

CRITICAL EVALUATION OF CONCEPT OF AWASTHAPAKA (PROCESS OF DIGESTION) AND ITS IMPACT IN DISEASE GENESIS

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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. Thirteen types of agnis are responsible for paka (digestion & metabolism). The impairment of agni is responsible for the creation or causation of vyadhi. The description, here pertains to the transformation process of the ingested food, beginning with the entry into the oral cavity. It is the dravas present in the alimentary canal which are responsible for the splitting of ingested food into small particles. Avastha-Paka (the process of digestion) includes madhura

awastha paka, amla awastha paka and katu awastha paka for the completion of digestion process associated with the development of kapha, pitta and 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 many diseases.

KEYWORDS: Grahani, agni, vyadhi, avastha paka, enzymes, carbohydrate, protein, fat, diseases.

INTRODUCTION

Grahani is the site of agni, because of its power to restrains the downward movement of undigested food and retains food till it is fully digested. The agni is primarily located in the grahani and it helps in the digestion of food. Agni performs its normal functions if person

consumes appropriate quality food taken in required quantity and in right time. Impairment of agni is responsible for the creation or causation of disease. Agnis (enzymes responsible for digestion and metabolism) are of thirteen categories, viz., jatharagni (enzyme present in the gastro-intestinal tract), five bhutagnis (enzymes responsible for transforming heterogeneous elements into homologous ones) and seven dhatvagnis (enzymes responsible for the synthesis of seven categories of tissue elements). Jatharagni controls the functioning of the remaining twelve categories of agnis(bio-digestive fire).^[1]

The five agnis such as parthiva, apya, taijasa, vayavya and akashagni are located in the food ingredients. They get stimulated and become activated by jatharagni in the gastrointestinal tract initially in oral cavity later in tissues and cells. The ultimate products which come out are the specific gunas and the fine particles of the food. The jatharagni causes splitting of all types of food ingredients into two fractions, viz., rasa (nutrient fluid) and mala (waste product). The dhatvagni undergo metabolic transformation of dhatus (tissue elements) into two-viz., kitta-paka and prasada paka.^[2] Two different types of digestion, namely, avastha-paka and nistha-paka have been described in the text. Avastha paka represents the transformation of the taste of the food-stuff as a whole during the process of digestion. Nistha-paka or vipaka, the taste that ultimately emerges out at the post-digestive stage.^[3]

Avastha-Paka (the process of digestion) includes madhura avastha paka, amla awastha paka, katu awastha paka. Madhura avastha paka occur in amashaya (from oral cavity to stomach), Amla avastha paka occur in grahani (small intestine) and Katu avastha paka occur in pakvashaya (large intestine).^[4]

Digestion is a process taking place in the gastrointestinal tract and it is characterised by a specific sequence of events following the ingestion of foods. These events allow the food to interact with the various secretions such as enzymes, emulsifying agents, acid, or alkaline substances thereby facilitating the breakdown of complex molecules into simpler molecules under optimum pH. The various events associated with the process of digestion include following.

1-Mixing and lubricating the food with secretion of the GI tract to ensure uniform homogenization.

2-Enzymatic secretion from various glands and cells lining the GI tract to break down complex molecules into simpler molecule such as oligomers, dimers, and monomers.

i) All digestive enzymes act by hydrolysis.

ii) Most GI tract enzymes are secreted as inactive precursors which are then activated in the GI tract.

3- Secretions of acid or bicarbonate from the GI tract to insure optimal pH for digestion.

4- In the case of fats, secretion of emulsifying agents such as bile acids helps in emulsifying dietary fat thereby promoting fat digestion.

5- Final digestion of most oligomers and dimers occurs at the small intestine brush border resulting in release of monomers that are finally absorbed.^[5]

MADHUR AWASTHAPAKA

The food consisting of six rasas is consumed via mouth (oral cavity). The process of digestion starts from mouth, only the fraction of it commences in the mouth. Later food is propelled into Amashaya for further digestion resulting into stimulation of kapha which is thin and frothy in nature. 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.^[6,7,8] The food that is propelled into the amashaya and gets mixed with the drava or fluid present in this organ is broken down-bhinna sanghatam and softened. In modern aspect the act of spitting of saliva and swallowing of food are important in the present context.

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 the first stage of awasthapaka is correlated 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.

Starch digestion

Starch digestion sometimes continues in the body and fundus of stomach for as long as 1 hour before the food becomes mixed with the stomach secretions. This Paka involves 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.^[9]

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.^[10] 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.^[11,12]

The implication of this phase of digestion as described by Chakrapani states that it is not fit for absorption and utilisation in metabolic processes described by Ayurveda as dhatwagni paka (nistha or paripaka).

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 consist of carbohydrate, fat, and protein.

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, but it is several times powerful. 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 is 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 protein 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 fibers 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 aminopolypeptidase 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 is 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.^[13]

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 cells 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 reaches 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. This aspects relates to the acrid and pungent nature of the reactions that occur in the pakwashaya or large intestine. Charaka has succinctly described the way in which the food residue or anna kitta is dealt with in this part of the gastrointestinal tract. Says Charaka "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".^[13] 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.^[14]

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 pacyamanashaya (being cooked) in the context of the digestion of food. Thereafter, the remnant of waste products (feces) of food take a bolus form, and because of drying effect of the agni(digestive fire) placed above, bring about acidity(pungentness) of vayu.^[15] 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 ends products of fermentation such as butyrate, vitamin K, thiamine, and riboflavin.
5. Storage of fecal matter until eliminated.^[16]

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 faces, also essentially all the ions are absorbed, leaving only 1 to 5 mEq each of sodium and chloride ions to be lost in faces. 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, mercaptanes and hydrogen sulphide.^[17]

Avasthapaka	Place	Dosha	Nature of food substances (swarup)
Madhura	Amashaya	Kapha	Phenabhuta
Amla	Pachyamanashaya	Pitta	Vidagdhatva
Katu	Pakvashaya	Vata	Paripindita pakvata

CONCLUSION

The process of food digestion takes place in three stages namely Madhura awastha-paka, Amla awastha-paka and Katu awastha-paka inside the gastro-intestinal tract and favors the formation of kapha, pitta and vata respectively for the maintenance of homeostasis. If any defect occurs in these stage causes defective formation of doshas leading to development of diseases. Various factors influences in the digestion process namely season, diurnal variation, quality and quantity of food, emotional status, mental status etc. Various diseases occurs due to mithya aahara vihara like samashana, vishamashana, and adhyashana because these factors causes the hindrances in the process of awasthapaka. After the completion of madhura awasthapaka there is formation of normal kapha dosha, if any deformity occurs at this stage causes kaphaja disorder.

Successful accomplishment of amla awasthapaka there is development of pitta, and any disturbance at this stage resulting into pittaja disorder. Successful accomplishment of katu awasthapaka generates development of vata, any disturbance at this stage of awasthapaka resulting into development of vataja disorder. Hence to maintain homeostasis and proper growth of cells and tissues successful completion of all the three avasthapaka is important.

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