AN AYURVEDIC LITERATURE REVIEW ON THE EFFECTS OF HERBS ON MALE INFERTILITY

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Introduction

Infertility affects above 10-15% of married couples. The World Health Organization (WHO) estimates that there are 60-80 million infertile couples worldwide (Wani et al.). Allopathic medicines are very useful in treating infertility but there are a large number of reported side effects. These side effects include and are not limited to irregular heart rhythms, suicidal tendencies, mental disorders and tremors (Wani et al.).

Approximately 50% of couples that are infertile have an abnormality detectable in the male partner. Due to the heterogeneous nature of the disorders causing male infertility, "specific

and directed treatment for male infertility is not available" (Ahmad et al.). Also, the treatments available are expensive and not necessarily accessible to everyone (Ahmad et al.).

Important factors to take into account concerning fertility issues from the male perspective are the health of the sperm, their motility, and the concentration. Herbs that address the results of oxidation, whether it be from free radicals in our bodily processes, or from pollutants in the atmosphere and food, also have positive effects on seminal parameters necessary for optimal opportunity for conception. These same herbs act to mitigate our hormone imbalances that are caused by stress. Shukla et al. states that stress impacts various parameters, typically associated with semen quality, including concentration, motility, and morphology.

In order to treat infertility Ayurvedic practice and related scientific research (Naquvi et al., Shukla et al., Singh, Wani, Mahdi, Bopana,) has recommended the use of certain herbs . This paper will focus on four herbs: Withania somnifera, or Ashwagandha in Sanskrit, Macuna Puriens or Kapikacchu, Asparagus Racemosus or Shatavari, and Kokilaksha, known as Hygrophila spinosa in Latin.

The karmas, or actions, that will be discussed are those of the antioxidant, the adaptogen and the aphrodisiac, and the Ayurvedic concept of preliminary cleansing.

Adaptogen: These herbs are mainly used to address stress. Adaptogens can deal with things like elevated cortisol levels. In the example of Ashwagandha, it “is also considered to have herbal intelligence, as it can increase or decrease stress hormones like cortisol depending on the needs of the body” (Douillard).

Antioxidant: Another interesting “pollutant” of the human body besides the cortisol that is made in response to stress, is in the form of unstable molecules called free radicals, that wreak

havoc on the body until quelled by attaching to a hydrogen donating atom (Biswas et al.). These are what we call antioxidants. Antioxidants, in the case of herbs, can help to reverse the damage at the cellular level. "DPPH is a stable free radical and accepts an electron or hydrogen radical to become a stable diamagnetic molecule (Biswas et al.).

Aphrodisiac: The need for a desire to copulate as well as the need to increase the number of healthy sperm are covered further by the section of aphrodisiacs.

A word about the term gunas: Gunas are qualities and used to describe the properties of herbs. "Ayurveda has developed a remarkably detailed and precise analysis of the qualities. These attributes are used in finding which qualities will heal or aggravate the doshas" (Tirtha 24).

Methods

A preliminary search was for infertility, herbs, and Ayurveda. The results were a dozen possible herbs, which were reduced to three due to the prevalence of previous information obtained through the teachings at Mount Madonna, and the writings of the Classical texts and the Fundamental Principles of Ayurveda, textbooks written by Dr. Lad. Once the herbs for the focus of the paper were chosen, an investigation into Ashwagandha and antioxidant activity was begun. Many articles using studies conducted by the harming of animals were disregarded and replaced with studies that used human beings. Two studies were kept that used animals as subjects, due to the importance of the findings.

Other Inclusion Criteria and Exclusion Criteria

In Macuna Pruriens, and Asparagus Racemosus, or Shatavari, both herbs were reviewed from the standpoint of antioxidant, and searches on the Pubmed research data base were done pertaining to hormonal effects, in addition to antioxidant affects. In the case of Shatavari, the search was for the herb and its effects on hormones. The search in regards to medical literature concerning Macuna, was focused on the herb's levodopa, dopamine, or l- dopa content. Many articles were returned in these searches, some from the standpoint of Naturopathic medicine, Western scientific literature, and researchers that had an interest in Ayurveda. Most of the articles found in this category were reviewed. Shatavari was the only herb where the articles found using animals in experiments and harming said animals were used. Otherwise, other articles were used that did not harm animals, though in an attempt to avoid these due to ethical reasons, only two in this category were referenced. These articles were used due to the importance of their findings.

In line with the discussion of using studies that conducted experimentations on animals, the herbs found to increase the desire to copulate in animals (see section 3.1 on Shatavari as an aphrodisiac, and its effects on Wistar rats), may also be a safe adjunct to veterinary treatment protocols for animals that are endangered and in need of reproductive results that may not be forthcoming due to the unnatural or unhappy circumstances. It seems possible that these herbs could be of benefit for animals in these situations since the actions on the animals and humans

are similar, and the effects of the precarious state of nature in today's world effects animals and man similarly.

In researching Kokilaksha, or Hygrophila spinosa, the first search was for the Shukrah Shodhana group in the Caraka Samhita. This required an on-line search which yielded three appropriate articles but did not properly cite the text. In this case, the library at Mount Madonna was utilized. Searches for the antioxidant properties of Kokilaksha yielded fewer results. Most of the articles were not used because they focused mainly on the increase of bulk of semen which was previously covered and was not included in the research on Kokilaksha. The description of cleansing techniques were taken from Dr. Singh's book The Holistic Principles of Ayurvedic Medicine.

The availability of Ayurvedic research articles continues to grow everyday. Also, knowledge was in this case, accessed from the lectures and books of teachers from The Mount Madonna College of Ayurveda. All of this yielded a substantial body of information.

Discussions and Results

To begin the discussion we will discuss the classical Ayurvedic text, The Caraka Samhita, where it is explained that pollutants can affect the ovum or the sperm negatively. The Caraka Samhita states: "for conception it is necessary that the sperm and the ovum should be free from any morbidity. And they should be endowed with their natural attributes and there is entry of the soul" (Sarma 161). According to this text, semen is diminished because of the following factors:

1. Constant exposure to worry, grief, anger, fear, envy, anxiety, intoxication, and nervousness:
2. Intake of ununctuous food, drinks and drugs by an emaciated person:
3. fasting by a person who is weak in nature; and
4. Intake of unwholesome food. (Sarma 176)

Foods can become unwholesome in a host of ways in today's world, such as GMO's, toxic fertilizers, and pollution. As well as stress, a factor detailed by The Caraka Samhita as cause of seminal diminution, as he states "worry" as a factor.

In today's world it is apparent that stress has an effect on health in all facets, and fertility is not exempt. Shukla et. al. in discussing the effects of stress on these male fertility issues wrote:

> Stress, especially psychological stress, has a negative impact on various parameters associated with semen quality, including sperm concentration, motility and morphology. Other disturbances, such as impotence, sham ejaculation, retrograde ejaculation and oligospermia, have been reported to be associated with psychological factors underlying male infertility. (Shukla, Tawari et al.)

Mahdi et al. explains that stress in males leads to an increase in cortisol and a resultant decrease in testosterone, which is the hormone responsible for spermatogenesis. This approach provides a holistic perspective to treatment of Ayurvedic medicine itself and its belief in synergistic formulas and treatment plans that address many components and factors of the health issue at once.

Ayurveda seeks to restore out of balance homeostasis in many ways including general rejuvenation techniques called Rasayana. Rasayana is often an herbal formula and "is nourishing to all dhatus equally" (Nanal et al.). Dhatus are equatable to tissues in western anatomical description. Ayurveda identifies seven tissues that "provide nourishment, growth, and structure to the entire body, remaining inside the human body in a proper equilibrium so that the body can function properly" (Dalal et al.). It is the belief of Ayurveda that any imbalance in this equilibrium causes disease and ailment (Dalal et al.) .

The seven dhatus are plasma (Rasa), Blood (Rakta), Muscle (Mamsa), Fat (Meda), Bone (Asthi), Bone marrow and nerve (Majja) and Reproductive fluid (Shukra) (Dalal et al.). These tissues are formed through the concept of which emphasizes healthy diet and optimal digestion in order to deliver nutrients as effectively as possible to all tissues (Lad Volume 2, 297). In Ayurveda there is a concept of optimal quality of reproductive attributes called Shukra Sara, or the optimal/excellence of the dhatu called Shukra (Lad Volume 1, 310) .

The Shukra tissue is created as a part of a chain of metabolic transformations starting with digestion of food and the transformation of this into the dhatus, or nutrient fluid, muscle, fat, bone marrow, and lastly, Athava and Shukrha. In terms of the order of development of dhatus, each dhatu helps to form the next, and the health of each depends on the health of the previous, which then culminates in the final dhatu which for men, is Shukra. And beyond this is Ojas.

Though different scholars have linked Ojas to different modern scientific concepts, Khalsa says that "Modern scholars have linked ojas to the blood protein albumin. Others have hypothesized that it may parallel essential fatty acids" (Khalsa 288). It is generally agreed upon that Ojas is the " the essence of all types of tissues and the physical expression of consciousness

in the body" (Khalsa 288). "Ojas is produced during the nutrition of all the dhatus, but it is the byproduct of shukra/artava dhatu in particular" (Lad Volume 1, 173). Dr. Vasant Lad explains ojas as: "The sperm become ojas, which becomes the aura, and the aura becomes supreme intelligence. Hence, the ultimate product of Shukra Vaha Srotas is intelligence" (Lad Volume 2, 313).

The notion of cellular intelligence and the effects of food and environment on such cannot be overemphasized. Due to the fact that the order of function and development of the dhatus is in a building block relationship where the health of one is dependent on the health of the previous, one can surmise that overall nutrition, and being free from toxins, is of the utmost importance. This would especially hold true in relation to the desire for fertility. Rasayana is oftentimes a way of achieving that which Ayurveda calls Shukra Dhatu Sara, which is a means to fertility.

Chapter 1 Ashwagandha

Ashwagandha is used as an astringent herb that is bitter hot and sweet and reduces Vata and Kapha but can increase Pita in excess (Tirtha 75). It's actions are that of "adaptogenic, analgesic, antihelmintic, aphrodisiac, estrogent, galactagougue, nervine, rejuvenate, sedative, tonic, and anti-inflammatory" (Tirtha 75). Spiritually it produces ojas and is Sattvic (Tirtha 76).

The qualities of Ashwagandha in Ayurveda are laghu, or lightening, and snigdha, or oily. (Salim). It is interesting to note that all of these herbs, which are included in this paper because of their antioxidant qualities, are described in ancient texts as having the the quality/guna of Snigdha, or "oily".

1.1 Antioxidant

a. What are free radicals?

> A free radical can be defined as any molecular species capable of independent existence that contains an unpaired electron in an atomic orbital. The presence of an unpaired electron results in certain common properties that are shared by most radicals. Many free radicals are unstable and highly reactive. They can either donate an electron to or accept an electron from other molecules, therefore behaving as oxidants or reductants. (Lobo et al.)

Free radicals involved in the process of lipid peroxidation are considered to play a major role in numerous chronic pathologies such as cancer and cardiovascular diseases (El-Shourbagy et al.). They are also damaging to sperm, which have a high concentration of lipids. Lipids would generally also be considered Kapha in the body (Lad Volume 1, 29). In the case of male fertility issues, when the body's natural defenses have cleared out as many free radicals as it possibly can, the remaining are called Reactive Oxygen Species, (ROS) and this remainder affects semen. This oxidative stress can result "from an excess of ROS, a reduction in antioxidants or both" (McMichael et al.).

High levels of the ROS can cause oxidative damage to the sperm and are associated with abnormal sperm parameters leading to infertility (Ambiye et al.). This uncontrolled or excessive production of free radicals can be particularly damaging: sperm are "more susceptible to oxida-

tive stress which may initiate lipid peroxidation because of paucity of cytoplasmic enzymes responsible for scavenging ROS" (Agarwal et al.). "Targets of free radicals include all kinds of molecules in the body. Among them, lipids, nucleic acids, and proteins are the major targets" (Lobo et al.).

The amount of free radicals the body can handle compared to the amount that is left over, or the ROS, is "hypothesized as a cause of oxidative stress in semen, with peroxidative injury to the sperm membrane and a consequent impairment of the related functional properties, such as sperm motility and morphology" (Ahmad et al).

b. What forms free radicals?

Free radicals can be formed, according to Ayurveda, through not only eating unwholesome foods but also faulty food habits. We have seen that there is a natural amount of free radicals that occur from metabolic reactions in the body that accompany chemical or metabolic activities like breathing, and that stress and pollution add internally and environmentally made free radicals respectively.

Theoretically free radicals in Ayurveda could be considered Vata pushing pitta in that it is a Vata, or unstable molecule, but it's damaging affects change the metabolism or cell function, which is the Pitta action of the cell. "These are highly reactive species, capable in the nucleus, and in the membranes of cells of damaging biologically relevant molecules such as DNA, proteins, carbohydrates, and lipids" (Lobo et al.).

Oxidative stress was traced by Agarwal et al. to the lowered activity of the enzymes. This study detected a measurable correlation between seminal oxidative stress and the presence of immature and abnormal spermatozoa due to lipids and protein peroxidations. In this study by Argawal et al, the oxidative stress was traced to the lowered activity of the enzymes that were for breaking down free radicals, mainly superoxide dismutase, a free radical inhibitor, and catalase, and low glutathione level. This eventually lead to a reduction "of the levels of lactoperoxidase (LPO) and protein carbonyl groups in infertile men" (Agarwal et al.).

Ashwagandha, the first herb we will be discussing, has a direct effect on stress as well as possessing antioxidant, adaptogenic, and aphrodisiac activities (Mahdi et al.). We will be looking at this herb in relation to the first two mentioned actions, the antioxidant and the adaptogen.

c. Ashwagandha's effects on hormones

Ashwagandha's effects on testosterone, healing the body's stress responses through optimization of the working of glands, and mitigating damage from stress through hormone regulation and the herb's antioxidant activity makes it an important herb in regards to male fertility. Studies have shown that aqueous extract of this plant elicits changes in pituitary gonadotropins. (Ambiye et al.). The same study found that Ashwagandha induced spermatogenesis in immature Wistar rats by directly affecting the seminiferous tubules (Ambiye et al.).

Treatment with Ashwagandha was also found to significantly increase Luteinizing hormone (LH), in all of the groups of infertile men in the study (Ahmad et al.). LH is responsible for triggering the production of testosterone in males.

Interestingly the researchers found that reduced stress, in effect, might have contributed to the significant improvement in sperm concentration and motility. Although there was an observed increase in fructose level which may have attributed to an increase in sperm motility, "it remains to be explored if the two could have the cause-and-effect relationship" (Ahmad et al.).

Ashwagandha therefore lowered stress levels through its affects on cortisol and improved the semen quality through the actions of the fructose, and sperm motility was also improved, all positively affecting fertility. Fructose's effects in the body would be thought of as Kapha and would have building, strengthening, and adhering qualities.

The aforementioned increase in psychological stress is associated with increased oxidant production, therefore not only does the elevated cortisol levels from stress inhibit the making of testosterone, which is needed for spermatogenesis, but the increased oxidation and increased free radical formation resulting from stress potentially damages whatever sperm has been able to be formed.

1.2 A Note on Ashwaghandha as an Adaptogen

Often times Adaptogens are thought of today in terms of their effects on stress. They are also considered highly intelligent plants due to their ability to gauge the body's needs and act accordingly. An example would be Ashwagandha's effect on cortisol levels (Douillard). The extreme influx of cortisol caused by stress needs to be regulated for people who want to conceive, as well as those who want to maintain optimal health in general.

In one study the mean serum cortisol level of healthy fertile men in the morning was 10.84 ± 1.63 μg/d. The study found that he levels of cigarette smokers and normozoospermic psychological stress groups were elevated. This study compared the mean cortisol levels of healthy males with the levels of cigarette smokers and normozoospermic psychological stress groups which had cortisol levels that were elevated by by 22, 88 and 129%, respectively. The cortisol levles of the latter group were significantly decreased after treatment with W. somnifera (Ashwagandha). Cortisol levels of normozoospermic, normozoospermic cigarette smokers and normozoospermic psychological stress were found significantly decreased by 11, 28 and 32%, respectively" (Mahdi et al.).

1.3 Effect on seminal parameters

Treatment with W. somnifera was found to significantly improve all semen parameters: normozoospermic men, cigarette smokers and those having psychological stress was increased by 17, 20 and 36%, respectively. Similarly motility of spermatozoa also increased by 9, 10 and 13% . Pregnancy outcome was 15% in normozoospermic men, 15% in men under psychological stress and 10% in cigarette smokers, giving an overall 14% rate of success (Mahdi et al.).

Poor overall semen quality is a factor in infertility. In the previous studies, Ashwagandha helped normozoospermic infertile men. The number of sperm as well as the motility, a sign of the health of the sperm, were improved. The exact actions, or in Sanskrit, karmas, of this herb were on psychological stress, by reduction of stress and serum coritsol levels (Mahdi et al.).

There was an increase in fertility for cigarette smokers as well. Interestingly, it had the lowest effect on cigarette smokers, which demonstrates the harsh and long lasting effects of cigarette smoke. Although, when considering the harsh effects of cigarette smoke as a chemical influence on the body, Ashwagandha can have positive benefits for many other less harsh chemicals that are a part of our daily lives and in our environment.

Chapter 2 Macuna Pruriens

The qualities or gunas of M. Pruriens are guru (heavy) and Snighta, producing oil or oleaginous. (Salim). This is, as previously mentioned, is a shared trait (guna) with Ashwagandha and all of the herbs in this paper. The high antioxidant qualities of each herb could be related, in Ayurvedic terms, to the oily action reducing the Vata of the unstable molecules, but in terms of Western thought it would be that there is a hydrogen donating election that stabilizes the molecule, as previously mentioned in the section on free radicals.

The actions/ karmas are “Utejaka, Vajikara, Krimigna, Vatanadi dourbanyhara, Mutrajana, Yoni sankocake, Brumhana, Vranavisodana, Arthavajana, Garvhadharaka.” (Salim)

Whereas Ashwagandha had a lowering affect on stress levels through it's effects on stress hormone, cortisol, and an improvement of semen quality as a result, Macuna has an effect on dopamine in that it raises dopamine levels which leads to production of testosterone and a resultant improvement in sperm production (Chuahan et al.). Dopamine plays a crucial role in the central control of male sexual behavior (Chuahan et al.).

The main benefit in this case, of taking an herb as a means to health is that Macuna is high in L-Dopa which can cross the blood brain barrier, unlike dopamine (Lajtha).

Testosterone, we have seen, is the hormone precursor necessary for spermatogenesis. Dopamine has a direct relationship on the increase of the production of testosterone as found by Shukla et al.,

> Dopamine stimulates the hypothalamus and forebrain to secrete gonadotropin-releasing hormone (GnRH). This in turn causes the anterior pituitary gland to secrete FSH and LH which causes an increase in the synthesis of testosterone by Leydig cells. (Shukla, Mahdi et al.)

In summary, stress in males leads to an increase in cortisol (Kirshbaum et al). Stress also leads to an increase in catecholamine (Laterra et al.). Increases in both lead to a decrease in dopamine, which will eventually lead to a decrease in testosterone, which is the hormone responsible for spermatogenesis (Shukla, Mahdi et al.).

Dopamine is also an important neurotransmitter in fertility through its effects on libido. Libido in Ayurveda is a completely healthy part of being human, as well as sex being a factor in over all health and an indication of health. "Therefore, an increase in dopamine level in the brain following M. pruriens treatment may not only induce the activation of sexual behavior but it may also increase plasma testosterone level" (Shukla, Mahdi et al.). This twofold action of dopamine working on male sexual behavior and its increase in testosterone is a part of the results of having a high amount of L-Dopa, which plays a role in fertility and generalized health.

2.1 Macuna as Antioxidant

We have seen that dopamine's effects on catecholamine affects stress and fertility, and Macuna Pruriens is a natural source of L-Dopa, therefore, it is another herb that can reduce stress, and improve the semen quality as a result. But how does it affect free radicals, which we have seen are products of stress and environment, and are damaging to sperm?

Primarily, there is a need for ways to control the excess of free radicals that form the previously discussed ROS, or the excess of the limit that the body can process. The need for maintenance outside of our body's natural processing ability becomes assumedly more important due to the fact that our natural environments introduce more and more toxins, pollutants, and/or chemicals in our every day environments. Although the body is equipped to handle some free radicals, there still can be damage caused if something like a pathological condition, for example, increases the formation of free radicals or exhaust the removal mechanism (Dhanasekaran et al.). Herbs are in a unique position to assist the body in maintaining these levels.

Not only are chemicals in the environment increasing but the consumption of sugar in diets is also is increasing (Powell). Another aspect in the question of the creation of free radicals, there is the factor of excessive sugar which can oxidize and create free radicals (Mohanty et al.). Therefore regulating sugar intake also has an equally important place in the process of oxidation reduction. One study found Macuna Pruriens positively affected free radicals caused by sugar oxidation (Dhanasekaran et al.).

The results of a study on M. Pruriens and the inhibition of oxidation caused by sugar found that,

> Incubation of ferrous ammonium sulfate with deoxyribose sugar causes oxida tion of sugar. Macuna cotyledon powder (2500 ug) significantly inhibited ferrous ammonium sulfate-induced deoxyribose sugar oxidation ($p< 0.05$)." This dose of Macuna blocked the oxidation by 15%, "exhibiting protective effects against oxidation of deoxyribose sugar by ferrous ammonium sulfate. (Dhanasekaran et al.)

The management of free radicals again shows to be of great importance, and more so as sources and abundance of free radicals increase in environment and diet. M. Pruriens recovers spermatogenic loss by combating ROS, or the excess of free radicals that the body cannot process (A.P. Singh et al). There was also a recovering of the mechanism of the hormonal axis, which is of a great benefit to the body's overall health maintenance (A.P. Singh et al.).

A. Singh et al. found that the effect that this had on seminal parameters was an increase in count and motility. This was due to the effect it had on the hypothalamic-pituitary-gonadal axis and the number of testicular germ cells that were recovered: "We observed efficient and quick recovery of spermatogenesis in MP and LD groups in comparison to the auto-recovery group."

Chapter 3 Asparagus Racemosus/ Shatavari

Gunas or qualities: Guru, heavy, and Snigdha, or oily (Salim). The herb's actions are "Mucilaginous, anti diarrhetic, refrigerant, diuretic, antidysenteric, nutritive, tonic, demulcent,

galactagogue, aphrodisiacc, aantispamodic, and stomachic" (Tirtha 104). It increases breast size, cures epilepsy, and night blindness" (Salim). Also is a general, reproductive, and nervine tonic, nutritive, rejuvinative, demulcent, and antacid (Lad, Frawley 183). The herb is "sweet, bitter-cold-sweet" (Tirtha 103). It reduces Pitta and Vata and in excess it can increase Kapha and cause an increase in ama, or toxins (Tirtha 103). Works on the circulatory, reproductive, respiratory, and digestive systems. (Lad, Frawley 183) "The guna is of the highest spiritual action, or Sattva. It increases "love and devotion, and increases ojas" (Tirtha 104).

3.1 Shatavari as an Aphrodisiac

In terms of our discussion of A. Racemosus as an aphrodisiac, it should be noted that some of the modern, medical research was conducted with an intellectual awareness of the collective thoughts of the scientific community's feelings about the actual benefits or rationale behind the study of aphrodisiacs. Chauhan et al. felt that this skepticism was not unjustified, but felt " a systemic evaluation and compilation of scientific information may provide a basis for the evidence based utilization of herbal drugs and treatment of sexual dysfunction in general."

Aphrodisiacs in western plant biology are often Rasayana in Ayurvedic medicine. A Rasayana by one Western definition acts on the body by modulating the neuro-endocrine immune system (Dalal et al.). The modern day concept for the term "aphrodisiac" can be considered close to the Vajikarna concept defined in traditional texts of Ayurvedic medicine (Chauhan et al.).

Modern medicine has trouble defining the mechanisms of sexual arousal due to the fact that there is still much research to be done concerning all of the different neurotransmitters, hormones, pheromones and interference caused by drugs that interfere with normal functioning (Chauhan et al.). This concept of molecular interactions is already in use in Ayurveda in its concentration on molecular interactions through the Vata, Pitta, Kapha structure, and the concept of Shookshma in its medicines. The advancement of the studies of sexual function at the molecular level, is "turning out to be stepping stones towards isolating the crucial physiologic factors involved in sexual arousal, thus helping to narrow down the search for aphrodisiac substances of choice" (Chuahan et al.).

Shatavari's actions are similar to the other herbs we have reviewed in that it does not only act on one aspect of infertility but has a holistic effect: there is a positive affect on chemical stress. In this sense Shatavari's Pitta pacifying effect can work in order to restore proper metabolism through balancing the HPA axis, reducing free radicals, thereby mitigating subsequent damage, while acting simultaneously as an aphrodisiac and increasing spermatogenesis, as found by Wani et al, Singh et al. and Nuqui et al.

"Biologically significant" aphrodisiacs have been placed into three categories. The first category provides a boost of nutritional value which acts to immediately improve the health of the person consuming the aphrodisiac and this leads to an increase in libido (Chauhan et al.). The second type enhances blood flow (Chuahan et al.). The third type, Chauhan et al. describes as being the most complicated to study due to the fact that only a limited amount of information is understood concerning the brain and sexual arousal. The study of this area is currently, mainly

focused on the study of pharmacological compounds that cross the blood brain barrier and stimulate sexual arousal (Chuahan et al.).

Ayurveda details the following types of aphrodisiacs: drugs which increase the quantity of semen or stimulate the production of semen, drugs which purify and improve the quality of semen, drugs which improve ejaculatory functions, drugs delaying the time of ejaculation or improving ejaculatory performance, and drugs arousing sexual desire (Chuahan et al.).

Shatavari and Macuna are listed in Traditional Ayurvedic treatise by Vaghbat as being in the category of drugs which increase the quantity of semen or stimulate the production of semen. Shatavari is included in many recipes in which it says, “consume vajikara recipes which gives strength to the semen and the offspring.” (Vaghbat 414)

Asparagus Racemosus showed a “significant aphrodisiac activity on male Wistar albino rats as evidenced by an increase in number of mounts and mating performance” (Wani et al). These affects were attributable to the testosterone-like effects of the milk decoction of A. racemosus: "Animal studies have shown that Shatavari caused an increase in testicular size by 6.8 percent that possibly followed an increase in spermatogenesis” (Wani et al.).

In the instance of hormones, Shatavari does affect the master gland (anterior pituitary gland) by supporting the secretion of the luteinizing hormone (Wani et al.). As we have said previously, in men LH promotes the production of testosterone. Hormones in Ayurveda are described by one researcher as one of the avenues Ayurveda utilizes as a way to bring the body to balance, in order to heal itself (Mishra 463). In the case that the hormones are depleted, there is a problem in the semen producing and transmitting organs which can lead to various issues of sexual dysfunction. (Mishra 463) “The Ayurvedic remedy for sexual dysfunction is aimed not

only at the immediate etiological factors of the disease but also toward improving the hormonal status of the body." (Mishra 464) Shatavari working as an aphrodisiac and a hormone stabilizer works to reach this aim.

3.2 Antioxidant effects of Shatavari

One of Shatavari's major constituent is phytoestrogens. The major bioactive constituents of Asparagus Racemosus are a group of steroidal saponins. The part of the plant that is mainly used in medicine is the root, where Shatavarins I–IV, major steroidal saponins, are present (Bopana et al.).

A. Racemosus extract was measured in the study in terms of protection against lipid peroxidation and protein oxidation. Even a very low dose was shown to be effective against the damage caused in that it showed a significant inhibition of lipid peroxidation and protein oxidation (Wani et al.).

The fact that there is a positive effect against lipid peroxidation is helpful for sperm, which we previously mentioned, are mainly made of lipids. There was an observed reduction in the membrane lipid peroxidation and protein carbonyl content "as well as am observed increase in the antioxdant activity in terms of DPPH (1-Diphenyl-2-picryl-hydrazyl) radical and NO (Nitric Oxide) radical scavenging activity" (Biswas et al.). DPPH is is a stable free radical which has an unpaired valence electron at one atom of nitrogen bridge (Eklund et al., 2005).

The study by S.D. Shukla et al. found that immobilization stress induced oxidative changes in the hippocampal subregion were also counteracted by the antioxidant effects of of Asparagus Racemosus extracts. This is very important for brain health.

3.3 **Shatavari as an adaptogen**

Adaptogen: The reputed adaptogenic properties of the plant are attributed to the presence of high concentrations of saponins, known as Shatavarins (Wani et al.). Its affects on the HPA axis helps to reduce stress and the effects, as well as antioxidant properties that have already been reviewed.

The way the HPA Axis is described in a psychology textbook is:

> Sensory information is projected to the thalamus, from there it is directed to other brain processing. Emotional stimuli follow two primary pathways, both of which lead to the amygdala. the first pathway might be called a "shortcut" and represents the evolved fear module for conditioned fear. The message follows direct connection between the thalamus and the amygdala, which is connected to the hypothalamus." Behavioral responses (such as fight or flight response) are then activated and coordinated through projections from the hypothalamus to endocrine glands and the autonomic nervous system. (Oltmanns 110)

This becomes important due to the effects of over using the fight or flight mechanism in today's highly stressful world. Overworking of this mechanism is referred to generically as "adrenal burnout".

A study was conducted to trace the effects of Shatavari on stress pathways by it being given to rats and then checking the levels of their plasma and unfortunately then dissecting their brains. In collecting the plasma and analyzing the amounts of corticosterone and norepinephrine in the brain tissues, it was found that the levels of cortisol and norepinephrine were decreased in the plasma, "indicating its effects on the hypothalamic-pituitary-adrenal cortex axis and the sympathetic-noradrenergic system, respectively" (Krishnamurthy et al.).

Monoamines like serotonin, dopamine were also measured. Interestingly, in Krishnamurthy et al.'s study it was found that in most brain regions the change in monoaminergic systems was limited by a ceiling effect at a dose of 100 mg/kg. "These observations could explain the traditional use of AR as an adaptogen and a functional food" (Krishnamurthy et al.).

The results of this research shows the intelligence of the adaptogenic plant. Once there is a cap to the body's needs, even though the dosage is raised the effects are kept in balance. The ability to measure the biological, ever changing needs of the body and to respond accordingly is a result that has yet to be duplicated by the synthetic pharmaceutical industry.

Chapter 4 Kokilaksha and Ayurvedic Cleanse

Kokilaksha's herbal energetics are as follows: qualities or gunas: Picchila or lubricous, Snigdha, or oily. Actions or karmas: Balya, Mtrala, Rucya, Vjikara, Vaya, Santarpana (Officnar 96).

Hygrophila spinosa, or Kokilaksha in Sanskrit, is another herb listed as an aphrodisiac (Karni 669) but the herb has an ultimate result of cleansing the Shukra Dhatu. This is listed in the Caraka Samhita states this herb, otherwise known as Ikshura, in the list of herbs that have an overall cleansing effect. This is called "semen depurant" in English and shukrsashodhan in Sanskrit (Sharma 20). The final dhatu is purified through this action. This herb also has a high rate of antioxidant qualities, is effective in cleansing, strengthening, and having an overall positive effect on the body's systems (Petra et al.).

In Ayurveda Kokilaksha's root is described as "cooling bitter, tonic, diuretic, demulcent and refrigerant. Leaves are demulcent and diuretic." (Karni 668). Studies are emerging with evidence that the real causes of infertility are the various tissue toxins called gonadotoxins (Mishra 463). These chemicals mimic hormones and impair their secretion, resulting in disruption of the normal physiological processes (Mishra 463). Ayurveda recognizes the concept of these toxins, which can be cleansed, as one of the causes of infertility,.

This is important due to the previously discussed need for a cleansing of toxins to build strong dhatus. Shukrah is the last, and dependent on the health of all previously formed. Although western scientific literature concentrates mainly on Kokilaksha's ability to increase the number of sperm (Buduru et al.), the cleansing or purifying techniques employed in Ayurveda are a cornerstone to its effectiveness. Ayurveda is in a unique position to assist people in a preliminary removal of toxins before embarking on any healing modality or the use of any medications, herbal or otherwise.

Ayurveda is the only system of medicine in the world which proposes the need for undertaking the purification of biological system and the gross channels up to the molecu-

lar levels aiming to clean the entire organism to render it suitable for self recovery and therapeutic responsiveness. (R.H. Singh, 84)

Although this is the final dhatu or system of tissues being cleansed, the impurities or toxins may be more easily dislodged or "cleansed" than in the case of a disease like cancer, depending on the form and chronicity. Ayurveda uses the concept of dislodging the deep seated toxins from tissues and moving them into the channels in order to be removed from the body (R.H. Singh 114). Shodhana, which consists of different therapeutic mechanisms to do so, is a viable way of recovering fertility in men, or at least should be at the foundation of a therapy for male infertility.

In general, Shodhana and samshodhana are the different ways and techniques to cleanse which is a vital part of health maintenance, and the most promising of therapies in cases of disease that have not been able to be cured. It is of utmost importance in the realm of prevention and cure. The reason for this Dr. R.H. Singh explains that the blockages that an accumulation of toxins (the result of improperly digested food) can cause malfunctionings: "Any alteration in the functioning of these passages or obstructions will lead to the maltransportation of metabolites to different parts when required for nutrition and excretion." (Singh, R.H. 111)

This disturbance is well known and understood in Ayurvedic medicine as what ultimately leads to the beginning stages of disease. Samshodhana "stands for rectification" and is more vital and complicated than shodhana, which is "merely a physical or chemical purification" (R.H. Singh 111).

Shodhana is procedurally less complicated but also effective. For more information or to better understand this information, Pancha Karma can be further looked into by all interested.

Conclusion

There is a need for further research concerning the effects of Kokilaksha and sperm morphology in laboratory based research. It is important for medical research to verify the uses of Ayurvedic herbs and procedures as described in the classical texts in order to help Ayurveda grow and stay true to its foundations.

Health problems are often times a combination of many factors, as seen in the case of male infertility where there are a few different causative factors. Some examples covered in this paper are stress, which leads to an increase in cortisol and decrease in testosterone, or chemicals from things like cigarettes and environmental pollutants which can cause oxidative damage to lipids in sperm. A holistic and cost effective approach is needed in helping the people who have fertility issues and Ayurveda can provide a system and framework which fosters healing and a wealth of effective and scientifically proven treatments to support these aims in a cost effective manner that is available to all in need.

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