Role of Homeostasis in Human Physiology: A Review

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Abstract
Homeostasis plays a major role in the proper functioning of the body. It is regulated by different mechanisms such as osmoregulation, thermoregulation and chemical regulation by different systems in the body like respiratory system, digestive system, nervous system, urinary system. These systems maintain the stability of the body by releasing the stimulus when the hormone levels increases or decreases. The stimulus is generated; the cells act accordingly to maintain the proper functioning of the cell. Thus feedback mechanisms work and maintain the cells to meet the set point. The endocrine system has a regulatory effect on other organ systems in the human body. In the muscular system, hormones adjust muscle metabolism, energy production, and growth. In the nervous system, hormones affect neural metabolism, regulate fluid and ion concentration and help with reproductive hormones that influence brain development.

Keywords: Homeostasis; Diffusion; Osmosis; Pituitary gland; Prolactin; Blood plasma

Introduction
Homeostasis is the word derived from the 2 Greek Words 'homeo' meaning 'similar,' and 'stasis' meaning 'stable.' Homeostasis [1-4] refers to stability, balance, or equilibrium within a cell or the body. Homeostasis is an important characteristic of living things. Maintaining a stable internal environment which requires adjustments as conditions change inside and outside the cell. The maintenance of systems within a cell is called homeostatic regulation. The continuous adjustments are made to meet the Set Point.

Homeostasis is regulated by 3 different mechanisms and they are:

a) Osmoregulation [5];
b) Thermoregulation [6];
c) Chemical Regulation.
These mechanisms are performed in the body by various systems of the body like Respiratory system, Endocrine system, Reproductive system, Urinary System, Nervous system.

Feedback Regulation
Hormones regulate the activity of body cells. The release of hormones into the blood is controlled by a stimulus. The response to a stimulus changes the internal conditions and itself may become a new stimulus and this self-adjusting mechanism by the internal system is called is called feedback regulation [1-64].

The feedback regulations are of 2 types:

1. Positive feedback regulation.
2. Negative feedback regulation.

Positive feedback regulation
Positive feedback is less common in biological systems. Positive feedback acts to speed up the direction of change e.g. Lactation (milk production) [40-45]. When the baby starts sucking the nerve messages the mammary glands which cause the hormone prolactin which is secreted by the pituitary gland [46-49]. The prolactin [50-55] release is directly proportional to the baby sucking the milk.

Negative Feedback regulation: Thermoregulation
Negative feedback is the most common feedback loop in the biological system. To maintain the homeostatic balance the system acts to reverse the direction of change to maintain the things constant.

Example 1: When the carbon dioxide level increases in the air which we breathe, the lungs are signalled to exhale carbon dioxide more which causes increase in the breathing rate and CO₂ level is balances and then lungs will function normally.

Example 2: When the body temperature increases then automatically the receptors in the skin and hypothalamus senses the temperature change and triggers a command from the brain which makes skin to sweat, the blood vessels near the skin surface will dilate and that helps to decrease the body temperature and this is called thermoregulation and this also comes under negative feedback loop.

Osmoregulation
Osmosis [6-11] is the essential process that is carried out in the body for the proper functioning of cells. Water movement in the body is carried out through Osmosis. Osmosis is carried out by balancing both sides of the cell membrane, for the proper functioning of Biochemical process [38,39] of the cells which is most required.

Two conditions which will alter the biochemical process and results in the death of the cells are:

1. When the concentration of solutes increases above normal in the extracellular fluid which causes in the movement of intracellular fluid to extracellular surface will occur which will result in the cell shrinkage?
2. When the concentration of solutes decreases in the extracellular fluid which causes in the movement of extracellular fluid inside

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the cells and will result in the swelling of the cell and ruptures the cell after certain extent.

The maintenance of stable concentration of solutes is most required for the proper functioning of cells and the organisms and is maintained through osmosis and diffusion.

Unicellular organism which lives in the atmosphere by the utilisation of nutrients [17-21] and oxygen from the external environment and produce the energy required for its growth and survival. It will also release the waste and CO₂ directly into the environment.

Multi cellular organisms like human beings are made up of trillions of cells and the most of the cells are embedded inside the organisms and so they cannot exchange with the environment directly so cells exchange substances with the fluid surrounding them. Blood plasma [22-26] is a part of the extracellular fluid of our organism. The extracellular fluid, which is formed on the external environment, is through the cells. Cells are in continuous contact with the extracellular fluid (Figures 1-5) [27-32].

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**Figure 1:** Flow chart showing the regulation of hormones.

**Figure 2:** Positive feedback mechanism (lactation).

**Figure 3:** Negative feedback mechanism in respiratory system.
Body temperature increases

Body releases more sweat

Body temperature decreases

Figure 4: Thermoregulation in human system.

Hypertonic Solution

Isotonic Solution

Hypotonic Solution

Shriveled cells

Normal cells

Cells swell and eventually burst

Figure 5: Osmoregulation in cells.

Stimulue in blood glucose level above the set point

Response: Body cells take up glucose removing it from the blood

Response causes high blood glucose level to reduce

Negative Feedback

Figure 6: Flow chart of chemical regulation in blood.
Chemical Regulation

Control of blood glucose level is an example of negative feedback. Blood glucose concentration rises after a meal (the stimulus). The hormone insulin [33-37] is released by the pancreas, and it speeds up the transport of glucose from the blood and into selected tissues (the response). Blood glucose concentrations then decrease, which then decreases the original stimulus. The secretion of insulin into the blood is then decreased (Figure 6) [64].

References
