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FORWARD

Dear Colleagues,

IJST was a fruitful effort issued by the International Centre for Advancement of Sciences and Technology – ICAST, which tries to take part in both globalization and revolution in information and communication technologies, because S&T development becoming not only the key elements of economic growth and industrial competitiveness, but also essential for improving the social development, the quality of life and global environment. ICAST took then a decision to establish a scientific alliance with TSTC (Tharwa for scientific Training & Consultations) and this alliance comes to support the efforts towards publishing IJST.

Today, we announce a new issue of our journal, that is the third issue from the fourteen volume of IJST, September, 2019.

Finally, I hope that all significant figures of sciences whom joined the editorial board, the researchers, and the readers of our journal will keep IJST between their eyes and contribute in continuing its journey, with their remarks, valuable recommendations and their researching outcomes.

Thanks a lot for all who support IJST.

Editor-in-Chief

IJST

Abdul Jabbar Al- Shammari

The Referees for this Issue

** The referees and advisory group below are listed according to alphabetical order, with deep appreciation for all.*

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Possible synergic toxic effects between heavy metal ions and extremely low frequency magnetic fields (50 Hz and 27.5 Gauss) on the permeability of the blood brain barrier in mice

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ABSTRACT

Extremely low frequency magnetic fields and environmental chemical pollution could both have synergic toxic effects on living beings. Biological effects produced by heavy metals could be enhanced by the presence of magnetic fields pollution wireless physical and medical devices, antennas and cellular phones, high tension electric power and domestic engines. Food is a way of heavy metal ions ingestion like Cd^{2+}, Hg^{2+} and Pb^{2+}. These elements are the most frequent and most toxic ones, which can induce the highest influence on the physical dielectric properties conductivity and permittivity. There are also more environmentally frequent and most toxic. Brain tumours and leukaemia were proposed by an epidemiologist that could be stimulated or induced by the influence of low frequency electromagnetic fields, principally in children.

The present study was scientifically designated to provide data in relation to the effect on the synergism between low frequency electromagnetic fields and the simultaneous presence of heavy metal ions in tissues of mammals. The study proposed the possible interference of the external electromagnetic fields to the internal ones. Chemical enzymatic reactions created light and low intensity electromagnetic fields in the mitochondrial electron transport chain. From NAD to molecular oxygen, there was an electric potential difference of 1.1 Volts. BALB/c male mice which were subjected to different treatments with Cd^{2+}, Pb^{2+} and Hg^{2+} separately and exposed to ELF-MF (7 days, 27 Gauss at 50 Hz) in comparison with control ones. Blood brain barrier permeability was showed after dorsal queue vein administration of 0.2 mg neutral red and with its spectrophotometric determination in brain extracts to 540 nm. The method of ANOVA statistical analysis was applied, and statistically significant differences were studied between the control and all other groups. All groups were treated with the vital colorant neutral red, and the corresponding element: mercury, cadmium and lead. The effects then was compared between: control; magnetic fields exposure; Me^{2+} treatment; Magnetic fields+Me^{2+}. The possible synergism was found to establish in the increase of the permeability of the blood brain barrier between ELF-MF and heavy metal ions experimentally.

Keywords: heavy metal ions, ELF-MF, Magnetic fields, synergic toxic effects.

INTRODUCTION

Extremely low frequency magnetic fields (ELF-MF) of 50 Hz involve the high-tension power lines and electro-domestic devices. Actually, they are submitted to scientific and social polemic because some opinions designed them to the possibility to be implicated to the potential injury on individual and Public Health. Some studies provoke in quietude principally for children and others unauthorized the precedents because the ELF-MFs are ubiquitous and also present at the proximities of the population densities (1).

In research to choose or select case control in experiments, it is fundamental not to have prejudices, to be partial or biased. After Mezei and Kheifets (2), the evidence is found both *for* and *against* the existence of selection bias in epidemiological studies of childhood leukemia and MFs.

Several epidemiological studies signalised a certain relationship between the exposition to ELF-MF of 50 Hz and the tumour induction in the brain and also leukaemia in children (3-6).

The objective of this experiment was to study the effect of the ELF-MF of 50 Hz on the permeability of the blood brain barrier in order to furnish new data to complete the information on the possible effects to provokes cancer, and to hypothesised on the possible physiological and biochemical mechanism to induce pathology.

The data on the possible effects of ELF-MF of 50 Hz in the scientific literature on the blood brain barrier are scarce. To know and establish the permeability for certain essential compounds of the brain, under the effects of electromagnetic fields, were begun a series of experiments, some presented here, which theme is of great clinical and pathological interest. Because there are proposed, in the scientific literature, brain tumours and nervous system pathology connected to the diffusion of the technologies of the information and the communications.

The blood brain barrier permeable effect of the urea is parallel used to visualize the physiological behaviour of the metal ions and the entrance of the vital dye neutral red to the brain, which is administered intravenously to mice. The colour is directly visualized nude eye and spectrophotometrically at 540 nm. The synergistic effect of mercury, as neurotoxic agent (7,8), with urea on the transference of the colorant neutral red to the brain is established, and it is also studied the effect of ELF-MF on the permeability of the blood brain barrier with the presence of mercury which frequently occurs in food (fish) and in our environment.

METERIALS AND METHODS

Animals:

For each metal ion (Hg^{2+}; Pb^{2+} and Cd^{2+}, two groups of 20 g weighing young female BALB/c mice were used, each group consisted of 8 animals and one of these groups was used as a control group, while the other was submitted to ELF-MF. Both groups were fed with standard diet and water “ad libitum”, and maintained in metabolic cages, with the same conditions at 12 hr light/12 hr obscurity, humidity and temperature, one cage one meter near the other. After the calibration solenoid chamber, the magnetic fields were established and infused inside the solenoid area.

Treatment schedule for the two groups of animals, and for each metal ion

Control animals	Exposition to electromagnetic fields
-control without NR	-control without NR
-control + NR	-control + NR
-control +urea +NR	-control +urea +NR
-control + Hg + NR	-control + Hg + NR
-control + Hg + urea +NR	-control + Hg + urea +NR

** $HgCl_2$ administration 0,01 mg/Kg/day Hg^{2+}.*
** NR (Neutral Red)*

Urea 5M solution: A solution of 5M urea is applied with the objective to permeable the blood brain barrier of mice, in both control animals and exposed ones after administration by intraperitoneal route. 0.2 mL urea/mouse/day is injected 30 minutes before the intravenous administration of the colorant Neutral Red. In other experiments, urea is also administered only one time after 7 days of exposition to the electromagnetic fields.

$HgCl_2$ solution: Mercury solution ($HgCl_2$) was administered by intraperitoneal route at the concentration of 0.01 mg Hg/kg/day /7 days in saline solution NaCl 0.8%, after a mother solution of 1 mgHg^{2+} /ml; with insulin syringe with divisions of 0.01 ml.

$CdCl_2$ and $PbCl_2$ solutions: Solutions of both metal ions were injected intraperitoneally in each case at the concentrations of 0.1 mg Me^{2+}/Kg/day/7days in saline solution of NaCl 0.8%, both Me^{2+} were administered equal as mercury.

Exposition to the electromagnetic field of 50 Hz: Each metabolic cage with 6 animals was placed in the geometrical centre of the solenoid chamber, inside the confined electromagnetic fields, meanwhile the other cage with the control animals situated to 1 meter distance, with the same experimental conditions during 7 days.

Calibration of the chamber to be used: The metabolic cages with 6 animals were filled with the intensity of 27.5 Gauss, 50 Hz (275 volts) generated by the solenoid conveniently evaluated through two

graphics, one represented the calibration of the chamber and the other showed the calibration of the magnetic field intensity.

RESULTS

Figure (1) represents the graphic scheme obtained after the calibration of the internal space of the two solenoids of copper wire, in function of the distance of separation of both. Figure (1) also shows that the electromagnetic field is confined inside the geometric structure of the solenoid. Figure (2) shows the evolution of the magnetic field intensity in Gauss, with the current intensity increasing in Amperes. The value of the field to which were submitted the animals during 7 days were 27.5 G (275 V) and the frequency of 50 Hz.

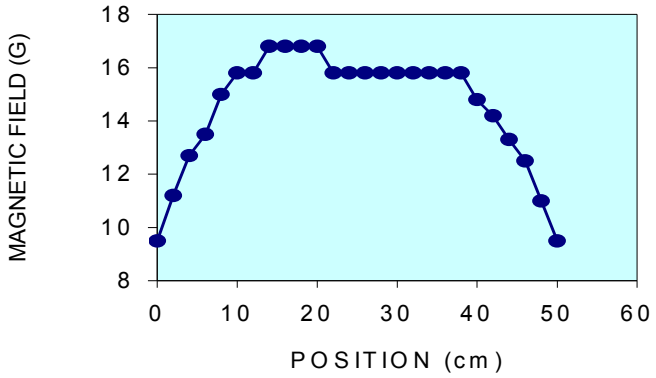

Figure (1): Calibration of the solenoid chamber. Magnetic fields are shown confined within the Solenoid chamber space

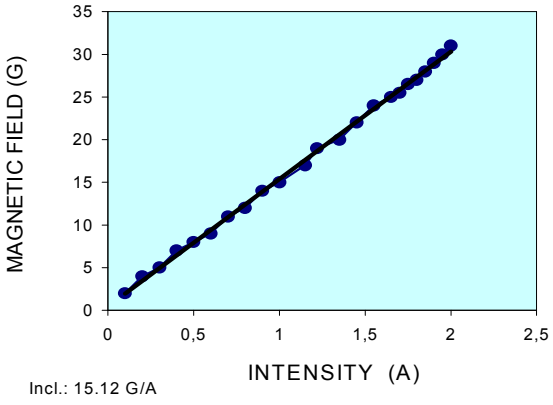

Figure (2): Distribution of the intensity of extremely low frequency electromagnetic fields within the Solenoid chamber space

Neutral Red solution: A solution of neutral red 5mg/ml in aqueous saline solution (Sigma Ref: 7005). The vital colorant will be administered by intravenous route through the dorso-lateral vein of the queue the volume 0.2 ml/mouse (0.2mg neutral red) to all the animals except to the control in each cage. The spectrum of neutral red has an absorption peak in the visible band of 540 nm where it will be measured the absorption of the extract in each sample of brain structures and liver (Figure 3).

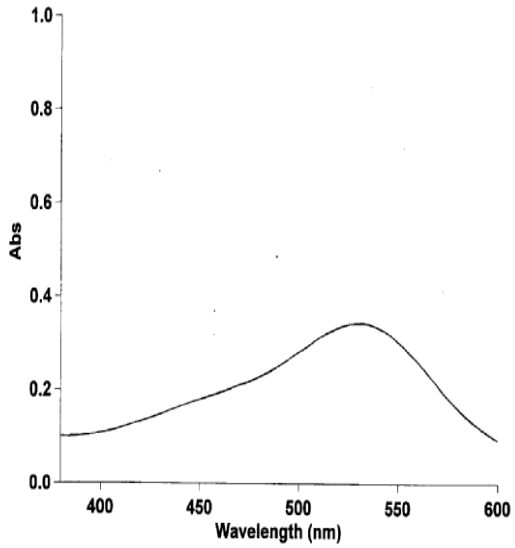

Figure (3): Absorbance of neutral red colorant in the visible band of the spectrum

Homogenisation and quantification: Animals were anaesthetized with ether 30 mins after the administration of neutral red till they died and dissected immediately. Brain, medulla oblongata, cerebellum and liver were dissected and isolated. Both encephalon and liver were homogenized with UltraTurrax (Janke & Kunkel) with physiological saline solution 1+3 (w+v) in plastic tubes of 5 mL, and centrifuged in Eppendorf tubes of de 1.5 ml to 13500 rpm in Minifuge (Heraeus). The supernatant will be filtered (0.45 μ), absorption measured at 540 nm and the neutral red in the brain estimated, showing the permeability value of the blood brain barrier in each animal. The extract in supernatant of control brain were not exposed to electromagnetic field represented the blank sample which absorption value was subtracted from the neutral red lecture at the 540 nm, and lecturing afterwards the rest of the samples. This experiment was repeated six times with the same conditions.

DISCUSSION

The society has today much concern about electromagnetic fields, and it is necessary among all of us to form an exact and responsible opinion to answer the questions about the actual problems of our Society. We must clarify with experimental data the art of the question about the possible biological and psychological effects of the electromagnetic fields in biomedicine. Informative Bulletins, 1998, and others emanated from the World Health Organization (9); and from the International Committee Non Ionizing Radiation Protection (ICNIRP, Guidelines 1Hz to 100 KHz, 2010). The recommendation of the Europe Council, 1999, are taken in serious in relation to the public exposure to electromagnetic fields from 0 Hz to 300 GHz, in order to the protection of human health. The experimental project proposed are in function to the European Parliament Report, 1994, promoting the research on electromagnetic fields in the presence of several possible synergistic factors, as chemical and physical agents. By this way we apply in this work mercury, lead and cadmium, heavy metal ions frequent in nature and anthropogenic uses and devices. Other results on cellular proliferation and micronuclei induction in human lymphocytes are assessed after exposition to 0.5 and 1 Amperes and 50 Hz of electromagnetic fields, and no effects were shown (10). In other way at different intensities, under exposure of microwaves 2.45 GHz, the physicochemical characteristics of the tissues was change in rats, after the overload of several metals independently (11).

The effect of petroleum products was independent of the intensity of ELFMF exposure whereas solvents, lead, and pesticides/herbicides were only associated with glioma in workers also exposed to moderate or high levels of ELFMF. On the other hand, whereas ELFMF seemed to enhance the effect of specific chemicals in the causation of gliomas, we did not find a relationship between ELFMF exposure and Meningiomas. The potential for ELFMF to act as an effect modifier of the association of chemical agents and glioma is an interesting new finding. It would be worthwhile to evaluate this hypothesis for other tumors. Also, it is necessary to confirm these results in epidemiological studies with individual exposure assessments, and in experimental studies that may elucidate whether there is a true causal mechanism for the results we observed (12).

Mercury is an actual frequent contaminant, principally in fish, as methyl mercury. This metal is generally accumulated in the brain in Human. We will use mice with urea treatment, mice with treatment of mercury, and mouse with a simultaneous treatment with urea and mercury. Urea is applied in all experiments, except to one of the two groups of the control animals, in order to facilitate the permeability of the blood brain barrier.

We will furnish some data on the permeability of the blood brain barrier in mammals (mouse), under the exposition to electromagnetic fields of the frequency 50 Hz and intensity 27.5 Gauss, (2750 μT

= micro Tesla) if it is the case provoking a significant increase of the blood brain barrier permeability. The combined effect between the aforementioned doses of the electromagnetic fields exposition and Me^{2+} (heavy metal Hg^{2+}, Pb^{2+} and Cd^{2+}) administration, induce separately to an increase or not of the blood brain barrier permeability, in comparison to the control mice without exposition of electromagnetic fields.

The National Institute of Environmental Health Sciences Working Group reported that there is limited evidence that residential exposure to ELF-MF is carcinogenic in children (13). The National Radiological Protection Board (NRPB) in the UK stated that relatively high average exposure to ELF-MF (0.4 mT or more) is associated with a doubling of the risk of childhood leukaemia (14).

The International Agency for Research on Cancer (IARC) classified ELF-MF as a possible human carcinogen in June 2001 (IARC, 2001). The International Commission for Non-Ionizing Radiation Protection (ICNIRP) Standing Committee on Epidemiology concluded that among all the health outcomes evaluated in epidemiological studies of ELF-MF, the strongest evidence for an association exists between childhood leukaemia and post-natal exposure to MFs . 0.4 mT (15).

In research to choose or select case control in experiments, it is fundamental not to have prejudices, predisposition and preferences, to be partial or biased. Evidence is found both *for* and *against* the existence of selection bias in epidemiological studies of childhood leukemia and MFs. (2). If present, such a bias would have wide implications for *case–control* studies in general. Often, reporting of selection processes in itself is biased and incomplete. Mezei and Kheifets (2) call for better reporting and evaluation of the potential for selection bias in all *case–control* studies and for the development of novel methods in control selection and recruitment.

After Gobba *et al*., (16) an inaccurate evaluation of exposure is considered a possible cause for the inadequate conclusiveness of epidemiological research on adverse effects of extremely low frequency-magnetic fields (ELF-MF). In the Job Exposure Matrix, about 50% of the classified occupations included significantly different individual Time-Weighted Averages levels at work. Occupational exposure to ELF-MF appeared low. Median exposures levels at home and outside were 20–28% of the occupational level, giving a minor contribution to overall day-to-day exposure.

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Prevalence of cryptosporidium parasites in farm animals at Basrah province-south of Iraq

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ABSTRACT

Three hundred sheep, 50 buffalos, 100 cattle and 50 goats were included in the current study to investigate the prevalence of Cryptosporidium parasite at Basrah province from January 2017 to January 2019. Modified Zeihl - Neelson stain, floatation with saturated sugar solution, and direct fecal sample examination were used to exclude the oocyst. Results showed that sample had infested with internal parasite cryptosporidium. This study is considered a first in type in Basrah province -Iraq, which possesses the largest livestock population in Iraq. 14% of 70 infested sheep died, cattle 3%, buffaloes 20 %, and goats 2% were died. Many treated sheep had good response. Zeihl –Neelson stain showed the best methods.

Keywords: Cryptosporidiosis, Prevalence Risk Factors, sheep, goats, buffaloes and cattle, Basrah.

INTRODUCTION

Cryptosporidium infection (cryptosporidiosis) is a disease caused by a tiny, one-celled protozoan parasite which belongs to family *Eucoccidiida* (1). There are more than 26 known Cryptosporidium species, at least 15 species are more common species. *Cryptosporidium hominis* is the only human's natural host, and *C. parvum*, which infects animals and humans that cause acute enteritis in human and animals (2,3). The Cryptosporidium parasite may be transmitted person to person. Infection is also spread directly by drinking (4) or eating (5) of contaminated water or uncooked food with cryptosporidium, also indirectly by contaminated hands, objects and surfaces with Cryptosporidium from feces of infected farm-animals (cow, sheep, and other domestic animals). The parasite must be taken in by the mouth to cause infection (6,7). When cryptosporidium enters the body, it travels to the small intestine and then burrow into the walls of that intestine, later cryptosporidia are shed in the feces (8). This phase of toxification of body and dehydration is caused by diarrhea, colic, vomiting or sever emaciation or die (9). Cryptosporidiosis disease is considered as a high epidemic infestation disease because of its short life cycle, and recurrent infestation and high number of oocysts which can infest another animal. Studies conducted by (10,11) showed that cryptosporidium oocyst can survive in the bad environment for six months, and it can live for 12 weeks at 10C (12).
The aim of the present study was to investigate the prevalence of cryptosporidium parasite in domestic animals at Basrah province which is not explored before.

MATERIALS AND METHODS

Sample of farm animals and duration of study:

Fecal samples were taken from 300 sheep, 50 buffalos, 100 head of cattle's and 50 goats; from January 2017 to January 2019.

Sample collection:

Fecal samples were collected directly from the rectum of farm animals using disposable gloves, placed in clean containers and transported to the laboratory at Veterinary hospital of Basrah Governorate.

Detection of Cryptosporidium parasites:

Samples were examined by direct dry sample and flotation in saturated sugar solution method (13) and modified Zeihl Neelson stain (acid fast stain) (14) for oocyst diagnosis on the clear slide and with aid of Olympus compound microscope. All samples were taken from acute shooting diarrhea and emaciated sheep.

RESULTS AND DISCUSSION

Table (1) reveals the prevalence of cryptosporidium parasite in domestic animals examined during this study. Twenty percent of sheep, goat and buffaloes were found positive for Cryptosporidiosis and only 3% of cattle were infected. The clinical signs of the disease were recorded among sample animals such as shooting diarrhea, but no previous studies documented and confirmed the disease laboratorial at Basrah. In contrast, the disease was confirmed in Baghdad (15,16) and Mosul (17,18). The disease also was reported in neighboring countries such as Iran (19) and Kuwait (20).

Table (1): The prevalence of Cryptosporidiosis according to animal species

Animal species	Age of animal/months	Number of examined animal	Number of positive	Percentage of positive
Sheep	1-4	300	60	20%
Goat	10-12	50	10	20%
Buffaloes	2-4	50	10	20%
Cattle	2-4	100	3	3%
Total		500	83	16.6%

The present study reported a high prevalence of cryptosporidiosis at Basrah province. This is may be due to lack of awareness and bad hygienic routine works at the slaughterhouse, which disposal the rumen and intestinal contents into yards and rivers. On the other hand, awareness must be taken in testing and identifying this parasite in surrounding regions. Further studies are required to determine the zoonotic transmission to humans. The parasite reaches the intestine or stomach of human, then proliferates inside the body and causes poisoning to those poor people or who have low immunity (21). Children are very sensitive to this parasite and may show fetal diarrhea staying several days without treated (22). The main clinical signs of disease are watery yellow to grayish in color diarrhea, fever, loss of appetite, mild to acute bloody diarrhea with bad odor, emaciation then death (23). The disease is spreading in Basrah province by exporting animals by illegal methods from town surrounding Basrah, which are carriers to this parasite. Prevention disposing of slaughter animals' rumen in river flow as taken to raw dogs or cats. Prevent inter infested animals by illegal method. Boil all water which is used for drinking or washing. At Nineveh province of Iraq, the study of cryptosporidium in sheep showed 108 fecal samples of them (26.66%) infested with cryptosporidium oocyst (17) showed that %of the infested calf was 34.85% from 422 and the number of the infested male was 34% male 35.09% female were showed a positive result for *cryptosporidium* parasite infested, that study showed although that April had a high ratio of infestation and the September had a low ratio of infestation by *cryptosporidium* oocyst.
The present study reported very significant finding, the occurrence of cryptosporidium species in buffaloes, which little information was existing. Azami(24) reported the prevalence of cryptosporidiosis (1.16-

14.59%) in buffalo in Iran, the percentage of infection in buffalo in current study higher than that reported, that because the population and the environment of living in Marshes area are different from that in Iran. In Egypt (25) the percentage was close to Iran for the same reason mentioned above.

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Studies of physical and chemical characteristics to assess the water quality of some selected wells water in Ninevah plain, Northern Iraq

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ABSTRACT

This study intends to assess the well water quality with reference to drinking uses in Nineveh plain district, Northern Governorate, Iraq. In order to characterize well water quality in Nineveh plain, twelve wells were selected to represent their water quality. Monthly samples were collected from the wells during February and July 2017. In this study, 72 well water samples were collected and analysed for various chemical constituents: Sulfate (SO4 2-) , total alkalinity (TA), total dissolved solids (TDS), total hardness (TH), (electrical conductivity (EC), pH, Nitrate (NO3-),magnesium (Mg2+) and Calcium (Ca 2+) according to the standard methods (American Public Health Association (APHA). The results showed that pH values of well water range from 7.4 to 8.5 with an average of 7.6-8.4, suggesting their alkaline nature and are considered to be suitable for drinking uses. The levels of total dissolved solids (TDS) range from (243-1228) mg/l, Dissolved Oxygen (DO) range from (5.4 to 7.5)mg/l, Electric Conductivity (EC) range from (380 to 1920) µs/cm, Chloride range from (19.9 to175.3) mg/l , total hardness (TH) range from (186 to 567) mg/l , Sulfate (SO4 2-) range from (8.6 to 133.5) mg/l , Nitrate (NO3-) range from (o.6 to 8.1) mg/l and total alkalinity (TA) range from (84 to 398 mg/l). The results of analysis showed difference among the wells water quality in the measured parameters, well water quality of Ninevah plain have high dissolved ions due to the dissolved rocks of study area. Total dissolved solids of more than 1000 mg/l, made the Bedara well need to be treated to made taste palatable. The water quality of only in site Bedara well was found hard water more than 500 mg/l .The sulfate, nitrate and chloride concentrations were below the guideline for (WHO). The results were compared with standards of World Health Organization (WHO). It was found that some of the water quality parameters were above the permissible limits and some were not. From the results it can be concluded that the most of the parameters of Ninevah plain well water are within the permissible limits of World Health Organization (WHO).

Keywords: wells, water quality, physical and chemical parameters, Ninevah plain.

INTRODUCTION

Safe drinking water should not expose the consumer to health hazards, and can be used for different household uses including personal hygiene. Water could become a source of diseases after contamination caused mainly by the impact of different man activities (1). Human pressure encompasses the consequences of all industrial and agricultural activities, as well as sanitation procedures (chemical household wastes or waste water and organic). Agricultural pollution which results from farm animal wastes is one of the most difficult to limit because of its dispersal into the soil and its infiltration into well water (2**)**. Most villages in Ninevah plain depend on well water sources to supply a high percentage of its domestic demand for potable water. In the study area there is lack of water sheds, lakes, dams, or rivers. Hence the wells are the main sources of water available to the village communities' settlement Northern Ninevah government. Wells water was usually consumed without any form of treatment. In this study, attempts have been made to assess the water quality of wells resources in Ninevah plain, which has not been reported for a long time. Chemical and physical characteristics were assessed and the values obtained are compared with the permissible/ desirable values prescribed by (3), guidelines to ensure the quality of wells for domestic uses. Moreover, it provides a hint on the relationships of chemical and physical characteristics like (NO3-), electrical conductivity (EC), total alkalinity, Sulfate (SO4 2-) , (TA), total dissolved solids (TDS), pH, total hardness (TH), Calcium (Ca2+), and magnesium (Mg2+). Well water plays an important role in the development of township, water is extremely essential for the survival of all living organism. The quality of water is of vital for the mankind, since it is directly linked to life human, animal, and plant kingdom. Ground water is considered as one of the purest forms of water available in nature and meets the overall demand of rural as well as urban population. According to WHO organization, about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored back easily and to device ways and means to protect it (4). Ground water is stored in-and moves slowly through layers of soil, rocks and sand, called aquifers. Aquifer typically consist of sandstone, Gravel, sand, or fractured rock, like basal and limestone, these materials are permeable because they have large connected spaces that allow water to flow through. Water in aquifers is brought to the surface naturally through a spring or can be discharged in to lakes *and streams* (5).

The main resource of fresh water is the groundwater, which is commonly used for industrial, domestic, and irrigation purposes. The agricultural and domestic activities in villages and towns entirely depend on the well water and hence, the importance of groundwater quality. The quality of water and its environment is subjective to the geologic formation of an area and mostly, the well water contains more mineral than the surface water. It is due to the fact that the well water movement is slow and hence, longer contacts time with the sediments (6).

The objective of the present study was to assess the physical and chemical variables of some well water in Ninevah plain and their suitability for drinking purpose. The geological formation of Ninevah District is mainly covered by sedimentary carbonate rocks of the Cretaceous and Tertiary periods. Lithological composition of these formations consists mainly of limestone, dolomite, marl, chalk, chert and alluvium (4).

MATERIALS AND METHODS

A total of 72 well water samples were collected from closed wells in different villages from Ninevah plain district, Ninevah governorate during the period February to July, 2017. The details of sampling sites are given in figure (1). Each sample was collected in a sterilized polyethylene bottle, one-liter plastic containers. The containers were washed with detergent and rinsed severally with the water samples from the respective before collection. The samples pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA), Nitrate (NO3-), Sulfate (SO4 2-) total hardness (TH) magnesium (Mg2+) and Calcium (Ca2+) were brought to laboratory and analyzed for the selected parameters using the standards methods (7). While Dissolved Oxygen (DO) and pH were measured on the spot of collection of samples, the other parameters were analyzed in the laboratory. The collected data were statistically analyzed to compare between the wells water quality using Duncan multiple range test.

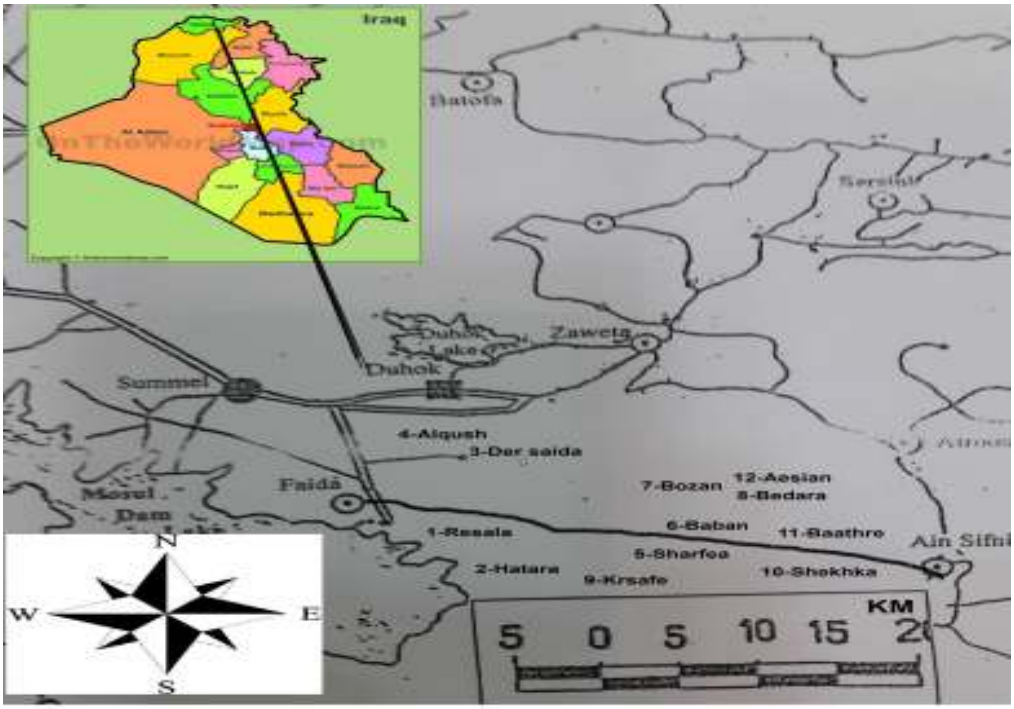

Figure (1) site location of the studied wells

RESULTS AND DISCUSSION

Temperature T (°C): Temperature is an express of the effective factors on the water quality and physical, chemical and biological properties of water. Table (1) shows a significant variation in temperature among the studied wells water, with a range from (14.2 - 27.6) ◦C during the study period. The highest value observed in site Aesian well was (27.6) ◦C in July, may be due to the change of climate, while the minimum value was recorded in Beban well (14.2 ◦C) in February, may be due to geological formation of the region. The result obtained shows an average temperature ranged between (17.3-22.2)◦C. The highest average was recorded in site Krsafe well, while the lowest average was recorded in site Alqush. These ranges were in agreement with that obtained from (2). However, results in the present study were significantly lower than those reported by (8).

Table (1): Variation of temperature (◦C) among the studied wells during the study period

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	16.2 d	16.8 f	19.1e	19.4f	22.1a	24.2a	19.6 a-c
2-Hatara	15.8 e	17.2 d	17.9 h	18.9 h	21.8a	26.4a	19.6 a-c
3-Dersaida	14.6 f	14.9 g	15.6 k	17.2 j	23.1a	24.3a	18.2 cd
4-Alqush	14.4 g	14.7 i	16.1 j	16.9 k	20.2a	21.8a	17.3 d
5-Sharafea	15.8 e	16.8 f	18.2 g	18.1 i	22.1a	24.7a	19.4 bcd
6-Beban	14.2 h	14.8 h	16.3 i	19.2 g	23.1a	26.3a	18.9 cd
7-Bozan	16.8 c	16.9 e	18.2 g	19.9 e	24.1a	25.6a	20.2 abc
8-Bedra	17.3 b	18.1 b	21.2 b	24.1 a	25.2a	26.7a	22.1 a
9-Krsafe	18.3 a	18.9 a	20.2 c	23.1 c	26.1a	27.1a	22.2 a
10-ShekhKa	16.8 c	18.1 b	21.3 a	24.0 b	26.1a	26.8a	18.2 a
11-Baathre	17.3 b	17.8 c	18.3 f	22.3 d	23.1a	25.6a	20.7 abc
12-Aesiam	16.8 c	18.1 b	19.2 d	23.1 c	26.1a	27.6a	21.8 ab

Electrical conductivity (EC) µs/cm: Pure water is not a good conductor of electric current rather a good insulator. Increase in ions concentration enhances the (EC) of water. Generally, the amount of dissolved solids in water determines the electrical conductivity. Table (2) shows a significant variation in the electrical conductivity among the studied wells water. The highest value was observed in site Bedara well, was (1920) µS/cm, in May. While the minimum value observed in site Resala well was (380) µs/cm in March. This variation is due to the geological formation of the soil in this region. The higher values may be due to the leaching of the minerals salt from the bedrock and re-suspended of solids. Electrical conductance has an average value of 401µs/cm in site Resala well and 1843µs/cm in site Bedara. Similar results were reported by (9). The analyses showed (EC) in water samples are within the (2) guide of 1000 (µs/cm).

Table (2): Variation of (EC) (µs/cm) among the studied wells during the study period

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	411 L	380 L	395 L	421L	409k	392 j	401j
2-Hatara	872 d	903 d	884 d	911 d	843d	867 d	880 d
3-Dersaida	533 i	562i	521 j	543 j	559 h	551 h	544h
4-Alqush	562 h	570 h	554 h	572 h	566 gh	572 g	566 g
5-Sharafea	1159 b	1121 b	1201 b	1189 b	1221 b	1244 b	1189 b
6-Beban	958c	1011 c	962 c	972 c	1022 c	988 c	985 c
7-Bozan	584 g	602 g	591 g	603 g	588 f	612 f	596 f
8-Bedra	1797 a	1816 a	1798 a	1920 a	1815 a	1913 a	1843 a
9-Krsafe	589 f	612 f	592 f	611 f	578 fg	614 f	587 f
10-ShekhKa	734 e	755 e	781 e	748 e	752 e	787 e	635 e
11-Baathre	510 j	536 j	547 i	569 i	538 i	541 h	540 h
12-Aesiam	432 k	427 k	445 k	429 k	452j	434 i	453 i

Total Dissolved Solids (TDS) in mg/l: The total dissolved solids of water represented in table (3) shows a significant variation in the (TDS) among the studied wells water. The minimum value of (243) mg/l, was recorded in site Resala well in March and the maximum value of (1228) mg/l was in site Bedara well in May, caused by filtration of waste and Agriculture run off. The high value may be due to the present of silt, decaying plant and animal matter, industrial wastes, and sewage. The sites (2, 5, 6, 8) were above the minimum level of drinking water standard (500 mg/l) for drinking water as recommended by (10), and (11). The TDS values were above the prescribed limits of 500 mg/l for drinking water purpose in two sites of well water. TDS has an average value of 256 mg/l in site Resala well, while Bedara site has an average value was 1179 mg/l, the site Resala of 256 mg/l, was fall within the accepted limit of 100 – 500mg/l of (2). While the site Bedara of 1179 mg /l, was exceeded the WHO, maximum allowable limit of 1000 mg/l, hence making these water sources not suitable for drinking. In this study are significantly higher than those reported by (12).

Table (3): Variation of (TDS among the studied wells during the study period (mg /l)

Months / sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	263 L	243 L	252 L	269 L	261j	250 j	256 j
2-Hatara	559 d	577 d	565 d	583 d	539d	554 d	563 d
3-Dersaida	341 i	359 i	333 j	347 j	357gh	352 gh	348 h
4-Alqush	359 h	364 h	354 h	366 h	366fg	362 g	362 g
5-Sharafea	741 b	717 b	768 b	760 b	781b	796 b	761 b
6-Beban	613 c	647 c	615 c	622 c	654c	632 c	631 c
7-Bozan	373 g	385 g	387 f	385 g	376f	391 f	383 f
8-Bedara	1150 a	1159 a	1150 a	1228 a	1161a	1224 a	1179 a
9-Krsafe	376 f	391 f	378 g	391 f	369fg	392 f	383 f
10-Shekhka	469 e	483 e	499 e	478 e	481e	503 e	490 e
11-Baathre	326 j	343 j	350 i	364 i	344h	346 h	346 h
12-Aesiam	276 k	273 k	284 k	274 k	289i	277 i	279 i

Table (4) shows a significant variation in the (pH) among the studied wells water, the minimum value of (7.4) was recorded in site Baathre well in April, while the maximum value of (8.5) was recorded in site Sharafea well in March. pH was higher than (7) along the study period. This study provides baseline information on the well water, this may due to the presence of carbonate and bicarbonate as dependent on the geology of area. (13). All the measured samples have concentration within the safe limit of (6.5 to 8.5) according to (2). The result obtained from analysis of 12 water samples collected revealed an average pH between (7.6-8.4) the maximum average recorded in site Sharafea was 8.4, while the minimum average was recorded in site Baathre 7.6. The pH value of average sample was found to be within Permissible limit (2). If pH value is higher than the permissible limit, this will affect adversely alkalinity of soil, microbial life and corrosion rate (14). Most of pH condition in this study proved that the water is safe for consumption. Similar results were reported by (15).

Table (4): Variation of pH among the studied wells during the study period

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	8.3b	8.2 c	8.3 b	8.4 a	8.3b	8.1d	8.2 b
2-Hatara	8.4 a	8.3 b	8.3 b	8.2 c	8.4 a	8.3 b	8.3 ab
3-Dersaida	8.3 b	8.1 d	8.0 d	8.2 c	8.1 d	8.0 e	8.1 c
4-Alqush	8.1 d	8.2 c	7.9 e	8.1 d	7.8 f	7.8 f	7.9 d
5-Sharafea	8.3 b	8.5 a	8.4 a	8.3 b	8.4 a	8.4 a	8.4 a
6-Beban	8.1 d	7.8 f	7.9 e	8.0 e	7.7 g	7.8 f	7.8 e
7-Bozan	8.4 a	8.3 b	8.3 b	8.2 c	8.4 a	8.4 a	8.3 ab
8-Bedra	8.2 c	8.3 b	8.0 d	8.1 d	8.2 c	8.2 c	8.0 c
9-Krsafe	8.1 d	8.2 c	8.1 c	8.1 d	7.9 e	7.8 f	8.0 d
10-Shekhka	8.1 d	8.0 e	8.1 c	8.0 e	7.8 f	7.8 f	7.9 d
11-Baathre	7.6 f	7.7 g	7.4 f	7.6 f	7.5 h	7.8 f	7.6 f
12-Aesiam	8.0 e	8.2 c	8.4 a	8.3 b	8.1 d	8.0 e	8.1 c

Dissolved oxygen (DO) in mg/l: (DO) is an important parameter in water quality assessment and biological processes prevailing in the water. Table (5) shows a significant variation in the dissolved oxygen among the studied wells water. The values of DO are found in the range of (5.4 - 7.5) mg/l, the highest value was observed in site Dersaida well, was (7.5) mg/l, in April, while the lowest value (5.4) mg/l was observed in site Bedara well in March, due to layer amount of salts (16).

The seepage of the landfill may cause the depletion of dissolved oxygen in the groundwater. An ideal DO value of 5.0 mg/l is the standard for drinking water (16). Similar results were reported by (17).

Table (5): Variation of (DO) among the studied wells during the study period (mg/l)

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	6.4 e	6.2 f	6.8 c	6.5 d	6.3a	6.4a	6.4de
2-Hatara	6.1 g	6.3 e	6.0 g	6.6 c	6.2a	6.3a	6.2 f
3-Dersaida	7.2 a	7.0 a	7.5 a	6.8 b	6.6a	7.4a	7.0 a
4-Alqush	6.8 b	6.6 c	7.1 b	6.9 a	7.2a	6.8a	6.9 b
5-Sharafea	5.9 h	5.8 g	5.9 h	6.1 g	6.0a	5.9a	5.9 g
6-Beban	6.5 d	6.8 b	6.4 d	6.6 c	7.1a	6.4a	6.6 c
7-Bozan	5.8 i	5.5 h	5.7 i	5.8 h	5.9a	5.9a	5.7 h
8-Bedra	5.9 h	5.4 i	5.5 j	5.8 h	5.6a	5.7a	5.6 h
9-Krsafe	6.3 f	6.6 c	6.2 f	6.4 e	6.6a	6.7a	6.4 de
10-ShekhKa	5.9 h	6.2 f	6.3 e	5.8 h	5.8a	6.1a	6.0 g
11-Baathre	6.7 c	6.5 d	6.8 c	6.3 f	6.4a	6.6a	6.5 cd
12-Aesiam	6.5 d	6.3 e	6.4 d	6.3 f	6.4a	6.3a	6.3 ef

Total hardness (TH) in (mg/l) as CaCO3: Table (6) shows a significant variation in the total hardness among the studied wells water. The lowest value was recorded in site Aesian well, was (186) mg/l in May, while the highest value of hardness recorded in site Bedara well, was (567) mg/l in Jun, The main natural sources of hardness in groundwater are sedimentary rocks in the regions with thick top soils and underlying limestone formations (18). The variation of hardness is probably related to the geological formation of the area, and Human activities such as agricultural use can be sources of hardness but natural sources are most common. (19), most wells water in this study classified as hard water as its hardness was higher than 300 mg/l (10). While the average value ranged between (204 – 547) mg/l as CaCO3, the highest average recorded in site Bedara well was 547mg/l, which the lowest average recorded in site Aesian was 204 mg/l. Only Bedara well was cross the maximum permissible limits of 500 of (2). The average values of total hardness at most locations were exceeded the acceptable limit (300 mg/L) according to (2). In this study are significantly higher than those reported by (20).

Table (6): Variation of total hardness among the studied wells during the study period (mg/l)

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	280 h	277 g	292 h	300 f	281e	305ef	289 f
2-Hatara	323 d	342 d	311 d	300 f	342d	331d	324 d
3-Dersaida	266 i	254 j	273 i	281 g	270e	283g	271 g
4-Alqush	355 c	343 c	361 c	376 c	364c	371c	361 c
5-Sharafea	288 f	293 f	302 f	281g	361c	315 de	306 e
6-Beban	428 b	434 b	411 b	432 b	441b	432b	429 b
7-Bozan	316 e	328 e	307 e	356 dd	327d	324 d	326 d
8-Bedara	532 a	546 a	556 a	540 a	567a	541 a	547 a
9-Krsafe	258 j	241 k	267 j	243 h	273e	245h	254 h
10-ShekhKa	284 g	276 h	293 g	301 e	267e	293fg	285 f
11-Baathre	252 k	262 i	241 k	281 g	263e	241h	256 h
12-Aesiam	196 L	201 L	209 L	186 i	211f	222i	204 i

Calcium (Ca2 +) in (mg/l) as CaCO3: Table (7) shows a significant variation in the Calcium hardness among the studied wells water. The maximum value was recorded in site Bedara well in June was (398) mg/l, this might be due to the geology of the area. While the minimum value was recorded in site Aesian well was (131) mg /l in May. The common source of calcium is through erosion of rocks such as limestone and dolomite and minerals such as calcite and aragonite (21). All well water samples having calcium concentration above 75mg/l WHO. Calcium salts and calcium ions occur most commonly in nature. They may result from the leaching of soil and other natural sources or may come from man-made sources such as sewage and some industrial wastes. Calcium is usually one of the most important contributors to hardness. In this study are significantly higher than those reported by (22).

Table (7): Variation of Calcium hardness among the studied wells during the study period (mg/l).

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	158 j	192 g	189 f	219e	194e	198fg	191fg
2-Hatara	189 f	259 d	210 d	215f	269c	248d	231 e
3-Dersaida	196 e	193 f	188 g	197h	189e	196fg	193 fg
4-Alqush	211 d	205 e	259 c	293c	229d	269c	244 d
5-Sharafea	173 g	185 i	191 e	188j	219d	221e	196 f
6-Beban	289 b	292 b	286 b	297 b	288b	296b	291 b
7-Bozan	263 c	265 c	259 c	268 d	271c	289b	269 c
8-Bedra	389 a	367 a	384 a	386 a	398a	386a	385 a
9-Krsafe	164 i	181 k	179 h	182 k	193e	187g	181 gh
10-ShekhKa	196 e	187 h	178 i	198 g	183e	204f	191 fg
11-Baathre	168 h	184 j	169 j	194 i	185e	168h	178 h
12-Aesiam	136 k	184 j	152 k	131 L	142f	163h	151 i

Magnesium (Mg2 +) in mg/l as CaCO3: Table (8) shows a significant variation in the magnesium hardness among the studied wells water, the minimum value of (35) mg/l, was observed in site Bozan well in July, while the maximum value of (179) mg/l was recorded in site Bedara well in March. Magnesium is commonly found in association with calcium -based minerals with rock and soil formation. Sources Calcium and magnesium are the most abundant natural cations in groundwater and they are the dominant contributors to water hardness (23)**.** Magnesium has an average value of 57 mg/l in Bozan well and Bedara well have an average value of 162mg/l. It is observed that all average values of Magnesium are above the Desirable limit of 1-50 mg/l of (WHO). Magnesium is directly related to hardness. In this study are significantly lower than those reported by (24).

Table (8): Variation of Magnesium hardness among the studied wells during the study period (mg/l)

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	122 e	85 f	103 e	81 j	87cd	107c	97d
2-Hatara	134 d	83 g	101 g	85 g	73 cde	83 de	93 d
3-Dersaida	70 j	61 j	85 i	84 h	81cd	87cde	78 e
4-Alqush	144 a	138 c	102 f	83 i	135b	102cd	117 c
5-Sharafea	115 f	108 d	111 d	93 d	92c	94 cd	102 d
6-Beban	139 c	142 b	125 b	135 b	153ab	136 b	138 b
7-Bozan	53 L	63 i	48L	88 e	56e	35g	57 f
8-Bedra	143 b	179 a	172 a	154 a	169a	155 a	162 a
9-Krsafe	94 g	60 k	88 h	61 k	80cd	58f	73 e
10-ShekhKa	88 h	89 e	115 c	103 c	84cd	89cde	94 d
11-Baathre	84 i	78 h	72 j	87f	78cd	72ef	78 e
12-Aesiam	60 k	53 L	57 k	55L	69de	59f	58 f

Chloride (CL-) in (mg/l): Table (9) shows a significant variation in the chloride among the studied wells water, the lowest concentration of chloride were recorded in site (Shekhka) during the study period was (19.9) mg/l, in April, while the highest concentration recorded in site Bedara well was (175.3) mg / l, in May. The high chloride concentration may be attributed due to solid waste leaching from upper soil layers in dry climates and natural geochemical activities in the area. The origin of chloride in groundwater may be from diverse sources such as weathering, leaching of sedimentary rocks and soils. The chloride value recorded in well water samples were within the permissible levels of chloride for safe drinking water set by (25) (250 mg/l). Results showed that the average concentrations of chloride ranged between (23.6-166.8) mg/l. The highest values were recorded in site Bedara was 166.8 mg/l. While the lowest average was 23.6 was recorded in site Shekhka. Similar results were reported by (26).

Table (9): Variation of Chloride among the studied wells during the study period (mg/l)

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	40.5 d	39.2 e	41.4 d	38.9 e	43.6cd	45.6 bc	41.5d
2-Hatara	57.4 b	60.2 b	58.1 b	54.2 b	55.9 b	54.3 b	56.6 b
3-Dersaida	23.8 j	20.2 L	24.5 k	23.8 j	24.6 g	25.5 f	23.7 hi
4-Alqush	25.8 i	26.1 i	28.1 h	24.1 i	26.5 g	27.6 ef	26.3 g
5-Sharafea	49.6 c	51.2 c	48.0 c	52.6 c	50.5 bc	52.8 b	50.7 c
6-Beban	37.7 f	35.6 f	40.1 e	35.3 g	37.4 def	36.2 de	37.0 e
7-Bozan	28.3 h	30.1 h	27.2 j	25.8 h	30.1 fg	25.9 f	27.9 g
8-Bedra	162.7 a	171.3 a	166.2 a	175.3 a	159.2 a	166.3 a	166.8 a
9-Krsafe	39.7 e	41.2 d	38.4 f	43.5 d	40.4de	37.2 cd	40.4 d
10-ShekhKa	21.8 L	23.1 k	19.9 L	20.6 L	23.4g	24.4 f	23.6 i
11-Baathre	31.7 g	35.1 g	32.4g	36.7 f	31.9efg	32.2 def	33.3 f
12-Aesiam	22.2 k	25.1 j	27.3 i	22.9 k	26.5g	23.3 f	24.5 h

Total Alkalinity (TA) in (mg/l): Table (10) shows a significant variation in the total alkalinity among the studied wells water. The alkalinity value ranged between 84 – 398 mg/l. The highest value was recorded in site Bedara was 398 mg/l in March, while the lowest value was recorded in site Aesian was 84 mg/l in April. Results showed that the average concentrations of alkalinity ranged between (92 –381) mg/l, the highest average was recorded in site Bedara while the lowest average was recorded in site Aesian. The highest value is due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium. All samples showed concentration within permissible limit by (2) except the sites Bedara and sharafea sites. Similar results were reported by (26).

Table (10): Variation of (TA) among the studied wells during the study period (mg/l)

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	137 i	141 h	129 j	152 h	121e	148ef	137h
2-Hatara	248 d	260 d	218 d	253 c	274 b	240 b	232 d
3-Dersaida	103 k	97 j	121 k	109 j	127 e	136 f	115 i
4-Alqush	135 j	141 h	138 i	152 h	163 cd	149 ef	146 gh
5-Sharafea	304 b	328 b	361 b	368 b	373 a	349 a	347 b
6-Beban	251 c	263 c	274 c	236 d	274 b	249 b	257 c
7-Bozan	148 h	152 g	173 f	162 g	150 d	171 cd	159 f
8-Bedra	387 a	398 a	375 a	388 a	375 a	368 a	381 a
9-Krsafe	149 g	137 i	152 g	174 f	128 e	159 de	149 g
10-ShekhKa	157 f	159 f	146 h	138 i	153 d	147 ef	150 g
11-Baathre	169 e	173 e	184 e	193 e	179 c	185 c	180 e
12-Aesiam	85 L	93 k	84 L	104 k	89 f	99 g	92 j

Nitrates (NO3-) in (mg/l): Nitrate enters well water from many sources, including nitrogen-rich geologic deposits, wild-animal wastes, precipitation, septic system drainage, and poultry production, municipal and industrial waste, and fertilizer. The increased nitrate level in drinking water may adversely affect the central nervous system. (27). Table (11) shows a significant variation in the nitrates among the studied wells water. The highest value was recorded in site Bedara well was (8.1) mg/l in March, while the lowest value recorded in site Dersaida was (0.6) mg/l in March. Nitrate are very soluble and do not bind with soil, therefore it has high potential to migrate to ground water, especially when the wells near agriculture areas and Runoff, transport, nitrate from sewage and fertilizers to ground water (28). All sites of well water concentrations were found within the desirable limit value of 45 mg/l set by (25). Similar results were reported by (29).

Table (11): Variation of nitrate among the studied wells during the study period (mg/l)

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	1.8 h	2.9 b	2.2 e	1.7 f	1.9bc	1.2bc	1.9 def
2-Hatara	2.0 g	2.5 d	2.9 b	1.6 g	1.9 bc	2.2bc	2.1 cde
3-Dersaida	0.8 j	0.6 j	1.2 j	0.9 h	0.7 c	1.2bc	0.9 g
4-Alqush	1.1 i	1.4 h	2.1 f	0.7 i	0.9 c	0.8 c	1.1 g
5-Sharafea	2.2 e	2.6 c	1.8 g	2.1 d	1.9 bc	2.3bc	2.1 cde
6-Beban	2.9 c	2.5 d	1.6 i	2.3 c	2.5 abc	1.9bc	2.2 b-e
7-Bozan	2.8 d	1.8 g	2.1 f	2.0 e	2.9 ab	2.3bc	2.3 bcd
8-Bedara	7.8 a	8.1 a	6.6 a	5.9 a	4.1 ab	4.8 a	6.2 a
9-Krsafe	2.1 f	1.9 f	2.3 d	2.4 b	3.1 a	2.9 b	2.4 bc
10-ShekhKa	3.0 b	2.9 b	2.4 c	2.0 e	3.2ab	2.4 bc	2.6 b
11-Baathre	1.8 h	2.1 e	1.7 h	2.0 e	1.8 bc	1.9bc	1.8 ef
12-Aesiam	1.8 h	1.3 i	1.8g	1.6 g	1.9 bc	1.6bc	1.6 f

Sulfate (SO42-) in (mg/l): Table (12) shows a significant variation in the nitrates among the studied wells water. The highest value was (133.5) mg/l in site Bedara well in March. The high concentration of sulfate is due to the geological strata with gypsum and anhydrite content. While the lowest value was (8.6) mg/l, was observed in site Aesian well in February. This variation of sulfate due to geological formation of area, the sulfate concentration in the wells water of study area were below the guidelines (10) of 250 mg/l sulfate concentration in drinking water must not exceed 250 mg/l otherwise the water will taste bitter. Higher SO4 2- concentrations can even produce laxative effect. (30). Results showed that the average concentrations sulfate ranged between (10.5-128.6) mg/l, the highest average was recorded in site Bedara well was 128.6 mg/l. This variation of sulfate is due to geological formation of area, while the lowest average was recorded in site Aesian well. In this study are significantly lower than those reported by (31).

Table (12): variation of sulfate among the studied wells during the study period (mg/l)

Months / Sites	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Average
1-Resala	24.3 f	28.1e	30.0 e	29.8 e	30.2de	30.4de	28.8e
2-Hatara	34.1 d	37.2 d	33.8d	39.4 d	36.5 cd	37.8 cd	36.4 d
3-Dersaida	19.6 i	20.5 g	18.8 i	23.1 i	17.5fgh	20.6 fg	20.0 h
4-Alqush	21.5 h	18.9 i	21.9 h	24.9 g	21.5 efg	23.7 efg	22.0 g
5-Sharafea	45.6 b	41.3 c	50.6b	48.4 b	52.6 b	55.6 b	49.0 b
6-Beban	38.1 c	42.0 b	39.7c	42.1 c	39.6 c	40.2 c	40.2 c
7-Bozan	18.8 j	16.1 j	18.2j	19.3 k	16.5 gh	17.8 gh	17.7 i
8-Bedra	124.1 a	133.5 a	123.6a	129.1 a	130.0a	131.3 a	128.6 a
9-Krsafe	21.9g	19.5h	22.3g	26.1 f	21.5 efg	27.7 ef	23.1 g
10-ShekhKa	26.2 e	23.9 f	28.2 f	24.5 h	26.1ef	28.5ef	26.2 f
11-Baathre	16.5 k	18.9 i	15.6 k	20.1 j	17.8 fgh	16.8 gh	17.6 i
12-Aesiam	8.6 L	10.3 k	9.5L	12.2 L	11.4 h	11.1h	10.5 j

CONCLUSION

Ground water in the studied area can be considered as excessively hard, total hardness of water, Calcium and magnesium were found to be above the permissible level (10). Chlorides were within the recommended levels (25) of 250 mg/l. The high alkalinity of most sites of Ground water studied. High electrical conductivity for site 5, 8 more than 1000 (µs/cm) . Sites of Hatara, Sharafea, Beban, and Bedara of TDS values were very high in the wells water and exceed the maximum permissible limit of 500 mg/l,(2). The nitrate and sulfate concentration of all sites were below the guideline for (10). The analysis reveals that the groundwater of the area, needs certain degree of treatment before consumption (at least disinfection).

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Synthesis and characterization of new 1,3-oxazepine-4,7-dione

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ABSTRACT

In this study a series of azomethine compounds have been synthesized from reaction of 4-methylaniline with appropriate benzaldehyde, which then converted to seven heterogeneous ring organic compounds consist of oxygen and nitrogen with two carbonyls group one of them called lactam carbonyl and others called lactone through reaction with maleic anhydride in hot dry toluene. These new compounds have been characterized by spectral analysis (FT-IR, ^{1}H-NMR, and Mass spectroscopy) which confirmed the proposed structures. All new compounds are solid yellow crystals with high melting points, moderate yield percent, stable in air and soluble in more organic solvents.

Keywords: 1,3-oxazepine-4,7-dione, Azomethine compounds, Lactam Carbonyl, Lactone

INTRODUCTION

Oxazepine is unsaturated non-homologous seven membered heterocycle having oxygen in position 1 and nitrogen in position 3 in adding to the five carbon atoms (1). Oxazepine derivatives show an essential role in medicinal chemistry, especially as anticonvulsant and central nervous system (CNS) depressants(2), anti-tumor and Colorectal Adenocarcinoma (3), antioxidant and anti-inflammatory(4), beside their uses as corrosion inhibitors and liquid crystal components(5). 1,3-Oxazepines have been synthesized mainly by dipolar cycloaddition reaction of imines with five atoms cyclic anhydride, such as maleic, succinic, phthalic(6). In the present study a series of five new Oxazepine derivatives have been described and the proposed structures were investigated by spectral technique.

MATERIALS AND METHODS

Solvents were purified according to standard procedures. IR spectra were register on a Shimadzu 8400S –Japan, FT-IR spectrophotometer. ^{1}H-NMR spectra were obtained by FT-NMR (400 MHz and 500 MHz) Inova apparatus in DMSO-d_6, using TMS as internal Standard. The mass spectra (electron impact, 70 eV). Melting points were recorded with an Electro-thermal apparatus and uncorrected.

Synthesis of compounds:

1. Synthesis of the azomethine (imine group):

1.1 Synthesis((E)-N-benzylidene-4-methylaniline (SH1): In Pyrex conical flask is a mixture of benzaldehyde (5 mmol, 0.530 g) and 4-methylaniline (5 mmol, 0.535g) were mixed with10 ml of absolute ethanol at room temperature, 2-3 drops of glacial acetic acid were added The mixture then it was exposed to microwave irradiation at 270W for (2-3) mins. The reaction was monitored by TLC using eluent (chloroform 6: 4 ethanol). The reaction mixture was then cooled in ice bath the products purified by recrystallization in ethanol to give (E)-N-benzylidene-4-methylaniline as yellow solid (0.71, yield=72%) R_f=0.66, m.p 53- 56 ^{0}C (7).

1.2 Synthesis (E)-4-Methyl-N-(4-nitrobenzylidene) aniline (SH2): In Pyrex conical flask is a mixture of nitro benzaldehyde (5mmol, 0.750g) and 4-methylaniline (5 mmol, 0.535g) were mixed with 10ml of absolute ethanol at room temperature 2-3 drops of glacial acetic acid were added. The mixture was then exposed to microwave irradiation at 270 W for (2-3) mins. The reaction was monitored by TLC using eluent (chloroform 6:4 ethanol). The reaction mixture then it was cooled in ice bath the products purified by recrystallization in ethanol to give (E)-4-Methyl-N-(4-nitrobenzylidene) aniline as yellow solid (0.88, yield=72%) R_f=0.76, m.p 104- 107 ^{0}C (7).

1.3 Synthesis (E)-N-(4-bromo- benzyliden) 4-methylaniline (SH3): In Pyrex conical flask a mixture of bromo benzaldehyde (5mmol,0.925 g) and 4-methylaniline (5mmol,0.535g) were mixed with 10 ml of absolute ethanol at room temperature 2-3 drops of glacial acetic acid were added. The mixture then it was exposed to microwave irradiation at 270W for (2-3) mins. The reaction was monitored by TLC using eluent (chloroform6: 4ethanol). The reaction mixture was then cooled in ice bath the products purified by recrystallization in ethanol to give (E)-N-(4-bromobenzylidene)-4-methylaniline as yellow solid (1.1g, yield=85%) R_f =0.711, m.p 140- 143 ^{0}C (7).

1.4 Synthesis(E)-N-(4-methoxy benzyliden)-4-methylanilineas (SH4): In Pyrex conical flask is mixture of methoxy benzaldehyde (5mmol,0.68 g) and 4-methylaniline (5mmol,0.535g) were mixed with10 ml of absolute ethanol at room temperature 2-3 drops of glacial acetic acid were added The mixture was then exposed to microwave irradiation at 270W for (2-3) mints. The reaction was monitored by TLC using eluent (chloroform 6: 4 ethanol). The reaction mixture then it was cooled in ice bath the products purified by recrystallization in ethanol to give (E)-N-(4-methoxybenzylidene)-4-methylanilineas yellow solid (6.5g, yield=58%) R_f= 0.83, m.p 98- 100 ^{0}C (7).

1.5 Synthesis (E)-N-(4-methoxy benzyliden)-4-methylanilineas (SH5) : In Pyrex conical flask is a mixture of hydroxyl benzaldehyde (5mmol,0.610 g) and 4-methylaniline(5mmol,0.535g) were mixed with 10 ml of absolute ethanol at room temperature, 2-3 drops of glacial acetic acid were added. The mixture then it was exposed to microwave irradiation at 270W for (2-3) mints. The reaction was monitored by TLC using eluent (chloroform 6:4 ethanol). The reaction mixture was then cooled in ice bath the products purified by recrystallization in ethanol to give (E)-4-((p-tolylimino)methyl)phenol as yellow solid (0.98g, yield=98%) R_f =0.81 , m.p 98- 100 ^{0}C (7).

2. Synthesis of heterocyclic compounds:

2.1 Synthesis 2-phenyl-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione (N1): Maleic anhydride (0.01mol, 0.098g) in hot dry toluene (10 ml) was added to the N-benzyliden) -4-methylaniline(0.01mol,0.272g) in hot dry toluene (20ml). The reaction mixture was refluxed for 2 hrs. The reaction monitoring by TLC using eluent (chloroform 8:2 ethanol) the solvent was removed under reduced pressure. The solid products were recrystallized in DCM/Ethanol to give 2-phenyl-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione yellow crystal (0.15 yield=51%) R_f =0.67, m.p 185-187^{0}C (8).

2.2 Synthesis 2-(4-nitrophenyl)-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione (N2): Maleic anhydride (0.01mol, 0.098g) in dry hot toluene (10 ml) was added to the N-benzyliden) -4-methyl aniline(0.01mol,0.244g) in hot dry toluene (20ml). The reaction mixture was refluxed for 2 hrs. The reaction was monitoring by TLC using eluent (chloroform 8:2 ethanol) solvent was removed under reduced pressure. The solid products were recrystallized in DCM/Ethanol to give 2-(4-nitrophenyl)-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione yellow crystal (0.38g, yield=69%) R_f =0.85, m.p 180-183 ^{0}C (8).

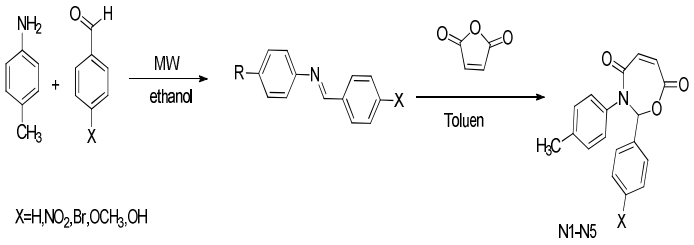
2.3 Synthesis 2-(4-bromophenyl)-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione (N3): Maleic anhydride (0.01mol, 0.098g) in hot dry toluene (10 ml) was added to the N-(4-bromobenzyliden) -4-methyl aniline (0.01mol ,0.273g) in hot dry toluene (20ml). The reaction mixture was refluxed for 2 hrs. The reaction was monitoring by TLC using eluent (chloroform 8:2 ethanol) solvent was removed under reduced pressure. the solid products were recrystallized in DCM/Ethanol to give 2-(4-bromophenyl)-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione yellow crystal (0.23g, yield=70%) R_f =0.53, m.p 190-193 ^{0}C (8).

2.4 Synthesis 2-(4-methoxyphenyl)-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione (N4): Maleic anhydride (0.01mol, 0.098g) in hot dry toluene (10 ml) was added to the N-(4-methoxybenzyliden) -4- methyl aniline (0.01mol ,0.213g) in hot dry toluene (20ml). The reaction mixture was refluxed for 2h. The reaction was monitoring by TLC using eluent (chloroform 8:2 ethanol) solvent was removed under reduced pressure. The solid products were recrystallized in DCM/Ethanol to give 2-(4-methoxyphenyl)-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione yellow crystal (0.22g, yield=69%) R_f =0.79, m.p 196- 199 ^{0}C (8).

2.5 Synthesis 2-(4-hydroxyphenyl)-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione (N5): Maleic anhydride (0.02mol, 0.196g) in hot dry toluene (10 ml) was added to the4-((P-tolylimino) methyl) phenol (0.02mol,0.422g) in hot dry toluene (20ml). The reaction mixture was refluxed for 2 hrs. The reaction was monitoring by TLC using eluent (chloroform 8:2 ethanol) solvent was removed under reduced pressure. The solid products were recrystallized in DCM/Ethanol to give 2-(4-hydroxyphenyl)-3-(p-tolyl)-2,3-dihydro-1,3-oxazepine-4,7-dione yellow crystal (0.34g, yield=55%) R_f =0.85, m.p 202- 205 ^{0}C (8). Table (1) below summarizes some physical properties of 1,3-oxazepine-4,7-dione compounds.

Table (1): Some physical properties data of 1,3-oxazepine-4,7-dione

Sym	Color	Melting point (^{0}C)	Yield %	R_f
N1	Yellow	185-187	51	0.67
N2	Yellow	180-183	69	0.85
N3	Yellow	190-193	70	0.53
N4	Yellow	196-199	69	0.79
N5	Yellow	202-205	55	0.85



Scheme (1): General synthetic procedure for all compounds

RESULTS AND DISCUSSION

FT-IR for 1,3-Oxazepine compounds:

The FT-IR spectra is important to identifies and supported the suggested structures. We noted that the stretching absorption of imine group (C=N) was disappeared, while the new carbonyl group of oxazepine ring appeared at (1701-1755) cm^{-1} . The stretching vibration of phenyl ring is showed at (1423-1616) cm^{-1}(8). The spectra of compounds showed the stretching vibration between (3028-3097) cm^{-1} attributed to the (C-H) aromatic system while the(C-H) aliphatic the stretching vibration absorption appeared at (2897-2974) cm^{-1} (figure 1) The spectra of 3-(4-mthoxyphenyl)-2-phenyl-2,3-dihydro-1,3-oxazepine- 4,7-dione (N5) showed broad absorption at (3448) cm^{-1} assigned to hydroxyl group (figure 2). The spectra showed stretching vibration at (3128-3286) cm^{-1} attributed to C-H benzyl bond (8). Important stretching absorption bands were collected in table (2).

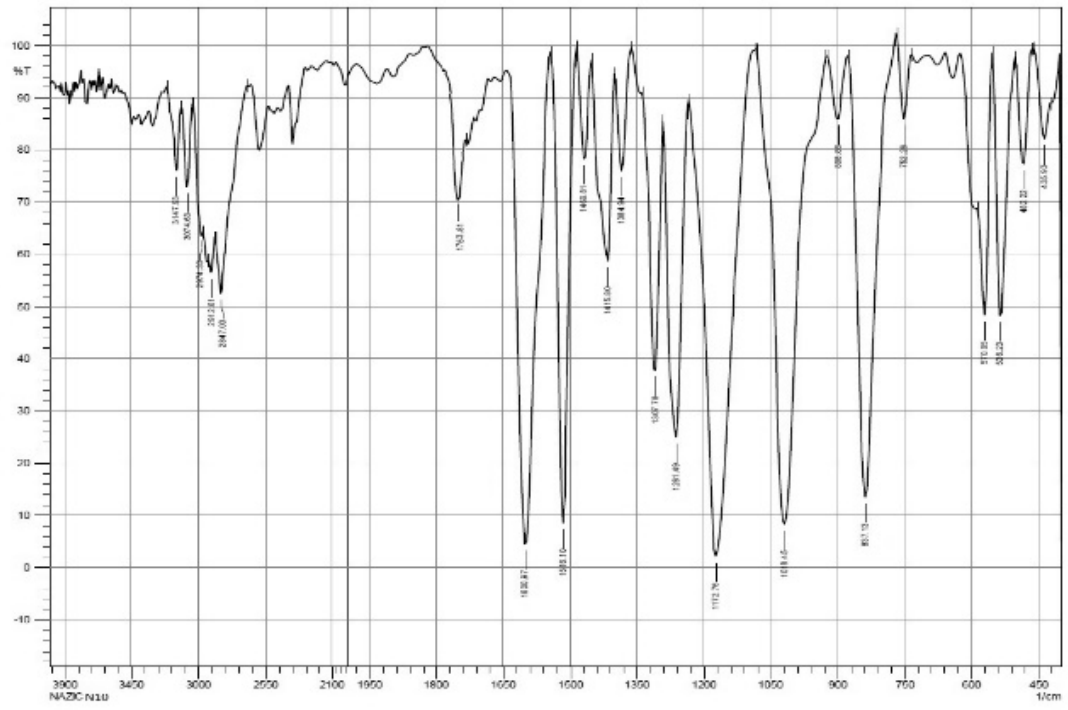


Figure (1): FT-IR Spectra of compound N1

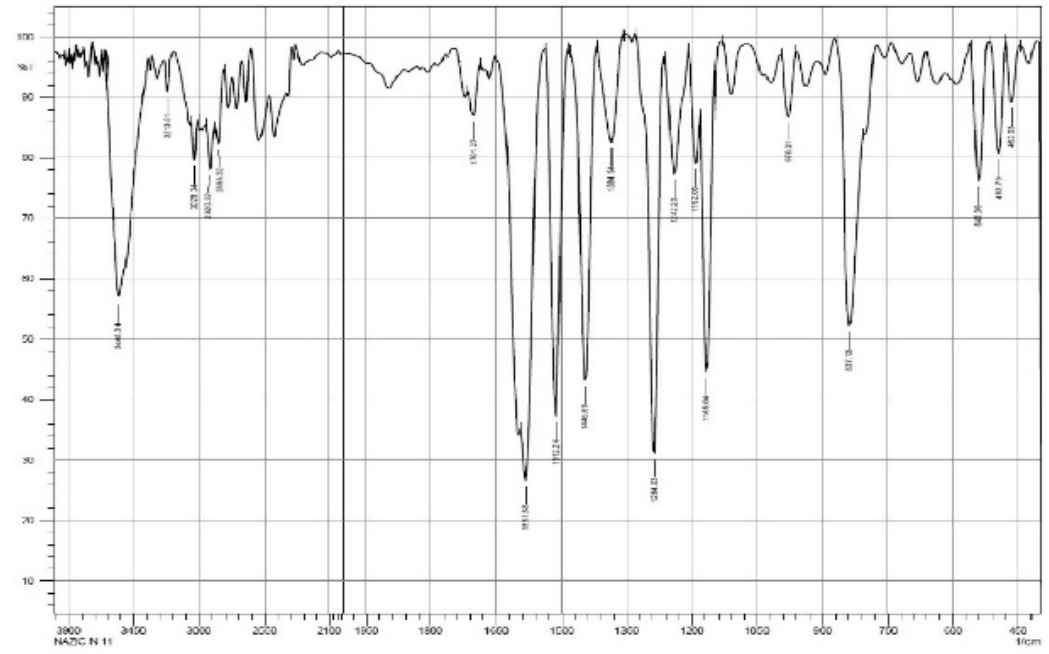


Figure (2): FT-IR Spectra of compound N5

Table (2): vibrational frequencies (cm^{-1}) and their assignments for compounds (N1-N5)

Sym	υ(O-H) stretching	υ(C-H) benzyl stretching	υ(C-H) aromatic stretching	υ (C-H) aliphatic stretching	υ (C=O) stretching	υ(C=C) aromatic stretching
N1	-	3147	3074	2974	1753	1600-1469
N2	-	3128	3063	2920	1701	1566-1446
N3	-	3286	3070	2897	1705	1585-1512
N4	-	3286	3097	2924	1701	1635-1500
N5	3448	3213	3028	2920	1701	1581-1446

^{1}H-NMR of N1-N5:

The proposed structures of new Oxazepine compounds were investigated by nuclear magnetic resonance spectroscopy. The ^{1}H-NMR of compounds (N1-N5) showed a signal at ~2.5ppm which is due to the DMSO and signal at 3-3.5 ppm due to H_2O in DMSO (figures 3 and 4). The ^{1}H-NMR spectrum of oxazepine compounds showed singlet signal at (2.29-2.30) attributed to proton of methyl group in compounds. The ^{1}H-NMR spectra showed the signal at (8.18-9.62) ppm due to (N-CH) related to phenyl ring, while aromatic protons were appeared as a multiple signals at (7.23-7.76)ppm, also appeared broad signal at (10.58) ppm which attributed to hydroxyl group (-OH) in N5 (8). All the chemical shifts (ppm) of compounds (N1-N5) were described in table (3).

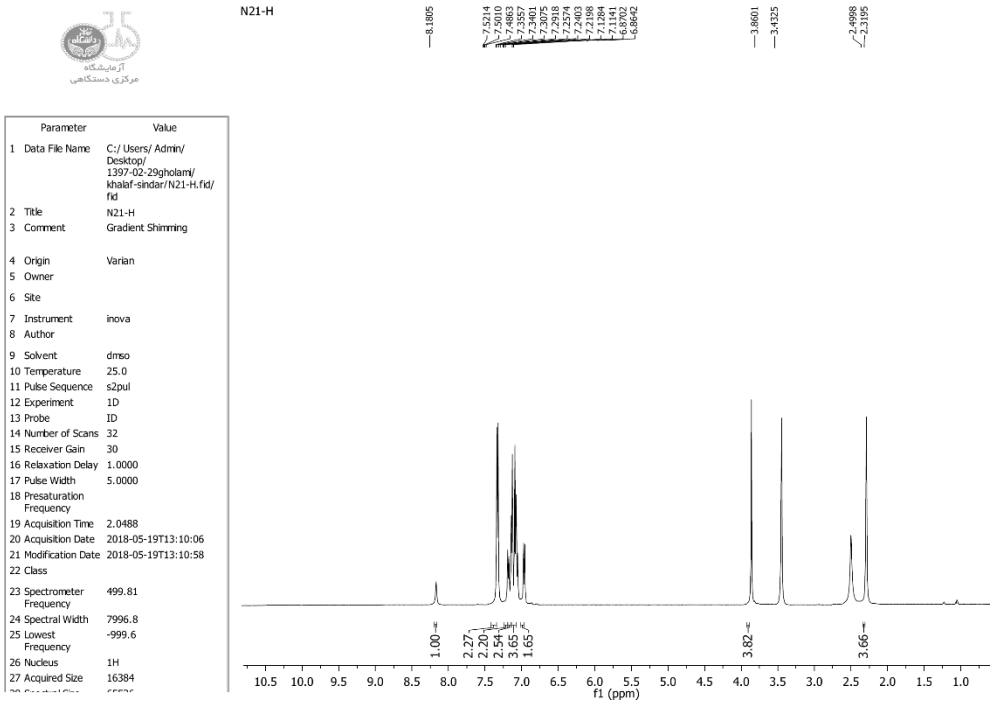


Figure (3): ^{1}HNMR spectra of N4 compound

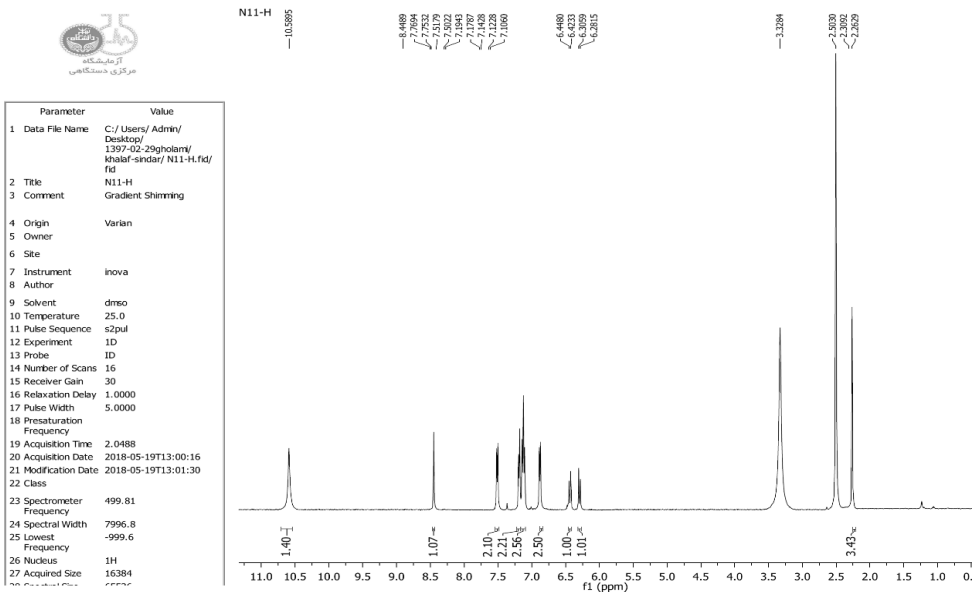


Figure (4): ^{1}HNMR spectra of N5 compound

Table (3): ^{1}H-NMR chemical shift (ppm) of compounds N1- N5

Sym	Chemical shift				
	Aromatic system	CH=CH	CH-N	CH_3	OH
N1	7.23-7.27	7.20, 6.7	8.50	2.30	-----
N2	7.13-7.95	7.11, 7.16	9.62	2.29	-----
N3	7.13-7.95	7.50, 7.1	8.65	2.7	-----
N4	7.25-7.53	7.28, 6.86	8.18	2.31	-----
N5	7.10-7.76	6.35, 6.29	8.44	2.26	10.58

Mass for N1:

The mass spectra of some of syntheses compounds are shown exhibited parent peak (molecular ion peak) which indicates to correct molecular formula of 1,3-Oxazepine-dione compounds (figure 5).

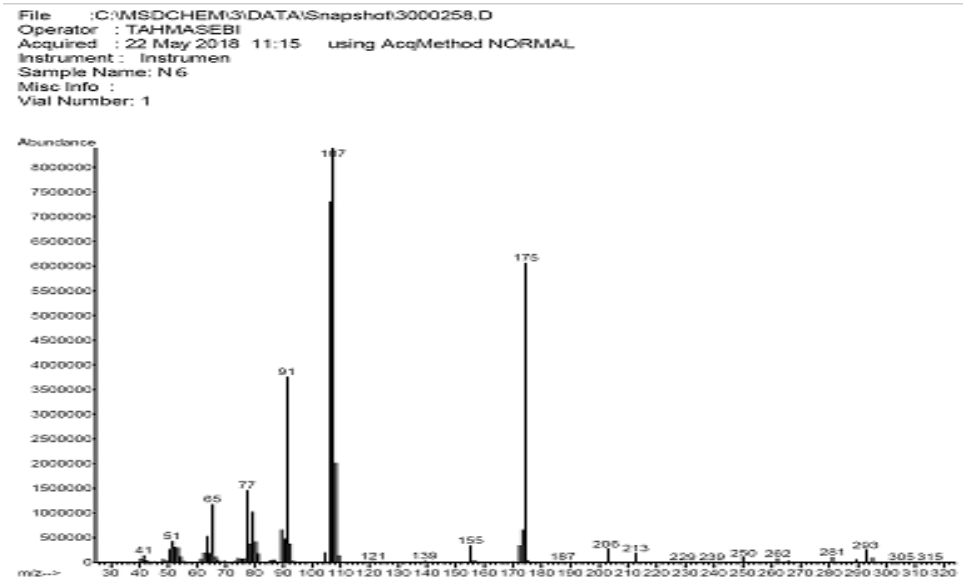


Figure (5): Mass spectra for compound N1 (m/z=293)

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