

Therapeutic strategies for eliminating biofilm produced by *Staphylococcus aureus* isolated from catheter by exposing to radiation emitted from radioactive sources (in vitro)

إعداد

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## Abstract:

**Objective:** In order to get rid of the biofilm and Staphylococcus aureus bacteria producing the biofilm using different therapeutic.

**Study design:** Cross-sectional in descriptive study design with case –control in analytical study design.

**Backgrounds:** S. aureus are gram positive bacteria, non-motile, non-spore forming, facultative anaerobes with grow on aerobic respiration. Cause several diseases include skin infection, pneumonia, sepsis and bacteremia. It is development by formation biofilm with stages attachment, adhesions, aggregations and biofilm maturation by quorum sensing. There are several strategies anti-biofilm inclusive natural products like plant extracts, photochemical. Sr90 is a radioactive sources isotope of Strontium by nuclear fission, possess different application in medicine and industry.

**Methodology:** Study populations and bacterial isolates with diagnosing S. aureus from catheter and several diseases from patients in Baghdad hospitals in 2024 /2023. Expose the bacteria to radiation emitted from Sr90 radioactive sources in different doses and screening biofilm production before and after exposure to radiation.

**Results:** The bacteria were biofilm producers before (%100) exposure to radiation and after exposure to radiation. All bacteria lost biofilm production by (%0) when grown on the

medium Congo-Red Agar (CRA) which changed the color of the bacterial colonies to red. This is an indication and evidence of their loss of biofilm production compared to the control before exposure to radiation emitted by Sr90 whose colonies were colored. Results of therapeutic strategies for killing *S. aureus* by exposing to Sr90 radiation without aluminium of activity 10  $\mu\text{ci}$ , percentage of humicide 100 % in doses 3.284235 through 1hr; 6.568471 through 2hr.; 9.852705 through 3hr. Also, exposed to Sr90 radiation to aluminium in activity 10  $\mu\text{ci}$ , percentage of humicides 100 % by doses 5-10\*5.2076 through 1hr.; 4-10\*1.04153 through 2hr. and 3-10\*1.56228 through 3hr.

**Conclusions:** Production of biofilm from *S. aureus* lower after exposure to Sr90 without aluminum indicated by the color of culture of colony become red compared with control.

**Key words:** Radiotherapy, rays, bacteria and biofilm.

## Introduction

Staphylococci are gram-positive bacteria, non-motile, non-spore forming, facultative anaerobes and implant in aerobic respiration. It is deemed to be a major pathogen that settles and infects both hospitalized patients with lowered immunity and healthful immune competent human in the society [1]. Cause several diseases include skin infections, pneumonia and bacteremia [3 ,2].

Natural outputs to biofilm inhibitory and disrupt activity that significant provenance of biocompatible anti-biofilm factor to evade the put away effectiveness of conventional antimicrobial on person good heal. Like, primary oils of worts [6 ,5 ,4], phenolic acids [9 ,8 ,7]. It is sturdy curative contra pathogens every after the aurous come of antimicrobial in the mid20-th hundred years [11 ,10]. The biofilm expansion process in four phases inclusive engagement and coherence, gathering to extracellular matrix with microbial propagation, biofilm constructing with maturation and biofilm stampede with cell disengagement [12 13].

Multiple regulatory suits control for every step of the foremost engagement to the maturation with stampede of biofilm. QS framework is an interior connection framework of bacteria wheresoever the expression of pertinent genes is started during the alterations to the indicative compound arrive a special outset. It encompass diverse indicative transduction path which regulate biofilm formulation malice and movement [14]. In *S. aureus* QS framework the extension control factor Agr framework responsible for QS [15]. Evolving novel anti-



biofilm agents from natural products like plant extracts and photo chemicals by suppression of microbial cell engagement and cohesion, deactivation of polymer formulation, lowering in the obstetrics of diseases factors and obstruction of QS framework [16]. Strontium90- (Sr90) is a radioactive isotope created via atomic fission with a semi-lifetime of 28.8 years. It kowtow  $\beta$ -dissolution into yttrium90- to a dissolution power of 0.546 MeV. It has implementation in medical and industrial uses [17].

## Methodology

### Study design

Case-Control study design depending in it research for analytical study design with Cross-Sectional for descriptive study design.

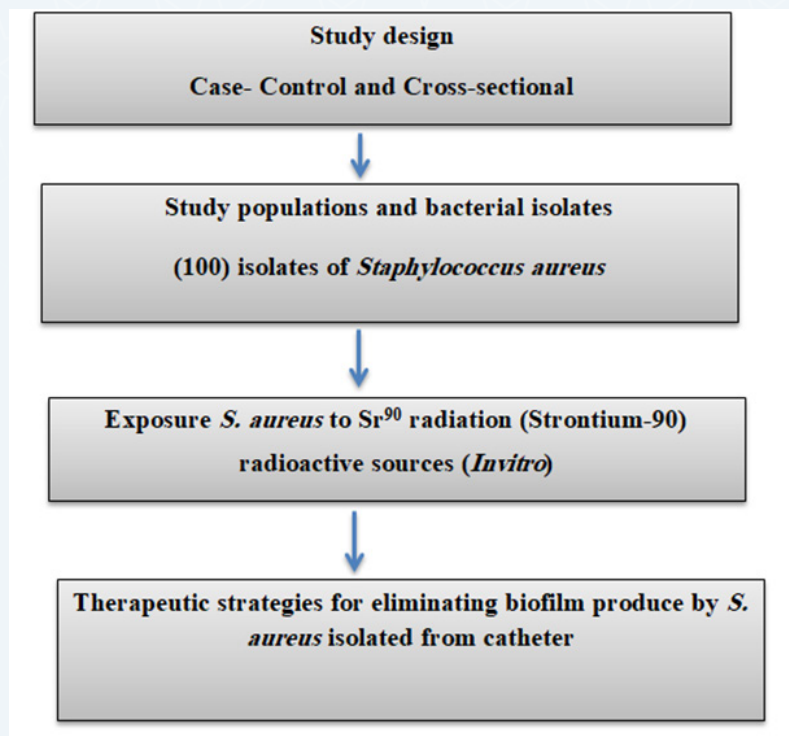


Figure (1): Plan of study design of this explore.

## Study populations and Bacterial isolates

A overall of assemblage of specimens (100) *S. aureus* for patients that were assumptive in Baghdad hospital through 2024/2023 which diagnosis via classical biochemical screening based [18].

Therapeutic strategies for exposure *S. aureus* to Strontium ( $Sr90$ ) radioactive sources in different doses

*S. aureus* grow was completed depending to [19] with many alterations, implanted within Nutrient stock at  $^{\circ}37$  C for 24 h, subsequently throw away at 5000 rpm until 10 min. The pellet was hanging of sterile naturalistic saline and compare with MacCfrland 0.5, subsequently exhibition 1 ml of hanged to rays released of  $Sr90$  with comparison of dominance (wanting exposure to rays), every round was done in replicate and injected in Trypton soy agar.

## The equation of attribution of death:

$$\text{Ratio of death \%} = \frac{\text{Dominance} - \text{patronized}}{\text{Dominance}} * 100$$

Therapeutic strategies for eliminate biofilm produced by *S. aureus* isolated from catheter by exposing to  $Sr90$

Congo Red process, the media formative of BHIB (37 g/ l), sucrose 5g/ l), agar numeral 10) 1 g/ l) and Congo red dye (0.8 gm/ l). Congo red dye was all set intensive liquid sol and autoclaved at 121 oC for 15 minutes. Thereafter, it was add up to autoclaved Brain heart infusion agar with each other with sucrose at 55 oC. Paten were grown with test organism and

brood at 37 oC for 24 to 48 hr. aerobically. Black colonies to a dry crystalline tenacity particular biofilm output [20].

## Results and discussions

The disintegration of the extra-polysaccharide is of specific connection for anti-biofilm mensuration. Thus far, different factors have been utilized to eliminate elementary and mingled species biofilms, originally via degenerating auto-produced adhesions, nucleic acids and polysaccharides [21].

The results in table (1) and figure (2) show biofilm production from *S. aureus* bacteria before and after exposure to radiation emitted from the Sr90 radioactive source (Strontium90-). The bacteria were biofilm producers before (%100) exposure to radiation and after exposure to radiation. All bacteria lost biofilm production by (%0) when grown on the medium Congo-Red Agar (CRA) which changed the color of the bacterial colonies to red. This is an indication and evidence of their loss of biofilm production compared to the control before exposure to radiation emitted by Sr90, whose colonies were colored. Dark black on Congo-Red Agar medium. Thus, it was proven that the radiation emitted by Sr90 is very effective and powerful in eliminating the biofilm of bacteria isolated from heart and urinary tract catheterization devices and isolated from patients after their catheterization procedure.

Table (1): Biofilm production from *S. aureus* before and after radiation



No.	Biofilm production before radiation	Percentage	Biofilm production after radiation	Percentage
1	+	100%	-	0%
2	+	100%	-	0%
3	+	100%	-	0%
4	+	100%	-	0%
5	+	100%	-	0%
6	+	100%	-	0%
7	+	100%	-	0%
8	+	100%	-	0%
9	+	100%	-	0%
10	+	100%	-	0%
11	+	100%	-	0%
12	+	100%	-	0%
13	+	100%	-	0%
14	+	100%	-	0%
15	+	100%	-	0%
16	+	100%	-	0%
17	+	100%	-	0%
18	+	100%	-	0%
19	+	100%	-	0%
20	+	100%	-	0%
21	+	100%	-	0%
22	+	100%	-	0%
23	+	100%	-	0%
Control (++++) Black colony		(+) : Positive production/ Black colony (-) : Negative production/ Red colony		



A previous study by [22] display Nerolidol was locate to repress *S. aureus* biofilm via more seventy percentage at concentricity extending of one to four mg/ml [131].

A preceding study by [23] exhibit Alkaloids, aromatic acids are naturalistic components that anti-biofilm efficiency contra *S. aureus* like, the alkaloid sinomenine able essentially up regulate *agrA* and down-regulate *icaA* level.

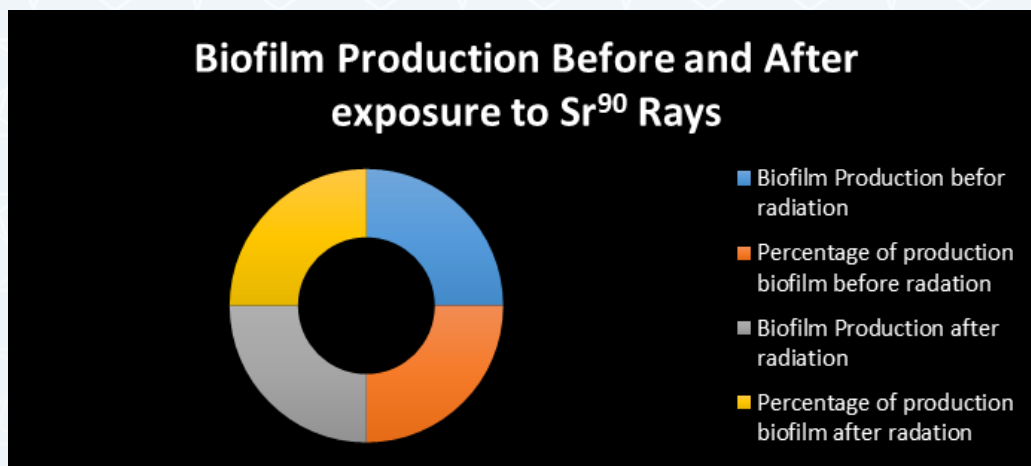


Figure (2): Biofilm production from *S. aureus* before and after exposure to Sr90 radiation.

A antecedent study by [24] revelation restricted therapeutic chosen for *S. aureus* recognizing efficient incorporation supplies an substitutional for infection therapy. Like, aside from possess considerable biological effectiveness, curcumin-founded metal complicated induce the bioavailability of curcumin. At the concentricity of one-hundred  $\mu\text{M}$ , curcumin suppressed *S. aureus* biofilm formulation fifty-six percentage whilst oxovanadium complicated of curcumin has a safely sturdy impact eithy-two percentage that might stay in the interaction together impact of complicated technicality have suppression and antibacterial technicality.



Figure (3): A- *S. aureus* production biofilm before exposure to Sr90 radioactive sources. B- *S. aureus* production biofilm after exposure to Sr90 radioactive sources.

A past study by [25] show the extractor of methanol from *Hemidesmus indicus* root that interaction together the anti-biofilm effectiveness of AML and CL contra Methicillin Resistance *S. aureus*. Furthermore, in the renal and liver of Methicillin Resistance *S. aureus* -infective mouse, the aggregates safely minimized microbial carriage, sickness effectiveness effect and gram-positive place.

Results of therapeutic strategies in table (2) for killing *S. aureus* exposed to Sr90 radiation wanting aluminium in activity 10  $\mu\text{ci}$ , percentage of humicides 100 % through doses 3.284235 through 1 hr.; 6.568471 in 2 hr.; 9.852705 in 3 hr. Also, exposed to Sr90 radiation wanting aluminium of activity 10  $\mu\text{ci}$ , percentage of humicide 100 % in doses 3.284235

through 1hr; 6.568471 through 2 hr.; 9.852705 through 3 hr. Also, exposed to Sr90 radiation to aluminium in activity 10 µci, percentage of homicides %100 via doses 5-10\*5.2076 through 1hr.; 4-10\*1.04153 through 2 hr. and 3-10\*1.56228 through 3 hr. as shown in table (2).

Table (2): Proportion of homicides of S. aureus exposure to Sr90 radioactive sources.

No.	Activity	Doses in 1hr./ msv	Proportion of assassination	Doses in 2hr./ msv	Proportion of assassination	Doses in 3hr./ msv	Proportion of assassination
Sr90 Without Alaminium	10 µci	3.284235	100 %	6.568471	100 %	9.852705	100 %
Sr90 With Alaminium	10 µci	5.2076*10 <sup>-5</sup>	100 %	1.04153*10 <sup>-4</sup>	100 %	1.56228*10 <sup>-3</sup>	100 %
Control = 250 Colony							

A anterior study by [26] demonstration a fatal impact on Pseudomonas through displayed to rays on various times through (1,2,3) hr. with diverse doses by cobalt with impact 1 µci and 10 µci in the existence and non-attendance of aluminium with the use of strontium in the existence and non-attendance of aluminium. The killing rate of P. aeruginosa by cobalt wanting aluminium was %78 with in the existence of aluminium %100. In rapprochement, the death average of Pseudomonas with efficient wanting aluminium was %100; in the existence of aluminium %98, the death average of Pseudomonas wanting aluminium was %83 and in the existence of aluminium %96 rapprochement with control.



## Conclusions

Production of biofilm from *S. aureus* lower after exposure to Sr90 without aluminium indicate by the color of culture become red compared with control is black colony.

## Ethical approval

All examination protocols were confirmed by the College of Ibn Sina University of Medical and Pharmaceuticals Sciences. All screening was achieved following the confirmed guidelines.

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There was no financial disclosure.

## Conflicts of interest

The authors declare that there are no conflicts of interest.

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Researcher Dr. Nebras Rada Mohammed PhD. in Biotechnology with a Genetic Engineering, Molecular Genetics and Protein Engineering, a scientist, expert, researcher, creator, inventor, writer, written and author, editor-in-chief of the Journal of Articles and Inventions in the American Goidi Journal, teaching, lecturer at the University College of Al-Turath University college, a Bachelor's degree in Microbiology and a Master's degree in Molecular Biology in Microbiology from Al-Mustansiriya University, an arbitrator, international resident and consultant In medical laboratories, an expert in medical laboratories and a holder of the title of a scientist project, an arbitrator, a distinguished publisher, a silver supporter of





scientific platforms, a chairman of a committee in a scientific society, receiving accolades from international intellectual property, the Best Arab Woman Award 2020, also the Best Community Personality Award, the Best Research Award 2019, also the Best Research Award 2020 and an American Award For the invention of 2020 by the American Goidi the World Investment Commission in America, holds the title of the best distinguished inventor in the world by the World Investment Commission in America and holds the first places in the world for inventions presented in the world from the American Goidi, the world investment commission in America. The Edison Prize, The Pascal Prize, The creativity award, the scientific medal and the Everest medal for innovation, creativity for inventions from USA.

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