

REVIEW OF THE CONCEPT OF AVASTHAPAKA IN AYURVEDA IN RELATION WITH THE PHYSIOLOGY OF DIGESTION IN MODERN SCIENCE

Dr. Vijay Khandagale*¹ and Dr. Ravindra Bhurke*²

¹PG Scholar, Department of Physiology (Kriya Sharir), R. A. Podar Ayurvedic Medical College, Worli, Mumbai -400018.

²Guide and Associate Professor, Department of Physiology (Kriya Sharir), R. A. Podar Medical College, Worli, Mumbai – 400018.

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*Corresponding Author

Dr. Vijay Khandagale

PG Scholar, Department of
Physiology (Kriya Sharir),
R. A. Podar Ayurvedic
Medical College, Worli,
Mumbai -400018.

ABSTRACT

Food provides nourishment to *deha dhatus*. The *agni* is primarily located in the *grahani* and it helps in the digestion of food of appropriate quality taken in required quantity and in right time.^[1] According to *ayurvedic* concept physiology of digestion, every food particle has to undergo a common path of digestion which include mainly three stages. The description, here pertains to the transformation process of the ingested food, beginning with the entry into the oral cavity. First stage of digestion is *madhura avasthapak*, second is *amla avasthapak*, and third is *katu avasthapak* for the completion of digestion process associated with development of *kapha*, *pitta*, *vata* respectively. Completion of all the three stages is important

to get proper homeostasis of *doshas*, *dhatus* and *malas* otherwise it leads to development of various diseases.

KEYWORDS: *Avasthapaka*, *agni*, digestion.

INTRODUCTION

In *Ayurveda*, *Ahara* is considered as one among the *Trayopastambha*.^[2] *Ahara* maintains and supports *Deha Dhatus*, *Ojas*, *Bala* and *Varna* with the help of *Agni*.^[3] The ingested *Ahara* has to get digested to undergo absorption. Every food particle should undergo different stages of digestion in order to convert macro nutrients into micro particles to aid easy absorption.^[3] Factors like *Agni*, *Ahara Parinamakara Bhavas*, *Ahara Vidhi Visheshayatana* and *Ahara*

Sevana Vidhi contributes to this process. Hence, all these factors collectively maintain the process of digestion leading to *Utpatti of Prakruta Dosha* thereby achieving *Dhatu*.

Poshana.^[3] In contemporary science, digestion and absorption of carbohydrates, proteins, fats, electrolytes, vitamins, minerals etc occur at different levels in GIT along with the formation of metabolic end products. This complete process involves secretions from endocrine glands, enzymes, acids etc. Variation in these alters the normal physiological process and paves way for manifestation of pathological conditions.

Due to action of *Agni*, *Aharapaka* starts and food is transformed through three *Avasthapaka*.

1. *Madhura Avasthapaka*^[4]
2. *Amla Avasthapaka*^[5]
3. *Katu Avasthapaka*^[6]

The processes that are explained under *Avasthapaka* can be correlated with the digestion of food according to modern science. For correlation, process of Digestion can be divided into three places of Alimentary canal.

1. Mouth and upper part of stomach
2. Lower part of stomach and small Intestine
3. Large intestine

AIM AND OBJECTIVES

- 1) To explain the physiology of digestion in *Ayurveda* with respect to *avasthapak*.
- 2) To explain the digestion of food according to modern science in stomach, small intestine, and large intestine.
- 3) To established the conceptual similarities between *avasthapak* and digestion process according to modern science.

MATERIALS AND METHODS

Physiology of digestion according to ayurveda

Pran vayu is responsible to brought food into alimentary canal which we consume.^[7] In stomach due to unctuousness of *kapha* the food particle becomes softened after which it gets splits into smaller particle by the liquid (saliva).^[8] The *Agni* (digestive enzymes) located in the *udara* (stomach), gets stimulated by *saman vata*. This *agni* stimulated by *saman vayu* digest the food that is taken in required quantity and in right time for the promotion of

longevity.

AVATHAPAKA

1. MADHURA AVASTHAPAKA

Explanation according to Ayurveda

The food consisting of six rasas is consumed via mouth (oral cavity). The process of digestion starts from mouth, only the fraction of it commenced in the mouth. During this process *Bodhaka kapha* is mixed with the food and the *Rasa* of this undigested food becomes *Madhura*.^[9] Later food propelled into *Amashaya* for further digestion. Here food is mixed with *Kledaka kapha* in upper part of *Amashaya*.^[10] The food again becomes *Madhura*.

During this *Avasthapaka*, *Fenbhoot* (Foam like) *kapha* is formed.^[11] The movement or the propulsion of food from the mouth to the *amashaya* is brought about by *pranavayu* and it is said to be responsible for *shtivanam* or the spitting of saliva, *kshavathu* or sneezing, *udgara* or belching (eructation) and *annapravesh* (deglutition or the act of swallowing) and respiration.^[12,13,14] The food that is propelled into the *amashaya* and get mixed with the *drava* or fluid present in this organ is broken down-*bhinna sanghatam* and softened.

To summarize

1. Place of *Madhura Avasthapaka* - *Mukh, Amashaya*.
2. *Rasa* of food - *Madhura*.
3. Formation of *Dosha – Kapha*

Digestion in mouth and stomach according to modern science

In modern aspect the act of spitting of saliva and swallowing of food are important in context of *madhura avathapaka* i.e. first stage of digestion.

Saliva

The act of secretion of saliva has been shown to be due to stimulation of the sympathetic and parasympathetic nerves that innervate the salivary group of glands. In the modern context first stage of *awasthapaka* is correlate with cephalic phase and gastric phase of gastric secretion. When food is chewed, it is mixed with saliva, which contains the digestive enzyme ptyalin (an α -amylase) secreted mainly by the parotid gland. This enzyme hydrolyses starch into the disaccharide maltose and other small polymers of glucose that contains three to nine glucose molecules, however the food remains only for short time in mouth. Food and its

accompanying saliva do become completely mixed with the gastric secretions, as much as 30 to 40% of the starches will have been hydrolysed mainly to form maltose.^[15]



Starch digestion

Starch digestion sometimes continue in the body and fundus of stomach for as long as 1 hour before the food becomes mixed with the stomach secretions. This *Paka* involve the conversion of the insoluble proteins into the soluble, under the influence of the enzyme. pepsin, in the presence of hydrochloric acid. Also, some extent a small amount of triglycerides is digested in the stomach by lingual lipase that is secreted by lingual gland in the mouth. Stomach secreted gastric lipase which accounts for only 10% digestion of fats. In modern aspect this phase is correlate by gastric phase which state that when food inter into stomach, in turn causes secretion of gastric juice during several hour while food remains in stomach. The gastric phase of secretion is 60% of total gastric secretion.^[15]



AMLA AWASTHAPAKA

The semi digested food moves downwards from the *amashaya* (stomach), this semi digested and sour stuff stimulates the production of pitta which is transparent in nature, since pitta is also of sour nature which mixed with sour food stuff.^[16] This process of digestion is production of acidified chyme, which has been characterised by both *Charaka* and *Vagbhata* as *vidagdha*. The term *vidagdha* as interpreted by *Chakarapani dutta* as *pakwapakwam* or *kinchit pakwam, kinchit apakwam* i.e. partly or not fully digested.^[17,18]

To summarize

1. Place of *Amla Avasthapa* – Lower part of *Amashaya, Grahani, Laghwantra*
2. *Rasa* of food – *Amla*
3. Formation of *Dosha* – *Pitta*

The major food on which the body lives can be classified as carbohydrates, fats and proteins. They generally cannot be absorbed in their natural forms through the gastrointestinal mucosa and, for this reason, are useless as nutrients without preliminary digestion. Now the major food consists of carbohydrate, fat, and protein.

Digestion in lower part of stomach and small intestine according to modern science:**Digestion of carbohydrates**

Digestion by pancreatic lipase- pancreatic secretions like saliva, contains a large quantity of α -amylase that is almost identical in its function. Therefore within 15 to 30 minutes after the chyme empties from the stomach into the duodenum and mixes with pancreatic juice, virtually all the carbohydrates will have become digested.

Absorption of carbohydrates

The carbohydrates are absorbed from the small intestine mainly as the monosaccharides viz. glucose, galactose and fructose. Glucose and galactose are transported from lumen of small intestine into the epithelial cells in the mucous membrane of small intestine by means of sodium co-transport. further glucose absorbed by portal vein by facilitated diffusion.

Absorption of fructose also by facilitated diffusion and some molecules converted into glucose and finally reabsorbed.

Digestion of proteins

The dietary proteins are chemically long chain of amino acid bound together by peptide linkages. Pepsin, the important peptic enzyme of the stomach, is most active at a pH of 2.0 to 3.0 and is inactive at a pH above about 5.0. Pepsin only initiated the process of protein digestion, usually providing only 10 to 20% of the total protein digestion to convert to protein to proteoses, peptones, and a few polypeptides. The splitting of proteins occurs as a result of hydrolysis at the peptide linkage between amino acids. Most protein digestion occurs in the upper small intestine, in the duodenum and jejunum, under the influence of photolytic enzyme from pancreatic secretions. Immediately on entering the small intestine from the stomach the partial breakdown products of the protein food are attacked by major photolytic pancreatic enzymes: trypsin, chymotrypsin, carboxypolypeptidase, and proelastase. Both trypsin and chymotrypsin split protein molecules into small polypeptides; carboxypolypeptidase then cleaves individual amino acids from the carboxyl ends of the polypeptides. Proelastase, in turn, is converted into elastase, which then digest elastin fibres that partially hold meats together. Only a small percentage of the proteins are digested all the way to their constituent amino acids by the pancreatic juices. Most remain as dipeptides and tripeptides.

The last stage digestive stage of the protein in the intestine lumen is achieved by the enterocyte that line the villi of the small intestine, mainly in the duodenum and jejunum. The two type of peptidase enzymes namely amino polypeptides and dipeptidase, they split the remaining larger polypeptides into tripeptides and dipeptides and few into amino acids. These are transported through the microvillar membrane to the interior of the enterocyte. Finally, tripeptides and dipeptides are digested to final stage to form single amino acids; these then pass in through to the other side of the enterocyte and hence into the blood.

Absorption of protein

Absorption of protein is mainly by dipeptides, tripeptides, or amino acids. They all are absorbed through the luminal membranes of the intestinal epithelium.

Digestion of fats

Most abundant fats of the diet are the neutral fats, also known as triglycerides. Neutral fats are a major constituent in food of animal origin. In the usual diet are also small quantities of phospholipids, cholesterol, and cholesterol esters. Main digestion of fat occurs in small intestine is as follows- the first step in fat digestion is physically to break the fat globules into small size so that the water soluble digestible enzyme can act on the globule surface, the process is called emulsification of the fats the most of the emulsification occurs in the duodenum under the influence of bile, which contains large quantity of bile salts as well as phospholipids lecithin. Lecithin in the bile is to make the fat globules readily fragmentable by agitation with the water in the small intestine. This action is same as that of many detergents. Triglyceride are digested by pancreatic lipase present in pancreatic juice enough to digest within 1 minute all triglyceride that it can reach. The end products of digestion are free fatty acids. Digestion of cholesterol esters and phospholipids are hydrolysed by cholesterol ester hydrolase.^[19]

Absorption of fats

Fats digested to form monoglycerides and free fatty acids, both are carried to the surface of the microvilli of the intestinal cell brush border. After entering the epithelial cell, the fatty acids and monoglycerides are taken up by the cell's smooth endoplasmic reticulum, here they mainly used to form new triglycerides that are subsequently released in the form of chylomicrons through the base of epithelial cell to flow upwards through thoracic lymph duct and empty the circulating blood.

KATU AWASTHAPAKA

The third aspect of *avasthapaka* is *katu avasthapaka*. When the food products reach the *pakwashaya* (colon) after the completion of *amla avasthapaka* for further digestion process. In this stage food gets further digested & dehydrated by the *agni*, and it takes a bolus form resulting in *katu rasa*. These aspects relate to the acrid and pungent nature of the reactions that occur in the *pakwashaya* or large intestine. *Charaka* has described the way in which the food residue or *anna kitta* is dealt with in this part of the gastrointestinal tract. *Charaka* says, the material passed down from the *amashaya*, having reached the *pakwashaya*, is dried up and converted into lumps by heat-an acrid and pungent gas being produced in the process.^[19] Amplifying this description, Chakrapani Dutta has observed that the term *shoshana* used by *Charaka* instead of *pachanam* is significant. The former in this view, relates to dehydration of the food residue which has been brought to the *pakwashaya*, whereas the latter refers to the digestion of food in the *amashaya* by *agni*. The term *paripindita pakwashaya*, according to him, refers to the process of the formation of faecal lump. The term *vayusyat katubhavatah* described the production, in the process, of an acrid and pungent gas.^[20] The food stuff then moves downwards and get rid of its liquid fraction (*shoshyamana*). Even though, *agni* (digestive fire) by nature, has its flames upwards, still its flame upwards which act as *pachan karma*, but drying effects on objects which placed below. That the term *shoshyamana* is used in lieu of *pachyamana* (being cooked) in the context of the digestion of food.

Thereafter, the remnant of waste products (faeces) of food take a bolus form, and because of drying effect of the *Agni* (digestive fire) placed above, bring about acidity (pungentness) of *vayu*.^[21]

In the large intestine various step occurs-

1. Reabsorption of water and maintenance of fluid and electrolyte balance.
2. Helps in the formation of stool.
3. Facilitates fermentation process.
4. Absorption of certain end products of fermentation such as butyrate, vitamin K, thiamine, and riboflavin.
5. Storage of faecal matter until eliminated.^[22]

About 1500 millilitres of chyme normally pass through the ileocecal valve into the large intestine each day. Most of the water and electrolytes in this chyme are absorbed in the colon, usually leaving less than 100 millilitres of fluids to be excreted in the faeces, also essentially

all the ions are absorbed, leaving only 1 to 5 mEq each of sodium and chloride ions to be lost in faeces. Most of the absorption in the large intestine occurs in the proximal one-half of the colon, giving this portion the name absorbing colon. Whereas the distal colon function principally for faeces storage until a propitious time for faeces excretion and is therefore called the storage colon. The large intestine can absorb a maximum 5 to 8 litres of fluid and electrolyte each day. Numerous bacteria, especially colon bacilli, are present even normally in the absorbing colon. Other substance formed as a result of bacterial activity are vitamin K, vitamin B12, thiamine, riboflavin and various gases that contribute to flatus in the colon, especially carbon dioxide, hydrogen gas, and methane. The faeces normally about three-fourth water and one-fourth solid matter that composed of about 30% dead bacteria, 10 to 20% fat, 10 to 20% inorganic matter, 2 to 3% protein, and 30% undigested roughage from the food and dried constituents of digestive juices, such as bile pigment and sloughed epithelial cell. The brown colour of faeces is caused by stercobilin and urobilin, derivatives of bilirubin. The odour is caused principally by products of bacterial action, these products vary from one person to other, depending on each person's colonic bacterial flora and the type of food eaten. The actual odoriferous products include indole, skatole, mercaptans and hydrogen sulphide.^[23]

Result A: comparison of *Madhura avasthapaka* and digestion food according to modern science

Table 1: comparison of *Madhura avasthapaka* and digestion food according to modern science.

<i>Madhura avasthapaka</i> according to <i>ayurveda</i>	Digestion in oral cavity and fundus of stomach according to modern science.
In <i>mukha</i> , <i>bodhaka kapha</i> is mixed with food.	In oral cavity, Saliva is mixed with the food
In <i>amashaya</i> , <i>kledaka kapha</i> is mixed with food.	In stomach, mucine is mixed with food.
Rasa of <i>ahara</i> becomes <i>madhura</i> (sweet)	Digestion of carbohydrates starts due to salivary amylase. End products formed are glucose and maltose which are sweet in nature.
<i>Kapha</i> is formed during <i>madhura avasthapaka</i> .	Symptoms like dizziness, lethargy, heaviness in stomach are seen which are similar as symptoms of <i>kapha</i> .

Result B: comparison of *amla avasthapaka* and digestion of food according to modern science

Table 2: comparison of *amla avasthapaka* and digestion of food according to modern science.

<i>Amla avasthapaka</i> according to <i>Ayurveda</i>	Digestion in pylorus in stomach and small intestine according to modern science.
In <i>amashaya</i> , <i>pachaka pitta</i> is mixed with <i>ahara</i> .	In pyloric end of stomach, HCl is mixed with food.
Rasa of <i>ahara</i> becomes <i>amla</i> .	Due to HCl food becomes acidic and sour.

Result C: Comparison of *katu avasthapaka* and digestion of food according to modern science

Table 3: Comparison of *katu avasthapaka* and digestion of food according to modern science.

<i>Katu avasthapaka</i> according to <i>Ayurveda</i>	Digestion in large intestine according to modern science.
In this phase, after absorption of water other nutrients, <i>ahara</i> becomes dry and <i>katu</i> .	Food is digested by bacteria. After absorption faeces are formed.
<i>Vata dosha</i> is formed during <i>katu avasthapaka</i>	During digestion of bacteria, various gases are formed. E.g. CO ₂ , methane, indole, skatol etc.

DISCUSSION

‘changing of *ahara rasa*’ is the central idea of to explain digestion according to *Ayurveda*. During *madhura avasthapaka*, *kapha* in whole body increases. But if there is large quantity of *katu*, *tikta* and *Kashaya rasa* in *ahara* then *kapha* rises in negligible quantity.^[24] During *amla avasthapaka*, *pitta* in whole body increases, but if there is large quantity of *madhura*, *tikta* and *kashaya rasa* in *ahara* then *pitta* rises in negligible quantity.^[25] During *katu avasthapaka* *vata* in whole body increases but in large quantity of *madhura*, *amla* and *lavana rasa* *vata* rises in negligible quantity.^[26] Hence, it is important to have food contains all six rasas.

CONCLUSION

From above tables, it can be concluded that –

1. In *Ayurveda*, *Aharpaka* is explained in terms of three *Avasthapakas*.
2. There are distinct places in Alimentary canal where these *Avasthapakas* occur.
3. If the digestion process which takes place in these respective places of *Avasthapakas* is considered, it is seen that, there is similarity in *Ayurvedic* aspect of *Avasthapaka* and digestion according to modern science.

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