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Effect of *Saussurea costus* on propylthiouracil induced hypothyroidism in rats

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ABSTRACT

The present study aims to evaluate the effect of *Saussurea costus*on on Propylthiouracil (PTU)-induced hypothyroidism in rats. The chemical composition, phenolic compounds and antioxidant activity in this plant were evaluated. Thirty male albino rats weighing about 170±10 g was divided into five groups; negative control group, positive control group, and three treated groups with *S. costus* (100, 200 and 400 mg/kg bodyweight, respectively. The thyroid gland activity was evaluated utilizing biochemical and histopathological methods. The results indicated that the positive control group showed a significant increase in kidney and liver function biomarkers and a significant decrease in FT3, FT4, and TSH hormones. On the other hand, rats with induced hypothyroidism showed significant reduction in their body weight gain with different doses of *S. costus*. Also, the treated rats showed normal biochemical and hormonal levels, as well as normal histological results like the control group. This indicated that *S. costus* exhibits a promising effect in ameliorating PUT-induced hypothyroidism by regulating hormonal levels and restoring tissue damage, making it a potential natural candidate for future therapeutic studies.

***Keywords*:** Thyroid gland*, Saussurea costus,* Propylthiouracil, histology.

INTRODUCTION

The thyroid gland is a small, butterfly-shaped endocrine organ situated in the anterior region of the neck. It plays a crucial role in regulating metabolic processes, growth and thermogenesis through the secretion of thyroid hormones-primarily thyroxine (T4) and triiodothyronine (T3). Dysfunction of the thyroid gland can result in systemic disturbances that affect cardiovascular, neurological, and metabolic functions (Vitti and Hegedus, 2020). According to the World Health Organization (WHO), approximately 31% of the global population equivalent to 1,900.9 million individuals are estimated to have insufficient iodine intake. The most affected regions include South-East Asia and Europe (WHO, 2001). There is a growing consensus among medical professionals that the prevalence of thyroid-related disorders is on the rise. Autoimmune thyroid diseases encompass both hyperthyroidism, such as Graves' disease (GD), and hypothyroidism, such as Hashimoto's thyroiditis (HT). GD is primarily driven by thyrotropin receptor antibodies (TRAbs), which target the thyroid-stimulating hormone receptor (TSHR), constituting the principal mechanism underlying the disease (Furmaniak *et al.,* 2015). Conversely, HT is characterized by TH1 lymphocyte-mediated infiltration of the thyroid gland and the presence of autoantibodies against thyroid

peroxidase and thyroglobulin—key proteins involved in thyroid hormone synthesis (Walsh *et al.,* 2010).

Anti-thyroid agents such as 6-n-propyl-2-thiouracil (PTU) and methimazole (MMI) have been utilized to suppress the thyroid axis to examine the role of thyroid hormone synthesis and metabolism during larval development and growth in vertebrates (Campinho *et al.,* 2015). Thyroras (Propylthiouracil or PTU) is a medication primarily used to manage hyperthyroidism; a condition characterized by excessive production of thyroid hormones. It works by inhibiting the synthesis of these hormones, thereby helping to alleviate symptoms such as rapid heartbeat, weight loss, and heat intolerance. As a member of the thiouracil family, Propylthiouracil is a heterocyclic compound known for its broad pharmacological activity and adaptability in chemical synthesis (Andersen *et al.,* 2019).

Saussurea costus (Falc.) Lipsch, also known as Indian costus, has a long-standing history in traditional Saudi Arabian medicine and is recognized as a medicinal plant (Mujammami, 2020). It exhibits a wide range of biological activities, including anti-inflammatory, anti-urolithiasis, and antimicrobial properties (Soliman *et al.,* 2022). Furthermore, it has demonstrated potential in improving thyroid tissue damage induced by carbazole-related hypothyroidism (Fekry *et al.,* 2023). The plant *S. costus* has been extensively investigated for its therapeutic efficacy in addressing various health conditions, offering multiple medicinal benefits that position it as a promising candidate for pharmaceutical applications. Its anti-inflammatory and anti-urolithiasis effects, along with its capacity to mitigate thyroid disorders and tissue damage, have been the subject of numerous studies (Mammate *et al.,* 2023). *S. costus* has also been thoroughly examined for its phytochemical composition and its traditional medicinal relevance (Rathore *et al.,* 2021). The therapeutic potential of its extracts has been validated in traditional medicine, where it has been employed to treat a broad spectrum of ailments (Idriss *et al.,* 2022). Therefore, the aim of this work is to determine the effect of *S. costus* in treatment of Propylthiouracil (PTU)-induced hypo-thyroidism rats.

MATERIALS AND METHODS

Materials:

Saussurea costus were obtained from local market. Propylthiouracil (PTU) tablets were purchased from Amoun Pharmaceutical Co., Egypt. Each tablet contains 50 mg of PTU.

Analytical methods

Moisture, protein, fat, crude fiber and ash were determined according to the method of AOAC (2018). All determinations were made in triplicate. while the percentage carbohydrate was determined by the formula Carbohydrate= 100 - (moisture + crude fiber + ash + fat+ crude protein).

Animal and Experimental Design

Thirty male albino rats weighing about 170±10 g was obtained from Agricultural Research Center, Giza, Egypt. The animal groups were kept in an atmosphere of filtered, pathogen-free air, water, and a temperature of 20-25ºC for 8 weeks, with a 12-hour light/dark cycle and a light cycle (8-20 h) and a relative humidity of 50%. For one week, all rats were fed a basal diet. The basal diet was designed to contain 14% casein, 10% sucrose, 4% corn oil, 5% fiber (cellulose), 3.5 percent mineral mixture, 1% vitamin mixture, 0.25 percent choline chloride, 0.3 percent D-L methionine, and 61.95 percent corn starch

(Reeves *et al.,* 1993). After becoming acclimated to the circumstances of the experimental room, the animals were randomly separated into five groups of six rats each**:** The first main group (6 rats) was the negative control group and given distilled water. The second was the hypothyroid groups (24 rats): fed on a basal diet with received daily oral dose of propylthiouracil (15mg/kg body weight) by gastric tube for (17 days) and the tablet was dissolved in 10ml water to induce hypothyroid state according to (Hatem and AL- Mayali, 2018). A sample was taken from the eyes of rats at the end of the seventeenth day to confirm the occurrence of hypothyroidism. FT4 and FT3 were determined to ensure the hypothyroidism.

Afterward, administrated rats (n=24) were divided into 4 equal subgroups (6 rats) as follows: Subgroup (1): Rats were fed on a basal diet only and kept as a positive control group. Subgroup (2): Rats were fed on a basal diet containing *S. costus* (100mg/kg bodyweight). Subgroup (3): Rats were fed on a basal diet containing *S. costus* (200mg/kg bodyweight). Subgroup (4): Rats were fed on a basal diet containing *S. costus* (400mg/kg bodyweight). The intervention continued for 8 weeks.

Sampling

At the end of the experiment, rats were allowed to fast for 12 to 14 hours before blood samples were collected (Williams *et al.,* 2020). Blood samples were collected into evacuated tubes, and serum was separated by centrifugation at 3000 rpm for 10 min at 4˚C.

Biochemical analysis

Thyroid hormone concentrations were analyzed by colorimetric competitive enzyme immunoassay using individual ELISA kit. Triiodothyronine (FT3) levels in plasma were determined according to the method described by Braverman *et al*. (1996), while thyroxin (FT4) levels in plasma were estimated following the method outlined by Mazzafferi *et al.* (1998). Thyroid stimulating hormone (TSH) was assessed based on the method detailed by Shamsian *et al.* (2016). Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities were determined calorimetrically using spectrophotometer (model DU 4700) at 505 nm according to the method of Reitman and Frankel (1957). Alkaline phosphatase (ALP) activity was determined calorimetrically using spectrophotometer (model DU 4700) at 510 nm according to the method by Belfield and Goldberg (1971). Serum urea nitrogen was determined according to the method of Batton and Crouch, (1977) using spectrophotometer (model DU 4700) adjusted nm 550 nm. Serum creatinine was determined by Tietz (1986) using spectrophotometer (model DU 4700) adjusted at 510 nm.

Histopathological examination

Tissue specimens were collected from thyroid, heart, liver and kidney and fixed in 10 % neutral buffer formalin. Tissues were then processed by paraffin embedding technique using ascending concentration of alcohol and xylene, embedded in paraffin wax, sectioned into 4 µm thick sections and stained by hematoxylin and eosin stain. Light microscope with installed digital camera is used for examination (Banchroft *et al.,* 1996).

Statistical analysis

The obtained values were given as means ± S.D of the mean. The comparisons between different groups were carried out by one-way analysis of variance (ANOVA) according to Snedecor and Cochran (1980) followed by Duncan's Multiple Range test

for post hoc analysis using SPSS software version 24. The level of significance was set at $P \leq 0.05$.

RESULTS AND DISCUSSION

Chemical composition of *Saussurea costus*

The chemical composition of *S. costus*as expressed in Table (1) showed that it contains 0.60g/100g moisture, 2.74g/100g of proteins, 5.33g/100g of crude lipid, 84.91g/100g of carbohydrates, ash content 3.74g/100 g and crude fiber 1.68g/100g. The low moisture content indicates effective post-harvest drying, which is critical for preserving bioactive compounds and preventing microbial degradation. This aligns with studies showing that low moisture (<10%) in *S. costus* roots enhances shelf life and concentrates phytochemicals like sesquiterpene lactones (Binobead *et al*., 2024).

Table (1): Chemical constituent of *Saussurea costus* Constituents.

Chemical composition	Samples g/100g
	Saussurea costus
Moisture	0.60±0.1
Crude Protein	2.74± 0.22
Lipids	5.33±0.15
Crude fiber	1.68±0.08
Total Ash	3.74±0.36
Carbohydrates	84.91±0.73

Protein content may be relatively low, the substantial presence of crude lipids and carbohydrates, along with the mineral composition, underscores the potential nutritional and medicinal value of the roots of S. *costus*. The relatively high presence of crude lipids suggests the presence of fats, which could be important for energy storage and the absorption of fat-soluble vitamins. The carbohydrate content provides information on the energy potential of these roots, and the ash content reflects the mineral composition, which is important for both nutritional and medicinal considerations, as minerals play a crucial role in various physiological functions (Tungmunnithum *et al*., 2018)

Biological evaluation of *S. costus* on experimental rats induced by Propylthiouracil

Body weight, body weight gain (BWG) and weight of the organs

Data in Table (2) indicated that the initial weight of all groups had similar values to that of the negative control group. The initial weights ranged from 170.02 to 180.83 g, where there was none statistically significant difference among groups.

The PTU group exhibited minimal body weight gain (7.6±0.15g) compared to the negative control (38.7±3.09g), aligning with the profound metabolic slowdown characteristic of hypothyroidism (Kyriacou *et al*., 2019). PTU inhibits thyroid peroxidase, disrupting thyroxine (T4) and triiodothyronine (T3) synthesis and reducing basal metabolic rate (BMR). This suppresses lipolysis, gluconeogenesis, and thermogenesis, collectively curtailing weight gain (Khaled *et al*., 2022).

All root extract *S. costus* treated groups showed significant recovery in weight gain, with near-complete normalization at 400 mg/kg (35.8±1.74g to negative control 38.7±3.09g). This demonstrates the significant effect of *S. costus* in counteracting PTU-induced metabolic dysfunction.

Table (2): Body weight and body weight gain (%) of experimental rats which treated with *Saussurea costus*.

Body weight (g) /wk	Groups				
	Negative control	Positive controll	Treated with*Saussurea costus*		
			100mg	200mg	400mg
Initial body weight	170.02±2.34 [a]	174.17±2.18 [a]	172.67±2.42[a]	180.83±3.28 [a]	179.83±3.94 [a]
Final body weight	271.3±2.26[a]	197.29±5.98 [c]	267.0±3.05[b]	270.0±2.77[a]	273.7±2.33[a]
Body Weight gain	38.70±3.09 [a]	7.6±0.15[e]	34.1±1.79[c]	34.8±1.67[d]	35.8±1.74[b]

Values are means ± SD, n=6. Means in the same row with different superscripts (a,b,c and d) are statistically significant ($p \leq 0.05$). WK: Week.

Thyroid hormones analysis

Results in Table (3) showed thyroid hormones analysis and the group induced with PTU alone exhibited the classical biochemical hallmarks of hypothyroidism: significantly depressed levels of Free Triiodothyronine (FT3: 0.8±0.06 ng/ml) and Free Thyroxine (FT4: 1.5±0.1 ng/ml) coupled with a substantial elevation in Thyroid Stimulating Hormone (TSH: 3.41 ± 0.3 mIU/l) compared to the negative control (FT3: 4.5±0.4 ng/ml; FT4: 6.4±0.5 ng/ml; TSH: 0.08±0.003 mIU/l). This pattern (low FT3/FT4, high TSH) is the definitive diagnostic signature of primary hypothyroidism (De Groot *et al*., 2012). PTU achieves this by inhibiting thyroid peroxidase (TPO), the enzyme critical for iodine organification and the coupling of iodotyrosines to form T3 and T4 (Cooper & Biondi, 2012). The resulting decrease in thyroid hormone synthesis triggers a compensatory rise in TSH secretion from the pituitary via the negative feedback loop of the hypothalamic-pituitary-thyroid (HPT) axis (Brent, 2012). Treatment with *S. costus* root extract at all tested doses (100, 200, 400 mg/kg) effectively ameliorated the hypothyroid state induced by PTU. This was evidenced by a dose-dependent increase in FT3 and FT4 levels and a corresponding decrease in TSH levels compared to the PTU-induced hypothyroid group. PTU-induced hypothyroidism is associated with increased oxidative stress in thyroid tissue. *S. costus* is rich in sesquiterpene lactones (e.g., costunolide, dehydrocostus lactone) and flavonoids known for potent antioxidant properties (Chen *et al*., 2016). By scavenging free radicals and reducing oxidative damage to thyroid follicular cells, the extract may protect thyroid tissue integrity and enhance its synthetic capacity, as demonstrated in studies with other antioxidants (Erdamar *et al*., 2008). Some phytochemicals may directly stimulate thyroidal iodine uptake or TPO activity or protect the gland from the inhibitory effects of PTU. While specific data on *S. costus* and TPO is limited, its overall hepatoprotective and tissue-regenerative properties (Pandey *et al*., 2007) could extend to the thyroid. The significant restoration of FT3 and FT4, especially at 400 mg/kg, strongly suggests enhanced thyroidal synthesis and/or secretion. These findings corroborate and extend previous research highlighting the thyroid-modulator potential of medicinal plants, especially those with strong antioxidant and anti-inflammatory profiles (Saeed *et al*., 2022; Sharma *et al*., 2019).

Table (3): Thyroid hormones analysis of experimental rats induced by Propylthiouracil and treated with *Saussurea costus*.

Thyroid hormones	Groups				
	Negative control	Positive control	Treated with *Saussurea costus*		
			100mg	200mg	400mg
FT3 (ng/ml)	4.5±0.4^{a}	0.8±0.06^{d}	3.5±0.09^{b}	3.05±0.04^{c}	3.7±0.1^{b}
FT4 (ng/ml)	6.4±0.5^{a}	1.5±0.1^{d}	3.2±0.1^{bc}	3.4±0.07^{c}	4.6±0.2^{b}
TSH (mlu/l)	0.08±0.003^{d}	3.41±0.3^{a}	1.49±0.3^{c}	1.01±0.1^{bc}	0.08±0.001^{d}

Values are means ± SE, n=6. Means in the same row with different superscripts (a,b,c and d) are statistically significant ($p \leq 0.05$) . FT_3, Threonine; FT_4, Thyroxine, TSH Thyroid stimulating hormone

Biochemical investigations of liver function biomarkers

Data in Table (4) indicated that administration of PTU resulted in a pronounced significant increase ($p < 0.05$) of all measured liver enzymes compared to the negative control (AST: 47.6 ± 0.6 vs 81.6 ± 1.2; ALT: 25.6 ± 0.2 vs 67.3 ± 1.4; ALP: 40.90 ± 1.1 vs 82.13 ± 1.13). PTU is known to cause liver injury through mechanisms involving oxidative stress, mitochondrial dysfunction, and direct cellular damage, leading to hepatocyte necrosis and potential cholestatic changes (Woeber, 2002; Heidari *et al*., 2012). These results align with previous studies showing PTU significantly raises serum AST, ALT, and ALP levels in experimental models (Abd El-Twab *et al*., 2016).

After the treatment with root extract of *S. costus* at doses of 100, 200, and 400mg alongside PTU induction resulted in a significant, dose-dependent attenuation of the PTU-induced enzyme elevations for all parameters. The dose-dependent normalization of AST, ALT, and ALP strongly suggests that *S. costus* possesses potent hepatoprotective properties against PTU-induced damage. This protection is likely mediated through several mechanisms previously attributed to SC and its bioactive constituents (such as sesquiterpene lactones, flavonoids, and essential oils) also, *S. costus* is rich in antioxidants capable of scavenging PTU-generated reactive oxygen species (ROS) and enhancing endogenous antioxidant defenses (e.g., glutathione, superoxide dismutase) (Al-Yahya *et al*., 2015). Oxidative stress is a primary mechanism of PTU hepatotoxicity; thus, counteracting it is crucial (Heidari *et al*., 2012). Hepatic inflammation often accompanies toxin-induced injury. Constituents like dehydrocostus lactone in *S. costus* have demonstrated significant anti-inflammatory properties, potentially reducing inflammatory cytokine release and subsequent hepatocyte damage (Cho *et al*., 2000; Lee *et al*., 2011).

Gilani *et al.,* (2007) and Pandey *et al.,* (2007) reported significant reductions in AST, ALT, and ALP in CCl_4-intoxicated rats treated with *S. costus* root extract, attributing it to antioxidant and anti-inflammatory effects. Also, Al-Yahya *et al.* (2015) demonstrated *S. costus* is efficient in protecting against paracetamol-induced liver damage, correlating reduced enzyme levels with improved histopathology and enhanced antioxidant status. The dose-dependent response observed here (particularly the superior effect of 400mg) is consistent with findings by Rasool *et al.,* (2010) who noted increasing hepatoprotection with higher doses of *S. costus* extract against thioacetamide.

Table (4): liver enzymes of experimental rats induced by Propylthiouracil and treated with *Saussurea costus.*

liver enzymes (mg/dl)	Groups				
	Negative control	Positive control	Treated with *Saussurea costus*		
			100mg	200mg	400mg
AST	47.6±0.6^{e}	81.6±1.2^{a}	51.6±1.4^{d}	57.6±0.9^{b}	56.6±0.3^{c}
ALT	25.6±0.2^{e}	67.3±1.4^{a}	43.6±0.8^{b}	42.6±0.8^{c}	39±1.5^{d}
ALP	40.90±1.1^{e}	82.13±1.13^{a}	56.74±1.16^{b}	48.60±1.40^{c}	43.00±1.15^{d}

Values are means ± SD, n=6. Means in the same row with different superscripts (a,b,c and d) are statistically significant ($p \leq 0.05$). AST, aspartate amino transferase; ALT, Alanine amino transferase.ALP: serum alkaline phosphatase

Biochemical investigations of kidney function biomarkers

It was obvious from data in Table (5) that the group induced with PTU alone exhibited a significant elevation ($p<0.05$) in all measured kidney function parameters compared to the negative control group. Urea increased from 31.29 ± 0.7 mg/dL to 61 ± 0.7 mg/dL, creatinine increased from 0.4 ± 0.07 mg/dL to 1.4 ± 0.08 mg/dL, and uric acid increased from 2.2 ± 0.2 mg/dL to 4.5 ± 0.3 mg/dL (Table 5). These marked increases indicate severe impairment of kidney function, specifically glomerular filtration rate (GFR) and tubular handling. This finding aligns with established evidence of PTU's adverse effects on renal function. Studies suggest PTU nephrotoxicity may involve direct tubular damage, induction of oxidative stress, generation of free radicals, and potential immune-complex mediated glomerulonephritis. The drastic rise in creatinine, a direct indicator of GFR, strongly suggests reduced filtration capacity (Al Asmari *et al*., 2015; Wiles *et al*., 2019). Similarly, elevated urea levels reflect impaired nitrogenous waste clearance. Increased uric acid could result from reduced excretion due to tubular damage or potentially increased production linked to metabolic disruption or oxidative stress (Kang *et al*., 2002).

Table (5): Serum kidney functions of experimental rats induced by Propylthiouracil and treated with *Saussurea costus*.

kidney functions (mg/dl)	Groups				
	Negative control	Positive control	Treated with *Saussurea costus*		
			100mg	200mg	400mg
Urea	31.29 ±0.7^{d}	61±0.7^{a}	38.7±0.9^{b}	34.4±1.4^{b}	29.3±1.8^{c}
Creatinine	0.4±0.07^{d}	1.4±0.08^{a}	0.54±0.1^{c}	0.44±0.07^{b}	0.43±0.03^{d}
Uric acid	2.2±0.2^{b}	4.5±0.3^{a}	3.2±0.1^{b}	3.2±0.1^{b}	2.9±0.2^{c}

Values are means ± SD, n=6. Means in the same row with different superscripts (a,b,c and d) are statistically significant ($p \leq 0.05$).

After treatment with *S. costus* extract at all doses (100, 200 and 400mg) significantly improved ($p<0.05$) the PTU-induced elevations in urea, creatinine, and uric acid levels compared to the untreated PTU group. The dose-dependent attenuation of renal dysfunction by *S. costus* strongly supports its nephroprotective potential. This aligns with numerous studies on medicinal plants rich in antioxidants and anti-inflammatory compounds. *S. costus* root is known to contain potent bioactive constituents like sesquiterpene lactones (costunolide, dehydrocostus lactone),

alkaloids, and flavonoids (Pandey *et al*., 2007). Previous research on *S. costus* and related species has demonstrated significant antioxidant activity (scavenging free radicals, boosting endogenous antioxidants like SOD and GSH), anti-inflammatory effects (inhibiting pro-inflammatory cytokines like TNF-α, IL-6), and potential anti-fibrotic properties (Singh *et al*., 2017; Kumar *et al*., 2019). PTU-induced nephrotoxicity is heavily mediated by oxidative stress and inflammation. By counteracting these pathways, *S. costus* likely protects renal tubular cells from damage, preserves glomerular integrity, and improves overall excretory function. The significant reduction in creatinine, particularly at 200mg and 400mg doses, highlights its potential to protect or restore glomerular filtration. The reduction in uric acid suggests improved tubular handling or reduced oxidative stress burden (Butterworth *et al*., 2008). The efficacy of *S. costus* was clearly dose-dependent across all parameters. The 400mg/kg dose consistently produced the most significant improvements. It is consistent with pharmacological principles where higher concentrations of active compounds exert greater biological effects. Similar dose-dependent nephroprotective effects have been observed with other plant extracts in models of drug-induced toxicity (Ateşşahin *et al*., 2005).

Histopathological studies:

Microscopy of the thyroid gland revealed normal histological structures in the negative control group. It is characterized by follicles, which are the functional units, and the colloid they contain. These follicles are lined by a single layer of thyroid follicular epithelium formed of cuboidal cells, with moderate amounts of eosinophilic cytoplasm and round, hyperchromatic nuclei. The follicles are embedded in connective tissue stroma, which includes capillaries and lymphatic vessels. The colloid is a homogeneous, eosinophilic, protein-rich fluid in the thyroid follicles and containing thyroid hormones produced by the thyroid follicular epithelium. (Fig.1A).

In positive control group, the thyroid gland microscopy showed less organized follicles which were hyper cellular, with occluded or small lumen having little colloid. Few desquamated cells were seen in the lumen (Fig.1B). Oxidative stress is implicated in various thyroid pathologies (Mancini *et al.,* 2016).

In *S. costus* (100mg/kg body weight) group, few large thyroid follicles lined by flattened epithelium and containing colloid were observed (Fig.1C). In *S. costus* (200mg/kg bodyweight) group, the thyroid gland, showed mild histopathological alteration (Fig.1D). In *S. costus* (400mg/kg bodyweight) group, the microscopy of thyroid gland, showed normal histological structure as seen in (Fig. 1 E).

S. costus is renowned for potent antioxidant properties due to sesquiterpene lactones (costunolide, dehydrocostus lactone), flavonoids, and phenolic compounds (Pandey *et al.,* 2007; Kumar *et al.,* 2015). Some phytochemicals can influence deiodinase enzymes, thyroid hormone transport, or even feedback at the hypothalamic-pituitary-thyroid axis (HPT axis) (Deiana *et al.,* 2020).

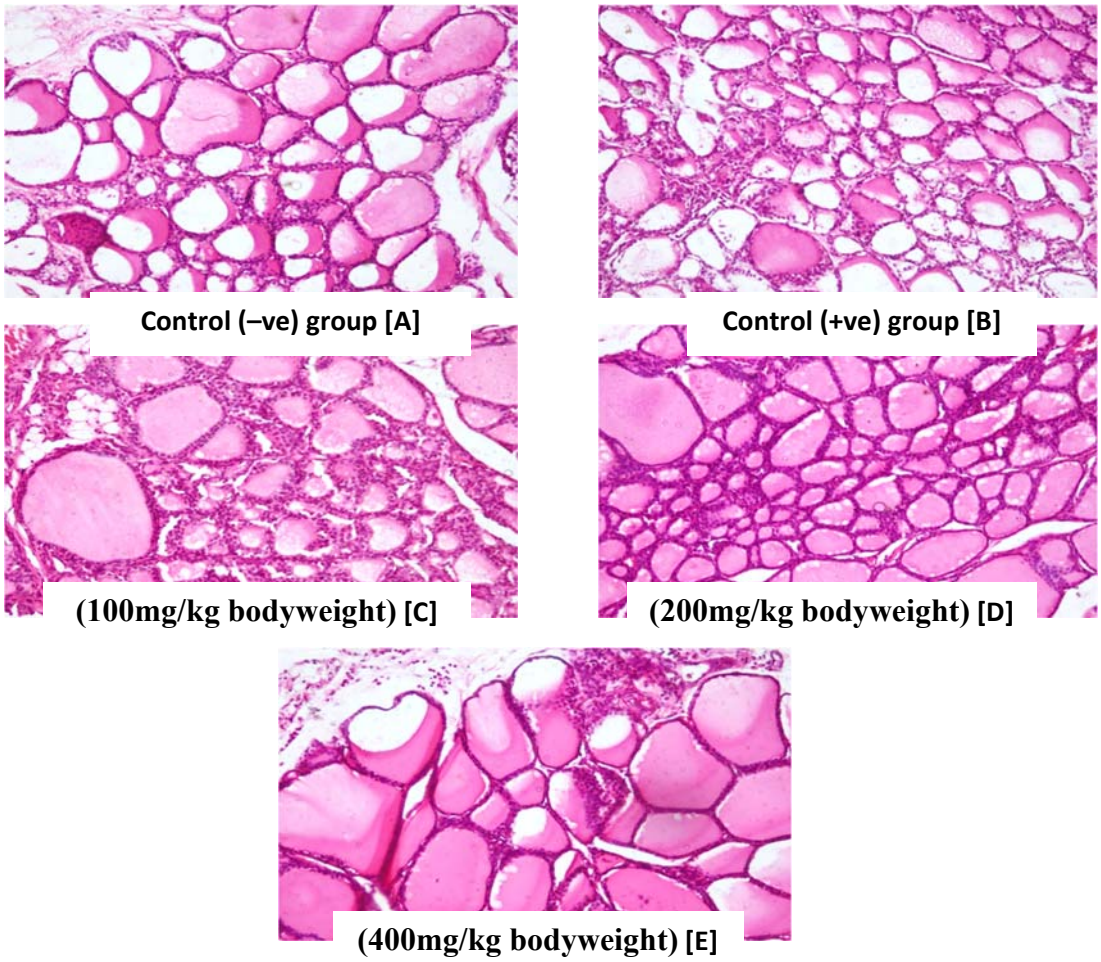

Fig. (1): Histopathological changes in thyroid gland of experimental rat (control –ve and +ve groups) and other groups treated by *Saussurea costus*. Stained with H and E stain X 200).

A- Showing multiple thyroid follicles lined by squamous epithelium and containing colloid.
B- Showing less organized follicles which were hypercellular, lined by columnar epithelium and with occluded or small lumen having little colloid.
C- Showing few large follicles lined by flattened epithelium and containing colloid.
D- Showing many large follicles lined by flattened epithelium and containing colloid

Showing many large follicles lined by flattened epithelium and containing colloid
E- Showing many large follicles lined by flattened epithelium and containing colloid

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تأثير أستخدم نبات القسط الهندى على قصور الغدة الدرقية المحدث بالبروبيل ثيوراسيل في فئران التجارب

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المستخلص

تهدف الدراسة الحالية إلى تحديد تأثير نبات القسط الهندى *Saussurea costuson* على قصور الغدة الدرقية المحدث بعقار البروبيل ثيوراسيل (PTU) في فئران التجارب. وقد تم تحليل التركيب الكيميائى , والمركبات الفينولية ونشاط مضادات الأكسدة في النبات. كما تم تقسيم 30 فأر ذكر البينو وزن كل واحد (170 ±10 جرام) إلى خمس مجموعات. مجموعة ضابطة سالبة, مجموعة ضابطة موجبة أحدث فيها قصور في الغدة الدرقية بواسطة (PTU), ثلاث مجموعات مصابة بقصور الغدة الدرقية وتم علاجها بجرعات 100, 200, 400 ملجم/كجم من وزن الجسم) على التوالي. تم تقييم وظيفة الغدة الدرقية باستخدام التحاليل البيوكميائية والفحص النسيجى. أظهرت نتائج القسط الهندى أنخفاض معنوى في وزن الفئران. كما أظهرت نتائج المجموعة الضابطة الموجبة زيادة جوهرية في مؤشرات وظائف الكبد والكلى وأنخفاض كبير جوهرى في مستويات هرمونات FT3, FT4 , TSH. بعد العلاج بنبات القسط الهندى أظهرت النتائج عودة النتائج البيوكيميائية ونتائج الهرمونات إلى المستوى الطبيعى, أيضاً تحسن في البنية النسيجية للغدة الدرقية لتصبح مشابه للمجموعة الضابطة. أظهرت النتائج أن لاستخدام نبات القسط الهندى *Saussurea costuson* تأثيراً واعداً في تحسين قصور الغدة الدرقية الناجم عن البروبيل ثيوراسيل (PTU), من خلال تنظيم الهرمونات وإصلاح الأضرار النسيجية, مما يجعله مرشحاً طبيعياً للدراسات العلاجية المستقبلية.

الكلمات الدالة: الغدة الدرقية، القسط الهندي، البروبيل ثيوراسيل (PTU) ،علم الأنسجة.