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Effects Of Nanoparticles On *Escherichia Coli* Causing Diarrhea In Ruminants

A thesis Presented

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Contents

No.	Title	Page
	Content.....	i
	List of Tables.....	iii
	List of figures.....	iv
	List of abbreviations	vi
1.	Introduction.....	1
2.	Review of literature.....	6
2.1.	Incidence of <i>Escherichia coli</i> in diarrheic ruminants.	6
2.2.	Serotyping of <i>Escherichia coli</i> .	8
2.3.	Antimicrobial sensitivity testing of <i>E.coli</i> .	10
2.4.	What are nanoparticles?	12
2.5.	Classification of nanoparticles.	13
2.6.	Synthesis of nanoparticles.	14
2.7.	Application of nanoparticles.	16
2.8.	Antibacterial effect of metal-based nanoparticles.	18
2.8.1.	Antibacterial activity of ZNO nanoparticles.	20
2.8.2.	Antibacterial activity of Tio ₂ nanoparticles.	22
2.8.3.	Antibacterial activity of silver doped-nanoparticles.	23
2.9.	Mechanisms of antibacterial activity of nanoparticles	24
3.	Material and Methods.....	28
3.1	Materials.....	28
3.1.1.	Samples for bacterial isolation.	28
3.1.2	Media used.	28
3.1.2.7.	Reagents and solution	31
3.1.2.7.1	Stains	31
3.1.3.	Materials used for serotyping of <i>E.coli</i> isolates	33
3.1.4.	Equipments used for isolation and identification.	34
3.15.	Materials used for antibiotic sensitivity test .	34
3.1.6	Synthesis of TiO ₂ , ZnO, Ag-doped TiO ₂ and Ag-	36
3.1.7.	Apparatus and Instruments	36
3.1.8.	Materials used for MIC determination .	37

3.2	Methods.....	39
3.2.1.	Sample collection	39
3.2.2	Bacteriological examination of the samples	39
3.2.3.	In vitro virulence assay of suspected <i>E.coli</i> isolates	42
3.2.4.	Antimicrobial susceptibility testing of isolated <i>E.coli</i>	44
3.2.5.	Serological identification of <i>E.coli</i> isolates	45
3.2.6.	Synthesis of TiO ₂ , ZnO, Ag-doped TiO ₂ and Ag-	46
3.2.7	Characterization of ZnO nanoparticles	47
3.2.8.	Antibacterial Activity Test of the prepared ZnO ,TiO ₂	48
3.2.9.	Determination of the MIC.	48
3.2.10.	Transmission electron microscope	49
4.	Results.....	51
4.1.	Incidence of <i>E. coli</i> in diarrheic cases of calves,	51
4.2.	Identification of <i>E.coli</i> Isolates	51
4.2.3.	Biochemical identification of <i>E.coli</i> isolates	53
4.3.	Antibiotic sensetivity of 48 <i>E. coli</i> isolates	54
4.4.	Serotyping of MDR pathogenic <i>E. coli</i> isolates	55
4.5.	Nano Material Characterization	55
4.6.	Antibacterial activity of TiO ₂ , ZnO, Ag-doped TiO ₂ and Ag-doped ZnO Nanoparticles:	59
4.7	MIC Of Tio2, Zno, Ag-Doped TiO ₂ and Ag-Doped Zno nanoparticles On <i>E.coli</i> Strains:	61
4.8	Transmission Electron Microscope	63
5.	Discussion.....	65
6.	Conclusion.....	73
7.	Summary.....	75
8.	Referance.....	78
9.	Arabic Summary.....	1

List of Tables

TableNo.	Title	Page
1	Antisera used in serological identification of <i>E. coli</i>	33
2	The antibiotic disks used in vitro sensitivity test for the isolated <i>E. coli</i> strains.	34
3	Biochemical identification of <i>Escherichia coli</i>	42
4	Zone of inhibition of the antibiotics used in vitro sensitivity test for the isolated <i>E. coli</i> strains	45
5	Prevalence of <i>E. coli</i> isolated from fecal sample of diarrheic cases.	51
6	Biochemical reaction of <i>E. coli</i> isolates	53
7	Antibiotic sensitivity for the 48 pathogenic <i>E. coli</i> isolates by disc diffusion method	55
8	Serotyping of MDR pathogenic <i>E. coli</i> isolates	55
9	Antibacterial Activity Of ZnO, TiO ₂ , ZnO Doped Ag and Ag-Doped TiO ₂ NPS Against Isolated <i>E. coli</i> Strains.	60
10	MIC of TiO ₂ , ZnO, Ag-doped TiO ₂ and Ag-doped ZnO NPS on <i>E.coli</i> strains	61

List of Figures

No. of figures	Title	Page
1	<i>E. coli</i> on Mac Conkony agar.	52
2	<i>E. coli</i> on EMB media .	52
3	<i>E. coli</i> On Congo red agar.	53
4	<i>E. coli</i> On blood agar.	53
5	Indol test for <i>E. coli</i> .	54
6	TSI test for <i>E.coli</i> .	54
7	XRD pattern ZnO Nps.	56
8	XRD pattern TiO ₂ Nps.	56
9	XRD pattern Ag-doped ZnO Nps.	57
10	XRD pattern Ag- doped TiO ₂ Nps .	57
11	TEM analysis of ZnO Nps.	58
12	TEM analysis of TiO ₂ Nps.	58
13	TEM analysis of Ag doped Zno Nps.	58
14	TEM analysis of Ag- doped TiO ₂ Nps.	59
15	Antibacterial activity of Ag-Doped Zno nanoparticles mg /ml on <i>E. coli</i> .	60
16	Antibacterial activity of Ag-Doped Tio ₂ nanoparticles mg/ml on <i>E. coli</i> .	60
17	MIC of ZnO Nps .	61
18	MIC of Ag-doped ZnO Nps.	62
19	MIC of TiO ₂ Nps.	62
20	MIC of MIC of Ag-doped TiO ₂ Nps.	62
21	TEM analyses of the morphological change of bacterial cells induced by the treatment of <i>E. coli</i> strains by synthesized NPS.	63

Contents

No.	Title	Page
	Content.....	i
	List of Tables.....	iii
	List of figures.....	iv
	List of abbreviations	vi
1.	Introduction.....	1
2.	Review of literature.....	6
2.1.	Incidence of <i>Escherichia coli</i> in diarrheic ruminants.	6
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2.3.	Antimicrobial sensitivity testing of <i>E.coli</i> .	10
2.4.	What are nanoparticles?	12
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2.6.	Synthesis of nanoparticles.	14
2.7.	Application of nanoparticles.	16
2.8.	Antibacterial effect of metal-based nanoparticles.	18
2.8.1.	Antibacterial activity of ZNO nanoparticles.	20
2.8.2.	Antibacterial activity of Tio ₂ nanoparticles.	22
2.8.3.	Antibacterial activity of silver doped-nanoparticles.	23
2.9.	Mechanisms of antibacterial activity of nanoparticles	24
3.	Material and Methods.....	28
3.1	Materials.....	28
3.1.1.	Samples for bacterial isolation.	28
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3.15.	Materials used for antibiotic sensitivity test .	34
3.1.6	Synthesis of TiO ₂ , ZnO, Ag-doped TiO ₂ and Ag-	36
3.1.7.	Apparatus and Instruments	36
3.1.8.	Materials used for MIC determination .	37

3.2	Methods.....	39
3.2.1.	Sample collection	39
3.2.2	Bacteriological examination of the samples	39
3.2.3.	In vitro virulence assay of suspected <i>E.coli</i> isolates	42
3.2.4.	Antimicrobial susceptibility testing of isolated <i>E.coli</i>	44
3.2.5.	Serological identification of <i>E.coli</i> isolates	45
3.2.6.	Synthesis of TiO ₂ , ZnO, Ag-doped TiO ₂ and Ag-	46
3.2.7	Characterization of ZnO nanoparticles	47
3.2.8.	Antibacterial Activity Test of the prepared ZnO ,TiO ₂	48
3.2.9.	Determination of the MIC.	48
3.2.10.	Transmission electron microscope	49
4.	Results.....	51
4.1.	Incidence of <i>E. coli</i> in diarrheic cases of calves,	51
4.2.	Identification of <i>E.coli</i> Isolates	51
4.2.3.	Biochemical identification of <i>E.coli</i> isolates	53
4.3.	Antibiotic sensetivity of 48 <i>E. coli</i> isolates	54
4.4.	Serotyping of MDR pathogenic <i>E. coli</i> isolates	55
4.5.	Nano Material Characterization	55
4.6.	Antibacterial activity of TiO ₂ , ZnO, Ag-doped TiO ₂ and Ag-doped ZnO Nanoparticles:	59
4.7	MIC Of Tio2, Zno, Ag-Doped TiO ₂ and Ag-Doped Zno nanoparticles On <i>E.coli</i> Strains:	61
4.8	Transmission Electron Microscope	63
5.	Discussion.....	65
6.	Conclusion.....	73
7.	Summary.....	75
8.	Referance.....	78
9.	Arabic Summary.....	1

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5	Prevalence of <i>E. coli</i> isolated from fecal sample of diarrheic cases.	51
6	Biochemical reaction of <i>E. coli</i> isolates	53
7	Antibiotic sensitivity for the 48 pathogenic <i>E. coli</i> isolates by disc diffusion method	55
8	Serotyping of MDR pathogenic <i>E. coli</i> isolates	55
9	Antibacterial Activity Of ZnO, TiO ₂ , ZnO Doped Ag and Ag-Doped TiO ₂ NPS Against Isolated <i>E. coli</i> Strains.	60
10	MIC of TiO ₂ , ZnO, Ag-doped TiO ₂ and Ag-doped ZnO NPS on <i>E.coli</i> strains	61

List of Figures

No. of figures	Title	Page
1	<i>E. coli</i> on Mac Conkony agar.	52
2	<i>E. coli</i> on EMB media .	52
3	<i>E. coli</i> On Congo red agar.	53
4	<i>E. coli</i> On blood agar.	53
5	Indol test for <i>E. coli</i> .	54
6	TSI test for <i>E.coli</i> .	54
7	XRD pattern ZnO Nps.	56
8	XRD pattern TiO ₂ Nps.	56
9	XRD pattern Ag-doped ZnO Nps.	57
10	XRD pattern Ag- doped TiO ₂ Nps .	57
11	TEM analysis of ZnO Nps.	58
12	TEM analysis of TiO ₂ Nps.	58
13	TEM analysis of Ag doped Zno Nps.	58
14	TEM analysis of Ag- doped TiO ₂ Nps.	59
15	Antibacterial activity of Ag-Doped Zno nanoparticles mg /ml on <i>E. coli</i> .	60
16	Antibacterial activity of Ag-Doped Tio ₂ nanoparticles mg/ml on <i>E. coli</i> .	60
17	MIC of ZnO Nps .	61
18	MIC of Ag-doped ZnO Nps.	62
19	MIC of TiO ₂ Nps.	62
20	MIC of MIC of Ag-doped TiO ₂ Nps.	62
21	TEM analyses of the morphological change of bacterial cells induced by the treatment of <i>E. coli</i> strains by synthesized NPS.	63

7- Summary

Emerging infectious diseases and the increase in incidence of drug resistance among pathogenic bacteria have made the search for new antimicrobials inevitable. In the current situation, one of the most promising and novel therapeutic agents are the nanoparticles. The unique physiochemical properties of the nanoparticles combined with the growth inhibitory capacity against microbes has led to the upsurge in the research on nanoparticles and their potential application as antimicrobials.

Among the various metal oxides studied for their antibacterial activity, titanium dioxide and zinc oxide nanoparticles have been found to be highly toxic. Moreover, their stability under harsh processing conditions and relatively low toxicity combined with the potent antimicrobial properties favors their application as antimicrobials. Many studies have shown that some NPs made of metal oxides, such as ZnO NPs, have selective toxicity to bacteria and only exhibit minimal effect on human cells, which recommend their prospective uses in agricultural and food industries.

Therefore, this study was designed to throw spot lights upon the effect of these NPs on pathogenic multiple drug resistant *E. coli* causing diarrhea.

1. In this study, *E. coli* was isolated from 150 fecal samples collected randomly from diarrheic calves (n=35), lambs (n=35) and goat kids (n=80) up to 3months from Gimmeza animal production researches station farm. Agriculture Research Centre (ARC).and the result were summarized as following:
2. Eighty two *E. coli* isolates were isolated from 150 fecal samples with incidence (54.6%=82/150).,as follow the number of *E. coli* isolates from calves was 28 with an incidence 80%, from goat kids was 39

- with an incidence 48.7% and from lambs was 15 with an incidence 42.8 %.
3. The number of pathogenic *E. coli* was 48 with an incidence 58.5 % and 41.5% nonpathogenic ones.
 4. Out of 48 pathogenic *E. coli* isolates 85% were resistant to Oxytetracycline (OT) followed by Ampicillin (AMP) 83%, Chloramphenicol (CHL) 60% and cefotaxime (CTX) 20% but no resistance to Amoxicillin+clavulinic acid(AMC), Ciprofloxacin(CIP), Gentamicin (GN) and Erythromycin (ER). Among those *E. coli* isolates, 10 isolates were found to be multi-drug resistant to 3 or more antibiotic groups.
 5. Serogrouping of the 10 MDR *E. coli* isolates revealed that the serogroups were *E. coli* O₁₅₇:H₇ (4/10) isolated from calves (n=2) and goat kids (n=2), and *E. coli* O₁₂₅ three (3/10) isolated from calves (n=2) and lambs (n=1) and three O₄₄ (3/10) isolated from goat kids (n=2) and sheep (n=1).
 6. ZnO, TiO₂, Ag-TiO₂ and Ag-ZnO were prepared via the sol-gel method.
 7. The synthesized NPs were characterized using XRD and TEM. XRD pattern of the prepared ZnO and Ag-doped ZnO powder revealed the hexagonal wurtzite phase With size equal to 26 nm and 19 nm respectively, But TiO₂ has anatase phase with size equal 32nm and Ag-doped TiO₂ has both rutile and anatase phases with size equal 15nm
 8. TEM analysis showing the particles are scattered in the case of ZnO and Ag-doped ZnO nanoparticles (Ag NPs<10 nm), ZnO nanoparticles (15–50 nm) and showed the particles are irregular in

shape, agglomerated in the case of TiO₂ whereas they are scattered in the case of Ag-doped TiO₂ Nps, particles size about (25–60 nm).

9. The antibacterial results showed that the low antibacterial activities of pure TiO₂ and ZnO were significantly improved by the incorporation of silver.
10. Ag-doped TiO₂ treatments showed the most significant antibacterial activities against *E. coli* followed by Ag-doped ZnO then TiO₂, while ZnO have the lowest antibacterial activity.
11. The synthesized NPs found to be effective against all *E. coli* strains with MIC of ZnO occurred at (31,25 µg/ml) for *O*_{157H7}, while MIC of TiO₂ occurred at (15,6 µg/ml) for *O*₄₄, MIC of Ag-doped ZnO occurred at (7,8 µg/ml) for and MIC of Ag-doped TiO₂ showed at 3,9 µg/ml for (ATCC25922).
12. TEM analyses was used to assess the morphological change of bacterial cells induced by the treatment of ZnO, TiO₂, Ag doped ZnO, Ag doped TiO₂ NPS .The leakage of intracellular contents and membrane disorganization were observed in bacterial cells treated with mentioned NPs.