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# Effect of Halawa Tahinia Alone or with Ginger and Cinnamon on Sex Hormones in Adult Male Rats

**Naeem M. Rabeh**

Nutrition and Food Science Dept., Faculty of Home Economics, Helwan University, Cairo, Egypt

**Email address:**
naeemrabeh@gmail.com

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**Abstract:** This study was performed to investigate the effect of halawa tahinia alone or in combination with ginger and cinnamon on sex hormones as well as serum antioxidant levels. Thirty Wistar adult male rat were divided into five groups, control group fed on basal diet only and test groups (n=24) divided into 4 groups as follow, group (1) fed on basal diet supplemented with halawa tahinia at the level of (15%), while the other three groups were fed on basal diet supplemented with halawa tahinia (15%) and were given orally (500 mg/kg/day) dried ginger, (500 mg/kg/day) dried cinnamon, both dried ginger and cinnamon (500 mg/kg/day) respectively for 8 weeks. The results indicated that, halawa tahinia have a high nutritive value. The obtained results revealed also that, oral administration of ginger and/ or cinnamon with halawa tahinia caused a significant ($p<0.05$) protective effects on testes due to increasing the levels of serum total testosterones, follicular stimulating hormone (FSH) and luteinizing hormone (LH) also increasing serum total antioxidants capacity (TAC) levels with decreasing malondialdehyde (MDA) level as well as have no deleterious effects on liver functions as compared to control group. Moreover, both ginger and cinnamon administration has a synergistic effect on infertility due to their antioxidant properties. In conclusion: These results provide scientific evidence to substantiate the traditional use of cinnamon and ginger as a drink as well as Halawa tahinia in improving infertility in male rats which might be a product for their potent antioxidant properties and androgenic activities.

**Keywords:** Sesame Seeds, Ginger, Cinnamon, Sex Hormones, Antioxidants

## 1. Introduction

Infertility is one of the medical problems in the world. About 10-15 % of couples have experienced some form of infertility problem [1]. It has been reported that 30% of couple's infertility problems related to male, 40% to 50% related to female and 20% to 30% related to both sexes [2]. Several conditions can interfere with spermatogenesis and reduce sperm quality and production. More factors such as drug treatment, chemotherapy, toxins, air pollutions and insufficient Vitamins intake have harmful effects on spermatogenesis and sperm normal production [3].

Halva tahinia (also called halawa, halaweh, havah) is one of the oldest traditional desserts and is popular confectionery products in Middle Eastern, Indian and North African countries and is available in different forms and flavors. It is a traditional food consumed generally at breakfast [4]. Halva spread worldwide, being produced with a wide variety of ingredients, methods and flavorings. In the Middle East, semolina-based halva is the usual type and is modified by the addition of nuts, dried fruits, coconut, yoghurt, honey and spices [5]. It's a greasy product due to high share of tahini paste which contains more than 50% sesame oil [6]. Tahini (tehinah, tehena, tehineh), the basic ingredient of halva, is mainly composed of 57-65% oil, 23-27% protein and some minerals [7-9].

Sesame seeds and oil have long been categorized as traditional health food in many countries. Sesame oil has been found to contain considerable amounts of the sesame lignans: sesamin, episesamin, and sesamolin [10]. Sesame oil also contains Vitamin E (40 mg/100 g oil), 43 % of polyunsaturated fatty acids, and 40 % monounsaturated fatty acids. The lignans present in sesame oil are thought to be responsible for many of its unique chemical and physiological properties, including its antioxidant and

antihypertensive properties [11, 12].The sesame species in the Middle East are similar to Africa; they are believed to be spread from Africa via Egypt [13].

Several studies have reported that antioxidants and Vitamin A, B, C, and E in diet can protect sperm DNA from free radicals and increase blood testes barrier stability [14-16]. Antioxidants protect DNA and other important molecules from oxidation and damage and can improve sperm quality and consequently increase fertility rate in men [17, 18].

Herbals and plants might be an alternative source of medicine for infertility enhancement and has aroused researchers' interest these days given its little or no side effects. Ginger root (*Zingiber officinale R.*), is a common kitchen spice widely used worldwide as powder or as the whole fresh root. Ginger has a long history of medicinal use in traditional medicine. Ginger is made up of phytocompounds such as zingerone, gingerdiol, zingibrene, shogoals and gingerol [19-21]. Ginger extract has been shown to have a variety of biological activities, including anticancer, antioxidation, anti-inflammation and antimicrobial properties [22-24].

Another herb, cinnamon (*C. zeylanicum*) bark is commonly used in Arabian countries as a spice for most foods. In Eastern and Western folk medicine it used for treating abdominal and chest pains, chronic diarrhea, hypertension, kidney disorders, rheumatism and type 2 diabetes [25]. Cinnamon extract, an antioxidant with rich source of polyphenolic compounds, plays a significant role in modulating of oxidative stress in the obese people with impaired fasting glucose, furthermore it is an appropriate remedy in order to reduce the risk of male infertility, cardiovascular, inflammation diseases and oxidative stress related complications [26]. The methanolic extracts of ginger and cinnamon have been shown to be effective in treating fertility issues [27].

In recent years many efforts have been made to identify an ideal food with strong and effective anti-metabolic effects on male fertility which already has created a serious problem. So that, this study was planned to investigate the ability of halawa tahinia alone or in combination with administration ginger and/or cinnamon in improving sex hormones of adult male rats.

# 2. Materials and Methods

### *2.1. Materials*

#### *2.1.1. Chemicals*

Casein, Vitamins, minerals and cellulose were purchased from El-Gomhoria Company – Cairo – Egypt.

#### *2.1.2. Herbs*

Ginger (*Zingiber officinale L*) dried roots and cinnamon (*C. zeylanicum*) dried bark were obtained from Haraz Market for Herbs and Medicinal Plants, Cairo, Egypt. Authentication of both herbs was carried out by staff members of Botany Department, Faculty of Science, Ain Shams University, Egypt.

#### *2.1.3. Halawa Tahinia*

Halawa Tahinia was obtained from local market.

#### *2.1.4. Animals*

Thirty healthy adult male Wistar rats weighing (200±5 g) were obtained from Helwan Experimental Animals Station and were kept in wire cages, controlled under the light regime (12 h light: 12 h dark), at room temperature (2±22°C) and humidity constant (5±55%). The experiment was carried out at the Animal House of Home Economics Faculty, Helwan University.

#### *2.1.5. Kits*

Kits for blood analysis were purchased from Gama Trade Company for Chemical, Cairo, Egypt.

### *2.2. Methods*

#### *2.2.1. The Gross Chemical Components*

Moisture, crude protein, crude fat, ash and crude fibers content for halawa tahinia were determined according to the standard methods of the AOAC, (2000) [28]. Total carbohydrates content was calculated by difference according to Pellet and Sossy (1970) [29] as follows: total carbohydrates content (%, on dry weight basis) = 100 - (crude protein% + crude fat% + crude fibers% + ash%). Moreover, calcium, magnesium, iron, copper and zinc contents in halawa tahinia were determined by using the atomic absorption spectrophotometer according to standard methods of AOAC, 2000) [28].

#### *2.2.2. Preparation of Herbs*

500 mg/kg body weight of dried ginger or cinnamon was dissolved separately in 2cm distilled water and each rat was received it daily for 8 weeks. The solution was freshly prepared every three days.

#### *2.2.3. Biological Study*

Thirty adult male rats were fed on basal diet for one week for adaptation. All diets were formulated to cover the nutrient requirements of rats following the recommendations of the American Institute of Nutrition (AIN-93M) Reeves, *et al*. (1993) [30] with some modifications. After this week rats were divided into 5 groups (6 rats each) as follows:- group (1) was fed on basal diet only (as a control group).The other rats was fed on basal diet supplemented with 15% halawa tahinia and subdivided into four groups including: subgroup (1) was fed on basal diet supplemented with halawa tahinia at (15%) only, subgroup (2) was fed on basal diet supplemented with halawa tahinia at (15%) and given orally 500 mg/kg BW of ginger, subgroup (3) was fed on basal diet supplemented with halawa tahinia at (15%) and given orally 500 mg/kg BW of cinnamon and subgroup (4) was fed on basal diet supplemented with halawa tahinia at (15%) and given orally (500 mg/kg BW) of both ginger and cinnamon (1:1).

At the end of the experimental period (8 weeks), rats were fasted overnight before sacrificing and the blood samples were collected from each rat and were centrifuged to obtain serum.

#### *2.2.4. Chemical Analysis*

Serum total testosterone level was determined according to Wilke and Utley (1987) [31]. Serum FSH and LH levels were measured according to Loraine and Bell (1976) [32]. Serum TAC was measured by a commercial kit (Randox Co-England) according to Miller, *et al*. (1993) [33] and serum MDA was determined by the method of Draper and Hadly, (1990) [34]. Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined according to Bergmeyer, *et al*. (1978) [35], alkaline phosphatase (ALP) was determined according to Belfield and Goldberg (1971) [36].

#### *2.2.5. Statistical Analysis*

The obtained results were analyzed according to SPSS program. ANOVA test was used to compare results among groups and $P<0.05$ was considered to be significant [37].

## 3. Results and Discussion

In recent years many efforts have been made to identify an ideal food with strong and effective anti-metabolic effects on male fertility which already has created a serious problem. Herbal plants has been famous from ancient times among people and in recent years, a multilateral approach has been appeared on using herbal medicines along with medical care they get from their health care provider [38]. Ginger and cinnamon are considered safe with little or no side effects compared to synthetic drugs [39].

Alternative therapies, such as herbal plants have more benefits since they are less invasive and less costly physical and emotional treatment compared with other methods. Therefore, this study was planned to investigate the ability of halawa tahinia alone or in combination with ginger and cinnamon to improve sex hormones of adult male rats.

***Table 1.*** *Gross chemical composition of Halawa tahinia.*

| Fat | Protein | Ash | Fiber | Moisture | Carb. | Ca | Mg | Zn | Fe |
|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | | | (mg/100g dry matter sample) | | | |
| 51.32 | 12.74 | 1.51 | 1.68 | 1.87 | 32.75 | 64.2 | 322 | 8.5 | 1.8 |

The obtained results in (Table 1) showed the gross chemical composition of halawa tahinia. Halawa tahinia (100 g) comprises of fat, protein, ash, fiber and carbohydrates 51.32, 12.74, 1.51, 1.68, 1.87 and 32.75 gram respectively. It was clear that halawa tahinia has a good nutritive value.

Halawa tahinia is a greasy product due to high share of tahini paste which contains more than 50% sesame oil [6]. The current results were in agreement with finding of Dashak, (1993) [40] who found that, the fat content of sesame seed is around 50% whereas the protein content is around 25% and a about 5% of ash, whereas the fiber and carbohydrate contents show large variation. Similar results were found by Many studies El Khier, *et al*. (2008) [41]; Nzikou *et al*. (2009) [42] and Mohammed *et al*., (2011) [43] whom reported that the sesame seed is an important source of oil (44-58%), protein (18-25%), total carbohydrates (~13.5%) and ash (~5%). Moreover, Ellagic acid was the most predominant amongst the sixteen phenolic acids identified in sesame seeds samples.

Sesame seeds contain up to 55% oil (rich in linoleic and oleic acids) and 20% protein (limited by lysine but rich in tryptophan and methionine) [44, 45]. Similar results were found by Nzikou, *et al*. (2009) [42] who reported that *sesamum indicum* L. seed oil is of unsaturated type and contains mainly the fatty acids oleic C18:1(38.84 %) and linoleic C18:2 (46.26%).

On the other hand, the current results illustrated that, minerals content (mg/100g dry halawa tahinia) contains Ca, Mg, Zn and Fe 64.2, 322, 8.5 and 1.8 respectively. Shittu, *et al*. (2008) [46] reported that sesame is very useful for humans due to the economic and medicinal value. These seeds are rich as minerals, Vitamins and antioxidant lignan (phytoestrogens) and can improve the fertility potential of male reproductive tract. Nzikou, *et al*. (2009) [42] mentioned that, sesame seed is a good source rich in protein, minerals and oil.

The mineral composition of sesame seeds revealed relatively high amounts (mg/100g) of Ca (1200), P (580), K (374), Mg (185), Na (72), Fe (10.6) and low amount of Zn (3.8) as reported by Alyemeni, *et al*. (2011) [47]. Tahini, the basic ingredient of halva, is mainly composed of 57-65% oil (oleic and linoleic acid), 23-27% protein (rich in methionine, cystine and tryptophan) and some minerals, such as calcium, phosphorous, potassium and magnesium [7-9].

***Table 2.*** *Effect of halawa tahinia alone or with ginger and cinnamon on sex hormones in adult male rats.*

| Parameters / Groups | Total testosterone (ng/ml) | FSH (ng/ml) | LH (ng/ml) |
|---|---|---|---|
| Control (-ve) | $1.90 \pm 0.10^{d}$ | $16.31 \pm 0.80^{d}$ | $1.49 \pm 0.05^{c}$ |
| Halawa 15% | $2.94 \pm 0.13^{c}$ | $19.43 \pm 0.43^{c}$ | $1.96 \pm 0.09^{b}$ |
| Halawa (15%) + (500 mg/kg BW) Ginger | $4.71 \pm 0.46^{b}$ | $22.99 \pm 1.03^{b}$ | $2.53 \pm 0.19^{a}$ |
| Halawa (15%) + (500 mg/kg BW) Cinnamon | $4.03 \pm 0.07^{b}$ | $21.71 \pm 0.82^{b}$ | $2.00 \pm 0.07^{b}$ |
| Halawa (15%)+ (500 mg/kg BW) Ginger and Cinnamon | $5.98 \pm 0.52^{a}$ | $25.65 \pm 0.45^{a}$ | $2.86 \pm 0.07^{a}$ |

*Values were expressed as Means ± SE.

* Values at the same column with different letters are significant at $P<0.05$.

The results in (Table 2) illustrated the effect of halawa tahinia with ginger and cinnamon alone or in combination on the level of total Testosterone, FSH and LH in rats. It was observed that, the supplementation with halawa tahinia at 15% caused a significant ($P<0.05$) increase in the concentration of serum total testosterone, FSH and LH in rats, compared to normal control group.

Sesame seeds are used in the making of tahin (sesame butter) and halva [42]. The mean cells number and motility of sperm in left epididym, number of cells epithelium and percentage volume of epithelial, lumen and interstitial of this tubules were extremely significant ($P<0.001$) in the experimental group fed on diet supplemented with 30% sesame seed compared to control. LH concentration increased significantly in the experimental group compared to control ($P<0.03$). Sesame seed intake improved testicular parameters, fertility and sperm production in males [48].

Dietary sesame seeds elevate the concentrations of both tocopherols and tocotrienols (Ikeda, *et al*. 2001). Eighty seven men with decreased sperm motility (asthenozoospermia) received Vitamin E (100 mg 3 times daily) for 6 months had significantly decreased levels of lipid peroxidation product and improved sperm motility as compared to the placebo group [49]. Higher levels of Vitamin E intake were associated with higher levels of progressive sperm motility [50].

The results of this study are in accordance with the study of Rengaraj and Hong (2015) [51] who found that a moderate amount of Vitamin E in poultry diet significantly protects semen/sperm qualities in male birds and egg qualities in female birds via decreasing the lipid peroxidation in semen/sperms and eggs.

The current results revealed that, rats fed on basal diet supplemented with 15% halawa tahinia with either administration with ginger or cinnamon had a significant ($P<0.05$) increase in total testosterone, FSH and LH levels, compared to control normal group. It was observed that the administration with either ginger or cinnamon caused a higher increase in sex hormones levels compared to the group fed on halawa tahinia only.

Grzanna, *et al*. (2005) [52] and Khaki, *et al*. (2009) [53] mentioned that, ginger was found to possess a protective against DNA damage induced by $H_2O_2$ and enhanced sperm healthy parameters in rats. Moreover, ginger can improve sperm quality and consequently increase fertility rate in men [54, 55]. Similar results were reported by Mares and Najam (2012) [56] who mentioned that, there was a significant ($p<0.01$) increase in sperm count (16.2%), sperm motility (47.3%), sperm viability and normal sperm morphology (40.7%), ejaculate volume (36.1%) and significant increase was observed for serum FSH, LH and testosterone levels of infertile men after treatment with ginger as compared with that before treatment. Aqueous extract (200 mg/kg BW) of ginger has fertility properties because it stimulates secretion from the testes that influences semen quality and had a positive impact on testosterone level. It also has potent antioxidant properties [57].

It is known that a major function of the epididymis is sperm maturation which leads to the acquisition of fertilizing ability and viability of spermatozoa. Therefore, improvement in the activities of the epididymis could have led to an increase in progressive motility of sperm in the experimental rats. The increased sperm count and motility thereby shows that treatment with ginger improves and enhances the fertilizing capacity of the semen. These qualities were often used as a measure of sperm production, testicular function and/ or male fertility. Low sperm count and motility and high percentage abnormal spermatozoa level each have been associated with reduced fertility [58].

Moreover, Fathiazad, *et al*. (2012) [21] found that ginger (100mg/kg/rat) administration could decrease testes apoptosis in rats who receive gentamicin to treat infections.

The obtained results revealed also that, rats fed on basal diet supplemented with halawa tahinia at 15% and orally given (500mg/kg/BW) of both ginger and cinnamon had the highest significant ($P<0.05$) increase in the level of total testosterone, FSH and LH in rats, as compared to other groups. On the other hand, there were no changes in the mean level of total testosterone and FSH among the rats fed either ginger or cinnamon. In regarding to LH, there was a significant ($P<0.05$) increase for the group fed on halawa tahinia and given orally ginger as compared to the group fed on halawa tahinia and given orally cinnamon. It was also seen that, supplementation with ginger together with cinnamon and halawa tahinia showed significant ($P<0.05$) synergistic effects on increasing the level of sex hormones including total testosterone, FSH and LH in rats. Similar results were obtained by (Shalaby and Samar (2010) [27]; Hemayatkhah, *et al*. (2012) [59]; Riaz, *et al*. (2011) [60]; Onwuka, *et al*. (2011) [61] and Mashhadi, *et al.* (2013) [62] whom reported that ginger and cinnamon both have been indicated to improve testicular function, sperm quality and quantity and sex hormones levels (Testosterone, LH and FSH). Furthermore Khaki, *et al*. (2014) [63] reported that, combined ginger (100mg/kg/rat) and cinnamon (75mg/kg) for 8 weeks have significant beneficial effects on the sperm viability, motility, and serum total testosterone, LH and FSH in diabetic rats

LH and FSH hormones are the main regulatory hormones used for stimulation of steroid hormone production including testosterone and gametogenesis in both men and women [64]. Testosterone is known to be critically involved in the development of sperm cells and derangement results widely in cell dysfunction and testicular steroidogenic disorder [65].

The study recorded a significant ($P<0.05$) increase in the level of serum TAC for the rats fed on basal diet supplemented with halawa tahinia at 15%, as compared to control negative group (Table 3). Also, the oral administration with ginger and/or cinnamon caused a significant ($P<0.05$) increase in the level of serum TAC, as compared to control negative group. Furthermore, oral ginger administration caused a significant ($P<0.05$) increase in the

level of TAC as compared to rats fed on diet supplemented with halawa tahinia only, however, there was no changes in the level TAC between the group fed on diet supplemented with halawa tahinia and the group fed on diet supplemented with halawa tahinia and given orally cinnamon. It was observed that the combination with ginger and cinnamon with halawa tahinia supplementation caused the highest increase in the level of TAC as compared to other groups.

***Table 3.*** *Effect of halawa tahinia alone or with ginger and cinnamon on TAC and MDA in adult male rats.*

| Parameters / Groups | Total antioxidant capacity (TAC) (nmol/ml) | Malondialdehyde (MDA) (nmol/ml) |
|---|---|---|
| Control (-ve) | 0.81±0.05$^{d}$ | 3.82±0.33$^{a}$ |
| Halawa 15% | 1.38±0.15$^{c}$ | 2.97±0.33$^{b}$ |
| Halawa (15%) + (500 mg/kg BW) Ginger | 1.90±0.09$^{b}$ | 2.11±0.11$^{c}$ |
| Halawa (15%) + (500 mg/kg BW) Cinnamon | 1.66±0.15$^{bc}$ | 2.30±0.19$^{bc}$ |
| Halawa (15%)+ (500 mg/kg BW) Ginger and Cinnamon | 2.33±0.14$^{a}$ | 0.94±0.08$^{d}$ |

*Values were expressed as Means ± SE.

* Values at the same column with different letters are significant at P<0.05.

Malondialdehyde is an indirect indicator of reactive oxygen species, ROS, resulting from lipid peroxidation breakdown in biological systems, which has potential toxic effects on sperm quality and function [66, 67]. Shahidi *et al*. (1992) [68] have reported that antioxidants are often added to foods to prevent the radical chain reactions of oxidation, and they act by inhibiting the initiation and propagation step leading to the termination of the reaction and delay the oxidation process.

Sesame lignan, have more tumorigenic, estrogenic or anti-estrogenic and antioxidant features compare with other plant species [69]. Phytoestrogens are phenolic compounds which are similar to hormones and nonsteroidal that derived from estrogen of sesame and are found in sesame seed, affect the reproductive system of male animals [70]. Sesame oil supplementation improved the reproductive parameters of diabetic rats at the levels of the testicular microstructure and function [71]. Moreover, TAC levels were significantly increased in group that has received 75mg/kg cinnamon daily for 4 weeks in comparison to control group [72].

Also, our results were in the same line with the finding by Moselhy, *et al*. (2012) [73] who reported that, ginger and cinnamon contribution to the recovery of sperms, and their uptake on free radicals, are related to their very high antioxidant virtue. Furthermore, ginger and cinnamon both have been indicated to improve testicular function and serum antioxidants level [27, 60-62]. Similar results were obtained by Khaki, *et al.* (2014) [63] who reported that, combined ginger (100mg/kg/rat) and cinnamon (75mg/kg) for 8 weeks have significant beneficial effects on serum total antioxidant capacity, SOD, Catalase and GPX and decreasing the levels of MDA and could be effective for maintaining healthy sperm parameters and male reproductive function in diabetics.

The administration with ginger to halwa tahinia increase the nutritive value and the antioxidant properties, as mentioned by Adel and Prakash, (2010) [74] who reported that ginger root contains protein and fat of sample were 5.08 and 3.72 g/100 g respectively. Ash, minerals namely iron, calcium, phosphorous, zinc, copper, chromium and manganese) and Vitamin C were 3.85 (g), 8.0 (mg), 88.4 (mg), 174 (mg), 0.92 (mg), 0.545 (mg), 70 (μg), 9.13 (mg) and 9.33 (mg) per 100 g of sample, respectively. Antioxidant components (polyphenols, flavonoids and total tannin) were higher in hot water. The total phenols of the alcohol extract were found to be 870.1 mg/g dry extract. 2,2-Diphenyl-1-picril hydrazyl radical (DPPH) scavenging reached 90.1% [75].

In regarding to MDA, halawa tahinia supplementation at 15% caused a significant (P<0.05) decrease in the level of MDA as compared to control negative group. Also, the level of MDA was significantly (P<0.05) decreased as a result of feeding on basal diet supplemented with halawa tahinia and orally given ginger or cinnamon alone or in combination as compared to control negative group. The administration with both ginger and cinnamon with halawa tahinia supplementation caused the lowest (P<0.05) decrease in the level of MDA as compared to other groups. Our results were in agreement with Mares and Najam (2012) [56] who reported that, there were a significant reduction in serum MDA and significant increase in serum glutathione for ginger group. Decrease in antioxidant capacity is manifested by an increase in MDA level. MDA is a byproduct of lipid peroxidation, and has a reverse relation with serum antioxidants' capacity. Increased lipid peroxidation is considered as responsible factor for these changes in infertile men [76].

Dietary sesame seeds elevate the concentrations of both tocopherols and tocotrienols [77]. Also, Yamashita, *et al*. (2003) [78] mentioned that sesame seed and its lignans content induced higher gamma-tocopherol and lower TBARS concentrations in rats fed Vitamin E-free. Jedlinska, *et al*. (2006) [79] reported that intake of antioxidants and Vitamins A, B, C, and E can increase stability of testicular blood barrier and protect sperm DNA from oxidative stress caused by active free radicals.

Ginger contains several compounds including acid, resins,Vitamin C, folic acid, Vitamin $B_6$, inositol, choline and panthotenic acid, gingerol, sesquiterpene, volatile oils and trace elements (Ca, Mg, P and K) [80]. Three hundred milligrams of Vitamin E (the amount found in approximately 2.7 cups of sunflower oil) was supplemented twice daily for 3 months. There was a significant improvement in the in vitro ability of spermatozoa to bind the zona pellucida of unfertilized oocytes as compared to binding during the 3 months of placebo [81]. Vitamin E inhibits peroxidation of polyunsaturated fatty acids (PUFA), which is especially important in spermatozoa due to their high PUFA content [82].

Cinnamon contains a good amount of phenolic antioxidants to counteract the damaging effects of free radicals and may protect against mutagenesis [83]. TAC and plasma thiol (SH) groups increased, while plasma MDA levels decreased in subjects receiving the cinnamon extract (250 mg two times per day for 12 weeks) [84].

***Table 4.*** *Effect of halawa tahinia alone or with ginger and cinnamon on liver function in adult male rats.*

| Parameters / Groups | AST (µ/L) | ALT (µ/L) | ALP (µ/L) |
|---|---|---|---|
| Control (-ve) | 63.48±3.43[a] | 27.94±1.86[a] | 87.31±2.22[a] |
| Halawa 15% | 65.09±2.46[a] | 29.92±1.53[a] | 91.98±2.17[a] |
| Halawa (15%) + (500 mg/kg BW) Ginger | 64.44±3.33[a] | 30.05±1.61[a] | 90.09±2.06[a] |
| Halawa (15%) + (500 mg/kg BW) Cinnamon | 65.67±3.10[a] | 29.69±1.58[a] | 88.14±3.41[a] |
| Halawa (15%)+ (500 mg/kg BW) ginger and cinnamon | 64.58±2.98[a] | 28.87±1.36[a] | 85.29±2.86[a] |

*Values were expressed as Means ± SE.
* Values at the same column with different letters are significant at P<0.05

Table (4) showed the effect of halawa tahinia alone or in combination with either ginger or cinnamon on liver functions in rats. It was obvious that the mean level of serum AST, ALT and ALP didn't change for the groups treated with halawa tahinia alone or in combination with either ginger or cinnamon as compared to the control negative group. Moreover, there were no significant changes were observed among the treated groups. So that ginger or cinnamon with Halawa tahinia have no side effects on liver functions

Sesame oil at 5% was possess a better improving potential for hyperlipidemia, serum glucose, thyroid hormones and hepatic lipid profile than sesame oil at 10% [85].

Cinnamon primarily contains vital oils and other derivatives, such as cinnamaldehyde, cinnamic acid, and cinnamate. In addition to being an antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anticancer, lipid-lowering, and cardiovascular-disease-lowering compound, cinnamon has also been reported to have activities against neurological disorders [86]. The results of Haniadka, *et al*. (2013) [87] related to the beneficial properties of ginger in ameliorating the toxic effects of hepatotoxins.

In conclusion: There has been a considerable interest in the food industry to find natural antioxidants to replace synthetic compounds in food applications, and a growing trend in consumer preferences for natural antioxidants, all of which has given more impetus to explore natural sources of antioxidants. Therefore, from the previous results, it provides scientific evidence to substantiate the traditional use of cinnamon and ginger as a drink as well as halawa tahinia in improving infertility and antioxidant status.

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