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# Studies on effects of aqueous leaf extract of *Achyranthes aspera* on thyroid function in male albino rats

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**Abstract :** The aqueous leaf extract of *Achyranthes aspera* was evaluated for its ameliorative effect in the regulation of hypothyroidism induced by methimazole in male albino rats. Rats were divided into four groups, three for each. Group I (control), group II (hypothyroid control) normal rats administered orally with methimazole 25 (mg/kg bwt.) for five successive days, treated group III and group IV with aqueous leaf extract of *Achyranthes aspera* 400 (mg/kg bwt.) for 14 and 28 days respectively, after hypothyroidism. Statistical analysis was done using student's t test. The obtained results revealed that hypothyroidism induced group II showed significant decrease in serum $T_3$ and $T_4$ ($p<0.001$), a significant increase in serum TSH was also observed ($p<0.001$), when compared to control group I. It was also observed that treated group III and group IV with aqueous leaf extract of Achyranthes *aspera* 400 (mg/kg bwt.) for 14 and 28 days respectively, after hypothyroidism showed significant increase in serum $T_3$ and $T_4$ ($p<0.001$), a significant decrease in serum TSH content was also observed, when compared with hypothyroid control group II. To conclude, aqueous extract of *Achyranthes aspera* leaf could be a potential therapeutic alternative for the management of hypothyroidism.

**Keywords :** ***Achyranthes aspera,*** **hypothyroidism, T3, T4 ,TSH**

## INTRODUCTION

Thyroid hormones play an important role in the normal activity of all body tissues. Decrease in the thyroid hormone levels is known as hypothyroidism.[1] It can occur because of the deficiency in iodine intake, thyroid gland lesions, autoimmune disorders and impaired activity of pituitary gland.[2,3] The untreated hypothyroidism leads to a wide range of abnormalities including loss of energy, fatigue sensation, weight gain, dry skin, depression, behavioural fluctuations, hair loss, hands and face swelling and increases cholesterol.[4]

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*Achyranthes aspera* L. (Family: Amaranthaceae), an erect and much branched diffuse herb is a medicinal plant, frequently found in tropical and warmer regions as weed.[5] The review reveals that wide numbers of phytochemical constituents have been isolated from the plant which possesses activities like antiperiodic, antiasthmatic, hepatoprotective, anti-allergic, expectorant, stomach tonic, laxative, antihelmintic, diuretic, linthontriptic, sudorific, demulcent, anti-inflammatory, anticataract, antifungal, antibacterial, hypoglycaemic, antihyperlipidemic and haematinic and various other important medicinal properties.[5] The present study is going to evaluate the effect of aqueous extract of *Achyranthes aspera* leaf on the level of thyroid hormones in methimazole-induced hypothyroid in rats.

## MATERIALS & METHODS

### Experimental Animals

12 adult male *albino rats* of the same age (6 weeks) and weight 110-150 g were used in the study. Animals were maintained under standard condition of ventilation temperature (25± 2ºC) and light/dark condition (12/12 h). Rats were housed in stainless steel cages and were provided with free access of food and drinking water *ad libitum*.

### Preparation of *Achyranthes aspera* leaf extract

Fresh *Achyranthes aspera* leaves were collected from the Lalpur locality of the city Ranchi (Jharkhand). The leaves were thoroughly washed with tap water followed by distilled water. The leaves were shade dried and powdered by using mechanical grinder. The powder was subjected to a series of maceration in distilled water and the extract decanted at an interval of 24 hours. The filtrate was then evaporated to dryness in a water bath at 40ºC giving a dark green solid yield. Powdered extract was refrigerated for future use.[6]

### Determination of doses

**(i) Dose for inducing hypothyroidism with methimazole**

Hypothyroidism was induced by daily oral administration of (25 mg/kg bwt.) methimazole for five successive days.[7]

**(ii) Dose of aqueous extract of *Achyranthes aspera* leaf**

The rats were treated with aqueous extract of *Achyranthes aspera* leaf at the dose of (400 mg/kg bwt.) for a period of 14 and 28 days after induction hypothyroidism.[8]

### Experimental Design

Animals were randomly divided into four groups of 3 rats each.

**Group I** served as the normal control and received rat feed and distilled water.

**Group II** (Hypothyroid Control): Orally administered with methimazole (25 mg/kg bwt.) for five successive days.

**Group III** (Treated group): Received aqueous extract of *Achyranthes aspera* leaf (400 mg/kg bwt.) orally for a period of 14, after induction of hypothyroidism.

**Group IV** (Treated group): Received aqueous extract of *Achyranthes aspera* leaf (400 mg/kg bwt.) orally for a period of 28 days, after induction of hypothyroidism.

### Sample collection

Blood serum was collected through cardiac puncture after anaesthetizing with ether.

### Estimation of hyroid hormones

Estimation of serum $T_3$, $T_4$ and TSH was done by chemiluminescence immunoassay method.[9]

### Statistical analysis

The data were analyzed as mean ± S.D. Statistical analysis were carried out by using student's 't' test.

## RESULTS

Table 1 showed that serum $T_3$, $T_4$ and TSH level of control group albino rats (G I) was 141.86 ±12.65 ng/dl, 7.63 ± 1.10 ug/dl and 0.77 ±0.48 ulU/mL respectively. Administration of methimazole (25 mg/kg bwt.) for five successive days caused hypothyroidism to group (G II). Statistical analysis was done using student's 't' test. Serum $T_3$ level was decreased significantly to 24.43 ± 3.30 ng/dl in group II rats (P<0.001).

Similarly, serum $T_4$ level also decreased significantly to 1.36±0.45 ug/dl after methimazole treatment (P<0.001). It was also noted that serum TSH level increased significantly to 3.77±0.34 ulU /mL in hypothyroid control group (G II) (P<0.001).

**Table 1: Effect of aqueous extract treatment of *Achyranthes aspera* leaf (400 mg/kg bwt.) for 14 and 28 days on serum thyroid profile ($T_3$, $T_4$ and TSH). Their percentage increase (+) or decrease (-) in relation to hypothyroid control and experimental group values in male rats.**

| PARAMETERS | Control Group I | Hypothyroid Control Group II | 14 Days of Leaf Extract Group III | % Change From Group II, (+) Increase, (-) Decrease | 28 Days of Leaf Extract Group IV | % Change From Group II, (+) Increase, (-) Decrease |
|---|---|---|---|---|---|---|
| Triiodothyronine $T_3$ (ng/dl) | 141.86±12.65 | *** 24.43±3.30 | ###189.86±4.36 | + 677.15 | ###191.06±4.53 | +682.07 |
| Thyroxine $T_4$ (ug/dl) | 7.63±1.10 | *** 1.36±0.45 | ###11.80±1.22 | +767.64 | ###10.13±0.28 | + 644.85 |
| TSH (ulU/mL) | 0.77±0.48 | *** 3.77±0.34 | ##0.80±0.03 | -78.77 | ### 0.70±0.04 | -81.43 |

**Values are expressed as mean ±S.D**

*****P<0.001, when compared between control and hypothyroid control group. ### P<0.001, ##p<0.01, when compared between hypothyroid control, 14 and 28 days of aqueous leaf extract of *Achyranthes aspera.***

In group (G III) rats treated with aqueous extract of *Achyranthes aspera* leaf (400 mg/kg bwt.) for 14 days showed significant increase in serum $T_3$ and $T_4$ content that was 189.86±4.36 ng/dl & 11.80±1.22 ug/dl respectively (P<0.001). A significant decrease in serum TSH content to 0.80±0.03 ulU/mL was also observed, when compared with hypothyroid control rats (G II) (P<0.01).

The treated group (G IV) in which rats were administered with aqueous extract of *Achyranthes aspera* leaf (400 mg/kg bwt.) for 28 days showed significant increase in serum $T_3$ and $T_4$ content to 191.06±4.53 ng/dl & 10.13±0.28 ug/dl respectively (P<0.001). A significant decrease in serum TSH content to 0.70±0.04 ulU/mL was observed, when compared with hypothyroid control rats (G II) (P<0.001).

## DISCUSSION & CONCLUSION

The thyroid gland is one of the important endocrine glands that play an essential vital role in the metabolism and energy expense in the body.[10] This gland is responsible for the production, storage and release of thyroid hormones triiodothyronine ($T_3$) and thyroxine ($T_4$).[11] These hormones are essential for cell growth and development.[12] One of the thyroid disorder is hypothyroidism which is defined as a deficiency in thyroid hormones production as a result of dysfunction of the synthesis and secretion of hormones.[13] The current investigation aimed to evaluate the hormonal changes in hypothyroid- model, also to assess whether *Achyranthes aspera* has potential ameliorating effects against hypothyroidism. Biochemically, methimazole induced the hypothyroidism that is reflected in the recorded hormonal levels of $T_3$, $T_4$ and TSH. A significant decrease in the serum $T_3$ and $T_4$ concentration was observed; also the TSH recorded a significant increase compared to the control values.

Methimazole prevents the thyroid peroxidase enzyme from coupling and iodinating the tyrosine residues on thyroglobulin, hence reducing the production of the thyroid hormones $T_3$ and $T_4$,[14] with subsequent increase in TSH. Methimazole was chosen to induce hypothyroidism in the rats, as it is easily absorbed by the gastrointestinal tract and concentrated in the thyroid gland.[15] It produces hypothyroidism by inhibiting the production of thyroid hormone.[16] Methimazole acts as a false substrate for thyroid peroxidase, thus inhibiting the incorporation of iodide into tyrosine residues on thyroglobulin catalyzed by thyroid peroxidise.[17]

Treated groups (G III and G IV) with aqueous extract of *Achyranthes aspera* leaf (400 mg/kg) for 14 and 28 days respectively, after methimazole-induction hypothyroidism, showed ameliorating effect. The extract showed significant increase in serum $T_3$ and $T_4$ content; a decrease in the level of TSH suggesting its thyroid hormone enhancing effects. Similar results have been reported in different plant extracts. In the same context Dehghani *et al*. (2016)[18] observed that on administration of *caraways* extract serum $T_3$ and $T_4$ levels were increased and TSH levels decreased significantly.

In agreement with present findings Mridul Yadav *et al*. (2016)[19] suggested that supplementation of *Ocimum sanctum* leaves significantly (P) increased levels of $T_3$ and $T_4$, whereas TSH levels were significantly reduced as compared to control group. They explained that increase in the levels of $T_3$ and $T_4$ may be due to increase in the activity of thyroid gland by some compound in *Ocimum sanctum* which affects the physiology and function of follicular cells.[20] They also reported that *Ocimum sanctum* may also cause enhancement of the transport of sodium-iodide transport and increased absorption of iodide resulting in increased production of $T_3$ and $T_4$ and effect on iodotyrosine deiodinases.[21]

Corroborating present investigation Tabassum *et al*. (2013)[20] reported a significant increase in $T_3$ and $T_4$, whereas a significant i(P<0.05) decrease in TSH as compared to those in the control group, while working on *Moringa oleifera.*

Similar results were reported by Abbas Abed Shahan *et al.* (2018)[22], with working on effect of methanolic leaf extract of *Ficus carica* on thyroid hormones. They suggested the stimulatory effect of leaf extract on thyroid follicles to elevate synthesis of high amount of $T_3$ and $T_4$ when used to treat hypothyroid animals.

Although further investigation are required to reveal the exact mechanism of action(s) of thyroid hormone regulation by *Achyranthes aspera* leaf extract, the present findings clearly indicates that this extract is stimulant to thyroid functions. However, the authors emphasize that further studies are required to observe the effect of leaf extract which might be effective and safe in ameliorating hypothyroidism.

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