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In vitro Assessment of the Antimicrobial Activity and Biochemical Properties of Camel's Urine Against Some Human Pathogenic Microbes

Munir Mustafa Al-Bashan

Department of Biology, College of Science, Taif University, Taif, P.O. Box: 971, K.S.A

Abstract: Studies were made on, 12 apparently healthy hydrated male and female camels (*Camelus dromedarius*) with ages ranging from 6 months to 4 years fed on the different wild plants and forages at Taif city. Twelve camels urine samples were aseptically collected from these camels. The samples were subjected to microbiological and chemical examinations. It showed a high concentrations of K, Mg, BUN, Ca and CREA values and a low concentrations of Na, Phos and GLU values. The obtained results revealed a significant ($P < 0.05$) increase under natural conditions of range and hydration of the camels with those values. Significant ($P < 0.05$) decrease of camels urine samples Na, Phos and GLU values was observed also. It was also established that all the *Candida albicans* and *Aspergillus niger* isolates were very susceptible to camels urine at all used concentrations. Somewhat, the antibacterial activity of camel urine is a very slightly and determinely evident after 48 hours of incubation, against *Staphylococcus aureus, Streptococci, E. coli, Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. However, it was observed that the antibacterial activity of camel urine induced discriminatively marked inhibition zones of growth after 72 h of incubation. Camels urine samples subjected to direct microbiological examination in the period of 9 days under different conditions of temperatures showed no bacterial growth up to the end of the sixth day of incubation. The most microbes detected afterward in this day and in the ninth day were mainly: *Staphylococci, Streptococci, Diplococci*, a few of *Bacilli*, *Streptobacilli* and Yeasts. It could be concluded that the alkaline camels urine, have boundly and restrictly many antimicrobial activities and resistance against the bacterial growth in the early stage of incubation, but the inhibitory effects of this urine on the bacterial growth were more distinct after 72 h of incubation. Biochemical and physiological properties of camels urine are discussed.

Key words: Camel's Urine · Antibacterial activity · Biochemical properties · Candida albicans · *Aspergillus niger* · *Staphylococcus aureus* · *Escherichia coli* · *Pseudomonas aeruginosa*

INTRODUCTION

Prophet Muhammad (peace be upon him) (770-622) himself praises God as the source and origin of the body of medical knowledge. As part of his hadith (Traditions), the Prophet (peace be upon him) said that medicine and theology are two of the greatest branches of knowledge in the service of God. The different ideas and concepts of the Qur'an on health and hygiene for the good practice of religion inspired the Prophet (peace be upon him) to take a keen interest in the field of medicine. Practically all the leading medical authors of Islamic manuscripts have taken the Tibb al-Nabawi ("The medicine of the Prophet") as the main aspiration and root-cause of their excellent works that have had a wide impact on the development process in both the East and the West [1].

The camel is a potentially important source of milk. Indeed, in some countries hosting large camel populations, camel milk is one of the main components of human diet. While a considerable amount of data is available on chemical and physical constitution of camel milk and its different life and healthy uses, very little is known about the physical and biochemical properties and antimicrobial effects of camel urine on various microbes infecting the human beings and animals. Information on the characteristics of camel urine and its medicinal benefits is limited. Data available show, however, significant antimicrobial activities against some pathogenic microbes infected humans such as *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli* and other pathogenic microbes [2].

Corresponding Author: Munir Mustafa Al-Bashan, Department of Biology, College of Science, Taif University, Taif, P.O. Box: 971, K.S.A., E-mail: prof.micro.albashan@hotmail.com.

The medicinal properties of the Arabian Camel were known to Arab physicians. In days of old, Arabs have been used the Arabian camel urine in therapy and they also treated the patients by camel urine after boiling it [3]. In his magisterial Canon- "a medical bible for a longer time than any other work". Ibn Sina (Avicenna) mentions that chronic imbalance of the liver produces jaundice, dropsy (istisqa') and swelling of the belly and that the health of the liver can be restored through a temporary diet of camel milk and male Arabian Najib camel urine, "the most beneficent type of urine, then human urine". Avicennan textbooks Ibn al-Azraq (d. 890) and Al-Suwaydi (600-690) state, "the cure [for dropsy] is to drink the milk of the she-camel- together with its urine-fresh out of the udder and to use that every day and leave everything else, for it is extremely efficient and of proven results [1, 2, 4].

Ibn Sayyid al-Nas specifies, "notably desert camels feeding on wormwood and southernwood [4]. Wormwood is among the herbs that are extremely useful in correcting digestive disorders in general and for helping detoxify the liver in particular and is used in the treatment of hepatitis [5].

Thus, Arabian camel urine was a standard prescription in Arabic medicine and remains a staple of Bedouin natural remedies to this day both as diuretic, snuff and delousing hair wash [6,7].

One of the great Arab physicians was Antiochene Dawud ibn "Umar Al-Antaki (d. 1008) who has been mentioned that urine differs according to its animal origin but it all tends to heat and dryness provided it does not come from an animal devoid of bile such as the camel. In the later case, its dryness is minimal because it is devoid of salinity since nothing breaks down salinity, with water, other than the bile. All urine types dispel the effects of diseases, cure the eye and the ear, chronic cough, difficulty in respiration, the spleen and uterine pains, especially aged and/or congealed. The most effective types are human urine then camel's [8].

Quite a few studies were done on the camel milk [9-11]. As well as, Kospakov [12], mentioned that antibacterial properties of camel milk were observed. However, there are relatively few investigations on the microbiological and chemical properties of camel urine.

In regard to chemical composition of the Arabian Camel (*Camelus dromedarius*) urine, Muhammad [5], stated that camel urine has in general several chemical characteristics, but the most important of these characteristics were: high osmolarity in comparison with ovine, bovine and human urine, efficiency of urine as slow diuretic, having high levels of potassium and proteins, its effectiveness as fibrinolytic factor and as a drug of useful antimicrobial activity and efficiency.

Recently, further studies on the chemical constitution of camel urine demonstrated that this urine differ somewhat obviously in hydrated and dehydrated camels. Most of laboratory analysis and examinations which are widely conducted in this field, were declared that camel urine contains high concentrations of potassium, urea and proteins, as well as low concentrations of uric acid, creatine and sodium [13, 14].

In recent years, the increase in microbial diseases, has grown into an ever bigger challenge for antimicrobial therapy. Proper natural drugs are identified as one of the essential elements of primary health care. From these drugs is camel urine in which has to be both therapeutical and antimicrobial factors.

Recently, there have been studies carried out on the antimicriobial activity of camel urine. Al-Awadi and Haikal [15] reported that camel urine showed antifungal activity against *Aspergillus niger*. Another investigation conducted by Al-Awadi [16] in 1998 indicated that camel urine affects Fungi called with *Candida albicans*.

In consecutive studies, there have also been established results of antifungal activity of camel urine against *Candida albicans*, *Aspergillus niger, Rhizoctonia solani* and *Fusarium oxysporum* Fungi [17] and a clear activity against the metabolic efficiencies of *Aspergillus niger* fungus [18].

In general, very rarely works have been carried out on the physical properties, biochemistry and antimicrobial effects of camel urine. Therefore, the present study was mainly designed to investigate the biochemical composition, physical features and antimicrobial activity of camel urine generally.

MATERIALS AND METHODS

During the period of 8 February to 9 May in the year 2009, a sum of 12 urine samples were collected from 12 apparently healthy males and females camels (*camelus dromedarius*) with ages ranging from 6 months to 4 years of one breed.

All samples were transferred to the laboratory in sterile screw-cap bottles. On arrival at the laboratory, the samples were immediately subjected to microbiological and chemical processing.

For Bacteriological Examination: All urine samples were cultured on Mueller Hinton Agar (HiMedia Laboratories Limited, India), on Mannitol Salt Agar (HiMedia Lab. India), on blood Agar Base No. 2 (Oxoid LTD. England), on MacConkey Agar (HiMedia Lab. India), on Nutrient Agar (Oxoid LTD. England), on Xylose-Lysine-Deoxychocolate (XLD) Agar (Scharlau Chemie S. A. Barcelona, Spain, European Union) and on Potato Dextrose Agar (Oxoid LTD. England). Agar plates were incubated at 37°C and bacterial growth was evaluated after 24 and 48 hours.

For Mycological Examination: The obtained urine samples were directly streaked on Sabouraud's Dextrose Agar (Oxoid LTD. England) containing penicillin, streptomycin and chloramphenicol.

Inoculated plates were incubated for 48 hr. at 37°C, then left at room temperature for another week. The obtained bacterial and fungi isolates were identified according to Finegold and Baron [19] and Forbes *et al.* [20].

For Anti-Microbial Activity Testing of Microorganisms: Two clinical fungal isolates which are: *Candida albicans* and *Aspergillus niger* and both Gram +ve [(*Staphylococcus aureus*, *Streptococcus pyogenes* (group A beta-hemolytic *streptococci*) and *Streptococcus agalactiae* (group B beta-hemolytic *streptococci*)] and Gram –ve (*Escherichia coli*, *Klebsiella pnemoniae* and *Pseudomonas aeruginosa*) bacteria obtained from department of microbiology, Pediatrics Hospital at Taif City, Kingdom of Saudi Arabia, were grown in Nutrient Agar medium and incubated at 37°C for 24-48 hrs follow by frequent sub-culturing to fresh media and were used as test bacteria and the bacterial culture was checked to confirm the presence of sufficient number of bacterial cells ($1X10^4$ CFU/ml). Microbiological procedure were done according to advised laboratory methods of Finegold and Baron [19] and Forbes *et al.* [20]. Determination of antimicrobial activity of camel's urine was carried out as follows: the agar diffusion method was used to screen for antimicrobial activity of camel's urine. Filter paper discs of 5 mm diameter were soaked with 20 µl of 25, 50, 75 and 100% of camel urine concentrations with sterile distilled water. The discs were dried at 37°C.

For Anti-Microbial Resistance Testing of Camel Urine: In the course of 9 days, determination of antimicrobial resistance of camel urine was conducted as part of microbiological study at temperatures of 0°, 1-4°, 20-25°, 37° and 40-45° C consecutively.

Microbiological determination procedures were applied according to the techniques recommended by Forbes *et al.* [20].

For Chemical Examination and Analysis: All collected urine samples were subjected to the chemical examination and analysis, at the King Faisal Hospital, Taif City, KSA, by using Dimension RxL Max™ Clinical Chemistry System, DADA BEHRING- Germany.

The culture grown was diluted to 1: 10 in liquid media. Five hundred µl of this diluted microbial culture, was spread on the solid agar plate (and Sabouraud Dextrose Agar) with the help of a glass spreader. The Petri plates were allowed to dry at 37°C for 15 minutes. The discs were applied to the surface of the seeded plates. Unsoaked (with camel urine) filter paper discs of 5 mm diameter were also used as negative control. The plates were incubated at 37°C for 24 hours or for 2-4 days on occasion. The antimicrobial activity was evaluated by measuring the inhibition zone diameter. Determination of antimicrobial activity was undertaken according to the method described by Forbes, *et al.* [20] with some modifications.

The obtained results were statistically analysed according to the procedures of Steel and Torrie [21] and Kalton [22].

RESULTS

The results are listed in Tables 1-4. Mean values of biochemical pictures and physical properties of healthy camel urine reared under hydration conditions and feeding on different forages are illustrated in Tables 1, 2 and Fig. 1. The *in vitro* antifungal activities of camel urine at four concentrations revealed a very good effects against *Candida albicans* and *Aspergillus niger* isolates with a diameters of growth inhibition zones (mm) of different values at various.

Concentrations, after 24-72 h of incubation which have been induced growth inhibition zones with diameters greater than that detected for experimented bacteria at the same concentration of camel urine (Table 3). Regarding antibacterial activity of camel urine with 25, 50, 75 and 100% concentrations, no growth inhibition zones were observed after 24 hours of incubation of all the culture media for whole bacteria used in these studies. After 48 hours of incubation, a very boundly and slightly growth inhibition zones for (*Staphylococcus aureus, Streptococcus* of both types

Table 1: Healthy camel urine concentration of Na and K (mmol/L) and PHOS, MG, BUN, CA, CREA and GLU (mg/dl) under hydration conditions and feeding on different forages

				Parameter / estimation of the result							
No. of camel	Sex	Age (years)	Constituent	Na	K	PHOS	MG	BUN	CA	CREA	GLU
1	Male	3		29	192.1	0.2	48.8	510	17.5	83.6	17
				LO	HI	LO	HI	HI	HI	HI	LO
2	Female	2		25	152.5	0.3	62.4	564	28.8	3.6	57
				LO	HI	LO	HI	HI	HI	HI	LO
3	Female	6 Months		19	117.2	0.1	23.3	325	8.5	30.7	4
				LO	HI	LO	HI	HI	-	HI	LO
4	Female	4		22	149.3	0.5	64.5	501	24.0	-1.9	77
				LO	HI	LO	HI	HI	HI	LO	-
5	Female	3		21	175.4	20.9	59.5	541	36.2	62.9	176
				LO	HI	HI	HI	HI	HI	HI	HI
6	Male	3		27	198.7	0.2	48.4	514	17.7	83.0	17
				LO	HI	LO	HI	HI	HI	HI	LO
7	Female	4		29	182.6	0.5	64.4	486	23.8	2.1	78
				LO	HI	LO	HI	HI	HI	LO	-
8	Male	3		26	184.2	0.2	48.3	509	17.7	82.9	17
				LO	HI	LO	HI	HI	HI	HI	LO
9	Female	4		24	195.8	0.4	64.5	441	31.3	-2.2	92
				LO	HI	LO	HI	HI	HI	LO	-
10	Male	3		28	197.9	0.2	48.8	508	17.7	83.1	17
				LO	HI	LO	HI	HI	HI	HI	LO
11	Male	3		27	199.5	0.2	49.0	518	17.7	83.6	17
				LO	HI	LO	HI	HI	HI	HI	LO
12	Female	2		29	198.5	0.4	64.8	519	17.7	83.9	17

Abbreviations:

No. = Number, Na = Sodium, K = Potassium, PHOS = Phosphorous, MG = Magnesium, BUN = Blood Urea Nitrogen, CA = Calcium, CREA = Creatine, GLU = Glucose, LO = Low, HI = High

Table 2: Physical, Chemical and Microscopic Examinations of healthy Camel Urine under hydration conditions and feeding on different forages

			Physical Examination						Chemical Examination							Microscopic Examination				
No. of camel	Sex	Age (years)	*Vol	Col	App	RE	pH	SG	*PR	*SU	AC	BL	BI	UR	NI	PC	RBC	CAS	CR	OT
1	Male	3	3.5	YE	CL	AL	9.0	1.010	NIL	NIL	NIL	NEG	NIL	NOR	NEG	1-3/hpf	0-1/hpf	NIL	NIL	Sperms: [+]
2	Female	2	4.75	YE	CL	AL	9.0	1.010	NIL	NIL	NIL	NEG	NIL	NOR	NEG	0-1/hpf	0-1/hpf	NIL	NIL	NIL
3	Female	6 Months	4	YE	ST	AL	8	1.015	NIL	NIL	NIL	NEG	NIL	NOR	NEG	0-1/hpf	3-5/hpf	NIL	Cal. Oxalate [+++]	NIL
4	Female	4	6	YE	CL	AL	9	1.010	TRACE	NIL	NIL	NEG	NIL	NOR	NEG	1-3/hpf	0-1/hpf	NIL	NIL	NIL
5	Female	3	5.5	YE	CL	ACIDIC	5	1.030	NIL	NIL	NIL	NEG	NIL	NOR	NEG	1-3/hpf	0-1/hpf	NIL	NIL	NIL
6	Male	3	4	YE	CL	AL	9	1.005	TRACE	NIL	NIL	NEG	NIL	NOR	NEG	3-5/hpf	0-1/hpf	NIL	NIL	NIL
7	Female	4	6.5	YE	CL	AL	9	1.005	TRACE	NIL	NIL	NEG	NIL	NOR	NEG	1-2/hpf	0-1/hpf	NIL	NIL	NIL
8	Male	3	4.5	LY	CL	AL	8	1.005	NIL	NIL	NIL	NEG	NIL	NOR	NEG	0-1/hpf	0-1/hpf	NIL	NIL	NIL
9	Female	4	6.75	YE	CL	AL	9	1.010	TRACE	NIL	NIL	NEG	NIL	NOR	NEG	0-1/hpf	0-1/hpf	NIL	NIL	NIL
10	Male	3	3.75	YE	ST	AL	9	1.010	TRACE	NIL	NIL	NEG	NIL	NOR	NEG	1-3/hpf	0-1/hpf	NIL		NIL
11	Male	3	5	YE	CL	AL	9	1.010	TRACE	NIL	NIL	NEG	NIL	NOR	NEG	0-1/hpf	1-2/hpf	NIL	NIL	NIL
12	Female	2	4.75	YE	CL	AL	9	1.010	[+]	NIL	NIL	NEG	NIL	NOR	NEG	0-1/hpf	0-1/hpf	NIL	NIL	NIL

Abbreviations: Vol = Volume, CL = Colour, App = Appearance, RE = Reaction, SG = Specific Gravity, PR = Protein, SU = Sugar, AC = Acetone, BL = Blood, BI = Bilirubin, UR = Urobilinogen, NI = Nitrate, PC = Pus Cells, RBC = Red Blood Corpuscles, CAS = Casts, CR = Crystals, OT = Others, YE = Yellow, CL = Clear, AL = Alkaline, NEG = Negative, NOR = Normal

* Volume = Amount of urine produced in 24 hours (in liters)

Table 3: Antifungal activity of camel urine at four concentrations

(S. No/ C. No)*	Concentration %	Diameter of Growth Inhibition Zone (mm)	
		Candida albicans	*Aspergillus niger*
1	25	16	14
	50	17	15
	75	18	17
	100	20	19
2	25	13	12
	50	14	13
	75	15	16
	100	17	18
3	25	14	13
	50	15	14
	75	16	17
	100	17	17
4	25	11	11
	50	12	12
	75	14	13
	100	15	15
5	25	12	13
	50	13	14
	75	15	16
	100	16	17
6	25	12	15
	50	15	17
	75	17	19
	100	19	20
7	25	12	12
	50	13	13
	75	14	15
	100	14	16
8	25	13	14
	50	16	15
	75	18	17
	100	19	18
9	25	10	11
	50	11	14
	75	12	15
	100	13	17
10	25	14	16
	50	15	18
	75	18	19
	100	18	21
11	25	15	12
	50	17	14
	75	19	16
	100	20	17
12	25	10	13
	50	12	14
	75	14	15
	100	18	16

* Abbreviations: S. No/C. No = Sample Number / Camel Number

Table 4: Microbiological Finding observed in Camel urine samples subjected to direct Stained Slide Examination in the Period of 9 days under different conditions of Temperatures

Age of Samples (in days)	Temperature Condition				
	Freezer T*	Refrigerator T	Room T	Incubation T	Outside T
1	NIL	NIL	NIL	NIL	NIL
3	NIL	NIL	NIL	NIL	NIL
6	NIL	NIL	NIL	*Straphylococci, Streptococci,* Yeasts, *Diplococci*, a few of single *Bacilli*, *Streptobacilli*, Long chains of *Bacilli*	NIL
9	NIL	Yeasts, a few of Fungi, a few of *Micrococci*	A few of *Actinomycetes*, *Micrococci*, *Dipococci*, a few of *Bacilli*, *Streptobacilli*, *Staphylococci.*	*Diplococci*, *Staphylococci*, a few of *Micrococci* and *Bacilli*, Spores of *Bacilli*, *Streptococci.*	Much more of *Diplococci, Staphylococci, Micrococci, Bacilli*, Spores of *Bacilli, Streptococci* and *Actinomycetes.*

Note: Some of yeasts were detected in a few of camel urine samples subjected to all temperature conditions

* T = Temperature

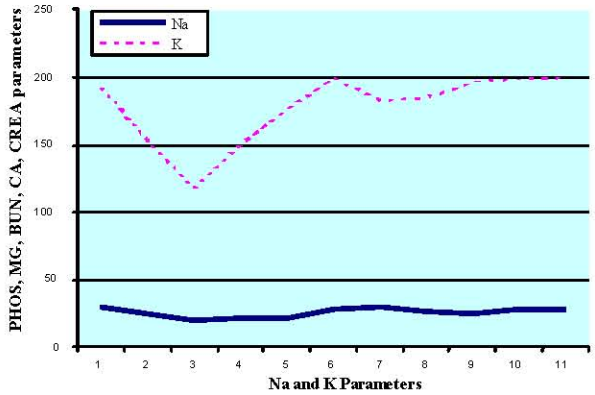

Fig. 1: Healthy camel urine concentration of Na and K (m mol/L) and PHOS, MG, BUN, CA, CREA and GLU (mg / dL) under hydration conditions and feeding on different forages and pastures

used in these studies and *Klebsiella pneumoniae*) bacteria, were noticed at all concentrations of male and female camel urine used, especially at 100%, in which concentrated camel urine have determinedly, but less distinct antibacterial activity against some of bacteria mentioned such as *E. coli* and *Pseudomonas aeruginosa*, in despite of the growth inhibition zones diameters were very small for most of the inhibited bacteria, in comparison of the antibacterial activity of that related to fungal isolates subjected to experiments. The obtained results have been revealed that the antibacterial activity of camel urine, induced discriminately marked inhibition zones of growth after 72 h of incubation, especially at 100% and 75% urine concentrations, consecutively, but the growth inhibition zones were much smaller than that observed for fungal strains underwent to the all same urine concentrations. In addition to that, it is evident that the antimicrobial activity of male camel urine was more effectiveness than female one. camel urine samples underwent to direct microbiological examinations in the period of 9 days under different conditions of temperatures, revealed no bacterial growth till to the end of the sixth day of urine incubation. The most microbes detected afterward in this day and in the ninth day, were mainly: *Staphylococci, Streptococci, Diplococci*, a few of *Bacilli*, *Streptobacilli* and Yeasts (Table 4).

DISCUSSION

The dromedary camels were not subjected to modern studies as it was the case of other domestic animals. Urine studies were least conducted with camels. Camel urine researches and observations in regard to its chemistry and microbiology, were mostly speculated by authors, researchers and western ventures. These studies lay the basics for the microbiological and chemical investigations on the dromedary camels urine to declare the different chemical and microbiological properties of camels urine, as well as the various physiological functions in general. An important, but as yet unanswered, question is the chemical and microbiological features and antimicrobial activity of camels urine. Under hydration and dehydration conditions, camels urine was widely comparable in its chemical and microbiological characteristics.

Tables (1, 2) show the healthy camels urine concentrations of Na and K (mmol/L) and Phos, Mg, BUN, Ca, CREA and GLU (mg/dL) (Fig. 1), in addition to the other physical, chemical and microscopic of healthful camels urine and hydration conditions and feeding on different forages. As shown in Table 1, the chemical analysis of the examined urine samples revealed a high

concentrations of K, Mg, BUN, Ca and CREA parameters and a low concentrations of Na, PHOS and GLU which might be due to the differences regarding some factors affecting camels urine under hydration and dehydration conditions such as: feeding and forages, breeding seasons, age and sex of camels, the nature of the ground state, camels breed and healthy condition of the camels., as well as individual case and the natural body state of animals. During the periods of investigations, no significantly variations as concerns chemical finding of both male and female camels urine samples subjected to the same examinations. Similar results were obtained by Read [13], Muhammad [5] and Ba'Smaeel, [14], in spite of a few of differences in finding results. Concerning camel urine samples K, Mg, BUN, Ca and CREA values, the obtained results revealed a significant ($P < 0.05$) increase under natural conditions of range and hydration comparing with range and dehydration conditions, from which, camels urine samples were subjected to examinations [5]. This increase might be due to ranging of the variety of plants, the wild forages and bushes for example, *Acacia raddiana, Acacia nubica, Acacia tortilis, Acacia seyal, Acacia ehrenbergiana, Acacia etbaica and Acacia farnesiana etc., Rhanterium epapposum, Indigofera Arabica, Indigofera articulata, Indigofera oblongifolia, Indigofera tribuloides and Indigofera tritoides, etc., Kalanchoe alternates, Rumex glaber, Rumex vesicarius, Rumex nepalensis, Rumex spinosus, etc., Polycarpaea fragilis, Polycarpaea repens, etc., Ruellia patula, Ifloga spicata, Juncus acutus, Juncus rigidus, Heliotropium arbainense, Herniaria cinerea, Dipterygium glaucum, Anabasis articulata, Anabasis setifera, Convolvulus hystrix, Rhazya stricta and Citrullus colocynthis.* The recorded results (Table 1) stated a significant ($P < 0.05$) increase of K, MG, BUN, CA and CREA parameters, under natural conditions of range and hydration of the camels. Significant ($P < 0.05$) decrease of camel urine samples Na, PHOS and GLU values was observed also. The present results were coincide with those of Muhammad [5] and Ba'Smaeel [14]. The results obtained in Table 2, point out that no abnormal finding were noticed in relation with some physical and chemical analysis of healthy camels urine. Furthermore, the obtained results were also mentioned that the reaction of all camel urine was alkaline and the (pH) was ranged between (8-9) values in general.

Several authors stated that the structure and function of the camel kidney are of extreme importance in water conservation. The long loops of Henle in the medulla have the function of urine concentration and the more loops there are the greater the degree of concentration that can be achieved. The ratio of medulla to cortex thickness is a useful index of potential reabsorption ability and this has recently been shown to be 4:1 in the camel [23]. The kidney controls water loss in two ways - by the absolute concentration achieved and by reduction in flow of urine [24]. Gauthier - Pilters and Dagg [6] mentioned that in March 1956, the average daily amount of urine was about 7 liters per day during a period when the camels were obtaining almost all the water they needed from vegetation. Those researchers were also found that far more urine is produced by camels that eat fresh green food rather than dry food and slightly more by hydrated camels compared with dehydrated ones. Leroux [25] calculated that camels that drank regularly and grazed freely in green winter pastures produced 5-7 liters of urine per day. After 6 days without drinking, camels produced about half as much urine per day. In summer, camels drinking regularly and eating green vegetation produced 4-6 liters, while dehydrated animals foraging in dry pastures produced only about three - quarters of a liter [6].

As presented in Table 2, values for urine production of camels are in agreement with Leroux [25] and Gauthier - Pilters and Dagg [6]. Concentration of urine not only serves to conserve water but allows camels to drink water even more concentrated than sea water and to eat very salty plants that would otherwise be poisonous. A peculiar variation occurs in the ratios of the salts excreted in the camel's urine. In most urine samples potassium is the dominant excreted but when the camel feeds on certain types of fodder, sodium can become the dominant ion [26]. The chloride concentration may reach a level of 1068 mN per litre in animals deliberately fed salt [27]. In addition as urine flow is decreased there may be a change in the balance of ions excreted. Charnot [27] found that the chloride concentration remained about the same potassium doubled, sodium increased by 9 times and that of sulphate was increased 16 times. In a well-watered camel, sulphate is an insignificant ion in the urine but this massive increase suggests an extraordinary ability of the camel kidney to eliminate sulphate. The products of nitrogen metabolism are normally excreted in the form of urea by terrestrial animals. Urine concentrations of this compound can reach high levels. As the volume of urine output decreases urea content increases. There are differences, however, in growing animals with high protein requirements [24].

Yagil and Berlyne [28] concluded that dehydration had more effect on K metabolism than on that of Na. In urine K fell but Na rose. There were large decreases in filtered Na and K loads in dehydration. Excreted load of Na increased nonsignificantly in mild and severe dehydration; that of K showed no change in mild dehydration but rose by more than 180% in severe dehydration. Reabsorption of Na fell in dehydration, but that there were significant changes in Na and K metabolism within 15 to 45 min. It is suggested that antidiuretic hormone and aldosterone caused the changes in metabolism [28].

Yagil and Berlyne [29] reported that there was a rise in creatinine and insulin clearance rations after dehydration and a fall after rehydration. As well as the previous researchers assured also that endogenous creatinine estimations are no measure of glomerular filtration rate in the camel.

Yagil and Berlyne [30] established that when camels were hydrated the extra glucose was readily given off in the urine, 6530 mg/100 ml, with only, a slight rise in blood values from 124 to 471 mg/100 ml. After dehydration, blood glucose rose significantly from 150 to 1153 mg/100 ml but excretion in urine was 3250 mg/100 ml only. Dehydration caused blood insulin to fall and glucose infusion caused it to rise.

Regarding of microbiology of human urine generally, it revealed that although the urethra hosts a resident microflora that colonize its transitional epithelium, consisting of coagulase-negative *staphylococci*, *viridans* and *nonhemolytic streptococci*, *lactobacilli*, *diphtheroids* (*Corynebacterium* species), nonpathogenic *Neisseria* species, transiet gram-negative aerobic *bacilli* (including *Enterobacteriaceae*), anaerobic *cocci*, *Propionibacterium* species, an-aerobic gram-negative *cocci* and *bacilli*, commensal *Mycobacterium* species, commensal *Mycoplasma* species and occasional yeasts, all areas of the urinary tract above the urethra in a healthy human are sterile [19, 20] and it may be the same condition in relation with the camel urinary tract, as we think.

In this study the antifungal activity of camel urine at four concentrations was determined. The susceptibility was shown by inhibition zones around the discs soaked with camel urine. The results are presented in Table (3). It was found that all the *Candida albicans* and *Aspergillus niger* isolates were very susceptible to camel urine at all different concentrations used. This result agreed with Al-Awadi [16], Al-Awadi and Al-Jedabi [31] and Al-Awadi and Al-Jedabi [18]. Also, the present results in regard to anti-*Aspergillus* isolates, were coincides with those of Al-Abdalall [32], who found that the effect of urine and camel milk in inhibition of biological effects of mycotoxins produced by nine isolates of *Aspergillus flavus* and one of isolate of *Aspergillus niger* isolated from pulse seeds, where these toxins lost their ability to inhibit *Bacillus subtilus* growth, milk could not. On the other hand, Al-Abdalall [32] has been recorded the effect of camel urine on mycelial growth of some roots rot fungi isolated from seeds of pulses like *Rhizoctonia solani*, *Fusarium moliniform*, *Aschocayta* spp., *Pythium aphanidermatum*, *Sclerotinia sclerotiorum* studies, also included are some storage fungi (*Aspergillus* spp.) isolated from coffee beans. However, Al-Abdalall [32] proved that camel urine at low concentrations has no significant inhibitory effect on fungal growth, while inhibition can be obviously revealed after using high concentrations. This antifungal activity may be attributed to the chemical constituents and physical features of camel urine as shown in Tables 1, 2. Furthermore, the antimicrobial components of wild plants, forages and shrubs from which camels were fed on it, then excrete it in the urine, may be the most important antimicrobial constituents of camel urine. In addition to that, many of the fungi have wide pH tolerances. Species of *Aspergillus*, *Penicillium* and *Fusarium* can grow down to pH values near 2 [33]. *Candida albicans* as we think may be behave the same behavior. Several fungi have been isolated from acid coal wastes and acid streams. Because of the high pH and the alkalinity of camel urine, probably the most fungi unthrive in alkaline camel urine.

For bacteriological studies on camels urine, it is evident that this urine have somewhat, a very slightly and determinely antibacterial efficiency against *Staphylococcus aureus, Streptococci, Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella preumoniae*, after 48 hours of incubation of culture media dishes. It was found that all the clinical isolates of bacteria applied in these studies, were not susceptible to the different concentrations of camel urine after 24 hours of incubation.

The antibacterial activity of camel urine is a very boundly and less obvious after 24-48 hours of incubation. Interpretation of this phenomenon in our opinion, might be due to the involved bacteria found naturally in camels urine, as well as to the growing bacteria (as bacteriophages) of the nature of bactericidal bacteria in this urine. The results of the present work are in agreement with those reported by Al-Awadi and Al-Jedabi [18] and Al-Talhi and Al-Bashan [2].

In addition, after 24- 48 h of incubation, biochemical components of camel urine may be produce a state of bacterial temporary growth inhibition, followed by bacterial permanent and complete growth inhibition after 72 h. In point of fact, maximum antibacterial activity, was observed against the mentioned bacteria after 72 h of incubation and manifested by a large diameter of inhibition zones. However, well planed electromicroscopic studies with relation to antibacterial activity would be of significant importance to know the real magnitude of the camel urine. Similar antibacterial effects of camel urine were observed and established by few investigators using different camel urine concentrations [2, 34, 35]. Shoeib and Ba-hatheq [34] by using Scanning Electron Microscope, demonstrated cases of antibacterial effects with camel urine collected from female camel (*Camelus dromedarius*) of age 5 years, against *P. aeruginosa*, *E. coli* and *Staph. aureus*. They added that the electrographs were showed crumple and abnormality of treated cell wall with camel urine for all tested bacteria. However, the same authors have been pointed out that the cells of *P. aeruginosa* (treated with camel urine) and *S. aureus* (treated with antibiotic Cefuroxime (CXM30μg) were shorter than untreated. Moreover, some cells of methicillin-resistant *Staphylococcus aureus* (MRSA) treated with camel urine, were lyses, as well as, *S. aureus* (treated with CXM30μg) revealed lyses of its cells, even some of it was mixed with medium. The results presented in Table 4, point out the microbiological finding observed in camel urine samples subjected to direct examination in the period of 9 days under different conditions of temperatures. The most important microbes detected in the camel urine samples were *Staphylococci, Streptococci, Diplococci, Streptobacilli, actinomycetes* and yeasts, especially in the ninth day.

Up to the end of sixth day, the bacteriological examination of camel urine samples showed no bacterial growth except of groups of bacteria including *Staphylococci, Streptococci, Diplococci*, a few of *Bacilli* and *Streptobacilli* from which were recovered and identified in incubated camels urine samples subjected to 37°C temperature.

Therefore, as the camel urine period of incubation increased, the antibacterial activity increased.

Among the bacteria are found several examples of organisms which are resistant to values approximately pH 10. The pH optimum for growth of many of these bacteria, however, is much lower. The most alkaline-resistant bacteria are found among the nitrate reducers, sulphate reducers and active ammonifiers. An extreme example of a bacterium which actually requires a high pH for growth is *Bacillus pasteurii*, a member of the ureaclastic bacteria. The organism hydrolizes urea in concentration up to 10% and grow well at about pH 11 [36]. There is a specific requirement for ammonia and growth is poor at pH 9 or less in medium made with 1% NH_4Cl [37, 38]. Several strains of related *bacilli*, *B. Sphaericus, B. Pantothenticus* and *B. rotans* do not require ammonia but are capable of growth at pH 11. Their lower limits for growth however, approximate pH 5 [39]. A similar organism described by Vedder [40] as *Bacillus alkalophilous* grows actively at pH 10 but not at pH 7. The organism does not hydrolize urea or require ammonia. Other *bacilli* have been isolated which are extremely resistant to alkaline pH, for example, *Bacillus cereus* and *Bacillus circulans* [33]. Many of the enteric bacteria are tolerant to pH values near 9 to 10 [41]. Downie and Cruickshank [42] were able to obtain pure cultures of *Streptococcus faecalis* using broth at pH 11. The ability to grow in media of about pH 10 is one of the characteristics of the *enterococcus* group [43]. Yeasts generally have mildly acidic pH optima of 5.5 to 6. Many species, however, are capable of growing down to pH 2 [44]. Probably the most acid resistant organisms reported are several fungal species [33]. Recently, several intracellular enzymes have been extracted from alkalophilic bacteria and reports on the properties of purified enzymes have been made [45].These enzymes may be play an important in relation to antimicrobial activity of camel urine. Alkalophilic bacteria have very interesting properties. One of them is that they change their environment to a pH value suitable for their growth. Moreover, almost all alkalophilic bacteria showed optimum temperatures at 25-45°C. Another characteristic feature of the alkalophilic bacteria is that they absolutely require sodium ion for their whole life, such as growth, germination and sporulation. Several alkalophilic *Bacillus* Strains cannot grow well at pH about 7, but in the presence of 5% NaCl they can grow very well even if at neutral pH value. Sodium ion stimulates the uptake of nutrients. Sodium requirement was also observed in differentiation processes, spore formation and germination; neither sporulation nor germination was observed in the absence of sodium ion. Only sodium ion stimulated them and other cations did not [45]. Finally, it is evident that much more studies on the camels urine should be carried out concerning its microbiological and chemical properties for different medicinal therapeutic applications and other life field uses.

On the basis of the present investigation, it could be concluded that camel urine proved to be antimicrobial activity natural material and satisfactory for using as a medicinal treatment in the field of medical therapy. It can be used for treatment several mycological infections, such as human diseases caused by *Candida albicans* and *Aspergillus niger*, or those bacterial illnesses induced by *Staphylococcus aureus, Streptococci, Escherichia coli, Klebsiella pneumoniae* and *Pseudomonas aeruginosa* definitely.

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