

The Effect of Alcoholic Extract of *Saussurea Costus* (*S. Costus*) Root in Rats with Hypothyroidism

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Abstract

Hypothyroidism happens when thyroid gland doesn't make enough thyroid hormones to meet the body need. This study aimed to investigate the effect of some levels of alcoholic extract of *Saussurea Costus* (*S. costus*) root on Propylthiouracil induced hypothyroidism in rats. Thirty-five rats were divided into two main groups as follows: the first main group (7 rats) control negative group. The second main group, 28 rat were injected with Propylthiouracil (PTU) then were divided into 4 subgroups (7 rats each), fed on basal diet and were *given orally (100, 300 and 500 mg Alcoholic Extract of root Saussurea /kg BW), respectively*. The results showed that rats injected with Propylthiouracil (positive control rats) had significant ($P < 0.05$) decrease in the concentrations of thyroxine (T4) and triiodothyronine (T3), Iodin, Iron, Zinc, Selenium and Vitamin C and significant increase in thyroid-stimulating hormone (TSH) level as compared to that of the negative control group. It was also observed that the oral alcoholic extract of (*S. costus*) root caused a significant ($P < 0.05$) improvement in the thyroid functions as increasing the concentrations of FT3, FT4 and lowering the level of TSH. Moreover, the level of lipid profile was decreased as well as the biomarkers of oxidative stress as compared to the positive control group. The level of Iodin, Iron, Zinc, Selenium and Vitamin C as well as the concentrations of antioxidant biomarkers were significantly increased as a result if giving oral alcoholic extract of (*S. costus*) root. The current investigation revealed that administration of PTU to rats was related to abnormalities levels of thyroid hormones, and oxidative stress parameters and that therapy with alcoholic extract of (*S. costus*) root ameliorated these variations in blood, suggesting alcoholic extract of (*S. costus*) root may be suitable for improving the functions of thyroid gland.

Keywords: *Saussurea costus*- Hypothyroidism - propylthiouracil- rats- thyroid functions – antioxidant- lipid profile.

INTRODUCTION

Worldwide, the incidence of individuals with thyroid dysfunction is increasing and represents approximately 30–40% of the patients seen in an endocrine clinic; thus, it is one of the leading endocrine disorders (**Tsegaye and Ergete, 2003**). Regarding the prevalence of thyroid diseases in Arab countries, in a Saudi Arabia study, the researchers revealed clear evidence that the prevalence of thyroid disorders in the Makkah region was very high at approximately 47.34% (**Lamfon, 2008**). The study conducted by (**Nouh *et al.*, 2008**) in Libya, observed the prevalence of hypothyroidism was 6.18%. Even more interestingly findings from other researchers suggested that the prevalence of subclinical hypothyroidism was 2.3% (**Ghawil *et al.*, 2011**).

Thyroid hormones play a key role in growth and neuronal development (**Taylor *et al.*, 2018**) Studies have shown that hypothyroidism is linked with cognitive impairment (**Shaji, 2022**). Hypothyroidism is associated with reduced functioning in several domains of cognition such as attention, memory, language, executive functioning and perceptuo-motor abilities (**Khaleghzadeh *et al.*, 2022**).

Propylthiouracil inhibits the production of new thyroid hormone in the thyroid gland It acts by inhibiting the enzyme thyroid peroxidase, which usually converts iodide to an iodine molecule and incorporates the iodine molecule into amino acid tyrosine. Hence, DIT (diiodotyrosine) or MIT (monoiodotyrosine) does not get produced, which are the main constituents in the production of thyroxine (T4) and triiodothyronine (T3) Peripherally, it acts by inhibiting the conversion of T4 to T3. It affects the existing thyroid hormones stored in the thyroid gland as well as

those circulating in the blood (**Drugs and Lactation Database, 2020**).

Saussurea is one of herbal plants that is rich in antioxidant, anti-hepatotoxic, antidiabetic, antifungal, anthelmintic, anti-ulcer, antitumor, anti-inflammatory, antimicrobial effects and immunostimulant activities (**Tousson et al., 2019**). *Saussurea costus* synonymous with *Saussurea lappa*, also known as qust in Arabic or Costus root in English, belongs to family of Asteraceae, a species of thistle in the genus *Saussurea* found worldwide mostly in Western Himalayan region of Pakistan and India (**Shah, 2006**). Bioactive components from natural sources have also captivated scientific attention because of their functional, pharmacological, and biological properties (**Shahein et al., 2022**).

Chemical constituents extracted from this plant are lactone cynaropicrin, dehydrocostus, germacrene, lappadilactone that show useful pharmacological and medical characters (**Kamal et al., 2019**). The main phenolic compounds are Naringenin, Chlorogenic acid, Ferulic acid, Ellagic acid, Gallic acid and coffeic acid followed by taxifolin, catechin, syringic acid, methyl gallate, vanillin, kaempferol, cinnamic acid and rutin. GC-MS results showed 14 compounds in *S. costus* extract (**Deabes et al., 2021**).

The phytochemical screening of ethanolic and aqueous extracts of *Saussurea lappa* root proved the presence of vitamin C (**El-Salam et al., 2019**). Moreover reported that *Saussurea costus* supplementation had ameliorating effects on altered thyroid stimulating hormone, thyroxine, sodium, potassium, chloride, albumin, creatinine, urea, calcium ions, cholesterol and triglycerides levels in hypo and hyperthyroidism, this may be related to antioxidant activity of *S. costus* (**Al-Megrin et al., 2020**).

Materials and methods

Materials:

Plant: Saussurea Costus roots were obtained from the Agriculture Research Center. **Chemicals:** Casein, vitamins, minerals, cellulose and Ethanol was purchased from El-Gomhoria Company, Cairo, Egypt. Propylthiouracil was obtained from Sigma Chemical Co., USA. **Kits** for blood analysis were purchased from Alkan Company for Bio Diagnostic Reagents, Dokki, Cairo, Egypt. **Animals:** thirty-five adult male rats (Sprague Dawley strain), (200±5 g.) were obtained from Helwan Farm, Ministry of Health and Population, Cairo, Egypt.

Methods:

Preparation of an alcoholic root extract: *The fresh roots of Saussurea were shade-dried for 4 days then they were milled into fine powder by electric blender.* Saussurea Costus roots were grinded then extracted 50 g of the plant roots then was extracted using 200 mL of 70% ethanol at room temperature, macerated for 72 hours, then was filtered three times and evaporated to obtain a crude Saussurea Costus extract (*Srivastava et al.,2012*)

Induction of Hypothyroidism:

Propylthiouracil (6-n-propyl-2- thiouracil) was dissolved in 0.1NaOH/ 0.9% NaCl and administered as 10 mg/kg. B.W./day by i.p. injection for 15 days according to (*Sener et al., 2006*).

Experimental Animal Design:

The basal diet was formulated according to *Reeves, et al., 1993*. After the adaptation period, thirty-five rats were divided into

two main groups, the first main group (7 rats) was fed on basal diet (as a control negative group). The second main group (28 rats) were injected with Propylthiouracil to induce hypothyroidism then were divided into 4 subgroups (7 rats each): subgroup (1): was fed on basal diet (as a control positive group) subgroups (2 to 5): were fed on basal diet and given orally (100, 300 and 500 mg Extract root *Saussurea* /kg BW), respectively.

Biological Evaluation:

During the experiment period of 28 days the quantities of diet that were consumed and/or waste, were recorded every day. Water and basal diet had been introduced under hygienic conditions. Feed intake was recorded daily, and animals were weighed at the beginning and twice a week throughout the experimental period. Body weight gain percent (BWG%) and feed efficiency ratio were determined according to (Chapman *et al.*, 1959), using the following equation:

$$\text{BWG}\% = (\text{Final body weight} - \text{Initial body weight}) / \text{Initial body weight} \times 100$$

$$\text{FER} = \text{Weight gain} / \text{Feed intake}.$$

Biochemical Analysis of Serum:

Serum Free triiodothyronine (FT3), free thyroxin (FT4) and Thyroid-Stimulating Hormone (TSH) were determined according to (Agharanya 1990 ;Frank *et al.*, 1996 and Sachidhanandam *et al.*, 2010). Malondialdehyde (MDA) and Glutathione peroxidase (GPx) were determined according to (Ruiz-Larnea *et al.*, 1994 and Beutler *et al.*, 1963). Serum Aspartate Aminotransferase (AST), alanine aminotransferase (ALT) Alkaline phosphatase (ALP) was determined according to (Reitman and Frankel, 1957; Reitman

and Frankel 1957 and Belfield and Goldberg 1971), respectively. *Total cholesterol* (TC), *Serum triglyceride*, *High density lipoprotein cholesterol* (HDL-c), *Low density lipoprotein cholesterol* (LDL-c) and *Very Low-density lipoprotein cholesterol* (VLDL-c) were determined according to (Richmond 1973; Wahlefeld 1974 and Albers *et al.*, 1983 and Freidewald *et al.*, 1972, respectively. *Serum Vit.C*, *Selenium* and *Iron* were determined according to ([Levine et al., 1999](#); Horky et al., 2016 and Ruutu, 1975) respectively. *Serum Iodine* and *zinc* were determined according to (Barnes, 1997 and Hambidge, 1987), respectively.

Statistical Analysis: The results were analyzed according to the SPSS program. An ANOVA test was used to compare results among groups and $P \leq 0.05$ were considered to be significant (Armitage and Berry, 1987).

Results and Discussion:

The study investigated the effects of alcohol extract of *Saussurea Costus* Root on body weight status in rats with induced hypothyroidism.

The results in table (1) showed that there were no significant differences in IBW among all groups, indicating that the initial body weight was well-balanced and not a confounding factor in this study. The negative control group (-Ve) fed on a normal diet showed an increase in FBW ($p < 0.05$) compared to the positive control group. Propylthiouracil-injected rats fed on a basal diet and given orally alcohol extract (100, 300 and mg/Kg BW) showed a significant increase in the FBW ($p < 0.05$) compared to the positive

control group but had a significant decrease compared to the negative control group.

The negative control group (-Ve) showed an increase in FI compared to the positive control group. The positive control group (+Ve) showed a significant decrease in FI compared to the negative control group but had a significant decrease compared to the positive control group. Propylthiouracil-injected rats fed on a normal diet and alcohol extract (100 mg/Kg BW, 300 mg/Kg BW, 500 mg/Kg) showed a significant increase in FI compared to the positive control group but had a significant decrease compared to the negative control group.

The positive control group (+Ve) showed a significant decrease in BWG% ($p < 0.05$) compared to the negative control group (-Ve). Propylthiouracil injected rats fed on a normal diet and given alcohol extract (100 mg/Kg BW, 300 mg/Kg BW, 500mg/Kg) showed a significant increase in the BWG% ($p < 0.05$) compared to the positive control group but had a significant decrease compared to the negative control group. There was no change in GWG% between the rats given either 300 or 500 mg/Kg BW.

Propylthiouracil-injected rats fed on a normal diet and alcohol extract (100mg/Kg BW) showed a significant increase in FER ($p < 0.05$) compared to the positive control group but had a significant decrease compared to the negative control group. Oral administration with the different levels of (*S. costus*) caused a significant increase in the mean of FER. Moreover, there were no significant changes among the treated groups. The results suggest that the alcohol extract of Saussurea Costus Root has a positive impact on managing hypothyroidism-related symptoms, including weight gain, food intake, and feed efficiency. While the extract does not fully restore normal levels, it significantly improves the

condition compared to untreated hypothyroid rats these findings were in the same line with (El Kutry, 2021) who reported that administrative an aqueous extract (50 & 100 mg/kg body weight/day) significantly improved the body weight status compared to the rats with Thyroiditis.

According to Rios-Prego et al., (2019), thyroid dysfunctions are linked to rat weight loss or gain. These agree with our results so rats with thyroids have low BWG, ($P < 0.01$), also groups treated with amiodarone plus *S. costus* showed that BWG, FI, and thyroid wt. ratio were improved but not in the normal range.

Table (1): The Effect of Alcohol Extract of *S. costus* on biological body weight in Rats with Hypothyroidism

Parameters Groups	IBW (g)	FBW (g)	FI g/d/rat	BWG (%)	FER
Control (-Ve)	203.20±1.89 ^a	274.20±2.13 ^a	22	34.97±1.38 ^a	0.076±0.002 ^a
Control (+Ve)	205.40±1.92 ^a	244.80±1.73 ^d	18	19.18±0.31 ^d	0.052±0.001 ^c
100mg/Kg BW	202.60±2.06 ^a	249.40±1.91 ^{cd}	19	23.11±0.36 ^c	0.058±0.001 ^b
300mg/Kg BW	207.20±1.66 ^a	257.40±1.81 ^{bc}	20	24.22±0.30 ^{bc}	0.059±0.001 ^b
500mg/Kg BW	203.80±2.26 ^a	259.60±2.22 ^b	21	27.39±0.38 ^b	0.063±0.001 ^b

Values are expressed as Mean ± Standard Error (SE),

Means with different letters in each column are significantly differs at $P < 0.05$.

The effect of Alcohol Extract of *Saussurea Costus* on activities of liver functions in Propylthiouracil -injected rats was recorded at Table 2. The obtained results revealed that the positive control group fed on a normal basal diet had a significant increase in serum concentrations of AST, ALT and ALP enzymes, compared to the negative control group. In contrast, oral feeding Propylthiouracil -injected rats with the alcoholic extract of (*S. costus*) caused significant ($p < 0.05$) decreases in serum concentrations of AST, ALT and ALP enzymes as compared to the positive control rats. The

highest improvement in serum levels of liver enzymes was presented in Propylthiouracil -injected rats treated with 500mg/Kg BW Alcohol Extract of Saussurea Costus. It was observed that there was a significant difference in serum AST and ALT among the treated groups. The results suggest that the alcohol extract of Saussurea Costus Root has a hepatoprotective effect in hypothyroid rats treated with Propylthiouracil. This effect is evidenced by the significant reduction in liver enzyme levels, which are indicative of improved liver function.

The findings highlight the potential therapeutic benefits of the extract in managing liver-related complications in hypothyroidism. These findings were in the same line with (**Abd, et al., 2022** and **Tousson, et al., 2020**), who revealed that Saussurea lappa root ethanol root extract significantly improved hepatotoxicity as evidenced by reversal of various biochemical and histopathological changes in female rats, this promising impact may be due to the antioxidant and free radical scavenging characteristics of Saussurea lappa constituents. **Moreover**, these improvements could be attributable to phytoconstituents compounds such as flavonoids and phenols that act as antioxidant compounds to effectively prevent radical-induced oxidative damage (**Ravindran and Mohamed, 2019**).

Table (2) summarized that negative control group had a significant ($p < 0.05$) decrease in the serum concentrations of TC, TG, TL and LDL-c, and increase in HDL-c and VLDL-c level as compared to that of the Propylthiouracil -injected rats and fed on the normal basal diet (positive control rats). The results indicated that, giving the different levels of Alcohol Extract of Saussurea Costus caused a significant decrease on serum lipid profile (TC, TG and

LDL-C) and significant increase in serum HDL-C as compared to the +ve control group.

It was observed that there were no significant changes in serum TG, VLDL-C and HDL-C between the groups given 100 or 300 mg/kg/BW Alcohol Extract of *Saussurea Costus*. However, there was no changes in serum TC, TG and VLDL-C between the groups given 300 or 500 mg/kg/BW Alcohol Extract of *Saussurea Costus*. The highest improvement of lipid profile was recorded at the level of 00 mg/kg/BW Alcohol Extract of *Saussurea Costus*.

These findings were in the same line with (Abd, *et al.*, 2022), who emphasize the importance of addressing thyroid function in the management of lipid disorders and highlight the potential benefits of the alcohol extract of *Saussurea Costus* Root in improving lipid profiles in hypothyroid conditions. Moreover, (Mahmoud, 2020) reported that excessive ethanolic extract of *Saussurea Costus* is rich in antioxidant Its antioxidant effect may attribute to its active constituents, namely flavonoids, anthraquinone, and many terpenes such as alpha-and beta-amyrin.

Table (2): The Effect of Alcohol Extract of *Saussurea Costus* (*S. Costus*) on Serum levels of lipid profile in Rats with Hypothyroidism

Parameters Groups	TC mg/dl	TG mg/dl	HDL mg/dl	LDL mg/dl	VLDL mg/dl
Control (-Ve)	121.77±1.82 ^d	76.68±0.33 ^b	39.14±0.55 ^a	67.29±0.41 ^e	15.33±0.86 ^b
Control (+Ve)	158.96±1.66 ^a	93.28±0.51 ^a	24.51±0.29 ^d	11578±1.39 ^a	18.65±0.13 ^a
100mg/Kg BW	140.60±1.17 ^b	89.51±0.72 ^a	25.93±0.22 ^{cd}	96.76±0.55 ^b	17.90±0.14 ^a
300mg/Kg BW	135.91±1.73 ^c	84.34±0.73 ^{ab}	27.84±0.54 ^c	91.19±0.50 ^c	16.87±0.14 ^{ab}
500mg/Kg BW	133.18±1.27 ^c	79.44±0.36 ^b	30.61±0.60 ^b	86.67±0.87 ^d	15.89±0.17 ^b

Values are expressed as Mean ± Standard Error (SE), Means with different letters in each column are significantly differs at P< 0.05.

Table (3) Results of injections with PTU caused a significant ($p < 0.05$) increase in the serum concentrations of MDA and decrease in GPX level as compared to that of the normal basal diet. These findings underscore the importance of addressing oxidative stress in the management of hypothyroidism and highlight the potential benefits of therapeutic interventions, such as the alcohol extract of *Saussurea Costus* Root, in improving oxidative stress markers. The results showed that there were significant differences among the treated rats for serum MDA. However, there were no significant changes in serum GPX between the rats treated either 100 or 300 mg/kg BW. The dose of 500 mg caused the highest increase in serum antioxidant enzymes GPX and decreased the concentration of MDA.

These findings were in the same line with (Kumar, *et al.*, 2024) who reported that costus root extract at 3 different doses (100, 250 and 500 mg/kg BW) for 18 weeks contains costunolide, which has anti-inflammatory and anti-cancer properties. Due to antioxidant constituents of *Saussurea Costus* Root extract (Mahmoud, 2020).

The improvement if oxidative biomarkers might be because phytochemical components including flavonoids, and chlorogenic acid function as antioxidants, reducing PTU toxicity by decreasing free radical-induced lipid peroxidation (Kadhem, 2019).

Table (3): The Effect of Alcohol Extract of *S. costus* on serum MDA and GPX in Rats with Hypothyroidism

Parameters Groups	MDA ng/mL	GPx U/mL
Control (-Ve)	103.83±1.86 ^c	134.22±1.99 ^a
Control (+Ve)	176.98±1.81 ^a	83.23±1.40 ^d
100mg/Kg BW	241.81±1.48 ^b	94.75±1.35 ^c
300mg/Kg BW	214.41±1.60 ^c	100.91±1.52 ^c
500mg/Kg BW	195.62±1.03 ^d	115.34±1.57 ^b

Values are expressed as Mean ± Standard Error (SE), Means with different letters in each column are significantly differs at $P < 0.05$.

Table (4): The results of serum FT3 and FT4 were significantly decreased however, the concentration of serum TSH was significantly increased at the +Ve control group injected with Propylthiouracil as compared to the -Ve control group. Treated rats with the different levels of Alcohol Extract of *Saussurea Costus* caused a significant increase in serum FT3 and FT4 while serum TSH was significantly decreased as compared to the +Ve control group. The highest improvement in thyroid function was recorded at the group given 500 mg/kg BW of Alcohol Extract of *Saussurea Costus*.

Table (4): The Effect of Alcohol Extract of *Saussurea Costus* (*S. costus*) on Serum levels of FT3, FT4, TSH in Rats with Hypothyroidism

Parameters Groups	FT3 pg/mL	FT4 ng/dL	TSH μIU/mL
Control (-Ve)	4.54±0.14a	3.67±0.03a	0.93±0.01d
Control (+Ve)	1.55±0.13d	1.70±0.01e	5.84±0.03a
100mg/Kg BW	2.43±0.25c	1.97±0.02d	4.82±0.25b
300mg/Kg BW	2.99±0.15b	2.33±0.06c	3.34±0.07b
500mg/Kg BW	3.18±0.14b	2.96±0.04b	3.09±0.02c

Values are expressed as Mean ± Standard Error (SE), Means with different letters in each column are significantly differs at $p < 0.05$.

PTU exposed rats showed hypothyroidism which was evidenced biochemically by significant ($P < 0.05$) decrease in serum T3 and T4 levels with significant ($P < 0.05$) increase in serum TSH level as compared to control rats. These results are in agreement with **Sener et al., (2006)** who reported that PTU dramatically reduced thyroid hormones. Serum concentrations of thyroid

hormones (T3, T4) and TSH are commonly used as reliable indicators of the thyroid function in humans and experimental animals (**Kelly, 2000**).

These findings were in the same line with (**Abd, et al., 2024 and Mahmoud, 2020**) who reported that excessive *Saussurea lappa* root ethanol extract caused a promising impact on thyroid functions due to the antioxidant and free radical scavenging characteristics.

Table (5) summarized that -ve control group have a significant ($p < 0.05$) increase in the serum concentrations of Iodin, Iron, Zinc, Selenium and Vitamin C, compared to that of the Propylthiouracil -injected rats and fed on the normal basal diet (positive control rats). Supplementation with different levels of Alcohol Extract of *Saussurea Costus* caused a significant increase in serum iron. While there were no significant changes in serum Iodin, zinc, selenium and vitamin C in rats given 100 mg/kg BW of Alcohol Extract of *Saussurea Costus* as compared to the +Ve control group. It was observed that the levels of Alcohol Extract of *Saussurea Costus* at 500 mg/kg BW caused the highest increase in serum tested minerals as compared to the +ve control group.

These findings underscore the importance of monitoring and addressing micronutrient deficiencies in the management of hypothyroidism and highlight the potential benefits of interventions aimed at improving micronutrient status these findings were in the same line with (**Iqbal, et al., 2019**) who reported that excessive ethanolic *Saussurea lappa* root extract are highly rich in bioactive phytochemicals and nutraceutical compounds such as alkaloids, flavonoids, terpenoids, tannins and saponins, vitamins, proteins. The quantitative phytochemical analysis revealed that plant parts had high phenolic, flavonoid, β -carotene, and lycopene content (**Singh, et al., 2018**). The high phenolic compounds contribute to the

enhanced ability of plants to quench reactive oxygen species (ROS) due to their redox potential (Mishra *et al.*, 2013). Moreover, (Rabeh and El-Ghandour, 2016) suggested that Vitamin C, Vitamin E, Zinc and Iron could be used as a suitable supplementation therapy for hypothyroidism patients.

Table (5): The Effect of Alcohol Extract of *Saussurea Costus* (*S. costus*) on serum levels of IODIN, IRON, ZINC, SELENIUM, VITAMIN C in Rats with Hypothyroidism

Parameters Groups	Iodin µm/ml	Iron µm/ml	Zinc µm/ml	Selenium µm/ml	Vitamin C µg/ml
Control (-Ve)	1.24±0.51 ^a	8.97±0.45 ^a	7.97±0.78 ^a	0.316±0.010 ^a	8.96±0.73 ^a
Control (+Ve)	3.09±0.39 ^c	2.05±0.51 ^c	2.50±0.14 ^c	0.049±0.002 ^c	2.27±0.61 ^d
100mg/Kg BW	3.98±0.35 ^{bc}	2.83±0.30 ^b	4.41±0.35 ^{bc}	0.093±0.001 ^c	3.81±0.26 ^{cd}
300mg/Kg BW	4.77±0.12 ^{bc}	5.53±0.13 ^b	4.85±0.19 ^b	0.190±0.003 ^b	5.38±0.11 ^{bc}
500mg/Kg BW	5.02±0.29 ^b	5.63±0.16 ^b	5.82±0.26 ^b	0.210±0.010 ^b	6.69±0.25 ^{ab}

Values are expressed as Mean ± Standard Error (SE), Means with different letters in each column are significantly differs at $p < 0.05$

Finally, the current investigation revealed that administration of PTU to rats was related to abnormalities levels of thyroid hormones, and oxidative stress parameters and that therapy with alcoholic extract of (*S. costus*) root ameliorated these variations in blood, suggesting alcoholic extract of (*S. costus*) root may be suitable for improving the functions of thyroid gland.

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تأثير المستخلص الكحولي لجذور القسط الهندي علي الفئران المصابة بقصور الغدة الدرقية

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المستخلص

يحدث قصور الغدة الدرقية عندما لا تنتج الغدة الدرقية ما يكفي من هرمونات الغدة الدرقية لتلبية احتياجات الجسم. هدفت هذه الدراسة إلى معرفة تأثير بعض مستويات المستخلص الكحولي لجذور القسط الهندي على قصور الغدة الدرقية الناجم عن Propylthiouracil (PTU) في الفئران. تم تقسيم خمسة وثلاثين فأراً إلى مجموعتين رئيسيتين على النحو التالي: المجموعة الرئيسية الأولى (٧ فئران) المجموعة الضابطة السالبة. المجموعة الرئيسية الثانية، ٢٨ فأراً تم حقنها بمادة PTU ثم تم تقسيمها إلى ٤ مجموعات فرعية (٧ فئران لكل منها) ، تم تغذيتها على النظام الغذائي الأساسي وتم إعطاؤها عن طريق الفم 100 و ٣٠٠ و ٥٠٠ ملجم من المستخلص الكحولي لجذور القسط الهندي / كجم من وزن الجسم الفأر على التوالي. أظهرت النتائج أن الفئران المحقونة بروبيل ثيوراسيل (المجموعة الضابطة الموجبة) كان لديها انخفاض معنوي ($P < 0.05$) في تركيزات الثيوركسين (T4) وثلاثي يودوثيرونين (T3) واليود والحديد والزنك والسيلينيوم وفيتامين ج وزيادة معنوية في مستوى هرمون الغدة الدرقية (TSH) مقارنة بالمجموعة الضابطة السالبة. وقد لوحظ أن المستخلص الكحولي لجذور القسط الهندي أدت الي تحسن معنوي ($P < 0.05$) في وظائف الغدة الدرقية حيث زاد من تركيزات FT3 و FT4 وخفض مستوى TSH. كما لوحظ انخفاض معنوي في مستوى صورة الدهون وكذلك المؤشرات الحيوية للإجهاد التأكسدي مقارنة بالمجموعة الضابطة الموجبة. علاوة على ذلك، ارتفع مستوى اليود والحديد والزنك والسيلينيوم وفيتامين ج في السيرم وكذلك تركيزات المؤشرات الحيوية المضادة للأكسدة بشكل كبير نتيجة إعطاء المستخلص الكحولي لجذور القسط الهندي . وتشير الدراسة الي أن إعطاء مادة PTU للفئران كان مرتبطاً بمستويات غير طبيعية من هرمونات الغدة الدرقية ومعايير الإجهاد التأكسدي وأن العلاج بالمستخلص الكحولي لجذور القسط الهندي خفف من هذه الاختلافات في الدم، مما يشير إلى أن المستخلص الكحولي لجذور القسط الهندي قد يكون مناسباً لتحسين وظائف الغدة الدرقية.

الكلمات المفتاحية: القسط الهندي- قصور الغدة الدرقية- بروبيل ثيوراسيل- الفئران - وظائف الغدة الدرقية- مضادات الأكسدة- ملف الدهون.