EFFECT OF METHANOLIC EXTRACT OF SWEET CORN SILK ON EXPERIMENTALLY INDUCED HYPERTHYROIDISM IN SWISS ALBINO RATS
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ABSTRACT
Plant materials have been used as medicine for a wide variety of human ailments due to increase in cost of treatment, side effects of several allopathic drugs and development of resistance to currently used drugs for infectious diseases. In the present study, hyperthyroidism was induced to male Swiss albino rats orally using thyroxine for 14 days. The impact of methanolic extract of sweet corn silk in different concentrations (200, 300 & 400mg/kg) for 21 days was assessed in these animals. The serum was analyzed for thyroid hormone level and lipid profile before and during the experiment. Results showed that 400mg/kg concentration of methanolic extract has the highest effectiveness which is equal to that of standard drug to revert the hyperthyroid condition in Swiss albino rats and were confirmed with the histopathological study of the thyroid gland.

Keywords: Sweet corn silk, hyperthyroidism, thyroid hormones, thyroxine

INTRODUCTION
Hormones are chemical messengers secreted by glands. A number of hormones of the endocrine system serve to regulate the activities of other tissue1. Thyroid secretes two metabolically important hormones i.e. Triiodothyronine (T₃) and Thyroxine (T₄). Thyroid hormones control various metabolic activities essential for energy, growth and development of the body2. Thyroid disorders are common endocrine disorders in humans and animals and are accompanied by important changes in hemodynamics. Thyroid disorders are mainly of two types: hypothyroidism and hyperthyroidism. Disturbances in the regulation of systemic arterial blood pressure are seen in both hypo and hyperthyroid states in human and animals. Usually, the pathophysiological changes of hyperthyroidism will be the opposite of those occurring in hypothyroidism. The term “hyperthyroidism” encompasses heterogenous group of disorders, all characterized by elevated levels of thyroid hormones in the blood3. Hyperthyroidism shows a hyperdynamic circulation with increased cardiac output, heart rate, pulse pressure and blood pressure and decreased vascular peripheral resistance, whereas the hypothyroid state is associated with low cardiac output, heart rate, pulse pressure and blood pressure and elevated vascular peripheral resistance4. Chemotherapy, radiotherapy and surgery are only three major existing modes of treatment in modern medicine. More than 50 per cent of all modern drugs in used are natural products5. Drug discovery from the medicinal plants has played an important role in the treatment of human diseases and indeed, most new clinical applications of plant secondary metabolites and their derivatives over the last half-century have been made towards combating human ailments6.

Zea mays L. (Family, Poaceae), also known as maize, Indian corn or corn is a cereal that produces one of the most important edible grains in the world. In addition to the grains, leaves, corn silks, stalk and inflorescence of the maize plant are used for the treatment of several ailments. Corn silk is a collection of the stigmas (fine, soft, yellowish threads) from the female flowers of the maize plant. They are relatively (4-8 inches) long with a mild sweetish taste. Corn silks are scientifically referred to as Maydis stigma or Zea mays. The corn silk is used as an anti-diabetic or diuretic and decoction of the silk is consumed for the treatment of urinary troubles and gallstones7. Corn silk is a traditional herbal medicine in India, which has been used in many parts of the world for the treatment of edema as well as for cystitis, gout, kidney stones, nephritis, prostatitis and similar ailments8. It contains a high level of phenolics that undergo enzymatic oxidation to form quinines, which condense among themselves or with proteins to form brown pigments9. Zea mays L. kernels shows effective impact on hyperthyroidism since there is no literature available on the use of sweet corn silk on the treatment of thyroid disorders; the study was carried to analyze the effect of sweet corn silk on thyroxine induced hyperthyroidism in Swiss albino rats.

MATERIAL AND METHODS
Plant Material
Fresh sweet corn silk was collected from Unicorn food, Salem for the study. The plant sample (No. BSI/SRC/5/23/2010-11/Tech.1614) was identified and authenticated by Dr. G.V.S. Murthy (Head of Office), Botanical Survey of India, Southern Regional Centre, TNAU Campus, Coimbatore. Then the collected sweet corn silks were shade dried ground to coarse powder.

Preparation of Organic Extract
Dried powder was successively extracted with different solvents such as petroleum ether, benzene, chloroform, ethyl acetate, methanol and ethanol with their increasing order of polarity by soxhlation for 6-12 hours. For the extraction, 20g of dried powdered sample was used with 200ml of the solvent. Then the extract obtained were collected separately and kept for further analysis. The qualitative phytochemical test of various extracts of sweet corn silk was carried out using standard procedure10. Free radical scavenging and total antioxidant activities of various extracts were also carried out using by DDPH assay11 and Phosphomolybdenum method12 respectively.

The phytochemical screening of various extracts of sweet corn silk showed positive results for flavonoids, alkaloids, phenols, steroids, glycosides, carbohydrates, terpenoids and tannins. Methanolic extract of sweet corn silk gave the maximum extraction of phytochemicals than any other
extracts and showed maximum DPPH scavenging and total antioxidant activities. The iodine content of the sweet corn silk was also analyzed. The result shows that dry sweet corn silk powder contains 0.98 ppm of iodine.

**Experimental animals**

Male Swiss albino rats weighing 150-200 g were purchased from Central Animal House (Kerala). Animals were maintained in a room at 23° ± 2, humidity 45 per cent to 55 per cent with a fixed 12 hour artificial light period. Rats were fed with standard rodent diet until the initiation of treatment. All animals received human care, as outlined in the guide for the care and use of laboratory animals. University Animals Ethical Committee (Reg no: 623/02/b/CPCSEA) has reviewed and approved all procedures described.

Thirty six adult albino rats which has assigned into six groups each having six animals were selected for the study. Serums from the experimental rats were analyzed for thyroid hormone level (ELISA method)\(^{13,14}\) and lipid profile (Kit method)\(^{16}\) before and during the experiment. Blood was collected by retro-orbital puncture under light diethyl ether anesthesia. Serum was separated by centrifugation at 2000rpm for 15min in normal centrifuge and used for the analysis. Hyperthyroidism was induced in experimental rats by administrating thyroxine (600µg/kg) orally for fourteen days\(^{16}\) and induction of hyperthyroidism was confirmed by analyzing the serum thyroid hormone level.

**Table I** shows the grouping of experimental rats.

### Treatment of the animals with standard drug methimazole

Hyperthyroid induced animals (Group III) were treated with standard drug 0.04 % of methimazole orally for twenty one days.\(^{17}\)

### Treatment of the animals with sweet corn silk extract

Hyperthyroid induced rats i.e. Group IV, V and VI were treated with 200, 300 and 400 mg/kg of methanolic extract of plant sample orally for twenty one days.

At 7 days interval serum from experimental rats was analyzed for thyroid hormone and lipid profile. At the end of the experiments, the thyroid glands of rats were dissected out and fixed in formal buffer solution and then embedded in paraffin for thyroid hormone and lipid profile analysis.

**Statistical Analysis**

All measurements were conducted in triplicate, and experimental results were evaluated by analysis of variance (ANOVA).

**RESULTS**

Hyperthyroid induced animals showed a decreased in body weight when compared to the normal rats. After 21 days of treatment with standard drug and plant extract, the body weight got increased and this was within the normal range.

### Changes in thyroid hormone level in different experimental groups

Figure I illustrates the changes in thyroid hormone levels in different groups of rats. T3, T4 and TSH of the normal animal were found to be 1.03 ng/ml, 6.11µg/dl and 3.70IU/ml respectively. The T3 and T4 values increased to 2.34 ng/ml and 16.18µg/dl while TSH level decreased to 1.13µIU/ml significantly at 5% level in hyperthyroid induced rats. T3 and T4 were decreased to 1 ng/ml and 7.89µg/dl whereas TSH was increased to 5.09µIU/ml for those rats treated with standard drug. Rats treated with sweet corn silk extract in three different concentrations (200,300 and 400mg/kg) showed decrease in T3 (0.08 to 1.10 ng/ml) and T4 (5.17 to 7.51µg/dl) levels and increase in TSH (1.51 to 2.84µIU/ml) level. Group treated with 400mg/kg of methanolic extract of sweet corn silk showed better result than the other two concentrations and was found to be more effective than the standard drug, methimazole in bringing the thyroid hormone to normal levels.

**Changes in lipid profile in different experimental groups**

Lipid abnormalities may attribute to the impaired thyroid function. Prior to the availability of serum thyroid hormone measurements serum cholesterol level was used to assist in the diagnosis of thyroid disorder. Figure II shows the lipid profile in different experimental groups of rats. Total cholesterol, HDL, LDL, VLDL and triglycerides were found to be 120, 41.09, 78.77, 7.04 and 35.22 mg/dl respectively in normal rats. The total cholesterol, HDL and LDL got decreased to 98, 39.01 and 55.76 mg/dl whereas VLDL and triglycerides was increased to 10.06 and 50.38mg/dl in hyperthyroid rats. After twenty one days of treatment with standard drug and sweet corn silk extracts of three different concentrations (200, 300 and 400 mg/dl) total cholesterol, HDL and LDL levels increased while VLDL and triglycerides decreased significantly at 5% level and reached normal range.

**Histopathological studies of thyroid gland of experimental rats**

The histopathological studies were undertaken to study the tissue section of the thyroid gland of different experimental groups of rats. Plate I showed histopathological results. Thyroid gland of normal rats showed numerous follicles some of which contain colloid (40-50 %). A colloid varies from thick to thin with occasional scalloping. The follicular cells have round nuclei surrounded by a clear cytoplasm. Thyroid gland of rats induced with thyroxine showed follicles lined by follicular epithelial cells. Thyroid follicle shows 60-70% of luminal colloids. In about 10% of follicles, the lumen is completely filled with colloid. There is no papillary infolding of the epithelium. Thyroid section of methimazole treated rats showed round nuclei surrounded by a clear cytoplasm. Section of thyroid gland of hyperthyroid rats treated with plant extract showed follicle lined by follicular epithelial cells which appeared normal. Many of follicular coloids showed scalloping. There is no papillary infolding of the epithelial cells.

**DISCUSSION**

Herbs have always been the principle form of medicine in India. Although very less reports are available on the adverse effects of thyroid medication, some of the side effects of the antithyroid medications include a potentially fatal reduction in the level of white blood cells, agranulocytosis, granulocytopenia, aplastic anemia, fulminant liver failure, rashes and peripheral neuritis.\(^{19}\)

Thyroid hormone stimulates the rate of metabolism and heat production has been known over a century. Hyperthyroidism induced rats showed a decrease in TSH level and increase in T3 and T4 levels which may be responsible for decrease in body weight.\(^ {20}\) Hyperthyroid rats have increased oxygen consumption than the normal rats resulting in increased T3 and T4 levels and decreased TSH level.\(^ {11,12}\) T3 and T4 values in thyroxine induced hyperthyroidism was increased whereas TSH level got decreased.\(^ {22}\) Hyperthyroidism exhibits an enhanced excretion of cholesterol and an increased turnover of LDL resulting in a decrease of total and LDL cholesterol whereas HDL is not affected.\(^ {23}\) The influence of experimentally induced hyperthyroidism on the lipid composition of the epidermis has been studied in pubertal and adult rats. Thyroxine treated did not alter the major lipid...
classes in the epididymis. But decrease of epididymal lipid profile was seen in regional and age–related fluctuations\(^2\). From the study, it was found that hyperthyroid induced rats when treated with the standard drug- methimazole and three different concentrations of the methanolic extract of sweet corn silk i.e. 200, 300 and 400mg /kg of body weight for 21 days showed normal thyroid hormone level and lipid profile. The group treated with the highest concentration of plant extract showed good result as that of the standard drug. This indicates that methanolic extract of sweet corn silk has the potential to cure hyperthyroidism in experimental rats. Histopathologies of thyroid gland of the hyperthyroid induced and treated rats were studied and were compared with the control rats. The thyroid gland of control rats have lesser amount of colloid in follicular epithelial cells but showed an increase in hyperthyroid induced rats which became normal after getting treatment with the plant extract. It was reported that thyroid follicles of hyperthyroid rat contain colloid with cell debris and stained unevenly, and apical microvilli were irregular and significantly reduced in some follicles\(^2\). Thyroid follicles of hyperthyroid rat were filled with homogenous colloid and the glands showing cuboidal lining epithelium of the follicles \(^2\). From the results, it was observed that the group treated with the highest concentration of plant extract showed good result as that of the standard drug and was supported by histopathological studies of the thyroid gland of experimental rats. Thus, it could be concluded that methanolic extract of sweet corn silk has the potential to overcome hyperthyroidism in Swiss albino rats.

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**TABLE I: GROUPING OF EXPERIMENTAL RATS**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Treatment</th>
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<tbody>
<tr>
<td>Group I</td>
<td>Normal Diet (Control)</td>
</tr>
<tr>
<td>Group II</td>
<td>Hyperthyroid induced animals (Thyroxine-600ug/kg/ml)</td>
</tr>
<tr>
<td>Group III</td>
<td>Hyperthyroid induced treated with standard drug (0.04% of methimazole)</td>
</tr>
<tr>
<td>Group IV</td>
<td>Hyperthyroid induced treated with plant extract (200mg/kg)</td>
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<tr>
<td>Group V</td>
<td>Hyperthyroid induced treated with plant extract (300mg/kg)</td>
</tr>
<tr>
<td>Group VI</td>
<td>Hyperthyroid induced treated with plant extract (400mg/kg)</td>
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FIGURE 1

a) $T_3$ LEVEL IN DIFFERENT EXPERIMENTAL GROUPS OF RATS

b) $T_4$ LEVEL IN DIFFERENT EXPERIMENTAL GROUPS OF RATS

c) TSH LEVEL IN DIFFERENT EXPERIMENTAL GROUPS OF RATS

THYROID HORMONE LEVEL IN DIFFERENT EXPERIMENTAL GROUPS OF RATS
FIGURE II

a) TOTAL CHOLESTEROL, HDL AND LDL

b) VLDL

c) TRIGLYCERIDES

LIPID PROFILE IN DIFFERENT EXPERIMENTAL GROUPS OF RATS

PLATE I

HISTOPATHOLOGICAL OBSERVATION OF THYROID GLAND OF EXPERIMENTAL RATS