ORIGINAL RESEARCH PAPER

Zoology

A MARINE ALGA EXHIBITS ANTI-TOXICITY POTENTIAL ON THYROID GLAND OF ALBINO RATS

KEY WORDS: Sargassum wightii, thyroid gland, cadmium, endocrine function

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ABSTRACT

Seaweed is the familiar name for immeasurable species of marine algae that grow in the Ocean. Many types of seaweed contain anti-inflammatory and anti-microbial agents and also possess powerful cancer fighting agents that ultimately prove in the treatment of malignant tumours and leukaemia in people. The purpose of the present work was to determine the anti-toxicity response of seaweed Sargassum wightii against on thyroid gland of cadmium treated Rats. An extract prepared from S.wightii was treated orally every day at a dose level of 200mg/kg of body weight to the rats exposed to 50ppm cadmium for 30 days. Histopathological analysis of thyroid gland showed that an administration of S.wightii treatment reduced the histopathological inflictions and enhancing endocrine functioning in cadmium treated rats.

INTRODUCTION

Natural products play a key role in the drug formation. Seaweeds or marine algae are potential source of secondary metabolites[1]. *S. wightii* is a bounteous marine brown alga commonly found on the shorelines of India. It is dark brown in colour, 21- 40 cm in height, 5- 8mm long and 2- 4 mm in width. It is highly branched, and the midrib is sphere-shaped to ellipsoidal [2]. It is a macroscopic, multicellular, photosynthetic, nonvascular, pelagic marine alga loaded with sulfated polysaccharides that noticeable effective free radical scavenging, antioxidant, and anti-inflammatory effects[3]. A different type of *Sargassum* species have been accomplished with antiviral, anticancer and antitumor activities [4].

The thyroid system plays an essential function in the body homeostasis and functioning of the nervous, cardiovascular and reproductive systems, and of body growth[5]. Thyroid function is controlled by the hypothalamic-pituitary-thyroid axis, with the secretion of Thyrotropin-Releasing Hormone (TRH), Thyroid-Stimulating Hormone (TSH), thyroxine (T4), and triiodothyronine (T3) [6]. In recent studies explored that exposition of human studies which have correlated Cadmium exposure to modifications in thyroid hormone function[7]. Endocrine toxicity causes hyperfunction or hypofunction of the thyroid gland and unprovoked level of T4, T3 and TSH levels, which are unfailing indicators of the thyroid function in experimental animals. Another indicator of thyrotoxicity is structural damage to thyroid tissues, i.e., thyroid hypertrophy or hyperplasia[8].

Information based on the modulation mechanism of *Sargassum's* bioactive compounds, the present study evidenced that it can be a role of anti-toxicity potential against thyroid gland of cadmium treated rats.

Methods:

Seaweed Collection & extract preparation:

Fresh seaweed of *S. wightii* was collected from coastal regions of Rameshwaram Algal research centre, Tamil Nadu, India. It was authenticated by the references[9]. The sea weeds were allowed to sun shade dry and powdered. A 200 g of dried seaweed powder was filled in a Soxhlet apparatus and 600 mL of the particular solvent in the solvent reservoir for extraction. The process was carried out for 6 h using solvent water. After that, the extract was filtered by Whatman No. 1 filter paper into a 500ml conical flask and kept in a dessicator to remove the solvents completely. The purified extract was stored for treatment.

Thirty days old female albino rats (*Rattus norvegicus*) weighing 70 ± 10 g used for the current investigation. Rats were kept in a animal house and were fed standard rat pellet diet and drinking water by libitum. The animals with were divided into the three groups, each group consist of five animals.

Group I: Control
Group II: Treated with 50 ppm (30 days).
Group III: Treated with Sea weed extract (30 days).

Acute toxicity was carried on female rats, the minimum dose of cadmium (50ppm) were treated in the form of cadmium chloride through drinking water for 30 days for group II animals. The cadmium treatment was stopped after 30 days, and the animals were treated with sea weed extract through drinking water for 30days for group III animals. The experimental procedures were conducted in accordance with the guidelines with the approval no: BDU/IAEC/2019/NE/12.

Hormonal Analysis

Trunk blood was collected and sera separated out for hormone assays. The quantitative determination of hormones using Enzyme Immunoassay for T3,T4, Thyroid Stimulating Hormone (TSH) in Human Serum or plasma[10] by CLIA kit.

Histopathology:

Animals were sacrificed after 30days of treatment. The thyroid gland was removed and weighed, and its volume was determined. Thyroid tissues was immediately removed after scarification and immediately fixed in 10% formalin and processed to get 5 µm thick paraffin sections. These sections were stained with Haematoxylin & Eosin stain (H&E) and toluidine blue for routine histological examination.

Statistical Analysis:

The collected data for serum levels of hormones was statistically analyzed using SPSS software v.20. All the data are presented as means standard error of the mean (SEM). The difference between groups was determined using the ANOVA test. The level of significance was assessed at $P < 0.05$.

Results

Body weight

To find out the influence of cadmium on the body weight was reduced, the rats we're treated with 50ppm of cadmium. It may be due to some sort of metabolic alteration and physiological tolerance during chronic treatment with cadmium. When the

rats were treated with sea weed extract for another 30 days the weight is gained significantly (Table 1).

Table 1. Body weight changes during cadmium treated and Sea weed treated rats.

Control (g)	Cadmium treated (g)	Sea weed treated (g)
87.5000±3.23	75.0000±2.04	95.0000±2.04

Each value represents the mean and SEM. n=5 for each group, p value=0.0001, p<0.05 (Significant)

Thyroid gland weight

The present study showed the weight of thyroid gland in cadmium exposure, the weight of thyroid gland decreased than control rat, but the seaweed extract treated rats, thyroid gland weight increased significantly (Table 2).

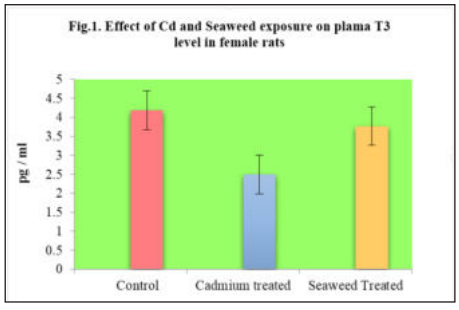
Table 2. Thyroid gland weight changes during cadmium treated and Sea weed treated rats.

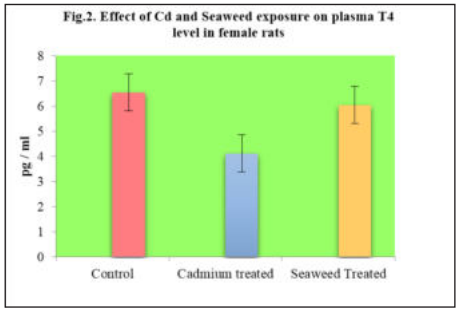
Control (g)	Cadmium treated (g)	Sea weed treated (g)
0.2425±0.00479	0.2050±0.00289	0.2300±0.00408

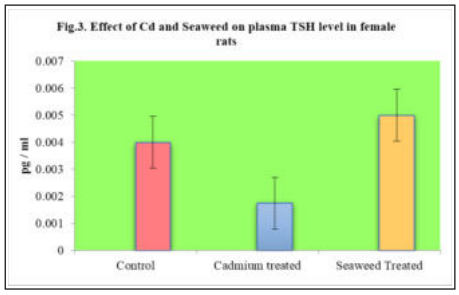
Each value represents the mean and SEM. n=5 for each group, p value=0.0002, p<0.05 (Significant)

Hormone level of T3, T4 and TSH

Regarding the concentration of plasma T3, T4 and TSH, they were high in control rats. In the rats exposed with cadmium (50ppm), the level of T3, T4 and TSH were decreased, when the rats were treated with seaweed extract the T3, T4 and TSH level were increased significantly (Fig.1, 2, 3).







Each bar represents the mean, and the vertical line above denotes SEM (n=5) Statistical significance of difference among groups at p< 0.05; Control versus Cd Treated p< 0.05 (** significant); Cd Treated versus Seaweed Treated p < 0.05 (**significant); Control versus Seaweed Treated p <0.05 (** significant).

Histopathological Study

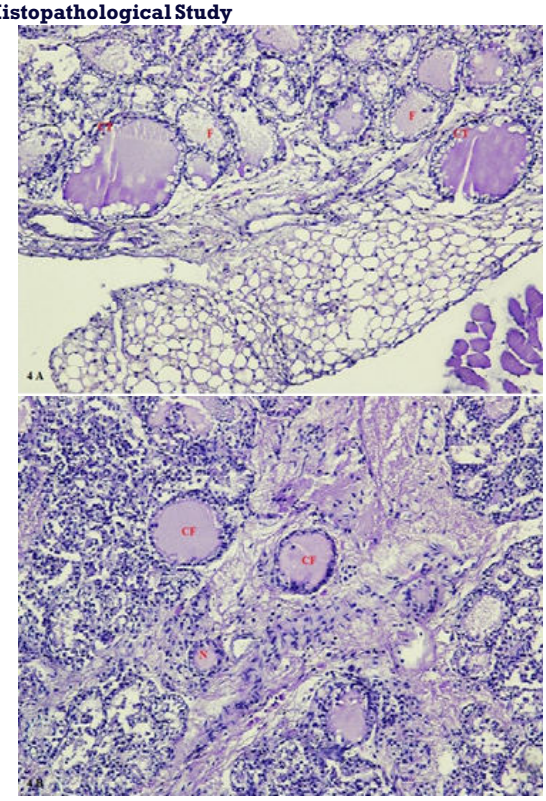


Fig 4 A & B. Photo micrograph **(A)** showed a section through, the thyroid gland of control animals showed well formed, closely impacted follicles separated by thin connective tissue septa (CT)**.** The thyroid follicles had variable sizes and shapes. Some follicles appear distended with colloid (C) and lined by flat cells. Other follicles have cuboidal cells (CF) with rounded nuclei **(B).**

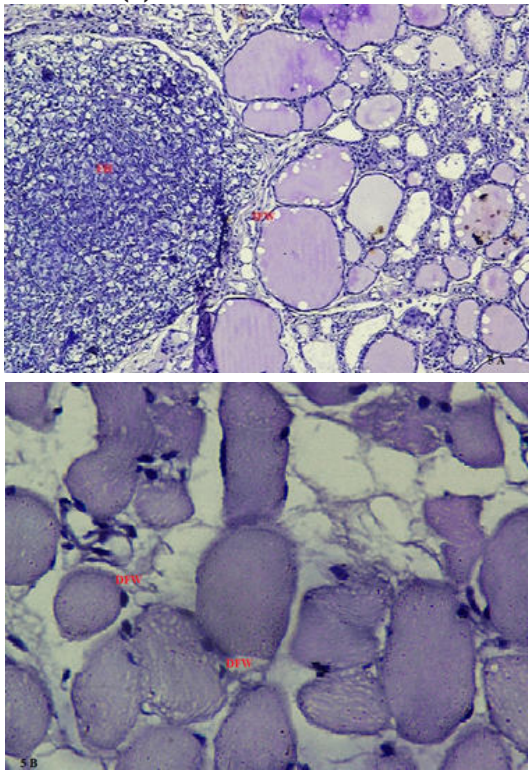
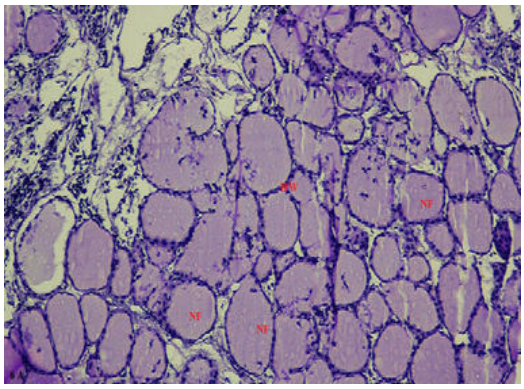


Fig 5 A & B. The gland in the exposed group showed disintegration and disorganization of thyroid follicles. Images showed follicular hyperplasia (FH) with darkly stained colloid. Some follicles appeared with interrupted follicular

wall (IFW), dissolute connective tissue, abnormal and scattered follicles. It also is showing abnormal aggregations of follicles in the form of various groups, it indicating the dissolution of follicular walls (DFW) **(B).**



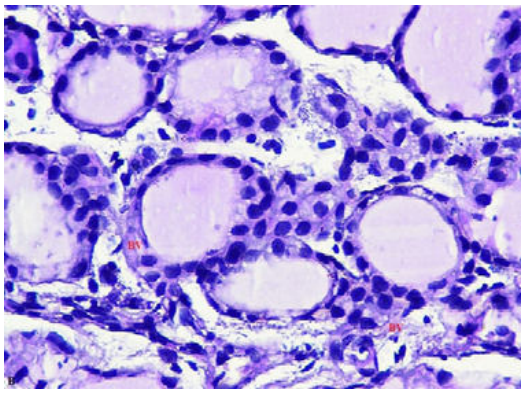


Fig 6 A & B. The thyroid gland of recovery group showed nearly normal thyroid follicles (NF) that lined with flattened cuboidal epithelium. The dissolution of follicular walls (IFW) was reconstructed **(A).** Showing thyroid follicles filled with colloid lined by simple cuboidal epithelium. Wide inter-follicular spaces contained many blood vessels (BV) and cellular infiltration. **(B).**

Discussion:

Cadmium (Cd) is one of the heavy metal with eminent endocrine distracting actions[11]. Chronic administration of cadmium directed to significant decrease in the body weight of rats, result of lowered food and water intakes, because of cadmium has a bad taste (Gupta and Gill 2000). The present study showed a change in the body weight (Table 1). The relative thyroid gland weight has notably declined in cadmium exposed rats [12]. Experimental group II of the present study confirmed the weight of thyroid gland in cadmium exposure, the weight of thyroid decreased than control rats (Table 2).

The thyro-toxicity is caused by gratuitous plasma T3, T4 and TSH levels, which are ordinary reliable indicators of the thyroid function in humans and experimental animals. The hormone levels changed in serum can reflect in disorders and glandular secretion in their extra-thyroidal peripheral metabolism [12]. In a study carry out by Hammouda et al., 2008 oral treatment of 200 ppm cadmium (as $CdCl_2$) significantly decreased serum T4 levels and TSH in Wistar albino rats after 35 days treatment. A lack of significant response of TSH to declined serum T3 and T4 could be owed to cadmium intrusion with pituitary regulation of thyroid hormones production and secretion, also the accrual of cadmium in the mitochondria of thyroid follicular epithelial cells might be disturb the oxidative phosphorylation of this organelle and defeat its energy supply caused inhibition of synthesis and release of thyroid hormones[13]. In the present study revealed that the concentration of plasma T3, T4 and T4, were high in control rats (Fig. 1, 2, 3). When the rats exposed with cadmium (50ppm), the level of T3, T4 and TSH were decreased significantly (Fig. 1, 2, 3). The observations of histopathological studies, together with our previous findings[13], indicated that cadmium alters the structure and function of both follicular and parafollicular cells of the thyroid.

Sea weeds or marine algae are probably inexhaustible resources of tremendously bioactive secondary metabolites that signify precious development in the development of new pharmaceutical agents[14]. Biological compounds separated from seaweed were proven to have potential medicinal activities such as antibacterial, antiviral, antitumour, antifungal, antiprotozoal, antioxidant, and mosquito and larva control[15]. Phytochemical screening of *S.wightii* exposed the occurrence of alkaloids, carbohydrates, glycosides, phenolic compounds, and tannins[16]. Fucoidan is one of the familiar components of *S. wightii* with varied natural activities including anti-inflammatory, anticancer, antimicrobial, and α-d-glucosidase inhibitory activity[17]. *Sargassum* has been used for remedial medicine for scrofula, goitre, tumour, edema, testicular pain and swelling[18]. In our investigation the rats were treated with sea weed extract (*S.wightii*) the T3, T4 and TSH level were increased significantly (Fig. 1, 2, 3).

As in the existing literature there is a lack of information on the protective effect of *S. wightii* supplement against cadmium toxicity. However, we hypothesize that the role of sea weed extract (*S.wightii*) against cadmium toxicity causing hormonal imbalance (T3, T4 and TSH) and histopathological inflictions in thyroid gland emerged to be associated with the antioxidant properties of sea weed extract (*S. wightii*) to reduce cadmium accretion in thyroid gland.

Conclusions

In conclusion, our results proved that the treatment of sea weed extract (*S.wightii*) was more effective and reversing cadmium induced alters in serum levels of T3, T4 and TSH and histopathological inflictions.

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