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# A critical review on *Samana Vayu* apropos regulation of Gastrointestinal Tract

Ritunanda Tripathi<sup>1</sup>, Shuchi Dubey<sup>2</sup>, N.K. Prasad<sup>3</sup>

<sup>1</sup>Assistant Prof., Dept. of Kriya Sharir, MAMC Bhopal, Madhya Pradesh, India.

<sup>2</sup>Reader, Dept of Kriya Sharir, PTKLS Govt (Auto.) Ayurveda College, Bhopal, Madhya Pradesh, India.

<sup>3</sup>Professor & HOD, Dept. of Kriya Sharir, SIARAM, Bhopal, Madhya Pradesh, India.

## ABSTRACT

Ayurveda believes in the theory that whatever is present, in the external universe is also present in the human body. Understanding the factors that constitute the body provides knowledge regarding the factors which are responsible for its well-being. The complete physiological action of the body can consolidate in *Dosha*, *Dhatu*, and *Malas*, these three are the main constituents of the body. The *Tridoshas*, control the fundamental physiological functions of the body. *Vata* being supreme among the three *Doshas*, conducts and controls all the activities of the body through *Vayu*. The *Samana Vayu* lies near the *Jatharagni* and its *Sanchasthan* (effective area) is *Kostha*; its function is *Grahana*, *Pachana*, *Vivechana*, and *Munchana* of *Anna Dravya* and providing strength to *Agni*. *Prana*, *Samana*, and *Apana* are three types of *Vayu*, that assist *Jatharagni* in the process of *Anna Pachana*. In modern science, a lot of research has been done regarding the factors participating in the regulation of the gastrointestinal tract such as enzymes, hormones, nerves, etc. However, the exact role of *Samana Vayu* in the regulation of *Agni* and consequent absorption of different food materials and metabolism followed by excretion, etc. is not properly understood in Ayurveda, leading to confusion between the functions of *Samana Vayu*, *Pachaka Pitta*, *Kledaka Kapha* and even up to the excretory functions of *Apana Vayu*. This study aims to understand the role of *Samana Vayu* in the physiology of *Pachana* through *Agni* and its regulatory mechanism.

**Key words:** *Samana Vayu*, *ENS*, *Gastric Reflexes*, *Prana Vayu*, *Apana Vayu*, *Agni*.

## INTRODUCTION

Ayurveda is the ancient eternal science of life and longevity. It is a system of medicine as well as a general philosophy of health and wellness. It aims to maintain the health of healthy individuals and preventions of diseases.<sup>[1]</sup>

### Address for correspondence:

Dr. Ritunanda Tripathi

Assistant Prof., Dept. of Kriya Sharir, MAMC Bhopal, Madhya Pradesh, India.

E-mail: ritunanda.tripathi@gmail.com

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*Dosha*, *Dhatu*, and *Mala* are given immense importance in contrast to the formation and maintenance of the body. *Doshas* are the main bio-energies that control all physiological activities; in a state of equilibrium, they are responsible for maintaining a normal and healthy state of the body. They are very important for our body both physiologically and pathologically because vitiated *Doshas* can vitiate *Dhatu*s and *Malas* and ultimately cause many diseases.

Digestion is important for breaking down food into nutrients, which the body uses for energy, growth, and cell repair. Food changes into smaller molecules of nutrients before the blood absorbs them and then it carries them to the cells throughout the body. The body elements indeed remain deprived of nutrients, until the food is properly digested by *Agni*.<sup>[2]</sup> Proper digestion is the first requirement for the maintenance

of body homeostasis because diet influences the physiological units of the body.

The *Annawaha Srotas* in the body is the channel that carries the food undergoing chemical-biochemical and metabolic changes. It provides the body with a frequent supply of nutrients water and electrolytes. Digestive secretions serve to chemically alter the components of food (particularly macromolecules) such that their constituents can be absorbed across the epithelium. The GI tract, the key interface between ingested nutrients and the body, plays a critical role in regulating energy homeostasis.<sup>[3]</sup>

*Prana, Udana, Samana, Vyana, and Apana* five types of *Vayu* perform different physiological functions. *Samana Vayu* supports the *Agni* and together they play a crucial role in the process of digestion. The *Samana Vayu* lies near the *Jatharagni* and its *Sanchasthan Kostha*; its function is *Grahana, Pachana, Vivechana, and Munchana* of *Anna Dravya* and gives strength to *Agni*.<sup>[4,5]</sup>

*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*.

## AIM

To study the concept of *Samana Vayu* and find out the correlation between *Samana Vayu* and regulation of the gastrointestinal tract.

## MATERIALS AND METHODS

Conceptual study based on classical references, modern literature and published research articles.

## REVIEW OF LITERATURE

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.<sup>[6]</sup> *Samana Vayu* resides in the *Kostha*, digests the ingested food and produces *Dhatus* and *Malas*.<sup>[7]</sup> Its function is to balance, carry and controlling of the food.

### Role of three Vayu in digestion

*Prana, Apana, and Samana*, the three types of *Vayu* when residing in their abode stimulate *Jatharagni* which causes the digestion of food. According to modern Science The whole digestive movements are controlled by various segments of the nervous system. Out of the five types of *Vayu*, the *Prana Vayu* helps in mastication and deglutition, *Samana Vayu* remaining in the stomach, duodenum and intestine helps in churning, segmentation, digestion, and the *Apana Vayu* helps in the retaining as well as outgoing activity of the digestive food material (i.e., defecation) from the sigmoid colon and the rectum.<sup>[8]</sup>

If the food is ingested properly, it is pulled into the *Kostha* (alimentary tract) by *Prana Vayu*, larger particles are split up into smaller ones by the fluids and made soft by their unctuousness (moistness), then cooked (digested) by the *Antaragni* activated by *Samana Vayu* inside the *Amashaya*.<sup>[9]</sup> When these five types of *Vayus* present in a particular place that is different from their own and when impaired, they afflict the body with diseases specifically in their locations and functions. This may also lead to instantaneous death.<sup>[10]</sup>

### Relation between Agni and Samana Vayu

The bio-energy of the body is *Agni*. The word '*Sama*' is understood to mean *Samana Vayu* "a helper of *Agni*". When the *Samana Vayu* residing in the naval region is located in its place, then *Jatharagni* is in a balanced state. *Samana Vayu* Vitiated from its abode, the *Agni*, vitiates and becomes *Vishama*, when the *Agni* is affected by *Pitta*, it becomes *Teekshna* and when *Agni* is obscured with *Kapha*, it becomes *Manda* (dull).<sup>[11,12]</sup>

The *Vishama Agni* (enzymes responsible for digestion and metabolism) cause irregularity in the digestion of food, thereby leading to discordance of tissue elements while *Manda Agni* causes poor digestion. The *Teekshna Agni* causes depletion (*Shoshana*) of the

tissue elements.<sup>[13]</sup> If the *Agni* is in its normal state and if the individual takes an appropriate quantity of food, then there will be proper digestion of food, which leads to the maintenance of the equilibrium of tissue elements.<sup>[14]</sup> For the maintenance of equilibrium of the tissue elements, the *Agni* must be in its normal state and this condition of the *Agni* is maintained with the help of *Samana Vayu*. Simultaneously, *Pitta* and *Kapha* should be in a state of equilibrium for the normal functioning of *Agni*.<sup>[15]</sup>

#### Location and functions of Samana Vayu

SN	Acharyas	Location (Sthan)	Functions (Karma)
1.	Charaka Samhita <sup>[16]</sup>	lies beside the <i>Agni</i> , Sweda, <i>Dosha</i> and <i>Ambuvaha Srotas</i>	the promoter of <i>Agni</i> and vitality, regulates the channels carrying sweat, waste matter and water
2.	Sushruta Samhita <sup>[17]</sup>	associates with <i>Agni</i> , in the organ where ingested food is undergoing digestion	digests food and separates its product; its vitiation causes <i>Agnisad</i> , <i>Gulma</i> , <i>Atisar</i> etc.
3.	Astang Hridaya <sup>[18]</sup>	stays near the <i>Agni</i> , and <i>Sanchar Sthan</i> is <i>Kostha</i> .	<i>Grahana</i> , <i>Pachana</i> , <i>Vivechana</i> and <i>Munchana</i> of ingested food.
4.	Sharangdhara <sup>[19]</sup>	navel (umbilicus) as the prime location	the <i>Samana Vayu</i> is helpful in the circulation of blood. <sup>[20]</sup>
5.	Bhavaprakash <sup>[21]</sup>	<i>Kostha</i> , the navel region, associated with <i>Agni</i>	digests food, transport to the duodenum and separates its products. <sup>[22]</sup> helps the feces to transport to the rectum after that <i>Apana Vayu</i> does its work. <sup>[23]</sup>
6.	Bhela Samhita <sup>[24]</sup>	pervades all over the body	maintains coordination in the entire body.

7.	Sharir Tatwa Darshnam Naam Vatadi Dosh Vigyanam <sup>[25]</sup>	transmits through the subtle sources ( <i>Sukshma Srotas</i> ) of the muscles in the intestine ( <i>Kshudrantra</i> ) and <i>Pakwashaya</i> (colon).	contraction and relaxation of the intestine, take the food from the stomach into the duodenum ( <i>Pachyamanashaya</i> ), stimulate the <i>Pachaka Pitta</i> present in the fluid form in the <i>Kshudrantra</i> , stimulates and carries <i>Sara Bhaga</i> to the liver and spleen by <i>Rasavaha Srotas</i> and carries the <i>Kitta Bhaga</i> (feces and urine) to the <i>Pakwashaya</i> and <i>Mutrawaha Srotas</i> , from <i>Pakwashaya</i> throws the <i>Purisha</i> (feces) out of the body. <sup>[26]</sup>
8.	Astang Samgrah <sup>[27]</sup>	<i>Kostha</i> , near the <i>Agni</i> circulates <i>Dosha</i> , <i>Mala</i> , <i>Shukra</i> and <i>Artav Vahi Srotas</i>	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. <sup>[28]</sup>
9.	Vaidyakiyash ubhashita Sahityama, <sup>[29]</sup> Yoga Science	<i>Manipura Chakra</i> (Solar plexus)	responsible for intestinal motility and digestive secretions ( <i>Agni</i> ).

#### DISCUSSION

Homeostasis and equilibrium of the *Tridoshas* are fundamental pillars of health. Among the *Tridoshas*, *Vata* has primarily been referred to as "*Vayusyantantradharah*" which is the primal constituent of the living body and it is holding both the

structure and functions of living beings. It has been mentioned that *Samana Vayu* is *Agni Sameepastha*, which means near to *Agni* or digestive fire, and further stated that it is responsible for the movement in the *Koshtha* (abdomen). In this regard, the Ashtanga Hridaya has acknowledged the effect of *Samana Vayu* in the entire process of digestion from intake of food to its removal (in form of *Anna Grahana*, *Pachana*, *Vivechana*, and *Munchana*). This entire process of transforming food materials into assimilable form is known as *Pachana* (digestion) as explained in modern science also.

After digestion, *Rasa* reaches the heart where it gets distributed to the whole body because only *Rasa* provides nutrition to the entire body. Acharya Sharangadhara opines that after digestion *Samana Vayu* (*Samanomaruteritah*) sends *Rasa* to the heart<sup>[30]</sup> and *Vyana Vayu* from the heart to the whole body. The *Samana Vayu* helps the *Jatharagni* to digest the food and also in the separation of *Sara* and *Mala* parts. *Rasa Dhatu* in one month is transformed into *Shukra* and *Artava* by *Agni* and in turn for *Kshaya* and *Vridhhi* of *Dhatu*s. In this way, *Samana Vayu* is not only limited to the digestion of the food, but it also contributes actively to the process of proper formation of *Shukra* and *Artava*.

Many neurons of the enteric nervous system are components of GI reflex pathways that regulate gastrointestinal secretion and motility in response to stimuli present in the lumen of the gastrointestinal tract. The initial components of a typical gastrointestinal reflex pathway are sensory receptors (such as chemoreceptors and stretch receptors) that are associated with the sensory neurons of the ENS. The axons of these sensory neurons can synapse with other neurons located in the enteric nervous system, central nervous system, or autonomic nervous system, informing these regions about the nature of the contents and the degree of distension (stretching) of the gastrointestinal tract.

#### Regulatory functions of the *Samana Vayu*

The main function of the *Samana Vayu* is *Annam Grahanti*, *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 Grahanti*)

Ingestion of food is called '*Anna Pravasha*' and *Grahanti* means receiving and retention of food in the gastrointestinal tract. Food once taken in bolus form gets mixed with saliva in the mouth. Chewing is a process in which the food particles get mixed with salivary secretion helps in the movement of the bolus. During this activity, the perception of *Rasa* is done by *Rasendriya* whereas *Bodhaka Kapha* is responsible for the exact taste. The food then further passes through the esophagus by peristaltic movements as it makes its way further to *Amashaya*.<sup>[31]</sup> These series of events are assisted by *Prana Vayu* as deglutition is the function of *Prana Vayu* - "*Uraha Kanthachara*" as it helps in action of inhalation, exhalation, and swallowing. The location of *Prana Vayu* is *Murdha*, *Kantha*, and *Jihwaadi* and helps to *Aharadi Karma*, taken as deglutition and retention (*Dharana*) both. The function of *Prana Vayu* is *Purana* which means passing down food with proper receptacles. Acharya Vagbhatta supported the view of control both activities. According to Acharya Dalhana, *Prana*, *Apana*, and *Samana* is helpful in digestion and perform together *Dhmapana* and *Palana Karma* in the whole body.<sup>[32]</sup> *Sthivana*, *Kshavathu*, *Udgara*, *Aharana* etc. are the *Prana Vayu* and controlled expulsion of *Shukra*, *Artava*, *Purish*, *Mutra*, *Garbha* are the functions of *Apana Vayu*.

Swallowing is activating centrally and is coordinated with a peristaltic wave along the length of the esophagus that propels the food bolus to the stomach.<sup>[33]</sup> It can be divided into three stages and can be substantiated as *Prana Vayu*: - First the voluntary stage which is a voluntary action. The second pharyngeal stage is mainly a reflex act, initiated by the voluntary movement of food into the back of the mouth which results evoke the swallowing reflex. Third

oesophageal stage, the trachea is closed and the esophagus is opened, then rapid-peristaltic wave initiated by the nervous system of the pharynx sends the bolus of food into the upper esophagus. The areas in the medulla and lower pons (*Murdha*) control the swallowing process.

The last part of deglutition wherein the oesophageal stage of swallowing is an involuntary action, probably the functions of *Saman Vayu* starts from here. Thus, we can say that the ingestion of food is a process done through the coordination of *Prana Vayu* and *Samana Vayu*.

### Digestion of food (*Annama Pachati*)

*Annam Pachati* means digestion of food; it is mainly the function of *Agni*. After the action of *Jatharagni* on ingested food, it gets assimilated in the body. *Samana Vayu* is responsible for the stimulation and balanced condition of *Agni* and eventually *Pachati Karma*.

The ingested food is transformed in the gastrointestinal tract and gets converted into *Ahara Rasa*. This process is affected by some factors that are called *Aahara Parinamakar Bhava*. These are six *Bhavas* i.e., *Ushma*, *Vayu*, *Kleda*, *Sneha*, *Kaal*, and *Samyoga*, amongst which *Vayu* is one responsible for all the movements and secretions of the Gastrointestinal tract.<sup>[34]</sup> While *Sneha* and *Drava* are property of *Kledaka Kapha*, making bolus soft for easy digestion; the transportation mechanism of the digestion is controlled by *Vayu* i.e., *Prana*, *Samana*, *Vyana*, and *Apana Vayu*. *Sama Vayu* also plays a major role in digestion of food by kindling *Agni*. *Vyana Vayu* is also responsible for contractions and relaxations of the skeletal muscles in the whole body as well as the sphincter of the GI Tract. As per Vagbhatta, it is helpful to the separation of nutrients and wastes part of the food after digestion and supplies nutrients to the entire body.

The *Samana Vayu* brings the food near to *Agni* and also helps in the further process like digestion and assimilation. The various movements in the gastrointestinal tract viz. peristalsis, segmentation, and mixing movements of food to carry forward and

secretion of gastric juices and enzymes which assist the digestion are done by *Samana Vayu*.

Food is stored in the stomach and gets mixed gastric secretions which are further known as chyme then it proceeds to the small intestine (*Grahani*) where the final digestion and absorption process takes place. The movements of the *Amashaya* are basic electrical rhythm, hunger contractions, receptive relaxation, and peristalsis. There is a certain difference in anatomical structure secretions and movement from the stomach to the small intestine.

*Samana* *vayu* circulating in the whole gastrointestinal tract stimulates the *Agni* or *Pachaka Pitta* and controls the movement of *Amashaya*, *Grahani*, and *Pakwashaya*. It is also present in the layer of intestinal muscles through peristaltic movement the food will be brought near the *Agni*. Due to contractions and relaxations of muscles (*Saman Vayu*), glands present in the inner layer of the small intestine contract and secrete enzymes, juices, and hormones (*Pachaka Pitta* collectively) and release the secretions into the lumen.

The hormones are peptides produced by enteroendocrine cells in the digestive tract and they reach their target organs by distribution in the circulatory systems (*Vyana Vayu*). Gastrin (*Pitta*) is secreted by the stomach in response to stimulus connected with the ingestion of food products of proteins (*Prana Vayu*) and it stimulates gastric acid secretion (*Pachaka Pitta*). Cholecystokinin is secreted by the mucosa of the duodenum and jejunum mainly in response to digestive products of fat (*Snehamsha*) in the intestinal contents; it contracts the gallbladder, expelling bile (*Pitta*) into the small intestine (emulsifying fatty substances - *Kledana*) and inhibits stomach contraction. Secretin is secreted by the mucosa of the duodenum in response to acidic gastric juice emptying into the duodenum from the pylorus of the stomach (*Agnivardhana Karma*). Its action promotes pancreatic secretion of bicarbonate which in turn helps to neutralize the acid present in the small intestine.

Peristalsis (*Apakarshana*) is mainly performed by *Samana Vayu* and can be compared with

gastrointestinal peristalsis. Peristalsis is a reflex response that is initiated when the gut wall is stretched by the content of the lumen and it occurs in all parts of the GI tract from the esophagus to the rectum. Peristalsis is a good example of the integrated activity of the enteric nervous system. It appears that local stretch release serotonin which activates the myenteric plexus.

The myenteric plexus secretes neurotransmitters acetylcholine and substance P which makes the contractions of smooth muscles present behind the bolus (*Prana & Samana Vayu*). At the same time, NO and VIP (vasoactive intestinal polypeptide) make the muscle relax present in the front of the bolus.<sup>[35]</sup>

The peristaltic wave of the lower two-thirds of the esophagus is strongly controlled by the Vagus nerves acting through connections with the oesophageal myenteric nervous system (*Samana Vayu*). When the vagus nerve is cut to the esophagus, the myenteric nerve plexus of the esophagus becomes excitable enough after several days to cause strong secondary peristaltic waves even without support from the vagal reflexes. Consequently, even after paralysis of the brain stem's swallowing reflex, food fed by a tube into the esophagus still passes easily into the stomach.<sup>[36]</sup>

The vagus nerve affects the contraction of *Amashaya* which is connected to the myenteric plexus. Receptive relaxation is coordinated by the enteric nervous system and vagus nerve (*Samana* and *Prana Vayu* respectively).

The presence of food in the lumen acts as a stimulus (*Sparsha Nimitta*). *Sparsha* is an attribute of *Vayu* and sensory information is also received by *Vayu*. (Vaishesik Sutra) Myenteric nerves are stimulated by *Sparsha Guna* of *Vata*. The *Panchbhautika* organization of *Vayu* is a mixture of many gases like oxygen, nitrogen, etc. NO, and CO is gaseous molecules that act like a neurotransmitter (surface receptor).<sup>[37]</sup> The relaxation of the sphincter and muscles due to these gases, there is strong evidence of the presence of *Vata*. In this way, we can say that the neurotransmitter activity in the gastrointestinal tract can be considered as the functions of *Vata*.

The activities of the digestive gland are coordinated by both neural and hormonal mechanisms. These regulatory mechanisms are centred around the duodenum (*Samana Vayu*), for it is there that acid must be neutralized and the appropriate enzymes must be added (*Pachaka Pitta*).<sup>[38]</sup> The endocrine cells of gastric mucosa run very close to the nerve fiber and also play a vital role in mucosal control. These endocrine cells take action in the luminal environment and release messenger (neurotransmitter) tissue of mucosa where nerve endings are found. That important is with serotonin-containing endocrine cells which activate motility reflexes.

Gastric and intestinal motility puts pressure on cells because of this it secretes gastric juices and enzymes. Similarly, the *Samana Vayu* stimulates the *Jatharagni* by motility and secretions. From the action of *Jatharagni* formation of *Ahara Rasa* takes place which consists of various types of nutrients and electrolytes.

#### Effect of *Samana Vayu* on different stages of *Paka*

*Avasthapaka* is the change in the state or form of food substance in the *Amashaya* and *Pakwashaya* in the process of digestion. It is divided into two phases the *Prapaka* and *Vipaka*, in which "*Prapaka*" has been defined as the first change and "*Vipaka*" as changes that the food has undergone.<sup>[39]</sup>

The term *Annapravesha* means the entry of food into the mouth, the perception of taste is under the influence of *Bodhaka Kapha* (saliva) dissolves the substance, provides an appropriate medium for the enzyme to their function and lubricates the food for easy swallowing.<sup>[40,41]</sup>

*Amashaya* is the place where the maximum part of digestion is completed. There it is mixed and disintegrated by juices and secretion of the stomach (*Kledaka Kapha*), that result moistens the food material.<sup>[42]</sup> *Kledana* is the transformation of food, it is one of the important parts of digestion as owing to this process the food particles are divided into small particles (*Bhinnasamghata*) and the food becomes easily assimilable (*Sukhajarobhavati*).<sup>[43]</sup> In this stage the *Ahara Rasa* is formed, elements *Kapha Dosha* is

secreted and makes the food soft, this is the *Madhura Awsathapaka*.

The process of the synthesis of the food is also assisted by the constant churning process carried out due to the movement of the muscles of the *Amashaya (Samana Vayu)*. This constant involuntary movement of the *Amashaya* helps in the fine churning and mixing of *Kledaka Kapha* with ingested food. The intake of food stimulates the secretion of *Pitta* in the *Amashaya*. The *Madhur Bhava* of the *Avastha Paka* is seen to be abolished by the hydrochloric acid secreted by the cells of the mucus membrane of the stomach. This makes the beginning of the *Amalabhava* or the acid phase of *Prapaka*.

The *Amla Avasthapaka* is further continued under the influence of *Jatharagni*, resulting in the final breakdown of various constituents of the food. As Charaka described that the food reaching *Amashaya* is fully digested, is distributed to the entire body by *Dhamanis* analogous to blood vessels and lymphatics in the villi of the small intestine, through which the absorbed food is transported to the liver, from there it is distributed to all the parts of the body through the circulating channels, for providing nourishment to tissues (*Vyana Vayu*).

The second stage of *Avasthapaka* can be correlated to expulsion of acidic chyme from the pyloric sphincter to the first part of the duodenum till absorption. The result of complete gastric digestion is acidified chyme, defined by Charaka as *Vidagdha*, and referred to by the Chakrapanidatta as "*Kinchitapakwakinchitaapakwa*" which means partially digested.

This entire area comprises digested and undigested food (*Vidagdhasyeti Pakwapakwasya*). Hence it extends to the second part of the ileum almost. Over here, pancreatic and hepatic secretions along with succus entericus, in form of *Pitta* digest all food components. This makes digested part of the food to be separate from the undigested part of the food.

The catalysts or enzymes which break down complex substances into simple ones during catabolism and liberate energy can be included in *Pitta Dosha* because

substances of the *Pitta* group are involved in breaking down complex substances into simple ones with the evolution of heat.<sup>[44]</sup>

The aspect of *Avasthapaka* can be seen form of peptic digestion of proteins. The *Bhutagni*, *Dhatvagni*, and *Jatharagni* are responsible for proper digestion as well as metabolism. *Pitta* is known as body heat and performs actions related to *Agni* such as heat, digestion, and transformation. *Pachaka Pitta* digests the food, separates the *Rasa*, *Purisha*, and *Mala*, and empowers the other *Pitta* with its power.

In third stage (*Katu Awastha Paka*), *Katu Rasa* is produced and *Vata* is generated. Further digestive events occur in the *Pakwashaya* as the material passing through the *Amashaya* reaches the *Pakwashya*, which is dried by heat and bound as a lump. In this process, *Katu Vayu* is produced.<sup>[45]</sup> Chakrapanidutta states that feces are produced in the form of lumps in this process (*Paripinditapakvasya*) and pungent *Vayu* arises during the process of forming lumps (*Vayuhsyatkatubhavatah*).

### Role of Samana Vayu during Pachana Kala and Bhojanantar Kala Prakarsh

When the meal is present in the lumen, the enteric nervous system promotes the segmentation contraction which provides the ample mixing of the intestinal contents (chyme) with gastric juices (*Kledaka Kapha* and *Pachaka Pitta Samsarga*). The membrane potential of the majority of gastrointestinal smooth muscle sustains rhythmic fluctuations that sweep along the length of the gut. The rhythm varies in different parts of the gut (segments) and is acknowledged by pacemaker cells known as interstitial cells of Cajal. This basic electrical rhythm (BER) provides for sites of muscle contraction when stimuli superimpose spike potentials on the depolarizing portion of the BER waves.<sup>[46]</sup>

In the period between meals, the intestine is relatively inactive, so it is swept through by a large peristaltic wave triggered by the hormone motilin. There are migrating motor complex that presumably serves a "housekeeping" function.



### Separation and absorption of food (*Annam Vivechayati*)

It means the separation of *Sara* (useful) and *Kitta* (waste) products from digested food. Water, minerals, etc. are present in the essence of the digested food which gets absorbed and feces, urine, etc. are expelled from the body. This function of separation is known as *Vivechan*.

A segment of the bowel contracts at both ends and then a second contraction occurs in the centre of the segment to force the chyme both backward and forward. These mixing patterns continue for as long as nutrients remain in the lumen to be absorbed (*Vivechana*). It is centrally reflecting the proximal activity of the bowel directed by the enteric nervous system and can also do its function independently of central input.

These observations correlate with modern research that deals with the formation of *Purisha*, according to which products are digestion are absorbed through the small intestine as well as many other compounds such as vitamins and mineral salts. This material reaches the large intestine, and the process is generally complete except for the absorption of water. Here, the chyme is transformed into a solid form by the *Agni* (*Shoshyamanasya*). In the large intestine, more water and salt are absorbed and the remaining material is now converted into the *Purisha* which excretes the body.

Chakrapani opines that *Vayu* disorders occur initially occurs in *Pakavashaya* and their treatment is also difficult. The treatment here can also *Shaman* (palliative).<sup>[47]</sup> If neural control of this system is disturbed, then peristaltic movement is affected, causing accumulation of waste products and fermentation gases, as a result of this accumulation toxins is absorbed into the system; the generalized, as well as local manifestations of the nervous system, exist.

The consistency of *Purisha* depends largely on the process of water absorption. It should be noted that the stability of feces also depends on factors such as gastrointestinal motility and the nature of the diet.

### Expulsion of waste (*Munchati*)

Elimination of waste products is the function of *Apana Vayu*. *Samana Vayu* initiates *Apana Vayu* to accomplish its function for the expulsion of waste products (removal of feces and urine from the body).

Distension of the stomach by food commences contractions of the rectum and constantly a desire to defecate. The response is called the gastrocolic reflex and may be augmented by the action of gastrin on the colon. *Samana Vayu* can be seen as ENS based on functions that control the entire gastrointestinal tract, especially gastrointestinal reflex pathways. It supports the three types of reflexes; first, that is integrated entirely within the gut wall (control gastrointestinal secretion, peristalsis, and mixing contractions), second from the gut to the prevertebral sympathetic ganglia, and after that back to the GI tract (a) the gastrocolic reflex- signals from the stomach to cause evacuation of the colon, (b) the enterogastric reflex -signals from the colon and small intestine to inhibit stomach motility and secretion, (c) the colonoileal reflex- from the colon to inhibit emptying of ileal contents into the colon) and third, from the gut to the spinal cord or brain stem and then back to the gastrointestinal tract(to control gastric motor and secretory activity, the inhibitory effect of the entire GI tract, and defecation reflex).

Re-absorption of water is an important function of the large intestine. In addition to absorbing water, the large intestine absorbs the number of other substances that remains faecal material secreted into the digestive tract along its length. Movements from the caecum to the transverse colon appear very slowly, allowing hours for water absorption to convert the already thick material into the *Pindarupa* (sludgy paste).

The parasympathetic nervous system is capable of stimulating the enteric nerves to enhance enteric functions. Parasympathetic enteric neurons participate in defecation and provide a rich nerve supply to the sigmoid, colon, rectum, and anus.

*Prana* is the first manifestation of life which integrate with *Apana* and stimulate the living beings, thus *Prana* and *Apana* are mentioned as the first two signs of

life.<sup>[48]</sup> Acharya Susruta has called *Pakwashaya* the place of *Apana* and from this place, *Purisha* moves downward.<sup>[49]</sup> Thus, *Samana Vayu* moves in *Kostha* and regulates the process of digestion and absorption of body fluids i.e., *Sara Kitta Vivechana*.

The next stage of excretion of the waste out of the body is the function which is mainly derived from the *Apana Vayu*. When feces enter the rectum, distention of the rectal wall initiates afferent signals that spread through the myenteric plexus (*Samana Vayu*) to initiate peristaltic waves in the descending colon, sigmoid, and rectum, pushing feces toward the anus. As the peristaltic wave reaches the anus, the internal anal sphincter is relaxed by inhibitory signals from the myenteric plexus; the external anal sphincter voluntarily relaxed (*Apana Vayu*) at the same time, defecation occurs.<sup>[50]</sup> The intrinsic myenteric defecation reflex functioning is relatively weak, so another type of defecation reflex (parasympathetic defecation reflex involving the sacral segment of the spinal cord) begins for effective defecation. It can be said that the *Samana Vayu* appears as a regulating factor for *Jatharagni*, but *Pitta* and *Kapha* have an important role to play in the digestive process because *Samana Vayu* alone cannot do this work properly.

The neurons of the enteric nervous system (*Samana Vayu*), central nervous system (*Prana Vayu*), or autonomic nervous system (*Vyana Vayu*) subsequently activate or inhibit gastrointestinal glands and smooth muscle, altering GI secretion and motility.

## 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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