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Review Article

A COMPREHENSIVE REVIEW OF *SAMAN VAYU* APROPOS REGULATION OF GASTROINTESTINAL TRACT

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ABSTRACT

Ayurveda stands as an ancient and profoundly beneficial discipline for humanity, rooted in the *Tridosha*, *Saptdhatu, Panchmahabhuta* theories. Among these *Doshas, Vata* holds a pivotal role in both states of well-being and illness. It encompasses five subdivisions, namely *Prana*, *Udana, Samana, Vyana*, and *Apana. Samana Vayu*, situated proximate to the *Jatharagni* or digestive fire, traverses the entirety of the gastrointestinal tract (GIT). Its function involves stimulating Agni for efficient digestion, facilitating the breakdown of nutrients, and aiding in the movement of gastrointestinal contents. Coordinated with *Prana Vayu*, it initiates the intake of food into the digestive system, while working with *Apana Vayu* to expel waste materials from the body. The functionalities of *Samana Vayu* closely mirror the physiological actions of structures within contemporary medical science. Specifically, it can be likened to the Enteric Nervous System (ENS) and Autonomic Nervous System (ANS) which regulates the gastrointestinal tract (GIT) through both sympathetic and parasympathetic pathways. Diets rich in proteins, lipids and fats are known to enhance the stimulation of Agni, the digestive fire, thereby promoting digestion and facilitating the movement of gastrointestinal products. This process can be likened to the concept of *Samanvayu*, which orchestrates the coordination and harmonious functioning of various physiological processes, including digestion, absorption, and other gastrointestinal functions.

INTRODUCTION

In Ayurveda, health is defined as a state where *Doshas* (biological energies), *Agni* (digestive fire), *Dhatus* (tissues), waste products, and all physiological functions are in a harmonious and balanced state. Additionally, the soul, sense organs, and mind should be in a condition of total wellbeing[1]. *Vata Dosha* is responsible for performing various functions within the body. In its normal state, it maintains the proper function of organs and organ systems. *Vata* serves as the initiating and controlling factor of the human body and is accountable for facilitating all types of movements[2].

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Vatadosha has been divided into five types on the basis of location namely *Prana, Udana, Saman, Vyana* and *Apana*[3]. All these five *Vatadoshas* have their different site as well as different functions. Within the five types of *Vata Doshas*, *Samana* is recognized as being closely associated with "*Agnisahayavana*," or the support of *Agni*, the digestive fire. The function of '*Samana Vayu*' in the digestion process is notably significant. Residing adjacent to *Agni, Samana Vayu* assumes the responsibility of accepting ingested food, aiding in its digestion alongside *Agni*, facilitating the separation between *Sara* and *Kitta* components, and subsequently delivering these processed products for further metabolic mechanisms[4]. *Agni* plays a major role in the process of digestion and metabolism. According to Ashtanga Hridaya "*Rogah Sarveapi Mandaagnau*" and "*Kayasyantargneshchikitsa Kayachikitsa*" i.e., all types of diseases are due to *Mandagni* and *Kayachikitsa* is the branch of Ayurvedic science which deals and rests on the concept of *Jatharagni*. *Samana Vayu* promotes *Agni*

but whenever *Samana Vayu* is vitiated it also vitiates *Agni* and causes disease related to *Agnisad*. Among the five types of *Vata, Samana Vayu* serves various functions operating at different levels. It collaborates closely with *Prana Vayu, Vyana Vayu*, and *Apana Vayu* to perform physiological functions effectively. Understanding these functions from a modern perspective is crucial, as Ayurveda emphasizes functional comprehension rather than viewing it as a singular entity at all times. Ayurvedic literature does not explicitly correlate *Samana Vayu* with other *Vayus* in terms of modern interpretations, posing a challenge for students, particularly in their first year of studying Bachelor of Ayurvedic Medicine and Surgery.

In the current scenario, there is a growing demand for Ayurvedic science to be understood in relation to modern medical principles. This review aims to retrospectively identify anatomical structures based on their physiological functions as described under the function of *Samana Vayu.*

AIM

To explore the concept of *Samana Vayu* and investigate its correlation with the regulation of the gastrointestinal tract.

MATERIALS AND METHODS

All *Samhitas*, Ayurved texts, research papers, online sources are used as material for present conceptual review.

Review of Literature

Health, according to Ayurveda, represents a condition where the *Doshas*, *Agni*, *Dhatus*, waste products, and all physiological systems are in a balanced state. *Vata*, when balanced, ensures proper functioning of all organs in the body. It is referred to as *Yantra Dhara*[5] and is considered as *Prana* of all individuals. *Vata Dosha* performs various functions, including maintaining the natural state of organ and system functions. *Vata* governs and initiates movements within the human body, influencing all types of motion. Cerebral functions and sensory abilities are both regulated and driven by *Vata*.

The term *Samana* means "*Samanthad Kosthe Samyak Samam Vaa Aniti, Iti Samanah*", which denotes prevalent all around or which equalizes into one whatever we eat.[6] *Samana Vayu* resides in the *Kostha*, digests the ingested food and produces *Dhatus* and *Malas*[7]. Its function is to balance, carry and controlling of the food.

Location and *Karma* of *Samana Vayu* according to various *Samhitas*

S.No	*Samhita*	Location	*Karma*
1.	Charak Samhita[8]	Present in channels of sweat, humors and water and lateral to the seat of *Agni* (digestive fire).	The promoter of *Agni* and vitality, regulates the channels carrying sweat, waste matter and water.
2.	Sushrut Samhita[9]	It moves in the *Aamashaya* and *Pakvashaya* associating with *Agni* (digestive power).	Digests food and separates its product; its vitiation causes *Agnisad, Gulma, Atisar* etc.
3.	Ashtang Sanghra[10]	Present near *Jatharagni* (digestive fire) and it travels all over the *Kostha* (GIT).	*Grahana, Pachana, Vivechana* and *Munchana* of ingested food.
4.	Ashtang Hridaya[11]	Present near the digestive fire, moves inside the large intestine, stomach and small intestine, channels of the *Doshas*, *Malas* (waste), *Sukra* (reproductive tissue of male), *Artava* (menstrual fluid), and ovum (the reproductive tissue of female), and *Ambu* (body fluid).	Holds food in the GI tract, digestion of food, separate into absorbable and non absorbable portion and sends it further in the lower part of the intestine
5.	Sharangdhara[12]	Navel (umbilicus) as the prime location	The *Samana Vayu* is helpful in the circulation of blood.
6.	Bhavaprakash[13]	*Kostha*, the navel region, associated with *Agni*	Digests food, transport to the duodenum and separates its products. helps the feces to transport to the rectum after that *Apana Vayu* does its work.

Relation Between *Agni* and *Samana Vayu*

The bio-energy of the body is known as *Agni*. The term '*Sama*' refers to *Samana Vayu,* which is described as assisting *Agni*. When *Samana Vayu*, located in the naval region, remains in its rightful place, *Jatharagni* (digestive fire) remains balanced. However, if *Samana Vayu* becomes disturbed from its

position, *Agni* also becomes disturbed. When *Agni* is aggravated by *Pitta*, it becomes *Teekshna* (intense), and when it is obscured by *Kapha*, it becomes *Manda* (dull).[14] *Vishama Agni* (enzymes responsible for digestion and metabolism) causes irregularities in food digestion, leading to imbalance in bodily tissues. *Manda Agni*, on the other hand, results in poor digestion. *Teekshna Agni* contributes to excessive depletion Normal *Agni*, when combined with appropriate food intake, ensures proper digestion and maintains tissue balance.[15] For maintaining tissue balance, *Agni* must remain normal, supported by *Samana Vayu*, while *Pitta* and *Kapha* must also be balanced for *Agni* to function properly.

Function of *Saman Vaayu* in Ayurveda and Morden Perspective

Homeostasis and equilibrium of the *Tridoshas* are essential for maintaining health. Among them, *Vata* is often described as "*Vayusyantatantradharah*," the primary constituent responsible for both the structure and functions of the living body. The Ashtanga Hridaya acknowledges *Samana Vayu's* role throughout the entire digestive process, encompassing food intake, digestion (*Pachana*), assimilation (*Vivechana*), and excretion (*Munchana*). This process of transforming food into absorbable nutrients is known as *Pachana*, a concept also recognized in modern science.

After digestion, *Rasa* travels to the heart and is distributed throughout the body, nourishing it. According to Acharya *Sharangadhara, Samana Vayu* assists in this transportation of *Rasa* to the heart, while *Vyana Vayu* then distributes it further to all parts of the body. *Samana Vayu* aids *Jatharagni* in breaking down food and separating nutrients (*Sara*) from waste (*Mala*). *Samana Vayu* contributes significantly to the formation of *Shukra* (reproductive tissue) and *Artava* by aiding *Agni* in transforming *Rasa Dhatu* over the course of a month. The enteric nervous system plays a crucial role in gastrointestinal function, regulating secretion and motility in response to stimuli within the gut lumen. Neurons within the ENS are part of reflex pathways that involve sensory receptors like chemoreceptors and stretch receptors. These receptors signal sensory neurons within the ENS, which in turn communicate with the central nervous system (CNS) and autonomic nervous system (ANS), providing information about the contents and distension of the gastrointestinal tract.

Regulatory Functions of the *Samana Vayu*

The main function of the *Samana Vayu* is *Annam Grahanati, Pachati, Vivechayati,* and *Munchati*, which describes the sequential events happening once after the consumption of food by a person, i.e., it explains the whole process of digestion in the GI tract right receptive relaxation of stomach to excretion in a systematic manner. Elaborating the individual processes (*Samana Vayu)* along with their resemblance in the digestion process.

Deglutition and Retention of Food (*Annama Grahnati*)

It means receiving and withholding the food in gastrointestinal tract. *Anna Grahan* is the function of *Prana Vayu*. *Samana Vayu* helps in receiving food by the coordinative function of *Prana vayu*. Deglutition is a complicated mechanism.

It involves 3 stages.

1. **Voluntary stage of swallowing**: It is the voluntary stage. The pressure of tongue upward and backward against the palate causes squeezing of food into pharynx posteriorly. Twelfth cranial nerve (hypoglossal nerve) is supplied to the muscle of tongue.
2. **Involuntary pharyngeal stage of swallowing**: After squeezing of bolus to posterior mouth and pharynx, the epithelial swallowing receptor areas around the pharynx are stimulated. Then the impulses are transmitted through the sensory portions of trigeminal and glossopharyngeal nerve into medulla oblongata. The motor impulse from swallowing center to pharynx and esophagus are transmitted by 5^{th}, 9^{th}, 10^{th}, 12^{th} cranial nerve.
3. **Esophageal stage of swallowing:** The esophagus functions primarily to conduct food rapidly from the pharynx to stomach. It exhibit two types of peristaltic movement i.e., propulsive and mixing movements. These peristaltic waves are initiated and controlled by intrinsic neuronal circuits in the myentric nervous system.[16]

Digestion of Food (*Annama Pachati*)

Anna Pachana means digestion of food and digestion and metabolism of food is the chief function of *Agni*. Function of *Samana Vayu* is to stimulate the *Agni* for digestion and metabolism. So all factors which stimulate the *Agni* for digestion and metabolism comes under the *Annam Pachati* function of *Saman Vayu*.

Enteric Nervous System

The enteric nervous system is found in gastro intestinal tract, lies in the wall of gut beginning from the esophagus to anus. There are 100 million neurons present in enteric nervous system. It is responsible for the control of gastrointestinal movement and secretion. It is composed of two plexus. Those are auerbach's plexus or myentric plexus and submucous plexus or meissner's plexus. Auerbach's plexus is an outer plexus present in between longitudinal and circular muscle fiber. It helps in controlling of gastrointestinal movement. Submucosal plexus is

present in the submucosa. It helps in controlling of gastrointestinal secretion and local blood flow. The extrinsic sympathetic and parasympathetic fibers of autonomic nervous system connect to myentric and submucosal plexus. Although ENS can function independently, stimulation of both the system enhances or inhibits the gastrointestinal function respectively.[17]

The sensory nerve fibers from intestinal epithelium send afferent fibers to both the plexus, prevertebral ganglia of sympathetic nervous system, to the spinal cord and in the vagus nerves all the way to the brain stem. Myentric plexus helps in control of muscle activity along the length of gut. When this plexus is stimulated it increases the tone of the gut wall, intensity of rhythimic contraction, velocity of conduction of excitatory waves along the gut wall and cause rapid movement. Some of the neuron of myentric plexus is inhibitory in actions because of inhibitory transmitter vasoactive intestinal polypeptide secreted by some of its neurons. These signals inhibit the pyloric sphincter which controls the emptying of stomach into the duodenum and sphincter of ileoceacal valve which controls emptying from small intestine to cecum. The submucosal plexus helps in controlling the function within the inner wall of each minute segment of the intestine for example to control local intestinal secretion, absorption and contraction submucosal muscle.[18]

Autonomic Control of Gastrointestinal Tract

The cranial parasympathetic nerve fibers provide innervation to the esophagus, stomach, lungs, liver, gall bladder, heart, kidney, pancreas, entire small intestine and proximal half of the colon, upper part of ureter. The sacral parasympathetic fibers supply to the descending colon, rectum, urinary bladder and lower portion of ureter. The post ganglionic neurons of gastrointestinal parasympathetic system are present mainly on the myentric and submucosal plexus. Stimulation of these nerves enhances the activity of ENS.[19] The sympathetic fibers of gastrointestinal tract originate in the spinal cord between T7 T-11 segment. Most of the preganglionic fibers leaves the cord the enter into the sympathetic chain some preganglionic nerve fibers pass on without synapsing through the chain to pre vertebral ganglia such as celiac ganglia and mesenteric ganglia then postganglionic nerves supply to all parts of the gut. Stimulation of sympathetic nerve fibers inhibits the action of gastrointestinal tract. It performs its function by direct effect of secreted norepinephrine to inhibit the intestinal tract smooth muscle or by inhibitory effect of NE on the neuron of ENS.[20]

Factors that Stimulate for Digestion

There are various factors which stimulate the digestive enzyme for their digestive action

Stimuli for Secretion	Site of Secretion	Hormone	Action
Protein diet, distention of stomach, gastrin relapsing peptide	G cells of antrum, duodenum, jejunum	Gastrin	Gastric acid secretion, growth of gastric mucosa
peptone or proteoses, fatty acid and monoglyceride	'I' cell in mucosa of duodenum and jejunum	Cholecystokinin (CCK)	Stimulate pancreatic enzyme secretion, pancreatic bicarbonate secretion, gall bladder contraction, inhibit gastric emptying
Acidic gastric juice, fatty diet	S cell of duodenum, Jejunum, Ileum	Secretin	Stimulate pepsin secretion, pancreatic bicarbonate secretion, biliary bicarbonate secretion and inhibit gastric acid secretion.
Fatty acid, amino acid, and carbohydrate	K cell of duodenum and jejunum	Gastric inhibitory peptide (GIP)	Stimulates insulin secretion and inhibits gastric acid secretion
Fatty diet, acid, nerves	M cell of duodenum and jejunum	Motilin	stimulate gastric and intestinal motility
Histamine	Parietal cell	HCL	Kills ingested bacteria, provide acidic medium for digestion, coverts pepsinogen into pepsin
HCL	Peptic cell	Pepsinogen	Converts into pepsin for protein digestion
Emotional factors	Peptic and Oxyntic	Pepsinogen and	Digestion of protein

	cell	HCL	
Chyme in upper portion of small intestine	Pancreatic cell	Pancreatic juice	Digestion of protein, carbohydrate and fat
Enterokinase	Pancreatic cell	Trypsinogen	Protein digestion
Acetylcholine, Cholecystokinin	Pancreatic cell	Pancreatic enzyme	Digestion of protein, carbohydrate and fat

Separation and Absorption of Food (*Annam Vivechayati*)

Digestion involves separating the *Sara* and *Kitta* products from digested food. Essential components like water and minerals are absorbed, while feces and urine are expelled from the body. This function of separation is known as *Vivechan*. Peristaltic movements of the bowel segment contract at both ends, followed by a central contraction to propel chyme backward and forward. This mixing continues as long as nutrients are present for absorption *Vivechana*. These actions are centrally governed by the enteric nervous system and can function independently of central control. Modern research aligns with traditional Ayurvedic concepts of *Purisha* formation, where digested products including vitamins and minerals are absorbed through the small intestine. In the large intestine, water absorption further consolidates chyme into solid feces through *Agni*. Additional water and salt absorption occurs here, resulting in the formation of *Purisha* for excretion.

According to Chakrapani, *Vayu* disorders often originate in *Pakavashaya*, posing treatment challenges that may require palliative measures *(Shaman)*. Disruption of neural control affects peristaltic movement, leading to waste accumulation and fermentation gases. This can result in the absorption of toxins, manifesting as systemic and local nervous system disturbances. The consistency of *Purisha* largely depends on water absorption, influenced by gastrointestinal motility and diet composition.

Expulsion of Waste (*Munchati*)

The expulsion of waste products is managed by *Apana Vayu*. *Samana Vayu* triggers *Apana Vayu* to facilitate waste removal, such as the expulsion of feces and urine from the body. When the stomach expands with food, it stimulates contractions in the rectum, prompting the urge to defecate. This response, known as the gastrocolic reflex, can be reinforced by gastrin's action on the colon. *Samana Vayu* functions akin to the Enteric Nervous System (ENS), controlling gastrointestinal reflex pathways that oversee gastrointestinal secretion, peristalsis, and mixing contractions. These reflexes include those entirely within the gut wall, from the gut to the sympathetic ganglia and back (such as the gastrocolic, enterogastric, and colonoileal reflexes), and from the gut to the spinal cord or brain stem, regulating gastric motor activity, secretion, and the defecation reflex. The large intestine plays a crucial role in reabsorbing water and other substances from fecal material along its length. Movements from the caecum to the transverse colon occur slowly, allowing ample time for water absorption, transforming material into a sludgy paste (*Pindarupa*).

The parasympathetic nervous system stimulates enteric nerves, enhancing gastrointestinal functions. Parasympathetic enteric neurons are integral to defecation, providing extensive innervation to the sigmoid, colon, rectum, and anus. *Prana*, the initial life force, integrates with *Apana* to stimulate living beings. Acharya Susruta identifies *Pakwashaya* as the seat of *Apana*, from where feces move downward. *Samana Vayu* operates within the *Kostha*, regulating digestion and the absorption of body fluids (*Sara Kitta Vivechana*). *Apana Vayu* predominantly governs the excretion of waste from the body. When feces enter the rectum, distension of the rectal wall initiates signals through the myenteric plexus (*Samana Vayu*), initiating peristaltic waves in the descending colon, sigmoid, and rectum to propel feces toward the anus. As the peristaltic wave reaches the anus, the internal anal sphincter relaxes due to inhibitory signals from the myenteric plexus, while voluntary relaxation of the external anal sphincter (*Apana Vayu*) occurs simultaneously, facilitating defecation.[21] Although intrinsic myenteric defecation reflexes are relatively weak, a parasympathetic reflex involving the sacral spinal cord segment begins for efficient defecation. It's noteworthy that while *Samana Vayu* regulates *Jatharagni*, *Pitta* and *Kapha* also play crucial roles in the digestive process, as *Samana Vayu* alone cannot perform this function effectively. Neurons from the enteric nervous system (*Samana Vayu*), central nervous system (*Prana Vayu*), and autonomic nervous system (*Vyana Vayu*) subsequently activate or inhibit gastrointestinal glands and smooth muscle, thereby influencing GI secretion and motility.

DISCUSSION

Basically *Vata, Pitta, Kapha* constitute three regulatory systems i.e., nervous, endocrine and immune system respectively of all living systems.

Among *Tridoshas* the supremacy of *Vata* is explained by all our *Acharyas*. *Vata* is the natural pacemaker from where all the activities are initiated and controlled. Among the five type of *Vata*, *Samanavayu* is located near *Jathargani* and stimulate the *Agni* for digestion. *Samanavayu* also helps in initiation of ingestion of food, stimulation of digestive secretion, absorption of essence part, gastrointestinal motility, separation of essence and waste product, initiation of elimination of waste product through *Srotas*. These functions of *Samana Vayu* are performed through the combined function of *Prana*, *Vyana*, *Apana Vayu* and *Pachaka Pitta*. It helps in ingestion of food to esophagus by the coordinative function of *Prana Vayu*. It helps in gastrointestinal motility by contraction and relaxation of the muscle which is the function of *Vyana Vayu*. It helps in digestion of food by the coordinative function of *Pachaka Pitta*. It helps in expulsion of waste material by the coordinative function of *Apana Vayu*. From the above details the functions of *Samana Vayu*, described by *Acharyas* can be compared with the physiological functions of 12th cranial nerve which control the movement of hypoglossal muscle, swallowing center of medulla, 5th, 9th, 10th, 12th cranial nerve, peristaltic movement of GIT controlled by myentric plexus of ENS, all stimulating factors that stimulate the secretion of digestive enzyme, bile micelles, sodium glucose co transporter, sodium amino acid co transporter, sodium hydrogen ion exchange, simple process of diffusion like osmosis, active absorption, some hormones like aldosterone, and parathormone, stretch reflex and parasympathetic part of ANS can be compared with the function of *Samanavayu*.

CONCLUSION

Samana Vayu is present throughout the *Mahasrotas* (GI Tract) as a regulating mechanism for food transformation. It is responsible for *Grahana* and *Pachana* (motility and secretions), *Sara-Kitta Vivechana* (separation and absorption), and *Munchana* (pushing feces onward) of *Anna Dravya*. It strengthens *Agni* and affects (*Anugraha*) the entire body through *Palana Karma*. *Samana Vayu* brings food near *Agni* for a specific duration and holds it in the *Amashaya*, *Pachyamanashaya*, and *Pakwashaya* respectively. During the process of deglutition, the lower two-thirds of the oesophagus are strongly controlled by the vagus nerves, which act through connections with the oesophageal myenteric nervous system. This action can be considered under the control of *Samana Vayu*, while the first two parts come under *Prana Vayu*. It is a component of gastrointestinal reflex pathways that regulate GI secretions (*Agni*) and motility in response to stimuli present in the lumen of the GI tract (*Samanoagnibalapradah*). Individual fibers of muscularis mucosa extend into the intestinal villi and cause intermittent contractions, increasing the surface area exposed to the chyme and enhancing the absorption process (*Shoshyamanasya*). These contractions, mediated by enteric nerve reflexes, can also be considered as functions of *Samana Vayu*. *Samana Vayu* enables *Pakwashaya* to produce peristalsis that pushes feces toward the rectum and anus. Mass peristaltic movement initiates the defecation reflex, known as the "intrinsic reflex," which is mediated by the local enteric nervous system in the rectal wall. The "parasympathetic defecation reflex," involving the sacral segment of the spinal cord, is also related to the functions of *Samana Vayu*. The role of the enteric nervous system in the defecation process is associated with *Apana Vayu*. The functions of gastrointestinal local hormones can be correlated with *Pachaka Pitta* (*Agni)*. In this context, *Samana Vayu* can be considered as a stimulus for hormonal regulation in the gastrointestinal tract. Some chemicals, such as acetylcholine and serotonin, are secreted by nerves and glandular cells of the mucosa, acting as neurotransmitters (paracrine fashion), and may affect small segments of the gastrointestinal tract. Their functioning can be partially attributed to *Samana Vayu*.

In conclusion, *Samana Vayu* can be mainly correlated with the nervous regulation of the gastrointestinal tract, including the enteric nervous system, gastrointestinal reflexes, and gastrointestinal hormonal regulation. Paracrine hormones stimulated by the enteric nervous system can also be understood as functions of *Samana Vayu* to some extent.

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