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PRINCIPLES OF PHYSIOLOGICAL NUTRITION, MOTOR ACTIVITY AND REGULATION OF THE DIGESTIVE SYSTEM. DIGESTION IN THE ORAL CAVITY AND STOMACH

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Abstract

This article examines the physiological foundations of human nutrition, focusing on the principles that ensure balanced nutrient intake and optimal metabolic functioning. Special attention is given to the motor activity of the digestive tract and the complex regulatory mechanisms that coordinate digestive processes. The physiological stages of digestion in the oral cavity and stomach are analyzed in detail, including enzymatic activity, neural and hormonal control, and mechanical transformations of food. The study integrates contemporary physiological concepts to demonstrate the interdependence between motor function, secretory processes, and nutrient assimilation.

Keywords: Physiological nutrition, digestive system, motor activity, oral digestion, gastric digestion, enzymatic processes, neurohumoral regulation, peristalsis, metabolism.

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Introduction

Nutrition is a fundamental biological process that ensures the maintenance of life, growth, development, and adaptation of the organism to environmental changes. The physiological principles of nutrition are based on the understanding that food not only provides energy but also supplies structural components and regulatory substances essential for cellular and systemic homeostasis.Modern physiology considers nutrition as a complex process involving mechanical, chemical, enzymatic, and regulatory mechanisms. The digestive system performs coordinated motor and secretory activities, transforming food into absorbable molecules.

The interaction between motor activity and regulatory systems guarantees the efficient progression of food through the gastrointestinal tract and the optimal breakdown of nutrients. This article explores the physiological basis of rational nutrition, the mechanisms controlling motor function in digestion, and the specific processes occurring in the oral cavity and stomach.

The concept of physiological nutrition is grounded in several core principles: energy balance, nutrient adequacy, digestibility, and adaptability.Energy balance is maintained when caloric intake corresponds to energy expenditure. An imbalance may result in metabolic disturbances such as obesity or malnutrition. Basal metabolic rate, physical activity level, age, and environmental factors influence daily energy requirements.

Nutrient adequacy implies that the diet must contain essential macronutrients—proteins, carbohydrates, and lipids—as well as micronutrients including vitamins and minerals. Proteins supply amino acids for tissue synthesis, carbohydrates serve as the primary energy source, and lipids provide structural components of cell membranes and facilitate the absorption of fat-soluble vitamins. Digestibility and bioavailability are equally important. Food must be processed into absorbable forms through enzymatic hydrolysis. Physiological

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nutrition therefore depends not only on dietary composition but also on the functional state of the digestive organs.

Adaptability refers to the organism's ability to adjust digestive and metabolic processes according to dietary composition and energy demands. Long-term changes in diet can modify enzyme production and intestinal absorption capacity. Together, these principles form the foundation of rational dietary planning and health preservation. Motor activity is a crucial component of digestion. It ensures the mechanical breakdown of food, its mixing with digestive juices, and its propulsion along the gastrointestinal tract.

The motor function begins in the oral cavity with mastication. Chewing reduces food particle size and increases the surface area available for enzymatic action. Swallowing (deglutition) transfers the bolus from the mouth to the esophagus through coordinated voluntary and reflex mechanisms.

In the esophagus, peristaltic waves propel the bolus toward the stomach. These rhythmic contractions are regulated by intrinsic neural networks of the enteric nervous system and modulated by autonomic input.In the stomach, motor activity includes receptive relaxation, mixing contractions, and gastric emptying. Receptive relaxation allows the stomach to accommodate incoming food without a significant increase in pressure. Mixing contractions blend food with gastric juice, forming chyme. Gastric emptying is carefully regulated to ensure that partially digested material enters the duodenum at an optimal rate.

Throughout the intestines, segmentation and peristalsis continue the processes of mixing and propulsion. Motor activity is precisely coordinated with secretory activity, illustrating the integrated nature of digestive physiology.The digestive system is regulated by neural, hormonal, and local mechanisms. These regulatory pathways ensure that digestive secretions and motor activity correspond to the quantity and composition of ingested food.

Neural regulation involves the central nervous system and the enteric nervous system. The cephalic phase of digestion is initiated by the sight, smell, or thought

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of food, activating vagal stimulation and increasing salivary and gastric secretion The enteric nervous system, sometimes referred to as the "second brain," coordinates local reflexes independently of central control. It regulates peristalsis, secretion, and blood flow within the gastrointestinal tract.

Hormonal regulation is mediated by gastrointestinal hormones such as gastrin, secretin, and cholecystokinin. Gastrin stimulates gastric acid secretion and enhances motor activity. Secretin promotes bicarbonate secretion from the pancreas, while cholecystokinin stimulates bile release and pancreatic enzyme secretion. Local regulatory mechanisms include chemical and mechanical receptors in the mucosa that respond directly to the presence of food. These mechanisms allow for fine-tuned adjustments in digestive activity.The integration of neural and hormonal signals ensures efficiency and prevents overloading of any segment of the digestive tract.Digestion begins in the oral cavity, where mechanical and chemical processes occur simultaneously.

Mastication breaks down food into smaller particles, forming a cohesive bolus. Saliva, secreted by the salivary glands, moistens and lubricates the food, facilitating swallowing. Saliva contains the enzyme salivary amylase, which initiates the hydrolysis of starch into maltose and dextrins. Although the duration of oral digestion is relatively short, this initial enzymatic activity significantly contributes to carbohydrate digestion.

Additionally, saliva contains mucins, immunoglobulins, and lysozyme, which protect the oral mucosa and contribute to immune defense. The pH of saliva provides an optimal environment for amylase activity.Thus, the oral cavity serves not only as the entry point of the digestive tract but also as an active participant in the early stages of nutrient processing.

The stomach plays a central role in both mechanical and chemical digestion. Gastric glands secrete hydrochloric acid, pepsinogen, mucus, and intrinsic factor.Hydrochloric acid creates an acidic environment (pH 1.5–2.0), which

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denatures proteins and activates pepsinogen into pepsin. Pepsin initiates protein hydrolysis, breaking peptide bonds and forming smaller polypeptides.

Gastric lipase contributes to lipid digestion, although its activity is limited compared to pancreatic lipase. Mechanical mixing movements convert the food bolus into chyme. The stomach also serves as a temporary reservoir, regulating the rate at which chyme enters the small intestine. This control is essential for optimal enzymatic digestion and nutrient absorption downstream.

Protective mechanisms, including mucus secretion and tight epithelial junctions, prevent autodigestion of the gastric wall. Motor and secretory processes are functionally interdependent. Effective digestion requires precise synchronization between mechanical mixing and enzymatic breakdown.

For example, inadequate gastric motility may delay emptying and impair nutrient absorption, while excessive motility may reduce digestion efficiency. Similarly, proper chewing enhances enzymatic activity in both the oral cavity and stomach. Physical activity also influences digestive motility. Moderate exercise can stimulate peristalsis, whereas intense activity immediately after meals may temporarily inhibit digestive processes. Understanding this interrelation is crucial for maintaining gastrointestinal health and preventing functional disorders.

The physiological principles of nutrition encompass energy balance, nutrient adequacy, digestibility, and adaptability. These principles are implemented through the coordinated activity of the digestive system. Motor function and regulatory mechanisms ensure the efficient transformation of food into absorbable molecules. The processes occurring in the oral cavity and stomach represent the initial and essential stages of digestion, involving both mechanical and enzymatic components. A comprehensive understanding of these physiological processes provides the scientific basis for rational nutrition and the prevention of digestive disorders.

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