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STORAGE AND AESTHETIC DEVICE OF DRINKING WATER WHICH IS ECO-FRIENDLY AND ELECTROLYTE REPLENISHER

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ABSTRACT

A surahi is a traditional Indian long-necked, bulbous vessel, usually made of clay (terracotta) or metal, designed to store water or liquids. It is used to keep water naturally cool in summer, for storing alcohol, and as a decorative centrepiece. Synonyms and similar terms include pitcher, jug, matka, or vessel.

KEYWORDS: clay, matka, ghada, surahi, pitcher.

INTRODUCTION

The surahi is a traditional, long-necked terracotta water vessel, originating in India over 4,000 years ago, that cools water via natural evaporation. Dating back to the Indus Valley Civilization, these clay pots have been used for centuries to store, transport, and cool water, acting as a sustainable, non-electric alternative to refrigerators.

Key Aspects of the Surahi

Cooling Mechanism: Its porous clay body allows small amounts of water to seep through and evaporate, which cools the water inside.

Historical Usage: Terracotta models of these vessels were found at sites such as Harappa, Mohenjodaro, and Mehrgarh, which date back to around 7,000 BC.

Health & Culture: Surahis are considered auspicious in Hindu belief for embodying nature's five elements. They are also associated with providing, naturally cooled water with improved pH levels.

Modern Adaptation: While historically made of clay, they are still used in states like Rajasthan and Madhya Pradesh, often paired with metal stands, for both storage and aesthetic, sustainable lifestyle purposes.

Key Aspects of Surahi

Usage: Used primarily for keeping water cold naturally by evaporation, making it a sustainable water container. They are also used for home decor, weddings, and serving drinks.

Material: Often constructed from terracotta (mitti), brass, or white metal with intricate engravings.

Design: Features a long, narrow neck and a broad, bulbous base, sometimes featuring traditional decorations or paintings.

Figure-1: Surahi.

Usage Examples

Clay/Terracotta Surahi: Used in households for keeping water naturally cold and eco-friendly drinking water.

Brass/Metal Surahi: Frequently used as decorative items (vases) or for serving purposes in restaurants.

Synonyms and Related Terms

- Pitcher
- Jug
- Earthen Pot/Matka/Surahi
- Vessel
- Vase
- Aftaba (often a metal pitcher). An .aftaba (or aftabeh) is a traditional water vessel, typically made of metal (copper, brass) or plastic, featuring a long, angled spout, a narrow neck, and a handle. Originating from Persian culture, it is primarily used for hand washing, personal hygiene, and ritual ablutions in South Asia and the Middle East.

Water stored in a surahi (traditional Indian clay/terracotta pot) is naturally alkaline. Because terracotta is alkaline, it interacts with the water to raise its pH level, helping to balance the body's acidity and improve digestion.

Natural Alkalinity: The clay contains minerals (like calcium and magnesium) that leach into the water, raising the pH.

Benefits: It helps to neutralize body acidity, acting as a natural antacid.

Temperature Regulation: The porous nature of the surahi allows water to evaporate, keeping it cool and refreshing, typically around to 15^{O}C.

Maintenance: To maintain this alkaline effect, it is recommended to wash the surahi regularly and place it in the sun to dry.

A Surahi (terracotta pot) typically keeps water 5°C to 10°C cooler than the ambient temperature through natural evaporative cooling. In typical hot climates, water in a Surahi usually stays between 15°C and 25°C, providing a refreshing, natural chill without electricity, particularly efficient during dry, warm weather.

How it Works: The porous clay allows water to seep through, evaporating on the surface and drawing heat away from the water inside.

Optimal Use: Works best in dry environments with low humidity.

Temperature Differential: Provides roughly (10°C or 18°F) reduction in temperature, making warm ambient water feel crisp and cool. Surahi (earthen/clay pot) water is alkaline in nature. Because clay is alkaline and contains natural minerals like calcium and magnesium, it interacts with stored water to balance its pH, typically neutralizing acidity and providing a higher pH level. This makes it beneficial for reducing stomach acidity.

Key Characteristics and Benefits

pH Balance: The alkaline nature of clay counteracts the acidic content of the human body, helping to regulate overall pH levels.

Natural Cooling: Surahis are porous, allowing water to evaporate, which keeps the water naturally cool.

Mineral-Rich: Clay enriches the water with natural minerals, enhancing its health benefits.

Improved Digestion: Drinking water from a matka or surahi is known to aid digestion and reduce stomach issues like bloating or burning sensations.

Safe Storage: Unlike plastic bottles, earthen pots are free from chemicals like BPA, offering a safer alternative.

Surahi (earthen pots) make water cold through a natural process called evaporative cooling. The clay's porous surface allows water to seep out, and as it evaporates, it absorbs heat from the water inside, cooling it naturally without electricity.

Figure-2: Preparation of surahi.

How it Works: The tiny pores on the clay pot allow moisture to move to the outer surface, causing a natural cooling effect through evaporation.

Benefits: Water from a surahi is refreshing, tastes earthy, and is healthier than refrigerated water, offering a natural coolness suitable for digestion.

Why It's Special: This ancient Indian method keeps water at an ideal, refreshing temperature rather than freezing it like a refrigerator.

Maintaining Coldness: Keeping the surahi in a shaded, well-ventilated area—or wrapped in a damp cloth—enhances this natural refrigerator effect.

A surahi (traditional Indian water pitcher) is crafted from specially prepared, porous clay designed for natural cooling. Artisans, or karigars, select, clean, and refine natural clay, often mixing it to improve workability before shaping it on a potter’s wheel. The pot is dried in the sun and finally fired in a kiln.

Key Steps in Surahi Preparation by Karigars

Clay Selection & Preparation: Artisans select high-quality natural clay, removing impurities such as stones and roots. The clay is often mixed with water to create a soft, workable dough, ensuring it is pliable for throwing on the wheel.

Throwing (Shaping): The karigar places the clay on the revolving potter's wheel (chaak), using their hands to create the distinctive narrow neck and wide base of the surahi.

Drying: Once shaped, the surahi is air-dried in the shade to remove initial moisture. It is then placed in the sun to become "leather-hard".

Thermal Regulation: A surahi (or terracotta pot) typically keeps water at a refreshing temperature of roughly to (24-27^{O}C), which is considered "cool" rather than ice-cold. This natural cooling is achieved through evaporation, often keeping water 10-15^{O}C) cooler than the ambient environment, even when outside temperatures reach 40-45^{O}C. An isothermal process is a thermodynamic change where a system's temperature (T) remains constant ($\Delta T=0$). It requires slow, quasi-static energy exchange to keep internal energy (U) stable for ideal gases. Heat added (Q) equals work done (W) by the system (Q=W).

Key Characteristics and Behaviour

Constant Internal Energy: For an ideal gas, since temperature remains constant, the internal energy does not change ($\Delta U=0$).

Pressure-Volume Relationship: According to Boyle's Law (PV=Constant), if volume decreases, pressure increases proportionally.

Heat Flow: To keep T constant during expansion, the system must absorb heat. During compression, heat is released.

PV Diagram: Represented as a hyperbola called an isotherm, where the area under.

Isothermal vs. Adiabatic
Isothermal: Constant temperature, heat exchange occurs ($Q \neq 0$).
Adiabatic: Temperature changes, no heat exchange occurs ($Q=0$).

The cooling effect in a surahi (earthen pot) is an adiabatic process, specifically an adiabatic evaporative cooling process. Water evaporates through the pores, taking its latent heat from the water inside. The system does not exchange heat with the surrounding environment to cool down; instead, energy is conserved inside the system.

Figure-3: Surahi & Ghada [Clay & Metal].

Key Details
Adiabatic Nature: The cooling relies on the evaporation of water, which uses the internal energy of the remaining water, fitting the definition of adiabatic cooling where latent heat is consumed without outside heat transfer.

Process: Water evaporates from the pores of the clay pot, removing heat from the internal water to turn it into vapour (latent heat of vaporization).

Temperature Drop: Because this heat is taken directly from the water's internal energy, the water temperature drops.

The latent heat of vaporization of water is the energy required to convert liquid water into steam at its boiling point ($100^{O}C$ or $212^{O}F$) which is approximately 2260kJ/kg. This high energy requirement is crucial for temperature regulation in biological and environmental systems.

Key Values and Units
SI Units: 2260kJ/kg or CGS Units: 540cal/g (approximate)
Specific Units: 40.8 kJ/mol
Temperature Dependence: The heat of vaporization slightly decreases as temperature increases.
Water stored in a surahi (earthen pot) typically has a mild alkaline pH, often ranging between 7.0 and 8.0 or slightly higher, which helps neutralize acidity in the body. The alkaline nature of the clay interacts with the water to raise its pH, while the porous material provides natural cooling.

Alkalinity: Clay is naturally alkaline, which balances the pH of water and makes it beneficial for neutralizing acidic foods in the body.

Mineral Richness: As water sits, it picks up trace minerals like calcium, magnesium, and iron from the clay.

Optimal Temperature: The water is naturally cooled through evaporation to a refreshing temperature, which is generally better for the throat than water from a refrigerator.

The pH enhancement is a natural process of the unglazed, porous clay, which makes the water healthier and more refreshing, particularly during hot summer. Surahi (terracotta/earthen) water pots naturally increase the water's pH, typically making it mildly alkaline, which helps balance the body’s acidic levels. The alkaline clay interacts with water, reducing acidity and gastric issues. This natural process often yields a pH range favorable for health, frequently noted as 7.0 or higher.

Key Benefits of Surahi Water
Alkaline Balance: The alkaline clay neutralizes acidity, improving metabolism.

Natural Cooling: Porous clay allows evaporation, cooling water naturally, which is gentle on the throat.

Mineral Rich: The clay adds minerals like calcium, magnesium, and potassium to the water.

Improved Taste: It provides a refreshing, earthy taste.

Cleaning Tip: To maintain effectiveness and safety, it is recommended to clean the surahi regularly to prevent mineral build-up and ensure hygienic storage.

Ghada" primarily refers to a traditional Indian earthen clay pot or pitcher (matka) used for storing and cooling water. Often handcrafted, these vessels are prized for natural cooling, eco-friendliness, and sometimes feature intricate designs. They are also made from brass or

copper for decorative or religious purposes, such as pooja.

Key Aspects of Ghada (Pottery)
Purpose: Primarily used for natural water cooling, purification, and storage.

Material: Traditionally terracotta (mud/clay), but also available in brass, copper, and stainless steel.

Cultural Significance: Used in Indian households for drinking water and in traditional ceremonies.

Variants: Ranges from simple, handmade clay pots to decorated metal pitchers.

Making a surahi (traditional Indian water pot) on a pottery wheel involves cantering clay, opening it, and carefully pulling the walls up to form a long, narrow neck and a wide base. This technique requires expert shaping, usually created by assembling two separate parts (body and neck) on a rotating wheel, often with hand-finished, intricate details.

Surahi (traditional water pitchers) are typically thrown from earthenware clay on a potter's wheel and fired in a kiln at low temperatures, generally between to 800-1000^{O}C. This relatively low temperature preserves the porosity of the clay, which is essential for the evaporative cooling that keeps water inside the surahi cool.

Key Firing & Production Details for Surahi
Firing Type: Low-fire (often called Earthenware or Terracotta).

Temperature Range: Often fired in the Cone 06 to Cone 04 range (approx. 900-1100^{O}C), but traditional rustic techniques may use lower, more variable heat.

Purpose of Temp: It must be high enough to make the pot sturdy but low enough to maintain the microscopic pores required for water to seep through and evaporate, providing natural refrigeration.

Steps in Making a Surahi
- **Centering:** A firm ball of clay is centered on the rotating wheel head.
- **Opening & Forming Body:** A hole is made in the centre, and the base is shaped into a rounded, wide belly.
- **Creating the Neck:** A long, narrow neck is created separately or pulled from the main body, ensuring the characteristic slender shape of the surahi.
- **Refining and Smoothing:** Water is used to smooth the surface as the wheel rotates.
- **Trimming & Finishing:** After partial drying (leather-hard stage), the piece is trimmed on the wheel to remove excess clay and perfected for its final form.
- **Firing:** The finished, dry piece is then fired in a kiln.
- **Tools Commonly Used:** Electric/Manual Pottery Wheel: For spinning the clay.

CONCLUSION

Terracotta surahis (traditional water pitchers) are finalized by firing them in a kiln or traditional pit at high temperatures, usually around 1000^{O}C, converting raw clay into durable pottery. This final, crucial step follows shaping and drying, hardening the clay to ensure it is porous enough to cool water through evaporation while being strong enough for daily use.

Final Firing Process: The dried, unglazed (or glazed) pottery is placed into a kiln. The temperature is gradually increased to roughly 1000^{O}C to initiate vitrification, where the clay particles melt and fuse together.

Colour Transformation: The firing process transforms the clay, resulting in distinct colors such as orange, red, brown, yellow, or gray, depending on the clay composition and firing environment.

Cooling Phase: After the firing, the surahi is slowly cooled down, often covered in sand to prevent cracking, before being ready for use.

This ancient, sustainable method of firing results in a functional, eco-friendly vessel capable of cooling water, commonly used in regions like Rajasthan and Uttar Pradesh.

REFERENCES

1. https://en.wikipedia.org/wiki/Matki_(earthen_pot)