



**A SYSTEMIC REVIEW: USEFULNESS OF SOME MEDICINAL PLANTS FOR THE
TREATMENT OF THYROID DISORDER**

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Article Received on 24/03/2020

Article Revised on 14/04/2020

Article Accepted on 04/05/2020

ABSTRACT

Endocrine disorders are common in India of which the thyroid disorders represent a major subset. Thyroid dysfunction prevalence is rising at an alarming rate in Indian population. Hypothyroidism and hyperthyroidism constitute the maximum percentage of thyroid diseases in India. The thyroid is a very important part of the human system, which are responsible for regulation of oxygen use, basal rate, cellular metabolism, growth and development. The variations within the levels of T3 and T4 hormones result in disturbed BMR and presents with signs and symptoms which are systemic in nature. Herbal drugs have proven to be useful in number of diseases. Conventional drugs available for thyroid disorders cure symptomatically. Herbal drugs have the capacity to cure such metabolic disorders synergistically at different steps. The objective of this review lies in summarizing different herbal drugs that can be used for treating thyroid and related disorders effectively.

KEYWORDS: Hypothyroidism, hyperthyroidism, herbal drugs, thyroid, synergistically, disorder.

INTRODUCTION

The thyroid is a very important part of the human system, which are responsible for regulation of oxygen use, basal rate, cellular metabolism and growth and development.^[1] The endocrine secretes thyroxine (T4) and triiodothyronine (T3), which are required for correct growth and development and which are primarily responsible for determining the basal rate. The thyroid hormones are transported through the blood and act at the cellular level. Through the activation of genes, thyroid hormones stimulate protein synthesis, promote maturation of systema nervosum, and increase the speed of cell respiration in tissues, thus elevating the BMR.^[2] The variations within the levels of those hormones result in disturbed BMR and presents with signs and symptoms which are systemic in nature. Globally, thyroid disease is one of the common endocrine disorders. According to a recent projection from various studies, it has been estimated that about 42 million peoples in India suffered from thyroid diseases. About 1 to 2% of the adult population is known to suffer from thyroid disorders.^[3] The need to combat this dysfunction has risen in recent years due to its increasing prevalence. Hormone replacement has been the choice of therapy. However, alternative medicinal approaches are gaining popularity in view of their efficacy with minimal side effects. This review throws light on various drugs of plant origin which have proven action on thyroid and its functioning and also on the various factors associated with thyroid dysfunction.^[4]

Hypothyroidism refers to any state that results in a deficiency of thyroid hormone, including hypothalamic or pituitary disease and generalized tissue resistance to thyroid hormone and disorders that affect the thyroid gland directly.^[5] The global incidence of hypothyroidism is increasing as the thyroid gland and easily responds to stimuli like stress and anxiety. Recent statistical study reveals that the iodine deficiency is the most common cause of hypothyroidism. According to World Health Organization, 2 billion people are iodine deficient worldwide.^[6] The relative iodine deficiency causes Goiter and severe deficiency causes hypothyroidism and cretinism. On the other hand over supply of iodine results in autoimmune thyroid disease. Hypothyroidism (congenital) occurs 1 in 4000 newborns worldwide whereas in India it is 1 in 2640 newborns. Females are more affected than males (6:1 ratio). Whites and Asians are more affected population. 80% of all Thyroid disease is diagnosed as hypothyroidism.

Hyperthyroidism is caused as a result of excessive thyroid function often hyperthyroidism is considered synonymous with thyrotoxicosis (a state of thyroid hormone excess). However, thyrotoxicosis is usually secondary to grave's disease, toxic multi nodular goiter and toxic adenomas. Hyperthyroidism presents with exophthalmos, increased BMR, hyperactivity, dysphoria, irritability, muscular weakness, nervousness, palpitation, fatigue, weight loss with increased appetite, diarrhea, polyuria, warm moist skin and Tremor.^[7]

Anatomy of Thyroid Gland

Thyroid gland is an endocrine gland situated in the lower part of the front and sides of the neck. It lies anterior to trachea between the cricoids cartilage and suprasternalnotch. It consists of two lobes connected by isthmus weighs 12-20gm (5cm x 2.5cm x 2.5cm). It is a highly vascular deep neck structure which is soft in consistency and lies against C5, C6, C7 and T1. The arterial supply is from superior and inferior thyroid arteries which are in turn supplied by external carotid and subclavian arteries respectively. The venous drainage is in to superior, middle and inferior thyroid veins which drain in to internal jugular vein and Brachiocephalic vein. Lymph drains in to deep cervical lymph nodes. Nerve supply is from middle, superior and inferior cervical ganglion. Along with thyroid gland there are 4 parathyroid glands which are located at the four posterior poles of thyroid gland. Thyroid gland is larger in females and increases in size during pregnancy and menstruation.^[8]

Histology of Thyroid Gland

Thyroid gland consists of numerous spherical follicles composed of thyroid follicular cell. Colloid a proteinaceous fluid containing large amounts of thyroglobulin which is the protein precursor of thyroid hormones. The follicular cells secrete triiodothyronin T3 and tetraiodothyronin (Thyroxine) T4. In between follicular cells, the para follicular cells are present, which secrete calcitonin. T3 and T4 are iodine containing derivatives of amino acid tyrosine.^[9]

Synthesis of Thyroid Hormones^[10]

It consists of mainly 5 steps viz.

1. Iodide uptake
2. Oxidation of Iodide and Iodination of Tyrosine
3. Coupling
4. Storage and release
5. Peripheral conversion of T4 to T3

Transport of Thyroid Hormones in Blood^[11]

The 80 % of thyroid hormones are transported by thyroxine binding globulin and 10% by albumin and transthyretin (Thyroxine binding prealbumin) respectively. Any defect in the stages of synthesis or transport of thyroid hormones will eventually result in hypothyroidism.

Functions of Thyroid Hormones^[12]

- Growth and development- for normal axonal and dendrite development myelination and linear growth with maturation of growing epiphysis end plates.
- Energy Metabolism- stimulates BMR, oxygen consumption and heat production.
- Nervous system-It regulates nervous system activity by exerting effect on adrenergic receptors.
- Heart- T3 maintains normal myocardial contractility.
- Muscle- normal skeletal muscle function is regulated.

- Respiratory system- Lung volume and breathing capacity is maintained
- Skin-Normal coetaneous circulation and secretion of glands.
- Colon- helps in controlling normal bowel movements.
- Vitamins- increases utilization and clearance of vitamins.
- Carbohydrate metabolism –stimulates absorption of glucose from intestine.
- Protein metabolism- increases the synthesis of proteins in the cells.
- Fat metabolism- decreases fat storage by mobilizing it and converting in to free fatty acid.
- Action on sleep – Hypo secretion of hormone causes excess sleep and hyper secretion causes sleeplessness.
- Action on sexual function – helps abnormal sexual development and reproductive function.

HPT Axis

Hypothalamo-Pituitary- Thyroid axis regulates the secretion of Thyroid hormones by the negative feedback mechanism. Hypothalamus secretes thyrotropin releasing hormone (TRH) which stimulates anterior pituitary which in response secretes Thyroid Stimulating hormone (TSH). TSH stimulates Thyroid gland to secrete Thyroid hormones T3 and T4. When the level of T3 and T4 exceeds the normal limit, it sends negative feedback to anterior pituitary which in turn reduces the secretion of TSH.^[12]

Epidemiology

Thyroid disorders commonly occur in female as compared with male, a common prevalence ratio of thyroid diseases is 4:1. On data of community based studies the prevalence of hyperthyroidism in female is 2% and in male 0.2%, and about 15% of patient of hyperthyroidism occurring in old age patient above 60 year of age.^[13] The prevalence of hypothyroidism in the developed world is about 4-5%^[14-15] and that of subclinical hypothyroidism is about 4-15%.^[16] India has a high prevalence of hypothyroidism, which is about 10%. It is much more common in females than males.^[17] The condition most commonly afflicts middle aged women who perhaps attribute their symptoms wrongly to ageing or menopause. Also, one out of every 5000 infants is born without a working thyroid gland. It is more common than anyone would believe and millions of people are currently hypothyroid and do not know it.^[18]

Normal Range for Thyroid Hormones (According to the AMA)

- TSH (0.45 – 4.5 uIU/ml) (0.5-6 mIU/L)
- Free T4 (Direct) (0.82-1.77 ng/dl)
- T4 – Thyroxin (5-12.5 ug/dl)
- Free T3 –Triiodothyronine (2.0-4.4 pg/ml)
- T3 –Triiodothyronine (120-195 mg/dl)

- TPO – Thyroid peroxidase AB (0-34 IU/ml)
- TGAB - Antithyroglobulin AB (0-40 IU/ml)

Hypothyroidism

The causes of hypothyroidism include:

- Thyroid gland failure
- A deficiency of TRH, TSH or both
- Inadequate supply of dietary iodine

Primary hypothyroidism occurs when thyroid hormone levels are lowered and TSH is elevated in the blood; it usually indicates defective thyroid synthesis. Secondary hypothyroidism occurs when both TSH levels and thyroid hormone levels are low. This indicates that the pituitary gland is responsible for low thyroid function.

Hashimoto's disease is an autoimmune condition in which antibodies bind to the thyroid and prevent the manufacture of sufficient levels of thyroid hormone. In addition to binding with thyroid tissue, the antibodies may bind to the adrenal glands, the pancreas, and the acid-producing cells of the stomach.

Cretinism results from hypothyroid function from birth. Low thyroid hormone levels can cause dwarfism, mental retardation and thyroid deficiency symptoms. Conventional western medical treatment employs exogenous thyroid hormone.^[19]

Hyperthyroidism

Hyperthyroidism means elevation of thyroid function. Hyperthyroidism refers that hyper metabolic situation due to excessive level of thyroid hormone secretion and synthesis. The most common name of hyperthyroidism is "Graves's disease". Graves's disease is autoimmune disorder. The main cause of hyperthyroidism is: Increase or elevated level of thyroid hormones by synthesis and secretion.^[20-21]

Key Symptoms of Hypothyroidism (An under active thyroid)

Fatigue; exhaustion feeling run down and sluggish depression, moodiness difficulty concentrating; brain fog; unexplained or excessive weight gain; dry, coarse and/or itchy skin; dry, coarse and/or thinning hair; feeling cold, especially in the extremities; constipation; muscle cramps; increased menstrual flow; more frequent periods; infertility/miscarriage; low blood pressure; frequent infections; bloating/puffiness in hands, feet, eye area, face etc.

Key Symptoms of Hyperthyroidism (An over active thyroid)

Nervousness; irritability; increased perspiration; thinning of your skin; fine brittle hair; muscular weakness especially involving the upper arms and thighs; shaky hands; panic disorder; insomnia; racing heart; more frequent bowel movements; weight loss despite a good appetite; lighter flow, less frequent menstrual periods etc.^[22]

Treatment Goals for Hypothyroidism and Hyperthyroidism Diseases

Some plants isoflavonoids have profound effects on thyroid hormones and on the hypothalamus–pituitary axis. Genistein and daidzein from soy (*Glycine max*) inhibit thyroperoxidase that catalyses iodination and thyroid hormone biosynthesis. Other plants with hypothyroid effects include pearl millet (*Pennisetum glaucum*) and fonio millet (*Digitaria exilis*); thiocyanate is found in *Brassicae* plants including cabbage, cauliflower, kale, rutabaga and kohlrabi, as well as in tropical plants such as cassava, lima beans, linseed, bamboo shoots and sweet potatoes. Tobacco smoke is also a source of thiocyanate.^[23] The antithyroid and goitrogenic effects of *Brassicae* plants (*Cruciferae*) have long been known including cabbage (*Brassica oleracea*), broccoli, cauliflower, kale, kohlrabi, Brussels sprouts and rutabaga (Swede or yellow)turnip, *Brassica napobrassica*, rapeseed and mustard. SCN interferes with active uptake and concentration of inorganic iodide by the thyroid and inhibits the enzyme thyroperoxidase thereby preventing the incorporation of iodine into thyroglobulin. Rutabaga and turnips contain a thiourea like product (progoitrin), a precursor of goiter in that also interferes with thyroperoxidase.^[24] A number of staple foods in the tropics contain large amounts of cyanogenic glycosides that are detoxified as SCN. These plants include cassava (*Manihot esculenta Crantz*), millet, yam, sweet potato, corn, bamboo shoots and lima beans (*Phaseolus vulgaris*). Tobacco smoke (*Nicotianata bacum*) also contains considerable amounts of cyanide (150–300µg per cigarette) in addition to other goitrogenic products such as resorcinol derivatives, flavonoids and hydroxyl pyridines.^[25] Natural flavonoids are usually conjugated to sugars or carbohydrates (glycosides) and polymerized to other flavonoids and non-flavonoids (acyl derivatives); non conjugated forms are called aglycones. Flavonoid aglycones resulting from intestinal digestion are rapidly and readily absorbed^[26] increasing the likelihood of development of antithyroid effects and goiter in infants receiving soy based formulas as milk substitute.^[27-33] It has been postulated that the fermentation of soybeans commonly used in China and the Orient could decrease some of its antithyroid effects.^[33] However, kojic acid, a fungal metabolite produced by *Aspergillus flavus*, used traditionally in the production of miso (soybean paste), shoyu (soy sauce) and sake also has antithyroid effects including iodine uptake inhibition, decrease in T3 and T4, increase in TSH and induction of goitre.^[34] Deiodinase-I is also affected by other plant flavonoids^[35] including catechin from tea (*Camellia sinensis*), quercetin (found in apples, onions, red grapes, citrus fruits, broccoli, cherries, berries and prickly-pear cactus), kaempferol (from Delphinium, Witch-hazel and grapefruit), rutin (found in buckwheat) and baicalein, isolated from the roots of baikal or Chinese skullcap (*Scutellaria baicalensis Georgi*). In the presence of iodine deficiency, some anthocyanins, catechins and tannins from nuts exhibit goitrogenic effects.^[36] These include peanuts

(*Arachishypogea*), cashew nuts (*Anacardium occidentale*), almonds (*Prunus amygdalus*), and the areca nut (*Areca catechin*). Other plants with hypothyroid effects include millets such as pearl millet (*Pennisetum glaucum*) and fonio millet (*Digitaria exilis*).^[37] N-propyl disulphide, the major volatile constituent of common onion (*Allium cepa*), inhibited thyroid activity in the rat.^[38] The possible antithyroid activity of four other volatile compounds of *Allium*: methyl disulphide, allyl disulphide, allyl alcohol and allyl monosulphide, these 4 compounds constitute the major volatile constituents of common onion; however they are also present in other *Allium* species. It is evident that, at the higher levels used, allyl alcohol and methyl disulphide inhibited thyroid function significantly, and as is shown by the low values for uptake of iodine-131 in the treated animals; however, allyl monosulphide showed no antithyroid activity even at the highest level used.^[38] Klein and Farkass have detected thiourea by microchemical methods in *Laburnum anagyroides*. In 1938 Hopkins obtained 5, 5-dimethyl-2-thioxazolidone from seeds of the crucifer *Conringia orientalis*; this compound was approximately one-fifth as active as thiouracil in the rat. On the other hand, the alleged existence of benzyl thiourea in seeds of *Carica papaya* is questionable.^[39]

HYPERTHYROIDISM ACTING DRUGS

Bugleweed (*Lycopus virginicus*): Bugleweed is used as thyro suppressive agents that suppress the thyroid function are the one which are most effective herbs for thyroid disease. The herbs are belonging to family of *lamiaceae*. It contains hydro cinnamic acid derived such as lithospermic acid, rosmarinic acid, chlorogenic acid and caffeic. Bugleweed and its extract have many beneficial effects such as it have ability to inhibit the binding of stimulating antibodies for Grave's diseases to the thyroid diseases, blockage production of thyroid stimulating hormones (TSH), decrease deionization of peripheral T4 and also inhibit metabolism of iodine.^[40-44]

Lemon balm (*Melissa officinalis*): Lemon balm is the herb used as thyro suppressive agent in treatment of hyperthyroidism. It is effective in blockage of TSH binding to the receptor by act on the hormones and receptor itself. It also act on inhibiting the cyclic AMP production to stimulating by TSH receptor as antibodies. It contains large amount of rosmarinic acid. Mostly rosmarinic acid affects IgG antibodies. They have ability to instead of creating a receptor response on thyroid gland, the response in immune system by reduce the loading of IgG, because of that IgG antibodies cannot be direct act on thyroid gland. Because of this result we conclude that lemon balm may also inhibit autoimmune activity in immune system. From traditionally, lemon balm is used to treatment of symptoms associated with hyperthyroidism such as insomnia, tachycardia and hyperactivity also.^[45]

Motherwort (*Leonurus cardiac*): In older studies, it studied that motherwort is herb which mostly used in the

combination with other herbs. Most commonly motherwort has an anti-inflammatory activity, because it contains quercetin, as flavonoids. For treatment of autoimmune diseases, it is important to reduce inflammation or swelling, because of that motherwort a good choice for treatment of hyperthyroidism. In this case, the enzyme 5 deiodanse is inhibit, when the addition to reducing inflammation. From traditionally motherwort uses include to treating symptoms of anxiety, palpitations and tachycardia.^[45,46-47]

Gromwell (*Lithospermum ruderale*): Gromwell has basically shown similar activity as bugleweeds. The gromwell herbs are belonging to family of *Boraginaceae*. It also contain rosmarinic acid The main function of herbs in hyperthyroidism is blocking the binding of TSH to thyroid follicles, it also inhibit transport of iodine to thyroid follicles, and as similar to bugleweeds it also decrease the peripheral deionization of T4 and also decrease the secretion of thyroid hormones.^[42,44,48]

Rose marry (*Rosmarinus officinalis*): Rose marry is a herbs which is a member of *Lamiaceae* plant. It contains a large amount of rosmarinic acid which is used in treatment of hyperthyroidism. Rosemary plant is similarly act as lemon balm, because in research it investigated that rosmarinic acid act on the effect of TSH on receptor site, also inhibit immunoglobulin effects on thyroid stimulating hormone (TSH) receptor, and it also decrease the peripheral conversion of T3. The rosmarinic acid may also beneficial in the treatment of Grave's diseases.^[45,49]

Sage (*Salvia officinalis*): Sage herbs are also belonging from the member of *lamiaceae* plants. It also contain rosmarinic acid. Both rosemary and sage contains rosmarinic acid in a high percent. Similar it act on act on the effect of TSH on receptor site, also inhibit immunoglobulin effects on thyroid stimulating hormone (TSH) receptor, and it also decrease the peripheral conversion of T3. Because of that Sage is also known as thyrosuppressive and sage herbs also have other activity such as antiviral, antioxidant, nervine and spasmolytic.^[40, 49,50-51]

Aloevera (*Aloe barbendesis*): *Aloevera*, reduce either one or both THs. Although *A. vera* extract decreases serum T3 and T4 concentrations, its inhibition rates for the two hormones are 25% and 13%, respectively, which indicates that the extract may not be adequately effective in reducing the concentration of THs. However, *A. vera* extract can be a better choice for mild hyperthyroidism cases because it does not produce a toxic effect on the liver.^[52]

Bale (*Aegle marmelos*): *Aegle marmelos* reduce either one or both THs. *Aegle marmelos* have a better potential to reduce T3 by 62%, which is comparable to the reduction by the standard drug propylthiouracil. *A.*

marmelos is relatively more effective than *A. vera* to reduce thyroid function and can therefore, be considered for the regulation of hyperthyroidism.^[52]

HYPOTHYROIDISM ACTING DRUGS

Gotu Kola (*Centella asiatica*): *Gotu Kola* leaf is commonly beneficial for treatment of hypothyroidism. It contains asiatic acid, asiaticoside, brahmoside, and brahmic acid also called as madecassic acid. More suggested that *gotu kola* has property to stimulate T4 synthesis. It also used as nervous system regulator to enhance the energy and vitality. Because of that it energizing effect of this herbs it enhance or stimulate the synthesis of T4. Mostly tincture of *gotu* leaf is used for treatment of hypothyroidism.^[45,48]

Coleus or forskohlii (*Plectranthus barbatus*): *Forskohlii* is a herbs mostly used for treatment of hypothyroidism, because it contain essential oils and terpens. Mostly commonly production and synthesis of thyroid hormones are enhanced by *forskohlii* or *coleus*. And it also activates Production of cyclic AMP. It also used with the combination of synthetic drugs to increase production of thyroid gland, if the patient has not been to use medication therapy for long period of time.^[40,45,53]

Bladder wrack (*Fucus vesiculosus*): Bladder wrack is a special type of algae, which one beneficial advantage is that this algae used in therapy of both antithyroid disorder both hypothyroidism and hyperthyroidism. Bladder wrack is obtained from algae not from any plant source, because of that it belonging from the family of *Fucaceae*. Traditionally use of bladder wrack involve in thyroid function in different conditions if whether is hyperactive, or normal and or is in underactive. Bladder wrack is category of seaweeds and all seaweeds contain variable amount of iodine. Dried bladder wrack contains approx. 50 mg of iodine. Iodine helps to stimulate thyroid gland. It contains substance that help to restore the normal function of thyroid gland and also reduce the size of goiter presence in thyroid. It is necessary to intake iodine in case of low iodine levels, because it cause side effect and cause hyperthyroidism. It contain s Iodine and L-fucose compound, it have anti-obesity, anti-inflammatory, antioxidant and anti carcinogenic properties.^[45,54]

Kanchanara (*Bauhinia Variegata*): *Kanchnara* is considered as a drug of choice for *Granthivikara* and *Galaganda*.^[18] It has a balancing activity on the thyroxin production, increasing any deficient production and decreasing any excess. It also clears swellings in the neck and goiter. It is a specific herb for swollen lymph nodes, cervical adenitis, *scrophularia* or swollen glands in general.^[55]

Ashwagandha (*Withania Somnifera*): *Ashwagandha* is an adaptogenic popular herb that has shown incredible results for lowering cortisol and balancing thyroid hormones. It has adaptogens which works well with the

hormones of the endocrine system which brings balance to the thyroid hormonal level. It increases the hormones which are secreted by thyroid gland. *Ashwagandha* is a immune modulator herb so it is useful in autoimmune thyroid conditions. Animal studies reveal *Ashwagandha* has a thyroid hormone balancing effect. In a 20 day study mice were given *Ashwagandha* and their T3 and T4 levels were analyzed, along with lipid peroxidation (anti-oxidant protection). Significant increases in serum T4 were found, which indicates this herb has a stimulatory effect on a sluggish thyroid.^[56]

Shigru (*Moringa oleifera*): *Shigru* seeds paste with *nichula* is applied locally in treatment of *galaganda*. The aqueous leaves extract of *Moringa oleifera* Lam. Was evaluated for its ameliorative effect in the regulation of thyroidism in rat model. Male albino rats of 120-150 g were treated orally with doses of 500mg/kg body weight (b.w.) and 250 mg/ kg b.w. of aqueous extract of *Moringa oleifera* Lam. leaf. The group which received maximum test dose (500mg/kg bw, 14days) showed maximum percentage increase in hormone concentration of T3 and T4 whereas a maximum percentage decrease in TSH levels was observed when compared to the other dose levels, which clearly proves that the response was dose effective and the *M. oleifera* leaf extracts can be used in hypothyroidism condition to normalize hormone levels.^[57]

Varuna (*Cratae vanurvula*): Decoction of *Varuna* root is given with honey in treatment of *Gandamala*. *Varuna* also possesses antitumor property which makes it beneficial in extra growths of thyroid as well as in hyper trophy of prostate.^[58]

Guggulu (*Commiphora mukul*): *Guggul*, known as *commiphora mukul*, supports thyroid function. It is a member of the *burseraceae* family and contains aromatic sticky resins with pharmaceutical properties. A compound of *commiphora*, oleoresin, increases iodine reabsorption by the thyroid gland and also increases the activity of thyroxidase. The *guggul* extract contains oleoresin. It has a strong thyroid-stimulating activity. It also increases the production of T3 by increasing the conversion of T4 to T3. It increases lipid peroxidation and also increases serum T3 level. Recent studies have shown that certain compounds of *guggul* resin have anti-inflammatory properties, lower cholesterol and other blood lipids and support thyroid function in different ways.^[59]

Jalakumbhi (*Pistia startiotes*): *Jalakumbhi bhasma* is given with *gomutra* in *Galaganda*. *Jalakumbhi* is a widespread weed in rivers and lakes which is applied in paste form topically to reduce the swelling of Thyroid.^[60]

Brahmi (*Bacopa monnieri*): It is from the *scrophulariaceae* family Function: *B. monnieri* stimulates thyroid activity by increasing the amount of T4 and is used to treat hypothyroidism. Since T4 (but not

T3) levels are increased by *B. monnieri*, it can be concluded that the plant extract stimulates or releases T4 directly at the glandular level, but not through peripheral conversion of T4 to T3.^[61]

Aaragvadha (*Cassia fistula*): Root bark of *Aaragvadha* is grinded with rice water and used for *Nasya* and *Lepa* in treatment of *gandamala*. Aqueous and ethanolic extract of *cassia fistula* Linn leaves were investigated for its potential to protect hypothyroidism against hypothyroidism induced by propylthiouracil (PTU) in rats. Serum T3, serum T4, TSH, cholesterol level and changes in body weight were used for evaluation of antihypothyroidism activity. Treatment with both extracts of *Cassia fistula* in dose of 300 mg/kg significantly increased serum T3, serum T4 and decreased TSH and cholesterol level compared with control group.^[62]

Apamarga (*Achyranthes aspera*): *Achyranthes aspera* Leaf extract administered in rats (n = 7) at a dose of

200mg/kg for 7 days caused an increase of T3 and T4 ($p < 0.001$ for both). Increase in blood glucose in this group ($p < 0.05$) further supported the extract's thyroid stimulating nature.^[63]

Nirgundi (*Vitex nigundo*): Root of *nirgundi* is grinded with water and used for *nasya* in treatment of *gandamala*. *Taila*, which is prepared by *Nirgundi svarasa* and paste of *Langali* root, is used for *nasya* in treatment of *Gandamala*.^[64]

Versicolor (*Iris versicolor*): *Versicolor* is also called blue flag. *Versicolor* is a small wild plant found in the marshlands of North America. *Versicolor* enhances the function of the thyroid gland by increasing the production of T3. It is a detoxifying agent and is specifically used to treat thyroid enlargement. It is also useful for the treatment of hepato splenomegaly. It contains volatile oils, resins, alkaloids, and oleoresin.^[65]

Table 1: Plants acts on Hyperthyroidism.

Sr. No.	Botanical Name/Family	Common name	Useful part	Activities
1	<i>Lycopus virginicus</i> Lamiaceae	Bugleweed	Leaves, flowers	Inhibit TSH through binding to receptor sites and reduce the excess production of Thyroid hormone. These plants are rich in rosmarinic acid that is beneficial for various thyroid conditions. These plants also block the antithyroid effects of immunoglobulin and reduce conversion of T4 to T3. ^[66]
2	<i>Melissa officinalis</i> Lamiaceae	Lemon balm	Leaves, stems, flowers	As noted in the older studies, lemon balm is effective in blocking the binding of TSH to the receptor by acting on the hormone and the receptor itself. It also inhibits cyclic AMP production stimulated by TSH receptor antibodies. Traditionally, lemon balm has been used to treat symptoms associated with hyperthyroidism, like tachycardia, insomnia, and hyperactivity. ^[67]
3	<i>Leonurus cardiac</i> Lamiaceae	Motherwort	Leaves, flowers	In autoimmune diseases, it is important to reduce inflammation, making motherwort a good choice in treating hyperthyroidism. In addition to reducing inflammation, the enzyme 5-deiodinase is inhibited. ^[68]
4	<i>Lithospermum ruderale</i> Boraginaceae	Gromwell	Root	The most important action of this plant in hyperthyroidism is to prevent TSH from binding to thyroid follicles. It also reduces the peripheral deiodination of T4 and also reduces the secretion of the TH. ^[69]
5	<i>Rosmarinus officinalis</i> Lamiaceae	Rose marry	Stems, leaves, flowers	It has a high amount of rosmarinic acid and is used to treat hyperthyroidism. This acid influences the effect of TSH on the receptor site and also prevents the effect of immunoglobulin on TSH receptor. In addition, it reduces the peripheral change in T3. ^[69]
6	<i>Salvia officinalis</i> Lamiaceae	Sage	Leaves, flowers, stems, seeds	It has a high amount of rosmarinic acid and is used to treat hyperthyroidism. It act on act on the effect of TSH on receptor site, also inhibit immunoglobulin effects on Thyroid stimulating hormone (TSH) receptor, and it also decrease the peripheral conversion of T3. ^[40, 49, 50-51]
7	<i>Convolvulus pluricaulis</i> Choisy Convolvulaceae	Shankhapushpi	Flowers, whole plant	<i>Convolvulus pluricaulis</i> acts strongly on some of the liver enzymes and helps in improving symptoms of hyperthyroidism. It has antiulcer properties and is helpfulness in alleviating the symptoms of hyperthyroidism. The studies on <i>C. pluricaulis</i> have also put forward that it is beneficial in remedying hypothyroidism. ^[70]
8	<i>Annona squamosal</i> L. Annonaceae	Custard apple	Seed	The aqueous leaf extract of <i>A. squamosal</i> was also reported to ameliorate hyperthyroidism, which is the major causative factor for

				diabetes mellitus. ^[71]
9	<i>Rauvolfia serpentine</i> <i>L. Benth.ex Kurz.</i> <i>Apocynaceae</i>	Indian snakeroot	Root	The <i>R. serpentine</i> root extract administered to T4 induced hyperthyroid mice significantly decreased both the serum T3 and T4 concentrations.
10	<i>Emblica officinalis</i> Gaertn. <i>Phyllanthaceae</i>	Amla	Fruit	The fruit extract decreased both serums T3, T4 concentrations. The decrease in T3 was by inhibiting peripheral conversion of T4 to T3 in extra-thyroid tissues.
11	<i>Trigonella graceum</i> L. <i>Fabaceae</i>	Methi	Seeds	The seed extract induced reduction in T3 level could be the result of inhibition in peripheral conversion of T4 to T3 in extra thyroidal tissues.
12	<i>Aloe barbadensis</i> <i>Liliaceae</i>	Aloevera	Aloe latex	Aloevera extract decreases serum T3 and T4 concentrations, its inhibition rates for the two hormones are 25% and 13%, respectively, which indicates that the extract may not be adequately effective in reducing the concentration of THs. However, <i>A.vera</i> extract can be a better choice for mild hyperthyroidism cases because it does not produce a toxic effect on the liver. ^[52]
13	<i>Aegle marmelos</i> <i>Rutaceae</i>	Bael	Fruit	<i>A. marmelos</i> is relatively more effective than <i>A. vera</i> to reduce thyroid function and can, therefore, be considered for the regulation of hyperthyroidism. ^[52]
14	<i>Ocimum sanctum</i> L. <i>Lamiaceae</i>	Tulsi	Leaves	The leaf extract of <i>O. sanctum</i> administered to male mice for significantly inhibited only T4 concentration. ^[75]
15	<i>Moringa oleifera</i> auct. <i>non Lam</i> <i>Moringaceae</i>	Shigru	Root, seeds, leaf	<i>M. oleifera</i> leaf extract treatment of female rats decreased serum T3 concentration and increased in serum T4 concentration. This observation suggests the inhibitory activity of the plant extract in the peripheral conversion of T4 to T3. ^[75]

Table.2 Plants acts on Hypothyroidism

Sr. No.	Botanical Name/Family	Common name	Useful part	Activities
1	<i>Centella asiatica</i> <i>Apiaceae</i>	Gotu Kola	Whole plant	Enhance Synthesis of T4. ^[45,48]
2	<i>Withania somnifera</i> <i>Solanaceae</i>	Ashwagandha	Root	<i>Ashwagandha</i> is a useful treating agent for hypothyroidism. Significant increase in serum T4 levels indicates the stimulating effect at the glandular level via its effect on cellular antioxidant systems. <i>Withania</i> may also stimulate thyroid activity indirectly, via its effect on cellular antioxidant systems. ^[77-78]
3	<i>Commiphora mukul</i> <i>Burseraceae</i>	Guggul	Oleo resin/gum	A compound of <i>Commiphora</i> , oleoresin, increases iodine reabsorption by the thyroid gland and also increases the activity of thyroxidase. The <i>guggul</i> extract contains oleoresin. It has a strong thyroid-stimulating activity. It also increases the production of T3 by increasing the conversion of T4 to T3. ^[59]
4	<i>Fucus vesiculosus</i> <i>Fucaceae</i>	Bladder wrack	Dried thallus	Treatment of thyroid disorders, marine alga rich in iodine, which is being used in alternative medicine as a laxative, diuretic, as a complement for weight loss and as source of iodine, particularly hypothyroidism. ^[79]
5	<i>Bacopa monnieri</i> (L.) Wettst. <i>Scrophulariaceae</i>	Brahmi	Whole plant	Stimulates thyroid activity by increasing the amount of T4 useful in treatment hypothyroidism. ^[80]
6	<i>Coleus forskohlii</i> (Willd.) <i>Lamiaceae</i>	Plectranthusbarbatus	Root	<i>Coleus forskohlii</i> , a traditional <i>Ayurvedic</i> thyroid herb, contains essential oils and diterpenes. Thyroid hormone production and secretion are increased by <i>coleus</i> . <i>Coleus</i> can help normalize hormone levels. ^[81]
7	<i>Fucus and Laminaria species</i> <i>Laminariaceae</i>	Kelp	Leaf	Seaweeds contain iodine and polysaccharides that affect thyroid hormone production and conversion of seaweeds on the thyroid, these plants have traditionally been used to treat thyroid issues. ^[81]
8	<i>Bauhinia purpurea</i> L. <i>Caesalpiniaceae</i>	Khairwal	Bark	It raised thyroid hormone levels and decreased lipid levels. ^[82]
9	<i>Ficus carica</i> L. <i>Moraceae</i>	Common fig	Fruit	Only one thyroid hormone- either T3or T4 was altered by the plant extract. ^[83]

10	<i>Mangifera Indica L.</i> <i>Anacardiaceae</i>	Mango	Fruit Peel	Showed thyroid stimulatory and anti-peroxidase roles. ^[84]
11	<i>Lithospermum officinale</i> <i>Boraginaceae</i>	Gromwell	Root	Club moss influences the hypothalamic pituitary thyroid axis. It can inhibit peripheral T4 deiodination, thus activating T3. The older studies that examined herbs in combination show that club moss may act as a block of TSH receptors. ^[68]
12	<i>Iris versicolor</i> <i>Iridaceae</i>	Blue flag	Flowers	Versicolor enhances the function of the thyroid gland by increasing the production of T3. It is a detoxifying agent and is specifically used to treat thyroid enlargement. ^[65]
13	<i>Vitex nigundo</i> <i>Verbenaceae</i>	Nirgundi	Root, leaves, seeds	It reduce swelling of thyroids. ^[85-88]
14	<i>Achyranthes aspera</i> Linn <i>Amaranthaceae</i>	Apamarga	Whole plant	Leaf extract administration caused an increase of T3 and T4. ^[63]
15	<i>Cassia fistula</i> Linn. <i>Caesalpiniaceae</i>	Aaragvadha	Fruit pulp	It raised thyroid hormone levels, decreased cholesterol levels. ^[85-88]
16	<i>Pistia startiotes</i> <i>Araceae</i>	Jalakumbhi	whole plant	It reduced swelling of thyroid. ^[85-88]
17	<i>Crataevanur Vula</i> Buch-Ham. <i>Capparidaceae</i>	Varuna	Bark, Root	<i>Varuna</i> possesses antitumor property which makes it beneficial in extra growths of thyroid as well as in hyper trophy of prostate. ^[85-88]
18	<i>Moringa oleifera</i> Lam. <i>Moringaceae</i>	Shigru	Root bark, seeds	It showed maximum percentage increase in hormone concentration of T3 and T4 whereas a maximum percentage decrease in TSH levels. ^[57]
19	<i>Morus alba</i> <i>Moraceae</i>	Shahtoot	Leaf	It cured goiter. ^[85-88]
20	<i>Zingiber officinale</i> <i>Zingiberaceae</i>	Adrak	rhizome	It restored thyroid health in hypothyroidism. ^[85-88]
21	<i>Linum usitatissimum</i> <i>Linaceae</i>	Alsi/Bijari	seeds	It maintained thyroid health, boost production of thyroid hormones. ^[85-88]
22	<i>Bauhinia variegata</i> <i>Fabaceae</i>	Kanchanara	Bark	It reduced swelling of neck, increased serum thyroid hormone concentrations, decreased Cholesterol and improved thyroid histology. ^[85-88]
23	<i>Eichhornia crassipes</i> <i>Pontederiaceae</i>	Water hyacinth	Whole plant	It stimulated thyroid function. ^[85-88]
24	<i>Saussurea lappa</i> <i>Compositae</i>	Kuth	Root	It improved thyroid histology. ^[85-88]
25	<i>Citrullus vulgaris</i> <i>Cucurbitaceae</i>	Water melon	Fruit Peel	It raised thyroid hormone levels and reduced oxidative stress. ^[85-88]
26	<i>Cucumis melo</i> <i>Cucurbitaceae</i>	Musk melon	Fruit Peel	It raised thyroid hormone levels. ^[85-88]
27	<i>Inula racemosa</i> <i>compositae</i>	Pushkarmool	Root	It stimulated thyroid histology. ^[85-88]

CONCLUSION

The herbal approach to thyroid dysfunction is invariably necessary to avoid the various side effects of hormonal therapy. The findings of the study suggested that an antithyroid compound, equal in potency to herbal plants and natural products, has been isolated from the root, leaf and seed of that various plants. The herbal cure is gaining worldwide acceptance and has emphasized the head of modern scientific exploration and evaluation of ethno medicine from plants. In expensive, effective and safe indigenous medication is gaining acceptance from both urban and rural people. The green remedy over the

world is pushing the knowledge of primitive sociation on ascending spiral. This will lead to remarkable discoveries from plant based ethno medicines. There is need for *in vitro*, *in vivo* and clinical research of the above plants to further certify their efficacy in normalising thyroid dysfunction and still various herbal plants were questionable need to be further study. This will provide the practitioners to have options to treat thyroid dysfunction.

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