INDOOR AIR QUALITY IN YANGON CITY

Collaborative Research conducted by NIES and UM-1

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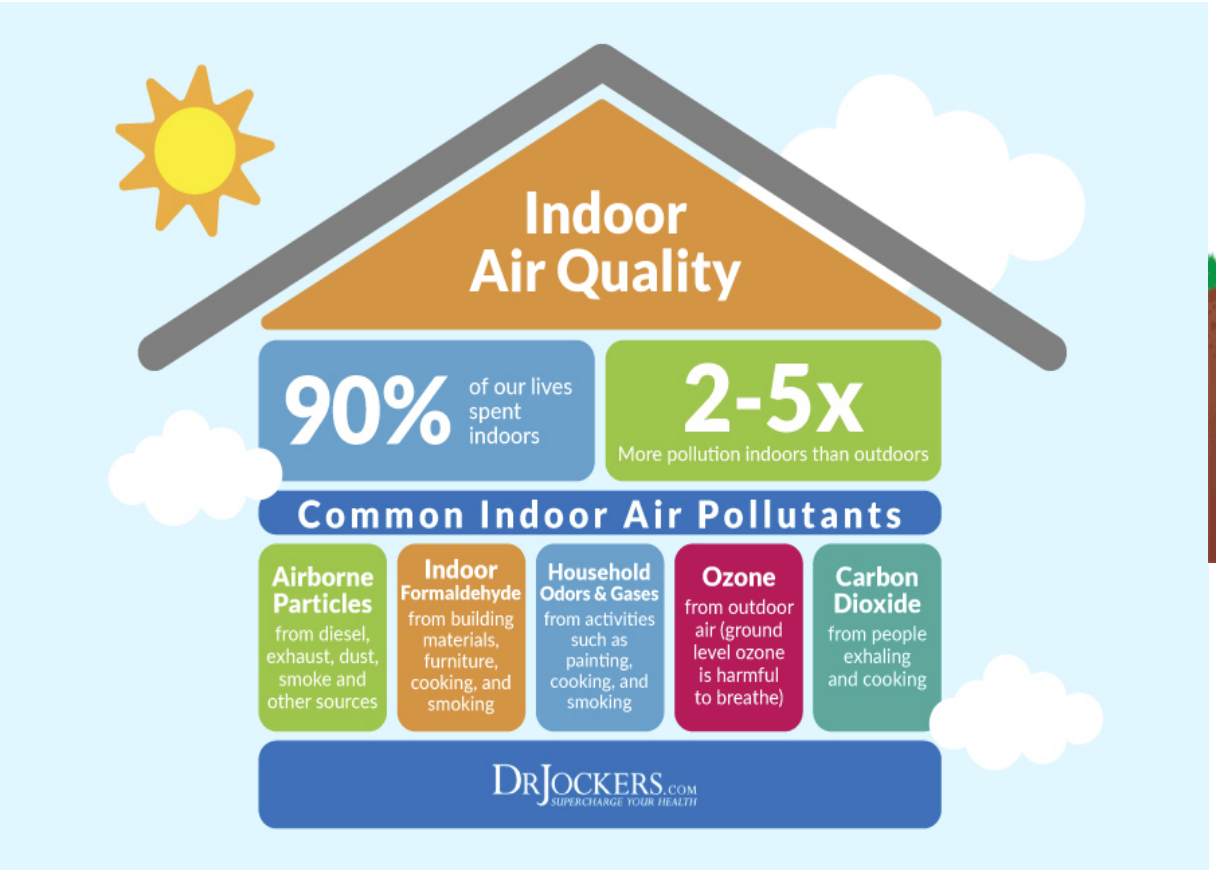
Indoor air

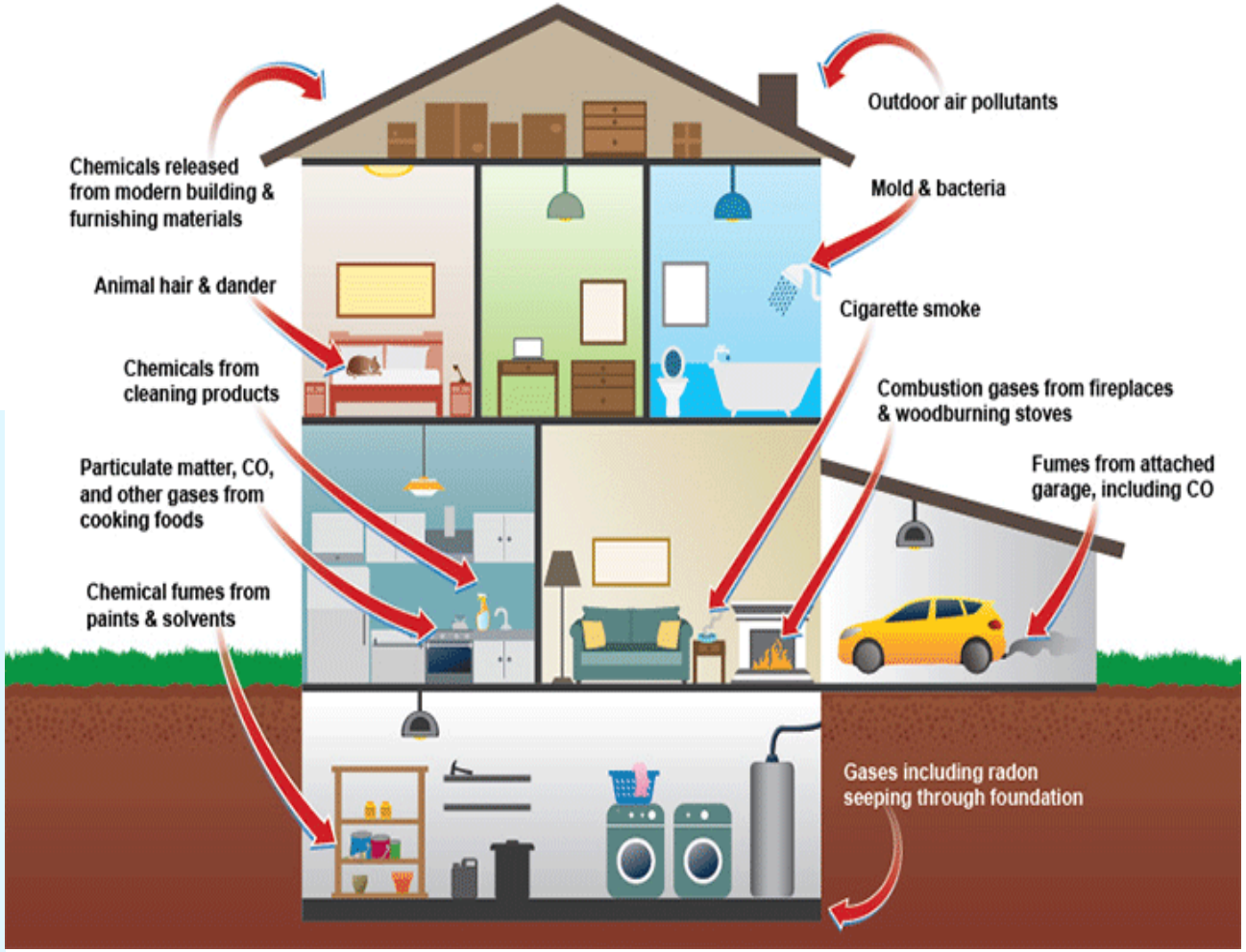
Indoor environments represent a mix of

- outdoor pollutants
  - prevalently associated with **vehicular traffic and industrial activities**, which can enter by infiltrations and/or through natural and mechanical ventilation systems,
- indoor contaminants: originate inside the building
  - from combustion sources (such as burning fuels, coal, and wood; tobacco products; and candles),
  - from emissions from building materials and furnishings, central heating and cooling systems, humidification devices, moisture processes, electronic equipment, products for household cleaning, pets,
  - from the behavior of building occupants (i.e., smoking, painting, etc.).

Indoor air pollution is usually caused by home utensils and human activities.

Indoor and Indoor pollutants






Moisture


VOCs and Chemicals


Smoking

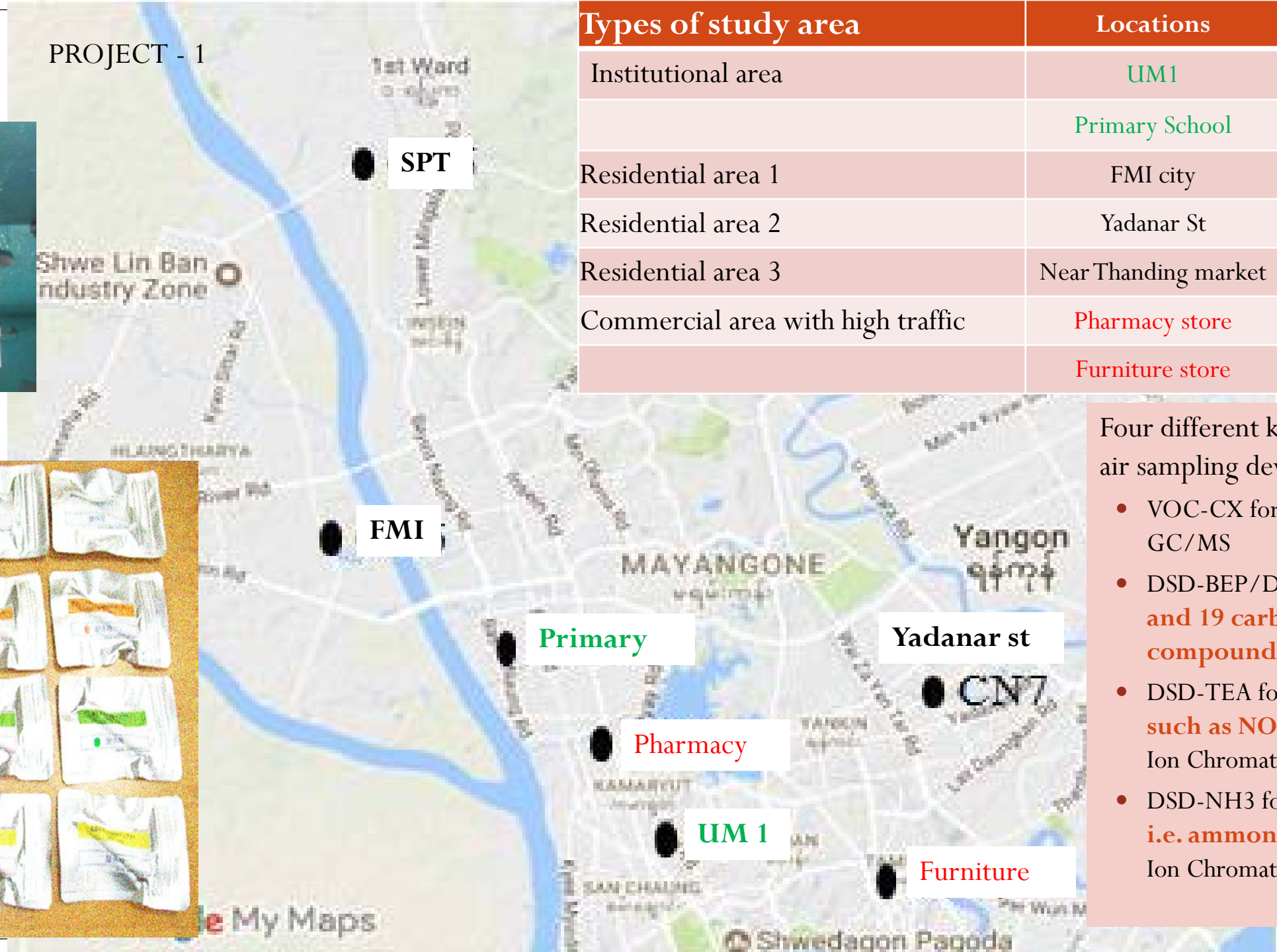

Dust


Pet Dandor

Preliminary projects for indoor air quality in Yangon city

PROJECT - 1

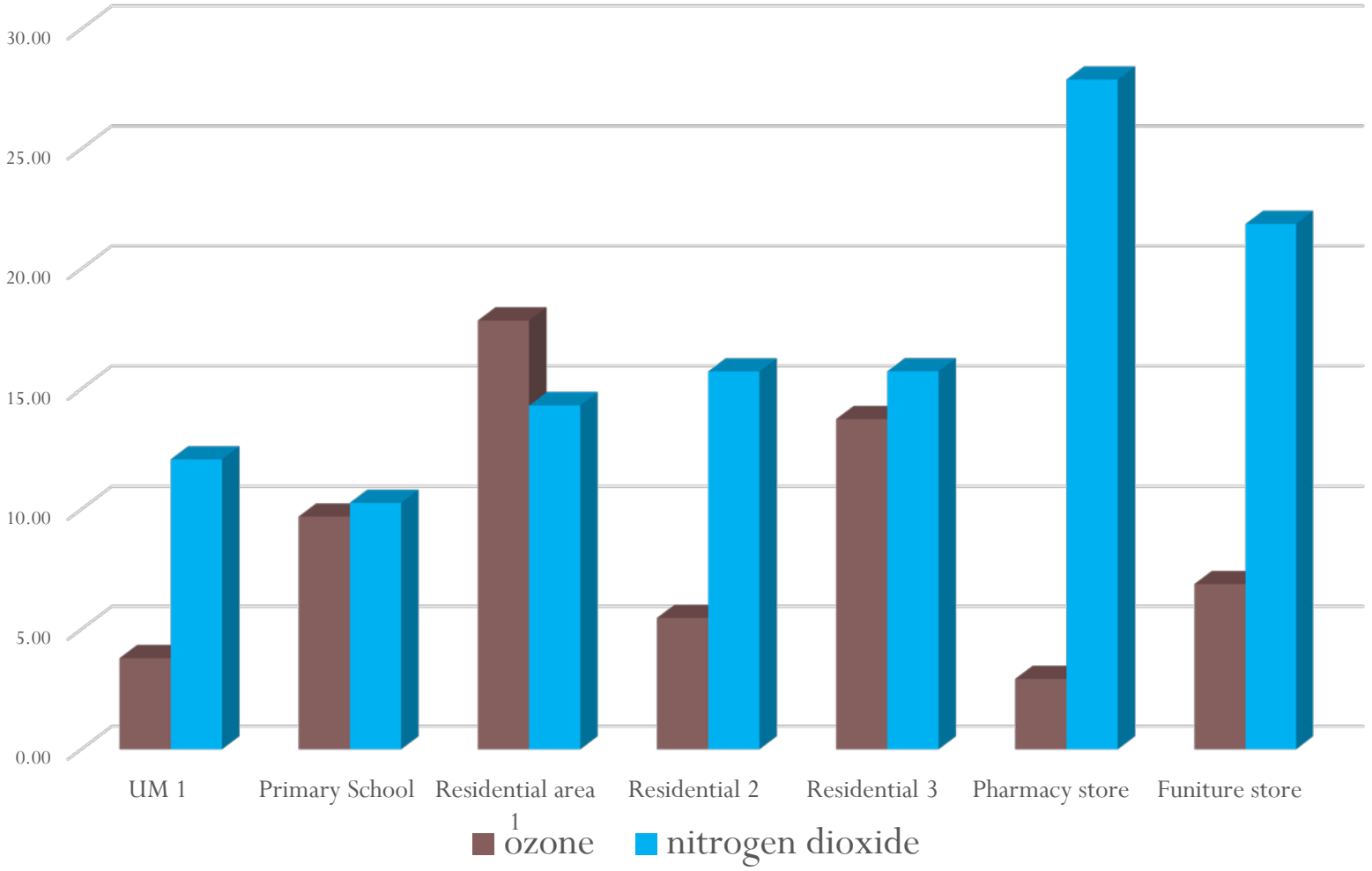
Types of study area	Locations	Townships
Institutional area	UM1	Kamayut
	Primary School	Hlaing
Residential area 1	FMI city	Hlaingthayar
Residential area 2	Yadanar St	South okkalapa
Residential area 3	Near Thanding market	Shwepyithar
Commercial area with high traffic	Pharmacy store	Hlaing
	Furniture store	Tamwe

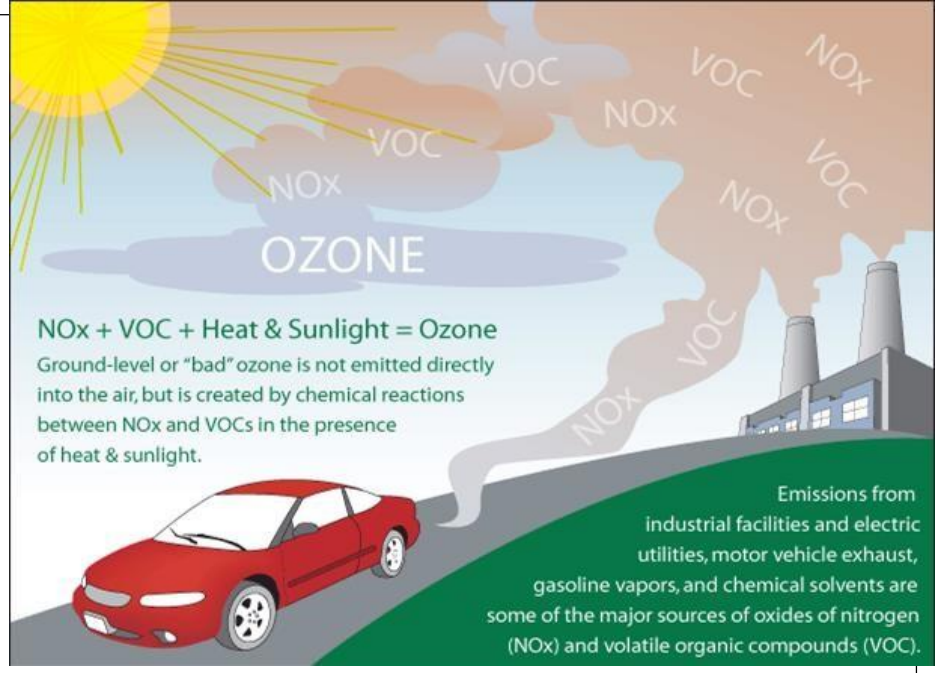


Four different kinds of diffusive air sampling devices

- VOC-CX for **34 VOCs**: GC/MS
- DSD-BEP/DNPH for **ozone and 19 carbonyl compounds**: HPLC
- DSD-TEA for **acid gases such as NO_2, SO_2:** Ion Chromatography
- DSD-NH3 for **basic gases, i.e. ammonia:** Ion Chromatography

Indoor air ozone and nitrogen dioxide: infiltration from outside

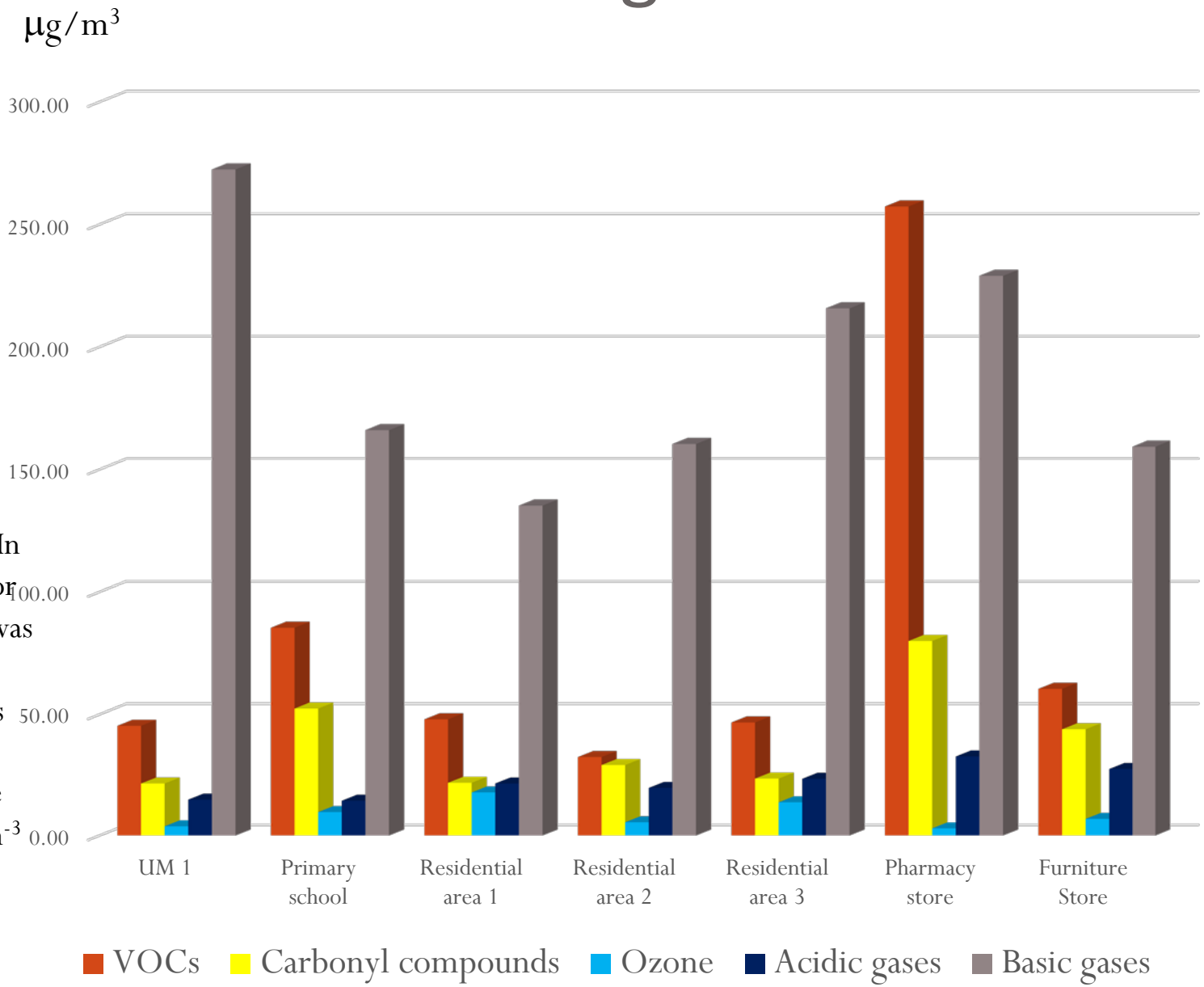




Indoor gases

Basic gases (i.e., ammonia)

- Sources of ammonia: Animals, residents and household goods such as bathroom cleaner, floor cleaner and glass cleaner release ammonia into the indoor air (Fedoruk et al., 2005; Suh et al., 1994).
- Indoor concentration can vary widely ranging from In this study, minimum indoor ammonia concentrations was 130 μgm^{-3} and maximum, 270 μgm^{-3}, concentrations were closed to or higher than the upper limit of the usual range (i.e. 0.09 μgm^{-3} to 166 μgm^{-3} (Leaderer et al., 1999).

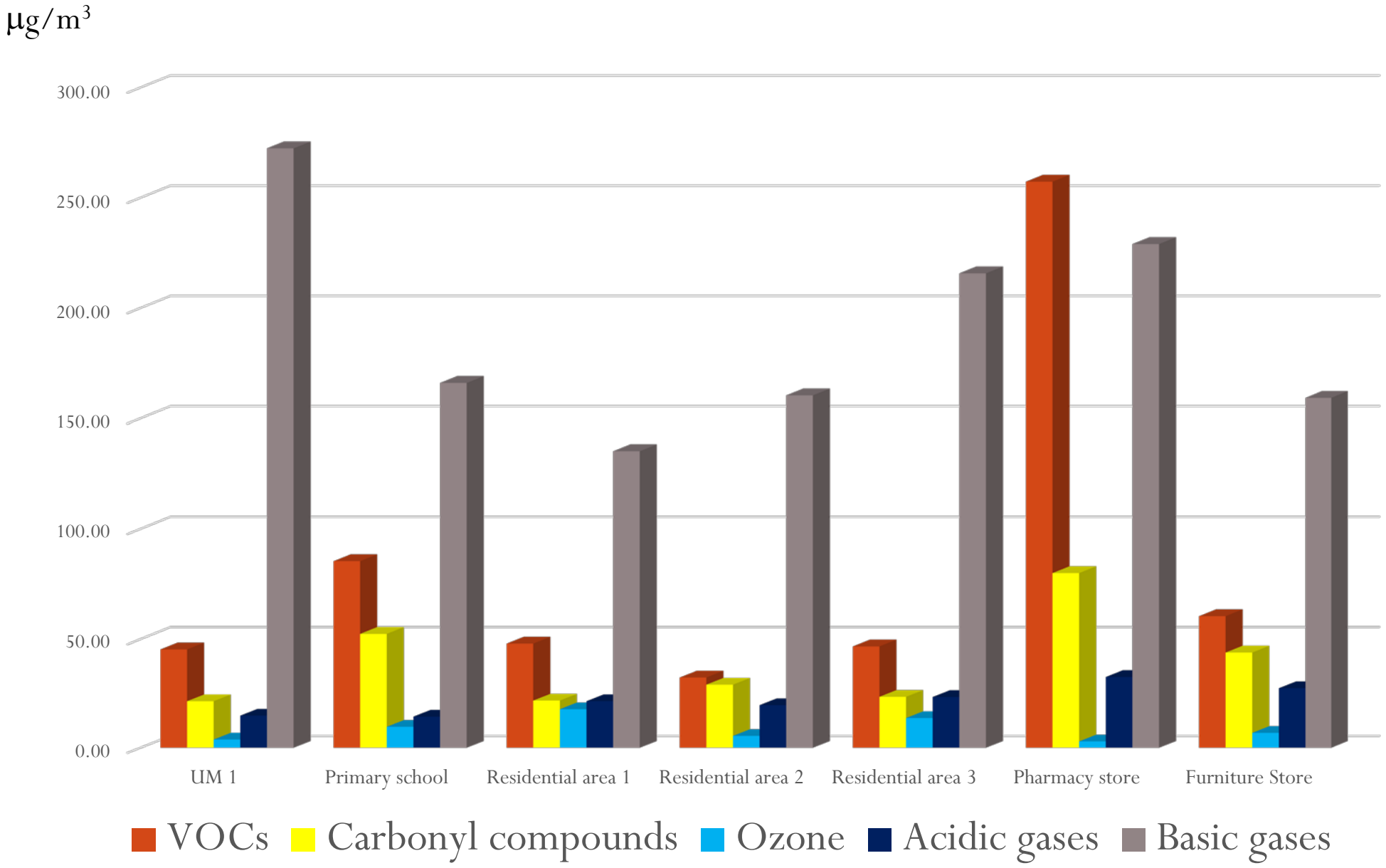


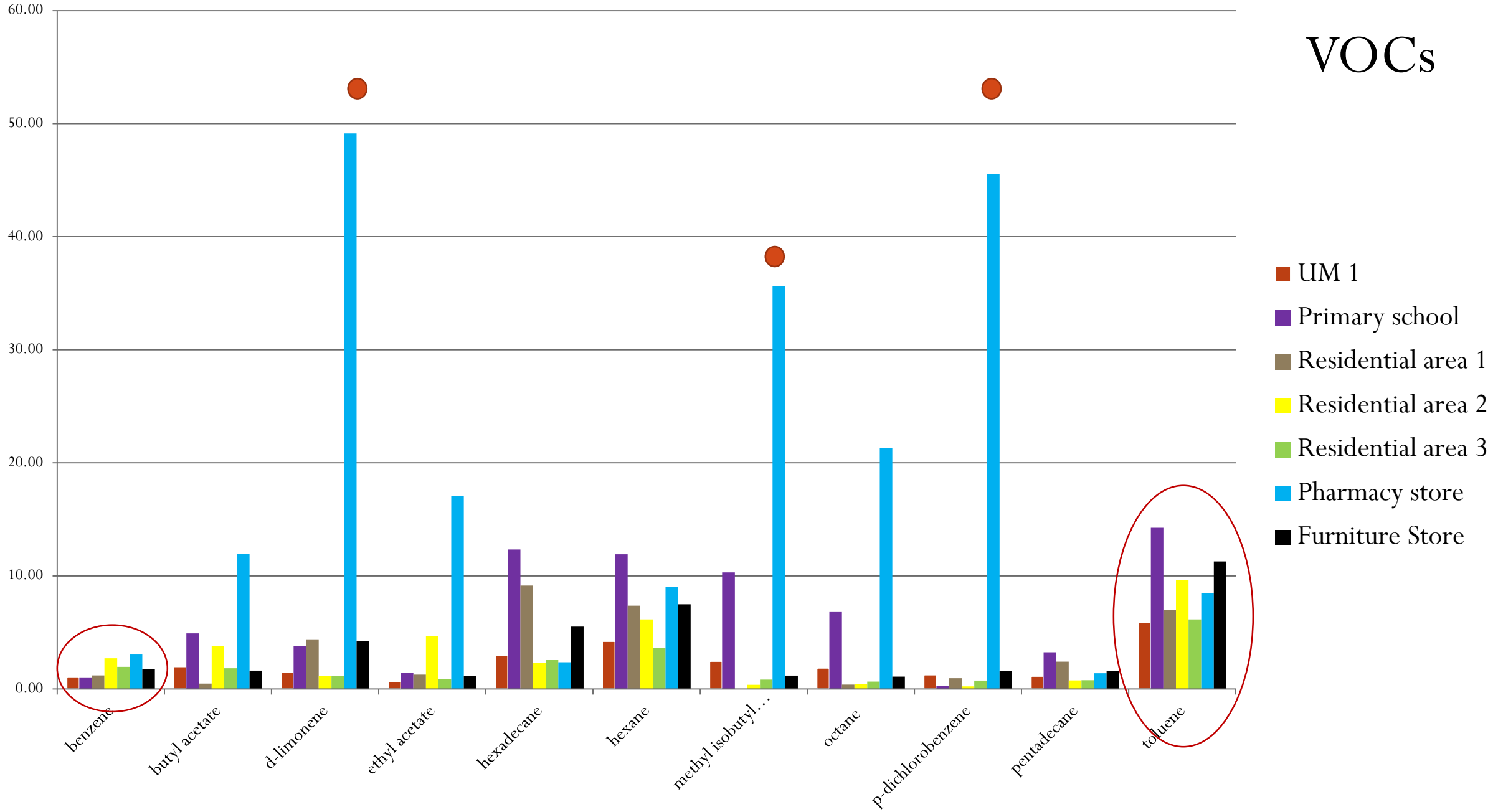
Acidic gases (NO_2 and SO_2)

- Maximum concentration of indoor NO_2 was 28 μgm^{-3} and minimum, 10 μgm^{-3}.
- Common sources of indoor NO_2 : use of gas-stove and smoking.
- Indoor SO_2 concentrations ranged between 1.9 μgm^{-3} and 6.4 μgm^{-3}.
- No location use charcoal regularly for cooking that is a frequent indoor SO_2 source.

Win-Yu-Aung et al.

Indoor gases: VOCs and Carbonyl compounds

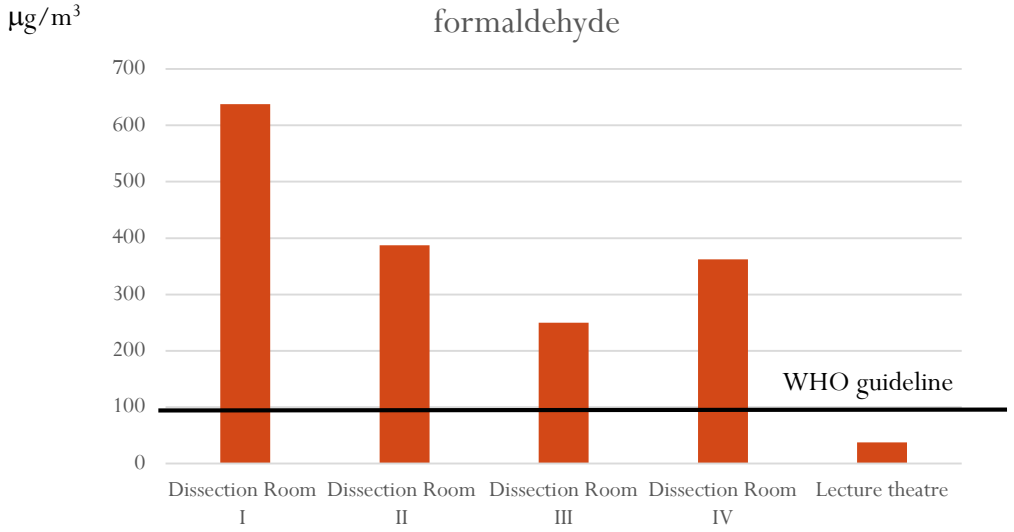


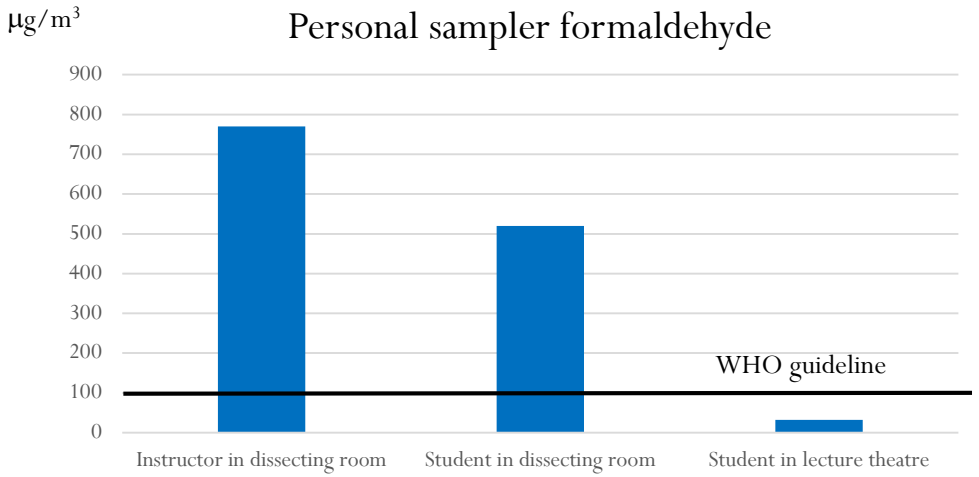

VOCs
60.00
50.00
40.00
30.00
20.00
10.00
0.00
benzene
butyl acetate
d-limonene
ethyl acetate
hexadecane
hexane
methyl isobutyl…
octane
p-dichlorobenzene
pentadecane
toluene
UM 1
Primary school
Residential area 1
Residential area 2
Residential area 3
Pharmacy store
Furniture Store

Formaldehyde & Formalin

- Indoor sources: combustion processes such as smoking, heating, cooking, or candle or incense burning
- Formaldehyde sources in indoor environments include:
  - furniture and wooden products containing formaldehyde-based resins such as particle board, plywood and medium-density fibreboard;
  - insulating materials; textiles;
  - products such as paints, wallpapers, glues, adhesives, varnishes and lacquers;
  - household cleaning products such as detergents, disinfectants, softeners, carpet cleaners and shoe products; cosmetics such as liquid soaps, shampoos, nail varnishes and nail hardeners;
  - electronic equipment, including computers and photocopiers; and other consumer items such as **insecticides** and paper products.

Assessment of indoor formaldehyde level in anatomy dissection rooms in UM 1 (2-h dissecting period)

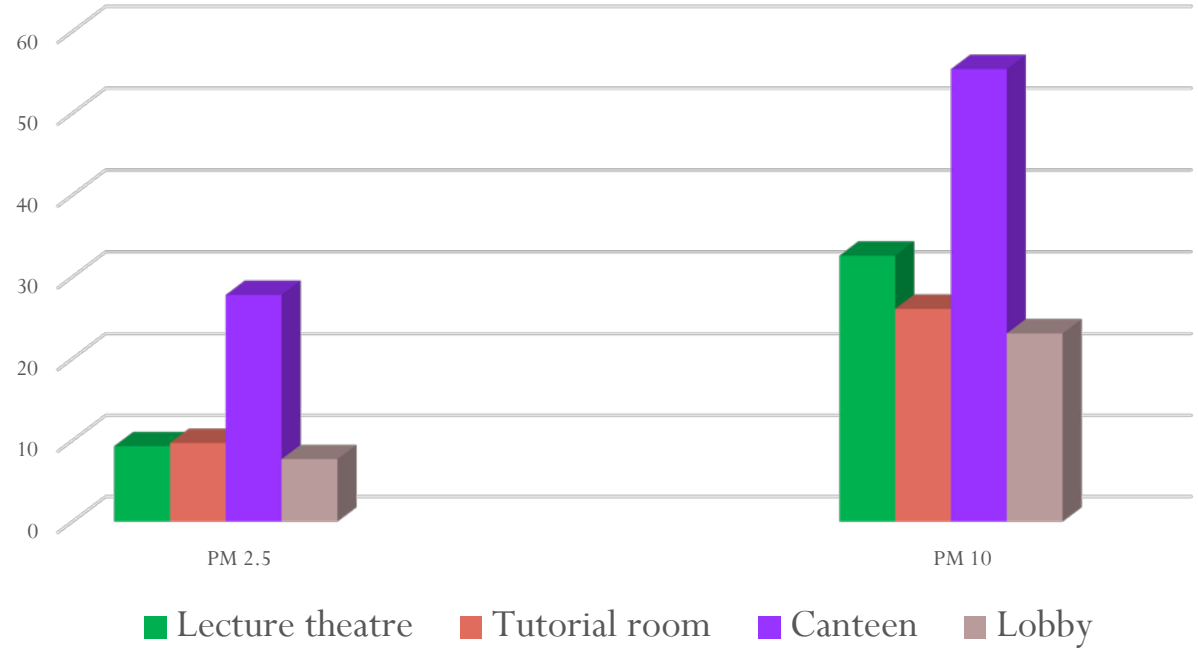




Indoor air quality ($PM_{2.5}$ and PM_{10}) in Institutional Areas: UM 1, Primary schools

UM 1 (3-h recording)

- lecture theatre,
- tutorial rooms,
- canteen
- lobby

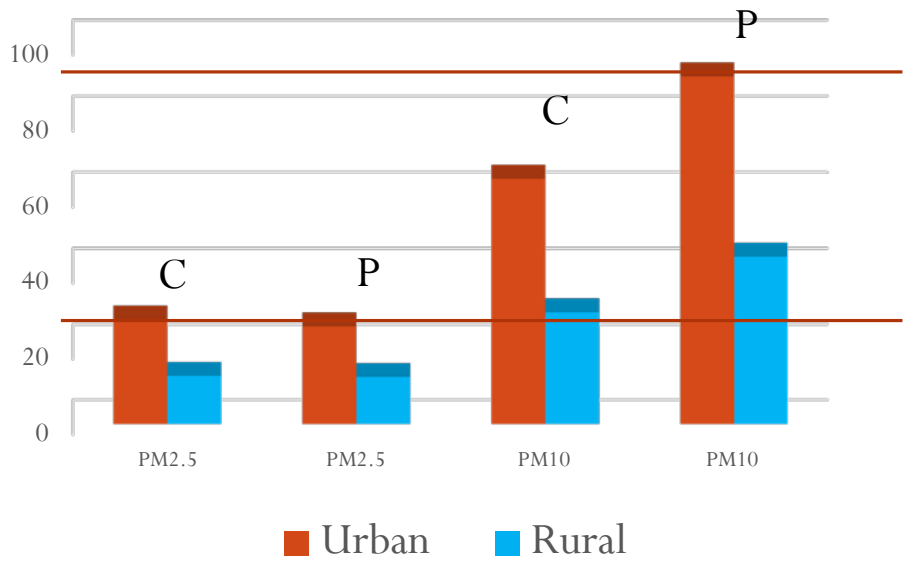


Primary schools

Urban: BEPS 1, Kamayut

Rural: BEPS, Yemon

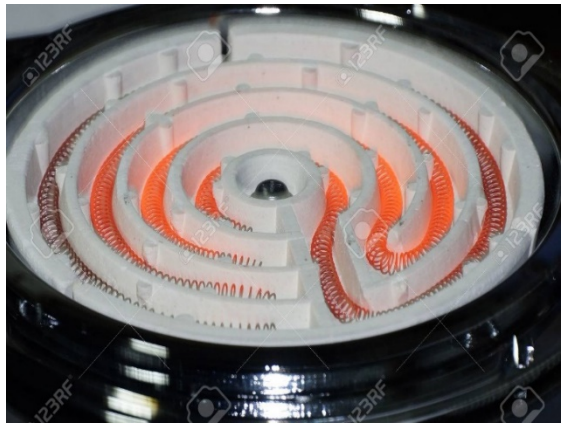
- Class rooms (C),
- Play ground (P)



Cooking-generated indoor pollutants: fuels

Solid fuel e.g. charcoal
expensive and less available
dirty and messy

Gas
clean
easily available

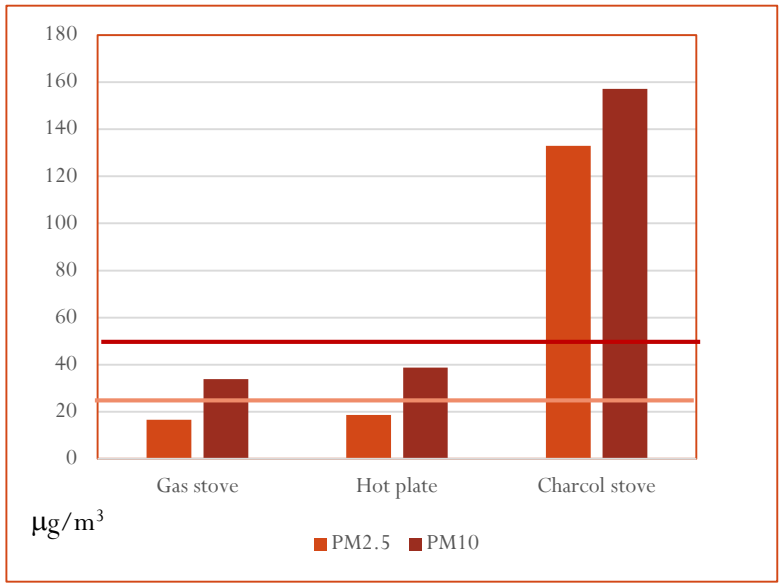


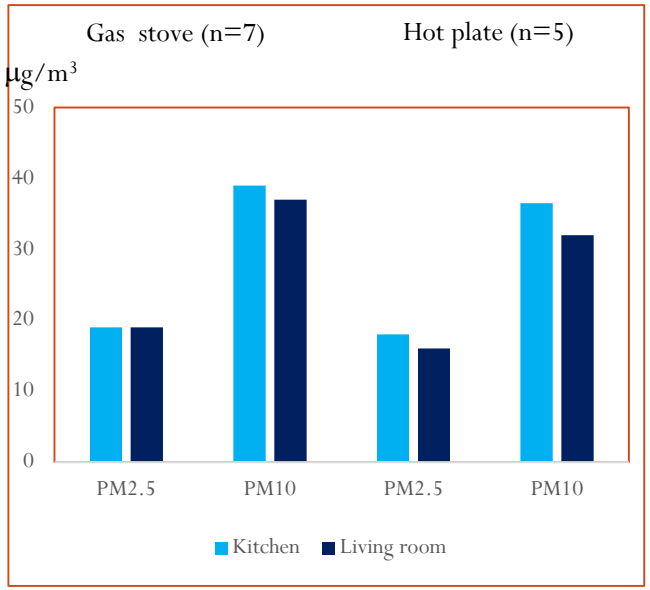
Electricity
- cheaper
- user friendly
- easily available

Cooking-generated indoor pollutants

- Pocket $PM_{2.5}$ Sensors (Yaguchi Electric Co., Ltd., Miyagi, Japan) were utilized for measurement of concentrations of $PM_{2.5}$ and PM_{10}.

- Assess $PM_{2.5}$ and PM_{10} level in kitchen and living room during boiling water for one hour





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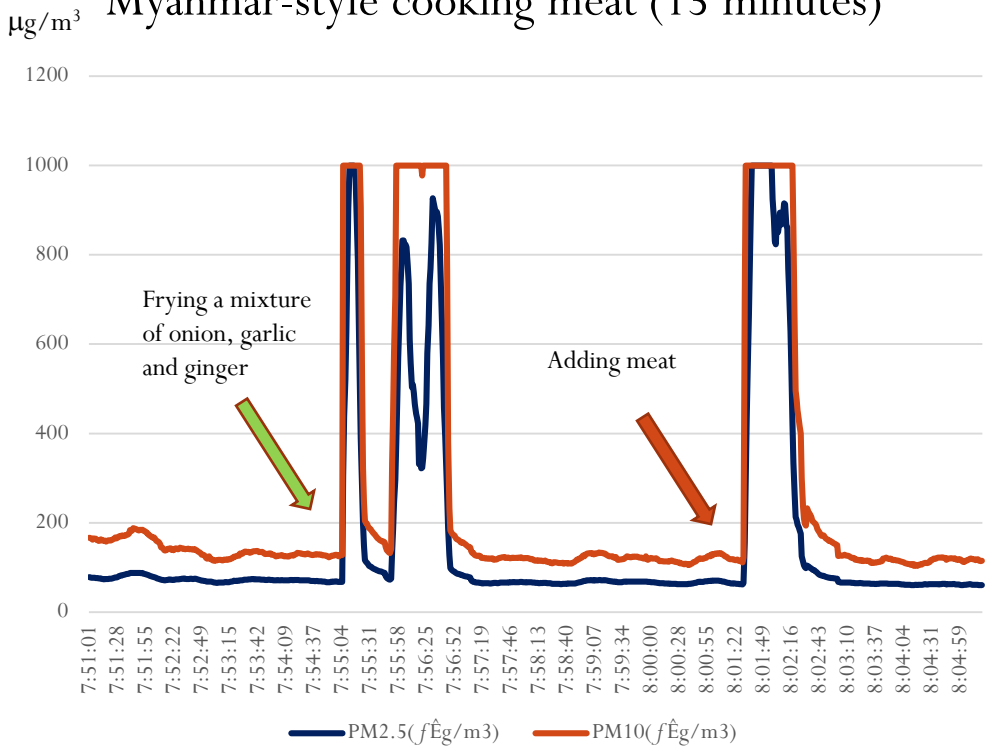
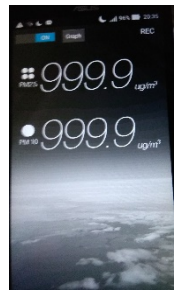
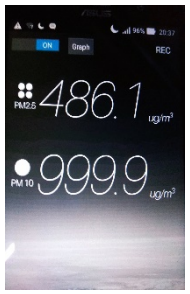
- Assess $PM_{2.5}$ and PM_{10} level in kitchen during Myanmar-style cooking meat (15 minutes)







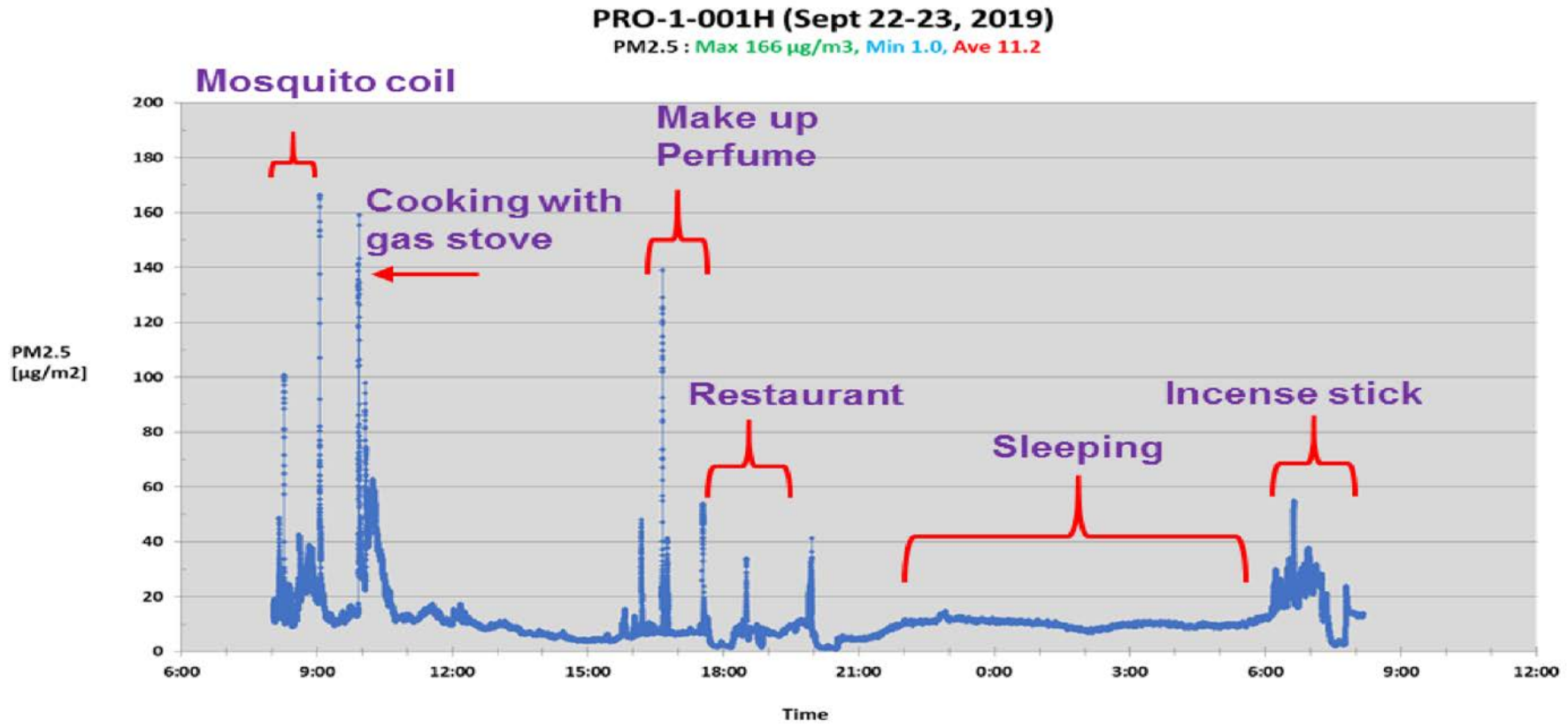
Personal exposure to PMs

- Housewives and career women
- GPS-attached pocket PM 2.5 sensor (Pro)
- both indoor and outdoor
- 24-h assessment

Average exposure level $PM_{2.5}$ level for 24 h

Housewives: $16.1 \pm 10\ \mu g/m^3$

Career women: $15.8 \pm 4\ \mu g/m^3$



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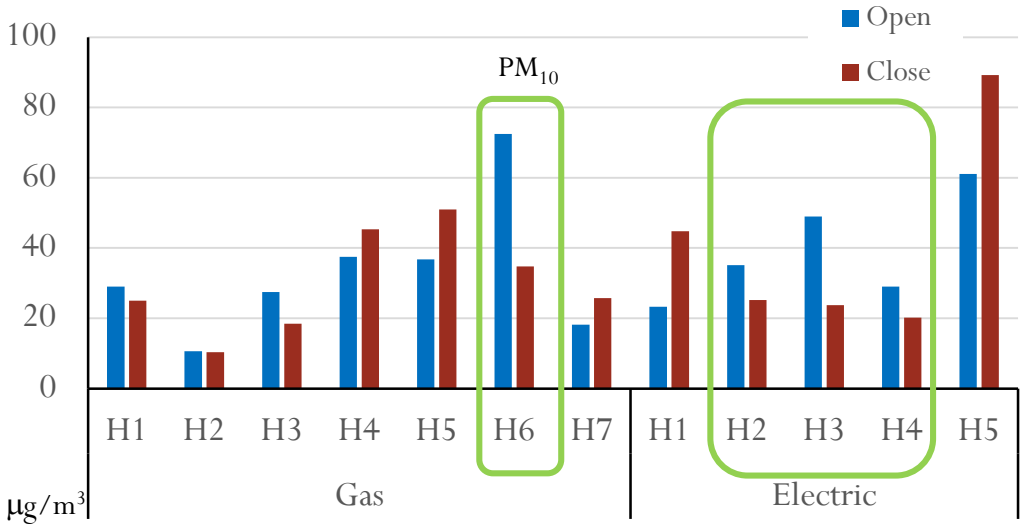
Although ventilation is good for IAQ

Natural ventilation



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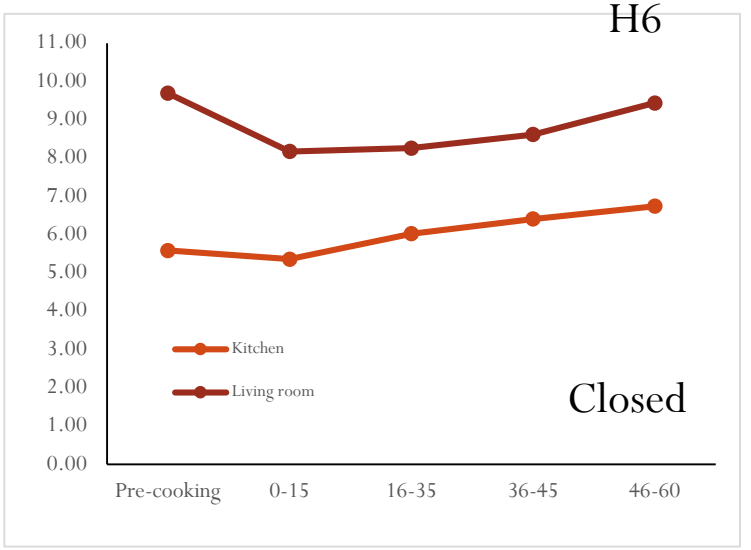
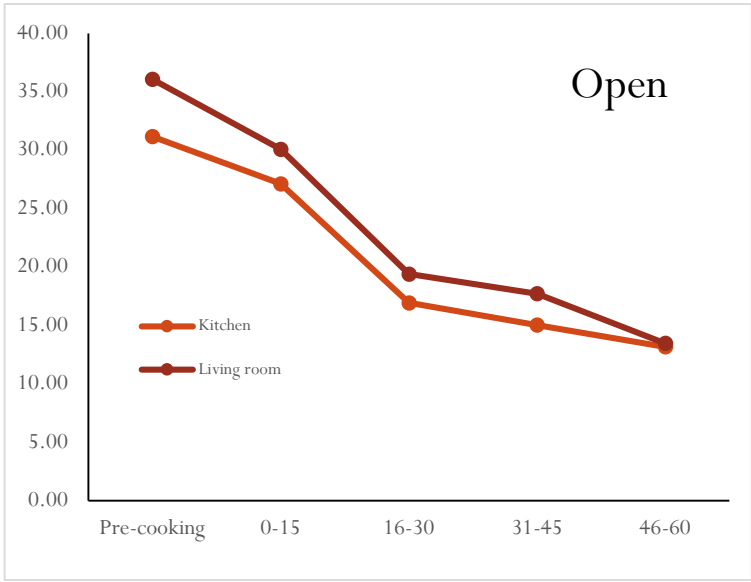
Due to invasion of outdoor air inside





Exhaust fan for air ventilation

Conclusion

- Regarding indoor air quality, it depends on indoor characteristics of the building.
- Some gases with important health impacts such as formaldehyde and toluene were recognized in indoor air of the selected locations.
- Occupation-related air pollutants are also detected in indoor air of the residence attached with shops.
- Cooking generated PMs production should be aware for indoor air quality.
- Ventilation and infiltration from outdoor sources are found having influence on indoor air concentrations.

Conclusion

Local: LRT

Local: URT

Systemic

Acknowledgements

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THANK YOU FOR YOUR ATTENTION