



Review Article

ROLE OF RASAJA BHAVA (NOURISHING FACTORS) IN DEVELOPMENT OF GARBHA (EMBRYO/FOETUS)

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ABSTRACT

Archaic scholars of Ayurveda lay great emphasize on intake of *Ahara* (food) as best source for nourishment and has a prime role in growth and development of foetus during pregnancy. In order to achieve a healthy progeny, Ayurveda classics have elucidated wholesome regimen to be followed by the parents before and after conception. There are specific procreating factors which help for the growth of embryo known as *Matrujadi shad bhava* (maternal and other 5 factors). *Shadbhava* (six factors) consist of *Matruja*, *pitruja*, *Atmaja*, *Rasaja*, *Satmyaja* and *Satwaja* in which *Rasaja bhava* plays an important role in providing nutrition to the foetus. The concept of *Upasneha*, *Upasweda*, *Ambu*, *Apara* and *Nabhinadi* are involved in nourishment of embryo/foetus at different stages of development. *Acharya* have drawn attention to certain food habits, to be avoided by the pregnant woman to refrain from abnormalities in the offspring. The concept of nutrition in *Garbhini* (Gravid Women) explained in classics has similarity with contemporary science.

INTRODUCTION

Ayurveda regards *Ahara* as one of the *Trayopasthambha*^[1] (three pillars) without which existence of life cannot be maintained. This ancient science of life not only has given priority to *Swasthavritta palana* (daily and seasonal healthy regimen) but also has drawn attention to antenatal care for healthy progeny. These measures start, well before conception by following particular diet and regimen for parents who aim maximum benefits and avoid birth defects of the child. Archaic scholars of Ayurveda lay great emphasis on *Garbhini Paricharya* (certain dos and don'ts for pregnant women) and specific factors influencing the growth and well-being of progeny. *Acharya* have mentioned about six specific *Garbhaja bhava* (procreational factors) that include *Matrija* (maternal), *Pitrija* (paternal), *Aatmaja* (Sentient), *Rasaja* (nutritional), *Satmyaja* (compatibility) and *Sattwaja* (psyche).^[2]

Rasaja bhava is one among those factors which indicate about the nutrition to the embryo/foetus. As per *Charaka*, *Rasaja bhava* does *Shareeraabhivridhi* (growth and development), enhances *Prana* (life force), instills *Trupti* (satisfaction), does *Pushti* (nutritional) and *Utsaha* (enthusiasm) in the fetus^[3]. As per *Sushruta*, *Rasaja bhava* helps for *Shareera upachaya* (anabolic), *Bala* (strength), *Varna* (complexion) of body and is responsible for existence or destruction of the foetus^[4]. Ayurveda classics elaborately explain the importance of physical and mental wellbeing of mother, proper nutrition during pregnancy and practice of wholesome regimen which play an important role in achieving healthy offspring. Pregnant woman, if not following the aforesaid things may be affected by serious illness or may lead to death of child.

MATERIALS AND METHODS

Literary review and critical analysis of *Rasaja bhava* from *Samhita* (authorized textbooks of ayurveda), articles from PubMed, Google Scholar and contemporary view on prenatal nutrition from authorized text books and online journals.

Rasa as Dhatu

The term *Rasa* is derived from the root '*Ras*' meaning movement. As it is moving constantly, it is

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called *Rasa*^[5]. It circulates throughout the body in subtle ways like continuity of sound, flame and water. Dalhana, the commentator of Sushruta Samhita clarifies that continuity of sound is sideward movement, flame is upward movement, and water is downward movement^[6]. From this we understand that *Rasa* moves all over the body. *Aahara* composed of *Pancha mahabhoota* component in the form of *Shad rasa* in various permutation and combination, possesses many properties. When ingested, it gets digested by *Koshtagni* (bio fire) and emerges in the form of vital essence known as *Rasa*, which is very subtle. *Hridaya*, is its main seat and from there it travels through 24 *Dhamani*, ten of them going upwards, ten going downwards, four going obliquely and dividing into innumerable branches, nourishing the entire body constantly^[7]. *Rasa* helps in growth of body, supports and maintains it, by biochemical action due to its innate quality.

Chakrapani, the commentator of Charaka Samhita has mentioned two types of *Rasa* i.e., *Sthayi rasa* and *Poshya rasa*^[8]. From *Rasa dhatu*, *Rakta dhatu* is formed and this formation continues till it becomes *Sukra dhatu* and for all *Dhatu*, nutrition supply is from *Poshaka rasa*. By curing the diseases and maintaining positive health bringing equilibrium in *Dhatu* is the only aim of administering therapies. All *Dhatu* gets strengthened by the use of substance having similar properties and get reduced by the use of those having opposite properties^[9]. The early foetus which is in the form of fertilized egg, is conglomeration of all *Dhatu*, that are in inexplicit form. The brown eggs, if consumed by the gravid women, promote nourishment of all *Dhatu* which is in subtle form in the fertilized egg^[10].

Rasa as Ambu

The blood and inter cellular fluid of endometrial tissues with healthy and required nutrients without any abnormality is helpful for formation and development of foetus. The term *Ambu* represents *Rasa dhatu* which is formed after complete digestion of *Aahara*^[11]. The main function of *Rasa dhatu* is *Preenana* meaning nourishment^[12]. In classics, nourishment of foetus is described in two parts. First when the body parts are not perceptible, it gets nourished through the process of *Upasneha* and *Upasweda*. Second, when the body parts are observable, it receives nutrition through *Nabhinadi*^[13]. *Nabhi nadi* of *Garbha* is attached with *Rasa vaha nadi* of mother which carries *Veerya* of *Ahara Rasa* from mother to foetus by *Upasneha*^[14].

In the first crucial week, womb milk is the embryo's only source of nourishment. At the beginning of a pregnancy, the placenta is much larger than the growing embryo, so the pressure of arterial blood dislodges the embryo from the wall of the uterus and

only by 11 weeks, embryo will be big enough to withstand and accept its mother's blood^[15].

Graham Burton of the University of Cambridge and team discovered in 2002 that the glands in endometrial lining nourish the embryo during the first trimester and not the mother's blood and called it uterine milk^[16].

Uterine glands discharge secretions into the intervillous space until at least eight weeks of pregnancy, and these are taken up by the syncytiotrophoblast. During early pregnancy selected maternal proteins accumulate within the fluid of the coelomic cavity, from which they are transported to the foetus by the secondary yolk sac. Histotrophic nutrition is advantageous to the foetus during the first trimester as it provides nutrients under a low oxygen concentration, reducing the risk of free radical mediated damage during the sensitive period of organogenesis. Once this is complete, and foetal oxygen requirements rise, there is a transition to haematrophic nutrition at the start of the second trimester, when the maternal placental circulation is fully established^[17].

Uterine glands are active until at least week 10 of pregnancy and their secretions are delivered freely into the placental intervillous space. Phagocytic uptake by the placental syncytiotrophoblast of two glycoproteins, the mucin MUC-1 and glycodefin A, synthesized in the maternal glands and Glycodefin is also detected within the epithelium of the secondary yolk sac lining the exocoelomic cavity. This indicates that the yolk sac plays an important role in nutrient exchange before vascularisation of the chorionic villi. Uterine glands are an important source of nutrients during organogenesis, when metabolism is essentially anaerobic.^[18]

The yolk sac provides nourishment, before the placenta is formed and can take over. It is also the main organ of embryonic blood cell production via blood islands near the yolk sac. The human yolk sac size is larger when maternal stature is small. This suggests an adaptive compensation to ensure embryonic nutrition and growth, an effect that can be traced until 24 weeks of gestation. Human yolk sac size reflects involvement in embryonic and foetal growth regulation.^[19]

The yolk sac is part of the gestational sac. It appears about a week or two after the embryo is implanted in the uterus and it disappears near the end of the first trimester. During that time, the yolk sac provides all the nutrients that the embryo needs. It also produces red blood cells until the placenta is fully formed and takes over^[20].

Male and female gametes are embedded in fluids that are produced by gonads and other reproductive tissues. Female reproductive fluids,

usually called ovarian fluid or follicular fluid (OF), often constitute a relevant volumetric component of the egg mass, rich in ions, sugars and proteins, and are involved in several functions. They protect gametes to facilitate fertilization, and often act as mediators of post-mating sexual selection. OF enhances sperm swimming longevity and velocity (a predictor of sperm competition success) and mediates post-copulatory inbreeding avoidance. OF quality is dependent on female nutritional condition and good OF quality increases sperm velocity^[21].

During early pregnancy, the yolk sac is responsible for delivering nutrition to the embryo through a process called vitelline circulation. The yolk sac absorbs nutrients through a complex process and then delivers these nutrients to the developing embryo. This nutrition is essential because the yolk sac is the primary source of nutrition until the placenta takes over at around 10 weeks. The yolk sac breaks down over time once the placenta takes over and is not visible at birth^[22].

The yolk sac has many essential jobs in foetal development before the placenta and organs develop. The yolk sac circulates gasses between the gravid woman and embryo, it delivers nutrients to the embryo, develops the earliest form of blood cells, makes cells that turn into the umbilical cord, gastrointestinal system, reproductive organs and more and provides early immune function and metabolism.

Rasa as Ahara rasa/Nourishment by consumption of food

Rasa refers to *Aahara rasa* due to intake of balanced diet taken by gravid woman. It helps in growth and proper development of foetus. As per *Charaka*, from fourth day of menstruation, couple should follow regimen and diet that include *Ghrita*, *Ksheera*, *Madhroushadha Samskrita Anna* for man and *Thaila*, *Masha Samskrita Anna* for woman^[23]. *Sushruta* opines that couple should undergo *Snehana* with *Ghrita* and *Pathya Anna* for one month^[24]. *Laghu Vagbhata* elaborates that healthy man should have coitus with healthy woman in auspicious period of night following specific diet regimen^[25]. *Vridha Vagbhata* advised to take food which increases *Pitta*. The commentators have explained that *Madhura Aahara* increases *Shukra* and *Pittala Aahara* increases *Rakta*^[26]. *Arunadatta* clarifies that initially woman should be given *Masha* etc. along with oil, however later on, these shouldn't be used as *Pitta Vardhaka Aahara* initiates abortion^[27].

Nutrition after Conception

The mechanism of tissue nutrition and transformation of tissue nutrient into bodily element is explained in a comprehensive manner through *Dhatu Poshana Nyaya* (theory of nourishment of tissue). These *Nyaya* are *Ksheera Dadhi Nyaya* (transformation

of nutrients), *Khale Kapota Nyaya* (selective uptake), *Kedari Kulya Nyaya* (transportation of nutrients) and *Ek Kala Dhatu Poshana Nyaya* (simultaneous supply of nutrients to whole body). All the theories are relevant and conjointly represent whole process of tissue nourishment at different levels of the metabolism.^[28]

In prenatal life embryo gets nutrition by *Upasneha* (filtration) and *Upasweda* (percolation/secretion) and the foetus by *Garbha nabhinadi* (umbilical cord) which is attached with the heart of mother via *Rasavahanadi* (blood vessels). Nourishment of body gets established just after the conception, which causes the gradual development of foetus. The foetus is entirely dependent upon mother for its nourishment and is lacking the urge of thirst and hunger. *Aahara Rasa* of mother gets divided into three parts- one part nourishes herself, one goes to the production of *Stanya* (breast milk), while one part nourishes the foetus^[29]. *Sushruta* has also opined that as soon as the process of fecundation gets completed, the vessels (*Dhamani*) of maternal body which carry the nutrients (*Rasa*), run laterally and longitudinally in all directions (*Thiryakgata Dhamani*) and through it, tend to foster the foetus with their own *Upasneha* (diffusion, selective permeation) all through its perpetuation in the womb.

Role of Nabhi nadi in Nourishment

After the completion of organogenesis, the foetus gets nourishment by the process of perfusion, through the root of hair follicles and also through the umbilical cord. The *Garbha nabhinadi* (foetal umbilical vessels) is attached to the umbilicus of foetus on one end and the placenta on the other end. The placenta in turn is connected with the heart (circulatory system) of the mother. The placenta gets huge blood supply and nourishment from the heart of mother through the *Rasavaha Nadi* (blood vessels)^[30]. *Indu*, the commentator of *Astanga Sangraha* has conceived *Upasneha* and *Upasweda* as *Snigdhatva* and *Utkleda* (becoming wet or moist) respectively^[31]. *Nabhi nadi* of foetus is connected with *Rasavaha nadi* of mother, this conveys the essence of food and vitality from mother to foetus and further nourished by this material, the foetus grows. From the time of deposition of semen into vagina till all the major and minor parts which are undeveloped become clearly differentiate and developed fully, the foetus derives its nourishment by *Upasneha* through the *Rasavahi dhamani* which spread sideways^[32].

As per *Vridha Vagbhata*, when the *Anga* (body parts) are fully conspicuous, the foetal *Nabhi* is connected to *Apara* through *Nabhinadi* and then to the mother's heart^[33]. It carries *Ahara rasa* from *Matruhridaya* to the *Apara* through pulsating *Dhamani*. Then it reaches *Nabhi*, *Pakwasaya* of fetus which is metabolized by *Kayagni* resulting in *Dhatu pushti*^[34].

Masanumasika Ahara vidhi

Pregnant woman during first, second and third month should partake foods which are sweet, cold in potency and more of liquids; especially during third month she should consume boiled *Shashtika* rice along with milk. In fourth month, she should have food added with milk and butter, together with meat of animals of desert like region and boiled rice which is pleasing to the mind. During fifth month food should be taken along with milk and ghee. During sixth month she should drink either ghee boiled with *Svadamshtra* or drink *Yavagu*. During seven month she should drink either ghee boiled with *Prithakparni* etc. During eighth month *Kashaya basti* has to be given^[35].

Food Habits Responsible for Impairment in Pregnancy

Mother who consumes:

- *Theekshna* and *Ushna* food in excess or less in quantity cause death of fetus inside the uterus.
- *Madya* (alcohol) cause constant *Pipasa*, *Alpa Smriti* and *Anavastitha Chitta* to the offspring.
- *Godha mamsa* (iguana flesh) affect the offspring from *Prameha* and *Ashmari Roga*.
- *Varaha Mamsa* in excess produce redness in eyes and roughness of hair.
- Addiction to intake of fish causes *Mookata* and *Athisthoulya*.
- *Amlarasa nitya* causes *Raktapitta*, *Twak* and *Akshiroga*.
- *Lavanarasa nitya* produce *Vali*, *Palita* and delayed closure or non-closure of eyes.
- Excess use of *Madhura* causes *Prameha Khalitya roga*.
- *Katurasa nitya* causes *Durbala*, *Alpasukra* and *Anapatya*.
- *Tiktarasa nitya* causes *Sosha* (emaciation) and reduces *bala*.
- *Kashayarasa nitya* produces *Shyava* (grey complexion), *Anaha* and *Udavarta*^[36].

Due to intake of *Ushna* and *Teekshna Ahara* loss of vital elements from the body through exudation occurs, resulting in inhibition to the growth of fetus known as *Upavishtaka*^[37]. If pregnant woman has malnutrition and aversion to intake of fats, it leads to aggravation of *Vata* and results in growth retardation of developing foetus and as *Vata* is having drying quality. This condition is called *Nagodara*^[38].

Effect of Teratogens (Vikruta Rasa Parinama)/ Metabolic Error

Folic acid deficiency leads to deficient methionine production RNA and DNA synthesis. Folic acid is essential for normal meiosis and mitosis. Periconceptional folate deficiency leads to neural tube defects, cleft lips and palate.

Tetracycline is a type of antibiotic that can cross the placental membrane and get deposited in the embryo's bones and teeth. Tetracycline exposure can result in yellow staining of the deciduous teeth and diminish growth of the long bones.

Anticonvulsant agents like phenytoin, produce the foetal hydantoin syndrome consisting of intrauterine growth retardation, microcephaly, mental retardation, distal phalangeal hypoplasia, and specific facial features.

Anti-neoplastic or chemotherapeutic agents are teratogenic as these agents inhibit rapidly dividing cells.

Retinoic acid or vitamin A derivatives and oral medications such as isotretinoin are potent teratogens. Craniofacial dysmorphism, cleft palate, thymic aplasia, and neural tube defects are some of the malformations caused.

Nicotine constricts uterine blood vessels and decreases the uterine blood flow further decreasing the supply of oxygen and nutrients to the embryo. This compromises cell growth and cause an adverse effect on mental development. Alcohol is a common drug abused by women of childbearing age. Infants born to alcoholic mothers demonstrate prenatal and postnatal growth deficiency, mental retardation, and other malformations^[39].

Energy intakes that diverge from the appropriate energy requirement may alter the foetal phenotype through epigenetic processes that alter expression of the genotype, such that insufficient or excess energy intake may cause growth restriction and overgrowth, respectively^[40].

Adverse effects on human progeny have been observed in the form of abortion, congenital malformations, low birth weight and increased perinatal loss when the father has been exposed to lead, anaesthetic agents, smoking or caffeine ingestion. These agents alter the morphology of the spermatozoa or cause some change in the composition of the semen.

The deficiency of glucose, amino acids and oxygen etc. in the mother causes intra uterine growth retardation. Deficiency of iron, folic acid, vitamin B12, protein causes hypoxemia and in turn leads to death. Maternal intake of alcohol, drugs and malnutrition lead to congenital malformation.

DISCUSSION

The stages of foetal nutrition following fertilization can be classified as

- Absorption: In the early post fertilization period, nutrition is stored in deutoplasm within cytoplasm and very little nutrition is supplied from tubal and uterine secretion.
- Histotrophic transfer: Following nidation and before establishment of uteroplacental circulation,

nutrition is derived from eroded decidua by diffusion and later on from stagnant maternal blood in trophoblastic lacunae.

- Haematotrophic nutrition: With establishment of foetal circulation, nutrition is obtained by active and passive transfer from third week onwards.
- Trophoblast serves the function as invasion, nutrition and production of hormones for the maintenance of pregnancy. Local cytokines regulate the invasion of cytotrophoblast in the decidua.

Two third of total calcium, three fifth of total protein and four fifth of iron are drained from mother during last three months^[41].

Acharya advises liquid food made of milk during first three months of life which indicate the need of calcium and vitamin and similar advises are given in contemporary science also. Adequate hydration is advised because water constitutes cells, detoxifies the blood, and assists circulation, oxygen and nutrient transportation, increases metabolism. Water treats hormonal imbalances and female cervical mucus. However, water, greens, vegetables and meat can be contaminated with pathogens or chemicals. Nutrition, water and associated contaminants affect intrauterine installation of fertilized eggs, particularly sensitive to the levels of natural estrogens^[42].

Poor nutrition leads to gestational failures due to the damage of DNA, lipids and protein. Intake of micronutrients before and throughout pregnancy prevents reproductive adverse outcomes. Vitamins and minerals control metabolism, gene expression and prevent imbalances between the production and scavenging of radical oxygen species. Increased copper levels relate to polycystic ovary syndrome, androgen excess, oxidative stress and inflammation^[43].

Calcium and zinc influence enzymatic function, important for embryo-endometrial interactions. Folate, zinc has antioxidant effects and is important for apoptosis, implantation, placentation, foetal development.^[44]

Absorption and histotrophic transfer can be compared with the concept of *Ambu*, *Upasneha* and *Upasweda*. The embryoblast spends approximately first 72 hours in uterine cavity before implantation, during which it can't receive nourishment directly from mother and must rely on secreted nutrients in uterine cavity. Endometrium secretes several steroid dependent proteins, glycoproteins, peptides, cholesterol which are important for growth and implantation. Uterine milk is a nutritive secretion produced by uterine glands during early phases of gestation and nourishes embryo prior to implantation.

Following the implantation of blastocyst and establishment of chorioallantoic placenta, there is transition to haematotrophic nutrition with exchange

between maternal and foetal circulations. Recent realization is that the maternal circulation to the placenta is not fully established until the end of first trimester. New evidence states that uterine glands discharge secretion into intervillous space until eight weeks of pregnancy and these are taken up by syncytiotrophoblast. Histotrophic nutrition is advantageous to the foetus during first trimester as it provides nutrients, under low oxygen concentration, reducing risk of free radical mediated damage during sensitive period of organogenesis. Once the foetal oxygen requirement rises, there is transition to hematotrophic nutrition from starting of second trimester, when maternal placental circulation is fully established.

Haematotrophic nutrition may be considered as *Garbha poshana* by *Apara* and *Nabhinadi*. From 8th week onwards nutrition is taken up by placenta. Placenta is the site of exchange of nutrients and nitrogenous waste between mother and foetus. There will be exchange of oxygen and carbon dioxide across the foetal membrane. The foetus obtains its nutrients, commonly designated as *Rasaja Bhava*, from maternal blood such as glucose, lipid, amino acid, water and electrolyte^[45]. Umbilical cord plays an important role in foetal nourishment by establishing connection between placenta and foetus through which foetal blood flows to and from placenta^[46].

CONCLUSION

Concept of *Upasneha*, *Upasweda*, *Ambu*, *Apara* and *Nabhinadi* may be considered under the broad heading of *Rasaja bhava* that cause *Shareera Abhivridi* and *Pushti* of fetus. The prenatal nutrition described in contemporary science such as absorption, histotrophic transfer and hematotrophic nutrition has similitude with the concept of *Rasaja Bhava*.

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