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### Herbal Spermicidal – A Better Contraceptive Approach



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#### ABSTRACT

The world's population is ballooning and by the end of this century about 8-10 billion people will inhabit the earth and out of them, 75-80% will be living in developing countries. Rapid population growth obstructs the overall developmental efforts and complicates the existing problems associated with the progress of any country. Family planning measures such as sterilization, use of contraceptives pills and intra uterine devices are the common ways to control the situation. Apart from these, adoption of natural methods like rhythm methods and coitus interrupts are the other birth controlling approaches. The search for widely accepted contraceptives still continues, as none of the available contraceptive is completely safe, effective and reversible. Out of the various population controlling devices, vaginal spermicidal contraceptives figure out to be preferred approach offering considerable advantages with regard to aforementioned expectations. Safer to a great extent, shortcomings of herbal spermicidal agents can be reduced by polyherbal formulations and thus an ideal spermicidal formulation can be expected from herbal origin.

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#### KEYWORDS

Population explosion;  
Spermicides;  
Herbal spermicides.

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## INTRODUCTION

The population explosion, although a major global problem, is being realized more seriously in developing and under-developed countries. The world's population is ballooning and by the end of this century about 8-10 billion people will inhabit the earth and out of them, 75-80% will be living in developing countries. Rapid population growth obstructs the overall developmental efforts and complicates the existing problems associated with the progress of any country<sup>[1]</sup>. Population explosion, in a way, is a threat to the life on the earth.

The main problems associated to over-population are inadequate food supply leading to malnutrition and associated health complications, space problems, unhygienic conditions causing spread of epidemics, ecosystem degradation, unemployment, price rise, low level of education, law and order problems and other related problems of social concern. Therefore it is a matter of concern to one and all for adopting adequate methods to check population growth. Family planning measures such as sterilization use of contraceptives pills and intra uterine devices are the common ways to control the situation. Apart from these, adoption of natural methods like rhythm methods and coitus interrupts are the other birth controlling approaches<sup>[2]</sup>.

⇒ There is a need to use contraceptives as they help to;

⇒ Avoid early conception after marriage,

⇒ Avoid the subsequent chances of conception after first or second child-birth,

Maintain proper spacing in child-birth in the interest of mother and child health.

From the available methods, rhythm and coitus interrupts are unreliable and due to associated complications they also have high failure rates. Adoption of Diaphragm, sponges, IUDs etc. apart from being esthetically unpleasant, may also cause hypersensitization of the tissues involved. Sterilization is an irreversible approach. Though widely used oral contraceptives possess side effects like nausea, vomiting, weight gain, development of acne, increased blood pressure and thrombosis etc<sup>[3]</sup>.

In the light of the above, the search for widely

accepted contraceptives still continues, as none of the available contraceptive is completely safe, effective and reversible. Ideally women desire a contraceptive, the use of which may be completely under their control. Like contraceptive pills, its use should not be continuous, rather be restricted to "as and when needed". More importantly it should be convenient, safe and effective and it would be preferred if it offers some protection against Sexually Transmitted Diseases (STD's) also. Out of the various population controlling devices, vaginal spermicidal contraceptives figure out to be preferred approach offering considerable advantages with regard to aforementioned expectations<sup>[4]</sup>.

## SPERMICIDES

Spermicides are the agents, having the ability to kill, immobilize or incapacitate the sperms upon contact. Several advantages related to the use of spermicides are<sup>[5]</sup>.

⇒ As they do not enter systemic route, they have minimal side effects.

⇒ They do not involve hormones nor interrupts any hormonal process for their action

⇒ Therefore they do not cause any health complication.

⇒ They additionally offer some protection against STDs.

⇒ The user immediately returns to fertility phase after discontinuation of their use.

⇒ Their use is easy to initiate and discontinue and they do not suffer from any withdrawal syndrome.

⇒ They do not require medical supervision for use.

⇒ They are rather inexpensive and easily available.

⇒ Their use is fully under the control of women and may be used only when needed.

⇒ They can well be used as supplement to other birth control methods.

⇒ They do not cause any physical or physiological disturbances to the body system.

⇒ Most, importantly like diaphragm and sponges, they do not create any barrier against coitus.

The above positive points make the use of spermicidal as a preferred method of contraception. Spermicidal formulations are available in market as

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gel, cream, suppository, foam tablet etc. Apart from these, surfactants like Nonoxynol-9 and Benzalkonium chloride are the widely used spermicidal agents. Phenyl mercuric nitrate, zinc sulphate, ricinoleic acid and antibacterial like chlorhexidine are other agents used for the purpose<sup>[6]</sup>. These spermicidal agents show their action<sup>[7-9]</sup> by retarding or inhibiting sperms motility or by inhibiting sperm specific enzymes such as, acrosin and hyaluronidase which play an important role in fertilization process.

Most of these spermicidals are also have side effects, as they may develop hyper-sensitization reaction and may cause vaginal irritations<sup>[10]</sup>.

### HERBAL SPERMICIDES

Scientists all over the world are trying to develop vaginal products that may eventually overcome some of the side effects of currently available spermicidal agents and also provide some protection against STDs and pathogens, however the goal is yet to be achieved. In such a scenario, it is quite obvious and rather a compulsion that the scientists have started looking for herbs, possessing an array of phytoconstituents with diversified birth limiting biological activities. Even on prolong use bioactives derived from plants are generally safe, nontoxic and relatively free from the side effects normally associated with synthetic spermicides. Being of herbal origin, they are more compatible with the human body systems are easily available and relatively cheaper. Moreover the herbs have been used traditionally for various ailments and hence the rural population will accept them easily. The herbal spermicidals may act by inhibiting the motility of sperm, by changing vaginal pH to more acidic side, which is detrimental to sperms, or by affecting the morphology of sperms or acting on the sperms surface disrupting the plasma membrane.

Plant derivatives have also been reported to inhibit sperm specific enzymes such as acrosin and hyaluronidase or may possess strong semen coagulating property. Some plant derivatives such as neem oil may also show additional antifertility effects by being absorbed through vagina. Various studies carried out on herbal contraceptives reveal that mani-

festation of spermicidal activity in plants is due to the presence of saponins, flavonoids and phenolic compounds which cause degenerative changes in the sperm morphology<sup>[11]</sup>.

Herbs are being used for controlling fertility and birth from time immemorial by influencing various phases of human fertility as preventing ovulation, checking fertilization or acting as spermicidal, anti-implantation or abortifacient<sup>[12]</sup>.

Ancient texts on ayurveda and other traditional systems of medications mention the use of plants as contraceptives and contraceptive measures have been described in "Bhaishajya Ratnavali" an ayurvedic text of repute, for the first time in 18<sup>th</sup> century<sup>[13,14]</sup>.

### MODERN APPROACHES

The scientists have carried out detailed studies on spermicidal properties of some plant products and the important outcome are mentioned below:-

#### *Azadirachta indica* (Neem)

Different parts of *Azadirachta indica* have been used since ages in India for contraception and therefore neem and neem products are important preferred candidates for studying spermicidal potential.

According to Sinha et al.,(1984)<sup>[15]</sup> spermicidal action of neem oil through 100 % sperm immobilization was reported against Rhesus monkey and human subjects without showing any side effects where, the effect was found due to its anti-flagellate activity, thus immobilizing the sperms and rendering them unable to fertilize the ovum.

Khillare et al., (2003)<sup>[16]</sup> evaluated the effective concentration of aqueous extracts of old and tender neem leaves to immobilize and kill 100% human sperms within 20 seconds.

Further work carried out by Bardhan J, (1991)<sup>[17]</sup> revealed a good level of spermicidal activity from neem oil after its pre and post coital intra vaginal application in Rhesus monkeys.

In albino rats the antifertility activity of neem oil applied intra-vaginally and orally from day 1 to day 10 of pregnancy was confirmed by Lal et al., (1986)<sup>[18]</sup>. These studies showed that continuous ad-

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ministration of neem oil is important to achieve a higher degree of antifertility effect.

Non hormonal nature of neem oil was further confirmed by Prakash et al.,(1988)<sup>[19]</sup> as female rats treated with neem seed oil at a dose up to 0.3 mL per rat did not show any estrogenic, antiestrogenic or progestational activity.

According to Riar et al., (1990)<sup>[20]</sup> A steam distillation derived volatile odorous fraction of neem oil, (NIM-76) exhibited a powerful *in-vitro* spermicidal action.

Sodium nimbinate, (sodium salt of nimbidin) - a terpenoid from neem seed extract was found to have spermicidal action with 10 mg/ml and 2.5 mg/ml concentrations for killing human sperms. This is probably the first *in-vitro* spermicidal report from neem products. (Sharma & Saxena,(1959)<sup>[21]</sup>.

Based on the antifertility studies carried out on Neem oil a neem oil based commercial product “Sensal” claimed to be an antiseptic and vaginal toner without any contraindication. Anon (1986)<sup>[22,23]</sup>.

The efficacy of intra vaginal application of neem oil studied in female volunteers of proven fertility showed no conception where it was observed that the active compound of neem oil is absorbed through the vaginal mucosa to enter the circulation and then exerting antifertility effect which was in addition to direct spermicidal effects of neem oil. [Sehrawat et al., (1998)]<sup>[24]</sup>.

Outcome of the work of Garg et al., (1994)<sup>[25]</sup> showed that the “Praneem” a polyherbal cream containing a purified fraction of neem oil has shown high contraceptive efficacy in rabbits and monkeys and the formulation was also found to be free from sensitization or irritation effects.

Talwar et al., (1995)<sup>[26]</sup> working on formulation such as cream and pessaries made out of neem oil revealed its dual properties of contraception and alleviation of genital infections.

Although *Azadirachita indica*, has established potential spermicidal properties, following are the other plants exhibiting the similar activity

Shetty et. al.,(1976)<sup>[27]</sup> observed promising spermicidal activity of the saponins isolated from 16 plants out of them, 8 plants showed promising results. *Albizia lebeck*, *Caltha paulstris*, *Clerodendron*

*serratum*, *Madhuca butyracea*, *Sapindus mukorossi*, *Schefflera capitata* and *Trigonella-foenum graecum* against human sperm. According to him saponins isolated from *Sapindus mukorossi* showed maximum spermicidal effect.

An instant spermicidal activity of pittedoside A and B saponins, from *Pittosporum nilghirens* has been reported by Jain et al., (1980)<sup>[28]</sup>.

Kamboj and Dhawan (1982)<sup>[29]</sup> reported instant sperm immobilization against human spermatozoa from acacic acid from the bark of *Acacia concinna*, oleanolic acid and proceric acid from the roots of *Albizza procera* and anagelligenone from *Anagallis arvensis*.

Primorac et al., (1985)<sup>[30]</sup> observed instant immobilization of human spermatozoa within 20 sec from saponins of *Cyclomen persicum*, *Primula vulgaris* and *Gyposophyla paniculata*. The saponin of *Primula vulgaris* and *Cyclomen persicum*, showed immobilization of sperm at a dilution 1:1000 while saponins of *Gyposophyla paniculata* showed spermicidal activity at dilution 1:20.

A noticeable *in-vitro* immobilization of spermatozoa by allitridium from garlic was reported at 7.5mg/ml concentration by Qian et al., (1986)<sup>[31]</sup>.

Pant et al., (1988)<sup>[32]</sup> noticed that the alcohol extract of *Asparagus plumosus* roots containing yamogenin and furostanol glycoside causes 100% immobilization of human sperm at 1.0% and 1.5% level.

According to the same group of workers Pant et al., (1988)<sup>[33]</sup> amyirin,  $\beta$ -sitosterol, oleanolic acid,  $\beta$ -sitosterol-D-glucoside and three hederagenin glycosides (nepaline 1-3) from ethanolic extract of inflorescence of *Hedera nepalensis* possess spermicidal activity.

Ethanol extract of *Ophiopogon intermedius* rhizomes was found to be active against human spermatozoa. Further Dioscin, an active constituent isolated from the rhizomes was found to show 100% immobilization of sperms at 1.5% level. Rawat et al., (1988)<sup>[34]</sup>.

Inhibitory effects of some C-27 steroidal saponins obtained from Liliaceous plants were reported against human spermatozoa *in-vitro* by Wang et al., (1996)<sup>[35]</sup>.

During *in-vitro* studies on the morphological changes in human spermatozoa exposed to *Sapindus*

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mukorossi saponins observed alterations in the glycoproteins associated with lipid bilayer of plasma membrane of the sperm. Dhar et al.(1989)<sup>[36]</sup>.

Spermicidal activity of Solasodine, a steroidal alkaloid from *Solanum xanthocarpum* was reported and the alkaloid was found to cause a significant inhibition in the motility of human and bovine spermatozoa. It was also reported that Solasodine inhibits the activity of enzymes like glucose-6-phosphatase, fructose-1, 6-diphosphatase, amylase etc. in the spermatozoal homogenates. Kanwar et al. (1990)<sup>[37]</sup>.

The alcohol extract from the roots and flowers of *Calotropis procera* had shown *in-vitro* spermicidal activity with a conclusion that the inhibitory effect on sperm motility might be due to the lipoidal components present in the extract. Qureshi et al. (1991)<sup>[38]</sup>.

From an exhaustive study Rajasekaran et al., (1993)<sup>[39]</sup> reported that molugenol-A an antifungal saponin from *Molluga pentaphylla* possess sperm immobilizing property through inhibition of superoxide dismutase activity which in turn causes increased membrane lipid peroxidation finally causes membrane damage and thus loss of sperm motility and viability.

David (1995)<sup>[40]</sup> studied that the alcoholic extract from the leaf of *Vinca rosea* at 5% level reduced the sperm motility to 19% in the first minute and to completely nonmotility at the end of second minute, while, the addition of *S. xanthocarpum* seed extract reduced the sperm motility to 23% in the first minute and complete non motility at the end of second minute.

Inhibition of human sperm motility by *Hypericum perforatum*, *Echiracia purpura*, and *Serenoa repens* was reported. Ondrizek et al. (1999)<sup>[41]</sup>.

Studies on human sperm immobilization effect of *Carica papaya* seed extracts *in vitro* by Lohiya et al. (2000)<sup>[42]</sup> revealed that benzene fraction of the chloroform extract at 2% concentration possess maximum sperm immobilization effect.

Chakrabarti et al., (2003)<sup>[43]</sup> reported the sperm immobilization activity of *Allium sativum* extracts at concentrations 0.25 g/ml against rat sperms and 0.5 g/ml against human sperms.

Pakrashi et al. (1991)<sup>[44]</sup> studied the sperm im-

mobilizing effect of triterpene saponins from *Acacia auriculiformis*. The saponins were found to be effective at 0.35 mg/ml concentration.

Wang et al., (2004)<sup>[45]</sup> studied the effect of tea saponin in ameliorating N-9 spermicidal action *in-vitro*. According to the study tea saponins can improve N-9 spermicidal action *in-vitro* and both have proved of synergic effect. The minimum spermicidal concentration of N-9 in mixed solution was 0.13 + 0.05 g/l and that of Tea saponin was 2.40 + 1.07 g/l.

Treyvaud et al., (2000)<sup>[46]</sup> evaluated the spermicidal and haemolytic properties of serjanic acid saponins and spergulagenic acid saponins from aqueous extracts of *Phytolacca icosandra* berries.

Batla et.al. (1990)<sup>[47]</sup> studied the inhibition kinetics of human sperm by gossypol from *Gossypium herbaceum*. Their studies showed that the inhibition of enzymes such as (Na<sup>+</sup>,K<sup>+</sup>) ATPase, acid phosphatase, may cause reduction in availability of energy to the sperms, as a result they may get killed.

According to Farnsworth and Waller, (1982)<sup>[48]</sup> a majority of spermicides are triterpene saponins, flavonoids and phenolic compounds.

According to Purohit et al. (1993)<sup>[49]</sup> 2% ethanol extract of *Schefflera venulosa* leaf causes 100% immobilization of human sperm.

Bandivedekar et al., (2002)<sup>[50]</sup> studied the spermicidal activity of *Pongamia glabra* seed oil. The oil is being used traditionally in the treatment of dyspepsia with sluggish liver.

According to Silva Torres et al., (2003)<sup>[51]</sup> ethanol extracts of *Sedum praealtum* in intra vaginal doses of 10, 20, 40, 50, 100 and 150 mg/kg body weight showed a toxic effect in spermatozoa viability after 24 hrs. of administration.

The purified fraction from crude aqueous extract of *Echeveria gibbiflora* showed instant immobilization. The *Echeveria gibbiflora* purified fraction causes immobilization of sperms through loosening of the plasma membrane and based on the findings the purified fraction of the plant has been suggested for use as a vaginal barrier contraceptive. Delgado, (1998)<sup>[52]</sup>.

Sandhya Kumari et al., (2003)<sup>[53]</sup> studied the antifertility effects of 50% ethanol extracts of *Ricinus communis* in rats. Reduction in sperm counts alteration in motility, mode of movement and morphol-

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ogy of sperms were observed during the study.

### CONCLUSION

After almost two decades of scientific eclipse, vaginal spermicidal contraceptive methods are gaining importance due to safety and acceptability reasons. At the same time increasing concern about the side effects of oral contraceptive, IUDs and other methods has resulted in a paradigm shift in attention by both, scientists and consumers from these methods to the traditional methods of fertility regulation. Because, the existing modern ways of contraception has serious physical and physiological side effects, hectic search is going on to find contraceptives from herbal origin and in a country, like India where population has already crossed billion mark, the search for newer and safer antifertility measures are required at a faster pace.

Development of improved and more effective spermicidal contraception depends upon a better understanding of sperms anatomy, vaginal anatomy and physiology, sperm migration in vaginal tract. Efforts have been made in past also to isolate effective chemical components from the plants for the purpose Work for a suitable herbal spermicidal agent for human use is in progress in different laboratories.

Safer to a great extent, shortcomings of herbal spermicidal agents can be reduced by polyherbal formulations and thus an ideal spermicidal formulation can be expected from herbal origin. As per the Recent, the prevalence of STDs is increasing at an alarming rate. In a situation where over 900 million people worldwide are infected with STDs, of them more than half are women, the development of herbal spermicidal formulations that are also antimicrobial in nature will be of utmost clinical interest.

Improving methods for evaluating vaginal contraceptive is a matter of considerable concern. The effectiveness of any vaginal spermicidal contraceptive is related directly to the accuracy and consistency with which it is used.

Although many of the formulations prepared from the crude extracts of the plants, have shown promising spermicidal results, detailed investigations

on the purified compounds are required to establish their safety and efficacy. Subsequently developing a safe, effective and acceptable formulation will be a challenging job for the pharmacists. Research work on spermicidal properties of the plants need to be continue with sincerity to make them really useful to the people. If done so, the work may finally lead to a break-through in achieving control on population explosion.

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