheners. The outcome of the survey determined the choice of air fresheners used for this study. The three most commonly used brands of air fresheners in our population were selected for the study (labeled A, B and C respectively). These air fresheners were stored at room temperature, and information on their names, active ingredients, and expiry dates were obtained from their packaging leaflets.

Experimental Design

A total of 42 albino rats (21 male and 21 female rats) weighing between 200-220g were used for the study. The rats in group 1 were housed in well-ventilated cages, maintained at a temperature of 27-30°C with a 12-hour natural light and 12-hour darkness cycle, and had free access to water and rat pellets. The rats in groups 2,3,4,5,6, were housed in cages covered but that have provisions for ventilation. This is to mimic indoor exposure as seen in houses or cars. The rats were divided into seven groups of six rats

each (3 male and 3 female rats per group). The exposure to the three air fresheners were as follows:

- Group 1 (Negative control): The rats in the first group were not exposed to any air freshener.
- Group 2: Exposed to air freshener A for 30 days
- Group 3: exposed to air freshener B for 30 days
- Group 4: exposed to air freshener C for 30 days
- Group 5: exposed to air freshener A for 60 days
- Group 6: exposed to air freshener B for 60 days
- Group 7: exposed to air freshener C for 60 days

The mean levels of the particles from the air fresheners in the experimental cages were measured daily using Air Quality Detector device.

Specimen Collection

After the varying exposure periods to the different air fresheners, the albino rats were fasted overnight. They were then anesthetized in a jar containing chloroform-soaked cotton wool until they were unconscious. Then, whole blood was collected using a sterile syringe and needle through cardiac puncture into sterile plain bottles. The serum obtained was used for assay of surfactant-D, interleukin 1 beta (IL-1 β), and tumor necrosis factor-alpha (TNF α) using ELISA technique. Additionally, the lung tissues were excised and placed in 10% formol saline for subsequent histological analysis.

Results

Comparison of Mean Levels of Parameters based on Duration of Exposure

Table 1 shows the mean levels of the parameters in the different groups of rats. The means levels of surfactant-D, interleukin-beta and tumour necrosis factor-alpha, were significantly higher in the exposed rats compared to the control rats.

Table 1: Comparison of Mean Levels of Parameters based on Duration of Exposure

Group	Surfactant-D (ng/ml)	Interleukin- β (pg/ml)	Tumour Necrosis Factor- α (pg/ml)
Group 1 (n=6)	0.62 \pm 0.08 ^a	25.10 \pm 1.55 ^a	0.24 \pm 0.01 ^a
Group 2 (n=6)	1.12 \pm 0.05 ^b	79.33 \pm 1.75 ^b	0.34 \pm 0.06 ^b
Group 3 (n=6)	1.11 \pm 0.04 ^b	80.05 \pm 1.41 ^b	0.33 \pm 0.02 ^b
Group 4 (n=6)	1.13 \pm 0.05 ^b	80.33 \pm 1.17 ^b	0.31 \pm 0.02 ^b
Group 5 (n=6)	1.28 \pm 0.02 ^c	86.17 \pm 1.17 ^c	0.34 \pm 0.02 ^b
Group 6 (n=6)	1.17 \pm 0.23 ^b	89.33 \pm 1.21 ^c	0.32 \pm 0.03 ^b
Group 7 (n=6)	1.26 \pm 0.03 ^c	88.50 \pm 1.05 ^c	0.36 \pm 0.05 ^b
p-value	<0.001	<0.001	<0.001
F-value	31.090	16.930	8.444

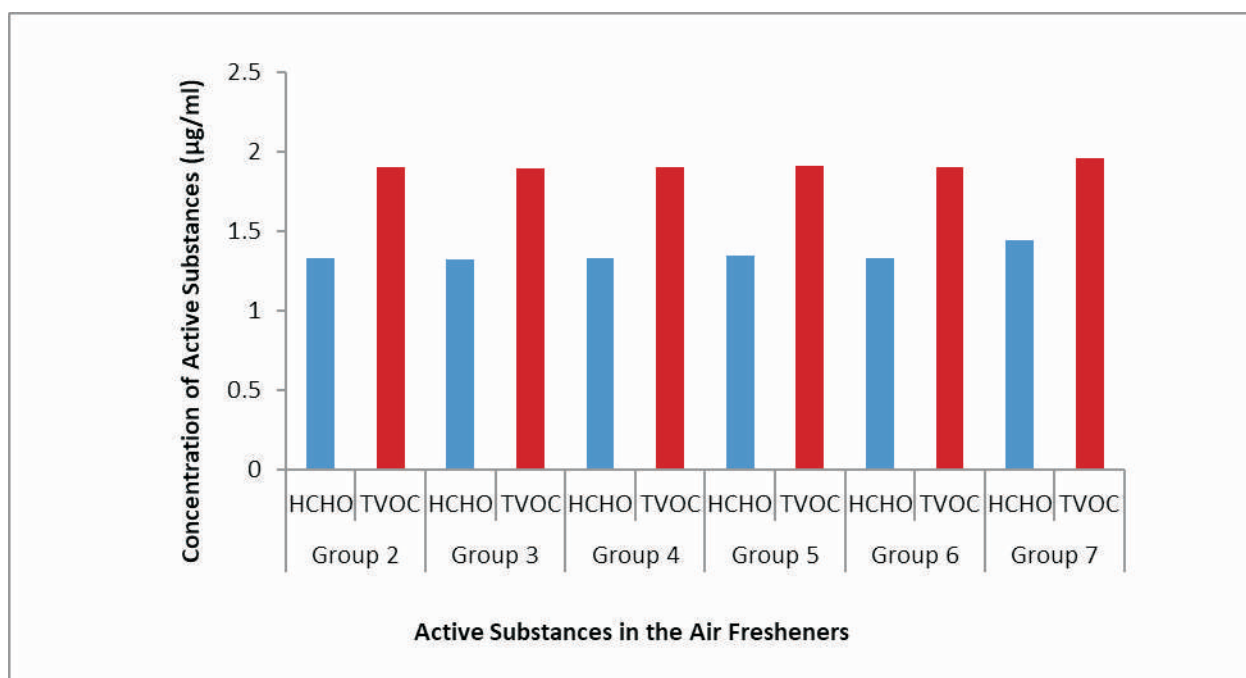


Figure 1: Mean Concentrations of the Active Ingredients Detected in the Air Fresheners

Discussion

This study evaluated some biochemical parameters in albino rats exposed to different air fresheners, at both acute and chronic periods. The results show that the mean level of surfactant-D in the exposed rats was significantly higher than the mean level in the control groups. Exposure to the components of air fresheners has been associated with inflammation in the respiratory tract.

This study detected volatile organic compounds (VOCs) and formaldehyde (HCHO) in the air fresheners used for the study, with the total volatile organic compounds (TVOCs) being higher in the detected concentrations than the formaldehyde. One of the commonly reported components of air fresheners are the volatile organic compounds (VOCs). The exposure to these VOCs has been associated with a variety of adverse health implications. Studies have shown that these VOCs have a high level of chemical reactivity with the mucous membrane and epithelial lining of the respiratory system. The mucous membrane of the respiratory tract contains a polymer of glycoproteins, known as mucin, which is rich in amine groups (Rahman and Kim, 2014). The C-O polar bonds that exist in the VOCs can react with these amine-rich molecules, creating some antigen materials that are immunologically recognized by immunoglobulin E (IgE) antibodies. This recognition results in an inflammatory response, which is the main contributor to airway inflammation. Similarly, mucin is also present in the oesophagus and eyes, which explains why these areas are also frequently affected by the air fresheners (Balasubramani and Pradeep, 2017).

Results from this study also indicate that the mean levels of interleukin-1 beta and tumour necrosis factor-alpha were raised in the groups of rats that exposed to the air fresheners, compared to the negative control rats. Another study (Kim *et al.*, 2021), had also established that exposure to a mixture of air fresheners was accompanied by generation of reactive oxygen species and inflammatory responses in the mice used in their study. The significant elevation in the levels of these inflammatory cytokines could be due to the presence of the VOCs in the air fresheners used in this study.

There are three principal routes of entry of volatile organic compounds into the human system; through the lungs (by inhalation), dermal contact (by absorption), and mouth (by ingestion) (Kyle and Naresh, 2021). However, the most affected system in acute exposure to VOCs is the respiratory and the central nervous systems, causing headache, dizziness, and irritation of the eyes, nose, throat, and membranes (like the mucin membrane) (Li *et al.*, 2021). Exposure to VOCs leads to airway inflammation (Kwon *et al.*, 2018). Airway inflammation is a complex inflammatory process of airways involving the contribution of various cells, with eosinophils, mast cells, and lymphocytes being the major components contributing to this inflammation (Rayees and Din, 2021). These immune cells are known to release cytokines, such as IL-1beta and TNF-alpha, in biological systems.

Indeed, air pollution is known to contribute significantly to the pathogenesis or exacerbation of many respiratory diseases. Air fresheners can also contribute to air pollution, especially indoor air pollution. These may have unpleasant health effects. For example, a study (Elechi-Amadi *et al.*, 2019) had reported that prolonged exposure to soot polluted air is harmful and associated with deterioration of some haematological and biochemical parameters.

Conclusion

The results from this study show that exposure to the components of air fresheners occur in both acute and chronic exposures.

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