

URINE: RENEWABLE ENERGY SOURCE FOR HYDROGEN FUEL

Prajapati Parimal M.*, Ganatra Maulik H., Patel Krunal R., Patel Yogesh A. and Solanki Anil S.

I. K. Patel College of Pharmaceutical Education and Research, Himatnagar, Dist: S.K. Gujarat, India

*Parimal M Prajapati, Department of Pharmaceutical Chemistry, I.K.Patel Colleg of Pharmaceutical Education and Research, Samarth campus, Opp.Sabar dairy, Himatnagar, and Dist: S.K. Gujarat, India
Email: swami.parimal@gmail.com

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ABSTRACT

Urine is a type of waste product that comes from our kidneys. Normal urine is clear, straw-colored and slightly acid. The main parts of urine are: Excess water from fluid that our body doesn't need, Urea is one of the waste products, our body makes when it uses the protein we eat, Electrolytes and minerals, Pigment (which gives urine its color). Urine's major constituent is urea, which incorporates four hydrogen atoms per molecule – importantly, less tightly bonded than the hydrogen atoms in water molecules. Electrolysis breaks down the urea, releasing hydrogen 'During the electrochemical process the urea gets adsorbed on to the nickel electrode surface, which passes the electrons needed to break up the molecule,' Pure hydrogen is evolved at the cathode.

KEY WORDS: Electrolytes, Pigment, Urea

INTRODUCTION

Urine is made up of excess water and dissolved waste materials which are secreted by the kidney via a process called filtration from the bloodstream and eventually expelled via the urethra from our body through a process called urination. It is an elimination process of liquid waste product from what we have been eating and drinking that our body wants to eliminate. Urine is a type of waste product that comes from your kidneys. Normal urine is clear, straw-colored and slightly acid. The main parts of urine are: Excess water from fluid that your body doesn't need, Urea is one of the waste products your body makes when it uses the protein you eat, Electrolytes and minerals, Pigment. Lot of ions and chemicals, salts, proteins, enzymes, hormones, and other metabolites are found in urine. Human urine has strengthening and curative characteristics concerning many deficiencies. A mixture of potato and sulphur powder, mixed with heated, old urine helps against hair loss. One should rub this mixture into the scalp; this slows down loss of hair. All kinds of throat inflammation can be helped by gargling with urine to which a bit of saffron has been added. Trembling hands and knees can be helped by washing, and rubbing one's own warm urine into the skin directly after one has urinated¹. (Fig.1)

A universal and excellent remedy for all distempers inward and outward. Drink your own water in the morning nine days together and it cures the scurvy, makes the body lightsome and cheerful. It is good against the dropsy and jaundice, drunk as before. Wash your ears with it warm and it is good against deafness noises and most other ailments in the ears. Wash your eyes with your own water and it cures sore eyes and clears and strengthens the sight. Wash and rub your hands with it and it take away numbness, chaps and sores and makes the joints limber. Wash any green wound with it and it is an extraordinary good things. Wash any part that itches and it takes the itch away. Wash the fundament and it is good against piles and other sores².

HOW URINE IS FORMED?

The kidneys are one of the main urinary system organs, and are made up of millions of tiny structures, which form the basic unit of each kidney, known as nephron. This nephron consists of a cup shaped

structure known as glomerulus's, which then merges into a tube known as the proximal tubule. The proximal tubule then gives rise to a U shaped structure known as loop of Henle or Henle's loop, which finally merges into the distal convoluted tubule, which carries the urine into the collecting tubules. The waste material along with blood is brought to kidneys by the renal arteries. Blood is filtered out from blood capillaries into Bowman's capsule under pressure which is known as Ultrafiltration³ (Fig.2).

This filtrate passes through the lumen of tubular parts of nephron. During these useful products such as water, glucose, amino acid, materials, ions etc. are reabsorbed by blood capillaries surrounding the nephron. The remaining fluid contains excretory substance and is called urine. From the ureter urine passes into urinary bladder where it is stored. When the bladder is filled with urine, it contracts and urine passes out of the body⁴.

COMPOSITION OF URINE

Urine contains an assortment of inorganic salts and organic compounds, including proteins, hormones, and a wide range of metabolites. Chemical composition of urine these are: urea, uric acid, creatinine, sodium, potassium, calcium, magnesium, water, chloride, ammonia, sulphate, phosphate. The typical color can range from clear to dark amber, depending mostly upon the level of hydration of the body, among other factors. Water - 95 per cent, other major and common constituents are sodium - 0.4 percent, ammonia - 0.05 per cent, phosphates - 0.6 per cent, urea - 2 per cent, sulfate - 0.2 per cent and creatine, urobilinogen, casts, etc. in minute quantities. Normally, soluble substances are excreted in the urine⁵ (Fig.3).

WHAT IS HYDROGEN?

Hydrogen is the simplest element known to exist. An atom of hydrogen has only one proton and one electron. Hydrogen has the highest energy content of any common fuel by weight, but the lowest energy content by volume. It is the lightest element, and a gas at normal temperature and pressure. Hydrogen is also the most abundant gas in the universe, and the source of all the energy we receive from the sun. The sun is basically a giant ball of hydrogen and helium gases. In a process called fusion, four hydrogen atoms combine to form one helium atom, releasing energy as radiation. Hydrogen is one of two natural elements that combine to make water. Hydrogen is not an energy source, but an energy carrier because it takes a great deal of energy to extract it from water. It is useful as a compact energy source in fuel cells and batteries. This radiant energy is our most abundant energy source. It gives us light and heat and makes plants grow. It causes the wind to blow and the rain to fall. It is stored as chemical energy in fossil fuels. The hydrogen found in urine is bonded much more loosely than in water. So loose, in fact, that by using simple and cheap materials hydrogen can be generated from urine using 1/3 of the voltage needed to make hydrogen from water⁶(Fig.4)

HYDROGEN IS AN EXCELLENT FUEL FOR MANY REASONS

Hydrogen is a very energetic fuel by weight, yielding around 33 kilowatt-hours per kilogram. This is two and a half to three times the energy of the same weight of conventional fuels, such as natural gas or petrol. However, hydrogen has a very low molecular weight⁷ (Fig.5).

- Carbon-free
- Exceptionally clean
- Lighter than air
- Odourless
- Non-toxic
- Safe to produce, store and transport
- Can be stored in large amounts
- Can be produced from a variety of resources

WHERE DOES HYDROGEN COME FROM?

It can be produced from natural gas, coal, biomass and oil, or from renewable energy sources such as wind, solar, geothermal and hydroelectric power. Uriner. Waste stream hydrogen is also available for capture from a variety of industrial processes. Communities can choose whichever resources make the most sense to make hydrogen, environmentally and economically. Hydrogen can also be produced locally, at large central plants or in small distributed units located at or near the point of use. This means

that every community, even remote areas, can become an energy producer. When produced using renewable energy sources and powering highly efficient fuel cells, the environmental benefits of hydrogen are even greater. Plus, hydrogen can be produced and stored using off-peak energy produced by renewable energy technologies such as solar, wind and tidal generation. When used with energy efficient fuel cells, hydrogen will play an important role in extending our current energy supplies as we move forward to a clean energy future⁸.

FROM WASTE TO ENERGY

- Liquid waste, which contains urea, from humans or livestock is stored.
- Urea separates from the water and is converted into ammonia.
- Ammonia is pumped into an electrolyzer.
- A power source, which may be renewable solar or wind energy, feeds an electrical charge into the electrolyzer.
- The electrolysis reaction at the anode produces nitrogen, which can be released to the air or bottled and sold.
- A reaction at the cathode produces hydrogen, which can be used to power a fuel cell that generates electricity.
- Using a nickel-based electrode, the scientists can create large amounts of cheap hydrogen from urine that could be burned or used in fuel cells. "One cow can provide enough energy to supply hot water for 19 houses⁹." (Fig.6).

HYDROGEN USE IN VEHICLES

Today, there are more than 300 hydrogen-fueled vehicles in the United States. Most of these vehicles are buses and automobiles powered by electric motors. They store hydrogen gas or liquid on board and convert the hydrogen into electricity for the motor using a fuel cell. Only a few of these vehicles burn the hydrogen directly (producing almost no pollution). The present cost of fuel cell vehicles greatly exceeds that of conventional vehicles in large part due to the expense of producing fuel cells¹⁰.

URINE TURNED INTO HYDROGEN FUEL

Using hydrogen to power cars has become an increasingly attractive transportation fuel, as the only emission produced is water - but a major stumbling block is the lack of a cheap, renewable source of the fuel. Using an electrolytic approach for production of hydrogen from urine - the most abundant waste on Earth - at a fraction of the cost of producing hydrogen from water. Urine's major constituent is urea, which incorporates four hydrogen atoms per molecule - importantly, less tightly bonded than the hydrogen atoms in water molecules. One molecule of urea, a major component of urine, contains four atoms of hydrogen bonded to two atoms of nitrogen. Stick a special nickel electrode into a pool of urine, apply an electrical current, and hydrogen gas is released. 'During the electrochemical process the urea gets adsorbed on to the nickel electrode surface, which passes the electrons needed to break up the molecule, Pure hydrogen is evolved at the cathode, while nitrogen plus a trace of oxygen and hydrogen were collected at the anode(Fig.7).

Urea molecule contains four hydrogen atoms, which, crucially, are less tightly bound to the molecule than the hydrogen in water. Splitting these bonds would require less energy, making hydrogen production more efficient. Hydrogen has been called "a renewable, versatile, simple sustainable domestic energy" because it can be produced from tap water to generate power for homes and cars¹¹⁻¹².

ADVANTAGE

- Hydrogen would appear to be the ideal fuel. It is available in great abundance and is non-toxic.
- Chemically binding hydrogen to other elements, like oxygen to create water, makes it easier to store and transport
- A fuel cell, urine-powered vehicle could theoretically travel 90 miles per gallon.

DIS ADVANTAGE

- Pee power is based on hydrogen, the most common element in the universe but one that has resisted efforts to produce, store, transport and use economically.

CONCLUSION

Using an electrolytic approach to produce hydrogen from urine - the most abundant waste on Earth - at a fraction of the cost of producing hydrogen from water.

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Figure 1: Urine

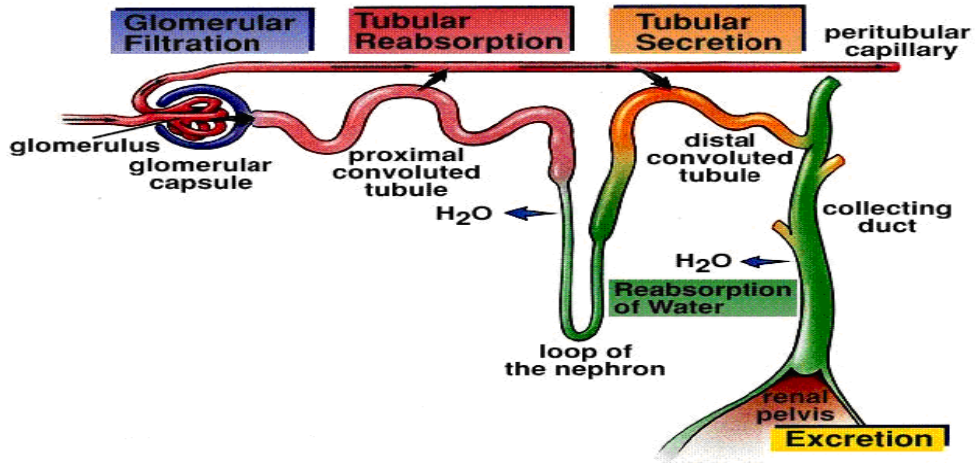


Figure 2: Urine formation

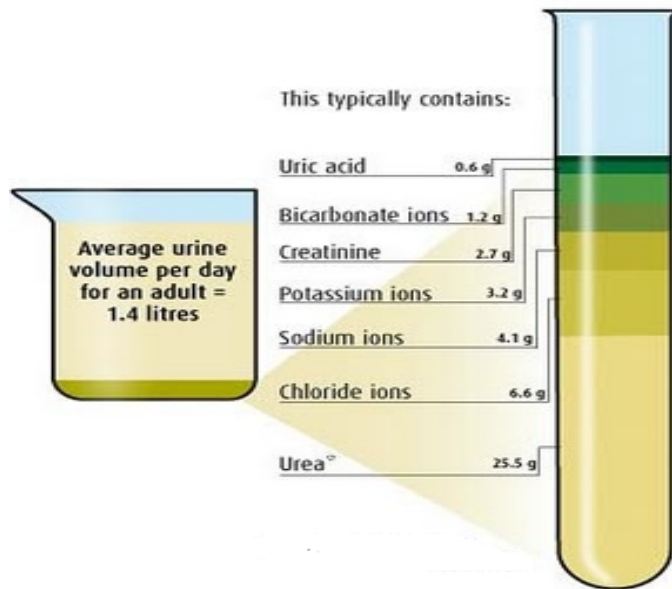
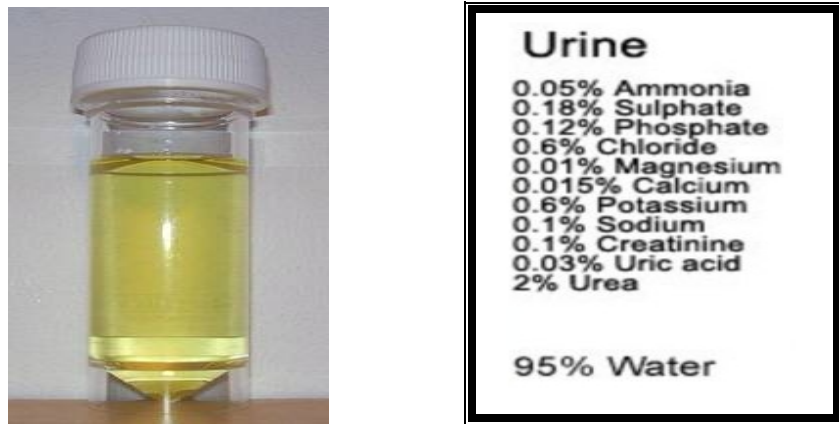


Figure 3: Urine content

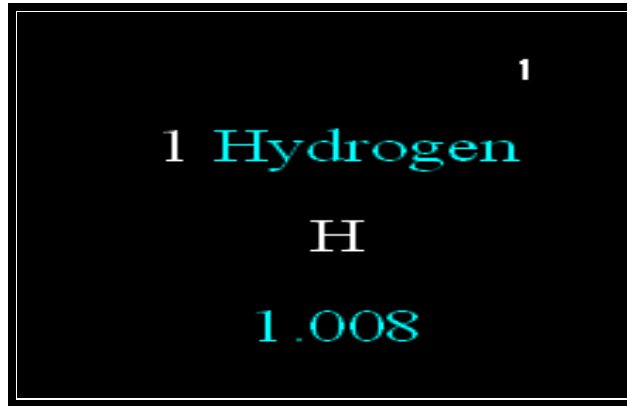


Figure 4: Hydrogen element



Figure 5: Hydrogen-Energetic fuel

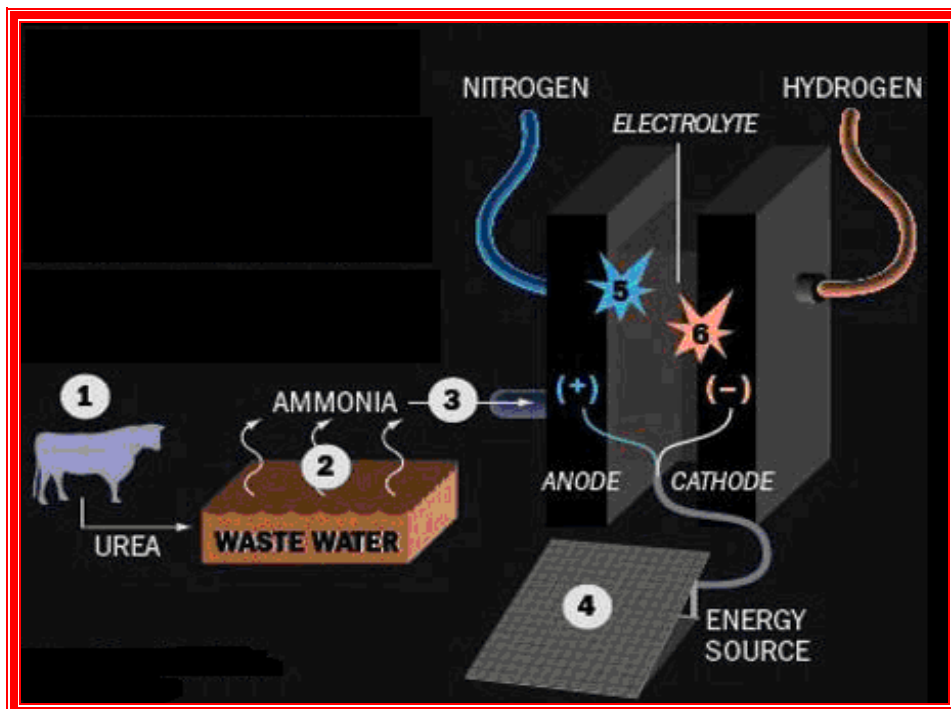


Figure 6: Hydrogen from urine

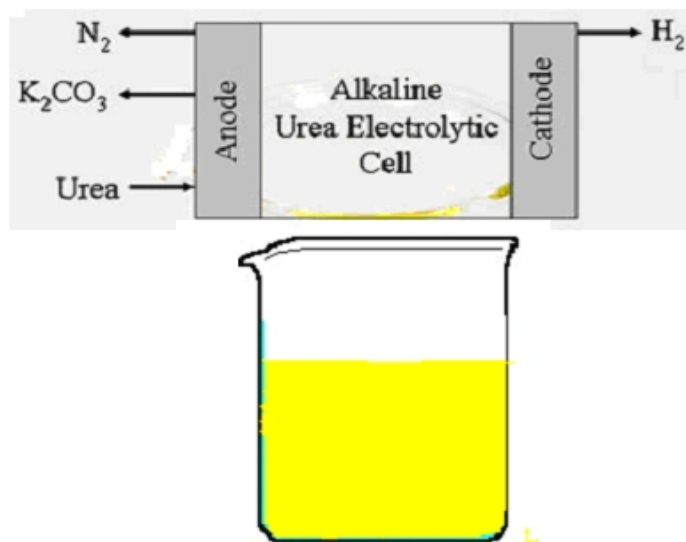


Figure 7: Electrochemical process