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A SYSTEMATIC REVIEW OF THE CRUCIAL ROLE OF RASA DHATU IN PRODUCING HEALTHY PROGENY.

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ABSTRACT

Each year in India, there are approximately 28 million pregnancies, in which 26 million live births, a million neonatal deaths & congenital deformities is occurring due to malnutrition of mother and fetus. The classics of Ayurveda detail the crucial role of *Rasa dhatu* in the production of healthy progeny. During gametogenesis, Rasa dhatu is the foremost requirement for normal, healthy sperm and oocytes *(Shukra & Artava).* Malformed paternal *Rasa dhatu* leads to malnourished and malformed gametocytes through mitochondrial dysfunction, epigenetics and defects in meiosis cause Bija dosha, which in turn lead to *Garbhshrava* (miscarriage), deformed *Garbha* formation or congenital deformities like *Suchi Mukh* uterus in female fetus and sterile progeny. After fertilization, the ceased *Artava* (accumulated nutritional substance in the fluid of decidual cells) acts as a storage nutrition for the developing embryo in the embryonic phase. During organogenesis the *Artava* which is the *Upadhatu of Rasa dhatu* forms the maternal part of placenta. After formation of placenta & umbilical cord the Maternal *Rasa dhatu* provides directly nutrition to growing fetus. The malformed *Rasa dhatu or* the blocked *Rasavaha* channels of mother may cause different levels of intra uterine growth retardation such as *Nagdhadara, Upavistaka, Lina garbha, Garbhashaya or Mritgarbha (IUD).*

Keywords: *Rasa dhatu, Shukra, Artava, Bija dosha, fetal nourishment, IUGR, IUD.*

INTRODUCTION

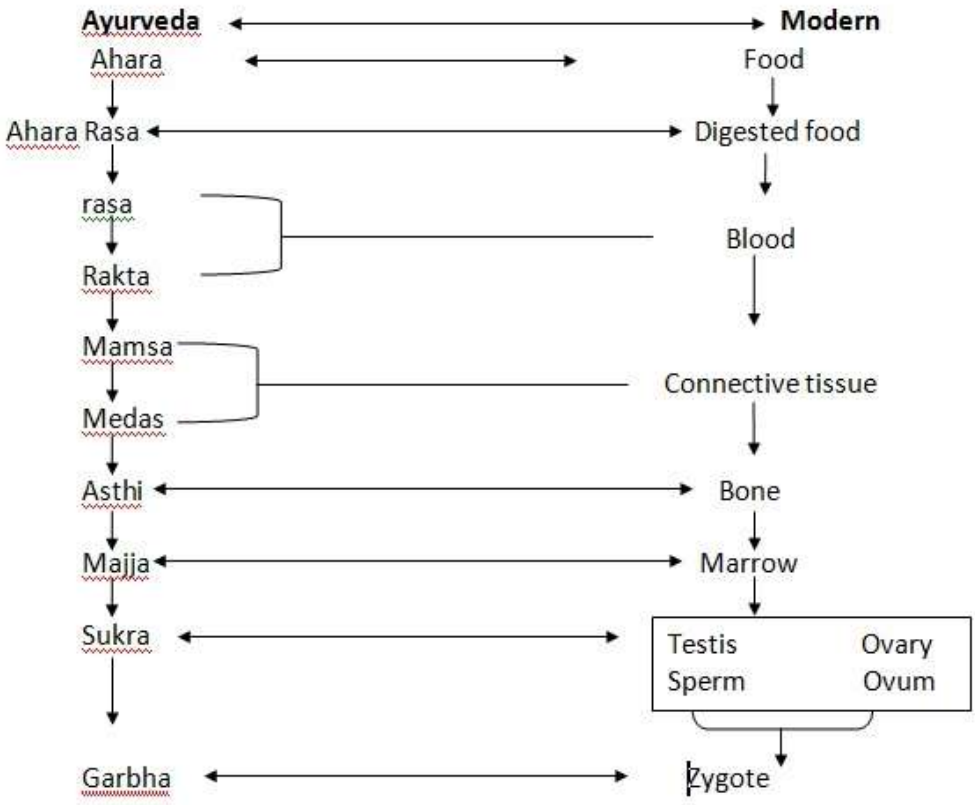
Dhatu is unique concept of *Ayurveda* related to origin, biotransformation, nutrition, sustaining and treatments of various tissues of the body. *Rasa dhatu* is one of them related to nourishment and maintaining of the body of an individual as well as his progeny. The healthy and long life, even existence of any individual is totally depending on the *Rasa dhatu* because of it nourish each and every cell of the body and forms the *Artava (oocyte)* and *Shukra(sperms)* which further form the new one and the healthy growth and development of this new one is further dependent on *Rasa dhatu* of mother. Thus, the concept of *Rasa dhatu* and its role and effects on growth and development of fetus is mentioned in the present research paper.

Literature review

In *Ayurvedic* texts, different ancient scholars have described that the *Shukra* (sperm), *Artava* (ovum), *Atma* and *Kukṣi* (uterus) is known as most/absolute essential factors for the formation of *Garbha* (fetus). Beside these factors *Acharya Susruta* mentioned one more factor nutrition required for the formation & development of *Garbha.* He described that the sprout comes out by the aggregate the season, soil, water and seed, conception takes place positively if *Ritu, Kshetra, Ambu, Bijja* are combined properly. *Dalhana* has elaborated *Ambu* as *Rasa dhatu* obtain from assimilation of *Ahara*. As water provides essential nutrients to the seed for its germination and growth, like wise *Ambu* is the biological nutritive fluid that contains healthy and required nutritive elements, essential for the formation as well as development of the *Garbha.*

1.Role of *Rasa dhatu* in gametogenesis-

Acharya Shushruta mentioned that the human being should be known to be derived from the nutrient fluid, *Rasa*, should be protected carefully by the wise person by keeping vigilance on foods, drinks and on the regimen.[1] As all the ancient scholars described that the most essential factors for formation of *Garbha* is *Shukra* and *Artava*, both are formed as a result of successive evaluative metamorphosis of *Rasa-dhatu* in one month.[2] Here the term *Artava* used for *stribija*, that is similar to *Shukra* in male.[3] The *Rasa dhatu* gives rise to *Rakta dhatu* which produces to next and next gives rise to next one, and finally form the *Shukra dhatu* and this formed *shukra* is responsible for origin of *Garbha* or any individual. *Acharya Caraka* also explained that the *Pancamahabhutas* derived from the mother and father are represented in the form of sperm & ovum in the fetus and these *Pancamahabhutas* nourished by the *Rasa dhatu.*[4]



Flow Chart no.1 Showing the role of *Rasa dhatu* in formation of *Garbha*

2. Effect of mal-formed parental *Rasa dhatu* in formation of *Garbha* via gametogenesis-

In the classical literature of *Ayurveda*, it is mentioned that the two extremes condition of nutrition that is *Stholya* (obesity) and *Karshaya* (undernuterition) is due to malformation of *Rasa dhatu*, which in turn effect the defective metabolism of the body causing these conditions.[5]Both these conditions are responsible for male & female infertility. In the *Stholya* (obesity) the formation of *Rasa dhatu* is increased, which caused to excessive formation of *Meda* (adipose tissue) in body. The increased *Meda* blocks the *Majja & Shukravaha srotus* so the formation of *Shukra & Artava* is hampered which leads to infertility. If the formation of *Rasa dhatu* is decreased the formation of succussive *dhatus* are decreased in the body. It causes *dhatu kshaya*, which further leads to infertility. *Achrya Caraka* says that due to intake of cold, rough, mixed, incompatible and uncooked food, fasting and grief, anxiety weak personality, intoxication and agitation, the *Rasa*, the chief of the *dhatu*, located in heart is diminished quickly resulting in deficiency of all other *dhatu* with *Shukra*. That further leads to infertility in male.[5]

Again, *Acharya Caraka* said that due to deformities in sperm or in semen the recurrent abortion in females occurs.[6]*Acharya Harita* described that there are eight types of sterile women suffering from infertility, in which who have damaged uterus or decay or diminution of *dhatu*, such woman never conceives.[7] *Acharya Caraka* describe a lot of congenital defects occurs due mal-formed *Rasa dhatu* which leads to impurities in *Artava. He* said that, due to genetic defect in ovum, if in female fetus *Vayu* destroys the ovary, the woman has aversion to males and is devoid of breasts. It is known as infertile and incurable, due to uses of rough diet or improper diet, if *Vayu* become vitiated, it vitiates the ovum that cause the abortion of formed fetus again and again. he said that if in female fetus *Vayu* due to roughness affects the

genital tract and thus makes it of minute opening caused by maternal dietetic and genetic defects, known as *Suchimukha*.[8]

3.Role of *Rasa dhatu* in growth & development of *Garbha*

As per Indian system of medicine, a fully grown embryo is not only the outcome of mere conjugation of sperm and ovum but there are many other intrinsic and extrinsic factors involved during the growth of fetus. A brief review of these factors has been presented by *Acharya Charaka* has mentioned. These are, Excellence of the factors responsible for the production of the fetus, via mother (ovum), father (sperm), *Atma* (consciousness), *Satmya* (wholesomeness), *Rasa* (nutrition) and *Satva* (psychic), Adoption of proper regimen by the mother during pregnancy, Availability of nourishment and heat (energy/ATP) through *Upasneha* and *Upasveda* respectively, Proper time, Instinctive or natural tendencies.[9]

As per Modern Medical Science, after fertilization and implantation, it is the nutritional supply, the role of the placenta and umbilical cord and the dietetics of mother, and inherited genetic factors which contributes and control of growth of an embryo and fetus.

1. **Maternal *Rasa dhatu*, role in fetal nourishment before implantation-**

After fertilization to full term delivery, the nutritional and gaseous exchange maintained for its growth and development, it dealt under two distinct headings, recognized as embryonic nutrition (before the establishment of communication between placenta and umbilical blood vessels) and fetal circulation (after establishment of feto-placental circulation) according to modern medical science. The period spent by fertilized ovum in the fallopian tube as a morula and blastocyst, it is three to four days, exposed to and take its nutrition by oviductal secretory fluid which composed of nutrients such as albumin, transferrin, glycoproteins, galactose, immunoglobin, glucose, pyruvate, amino acid, lactate, cytokines, many growth factors such as epidermal growth factor(EGF), fibroblast growth factor (FGF), insulin-like growth factor(IGF), transforming growth factor (TGF) and a monitored gas composition to promote cleavage and embryo development.

In the context of Ayurveda, the nutritional substances present in ICF & ECF of each & every cell of the body are known as proper Rasa dhatu of the body, which nourish & maintain the body. Here, the nutritional substance present in the oviductal secretory fluid of the mother is the maternal Rasa dhatu, which provides nutrition to fertilise the ovum till implantation. [10-12]

2. **Maternal *Rasa dhatu*, role in fetal nourishment during the embryonic period-**

In *Ayurveda, different scholars explained the maternal Rasa dhatu is the primary and ultimate source* of nutrition for the *Garbh* during growth and development. *Sushruta* described that after impregnation, the openings of *Artavavaha sroṭasas* are obstructed by conceptions thus the *Artava* (menstruation) is not visible after conception. This *Artava, being repelled from downward passage, goes upward and accumulates into the uterus,* known as *Apra.*[13] As per the review of Ayurvedic literature, the Artava is the Upadhatu of Rasa dhatu, which is the nutrient substance present within the ICF & ECF of tissues of the decidua. When fertilization occurs, the Artava ceases & accumulates in the decidual tissue to provide nutrition for the implanted embryo through the process of Upasneha & Upasveda before organogenesis in the embryo.[14] When organs are developed in the embryo, this accumulated Artava forms the maternal part of the placenta. Some parts of this accumulated nutrients *(Artava)* go upward to mammary glands through *Rasavahanies* to form *Stanya*, another *Upadhatu* of *Rasa dhatu.*[15]

During the embryogenic phase the primary source of nutrition of the fetus is the cellular fluid of the uterine cavity or Ceased *Artava (Upadhatu of maternal Rasa dhatu)* as per classics of Ayurveda

As per modern theories, the embryo takes nutrition from the Oviductal (fallopian tube) fluid through the diffusion before implantation. However, the oviductal nutrition cannot be continued for a longer period; hence, the process of implantation into the uterine cavity and establishment of the constant nutritional

supply to the growing embryo from uterine secretions and then to the fetus through the placenta is required. In humans, two principal pathways have evolved to transfer nutrients from the mother to her fetus. These are termed histiotrophic and hemotrophic, respectively. Before the formation of the placenta, nutrition of the conceptus is, therefore, essentially histiotrophic. Once the placenta is established, hemotrophic nutrition becomes predominant.

Histiotroph is an extracellular material derived from the endometrium and the uterine glands that accumulate in the space between the maternal and fetal tissues (IVS). It is phagocytosed (endocytic uptake of proteins, epithelial mucin MUC-1 and, glycodelin & other nutrients) initially by the trophectoderm of the blastocyst and later by the trophoblast of the placenta or the endoderm of the yolk sac.[16-18]

3. Maternal *Rasa dhatu*, role in fetal nourishment after formation of placenta & umbilical cord-

Acharyas explained that the *Rasa* formed from the food taken up by the mother is distributed into three parts - first for the nutrition of the own body, second for the nourishment of *Garbha* and third for the formation of *Stanay* (breast milk). Later on, in the phase of development when the placenta and umbilical cord are developing, then, the umbilical cord of the fetus is directly attached to the placenta & placenta to the mother's heart. The mother's heart supplies *Rasa dhatu* (a nutritional substance present in the blood) to the placenta through the vessels of the maternal body. By the placenta and umbilical cord, this Rasa-dhatu reaches the fetus. In this phase, the main source of fetal nourishment is maternal *Rasa dhatu*. This communication process may be correlated with heamotrophic nutrition of modern medical science, where nutritive substance passes from the mother's circulating blood to the fetus through the placenta and umbilical cord.[19]

6. Effect of mal-formed maternal *Rasa dhatu* on the development of the fetus-

In classics of *Ayurveda* describe a lot of diseases related to the growth & development of the fetus that occur due to malformed maternal *Rasa dhatu* in which *Garbha srava(miscarriage), Mrita garbha (IUD), Garbha kshaya,* different levels of IUGR such as *Nagodhara, upavistaka, leena garbha* are includes. *Acharya Caraka* described mainly three causes of abortion: harmful and improper diet, which forms impure rasa, abnormalities in *Shukra* and *Shonita* and the aggravation of *Vata dosha* or abnormalities in the factors responsible for proper growth and development of fetus, which are causes of its expulsion before viability.[20]The *Indu* opinion that leading cause of abortion is the fetus gets detached from the bond existing between mother and fetus for its nourishment.[21] Similarly, *Putraghani* (repeated abortion of *Sthita Garbha* or after the fourth month), Vamini (expulsion of Artava along with Shukra or very young zygote), and Ashrja (abortion due to bleeding after conception) are diseases that denote repeated abortion occurs due to nutritional abnormalities leading to improper formation of *Rasa dhatu*. [20]

Similarly, *Garbhashosha* or *Vatabhipanna Garbha*, *Upaviataka*, *Nagodara*, *Leena-Garbha*, *Garbhakshaya*, *Garbhavriddhi*, *Mritagarbha*, *Vikrita Garbha* (Congenital malformation), *Fakkaroga* etc. are diseases described in the literature of *Ayurveda* due to improper growth and development of fetus either by the troubles in the channel of *Rasa* of the fetus or mother; these channels getting blocked, by the *doshas*; the fetus not getting nourishment or the mal formation of *Rasa dhatu* of the mother.[22-24]

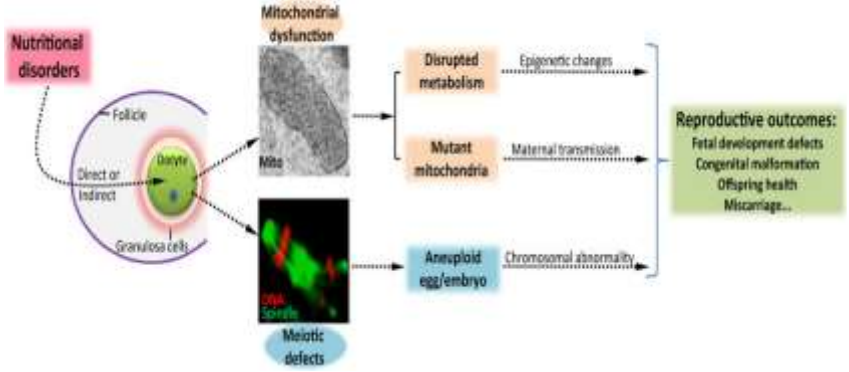
DISCUSSION

Apart from nourishing and maintaining the body, Rasa dhatu has a crucial role in gametogenesis, i.e. spermatogenesis and oogenesis. According to Ayurveda literature, gametogenesis is completed in one month from the formation of *Rasa dhatu.*

1. Effect of *Rasa dhatu* on reproductive outcome via gametogenesis-

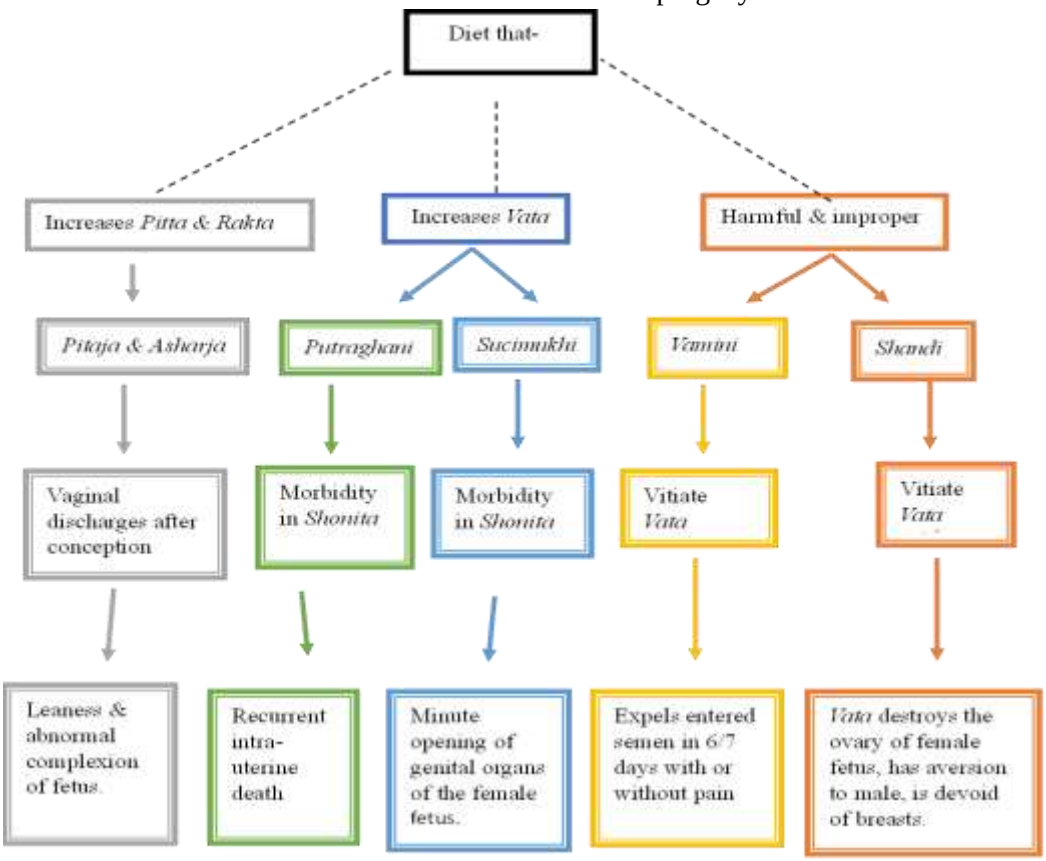
The proper *Rasa dhatu* formation is the foremost requirement for normal healthy sperm and oocyte formation, as malformed Rasa dhatu leads to malnourished and malformed oocytes through mitochondrial dysfunction, epigenetics and defect in meiosis. Also, malformed Rasa dhatu may lead to malnourished and

malformed spermatocytes, as the cholesterol most needed for spermatogenesis is derived from interstitial lipoproteins by Sertoli cells. Nutrition of parents (deficiencies or excesses in a range of macro- and micronutrients) imbalance disrupts energy metabolism in oocytes & sperm, also associated with significant impairments in reproductive performance, fertility, fetal development, and long-term offspring health. This disruption further contributes to reproductive problems via the metabolic control of meiosis, mitochondria, or epigenetic modifications.[25-27]



2. Effect of *Rasa dhatu* on reproductive outcome via oogenesis-

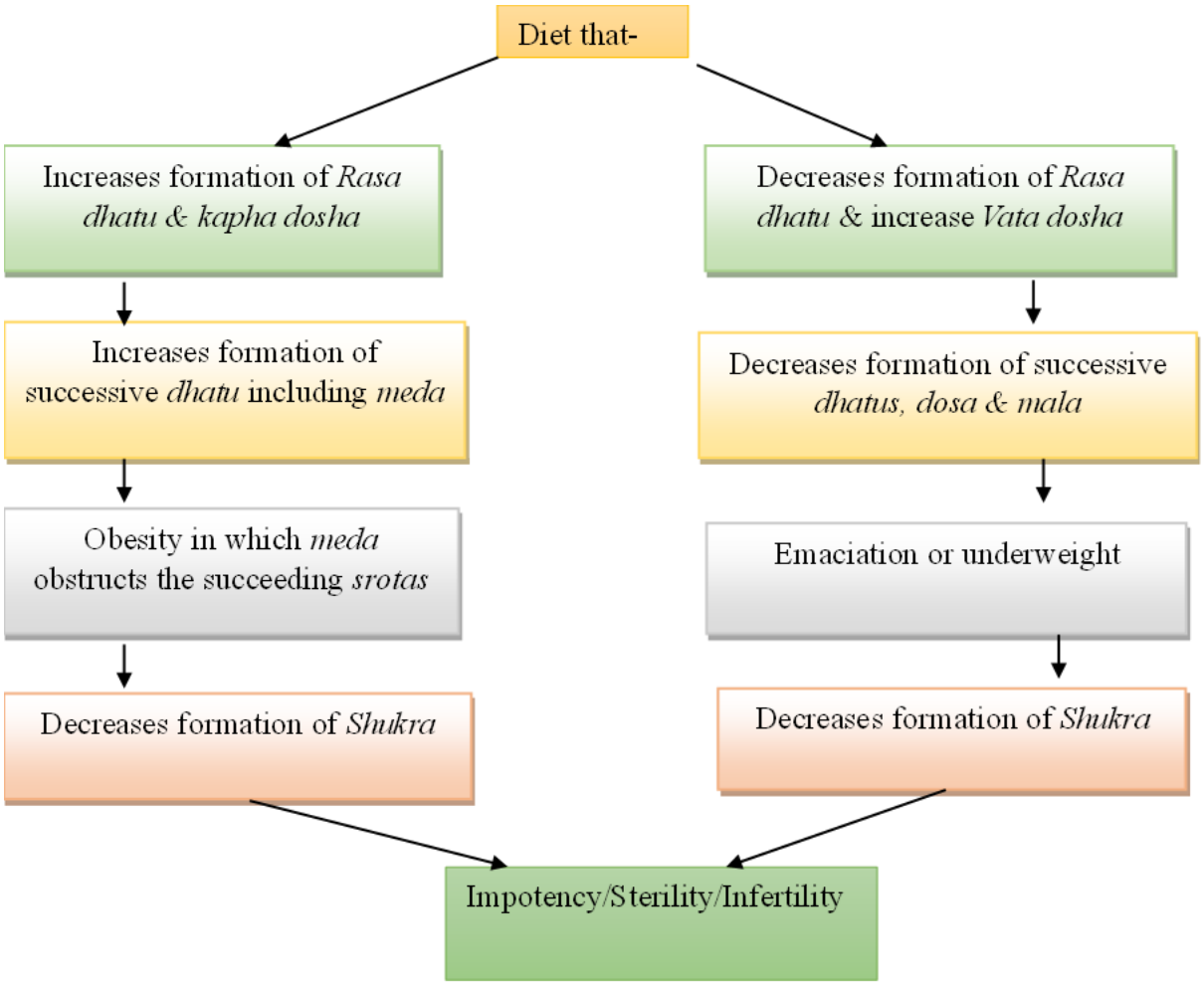
The malformed *Rasa dhatu* may cause *Bija dosha* (malformed gametes), which in turn lead to *Garbhsrava* (miscarriage), *Mritgarbha* or may cause deformed *Garbha* formation (congenital malformations like *suchi mukh* uterus in the female fetus and sterile progeny.[28]



Flow Chart no. 2 Showing Effect of *Rasa dhatu* on Reproductive Outcome via Oogenesis.

3. Effect of *Rasa dhatu* on reproductive outcome via Spermatogenesis-

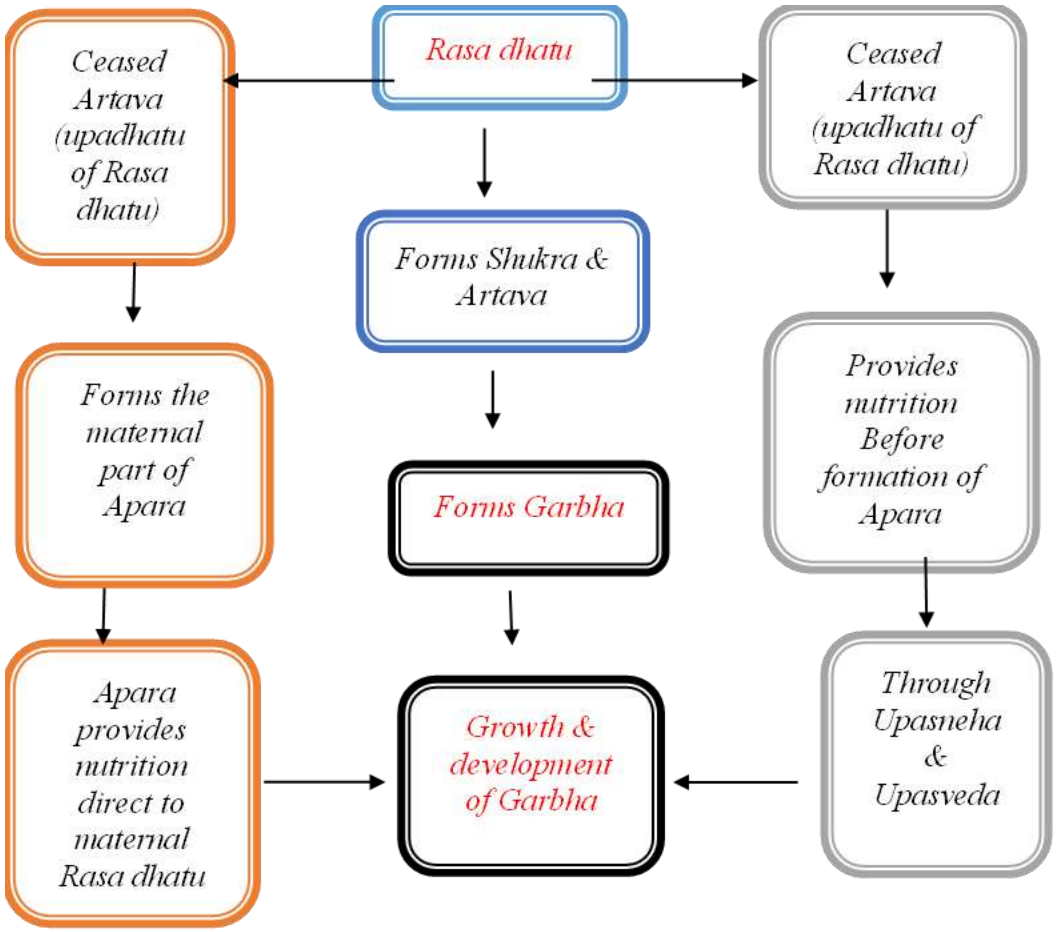
As per different classics, overweight and underweight pathology are due to malformed Rasa-dhatu; therefore, in both these conditions, there will be gamete malformation leading to infertility.[29]



Flow Chart no.3 Showing Effect of *Rasa dhatu* on Reproductive Outcome via Spermatogenesis-

4. Role of *Rasa dhatu* in the growth and development of *Garbha*

As described in *Ayurveda, the Shukra & Artva are formed by the Rasa dhatu, and during fertilization, their fusion* forms the *Garbha*. After formation, the Garbha, the ceased *Artava(upadhatu form)* provides nutrition to the embryo during organogenesis. This ceased *Artava* also forms the maternal part of *Apara*, which provides nourishment to the fetus directly from circulating Rasa dhatu of the mother.



Flow Chart no.5 Showing the Role of *Rasa dhatu* in Formation & development of *Garbha*-

4. Role of *Rasa dhatu* in the formation & development of *Garbha*-

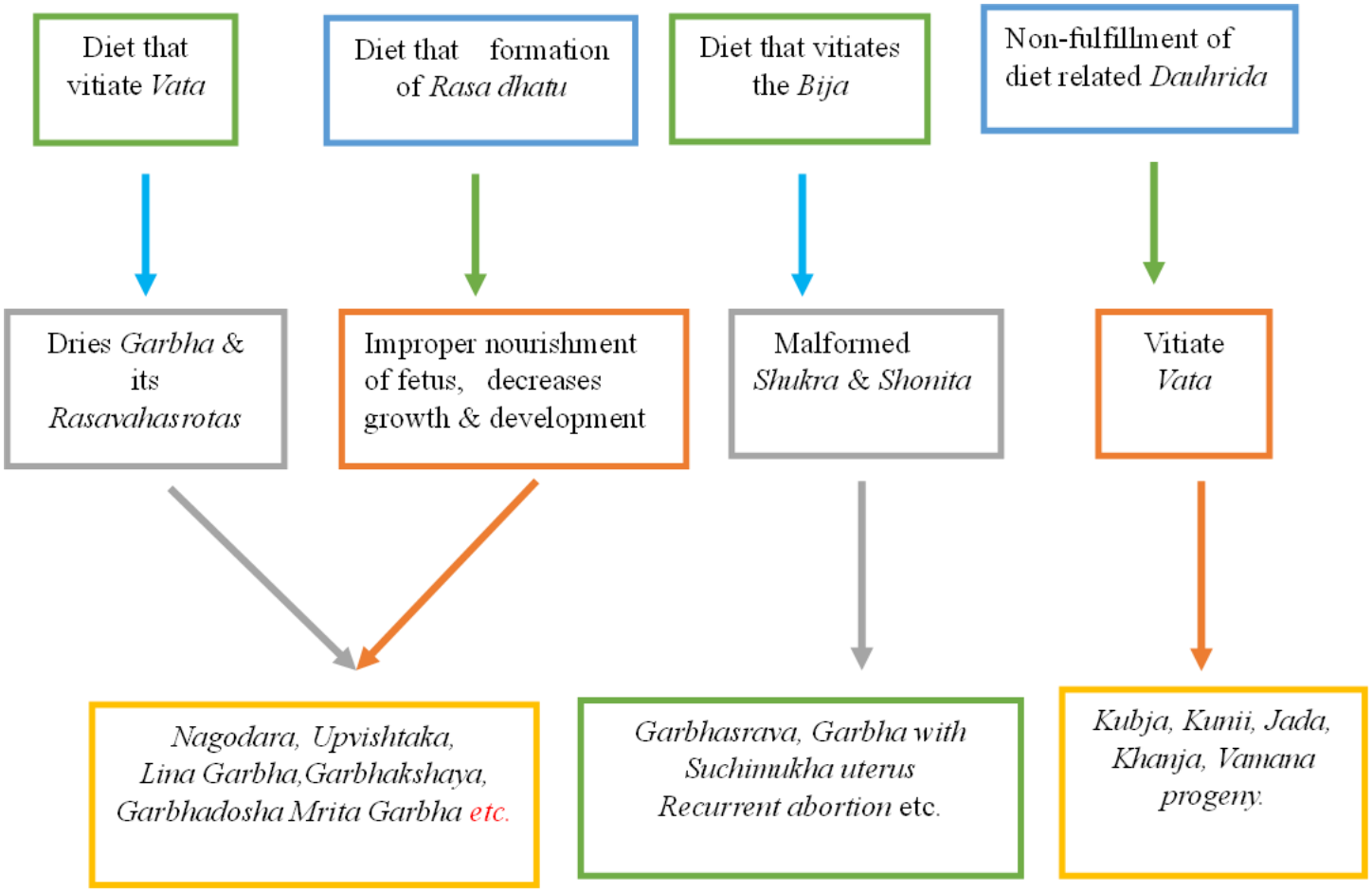
During the development of *Garbha*, the nutritional requirement of the *Garbha* is fulfilled in three stages, which can be summarized and correlated as follows –

Role of *Rasa dhatu* in Nourishment of *Garbha* at different stages of intra-uterine life.	
As per *Ayurveda*	**As per Modern Medical Science**
From the ceased *Artava* (nutritional substances present in ICF& ECF of uterine cavity) by the process of *Upasneha & Upasveda* during *Asadasadbhutanga-avayava* stage of development.	Histotrophic nutrition (nutritional substances present in ICF& ECF of uterine cavity) by the diffusion & endocytic uptake of during critical period of organogenesis in 1st trimester.
Some from ceased *Artava* through *Lomakupayana* & major nutrition directly from *rasa dhatu* of mother through *Nabhinadi* by the process of *Upasneha during transitory phase of from Asadasadbhutanga-avayava* stage to *Sadasadbhutanga-avayava* stage.	Nutritive component from glandular secretion of endometrium & maternal blood vessels to the blood vessels of tertiary chorionic villi of fetus. (Transitory phase from histotrophic nutrition to haemotrophic nutrition).
Directly from the circulating *Rasa dhatu* of mother through *Nabhinadi* & *Apra* after organogenesis.	Exchange of nutrition and waste products through placenta barrier. (Phase of complete haemotrophic nutrition.)

Table no. 1 Showing role of *Rasa dhatu* in Nourishment of *Garbha* at different stages of intra-uterine life.

6.Effect of parental mal-formed *Rasa dhatu* on progeny-

Garbhashosha or *Vatabhipanna Garbha, Upaviataka, Nagodara, Leena-Garbha, Garbhakshaya, Garbhavriddhi, Mritagarbha, Vikrita Garbha* (Congenital malformation), *Fakkaroga* etc. are diseases described in literature of *Ayurveda* due to improper growth and development of fetus either by the troubles in the channel of *Rasa* of the fetus or mother; these channels getting blocked, by the *doshas*; the fetus not getting nourishment or the malformation of *Rasa dhatu* of mother.



Flow Chart no.6 Showing Effect of parental malformed *Rasa dhatu* on progeny.

CONCLUSION

As per the above discussion, the Rasa dhatu plays a crucial role in the production of healthy progeny. In the 1st stage, during gametogenesis, Rasa dhatu is a prime source of nutrition in the production of germ cells *(Shukra & Artava).* Therefore, when fertilisation is occurs, the ceased *Artava* (accumulated nutritional substance in the fluid of decidual cells) act as a storage nutrition for the developing embryo in the embryonic phase. During organogenesis, the Artava, the Upadhatu of Rasa dhatu, forms the maternal part of the placenta. After the formation of the placenta & umbilical cord, the Maternal Rasa dhatu directly nourishes the growing fetus.

Apart from the nourishment and maintenance of the body, *Rasa dhatu* has a crucial role in the process of gametogenesis, i.e., spermatogenesis and oogenesis. As per the literature of *Ayurveda* gametogenesis completes in one month from the formation of *Rasa dhatu*. The proper *Rasa dhatu* formation is the foremost requirement for normal healthy sperm and oocyte formation, as malformed Rasa dhatu leads to malnourished and malformed oocytes through mitochondrial dysfunction, epigenetics and defect in meiosis. Also, malformed Rasa dhatu may lead to mal-

nourished and malformed spermatocytes, as the cholesterol most needed for spermatogenesis is derived from interstitial lipoproteins by Sertoli cells.

In the context of Ayurveda, the nutritional substances present in the ICF and ECF of each and every cell of the body are known as the proper Rasa dhatu of the body, which nourish and maintain the body. Here, the nutritional substances present in the oviductal secretory fluid of the mother are the maternal Rasa dhatu, which provides nutrition to fertilize the ovum until implantation.

The malformed *Rasa dhatu* may cause *Bija dosha* (malformed gametes), which in turn lead to *Garbhshrava* (miscarriage), *Mritgarbha(IUD)* or may cause deformed *Garbha* formation (congenital malformations like *Suchi mukh* uterus in the female fetus and sterile progeny.

As discussed earlier, overweight and underweight pathology are due to malformed Rasa; therefore, in both these conditions, there will be gamete malformation leading to infertility.

During the development of *Garbha*, the nutritional requirement of the *Garbha* is fulfilled in three stages; the first stage, before the differentiation of body parts (*ashanjata anga-pratanga stage*), the fetus gets its nutrition through the process of *Upasneha* and *Upasveda* from the uterus in which the nutritional substance present in the cellular fluid of decidua basilis of uterine cavity, histiotroph, ceased *Artava* as per *Ayurveda*, comes to embryo through the process of diffusion & endocytosis. The 2nd stage is the transitory stage, from histiotrophic to chemotrophic. Later on, when the placenta and umbilical cord develop, the umbilical cord of fetus is directly attached to the placenta & placenta to the mother's heart. In this phase the main source of fetal nourishment is maternal *Ahara rasa*. In first stage the ceased *Artava* which is get accumulated in the decidual tissue to provides nutrition of implanted embryo through the process of *Upasneha* & *Upasveda* before organogenesis in embryo. When organs are developed in embryo this accumulated *Artava* forms the maternal part of placenta.

Due to any of cause either the dietary or life style if maternal *Rasa dhatu* is malformed or the *Rasavaha* channels of mother is blocked, there is improper nourishment of fetus, therefore the growth & development of fetus is not proper occurred so different levels of intra uterine growth retardation manifest such as *Nagdhadara, Upavistaka, Lina garbha, Garbhashaya* or intra uterine death may be possible. Malformed parental *Rasa dhatu* produced unhealthy gamete which further become the causes of congenital deformities such as *Suchimukh uterus, Kubja, Kuni, Vaman or Jada i*n the fetus or recurrent abortion.

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