IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

Role of Gut Hormones in the Control of Digestive Physiology: Emerging Insights and Clinical Relevance

Dr. S. Priyanka

Lecturer in Biotechnology, Department of Biotechnology, D.K. Govt Degree College, Nellore, Andhra Pradesh, India.

Abstract

Gut hormones are integral to the regulation of digestive physiology, modulating functions such as appetite control, nutrient absorption, motility, and intestinal homeostasis. Hormonal imbalances have been linked to gastrointestinal (GI) disorders like irritable bowel syndrome (IBS), gastroesophageal reflux disease (GERD), inflammatory bowel diseases (IBD), and metabolic syndrome. The enteroendocrine system, via hormones like ghrelin, motilin, gastrin, and glucagon-like peptide-1 (GLP-1), plays a pivotal role in digestive regulation. Emerging research highlights the role of gut-brain axis signaling, circadian rhythm influences, and hormonal feedback loops in maintaining GI function. This article explores the physiological, pathological, and clinical implications of gut hormones in digestive health, while emphasizing recent developments and therapeutic prospects.

Keywords: Gut hormones, digestive disorders, enteroendocrine regulation, homeostasis, signal transduction, gut-brain axis.

1. Introduction

Digestive diseases contribute significantly to global morbidity and mortality, with non-malignant gastrointestinal disorders affecting over 2.2 billion people globally and causing more than 2.5 million deaths annually (Wang et al., 2023). These conditions, including functional gastrointestinal disorders (FGIDs) like IBS and IBD, are often influenced by hormonal dysregulation. The gut, often referred to as the "second brain," houses a complex network of hormones that modulate digestion, absorption, and systemic metabolism (Rehfeld, 2019).

2. Gut Hormones and Nervous System Coordination

The gut-brain axis, an intricate communication network between the gastrointestinal tract and the central nervous system (CNS), is largely mediated by hormonal and neural signals (Mayer et al., 2015). Enteroendocrine cells, in concert with autonomic and enteric nervous systems, release hormones such as gastrin, motilin, and GLP-1 that influence digestive motility and secretion. For example, vagal stimulation enhances motilin release, promoting gastric emptying (Furness et al., 2014).

3. Hormonal Regulation of Digestive Physiology

Digestive hormones act as chemical messengers that regulate gastrointestinal motility, enzyme secretion, bile release, and acid production. Hormonal feedback mechanisms are essential for synchronizing food intake with digestive activity. Notably, ghrelin increases pre-meal hunger, while cholecystokinin (CCK) and GLP-1 suppress appetite postprandially and stimulate bile and enzyme secretion (Cho & Lim, 2024).

Recent Insights: Advances in receptor pharmacology have elucidated how these hormones bind to G-protein-coupled receptors (GPCRs), triggering downstream effects on ion channels and cellular metabolism (Latorre et al., 2021).

4. Hormones and Homeostasis

Homeostasis, or internal balance, is regulated by gut hormones through control of pH, water balance, electrolyte levels, and glucose metabolism. Hormones like secretin regulate bicarbonate release, neutralizing stomach acid, while insulinotropic hormones like GIP and GLP-1 regulate postprandial glucose (Drucker, 2021). Hormonal imbalance can lead to constipation, diarrhea, and nutrient malabsorption, affecting systemic health.

5. Hormonal Signaling and Digestive Pathophysiology

Disruption of hormonal signaling pathways can result in gastrointestinal pathology. For instance, ghrelin dysregulation is implicated in obesity and cachexia, while GLP-1 deficiency is associated with type 2 diabetes (Severinsen et al., 2022). Somatostatin acts as a negative regulator of acid and hormone secretion, and its imbalance can exacerbate gastric ulcers or inflammation.

Clinical Relevance: Targeting hormone receptors (e.g., GLP-1 analogs) is now a key therapeutic approach for metabolic and digestive disorders (Drucker, 2021).

6. Hormonal Interaction with Other Organs

Gut hormones not only regulate digestion but also influence systemic organs including liver (glucose regulation), pancreas (insulin secretion), and kidneys (fluid balance). For example, elevated sodium levels stimulate vasopressin release, promoting renal water excretion. This illustrates the hormonal integration of digestive function with broader metabolic and fluid homeostasis (Lundberg et al., 2023).

7. Hormones in Intestinal Injury and Inflammation

Inflammatory conditions like Crohn’s disease and ulcerative colitis are associated with altered gut hormone levels. Reduced GLP-2 impairs mucosal healing, while dysregulated motilin contributes to motility issues (Haq et al., 2019). Autophagy, influenced by hormonal signals, is disrupted in IBD, further aggravating inflammation and epithelial barrier dysfunction.

Emerging Concern: Food additives and preservatives (e.g., calcium channel blockers in certain oils) negatively affect gut hormone function and motility, posing public health risks (Hills & Aaronson, 1991; Johnson et al., 2024).

8. Prevention and Public Health Strategies

To mitigate gut hormone disorders and associated digestive diseases, the following strategies are recommended:

Dietary Management: Consumption of high-fiber, prebiotic-rich foods to support enteroendocrine function (Sandhu et al., 2023).

Lifestyle Modifications: Circadian rhythm alignment via regular meal timings, sleep hygiene, and physical activity.

Avoidance of Endocrine Disruptors: Limiting processed food intake and exposure to food preservatives.

Medical Surveillance: Early screening for hormonal imbalances in individuals with chronic digestive complaints.

9. Conclusion

Gut hormones play a critical role in maintaining digestive health and systemic homeostasis. Hormonal disturbances contribute to a wide spectrum of gastrointestinal and metabolic disorders. Recent research underscores the importance of gut hormone regulation through both endogenous mechanisms and external factors, including diet and environment. Promoting hormonal balance via lifestyle, dietary strategies, and pharmacological interventions offers promising avenues for managing digestive health.

References

Cho, H., & Lim, J. (2024). The emerging role of gut hormones. Molecules and Cells, 47(11), 100126. https://doi.org/10.1016/j.mocell.2024.100126

Drucker, D. J. (2021). Advances in gut hormone biology: Therapeutic implications. Cell Metabolism, 33(4), 713–727. https://doi.org/10.1016/j.cmet.2021.03.002

Haq, S., et al. (2019). Autophagy in intestinal homeostasis. J Biomed Sci, 26:19. https://doi.org/10.1186/s12929-019-0512-2

Hills, J. M., & Aaronson, P. I. (1991). Peppermint oil and smooth muscle. Gastroenterology, 101, 55–65.

Latorre, R., Sternini, C., De Giorgio, R., Greenwood-Van Meerveld, B. (2021). Enteroendocrine cells: Sensors and transducers. Nat Rev Gastroenterol Hepatol, 18, 263–276.

Lundberg, M., et al. (2023). Gut hormone crosstalk with renal function. Kidney International Reports, 8(2), 350–361.

Mayer, E. A., et al. (2015). Gut/brain axis and GI regulation. Nat Rev Gastroenterol Hepatol, 12(8), 453–466.

Rehfeld, J. F. (2019). Evolutionary biology of gut hormones. Regulatory Peptides, 262, 1–7.

Sandhu, K. V., Sherwin, E., Schellekens, H., Stanton, C., Dinan, T. G., & Cryan, J. F. (2023). Feeding the microbiota–gut–brain axis: Diet, microbiome, and gut hormones. Molecular Metabolism, 71, 101682.

Severinsen, M. C., et al. (2022). GLP-1 and metabolic disorders. Diabetes Obesity Metabolism, 24(8), 1632–1643.

Wang, R., Li, Z., Liu, S., & Zhang, D. (2023). Global burden of digestive diseases: 1990–2019. Front Public Health, 11, 1061453. https://doi.org/10.3389/fpubh.2023.1061453