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A CONCEPTUAL STUDY TO UNDERSTAND THE PHYSIOLOGICAL PERSPECTIVE OF SHUKRA DHATU

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ABSTRACT

Ayurveda is the 'Science of Life' and its aim is to maintain healthy status of healthy living being, i.e. prevention and treatment of disease. As per Ayurvedic Science, *Purusha* consists of three *Dosha,* seven *Dhatu* and three *Mala* which are the primary basis of living body. *Dhatu* are those which give support and strength to the body. *Shukra* is the seventh *Dhatu,* which is responsible for all systemic body activities including metabolic functions and performs specific functions of reproduction. According to *Acharya Vagbhata* and *Charaka*, *Shukra* is one which responsible for the process of *Garbhotpadana* (reproduction). According to Susrutha, *Shukra* provides courage, nourishment, happiness, strength and production of offspring. Main objective of this study is to review the conceptual facts of *Shukra Dhatu* from different classical Ayurveda texts and to analyse the physiological perspective about the same. In this article, the classical references related to *Shukra Dhatu* is collected and tried to correlate the concept with modern physiological entities. From the available references in the *Samhitas*, *Shukra Dhatu* can be better co related to sperm along with semen, sex hormones (oestrogen, androgen etc.), and sex chromosome.

Keywords: *Shukra Dhatu, Sthree Shukra*, semen, sex chromosome, sex hormone, *Shukradhara kala*

INTRODUCTION

Ayurveda is the 'Science of Life' and its aim is to maintain healthy status of healthy living being, i.e. prevention and treatment of disease. As per Ayurvedic Science, *Purusha* consists of three *Dosha*, seven *Dhatu* and three *Mala* which are the primary basis of living body[1]. *Dosha, Dhatu* and *Mala* are considered as roots of living body because as roots maintains the life of plant, these three factors also sustains the life of human. Among all seven *Dhatus, Shukra Dhatu* is considered as the best[2]. *Shukra Dhatu* is the one which is highly involved in reproductive functions of the body (*Garbhotpadana)*. Every cell in the body is involved in reproduction by mitosis and meiosis; hence the presence of *Shukra Dhatu* throughout the body gets identified. Main objective of this study is to review the conceptual facts of *Shukra Dhatu* from different classical Ayurveda texts and to analyse the physiological perspective about the same.

Aim and Objectives

To compile description of *Shukra Dhatu* as explained in different classical Ayurveda texts.

To review the concept of *Shukra Dhatu* with specific reference to sex hormones, semen, sex chromosome.

Materials and Methods

Literary materials were collected from all Ayurveda classical texts *(Charaka Samhita, Sushruta Samhita Astanga Hridaya, Astanga Sangraha)* and commentaries. Modern books of physiology were also reviewed to collect the data. Classical data collected were compared and analysed with modern scientific knowledge. The term *Shukra* is derived from the *Sanskrit* root word *Shucha+Klede*, which means purity[3]. The term has other meanings like bright, resplendent, and white. *Shukra Dhatu* is the seventh *Dhatu* and *Teja, Reta, Veeryam,* are synonyms of *Shukra Dhatu*[4]. *Shukra* is *Soumya* which is derived from *Jalamahabhuta*. It is the product of four proto elements *Vayu, Agni, Aapa* and *Prithvi* with all six rasa[5].

Functions of *Shukra Dhatu*

Shukra is a factor which is responsible for *Garbhotpaadana* (Production of off springs). It gives *Dhairyam* (Courage), *Chyavanam (*ejaculation*), Preeti* (attraction or love towards opposite sex), *Harsham,* (pleasure, sexual excitement), *Dehabalam* (energetic, enthusiastic and nourishing property) also[6]. Functions of *Shukra Dhatu* can be categorized as *Sarvadaihika karma* (systemic function) and *Garbhotpadana karma* (reproductive functions) mainly. *Sarvadaihika karma* of *Shukra Dhatu* includes *Dhairyam* and *Dehabalam. Dhairya* is the control over mind, by which one does the good and avoids the bad. By this quality, one can face any difficulties without much anxiety. Acharya *Dalhana* describes it as the capacity to fight against any condition[7]. *Dehabalam* includes both *Deha Upachaya* (body nourishment) as well as *Utsaha* (enthusiasm) [8]. *Upachaya* is the physical nourishment which imparts *Bala* to the individual. Whereas *Utsaha* is the physical and mental enthusiasm to perform any activity.

Garbhotpadana and *Maithunagata karma* includes *Preeti, Harsham,Chyavanam* and *beejartham*. The word meaning of *Chyavana* is "to secrete". According to Acharya Dalhana, *Chyavana* is the ejaculation of semen[9]. *Harsha* in relation to sexual act may be understood as desire or exhilaration (*Utkantha Janam[10]). Preeti* is the love and affection towards opposite sex[11]. Since cellular division and proliferation take place in entire living body, the *Garbhotpadana karma* of *Shukra Dhatu* can be included in both *Sarvadaihika* and *Beejarthagata karma*. All these functions intimate that *Shukra Dhatu* is not only responsible for production of progeny, but also involved in other systemic bodily functions.

Location of *Shukra Dhatu*

Like every other *Dhatu*, it is also located in the entire body. Various *Acharyas* have quoted different description about *Shukra Dhatu Sthana* as: As fragrance is not manifested in a flower bud, but the same gets exhibited once it blossoms similarly is the *Shukra*. In childhood *Shukra* is present in body in *Avyaktaroopa*, as puberty is achieved, functions of *Shukra* starts manifesting[12]. *Shukra* is pervaded all over the body like juice in sugarcane, ghee in curd and oil in sesame seed[13]. Location of *Shukradhara kala* is also throughout the body [14]. The *Moola sthana* (source of origin) of *Shukravahasrothas* are testes, penis, breast and

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majja[15, 16, 17]. These all references as cited above reveal that *Shukra Dhatu* is present generally in each and every cell and specifically in reproductive organs of the body.

***Shukra Dhatu, Shukravahasrotas* in modern viewpoint**

Based on functions, *Shukra Dhatu* can be primarily understood as sex hormones and semen with sperm. Action of sex hormones can be counted for all the above metabolic functions of *Shukra Dhatu*. *Beejarthagata karma* may specify semen along with sperm and it is mainly involved in reproduction.

Shukravaha Srotas can be understood as all micro, macro channels responsible for production, transformation and transportation of sperm. Hypothalamo hypophyseal gonadal axis involved in sex hormone production can also be taken here. Hypothalamic hypophyseal gonadal axis (HPG) directs secretion of FSH and LH. Both of these hormones are very much essential for production of sex hormone and gametogenesis. In male, *Shukravaha Srotas* correlation might be HPG axis and semen producing, transforming and transporting pathway. In female it might be the hypothalamo hypophyseal gonadal axis only, because *artavavahasrotas* are directed for the transformation and transportation of ovum.

Formation of *Shukra Dhatu* and *Shukradhatvagni*

Shukra Dhatu is formed from *Snehamsha* of *majja Dhatu*[18, 19]. One month is required for conversion of *Ahara Rasa* into *Shukra Dhatu*[20]. By the action of *Majja Dhatu Agni* on *Majjasadharmiamsa*; *Prasada* and *Kittabhaga* get formed. *Prasadabhaga* formed as *Sthoola* and *Sookshmabhaga*. *Sthoolabhaga* is *Majja Dhatu* and *Sookshmabhaga* is *Majjaupadhatu* and *Shukrasadharmiamsa*. *Shukrasadharmiamsa* is again acted upon by *Shukradhatvagni* and *sthayi Shukra Dhatu* gets formed. The unctuous portion of *Majja* which oozes out from *Asthi* also forms *Shukra Dhatu*[21].

Mastishka (brain) is also made up of *Majja Dhatu* only[22,23]. So, the hypothalamo hypophyseal gonadal/testicular axis and its role in regulation of spermatogenesis can be previewed, if *Mastishkamajja Dhatu* is considered in *Shukra Dhatu Utpatti*. Gonadotropin releasing hormone (GnRh) from hypothalamus initiates secretion of Follicular stimulating hormone (FSH) and Luteinizing hormone (LH) from pituitary. FSH helps to increase LH receptors on Leydig cells which are the sites of formation of testosterone. LH helps to increase secretion of testosterone which in turn promotes spermatogenesis. FSH can initiate the proliferative stage of spermatogenesis too[24].Hence *Majja* as *Masthishka Majja* involvement in *Shukra Dhatu utpatti* gets clarified.

Haematopoiesis from uncommitted pluripotent haemopoietc stem cells takes place in bone marrow also could prove the importance of *Majja Dhatu*. Here also production of new cells (*Beejartha karma* of *Shukra Dhatu)* is happening[25].If sex steroids including androgen are taken in the preview of *Shukra Dhatu*, it is originated from cholesterol. Cholesterol undergoes conversion to pregnenolone which converts into progesterone and 17 alphas hydroxy pregnenolone. Progesterone ultimately turns into androstenedione. 17alpha hydroxy pregnenolone converts into DHEA. DHEA is ultimately converted to form androstenedione and eventually forms testosterone[26]. The importance of *Snehamsa* in production of *Shukra Dhatu* proved from the evidence that sex hormones too produced from cholestrol[27].

Shukradhatvagni which helps in the formation of *Shukra Dhatu* can be understood as CYP 11 A 1 enzymes,17 alpha hydroxylase,3 beta HSD 2,17 20 alpha hydroxylase which are involved in the formation of sex hormones from cholesterol. Testosterone exerts its action in tissues as DHT.5 alpha reductase (secreted from Sertoli cells) which takes part in the formation of DHT can also be included in the umbrella of *Shukra dhatvagni*[28]. Oestradiol and oestrone are originated from testosterone by the action of aromatase enzyme from sertoli cells. GnRh, FSH, LH hormones which are involved in spermatogenesis and oogenesis also can be taken as *Shukradhatvagni*. *Shukradhatvagni* might comprise all the hormones and enzymes which are involved in spermatogenesis and sex hormones production.

Existence of Shukra in childhood and *Shukra abhivyakti*

According to Caraka and Susrutha, even though *Shukra Dhatu* is seen from the childhood, but its action is more exhibited during puberty (*Vaya Parinamat*) [29, 30]. The spermatogenesis starts from the seventh week of intra uterine life. Amount of testosterone increases during the first three months after the birth and then fall by one year and remain low until the onset of puberty. Oogenesis takes place before birth, but the ovum is still in primary oocyte stage during puberty and further progress happens during ovulation only. Hence the importance of *Vaya Parinamat* may be understood as the onset of puberty. Developments of axillary and pubic hair during puberty (*Romaraji Udbhavam*) are also due to the effect of sex hormones. Till puberty, a slightest secretion of sex steroid hormone produces a strong negative inhibitory feedback to GnRh secretion and to testosterone.

***Shukra Dhatu* in female**

As per Susrutha and Caraka, *Sthree Shukra* is produced during the sexual intercourse and it is not responsible for the production of offspring[31, 32]. Bartholin secretion at the time of copulation can be taken as *Sthree Shukra*. And the same secretion is not *garbhaotpadana samartha* (involved in production of offspring). All the secondary sexual characters in female like development of pubic and axillary hairs etc. are due to the presence of sex hormones [33]. So, *Shukra*-the seventh *Dhatu* which can be viewed as sex hormones which is helpful for the systemic body functions and takes part in the development of secondary sexual characters, and other glandular secretions like Bartholin secretion which are related to reproduction in females. In another context, it is said that predominance of *Shukra* can produce male progeny and predominance of *artava* results in female offspring[34] which suggest that these two entities can also be understood as X, Y sex chromosomes. So, it can be concluded that *artava* may be a factor which is responsible for ovulation, menstruation and gender determination. *Shukra* might be the sex hormones involved in the formation of secondary sexual characters and the Bartholin secretions.

Existence of *Shukra* in old age

Function of Shukra Dhatu is progressively decreasing during oldage[35]. Serum free and total testosterone also progressively decreasing after 70 -80 years of age[36].

Shudha Shukra lakshana

As per various references, pure *Shukra* has the characteristic features like white crystalline colour, heavy, sweet taste, dense and has the consistency of ghee, honey and oil[37,38]. *Madhura rasa* of *shudha Shukra* is due to the fructose content in semen, from seminal vesicle and *Ghruta makshika tailabham* (consistency) might be the weak coagulum formation and its secondary liquefaction during semen ejaculation[39]. *Sphatikabha (sankhabham, shuklam)* indicates the colour of semen which is milky white due to prostatic secretion[40]. pH of the semen is 7.3-7.4 which is referred by the term *Avidahi* i.e., not causing burning sensation indicating neither acidic nor highly alkaline. *Gurutvam and bahalam* (heaviness) indicates the specific gravity (1.028) imparted by seminal contents. *Bahu* indicates the sperm content (50-200 milliom/cu mm) [41]. All the above properties of *shudha Shukra* well match to the physical properties of seminal fluid only.

Shukra Dhatu sara purusha lakshana

Shukra Dhatu sara purusha lakshana includes gentle behaviour, good looking, charming, eyes with milky appearance, even and compact teeth, compact bones, charming, soothing voice and radiant complexion etc[42].

Excess testosterone provides aggressiveness (*Asoumyatva*). It is proved that androgen deficiency can cause meibomian gland dysfunction and dry eyes. The sex steroid hormonal status plays a role in the homeostasis and function of ocular surface, accomplished by estrogenic and androgenic receptors located on corneal, conjunctival epithelia and in Meibomian gland The ocular surface dysfunction leads to unstable preocular tear film which produce dry eye[43](*Ksheerapoornalochana*). Testosterone also provides the attraction towards opposite sex (*Sthreepriyopabhoga*). Radiant appearance (*Bhrajishnutha*) in *Shukra Dhatu sara purusha* may be produced due to the vasodilation produced by sex hormones especially

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estrogen. Testosterone can influence the bone-mineral metabolism (*Samasamhata shikhara dasana, Samasamhataasthi*) and also in deposition of subcutaneous fat (*Mahasphik*). Testosterone can cause the hypertrophy of laryngeal muscles and thickening of vocal cord also (*Prasannasnigdhaswara*). Testosterone can increase the quantity of melanin pigment in skin and also increases the thickness and ruggedness of skin.

DISCUSSION

From all the above classical references like formation, function and *Shukra Dhatu sarata*, the particular *Dhatu* can be better correlated with sex hormones. Following table illustrates the same.

Table 1: *Shukra Dhatu* comparison with sex hormone

Shukra Dhatu Vs Sex hormones[44]			
Shukra Dhatu		**Testosterone**	**Estrogen**
Location and action	Throughout the entire body (*Sarvasareeravyapi*)	Action seen throughout the entire body. Secreted from Leydig cells in testis and from adrenal cortex.	Throughout the entire body. Secreted from granulose cells of ovarian follicle from adrenal cortex
***Shukravaha sroto moolam* (Source of Origin)**	Testes, penis, breast (Reproductive activity)	Cause pubertal enlargement of testes, penis and scrotum, Descent of testis, Growth of accessory sex organs like seminal vesicle and prostate	Development of stromal tissues of breasts, Growth of an extensive ductile system in breast. Deposition of fat in the ductile system.
Formation	*Snehamsa* of *Majja*	Cholesterol ultimately converts to form androgen Hypothalamo pit gonadal axis helps in the formation of FSH, LH Which are necessary for hormone production (involvement of *Mastaka Majja*)	Cholesterol ultimately converts to form oestrogen Hypothalamo pit gonadal axis helps in the formation of FSH, LH Which are necessary for hormone production (involvement of *Mastaka majja*)
Time of manifestation of action	*Balanam vayaparinamat*	At puberty hypothalamic cells become more mature and sensitivity for circulating sex hormone decreases so much. So, there is a pulsatile release of GnRh from hypothalamus favours FSH, LH release from pituitary too. Spermatogenesis starts in puberty. Testosterone amount starts rising.	At puberty hypothalamic cells become more mature and sensitivity for circulating sex hormone decreases so much. So, there is a pulsatile release of GnRh from hypothalamus favours FSH, LH release from pituitary too. Further development of primary oocyte to secondary oocyte takes place
Influence on sexual drive	*Sthreepriyopabhoga* *PreetiPramadasu* *Harshabahulam* *Apatyabahulam* *Chyavanam*	Libido Exhilaration Erection and ejaculation	Oestrogen can enhance sexual drive in female.
Influence of hormone on morphology			
Effect on Bone and teeth	*Samsamhataasthi* *Snigdhavruttasara* *Sama samhata shikhara dasana*	Helps in bone mineralization Helps in formation of bone matrix Deposition of calcium in bone Early fusion of epiphyses of long	Increase osteoblastic activity

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		bones with shaft	
Effect on Muscular system	*Dehabalam Dehaupacayam*	Act as anabolic hormone and increase the muscle bulk Also cause nitrogen retention in body (positive nitrogen balance) Muscle mass increases by about 50%, after puberty	Act as anabolic hormone and increase the muscle bulk Also cause nitrogen retention in body (positive nitrogen balance)
Changes in pelvic bone	*Mahasphik*	Lengthening of pelvis Funnel-like shape of pelvis.	Subcutaneous fat deposition in hip, breast, buttock Broadening of pelvis with increased transverse diameter
Influence of hormone on psyche			
Aggressiveness	*Soumya* in *Shukra-Dhatu sarata, Dhairyam*	Yes	Empathy etc. emotions
Influence of hormone on physiology			
Voice	*Prasanna swara* *Snigdha swara*	Bass masculine voice Hypertrophy of laryngeal muscles, Enlargement and lengthening of larynx, Thickening of vocal cords.	Larynx in prepubertal stage High pitched voice
Skin	*Prasanna varna* *Snigdha varna*	Thickness and ruggedness of subcutaneous tissue Deposition of proteins in skin Increases the quantity of melanin pigment Enhances the secretory activity of sebaceous glands	Skin becomes soft and smooth. Vascularity of skin also increases
BMR	*DehaUpachayam, Utsaham*	Increases the basal metabolic rate to about 5% to 10% Anabolic effects on protein metabolism.	Increases the whole-body metabolism slightly 1/3rd increase as caused by male sex hormone
Haemopoietic system	*Pandutvam* in *Shukrakshaya.* Bhrajishnuta in Shukra sara	Testosterone can enhance erythropoiesis Increases the blood volume by increasing the water retention and ECF volume	Vasodilation
Secondary sexual characters like hair growth	*Balanamapi vaya: parinamat Shukra pradurbhavanti Romarajyadaya-nareenam*	At the onset of puberty, Causes male type of hair distribution on the body Hair growth over the pubis, along linea alba up to umbilicus, on face, chest and other parts of the body such as back and limbs	At the onset of puberty, Hair develops in the pubic region and axilla. Body hair growth is less. Scalp hair grows profusely

Few other references show that *Shukra* can also be correlated to semen along with sperm. The secretion of *Shukra* during the copulation (*Sthree purusha samyoga*) and the *shudha Shukra lakshanas* like the consistency of *Shukra* prove the same. Existence of *Shukra* throughout the entire body and its predomi-

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nance decide the gender exemplifies that it could be sex chromosome too. *Sthree Shukra* concept can be understood as sex hormones in female which are involved in the general metabolic functions and the Bartholin gland secretion too.

CONCLUSION

Human being has seven *Dhatu.* Even though all these *Dhatu* have specific locations in the body, but they are present in subtle form in each cell. In the same way, every cell has a part of *Shukra Dhatu*, as every cell is replicated by mitosis and meiosis. It can function as an anabolic hormone; along with contributes to reproduction. On broad aspect, stem cells which have the self-renewal and reproduction ability can be taken as *Shukra Dhatu*. Focusing on reproductive physiology, it could be sex hormones, seminal secretions along with sperm and sex chromosomes.

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