

Review Article

An integrative perspective on urine analysis: from humoral theory to biomarkers

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ABSTRACT

Urine examination has served as an essential diagnostic tool across civilizations, reflecting the evolution of medical understanding from traditional to modern systems. In Unani medicine, Mu'āyana'-i-Qārūra (Urine analysis) was a key diagnostic approach based on the Naẓariyya'-i-Akhlāt (humoral theory), aimed at identifying imbalances in the body's temperament (Mizāj). Unani physicians meticulously observed features such as color, odor, clarity, froth, and sedimentation to interpret the state of humours and organ function, forming the basis for individualized treatment. In contrast, modern medicine employs advanced laboratory investigations, chemical assays, and imaging modalities to assess urinary composition and pathology with precision. This paper explores the historical context, methodologies, and diagnostic philosophy of urine examination in the Unani system, comparing them with contemporary scientific techniques. Integrating the personalized and qualitative diagnostic principles of Unani medicine with the quantitative precision of modern science may contribute to improved diagnostic accuracy and promote a more holistic, evidence-based approach to patient care.

Keywords: Urine examination, Urinalysis, Mu'āyana'-i-bawl, Tashkhīṣ, Qārūra, Mahiyatul amraz

INTRODUCTION

The macroscopic assessment of urine, commonly termed uroscopy, is one of the most ancient diagnostic practices known to medicine. Urine serves as a valuable, non-invasive medium for evaluating the physiological and pathological conditions of the human body.¹ Urine examination has remained a fundamental component of medical diagnosis across various civilizations since ancient times.² Urine analysis ranks as the third most frequently performed diagnostic laboratory test.³ Uroscopy stands as one of the earliest known laboratory diagnostic methods. Although the techniques and instruments for urine examination have advanced over the centuries, the essential practice of studying urine to assess the body's health has persisted. Urine provides valuable

insights into both normal physiological conditions and disease states. References to urine analysis are found in ancient Sumerian and Babylonian writings from around 6,000 years ago.⁴ Additionally, references to urine examination can be found in ancient Egyptian texts, including the Kahun Papyrus dating back to 1900 BC.⁵

Unani physicians had long acknowledged the crucial role of urine in diagnosing diseases. Esteemed scholars like Buqrāt (Hippocrates, 460–377 BC), Jālīnūs (Galen, 131–201 AD), and Ibn Sīnā (Avicenna, 980–1037 AD) provided detailed and influential writings on the analysis and interpretation of urine.⁶ Moreover, they highlighted the significance of urine examination in both diagnosing illnesses and predicting their outcomes.¹

In the Unani System of Medicine, digestion is described in four stages (*Huḍūm Arba'a*): *Haḍm Mi'dī* (alimentary digestion), *Haḍm Kabidī* (hepatic digestion), *Haḍm 'Urūqī* (vascular digestion), and *Haḍm 'Uḍwī* (organic digestion). According to most Unani scholars, *Qārūra* (urine) is considered the waste product resulting from *Haḍm Kabidī* & *Haḍm 'Urūqī*.⁷

In ancient Unani medicine, urine examination was a central diagnostic tool, with physicians interpreting characteristics such as color, odor, and sedimentation to inform personalized treatment. Modern medicine, however, employs advanced laboratory techniques and imaging modalities to provide precise, objective assessments of biochemical, cellular, and microbial parameters, as well as detailed anatomical insights. This paper presents a comparative analysis of urine examination in Unani and contemporary medical practice, exploring potential correlations and complementary perspectives that may enhance current diagnostic approaches.

Aims and objectives

The primary aim of this study is to investigate the historical importance of urine examination in Unani medicine and to assess its relevance in the context of modern medical diagnostics. The research seeks to integrate traditional Unani diagnostic principles with contemporary scientific approaches to promote a more comprehensive and holistic understanding of healthcare. Through this study, an effort is made to bridge the gap between ancient medical wisdom and modern scientific practices, highlighting the enduring value and applicability of classical Unani knowledge in present-day medicine.

METHODS

A thorough literature review was carried out using various databases such as Google Scholar, PubMed, and ResearchGate to collect published studies related to urine examination in both Unani and modern medical systems. In addition, classical Unani manuscripts and texts were systematically reviewed to obtain historical perspectives and detailed descriptions of urine examination methods practiced in the Unani tradition. The gathered information was then subjected to qualitative analysis to identify major findings, as well as to compare and contrast the diagnostic approaches of Unani and modern medicine.

RESULTS

The study revealed that urine examination has held a pivotal role in both Unani and modern medical diagnostics, reflecting a shared emphasis on observation and interpretation of urinary characteristics for disease identification. The comparative analysis demonstrated that while Unani medicine focuses on qualitative aspects such as color, odor, consistency, and sediment to assess humoral imbalances, modern medicine employs

advanced biochemical and microscopic techniques for precise diagnosis. This exploration highlights that integrating traditional Unani insights with modern scientific methods can enhance diagnostic accuracy and promote a more holistic, patient-centered approach to healthcare. The findings underscore the potential for meaningful collaboration between traditional and contemporary systems of medicine, fostering innovation and comprehensive patient care.

DISCUSSION

Historical background

In ancient times, the symbol representing urine was derived from a combination of the symbols for water and the phallus.^{8,9} Around 4000 B.C., Sumerian and Babylonian physicians recorded their medical observations on clay tablets. The Sumerians, among the earliest known civilizations, understood that various diseases could alter the color and consistency of urine.⁹

In the 4th century B.C., Hippocrates suggested that urine was a product formed from the filtration of the four bodily humours as it passed through the kidneys.¹⁰ Furthermore, Hippocrates described the different types of urine associated with various diseases, while also outlining the characteristics of urine in healthy individuals.^{11,12} Galen asserted that the kidneys functioned to attract and eliminate excess or harmful humours, making urine a reflective indicator of the body's humoral balance.¹³

During the Middle Ages, urine was regarded as the primary bodily fluid for diagnostic examination and was extensively discussed by prominent scholars, Zakariyyā Rāzī, (Rhazes, 865–925 AD) and Ibn Sīnā, (Avicenna, 980–1037 AD).¹⁴ Furthermore, Unani scholars have provided detailed guidelines for the proper collection and examination of urine. The renowned Persian scholar Ismael Al-Jurjānī, recommended that urine should be collected in a large, transparent, and clean container, ideally shaped like a bladder—a round-bottomed flask referred to as a *Qārūra*.¹⁵

During the Byzantine era, the earliest recorded laboratory procedure was described by Theophilus Protospatharius, who conducted experiments by heating urine samples. He observed that proteinuria could be detected as cloudiness caused by the precipitation of proteins upon heating. Additionally, Byzantine uroscopists advanced the examination of urine sediment through stratification techniques. This innovation contributed to the evolution of the *Matula*, transforming it from a simple bulbous vessel into a more complex container designed to reflect the shape of the human body.¹⁶ De Corbeil developed the *Matula*, a transparent, thin-glass bladder with a rounded bottom, designed to be held up to the light for detailed observation. It was also referred to as a 'jorden', a glass vessel used by physicians to assess urine for its color, consistency, and clarity.¹² Historical accounts suggest that

the *Matula*, a specially designed glass jar, was first described by Hippocrates.¹⁶ According to De Corbeil, the various sections of the vessel represented different parts of the body. The *Matula* was vertically divided into four levels: the top level corresponded to diseases of the head, the second to the heart and lungs, the third to the abdomen, and the fourth to the urogenital organs.¹⁷

In the 15th century, De Ketham introduced a self-diagnostic color wheel that enabled individuals to assess their own health. This system consisted of a *Matula* at the center, encircled by a large, circular wheel displaying 21 different urine colors for comparison.¹⁸ For diagnostic purposes, the color and consistency of a urine sample were compared with the corresponding color on the *Matula*. Additionally, the four-body temperaments were represented in four small circles, positioned at each corner of the wheel.¹⁹ The urine color wheel was primarily grounded in the Hippocratic theory of the four bodily humours and their role in disease.²⁰

Later, in the 16th century, Paracelsus' followers further advanced urine analysis by incorporating alchemical (*chymical*) techniques into its examination.¹⁸

Various tools and techniques used in Unani medicine for diagnostic purposes, with particular emphasis on urine examination

Role of the ṭabīb (physician) in assessing & interpreting urine

Ancient Unani physicians held a central role in the practice of urine examination. As highly trained and experienced practitioners, they possessed in-depth knowledge of Unani principles, particularly the Naẓariyya'-i-Akhlāt (humoural theory) and Mizāj (temperaments). By carefully observing features such as the color, odor, consistency, and sedimentation of urine, they were able to extract valuable diagnostic information. These observations were then linked to specific disease patterns, allowing physician to design personalized treatment plans.

Urinalysis methods and interpretations

Urine analysis in Unani medicine is based on observing key characteristics such as color, density, clarity or turbidity, sedimentation, volume, odor, and the presence of froth.¹⁴ Avicenna recommended specific preliminary steps to be followed before conducting urine examination.²¹

The urine sample should be collected first thing in the morning.

The patient should avoid eating or drinking for an extended period before the test, ideally from the night before.

Urine should not be examined immediately; instead, it should be allowed to settle for a while before analysis.

Patients must refrain from consuming foods or medications that can alter urine color, such as beetroot or saffron.

Avicenna also noted that certain external substances, like henna, could affect urine color due to skin absorption.^{22,23}

He emphasized that urine should be examined promptly after voiding, ideally within six hours, as delayed analysis could lead to color changes and the disappearance of foam, compromising diagnostic accuracy.²²

Identifying disease patterns through urinalysis

The comprehensive understanding of urine examination in Unani medicine enabled physicians to recognize patterns linked to a wide range of disease conditions. Classical Unani texts recorded these observations in detail, offering essential insights for diagnosis, treatment planning, and even disease prognosis. Key indicators included urine color, consistency, clarity, sediment, volume, odor, and the presence of froth.

Color (alwān al-bawl)

Avicenna noted that variations in urine color could reflect underlying health issues in different parts of the body. He observed that patients experiencing symptoms such as headaches, insomnia, hearing loss, or mental disturbances might also exhibit changes in urine color. Based on this observation, he classified urine into five distinct types according to its color.

Bawl aṣḡar (yellow urine): Ibn Sīnā, classified Zard Qārūra into several shades— Bawl Tibnī (straw-yellow), Bawl Utrujī (citron yellow), Bawl Ashqar (reddish-yellow), Bawl Aṣḡar Nāranjī (orange-yellow), Bawl Nārī (flame-yellow), and Bawl Za'frānī (saffron-yellow), each reflecting varying degrees of heat, hyperactivity, pain, starvation, or dehydration.²⁴

Bawl aḡmar (red urine): The red color of urine has four shades: Aṣḡab (yellow-reddish), Wardī (rose-red), Aḡmar Qānī (intense red), and Aḡmar Aqṡam (blackish-red), all indicating blood dominance and increased Ḥarārat. In acute fevers, excessive bile causes urine to appear saffron or flame yellow. Persistent red urine without sediment in acute illness suggests renal inflammation, while turbid red urine indicates hepatic inflammation and deficient innate heat.²⁵ In conditions like Falij (paralysis), Sū'al-Qinya (anemia), and Qūlanj Barid (cold colic), urine appears red.²⁶ In kidney diseases, red urine denotes a hot inflammatory process.²²

Bawl akḡdar (green urine): Unani scholars describe several types of green urine: Fustuqī (pistachio green), Zanjārī (verdigris green), Nīljī (emerald green), and Āsmānjūnī (sky green). Except for verdigris and leek green, all shades indicate severe combustion, while Fustuqī suggests a cold temperament. In children, Fustuqī

and Nīljī urine signify Tashannuj (spasm).²⁶ Sky green urine denotes intense cold or, in some views, poisoning.²⁴

Bawl aswad (black urine): The black color of urine is mainly due to the combustion of Ṣafrā' (yellow bile), Dam (blood), and abnormal Sawdā' (black bile). Dark urine with a strong odor signifies dominant heat, while a faint smell indicates a cold temperament. It may also appear dark during the return of menstruation, after relief from bleeding piles, or following diuretic and emmenagogue use. In amenorrhea, dark urine results from the elimination of waste materials.^{27,28}

Bawl abyad (white urine): Based on transparency and whiteness, urine is classified into two types:

Abyad haqīqī (translucent): Absolutely white like milk, indicating Balgham (phlegm).

Abyad majāzī (transparent): Denoting cold temperament and defective maturation.

White urine is further divided into eight varieties:

Bawl Mukhāṭī (mucilaginous urine): Denotes excess of immature phlegm.

Bawl Dasmi (oily urine): Urine that contains emulsified fat derived from tissues.

Bawl Ihālī (waxy urine): Denotes actual or threatened dissolution of tissues.

Bawl Fuqqā'ī (champagne-like urine): Indicates ulceration of urinary tract, without pus indicates presence of partially matured phlegm or stone in the bladder.

Bawl Manwī (semen-like urine): Passes during crisis of phlegmatic swellings, in case where the tissues are loose and in diseases caused by vitreous phlegm.

Bawl Raṣāṣī (lead-white urine): Urine which is a grave sign when passes without sediment.

Bawl Labanī (milky urine): A fatal sign when passed in the course of an acute fever.

Bawl Ghusālī (urine like color of raw-meat washings): Denotes weakness of liver or excess of blood.²⁴

Density (qīwām al-bawl)

Based on its density urine can be dilute, concentrated and moderate

Bawl Raqīq (urine of thin consistency): Generally, shows that maturation is incomplete and sometimes indicates excessive fluid consumption, obstruction in the blood vessels or weakness of kidneys, Renal failure in febrile

children, if urine continues to be very dilute, renal insufficiency is indicated.

Bawl Ghalīz (urine of thick consistency): Generally, shows defective maturation and sometimes indicates elimination of thick mature humours. When a healthy person's urine turns concentrated, it often indicates that a fever may soon develop; however, in healthy individuals, it can also simply be due to dehydration.²⁴

Turbidity

Urine turbidity occurs when air (Rīḥ) mixes with the earthy particles in the fluid. Cloudy urine is often associated with renal failure. A foggy or smoky appearance at the bottom of the urine suggests a poor prognosis and is often followed by death after a prolonged illness. Turbidity may also result from the discharge of obstructive substances from the liver or nearby tissues. In some cases, urine becomes highly turbid similar to that of cattle or donkeys due to imbalance of humours, particularly the formation of thick air (Rīḥ) from immature phlegm under heat, which may also indicate the presence of a headache.²⁴

Odor (rā'īḥa al-bawl)

Urine with a sweat-like smell indicates the predominance of Damwi Khilṭ (sanguine humour). A strong, pungent odor suggests an excess of Ṣafrā' (bile), while a sour or acidic smell reflects the dominance of Sawdā' (black bile). A foul (Muntin) odor accompanied by signs of maturation in the urine points to the presence of ulcers in the urinary tract or scabies.²⁵ Odorless (Al-Bawl al-'Adīm al-Rā'īḥa), black urine is considered a sign of Bārid Mizāj (cold temperament). In cases of acute illness, if urine that previously had an odor becomes odorless, it indicates a weakening or impairment of the Quwā (powers).²⁸ Avicenna stated that foul-smelling urine, along with itching, pain in the bladder region, and the presence of pus in the urine, are indicative of bladder pustules.²⁹

Froth (zabada al-bawl)

Froth in urine forms due to the mixing of Rīḥ (air) during urination. Large bubbles of Rīḥ are typically seen in patients experiencing excessive abdominal distension. Dark or orange-colored froth suggests the presence of jaundice, while an abundance of urine bubbles (Kathra al-Zabad), which denotes viscosity of matter and presence of gas. If the froth persists, it signifies that the excreted matter is thick or viscous. Increased viscosity of urine is considered an unfavorable sign in kidney disorders, as it indicates the presence of abnormal Balgham (phlegm) or Sawdā' (black bile) in the body.²⁴

Sediments (rasūb al-bawl)

Sediment composition, provide important insights into the body's condition. Abnormal urinary sediments and their significance are as follows:²⁴

Rasūb Khurāfī (Flaky): Large red or large white sediments, usually coming from organs of urinary system; white flaky sediments come from the bladder and red or fleshy flaky sediments come from the kidney. Dusky red suggests liver disorder. Squamous deposits in acute illness indicate serious conditions.

Rasūb Laḥmī (Fleshy): arise from kidneys or from the breakdown of tissues in the body

Rasūb Dasmī (Fatty): Two types—abundant and discrete (renal fat) or scanty and mixed (distant fat). Rapid sinking indicates urethral ulcers with pus.

Rasūb Mukhāfī (Mucoid): Indicates the presence of large quantity of thick immature humour in the body, possibly cold kidney temperament. In gout, abundant mucoid sediment at the end of an attack is favorable.

Rasoob Middi (Purulent): Denote discharge of pus from ulcers of urinary organ.

Rasūb Sha'rī (fibrillary): Indicate that active heat has coagulated the elongated exudates and converted them into fibrils.

Rasūb Khamīrī (like a wet piece of leaven): Denote weakness of stomach and intestine and impairment of digestion.

Rasūb Ramlī (Sandy): indicate stone formation or stone disintegration.

Rasūb Ramādī (Ashy): Shows serous humour or pus has stagnated and broken down.

Rasūb 'Alaqī (sediments of blood clots): Well-mixed with urine indicates liver insufficiency; discrete suggests bladder or urethral lesion.

Modern diagnostic perspectives on urine examination

In modern medicine, urine analysis has advanced with sophisticated laboratory techniques. These methods allow clinicians to gather detailed information about a patient's health and assist in diagnosing various conditions.

Clinical laboratory assessment of urine sample

Modern urine examination primarily relies on laboratory analysis. Urine samples undergo a series of tests to evaluate their physical, chemical, and microscopic characteristics. Initially, visual inspection assesses color, clarity, and any unusual features such as cloudiness. Chemical analysis then measures substances like glucose, protein, ketones, bilirubin, and urobilinogen. Microscopic examination, enhanced by the invention of the compound microscope,³⁰ allows the identification of cellular elements including red and white blood cells, epithelial cells as well as crystals, casts, and bacteria. These findings provide

valuable indicators for diagnosing specific medical conditions.

Clinical relevance of urinalysis parameters

Modern urine analysis provides vital clinical information for diagnosing and managing various diseases. Key urinalysis parameters are particularly significant; for example, elevated urine glucose (glycosuria) may indicate diabetes mellitus or other disorders of glucose regulation.^{31,32} The presence of protein in urine (proteinuria) can signal kidney dysfunction or other underlying health issues.³³⁻³⁵ The presence of ketones in urine (ketonuria) may indicate diabetic ketoacidosis or prolonged fasting/starvation.³⁶⁻³⁷ The detection of red or white blood cells in urine may indicate kidney infections, urinary tract infections, or other urological disorders.³⁸⁻⁴⁰ Additionally, the presence of crystals in urine can suggest kidney stones or underlying metabolic disorders.

Advanced imaging techniques in urinary tract evaluation

In addition to laboratory tests, modern medicine uses advanced imaging techniques to assess the urinary tract and associated organs. Methods like ultrasound, CT, and MRI offer detailed anatomical insights, enabling clinicians to detect and diagnose conditions affecting the kidneys, bladder, and urinary system.⁴¹⁻⁴³ Furthermore, specialized tests such as urodynamic studies are used to evaluate bladder function and help diagnose urinary incontinence or other bladder disorders.⁴⁴⁻⁴⁶ The combination of advanced laboratory tests and imaging has made urine examination a comprehensive diagnostic tool. Comparing ancient Unani and modern approaches highlights their similarities, differences, and potential complementarities.

Converging concepts and observations

Both systems view bodily fluids as essential reflections of an individual's overall health and potential disease conditions. The Unani system and modern urinalysis share striking similarities in their diagnostic approach, both closely examine the color, clarity, and appearance of urine, as well as the presence of sediments. These observations are considered valuable for identifying underlying imbalances or pathological changes in the body.

Methodological and interpretative differences

Although both systems emphasize urine examination, their techniques and interpretations differ significantly. In Unani medicine, urinalysis is guided by holistic principles and personalized assessment based on an individual's temperament and the balance of bodily functions. In contrast, modern urinalysis relies on standardized laboratory methods that yield quantitative, objective results. The Unani approach also considers sensory attributes such as odor and foam formation aspects largely absent in modern analysis. Meanwhile, contemporary medicine employs advanced technologies and imaging

tools to study the urinary system capabilities that were unavailable in ancient Unani practice.

Integrative perspectives: Unani and modern medicine

Despite clear differences, Unani and modern scientific approaches to urine examination can complement one another. Unani's holistic and individualized perspective provides deeper insight into a person's constitution and overall wellbeing, while modern urinalysis delivers precise, objective data for accurate diagnosis. Integrating Unani principles with modern laboratory techniques can foster more personalized treatments and a comprehensive understanding of health.

Exploring correlative insights and practical implications

Comparing urine examination in Unani and modern medicine offers opportunities to uncover correlations between traditional humour imbalances and modern biomarkers. Such insights could enhance understanding of disease patterns and support more precise diagnostic methods. This approach may also inform personalized treatment strategies that account for an individual's constitution, lifestyle, and environment, improving patient outcomes.

From challenges to opportunities: paving the way forward

Integrating Unani practices with modern healthcare faces challenges due to differences in terminology, methodology, and cultural context. Collaborative efforts and scientific research, including clinical trials, are needed to ensure safety and efficacy. Traditional diagnostic methods like urine analysis (Mu'āyana'-i- Bawl) can be correlated with modern laboratory techniques to enhance diagnostic accuracy. Educating healthcare professionals and the public can further promote the acceptance of such integrated approaches.

CONCLUSION

In conclusion, studying urine examination through both Unani and modern scientific perspectives provides a valuable opportunity to blend traditional wisdom with contemporary medical advancements. Through interdisciplinary research, education, and collaboration, a balanced integration of Unani and modern practices can be achieved, enhancing patient care and advancing medical science. As this exploration continues, the commitment to holistic, patient centered healthcare will guide us toward a healthier and more compassionate future.

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