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PHYTOCHEMICAL ANALYSIS AND ANTIBACTERIAL EFFICACY OF *RICINUS COMMUNIS* L. AGAINST SELECTED PATHOGENS

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ABSTRACT

The present study was aimed to determine the phytoconstituents and antibacterial efficacy present in the aerial parts of *Ricinus communis* L. Phytochemical analysis of *R. communis* crude extracts was performed by the Harborne method with little modifications. The antibacterial activity of *R. communis* was evaluated against the following pathogens viz., *Escherichia coli, Proteus* sp., *Staphylococcus aureus* and *Pseudomonas aeruginosa* by agar well diffusion method. Phytochemical screening revealed the presence of steroids, phenolic groups, flavonoids, saponins in different extracts of *R. communis*. Petroleum ether extracts of *R. communis* showed antibacterial activity against all the selected four pathogenic bacteria and the maximum zone of inhibition (25 mm) was observed against *P. aeruginosa*. Chloroform and methanolic extracts of *R. communis* showed antibacterial activity against the selected pathogens except *P. aeruginosa*. Acetone extract of *R. communis* exhibited antibacterial activity against the selected pathogens except *E. coli*. Aqueous extract does not show any inhibition against all the selected four pathogens. Thus the present study on phytochemical and antibacterial efficacy of *R. communis* may lead to the discovery of new antimicrobial compounds for treating various infections.

KEYWORDS: *Ricinus communis,* Phytochemical, Antibacterial.

INTRODUCTION

In India, the use of different parts of several medicinal plants to cure specific ailments has been in vogue from ancient times [1]. India is rich in all three levels of biodiversity, as species diversity, genetic diversity and habitat diversity [2]. In folk medicine, medicinal herbs and plant products were used in treating a wide spectrum of infections and other diseases [3]. The plants which have been selected for medicinal use over thousands of years constitute the most obvious choice of examining the current search for therapeutically effective antimicrobial compounds [4]. According to World Health Organization (WHO), medicinal plants would be the best source to obtain variety of drugs. About 80% of individuals from developing countries use traditional medicines, which has compounds derived from medicinal plants. However, such plants should be investigated to better understand their properties, safety and efficiency [5]. Approximately 20% of the plants found in the world have been submitted to pharmacological or biological test, and a substantial number of new antibiotics introduced on the market are obtained from natural or semi-synthetic resources [6]. Today, there is a renewed interest in traditional medicine and an increasing demand for more drugs from plant sources. This revival of interest in plant-derived drugs is mainly due to the current widespread belief that "green medicine" is safe and more dependable than the costly synthetic drugs, many of which have adverse side effects [7].

The action of medicinal plants on microorganisms have been found to be due to the presence of certain substances such as alkaloids, glycosides, tannins, steroids, saponins, tannins, flavonoids and a host of other chemical compounds referred to as secondary metabolites that are present in them [8]. Before an antimicrobial agent is accepted for use in human beings it must demonstrate the following properties, selective toxicity, it should be bactericidal rather than bacteriostatic; it should be effective against a broad range of bacteria. It should not be allergic, it should remain active in plasma, body fluids etc., it should be stable and preferably water soluble; desired levels should be reached rapidly and maintained for adequate period of time; it should not give rise to resistance in bacteria; it should have long shelf life; it should not be expensive [9].

The Euphorbiaceae is the fourth largest family of the angiosperms comprising over 300 genera and about 7500 species. It provides food and varied medicinal properties used in ethanobotany [10,11]. In the traditional system of medicines, these plants are used to treat various microbial diseases such as diarrhoea, dysentery, skin infections and gonorrhea [12]. *Ricinus communis* L. (Euphorbiaceae) is a soft wooden small tree, wide spread throughout tropics and warm temperature regions of the world [13]. In Indian system of medicine, leaf and the seed oil of *Ricinus* have been used for the treatment of the inflammation and liver disorders [14].

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Tan *et al.,* [15] founded three terpenoids and tocopherol-related compounds in the aerial parts of *R. communis*. Compounds named (3E, 7Z, 11E) 19 – hydroxycasba – 3, 7, 11 – trine – 5 – one, 6X –hydroxy – 10β – methoxy - 7α, 8α - epolxy -5- Oxocasbane-20, 10 – olide, 15α - hydroxyl lup -20 (29)-en-3 –one and (2R, 4aR, 8aR) – 3, 4, 4a, 8a-tetrahydro-4a – hydroxyl – 2, 6, 7, 8a – tetramethyl – 1 – (4, 8, 12 – trimethyltridecyl) – 24 – chromene – 5, 8 – dione were isolated from the methanolic extracts *of R. communis* by chromatographic methods. With this knowledge, the present study aims to determine the phytoconstituents present in aerial parts of the economically important plant *R. communis* from Tirunelveli, Tamil Nadu, India. In addition the antibacterial activity of *R. communis* against the selected pathogens were also evaluated.

MATERIALS AND METHODS

Ricinus communis L. was collected from Kalakad, Tirunelveli, Tamil Nadu, India. The aerial parts of *R. communis* were cut into small pieces and shade dried for 15 days at room temperature. The shade dried plant samples were powdered using mechanical homogenizer. 5 g of shade dried powder was extracted (cold extraction) with 30 mL (1:6) of solvents viz., petroleum ether, chloroform, acetone, methanol and aqueous for 72 hrs. After incubation, the slurry was filtered through filter paper (Whatmann No.1) and the filtrate was collected and stored in the refrigerator at 4°C. The phytochemical analysis of *R. communis* crude extracts was performed by the Harborne method [16] with little modifications. The antibacterial activity of *R. communis* was evaluated by agar well diffusion method as followed by Perez *et al*., [17]. The following bacterial strains were used viz., *Escherichia coli, Proteus* sp., *Staphylococcus aureus* and *Pseudomonas aeruginosa.* The test bacterial pathogens were inoculated into the nutrient broth and incubated at 37°C for 18 - 24 hrs. The zone of inhibition against the selected pathogens was determined and recorded. The standard antibiotic pencillin was served as positive control.

RESULTS AND DISCUSSION

Phytochemical screening revealed the presence of steroids, phenolic groups, flavonoids, saponins in different extracts of *R. communis* and the results were illustrated in Table 1. The crude extracts of *R. communis* were tested for antibacterial activity against *E. coli, S. aureus, Proteus* sp., *P. aeruginosa*. The antibacterial activity of *R. communis* crude extracts was represented in Table 2. Petroleum ether extracts of *R. communis* showed antibacterial activity against all the selected four pathogenic bacteria and the maximum zone of inhibition (25 mm) was observed against *P. aeruginosa*. Chloroform and methanolic extracts of *R. communis* showed antibacterial activity against the selected pathogens except *P. aeruginosa*. Highest zone of inhibition (12 mm) was demonstrated in chloroform extract against *Proteus* sp. and methanolic extract illustrated the maximum zone of inhibition (10 mm) against *S. aureus.* Acetone extract of *R. communis* exhibited antibacterial activity against the selected pathogens except *E. coli* and the highest zone of inhibition (10 mm) was observed in *Proteus* sp. Aqueous extract does not show any inhibition

Table 1. Preliminary Phytochemical studies on different extracts of *R. communis*

Secondary metabolites	Solvents				
	Petroleum Ether	Chloroform	Acetone	Methanol	Aqueous
Steroids	+	-	+	-	-
Alkaloids	-	-	-	-	-
Phenolic groups	-	+	+	+	+
Flavones	-	-	+	+	-
Saponins	-	-	+	-	-
Amino acids	-	-	-	-	-
Anthroquinones	-	-	-	-	-

against all the selected four pathogens. Similar to our results, Koduru *et al.,* [18] and Ashafa *et al.,* [19] also failed to observe antibacterial activities in the aqueous extracts of *Solanum aculeastrum* and *Felicia muricata* against most of the bacterial pathogens.

A large number of phytochemicals belonging to several chemical classes have been shown to have inhibitory effects on all types of microorganisms *in vitro* [20]. Plant products have been part of phytomedicines since time immemorial [21]. Medicinal plants contain some organic compounds which provide definite physiological action on the human body and these bioactive substances include tannins, alkaloids, carbohydrates, terpenoids, steroids and flavonoids [22]. Bioactive compounds are synthesized by primary or rather secondary metabolism of living organisms. Secondary metabolites are chemically and taxonomically extremely diverse compounds with obscure function. They are widely used in the human therapy, veterinary, agriculture, scientific research and countless other areas [23]. Flavonoids are hydroxylated phenolic substances known to be synthesized by plants in response to microbial infection and they have been found to have antimicrobial substances against wide array of microorganisms *in vitro*. Their activity is probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell wall [24]. The antibacterial activity of acetone and methanolic extracts of *R. communis* confirmed the Marjorie's observation. Flavonoids are also effective antioxidant compounds which show strong anticancer activities [25,26]. The results of the present study determined the presence of flavonoids in acetone and methanolic extracts of *R. communis*.

Table 2. Antibacterial Activity of different extracts of *R. communis*

Organisms	Zone of Inhibition (mm)				
	Petroleum ether	Chloroform	Methanol	Acetone	Aqueous
E. coli	20	8	8	-	-
Proteus sp.	12	12	8	10	-
S. aureus	21	9	10	5	-
P. aeruginosa	25	-	-	6	-

Steroidal compounds present in *R. communis* extracts are of importance and interest due to their relationship with various anabolic hormones [27]. The results of the present study confirm the steroids presence in petroleum ether and acetone extracts of *R. communis.* Phenolic compounds are one of the largest and most ubiquitous groups of plant metabolites [28]. They possess biological properties such as antiapoptosis, antiaging, anticarcinogen, antiinflammation, antiatherosclerosis, cardiovascular protection and improvement of endothelial function, as well as inhibition of angiogenesis and cell proliferation activities [29]. The results of the present study showed the presence of phenolic groups in chloroform, methanolic, acetone and aqueous extracts of *R. communis*. Saponins were present only in acetone extract of *R. communis.* Thus the present preliminary phytochemical analysis showed that the extracts of *R. communis* containing the bioactive compounds saponins, steroids, phenolic groups and flavonoids may be used in drug development and also to treat various bacterial infections and antiapoptosis, antiaging, anticarcinogen, antiinflammation, antiatherosclerosis, cardiovascular protection and improvement of endothelial function, as well as inhibition of angiogenesis, cell proliferation and anti-cancer activities in the near future.

Ideally, antimicrobial agents disrupt microbial processes or structures that differ from those of the host. They may damage pathogens by hampering cell wall synthesis, inhibiting microbial protein and nucleic acid synthesis, disrupting microbial membrane, structure and function, or blocking metabolic pathways through inhibition of key enzymes [30]. Kalai Selvi *et al*., [31] proved that the alcoholic extract of the *R. communis* leaves possess hepatoprotective activity in rats. Kensa and Yasmin [32] reported that acetone and hexane extract of *R. communis* possess good zone of inhibition where as ethanolic extract showing antibacterial activity only on higher concentration. But in the present study, acetone extract demonstrated average zone of inhibition whereas petroleum extract exhibited maximum zone of inhibition in all the tested bacterial pathogens. In concern to drawbacks of conventional medicine, the use of natural products as an alternate to the conventional treatment in healing and treatment of various diseases has been rise in the last few decades because of low cost and less toxicity. Thus the present study on phytochemical and antibacterial activity of different extracts of *R. communis* may lead to the discovery of new antimicrobial compounds for treating various infections.

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