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Studies on Jurak Smoke: I. The Organic Constituents of Jurak Smoke

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ABSTRACT. Jurak smoke condensate was analyzed for its major components by gas chromatography-mass spectrometry (GC/MS). Eighty-eight compounds were detected in the smoke condensate, including alkenes; alkynes; alkaloids and other bases; alcohols; aldehydes and ketones. The polynuclear aromatic hydrocarbons, the major carcinogenic agents in cigarette smoke, were not detected in jurak smoke condensate. The GC/MS analysis of the portion of jurak smoke trapped by the water in the shisha reservoir revealed additional 54 compounds beside those detected in jurak smoke condensate. Water filtration in the shisha reservoir is more effective with alkaloids and other bases, phenols and phenolic ethers, esters and alcohols. The absence of polynuclear aromatic hydrocarbons in jurak smoke, and the retention of most phenolic compounds from the inhaled smoke by water filtration may explain the reported low incidence of tumours of upper respiratory tract among jurak smokers compared to cigarette smokers.

Introduction

Smoking is probably the largest single preventable cause of ill health in the world. The relationship of cigarette smoking to a variety of diseases have been clearly demonstrated. Smoking increases the risk of lung cancer, heart disease and respiratory diseases of all kinds[1].

Epidemiological investigation have suggested a correlation between cigarette, cigar and pipe smoking and certain types of cancer in man, particularly between

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primary lung cancer and cigarette smoking[2]; cancer of alimentary tract and cigar and pipe smoking[3,4].

During the last forty years, efforts have been concentrated on investigating the major and minor components of tobacco smoke and their relation to cancer and other diseases associated with smoking. More than 3000 compounds has been identified in cigarette smoke[5]. Among these, the polynuclear aromatic hydrocarbons were shown to be carcinogens[6-9]. Certain volatile phenols and fatty acids were identified as tumour promotors[10,11]. The increased risk of the cigarette smokers to develop cancer of the urinary tract was attributed to certain amines, aminophenols and the nicotine metabolites excreted in the urine[12].

In the Kingdom of Saudi Arabia smoking of jurak is very common. There is a general belief among smokers that jurak smoking is not as dangerous as cigarette smoking, as they thought that jurak is manufactured from the bulb of fruits and tobacco leaves is not one of its constituents. However, analysis of different brands of jurak paste indicated that it approximately contains (on dry weight base) 47% carbohydrates (estimated as glucose), 15% tobacco leaves, 0.03% nicotine, 0.53% alcohol, 0.56%, 1.92% and 1.16% sodium, potassium and calcium respectively[13].

Despite the widespread of jurak smoking in the western region of Saudi Arabia lung cancer incidence is low (in comparison with other cancers) compared to USA and UK[14]. Yousif[15] also reported low incidence of laryngeal tumours compared with other head and neck tumours. They speculated that the low incidence of these tumours is due to the partial or complete removal of the carcinogenic polynuclear aromatic hydrocarbons and the reduction of the phenolic content of the inhaled smoke by filtration of the smoke through the water in the reservoir of the shisha. However, neither the analysis of the chemical constituents of jurak smoke, nor the evaluation of the importance of the water filtration in jurak smoking has been performed.

The objectives of this work are to: (a) Identify the major chemical components in jurak smoke condensate (the fraction of jurak smoke inhaled by the shisha smokers). (b) Identify the major chemical components in jurak smoke trapped by the water in the shisha reservoir (jurak smoke extract), (c) Evaluate the importance of the water filtration in the shisha reservoir.

Material and Methods

Apparatus

Patches of 100 g each of jurak paste (trade mark Gannet El-Fawakeh) were burnt in an experimental shisha (Fig. 1). The smoke from burning jurak paste was drawn by intermittent vacuum through two reservoir connected in series. The first reservoir is filled with 750 ml water for trapping the portion of jurak smoke corresponding to that trapped by the water reservoir of the actual shisha (jurak smoke extract). The second reservoir is filled with 750 ml chloroform, and cooled by ice/salt mixture (−5.0 to −

8°C) for trapping the smoke corresponding to that inhaled by the shisha smokers (jurak smoke condensate). The experimental shisha was set up to operate at negative pressure equivalent to 8 mm Hg which approximated the mean suction of smoke inhaled by shisha smokers (6.8-9.3 mm Hg) tested in our laboratory. The intermitted suction was applied for five seconds intervals every 30 seconds which approximately mimic to the inhalation/relaxation cycle in shisha smoking. During the burning of jurak paste which took about 15 minutes the temperature was gradually increased from ambient temperature to about 435 to 450°C. The initial increase in temperature was slow until it reached 110°C, and then the temperature increased at higher rate.

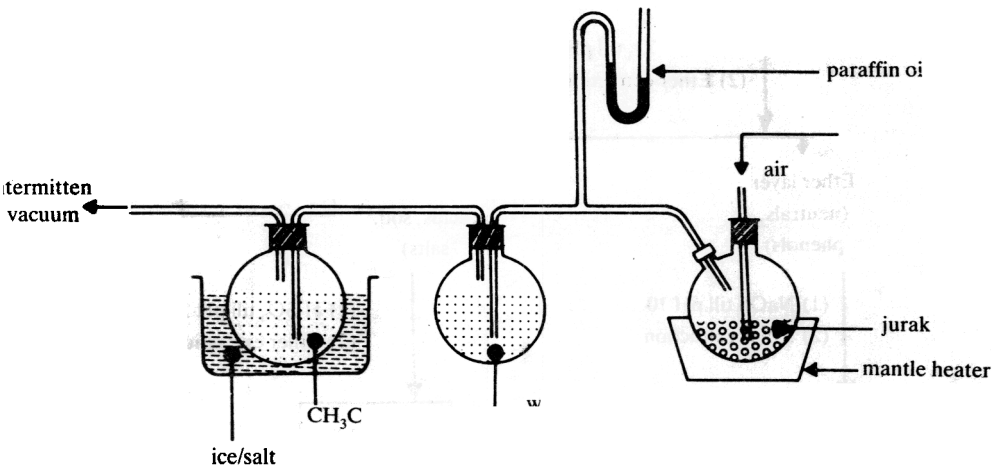


FIG Experimental shisha for preparation of jurak smoke

Preparation of Jurak Smoke Condensate

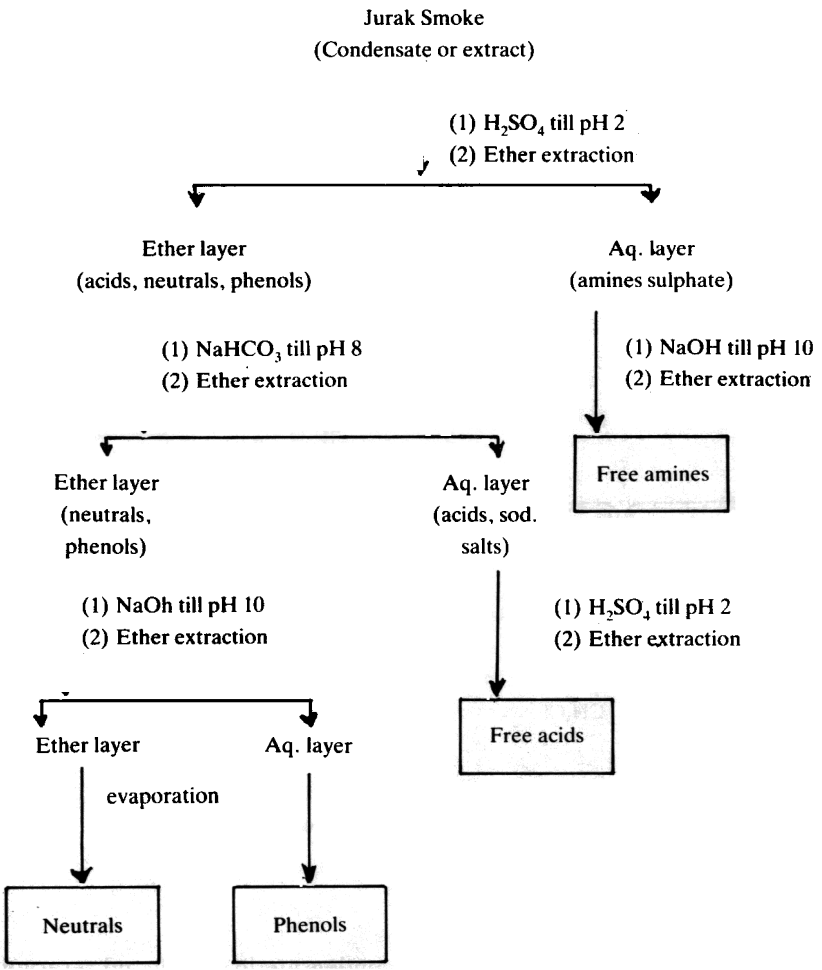
The chloroform with the trapped smoke condensate in the second reservoir was dried with anhydrous sodium sulphate. Chloroform was then removed from the condensate by evaporation at 45°C under reduced pressure.

Preparation of Jurak Smoke Extract

The smoke trapped in the water reservoir was extracted by diethyl ether. The ether extract was dried with anhydrous sodium sulphate, and the ether was then removed by evaporation on water bath at 45°.

Fractionation of Jurak Smoke

The jurak smoke condensate and extract prepared as described above were fractionated to neutral, basic, acidic, and phenolic fractions according to the method reported by Hoffmann and Wynder[12] as outlined in Scheme 1.



SCHEME 1. Fractionation of jurak smoke condensate and extract.

Gas Chromatograph-Mass Spectrometry

Components in the different fractions of jurak smoke condensate or extract were identified by capillary column gas chromatography-mass spectrometer, Finnigan Model 1020 automated quadropol mass spectrometer system connected to a Perkin-Elmer gas chromatography (Sigma 3) equipped with a 30-meter SE-54, 25 mid-fused silica column (J & W Scientific). The column was operated with helium carrier gas (head pressure lo psi, Split; 10 ml/min, sweep; 5 ml/min) and a program rate of 6°C/min from 50 to 220°C was employed. Mass spectrometer condition for scanning analysis were the following: mass range 4 to 800 amu, scan speed 700 amu per sec-

ond, electron multiplier voltage 1400 V. Sample volumes were 1-2 μl delivered by using 10 μl Hamilton syringe.

Compounds were identified by computer matching of experimental mass spectra of compounds with the current National Bureau of Standard (NBS) mass spectrum library. The similarity of two mass spectra, the unknown spectrum and the library spectrum, is given a numerical value between 0 and 1000 which represents the fit between the unknown spectrum and the library spectrum. In the present analysis, only the compounds which gave fit between 650 and 1000 were accepted, and those that show fit less than 650 were rejected.

Results

The compounds identified in jurak smoke condensate and extract using scanning gas chromatograph-mass spectrometer are presented in tables 1-9.

TABLE Alkenes and alkynes identified in jurak smoke condensate and extract

Compound	Jurak smoke* condensate	Jurak smoke* extract
Cyclopentene, 3-methyl	+ (898)	+ (849)
1, 3-Cyclopentadiene, 5 (1-methyl, 2-propene)	+ (948)	+ (878)
Cyclohexene-1, 2-dimethyl	+ (877)	+ (898)
Cyclohexene-1, 4-dimethyl	+ (942)	+ (868)
Cyclohexene-3, 3, 5-trimethyl	+ (905)	+ (893)
1, 3-Hexadiene, 3-ethyl-2, 5-dimethyl	+ (913)	+ (904)
1, 4-Hexadiene-2, 3-dimethyl	+ (884)	+ (948)
1, 4-Undecadiene (Z)	+ (927)	+ (919)
1, 3, 6-octatriene-3, 7-dimethyl	+ (937)	+ (904)
1-Nonene-4, 6, 8-trimethyl	+ (874)	+ (855)
1-Bentene-3-yne	+ (923)	+ (888)
1-Hexene-3-yne	+ (942)	+ (959)
Cyclohexene-1 (propenyl)	+ (888)	+ (898)
2, 3-Heptadiene-5-yne, 2, 4-dimethyl	+ (920)	+ (911)
3-Octyne	+ (959)	+ (947)
4-Octyne	+ (944)	+ (918)
3-Octyne, 2-methyl	+ (980)	+ (915)
3-Heptyne, 2, 2-dimethyl	+ (919)	+ (862)
4-Decyne	+ (833)	+ (893)
1, 3-Dacadiyne	+ (828)	+ (878)
2, 8-Decadiyne	+ (881)	+ (887)
1- Undecyne	+ (845)	+ (922)
3- Undecyne	+ (939)	+ (871)
3-Octene-5-yne, 2, 7-dimethyl (Z)	–	+ (933)

+ Compound detected.
– Compound not detected.
Numbers in parenthesis refer to the fit between the unknown spectrum and the library spectrum.

TABLE 2. Aromatic hydrocarbons identified in jurak smoke condensate and extract

Compound	Jurak smoke* condensate	Jurak smoke* extract
Benzene-1, 2-dimethyl	+ (898)	+ (904)
Benzene-1, 2, 3-trimethyl	+ (926)	+ (914)
Benzene-1, 2-diethyl	+ (873)	+ (910)
Benzene, (2-methyl-2-propenyl)	+ (796)	+ (809)
Benzene, (3-methyl-2-butenyl)	+ (846)	+ (893)
Benzene, (3-methylbutyl)	+ (886)	+ (914)
Benzene, 1, 2, 4-triethyl-5-methyl	+ (914)	+ (816)
IH-indene, 2, 3-dihydro-4, 7-dimethyl	+ (818)	+ (872)
Naphthalene, 1, 3, 6-trimethyl	–	+ (813)
Benzene, (1, 1-dimethyl-2-propene)	–	+ (800)

TABLE 3. Alkaloids and other bases identified in jurak smoke condensate and extract.

Compound	Jurak smoke* condensate	Jurak smoke* extract
Pyridine	+ (871)	+ (923)
Pyridine, 2-methyl	+ (945)	+ (922)
Pyridine, 3-methyl	+ (938)	+ (844)
1, 2, 4-Triazolo (4, 3-A) pyridine	+ (991)	+ (889)
Nicotine [pyridine, 3-(1-methyl-2-pyrrol)]	+ (992)	+ (916)
Aniline (benzeneamine)	+ (922)	+ (913)
Propanedinitrile, dimethyl	+ (949)	+ (830)
Aziridine, 1-(methoxymethyl)	+ (974)	+ (895)
1, 3, 4-Thiadiazol, 5-(methylamino, N - propane)	+ (920)	+ (882)
Diazene (4-methylphenyl) phenyl	+ (896)	+ (895)
1 - Phenazinamine	+ (822)	+ (852)
2 - Phenazinol, 6-amino	+ (884)	+ (891)
1, 2-Benzisoxazol, 3-methyl	+ (976)	+ (875)
Benz (c) acridine 5, 10-dimethyl	+ (657)	+ (732)
Benz (c) acridine 7, 10-dimethyl	+ (666)	+ (791)
Methanamine, N (diphenylmethyl)	+ (843)	+ (911)
Pyridine, 2-[(3-methoxyphenyl) methyl)]	+ (815)	+ (903)
Benzenemethanol, 4(phenylamine)	+ (850)	+ (897)
Pyrimidine, 5-methyl	–	+ (884)
Pyridine, 4-ethyl	–	+ (874)
Pyridine-2, 3-dimethyl	–	+ (871)
Pyridine, 2-methyl-5-ethyl	–	+ (878)
Pyridine, 2, 3, 5-trimethyl	–	+ (856)
Pyridine, 2-ethyl, 4, 6-dimethyl	–	+ (924)
4-Pyridinemethanol, 3-hydroxy-2-ethyl	–	+ (960)
Pyrido [3, 2-b] pyrimidine-4 (3H) - one	–	+ (905)
4 (3H) - Quinolinone, 3-hydroxy	–	+ (912)
1H-Indol, 2, 3-dihydro-2, 3, 3-trimethyl	–	+ (828)
6(5H) Phenanthridinone, 8-methoxy	–	+ (753)
Formamido, N-(2-methylphenyl)	–	+ (918)

*Legends as table

Table 3. (Continued).

Compound	Jurak smoke* condensate	Jurak smoke* extract
1, 2-Benzisoxazol, 3-methyl	–	+ (927)
2-Heptanamine, 6-methyl	–	+ (887)
1H-Indol-2-one, 3[(4-aminophenyl)]	–	+ (992)
Pyridino, 3(1-methyl-2-pyrrolidine)	–	+ (981)
3-Pyridinecarboxymide, N-phenyl	–	+ (894)
Diazine, methylphenyl, 2-oxide	–	+ (901)

TABLE 4. Phenols and phenolic ethers identified in jurak smoke condensate and extract.

Compound	Jurak smoke* condensate	Jurak smoke* extract
Phenol, 2-ethyl-4-methyl	+ (942)	+ (868)
Benzene, 1-methoxy-4-propenyl	+ (906)	+ (821)
Benzene, 1-methoxy-4- (phenylmethyl)	+ (901)	+ (843)
Phenol	–	+ (928)
Phenol, 3-methyl	–	+ (940)
Phenol, 3-ethyl	–	+ (930)
Phenol, 4-methyl	–	+ (905)
Phenol, 2, 3-dimethyl	–	+ (931)
Phenol, 3, 4-dimethyl	–	+ (914)
Phenol, 3, 4-dimethoxy	–	+ (916)
Phenol, 2- (3-hydroxy-3-methyl-1-buten)	–	+ (951)
Benzene (1-methylpropxy)	–	+ (780)
Benzene ethoxy	–	+ (935)
Benzene, 1-methoxy-2-(methylthio)	–	+ (905)

TABLE 5. Aldehydes and ketones identified in jurak smoke condensate and extract.

Compound	Jurak smoke* condensate	Jurak smoke* extract
Benzaldehyde, 3, 4-dimethyl	+ (884)	+ (877)
Benzaldehyde, 4(1-methylethyl)	+ (868)	+ (901)
Benzeneacetaldehyde, alphamethyl	+ (861)	+ (922)
2-Cyclohexene-1-acrolein, 2, 6, 6-trimethyl	+ (918)	+ (872)
Ethanone, 1-(2-furanyl)	+ (913)	+ (829)
2-Cyclopentene-1-one, 3, 4, 4-trimethyl	+ (945)	+ (957)
2-Cyclopentene-1-one, 2, 3, 5-trimethyl, 4-(1, 3-Butadiene)	+ (921)	+ (889)
2, 4-Cyclohexadiene-1-one, 2, 6-dimethyl, 5(1, 2-Propandiene)	+ (889)	+ (982)
1-Methyl-2-tetrolon	+ (910)	+ (923)
Bicyclo [3.2.0] heptane-2-one, 1-methyl, 4-ethyl	+ (940)	+ (901)
Spiro (2.4) heptane-4-one	+ (979)	+ (930)
Cyclopentanone, 2-methyl	–	+ (839)
3(2H) Benzofuranone, 2-methyl	–	+ (876)
3-Nonene-2-one, 3-ethyl	–	+ (890)

*Legends as table 1

TABLE 6. Acids and esters identified in jurak smoke condensate and extract

Compound	Jurak smoke* condensate	Jurak smoke* extract
4-Hexenoic acid, 3-methyl-1-2, 6-dione	+ (897)	+ (914)
Benzoic acid	+ (815)	+ (800)
Benzeneacetic acid, 4-nitrophenyl	+ (665)	+ (910)
Benzoic acid, 4-methyl, 2-oxo-2-methylphenyl	+ (906)	+ (878)
Dodecanoic acid, 2, 6, 10-trimethyl	+ (872)	+ (884)
Nonanoic acid	–	+ (948)
Decanoic acid	–	+ (974)
Tetradecanoic acid	–	+ (943)
Tetradecanoic acid, 2-oxo- methyl ester	–	+ (957)
Hexadecanoic acid	–	+ (951)
9, 12-Octadecadienoic acid (Z, Z)	–	+ (988)
2, 5-Octadecadienoic acid, methylester	–	+ (847)
Phthalic acid, mono (O-methylbenzene-4-methyl)	–	+ (811)
Hexacosanoic acid, 2-methyl-, methylester	–	+ (906)

TABLE 7. Alcohols identified in jurak smoke condensate and extract.

Compound	Jurak smoke* condensate	Jurak smoke* extract
2-Butene-1-01, 2-methyl	+ (743)	+ (732)
3, 5-Nonadien-7-yne-2-01 (E, E)	+ (951)	+ (897)
2-Pentadecyne-1-01	+ (901)	+ (868)
Cyclohexanol, 2(1-methylethyl)	+ (833)	+ (897)
Cyclohexanol, 3-methyl-2-(1-methylethyl)	+ (824)	+ (907)
1-Cyclohexene-1-methanol, alph-1-pentene	+ (778)	+ (884)
Cycloheptanol, 3- (3, 3-dimethylbutyl)	+ (894)	+ (865)
2-Propene-1-01, 3-(2, 6, 6-trimethyl, 1-cyclohexene)	+ (878)	+ (892)
4, 7-Methano-1H-inden-1-01, octahydra	+ (981)	+ (913)
Benzenemethanol, 4-methyl	+ (836)	+ (921)
Phenathylacohol, alpha-pentyl	+ (829)	+ (903)
Hexanol, 2, 3-dimethyl	–	+ (896)
p-Menthan-9-01-trans	–	+ (928)
2-Cyclopenten-1-01, phenyl	–	+ (930)
1, 4-Butandiol, 2, 3-bis(methylene)	–	+ (973)
2-Heptanol, 5-ethyl	–	+ (894)
2-Furanmethanol (furfuryl alcohol)	–	+ (834)
Tridecanol	–	+ (807)
3-Heptanol, 3, 6-dimethyl	–	+ (886)

TABLE 8. Ethers and cyclic ethers identified in jurak smoke condensate and extract.

Compound	Jurak smoke* condensate	Jurak smoke* extract
Benzene (2, 2-dimethoxyethyl)	+ (893)	+ (873)
Oxirane (3, 3-dimethylbutyl)	+ (877)	+ (886)
3, 10-Dioxatricyclo [4.3.1.0] decane	+ (816)	+ (833)
2H-Pyron, 2(7-heptadecynyloxy)	–	+ (842)
Naphtho [2, 3-B] oxirene, decahydro	–	+ (888)

*Legends as table 1.

TABLE 9. Cyclic and polycyclic hydrocarbons identified in jurak smoke condensate and extract.

Compound	Jurak smoke* condensate	Jurak smoke* extract
Cyclohexane, 1, 2, 4, 5-tetraethyl	+ (917)	+ (930)
Bicyclo [5.1.0] octan	+ (900)	+ (868)
Bicyclo [3.1.1.] heptane, 2, 6, 6-trimethyl	+ (781)	+ (949)
Tricyclo [3.2.1.0] octa-3-ene-4-butyl	+ (888)	+ (897)
Cyclohexane (2, 2-dimethyl cyclopentane)	+ (900)	+ (912)
Bicyclo [2.2.2] octa-2, 5-diene, 1-butyl	+ (955)	+ (905)

The Extent of Water Filtration in the shisha

Comparing the chemical constituents of jurak smoke condensate and jurak smoke extract (table 10), it can be seen that the water in the shisha reservoir retains some organic inhalants. In addition it also retains huge amount of brown pigments and resins which has not been analyzed yet.

TABLE 10. Effect of water filtration of jurak on its organic constituents**.

Compounds	No. of compounds detected		Effect of water filtration	
	Smoke condensate	Smoke traped in water reservoir	No. of compounds retained	% retained
Alkenes and alkynes	23	24	1	4.2
Aromatic hydrocarbons	8	10	2	20.0
Alkaloids and other bases	18	36	18	50.0
Phenols and phenolic ethers	3	14	11	78.6
Acids and esters	5	14	9	64.3
Aldehydes and ketones	11	14	3	21.4
Alcohols	11	19	8	42.1
Ethers and cyclic ethers	3	5	2	40.0
Cyclic and polycyclic hydrocarbons	6	6	0	0.0
Total	88	142	54	38.00

Discussion

In the present study, the major organic constituents in jurak smoke condensate and extract were identified in an attempt to correlate their chemical nature with cancer epidemiological finding.

*Legends as table 1.

**Besides the effect of water filtration in retention of 54 compounds, it also reduce the concentration of the other compounds, since the compounds detected in the smoke condensate were also detected in the smoke traped by water reservoir.

Burning of organic matrix such as jurak or tobacco generates a complex mixture of compounds (smoke) by a variety of processes responsive to thermodynamic constraints. The smoke formation occurs by pyrolysis, oxidation, decarboxylation, dehydration, condensation, distillation and sublimation. The products of these processes are highly influenced by moisture content, temperature and availability of oxygen.

In order to generate reproducible physical and chemical data for the analysis of jurak smoke with unavailable standard jurak smoking machine at present, we have been set up an experimental shisha with smoking conditions based on observation of patterns in jurak smoking; one suction per 30 seconds, and 5-second duration, and withdrawn negative pressure of 8 mm Hg. Since it was difficult to standardized this procedure, slight variation of these conditions could not be avoided.

The number of compounds detected in jurak smoke in this study is very small (142 compounds) compared to that detected in cigarette smoke (more than 3000 compounds). Although many factors can contribute to these differences, three factors appear to be important; the physical and chemical properties of the matrix, burning temperature and the differences in apparatus and detection procedures. The matrix in cigarette smoking is tobacco leaves which have a low moisture content, and the temperature in burning cigarette reaches 900°C[16]. The matrix in jurak smoking on the other hand, contains (on dry weight base) 15% tobacco leaves, and 47% carbohydrates, and the burning temperature in jurak is 450°C. The high water content in jurak matrix and the low burning temperature of jurak may lead to a relatively small number of the degradative products in jurak smoke relative to cigarette smoke. The difference in the chemical nature of the components in both smokes is also reflection to these factors and the difference in the matrix composition. Nevertheless, several compounds present in cigarette smoke were detected in jurak smoke, these include; nicotine, pyridine, pyridine 2-methyl-, pyridine 3-methyl, benz (c) acridine, aniline, cyclopentene 3-methyl, furfuryl alcohol, benzoic acid, nonanoic acid, phenol, phenol 3-ethyl and benzen 1, 2, 3- trimethyl[17]. It seems that these compounds are formed from tobacco matrix at relatively low temperature and thus appear in both smokes.

Chloroform may not be the best solvent for trapping all the compounds in jurak smoke, and the vacuum generated near the head space of chloroform, even it is small (8 mm Hg), it may increase the volatility of some compounds. Thus our results do not ruled out the possible presence of other compounds in jurak smoke which present in minute amounts, or have high vapour pressure and thus escaped from the trapping system.

The polynuclear aromatic hydrocarbons, the major carcinogenic and co-carcinogenic agents in tobacco smoke[9] were not detected in jurak smoke condensate or extract. These compounds are formed by pyrosynthesis from carbon-hydrogen free radicals or by Diels-Alder addition of dienes[12-18]. The products of such reactions are highly influenced by temperature, moisture content, and, to some extent, by the pre-

sence of special precursors, *i.e.* terpenes which regarded as tobacco-specific constituents. We speculate that the burning of jurak (high moisture content, low burning temperature, and low content of tobacco leaves and consequently low terpenes) delivered no appreciable amount of polynuclear aromatic hydrocarbons.

The jurak smoke condensate, however, contains some toxic agents, e.g. pyridine, nicotine, and four potentially carcinogenic agents namely; benz (c) acridine, 5, 10-dimethyl, benz (c) acridine, 7, 10-dimethyl aziridin, 1-(methoxymethyl) and diazine (4-methylphenyl) phenyl. These compounds are found also in jurak smoke extract beside three more potentially carcinogenic agents, namely; oxirane (3, 3-dimethylbutyl), phenanthridinione, 8-methoxy and naphtha (2, 3-ß) oxirene decahydro and the toxic agent phenol.

Results in table 10 indicate that the water in the shisha reservoir retains some organic inhalants by acting as solvent and as condensation medium. Our experimental design does not allow these two effects to be separated. However, this combined effect is important in this study. Water removed some components completely from the smoke e.g. some acids, ethers and some bases and reduced the others as they appear in both smoke condensate and extract. Although no quantitative estimation was carried out on the extent of water filtration for the different compounds, the total volume of the smoke trapped by the water that produced from fixed quantity of jurak is about two-fold the volume of smoke condensate. Moreover, the qualitative analysis of trapped components indicated that water is more effective as a solvent with the relatively polar compounds, and more effective as a condensation medium with the low volatile compounds.

The absence of polynuclear aromatic hydrocarbons in jurak smoke, or their presence in minute amounts, and the retention of large portion of organic inhalants especially phenols and bases by the water trap may explain the clinical finding previously published by Sterling *et al.*[14] and Yousif[15]. These authors reported low incidence of tumour of upper respiratory tract among jurak smokers in the western region of Saudi Arabia.

Similar results were also reported among smokers of oriental water pipe and Goza. Rokower and Fatal[19] reported low rates of lung cancers among smokers of oriental water pipe (Narghile). This was explained by Hoffmann *et al.*[20] to be due to the retention of the majority of the phenols, nicotine, and benzo (a) pyrene by the water-filled oriental pipe. Salem *et al.*[21], also reported low incidence of bronchial cancers among Goza smoker in Egypt compared to cigarette smokers, and this was also attributed to the water filtration of the smoke.

Although the physico-chemical nature of jurak matrix, and the retention of some organic inhalants by the water could decrease the risk factors for lung cancer and laryngeal tumours among jurak smokers compared to cigarette smokers, this does not completely free jurak smoking from other health hazard.

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دراسة على دخان الجيراك
١ - المكونات العضوية لدخان الجيراك

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المستخلص . تناول البحث التعرف على المركبات الكيميائية الموجودة في دخان الجيراك وكذلك جزء الدخان المحجوز بوساطة الماء في خزان الشيشة باستخدام جهاز كروماتوجراف الغاز - مطياف الكتلة - وتتلخص النتائج في النقاط التالية :

١ - تم التعرف على ثمانية وثمانين مركبًا كيميائيًّا في دخان الجيراك ومع ذلك لم يتم الكشف عن وجود الهيدروكربونات العطرية المتعددة الحلقات وهي من أهم العوامل المسببة للسرطان في دخان السجائر .

٢ - تم أيضًا التعرف على أربعة وخمسين مركبًا أخرى في دخان الجيراك المحجوز بوساطة الماء في خزان الشيشة بالإضافة إلى المركبات الموجودة في دخان الجيراك وبذلك يصبح عدد المركبات المحجوزة في مياه خزان الشيشة مائة واثنين وأربعين مركبًا .

٣ - إن عدم وجود الهيدروكربونات العطرية المتعددة الحلقات أو وجودها بكميات ضئيلة جدًا بحيث لم يتم الكشف عليها في دخان الجيراك ، بالإضافة إلى ترشيح دخان الجيراك في مياه خزان الشيشة والذي يحجز عددًا كبيراً من المركبات ، وخفض تركيز المركبات الأخرى في الدخان ربما يفسر انخفاض معدل حدوث أورام الجزء الأعلى للجهاز التنفس بين مدخني الجيراك بالمقارنة بمدخني السجائر .