

Estimation of the Concentrations of Some Pollutants Resulting from the Use of Arabian Bakhour and Their Effect in Patients with Asthma in the City of Baghdad

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Abstract—This research focus on studying 3 types of Bakhour in the markets of Baghdad city and assessing their impact on the quality of life for asthmatic whom used Bakhour at their houses through investigating particles physical properties, also estimating the levels of heavy metals (Cd, Cu, Mn, Pb and Zn), Particulate Matter PM_{2.5}, PM₁₀, Total Volatile Organic Compounds (TVOC) and formaldehyde (HCHO). The quality of life for asthmatic patients whom use Bakhour was assessing by Mini Asthma Quality of Life Questionnaire. The results indicated that shapes of Bakhour particles were irregular or spherical. Burning process generated the higher percent of PM <1 μ m. Type 2 Bakhour showed the highest percent of <1 μ m which was 73%. The amount of Cd, Cu and Pb found to have the highest concentrations in type 2 as compared to others. The mean of PM_{2.5}, PM₁₀, TVOC and HCHO in type 1, 2 and type 3 have recorded high as compared to the control (fresh air) values. The results of Mini Asthma Quality of Life Questionnaire AQLQ referred that Asthma patients whom consumed Bakhour recorded significantly the worse in all scores as compared with non-consumers, except Activity limitation. The regression test revealed that smoking habit and consumed Bakhour daily have more effects on asthmatic patients. This study concluded that Bakhour consuming resulted high levels of indoor air pollutants such as particles <1 μ m, Heavy metals, PM_{2.5}, PM 10, TVOC and HCHO which considered harmful to human health and leads to the worse quality of life especially in asthmatic patients.

Index Terms—Bakhour, asthma, Mini-AQLQ, Baghdad.

I. INTRODUCTION

Bakhour (classic Arabian incense), is extensively used in houses, perfumed stores, shops, clothes stores, and so many ceremonies and worship sites throughout the Middle East and North Africa [1]. It is typically used to remove bad odors of indoor environment [2]. In Gulf countries Bakhour represents the most prevalent indoor smoke sources, and it could be one of the factors leading to the regions of high asthma prevalence and severity [3]. Bakhour is made up of a range of natural components that have been steeped in scented oils, including agar wood (Oud), woodchips, musk, and sandalwood. To make the fragrant smoke, the components are combined together and molded into tiny bricks which have been fired on charcoal, electricity, or gas. Bakhour can be purchased in a variety of forms, including Mini blocks, powders, as well as cones, coils, rods, and sticks [1].

Incense burning is known to produce a considerable

amount of fine and ultrafine particles due to the incomplete combustion process. It is coupled with harmful gases like Nitrogen Oxides (NO_x), Carbon Monoxide (CO), poisonous Polycyclic Aromatic Hydrocarbons (PAHs), and volatile organic compounds (VOCs) like isoprene and benzene that easily accumulate indoors, especially when ventilation is insufficient. A typical composition of stick incense consists of 21% (by weight) herbal and wood powder, 35% of fragrance material, 11% of adhesive powder, and 33% of bamboo stick [4]. Exposure to Incense smoke's chemical composition can cause a variety of health concerns, including acute effects like irritation of the eyes, nose, and throat. Contact dermatitis asthma or cancer could result from long-term exposure. [5]. The presence of smoke has an important direct effect on air quality and on people's exposure to contaminants [6].

The vast majority of people spend ninety percent (90%) of their time indoors, where the levels of various contaminants are frequently higher than outside. House dust, incense, tobacco smoke, mold and pet dander are among indoor contaminants that can aggravate asthma [7].

Incense smoke contains chemical substances, such as particulate matter, heavy metals, Polycyclic Aromatic Hydrocarbons (PAHs) and Volatile Organic Compounds (VOCs) [8], [9]. Large quantities of fine and ultrafine particles results from the incomplete combustion process of incense [10]. The tiny size of these particles makes it penetrate deeply into the respiratory tract and even across biological barriers leading to different adverse health effects [11].

Incense smoke have sub micrometer particles with a Count Median Diameter (CMD) range between 0.08 - 0.2 μ m [12]. These characteristics can influence how the particles deposits in the parts of respiratory tract and may also have effects of toxicity, they may also act as efficient carriers of toxic compounds (mutagenic in nature, such as Polycyclic Aromatic Hydrocarbons (PAH) into the pulmonary alveoli which can result in lung cancer [13].

The shape of particles represent important physical characteristic because it effects on particles movement inside respiratory tract as well as the deposition along respiratory parts.

It is usually necessary to assume that particles are not spherical and the most particles have irregular shape [14].

Individuals who are exposed to Bakhour exhaust continuously breathe in the total complex blend that contains particulate matter, gas items and numerous natural compounds. In order to approve that indoor natural variables influences respiratory dysfunction, Wang *et al.* 2021, have overviewed 4164 elementary school children in a few rustic

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zones in Kaohsiung, Taiwan. They found that, among the other chemical variables, incense burning and mosquito repellent burning were altogether related with cough [15].

During incomplete combustion of Bakhour Carbon Monoxide (CO) generates, and cause low symptoms of headache, dizziness, weakness and nausea, also it can be fatal in high concentrations. Furthermore, Bakhour combustion emits Nitrogen Oxides (NO_x), toxic (PAHs) and (VOC) like benzene and isoprene [16]. Some previous studies shown noticeable cell inflammatory reactions during clinical investigations for persons exposed to Bakhour smoke constituents, such as particulate matter smaller than 2.5 microns (PM_{2.5}), carbon monoxide (CO), sulfur dioxide (SO₂), oxides of nitrogen (NO_x), formaldehyde (HCHO), and carbonyls [10], [17].

In different parts of the world Asthma is a global major issue with significant variations in its prevalence and strictness [18]. Previous studies mentioned that Asthma may be defined by the history of respiratory signs such as 'wheeze, the breath shortness, tightness of chest, cough that varies over time and intensity, with limitation in variable expiratory airflow'. Asthma conclusion requires the nearness of more than one of the respiratory side effects, declining of the indications at night and worsening of the indications by viral disease, work out, allergens, changing climate or smoke. From 2011 to 2013, 235–300 million individuals around the world endured from asthma which may increment to 400 million in 2025 [19]-[21]. Family history, house dust, sensitization and pollens, respiratory diseases, nutritional behaviors, as well as outdoor and indoor air pollutants such Bakhour smoke, all play a role. These variables may impact the pathogenesis and seriousness of asthma, this necessitating further inquiry not just to better understand asthma etiology but also to plan asthma control approaches. It's especially crucial to look into the less well-known risk factors relating to lifestyle, culture, and family environment, which may be unique to different groups. In Oman and other Gulf countries (Bakhour) is one of the most public indoor smoke sources and it may provide a reason of great asthma dominance and severity [18].

This study aims to estimate the concentrations of some pollutants resulted by burning three different types of Arabian Bakhour commonly found in Baghdad city markets in order to assess the extent of their impact on the quality of life for asthmatics whom consume Bakhour inside their houses.

II. MATERIALS AND METHODS

A. Bakhour Samples

Three Arabian Bakhour samples were collected from local markets of Baghdad city; the Bakhour samples were selected according to their low cost, common sell and usage in the Baghdad marketplace. The samples were labeled as (type 1), (type 2) and (type 3).

Each Bakhour samples (type1, type2 and type3) were ashed by burning five sticks; the weight before burning of each stick was (1gm). Particle shapes, particle sizes were determined before and after burning for each Bakhour

sample, while heavy metal concentrations were determined after burning process only. The time of burning was between 60 - 90 minutes [22].

B. Bakhour Particles Shapes and Size Determination

In order to determine Bakhour particles shape and size, the preparation of microscope slides was achieved in the current study. It was important to achieve a proper dispersion, which insures that large and small particles are uniformly scattered across the slide, a thin layer of Vaseline was spread on slides. Vaseline plays an important role by sticking the incense particles on slides surface. Bakhour particle samples (type1, type 2 and type 3) were examined to determine shapes and diameters by using light microscope which attached to oculometer. Two slides for each studied Bakhour type examined precisely using the magnification power of (40X). The particle size distribution of each type was estimated by counting three certain particle sizes: (<1, 1 to 5, > 5 μm), and chosen according to their deposition status inside the respiratory tract parts.

Particles counting and size measurement begins at one of the slide dispersion edges. The slide is moved to bring the adjacent field into view once one field has been measured. This is repeated until the dispersion is completely covered. If the number of particles provided is inadequate, the slide is simply moved to reveal another row of field and counted as shown in Fig. (1). This method is repeated until approximately 100 particles are counted in each slide [23].

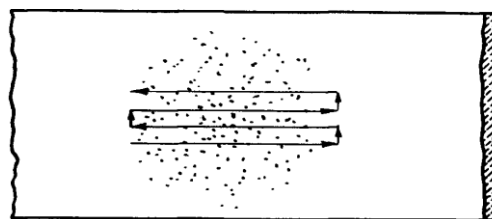


Fig. 1. Measuring particles size and shape on microscopic slides [23].

III. HEAVY METAL CONCENTRATION LEVELS

The determinations of heavy metal concentrations have achieved by adopting two steps which are: the digestion of samples and the Atomic Absorption Spectrometry (AAS) Examination. AAS were used to examine Bakhour samples for heavy metal element concentrations such as Cd, Cu, Mn, Pb, and Zn, which could be present as trace amounts.

A. Samples Digestion

Acid digestion of the Bakhour samples after burning was achieved by dissolving solid samples with acids in order to transform them in to the liquid state which is capable of being measured by the AAS, and then quantities of the specified elements in solutions were evaluated. This procedure represents the following:

- 1) 0.5 g of Bakhour samples was put in glass beaker.
- 2) 3:1 of (HNO₃) acid will be added to the sample.
- 3) Drying the samples by using a heater.
- 4) Dry samples left to cool after heating.
- 5) 3:1 of (HClO₄) acid will be added to each cooled sample and re-heat it.
- 6) Sample will be removed from heat before it dries then left

to get cold.

- 7) Each sample was filtered by using a volumetric flask of 50 ml size.
- 8) Each sample volume was completed with a de-ionized water to 50 ml. Samples preserved in plastic containers to be ready for the AAS examination.

The blank solution represents the digestion acids with a certain concentration under the same conditions of samples during the analysis [24].

B. Atomic Absorption Spectrometry (AAS) Examinations

This device works to heat the samples to (2000 °C), by using Acetylene gas flame in order to transform sample from the liquid to the vapor state and to allow the measurement of element concentrations in each sample. The current study used the (AAS) device of the model specifications: (AA-6200), US made and available in the Central laboratory /College of Science /Baghdad's University [24].

IV. PM2.5, PM10, TVOC AND HCHO, CONCENTRATIONS DETERMINATION

For determining PM2.5, PM10, TVOC and HCHO concentrations, a specific monitor/detector device was used. It is called Temtop LKC-1000S+ Air Quality Detector/IAQ monitor. This detector was used inside a chamber which made of transparent Plexiglas and manufactured locally with the dimensions of (50cm length x 40cm width x 40cm height) and 80 Lt capacity. 1g of each Bakhour sample inside the chamber burned, the burning period for each type of Bakhour was about 60 minutes, during that time the concentrations of PM2.5, PM10, TVOC and HCHO were measured every 12 minutes for five times [25]. The same procedure was applied to measure the concentrations of the same gases and particles, but in fresh air inside the chamber and considered as control values.

A. Study Design

A cross sectional design was used in this study to assess effects of inhalation Bakhour smoke on Health Related Quality of Life (HRQOL) by using the Mini Asthma Quality of Life Questionnaire (AQLQ) which is a highly reliable and well-validated tool covered The most significant and annoying factors affecting the everyday lives of asthmatics and has been translated into several languages, including Arabic [26]. The Mini AQLQ a health survey questionnaire for asthmatic patients that maintains as much as possible the measurement properties of the original AQLQ and each of its four categories: symptoms (5 items), activity (4 items), emotion (3 items), and environment (3 items). The total score is based on the average of all 15 items. The scale range between (0 - 7) of higher scores indicates higher quality of life [27]. The questionnaire administered and translated into Arabic before introducing to participants.

Patients clinically diagnosed with asthma were enrolled from the allergy and asthma clinic center in Baghdad-Iraq for the period between January and June, 2020.

The number of subjects that asked to the participants in this study was 132 patients, only 100 persons (75.7%) individuals were helpful in the study, their age ranged between (10-60)

years old, while 32(24.2%) individuals refused to participate. Prior to taking part in this study, the respondents provided written informed consent and approached to collect data by asking them directly face-to-face. Patients were interviewed separately and wherever possible in a designated room to preserve confidentiality and privacy. The interviewer classified each patient into being using Bakhour or non-using Bakhour in their houses.

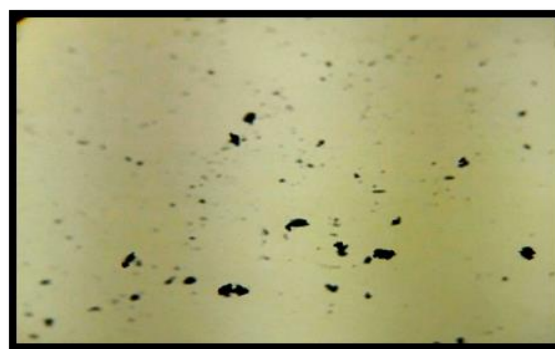
B. Statistical Analysis

Mean \pm standard deviation were used to present data by using the SAS, Version 9 Tukey's' test in order to analyse the differences among examined three types of Bakhour . Studying the population sample characteristics (qualitative factors) were expressed as percentages and analyzed by adopting chi-square test to determine the differences across variables. T-test at ($p < 0.05$) ($p < 0.01$) was used to compare the mean score of each subscale between Bakhour users and non-users. To estimate the strength of linear relationship between variables of Bakhour user categories (age, cigarette smoking status, Bakhour consumption daily or weekly), and the four summary scales (symptoms, activity, emotion and environment) the regression test was used [28].

V. RESULTS AND DISCUSSION

A. Particle Shape

The aim behind this examination is to determine Bakhour samples particles diameters which considered as one of the most important physical properties as well as the particles shapes .The microscopic examination showed that the shapes of Bakhour particles of three types after burning were irregular or spherical, and some has many smaller particles connected to them. (Fig. 2, 3, 4). Cheng *et al.* (1995), observed in their examination that the Transmission Electron Microscope (TEM) images confirmed the incense particles to be round in cross-sectional shape and just like droplet particles from combustion merchandise or seem like a droplet flattened to form a spherical segment whilst collected on a flat surface. Additionally the shape of the incense particles were similar in shape to the combustible aerosols which produced by cigarette and coal fuel smoke. Particles were probably liquid droplets generated via the condensation of vapors which resulted by burning incense and aggregate as tiny particles [29].

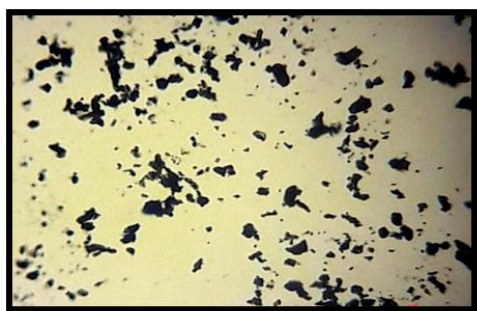


(A)

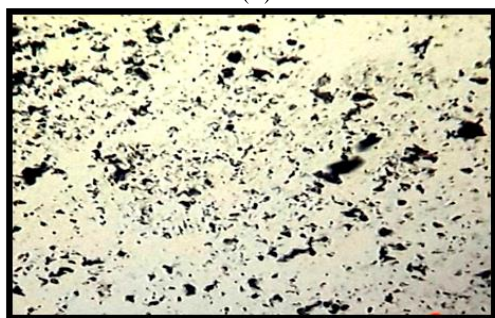


(B)

Fig. 2. Particles of type 1 of Bakhour, A; before burning, B; after burning (40x).

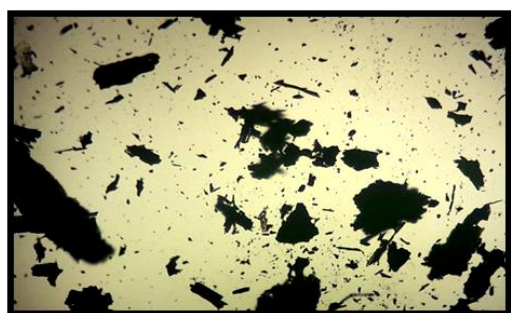


(A)

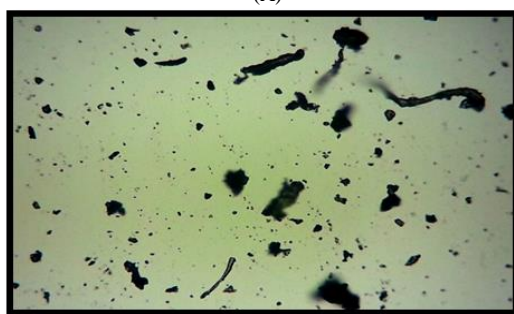


(B)

Fig. 3. Particles of type 2 of Bakhour, A; before burning, B; before burning (40x).



(A)



(B)

Fig. 4. Particles of type 3 of Bakhour, A; before burning, B; before burning. (40x).

B. Particle Size

The Results of the current study showed that the particle size percent with a diameters of $<1 \mu\text{m}$ for the three studied types of Bakhour after burning process has higher percent than those before burning Table I. Type 2 showed the particle size of $<1 \mu\text{m}$ has the highest percent (73%) among other types, while Type 3 showed the particle size $>5 \mu\text{m}$ have the highest percent (29%) among other types after burning process. This results indicated that type2 has its more effects on human respiratory tract because this particle size ($<1 \mu\text{m}$), can penetrate easily to deep lung parts ,such as, bronchioles and alveoli and could cause damages to its structures.

The results of the current study agrees with previous studies results which mentioned that large quantities of particulate matter with median diameter of particulates between (0.24 - 0.40 μm) generate from burning incense. These particles could deposit in the respiratory tract. Furthermore, incense smoke may produce larger particles with diameter range of (0.1 - 0.7 μm) [30].

TABLE I: THE PERCENT (%) OF PARTICLE SIZE DISTRIBUTION FOR TYPES (1, 2, AND 3) OF BAKHOUR

Bakhour types	Particle size distribution(μm)	% Before burning	% After burning
1	<1	43	70
	1-5	49	27
	>5	8	3
	Total	100	100
2	<1	55	73
	1-5	39	27
	>5	6	0
	Total	100	100
3	<1	20	38
	1-5	27	33
	>5	53	29
	Total	100	100

C. Heavy Metals' Analysis

After burning three types of Bakhour, the results indicated that the trace metal concentrations varied in their values. Cd, Cu and Pb were found to have the highest concentration in type 2 as compared to the other two types, while Mn recorded the highest concentrations in type 1, type 2 and type3, respectively. On the other hand, Zn concentration in type 3 has the highest value (170 $\mu\text{g/g}$) as compared with other two types. All Bakhour samples revealed high levels for both Cd and Pb. Statistically, Tukey's' test showed that the differences among examined three types of Bakhour were significant at $P < 0.01$ for Cu, Mn , Pb while statistical analysis showed no differences between type1 and type3 for Cd, as well as, between type 1 and type 2 for Zn as demonstrated in Table II .

TABLE II: MEAN \pm SD CONCENTRATIONS OF HEAVY METALS IN BAKHOUR TYPES

Samples type	Heavy metal concentrations(mean \pm SD) $\mu\text{g/g}$				
	Cd	Cu	Mn	Zn	Pb
1	1.1 \pm 0.2 ^a	33 \pm 3.7 ^a	131.1 \pm 6.2 ^a	113.2 \pm 16.9 ^a	1.6 \pm 0.2 ^a
2	4.2 \pm 0.5 ^b	54 \pm 2.9 ^b	36.3 \pm 2.08 ^b	110 \pm 5.0 ^{ab}	8 \pm 0.8 ^b
3	1.6 \pm 0.1 ^{ac}	22 \pm 2.1 ^c	18.0 \pm 0.8 ^c	170 \pm 16.3 ^c	7 \pm 0.8 ^c
p value	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001 p = 0.9055	p < 0.0001
	p = 0.0703				

^{a-c} Similar letters in each column indicates not significant statistical differences at (p < 0.01, Tukey's' test)

Through the combustion process, metallic elements are supposed to be released as a part of the expelled particles, especially if it is freed to air in the form of PM2.5 or even smaller particles and that they would become hazardous pollutants to human health [31]. The body's homeostasis is maintained by trace elements, which plays a key role in a variety of pathophysiological processes, including the development of asthma [32]. For example, the deregulation of Zinc (Zn) homeostasis can lead to a shift in the Th1/Th2 balance to a Th2 response, which can lead to increased responses to inflammation [33].

Excess or deficient of copper can cause oxidative stress and chronic inflammation [34]. As a result, the asthma risk and its progression may be associated with trace elements levels. Elsayed *et al.* (2014) found that inhaled Bakhour particles which transport iron (Fe) into the lungs have been shown to produce oxidative stress, lung cells irritate and produce inflammation in the same way that cigarette smoke does. [35].

It's possible that the existence of both trace metals and their salts in raw Bakhour is harmful to health. Cadmium is an extremely hazardous metal that can cause problems with the lungs, bones and kidneys. Cadmium oxide is a cancer-causing agent that can produce pulmonary edema and tracheobronchitis are also known to cause asthma in people who are exposed to it. Pyrolysis and combustion produce it as a by-product. Lead is a toxic metal that has been related to human heart and kidney failure [31].

D. PM2.5, PM10, TVOC and HCHO Concentrations Measurement

The results refers that mean concentration values of PM2.5 in types 1, 2 and type 3 recorded high values (460.56±1.51 µg/m³), (179.08±36.77 µg/m³) and (902.04±26.02 µg/m³) respectively as compared with the control value (92.6±12.46 µg/m³), this is shown in Table III. PM10 mean concentration values recorded (286.78±2.38 µg/m³), (159.36±34.74 µg/m³) and (459.58±34.91 µg/m³) respectively as compared with the control value (78.82±4.94 µg/m³). Variance Analysis shown a highly significant differences at (P < 0.01) in the three types as compared with control (fresh air) values.

TABLE III: PM2.5, PM10, TVOC AND HCHO CONCENTRATION MEAN VALUES OF BAKHOUR TYPES INSIDE TEST CHAMBER

Types of Bakhour samples	Mean ±SD			
	PM2.5 (µg/m ³)	PM10 (µg/m ³)	TVOC (mg/m ³)	HCHO (mg/m ³)
Fresh air (control)	92.6±12.46	78.82±4.94	0.018±0.00	0.0026±0.0
1	460.56±1.51**	286.78±2.38**	2.42±0.37**	0.348±0.04
2	179.08±36.77*	159.36±34.74**	0.716±0.08	0.046±0.01
3	902.04±26.02*	459.58±34.91**	2.024±0.44	0.606±0.11

** highly significantly (P<0.01).

It is important to indicate that the PM2.5 and PM10 concentrations in Bakhour had exceeded the standard limits of WHO which are 25 µg/m³ for PM2.5 and 50 µg/m³ for PM10 [36].

In home Burning incense with insufficient ventilation

score could be in a peak levels with total suspended particulates (TSPs) of about 1850 µg/m³ [37].

In a study achieved at Kanpur, India, concerning burning incense in temples as a popular ritual, sampling has been carried out inside the temples and PM10 mass concentrations measured to reach 2184 µg/m³. All mass concentration values surpassed the national Air Quality Index NAAQS of 100 µg/m³ for all samples. The quantity of particles created was substantial with PM2.5 accounting for over 99 % of the total [38].

In the United Arab Emirate UAE, a hazard study on burning Bakhour smoke estimated the concentration of PM to be 1.34–1.36 mg/m³ with an emission rate of 5.9 mg/min, which is considered higher than the emission rate of cigarettes (0.7–0.9 mg/min) [39].

For TVOC and HCHO mean values The result in Table III demonstrated that mean concentration of TVOC in types 1, 2 and 3, have recorded high values (2.42±0.37mg/m³), (0.716±0.08mg/m³) and (2.024±0.44mg/m³) respectively as compared with control value(0.018±0.00 mg/m³), also for HCHO which recorded (0.348±0.04mg/m³), (0.046±0.01mg/m³) and (0.606±0.11mg/m³) respectively as compared with control(fresh air) value(0.0026±0.00mg/m³). The analysis of variance shows differences between the mean concentrations of HCHO among the three types of Bakhour this difference is considered to be extremely statistically significant at (P < 0.01) as compared with mean value of HCHO in control (fresh air) . It is essential to denote that the HCHO levels in Bakhour were above the threshold limit value of WHO which are between 0.1 and 0.3 mg/m³[36].

The results of the current study agrees with other previous studies like Zhanga *et al.* (2015) , they found that HCHO and TVOC were the main components of incense smoke during peak and non-peak times in the chosen Temples and they recorded values which range between 0.05-1.22 mg/m³ for HCHO and 1.66-2.72 mg/m³ for TVOC ,also they mentioned the important factors affecting TVOC concentrations such as processing methods , combustion of incenses and fragrance ingredients[40]. Clinical studies reported that the exposure of persons to constituents in Bakhour smoke leads to noticeable cell inflammatory responses, because of sulfur dioxide (SO₂, formaldehyde (HCHO), carbonyls, (PM2.5), carbon monoxide (CO) and oxides of nitrogen (NOx), [16].

Lee *et al.* (2004) mentioned acute symptoms of VOC exposure results from Incense burning which are: headaches, nausea ,vomiting, nose and throat irritation dizziness, eye irritation and asthma exacerbation. These symptoms increased the risk across contact to PM or VOCs. Most of VOC (toluene, benzene, and xylenes, in addition to aldehydes and polycyclic aromatic hydrocarbons (PAHs)), are absorbed on particle matter. The average concentration levels of numerous organic compounds in indoor air are two-five times more than of outdoor air [41]. Table IV show that the average age of male and female asthma patients participating in this study ranged between (10-60) years, and the chi-square statistic is 9.2714 while for gender was 3.3048 these results showed that there were no significant differences (P > 0.05) between Bakhour users and non-users in terms of age and gender.

TABLE IV: POPULATION SAMPLE CHARACTERISTICS (ASTHMA PATIENTS) (N=100)

Characteristics	Bakhour users in house (80%)	Non-users Bakhour in house (20%)	X ²	p < 0.05
Age(years)				
10-20	23(28.75%)	3(15.00%)	9.27	0.054663 N.S.
21-30	17(21.25%)	4(20.00%)		
31-40	11(13.75%)	2(10.00%)		
41-50	17(21.25%)	2(10.00%)		
51-60	12(15.00%)	9(45.00%)		
gender				
Male	42(52.5%)	15(75.00%)	3.30	0.069079 N.S.
Female	38(47.55%)	5(25.00%)		
Cigarette smoking status				
Yes	21(26.25%)	1(5.00%)	4.21	0.040178*
No	59(73.75%)	19(95.00%)		
Used Bakhour in house				
Daily	63(78.75%)	0(0%)	6.70	0.009588*
Weekly	17(21.25%)	0(0%)		

X² chi square value *significant at p < 0.05. N.S. Not-Significant

While it was noted that significant differences ($P < 0.05$) between cigarette smokers of asthmatic patients who use Bakhour as compared to non-smokers, the chi-square statistic was 4.2104, and the daily use of Bakhour by asthma patients was 63% as compared to 17% whom using it in a weekly manner, the chi-square statistic value was 6.7098 and differences were significant between them.

The prevalence of asthma in Iraq was found to be 8.9 % in older children and 15.55 % in younger [42]. Environmental pollution, asthma in family members, increasing exposure to varied chemical fumes, such as Bakhour, biological and physical exposures from numerous indoor sources and cigarette smoking have all been identified as important risk factors for asthma prevalence [42].

TABLE V: COMPARING MINI –AQLQ SCORES BETWEEN BAKHOUR USERS AND NON-USERS WHICH EXPRESSED IN TERMS OF MEAN ±SD OF ASTHMA PATIENT

Score of Mini –AQLQ	Bakhour users (80%)	Bakhour non-users (20%).	P-value ≤ 0.01
symptoms	2.99 ± 0.52	3.48 ± 0.92	P value = 0.002**
Activity limitation	3.65 ± 0.79	3.98 ± 1.00	P value = 0.117(n.s.)
Emotional function	3.93 ± 0.70	4.49 ± 0.99	P value = 0.004**
environmental stimuli	3.35 ± 0.72	4.08 ± 0.74	P value = 0.001**
overall	3.48 ± 0.68	4.23 ± 0.91	P value is less than 0.001**

n.s. not significant

Table V demonstrated comparison in total and domain Mini –AQLQ scores between Bakhour users (80%) and non-users Bakhour (20%). Asthma patients whom used Bakhour have recorded significantly as the worse in all scores as compared with non-users except Activity limitation. In symptoms score 2.99 ± 0.52 vs. 3.48 ± 0.92, difference is considered to be very statistically significant, $P < 0.01$, while in Activity limitation 3.65 ± 0.79 vs. 3.98 ± 1.00 the difference is considered to be not statistically significant in P value ($P =$

0.117). Emotional function score recorded for Bakhour users as 3.93 ± 0.70 vs. 4.49 ± 0.99 for non-users, this difference is considered to be very statistically significant $P < 0.01$. The environmental stimuli score reports 3.35 ± 0.72 for Bakhour user patients vs. 4.08 ± 0.74 in non-user patients, this difference is considered to be extremely statistically significant $P < 0.01$. In overall of scores records 3.48 ± 0.68 vs. 4.23 ± 0.91, the difference is considered to be extremely statistically significant $P < 0.01$ which means that the quality of life among asthmatics Bakhour users will be reduced.

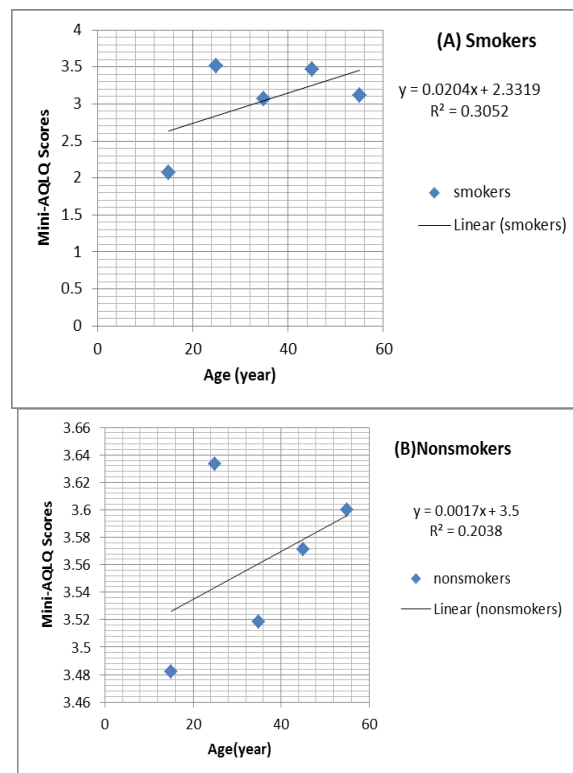
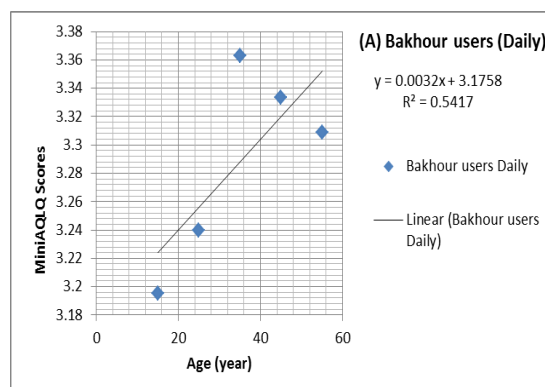


Fig. 5. Regression analysis of asthmatic Bakhour users, (A) smokers, (B) nonsmokers.

The regression analysis revealed that both asthmatic smokers and nonsmoker whom use Bakhour inside their houses showed a positive correlation, for smokers ($R = 0.5524$). The regression line equation was. $\hat{Y} = 2.3319 + 0.02039X$ and β (slope of the regression line) = 0.02 (Fig. 5 A). While for nonsmokers the value of R was 0.4514. The regression line equation was $\hat{Y} = 3.5 + 0.001745X$ and $\beta = 0.0017$ (Fig. 5 B). It means that there is a moderate direct relationship between Mini –AQLQ scores in both smokers and nonsmokers with asthmatic patient's age.



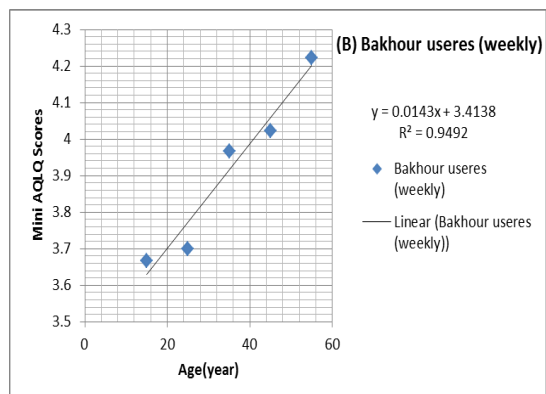


Fig. 6. Regression analysis of asthmatic Bakhour users, A: daily users B: weekly users.

Fig. 6A shows that the regression analysis for asthmatic patients whom consume Bakhour in daily basis is positive; correlation (R) equals 0.736. This expresses a strong direct relationship between age categories and Mini –AQLQ scores. Regression line equation was ($\hat{Y} = 3.1758 + 0.00321X$) and $\beta = 0.0032$, also the regression analysis in asthmatic patients whom used Bakhour weekly revealed a positive correlation ($R = 0.9743$). This refers to a very strong direct relationship between age categories and Mini –AQLQ scores. Regression line equation was ($\hat{Y} = 3.4138 + 0.01434X$) and $\beta = 0.014$, Fig. 6B.

In a previous study achieved in the UAE , 2012 for 628 home indoor environments it was found that burning Bakhour on a daily routine is linked with the increase of headaches, difficulty in attention and amnesia [17]. Other community survey managed in Oman shown that Bakhour burning causes wheezing amongst asthmatic patients [10].

The results of the current study is compatible with Previous discoveries which states that asthmatic Bakhour users who consume it more than twice a week have obvious respiratory problems and represents about three times more than that of non- Bakhour consumers.

It was also found that inhaling Bakhour smoke made 38 % of asthmatics' wheeze getting worse and making it the fourth most common asthma cause factor after dust, weather, and respiratory tract infections [19].

VI. CONCLUSIONS

The composition of different types of Bakhour is not free of fine particulate matters, gases and heavy metals, which are harmful to human health generally and asthmatic patients particularly. Consuming Bakhour by Iraqi asthmatic patients on daily or weekly basis within all age categories and smoking habits makes the quality of life in several aspects significantly low, this could be observed clearly especially when examining symptoms, environmental and emotional factors. While examining activity limitation, Bakhour does not influence this factor. Further research is recommended to prevent bad habits concerning asthmatic patients to improve their quality of life in the future.

VII. LIMITATIONS

Although we obtained useful information directly from

asthmatic patients, our main goal was achieved about the effect of consuming Bakhour in houses. Furthermore, Outdoor air pollution and poor air quality of Baghdad city due to the later impact of frequent dust storms have their health effects, especially on asthmatic patients.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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