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The Mineralogical and Micro-Organisms Effects of Regional Dust Storms over Middle East Region

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Abstract: The identified regional dust storms by satellites images, which blowing over Iraq and the Middle East were studied, from March 2007 to October 2008. The collected dust storms samples were from the middle and south Iraq. The climatic elements with the dust storms types were studied. The average means annual rainfall (in mm), evaporation (in mm), temperature (in ºC) & relative humidity % indicate that there were remarkable variations in values, with increase of the number of days / years of the dust storms reflected the effect of the regional climatic change. The results of particle size analyses indicate the texture most of samples are ranging from sandy clayey silt (72 %) and clayey sandy silt (28 %). The result of roundness of quartz grains, (20% rounded, 80 % sub rounded). Moreover, the dust samples were analyzed and identified by using XRD analyses and reflects the following minerals, quartz, feldspars and calcite, with small amount of gypsum. The clay minerals (Chlorite, Illite, Montmorillonite, Palygorskite and Kaolinite) were recognized. The analyses of heavy minerals percentages by using the microscope were done. The results of pollen distribution, in descending order, were Chenopodiaceous, Graminea, Pine, Artemisia, Palmae, Olea & Typha, (reach 83%,70%, 65%,50%,15%,10%,&5% of the counted pollen grains, respectively). The results of microorganism (i.e. isolated bacteria and fungal), in descending order, were the gram – positive *Bacillus* species (40.6 %), *Aspergillus* species plus *Candida albicans* (14.5%) and (7,7%) respectively, the gram-negative rods, *Escherichia coli* (8.4%), the gram-positive *Cocci streptococcus pneumonia* (7.4%), than the gram-negative rod *Enterobacter Cloacae* (5.8%), *Staphylococcus epidermidis* and *Staphylococcus* (4.2%) & (2.6%), respectively. The remaining Gram -negative microorganisms were *Pseudomonas aeruginosa* (2.9%). Regarding the viral etiology; there is no any viral isolate among the work results. The allergens commonly associated with dust storms include fungal spores, plant and grass pollens and organic detritus represent an agricultural area pollens grains.

Key words: Dust storm • Mineralogy • Pollens • Micro organisms

INTRODUCTION

Dust and sand storms are persistent problem in Iraq and Middle East Region. The regional dust storms had bad effects on health of human life which can cause asthma, bronchitis and lung diseases, due to their carrying micro-organisms (such as bacteria, fungi, spores, viruses and pollen) and their sharp edged particle. Several researches have shown that microorganisms mobilized into the atmosphere along with desert soils are capable of surviving long-range transport on a global scale, Dust-borne micro organisms in particular can directly impact human health via pathogenesis, exposure of sensitive individuals to cellular components (pollen and fungal allergens, etc.) and the development of sensitivities (i.e., asthma) through prolonged exposure. The chemical components of dust are affecting the microbial life beside the precipitation, wind direction, time of day, season and atmosphere inversion conditions, all affecting the survival of total culturable bacteria associated with dust particles and the microbes were capable of surviving long distance transport, [1-6]. Several studies conducted to investigate the role of dust storms that consists of concentrated crustal particulates have shown an associated allergic, asthma and silicosis/pulmonary fibrosis risk. Areas impacted by desert dust storms, such as communities in the Middle East, were known to have some of the highest incidences of asthma on the planet, as it was determined that the incidence of asthma increased between 1973 and 2004,

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due to the increasing dust storms in the Middle East region, [7,8]. Allergens commonly associated with dust storms include fungal spores, plant and grass pollens, anthropogenic emissions and organic detritus. *Aspergillus* species is a common soil fungus which was the first pathogen to be identified and proven to cause disease, [9,10]. Moreover, long-range transport of human influenza virus could occur in the winter months given the prevailing wind pattern and the low dose of virus required for infection, Pneumonia from dust storm exposure has also been reported in the Middle East, especially those cases pertaining to deployed military personnel [11-25].

However, it is considered that the study of dust storms is important and vital in Iraq. The aims of this research were to study the regional dust storms that blowing over Iraq and the Middle East by using satellites images and GIS Technology, according to [26, 27] and the MODIS Land Rapid Response Team, 2008. Also, to study the effect of climatic change, source of materials of regional dust storms by analyzing the heavy, light, clay minerals, trace metals, grain size analyses, pollen & the microorganisms include, the bacteria, fungal, viruses and their effect.

MATERIALS AND METHODS

The dust samples were collected for the period from March 2007 to October 2008 from many IRAQI governorates, Figure 1. The total number of studied dust storm was 27 during (2007-2008), 7 in 2007 and 20 in 2008, Table 1. The collected dust storms samples were from Baghdad (312), Ramadi (77), Kut (46), Basra (33), Najaf (28), Karbala (21), Hilla (27) and Sallahaldin (4) samples.

Table 1: The studied regional dust storms over Iraq for the years (2007-2008)

No.	Date of dust storm	No.	Date of dust storm
1	17-3-2007	15	16-5-2008
2	18-4-2007	16	25-5-2008
3	11-5-2007	17	7-6-2008
4	16-5-2007	18	15-6-2008
5	8-7-2007	19	28-6-2008
6	16-7-2007	20	1-7-2008
7	7-9-2007	21	7-7-2008
8	19-2-2008	22	11-7-2008
9	3-3-2008	23	27-7-2007
10	15-3-2008	24	30-7-2007
11	30-3-2008	25	15-9-2008
12	4-4-2008	26	24-9-2008
13	17-4-2008	27	16-10-2008
14	27-4-2008		

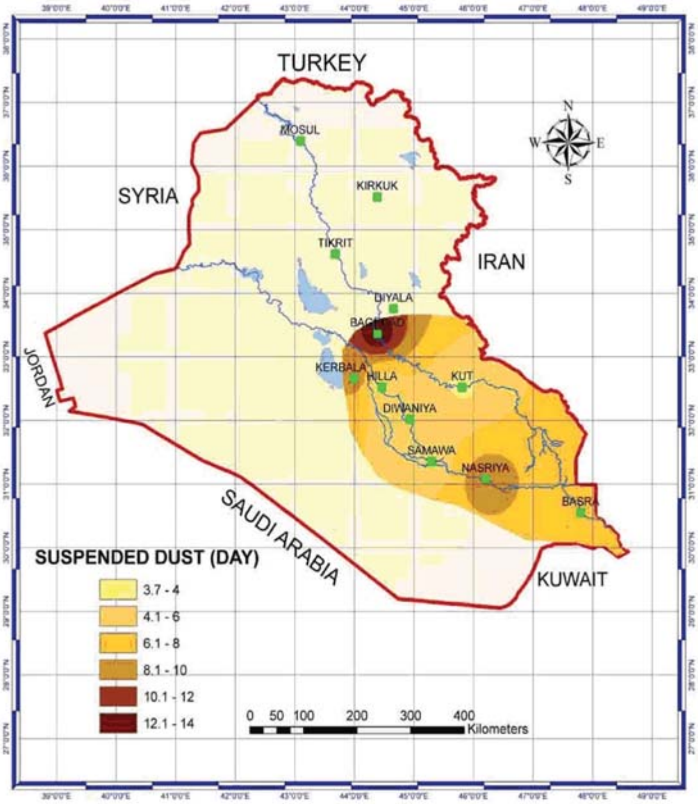

Fig. 1: Suspended Dust (Days) distribution over Middle & Southern Iraq (1971-2000)

The samples were collected from the roof of high buildings by using either big volume plastic basins, or by using the cyclone, with 1.65 meter high by rotating the air inside the instrument using an electrical motor to pull & suck the air inside the instrument, [28]. The following analysis had been preformed for the collected dust samples:

Method Number One

Grain Size & Shape Analyses: Grain size& Shape analyses were performed by using the sieve and pipette technique [29, 30].

Method Number Two

Mineralogy analysis: The mineralogy of dust samples were determined by applying [31], method to study the light minerals & heavy minerals, also the mineralogy of dust samples were determined by X-Ray diffraction method as well.

Method Number Three

Analyses of the Heavy Elements: Analyses of the heavy elements were preformed to determine the heavy metals (Pb, Zn, Cd, Ni, Cu, Co, Fe) concentration in the dust samples by using the atomic absorption spectrophotometer (AAS).

Method Number Four

Pollen Analyses: Pollen analyses were preformed to identify the Pollen concentration in the dust samples according to Moore and Webb, 1978, procedure.

Method Number Five

Microorganisms Analyses: Microorganism's analyses were preformed to identify Bacteria, fungi & Viruses analyses according to the international methods for microorganisms analyzed [29].

RESULTS AND DISCUSSION

Climate: Data of 44 meteorological stations records the climatic elements within Iraq were studied, such as types of dust, maximum and minimum of temperature, wind speed and direction, rainfall, relative humidity and evaporation for the years 1968- 2007, [32]. The results were discussed as follow:

The Average Mean Annual Rainfall in Iraq: The results show that more than 80% of Iraq receives between 100-300 mm. while, the other 20% areas of Iraq receives between 300- 800mm. The amount of rainfall in Iraq varies from the extreme south and southwest parts to reach relatively ten times toward the extreme north and northeast parts of Iraq. Remarkable decrease in the average mean annual rainfall (in mm) for ten years intervals were indicated that may reflect the regional climatic change as shown for Baghdad meteorological station that the average means annual rainfall decrease from 138 mm for the years 1970 -1979 to about 37 mm for the years 2000 -2005, this is true for the meteorological stations of Ramadi, Kut, Dewania, Karbala, Basra & Mosul meteorological stations that decrease from 103, 47, 109,130, 132 & 327 mm for the years 1970-1979 decrease to about 35, 30, 46, 88, 33 & 152 mm the years 2000-2005 respectively.

The Average Mean Evaporation Values in Iraq: The average mean evaporation values vary widely between the northern (1200 – 1600mm), middle (about 2300 mm) and southern parts and western desert (3400mm – 3700 mm) of Iraq. The average mean annual evaporation (in mm) for two intervals of years indicate that there were a remarkable increase in many stations for years (1967-2007) that reflected the regional climatic change as shown for Baghdad station average mean annual evaporation increase from 3185 mm for the years 1971 -1986 to about 3229 mm for the years 1987 -2007, this is true for the meteorological stations of Ramadi, Kut, Dewania, Karbala, Basra & Mosul meteorological stations that increase from 2653, 4018, 3368, 2711, 2348 & 1868 mm for the first years interval then they increase to about 3065, 4411, 3513, 2735, 3488 & 1980 mm for the second years interval until 2007 respectively.

Temperature: The average mean annual temperature (in °C) of about thirty years periods (1971 -2002) were divided to three ten year’s intervals. The results reflect that there is a remarkable increase of average mean annual temperature with time for all the studied meteorological stations which obviously indicate the effect of regional climatic changes on Iraqi climate for the last thirty years, for Baghdad, Ramadi, Kut, Dewania, Basra & Mosul meteorological stations to be 21.9, 21.8, 23.9, 23.4, 24.6 & 19.7°C for the first interval then the average mean annual temperature in°C increased to reach 22.9, 22.1, 24.9, 24.8, 27, & 20.2°C respectively.

Dust Storms

Suspended Dust: The suspended dust is raised by local, generally light or calm winds. The mean monthly affected days by suspended dust that recorded to cover the middle and southern meteorological stations were used

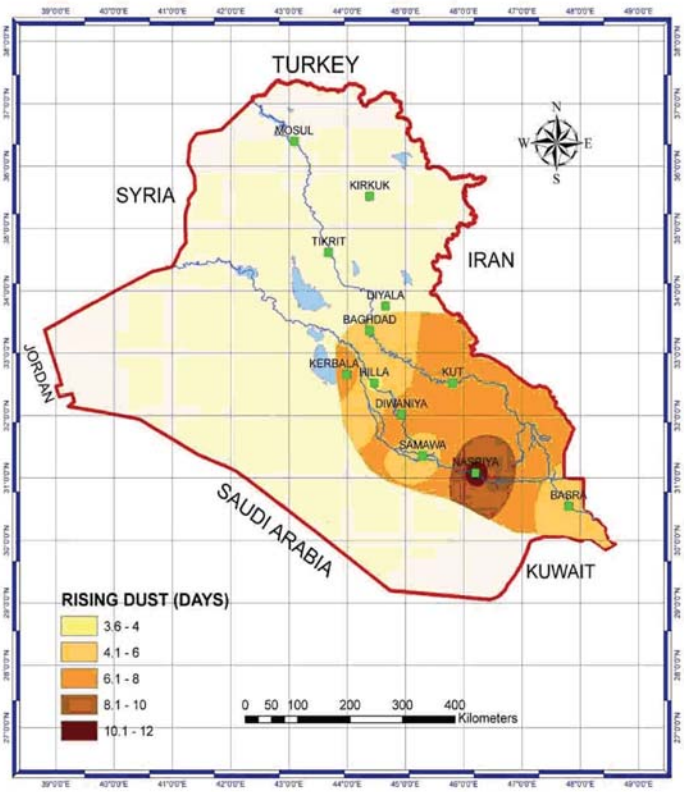

Fig. 2: Rising Dust (Days) distribution over Middle & southern Iraq (1971-2000)

to draw a contour map to reflect their distribution over the studied Iraqi regions, Figure 1. The results indicated that Kut and Dewania were the minimum governorates that covered by suspended dust as ranges between 3 to 4 days / month followed by Basra that was covered with 4-6 days /month, then Karbala of 8-10 days/month, while, Baghdad governorate represent the maximum city that had been covered for 12- 14 days of suspended dust.

Rising Dust: The Rising Dust is raised by local, generally moderate winds. Horizontal visibility is equal to/ or more than 100 meters. The mean monthly affected days by rising dust that recorded to cover the middle and southern meteorological stations were used to draw a contour map to reflect their distribution over the studied Iraqi regions, Figure 2. The results indicated that Baghdad & Basra were the minimum governorates that covered by rising dust as ranges between 3 to 4 days / month, followed by Karbala, Kut and Dewania of 6-8 days/month.

Regional Dust Storms: The regional dust storm is raised by regional winds. Winds are generally strong .Horizontal visibility is less than 1000 meters. The mean monthly affected days by Dust storm that recorded to cover the middle and southern meteorological stations were used to draw a contour map to reflect their distribution over the studied Iraqi regions, Figure 3. The results indicated that Kut was the minimum governorates that covered by Dust storm as ranges between 0 to 5 days / month, followed by Baghdad, Basra, Karbala and Dewania of 5-10 days/month.

Mean Monthly Fallen Dust Weights (in gm/m^2): Mean monthly fallen dust weights (in gm/ m^2), that distributed over Middle & southern Iraq for years (1993-2007) were studied. These weights were used to draw a contour map to reflect their distribution over the studied Iraqi regions, Figure 4. The results indicated that Kut was the maximum governorates that are covered by fallen dust weights in gm/ m^2 as ranges between 100 to 150 gm / month, followed by Baghdad, Basra, Karbala and Dewania of 18.3 -50 gm /month.

Evidence of Climate Change from Iraq: There are many evidences of the climatic changes given in this research from Iraq. Such as the remarkable decrease of the average

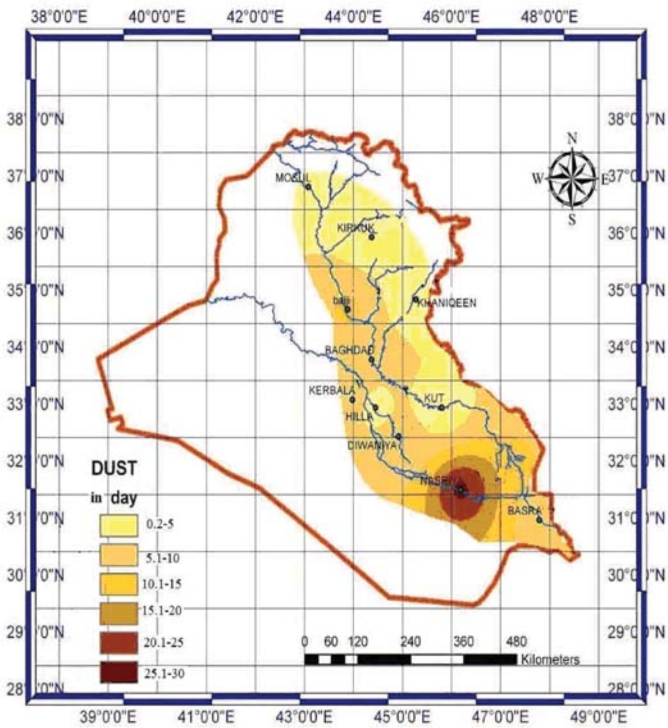

Fig. 3: Mean Monthly Number of days/month of Dust storms that distributed over Middle & southern Iraq (1971-2000)

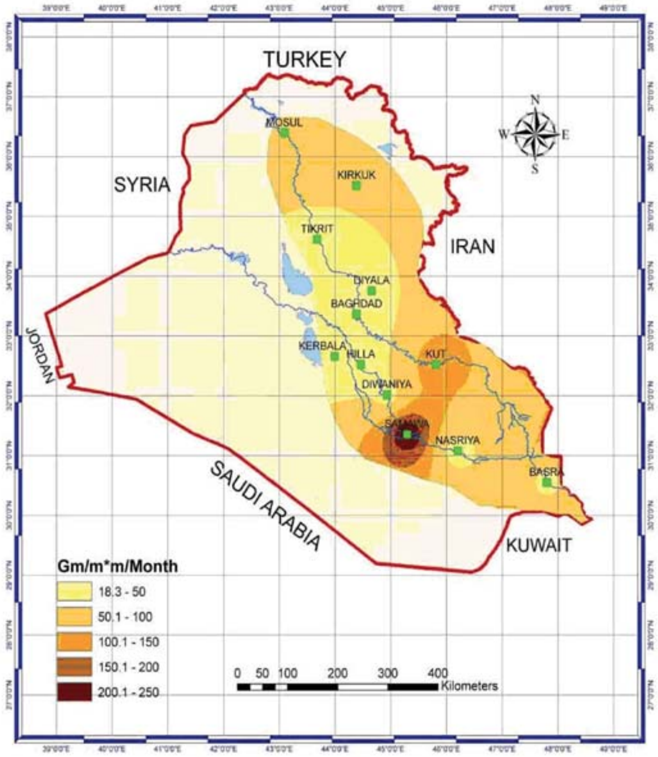

Fig. 4: Mean monthly fallen dust weights in gm/ m2 that distributed over Middle & southern Iraq (1993-2007).

means annual rainfall for ten years intervals in many stations, with the remarkable increase of the average means annual evaporation for two intervals of years, in many stations & the average mean annual temperature of about thirty years that were divided to three ten year's intervals for years (1970-2005). Moreover, the percentages of the sum mean annual days /year of suspended & rising dusts days that were divided into 10 years intervals reflect that there was an increase of the number of dust storm days, for years (1970-2005).

The Size and Shape of Dust Samples

Grain Size Analyses: The results of the particle size analyses indicate that the dust samples composed mainly of Silt (Min.=41%, Max.= 62%, Mean=53%), Clay (Min.=22%, Max.= 30%, Mean= 28%) and Sand (Min.=10%, Max.= 25%, Mean= 19%). However, the texture of samples is ranging from the higher percentages of sandy clayey silt (72%), to the relatively less common clayey sandy silt (28%). The most of dust texture are clay & silt with less quantities of sand, actually, the reason for that the high values of clay and silt depends on the energy of the wind that form the dust storm which carries the grains of less than 63 micron in dryness season, that include clay and silt, with few quantities of sand.

Roundness of Dust Particles: The roundness of Quartz (reach more than 80% of the sand fraction), in the dust storms samples was studied. The results reflect that the roundness were mostly ranging from sub-rounded grad of roundness, (80% of all the studied samples), to Rounded grad of roundness, (20% of all the studied samples), that reflect long distance of transportation.

The Mineralogy of Dust Samples: Light & Heavy minerals of Dust Samples for sand size fraction were studied by using polarized microscope. The result reflects that the light minerals reach 98% of the sand fraction, while the heavy minerals equal to 2% as a maximum. Heavy minerals were separated from light minerals by using bromoform (Sp. Gr. 2.89). Light & Heavy minerals were mounted on slides in Canada balsam and about 300 mineral grains were counted, from random fields, in each slide, in order to study their petrographic and mineralogical characteristics. The percentages of the different minerals were computed. The light minerals that were recognized in the dust samples are quartz, feldspars, calcite, with little amount of gypsum. The results of heavy minerals analyses indicated that the highest percentage were opaque heavy mineral, pyroxene, garnet, hornblende, zircon, chlorite, epidote, staurolite, celestite, & biotite.

The carbonate minerals were studied separately from the bulk dust samples by using diluted HCl acid, the result reflect that the carbonate ranging from 4.3% to 53.2 %, with an average 12.1% Carbonate of the total dust samples.

A- Mineralogy of Dust Samples by Using X-Ray Diffraction Analyses: The dust storms samples were examined by X-Ray diffraction method (XRD). Samples were prepared as (Bulk sample) in order to study non-clay minerals in the 2θ angle range between (2- 40) degree. The results indicate that the recognized minerals are quartz, feldspar, calcite and gypsum. The results show clay minerals for the different slides were, palygorskite, Illite, Kaolinite, chlorite, Montmorillonite, Smectites. The presence of Palygorskite and Kaolinite among the clay minerals reflects the arid and semi-arid climatic conditions. The formation of chlorite mineral reflects arid and semi arid climate with alkaline environment, while, the Illite minerals are very common in desert soils. The sources of clay minerals are from the different sediments and rock formations that exposed through the wind rote, [33-35]. The results were in agreement with [36-44]. [38], studies of non-clay minerals in soils, sand dunes & dust storms of Iraq. The clay minerals in the studied samples are recognized and identified on the basis of special diffraction pattern of each mineral, using the methods for clay sample preparation for XRD analyses. The results of clay minerals are in concordance with other studies of clay minerals in soils, sand dunes, alluvial plain and dust storms.

Toxic Trace Elements Analyses and Their Effect: Air quality is defined in terms of physical, chemical and biological characteristics as the characteristic of air that influences its suitability for a specific use. Winds that blow over the soil will pick up a variety of dissolved and suspended substances including salts, organic compounds and soil particles. Wind storms contain substances that are of potential pollutants. Suspended solids are important pollutions which consist of suspended minerals and other suspended solids such as soil, wash off plowed fields and fertilizers. Inorganic trace elements are commonly present at low levels in nature and there is already a natural level of tolerance. There is, however, a fine division between natural tolerance and toxicity. It is therefore essential to have good information on the concentration of trace elements in the air. These trace elements pose a threat to human health. Therefore, trace elements should be a priority for evaluation in all dust storms studies. The source of heavy elements can be divided into two sources, natural and artificial. The source of heavy metals in dust storms are mainly natural, include geologic sources such as rocks formation, soils and transported sediments by winds and dust storms, while the artificial sources include industrial sources that supply the heavy metals to the air and causing contamination of the atmosphere. The trace elements (Pb, Fe, Cu, Co Cd, Ni and Zn), are designated as priority pollutants by many researchers, [45-49]. In the present research, those seven heavy metals concentration (Pb, Fe, Cu, Co Cd, Ni and Zn), were analyzed by using atomic absorption, from 43 samples of dust storms which have been collected from many regions of Iraq (Baghdad, Ramadi, Basra, Kut, Karbala, Najaf & Hilla Cities) . It is expected that the heavy metals concentration were varies considerably with the polluted, industrial & contaminated areas, depending on the wind speed and directions. The results reflect that the mean concentration of trace metals of all studied stations are shown in descending order from the highest values, Fe (1419.7 ppm), Pb(226.3 ppm), Zn(209 ppm), Ni(126.5 ppm), Cu(53ppm),Co(39.5ppm) and finally the lowest values of Cd (24ppm), while, their minimum, maximum and health effects are discussed as follow:

The maximum high value of Fe was in Basrah (2937 ppm) and minimum low value was in Hilla (472 ppm), with the mean concentration of Fe 1419.7 ppm. The iron element is an important to human body and non harmful, it enters in metabolism for human and animals but its increment above the allowed level will be harmful to health which means if level increases over (0.3 Mg/ L). The maximum value of Pb was indicated in Basrah (432 ppm) and minimum low value was in Hilla (149 ppm), with the mean concentration of Pb 226.3 ppm. This element causes stimulation to bronchial mucosa of respiratory system which results cause of allergy and asthma. If it reaches to narrows system through food and drink will result to headache, fatigue and causes bone weakness if its rate increases in human body. The Pb vapors resulting from fuel compounds because of full burn evaporation will complexes in the environment through the vapors produced from cars which get bad negative effects on living bodies. The human body may take the lead through air which ranges between less than (4 Mg /day) and more than (200 Mg/ day) according to area where he lives. The maximum value of Zn was shown in Basrah (374.7 ppm) and minimum low value in Karbala (148 ppm), while, the mean concentration of Zn 209 ppm. Zinc element enter in food metabolism for both plants and animals, zinc regarded important to human growth and animal growth especially in first steps of growth and advances in spite of the need amount is very few decrease of this amount will cause bone damage and damage to skin fertility. Decrease rate of zinc in males will be going with cardiac chronic diseases (Specially arterial). The maximum Ni value was determined in Baghdad (203.1 ppm) and minimum low value in Najaf (58 ppm), with the mean concentration of Ni 126.5 ppm. Nickel element has bad effects on human and cause bronchial carcinoma or Nasal Carcinoma due to nickel gasses. The nickel carbonate (Ni) which results from interaction with carbon monoxide producing complex which is carcinogenic to human and animals which result in respiratory system rapid damage its large doses cause many health affection like infection of other layer of skin beside it effect kidneys and causes vertigo, bronchitis, Asthma. The maximum high value of Cu was reflected in Ramadi (96.2 ppm) and minimum low value in Najaf (29 ppm) with, the mean concentration of Cu 53 ppm. The Copper element is one of the non important elements to human body and will be poisonous if its rate increases. Usually Cu damage effect will not be oriels present in plenty food because it has high rates in swage substances used for plants, its increment through plants in the human blood and liver tissues will cause the Wilson disease which results in changes in tissues of brain and liver and ophthalmic cornea.

The maximum of Co value was indicated in Basrah (89.6 ppm) and minimum low value in Najaf (12.2 ppm), with the mean concentration of Co 39.5 ppm. Cobalt element is important for human and animals, because it enters in chemical construction of hemoglobin. If cobalt rate decreases it will effect the oxygen transport through hemoglobin but its increase rats will cause disturbances in some important orgasm. The maximum value of Cd was shown in Basrah (61 ppm) and minimum low value in Najaf (8 ppm) with the average mean concentration of Cd 24 ppm.

The cadmium element will be absorbed easily through respiratory and gastro intestinal system in human, when reaches blood will distribute quickly through human tissues like liver, kidneys will take place the useful elements to human body which prevents their absorption through intestine and this element will increase the effect of Anemia, (Al- Saad and Abed, 2006). Cadmium poisoning result damages the kidneys and hypertension and takes place the calcium. It has accumulative effect to human body and cause bony damage. The highest level allowed for cadmium in air is (0.05 Mg/m3) according to, [50-52].

Table 2: Pollens isolates from dust storms in Iraq during March 2007 to October 2008)

Identified Pollen Grains	Number of Samples	Range percentages
Chenopodiaceae	21	3-83 %
Graminea	19	5- 70 %
Pine	14	10- 65%
Artemisia	8	0-50%
Palmae	6	0.0- 15%
Olea	4	0- 10%
Typha	3	0-5%
Spores, Fungi, Algae & Micro Spines		
Cuticle	32	10 – 80 %
Fungi	26	3- 60 %
Algae	5	0- 20 %
Lycopodium	10	5- 75%
Sphagnum	3	0-8 %
Unnamed spores	2	0-6 %
Micro Spines	2	0-20%

The results of the heavy metals concentration are in concordance with other studies of heavy metals concentration in soils, sand dunes and dust storms, [47,26 48,49].

Palynological Analysis: The dust samples for the pollen grain analysis were collected from many dust storms and many governorates. Accordingly, the results of the studied dust storms samples of Baghdad, Najaf, Ramadi, Wasit, Babel, Basra and Karbala & Sallahaldin, reflect that the relatively highest percentages of the pollens are Chenopodiaceae, Graminea, Pine, Artemisia, Palmae, Olea & Typha, (that reach 83%, 70%, 65%, 50%, 15%, 10%, & 5% of the counted pollen grains from the total studied slides, respectively), with miscellaneous Palynomorphs Cuticle, Fungi, Algae, Lycopodium spores, Sphagnum spores, Unnamed spores & Micro Spines, (that reach 80%, 60%, 20%, 75%, 8%, 6% & 20%, of the counted pollen grains from the total studied slides, respectively), (Table 2). The results reflect that they are within the ranges of other studies results and these different quantities depends on the wind direction, wind speed & energy of transportation of these fraction, which carrying the different pollen grains densities & also, depend on the sources of these grains.

However, the period of analyzed dust samples reflect that they are collected during the periods from March-2007 to June 2008 which represents the end of the spring season and the beginning of the summer season in Iraq. During this period the expected pollens may reflect relatively the dry to semi-dry climate, but the studied pollens reflect a wet –moist climate as indicated by the pollen grains such as, Graminea, Pine, Artemisia, Palmae, Olea & Typha, as well as the other spores, fungi & algae concentrations that were recorded to represent wet storms, except for Chenopodiaceae, that represents the dry climate. Such results may give good evidence of the regional dust storms that originated in far away places as indicated by the pine pollens that have sacs to keep pollen afloat and carried to great distances by the wind, as it could be from northern Syria, Turkey or transported from the countries near to Iraq which have the same climate. As mentioned before, the allergens commonly associated with dust storms include fungal spores, plant and grass pollens and organic detritus represent an agricultural area pollens grains. Some of the fungi & algae may grown, increasing in soil and transportation with regional dust storms that carrying them, Figures 5 & 6, [53-55].

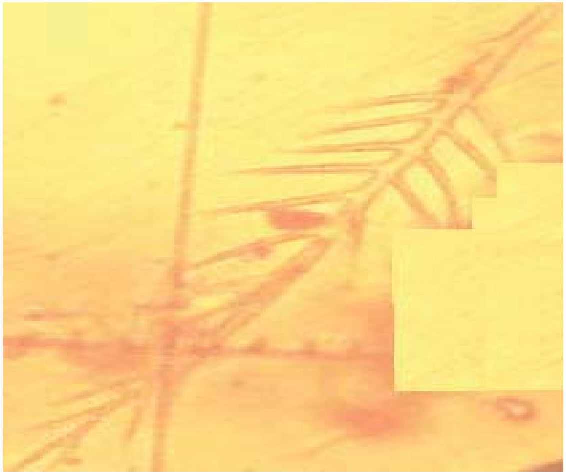

Fig. 5: Micro Spine in the studied dust storms samples of Baghdad, (relatively small at 18 to 25 µm)

Microorganisms Analyses for Bacteria, Fungi & Viruses: The Microorganisms in the dust samples were analyzed for Bacteria, fungi & Viruses. The samples were collected from many dust storms and many governorates. Accordingly, the results of the studied dust storms samples of Baghdad, Najaf, Ramadi, Wasit, Babel, Basra and Karbala & Sallahaldin, results reflect that the prominent bacterial isolate was the gram-positive bacilli (*Bacillus* species) (40.6 %), then *E. coli* (8.38%), *S. pneumonia* (7.4%), *E. cloacae* (5.8%), *S. epidermidis* (4.1%), *P. aeruginosa* (2.9%), *S. aureus* (2.58%), *E. aerogenes* (1.9%), *P. mirabilis*, *K. pneumoniae* (1.6%) and *P. vulgaris* (0.64%) are all came in consequence respectively, (Table 3).

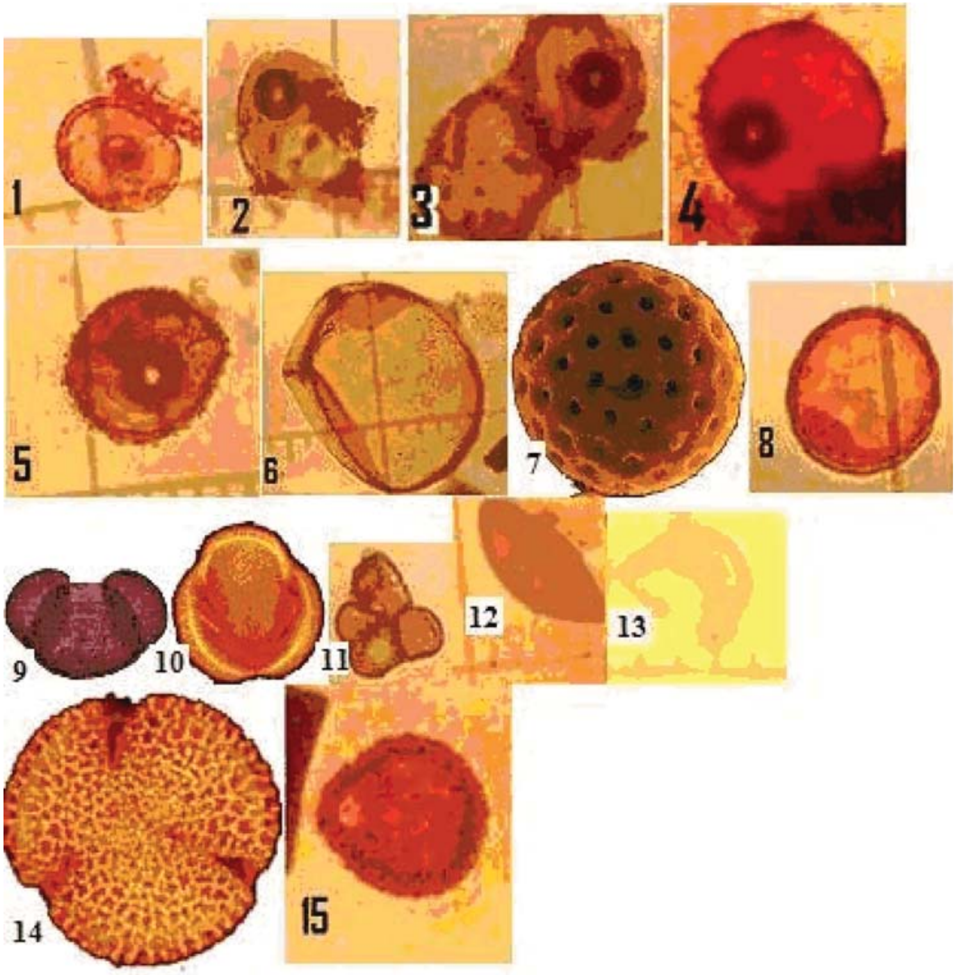

Fig. 6: (1-6), cultivated Graminea, (7-8)- Chenopodea, 9- bisacate Pinus, 10- Artemisia, 11- Typha, (12-13)- Palmae, (14- 15)-Olea

Table 3: Microorganisms isolates from dust storms in Iraq during a year period (From March 2007 to June 2008)

Isolated microorganisms	Number of isolates	Percentage
Gram-positive cocci		
Staphylococcus aureus	8	2.58%
Staphylococcus epidermidis	13	4.19%
Staphylococcus pneumoniae	23	7.4%
Gram-positive rods		
Bacillus species	126	40.6%
Gram-negative cocci	0	0.0%
Gram-negative rods		
Escherichia coli	26	8.38%
Enterobacter cloacae	18	5.8%
Proteus mirabilis	5	1.6%
Pseudomonas aeruginosa	9	2.9%
Klebsiella pneumoniae	5	1.6%
Enterobacter aerogenes	6	1.9%
Proteus vulgaris	2	0.64%
Fungi		
Aspergillus species	45	14.5%
Candida albicans	24	7.7%
Total	310	100%

On the other spectrum of the present study, the fungal isolates, *Aspergillus* species (14.5%) and *C. albicans* (7.7%) were identified.

Many well - known pathogenic bacteria, fungi and viruses are transmitted through airborne transport (e.g. the organism causing plague, anthrax, tuberculosis, influenza and Aspergillosis). The closest known association of dust storms and human disease of microbial origin are the out breaks of meningitis such as with *Staphylococcus aureus* (wide rang of infections) *Bacillus circulans* (opportunistic), *Bacillus ticheniform* (opportunistic), [56-60]. Fungi are of health concern because many of them are aero allergens as *Aspergillus* and other as allergenic agent. It is clear from the current study that the *Bacillus* species were highest during April and May (spring season), may be due to many dust storms events in these months in Iraq and the environment was suitable for microbial growth or it might be due to transportation from the countries near to Iraq which have the same climate. The other dominant microbe isolated in the present work was *Aspergillus* species, which had a relatively high percentages at March, April and May (in 2007) and declined at the same month in the year (2008), the reason may be that a certain elements in the climate in these months help this kind of fungi being in much quantities much more than during summer months (July and September). It was noted that *C. albicans* had a relatively high percentages at May and July, which it is believed to be due to the high temperature, high evaporation and low relative humidity %, during these months that will assist the fungal growth and increasing in soil and transportation with regional dust storms which carrying them.

CONCLUSIONS

The Present Study Has Given Rise to the Following Conclusions:

- It is clear from studying the dust storm blowing across Iraq, Saudi Arabia & the Arabian Gulf Shown by Meteosat-7 Satellite Images, the Aqua satellite Images and the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite for 2007-2008 that more than 80% of the regional dust storms came from Africa and the east direction of the middle east region passing the Mediterranean sea to Syria, Jordan or Turkey then to the north Iraq toward the Saudi Arabia & the Arabian Gulf .While, the other less than 20% dust storms came from the southern Iraq from the Arabian Gulf northward.
- The result indicated that Iraq and Middle East region were affected by global climatic change, as shown by the increase of the temperature, evaporation and decreasing of rainfall, relative humidity from the year 1967 to 2007 and there is a remarkable increase in the number regional dust storm that blowing in Iraq doubled during 2008.
- The results of particle size analyses indicated that the main texture of most dust samples were sandy clayey silt and to less extent clayey sandy silt, that depend on the energy and velocity of the wind from the regional dust storm which carries these grains.
- The result of roundness of quartz grain reflects that they were transported over long distances.
- The dust storms loads were depend on the direction of the wind and the geological formations that were in their path way. Consequently, the stable heavy minerals may reflect such geological formations as the regional dust storms blowing from western desert of Iraq.
- The desert land, different geological formations, Sabkha, irrigated land, agriculture land, considered as sources of the clay minerals which were transported with regional dust storms from different locations.
- The studied pollens reflect a wet - moist climate as indicated by the pollen grains. Such results may give good evidence of the regional dust storms that originated in far away places as shown by the pine pollens that have sacs to keep pollen afloat and carried to great distances by the wind, as it could be from northern Syria, Turkey or transported from the countries near to Iraq which have the same climate. The allergens commonly associated with dust storms include fungal spores, plant and grass pollens and organic detritus represent an agricultural area pollens grains. Some of the fungi & algae may grown, increasing in soil and transportation with regional dust storms which carrying them.
- Regarding the bacterial isolates; Bacillus species were more common than others, followed by *E.coli, S.pneumoniae, E.cloacae*, *S.epidermidis, P.aeruginosa*, equal values is shared between *P.mirabilis* and *K.pneumoniae*, least value reported by *P. vulgaris*.
- Regarding the fungal isolates; *Aspergillus* species was the common, followed by *C. albicans*.
- Regarding the viral etiology; there is no any viral isolate among the work results.
- The highest values of isolates regarding the bacterial and fungal etiology were among the late spring season months and early summer season due to increased dust storms incidence.
- During the strong dust storm affected Baghdad and other Iraqi countries, reports from the Iraqi ministry of health and statistical analyses that have been done by researchers for many cases in many hospitals in Baghdad and the governorates indicated that many people were taken to hospitals after sustaining breathing problems, asthma, bronchitis and lung diseases.

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