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The Chickpea Is Anti-Microbial: Review Study

Sanjeev Mittal
RIMT University, Mandi Gobindgarh,
Punjab, India
Email Id- sajeevmittal@rimt.ac.in

ABSTRACT

Antibiotic resistance is serious global problem. Many commercial antibiotics due to over use have induced some microbes to become multi drug resistant. Tetracyclines are important bactericidal agents towards various bacteria. Resistance towards tetracyclines includes factors like intrinsic, adaptive & mutational modes. Thereby many researchers are gravitating towards searching for novel anti-microbial agents from the natural world. In this paper, the resistance towards tetracyclines have been briefly stressed upon along with the evaluation of the anti-microbial role of Chickpea (Cicer arietinum) towards a set of bacteria. Bacteria, Klebseilla & Bacillus subtilis were grown as a lawn culture that was then exposed to varying concentrations of butanolic & aqueous extracts. After 24 hours, the butanolic extract showed higher activity as compared to the aqueous extracts. However, Sumycin showed the highest activity. This result has given hope that novel anti-microbial agents can be isolated from this plant.

Keywords

Anti-microbial resistance, Anti-microbial agents, aqueous extract, butanolic extract, Chickpea (Cicer arietinum), Sumycin

1. INTRODUCTION

Tetracycline antimicrobial agents are famous for their broad spectrum role, over a wide range of microbes. Many “legacy” tetracyclines are still in clinical use regarding treating of infections; unfortunately, the occurrence of tetracycline-resistant manners has reduced their usage. Some of the commonly used tetracyclines namely; Chlortetracycline, Oxytetracycline, Tetracycline, Demethylchlortetracycline, Rolitetracycline, Limecycline, Chlomocycline, Methacycline, Doxycycline, Minocycline, Tigecycline, Omadacycline, Eravacycline as illustrated in (Figure 1) [1-5].

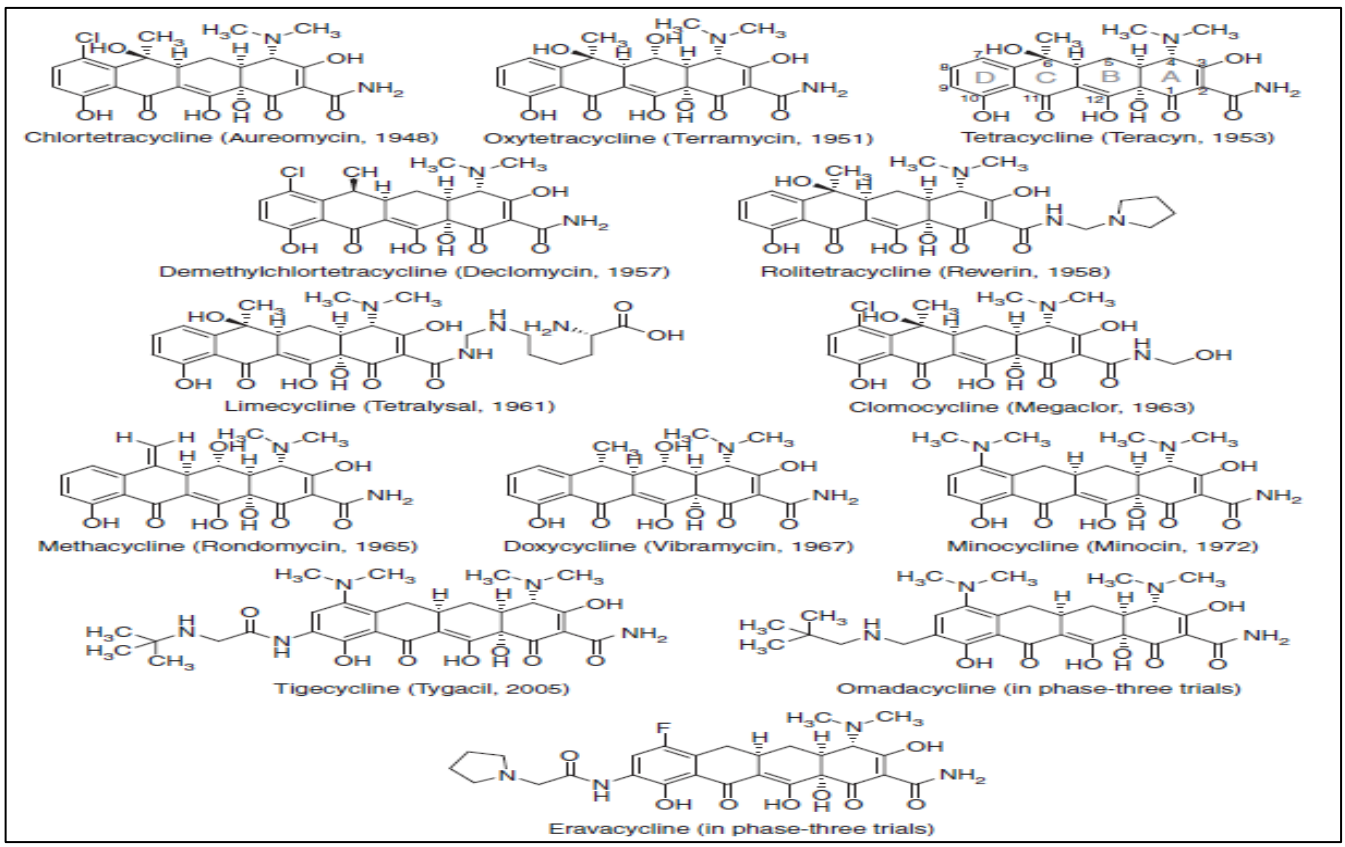

Figure 1: Chemical structures of commonly used tetracyclines and they are named as Chlortetracycline, Oxytetracycline, Tetracycline, Demethylchlortetracycline, Rolitetracycline, Limecycline, Chlomocycline, Methacycline, Doxycycline, Minocycline, Tigecycline, Omadacycline, Eravacycline Figure courtesy [16]

The resistance to tetracyclines occurs by many modes such as by Binding site mutations, tetracycline particular protection of ribosomes, tetracycline particular efflux, enzymatic inactivation of tetracyclines and intrinsic multidrug resistance mechanisms affecting tetracyclines. In Figure 2, a simple representation of the mode of tetracycline resistance has been illustrated while in Table 1, the inherent multi-resistant mode of tetracycline resistance in bacteria has been illustrated [7-10].

1.1. Binding-Site Mutations

As many bacteria have many rRNA copies, tetracycline resistance are generally found in bacteria having low rRNA copy gene numbers. Aberrations in 16S rRNA have been found in certain bacteria, and the role of these aberrations on tetracycline binding can be determined by biophysical information. However, genes coding for ribosomal proteins are one copy and aberrations in these genes can induce resistance towards antibiotics [11-14].

1.2. Tetracycline-particular Protection of Ribosomes

Tetracycline ribosomal protection proteins (RPPs) are GTPases with important sequence and structural similarity to the elongation factors EF-Tu and EF-G. These genes are spread via the bacterial populations via mobile genetic elements, and most of the genes are located in both the Gram-positive and Gram-negative microbes [15].

1.3. Tetracycline-particular Efflux

The latest reports indicates that nearly 30 unique tetracycline-particular efflux pumps found in bacteria. The pumps release tetracycline antibiotics from inside the cells by using a proton [7].

1.4. Enzymatic Inactivation of Tetracyclines

Reports of a tetracycline-changing enzyme manner was first reported as a venture encoded by plasmid found in E. coli. This role was finally determined as a flavin- based monooxygenase, encoded by a family of tet(X) orthologs, capable of covalently dozing all tetracyclines [16].

1.5. Intrinsic multidrug-resistance Mechanisms Affecting Tetracyclines

Complex modulatory pathways in bacteria regulates the uptake and intracellular storing of most antibiotics that includes tetracyclines. Aberrations affecting expression of one or more important repressor, activator etc. can impact the antibiotic classes [17].

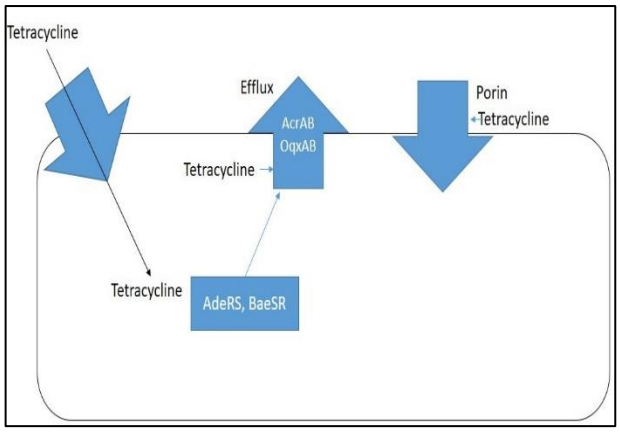

Figure 2: Modulation of bacterial multi-bacterial agent resistance manners regarding tetracyclines. The image shows the various modes of tetracycline resistance [11]

Table 1: Inherent multi-antibiotic efflux roles in bacteria [18]

Pathogen	**Known tetracycline**	**Efflux pump kin**
A.baumanii	AdeABC: tetracycline AdeDE: tetracycline AdeFGH: tetracycline	RND
	AdeIJK: tetracycline	
B.fragilis	BmeABC: tetracycline	RND
E.coli	AcrAB: tetracycline	RND
Enterobacter spp.	AcrAB: tetracycline OqxAB: tigecycline	RND
E.faecalis	AfrAB: doxycyline	ABC
K.pneumonia	AcrAB: tetracycline	RND
P.auruginosa	MexAB-OprM: minocycline MexCD- OprJ: tigecycline MexJK: tetracycline MexXY- OprM: minocycline	RND
P.mirabilis	AcrAB: minocycline	RND
S.aureus	MepA: eravacycline	MATE

2. LITERATURE REVIEW

P. Li et al., in his study discussed about tetracyclines having several features which are regarded suitable for antibiotic medicines, including Gram-positive and negative pathogenic activity, established clinical safety, tolerable tolerance, and intravenously (IV) and orally available formulas for most class members. Like every antibiotic class, antibiotic resistance mechanisms of tetracyclines are class-specific and intrinsic. Since the initial tetracyclines have been detected more than 60 years ago, continuing optimisation of the core fabric generated tetracyclines that can foil several of those resistance mechanisms for clinical use and development [19-25]. New approaches to chemical science have enabled the creation of synthetic derivatives with improved in-vitro power and in-vivo efficiency which have ensured that the full potential of the class for the use of current and emerging MDR pathogens such as carbapenem-resistant Enterobacteriaceae, MDR species

Acinetobacteria and Pseudomonas aeruginosa can be explored [26].

F. Nguyen in his study discussed about two antifungal peptides, cicerin and arietin, from the chickpeas have been reported. The seed and aerial parts of Cicer arietinum (Chickpea) have been reported for their antifungal and antibacterial roles. The antimicrobial role of the hull extracts of the chickpea was active against various types of bacteria. The present study involves determining the anti-microbial property of the leaves of chickpea. Some of the reported activities of chickpea has been elaborated in (Table 2) [27].

Table 2: Important phytochemicals in Chickpea [15]

Compounds	Activity
Extract of Chickpea protein	Antioxidant role
Hydrolysate of Chickpea protein	Antioxidant role
Crude protein extract	Antioxidant role
RGHFA	Antioxidant role
NRYHE	Antioxidant role
Protein hydrolysate	Antioxidant role
Legumine extracts	Antioxidant role
F3E	Antioxidant role
Protein hydrolysates	Antioxidant role
Albumin peptide	Antioxidant role
DHG	Antioxidant role
Fraction of germinated glutelin	Antioxidant role
Methanolic extract	Antioxidant role
Fermented seed Methanolic extract	Antioxidant role
Ethanolic fermented seed extract	Antioxidant role
Isoflavones from Germinated seeds	Antioxidant role
Peptides	ACE inhibition
Ethanol-acetone extract	Colon cancer inhibition
Legumine peptides	ACE inhibition
Chickpea fermented peptides	ACE inhibition
Peptides	Colon cancer inhibition
Protease inhibition	Colon cancer inhibition
Extract of Chickpea	Hypoglycaemic role

3. DISCUSSION

Experiment design: Firstly, leaves of the plant Cicer arietinum would be collected & their extracts would be prepared & bacterial strains would be treated with them for evaluating its anti-microbial roles.

3.1. Collection and preparation of plant material

The plant Cicer arietinum was collected from the local nursery & a voucher specimen was submitted to the institute. The leaves were removed, dried, pulverized into powder & their respective butanolic & aqueous extracts were prepared. These extracts were then suspended in DMSO at room temperature for further use [17].

3.2. Antibacterial efficacy

The antibacterial roles of the extracts were evaluated against Klebsiella & Bacillus subtilis by using the agar well diffusion assay [18].

4. METHODOLOGY

Firstly, Luria agar media was prepared & poured onto the plates. Once the media in the plates got solidified, specific pure bacterial lawn culture was established, following which wells were punched into it via a 1mililiter sterile tip. Nearly 50 microliters of each solvent extract (0, 1, 2.5, 5, 7.5 & 10 µg/ml) was separately poured into each well. Blank well having DMSO (0, 1, 2.5, 5, 7.5 & 10 µl) was noted as negative control & wells having Sumycin (0, 1, 2.5, 5, 7.5 & 10 µg/ml) as positive control. Following incubation for 24 hours & at 37°Centrigrade, inhibition was observed by the measurement of the zone of inhibition's diameter. The experiments were repeated thrice.

The anti-bacterial role of the root extracts of the plant Cicer arietinum was evaluated on 2 bacterial species. The root extract of the butanolic extract (10 µg/ml) was found to be highly active against Klebsiella & Bacillus subtilis as compared to the aqueous extract (10 µg/ml) towards the same bacterial species. The DMSO had minimal efficacy towards all the 2 bacterial species studied. The known antibiotic, Sumycin (10 µg/ml) however showed excellent activity against all 2 bacterial species (Figure 3) (Table 3). The results indicate that this plant can be researched further for its anti-bacterial role [16].

Table 3: Anti-bacterial role of the roots of Cicer arietinum towards the bacterial species by the agar well assay. The root extract of the butanol (10 µg/ml) was found to be highly active against Klebsiella & Bacillus subtilis as compared to the aqueous extract (10 µg/ml) towards the same bacterial species [11]

Bacterial species	**Zone of inhibition (mm)**			
	DMSO	**Aqueous extract**	**Butanolic extract**	**Sumycin**
Klesiella	3	6	10	18
Bacillus subtilis	4	7	13	20

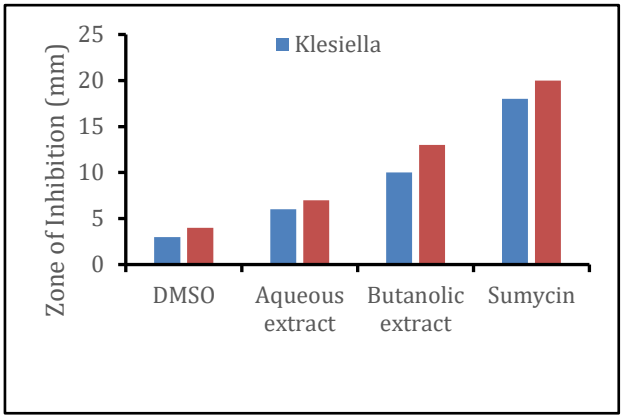

Figure 3: Graphical representation of the zone of inhibition induced in both Klebsiella & Bacillus subtilis. The positive (+) control, Sumycin induced highest zone of inhibition for both the bacterial species, whereas among the extracts, the Butanolic extract showed higher inhibition as compared to the Aqueous extract while the negative (-) control showed the least inhibition[16]

5. CONCLUSION

Antibiotic resistance is serious global problem. Many commercial antibiotics due to over use have induced some microbes to become multi drug resistant. Sumycin is important bactericidal agents towards various types of bacteria. Resistance towards Sumycin includes factors like intrinsic, adaptive & mutational modes. Thereby many researchers are gravitating towards searching for novel anti-microbial agents from the natural world. In this paper, the resistance towards tetracycline have been briefly stressed upon along with the evaluation of the anti-microbial role of Cicer arietinum towards a set of bacteria.

Firstly, roots of Cicer arietinum were collected, washed, dried and Butanolic extracts & aqueous extracts were prepared. The extracts were suspended in Dimethyl sulfoxide (DMSO) and stored at room temperature. Next, bacterial species like, Klebsiella & Bacillus subtilis were grown as a lawn culture who were then exposed to varying concentrations of butanolic & aqueous extracts. After 24 hour, the butanolic extract showed higher activity as compared to the aqueous extracts. However, Sumycin showed the highest activity. This result has given hope that novel anti-microbial agents can be isolated from this plant.

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