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Research Article

A COMPARATIVE STUDY ON INHALATION TOXICOLOGY BETWEEN AIR FRESHENERS OF SYNTHETIC AND NATURAL ORIGIN

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ABSTRACT

The main objective of this research is to design and formulate natural air freshener gel and evaluate the inhalational toxicity by comparing it with synthetic air freshener gel. The natural air freshener was prepared using natural gelatin and sandalwood oil as essential oil and the synthetic air freshener was prepared by using carbopol-940, Propylene glycol (10 % w/w), Ethanol (3% of total volume), triethanolamine as chemical composition and sandalwood as essential oil. The animals were acquired as per the CPCSEA guidelines, divided into groups and undergone with chronic exposure of prepared gels for 2 months. The animals were sacrificed, and the tissues were sent for histopathological studies. As per the results obtained from histopathology, it is observed that the animal groups which were allowed for the chronic inhalation of natural air freshener are safer when compared with the synthetic air freshener. The alveolar walls of the lungs became thicker and destroyed at some places for the animal group that was treated with synthetic air freshener and very less thick in case of natural ones. In case of liver, the normal polygonal shape of hepatocytes was distorted, their nuclei were enlarged, tissue was also damaged due to the appearance of blood streaks among the hepatocytes in synthetic treated group and the similar effects in natural are very less. In case of cerebral cortex of brain of mice, vacuolation was found in some areas due to damage and degeneration of neuronal cell body in synthetic treated group and these are very less in natural treated groups.

Keywords: Air freshener, triethanolamine, sandalwood oil, carbopol – 940, propylene glycol.

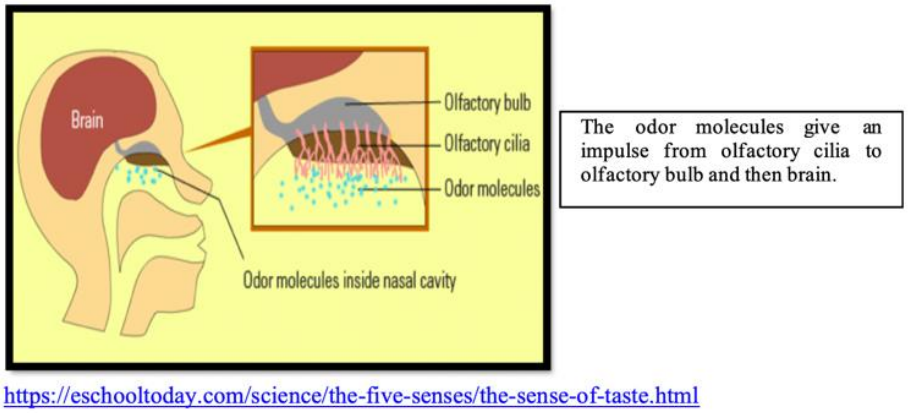
INTRODUCTION

Many things in this world change according to the trend. Now due to the impact of globalization, everyone has the opportunity to access what the other person is able to, since every industry is reaching global standards. So, if there is any bright thing about the product and people start to use it, it is acceptable. Suppose if there is a dark shade of the product which is found very later, after the widespread of it, then it is difficult to eradicate it. In this current scenario, where perfumery merged with various other industries like disinfectants, clothing and air fresheners especially, to enhance the fragrance and solubilize various fragrant ingredients, lot of harmful chemicals are being used, since they are available at cheaper range. Though they might not show immediate adverse reactions, they even can cause cancer on long term exposure.

Here, we chose to observe if there are any clear differences between natural ingredients-based air freshener and synthetic air freshener in terms of safety and efficiency.

To begin with the mechanism of the reception activity of olfactory bulb, it is shown with a diagrammatic representation:

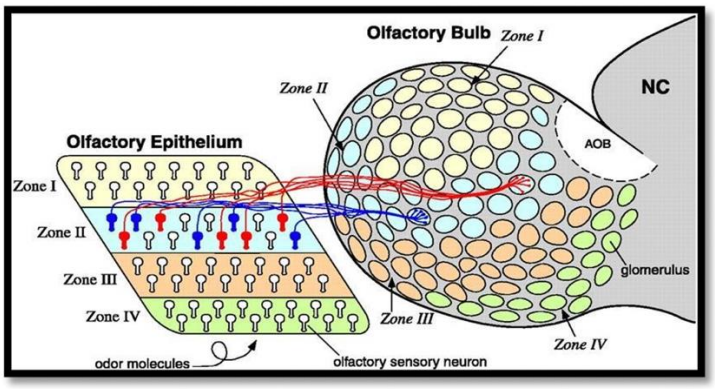
External View



https://eschooltoday.com/science/the-five-senses/the-sense-of-taste.html

Figure 1: Physiology of Olfaction (External)

Internal View



Since the signal or the molecules directly reaches the brain the response is very quick.

https://science.sciencemag.org/content/286/5440/711

Figure 2: Physiology of Olfaction (Internal)

There are many ailments that occur due to the toxicity of synthetic ingredients in air fresheners. These occur in less number during regular usage but are at times very severe. People who are working in the manufacturing units that produce these synthetic ingredients are more likely to show these side effects.

The common adverse effects shown are [1-4]

- **Autism**: a developmental disorder that disables the ability to communicate and interact.
- **ADHD (attention deficit hyperactivity disorder)**: a condition where the patient has cognition failure.
- **Migraines:** the neurological condition in which the patient has intense, debilitating headache.
- **Cancer:** formation of tumors due uncontrolled cell division. Here usually benign tumors are observed due to the inhalation toxicology of air fresheners.
- **Asthma:** the condition in which there is an obstruction of pathway in lings due to the deposition of mucus.
- **Allergies and rashes:** usually these occur big and all of a sudden.
- **Reproductive toxicity:** this includes mainly degeneration of the gonads.

Side effects caused by various synthetic ingredients like benzene, toluene, formaldehyde and phthalates include[5-6]

Benzene

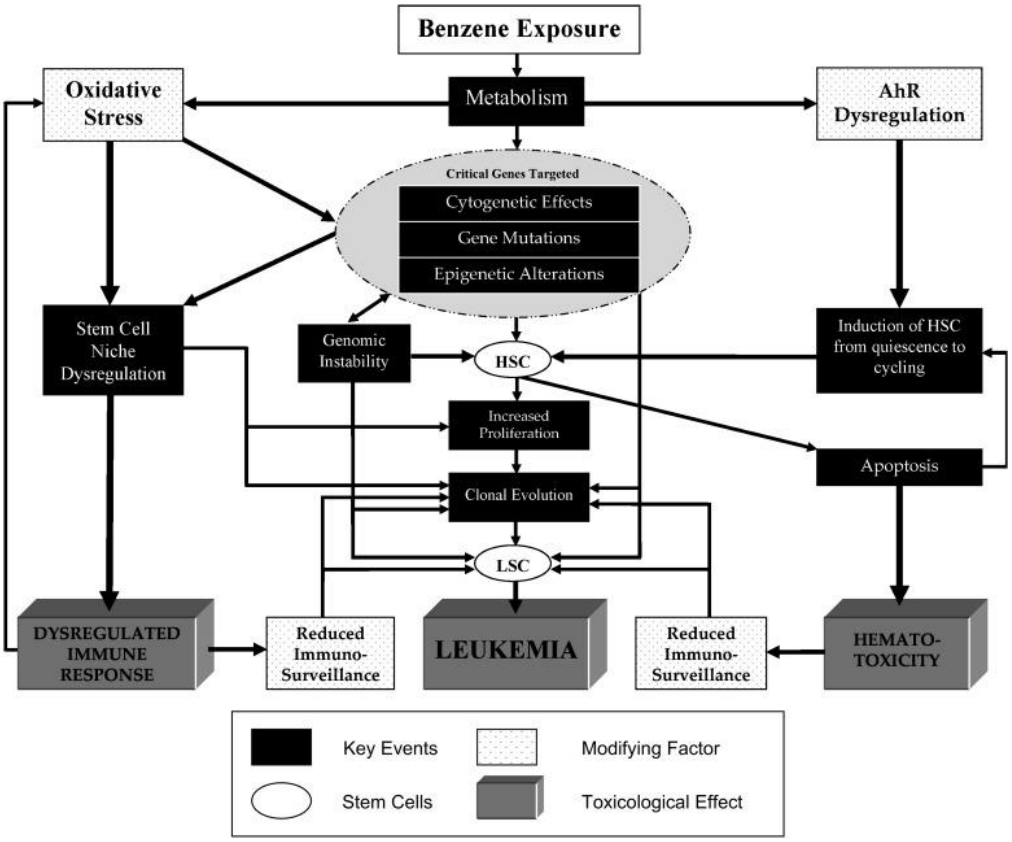


Figure 3: Effects of Benzene Exposure

Toluene

Table 1: Effects of toluene exposure

Acute effects	Chronic effects
• Irritation of eyes and respiratory pathways • Emotional liability: sudden mood changes • Dizziness • Slurred speech, Blurred vision • Lack of motor coordination • Illusions, hallucinations	• Cognitive impairment (memory loss, difficulty in concentrating, attention deficit) • White matter abnormalities, particularly around brain ventricles • Ventricular enlargement • Loss of muscle strength • Cerebellar ataxia which leads to impaired motor coordination • Hearing loss, sight impairment, nystagmus

Advantages of Natural Air Freshener [7-11]

Flexible: Air freshener can be installed virtually anywhere in your building. It is designed not just for restrooms but also for use in areas such as offices, meeting rooms, care homes, hotels, reception areas, school classrooms or anywhere that a pleasant fragrance is desired.

Natural: Most air fresheners use natural essential oils to make their scents. The freshener contains no volatile organic compounds (VOC's) or aerosol products. And although most fragrances are strong and overpowering, Air fresheners leave a light, fresh fragrance behind.

Neutralizes: Some air fresheners simply will mask the smell of malicious odors instead of neutralizing the bad smell. However, air fresheners that eliminate odors completely as to avoid mixing uncomplimentary smells together are available in most departmental stores. It truly creates a fresh, clean smell completely void of ghastly whiffs and scrunching noses.

Convenient: By choosing a good air freshener, you can easily refill the content as and when required.

Positive change in mood: There are situations when you are in a tremendous off mood. Even you feel like breaking your head. But, if suddenly if you get a fresh smell of lemon or natural flower, it will instantly change your mood and you can easily get in to moon on with salinity and peace in mind.

Killing airborne pathogens: Some microorganisms and airborne pathogens are present in the environment that sometimes creates unhealthy atmosphere. If you can use the air fresheners with natural essential oil extracts, the airborne pathogens which are harmful for your body will be eradicated with the natural air fresheners. Even in your vehicles and bathrooms you can use these air fresheners in order to stay fresh and healthy.

MATERIALS AND METHODS

Experimental Animals

Mice of both sex (25-30g) were maintained for 7 days in the animal house of Chalapathi Institute of Pharmaceutical Sciences, Guntur under standard conditions temperature (24 ± 10 C), relative humidity (45-55%) and 12:12 light: dark cycle. The animals were fed with standard mice pellet and water ad libitum. The animals were allowed to acclimatize to laboratory conditions 48 h before the start of the experiment. 5 mice/group were used in all sets of experiments. All the experiments were conducted after obtaining permission from the Institutional Animal Ethics Committee (IAEC) Chalapathi Institute of Pharmaceutical Sciences, Guntur.

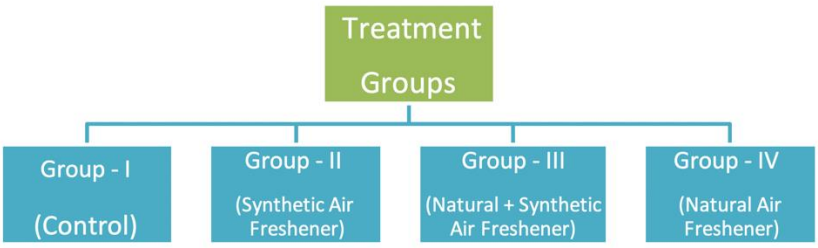


Figure 4: Treatment Groups

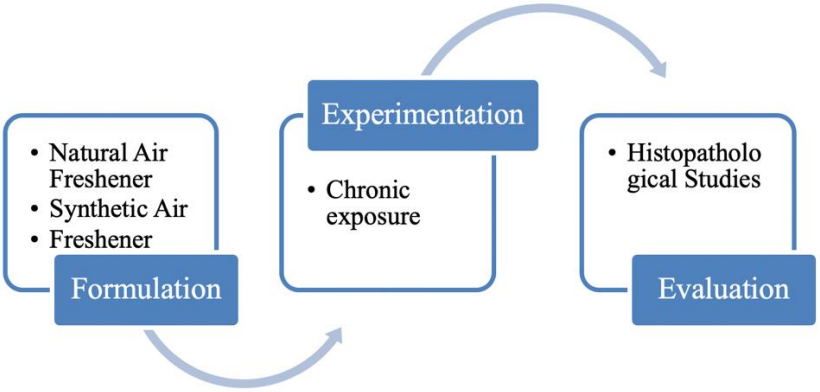


Figure 5: Experimental Design

Preparation of Synthetic Gel [12-16]

Synthetic gel was prepared using different concentrations of Carbopol 940 (0.75 and 1%), Na CMC (2 and 3%) and HPMC (8 and 10%) as gelling agents. The required amount of the polymer was dispersed in purified water in a beaker and stirred using a magnetic stirrer. Propylene glycol (10 % w/w) was added and stirred until a homogenous gel was achieved. For gels containing Na CMC, the polymer was dispersed in the purified water and kept in a refrigerator overnight. The essential oil along with ethanol (3% of total volume) was added to the previous polymer dispersion with stirring. For Carbopol 940, adequate amount of triethanolamine was added to neutralize free carboxylic acid groups of carbopol 940 to pH 6.8 ± 0.2.

Table 2: Formulation of Synthetic gel

Carbopol – 940 (%)	Propylene Glycol (%)	Essential Oil (%)	Ethanol (%)
0.75	10	3	3
1	10	3	3

Evaluation parameters [17-20]

pH: pH of individual and polyherbal gel formulation was determined by using a pH meter.

Appearance and Homogeneity: The developed individual and polyherbal gels were evaluated for physical appearance and homogeneity by visual observation.

Viscosity: The viscosity of individual and polyherbal gels was measured by Brookfield viscometer (Model RVTDV II) at 100 rpm using spindle no. 6

Spreadability: The spreadability of the gel formulations was determined by measuring the spreading diameter of 1 g of gel between two horizontal plates (20 cm x 20 cm) after one min. The standard weight applied on the upper plate was 125gm.

Extrudability: The gel formulations were filled in standard capped collapsible aluminum tubes and sealed by crimping to the end. The weights of the tubes were recorded. The tubes were placed between two glass slides and were clamped. 0.5 gm was placed over the slides and then the cap was removed. The amount of the extruded gel was collected and weighed.

The percent of the extruded gel was calculated:

- >90% extrudability: Excellent
- >80% extrudability: good
- >70% extrudability: fair

Preparation of Natural Gel [21-27]

In a small container, heat 3/4 cups of water and the salt. When the salt is completely dissolved, slowly add the gelatin, and stir until that is completely dissolved as well. If the gelatin was added too quickly, it might get a little sticky and "clumpy," but just keep stirring until it dissolves.

Remove the container from the heat and then add the remaining liquid. Stir until fully blended and pour the mixture into the small containers.

Sandalwood as added and allow the whole content to dry.

Figure 6: Natural Gel made by Gelatin

Preclinical Studies [28-34]

Mice were divided into cages based on the treatment groups and the gels of various types prepared were set inside the cages. Every day the mice were exposed to the cages for 4 hours and the experimentation lasts for 2 months.

Meanwhile the changes in the animals' weight and other skin diseases (if any) were observed to isolate them immediately if the problem persists.

Histopathological Studies

Animals were sacrificed by cervical dislocation and the tissues of lungs, liver and Brain were isolated for evaluating histopathological changes due to the chronic inhalation of animals of all groups. IAEC Number: 10/IAEC/CLPT/2019-20.

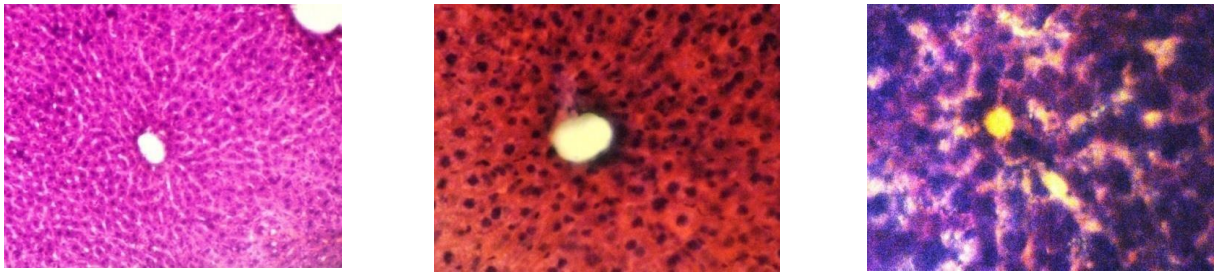
RESULTS AND DISCUSSION

Table 3: Evaluation parameters of Gel

Properties	Inference
pH	6.15
Appearance	Cherry red
Homogeneity	Good
Spreading Diameter (After 1 Min)	48mm
Viscosity (cp)	4700

Histopathological Studies

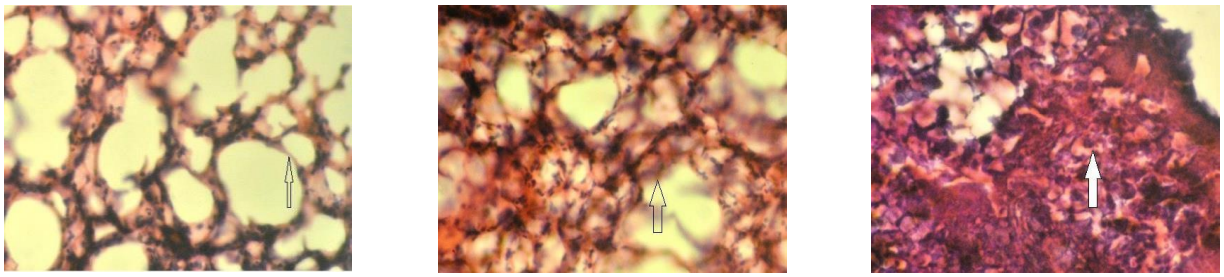
LIVER



A **B** **C**

Figure 7: Histological Results of A) Normal B) Natural C) Synthetic treated liver

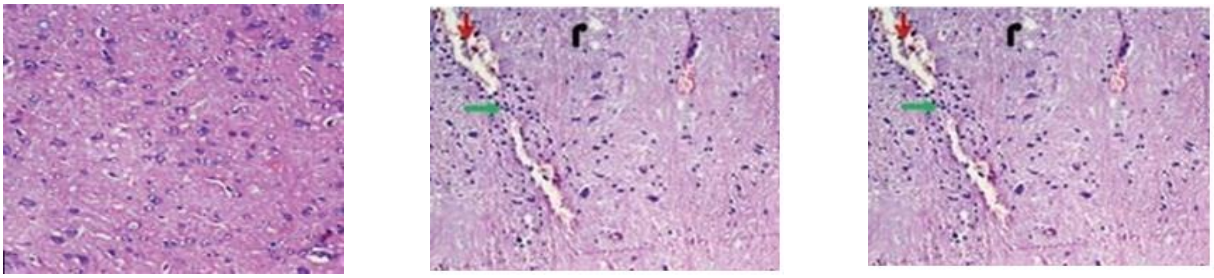
LUNGS



A **B** **C**

Figure 8: Histological Results of A) Normal B) Natural C) Synthetic treated lung

BRAIN



A **B** **C**

Figure 9: Histological Results of A) Normal B) Natural C) Synthetic treated Brain

DISCUSSION

As per the results obtained from histopathology, it is observed that the animal groups which were allowed for the chronic inhalation of natural air freshener are safer when compared with the synthetic air freshener. The alveolar walls of the lungs became thicker and destroyed at some places for the animal group that was treated with synthetic air freshener and very less thick in case of natural ones. In case of liver, the normal polygonal shape of hepatocytes was distorted, their nuclei were enlarged, tissue was also damaged due to the appearance of blood streaks among the hepatocytes in synthetic treated group and the similar effects in natural are very less. In case of cerebral cortex of brain of mice, vacuolation was found in some areas due to damage and degeneration of neuronal cell body in synthetic treated group and these are very less in natural treated groups.

CONCLUSION

The practice of chronic inhalation is not good always in case of both natural and synthetic air fresheners. The use of air fresheners must be minimized as per the convenience and should be dispensed with specific instructions. Anyhow, based on the current research, it was concluded that the air fresheners made of natural ingredients were safe when compared with synthetic air fresheners.

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