

A REVIEW OF THE THERAPEUTIC CHARACTERISTICS OF CAMEL URINE

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Article History

Received: Mar. 19, 2017.

Revised Received: Aug. 10, 2017.

Accepted: Aug. 14, 2017.

Published Online: Nov. 15, 2015

Abstract

Background: The therapeutic use of camel urine has been known for centuries, with evidence of its use for medicinal purposes found in early folklore. It has been used to cure different diseases; however, the significant therapeutic benefits of urine have yet to undergo rigorous scientific evaluation. In this review, a summary of the scientific evidence that supports these therapeutic actions has been presented.

Materials and methods: A literature search of different electronic databases including PubMed, Medline, SCOPUS, Web of Knowledge, and Google Scholar were conducted to identify published studies exploring the therapeutic effects of camel urine. ‘Camel’ and ‘Urine’, ‘Medicinal properties’, ‘Natural products’ were entered into the databases as key words. Reference lists of published reviews retrieved by the search were also searched to identify relevant papers.

Result: There have been several laboratory and limited clinical studies providing evidence of the therapeutic effects of camel urine in the treatment of cancer, viral hepatitis and other viral, bacterial and parasitic infections. Therapeutic uses in the cardiovascular system have also been discovered, with regard to platelet and fibrinolytic actions.

Conclusion: The exploration of the use of camel urine is of great interest to determine the efficacy of this practice, as well as the safety of the patients being treated. This review presented the benefits of camel urine, which were commonly drawn from small laboratory studies. Therefore, many more preclinical and clinical studies are needed to examine the efficacy and safety of the use of camel urine in the treatment of disease.

Keywords: natural products, camel, urine, camel urine, medicinal properties

Abbreviations: **AA:** Arachnoidic Acid, **ADP:** Adenosine Diphosphate, **HEPG2:** cell line derived from a human hepatoblastoma, **HCT116:** cell line derived from a human colon carcinoma, **LF:** Lactoferrin, **PFA:** Platelet Function Analyser, **U251:** human glioma cell line.

Introduction

Urotherapy Concept

Urine-therapy or urotherapy is the ancient use of urine to diagnosis and treat diseases, with evidence being found in some traditional medical texts. John Armstrong was a British naturopath of the 20th century who successfully developed a urine-therapy regimen, using it on many patients and curing them (Armstrong, 2005). The use of urine in the treatment of disease is more common than one would think, and electronic databases have numerous of literature on the different uses of urine (Alhaidar et al., 2011). Human urine is the most widely used, and interestingly enough, it is used in the treatment of different human diseases (Al-Harbi et al., 1996).

Urotherapy is classified under the category of alternative medicine, is a common practice in many countries, and is particularly significant in countries like India and China where alternative medicine is widely practiced (Alhaidar et al., 2011, Al-Abdalall, 2010). However, it is not restricted to these countries, with practitioners being found in the United States, United Kingdom and other European countries (Gader and Alhaider, 2016). The literature in print is widely read, mainly by those who believe in alternative medicine, and includes practitioners and/or patients who have benefitted from urotherapy. These papers and books often promote the use of one’s own urine for the treatment of different ailments (Gader and Alhaider, 2016).

Scientific research has yet to be conducted to verify these claims about the effectiveness of urotherapy. Cases of qualified physicians advising and co-prescribing urotherapy have been reported; however, no studies have established scientific evidence to support this type of therapy (Van Der Kroon, 1996). Currently, urine-therapy can only be used as an unconventional or complementary medical practice on the basis of trial and error, and requires significant research to support its use in conventional medicine (Alyahya et al., 2016).

Many diseases, such as abdominal tumours, tuberculosis, haemorrhoids, leprosy, dropsy, abdominal enlargement, flatulence, colic and anaemia, have been treated with the urine of animals, including goats, sheep, buffalo, elephants, horses, camels and donkeys (Al-Abdalall, 2010). The use of cattle urine (cows and oxen) has been reported in India and Tibet. Some studies have also reported the use of llama urine in the Asian countries of Mongolia and China (Christy, 1994). Camel urine holds the record for being the prototype of urotherapy, and its use can be dated back to the time of Avicenna (980-1037 AD) (Gader and Alhaider, 2016).

Traditional and Religious Background of Camel Urine Usage

As previously mentioned, camel urine is used for therapeutic purposes most widely in Asia and Africa, since these locations are the largest camel habitats. The religious aspect of using camel urine stems from the fact that there has been convincing evidence that the Prophet Mohamed advised its use in the treatment of a wide range of diseases (Alhaider et al., 2011). Anecdotal records of the management of many diseases, ranging from liver cirrhosis to skin and hair ailments, with the use of camel urine have been discovered (Christy, 1994). The anticancer activity of both human and camel urine is of the greatest interest. Based on the evidence from recent studies, camel urine components are said to inhibit the growth of cancer cells and shrink tumours and secondary metastases, *in vitro* as well as *in vivo*, in humans and animals (Lillie et al., 1993, Miller et al., 1993).

Patterns of Use of Camels and their products

According to one estimate, there are more than 250 million camels in the world (Yadav et al., 2015, Kula and Tegegne, 2016), with the one-humped dromedary or Arabian camel (*Camelus dromedarius*) making up 90%. The two-humped Bactrian camel (*Camelus bactrianus*) makes up the other 10%. North Africa and Western Asia, the lands of hot deserts, are the natural habitats of the dromedary camel, while Bactrian camels are habituated mostly in the cold deserts of Asia (Kula and Tegegne, 2016, Mihic et al., 2016).

Dromedary camels are important for the dry and hot desert ecosystem. The role of camels in everyday life is appreciated by the people living in the deserts in Asia and Africa, and they use these animals for transportation and as a food resource. In these areas, camel's milk and urine are used for the treatment of various diseases, such as cancer, ulcers, skin problems, chronic hepatitis, hepatitis C, stomach infections, a weakened immune system, infectious diseases and certain cardiovascular conditions (Kula and Tegegne, 2016, Gader and Alhaider, 2016, Yadav et al., 2015). The desert dwellers of Asia and Africa use camel urine in addition to other natural products for the treatment of several ailments. More specifically, the Bedouins in the Arabic peninsula drink approximately 100 ml of camel urine each day, either alone or mixed with milk (Al-Yousef et al., 2012).

Materials and Methods

This review has shed some light on the historical, religious and medicinal backgrounds of camel urine, in particular. A comprehensive literature search of different electronic databases including PubMed, Medline, SCOPUS, Web of Knowledge, and Google Scholar were conducted to identify published studies exploring the therapeutic effects of camel urine. 'Camel' and 'Urine', 'Medicinal properties', 'Natural products' were entered into the databases as key words. Reference lists of published reviews retrieved by the search were also searched to identify relevant papers.

Reasons behind Camel Urine Benefits

The traditional therapeutic benefits of camel urine can be collectively considered as the treatment of cancer and certain infectious and cardiovascular abnormalities. Camel urine may acquire these therapeutic activities via the camel's consumption of desert plants possessing various active substances. Certain different desert plants have been shown to have strong antibacterial and antifungal activity. Studies of the wormwood plant have shown evidence of its strong antibacterial activity and antifungal activity against some yeast (Zaki et al., 1984, Kaul et al., 1976).

Some scientists believe that the medicinal properties of both camel's milk and urine can be attributed to the gamma globulins and other immune components, such as immunoglobulins, which can be found in both (Alhaider et al., 2013, Alhaider et al., 2012). Fifty percent of the circulating antibodies in camel blood are made up of two heavy chains, lacking light chains, which make them one-tenth the size of human antibodies. This smaller size gives them the advantage of being transmitted through the milk of the lactating camel, and also enables them to cross the blood-brain barrier or to be filtered in the urine. In addition, the small size makes them available to be absorbed from the gut into the general circulation of individuals who have consumed camel's milk and/or urine (Hamers-Casterman et al., 1993). The single antigen-binding domains (VHH) of these heavy-chain antibodies, also known as nanobodies, could be used in the diagnosis and treatment of cancer, as well as in the development of biosensors (Muyldermans et al., 2009). A

Belgian biotechnology company (Ablynx NV, Ghent/Zwijnaarde, Belgium) has been testing these recently discovered unique features of the camel's immune system and its implications on human health by using animals from the camelid family (camels and llamas) to develop immune therapy for the treatment of cancer and other autoimmune diseases, like multiple sclerosis and Alzheimer's disease (Gader and Alhaider, 2016).

Composition of Camel Urine

The chemical constituents of camel urine were studied by Dr Bernard E. Read in 1925. His experimental results showed the presence of creatinine, creatine, hippuric acid, total nitrogen ammonia, urea, chlorides and purine bases in the collected urine samples. Interestingly, only traces of urea and ammonia were found in these samples (Read, 1925). In the urine of older camels (5-10 years old), the relative density ranged from 1.01 to 1.07, while the pH values varied (acidic or alkaline), the level of the urea ranged from 18 to 36 mg/dl and the keratin ranged from 0.2 to 0.5 mg/l (Amer and Al-Hendi, 1996). Calcium oxalate, phosphorus and ammonium urate were present, as well as some epithelial and granular cells, as revealed through a microscopic study (Amer and Al-Hendi, 1996). In a neutron activation analysis carried out by Al-Attas (2009), it was discovered that the milk and urine of camels have large amounts of Na and K, which can help reverse the electrolyte imbalance in patients with diarrhoea. Large amount of Zn were also identified in the sample; Zinc acts as a cure for diarrhoeal infections (Al-Attas, 2009). In a recent study, the unique biochemical constituents of camel urine have been discovered. The study stated that that camel urine contains very slight traces of urea and ammonia, and these molecules are known to be responsible for bad smell and toxicity of urine. Also, it has mentioned that camel urine contains approximately 10 folds more mineral salts than human urine (Al-Yousef et al., 2012).

Therapeutic Properties of Camel Urine

Generally, researchers have had little inclination to study the scientific reasoning behind the traditional use of camel urine in recent years. Contrarily, much work has been done to determine the properties and constituents of camel's milk. However, the claims of camel urine treating disease have been tested in several different trials conducted over the years. Therefore, the objective of this review was to discuss the current scientific literature investigating the therapeutic characteristics of camel urine, and create a summary of the diseases and effects of camel urine on their treatment.

Anticancer activity

Traditional healers use a mixture of camel's milk and urine for the treatment of a variety of cancers, including lung, nasopharyngeal and breast cancers, and they firmly believe in the claimed anticancer activity of these substances (Gader and Alhaider, 2016). The lack of a long-term cancer cure and the beliefs of the practitioners of alternative medicine have led to attempts to find scientific evidence that would verify the anticancer activity of camel's milk and/or urine. Consequently, this could help in the identification of the components of camel's milk and/or urine responsible for this activity, and the discovery of new and effective drugs to treat cancer (Mihic et al., 2016).

For some decades, there have been numerous accounts of research studies exploring the possible anticancer properties of urine (Eldor, 1997). It has been clinically determined that the active peptides and a bigger part of the protein fraction of human urine have been observed to be cytotoxic against human leukemic cells, osteosarcoma and HeLa cells (Sloane et al., 1986). According to Malaveilla et al. (1992), human urine extracts are antimutagenic in *Salmonella Typhimurium* (*Salmonella enterica*) (Malaveilla et al., 1992). Many of the chemicals present in camel urine show cytotoxic and antitumor activity in different animals, human tumours and cell lines, and are similar to the constituents present in human urine, such as purine bases, urea, creatinine and hypoxanthine. Previous observations have also shown that camel urine represses the formation of *c*-tumours in *Allium cepa* L. (Liliaceae) root tips (Kabarity et al., 1988).

Dr Fatin Khorshid headed a group of researchers in a series of in vitro experiments, and they were the first to succeed in showing that the development of cancer cells could be repressed by using lyophilized camel urine (Mushref, 2006). They implanted it into experimental animals and it inhibited the growth of several malignant cell lines, including hepatocellular carcinoma (HEPG2), colon carcinoma (HCT116), human glioma (U251), lung cancer and leukaemia (Khorshid, 2008). She reported that this anticancer action may have been the result of either direct cell cytotoxicity or the restriction of the blood supply to the tumour cells, via an antiangiogenic mode of action (Alghamdi and Khorshid, 2012).

The Al Haidar group was able to prove the second observation of Dr Fatin Khorshid by conducting a number of experiments using both camel's milk and urine, separately, by showing that both have the power to repress inflammatory angiogenesis in the murine sponge implant angiogenesis model (Alhaider et al., 2014a, Alhaider et al., 2014b). There has been further confirmation by Alhaider et al. that camel urine has anticancer properties via the considerable repression of the expression of the gene encoding carcinogen activating enzyme Cyp1a1 at the mRNA level in cancerous liver cells (Alhaider et al., 2011). Moreover, camel's milk alone has also been shown to have some apoptotic anticancer properties (Korashy et al., 2012). However, the exact nature of the constituents of camel's milk or urine that are responsible for their antimalignant actions have not yet been determined, but some research findings have

shown that they might be related to the iron binding, multitasking and multifunctional protein lactoferrin (LF) (Kanwar et al., 2015).

It can now be clearly understood why traditional healers recommend the use of both camel's milk and urine to treat cancer patients. Both have healing properties, and since the taste or identity of the urine can be repressed by taking it with milk, these two substances combined can be more palatable to the consumer (Gader and Alhaidar, 2016).

Antimicrobial activity

The antiviral characteristics of camel's milk were first observed by Sharmanov et al. in 1981, when it was determined that chronic hepatitis patients were getting much better when treating them with camel's milk rather than with mare's milk (Sharmanov et al., 1981). After this, camel urine was used to treat patients with bilharzial liver disease. It was observed that these patients recovered from the disease at a better rate, and that there were significant changes in their cirrhotic livers (Ohag et al., 1998).

Some similarities have been found between the effects of camel urine on bacterial cells and cancer cells. A study conducted on rabbit liver tissue infected with *Escherichia coli* showed that it could be cured with no histopathological effects after the use of camel urine in concentrations of up to 100% (Khalifa et al., 2005). There has been other research in which camel urine was studied for its antimicrobial properties against pathogenic microorganisms, including bacteria (*Staphylococcus aureus*, *Streptococci*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*) and fungi (*Aspergillus niger*, *Aspergillus flavus*, *Fusarium oxysporum*, *Rhizoctonia solani*, *Ascochyta* spp., *Pythium aphanidermatum*, *Sclerotinia sclerotiorum* and *Candida albicans*). These experiments have found strong antimicrobial activity against these bacteria and fungi (Mostafa and Dwedar, 2016, Al-Bashan, 2011, Al-Abdalall, 2010).

Camel urine has been found to have in vitro antibacterial effects with regard to clinically important multidrug resistant bacteria, as well as strong antifungal effects against *C. albicans* and nonalbicans *Candida* according to some very recent research (Mostafa and Dwedar, 2016). In perfect accord with these observations, the repressing and antibiotic actions of camel urine against the development of *C. albicans* (yeast), *A. niger* and *F. oxysporum*, even after boiling to 100°C, were proved by Alawadi and Al-Jedabi (2000). They also observed a repression reaction on the dry weights of the fungi and yeast (Al-Awadi and Al-Jedabi, 2000).

The action of urine on the morphological properties of some human pathogenic bacteria was evaluated through electron microscopic studies by Shoeib and Ba-hatheq (2008). Their results showed that the chemical and organic constituents of urine have repression characteristics against the development of bacteria and fungi (Shoeib and Ba-hatheq, 2008). In 2007, Shoeib and Ba-hatheq observed that there were no effects on deadly *E. coli* and *P. aeruginosa* bacterial cells when treated with fresh urine using two steps. The first step was to block the proliferation of the bacterial cells and plasmids, causing the formation of cured cells free of plasmids, in accord with the study by (Rose and Barron, 1983). According to them, the continued exposure of the cells to camel urine resulted in effects on the killer cells. It also resulted in no disintegration of the bacterial cells (bacteriolysis after death), which is in agreement with the study by (Höltje, 1998), due to the existence of the bacterial chromosome without plasmids (Al-Abdalall, 2010). In more details, Shoeib and Ba-hatheq carried out their experiments by isolating and identifying pathogenic *P.aeruginosa* and *E.coli* (gram negative bacteria). Both of the isolates and standard isolate for each genus were studied. Samples treated with fresh urine showed bactericidal effects on bacterial cell and lose of the plasmids from the bacterial cells. However, the cells didn't lose their resistance towards different antibiotics and its plasmids. Subsequently, cells didn't lose their viability when samples were treated by the stored urine compared to the control treatment.

The antimicrobial activity of camel urine has been related to its high salt concentration and alkalinity, along with the natural bioactive compounds obtained from the plants consumed by the camels, and some resident bacteria and excreted antimicrobial agents. Camel urine, unlike other animal urine, is alkaline, since it contains high levels of potassium, magnesium and albuminous protein, and low concentrations of uric acid, sodium and creatine (Mostafa and Dwedar, 2016, Kamalu et al., 2004).

Cardiovascular activity

Recently, Al Haidar et al. discovered that there are powerful cardiovascular activities exhibited by both camel urine and milk (Gader and Alhaidar, 2016). Moreover, some of the strongest antioxidants, like uric acid and creatinine, are found in camel urine (Al-Harbi et al., 1996). Camel platelets show repressed platelet aggregation reactions to simple aggregation agents, and the platelet function analyser (PFA- 100) closure times are drawn out. Both camel plasma and urine show repression reactions on human platelets; in particular, lactating camel urine exhibits a strong repression reaction on human platelet aggregation (Alyahya et al., 2016). It has been observed that the strong platelet blocking characteristics of camel urine are quite like the reactions of commonly used antiplatelet drugs, such as clopidogrel and aspirin (Alhaidar et al., 2011).

Camel urine shows strong platelet repression functions, like jamming both the prostaglandin pathway (aspirin-like activity), as well as the adenosine diphosphate (ADP) receptor-mediated pathway (clopidogrel-like activity). These kinds of reactions have not been observed in either bovine or human urine. Camel urine works in a way similar to aspirin, since the repression of arachidonic acid (AA)-induced aggregation blocks the prostaglandin pathway of platelet activation by acetylating, irreversibly, the cyclooxygenase enzyme (Malik et al., 2012, Agrawal et al., 2004). It has not

yet been confirmed whether the camel urine function copies that of aspirin, or if it works with the prostaglandin pathway that way naturally (Alhaidar et al., 2011).

Previous pharmacological experiments conducted by (Khogali and Baragob, 2011), showed that camel urine exhibited two types of effects on isolated rabbit jejunum strips; the diluted urine stimulated the organ, while the crude urine abolished the spontaneous rhythmicity of the same organ. The stimulant effect was deemed to be mediated through muscarinic receptor stimulation, since its reaction was neutralized by atropine sulphate (0.25 ml/bath). Similar results were found by (Ali et al., 1991), while using medicinal plants. The results of this study showed that camel urine can permeate subepithelially, resulting in the generation of mast cells with a release of chemical mediators, followed by vigorous peristaltic contractions caused by 5-HT and other newly formed mediators. Other Iranian research stated that camel urine can be used as a bronchodilator because it possesses anticholinergic characteristics (Zibayi et al., 2015).

Camel's milk has also been known to possess strong thrombolytic functions, since it decreased the plasma fibrinogen of diabetic rats (Korish et al., 2015). The previously detected antiplatelet action, along with this vital data, shows that there is a high possibility for the claimed anticancer activity of camel's milk and urine, since the repression of coagulation and fibrin formation can block the expansion and development of metastatic tumour cells (Gader and Alhaider, 2016).

Conclusion

The use of camel's milk to prevent or treat disease, in principle, is deemed to be plausible; indeed, it is extensively used by a variety of populations worldwide. Accordingly, there have been numerous studies investigating the constituents of camel's milk and its therapeutic properties (Mihic et al., 2016). Thus, an exploration of the use of camel urine is of great interest to determine the efficacy of this practice, as well as the safety of the patients being treated. To the best of our knowledge, this is the first review conducted to identify and discuss studies that focus, specifically, on the medicinal characteristics of camel urine.

It has been reported that patients usually consider natural products to be safe and effective. Based on the fact that the use of natural products has increased significantly, most patients use these products concurrently with their conventional medicines, without informing their doctors (Ernst, 2008). In addition, it has been argued that patients have very different notions regarding the evidence of therapeutic efficacy when compared to clinicians (Evans et al., 2007). Patients tend to use anecdotal rather than scientific evidence (Singh et al., 2005), which establishes the worrying fact that patients tend to rely largely on their own ideas rather than the consultation of a conventional doctor to help them decide whether or not to use these products (Corbin et al., 2009). Therefore, it is essential to understand patients' perceptions and appreciate their experiences in order to support them when choosing appropriate natural treatments, and prevent any harm due to their lack of knowledge or erroneous notions about such treatments.

This review presented the benefits of camel urine, which were commonly drawn from small laboratory studies. Therefore, many more preclinical and clinical studies are needed to examine the efficacy and safety of the use of camel urine in the treatment of disease.

Conflict of Interest: The authors declare no conflict of interest.

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