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Insinuation Salmonella Typhi for ^{23} Na and ^{60}Co Radioactive Sources

Hanaa Salih Sabaa [1], Nebras Rada Mohammed[2], Hayim Chasib Magid[3], Ali Abdulwahab Ridha[4], Waleed Jabar Mhana[5] and Saad N. Ibrahim[6*]

1 Physics department – College of Science – Mustansiriya University/ Iraq
hanaasalah181@gmail.com
2 Ibn Sina University of Medical and Pharmaceutical Sciences, Density Department
almustafa81@yahoo.com
3 Al- Turath University college / Iraq
halhelfy@yahoo.com
4 University Of Technology And Applied Science, Rustaq College Of Education, Science Department, Physics Unit, Sultanate Of Oman.
ali_ridha.rus@cas.edu.om
5 Physics department – College of Science – Mustansiriya University/ Iraq
dr.waleed1967@uomustansiriyah.edu.iq
6 Physics department – College of Science – Mustansiriya University/ Iraq
*Correspondent contact: saad.ibrahim@uomustansiriyah.edu.iq

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ABSTRACT

The objective of this treatise is to determine insinuation of radioactive sources rays on Salmonella typhi. In this descriptive study a design of 50 S. typhi cross-sectional study design collected from Baghdad Hospital from different patients. Identification by Viteck2, S. typhi were implanted on Nutrient broth and Nutrient agar, then placed within test tube containing 5ml distilled water, then exposing to a different radiosoactive sources including Na23 , CO60 (1 µCi and CO60 10 µCi), implanted on petridishes plates of Nutrient agar incubated in the incubator for 24 hrs. at 37 ° .

Results of exposure to beta and gamma rays emitted by Na23 activity 10 µCi, without aluminum at a dose of (1, 2, 3) hours. with viable cell (26,51,0) respectively And with aluminum in a dose of (1, 2, 3) hours with viable cell (0,2,1) respectively.

Also exposure to CO60 (1µCi) with aluminum at dose for (1, 2, 3) hours. With a viable, cell (70, 3, 0) respectively and without aluminum at dose for (1, 2, 3) hours. With viable cell (12, 0,8) respectively.

Another exposure to CO60 (10 µCi) without aluminum at dose for (1,2,3) hours. With a viable cell (66, 6, 18) respectively and with aluminum at a dose of (1, 2, 3) hours. With a viable cell (0, 0, 0), respectively. It was observed through this study an increase in the rate of killing bacteria by gamma rays is greater than the rate of killing bacteria using beta rays and also an increase in the killing rate using cobalt source is higher than the killing rate using radioactive sodium source and the elimination of this disease with the least exposure time. Geochemical factors and radiation (at low, medium, high and controlled levels) both affected the structure of the internal communities

Keywords: Radioactive sources, Gamma rays, Beta rays and Inhibition.

الخلاصة

في هذه الدراسة تم جمع (50) عينة من انواع مختلفة من البكتريا من مستشفى بغداد من مرضى مختلفين الاعمار ولغرض تصنيف البكتريا وتشخيص انواعها تم زرع هذه الانواع من البكتريا على انواع مختلفة من المغذيات (الاكار) ومن ثم وضعها في انبوب اختبار يحتوي على (5ml ماء مقطر بمقدار وبعد عملية الاختبار تم اخذ العينات الخاصة ببكتريا السلمونيلا التايفوئيد واجراء الدراسة عليها حيث تم تعريض هذه البكتريا الى المصادر المشعة مثل مصدر الصوديوم والكوبلت Co (1μci), 60Co (10μci), 23Na (10μCi)

وبعدها تم وضعها في الحاضنة مدة 24 ساعة عند درجة حرارة 37درجة مئوية

نتائج التعرض لأشعة بيتا وجاما المنبعثة من المصدر المشع الصوديوم (Na^{23}(10 μCi بدون وجود الألمنيوم بجرعة (1,2,3) ساعات. مع بقاء بعض الخلايا الحية لهذه البكتريا (0,51,26) على التوالي

والتشعيع بوجود الألومنيوم لنفس المصدر المشع للحصول على اشعة كاما فقط بجرعة (3، 2 ،1) ساعات. مع بقاء بعض الخلايا الحية لهذه البكتريا (,1,2,0) على التوالي.

التعرض أيضًا للكوبلت المشع CO^{60} (1μCi مع وجود الألمنيوم للحصول على اشعة كاما بجرعة لمدة (1,2,3) ساعات. مع بقاء بعض الخلايا الحية لهذه البكتريا (0,3,70) على التوالي وبدون وجود الألمنيوم بجرعة لمدة (1,2,3) ساعات. مع بقاء بعض الخلايا الحية لهذه البكتريا (8,0,12) على التوالي.

تعرض أخر للكوبلت المشع ولكن بفعالية CO^{60} (10 μCi) بدون ألمنيوم بجرعة لمدة (1,2,3) ساعة. مع بقاء بعض الخلايا الحية لهذه البكتريا (66,6,18) على التوالي ومع وجود الألمنيوم بجرعة (1,2,3) ساعات. مع بقاء بعض الخلايا الحية لهذه البكتريا (0,0,0) ، على التوالي. وقد لوحظ من خلال هذه الدراسة زيادة معدل قتل البكتيريا بواسطة اشعة كاما أكبر من معدل قتل البكتريا باستخدام اشعة بيتا وأيضا زيادة نسبة القتل باستخدام مصدر الكوبلت اعلى من نسبة القتل باستخدام مصدر الصوديوم المشع والقضاء على هذا المرض بأقل وقت تعرض له.

العوامل الجيوكيميائية ا والإشعاع (عند المستويات المنخفضة والمتوسطة والعالية) كلاهما أثر على التركيب الداخلي والغشاء الخارجي لهذه البكتريا المسببة لهذا المرض

INTRODUCTION

Salmonella is the name given to a genus of rod-shaped (bacillus), gram-negative, facultatively anaerobic, non-spore producing, motile enterobacteria that belong to the family Enterobacteriaceae [1]. These bacteria are not able to create spores. Salmonella enterica and Salmonella bongori are the two different species of this type of bacteria. S. enterica is the type species, and it can be further subdivided into six different subspecies [2,3], with over 2,600 different serotypes. Daniel Elmer Salmon (1850–1914), an American veterinary surgeon, is honored with the naming of the bacterium Salmonella [4].

Salmonella species are capable of infecting cells from the inside [5, 6]. Salmonella is capable of infecting a wide range of cell types, including epithelial cells, dendritic cells, macrophages, and M cells [7]. When oxygen is present in an aerobic environment, Salmonella, a facultative anaerobic bacteria, uses it to produce ATP. However, oxygen is not present in an anaerobic environment. Salmonella generates ATP through the fermentation process by exchanging one or more of the four electron acceptors that are less effective than oxygen at the end of the electron transport chain. These electron acceptors are sulfate, nitrate, sulfur, or fumarate [8].

The vast majority of infections are contracted as a result of consuming food that has been tainted with waste from either humans or animals, such as that which was left behind by a worker in the food service industry at a restaurant. The typhoidal and nontyphoidal serotypes of Salmonella are the two basic categories of this pathogen. Nontyphoidal serotypes are responsible for the majority of cases of gastrointestinal illness, which normally clear up on their own. They are zoonotic, which means that they can be transmitted from humans to other animals and can infect a range of different species of animals. Two typhoidal serotypes that are unique to humans and do not exist in any other species are known as Salmonella Typhi and Salmonella Paratyphi A [9].

AHL transcriptional regulators' unique binding patterns are revealed by molecular modeling and active site study of the SdiA homolog, a potential quorum sensor for Salmonella typhimurium pathogenecity [10]. It is also known that the spvB gene from the Salmonella plasmid increases bacterial pathogenicity by preventing autophagy [11].

It is well known that salmonellosis can result in spondylosis or back discomfort. Infection of the gastrointestinal tract, enteric fever, bacteremia, local infection, and the chronic reservoir state are some of the five clinical patterns it might take. The early signs

It is well known that salmonellosis can result in spondylosis or back discomfort. Infection of the gastrointestinal tract, enteric fever, bacteremia, local infection, and the chronic reservoir state are some of the five clinical patterns it might take. The early signs include a generalized temperature, fatigue, and myalgia, among others [12, 13]. When a person has bacteremia, it can spread to any part of the body and cause a localized infection or abscesses. Arthritis, urinary tract infections, central nervous system infections, bone infections, and soft tissue infections are some of the manifestations of localized Salmonella infections. When the reticular endothelial cells' ability to function declines, the infection may become activated and, as a result, travel to the bone several months or even years after the acute form of salmonellosis. Infections can also remain dormant for a long time [14, 15].

Ionizing and non-ionizing radiation can be classified by the energy of the particles that are radiated. In order for ionizing radiation to ionize and break chemical bonds, it must carry more than 10eV, because to their vastly differing levels of toxicity, this distinction is critical. Radioactive materials emitting helium nuclei, electrons or positrons, or photons, respectively, are a typical source of ionizing radiation. Radioactive sources are defined as a known quantity of a radionuclide that emits ionizing radiation; gamma rays, alpha particles, beta particles, and neutron radiation are the most frequent types of radiation. One of the most common uses of radioactive sources is in the treatment of target materials, where the radiation acts as an ionizing agent. Cobalt-60 (^{60}Co) is a radioactive isotope of cobalt that was created artificially and has a half-life of 5.2713 years. In nuclear reactors, it is created artificially and used in various applications, the equation of Cobalt is $+ n \rightarrow \; \rightarrow + e^{-} + \nu e +$ γ rays. From ^{18}Na through ^{39}Na, there are 21 known isotopes of sodium (^{11}Na), as well as the two isomers (^{22}Na and ^{24}Na). ^{23}Na is the only isotope that is both stable and primordial. As it turns out, sodium possesses two radioactive cosmogenic isotopes: ^{22}Na and ^{24}Na, both with half-lives of about 15 hours. All other isotopes have half-lives of less than a minute, with the exception of those two. A half-life of $1.3(4)\times10^{-21}$ seconds makes ^{18}Na the fastest-acting [16].

Methodology
Study Design

Cross-sectional study design depending in this research for descriptive study design.

Figure (1): Scheme of study design of this research.

Study populations and Bacterial isolates

A total of summation of sample *Salmonella typhi* strain were raised from patients who were admitted in Baghdad infirmary in 2022 that identification via conventional biochemical responses depending [17].

Insinuation Salmonella Typhi for Na^{23} and Co^{60} Radioactive Sources

Salmonella typhi implanted was accomplished depending to [18] with several alterations, implanted in Nutrient broth at 37° C for 24 h , then centrifuged at 5000 rpm till 10 minutes. The pellet was suspended of sterile normal saline and rapprochement with MacCfrland 0.5, subsequently exposition 1 ml of suspension to Nd:YAG laser with comparison of control group (without exposure to radiance), each run was done in triplicate and injected in Trypton soy agar.

Results and Discussions

Study Design

Cross-sectional study design in Analytical study design by 50 isolates from patients have S. typhi.

Study Populations and Bacterial Isolates

Outcomes of combination of sample are 50 of S. typhi of patient human.

Impact of Radioactive Sources of S. Typhi

S. typhi exhibition to Na^{23} (10μCi) , CO^{60} (1 μci) and CO^{60} (10 μci) , implanted on petridishes plates of Nutrient agar incubated in the incubator for 24 hrs. at 37 ° C.

The results of exposure beta and gamma rays emitted by Na^{23} activity 10 μCi, without Almmonium in dose D (1hr.)= 9.6425396497 mSv; D (2hr.)=19.2850792994 mSv; D (3hr.)= 28.9276189491 mSv for (1, 2, 3) hrs. with viable cell (26, 51, 0) respectively and with Almonium in dose D (1hr.)= 0.01528854 mSv; D (2hr.)=0.03057708 mSv; D (3hr.)= 0.04586562 mSv for (1, 2, 3) hrs. with viable cell (0, 2, 1) respectively.

Also exposure to CO^{60} (1 μCi) with Almmonium in dose D (1hr.)= $0.34735529*10^{-2}$ mSV; D (2hr.)=$0.694710586*10^{-2}$ mSV; D (3hr.)= $1,042065879*10^{-2}$ mSv for (1, 2, 3) hrs. with viable cell (70, 3, 0) respectively and without Almonium in dose D (1hr.)=12.4667424 mSv; D (2hr.)=24.93348494 mSv; D (3hr.)=37.40022741 mSv for (1, 2, 3) hrs. with viable cell (12, 0,8) respectively.

Another exposure to CO^{60} (10 μCi) without Almonium in dose D (1hr.)= 1.86870209 mSV; D (2hr.) =3.73740418 mSv; D (3hr.)= 5.60610627 mSV for (1, 2, 3) hrs. with viable cell (66,6,18) respectively and with Almmonium in dose D (1hr.)=$0.23348838*10^{-5}$ mSv; D (2hr.)=$0.466977476*10^{-5}$ mSv; D (3hr.)= $0.700466214*10^{-5}$ mSv for (1, 2, 3) hrs. with viable cell (0, 0,0) respectively.

Table (1): Number of viable cells after exposure to different radioactive sources including Na^{23} with activity 10 µci, Co^{60} with activity 10 µci Co^{60} with activity 1 µci.

No.	Radioactive sources	Activity (µci)	Viable cell in 1 hr.	Viable cell in 2 hr.	Viable cell in 3 hr.
1	Na^{23} Without Almmonium	10	26	51	0
	Na^{23} With Almmonium		0	2	1
2	Co^{60} Without Almmonium	1	70	3	0
	Co^{60} With Almmonium		12	0	8
3	Co^{60} Without Almmonium	10	66	6	18
	Co^{60} With Almmonium		0	0	0

Figure (2): Viable cells of irradiated *S. typhi* after exposure to Na^{23} (10 μCi), Co^{60} (10 μCi) and Co^{60} (1 μCi) on Nutrient agar.

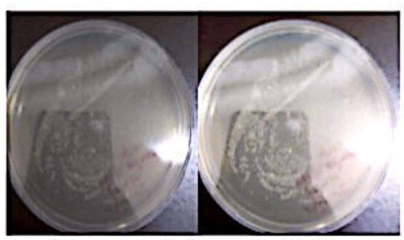

Figure (3): Irradiated S. typhi viable cells after exposure to Na^{23}, Co^{60}.

In a previous study by [19], cobalt toxicity in Escherichia coli caused by high cobalt concentrations was explained by competition between cobalt and iron in several metabolic processes, including the formation of free radicals and the reduction of the free thiol pool. The cobalt protoporphyrin IX (CoPPIX) that was produced as a result of higher cobalt concentrations in the culture medium was integrated into heme proteins, such as membrane-bound cytochromes and an expressed human cystathionine beta-synthase (CBS), in this article. The ability of cytochromes to transport electrons was blocked by CoPPIX, which significantly reduced respiration. Bacterial cells adjusted their mixed acid fermentative pathway during aerobiosis in order to adapt to the elevated cobalt concentration. We took advantage of E. coli's capacity to introduce cobalt into PPIX in order to create heme proteins that were CoPPIX replaced. The number of cell passes in a cobalt-containing media led to a rise in the level of CoPPIX-substitution. When compared to in vivo replacement with metalloporphyrin heme analogs or in vitro enzyme reconstitution, this method is less expensive to synthesize cobalt-substituted heme proteins, and it appears to be especially appropriate for complex heme proteins containing an extra cofactor, such as human CBS.

Endophytic bacteria and fungi colonize plants that thrive in diverse terrestrial and aquatic environment types, according to results of a different study by [20]. under our study, we look at the populations of endophytic bacteria and fungi living on the halophyte Kalidium schrenkianum under radiation-stressed environments. The geochemical elements and radiation (at low, medium, high, and control levels) had an impact on the endophytic communities' structure. In the endophytic communities of K. schrenkianum, the bacterial class Actinobacteria and the fungal class Dothideomycetes were dominant. While the roots of K. schrenkianum showed more bacterial diversity, the aerial tissues displayed higher fungal diversity. There was no discernible impact of radiation on the diversity of bacterial classes. The variety of root endophytes was significantly influenced by the soil's pH, total nitrogen content, and organic matter. Radiation had a significant impact on fungal co-occurrence networks and had an impact on bacterial and fungus community structure in roots but not in aerial tissues. Overall, endophytic bacterial and fungal genetic diversity was higher in radioactive environments; however, endophytic bacterial and fungal diversity in the plant showed negative associations. In radioactive conditions, both endophytic bacteria and fungi had more genetic diversity. Our research suggests that radiation has an impact on root endophytes and that the endophytes connected to K. schrenkianum's aerial

CONCLUSIONS

1-The effect of radiation on killing typhoid bacteria is very strong in high doses.

2- Cobalt and sodium radiosources active are effective in eliminating typhoid bacteria.

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