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Occupational exposure to cooking emissions in India

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Abstract

Food is amongst the basic necessities of life. Most of the commercial places or kitchens in India, specially in 5-star or 3-star hotels have various facilities like exhaust systems or fire suppression systems installed to get rid of the smoke & harmful fumes. However, a large number of people in India still reside in villages & most of this rural population depends on burning biomass as a fuel. There is no proper exhaust system & a lot of these fumes are inhaled by the people causing serious health hazards. Cooking fumes contain a wide gamut of organic compounds & can cause serious lung damage. The ever-growing food industry is giving very less attention to the health of the workers or employees, chefs, waiters etc. Despite making healthy profits, ironically the health of the poor is manipulated by offering petty insurances & unhygienic living conditions in return. Very few establishments actually have proper exhaust systems in their respective kitchen areas. Even if they do, the exhaust system's functionality and proper inspection is followed only on paper. The commercialization & globalization has ever grown. The hospitality & food industry is one of the fastest growing industries globally and in India as well.

Despite the growth, healthcare check-ups for the employees are not provided. In this report we will study an unexpurgated review and measurement of cooking fumes & harmful gases & its hazardous repercussions on the employee's health especially in Indian restaurants, cafeterias, industrial canteens, mess & most importantly raising awareness in the rural population as well. We are taking Indian restaurants as an example as the Indian catering industry comprises more than 2 million restaurants. Asian cuisine in general has more particulate matter than European or Western cooking. The present study has been conducted through a case study in Sai Krishna restaurant, Shirdi, Maharashtra, India & 10 other restaurants around the vicinity.

Highlights

- Deteriorated Lung functions of employees/chefs/workers due to the indoor pollutants at work place.
- ICLR (Incremental Lifetime Cancer Risk)

Keywords: Carcinogenic components, Indian kitchens, restaurants, occupational hazard, cooking fuel, health hazards

Introduction

'Incredible India', 'the country of rivers', 'flavourful journeys', 'spice capital of the world' these are some abbreviations used to express or promote India as a tourism & food paradise. We as a country are really incredible & abundant. The resources we have are endless and we surely have a very rich cultural heritage. The climatic conditions are favourable for a vast variety of crops, legumes, pulses. As most of these abbreviations are correct there is a completely different side to the hospitality & food industry inside the kitchens. A lot of these successful brands have grown over the health of the poor. A handful of entrepreneurs or business owners actually do care of the health of their employees. Again, if there is enough business and if the companies are actually making profits they will invest in the healthcare of the staff. There are many such eateries where no proper ventilation system, exhaust, fire safety measures are followed. This study will help the officials to track down such facilities and help them to secure a safe & healthy work environment for their employees.

Hospitality and especially the culinary industry have a wide spectrum of sub industries in India. The ever-growing culinary industry & simultaneous growth of population gives way for the food industry to splurge hap-hazardously. Chahal PK, Mehta M. (2021) ^[4] in this time where growth is unplanned, there is a struggle for having a proper planned layout of kitchens. The food industry specifically works on one critical parameter which is 'Location'.

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The more prime the location the more real estate value it holds up. In these times of unplanned kitchens, the businesses make sure to hire men & women from poor backgrounds. In search of better prospects and incomes for their families these employees, workers are handled in a way which is inhumane.

Most of these eateries, cafes, restaurants are located in close proximity to hospitals, educational campuses, schools, industrial areas, pilgrimage places etc. Apart from these commercial examples there is lack of awareness in people about the visible fumes released domestically at our homes as well. The indoor air quality thus becomes absolutely crucial. A large number of people at home come in contact directly or indirectly by inhaling these harmful components. Thus, be it domestic or commercial there has to be a protocol or standards to check or investigate the indoor air quality in kitchens.

Parveen N, Kala S. (2019) ^[8] There are many factors in the kitchen design. Attention needs to be paid while designing the kitchens. There goes a lot in planning the kitchen space. Factors like:

- Optimum utilization of space, as the commercial spaces are expensive at the prime locations utilization of space becomes very important.
- Proper ventilation of the kitchens. (Exhaust systems, chimneys, fire suppression systems are all examples of mechanical ventilation systems) If the exhaust hood is functioning properly it has to be checked on a regular interval.
- If the exhaust system is manual, there must be proper windows, doors & cross-ventilation of air for the workers, chefs or waiters to work in a comfortable environment. Supply air strategy & capture strategy must be in place.
- The kitchen area must be well lit. Combination of both natural and artificial lighting should be sufficient to work efficiently.
- There must be empty spaces next to the ovens, refrigerators, walk-ins. There must also be empty spaces near the wash-up areas, sinks.

(According to the study it was observed that the cleaning staff still washed the utensils in a squatting position for long hours)

- Careful planning of kitchen space is crucial to avoid fatigue & the chefs or cooks can work with less strain & can be comfortable.
- The storage area must be accessible conveniently. Both vertical & horizontal shelves must be in reach.
- Waste segregation & garbage disposal must be carried away all through.
- The flooring must be slip resistant to avoid accidents.
- Regular pest control & deep cleaning activities must be carried along.

Darekar S, Peshave M. (2016) ^[6] It has been observed that the places which had all these necessary parameters & the design standards were proper, the health of their employees was better, comfortable & convenient for the employees to work efficiently.

Juntarawijit C., Juntarawijit Y. (2017) ^[7] It has been observed that cooking methods where these emissions are much higher, such kitchens must have better exhaust systems in place. The study also proves that 'Stir fry'

cooking has the maximum emissions or fumes released. Especially Chinese or Indo-Chinese restaurant places where very less or no exhaust system is in place. The employees deal with unhygienic workplaces, clustered accommodation, no insurance facility, un-social-able and long work hours, and hot conditions having a direct impact on their health & well-being. Despite staying away from their families and working so hard very little or no care is taken or provided. The rich get richer & poor get manipulated.

Research and Methodology

Svendson K, Sjaastad AK, Sivertsen I. (2003) ^[12] We have conducted Spirometry tests on the employees to find out about the lung disorders and carcinogenic components present in the smoke and fumes caused due to cooking on high heat, in different cooking mediums & compare various cooking methods to identify when these components flare up in different fats both plant based and animal-based. However, getting exact readings and measurements is a tedious job & requires precision resulting in lower detection limits. This process requires a lot of solvents and hence not many establishments actually take the tests.

In this study we have conducted tests on 40 men & 40 women working for more than 6 hours in the kitchen daily. The age of the respondents on average is 23-47 years who were involved in cooking activities for more than 2 years. The study also observed that these women after working long hours in the kitchen and in the proximity of fumes, go home and cook for their respective families as well. As they are not well aware or educated about proper exhausts at home they indirectly or directly end up inhaling the harmful components. It was observed that large numbers of polycyclic aromatic hydrocarbons (PAHs), fatty acids (FAs) & aromatic amines (AAs) were present in the tests, deteriorating their lung function due to indoor pollution in both men & women.

PAHs are readily metabolized & eliminated in the urine. Especially men working close to high burning flames, there was higher concentration of metabolites.

Group A- 8 Females, 4 males

Group B- 7 Females, 5 males

Nowakowski P. (2018) ^[9] Measurements of their pulmonary function under the same setting was taken on 2 consecutive days during one week without exposure to cooking fumes then on the same week days during one subsequent week with exposure in an experimental setting. Exposing subjects in the experimental setting it was observed that there is a spike in aldehydes & acids leading to release of aerosols from fats which cause mucosa, pneumonia & airway diseases like asthma.

Chan Dingchao et al. (1999) The following formula can be used to calculate lifetime cancer risk (LCR)

$$LCR = CDI \times SF$$

Lifetime cancer risk is dimensionless.

SF is the carcinogenic slope factor of pollutants (kg/mg)

And, CDI is the chronic daily intake of carcinogenic pollutants (mg/kg)

Chang Dingchao et. Al (1999) ^[5] also studied health risk of benzene and other substances in volatile organic compounds in Rapeseed oil, Soybean, Peanuts, Corn & lard). It is also

clear that the majority of these organic pollutants were in gaseous state. Chang Dingchao et al. (1999) [5] also mentioned that high temperature oils are used in traditional Chinese stir-fry cooking and hence, Chinese chefs have comparatively higher chances of lung cancer risk & lung inflammation.

Edible oils used in Kitchen

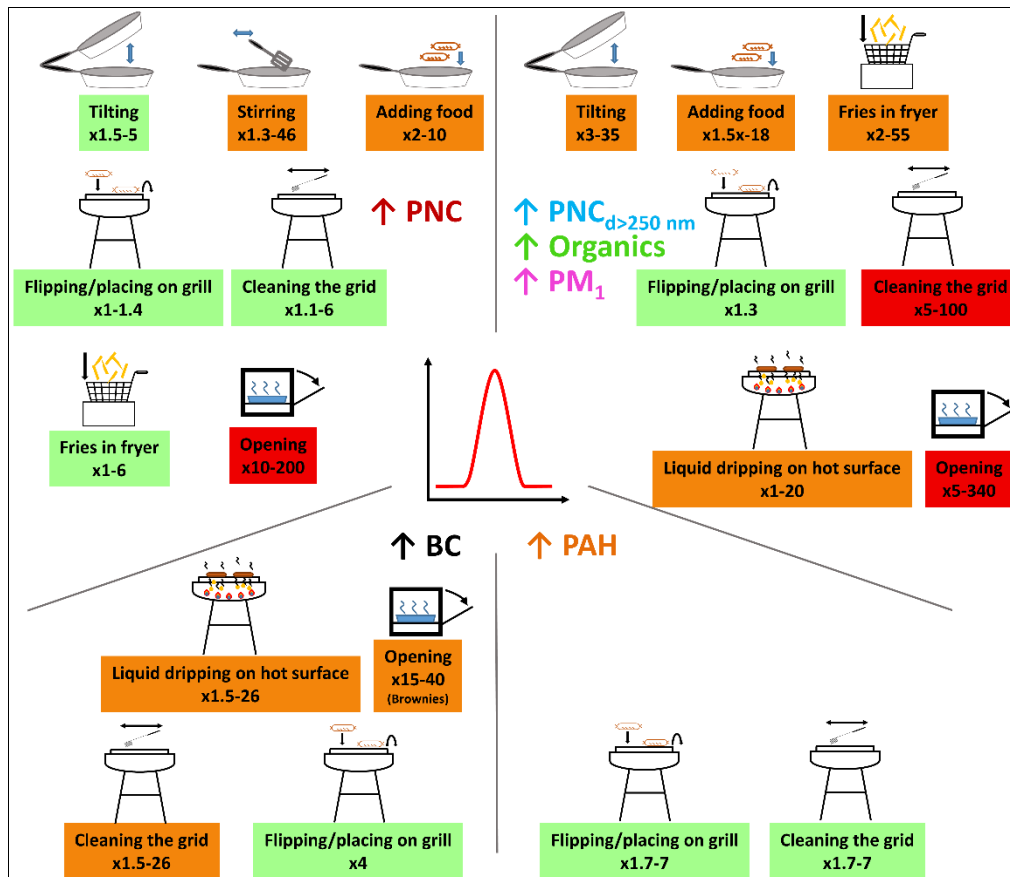
The most common oils used for cooking purposes in India are plant-based oils for example Sunflower, groundnut, Palm, Canola, Olive, Coconut are common, combinations of oils or blends are also used. Compared to the west where mostly animal-based fats are used on a large scale like lard, even commonly used fat like margarine was procured from

animal bovine tallow initially. There is massive adulteration and heavy additives being used in the manufacturing of these as well.

Every fat has linoleic acid, aldehydes, ketones, alkanes and polyunsaturated fatty acids which oxidize. However, not all fats are bad for health. There are some fats which are essential for health as well. The basic principle is to avoid trans-fats completely (usually found when the fat is re-heated), reduce saturated fats and have more polyunsaturated fats. The studies support that Trans fats & saturated fats increase cholesterol levels.

Evaluated Cooking Methods

Mass ratio of (PFs) Particulate matter During Cooking



Diagrammatic representation of the short-term increases in concentration for the various variables brought on by different activities during dish preparation. As a representative of PM, PM1 is displayed. Numbers representing the range of causes that usually cause concentrations to rise are displayed, with red denoting significant concentration increases, orange denoting medium concentration increases, and green denoting modest concentration increases. Alves, C. A., Evtugina, M., Cerqueira, M., Nunes, T., Duarte, M., and Vicente, E (2015) [2].

Fuel used

Biomass which is charcoal, agricultural residues & wood are still used on a large scale in the country. Apart from that LPG is gaining a lot of popularity along with the use of electrical energy. These are also considered to be greener alternatives and do not emit smoke. The most efficient, clean & green energy to use and promote is solar energy.

Application of the same on domestic and commercial

kitchens is still not practiced at large however, there are a few mega kitchens which are using this natural resource tactfully. One such example is Shirdi, Saibaba Prasadalya in Maharashtra state of India.

As it is completely free and abundant in locations where there is sufficient sunlight all day around it is the cleaner form of energy that can be used. Many experts in the industry and nature conservationists are working together to manufacture cooking equipment which can be used domestically by all.

However, there are still challenges at the geographical locations where there is no sufficient sunlight and the solar energy cannot be harnessed.

Many countries are shifting to more sustainable ways and there is a positive shift towards the mindset of people however, there are still many loopholes and we must

practice and work towards conserving the natural resources we have abundantly.

Demographic data

Singh A., Nair K.C (2016) ^[11] Most of the employees interviewed were above 35 years. Most of them did not even complete their school education, forget about higher education. Even if some are in higher positions & have completed their schooling there are hardly any facilities to tackle any medical emergencies. Many of the employees were of young age as well below 23 years. As there is very little awareness about the harmful components and their effects on the lungs. Around 60% of employees smoked cigarettes making it even worse. Due to economic poverty and unemployment these workers desperate to sustain their families choose working in such environments. They get exploited at getting peanut salaries in return.

As for hospitality graduates passing out from culinary schools & colleges, getting good packages and salaries in our country seems to be still challenging. Therefore, around 70% of them are still willing to work outside the country for better prospects, living conditions and justified salaries. Most importantly they are treated as equals and given fair insurance for all their hardships. Our country has a young force however, we must ensure to give them an equal opportunity & treat them respectfully to enrich the society as a whole.

Literature review

Zhong L, Goldberg MS, Gao YT, et al (1999) ^[16] Diseases like emphysema, asthma, lung cancer mortality, abnormalities in lung functions, rhinitis, ICLR (Incremental Lifetime Cancer Risk), Tracheal Bronchus ranks 2nd globally by number of incident cases in both sexes.

Xue Y., Jiang Y., Jin S., Li Y. (2016) ^[15] Concentration of Urinary PAH metabolites was higher in kitchen workers leading to cervical cancer, kidney stones. The cooking fumes in the kitchen are also termed 'killer of the kitchen'. Increased mortality from airway diseases.

Discussion and findings

Observations in 10 different restaurants & eateries were done in and around Shirdi, a pilgrimage town located in Maharashtra state of India. Most of the kitchen areas were designed according to the 'Vaastu' on the East side. Kitchen sizes were standard according to the specifications as minimum size was 120 sq. ft & maximum size being more than 1500sq.ft against 500 sq. ft as a standard size. Kitchen hood or exhaust is hung 150 to 200 cm above the cooking range according to the power and scale of operations. In a domestic setting it is 75cm above the cooking or gas range.

Conclusion

Cooking oil fumes (COFs) are clearly visible emissions from the kitchen. Choosing the right cooking oil & knowing the exact effects of the same on the health of humans is crucial. Cooking on electric hobs is much better than cooking on gas where the fumes which are carcinogenic are much more. Cooking style and heating fat at higher temperatures above 270-degree Celsius releases this harmful component. (VOCs) Volatile organic compounds in cooking oil fumes cause significant damage to the environment as well. Re-heating the cooking oil imparts a huge number of Tran's fats & is extremely hazardous to health. Further

study will be needed as calculating or measuring the harmful components and its effects on the health of employees is a tedious process and also not cost effective. As the margins are small in this competitive industry, the business owners do not invest in necessary technology to reduce chef's exposure to fumes.

There are some rules established for the release of particulate matter in the environment however, very few or no rules are established specifically for the chef's, cooks, employees working environment in the kitchen. After surveying most of the eateries & restaurants it was observed that 40% employees working were women thereby this research needs more attention. As for domestic kitchens in rural India there is a huge shift from burning biomass to switching to LPG (Liquified petroleum gas). However, there is still a possibility to increase awareness & scope for introducing better technologies in terms of exhausts.

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