Ayurveda is the oldest life science. Ayurveda believes that our bodies, like all universal substances, are made up of Pancha Mahabuta (the five basic elements). In this Panchabhautika Sharira, various processes are continuously going on leading to the loss of various elements. To replace it, you need to consume appropriate ahara (food). Acharya Charaka states that the body is the result of food and Agni (the element responsible for digestion) plays an important role in the proper digestion and metabolism of Akhara (food).

Ayurveda's Ahara pak also indicates relevance to contemporary texts. This hypothesis emerged millennia ago after extensive research that has confirmed its scientific status today.

### INTRODUCTION

The Ayurvedic hypothesis of the Sharira (body) is unique and is based on a pragmatic and scientific approach. According to Ayurvedic methodology, like all universal substances, our bodies are also formed by Panchamahabhutas (Sarvam dravyam Panchabhautikam). In this panchabhautika sharira, various metabolic processes occur continuously leading to the loss of various elements. To replace this, you need to eat a proper diet. Acharya Charaka says that the body is the result of Akhara (food). Agni (fire) plays an important role in the proper digestion and metabolism of ahara. For the metabolism of different types of elements, Agni works in 13 different forms. To understand the concept of Ahara Pak in Ayurveda, you need to know Agni's role in digestion. Consumed food containing all elements is first digested in Amashaya (stomach) by the action of Jataragni. After this initial digestion and related metabolic processes, specific elements are metabolized by specific Agni.

All five Mahabuta-related elements are individually metabolized by the associated Agni known as Butani. The formation of a dhatu (organization) is possible only through the maturation of the basic elements by a certain type of Agni, i.e. Dhatvagni.
Metabolic process (Vipaka-Prakriya) occurring after consumption of diet leads to formation of two parts—Prasada (pure) and kitta (excretory part). The Doshas and Dhatus, etc., get nourished by Prasada part (nutrients). Kitta part (metabolic waste) is to be excreted from the body in any form. The concept of Aharapaka in Ayurveda provides an extensive field of research and scientific status in the present scenario [1].

AIMS AND OBJECTIVES

1. To emphasize and discuss the concept of Aaharapaka in various Ayurveda classical literatures.
2. To evaluate the process of digestion and metabolism in Ayurveda and modern texts.

MATERIALS AND METHODS

This article is based on a review of various classical Ayurvedic texts. Gathered material related to Aharapaka, Agni and other related topics. For a complete and deep understanding of Ayurveda’s concept of Aharapaka, references were collected, analyzed and discussed.

The main Ayurvedic texts used in this study are Annotated Charaka Samhita, Shushruta Samhita, and Astang Hridaya. For research, I collected information about the contemporary medical literature and various sites.

Conceptual Study

Importance of Aahara in Ayurveda

Aahara (food) has been given the prime importance since the Vedic period. It is considered as Brahma in Upanishad, Mahabhaishajya in Kashyapa Samhita and one among the Trayayupstambha by Acharya Charaka [2].

Food helps in sustenance of life of living beings. All living beings in the world require food. Complexion, clearness of mind, good voice, longevity, understanding, ease and pleasure satisfaction (contentedness), growth, strength and intelligence are all dependent upon Aahara [3].

Acharya Charaka emphasizes importance of Aahara. Sharira (body) is the outcome of food. Even so, disease is the outcome of food. The distinction between ease and disease arises on account of wholesome nutrition or the lack of it respectively [4].

Aahara sustains and supports the Deha-Dhatus (tissue elements), Ojas (the factor of resistance to disease and decay), Bala (strength or capacity to perform physical work) and Varna (complexion) among people. Aahara depends upon Agni to contribute to the nourishment of the body. It is obvious that the body elements or Sharira Dhatu cannot be nourished and developed when food is not properly digested by Agni [5, 6].

The key to health and disease does not lie in the application of drugs or chemical or special therapies but in the prime factors on which our life and vitality is based. The Aahara enhances vitality, strength and makes the body sturdy. Aahara increases enthusiasm, memory, Agni, Ayu, Teja (luster) and Ojas. Consumption of pure food, i.e., Satvika Ahara makes the mind clear. When mind is devoid of blemishes, memory power enhances [7–9].
Agni and Pitta

To understand the concept of digestion and metabolism in Ayurveda we must first understand the concept of Agni and Pitta (one of the three bodily doshas responsible for digestion and metabolism) in Sharira.

There is no fundamental difference in physical and biological Agni except that the latter is associated with living organism. The effect of Agni at physiochemical level is decomposition, disintegration and acceleration of various chemical reactions occurring in nature. Similarly, the main function of Agni in the body is to breakdown or to disintegrate the food in its simplest possible components for absorption and utilization. Technically, these functions are termed as digestion and metabolism.

The concept of biological Agni has been described in Charak Samhita in two references:

(a) Agni (b) Pitta

The functions attributed as Dahana, Pachana, etc., of Agni correspond to the functions performed by varieties of biological substances known as enzymes [10].

It is the Agni alone that located in Pitta, gives rise to beneficial or harmful consequences, according as it is normal or abnormal. The concept of Pachak Pitta (Kosthagni) pointed to some internal secretions or secretions secreted by the Agnidharakala, in the Grahani (corresponding to the mucosal glands of the duodenum) [11,12].

Systemic Control of Jatharagni on Other Agnis and Pittas

The first ruk of Rigveda starts with “aagni meele purohitam” which means Agni is purohita, here purohita means who leads ahead, pura also means body, Agni is the protector of the body. In Ayurvedic texts, lots of importance has been given to Agni. One of the eight branches of Ayurveda called Kayachikitsa itself is equated with Agni maintenance ((kayasa antaragni chikitsa kayachikitsa)) [13].

Chakrapani Dutta enumerates 13 Agnis among which Jatharagni plays important role in regulation of five Bhutagnis and seven Dhatwagnis.

Dehagni or Jathagagni is the main principle substance responsible for disease and health. It is responsible for longevity, complexion, strength, health, enthusiasm, well built, luster, immunity (ojas), Tejas (luster), other Agnis (bhutagni and dhatwagni) and other vital functions are all dependent on Jatharagni. Healthy state of body and diseased condition is entirely dependent on Agni [14, 15].

Aahara (food) nourishes Deha Dhatus (tissue elements of the body), Ojus provides strength and complexion. But in effect, it is the Agni (enzymes) that plays a vital role in this connection because tissue elements like Rasa, etc., cannot even originate from undigested food particles [16].

Process of Digestion (Paka Prakriya)

According to Acharya Charak Prana Vayu (one type of Vata dosha responsible for respiration and swallowing) with its power of attraction, draws the ingested food into the Kostha (alimentary tract). This food gets softened by the unctuous substance after which it gets split into small particles by the liquid (saliva). Thereafter, the Agni (enzymes) located in the Udara (stomach) gets stimulated by Samana Vayu (one type of Vata dosha, performs function like receiving, digestion and division of food). This Agni
(enzymes) stimulated by Vayu, helps in the digestion of food of appropriate quantity taken in required quantity and in right time for promotion of longevity.

As the fire placed below helps in the cooking of food namely rice and water kept in a vessel placed there on, so does the Agni (enzymes) helps in the digestion of food located in the ashaya (amashaya), i.e., stomach for production of Rasa (chyle) and Mala (waste product) [16].

Jatharagni paka, i.e., gastrointestinal digestion of food has been described as Avasthapaka or the change in the state or form of food substance in the Amashaya and Pakwasaya in the course of digestive process. Two phases of this paka, the prapaka and vipaka have been envisaged. The term “Prapaka” has been defined by Chakrapani Dutta as Pratham paka or the first change. He on the other hand has defined the term “Vipaka” as changes which the food has undergone. Prathampaka is again subjected to further changes under the influence of Jatharagni [17].

Avasthapaka (Prapaka) – Primary Digestion

The Madhur Bhava of Avasthapaka in Adho-Amashaya: Prapaka phase of digestion of food stuff ingested commences from the time the food is introduced into the mouth. This aspect of digestion in the upper portion of Urdhwa amashaya is comprehended by Madhura bhava. The process of digestion, especially the fraction of it commences in the mouth, under the influence of Bodhaka Kapha (one of five types of Kapha, responsible for taste perception), is seen to be completed in the Urdhwa amashaya (i.e., fundus of stomach). This stage of digestion is reminiscent of salivary digestion which is completed in the fundus of stomach where the insoluble starch polysaccharides is converted to soluble dextrin, under the influence of salivary amylase (ptyalin)

Starch Erythrodextrin Achrodextrin Stable Dextrin: The action of the salivary amylase is of the nature of Bhinnasamghata (spitting) brought about by hydrolysis. The final Rasa (taste) of the resultant product in the upper portion of the Urdhwa amashaya (fundus of stomach) is Madhura [18].

The movement or the propulsion of food from the mouth to the Urdha amasaya is brought by Prana Vayu (One type of Vata dosha responsible for respiration and swallowing) which according to Acharya Charaka is said to be responsible for Sthivanam (the spitting of saliva), Ksavathu (sneezing), Udgara (belching) and Aahara karma (deglutition or the act of swallowing) and respiration [19].

In the language of modern physiology, the stages associated with the digestion of carbohydrates in the gastrointestinal tract mean the first stage Madura-Baba. When food is chewed, it mixes with saliva (ptyalin) to hydrolyze starch into the disaccharide maltose and other small glucose polymers containing 3 to 9 glucose molecules. Further digestion takes place in the small intestine, where pancreatic secretions, namely α-amylase, digest almost all the starch into maltose and other small glucose polymers. Digestion is also carried out by enterocytes that line the villi of
the small intestine and contain four enzymes. Lactase breaks down lactose into galactose and glucose. Sucrase splits sucrose into fructose and glucose. Maltase splits maltose into small glucose polymers and glucose. Thus, the final product of carbohydrate digestion is all monosaccharide. They are all water soluble and are absorbed immediately into portal blood [21–23].

**The Amlabhava of Avasthapa in pachayamanashya**

The Madhur bhava of the Avasthapa is seen to be brought to an end by the hydrochloric acid (HCl) secreted by the cells of the mucus membrane of the stomach. This makes the commencement of the Amalabhava or the acid (sour) phase of prapaka. This paka (digestion) involves the conversion of insoluble proteins into the soluble ones under the influence of enzymes pepsin in the presence of HCl.

This aspect of Prapaka does not seem to have anything to do with the digestion of the end products of Madhura Paka, i.e., the substance the taste of which is madhura (sweet-carbohydrates). The process of conversion of insoluble proteins into soluble peptones in the course of the Amlabhava of Prapaka can be written as follows.

**Proteins Proteoses Peptones:**

Simultaneously with the passage of ahara (food) reaching Amlabhava, achapitta (pancreatic/bile fluid) is released. As it passes slowly from the pylorus to the duodenum, the acidified chyme acts as a secretion and stimulates the duodenum to secrete a lot of intestinal juice. Gallbladder emptying occurs under the influence of partially digested food in the intestine.

It would seem that the Vidagdha Ahara (partly digested food) from the Amashaya which is Amla in Rasa stimulates the humoral mechanism located in the upper segment of Adho Amashya and the discharge of Accha Pitta into it. The term Accha has been interpreted by Chakrapani Dutta and Gangadgara as Aghana (thin) and Swacha (clear). It is obvious that the concept of Accha Pitta includes the gall bladder, bile and pancreatic secretions which together have been shown to be responsible for digestion of fats, proteins and carbohydrates [21, 24, 25].

In the parlance of modern physiology, the steps involved in digestion of proteins and fats occur in this stage. In digestion of proteins enzyme pepsin in stomach (active at pH 2–3) converts protein to proteoses, peptones and a few polypeptides. Most of protein digestion occurs in upper small intestine in the duodenum and jejunum under the influence of proteolytic enzymes from pancreatic secretions, viz., chymotrypsin, trypsin, carboxypolypeptidase, proelastase leading to digestion of small percent of proteins and formation of polypeptides and amino acids. Further digestion of peptides by peptidase in the enterocytes that lines small intestine leads to formation of amino acids. Finally, 99% of di- and tripeptides are digested to single amino acids forms within enterocytes [26].

Digestion of fats occurs starting in stomach where a small amount of triglycerides is digested in the stomach by lingual lipase. Emulsification of fat occurs for its absorption. Most of emulsification occurs in the duodenum under the influence of bile. Bile does contain a large quantity of bile salts as well as the phospholipids lecithin which is extremely important for emulsification of fat. Most of the triglycerides of the diet are split by pancreatic lipase into free fatty acids and two monoglycerides [27].
The Katubhava of Avasthapaka in Pakvashaya

The third aspect of Avasthapaka is spoken of as the katubhava. This aspect related to the acrid and pungent nature of the reaction that occurs in Pakwasaya or large intestine. Charaka has described the way in which the food residue or Annakitta is dealt with in this part of GIT. Charaka narrates that the material passed down from the Amashaya having reached the Pakwasya is dehydrated and converted into lumps by heat and acrid pungent gas being produced in the process.

Amplifying this description, Chakrapani Datta has observed that the term Sosana (absorption) used by Charaka instead of pachana (digestion) is significant. The former in his view relates to the 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 Pari pindita Pakwasya refers to the process of the formation of fecal lumps. The term Vayusyat Katubhavatah describes the production in the process of an acrid and pungent gas [21, 28].

In the parlance of modern physiology, with the passage of contents in small intestine maximum process of digestion and absorption is completed. As the contents reach the large intestine, absorption of remaining nutrients is completed. In large intestine, more water and salts are absorbed and the remaining material is now converted into feces which leave the body.

The large intestine is the nidus of a large bacterial flora of which Escherichia coli is ordinarily the predominant organism. These microorganisms are shown to be involved in the alteration affection products derived from the digestion of proteins. They are described as putrification flora which bring about the purifications of the protein residues of the food and the liberation in the process of various kinds of pungent gases with disagreeable and often foul odors such as iodole, phenol, hydrogen sulphide, and ammonia.

The foregoing modern contribution is seen not only to confirm but also amplify the ancient Ayurvedic version of events that take place in the large intestine and the formation of feces with production of pungent Vayu [29].

Vipaka – Post-Digestive Effect

The post-digestive action on food has also been classified as taking place in three phases. It is important to note here that the primary phase, Avasthapaka – consistency of three phases – Madhura, Amla, Katu occur for every type of food. But the post-digestive phase, Vipaka takes place depending upon the quality of the food ingested.

The ultimate change in the Rasa that occurs at the end of digestion by the association of (coming in contact with and being acted upon) the Jatharagni (fire in the stomach vis-à-vis digestive juice of the alimentary tract) is called as Vipaka [30].

According to Acharya Charaka, the six Rasas yield three kinds of Vipaka, i.e., Madhura and Lavana Rasa to Madhura Vipaka (sweet ), Amla Rasa to Amla Vipaka (sour) and Katu, Tikta, Kasaya Rasa to Katu Vipaka
(acid, pungent). According to Acharya Shushruta, Vipakas are only two – Madhura and Katu Vipaka [31, 32].

Secondary Digestion – Metabolism

Secondary digestion is also known as tissue digestion or metabolism. In this phase, all the seven tissues are formed in their respective tissue channel systems with the help of Dhatwagni, Vyana Vayu and Ranjaka pitta and the proper food substance which is the result of primary digestion that has taken place in the gastrointestinal tract. Needless to say, this absorbed food from the intestine must contain all the necessary substances for providing nutrition to all the seven tissues in the body.

Metabolism takes place in each tissue channel. Due to this conversion, each tissue is formed in each channel for that particular tissue. Ranjaka Pitta is the medium through which the dhatwagni works for conversion. Vyana Vayu also aids in this conversion [33].

In modern physiology parlance, the nutrients absorbed are subjected to metabolism in the body. The metabolism of glucose in the body occurs in the form of hepatic glycogenesis, glucogenesis in muscle and other tissues, conversion to fat (lipogenesis) in adipose tissue, oxidation of glucose to supply energy, synthesis of glycoprotein, glycolipid, lactose, ribose sugars, fructose, etc., and synthesis of non-essential amino acids [34].

The metabolism of free fatty acids leads to formation of gluco-corticoids and mineralo-corticoids, formation of androgens, formation of estrogens and prostaglandin hormones [35].

The metabolism of amino acids in body leads to formation of tissue proteins, plasma protein formation, formation of globin of Hb, formation of enzyme proteins, formation of protein hormones and neurotransmitters, formation of other nitrogenous substances, e.g., choline, purines and pyrimidines, formation of glucose (glucogenic amino acids), formation of biogenic amines and polyamines, ketone body formation (ketogenic amino acids), ammonia and urea formation [36].

DISCUSSION

Avasthapaka refers to series of changes which Ahara dravyas (food) undergo in the Kostha (alimentary tract) [37]. Agni is the only chemical agency responsible for Ahara Pachana (digestion) in the kostha (corresponding to gastrointestinal digestion) [38]. In the first stage of digestion (Madhura Avasthapaka), the food in Urdhwa amashaya (fundus of stomach) attains Madhura bhava by action of salivary amylase on starch, digestion of carbohydrates occur into simpler forms (glucose) rendering it fit for absorption.

In the second stage (Amla Avasthapaka), the Ahara is stated to undergo Amlabhava/Vidagdha (partly digested food) by release of Accha pitta (bile/pancreatic secretions) resulting into acidified chyme formation in Urdhwa amashaya (fundus of stomach) and pylorus of stomach. In parallel to modern physiology, digestion of proteins and fats occur in this stage resulting into simpler forms, i.e., amino acids and free fatty acids.

In the third phase (Katu Avasthapaka), Paripindita Pakvasya Vayu the absorption of nutrients occur in the large intestine and formation of feces with production of pungent Vayu occur. Bhutagni, ignited by Jatharagni transforms the Vijatiya Annarasa into Sajatiya Poshaka dhatus (organism specific). After
Bhutagnipaka, Dhatwagnipaka occur in which the Ahara Rasa absorbed from the Adhoamashaya is subjected to Paka(digestion) before it is utilized. The Prasadabhaga as Poshya or Asthayi dhatu and Kittabhaga, some portion of which are used up the body and others are eliminated out as metabolic waste product.

Dravyas are either Tulya or Visitha which cause an increase or decrease of the dhatus (tissues) due to properties potentially inherited by them, i.e., homologous properties of Dravyas cause sufficient and rapid increase of identical or homologous properties in the dhatus [39]. Thus, all the seven tissues are formed in their respective tissue channel system with the help of Dhatwagni Vyana Vayu and food substances which are the result of primary digestion that has taken place in the gastro-intestinal tract.

CONCLUSIONS

Ayurveda is one of the great gifts given to mankind by the ancient Indian sages. Food is essential to life, just as oxygen is essential to life. Agni is commonly used for the digestion and metabolism of food and for processing when it is suitable for digestion. When food is digested in the Amashaya and Pachayamanashaya (corresponding to the stomach and small intestine), complex food substances are converted into simple forms (i.e., can break down complex proteins into amino acids, fats into fatty acids and glycerol, and starch into glucose, making them suitable for absorption in kayagni (digestive fluids containing powerful enzymes, acids and bases in terms of modern physiology).

Sara and Kitta Vibhajana are applied to food promoted by Pakvashaya. The sara (pure) part undergoes various metabolic processes under the influence of dhatvagni to form dhatu and updhatu, while the kitta (waste) part excretes metabolites (feces, urine) from the body. Thus, the concept of Aaharapacka in Ayurveda represents its relevance to the modern physiology of digestion and metabolism, providing extensive research and scientific status in the current scenario.

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