



EVALUATION OF *In-Vitro* ANTI-BACTERIAL QUALITIES OF CAMEL'S URINE IN SOMALI REGION OF ETHIOPIA AGAINST SELECTED BACTERIAL PATHOGENS

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ABSTRACT

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Camel urine is believed to contain therapeutic and anti-bacterial factors. Until recently, there is no relevant study done to assess the antibacterial qualities of camel's urine in Somali regional state, Ethiopia. The aim of this study was to evaluate the anti-bacterial activity of camel urine against some selected bacterial in the region. A laboratory based experimental research was conducted in Jigjiga University, Ethiopia. 13 samples of camel's urine were collected in the Morning during April, 2020, of which 7(56.8%) were female camels and 6(43.2%) were male camels and the anti-bacterial potency of camel urine against some pathogenic bacterial including *Klebsella Pneumonia*, *Citrobacter*, *Escherichia Coli*, and *Staphylococcus aureus* were tested. Then, Minimum inhibitory concentrations and Minimum bactericidal concentrations values were figured out accordingly. Data were analyzed SPSS Version 23. Mean inhibition zone of *Klebsella Pneumonia* (18.631 \pm 1.39) *Citrobacter* (16.83 \pm 1.39) *Escherichia Coli* (14.73 \pm 1.39), and *Staphylococcus aureus* (10.66 \pm 1.39) were founded in the study and mean minimum inhibitory concentration of *Klebsella Pneumonia* (12.02%), *Citrobacter* (8.2%), *Escherichia Coli* (12.5%), and *Staphylococcus aureus* (10.6%) and also the result indicated a mean minimum bactericidal concentration of *Klebsella Pneumonia* (9.6%), *Citrobacter* (9.1%), *Escherichia Coli* (9, 6%), and *Staphylococcus aureus* (10.1%). The result showed potential antibacterial effects of camel (*Camelus dromedarius*) urine against bacterial strains tested on. Therefore, camel urine could be used as an ingredient that can be produced antibiotics to prevail against any of the illnesses caused by the bacterial species tested on it.

Contribution/Originality: The study contributes to the existing literature fill the geographical research gap of camel's urine anti-bacterial quality and also global community a new agent that can be used to mitigate the diseases that is caused by bacterial pathogen.

1. INTRODUCTION

Camels (*Camelus*) are mammals characterized to have long legs, a big-lipped snout and a hump in their back, two categories of camels exist: one-humped Arabian camels or dromedaries (*Camelus dromedarius*) – the camels of the plains; and two-humped Bactrian camels (*Camelus bactrianus*) – the camels of the mountains (FAO, 2020). Camels' humps are known to consist of stored fat, which they can metabolize when food and water are scarce, (Bradford, 2017).

Camels are the most populous species of animals in the arid regions of Africa and Asia, especially East Africa. Single humped camels (*Camelus Dromedarius*), are very vital livestock that can adapt to the hot and arid habitats more than any other domestic animal (Schwartz & Dioli, 1992). According to FAO (2004) there are 19 million camel species in the globe, of these 15million are available in Africa and 4million in Asia and among the camel world population, 17 million are known to be Single-humped camel (*Camelus Dromedarius*) and the remaining 2 million are Double-humped camels (*Camelus bactarianus*).

Camels (*Camelus Dromedarius*) are multi-purpose animals mostly used for meat, milk and some places utilized as means of transportation (Abdurahman, 2005). Studies on the camels was exaggerated since the late seventies as it has been found to bear more competently the draught of that period compared to any other animal species. Prominence on research was bound for disease prevention and replication (Sumia, 2016).

Urine is excreted in mammals through the kidneys. It is crystal clear, hygienic and slight yellowish in character. It constitute of urea, amino acids, creatinine, organic acids, ammonia, toxins and inorganic salts. The ingredients of urine are water soluble so they are simply excreted.

Urotherapy is categorized in the type of alternative medicine, is commonly practiced in some parts of the world, and is especially significant in countries such as India and China where alternative medicine is greatly used (Al-Abdalall, 2010; Alhaidar, Abdel Gader, & Mousa, 2011). Yet, it is not constrained to these nations, and practitioners also available in the United States, United Kingdom and other European countries (Gader & Alhaider, 2016).

Camel's urine is a physiological catabolic liquid; it has been utilized conventionally in the management of many illnesses in Arabic countries (Alhaidar et al., 2011). Camel urine are also used for medical intentions in some countries, ancient Arabs cooked camel urine and drank it to cure some inner ailments such as fasciolosis and for dealing with illnesses in broad, principally hepatitis, liver inflammation, abscesses (Muna, Abdalla, & Hadya, 2008).

in excess of current years, novel areas of study has been done in the prospective function of camel products such as milk and by-products such as urine in the handling of human being ailments and camel immunoglobulin antibodies have also exposed excellent latent for the managing and handling of illnesses for instance cancer as well as their relevance in the identification and manufacturing of chemotherapy to resistant pathogens (Kula, 2016).

Single-humped camels are significant for the arid and warm desert ecology and the function of camels in daily life is cherished by the community living in the deserts of Asia and Africa, and they apply these animals for transportation and as a foodstuff source, in these environments, camel's milk and urine are utilized for the healing of different diseases, including cancer, ulcers, skin problems, chronic hepatitis, hepatitis C, stomach infections, a weakened immune system, infectious diseases and certain cardiovascular conditions (Gader & Alhaider, 2016; Kula & Tegegne, 2016; Yadav, Kumar, Priyadarshini, & Singh, 2015).

Ancient Arabs used to cook camel urine and consume it to alleviate some interior disease tribulations such as fasciolosis and for managing of diseases in common, mostly hepatitis, liver malfunction and abscesses (Muna et al., 2008).

1.1. Statement of the Problem

Recent years, the raise in microbial pathogens formed larger difficulty for anti-bacterial therapy (WHO, 2020). Accurate natural drugs are recognized as one of the fundamental basics of primary healthcare. These products tender a very precious supply of effective compounds with a wide range of biological properties and fresh substance structures, many of which might be central for novel drug development (Vuorela et al., 2004). Among these natural healing products, camel urine is believed to contain therapeutic and anti-bacterial factors. Camel products and byproducts are important sources of many natural agents used for various medical applications. Since a long time ago, camel's milk and urine were recognized as valuable therapeutic products and has been accessed conventionally in the healing of several illnesses in different nations (O'haj, 1993).

For centuries, people in Arab and most important camel-keeping communities in Ethiopia include Afar, Somali, Oromo (Karayu, Gabra, Boran and Guji groups), Kunama and Irob peoples, among others. The Afar and the Somali peoples are well-known for their camel-keeping customs for centuries; the Boran and Guji pastoralists, started camel herding lately. Gabra and Somali, who have been keeping camels for centuries, are thought to play active roles in introducing camels to the Borana Plateau (Coppock, 1994) had an indigenous belief which states that camels urine and milk have medicinal qualities against some of the world's most dangerous diseases including cancer, bacterial, fungal as well as cardiovascular disease (Mirkena et al., 2018). However, this indigenous believe that camel urine can curie bacterial and others diseases is not scientific based and there is a demand to prove scientifically whether camel's urine has medicinal ability against bacterial pathogens.

Even though camel urine has outstanding curative agents, scientific studies in the area still stay at a young stage. The important gap is apparent in regards to sophisticated research emphasized towards identifying and manipulating appropriate nanomaterial. On the other hand, multi-functional proteins, lipids, and inorganic compounds of camel's products and by-products are capable of carrying both remedial and investigative agents are now being explored for more effective therapeutic product from camel urine (Alebie, Yohannes, & Worku, 2017).

On the other hand, scientist and research communities in the Arabian world had conducted several research studies to characterize the anti-bacterial, anti-cancer, and anti-cardiovascular effects of camel's urine in the middle-east. However, there is no single laboratory-based research carried out to characterize the anti-bacterial property of camel urine in the Somali regional state of Ethiopia so far. Therefore, this geographical research gap has necessitate the present study which is expected to bridge the existing gap of the region particularly and the country at large.

1.2. Objectives of the Study

1.2.1. General Objective

- To evaluate the *in vitro* anti-bacterial qualities of camel's urine in Somali regional state against selected bacterial pathogens.

1.2.2. Specific Objectives

- To investigate the *in vitro* anti-bacterial susceptibility of camel urine in Somali regional state against bacterial pathogens.
- Determination of the minimum inhibitory concentration (MIC) of camel's urine in Somali regional state against tested bacterial pathogens.
- To determine minimum bactericidal concentration (MBC) of camel's urine in Somali regional state against tested bacterial pathogens.

1.3. Significance of the Study

This study contributes to evaluate the anti-bacterial activity that can be obtained from camel urine and the bacterial species that are sensitive to camel urine to cure the diseases and illnesses they cause. The present study also contributes to the existing literature the medical importance of camel urine and also convinces international and national organizations that camel urine needs consideration and awareness. The study is expected to increase the scientific knowledge of camel urine and boost the focus of the researcher on this particular anti-bacterial agent. Moreover, it shall also contribute to global community at large new agent that can be produced anti-bacterial bills, tablets or drugs.

2. MATERIALS AND METHODS

2.1. Study Area

The study was done in Somali regional state, Ethiopia.

2.2. Study Design

In-vitro experimental study of antibacterial activity.

2.3. Study Populations

The study populations were camels living in Somali regional state of Ethiopia.

2.4. Study Period

The study was taken place during January 2020 to May 2020.

2.5. Inclusion and Exclusion Criteria

All type of healthy camels from Somali region were included in the present study regardless of age, breed and sex. Those camels that have some illness or started or recently taking antibiotics during and before sample collection, respectively, were excluded from the study

2.6. Collection of Samples

13 samples of camel's urine (*Camelus dromedarius*) were collected in the morning during April, 2020 from Somali regional state (Jigjiga livestock market) from healthy males and females. These samples were collected aseptically by taking Twisting J method (a method that involves lifting the tail of the camel up while collecting the urine of the camel). Five ml's of urine were transferred aseptically into sterile bijoux's bottles.

2.6.1 Sample Transportation

All the urine samples were labeled legibly with permanent marker identifying the gender and age of the camel urinated and status of the camel if it's female. The samples were kept in icebox containing ice packs and immediately were transported to the microbiology laboratory and were processed upon arrival.

2.7. Laboratory Procedure

2.7.1. Test Organism

Clinical isolates of bacterial pathogen which include *Escherichia Coli*, *staphylococcus aureus*, *citrobacter* and *Klebsella Pneumonia* were collected from laboratory of University of Gondar comprehensive and specialized hospital. The microorganism were transported to Jigjiga University, Veterinary microbiology laboratory by using nutrient broth and preserved at 4°C for further use. The obtained bacteria suspensions were arranged by adding 0.5 McFarland standard. 0.5McFarland standard were prepared by adding 0.5ml of 1.175%w/v barium chloride anhydrate ($\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$) solution to 99.5ml of 1%v/v sulfuric acid (H_2SO_4) with constant stirring to maintain a suspension.

2.8. Standard Antibiotics

Gentamycin discs were used as a control (Olila & Opuda-Asibo, 2001).

2.9. Antibacterial Sensitivity Test of Camel Urine

Antibacterial Sensitivity of camel's urine against bacterial pathogens were tested on Mueller Hinton agar medium. These species were *Escherichia Coli*, *staphylococcus aureus*, *citrobacter* and *Klebsella Pneumonia*. Following the procedure of Buxton and Fraser (1977) discs of 6mm diameter form sheet of thick filter paper (whatman No1) were punched out using paper drill, sterilized hot air oven at 160°C for 30 min then impregnated in the tests camel urine samples. Bacterial species were cultured in normal saline then diluted to a density visually equivalent to 0.5 MacFarlane that were prepared by adding 0.5 ml of percent BaCl_2 to 99.5 of I percent H_2SO_4 approximately (Kirby, Bennett, Brodie, & Benner, 1966). The discs of Mueller Hinton Agar were dried out in incubator for 30 min; drops

of diluted culture of the tested organisms floated on the medium and distributed all over the plate, to ensure good growth discs were dried for 5 min. Using forceps, discs were gently pressed down to ensure better contact with the agar. The plates were incubated at 37°C for 48 hours. The zones of inhibition were measured as a diameter from the edge to edge of the clear area using ruler. The anti-bacterial activity were evaluated by measuring the zone of inhibition (Sumia, 2016).

2.10. Determination of Minimum Inhibitory Concentration (MIC)

The minimum inhibitory concentration (MIC) were figured out by the broth two fold serial dilution technique on tested microorganism (Andrews, 2001). During the determination of MIC, four sterile test tubes screw capped were prepared and labeled with the percentage of its concentration. The first test tube were added 1ml of camel urine and labeled 100%, 1ml of the camel urine from the first test tube were diluted with 1ml of distilled water and added to the second test tube and 1ml and labeled to 50 %, another 1ml from the second test-tube were transferred to the test tube and 1ml of water were added and then shake and labeled to 25% concentration. And then the 1ml of the third test-tube will diluted with 1ml of water and labeled 12.5% concentration. Finally the 1ml of the fourth test-tube will diluted with 1ml of water and labeled 6.25% concentration. 1ml of each test tube was transferred to the match place in the plate, and incubated. After incubation, the discs fold with least concentration of camel urine showing no growth was recorded as the MIC value for the respective micro-organism.

2.11. Determination of Minimum Bactericidal Concentration (MBC)

The minimum bactericidal concentration (MBC) is the least concentration of an antibacterial agent required to kill a particular bacterium. It was determined from broth dilution minimum inhibitory concentration (MIC) tests by sub culturing to agar discs that do not contain the test agent. The MBC is identified by determining the lowest concentration of antibacterial agent that reduces the viability of the initial bacterial inoculum by $\geq 99.9\%$. Streak discs were taken from the lowest concentrations of camel urine discs exhibiting visible inhibition zones of MIC discs and subcultures on sterile. The discs were incubated at 37°C for 24hours then examined the bacterial growth in corresponding to camel urine concentration. MBC was taken as the concentration camel urine that didn't exhibit any bacterial growth on the freshly incubated agar discs.

2.12. Data Quality Control

To ensure the quality of the data, all the processes were monitored and evaluated, also all the equipment's, reagent and chemicals were utilized aseptically.

2.13. Benefits and Beneficiaries of the Study

Scientific community, research institutes, the pharmaceutical companies, public, agricultural and human policy makers, and individuals making research on camel will be benefited from the study either directly or indirectly.

2.14. Data Management and Analysis

The data were summarized in Microsoft Excel 2010 spread sheet and transferred to SPSS version 23 for statistical analysis. All the experiments were performed in triplicate and different data were analyzed and compared statistically using ANOVA at 95% level of confidence. Value at $p \leq 0.05$ is considered statistically significant.

3. RESULTS

In the current study, the antibacterial activities of camel's urine in Somali regional state against some selected bacterial pathogenic species were tested. Clinical isolates of bacterial pathogenic species such as *Escherichia Coli*,

Staphylococcus aureus, *Citrobacter*, and *Klebsella Pneumonia* from laboratory of University of Gondar comprehensive and specialized hospital were tested for their sensitivity against camel urine.

3.1. Gender Ratio of the Camel Urine

Of the 13 camel urine samples tested 6 (46.2%) were males while the other 7 (53.8%) were females [Figure 1](#).

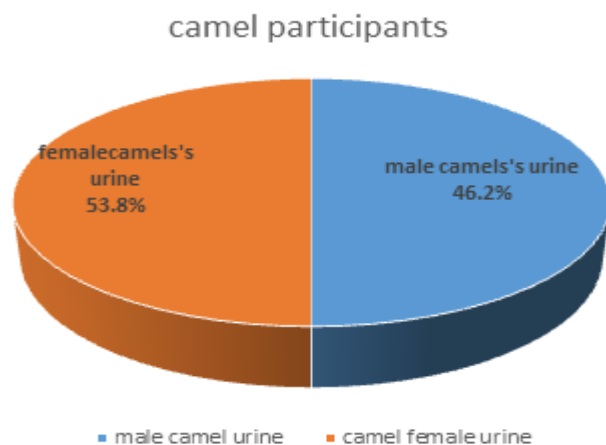


Figure-1. Camel participant's ratios.

3.2. Status of females camels Admitted to the Study

On the status of the female camels admitted to this study, of the 7 female camels that their 14.3 % were lactating, 14.3 % were pregnant, 28.6% were virgins and 57.1 % were having no condition among the mentioned status.

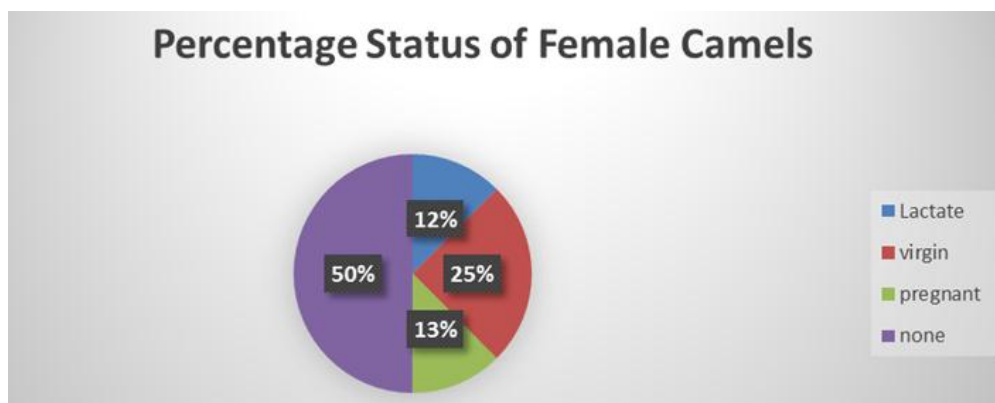


Figure-2. The distribution of female camels based on their Status.

3.3. Antibacterial Activity of Camel Urine

Camel urine has shown great inhibition against the bacterial species tested with mean diameter of inhibition of *Klebsella Pneumonia* (18.631 ± 1.39) *Citrobacter* (16.83 ± 1.39) *Escherichia Coli* (14.73 ± 1.39), and *Staphylococcus aureus* (10.66 ± 1.39) as the following table illustrates [Table 1](#).

Table-1. Diameter of inhibition zone of camel urine against bacterial pathogens (in mm).

Diameter of inhibition zone of camel urine against bacterial pathogens in mm

Bacterial Species	Mean Inhibition Zone ±Standard Error	Lowest Diameter of Inhibition	Highest Diameter of Inhibition
<i>Escherichia Coli</i>	14.738 ±1.392	11.933	17.543
<i>Staphylococcus Aureus</i>		7.858	13.468
<i>Klebsella Pneumonia</i>	10.663 ±1.392	15.826	21.436
<i>Citrobacter</i>	18.631 ±1.392	14.028	19.638
	16.833 ±1.392		

The value of Mean inhibition zone ±Std. Error of mean after two way ANOVA.

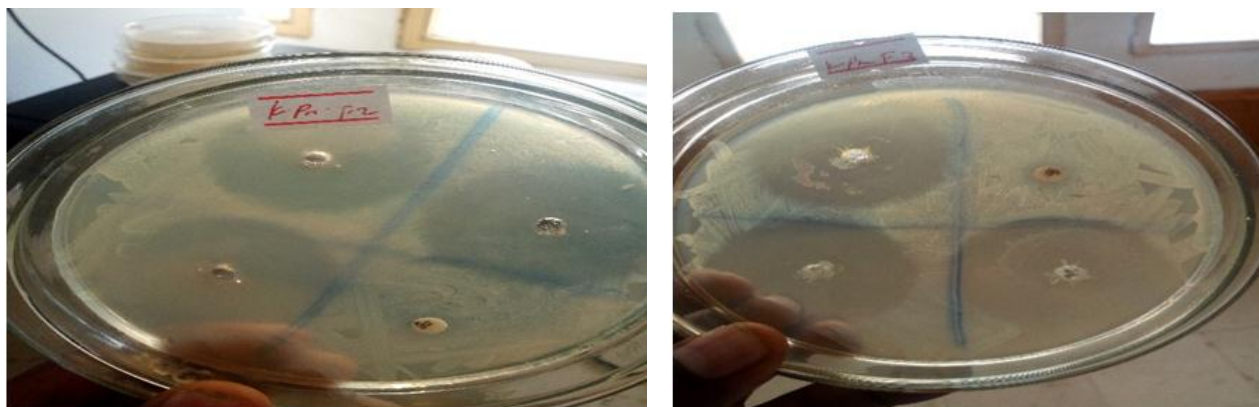


Figure-3. Inhibition zone of camel urine against bacterial pathogens.

3.4. Susceptibility Test of Control Antibiotic

The bacterial pathogenic isolates were also examined for their antibacterial activity against the commonly prescribed antibiotics (gentamycin) accessing similar methods for the determination of antibacterial activity of camel's urine as control antibiotic and has become susceptible to all the bacterial species used as following table shows (Table 2). With respect to their diameter of the inhibition zone the microorganism exposed to the control antibiotic were classified into susceptible, intermediate and resistant but all of the organism showed to be susceptible to the antibiotics as following table depicts.

Table-2. Control antibiotic against bacterial pathogens.

Bacterial samples	Antibiotic Gentamycin
<i>Escherichia Coli</i>	Susceptible
<i>Staphylococcus aureus</i>	Susceptible
<i>Klebsella Pneumonia</i>	Susceptible
<i>Citrobacter</i>	Susceptible

Where susceptible, intermediate and resistance where the three parameters measured based on the inhibition of antibiotics against bacterial pathogenic species.

3.5. Age Perspectives of the Camels and their Potency against Bacterial Pathogens

The age of the camels recorded were 4-6 age group (30%), 7-9 age group (46%) and 10-14 age group (23.1%) and has shown mean diameter of inhibition in millimeter against the bacterial species tested of 4-6 age group (16.72 mm), 7-9 age group (13.95 mm) and 10-14 age group (15.44 mm)

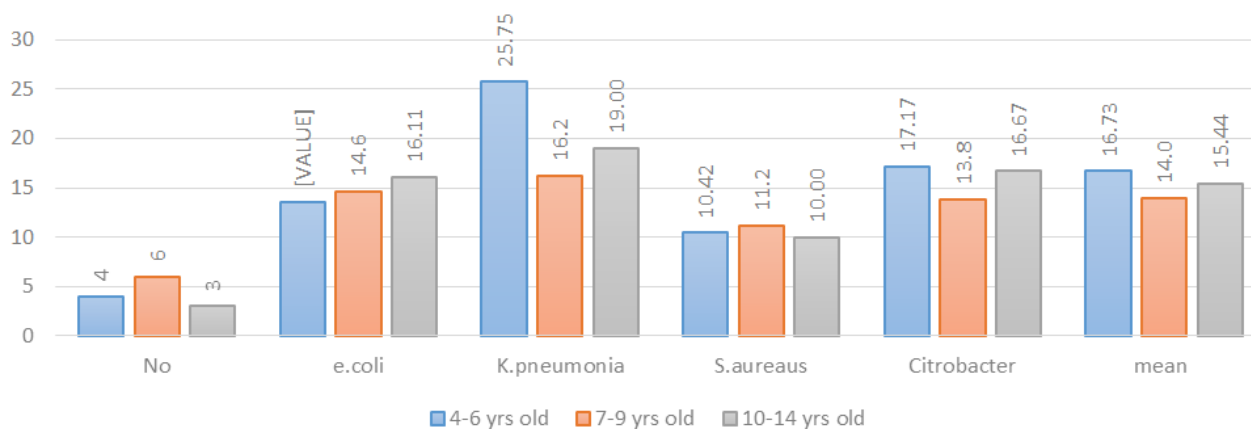


Figure-4. Age of the camel perspective and its diameter of inhibition.

3.6. Comparison Camel Urine Efficacy among Sex

On the gender perspective, there is no significant difference between the female camels urine and male's camel urine as the study has shown, females camel urine has average inhibition of 15.32 ± 0.94 mm while male camels urine has shown average inhibition of 15.11 ± 1.02 mm with p-value of 0.067 which is not significant.

Table-3. Diameter of inhibition of camel urine against bacterial species and difference among sex in mm.

Diameter of inhibition of camel urine against bacterial species among sex in mm			
Gender	Mean diameter of inhibition \pm Standard Error of mean	Lowest diameter of inhibition	Highest diameter of inhibition
		Male	15.11 ± 1.021
Female	15.32 ± 0.946	13.416	17.227
P-value	0.067		

3.7. Comparison Camel Urine Efficacy among Different Camel-Female Statuses

With respect to the female camel states as shown in the figure below, female urine has shown mean inhibition of None (15.02mm), pregnant (14mm) lactating (11.9mm) and virgin (18.125mm). In general, female camels can stay either of the above-mentioned statuses.

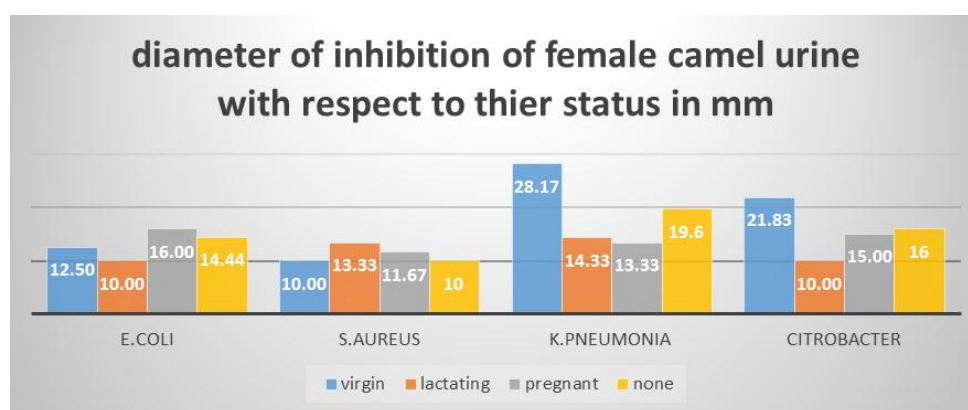


Figure-5. Diameter of inhibition of female camel urine with respect to their status in mm.

3.8. Minimum Inhibitory Concentration of Camel Urine against Bacterial Pathogens

The least concentrations of camel's urine that can inhibit the growth of the bacteria were *Klebsella Pneumonia* (12.02%), *Citrobacter* (8.2%), *Escherichia Coli* (12.5%), and *Staphylococcus aureus* (10.6%) as following table illustrates Table 4.

Table-4. Minimum inhibitory concentrations of camel urine against bacterial spp by percentage.

Minimum inhibitory concentration of camel urine against bacterial spp in %					
Bacterial pathogenic organism					
Gender	<i>E.coli</i>	<i>S.aureus</i>	<i>k. pneumonia</i>	<i>citrobacter</i>	Mean MIC
Male	11.4	9.4	9.4	7.3	9.37
Female	13.4	11.6	14.3	8.9	12.05
over all	12.5	10.6	12.02	8.2	10.8

3.9. Minimum Bactericidal Concentration of Camel Urine against Bacterial Pathogens

The least concentrations of camel urine that can kill bacteria were reported as shown in Table 5. The result indicated a mean MBC of *Klebsella Pneumonia* (9.6%), *Citrobacter* (9.1%), *Escherichia Coli* ((9, 6%), and *Staphylococcus aureus* (10.1%).

Table-5. Minimum bactericidal concentration in %.

	<i>E.coli</i>	<i>S.aureus</i>	<i>k.pneumonia</i>	<i>Citrobacter</i>	Mean MBC
MBC of female's camel urine	11.6	10.7	11.6	9.8	10.9
MBC of male's camel urine	7.3	9.4	7.3	8.3	8.07
Mean MBC of all	9.6	10.1	9.6	9.1	9.6

3.10. Comparison of Camel Urine Efficacy among the Bacterial Species

As shown in Table 6. There are significant differences among the bacterial species tested to camel urine with the mean difference listed in the table below. There is significant difference among the bacterial species with mean p-value of 0.05.

Table-6. Comparison of camel urine efficacy among the bacterial species.

(I) Bacterial Species	(J) Bacterial Species	Mean Difference among the bacteri (I-J)	Standard Error	Significance	95% Confidence Interval	
					Lowest difference	Highest difference
<i>Escherichia Coli</i>	<i>Staphylococcus Aureaus</i>	3.9744*	1.96258	.049	.0190	7.9297
	<i>Kelebsella Pneumonia</i>	-4.1282*	1.96258	.041	-8.0835	-.1729
	<i>Citrobater</i>	-2.1795	1.96258	.273	-6.1348	1.7758
<i>Staphylococcus Aureaus</i>	<i>Escherichia Coli</i>	-3.9744*	1.96258	.049	-7.9297	-.0190
	<i>Kelebsella Pneumonia</i>	-8.1026*	1.96258	.000	-12.0579	-4.1472
	<i>Citrobater</i>	-6.1538*	1.96258	.003	-10.1092	-2.1985
<i>Kelebsella Pneumonia</i>	<i>Escherichia Coli</i>	4.1282*	1.96258	.041	.1729	8.0835
	<i>Staphylococcus Aureaus</i>	8.1026*	1.96258	.000	4.1472	12.0579
	<i>Citrobater</i>	1.9487	1.96258	.326	-2.0066	5.9040
<i>Citrobater</i>	<i>Escherichia Coli</i>	2.1795	1.96258	.273	-1.7758	6.1348
	<i>Staphylococcus Aureaus</i>	6.1538*	1.96258	.003	2.1985	10.1092
	<i>Kelebsella Pneumonia</i>	-1.9487	1.96258	.326	-5.9040	2.0066

Note: Based on observed means.

The error term is Mean Square (Error) = 25.036.

*. The mean difference is significant at the .05 level.

In the table above, we can see the difference among the bacterial species which is obvious that there is little difference among them.

4. DISCUSSION

Antibiotic resistance is a problem that challenges the public healthcare sector in the world both developing and developed countries (Boucher et al., 2009). The emergence and spread of multidrug resistant pathogens have massively threatened the current antibacterial therapy (Romero et al., 2005). This has forced a search for a new source of antibacterial agents such as camel urine as they possess a variety of bioactive substances of known

therapeutic abilities. This study has been done to evaluate the *in-vitro* antibacterial activity of camel's urine in Somali region against human pathogenic bacteria species including *Klebsella pneumonia*, *Citrobacter*, *Escherichia Coli* and *Staphylococcus aureus*. The finding demonstrated bacterial growth inhibition *Klebsella Pneumonia* (18.631 ± 1.39) *Citrobacter* (16.83 ± 1.39) *Escherichia Coli* (14.73 ± 1.39), and *Staphylococcus aureus* (10.66 ± 1.39) Table 1 and in agreement with a study conducted by Jamal, Mohammed Issa, Abdul Bagi, and Rabie (2019) in Sudan with aim to evaluate the antimicrobial effects of Camel's urine in bacteria isolated from clinical specimens of wounds collected from patients admitted in Kassala teaching hospital and also study by Alzahrani and Alharbi (2011). Our findings are also in similar accord with a study by Mostafa and Dwedar (2016) that has reported that camel urine is proved to have *in-vitro* antibacterial ability with regard to clinically important multidrug resistant bacteria.

The bacterial species were also tested for their antibacterial sensitivity against the commonly prescribed antibiotics (gentamycin) using similar methods for the investigation of anti-bacterial activity of camel's urine as control antibiotic and has become susceptible to all the bacterial species used and it is in contrary with Mulani, Kamble, Kumkar, Tawre, and Pardesi (2019) who found gentamycin resistance of some bacterial pathogens and Lübbert et al. (2013) who found gentamycin resistance with *Klebsella Pneumonia*.

The result of this experimental study is disclosing that camel's urine constitute potent ingredient to kill or inhibit the growth of bacterial species tested on regardless of the gender of the camel as the result demonstrated that 15.32 ± 0.94 mm and 15.11 ± 1.02 mm of inhibition for female and male camel urine respectively Table 3, which has almost no significant difference and both have significant ability to prevail against the growth of bacterial species since their p-value is 0.067 and it is greater than the significant p-value (0.005) and the study in agreement with study in Sudan (Osman, Lodiog, Siddig, & Abdullah, 2018) that reported both female and male camels urine can kill bacteria. Also on the age perspective, the result indicated average inhibition of 4-6 years (16.72 mm), 7-9 years (13.95 mm) and 10-14 years (15.44 mm) and there is no significant difference among the different ages of the camels and similar observation have been reported by study in Kingdom of Saudi Arabia (Bakhsh et al., 2019) Figure 3.

With respect to the female camel states, female urine has shown mean inhibition against bacterial pathogens of None (15.02 mm), pregnant (14 mm) lactating (11.9 mm) and virgin (18.125 mm), which shows that virgin camel urine are most effective among the other camel status followed by camels with none of statuses mentioned and pregnant while lactating camels are the camels with lowest effective urine against bacterial species tested on Figure 4. The finding also exposed that camel urine has minimum inhibitory concentration of *Klebsella Pneumonia* (12.02 %), *Citrobacter* (8.2 %), *Escherichia Coli* (12.5 %), and *Staphylococcus aureus* (10.6%) Table 4. It is also very significant and discloses that even low concentration of camel's urine have ability to inhibit the growth of bacterial pathogens and this study is similar with Humaid (2016) and another study in Kingdom of Saudi Arabia (Al-harbi, 2010).

In the present study, the finding has expressed a mean MBC of *Klebsella Pneumonia* (9.6%) *Citrobacter* (9.1%) *Escherichia Coli* (9.6%), and *Staphylococcus aureus* (10.1%), which is absolutely effective against the bacterial pathogen disease that are caused by these species Table 5. These finding mean that even low concentrations of camel urine can kill bacteria and can be produced an antibiotic that can treat bacterial diseases caused by the species tested and the study is in similar line with Al-Bashan (2011) and Al-Awadi and Al-Judaibi (2014).

On the difference of camel urine ability among tested bacterial pathogen, there is difference (p-value of 0.041) between *Escherichia Coli* and *Kelebsella pneumonia* with respect to their interaction to camels urine followed by *staphylococcus aureus* (p-value of 0.049) and finally *citrobacter* which has shown insignificant difference (p-value of 0.273). *Staphylococcus aureus* has significant difference with *Kelebsella pneumonia* (p-value 0.00) followed by *citrobacter* (p-value 0.03) and lastly *Escherichia Coli* (p-value 0.049). *Kelebsella pneumonia* has depicted a significant difference with *Staphylococcus aureus* (p-value of 0.00) followed by *Escherichia Coli* (p-value 0.041) and *citrobacter* has

shown no significant difference to *Kelebsella pneumonia* (p-value of 0.3). *Citrobacter* has shown significant difference of P-value 0.003 to *Staphylococcus aureus* and no significant difference to *Escherichia Coli* and *Kelebsella pneumonia* with p-values of 0.27 and 0.32 respectively and the study is similar with study in Iraq by AL-Zaiadi, Thapti, and Rasaak (2016).

To our knowledge, this is the first studies that are conducted on the antibacterial effect of camel's urine in Ethiopia and it has shown a potential *in-vitro* antibacterial activity of camel's urine against bacterial pathogens in Somali region, Ethiopia. And it was very effective agent that can be used for pharmaceutical discovery of drugs to combat the infectious diseases caused by the bacteria.

5. LIMITATION OF THE STUDY

This study assessed the anti-bacterial property of camel's urine in Somali region. During this study camels living in Somali region were taken as participant. The study particularly focused only the antibacterial activity urine of the camels (dromedary camels) located in Somali regional state of Ethiopia. The study was excluded from the camels in Afar region and Oromia regions and limited to Somali region only. The study hasn't assessed the chemical composition of the camel urine in SRS and other medical importance such as antifungal, Anticancer and Anti-diabetics property of camel urine.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

In conclusion, anti-bacterial activities of camel's urine from Somali region, Ethiopia were assessed. The result showed potential antibacterial effects of camel (*Camelusdromedarius*) urine in Somali region of Ethiopia against bacterial strains tested and were effective against *Klebsella pneumonia*, *Citrobacter*, *Escherichia Coli* and *Staphylococcus aureus*.

The result showed that low concentration of camel (*Camelusdromedarius*) urine in Somali region of Ethiopia against can inhibit the growth of bacterial strains tested and also low concentration of camels urine in Somali region of Ethiopia can kill bacterial pathogens such as *Klebsella pneumonia*, *Citrobacter*, *Escherichia Coli* and *Staphylococcus aureus*,

The study also demonstrates that urine of both sexes can inhibit and kill bacteria with little preference of female camel urine.

The outcome of this study also depicted that urine of all ages of camels in Somali region of Ethiopia has potential of inhibiting and killing bacterial species like *Klebsella pneumonia*, *Citrobacter*, *Escherichia Coli* and *Staphylococcus aureus*. The study proves clear evidence that camel's urine has antibacterial effect against bacteria pathogens and can be cured diseases caused by bacterial species such as *Klebsella pneumonia*, *Citrobacter*, *Escherichia Coli* and *Staphylococcus aureus*. Even though the study determined potent *in vitro* antibacterial activity of camel's (*Camelusdromedarius*) urine for certain bacteria, it doesn't me that camel's urine has potential antibacterial property in *in-vivo*

6.2. Recommendations

The results of this study were found to be promising to be applied to address practical problems of bacterial diseases treatment by using camel's urine. Hence, the researcher has suggested the following recommendations to be considered.

- Further studies should be conducted on the camels' urine antibacterial property in *in-vivo* utilizing a different animal laboratories and human volunteer for the trail effect.

- Further studies are necessary to figure out the active antibacterial components of camel's urine and to study its effect on other bacterial pathogens and its active components into local and systemic antimicrobial pharmaceutical preparations.
- Pharmaceutical industries should take camel urine as a valuable agent that can be produced antibiotics
- Governments and agencies should conserve camels as they have values more than medicine.
- Instead of disc diffusion method, other specific methods such as molecular methods, sub-fraction, semipure compound, or a pure compound isolated from camel's urine might expose better antibacterial activity.
- Additional studies are necessary to evaluate ant-mycobacterial, antiviral, and anti-parasitic activity of camel's urine.

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REFERENCES

- Abdurahman, O. (2005). *Udder health, milk quality and constraints to camel pastoralist in the Horn of Africa. Structures of vulnerability: Mobilization and resistance*. Paper presented at the Interdisciplinary Research Conference, Stockholm University 12th-14th of January.
- Al-Abdalall, A. H. A. (2010). The inhibitory effect of camels urine on mycotoxins and fungal growth. *African Journal of Agricultural Research*, 5(11), 1331-1337.
- Al-Awadi, A., & Al-Judaibi, A. (2014). Effects of heating and storage on the antifungal activity of camel urine. *Clinical Microbiology: Open Access*.
- Al-Bashan, M. M. (2011). In vitro assessment of the antimicrobial activity and biochemical properties of camel's urine against some human pathogenic microbes. *Middle-East Journal of Scientific Research*, 7, 947-958.
- Al-harbi, A. A. (2010). Using molecular and bacteriological methods in detection of methicillin-resistant staphylococcus aureus in Gazan Region and effect of camel's urine and some plant extracts on it.
- AL-Zaiadi, R., Thapti, I., & Rasaak, J. (2016). Evaluation of the antimicrobial activity of camels urine against some pathogenic bacteria and yeasts. Retrieved from <http://journals.uokufa.edu.iq/index.php/kjvs/article/view/5393>. [Accessed 1 October 2020].
- Alebie, G., Yohannes, S., & Worku, A. (2017). Therapeutic applications of camel's milk and urine against cancer: Current development efforts and future perspectives. *Journal of Cancer Science and Therapy*, 9(5), 468-478. Available at: <https://doi.org/10.4172/1948-5956.1000461>.
- Alhaidar, A., Abdel Gader, A. G. M., & Mousa, S. A. (2011). The antiplatelet activity of camel urine. *The Journal of Alternative and Complementary Medicine*, 17(9), 803-808. Available at: <https://doi.org/10.1089/acm.2010.0473>.
- Alzahrani, S. H., & Alharbi, A. A. (2011). Antimicrobial activity of camel's urine on methicillin-resistant Staphylococcus aureus Isolated from clinical specimens. *Science*, 23(1), 251. Available at: <https://doi.org/10.4197/sci.23-1.16>.
- Andrews, J. M. (2001). Determination of minimum inhibitory concentrations. *Journal of Antimicrobial Chemotherapy*, 48(suppl_1), 5-16. Available at: https://doi.org/10.1093/jac/48.suppl_1.5.
- Bakhsh, R. S., Noor, S. O., Khorshid, F. A. R., Ahmed, F., Alsulaimany, A. A., Najjar, A. A., & Al-Hejin, A. M. (2019). The antibacterial activity of a fraction extracted from camel urine against mycobacterium tuberculosis isolated from tuberculosis patients in Jeddah City. *Advances in Environmental Biology*, 13(4), 1-6.

- Boucher, H. W., Talbot, G. H., Bradley, J. S., Edwards, J. E., Gilbert, D., Rice, L. B., & Bartlett, J. (2009). Bad bugs, no drugs: No ESCAPE! An update from the infectious diseases Society of America. *Clinical Infectious Diseases*, 48(1), 1-12. Available at: <https://doi.org/10.1086/595011>.
- Bradford, A. (2017). Camels: Facts, types & pictures. Retrieved from <https://www.livescience.com/27503-camels.html>.
- Buxton, A., & Fraser, G. (1977). *In animal microbiology*. Oxford London, Edinburgh, Melbourne: Blackwell Scientific Publications.
- Coppock, D. L. (1994). The Borana plateau of Southern Ethiopia: Synthesis of pastoral research, development and change, 1980–91 (Vol. 374). Addis Ababa: ILCA systems Study No. 5, International Livestock Centre for Africa.
- FAO. (2004). FAOSTAT DATA, statistical databases. Retrieved from <http://earthtrends.wri.org/text/agriculturefood/variable-334.html>.
- FAO. (2020). Dairy production and products: Camels. Retrieved from <http://www.fao.org/dairy-production-products/production/dairy-animals/camels/en/>. [Accessed 18 July 2020].
- Gader, A. G. M. A., & Alhaider, A. A. (2016). The unique medicinal properties of camel products: A review of the scientific evidence. *Journal of Taibah University Medical Sciences*, 11(2), 98-103. Available at: <https://doi.org/10.1016/j.jtumed.2015.12.007>.
- Humaid, A. A. (2016). Antagonistic Effect of camel's Urine on some pathogenic bacterial species. *PSM Veterinary Research*, 1(1), 8-12.
- Jamal, B. S., Mohammed Issa, A., Abdul Bagi, A. J., & Rabie, A. B. (2019). Antimicrobial effects of Camel's Urine in Bacteria Isolated from Clinical Specimens of Wounds Collected from Patients Admitted in Kassala Teaching Hospital, Sudan. *Int.J.Curr.Microbiol.App.Sci.*, 8(12), 2717-2728. Available at: <https://doi.org/10.20546/ijemas.2019.812.318>.
- Kirby, W. M., Bennett, J. V., Brodie, J. L., & Benner, E. J. (1966). Simplified, accurate method for antibiotic assay clinical Kiby department of microbiology and medicine. *Applied Microbiology*, 14(2), 170-177. Available at: <https://doi.org/10.1128/am.14.2.170-177.1966>.
- Kula, J. (2016). Medicinal values of camel milk. *International Journal of Veterinary Science and Research*, 2(1), 018-025.
- Kula, J. T., & Tegegne, D. (2016). Chemical composition and medicinal values of camel milk. *International Journal of Research Studies in Biosciences*, 4(4), 13-25.
- Lübbert, C., Fauchaux, S., Becker-Rux, D., Laudi, S., Dürrbeck, A., Busch, T., & Kaisers, U. X. (2013). Rapid emergence of secondary resistance to gentamicin and colistin following selective digestive decontamination in patients with KPC-2-producing *Klebsiella pneumoniae*: A single-centre experience. *International Journal of Antimicrobial Agents*, 42(6), 565-570. Available at: <https://doi.org/10.1016/j.ijantimicag.2013.08.008>.
- Mirkena, T., Walegign, E., Tewolde, N., Gari, G., Abebe, G., & Newman, S. (2018). Camel production systems in Ethiopia: A review of literature with notes on MERS-CoV risk factors. *Pastoralism*, 8(1), 1-17. Available at: <https://doi.org/10.1186/s13570-018-0135-3>.
- Mostafa, M. S., & Dwedat, R. A. (2016). Antimicrobial activity of camel's Urine and Its effect on multidrug resistant clinical bacterial and fungal isolates. *Journal of Pharmaceutical Research International*, 13(6), 1-6. Available at: <https://doi.org/10.9734/bjpr/2016/29342>.
- Mulani, M. S., Kamble, E. E., Kumkar, S. N., Tawre, M. S., & Pardesi, K. R. (2019). Emerging strategies to combat ESCAPE pathogens in the era of antimicrobial resistance: A review. *Frontiers in Microbiology*, 10, 539. Available at: <https://doi.org/10.3389/fmicb.2019.00539>.
- Muna, E. A., Abdalla, E. A., & Hadya, E. A. (2008). Bacteria associated with healthy sudanese camels' urine and drugs susceptibility of some bacteria of human origin to camel Urine. *Sudan Journal of Veterinary Research*, 23, 79-82.
- O'haj, H. (1993). *Camel urine as medicament in Sudan*. B.Sc Dissertation, University of Gezira, Sudan.
- Olila, D., & Opuda-Asibo, J. (2001). Antibacterial and antifungal activities of extracts of *Zanthoxylum chalybeum* and *Warburgia ugandensis*, Ugandan medicinal plants. *African Health Sciences*, 1(2), 66-72.
- Osman, N. A., Lodiong, S. S., Siddig, W., & Abdullah, A. (2018). Antimicrobial effect of camel urine in some human pathogenic bacteria.

- Romero, C. D., Chopin, S. F., Buck, G., Martinez, E., Garcia, M., & Bixby, L. (2005). Antibacterial properties of common herbal remedies of the Southwest. *Journal of Ethnopharmacology*, 99(2), 253-257. Available at: <https://doi.org/10.1016/j.jep.2005.02.028>.
- Schwartz, H., & Dioli, M. (1992). The one-humped camel in eastern Africa. A pictorial guide to diseases, health care and management (8th ed., pp. 50-57). Weikersheim, Germany: Verlag Josef-Margraf Scientific.
- Sumia, A. D. A. A. (2016). Antimicrobial activity of Camels (*Camelus dromedarius*). *Journal of Agriculture and Veterinary Science*, 9(10), 65-71.
- Vuorela, P., Leinonen, M., Saikku, P., Tammela, P., Rauha, J.-P., Wennberg, T., & Vuorela, H. (2004). Natural products in the process of finding new drug candidates. *Current Medicinal Chemistry*, 11(11), 1375-1389. Available at: <https://doi.org/10.2174/0929867043365116>.
- WHO. (2020). Antimicrobial resistance. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>. [Accessed 19 July 2020].
- Yadav, A. K., Kumar, R., Priyadarshini, L., & Singh, J. (2015). Composition and medicinal properties of camel milk: A review. *Asian Journal of Dairy and Food Research*, 34(2), 83-91. Available at: <https://doi.org/10.5958/0976-0563.2015.00018.4>.

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