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RESEARCH ARTICLE
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TO STUDY THE ANTIBACTERIAL ACTIVITY OF *RICINUS COMMUNIS* EXTRACTS AGAINST COMMON BACTERIAL ISOLATES OBTAINED FROM SURGICAL SITE INFECTION IN A TERTIARY CARE HOSPITAL AT KANPUR, UTTAR PRADESH

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INTRODUCTION: There are many natural crude drugs from plants that have the potential to treat many diseases, in healing wounds and disorders and one of them is *Ricinus communis.*
OBJECTIVE: To study the antibacterial activity of *Ricinus communis* extracts against common bacterial isolates obtained from surgical site infection at a tertiary care hospital in Kanpur, Uttar Pradesh.
METHODS: This was a cross sectional study carried out in the Departments of Microbiology and Medicine Department of Rama Medical College Hospital and Research Centre, Kanpur. A total of 20 SSI infections, were studied, the pus samples were cultured and studied for identification & Antimicrobial susceptibility was performed according to CLSI guidelines 2023. The antimicrobial activity of Ricinus communis (castor oil) was studied. The *Ricinus communis* plant leaves were collected from the medical garden of RMCH&RC where the leaves were crushed cleaned with distilled water and different solvents of the extracts were prepared and impregmented with 20ul of the plant extract in prepared whatsmann paper disc.
RESULTS: Out of 45 pus samples studied, 20 were of SSI, 18 were from ear infection and 7 were from other samples in Gram positive organisms were 100% sensitive to Linezolid, and Gram negative organisms were 100% sensitive to Colistin. In the present study **t**he crude extract of *Ricinus communis* leafs was most effective with methanol solvent in350 mg/mL. The highest zone of inhibition was observed against *Staphylococcus aureus* (22±0.2 mm) followed by *Escherichia coli* (19±0.3 mm), *Klebsiella pneumoniae* (18±0.3 mm) and least for for Pseudomonas aeruginosa (9±0.3 mm). It was noted that gram positive bacteria had significantly shown more the sensitive zones of inhibition as compared to the gram negative bacteria.
CONCLUSION: This study supports the antibacterial properties of *Ricinus communis* leaf extraction be used to treat various diseases like SSI.

KEYWORDS: SSI, Disc diffusion, Kirby-Bauer, Antibacterial activity, Plant extract

INTRODUCTION

Plant kingdoms are the rich source of organic compounds, many of which have been used for medicinal purposes. There are many natural crude drugs from plants that have the potential to treat many diseases and disorders and one of them is *Ricinus communis*[1, 2]. Ricinus communis belongs to the family Euphorbiaceae that is a group of flowering plants. The most important plant parts of *R. Communis* that are utilized for treatment are the root, stem, leaves, fruits, whole of aerial parts, the complete plant and flowers [3]. The worldwide utilization of the medicinal plants, such as herbal medication and healthcare preparations, is also found in ancient literature. In fact, plants have enormous diversity of biologically active compounds, and it is a sign which makes the plants a wealthy source of a variety of drugs [4]. The richest organic compounds are found in the plant kingdom, and they have been regularly used since ancient times for therapeutic purposes. A numerous unrefined drug that are isolated from these medicinal herbs have greatest implicational ability to treat a wide variety of diseases and *Ricinus communis* holds an extraordinary position in this group of medicinal plants [5,6]. The plant is proven to contain antioxidant properties in its methanolic leaf extract anti-inflammatory activity, anti-diabetic activity and antibacterial activity [7-10]. The plant has hepatoprotective effect and is used in the treatment of skin cancer [11,12]

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The plant is proven to contain antioxidant properties in its methanolic leaf extract anti-inflammatory activity, anti-diabetic activity and antibacterial activity [7-10]. The plant has hepatoprotective effect and is used in the treatment of skin cancer [11,12]. The parts of these medicinal healing herbs have depicted their therapeutic value and have been used to avert, alleviate or heal several human ailments. Since, ancient times in terms of traditions that are related to herbal medicine, India is one of the leading countries in Asia and it includes a large number of plant species which includes Ayurveda, Unani, Siddha, and Tibetan [13]. Surgical site infections (SSI) are a common type of healthcare-associated infections and frequent complication of hospitalization, responsible for prolonged hospital stay, increased intensive care unit admissions, hospital readmissions after surgery, significantly increased costs and delays to adjuvant systemic therapy; they occur in 2 to 5% of patients undergoing surgery.

According to the CDC, there are three types of surgical site infections.

MATERIAL AND METHODS:

This study was conducted in the Department of Microbiology, Central Research Laboratory & Department of Surgery Rama Medical College Hospital and Research Centre Kanpur. This cross-sectional study was conducted in the department of microbiology of a tertiary care teaching hospital for a period of one month in April 2021. RAMA Medical College Hospital And Research Centre approval for the study was obtained **(RMCHRC / Academic / M.SC / 2023 / 2937)**

SAMPLE SIZE: $n=4pq$ / L^2

p-Prevalence - 12%

q-100-p 88

L-acceptabl error-10%

$$\text{Sample size(n)}=\frac{4pq}{L^2}$$

$$=\frac{4224}{100}$$

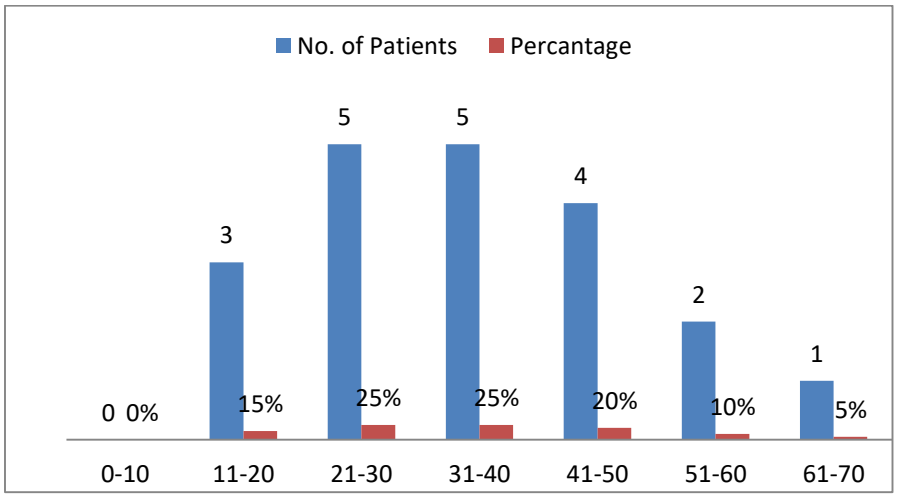
Sample size(n)= 42.6

CLSI (2023): *Linezoid*, Colistin, Teicoplanin, Vancomycin, Cefoxitin, Oxacillin, Erythromycin drugs of GPC organism were studied.

PLANT EXTRACTION: Plant leaves were washed thoroughly with distilled water. The *R. communis* were finely grinded using electrical grinder and stored in air tight containers for further use. The pulverized plant material (250 g) was extracted in polar as well as non-polar solvents such as in methanol, ethanol and autoclaved water, DMSO hexane[50]. The separated extracts were then filtered through Whatman's No. 1 filter paper, and the methanol and ethanol filtrates were then separately condensed to dryness using rotary evaporator. Finally extract dried at room temperature. Dried extract was collected in an air tight container and stored at 4 °C till further analysis.

Inclusion criteria: Organisms Isolates obtained from only surgical site infection was studied.
Exclusion criteria: 1. Wound infections (prick infections, diabetic foot, burn wounds and accident wounds etc.) were not included in the study.
2. The patients with antibiotic history in the recent past and also on topical application of antimicrobial ointments were excluded from the study.

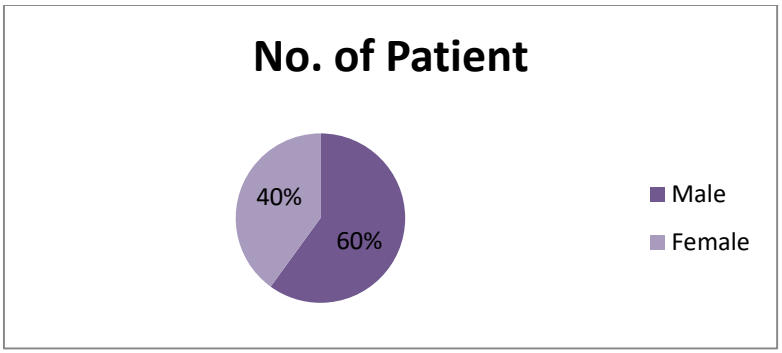
RESULTS



Graph No:1. Age wise distribution of study participants were more in the age group of 31-40 years, followed by more than 21-30 years the least number of RECINUSS COMMUNIS participants belong to the age range of 61-70 years.

GENDER	NO. OF PATIENT	PERCENTAGE
MALE	**12**	**60%**
FEMALE	**8**	**40%**
TOTAL	**20**	**100%**

Table NO:2. Gender wise distribution of males were more affected than females, In our study it was found that 60% study population were male and were females 40%.



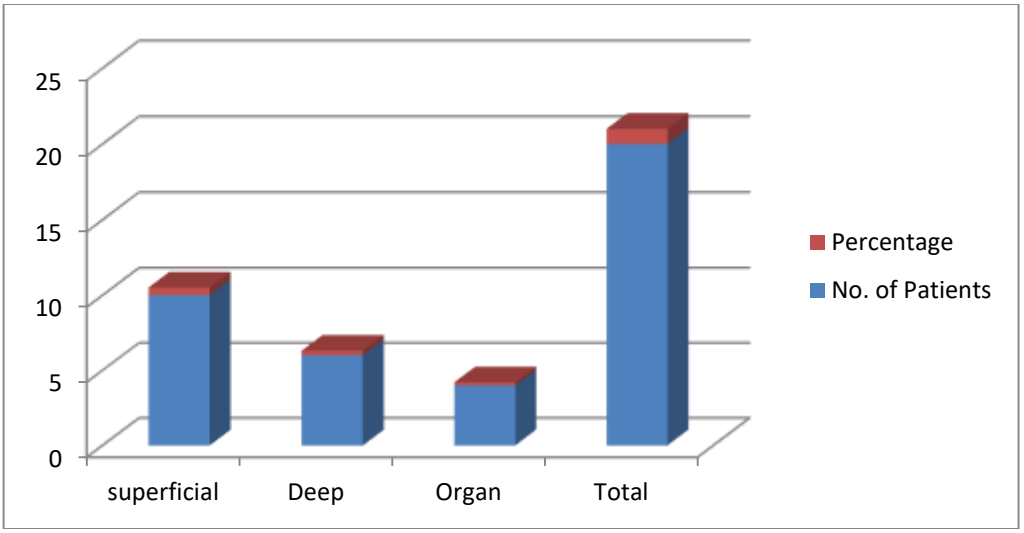
Graph No:2. GENDER WISE DISTRIBUTION

DEMOGRAPHIC PROFILE	NO. OF PATIENT	PERCENTAGE
RURAL	**13**	**65%**
URBAN	**7**	**35%**
TOTAL	**20**	**100%**

Table No:3. Demographic study of profile patients in which 35% belong to urban areas while 65% hailed from Rural.

TYPES OF INFECTION	NO.OF PATIENT	PERCENTAGE
SUPERFICIAL	**10**	**50%**
DEEP	**6**	**30%**
ORGAN	**4**	**20%**
TOTAL	**20**	**100%**

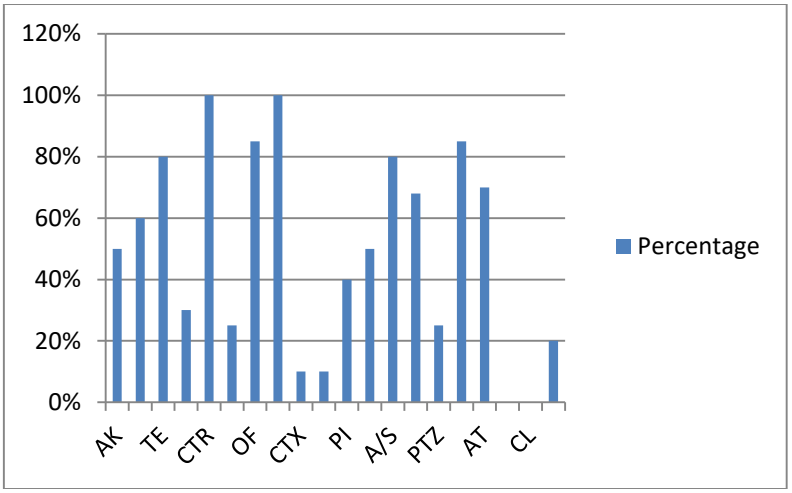
Table No:4. Types of SSI in our study it was found that 50% were superficial followed by Deep SSI infection the least number of organ SSI infection 20%.



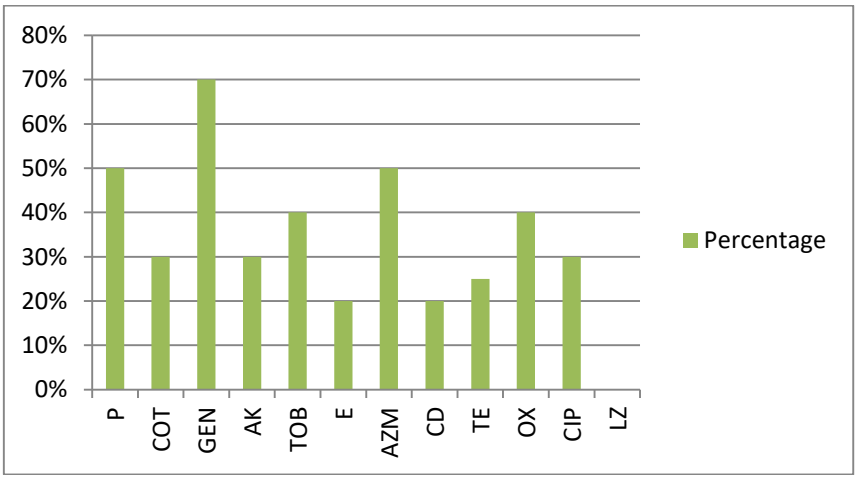
Graph No: 4. TYPES OF SSI

S. No.	No. of Sample	No. of Isolates	Percentage
	GPC		
1.	**Staphylococcus aureus**	**6**	**30%**
	GNB		
1.	**Escherichia coli**	**10**	**50%**
2.	**Klebsiella pneumoniae**	**2**	**10%**
3.	**Pseudomonas aeruginosa**	**2**	**10%**

Table No. 5. Types of Bacterial Organism



Graph No. 6. Antibiotic Resistance pattern of GNB



Graph No. 7. Antibiotic Resistance pattern of GPC

Types of Isolation	**Average zone of Inhibition**
Staphylococcus aureus	22±0.2mm
Escherichia coli	19±0.3mm
Klebsiella pneumoniae	19±0.3mm
Pseudomonas aeruginosa	9±0.3mm

Table No. 8: Zone of Inhibition of Test Isolates

DISCUSSION

Surgical site infections (SSI), one of the most common causes of nosocomial infections are a common complication associated with surgery, with a reported incidence rates of 2-20% [16]. They are responsible for increasing the treatment cost, length of hospital stay and significant morbidity and mortality. Despite the technical advances in infection control and surgical practices, SSI still continue to be a major problem, even in hospitals with most modern facilities [17]. There are many natural crude drugs from plants that have the potential to treat many disease and disorders and one of them is *Ricinus communis* [18,19]. A phytopharmacological review by Jena and Gupta in 2012, revealed that, *Ricinus communis* has proven to possess antimicrobial activities as they were used against dermatophytic and pathogenic bacterial strains *S. aureus*, *P. aeruginosa* as well as *K. pneumoniae* and *E. coli* [20]. The *Ricinus communis* possess wound healing activity due to the active constituent of castor oil which produce antioxidant activity and inhibit lipid peroxidation. The leaves of *R. communis* are believed to be used in the form of a poultice or fomentation on sores, boils and swellings [21]. Out of the total 42 cases the culture positive was observed in 20 cases considered as cases of SSI thus, the overall percentage rate of ssis was observed to be 47.6% in the present study.

There was another study which was in accordance to the present study by Setty et al. [22] which reported the prevalence rate with 21.66% and 22.2% respectively.

There were other studies performed by the other research investigators which were in contrast to the present study where, Kumar et al. [23] and Al-Mulhim et al. [24] reported in their study that the overall prevalence rate of SSIs was 2.5%, which was lesser as compared to the present study.

In the present study it was observed that the ratio of Males 12 (60%) was more as compared to that of females 8 (40%). This study was similar to the study performed by the other research investigator Vikrant Negi et al.,[25] where Males (74.6%) were more commonly affected than females (25.5%) and the sex ratio male: female was 2.9:1. A study by Hernandez et al., in 2005 conducted in a Peruvian Hospital reported more occurrences among males (65.6%) [26].

In contrast, a study done by Shanmugam et al. reported almost equal occurrences among females (52%) and males (48%) [27] the increasing occurrence among males was attributable to the nature of the infected wounds with which they come to surgical departments.

In the present study the maximum number of cases was recorded in the age group of 31 to 40 year of age followed by 21-30 years with 25% then with 41-50 years of age with 20% and least with 61-70 years of age with 5%. This study was similar to the study conducted by the other research investigator where the 31 -50 years was affected the most [25].

In the current study the sign and symptoms observed in the present study were fever, Abdominal pain, Nausia which were comparable to the other study where fever was the most common symptom [28]

In the present study, it was observed that the maximum SSI was observed in the superficial site with the ratio of 50% followed by deep site with 30%. There were no SSIs observed in the organ site. There was another study which was similar to our study where the rate of SSI in superficial was observed to be more stated by Kumar et al. [23] reported that superficial incision SSI was more prevalent (215 cases, 55.9%) followed by deep incisional SSI (169 cases, 44%), and van Walraven et al. [29] reported the same that a majority of these (n= 8188, 57.5% of all SSIs) had a superficial component. This is discordant with the study by Dessie et al., who reported superficial SSI as 42.1% and deep SSI as 57.9% (112 cases) [30].

In the present study it was observed that GPC was found more than GNB where *S.aureus* was the most common isolate (30%) followed by *E.coli* and *Klebsiella pneumonia* with 5% respectively. It was observed that *Pseudomonas aeruginosa* was least with 10%. There was the study which was in support to the present study where *E. coli* (46.4%) was the commonest gram negative bacteria isolated [25].

In the present study the antibacterial properties of *Ricinus communis*· Leaf extract was tested against

the common human pathogens that were isolated from the surgical wounds. This showed that methanol solvent extract at 300 mg/mL concentration has shown the maximum activity. This inference was also supported by a study that was performed by Naz R and Bano A on antimicrobial potential of *Ricinus communis* leaf extracts in different solvents against pathogenic bacterial and fungal strains in which they concluded that the efficient activity of *Ricinus communis* leaf extract in methanol solvent has shown significant potential to inhibit the pathogenic bacteria [31].

In the present study the zone of inhibition observed for *Staphylococcus aureus* was 22±0.2mm, *Escherichia coli* 19±0.3mm, *Klebsiella Pneumoniae* 19±0.3mm and *Pseudomonas aeruginosa* was 9±0.3mm . It was observed that there was no zone of inhibition observed for DMSO. There was another study by Voleti A. etal., in 2022 which was similar to the present where the crude extract of *Ricinus communis* leafs in methanol solvent with 300 mg/mL showed highest zone of inhibition against *Staphylococcus aureus* (25±0.2 mm) and was very minimal for *Pseudomonas aeruginosa* (11±0.3 mm). Other gram negative bacteria that were tested with 300 mg/mL had significantly shown the sensitive zones of inhibition. *Escherichia coli* (22±0.2 mm), *Proteus vulgaris* (21±0.2 mm), *Klebsiella pneumoniae* showed (20±0.3 mm). No zone of inhibition was seen in DMSO that was taken as negative control [32].

There was another study performed by Hajrah N et al., where the antibacterial activity of *Ricinus communis L*. against bacterial pathogens *Escherichia coli* and *Klebsiella oxytoca* was evaluated by Transmission Electron Microscopy (TEM) [33]. In their study, they observed that the leaf extract had significant inhibition on the pathogenic bacteria they opted for the study. As the present study was conducted, similarly the leaf extract of Ricinus was evaluated for its antibacterial activity by agar well diffusion method.

In today's scenario, there has been a live again momentum of attention in healing plants as the awareness about the insufficient ability of manufactured pharmaceutical products to control major human ailments and there is a real need to discover new compounds from the medicinal herbs. The therapeutic potential of *Ricinus communis* medicinal plant is boundless in the treatment of infectious diseases and also minimises the adverse effects that are often associated with synthetic antimicrobials. It was evident that these healing plants and their products have been used to heal diarrhoea, dysentery, cough, cold, cholera, fever, bronchitis and in healing of wounds [34].

CONCLUSION:

This research gives a scientific validation to the fact that bioactive components in the plant *Ricinus communis* are extracted substantially in methanol and exhibited highly promising antibacterial inhibitory activity. Therefore, this study supports the antibacterial properties of *Ricinus Communis* leaf extract which can be used to treat various diseases like SSI.

LIMITATION

One of the study's limitations was that the wound swabs from SSIs were not subjected to fungal cultures or anaerobic bacteria profiles. It is possible to carry out further prospective research in this area.

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DECLARATIONS

Conflicts of interest: There is no any conflict of interest associated with this study
Consent to participate: There is consent to participate.
Consent for publication: There is consent for the publication of this paper.
Authors' contributions: Author equally contributed the work**.**

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