1. INTRODUCTION

1.1 Role of medicinal plants in modern medicines

The use of natural products with therapeutic properties is as ancient as human civilization and, for a long time, mineral, plant and animal products were the main sources of drugs\(^1\). Primitive peoples throughout the world made use of their indigenous flora as a source of medicines. Through the process of trial and error, these cultures examined and discovered many plants that produce unique molecular entities with valuable biological properties such as aspirin from willow bark (\textit{Salix alba}), the anticancer alkaloid vincristine from the Madagascar periwinkle (\textit{Catharanthus roseus}), and cardiac glycoside digoxin from \textit{Digitalis} species\(^2\).

Just over 200 years ago, a 21-year-old pharmacists apprentice named Friedrich Sertürner isolated the first pharmacologically active compound, morphine, from opium produced by cut seed pods of the poppy plant, \textit{Papaver somniferum}\(^3\). Drug discovery from medicinal plants led to the isolation of early drugs such as cocaine, codeine, digitoxin, and quinine, in addition to morphine, of which some are still in use\(^4\)-\(^5\). Arteether (Artemotil\textsuperscript{®}) is a potent antimalarial drug derived from artemisinin, a sesquiterpene lactone isolated from \textit{Artemisia annua} L. (Asteraceae), a plant used in traditional Chinese medicine\(^6\)-\(^7\). Galantamine (Reminyl\textsuperscript{®}) is a natural product discovered through an ethnobotanical lead and first isolated from \textit{Galanthus woronowii} Losinsk. (Amaryllidaceae) and approved for the treatment of Alzheimer’s disease\(^8\). Tiotropium (Spiriva\textsuperscript{®}) is an inhaled anticholinergic bronchodilator, based on ipratropium, a derivative of atropine that has been isolated from \textit{Atropa belladonna} L. (Solanaceae) and recommended for treatment of chronic obstructive pulmonary disease\(^9\). Exatecan is an analog of camptothecin from \textit{Camptotheca acuminata} Decne. (Nyssaceae) and developed as an anticancer agent\(^10\).

Galegine, an active antihyperglycemic agent isolated from the plant \textit{Galega officinalis} L. provided the template for the synthesis of metformin and opened up interest in the synthesis of other biguanidine-type antidiabetic drugs. Papaverine, useful as a smooth muscle relaxant, provided the basic structure for verapamil, a drug used to treat hypertension\(^11\). Plant derived anti-cancer drugs include Camptothecin from \textit{Camptotheca acuminata} Decne. (Nyssaceae), Paclitaxel from
Introduction

*Taxus brevifolia* Nutt. (Taxaceae)\(^\text{12}\), Silvestrol from fruits of *Aglaia foveolata* Pannell (Meliaceae) in Indonesia\(^\text{13}\), Vinblastine and Vincristine from *Catharanthus roseus* L. G. Don (Apocynaceae)\(^\text{14}\). Calanolide A, an anti-HIV drug, is a dipyranocoumarin natural product isolated from *Calophyllum lanigerum* var. austrocoriaceum (Clusiaceae), a Malaysian rainforest tree\(^\text{15}\). Actinophyllic acid, an indole alkaloid isolated from the leaves of Australian plant, *Alstonia actinophylla* (Apocynaceae), by inhibiting Carboxypeptidase U to facilitate fibrolysis, removes blood clot and considered as a valuable lead for therapeutic agents to treat cardiovascular disorders\(^\text{16}\). Globularioside, a chlorinated iridoid glucoside isolated from the aerial parts of *Globularia alypum* L. (Globulariaceae), exhibited significant anti-oxidant effects based on the scavenging activity of the stable 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical\(^\text{17}\).

According to Butler (2004)\(^\text{10}\), around 21 natural product (NP) and NP-derived drugs were launched onto the market in the United States, Europe or Japan from 1998 to 2004. In addition, a semi-synthetic camptothecin derivative, belotecan, was launched in Korea in 2004. The 21 drugs, classified as 3 NPs, 10 semi-synthetic NPs and 8 NP-derived drugs, include the “first in kind” drugs caspofungin (antifungal), galantamine (novel anti-Alzheimer’s drug), nitisinone (new treatment for the orphan disease hereditary tyrosinemia type I), miglustat (new treatment of type 1 Gaucher disease) and daptomycin (novel antibacterial lipopeptide).

Newman (2008)\(^\text{18}\) estimates that about 60% of the drugs that are now available-including household names such as artemisinin, camptothecin, lovastatin, maytansine, paclitaxel, penicillin, reserpine and silibinin-were either directly or indirectly derived from natural products. Subsequently, a large number of well-known natural compounds were identified, analysed and synthesized: emetine from *Cephaelis ipecacuanha* (ipecacuanha), strychnine and brucine from *Strychnos nux-vomica* (strychnos), quinine from *Cinchona ledgeriana* (cinchona bark), colchicine from *Colchicum autumnale* (colchicum), caffeine from *Coffea arabica*, nicotine from *Nicotiana tabacum*, atropine from *Atropa belladonna* and cocaine from *Erythroxylum coca*. Many of these compounds are still widely used as drugs.

Recently, Butler et al. (2015)\(^\text{19}\) have reported that a total of 25 natural product (NP) based drugs were approved for marketing worldwide during 2008 to
2013, among which 5 are classified as NP, 10 as semi-synthetic NPs, and 10 as NP derived drugs. At present, around 10 compounds (purely plant derived) are in clinical phase III or in registration phase. Some of plant derived drugs are mentioned in Table 1.

### Table 1. Natural product derived drugs launched since 2008

<table>
<thead>
<tr>
<th>Year</th>
<th>Generic name (trade name)/Company name</th>
<th>Lead compound</th>
<th>Type</th>
<th>Disease area</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Methylnaltrexone 8 (Relistor®)/Wyeth and Progenics, Canada</td>
<td>Morphine</td>
<td>NPD</td>
<td>Opioid-induced constipation</td>
</tr>
<tr>
<td>2009</td>
<td>Vinflunine 15 (Javlor®)/Pierre Fabre M’edicament</td>
<td>Vinorelbine (vinblastine)</td>
<td>SSNP</td>
<td>Cancer</td>
</tr>
<tr>
<td>2009</td>
<td>Nalfurafne (Remitch®)/Toray International, Japan</td>
<td>Morphine</td>
<td>SSNP</td>
<td>Pruritus</td>
</tr>
<tr>
<td>2010</td>
<td>Cabazitaxel (Jevtana®)/Sanofi Aventis</td>
<td>Paclitaxel</td>
<td>SSNP</td>
<td>Cancer</td>
</tr>
<tr>
<td>2010</td>
<td>Zucapsaicin (Zuacta®)/Winston Pharmaceuticals, Canada</td>
<td>Capsaicin</td>
<td>NPD</td>
<td>Pain</td>
</tr>
<tr>
<td>2012</td>
<td>Ingenol mebutate (Picato®)/Leo Pharma</td>
<td>Ingenol mebutate</td>
<td>NP</td>
<td>actinic keratosis</td>
</tr>
<tr>
<td>2012</td>
<td>Dapagliflozin (Forxiga®)/AstraZeneca and Bristol Myers Squibb</td>
<td>Phlorizin</td>
<td>NPD</td>
<td>Type 2 diabetes</td>
</tr>
<tr>
<td>2012</td>
<td>Arterolane /piperaquine (Synriam™)/Ranbaxy, INDIA</td>
<td>Artemisinin</td>
<td>NPD</td>
<td>Antiparasitic</td>
</tr>
<tr>
<td>2013</td>
<td>Canagliflozin (Invokana®)/Mitsubishi Tanabe Pharma/</td>
<td>Phlorizin</td>
<td>NPD</td>
<td>Type 2 diabetes</td>
</tr>
</tbody>
</table>

NP-Natural Product, SSNP-Semi synthetic natural products, NPD-natural product derived

Approximately two-third of new drugs in the past 25 years has originated from the discovery of particular secondary metabolites derived from natural biodiversity. Natural products, besides being source of leads for a number of drugs,
also play an important role in the industrial drug synthesis. This is because of the presence of a wide chemical diversity in natural products which enables them to act as starting material for several stereo specific reactions. The latest example of this type is of Oseltamivir (Tamiflu) which is the only drug available for the treatment of Swine flu caused by H1N1 virus. For the synthesis of this drug, shikimic acid (obtained from Chinese star anise) is used as a precursor. A recent study reveals that this compound is present in high yields in Indian plants such as *Calophyllum apetalum* (4.10 %) and *Araucaria excelsa* (5.02 %) which can be used as an alternative source of shikimic acid.

Natural products discovered from medicinal plants (and derivatives thereof) have provided numerous clinically useful medicines. Even with all the challenges facing drug discovery from medicinal plants, natural products derived from medicinal plants will remain an essential component in the search for new lead compounds/ medicines.

1.2 **Role of World Health Organization (WHO) in Phytomedicine**

The vast majority of people on this planet still rely on their traditional *Materia Medica* (medicinal plants and other materials) for their everyday health care needs. It is also a fact that one quarter of all medical prescriptions are formulations based on substances derived from plants or plant-derived synthetic analogs, and according to the World Health Organization (WHO), 80 % of the world’s population primarily those of developing countries rely on plant-derived medicines for their primary healthcare needs. WHO states that this “traditional medicine” implies the knowledge and practices of herbal healing for the prevention, diagnosis, and elimination of physical, mental, or social imbalance. About 25% of the drugs prescribed worldwide come from plants, 121 such active compounds being in current use. Of the 252 drugs considered as basic and essential by WHO, 11% are exclusively of plant origin and a significant number are synthetic drugs obtained from natural precursors. Some of important drugs obtained from plants are digoxin from *Digitalis* sp., quinine and quinidine from *Cinchona* sp. vincristine and vinblastine from *Catharanthus roseus*, atropine from *Atropa belladonna* and morphine and codeine from *Papaver somniferum*.

Traditional medicine practitioners/ tribal healers in most of the countries,
where traditional medicine is frequently used to treat cut swelling, aging, mental illness, cancer, asthma, diabetes, jaundice, scabies, eczema, skin infection, venereal diseases, snakebite, wounds and gastric ulcer, provide instructions to local people as how to prepare medicines from plants. They preserve no records and the information about herbal medicines is mainly passed verbally from one generation to next generation\textsuperscript{23-24}.

World Health Organization has shown great interest in documenting the use of medicinal plants used by tribals in different parts of the world\textsuperscript{25}. Many developing countries have intensified their efforts in documenting the ethnomedical data on medicinal plants. Research to find out scientific evidence for claims by tribal healers on Indian herbs has been intensified. Once these local ethnomedical preparations are scientifically evaluated and disseminated properly, people will be informed in better way regarding efficacious drug treatment and improved health status\textsuperscript{26}. In 1991, WHO developed the guidelines for the assessment of herbal medicine, which were approved in the 6\textsuperscript{th} International conference of drug regulatory authorities held at Ottawa\textsuperscript{27}. The salient features of WHO guidelines are:

1) Quality assessment: Crude plant materials or extract plant preparation and finished product

2) Stability: Shelf life.

3) Safety assessment: Documentation of safety based on experience and toxicological studies.

4) Assessment of efficacy: Documented evidence of traditional use and activity determination in animals and human.

In 2006, WHO created the International Regulatory Cooperation for Herbal Medicines (IRCH) with the objective to protect and promote public health and safety through improved regulation of herbal medicines\textsuperscript{28}.

1.3 \textit{Role of medicinal plants in economy}

As per WHO estimate, traditional, complementary, alternative, or non-conventional medicines are used by 70-95\% of global population particularly in developing countries for their health-care\textsuperscript{28}. The global market for traditional
Introduction

Chemical and Biological Screening of Selected Medicinal Plants

medicines was estimated at US $ 83 billion annually in 2008. Annual revenues in Western Europe reached US$ 5 billion in 2003-2004. In China sales of products was totaled US$ 14 billion in 2005. Herbal medicine revenue in Brazil was US$ 160 million in 2007. The estimation of total phytomedicine sale reported in country wise European Union was about US$ 6 billion in 1991 and $ 4 billion in 1996, of which almost half were sold in Germany $ 3 billion, in France $ 1.6 billion, in Italy $ 0.6 billion and in Japan $ 1.5 billion. The present global market is said to be US 250 billion. In India, the sale of total herbal products is estimated at $ 1 billion and the export of herbal crude extract is about $ 80 million, of which 50% is contributed by Ayurvedic classical preparations.

Herbal treatments are the most popular form of traditional medicine, and are highly lucrative in the global marketplace. Indeed, it has been estimated that as much as 37% of all pharmaceutical sales are for compounds that are derived, either wholly or in part, from natural products. The demand for medicinal plant-based raw materials is growing at the rate of 15 to 25% annually, and according to an estimate of WHO, the demand for medicinal plants is likely to increase more than US $5 trillion in 2050. In India, the medicinal plant related trade is estimated to be approximately US $1 billion per year.

De Luca et al. (2012) have reported that most important commercially relevant pharmaceuticals to be derived from plants are valued at over US $25 billion per year. Plant drugs of most economic value include codeine and morphine (Papaver somniferum); capsaicin (Capsicum annum); emetine (Psychotria ipecacuanha); atropine, hyoscyamine, and scopolamine (Atropa belladonna, Datura stramonium, and Hysocyamus niger); reserpine and yohimbine (Rauwolfia serpentina); quinine, quinidine and quinoline (Cinchona ledgeriana); camptothecin (Camptotheca acuminata); vinblastine and vincristine (Catharanthus roseus); taxol (Taxus baccata); podophyllotoxin (Podophyllum peltatum); digoxin and digitoxin (Digitalis purpurea); galanthamine (Narcissus pseudonarcissus); physostigmin (Physostigma venenosum); pilocarpine (Pilocarpus jaborandi); diosgenin (Dioscorea mexicana); hecogenin (Agave sisalana); stigmasterol (Glycine max); sennenoside A and B (Senna alexandrina);
cocaine (*Erythroxylon coca*); tubocurarine (*Chondrodendron tomentosum*); and nicotine (*Nicotiana tabaccum*).

### 1.4 Current status

According to WHO, more than 80% of the world’s population, mostly in poor and less developed countries depends on traditional plant-based medicines for their primary healthcare needs. Lag phase for plant based medicine is now rapidly changing for a number of reasons. Problem with drug resistant microorganisms, side effects of modern drugs and emerging diseases for whose no medicines are available, have stimulated renewed interest in plants as a significant source of new medicines\(^3^4\). However, the last few years have seen a major increase in their use in the developed world because of better cultural acceptability, better compatibility with the human body and lesser side effects\(^3^5\). Currently, approximately 25% of drugs are derived from plants, and many others are synthetic analogues built on prototype compounds isolated from plant species in modern pharmacopoeia\(^3^6\).

Plants are important sources of medicines and presently about 25% of pharmaceutical prescriptions in the United States contain at least one plant-derived ingredient. In the last century, roughly 121 pharmaceutical products were formulated based on the traditional knowledge obtained from various sources. Today, natural products and their derivatives represent about 50% of all drugs in clinical use, with higher plant-derived natural products representing commonly approximately 25% of the total\(^3^0\).

Plants have always been an exemplary source of drugs and many of the currently available drugs have been derived directly or indirectly from them. Since time immemorial, various plants and plant derived compounds have been used in regulating fertility in females in different ethnic societies. Kumar et al. (2012)\(^3^7\) in their ethnobotanical reports provide information about 577 plants which may have a role in fertility regulation in females. Several such plants have shown antifertility activity when assessed using presently available experimental techniques\(^3^7\), however, the search for novel antifertility drugs still continues.
1.5 Need of fertility regulation

World population, especially of developing country like India, has reached to an alarming rate and is the root cause of poverty, decline in sources like food, shelter and raw material supply and decrease in mortality leads to increase in life expectancy. Over population is one of the serious problems in the developing countries and is expected to be increased about 9.2 billion by the year 2050\textsuperscript{38}. Consequently, intensive efforts have been made to control the birth rate by various means. In the area of female fertility regulation, the development of orally active anti-fertility agents has been the main area of focused research for the last six decades. WHO advocated the legitimization of traditional practices in maternal and child health, including herbal contraceptive use\textsuperscript{39} and set up a task force on plant research for fertility regulation with an objective to find new orally active non-steroidal compounds having anti-implantation property\textsuperscript{40}. Initially, the major research efforts were focused towards the discovery of oral contraceptives of synthetic origin and very little attention was paid to the plant kingdom, although the chemical nature of the compounds derived from plants are so diverse that they encompass the prototypes of practically every pharmacological category.

In the modern system of medicine, about 25\% of prescriptions contain active principle(s) derived from plants. Plant kingdom, therefore, holds a great promise for the discovery of new and effective anti-fertility agents. The synthetic agents available today for fertility control produce severe side effects like hormonal imbalance, hypertension, increased risk of cancer and weight gain\textsuperscript{41}. Therefore, there is an urgent need to replace these synthetic agents by safe and effective alternative such as plant-based antifertility agents having lesser side effects.

1.6 Female reproductive cycle

Various parts of human female reproductive systems are shown in the figure 1.

The human female produces gametes in monthly cycle (Average 28 days; Normal range 24-35 days). This cycles is commonly called menstrual cycle because
it is marked by a 3-7 day period of bloody discharge known as menses or menstruation.  

**Figure 1. Female Reproductive system**

**Menstrual Phase:** The female reproductive cycle is a monthly cycle that begins with menstruation (shedding of the endometrium, or uterine lining) and ending with either pregnancy or the beginning of another menstruation. Different events occurring in the menstrual cycle of human being are mentioned in figure 2.

**Proliferative Phase:** Following the menstual phase when hormone levels
drop off and the uterine lining is shed, the proliferative phase begins, and estrogens produced by the ovary begin to act on the female reproductive tissues. The endometrium thickens in preparation for implantation of a fertilized egg. Meanwhile, in the ovary, the cycle of ovulation is preparing for release of a mature oocyte, or egg. Developing from primary follicle, then a secondary follicle, and finally a mature follicle, the mature egg awaits hormonal signals that cause its release from the ovary. The increase in levels of estrogens produced by the ovary causes the hypothalamus to secrete a hormone GnRH which in turn causes the anterior pituitary gland to secrete large amounts of the hormones FSH (Follicle Stimulating Hormone) and LH (Luteinizing Hormone).

- **Ovulation**: The LH surge causes the egg to be released from the mature follicle and the ovary itself. It is released into the body cavity where it is (almost always) caught by the fimbriae (finger-like projections) of the fallopian tube where it travels toward the uterus, awaiting fertilization by a sperm.

- **Secretory Phase**: Once the egg is released from the ovary, the mature follicle from which it erupted becomes the corpus luteum, which still secretes small amounts of estrogen. But the secretory phase is dominated by the hormone progesterone, which is produced by the cells of the ovary. The secretion of progesterone causes the endometrium to thicken and prepare for implantation of an embryo.

- **Fertilization and Implantation**: If the egg is not fertilized by a sperm, the corpus luteum regresses, levels of estrogens and progesterones drop off, and the menstrual phase begins the reproductive cycle again. However, if the egg is fertilized by a sperm while traveling down the fallopian tubes and the embryo implants into the wall of the uterus, the future placental tissues secrete chorionic gonadotropin which maintains the corpus luteum. The corpus luteum is responsible for producing the estrogens and progesterone required to maintain the pregnancy for the first few months of the pregnancy. After that point, the placenta itself produces enough estrogen and progesterone to maintain the pregnancy on its own. \(^{43}\)
Hormonal regulation of the female reproductive cycle

- **Estrogen:** Estrogen is secreted by the cells of graffian follicle under the influence of follicle stimulating hormone (FSH), luteinizing hormone (LH) and Gonadotrophine-releasing hormone (GnRH). It is secreted in the form of estradiols which is the most potent endogenous estrogen. Estrogen act on reproductive organs, breast and CNS. They are responsible for the growth and development of female genital organs like ovaries, oviduct, uterus and influences the reproductive cycle in females, stimulate the proliferation of breast cells and promote the growth of hormone dependent mammary glands. Another important role of estrogen is to promote the development of secondary sexual characteristics in the female. The feminizing characteristics include growth of hair, softening of skin, growth of breast and accretion of fat in the thighs, hips and buttocks.

- **Progesterone:** Once ovulation takes place, the tissue remaining from the ruptured graffian follicle forms the corpus luteum which is the main source of progesterone. It has the primary site of the physiological action of progesterone is the uterus. The hormone acts on both endometrium (inner mucous lining) and the myometrium (muscle mass) of the uterus. It induces the secretary phase during which the endometrial glands grow, secrete large amounts of carbohydrates that will possibly be used by the fertilized ovum as a source of energy. The primary function of progesterone with respect to the myometrium is to stop the spontaneous rhythmic contractions of the uterus. The effects of progesterone on the uterus are to prepare the endometrium for reception, implantation and maintenance of the fertilized ovum and to suppress the myometrial contractions so that the embryo is not dislodged from the uterus, thus it helps in the maintenance of the pregnancy, hence, it is known as hormone of pregnancy.

- Hormonal regulation of the female reproductive cycle is shown in figure 3. The main hormone which controls the ovarian and uterine cycle is Gonadotrophine-releasing hormone (GnRH). GnRH in turns stimulates the release of FSH and LH from anterior pituitary. FSH initiates the follicular growth while LH further develops then ovarian follicles and secretes
estrogens. LH stimulates the theca cells of developing follicle to produce androgens. At the middle of cycle, LH triggers ovulation and the Graffine follicle (GF) is shown developing on the left, then involuting to form corpus luteum has been released, LH, FSH, GnRH hormones leads to formation of corpus luteum. LH stimulates the corpus luteum to produce and secrets estrogen, progesterone, relaxin, and inhibin. Higher level of estrogen during last part of pre-ovulation phase exerts positive feedback effect on the cells which secrete LH and GnRH and cause ovulation.

Figure 3. Hormonal inter-relationship in the control of female reproductive system.

- If the oocyte does not get fertilized, corpus luteum has life span of 2 weeks, then its secretary activity declines and degenerates into corpus ablican. Decline level
of progesterone, estrogen leads to rise in the GnRH, LH and FSH levels due to negative feedback suppression by ovarian hormones.\textsuperscript{44}

1.7 *Antifertility agents*

These are the substances which prevent the fertility by interfering with various normal reproductive mechanisms, both in males and females. These active principles may be used as food or medicines and even for purposes of contraception. Antifertility agents may exert their actions in a number of areas (hypothalamus, anterior pituitary, oviduct, uterus and vagina), inhibiting synthesis and/or liberation of hormones (follicle-stimulating, luteinizing, and steroid hormones), ovulation, ovum transportation and implantation process.\textsuperscript{45}

Antifertility agents\textsuperscript{46-47} include:

- **Abortifacient**: It is a drug or compound that causes expulsion of an embryo or foetus prematurely, at any time before it is viable or capable of sustaining life.

- **Antiovulatory agents**: These are the agents which prevent or suppress ovulation.

- **Emenogogue**: It is an agent which is taken internally to promote menstrual flow and in sufficient quantities to induce abortion.

- **Contraceptive agents**: are the agents used for reversible suppression of fertility.

*Mode of action of anti-fertility agents*

Antifertility agents may act by following mechanisms:

- **Inhibition of ovulation**: Ovulation can be inhibited by the inhibition of release of hormones like GnRH, FSH and LH from the ovary.

- **Prevention of fertilization**: It involves the inhibition of maturation of ovum.

- **Interference with the implantation of fertilized ovum**: Interference with the transportation of fertilized ovum.

- **Destruction of early implanted embryo**: Failure of the maturation of early implanted embryo.
Contraceptive methods:

During last few years, most of the synthetic contraceptives methods popular among the people involve the barrier methods like condoms, vaginal sponge, contraceptive foams, creams, jellies, film and suppositories, implants, emergency contraceptives (Birth control pills), Intra uterine devices etc. Now days, hormonal contraceptives are widely used with 100% confidence and complete return of fertility on discontinuation. In order to avoid pregnancy, there are various methods which are popular all over the world. These methods are divided into following two categories:

- **Hormonal methods:**
  a) Oral contraceptives (The Pill)
  b) Nuvaring (Vaginal ring)
  c) Ortho Evra (Patch)
  d) Depo-provera (Injectable)
  e) Interauterine device (Mirena, Progestine)
  f) Implants

- **Non-Hormonal methods:**
  a) Male/ female condom
  b) Vaginal spermicide
  c) Diaphragm
  d) Contraceptive sponge
  e) Cervical cap
  f) Intrauterine device (Paragard)
  g) Fertility awareness

A list of certain synthetic anti-fertility drugs available in market is mentioned in table 2.
### Table 2. Currently available synthetic anti-fertility drugs

<table>
<thead>
<tr>
<th>Trade name(s)</th>
<th>Ingredient(s)</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arpan</td>
<td>Norgestrel + Ethinyl estradiol</td>
<td>Hindustan Lever Ltd.</td>
</tr>
<tr>
<td>Dianette</td>
<td>Cyproterone acetate + Ethinyl estradiol</td>
<td>Bayer schering Pharma</td>
</tr>
<tr>
<td>Heather®</td>
<td>Norethindrone</td>
<td>Glenmark</td>
</tr>
<tr>
<td>i-Pill</td>
<td>Levonorgestrel</td>
<td>Cipla</td>
</tr>
<tr>
<td>Lo/ovral-28</td>
<td>Norgestrel + Ethinyl estradiol</td>
<td>Pfizer</td>
</tr>
<tr>
<td>Lybrel</td>
<td>Ethinylestradiol + Levonorgestrel</td>
<td>Pfizer</td>
</tr>
<tr>
<td>Ortho-cyclen®</td>
<td>Norgestimate + Ethinyl estradiol</td>
<td>Barr.laboratories</td>
</tr>
<tr>
<td>Saheli, Sevista, Centrone</td>
<td>Ormeloxifene (centchroman)</td>
<td>Hindustan Lever Ltd.</td>
</tr>
<tr>
<td>T-Pill 72</td>
<td>Levonorgestrel</td>
<td>Bestochem</td>
</tr>
<tr>
<td>Unwanted 72</td>
<td>Levonogesterel</td>
<td>Mankind</td>
</tr>
<tr>
<td>Yasmin</td>
<td>Ethinyl estradiol + Drospirenone</td>
<td>Bayer Schering Pharma</td>
</tr>
</tbody>
</table>

1.8 *Need to explore traditional plants*

The rapid increase in the world population suggests the need for development of new contraceptive methods. Ideally, new antifertility agents should have minimal side effects and should be easily reversible, affordable, accessible, and acceptable—especially to women in developing countries.

Now days, hormonal contraceptives are widely used with 100% confidence and complete return of fertility on discontinuation, but they also show severe side effects like increased blood clot risk, fatal embolism, breast cancer, HIV transmission risk, stroke risk, endometrial and ovarian cancer. This deficiency gives challenging encouragement to pharmaceutical and modern science for the
development of more potent drugs with little toxic effects, self-administrable, less expensive and completely reversible. Hence, there is a scope in herbal medicine to explore new antifertility agent which can be used as safe alternate for regulating the fertility in women in developing countries.

In recent years, several researchers/scientists evaluated and identified the antifertility potential of traditionally used medicinal plants using experimental animals. Although a large number of medicinal plants have been tested for their antifertility effects, these effects remain to be investigated in several other unexplored medicinal plants for the want of newer drugs.
1.9 References


50. Commercial contraceptive pills (http://rxlist.com)