Increase in Aeroallergen, Allergy cases in the Texas Panhandle with a special reference to PM2.5 and Respiratory Ailments

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Abstract

The aerosolized solid, liquid, mix-phased particles are the Particulate Matter or PM having serious health impacts. Allergies are caused by a hypersensitive reaction of the human body's immune system to the allergen. In the recent years with the unprecedented situation of COVID-19 pandemic, it became a necessity that the scientific world comes forward with an objective of developing more equipment for air purification with novel technology to combat airborne pathogen, aeroallergen and viruses. We have applied AFLPCO Nanotechnology to build equipment and mask. We have analyzed the 20-year aeroallergen data of the Texas Panhandle using a Burkard Volumetric Spore Trap (UK) and digital microscopy. Exposed Melinex tapes were stained and observed under a BX-40 Olympus microscope. Most frequent fungal spores included *Alternaria*, *Cladosporium*, *Curvularia*, *Pithomyces* and many smut teliospores; among pollen were grass (*Poaceae*), ragweed (*Ambrosia artemisiifolia*) redroot pigweed *(Amaranthus retroflexus)*, lamb's quarters (*Chenopodium album)*, and Pine (*Pinus*). The 20-year aeroallergen data revealed a gradual shift and anomalous aeroallergen indices consisting of other particulate matters than the pollen and mold spores. The aerosolized particulate matters consisted of PM2.5, fibers, dander, plant exudates, burnt residues generated from the wildfires and other sources and insect parts that caused the increased cases of allergy and asthma in the Texas Panhandle area. We have been working on developing and efficient device to reduce the indoor aeroallergen to sublimate the symptoms of allergy and asthma. A collaborative effort helped in developing a nanotechnology called Advanced Hydrated Photocatalytic Oxidation (AHPCO) technology. AHPCO has been used in reducing indoor aeroallergens, MRSA in the hospitals, and microflora that cause contamination during food processing. AHPCO nanotechnology has been proved to reduce allergy and asthma symptoms by reducing the indoor VOCs and aeroallergens, such as air-borne pollen, bacteria, fungal spores and hyphae, dust particles, fibers and animal dander.

Methodology

Aeroallergen Data were recorded and analyzed at the Aerobiology research laboratory of at the West Texas A&M University. The aeroallergen data were recorded by using a Burkard Volumetric Spore Trap located on rooftop of the Agricultural and Natural Sciences Building, which is above the tree line, on the University's campus. The exposed Melinex tape was stained, mounted and analyzed with a BX-40 Olympus microscope and aeroallergen counts were taken using standard graticule of the slide.

We built a fiberglass chamber to evaluate the Mini air purifier and the AFL-Mask to improve the IAQ and prevent the entry of particulate matters and pathogens. To evaluate the air in the chamber, we used a LightHouse Handheld Particle Counter to sample airborne particles. We have recorded the particle concentrations at time-intervals to determine the percentage of particles entering the other chamber with the mask placed in the junction dividing the chamber.

This mask involves a 4-stage filtration system designed to combat all forms of airborne pathogens including bacteria, viruses, mold spores and harmful VOCs (Volatile Organic Compounds) present in the air. We found that the AFL-Mask was efficient in preventing any particulate matter including PM2.5, PM10, bacterial and fungal spores and VOCs.

Aeroallergen: Texas Panhandle 2001-2021

Most Frequent Aeroallergen: Fungal Spores and Pollen of Texas Panhandle

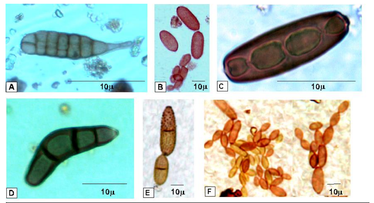
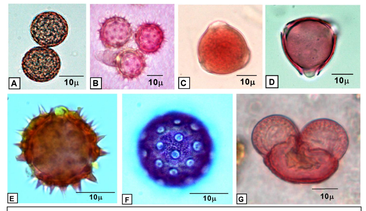


Fig.1A-F showing the most frequent fungal allergens of Texas Panhandle: Fungal spores: A. *Alternaria* sp. B. *Stachybotrys* sp. C. *Drechslera* sp. D. *Curvularia* sp., E. Ascospores, F. *Cladosporium* sp.



Figs. 2 A-G: Most frequent pollen of Texas Panhandle Fig. A. *Ambrosia artemisiifolia (40x),* Fig. B. *Helianthus ciliaris* , Fig. C. *Solanum rostratum*, Fig. D. *Solanum elaeagnifolium*, Fig. E. *Helianthus annuus (100x),* Fig. F. *Chenopodium album(100x),* Fig. G *Pinus sylvestris.*

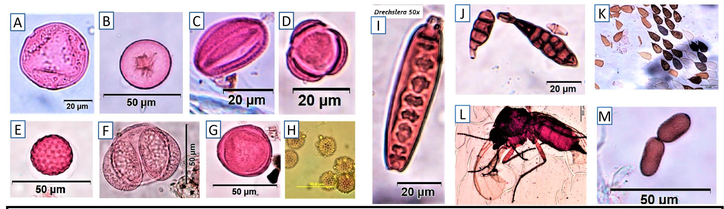


Fig. 3A-M Various aeroallergen and particulate matters of Texas Panhandle. Pollen: A. *Cyperus* sp., pollen B. *Juniperous* sp. C. *Quercus* sp., D. *Artemesia* sp., E. *Chenopodium sp., F. Pinus* sp., G. *Solanum* sp., H. *Ambrosia* sp., Fungal spores: I. *Drechslera* sp. J. *Alternaria* sp. K. Scales from an insect L. A whole insect M. *Stachybotrys* sp.

Air Purifier with AHPCO Technology and a novel Face Mask

Fig. 4A-F. Evaluating the efficiency of AFL Mini and AFL Mask. A,B. Assessing the air quality using the *LIGHTHOUSE* Particulate Monitor. C. AFL Mini, D. Petri plate exposed without any AFL Mini air purifier. E. AFL-Masks. F. Petri plates with AFL Mini running after 48h, 72h.

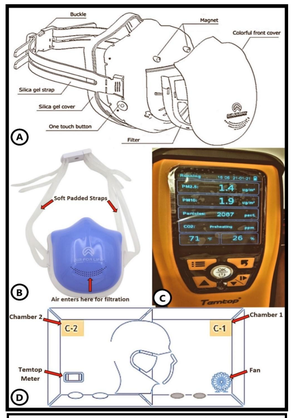
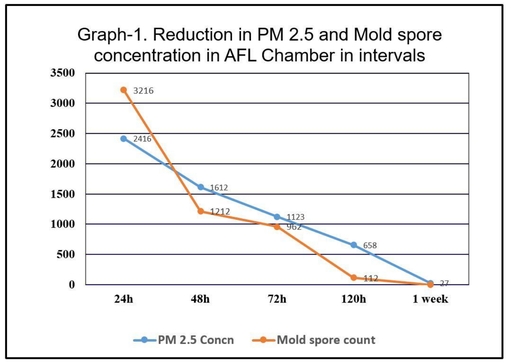


Fig. 5. A. Design of the face mask, B. Air inlet and soft padded straps, C. Temtop Air Quality Meter, D. Exp. Using the fiberglass chamber. Fig. 5D shows the diagram of the fiberglass chamber and the experimental set up.

The fiberglass chamber (Fig. 5D) was divided into sub chambers C1 and C2 for testing the efficiency of the mask. On the C1 side, the fan and the Petri plates were kept to assess the composition of the air on the C1 before using the mask. On the C2 side, the Petri plates and the Temtop monitor were placed to assess the air after it passed through the mask. The back of the mask is padded with a silica gel cover. The silica gel strap provides a comfort fitting of the mask to the users face. Figure 5B is showing the whole mask with the soft padded straps. From the front of the mask, the air flows inside through a series of holes. Then, the air passes through the 4-staged filtration system in the mask. The air is filtered before entering into the users nostrils.

Findings

The data from the different types of aeroallergens show an overall increase in aeroallergens including the aerosolized particulate matters consisted of PM2.5, fibers, dander, plant exudates, burnt residues generated from the wildfires. Some trends displayed unusual spikes in their counts beginning around 2019 and ending of 2021. The Anomalous Aeroallergen indices, early flowering caused an increase in Allergy and Asthma cases as evident in the patient data from Allergy ARTS, Amarillo. From the experiments on assessment, AHPCO technology proved to be a safe and effective means of eradicating aeroallergens such as mold and microbes from indoor air. VOC concentrations has reduced on running the AFL Mini purification units.



A simulated testing in the AFL fiberglass chamber, there was a gradual reduction in the mold spore and the PM2.5 counts on using the Mini air purifier with the increased interval (Graph-1).

Conclusions

The aeroallergen index in Texas Panhandle exhibited an increasing trend in the last 20 years. However this may be a result of the constantly fluctuating meteorological conditions evidenced globally. This anomaly is showed in a large spike in aeroallergen counts for both allergen types and the spikes are nearly identical to each other.

The *Lighthouse Particulate Monitor* and the *Temtop Air Quality Monitor* was used to detect the level of CO_2 PM2.5 and PM10, Temperature and humidity. These multi-functional air quality monitors have easy calibration module. Using these multi-functional air quality monitors we have collected the data on various types and forms of particulate matters from the ambient air on simulated experiments running within the fiberglass chamber (Fig. 5D). The AFL-Mask and the Mini air purifier are built for long-term use to improve the inhaled air quality. The ergonomic design with padded lining and straps and 4-staged improved filtration technology made the AFL-Mask a superior mask that provides a continuous airflow to prevent suffocation, troubled breathing and fluctuating blood pressure, especially pertaining to patients with cardiovascular or pulmonary issues.

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