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Review Article

The Chemistry of Some Internal Human Organs and Its Biological Fluids

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Abstract

PH is a scale from 0-14 used to determine if substances or mediums are acidic, alkaline or neutral. Blood is a buffer solution with a PH of 7.4, and it resists change in PH as it contains week conjugate acid and base pair; carbonate HCO_3^- and carbonic acid H_2CO_3. Mediums and solutions can be either acidic, alkaline or neutral; acidic if their measured PH is less than 7, neutral if their measured PH is 7, and alkaline if their measured PH is greater than 7. An organ can be made of different types of tissues that combine to form an organ. An organ system or a biological system is when two or more organs work together in execution of a body function. Reproductive organs in men or women are organs involved in the producing of children and involved in sexual function. The series of hollow organs joined in a long tube from mouth to anus is the GI tract. Biological fluids are Liquids within living organisms; each has a distinct physiological role. These fluids can be either extracellular or intracellular. The objective is to determine and list the PH of some internal human organs and their biological fluids based on their acidity or alkalinity. The PH of some internal human organs is listed in Table 1 and the PH of some biological fluids are listed in Table 2.

Keywords

Chemistry, PH gradient, Internal Organs' PH

1. Introduction

Substances and mediums can be either acidic, alkaline or neutral. Mediums and solutions are acidic if their measured PH is less than 7, neutral if their measured PH is 7, and alkaline if their measured PH is greater than 7. Citric acid (vitamin C), sulfuric acid (battery acid), acetic acid (vinegar), and hydrochloric acid (digestive fluid in the stomach) are acids. Magnesium hydroxide used in antacid and in laxatives, ammonia used in household cleaners, and sodium hydroxide as in drain cleaners are all bases. A solution that would resist change in PH is a buffer solution as it contains week conjugate acid and base pair. Blood is a buffer solution with a PH of 7.4, and it contains carbonate HCO_3^- and carbonic acid H_2CO_3. In the body the PH varies from one part to another. The stomach has a PH of 1.35-3.5, the highest acidity area in the body as it aids in digestion and protects against microbial organisms. The layer outside the epithelium in the stomach is basic to prevent mucosal injury [1-6].

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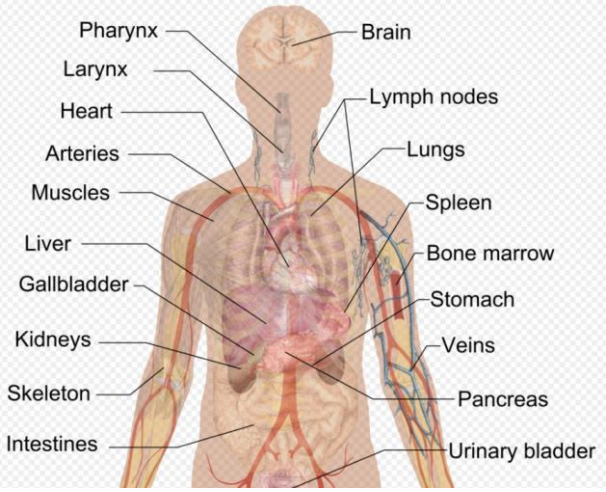

Figure 1. *Some of the Human Internal Organs [17].*

The two main organs that regulate blood PH are the kidney and the lungs. Blood PH is regulated slowly (days or hours) by the kidney by excreting acids in the urine and producing bicarbonates, increasing blood PH. Lungs rapidly regulate blood PH through exhaling carbon dioxide preventing the blood from being too acidic [7-12].

An Organ are tissues joint together in a structural unit to serve a function. Same type of cell form tissues that have a function. An organ can be made of different types of tissues that combine to form an organ. An organ system or a biological system is when two or more organs work together in execution of a body function. Organ tissues are classified into functional tissues called parenchyma, and tissues with supportive and connective functions called stroma. There are almost 79 organs in the human body. Figure 1, shows some human body organs; bone, lung, heart, intestine, brain, liver, kidneys, lung, stomach, pancreas, and urinary bladder…etc [13-17].

Reproductive organs are organs involved in the producing of children and involved in sexual function. The female reproductive system includes ovaries, uterus, cervix, fallopian tubes, and vagina as shown in Figure 2. The uterus contains an inner and outer lining; the inner lining is the endometrium, and the outer layer is the myometrium [18-21].

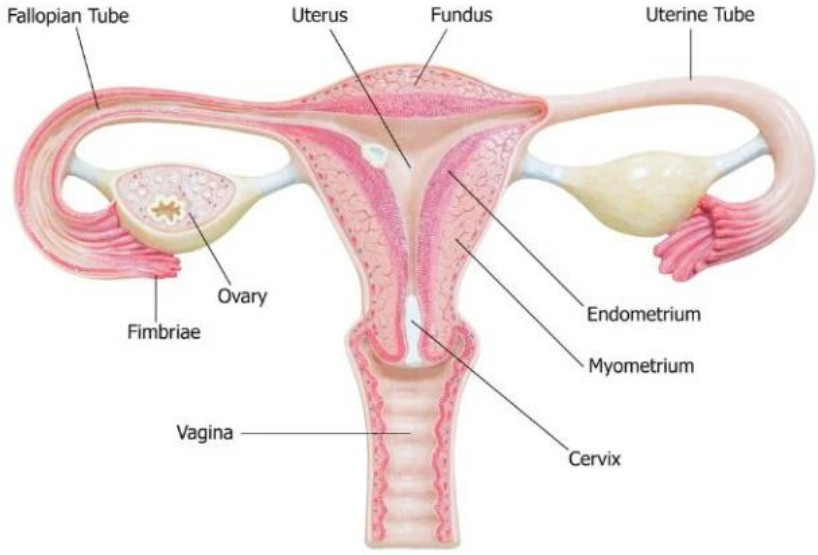

Figure 2. *Anatomy of the Female Reproductive System. [18].*

A group of organs the make up the reproductive system in a male is the male reproductive system is shown in Figure 3. It consists of scrotum, penis and testicles. The scrotum is a pouch skin that hangs behind the penis. The male organ for sextual intercourse is the penis. Testes, the testicles, lie in the scrotum and it's an oval shaped organ. The prostate gland is divided into two lobes and is the size of a walnut. As you get older it becomes bigger. It's below the bladder. The urethra surrounds the first part of the tube. The urethra carries semen, a sperm contained fluid, and it also carries urine from bladder to penis [22, 23].

The digestive system consists of the GI tract, pancreas, liver and gallbladder is shown in Figure 4. The series of hollow organs joined in a long tube from mouth to anus is the GI tract. The GI tract is made of esophagus, mouth, small intestine, stomach, large intestine, and anus. The solid organs of the digestive system are pancreas, liver and gallbladder [24].

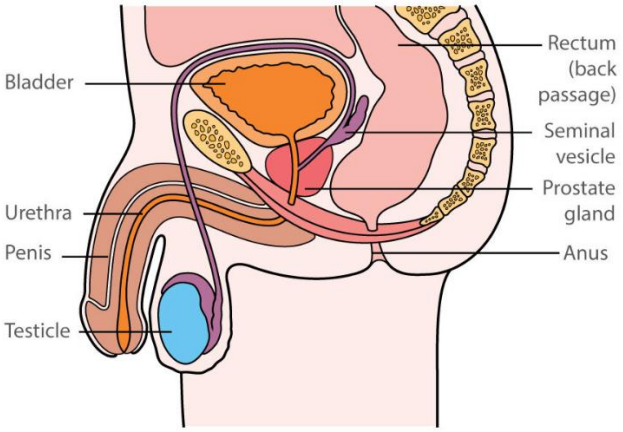

Figure 3. *Anatomy of the Male Reproductive System. [23].*

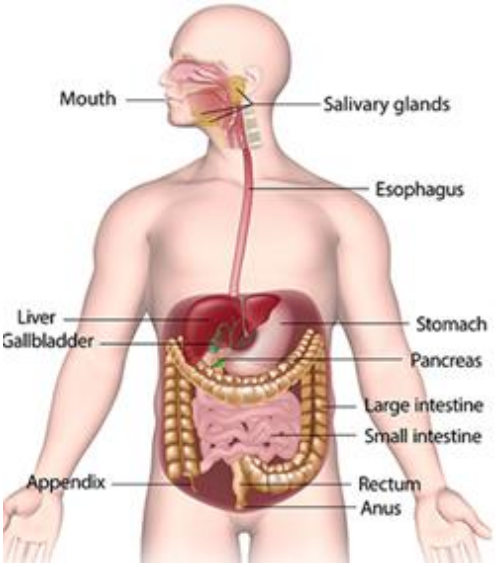

Figure 4. *The Digestive System. [24].*

Liquids within living organisms are called biological fluids. Biological fluids each have a distinct physiological role. These fluids can be either extracellular or intracellular. Examples of biological fluids are; saliva, blood, cerebrospinal fluid, semen, urine, lymph, and gastric juice. These biological fluids carry hormones, nutrients, waste products…etc. throughout the body to support bodily function and maintain homeostats. Blood contains red and white blood cells, platelets and plasma. Blood transports nutrients, oxygen, and hormones to the cells, provision of immune defense and removal of waste. Lymph plays a role in immune function, the transportation of dietary fats and it contains proteins, fats and lymphocytes. Cerebrospinal fluids cushion the spinal cord and brain, remove waste products, supplies nutrients to the central nervous system, and it's a colorless liquid. Saliva contains electrolytes, water, some enzymes, and mucus. It facilitates swallowing, maintains oral hygiene, and aids in digestion. Urine contains metabolic waste products, water, urea, and some electrolytes. It regulates water and electrolyte balance and eliminates waste from the body. Gastric juice consists of mucus, intrinsic factor and hydrochloric acid, all contributes to the elimination of pathogens and contributes to digestion. Bile, a yellow- green fluid stored in the gallbladder and produced by the liver, facilitates the absorption of fat-soluble vitamins and digestion by emulsifying fat. It contains electrolytes, bile salts, cholesterol, and bilirubin. Semen consists of seminal fluid made of proteins, fructose and enzymes, and sperm cells. It transports sperms to the female reproductive system. Vaginal fluids are made up of microflora, water, mucus and cells. It offers protection against infections, maintains the PH of the vagina, and provides lubrication. Synovial fluid contains water, lubricin, proteins, and hyaluronic acid. It nourishes and lubricates the cartilage in joints and reduces frictions. Amniotic fluid cushiness and protects the fetus during pregnancy. It consists of water, fetal cells, electrolytes, and proteins [25-27].

The prostate gland and the seminal vesicle produce a white fluid which mixes with the sperm in the testicles forming semen. Semen contains 1-5% sperm, 65-75% fluid from the seminal vesicles, and 25-30% fluid from the prostate. Semen protects and nourishes the sperm. Semen transports the sperms out of the body into the female reproductive system to start the fetal development process by fertilizing an egg. Sperms are stored in a tube in the back of the testicles until it matures. After orgasm semen comes out of the penis. The sperm then combines with the prostate fluid and seminal vesicle fluids forming semen. Semen contains water, plasma, mucus, and a small amount of calcium, zinc, potassium, magnesium, fructose, citrate, lactic acid and glucose. These nutrients give sperms the energy to swim and nourish the sperm [28].

Cerebrospinal fluids, CSF, supports, protects, surrounds and cushiness the spinal cord and the brain. It's a clear liquid made of pure plasma. It helps remove waste, helps the brain float, keep the brain's temperature and pressure steady, carry antibodies and immune cells supporting the immune system and it delivers nutrients. There is almost 150 ml or 5 ounces in an adult's body. Figure 5 shows the cerebrospinal fluid and brain [29].

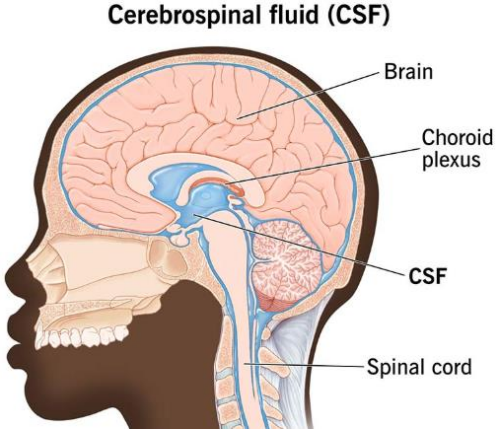

Figure 5. *Brain and the Cerebrospinal Fluid [29].*

2. Experimental

The PH of some internal human organs are listed in Table 1. The PH of the small intestine, brain, intrafollicular pH (PH of storage area of thyroid hormone), and bone is mildly alkaline. Their PH's range from 7.1 to 8.3. The PH of rectum, gallbladder bile, intracellular pH- thyroid follicular cells, and uterine cavity are mildly acidic to mildly alkaline. Their PH's range from 6.6 to 7.8. The PH of large intestine (colon) is mildly acidic with PH of 5.5 to 7. The PH of the stomach is strongly acid with a PH of 1.5 to 3.5. The liver and heart have a neutral to mildly alkaline PH. Their PH's range from 7 to 7.4. The upper vagina has a moderately acidic PH. Its PH is 5.7. The PH of the lower vagina is weakly acidic. Its PH is 3.8 to 4.5. Skin has a weakly acidic to mildly acidic PH. Its PH ranges from 4 to 6.5. Skin acts as a protective barrier from microbial overgrowth. The skin layers have a PH gradient as the PH of the outer layer is 4, and the basal layer has a PH of 6.9.

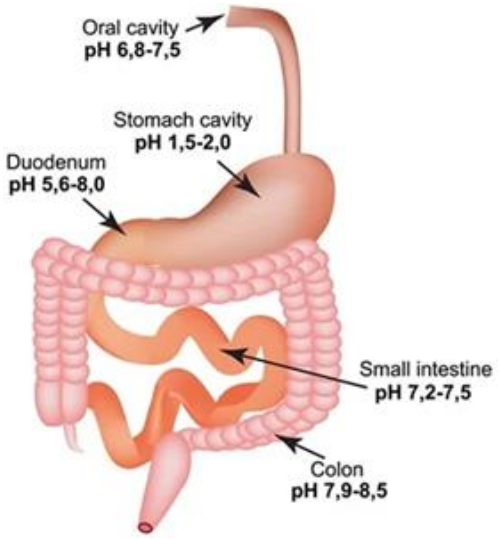

Figure 6. *PH of the gastrointestinal tract; oral cavity, stomach cavity, duodenum, small intestine, and colon. [39].*

Table 1. *PH of Some Internal Human Organs and Fluids3,5,6, [30-40].*

Organ Type	PH	Acidic / Basic / Neutral
Bone [33]	7.4	Mildly Alkaline
Skin [5]	4-6.5	Weakly Acidic to Mildly Acidic
Stomach [40,41]	1.5-3.5	Strongly Acidic
Large intestine (Colon) [35, 39,40]	7.9-8.5	Mildly Alkaline
Small intestine [3,39,40]	7.2-7.5	Mildly Alkaline
Rectum [3,39,40]	6.6-7.5	Mildly Acidic to Mildly Alkaline.
Bladder-Gallbladder bile [33]	6.8 to 7.65	Mildly Acidic to Mildly Alkaline.
Liver [33]	7-7.2	Neutral to Mildly Alkaline.
Heart [33]	7-7.4	Neutral to Mildly Alkaline.
Brain [33]	7.1-7.2	Mildly Alkaline
Pancreas and Pancreatic Secretion [33]	7.5-8	Mildly Alkaline
Thyroid Gland		
Intrafollicular pH-PH of storage area of thyroid hormone [36]	7.6	Mildly Alkaline
Intracellular pH- Thyroid follicular cells [36]	6.94-7.01	Mildly Acidic to Mildly Alkaline.
Male Reproductive System		
Seminal vesicle gland fluid [32,38]	7.2-8.5	Mildly Alkaline
Prostate fluid [32, 38]	6.6-7.3	Mildly Acidic to Mildly Alkaline
Sperm [32,38]	6.5 to 6.9	Mildly Acidic
Liquified semen fluid [32,38]	7.2-8	Mildly Alkaline.
Female Reproductive system		
Uterine Cavity [6, 30, 31,34,37]	6.76 to 7.8	Mildly Acidic to Mildly Alkaline.
Upper Vagina [6, 30, 31,34,37]	5.7	Moderately Acidic
Lower Vagina [6, 31,34,37]	3.8 to 4.5	Weakly Acidic

Organ Type	PH	Acidic / Basic / Neutral
Vaginal PH [6, 31,34,37]	3.5- 4.5	Weakly Acidic.

The PH of GI tract is shown in Figure 6. The PH or the oral cavity is mildly acidic to mildly alkaline with a PH range of 6.8-7.5. The upper part of the stomach cavity is highly acidic with a PH of 1.5-2, and the lower part of the stomach has a mildly acidic to mildly alkaline with a PH ranging from 5.6-8. The PH of the small intestine is mildly alkaline with a PH ranging from 7.2-7.5. The large intestine has a mildly basic PH ranging from 7.9-8.5 [39].

The PH of some biological fluids are listed in Table 2. The PH values of bodily fluids are different. Blood, cerebrospinal fluid, pancreatic secretion, seminal vesicle gland fluid, and liquified semen fluid are mildly alkaline. Their PH's range from 7.2 to 8.5. Stool, urine, prostate fluid, saliva, and gallbladder bile have a mildly acidic to mildly alkaline PH. Their PH's range from 4.5 to 8. Sperm has a mildly acidic PH ranging from 6.5 to 6.9. The bodily fluid with the widest range of PH is urine. Its PH ranges from 4.5 to 8 [40-44].

Table 2. *PH of Some Biological Fluids. Cite blood PH value ref after ref are numbered [41-44].*

Fluid Type	PH Value	Acidic/ Basic/ Neutral
Cerebrospinal Fluid	7.3-7.36	Mildly Alkaline
Blood	7.35-7.45	Mildly Alkaline
Stool	6.5- 7.5	Mildly Acidic to Mildly Alkaline
Urine	4.5-8	Weakly Acidic to Mildly Alkaline.
Pancreatic Secretion	7.5-8	Mildly Alkaline
Seminal vesicle gland fluid	7.2-8.5	Mildly Alkaline
Prostate fluid	6.6-7.3	Mildly Acidic to Mildly Alkaline.
Sperm	6.5 to 6.9	Mildly Acidic
Liquified semen fluid	7.2-8	Mildly Alkaline
Gallbladder bile	6.8 to 7.65	Mildly Acidic to Mildly Alkaline.
Saliva	6.5-7.5	Mildly Acidic to Mildly Alkaline.

3. Conclusion

The mildly alkaline human organs and biological fluids are brain, small intestine, colon, bone, intrafollicular thyroid storage, blood, pancreatic secretion, seminal vesicle gland fluid, cerebrospinal fluid, and liquefied semen; their PHs range from 7.1-8.5. The mildly acidic to mildly alkaline human organs and biological fluids is the uterine cavity, intracellular thyroid follicular cells, gallbladder bile, rectum, stool, urine, saliva, and prostate fluid; their PHs range from 4.5-8. The weakly acidic human organ is the upper vagina, its PHs range from 3.8-4.5. The strongly acidic organ is the stomach with a PH of 1.5-3.5. The neutral to mildly alkaline human organs are heart and liver; their PHs range from 7-7.4. The skin has a weakly acidic to mildly acidic PH of 4-6.5.

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Author Contributions

Hebah Abdel-Wahab: Conceptualization, Data curation, Methodology, Resources

Tamara Gund: Conceptualization, Data curation, Methodology, Resources

Joseph Bozzelli: Conceptualization, Data curation, Methodology, Resources

Conflicts of Interest

The authors declare no conflicts of interest.

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