



Research Article

EGGPLANT PEEL EXTRACT AS A REMEDY FOR HYPERTHYROIDISM IN MALE RABBITS

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ABSTRACT

This study aimed to investigate the effect of three different concentrations of eggplant peel extract as a remedy for hyperthyroid in male rabbits. Twenty male rabbits with average weight 1600 ± 105 g and age of 5-6 months were chosen. These rabbits were randomly and equally divided into four groups (five animals in each). The first group (GI) was considered as a control and never received any treatment. The second, third and fourth groups (GII, GIII and GIV) were received $30 \mu\text{g}/\text{Kg}$ BW sodium L-Thyroxine injected subcutaneously to induce hyperthyroidism for three weeks. After that, these groups (GII, GIII and GIV) were administered 5, 8 and 12 mg/kg of body weight eggplant peel aqueous extract, respectively for three weeks. Blood samples were collected from hyperthyroids and treated groups. Serum was centrifuged at 3000 rpm for 15 minutes. The collected serum was used in the assessment of the levels of thyroxine (T4), triiodothyronine (T3) and thyroid stimulating hormones (TSH) by analytical kits which determined on ELISA method. The results of the present work showed that there was a significant ($p < 0.05$) decrease in the means of T3 and T4 hormone levels in rabbits treated with eggplant peel extract at 5, 8 and 12 mg/kg body weight compared with hyperthyroid. While, these results demonstrated that there was a significant ($p < 0.05$) increase in the means of TSH hormone levels in rabbits treated with eggplant peel extract at 5, 8 and 12 mg/kg body weight compared with hyperthyroid. It concluded from the present study that the natural products such as anthocyanins (nasunins) which extracted from eggplant peel might be used as a remedy to recover from hyperthyroid states in order to reduce the intake of chemical drugs.

KEY WORDS: Eggplant peel; hyperthyroid; TSH; T3; T4.

INTRODUCTION

Thyroid is one of the principal glands in the body's endocrine system [1]. Two thyroid hormones, thyroxine (T4) and triiodothyronine (T3) are involved in the regulation of myriad of body functions including cellular metabolism, oxygen consumption, nerve conduction and reproduction [2, 3]. In addition, thyrotropes in the anterior pituitary produce Thyrotropin (Thyroid stimulating hormone (TSH)) to maintain the appropriate level of thyroid hormones (T3 and T4) [1].

Thyroid disorders in many developing countries constitute a growing health problem [2]. Thyroid hormones are kept within normal levels in the body via the endocrine negative feedback mechanism [3]. Alterations in the normal levels of these hormones usually lead to physiological/clinical abnormalities, such as hypothyroidism and hyperthyroidism [2].

Further, these hormones have a considerable impact on oxidative stress. However, changes in their levels could alter redox environment, via causing changes in the number and activity of mitochondrial respiratory chain components resulting in increased generation of reactive oxygen species (ROS) which are often attenuated by antioxidants [3, 4]. In hyperthyroidism and hypothyroidism, disturbance of oxidant/antioxidant balance leads to cellular damage, severe metabolic dysfunctions, and damage to biological macromolecules such as proteins, lipids and DNA [1].

Eggplant (*Solanum melongena* L.) commonly known as aubergine, melanzana, garden egg, brinjal, or patican [5, 6], is a vegetable typical of the Mediterranean diet and consumed throughout the world [7]. It is one of the most important vegetable

crops grown on over 1.7 million of the worldwide, such as China, India, Bangladesh, Nepal and Srilanka [6].

This fruit is particularly rich in antioxidants, ranking among the top 10 vegetables in terms of antioxidant capacity [5, 7, 8, 9, 10]. It contains a higher content of free reducing sugars, anthocyanin, phenols, glycoalkaloids (solasodine) and amide proteins [6]. Further, it has a valuable importance in the prevention of major diseases, including cardiovascular disease, liver complaints, diabetes and tumors [6, 7, 9].

As anthocyanins are the main phenolic compounds in eggplant peel [8], therefore, the present study aimed to investigate the effect of three different concentrations of eggplant peel extract as a remedy of hyperthyroid gland in male rabbits.

MATERIALS AND METHODS

Preparation of Aqueous Extract of Eggplant Peel

The eggplant peels were prepared manually and washed twice with tap and distilled water. Each sample was then chopped to small pieces and soaked in distilled water (1:5) over night at 4°C. Samples were then homogenized in a homogenizer and the resulting homogenates were filtered with a three-layer of cloth. The crude juices were centrifuged at $20,000 \times g$ for 30 min to remove any particulate material. The supernatants were further filtered through two Millipore filters (0.45 and 0.22 μM). The filtrates were lyophilized and the lyophilized extracts were stored in an airtight container at -80°C until application [11]. Then, the dried samples were crushed using a grinder, and each 30 g was extracted with 20 volumes of water [8].

Experimental Design

This experiment was performed on 20 male rabbits weighing 1600 ± 105 g, with an age of 5-6 months. These rabbits were obtained from Central Health Laboratories in Baghdad City, Iraq. They were kept in the Animal House for one week before the experiment and administered a standard diet which constitute from corn starch, vitamins, fibers and minerals. The temperature in the Animal House was maintained at $23 \pm 2^\circ\text{C}$ with a relative humidity of $55 \pm 5\%$. Light period was 12: 12 hours light: dark. The rabbits were randomly and equally divided into four groups (five animals in each). The first group (GI) was considered as a control and never received any treatment. The second, third and fourth groups (GII, GIII and GIV) were received $30 \mu\text{g/Kg BW}$ sodium L-Thyroxin injected subcutaneously to induce hyperthyroidism for three weeks [12].

After the three weeks were elapsed, these groups (GII, GIII and GIV) were administered 5, 8 and 12 mg/kg of body weight eggplant peel aqueous extract, respectively for three weeks.

Blood samples were collected from hyperthyroids and treated groups with the three concentration of aqueous extract of eggplant peel. Blood was collected from the inferior vena cava of each rabbit and drained in non-heparinized tubes. Serum was centrifuged at 3000 rpm for 15 minutes. The collected serum was stored at -20°C until it was used in the assessment of the levels of thyroxine (T4), triiodothyronine (T3) and thyroid stimulating hormones (TSH) by analytical kits which determined on ELISA method [13].

Statistical Analysis

The results of the present study were analyzed statistically using analysis of variance test (ANOVA). The significance between means was determined by Duncan test with the aid the program of SPSS (ver. 17) at probability level $p < 0.05$ [14].

ETHICAL CLEARANCE

This study was carried out as per ethical standards of Department of Biology, College of Science, University of Baghdad. The animal ethical clearance number for this study was 267 at 23/10/2017.

RESULTS AND DISCUSSION

The results of the present study showed that there was a significant ($p < 0.05$) decrease in the means of T3 and T4 hormone levels in rabbits treated with eggplant peel extract at 5 mg/ kg body weight compared with hyperthyroid. The levels of T3 were 46.52 ± 3.37 , 61.90 ± 4.47 and 40.80 ± 2.49 ng/dl in eggplant peel extract at 5 mg/kg, hyperthyroid and control rabbits, respectively. While the levels of T4 were 2.58 ± 0.27 , 3.8 ± 0.44 and 1.9 ± 0.34 ng/mL in eggplant peel extract at 5 mg/kg, hyperthyroid and control rabbits, respectively. Concerning the levels of TSH hormone, the results showed that there was a significant ($p < 0.05$) increase in the means of TSH hormone levels in rabbits treated with eggplant peel extract at 5 mg/ kg body weight compared with hyperthyroid. The levels of TSH hormone were 6.52 ± 0.69 , 5.28 ± 0.59 and 7.2 ± 0.84 ng/mL in eggplant peel extract at 5 mg/kg, hyperthyroid and control rabbits, respectively. (Table 1).

Table 1: Thyroid hormones in hyperthyroid rabbits before and after treatment with eggplant peel extract at 5 mg/ kg of body weight.

Groups Hormones Levels	Control	Hyperthyroid	Eggplant peel extract
T3 (ng/dl)	40.80 ± 2.49 c	61.90 ± 4.47 a	46.52 ± 3.37 b
T4 (ng/mL)	1.9 ± 0.34 c	3.8 ± 0.44 a	2.58 ± 0.27 b
TSH (ng/mL)	7.2 ± 0.84 a	5.28 ± 0.59 c	6.52 ± 0.69 b

*Different letters in the same row indicate a significant difference at $p < 0.05$.

Further, the results in Table (2) demonstrated that there was a significant ($p < 0.05$) decrease in the means of T3 and T4 hormone levels in rabbits treated with eggplant peel extract at 8 mg/ kg body weight compared with hyperthyroid. In addition, there was no significant difference in the means of T4 hormone level in eggplant peel extract at 8 mg/kg compared with control rabbits. The means of T3 hormone levels were 45.32 ± 4.16 , 62.46 ± 6.28 and 40.80 ± 2.49 ng/dl in eggplant peel extract at 8 mg/kg, hyperthyroid and control rabbits, respectively. While the means of T4 hormone levels were 2.30 ± 0.33 , 3.12 ± 0.37 and $1.9 \pm$

0.34 ng/mL in eggplant peel extract at 8 mg/kg, hyperthyroid and control rabbits, respectively. On the other side, the results illustrated that there was a significant ($p < 0.05$) increase in the means of TSH hormone levels in rabbits treated with eggplant peel extract at 8 mg/ kg body weight compared with hyperthyroid. Further, there was no significant difference in the means of TSH hormone level in eggplant peel extract at 8 mg/kg compared with control rabbits. The levels of TSH hormone were 6.66 ± 0.68 , 5.46 ± 0.56 and 7.2 ± 0.84 ng/mL in eggplant peel extract at 8 mg/kg, hyperthyroid and control rabbits, respectively.

Table 2: Thyroid hormones in hyperthyroid rabbits before and after treatment with eggplant peel extract at 8 mg/ kg of body weight.

Groups Hormones Levels	Control	Hyperthyroids	Eggplant peel extract
T3 (ng/dl)	40.80 ± 2.49 a	62.46 ± 6.28 c	45.32 ± 4.16 b
T4 (ng/mL)	1.9 ± 0.34 a	3.12 ± 0.37 b	2.30 ± 0.33 a
TSH (ng/mL)	7.2 ± 0.84 a	5.46 ± 0.56 b	6.66 ± 0.68 a

*Similar letters in the same row indicate no significant difference while different letters in the same row indicate significant difference at $p < 0.05$.

Concerning the results in Table (3), there was a significant ($p < 0.05$) decrease in the means of T3 and T4 hormone levels in rabbits treated with eggplant peel extract at 12 mg/ kg body weight compared with hyperthyroids. In addition, there was no significant difference in the means of T3 and T4 hormone level in eggplant peel extract at 12 mg/kg compared with control rabbits. The means of T3 hormone levels were 42.18 ± 2.53 , 63.34 ± 6.76 and 40.80 ± 2.49 ng/dl in eggplant peel extract at 12 mg/kg, hyperthyroid and control rabbits, respectively. While the means of T4 hormone levels were 2.09 ± 0.30 , 3.04 ± 0.43 and $1.9 \pm$

0.3449 ng/mL in eggplant peel extract at 12 mg/kg, hyperthyroid and control rabbits, respectively. In addition, these results showed that there was a significant ($p < 0.05$) increase in the means of TSH hormone levels in rabbits treated with eggplant peel extract at 12 mg/ kg body weight compared with hyperthyroid. Further, there was no significant difference in the means of TSH hormone level in eggplant peel extract at 12 mg/kg compared with control rabbits. The levels of TSH hormone were 6.89 ± 0.67 , 5.32 ± 0.53 and 7.2 ± 0.84 ng/mL in eggplant peel extract at 12 mg/kg, hyperthyroid and control rabbits, respectively.

Table 3: Thyroid hormones in hyperthyroid rabbits before and after treatment with eggplant peel extract at 12 mg/ kg of body weight.

Groups Hormones Levels	Control	Hyperthyroid	Eggplant peel extract
T3 (ng/dl)	40.80 ± 2.49 b	63.34 ± 6.76 a	42.18 ± 2.53 b
T4 (ng/mL)	1.9 ± 0.34 b	3.04 ± 0.43 a	2.09 ± 0.30 b
TSH (ng/mL)	7.2 ± 0.84 a	5.32 ± 0.53 b	6.89 ± 0.67 a

*Similar letters in the same row indicate no significant difference while different letters in the same row indicate significant difference at $p < 0.05$.

In hyperthyroid rabbits, the elevated levels of thyroid hormones (T4 and T3) lead to increased basal metabolic rate, elevated oxygen intake and released high quantities of reactive oxygen species which increased free radicals production and declined anti-oxidant metabolites; [1, 13, 15]. Relatively, high levels of free radicals are generated particularly in response to thyrotropin. These serve as substrate for thyroperoxidase enzymes which catalyze the synthesis of thyroid hormones, thyroxine and triiodothyronine [15].

Further, TSH was declined in the presence of increased thyroid hormone levels is related to the negative feedback effect, which regulated the secretion of TSH from the anterior pituitary gland [1].

Generally, peel tissue of plant contains higher amounts of phenolics, anthocyanins, and flavonols than pulp tissue (about two and four times greater than in pulp) [8, 9, 10]. Eggplant peel also showed higher amounts of those compounds than pulp [8, 9]. Especially, the anthocyanin content in the peel which is much higher than the pulp tissue [9]. Different kinds of anthocyanins have been extracted and identified from eggplant skin [16]. Nasunin, delphinidin-3-(p-coumaroylrutinoside)-5-glucoside, as a major anthocyanin in eggplant peel [8, 9] (ranging from 69.1% to 87.7%) [16]. These anthocyanin present in the eggplant peels had high antioxidant activity, powerful scavenger of hydroxyl radicals and superoxide radicals [7]. So there should be a close correlation between the content of phenolic compounds and antioxidant activity [8, 10].

Therefore, the usage of aqueous extract of eggplant peel as a remedy of the hyperthyroid rabbits may be due to the high contents of anthocyanins in these peel especially nasunin. Thus, these compounds act to reduce the high levels of thyroid hormones and return their levels to the normal range. Further, it had been found that the higher concentration of this extract (12 mg/ kg of body weight) had a high efficacy in the recovery from hyperthyroidism than other two concentrations.

CONCLUSION

It was concluded from the present study that the natural products such as anthocyanins (nasunins) which extracted from eggplant peel and might be used as a remedy to recover from hyperthyroid states in order to reduce the intake of chemical drugs.

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