THE INHIBITORY EFFECT OF TELLURIC ACID AGAINST GROWTH OF SOME BACTERIA(*IN VITRO*)

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ABSTRACT

It was found that 0.3M of telluric acid dissolved in distilled water added in to Muller-Hinton agar media inhibited the growth of some gram positive bacteria (*Staphylococcus aureus, Staphylococcus albus* and *Streptococcus pyogenes*) as well as some gram negative bacteria (*Escherichia coli, Klebsiella aerogenes and Pseudomonas aeruginosa*). Higher concentration of telluric acid solution in to the media inhibited growth of bacteria more strongly

INTRODUCTION

Tellurium is an element which resembles Selenium in terms of its chemical properties. Telluric acid is a chemical compound with the formula $Te(OH)_6$. It is a weak acid (P^{ka} =7.68), forming tellurate salts with strong bases[1] . Telluric acid was formed by the oxidation of tellurium or tellurium dioxide with hydrogen peroxide or Chromium trioxide.

$$TeO_2 + 2H_2O_2 + 2H^+ \rightarrow Te(OH)_6$$

It is water soluble[2]. It was oxidizing, as shown by the electrode potential for the reaction below, although it was kinetically slow in its oxidations.

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$$H_6TeO_6 + 2H^+ + 2e^- \rightarrow 4H_2O_2 + TeO_2 \qquad E^o = +1.02v$$

Metatelluric acid , H_2TeO_4, the analogue of sulfuric acid , is unknown[3]. Morgan and coworkers prepared a large number of compounds containing the 1-tellura-3,5-cyclohexanedione ring system, the first paper[4] describing the inhibitory action of these compounds on the growth of bacteria appeared in 1922 . In the following years the mean bactericidal concentrations of 1-tellura-3,5-cyclohexanedione and many of its derivatives with respect to a variety of organisms were determined[5,6,7] . The cyclic tellurium compounds, especially 2,6-dimethyl-1-tellura-3,5-cyclohexanedione, were extremely active as germicides in the presence of urine[6,7] . Gulland and Farrar[8,9] pointed out the structural similarity between the cyclic tellurium compounds and pyridoxine. Their hypothesis, that an enolic hydroxyl group in the 3-postion of the 1-tellura-3,5-cyclohexanedione ring was necessary for bactericidal activity, was untenable yet. Dewar and coworkers[10] have shown that the compounds exist in the dione-form. Taniyama and coworkers found that diaryl tellurium dihalides posses a strong antibacterial action[11]. The unsymmetric diorganyl tellurides prepared by Rogoz[12] had much weaker bacteriostatic action than chloramphenicol against 21 strains of various microorganisms. The cyclic tellurium compounds were highly toxic[13]. A recent review deals with the toxicology of tellurium and its inorganic compounds was published in 1961[14] . The ability of living systems to convert tellurium and inorganic tellurium compounds into gaseous tellurium derivatives has been noticed early upon administration of potassium telluride to doges and men, the odorous compounds exhaled were

easily detected as bad breath[15,16] .

The aim of the present work was to study the bactericidal action of telluric acid on *Staphylococcus aureus, Staphylococcus albus and Streptococcus pyogenes* as well as *Escherichia coli, Klebsilla aerogenes and Pseudomonas aeruginosa* which till of our knowledge, no study has been done. .

MATERIALS AND METHODS

Telluric acid was obtained from (BDH) with purity of 99.99% were used in this study. Standard solution of telluric acid was prepared by dissolving (1.0 gm) of telluric acid in (10ml) of distilled water (0.43M), different concentrations (0.3, 0.2, 0.1, 0.05,and 0.04M) of telluric acid were used. All Bacterial isolates (*Staphylococcus aureus* and S*treptococcus pyogenes* from Vaginal swab. *Staphylococcus albus* from Tonsil, *Escherichia coli* from ATCC25922, *Pseudomonos aeruginosa* and *Klebsiella aerogenes* from Blood culture) were collected , identified and as agifts from Mr.Hussein Al-Timimi. The telluric acid activity were tested on pathogens isolates by disc diffusion method (Bauer *et al* ., 1966)[17] by using Muller-Hinton agar medium (Oxoid) of a depth of 4mm (90mm diameter Petri dish) inoculated with 10^5 CFU/ml bacterial suspension by dispersion method (according to McFarland standard scale)[18],then the Petri dishes were left after inoculation for(15-30) minutes. Six units of sterillized paper disc (5mm diameter) saturated with above concentrations of telluric acid were put in the bottom of the Petri dishes , Lightly touch each disc with sterile inoculating forceps to make sure that it was in good contact with the agar surface, incubated upside down at 37C° for 24 hours to measure the inhibition zone. Six Petri dishes were used as an experimental unit and the trial was repeated twice.

RESULTS AND DISCUSSION

It is well known that telluric acid contain hydroxyl groups attached directly to the tellurium atom in octahedral arrangement that make it easily to bind with other suitable molecules either through coordinating or by hydrogen bond[1] .Moreover; it is oxidizing agent. According to table(1), the minimal inhibitory concentration level of telluric acid against *Escherichia coli, Staphylococcus aureus, Staphylococcus albus, Streptococcus pyogens, Klebsilla aerogenes* and *Pseudomonas aeruginosa* were (4,6,2,10,4 and 6)mm in diameter at concentrations (0.05, 0.1, 0.04, 0.05, 0.2 and 0.43)M respectively.

The inhibition zones of *Escherichia coli, Staphylococcus aureus, Staphylococcus albus, Streptococcus pyogens, Klebsilla aerogenes* and *Pseudomonas aeruginosa* were (20, 20, 10, 12, 4, and 6)mm in diameter at 0.43M concentration of telluric acid. The mechanism of antimicrobial action of telluric acid was not known, But one can suggest that the telluric acid at bacteristatic and bactericidal level disrupt cell metabolism by oxidizing or binding through hydroxyl groups of telluric acid with essential amino acids and proteins including enzymes, also may be by dustruction of the pathogens cell wall[19]. *Pseudomonas aerugenosa* resist the effect of telluric acid concentrations except at standard concentration 0.43M which show inhibition zone of 6mm in diameter that is may be *Pseudomonas aerugenosa* was resistant to many antibiotics including Ampicillin, Sulphonamids, Trimethoprim, Tetracyclin, Cephaloidine and many Cephalosporins,Streptomycin and Kanamycin[20]. While the minimal inhibitory concentration of telluric acid against *Klebsilla aerogenes* was 0.2M and the inhibition zone was 4mm in diameter that because it carry resistant plasmid enzyme that release β-lactamase enzyme that give the *Klebsilla aerogenes* an effect to damage the Cephalosporine[21] . The minimal inhibitory concentration of telluric acid against both *Escherichia coli* and *Streptococcus pyogenes* was 0.05M and the inhibition zones were (4 and 10) mm in diameter, while the minimal inhibitory concentration of telluric acid against

Staphylococcus albus was 0.04M and the inhibition zone was 2mm in diameter that because some bacteria like *Escherichia coli , Pseudomonas aeruginosa*, *Klebsilla aerogenes* and *Staphylococcus albus* were characterized by its resistant to diferent kinds of antibiotics and prevent those antibiotics to arrive to inhibitory concentration of the cell by complexes essentially present on the external cell wall[22].

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Telluric acid	Concentration					
Isolates	0.43M	0.3M	0.2M	0.1M	0.05M	0.04M
Escherichia coli	20	20	15	15	04	--
Staphylococcus aureus	20	16	10	06	--	--
Staphylococcus albus	10	10	10	10	08	02
Streptococcus pyogenes	12	10	10	10	10	--
Klebsilla aerogenes	04	04	04	--	--	--
Pseudomonas aeruginosa	06	--	--	--	--	--

Table -1:- The inhibition zones in mm diameter for bacterial isolates against Telluric acid at different concentrations.

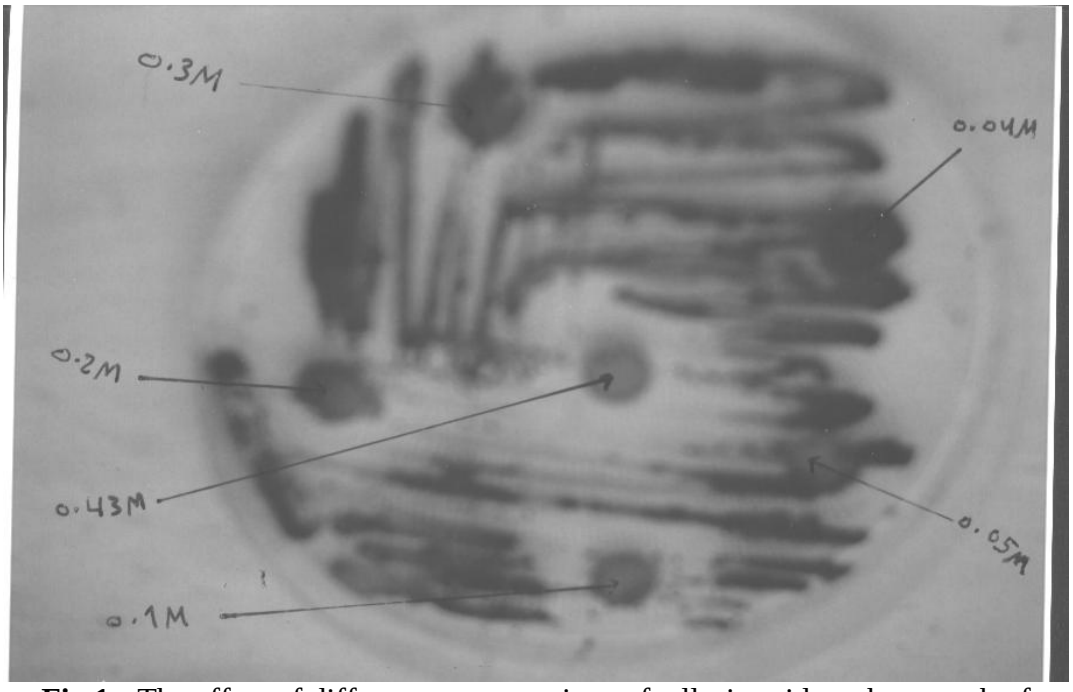

Fig.1:- The effect of different concentrations of telluric acid on the growth of

دراسة الفعالية التثبيطية لحامض التلوريك على نمو بعض البكتريا خارج الجسم الحي

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الخلاصة

تضمن البحث دراسة الفعالية التثبيطية لحامض التلوريك على نمو بعض البكتيريا حيث وجد إن تركيز (0.3M) من حامض التلوريك المذاب في الماء المقطر عند إضافته الى الوسط ألزرعي فأنه يثبط نمو بعض بكتريا الموجبة لصبغة الغرام مثل (*Staphylococcus aureus, Staphylococcus albus and Streptococcus pyogenes*) بالأضافه إلى تثبيط نمو بعض البكتريا السالبة لصبغة الغرام مثل (*Escherichia coli, Klebsiella aerogenes and Pseudomonas aeruginosa*). كما وجد إن استخدام تراكيز أعلى من محلول حامض التلوريك يؤدي إلى تثبيط اكبر لنمو هذه البكتيريا.

REFERENCES

1-Holleman,A,F;Wiberg,E. (2001)."Inorganic Chemistry" Academic press;San Diego,

2-Cotton,F.Albert;Wilkison, Geoffrey; Murillo, Carlos.A; Bochman, Manfred (1999)."Advanced Inorganic Chemistry" 6thedu. New Youk;Wiley-Interscience.

3-Lide,D.R. (2002). (Ed)CRC Handbook of Chemistry and Physics(83rd Edu.) Boca Raton (FL): CRC press

4-G.T.Morgan and H.D.K.Drew(1922), J.Chem.Soc. 922,

5-G.T.Morgan, E.A.Cooper and F.J.Corby(1924). J.Soc.Chem.Ind.190,18,

6-G.T.Morgan, E.A.Cooper and A.W.Burtt(1923). Biochem. J. 30,17,

7-G.T.Morgan and H.G.Reeves, J.Chem.Soc. 444,

8-J.M.Golland and W.V.Farrar,(1923) Nature, 88,154,1944

9-J.M.Golland and W.V.Farrar(1944). Annales Farm, Bioquim.(Buenos Aires). 73,15.

10-D.H.Dewar,J.E.Fergusson,P.R.Hentschel,C.T.Wilkins and P.P.Williams(1964) J.Chem.Soc. 688,

11-H.Taniyama, F.Miyoshi, E.Sakakibara and H.Ushida,Yakugaku Zasshi(1957) 57, 77,

12-F.Rogoz, Dissertationes Pharm. 157,16,

13-K.J.Irgolic (1974)"The organic chemistry of tellurium" Gordon and Breach Science Publishers New Yourk p.378, 14-E.D.Cerwenka,Jr. and W.C.Cooper. Arch. Environ. Health, 189,3,1961

15-F.Challenger.(1935) Chem. Ind.(London), 657,54.

16-F.Challenger.(1945). Chem. Rev. 315,36.

17- H.W.Bauer, W.M. Kirby, J.C. Sherris and M.Turck, (1966 .Antibiotic Susceptibility testing by standard single disc method. Am.J.Clin.Pathol.,493-496,45.

18-J.McFarland, (1989) The Nephelometer: An instrument for estimating the number of bacteria in suspensions used for calculating the opsonic Index and for Vaccines, J.Amer.Med.Assoc.1176,49,1907. In: Practical Immunology, L.Hudson and F.C.Hay, 3rd ed. Blackwell Scientific Publications, Oxford,pp1-496.

19-D.C.Shanon and D.C.E.Speller. (1987)Microbiology in Practice. 2nd ed.

20-J.M.Adelberg.(1989) Review of Medical Microbiology" 17th ed.Applenton and Lange Publications . p 130,

21-A.Philippon, R.Labia and G.Jacoby.(1989) Extended spectrum β-Lactamase antimicrob agents Chemothr.1136, 33.

22-M.R.W.Browns(1975) (ed). Resistance of Pseudomonas aeruginosa in W.B.Hugo and A.D.Russell. Pharmaceutical microbiology. Buller and Tonner Ltd. London. John Wiley pp 200-203.