Effect of Soybean, Virgin Coconut and *Moringa oleifera* Seed Oils on the Propylthiouracil Induced Hypothyroidism in Rats

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ABSTRACT

This study investigated the possible effect of soybean, virgin coconut and *Moringa oleifera* seed oils for 8 weeks on Propylthiouracil (PTU) induced hypothyroidism in rats. Thirty five male albino rats were divided into two main groups; Group (I) (7 rats) was fed only basal diet and served as a negative control group. Group (II) (28 rat) were injected with (10 mg / kg / day PTU) for 15 day to cause hypothyroidism, then divided into 4 subgroups: namely control positive group based on basal diet, and 2nd, 3rd and 4th subgroup were treated orally with dose of 5ml/kg BW oils of Soybean (SO), Virgin coconut (VCO) and *M.oleifera* seeds (MOO), respectively beside basal diet. The results showed that PTU exposed rats showed significant decrease (P≤0.05) in serum FT3, FT4 levels and significant increase (P≤0.05) in serum TSH levels. The orall treatement with SO, VCO and MOO was significantly increased FT4 and FT3, while decreased the level of TSH comparing with the positive control group. It was also reduced level of malondialdehyde (MDA) level, significantly, increased activity of liver antioxidant enzymes-superoxide dismutase (SOD) and improved liver functions and lipid profile compared with the positive control group. So, it could be concluded that oils of soybean, virgin coconut and *M. oleifera* seed oils improve the role of thyroid by raising thyroid hormones and reducing oxidative stress in patients with hypothyroidism.

Keywords: Hypothyroidism, Moringa oleifera seeds, Propylthiouracil, soybean oil, virgin coconut oil, thyroid stimulating hormone.

INTRODUCTION

Around 42 million people are estimated to suffer from thyroid disease (Bagcchi, 2014). Hypothyroidism is the most common thyroid condition. It is linked to various metabolic abnormalities, affecting one in ten adults. Hypothyroidism can occur due to iodine intake deficiency, lesions of the thyroid gland, autoimmune disorders, and pituitary gland impaired activity (Ott *et al*., 2011). The definition of hypothyroidism is lower serum FT3, FT4, and higher TSH (Dons and Wians, 2009). Thyroxine (T4) and tri-iodothyronine (T3) are necessary for the physiological functions of almost all body tissues (Sharma *et al*., 2018).They regulate reproductive functions, heart pulses, body thermogenesis, gastrointestinal motility and emotional stability. In addition, they control metabolism of proteins, lipid and carbohydrate (Nair *et al*., 2015).

Propylthiouracil (PTU) is an antithyroid thioamide drug. It has been used for more than half a century in the treatment of hyperthyroidism. This establishes a status of hypothyroidism (Bertram, 2012). Disorder of thyroid function may produce various subclinical or clinical manifestations (Chaker *et al*., 2017), such as weight change, sweating, exhaustion, lethargy, cold resistance, voice change, an increase in metabolism of cholesterol, decrease in metabolic rate. Sometimes, there may be swelling of the front part of the neck due to goiter diseases (Louzada and Carvalho, 2018). Hypothyroidism is related to oxidative stress due to excessive free radical growth (Chakrabarti *et al*., 2016).

As an approach to modulating defects and oxidative stress-induced pathologies associated with thyroid disorders, the growing trend towards prevention supports the efficacy of natural products and their derivatives. It resulted in increased interest in using the beneficial ability of the antioxidant properties of natural products to quench or break free radical chain. A growing collection of evidence shows that soybean, virgin coconut and *moringa oleifera* seed oils possesses antioxidant and pharmacological activities (Retana-Marquez *et al*., 2012 and Famurewa *et al*., 2019).

The most important dietary source of isoflavones is soybean [*Glycine max* (L.)], an essential class of phytoestrogen (Cederroth *et al*., 2012). Soybean oil (SO), derived from soybean, is the world's most widely commercial edible oil (Hayes and Khosla, 2007). Soybean oil contains about 60% of polyunsaturated fatty acids (PUFAs), 24% of monounsaturated fatty acids (MUFA) and 16% of saturated fatty acids (SFAs) (Warner, 2005). Positive results between soy isoflavone intake and lower incidences of diseases have promoted the popularity and safe value of soybean (Shu *et al*., 2009), due to it's many estrogenic and antioxidant activites (Retana-Marquez *et al*., 2012). Also, crude soybean oil has natural antioxidants inhibit lipid peroxidation (Zainuddin *et al*., 2015).

Virgin coconut oil (VCO) or coconut butter, is extracted from coconut. It has a long shelf life without chemical refining (Jaarin *et al*., 2014). It has a long shelf

DOI: 10.21608/ASEJAIQJSAE.2019.66050

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Received November 17, 2019, Accepted December 24, 2019

life without chemical refining. It is used in the baking and manufacturing of pharmaceutical products (Krishna *et al*., 2010). It is consisted mainly of a combination of short- and medium-chain (SFAs) (92%) in addition to low level of unsaturated fatty acids (8%) (Che Man and Marina, 2006).

Studies on the biological effects of VCO showed its ability to improve the antioxidant defense system, by inhibiting free radicals. This helps in reducing lipid peroxidation (Iranloye, 2013), keeping high-density lipoprotein (HDL), total cholesterol levels and decreasing low-density lipoprotein (LDL) levels in serum and tissues of rats (Nevin and Rajamohan, 2006), and body fat accumulntion (Takeuchi *et al*., 2008 and Iranloye *et al*., 2013). The pharmacological effects of VCO are due to their phenolic content which increases from its antioxidant and cholinergic activites and reduces oxidative stress (Rahim *et al*., 2017).

Moringa oleifera seed oil (MOO) is a light yellow oil with an acceptable nutty flavour. The oil consists of 82% unsaturated fatty acids, 70% of which is oleic acid. It has relatively more oleic acid than olive oil (Rahman *et al*., 2014). It is a good source of flavonoids which have health promoting properties (Kou *et al*., 2018). Its therapeutic effectiveness against thyroid disorders was observed (Lin *et al*., 2018). It has antioxidant, hepatoprotective, nephrotoxicity and testicular protective in rats (Olatosin *et al*., 2013; Abarikwu *et al*., 2017and Gupta *et al*., 2018). The present work was aimed to investigate the changes of thyroid function induced by PTU and effect of soybean, virgin coconut and *moringa oleifera* seed crude oils on hypothyroidism.

MATERIALS AND METHODS

Plant materials:

- **Soybean, coconut and *Moringa oleifera* seeds** were procured from the local food *company in Egypt*. Plant materials were identified and authenticated by a plant taxonomist, Faculty of Agriculture, Ain Shams University.
- **Chemicals:** Casein, vitamins, minerals, cellulose, choline chloride were bought from El- Gomhoria Company, Cairo, Egypt. Propylthiouracil was obtained from the local distributer of Sigma-Aldrich Chemical Co. USA. Kits for biochemical analysis were purchased from Biodiagnostic Company for Pharmaceutical and chemicals, Dokki, Egypt.
- **Animals:** Thirty-five healthy male albino rats (Sprague-Dawley strain) were bought from the Helwan Experimental Animals Station at the age of eight weeks (185±20 g).

Methods:

- **Extraction of soybean oil:** Soybean seeds were crushed to extract the oil using n-hexane as a solvent. The extracted oil was next purified by distillation to remove any hexane from oil according to the method of Wu *et al*. (2011).
- **Extraction of virgin coconut oil:** The wet coconuts are subjected to pressing to extract the oil out along with coconut milk. This is processed afterwards without employing heat, chemicals, refining according to the method of Krishna *et al*. (2010).
- **Extraction of *M. oleifera* oil:** Cold press method was used to obtain MOO from *M.oleifera* seeds without chemical treatment according to the method of Abarikwu *et al*. (2017).

Induction of Hypothyroidism: According to Sener *et al.* (2006), hypothyroidism was caused by intraperitoneal injection for 15 days once daily in rats using propylthiouracil, 10 mg PTU / kg BW / day. Blood was obtained by capillary tube from the rats ' eyes and the serum was isolated and tested to equate the T3, T4 and TSH levels with the negative control rats.

Experimental animal design:

The basal diet was formulated according to Reeves *et al*. (1993). Thirty five male albino rats were randomly divided into two main groups after the acclimatization time, (7) day. Group (I) (7 rat) was fed only with the basal diet and served as a negative control group. Group (II) (28 rat) were injected with (10 mg / kg / day PTU) for 15 day to cause hypothyroidism, then divided into 4 subgroups: namely the control positive group based only on basal diet, and 2nd, 3rd and 4th subgroup were treated orally with a dose of 5ml/kg BW of SO, VCO and MOO, respectively beside basal diet. The dose of oils were chosen according to Famurewa *et al*, (2019). After 8 weeks, fasted rats were anesthetized with diethyl ether and sacrificed. The blood samples were obtained from each rat and centrifuged at 3500 rpm for 20 min.

Preparation of fatty acid methyl esters (FAMEs) and total tocopherols of SO,VCO and MOO: Fatty acid (FA) composition of the oils and fats were determined as their corresponding methyl esters (FAMEs) derived by transesterification or esterification from fats, oils, and fatty acids by capillary gas chromatography (GLC). Preparation of FAMEs was carried out according to ISO 12966 (2015) method. While HPLC was used to determine vitamin E according to AOAC (2005).

Determination of total phenolic content: The total phenolic content of the SO, VCO and MOO was determined by Folin–Ciocalteu colorimetric method (Zilic *et al*., 2012) and expressed as mg of gallic acid

equivalent (GAE) per 100 g of oil.

Biochemical Analysis: Free triiodothyronine (FT3), free thyroxin (FT4) and TSH hormones were estimated via ELISA method using special kits (Shamsian *et al*., 2016). Oxidative stress markers: Superoxide Dismutase (SOD) and malondialdehyde (MDA) were determined according to Kakkar *et al*. (1984) & Draper and Hadly (1990) methods, respectively. Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured according to Bergmeyer *et al*. (1978), while alkaline phosphatase (ALP) was determined according to Belfield and Goldberg (1971). Serum was analyzed for the following biochemical parameter: total cholesterol (TC) by the method of Fossati and Praneipe (1982), HDL-cholesterol by Albers *et al*. (1983), triglyceride (TG) by Jacobs and Vander (1960). While low density lipoprotein cholesterol (LDL-C) and very low density lipoprotein cholesterol (VLDL-C) were calculated according to the equation of Fruchart (1982). Low density lipoprotein cholesterol can be calculated as follows: LDL-C = Total cholesterol – HDL-C –VLDL-C.

Statistical analysis: The results were expressed as mean ± sandard Error (SE) and were analyzed statistically using one-way analysis of variance ANOVA. The results were considered signifcant at $P \leq 0.05$. Calculations were made on SPSS software version 20 (SPSS Inc., Chicago, Illinois, USA) (Emsley *et al*., 2010).

RESULTS AND DISCUSSION

Natural oils such as SO, VCO and MOO are evolving as functional foods due to their health-promoting pharmacological activities reported in published literature (Abarikwu *et al*., 2017؛ Famurewa *et al*., 2017and Ogedengbe *et al.*, 2018). The current study was carried out to investigate the possible role of soybean, virgin coconut and *moringa oleifera* seed oils on thyroid hormones level, liver function, lipid profile and biological parameters in experimentally induced hypothyroidism of adult male albino rats.

The fatty acid profile of soybean, virgin coconut and *m. oleifera* seed oils are shown in Table (1). SO is rich in polyunsaturated fatty acids, it contains about 58.5% of (PUFAs), 26.5% of (MUFA) and 14.5% of (SFAs), respectively, while VCO consisted mainly of a combination of short-and medium-chain (SFAs) 90.5% in addition to low level of unsaturated fatty acids 9.3%. MOO is rich in monounsaturated fatty acids, it contains about 77.5% of (MUFA), its low in polyunsaturated fatty acids 1.5% of (PUFAs) and 20.6% of (SFAs).The obtained results are in agreement with Deol *et al*. (2015) who reported that soybean oil is rich in polyunsaturated fatty acids (PUFAs), it contains about 28.83% of (PUFAs), 11.8% of (MUFA) and 59.3% of (SFAs).

Burnett *et al*. (2011) reported that, coconut oil is very commonly used as a tropical edible oil in many Asian cultures and is composed of almost 90- 95% saturated fatty acids. Furthermore, Feranil *et al*. (2011) mentioned that coconut oil primarily comprises of lauric acid (47.5%), a low molecular weight saturated fatty acid known to be a better alternative to other saturated fatty acids. Coconut oil is a saturated fat that is mainly composed of high proportion of medium-chain fatty acids (MCFA), lauric acid (source of vitamin E), and polyphenols with antioxidant activity (Nevin and Rajamohan, 2008 and Rabeh 2017).

Ogunsina *et al*. (2014) reported that cold pressed extracted moringa seed oils (CPMSO) had 79.5 of monounsaturated oleic acid and 80.7 of unsaturated fatty acids respectively. Leone *et al*. (2016) showed that *M. oleifera* seed oil falls in the category of high-oleic oils and contains a high monounsaturated to saturated fatty acids ratio (MUFA/SFA). However, the oil is a source of some minor compounds (phytosterols and tocopherols) (Saa *et al*., 2019).

The effect of soybean, virgin coconut and *M.oleifera* seed oils supplementation on serum TSH, FT3 and FT4 levels of rats induced with hypothyroidism are tabulated in Table (2). Rats exposed to PTU (exhibited hypothyroidism) showed a significant decrease ($P \leq 0.05$) in serum FT3, FT4 and higher increase in TSH concentrations compared to the negative control group.

Table 1. Fatty acid profile, vitamin E and total phenolics in soybean, virgin coconut and *M. oleifera* seed oils

Component		Soybean oil	virgin coconut oil	*Moringa oleifera* seed oil
Saturated fatty acid (SFA) (%)		14.5	90.5	20.6
Unsaturated fatty acid:	Mono-unsaturated fatty acid (MUFA)	26.5	8.8	77.5
	Poly-unsaturated fatty acid (PUFA)	58.5	0.5	1.5
Tocopherols (mg/100 g)		1.03	2.53	3.78
Total phenolics (mg GAE/100g)*		34.46	61.22	63.18

* GAE: Gallic acid equivalent

The supplementation with SO, VCO and MOO caused significant (P≤0.05) increased in concentration of FT3, FT4 and a significant (P≤0.05) decrease in the TSH, compared to the positive control group. No significant differences were noted in TSH level between the treated rats with VCO and MOO. The best thyroid functions were observed in rats fed on MOO compared to the other treated groups.

The results of Rabeh and El-Ghandour (2016) and Rabeh (2017) indicated that thyroid hormones were dramatically reduced by PTU. Bhanja and Chainy (2010) reported that hypothyroidism causes oxidative stress in rats. This leads to tissue damage and apoptosis.Fumarola *et al*. (2010) stated that PTU inhibits iodine oxidation and monodotyrosine ionization. It is also prevented the coupling stage and inhibited the peripheral conversion of (T4) to (T3).So, it suppresses the synthesis of thyroid hormones by blocking the activity of thyroid peroxidase (Sue *et al*., 2012).

Dietary fatty acids have marked influence on functioning of thyroid gland (Gupta *et al*., 2009). Some authors suggest that isoflavones have a moderate or no effect on the role of thyroid (Dillingham *et al*., 2007). Meanwhile others showed that isoflavones suppress the function of thyroid (Sathyapalan *et al*., 2011). Modaresi *et al*. (2014) reported that feed 30% and/or 50% soybean meal may result in an increase in TSH release. Bitto *et al*. (2010) concluded that postmenopausal women isoflavone intake for three years had no effect on thyroid functions. Soybean oil consumption by pregnant women up to three times a week has been shown to be safe without any effect on thyroid or thyroid autoimmune functions (Li *et al*. 2011). Sarathi *et al*. (2016) found that short-term soy food consumption did not change the functions of the maternal and neonatal thyroid. Otun *et al*. (2019) mentioned that soybean supplementation has no effect on thyroid hormones and may increase levels of TSH.

Gupta *et al*. (2009) found that coconut oil-fed rabbits had a significant reduction in TSH levels. This implies that saturated fats decrease serum TSH levels (as seen in Table 1). Rabeh (2017) found that, virgin coconut oil, curcumin, Vit.D or their mixture increased the level of thyroid hormones and lowered the level of TSH. Such effects may be due to high content in VCO of polyphenolic and other antioxidants. Takeuchi *et al*. (2008) and Rabeh (2017) found that coconut oil enhances thyroid functions.Tabassum *et al*. (2013) and Wazida *et al*. (2013) observed that ethanol extract of leaves moringa led to a significant increase in the level of T3 and T4 hormones and a significant decrease in TSH level. Also, Mohamed *et al*. (2019) found that oral administration of *Moringa* leaves extract to hyperthyroid rats can attenuate the reduction of plasma TSH.

Table (3) illustrates the impact of supplementing soybean, virgin coconut and *M.oleifera* seed oils on the levels of liver functions in rats suffer from hypothyroidism. The results showed that hypothyroidism caused significantly increase (P≤0.05) activity of ALT, AST and ALP in rats of the control positive group compared to the negative control group. This may be due to the disruption occurred in liver functions. Also the results showed that, feeding rats suffering from hypothyroidism with SO, VCO and MOO led to a significant decrease (P≤0.05) in AST, ALT, and ALP levels comparing with the positive control group. Regarding to ALT, no significant difference between the effect of supplemented diets with VCO and MOO was noted. On the other hand, the supplement with MOO lowest decline both AST and ALP levels, followed by VCO.

Table 2. Effect of soybean, virgin coconut and *M. oleifera* seed oils on thyroid hormones concentration in rats suffer from hypothyroidism.

Parameters / Groups	TSH (µIU/mL)	FT3 (pg/mL)	FT4 (ng/dL)
Control (-ve)	0.95±0.09^{d}	4.73±0.17^{a}	3.56±0.12^{a}
Control (+ve)	5.23±0.49^{a}	1.85±0.06^{e}	1.60±0.08^{e}
Soybean oil (SO)	3.83±0.27^{b}	2.86±0.07^{d}	2.36±0.12^{d}
Virgin coconut oil (VCO)	2.96±0.07^{c}	3.52±0.14^{c}	2.75±0.11^{c}
M. oleifera seeds oil (MOO)	2.48±0.07^{c}	4.05±0.05^{b}	3.21±0.07^{b}

Mean values are expressed as means ± SD.
Means with different superscript letters in the column are significantly different at P ≤ 0.05.

Table 3. Effect of soybean, virgin coconut and *M. oleifera* seed oils on liver functions in rats suffer from hypothyroidism

Parameters / Groups	ALT (µ/L)	AST (µ/L)	ALP (µ/L)
Control (-ve)	27.15±1.38^{d}	70.10±1.05^{e}	199.25±0.75^{d}
Control (+ve)	50.40±1.28^{a}	95.75±2.49^{a}	235.52±2.37^{a}
Soybean oil (SO)	41.20±1.29^{b}	88.82±1.16^{b}	223.47±2.40^{b}
Virgin coconut oil (VCO)	35.12±0.82^{c}	82.25±1.25^{c}	218.05±1.99^{b}
M.oleifera seeds oil (MOO)	36.50±1.57^{c}	75.70±1.63^{d}	208.80±1.19^{c}

Mean values are expressed as means ± SD.
Means with different superscript letters in the column are significantly different at $P \leq 0.05$.

Thyroid hormones control the basal metabolic rate of all body cells including hepatocytes and thus modulate the function of the liver. In exchange, the liver metabolizes thyroid hormones and controls their endocrine systemic effects. Therefore, thyroid dysfunction may disturb liver function (Khan *et al*., 2010). Our findings are consistent with Carrion *et al*. (2010) who recorded a positive relationship between thyroid hormones and liver enzymes. Thyrotoxicosis is generally associated with a variety of liver dysfunction. Nishimura *et al*. (2006) showed that soybean oil prevents liver damage. It is stressed that soybean oil positively controled the amount of blood and lipids in liver (Lin *et al*.,2005). Generally, the elimination of lipid peroxidation by natural dietary antioxidants has been correlated with hypolipidemic (Abhilash *et al*.,2011).

According to Siddalingaswamy *et al*. (2011) and Pretha *et al*. (2013), VCO ables to positively influence liver functions. Rabeh and El-Ghandour (2016) and Aisuodionoe *et al*. (2018) reported that VCO improves metabolic parameters, antioxidant enzyme activities, reduces oxidative stress and lipid peroxidation in diabetes. Famurewa *et al*. (2018) mentioned that beneficial effects of VCO on lipid profile, antioxidant hepatic defense system, and cardiovascular risk indices in rats. Hamza (2010) revealed that treatment with *moringa* seed extract can significantly reduce the indices of hepatotoxicity. Fakurazi *et al*. (2008) and Paliwal *et al*. (2011) stated that *moringa* seed oil has been used as an indigenous medicine for cardiac care, gastrointestinal, haematological and hepatorenal disorders. Sheikh *et al*. (2014) reported that both ethanol *moringa* leaves and seeds extracts reduced arsenic-induced elevation of liver activities. These findings are in accordance with Nada *et al*. (2015), Toppo *et al*. (2015) and Habib & Al-Moalem (2018).

The levels of TC, TG, LDL-c and VLDL-c increased significantly and HDL-c decreased by PTU injection into rats ($P \leq 0.05$) compared with the negative control group, as shown inTable (4). The supplementation with SO, VCO and MOO caused a significant ($P \leq 0.05$) decrease in TC, TG, VLDL-c, LDL-c and HDL-c significant increase than the positive control group. Both VCO and MOO had nearly the same effect on the determined parameters. Also, no significant changes in the HDL and LDL levels were observed due to type of oil intake. The opposite trend was noted between the mean value of serum TG and VLDL among the treated groups. The high reduction in lipid profile was observed in the group fed with MOO.

Table 4. Effect of soybean, virgin coconut and *M. oleifera* seed oils on lipid profile in rats suffer from hypothyroidism.

Parameters / Groups	TC (mg/dl)	TG (mg/dl)	HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c (mg/dl)
Control (-ve)	123.25±2.01^{d}	61.15±1.97^{e}	47.75±1.65^{a}	63.27±3.28^{d}	12.23±0.39^{e}
Control (+ve)	166.82±2.51^{a}	92.90±1.87^{a}	29.07±0.88^{d}	119.17±2.02^{a}	18.58±0.37^{a}
Soybean oil	152.95±2.17^{b}	86.42±1.43^{b}	39.20±0.82^{bc}	96.46±3.09^{b}	17.28±0.28^{b}
Virgin coconut oil	144.02±2.95^{c}	79.67±2.39^{c}	36.92±1.56^{c}	91.16±2.69^{b}	15.93±0.47^{c}
M.oleifera seeds oil	138.75±1.79^{c}	71.10±2.76^{d}	42.32±0.97^{b}	82.20±0.51^{c}	14.22±0.55^{d}

Mean values are expressed as means ± SD.
Means with different superscript letters in the column are significantly different at $P \leq 0.05$.

The current results are in accordance with Abdou *et al*. (2018) who displayed that soybean oil, can be used as a hypolipidemic agent. Siddalingaswamy *et al*. (2011) found that VCO improved lipid profile and antioxidant status by enhancing antioxidant enzyme activity such as SOD and decresed lipid peroxidation in liver. Rahim *et al*. (2017) and Rabeh (2017) showed that VCO lowered TC, TG, LDL, VLDL and increased HDL. Similar result was consistent with Hima *et al*. (2019) who showed that VCO had hypolipidemic effect on rats which elevated high density lipoprotein cholesterol (HDL-c) and reduced level of triacylglycerol (TG). The current findings are in line with Mehta *et al*. (2003) and Ara *et al*. (2008).They observed that *M. oleifera* lowered serum cholesterol, triglyceride, VLDL , LDL and increased HDL. Concomitant to this finding, Pankaj *et al*. (2010) and Khanna *et al*. (2015) observed that *M. oleifera* caused a temporary reduction in the level of the liver enzymes and prevent liver damage from a high-fat meal.

Table (5) reveales the impact of supplementing soybean, virgin coconut and *M.oleifera* seed oils on antioxidant enzymes MDA and SOD in rats. The positive control group showed a significant increase ($P \leq 0.05$) in the serum MDA value and a decrease in the level of SOD compared with the negative control group. The supplementation with SO, VCO and MOO decreased the mean level of serum MDA and increased serum SOD compared to the positive control group. MOO supplementation was also able to reduce MDA levels in contrast with the normal group levels. No significant difference was observed in serum level of SOD between the groups fed on diet supplemented with SO and VCO. The best concentrations of SOD and MDA were recorded for group fed on MOO.

Malondialdehyde (MDA) is an oxidative stress marker that can be used to measure the extent of lipid peroxidation (Gaweł *et al*., 2004). In hypothyroid subjects, MDA level was found to be higher in oxidative stress (Lakshmi *et al*., 2013). Excess TSH causes oxidative stress. Our results showed rise in MDA level due to hypothyroidism induced oxidative stress and decrease in the values of SOD and also the results of Haribabu *et al*. (2013) showed the same trend. Free radical scavenging enzymes like SOD are the first line of cell defense against oxidative injury and are involved in the elimination of superoxide anions, hydrogen peroxide, etc. (Vijayaraj *et al*. 2013). Phytoestrogens can play an antioxidant role not only by breaking down reactive oxygen species, but also by stimulating antioxidant enzyme activity (Taha *et al*., 2014).

Ironically, in this study, the antioxidant properties of oils (soybean, virgin coconut and *M.oleifera* seeds) were also observed by reducing lipid peroxides (MDA) and elevating endogenous antioxidant enzymes (SOD). The decrease in lipid peroxidation indicates that soybean oil counteracts the deleterious effects of lipid peroxidation (Cheng and Kong, 2011). Furthermore, Mallo *et al*. (2013) reported that soybean flavonoids, have gained importance as free radical scavengers and as a potent lipid peroxidation inhibitor.

Marina *et al*. (2009) and Yeap *et al*. (2015) demonstrated the antioxidative potential and powerful countermeasures of VCO polyphenols against lipid peroxidation in tissues. Iranloye *et al*. (2013) suggested that VCO reduces oxidative stress by boosting the antioxidant defense system, scavenging free radicals and reducing lipid peroxidation; another independent study suggested that fresh coconut oil can reduce oxidative stress associated with diabetes mellitus. Famurewa *et al*. (2018) showed that VCO decreased malondialdehyde (MDA) levels, and increased activities of hepatic antioxidant enzymes superoxide dismutase (SOD). Virgin coconut oil contains high unsaponifiable lipid components like vitamin E and polyphenols, tocotrienols, tocopherols, β carotene and phytosterol in stabilising cell membranes by preventing alterations in membrane lipid polarity and fluidity (Jaarin *et al*., 2014).

Table 5. Effect of soybean, virgin coconut and *M. oleifera* seed oils on antioxidant enzymes MDA and SOD in rats suffer from hypothyroidism.

Parameters / Groups	MDA (nmol/ml)	SOD (µ/dl)
Control (-ve)	10.52 ± 0.65^{d}	68.60 ± 1.31^{a}
Control (+ve)	45.27 ± 2.03^{a}	25.30 ± 2.44^{d}
Soybean oil (SO)	31.75 ± 1.28^{b}	33.52 ± 1.60^{c}
Virgin coconut oil (VCO)	20.27 ± 0.89^{c}	37.35 ± 1.34^{c}
M. oleifera seeds oil (MOO)	13.76 ± 2.05^{d}	48.87 ± 1.66^{b}

Mean values are expressed as means ± SD.

Means with different superscript letters in the column are significantly different at $P \leq 0.05$.

The current results are in accordance with Sreelatha and Padma (2009) who observed that treatment with *M.oleifera* extract was significantly reduced serum MDA level. This could be attributed to its high polyphenol contact. Toppo *et al*. (2015) results, indicated that *M. oleifera* significantly increased the levels of SOD to 500 mg / kg ($p \leq 0.01$).

CONCLUSION

The studied oils have prophylactic potential against thyroid dysfunctions and the subsequent oxidative stress, as well as improvements in liver function and lipid profile. So, the present findings inferred that the treatment with soybean, virgin coconut and *M.oleifera* seed oils could be used as a potential strategy for the treatment for patients with hypothyroidism.

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الملخص العربي

تأثير زيوت فول الصويا وجوز الهند البكر وبذور المورينجا على قصور الغدة الدرقية الناجم عن البروبيل ثيوراسيل في الفئران

شيماء حسن أحمد نجم

تهدف هذه الدراسة الي معرفة التأثير المحتمل لزيوت فول الصويا وجوز الهند البكر وبذور المورينجا أوليفيرا لمدة ٨ اسابيع ضد مادة البروبيل ثيوراسيل (PTU) المسببة لقصور في الغدة الدرقية. تم تقسيم عدد (٣٥فأر) إلي مجموعتين رئيسيتين: المجموعة الرئيسية الأولي (٧ فئران) تتغذي علي الغذاء الاساسي فقط (مجموعة ضابطة سالبة)، المجموعة الرئيسية الثانية (٢٨ فأر) تم حقنهم لمدة ١٥ يوم بمادة البروبيل ثيوراسيل بجرعة ١٠ ملجم /كجم من وزن الجسم لاحداث قصور في الغدة الدرقية. ثم تم تقسيمهم إلي ٤ مجموعات فرعية: المجموعة الفرعية بما في ذلك المجموعة الضابطة الموجبة التي تتغذى على النظام الغذائي الأساسي، وعولجت المجموعة الفرعية الثانية والثالثة والرابعة عن طريق الفم بجرعة ٥ مل/ كجم من وزن الجسم بكلا من زيت فول الصويا، زيت جوز الهند الخام وزيت بذور المورينجا، على التوالي. تشير النتائج إلي أن الفئران التي تم حقنهم بمادة البروبيل ثيوراسيل لديها قصور في نشاط الغدة الدرقية متمثل في انخفاض في مستوي FT3, FT4 وارتفاع في مستوي TSH. أدى العلاج عن طريق الفم بكلا من زيت فول الصويا، زيت جوز الهند الخام وزيت بذور المورينجا إلي حدوث ارتفاع معنوي في هرمونات الغدة الدرقية (FT3, FT4) بينما حدث انخفاض معنوي في مستوي TSH مقارنة بالمجموعة الضابطة الموجبة بسبب خصائصها المضادة للأكسدة. وعلاوة على ذلك، فإن مستوىMDA انخفض بشكل ملحوظ وزيادة أنشطة إنزيمات مضادات الأكسدة (SOD)، كما لوحظ تحسن كبير في وظائف الكبد ومستوى الدهون في جميع المجموعات المعالجة مقارنة بالمجموعة الضابطة الموجبة. لذلك يمكن أن نستنتج أن العلاج بكلا من زيت فول الصويا، زيت جوز الهند الخام وزيت بذور المورينجا يحسن وظيفة الغدة الدرقية عن طريق تحسين هرمونات الغدة الدرقية ومنع الإجهاد التأكسدي لمرضى قصور الغدة الدرقية.