J HerbMed Pharmacol. 2014; 3(2): 93-96.

Journal of HerbMed Pharmacology

Journal homepage: http://www.herbmedpharmacol.com

The effect of feeding with soybean on serum levels of TSH, T_3 and T_4 in male mice

Mehrdad Modaresi[1*], Hormat Khorrami[2], Majid Asadi-Samani[3]

[1]Biology Faculty, Khorasgan (Isfahan) Branch, Islamic Azad University, Isfahan, Iran
[2]Payam-e-Noor University, Isfahan Center, Isfahan, Iran
[3]Medical Plants Research Center, Shahrekord University of Medical Sciences, Shahrekord, Iran

ARTICLE INFO

Article Type:
Original Article

Article History:
Received: 6 June 2014
Accepted: 8 September 2014
ePublished: 1 December 2014

Keywords:
Isoflavone
Soybean
Thyroid stimulating hormone
Triiodothyronine
Thyroxine
Male mice

ABSTRACT

Introduction: Soybean possesses isoflavones and might, therefore, cause problem in thyroid hormone synthesis. The purpose of this study was to study the effect of soybean on serum levels of Thyroid stimulating hormone (TSH), Triiodothyronine (T_3), and Thyroxine (T_4) in male mice.
Methods: In this experimental study, 24 Balb/C male mice were randomly assigned to three groups of eight including control or base diet-fed group and treatment groups 1 and 2 receiving respectively 30% and 50% soybean-containing diet. After nine weeks, the blood sample was taken from the animals' heart and serum levels of TSH, T_3, and T_4 were measured. The data were analyzed by SPSS software using one-way ANOVA and Duncan's test.
Results: In 50% soybean group, a significant decrease was observed in T_4 serum level compared to the control group ($p<0.05$). On the other hand, this hormone level non-significantly decreased in the group fed by 30% soybean compared to the control group ($p<0.05$). TSH serum level increased significantly in 30% soybean group compared to the control group ($p<0.05$). But, serum level of T_3 was not significantly different between 30% or 50% soybean groups and control group ($p>0.05$).
Conclusion: In view of the findings, it is estimated that the effect of addition of soybean into meal on thyroid function is dose-dependent, so that the diet containing 30% and 50% soybean might cause increased TSH release in thyrotrope cells and hence variation in pituitary-thyroid axis function.

Implication for health policy/practice/research/medical education:
Feeding with soybean can have a dose-dependent effect on thyroid function and might cause increased TSH release in thyrotrope cells and variation in pituitary-thyroid axis function.

Please cite this paper as: Modaresi M, Khorrami H, Asadi-Samani M. The effect of feeding with soybean on serum levels of TSH, T_3 and T_4 in male mice. J HerbMed Pharmacol. 2014; 3(2):93-96.

Introduction

Soybean (*Glycine max*) has been of interest as an effective herbal compound to treat osteoporosis and reduce menopausal symptoms (1). Soybean could inhibit peroxidase enzyme thanks to containing various isoflavones and therefore causes inhibition of thyroid hormones synthesis (2).

Soybean contains minerals, protein, vitamin, and various carbohydrates. 60% of the dried soybean weight consists of fat (17.20%) and protein (40-67.30%). Since soybean protein is rich in vitamins B1 and B2, pantothenic acid, colin, niacin, and all essential amino acids for the body, it is undoubtedly considered as a main source of nutrients for human (3).

One of the other important compounds found in soybean which is today the main reason for tendency toward its consumption worldwide is phytoestrogen. Phytoestrogens are plant derivatives of estrogens with diphenolic structure found in fruits, vegetables, peas, and particularly seeds like cotton, alfalfa, clover, and soybeans. Phytoestrogens enjoy all physiological, physical, and chemical specifications of estrogens. The main isoflavone of soy is genistein (4).

By recent works, administration of estrogen-containing drugs causes increased risk of breast and endometrial cancers in postmenopausal women. Use of estrogen-like compounds particularly plant types (phytoestrogens)

***Corresponding author**: Mehrdad Modaresi, Tell: +989132074854,
Email: mehrdad_modaresi@hotmail.com

abundantly found in soy foods including soy milk and protein not only satisfies postmenopausal women's need for estrogen, but also is free from any side effect and decreases the risk of cancer development (5).

Some studies indicated that soy consumption could lead to suppression of thyroid activity and goiter incidence (6). Also, the reported effects for soy on cancer, osteoporosis, and cardiovascular diseases have led to increased interest in soy consumption. Although the US Food and Drug Administration IN 1999 mentioned soy as contributing to cholesterol decrease and containing numerous bioactive elements, soy isoflavones are still attracting public attention. On the other hand, genistein found in soy causes dilation of blood vessels, improvement of blood vessel elasticity, and decrease in blood pressure by increasing nitric oxide release.

All these contribute positively to heart and decrease systolic and diastolic pressure (6); however, some studies have indicated that phytoestrogens causes decreased quality of sperm in men. Empirically, the diet rich in phytoestrogen compounds such as soy could cause change in pituitary–hypothalamic–gonadal axis in men as with diethyl acetyl nisterol compounds (7).

Since thyroid is considered as one of the most important endocrine glands and contributes to regulating general metabolism of the body including its most fundamental constituent, that is oxygen, growing of fetal nervous system, and functioning of most body's organs such as cardiovascular, digestive, and reproductive systems, any disturbance in function of thyroid leads to disturbance in function of other body organs, and genistein found in soy could cause disorder effects on pituitary-hypothalamic axis, we aimed to investigate soy effects on concentrations of Thyroid stimulating hormone (TSH), Triiodothyronine (T_3), and Thyroxine (T_4).

Materials and Methods

In this study, 24 Balb/C male mice with mean weight of 35±5 g were enrolled. The study samples were maintained in appropriate laboratory at 25±3 °C, with normal light period, and in sterilized cages. The mice were provided with enough water and food.

The mice were randomly assigned to three groups of eight each including control group (fed with base diet) and intervention groups 1 and 2 (fed with the diet containing respectively soy 30% and soy 50%).

As this study was based on feeding of mice with soy protein, the consumed food by each mouse was calculated by the difference in weight of the given food per day during a week. Livestock concentrate for feeding the mice was pulverized by an electric mortar and then the food mixture containing soy 30% and 50% was prepared based on the treatment dose. The mixture was again pelleted and made available to the mice. The duration of treatment was considered nine weeks for each animal.

After nine weeks treatment, the blood was taken to investigate the levels of TSH, T_4, and T_3. For this, experimental samples were partially anesthetized by ether and the blood was taken directly from the heart. The samples were collected and were hormonally measured. Hormonal measurement was done by immunoenzymatic methods in the solid-phase by Eliza reader.

Results

In the group treated with soy 30% in the diet, mean serum level of TSH hormones increased significantly compared to the control group and group treated with soy 50% in the diet ($p<0.05$); However, the increase in the group treated with the diet containing soy 50% was not significant compared to the control group ($p>0.05$) (Figure 1).

In the group treated with soy 50% in the diet, mean serum level of T_4 hormones decreased significantly compared to the control group ($p<0.05$). However, the corresponding decrease was not significant in the group treated with the diet containing soy 30% compared to the control group ($p>0.05$; Figure 2).

In the group treated with soy 30% in the diet, mean serum level of T_3 hormones decreased and in the group treated with soy 50% in the diet T_3 hormones increased (Figure 3). However, these variations were not significant compared

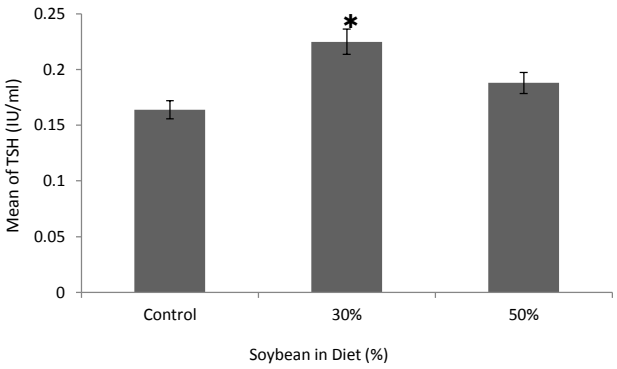

Figure 1. Comparison of serum TSH hormones in the groups of study; *Significant difference from control group ($p<0.05$)

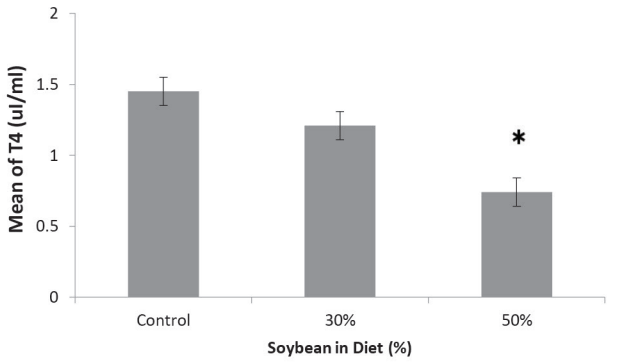

Figure 2. Comparison of serum T_4 hormones in the groups of study; *Significant difference from control group ($p<0.05$)

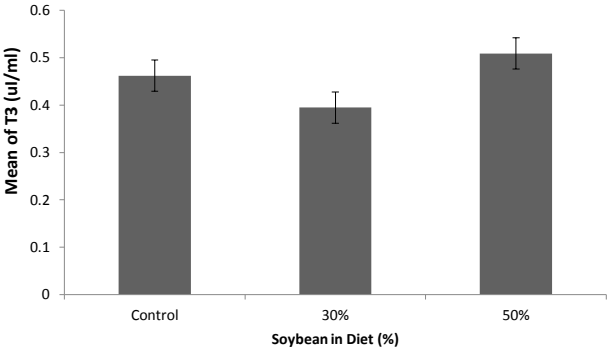

Figure 3. Comparison of serum T_3 hormones in the groups of study

to the control group (p>0.05).

Discussion

In this study, the effects of the diet containing soy 30% and 50% on serum levels of TSH, T_3, and T_4 were investigated in laboratory male mice and the results indicated mean serum level of TSH hormones increased significantly in the group treated with soy 30% compared to the control group. Isoflavones found in soy, particularly genistein, prevent thyroid peroxidase which is vital to thyroid hormones synthesis. This primary decrease in thyroid hormones stimulates pituitary-thyroid axis and hence the serum level of this hormone increases (8). But, this increase was non-significant in the group treated with soy 50%.

Other studies have reported risk of developing hypothyroidism due to consuming soybean and its products. This is another explanation for inhibitory effect of soy's estrogen-like compounds on hypothalamic-pituitary-thyroid axis. Since increased serum level of TSH normally causes increase in thyroglobulin proteolysis and thyroid hormones release in the blood, increase in T_3 and T_4 is expected. However, the phytoestrogens found in soy caused decreased susceptibility of pituitary-thyroid glands axis in normal feedback mechanism and function (8). As noted, T_4 serum level decreased significantly in the group treated with 50% soy. T_4 serum level decreased in 30% soy group non-significantly, but the decrease was still noted. General course and mechanism of soy's isoflavone effect on thyroid-pituitary axis is still unknown. Isoflavones are fundamentally known as anti-thyroid compounds (9,10), as they prevent the function of thyroid peroxidase, which is the key enzyme for synthesis of thyroid hormones. However, other works have also demonstrated an extensive thyroid hyperplasia by treatment with soy (11,12). Studies also highlighted that the children and individuals fed with greater amounts of soy needed more iodine, even up to twice more than that required by other individuals (13,14).

Conclusion

The foods rich in soy phytoestrogens are found abundantly in Southeast Asian populations' meal and are likely to contribute greatly to thyroid function. Therefore, it is recommended to pay attention to dose-dependent consumption of soy and its components as pharmaceutical compounds with plant origin.

Acknowledgments

Appreciate and thanks to all persons in biology department of Payam-Noor University of Isfahan who helped us in implementing this project.

Authors' contributions

All the authors wrote the manuscript equally.

Conflict of interests

The authors declared no competing interests.

Ethical considerations

Ethical issues (including plagiarism, misconduct, data fabrication, falsification, double publication or submission, redundancy) have been completely observed by the authors.

Funding/Support

This project was financially supported by Payam-Noor University of Isfahan.

References

1. Chang HC, Doerge DR. Dietary genistein inactivates rat thyroid peroxidasein Vivo without an apparent hypothyroid effect. Toxicol Appl Pharmacol 2000; 168(3):244-52.
2. Doerge DR, Sheehan DM. Goitrogenic and estrogenic activity of soy isoflavones. Environ Health Perspect 2002; 110 (Suppl 3): 349-53.
3. Zargari A. Medicinal plants. Tehran: Tehran University Publication; 2004. p. 352-56.
4. Vandenplas Y, Castrellon PG, Rivas R, Gutiérrez CJ, Garcia LD, Jimenez JE, *et al.* Safety of soya-based infant formulas in children. Br J Nutr 2014; 111(08): 1340-60.
5. Evans B, Griffiths K, Morton M. Inhibition of 5α-reductase in genital skin fibroblasts and prostate tissue by dietary lignans and isoflavonoids. J Endocrinol 1995; 147(2):295-302.
6. Crouse JR, Morgan T, Terry JG, Ellis J, Vitolins M, Burke GL. A randomized trial comparing the effect of casein with that of soy protein containing varying amounts of isoflavones on plasma concentrations of lipids and lipoproteins. Arch Int Med 1999; 159(17):2070-6.
7. Malloy MJ, Kane JP. Agents used in hyperlipidemia. In: Katzung BG editor. Basic & clinical Pharmacology. 8th ed. New York: Mc Graw- Hill; 2001. p. 588–95.
8. Greco D, Stabenfeldt GH. Endocrinology. In: Cunningham JG, editor. Textbook of Veterinary Physiology. 4th ed. Philadelphia: Elsevier Saunders Inc;2007.

9. Messina M, Redmond G. Effects of soy protein and soybean isoflavones on thyroid function in healthy adults and hypothyroid patients: a review of the relevant literature. Thyroid 2006; 16(3):249-58.
10. Borradaile N, De Dreu L, Wilcox L, Edwards J, Huff M. Soya phytoestrogens, genistein and daidzein, decrease apolipoprotein B secretion from HepG2 cells through multiple mechanisms. Biochem J 2002; 366:531-9.
11. Divi RL, Chang HC, Doerge DR. Anti-thyroid isoflavones from soybean: isolation, characterization, and mechanisms of action. Biochem Pharmacol 1997; 54(10):1087-96.
12. Chen H, Walfish P. Effects of estradiol benzoate on thyroid-pituitary function in female rats. Endocrinology 1978; 103(4):1023-30.
13. Ikeda T, Nishikawa A, Imazawa T, Kimura S, Hirose M. Dramatic synergism between excess soybean intake and iodine deficiency on the development of rat thyroid hyperplasia. Carcinogenesis 2000; 21(4):707-13.
14. Van Ruth SM, Shaker ES, Morrissey PA. Influence of methanolic extracts of soybean seeds and soybean oil on lipid oxidation in linseed oil. Food Chem 2001;75(2):177-84.