Soy milk and Sesame seeds (Phytoestrogens) Ameliorate cardiotoxicity induced by adriamycin in experimental animals

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Abstract

Soy milk and sesame seeds consumption has been linked to a lower incidence of chronic diseases such as cardiovascular diseases and atherosclerosis. In this study, fifty male adult albino rats (120-125 g) were divided into five experimental groups, healthy control group, positive control group injected with single dose of adriamycin ADR (10 mg/kg b.w) for induction of cardiotoxicity, group fed on diets supplemented with 20% soy milk powder after ADR injection, group fed on diets supplemented with 10% sesame seeds powder after ADR injection and group fed with diets supplemented with soy/sesame combination after injection. Results showed that, ADR injection induced cardiovascular disorders manifested by increased plasma amylase activity, troponin-T concentration, acid phosphatase activity, anticardiolipin IgM, C-reactive protein and apolipoprotein- β with highly elevated levels of triacylglycerols, total cholesterol, LDL-C and reduction of HDL-C. Observation of this study indicated that supplementation of animal diet with either soy protein or sesame seeds powder or combination of them has significant beneficial effects on ADR injected rats, through the improvement of lipid profile and reduction of elevated cardiac disease biomarkers levels. It should be noticed here that the efficiency of soy/sesame combination in reduction of adverse effects of ADR is greater than either supplement alone.

Key words: Soy protein-Sesame seeds- Adriamycin- Cardiotoxicity- Cardiac Biomarkers-Lipids profile

Introduction

Cardiotoxicity occurs during therapy with several cytotoxic drugs and may be the dose limiting factor in cancer treatment and hence tumor response. Furthermore, cardiotoxicity can also be responsible for long term side effects and may cause severe morbidity in surviving cancer patients. Cardiotoxicity includes a wide range of cardiac effects from small changes in blood pressure and arrhythmias to cardiomyopathy. In literature, different mechanisms of chemotherapy induced cardiotoxicity are postulated including cellular damage due to the formation of free oxygen radicals and the induction of immunogenic reactions with the presence of antigen presenting cells in the heart. Moreover, the influence of the cytotoxic agent on certain phospholipids, especially cardiolipin, may also explain the development of cardiotoxicity [1].

Adriamycin (ADR) is an anthracycline chemotherapeutic agent that has been commonly used in treatment of a wide range of cancers. Unfortunately, the clinical use of ADR is associated with severe cytotoxic side effects including cardiotoxicity and nephrotoxicity [2].

There is great interest in the potential of soy and soy foods to prevent or treat chronic diseases, including cardiovascular disorders, osteoporosis and cancer. These potential benefits are mostly attributed to dietary isoflavones, a subclass of flavonoids that possess numerous biological properties and are most commonly found in legumes; with the highest amounts found in soybeans. The predominant isoflavones found in soybeans are the β-glycoside forms of genistein, daidzein and glycine, which are not bioavailable. Upon ingestion, small intestinal brushborder membrane enzymes and bacterial β-glycosidases remove the glycoside group, after which the isoflavones are readily absorbed and become bioactive [3].

Soy consumption has been linked to a lower incidence of chronic diseases such as cardiovascular diseases, atherosclerosis, type II diabetes, and certain types of cancers [4]. These beneficial effects are attributed mainly to the abilities of soy components in improving blood lipid profiles, such as lowering total cholesterol, LDL cholesterol, and triglyceride levels, and decreasing the ratio of LDL to HDL cholesterol. However, the bioactive components in soybean responsible for the hypocholesterolemic and hypotriglyceridemic properties have not been consistently identified [5]. The interest in the potential health effects of soy and soy isoflavones is growing as epidemiological studies have associated with a diet rich in isoflavones with a lower risk of certain diseases [6].

It is well known that, each 200 gm of soy milk consists of (carbohydrates 1g, fat 3.5 g, saturated fats 0.5 g, monosaturated fat 0.5 g, fiber 0.25g, genistein 9.96 mg, daidzein 6.68 mg, glycine 0.94mg) [7].

Sesamum indicum Linn. (Pedaliaceae) has long been used extensively as a traditional food in the orient for various purposes and commonly known as sesame. Sesame is an important oilseed crop of the world, India being a major producer. Sesame oil is widely used in cooking and as an ingredient of confectionery and for making margarine, and provides highly stable oil and nutritious protein and meals; also it has varieties of medicinal properties. The seeds are used as a demulcent in respiratory affections, infantile cholera, diarrhea, dysentery and other bowel infections and bladder diseases. The seed powder is useful in amenorrhea, dysmenorrhea, ulcers and bleeding piles. Unsaponifiable matter (sterols), fibers as well as lignan-type compounds such as sesamin, sesamolin, sesamol and sesaminol are recognized to be potent therapeutic agents [8].

Therefore, this study aimed to investigate the protective effect of soy milk powder and sesame seeds on ADR-induced cardiotoxicity in rat model.
Materials and Methods

Drug and plant materials: Adriamycnie (ADR) was purchased from NOVARITS Co. Egypt. Soy milk powder, sesame seeds were purchased from local markets, sesame finely powdered in electric miller for use in animal diet. Adriamycin was dissolved in saline immediately before use and injected to rats with a single dose of 10mg/Kg according to Itoh et al., [2]. To induce cardiotoxicity ADR was intraperitoneally injected with a single dose of 10 mg/kg, which is well documented to induce cardiotoxicity in rats [9].

Experimental Design: Fifty male adult albino rats (120-125 g) were obtained from Animal House of National Research Center, Egypt are used in the present study. Rats were acclimatized for 7 days, the animals were housed one per cage in wire bottomed stainless steel cages in a temperature controlled room (25 ± 5 °C), with relative humidity (50± 10 %), and with 12hour light / dark cycle. The animals were randomly assigned into five experimental groups (10 rats /group) which were classified as follows:

Group (1) rats were fed standard control diet and set as healthy control group.

Group (2) rats were fed standard control diet and injected ADR, and set as positive control.

Rats of groups (3, 4, 5) were intraperitoneally injected with a single dose of ADR 10 mg/kg. At the second day of the experiment, rats were fed on different experimental diets:

Groups (3) rats were fed on diet supplemented with 20% soy milk powder [10].

Group (4) rats were fed on diet supplemented with 10% sesame seeds powder [11].

Group (5) rats were fed on diet supplemented with combination of 20% soy milk and 10% sesame seeds powder.

The experiment lasts for 6 weeks. At the end of the experimental period, fasting blood samples were collected from retro-orbital venous plexus under diethyl ether anesthesia. Blood samples were collected in dry clean centrifuge tubes and then centrifuged at 3000 rpm for 15 minutes at 4 °C. Serum samples were collected, stored at -80 °C in clean plastic eppindorf tubes till analysis.

Biochemical analysis: Serum amylase, acid phosphatase and C-reactive protein were measured [12, 13,14]. Troponin T immunoassay was measured [15]. While, immunometric enzyme immunoassay for the quantitative determination of anti-cardiolipin (IgM) was performed [16]. Apo-lipoprotein-β was also measured in serum [17]. Serum cholesterol, triacylglycerols (TAG), High density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL-C) were measured colorimetrically [18,19, 20,21].
Statistical Analysis:

The data were statistically analyzed using SPSS computer Program. The results were presented as mean ± SE. The differences between mean values were determined by analysis of variance (ANOVA test), where $P \leq 0.05$ was considered significant.

Results

Table (1): Effect of Soy milk and Sesame on Troponine-T, Acid phosphatase and Amylase levels in all experimental animals

<table>
<thead>
<tr>
<th>Groups</th>
<th>Tropopine-T ($\mu$g/dL)</th>
<th>Acid phosphatase (U/L)</th>
<th>Amylase (U/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy control</td>
<td>0.008 ± 0.00029</td>
<td>8.66 ± 0.561</td>
<td>1827.4 ± 7.5</td>
</tr>
<tr>
<td>Positive control</td>
<td>0.123 ± 0.00017</td>
<td>14.66± 0.38</td>
<td>2608.5 ±10.6</td>
</tr>
<tr>
<td>Adriamycin+Soy</td>
<td>0.004 ± 0.00029</td>
<td>6.759 ± 0.164</td>
<td>2080.7 ± 5.11</td>
</tr>
<tr>
<td>Adriamycin + Sesame</td>
<td>0.008 ± 0.0003</td>
<td>7.50 ± 0.512</td>
<td>2066.1 ± 17.01</td>
</tr>
<tr>
<td>Adriamycin + Soy + Sesame</td>
<td>0.0037± 0.0003</td>
<td>5.04 ± 0.338</td>
<td>1928.3 ± 12.4</td>
</tr>
</tbody>
</table>

Data are represented as Mean ± SE

Table (1) shows the activity of amylase, acid phosphatase and troponine-t in healthy, ADR injected and treated groups. It is clear from our results that ADR injection showed a significant increase in amylase activity comparing to healthy control group ($p \leq 0.05$). While addition of soy or sesame decreased amylase levels significantly as compared to the positive control group. The obtained results showed that, animals fed both soy and sesame showed significant lower levels of amylase comparing to groups fed soy or sesame only.

It is clear that the activity of acid phosphatase and troponine-t level increased significantly in ADR injected group as compared to healthy control animals ($p \leq 0.05$). On the other hand, the addition of soy or sesame plus soy showed a significant improvement in acid phosphatase and troponine-t levels as compared to positive control and group fed on sesame only. Noteworthy, group fed on sesame only showed the highest level of acid phosphatase when compared to either group fed on soy or the group fed on soy and sesame combination.
Table (2): Effect of Soy milk and Sesame on Anticardiolipin , C-reactive protein and Apo-lipoprotein β levels in all experimental animals

<table>
<thead>
<tr>
<th>Group</th>
<th>Anticardiolipin-IgM (GPL/ml)</th>
<th>C-reactive protein (mg/dL)</th>
<th>Apo-lipoprotein β (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy control</td>
<td>1.359 ± 0.055</td>
<td>2.158 ± 0.086</td>
<td>10.48 ± 0.276</td>
</tr>
<tr>
<td>Positive control</td>
<td>1.873 ± 0.068</td>
<td>5.150 ± 0.087</td>
<td>31.2 ± 1.142</td>
</tr>
<tr>
<td>Adriamycin+Soy</td>
<td>1.528 ± 0.053</td>
<td>4.350 ± 0.029</td>
<td>15.24 ± 0.127</td>
</tr>
<tr>
<td>Adriamycin + Sesame</td>
<td>1.500 ± 0.055</td>
<td>2.620 ± 0.066</td>
<td>13.14 ± 0.396</td>
</tr>
<tr>
<td>Adriamycin + Soy+Sesame</td>
<td>1.482 ± 0.073</td>
<td>3.080 ± 0.076</td>
<td>12.03 ± 0.630</td>
</tr>
</tbody>
</table>

Data are represented as Mean ± SE

Data in table (2) showed that levels of anticardiolipin IgM, CRP increased significantly in positive control group as compared to healthy control group which indicates inflammation as a result of adriamycin injection. Animals fed on soy, sesame and both of them showed a significant decrease (P ≤ 0.05) in anticardiolipin IgM levels as compared to the positive control. It could be also concluded from table (2) that groups fed sesame or (soy+ sesame) showed a significant decrease in CRP and apolipoprotein β levels comparing to group fed o soy only. On the other hand, group fed on sesame showed the lowest levels of CRP as compared to all other treatments. While there was no significant change between these groups in Anticardiolipin IgM levels.

Table (3): Effect of Soy milk and Sesame on Total cholesterol, TAG , LDL-C and HDL-C, in all experimental animals

<table>
<thead>
<tr>
<th>Group</th>
<th>Total cholesterol (TC) (mg/dl)</th>
<th>Triacylglycerols (TAG) (mg/dl)</th>
<th>LDL-C (mg/dl)</th>
<th>HDL-C (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy control</td>
<td>160.17 ± 3.29</td>
<td>128.45 ± 2.34</td>
<td>66.9 ± 1.49</td>
<td>61.67 ± 1.42</td>
</tr>
<tr>
<td>Positive control</td>
<td>200.30 ± 4.58</td>
<td>272.86 ± 2.33</td>
<td>83.0 ± 1.15</td>
<td>40.01 ± 1.29</td>
</tr>
<tr>
<td>Adriamycin+Soy</td>
<td>158.55 ± 2.65</td>
<td>188.24 ± 1.34</td>
<td>66.8 ± 2.1</td>
<td>59.7 ± 1.92</td>
</tr>
<tr>
<td>Adriamycin + Sesame</td>
<td>145.02 ± 1.83</td>
<td>179.2 ± 2.818</td>
<td>68.1 ± 1.5</td>
<td>60.25 ± 1.15</td>
</tr>
<tr>
<td>Adriamycin + Soy+Sesame</td>
<td>167.6 ± 2.03</td>
<td>184.1 ± 1.81</td>
<td>55.8 ± 2.45</td>
<td>77 ± 1.49</td>
</tr>
</tbody>
</table>

Data are represented as Mean ± SE
Levels of cholesterol, triglycerides, HDL-C and LDL-C are shown in table (3). Data represented in this table showed significant increase in cholesterol, triglycerides and LDL-C levels in ADR injected group (positive control) as compared to healthy control group, while HDL decreased significantly (\(p \leq 0.05\)) comparing also to the healthy control group. Groups of animals fed on soy, sesame or both of them showed a significant decrease in cholesterol, triglycerides and LDL-C levels and significant increase in HDL-C level as compared to positive control (\(p \leq 0.05\)). It is also clear that group fed soy + sesame combination showed a significant increase in HDL concentration as compared to groups fed soy or sesame only.

**Discussion**

The present study revealed that levels of amylase, acid phosphatase and troponine-T in healthy, ADR injected and treated groups. In this study it was found that, a single ADR dose (10 mg/kg) induced marked acute cardiotoxicity. ADR-induced cardiotoxicity was manifested by increased serum amylase activity troponin-T concentration and acid phosphatase in adriamycin injected group as compared to healthy control animals. Amylase is derived from the Greek word "amylone," which means starch. The main sources of amylase in humans are the pancreas and salivary glands, but it can be found in other tissues in small quantities. The main function of amylase is to cleave starch into smaller polysaccharides at the internal 1 to 4 alpha linkage in the process of digestion. Among healthy individuals, the pancreas and the salivary glands account for almost all serum amylase, 40-45% from the pancreas and 55-60% from the salivary glands [22]. Addition of soy or sesame decreased amylase levels significantly as compared to the positive control group. On the other hand, feeding animals with soy and sesame combination showed significant lower levels of amylase comparing to groups fed either soy or sesame only. A study by [23] showed that, isoflavones positively affect serum amylase level and was able to normalize its level in the blood. Amylase was previously used in assessment of cardiotoxicity [24]. There was a clear positive correlation between the yield of free phenolics and amylase activity.

Troponine-T is a complex of three regulatory proteins that is integral to muscle contraction, skeletal and cardiac muscle. It is the biomarkers of myocardial damage [25]. Our results indicated that supplementing diets with either sesame or soy protein or combination of them remarkably reduce serum levels of troponine T. Cardiac troponin T is currently the preferred biomarker for the detection of myocardial infarction, due to superior sensitivity and specificity. Furthermore, troponin concentrations provide powerful prognostic information across a spectrum of disease states, even at the lower limit of detection. Troponin testing is primarily used as a tool in diagnosing heart attacks - where damage to the heart is caused by blocked blood flow to the heart [26].

ADR administration increases the acid phosphatase levels. This was in agreement with study which showed that ADR injection causes alterations in acid phosphatase levels [27]. Significant activity of acid phosphatase is found in the spleen, erythrocytes, platelets and prostate gland [28]. Enhanced reduction in the acid phosphatase level observed with increased supplementation of soy and sesame in diet suggests that increased soy consumption may reduce or suppress the release of the enzyme into the blood stream. This reduction may be ascribed to the protein content of either soy or sesame. A study [29] concluded that, supplementing diets with phytoestrogens normalize acid phosphatase level in human model.
Levels of anticardiolipin IgM, CRP and apolipoprotein-β increased significantly in positive control group as compared to healthy control group, thus indicating inflammation as a result of adriamycin injection. Animals fed on soy, sesame and both of them showed a significant decrease in anticardiolipin IgM levels as compared to the positive control, thus reflects the role of soy and sesame, either alone or in combination, in reduction of hazardous effects on ADR. Anticardiolipin antibodies ACA is a member of antibody family, they are autoantibodies that target one or more phospholipids or phospholipid binding proteins present on cellular membranes, bind cardiolipin in the presence of their cofactor b2-glycoprotein [30]. It could be also concluded from this study that groups fed on sesame or soy/sesame combination showed a significant decrease in CRP, while animal group fed on sesame showed the lowest levels of CRP as compared to all other treatments, similar results were previously reported [31]. C-reactive protein (CRP) is a hepatically-derived acute-phase reactant protein and its serum levels are associated with clinical inflammation. Elevated serum levels of CRP can predict the risk of first myocardial infarction and ischemic stroke in humans. Studies have been published proposing a role for CRP in determining lipid response to various dietary interventions [32]. In addition to dyslipidaemia, cardiotoxicity is typified by low grade chronic inflammation. Elevated levels of inflammatory markers, that is, C-reactive protein (CRP), have been shown to predict all-cause and cardiovascular mortality [33]. Results obtained from this study were in agreement with previous studies [34, 35, 36].

Results of this study revealed that, supplementing diets with soy, sesame either alone or in combination reduced the elevated level of apolipoprotein-β. Apolipoprotein-β (apo-β) is the main structural proteins of atherogenic lipoproteins and HDL particles. Apolipoprotein -β levels reflect the entire spectrum of pro-atherogenic particles, including very-low-density, intermediate-density, and low-density lipoproteins, whereas LDL cholesterol levels do not. Apolipoprotein -β levels also provide a good measure of the number of LDL particles, which reflects the atherogenicity of LDL. This association and the ability to measure apolipoprotein in non fasting blood samples have led to recommendations that the apo-β be used in routine clinical care [37].

It is now evident that an increased serum apo-β concentration is an important coronary heart disease (CHD) risk factor. Even in hypertriglyceridemic models, however, most of the total plasma apo-β is associated with LDL, making apo-β a good surrogate for LDL particle concentration. The larger apo-β carrying particles may be less atherogenic than the smaller LDL particles, suggesting that specific measurement of apo-β might be a better predictor of heart diseases [38].

The protective effect of soy and sesame against elevation of cardiac disease biomarkers may due to their content of linolenic acid .Soy bean is rich in linolenic acid and is similar to sesame in its linolenic acid content. Five fatty acids make up nearly the entire oil portion of soybean seed. Soybean oil averages 12% palmitic acid (16:0), 4% stearic acid (18:0), 23% oleic acid (18:1), 53% linolenic acid [39]. Sesame seeds powder contains about 45% linolenic acid [40].Alpha-linolenic acid (ALA) is one of the two essential fatty acids in humans, it may prevent cardiac arrhythmias and sudden cardiac death [41]. Epidemiological studies as well as dietary trials including moderate amounts of ALA in the experimental diet suggest that this essential fatty acid, despite its low concentrations in blood and tissues, may be important in relation with the pathogenesis (and prevention) of heart diseases. Soy-based foods are an important source of dietary protein in Asian countries. A study with Chinese women found that soy food consumption was associated with a lower risk of coronary disease [42]. Sesame seeds supplementation appeared to reduce cardiac disease biomarkers levels to a greater extent than soy protein this effect may due to its content of
Sesamol (3,4-methylenedioxyphenol), the lignan of sesame oil, is a potent antioxidant and anti-inflammatory agent in various oxidative systems, including endotoxin and iron intoxication [43].

A noteworthy result is significant increase in cholesterol, triglycerides and LDL-C levels with a reduction HDL-C level in adriamycin injected group as compared to healthy control. ADR injection is associated with marked hyperlipidemia, ADR treatment also resulted in high level of plasma triglycerides and phospholipids [44]. Our results corroborated with previous studies [45] and [46]. A previous work demonstrated myocardial toxicity of ADR paralleled by an increase in serum lipids especially cholesterol and triglycerides. ADR administration may lower the level of cytochrome P 450 which may in turn depress cholesterol 7-hydroxylase activities, the key enzyme in the conversion of cholesterol to bile acids [47].

The results of this study demonstrated that animals fed on soy, sesame or both of them showed a significant decrease in cholesterol, triglycerides and LDL-C levels, with higher HDL-C level, when compared with positive group. Recent research has focused primarily on efforts to identify the components of soy protein responsible for the beneficial lipoprotein changes. Amino acid composition of soy was investigated for its effect on plasma lipid and lipoprotein metabolism, and its role in atherosclerosis inhibition [48]. Studies investigated that, there were components (such as isoflavones, saponins, and fibers) of the intact soy protein other than amino acids that independently lowered plasma cholesterol concentrations interacted with the protein moiety to affect lipoprotein metabolism favorably [49]. Clarkson noted a reduction in LDL cholesterol concentrations with increasing isoflavone content in soy protein [50].

Several studies [51, 52] had examined the effect of soy and supported the role of soy protein in the reduction of elevated cholesterol. Most of the previous studies used a relatively large quantity of soy protein (36-50 g). A study [53] used composite soy products containing 8-17 g soy milk, and one study by Cicero et al [54] used 20 g soy protein have found favourable effects of soy on lipids. Several mechanisms were suggested to contribute to the cholesterol-lowering effect of soy protein, including enhancement of bile acid excretion, increased tissue LDL receptor activity, and reduced absorption of dietary cholesterol. Interest in the potential role of soy isoflavones as a hypocholesterolemic agent was raised because of their estrogenic activity. In addition to soy isoflavones, a number of other components were shown to have cholesterol-lowering effect, such as saponins [55]. The observations that soy isoflavones including genistein and daidzein lower serum lipid levels in rodents raise the possibility that the isoflavone, not protein, component of a soy milk preparation is responsible for the hypolipidemic propensity. In this context, studies have indicated that soy milk low in isoflavone had a weaker lowering effect on serum and liver lipid levels in rats and mice [56].

Many attempts have been made to elucidate the mechanisms involved in the multiple beneficial effects when following soy diets. A study [57] stated that, an increased excretion of cholesterol from the liver into the intestine via bile acids is unlikely to be the reason for the diminished cholesterol concentration in the liver because the concentration of mRNA coding for CYP7A1, the initial and rate-limiting enzyme in the conversion of cholesterol to 7a-hydroxylated bile acids, was decreased by 40% in rats fed soy protein isolate compared to rats fed casein. This confirms the findings from a recent study in which the soy-protein-induced reduction of hepatic cholesterol. Torres et al., [58] demonstrated that soy milk protein compared to animal proteins lowers serum lipid levels in experimental animals and humans. With regard to the mechanism...
underlying this hypolipidemic effect, the study shows that soy protein decreases cholesterol absorption.

On the other hand, Hyson et al., [59] proved the role of Soy proteins, plant sterols, and almonds reduce LDL-C. Well-documented experimental studies have shown beneficial effects of soy in serum lipids, including reduction of low-density lipoprotein (LDL), cholesterol and triglycerides. In general, the present results were consistent with the finding of Anthony et al., [60] who reported that isoflavones were effective in decreasing serum total cholesterol concentration. However, further investigations are required to assess an independent and favorable effect of isoflavones on blood lipids.

Administration of sesame reduced the elevated levels of cholesterol and triglycerides as compared to ADR injected animals. Studies on isolated or extracted physiologically active components such as sesamin, sesaminol, globulin and defatted sesame seed fraction have been demonstrated to possess beneficial effects on cholesterol metabolism and oxidative stress. A study [61] reported that, lipid-lowering effects of sesame seed in hypercholesteraemic rats is related to an increased excretion of cholesterol, neutral sterols, bile acid and an increase in hepatic bile acid content. The increased intake of sesame seeds or purified sesamin, has hypocholesterolemic effects in rats, and can reduce blood pressure. Sesame may also have antioxidant and anti-inflammatory effects. Oral administration of sesame seeds has been shown to reduce iron-induced lipid peroxidation and lipopolysaccharide-stimulated proinflammatory cytokine production in rats. These properties may be important in diseases such as atherosclerosis where inflammation and oxidative damage have been suggested to be key pathological mechanisms. Apart from its direct effect on pathological mechanisms in cardiovascular diseases, sesame could also increase nutrients which may protect against cardiovascular diseases [8].

In this study, soy administration reduces lipid profile when compared to ADR injected rats. Many attempts have been made to elucidate the mechanisms involved in the multiple beneficial effects following soy diets. These studies have suggested an inhibition of cholesterol absorption at the small intestine by soy protein, a reduced rate of saponin-mediated bile salt absorption, and an antioxidant effect on lipids associated with soy protein with or without isoflavones. The higher increase of high-density lipoprotein (HDL) cholesterol serum levels appears to be associated with the presence of isoflavones in the soy protein. In addition, an activation of peroxisome proliferator-activated receptors (PPARs) was recently reported, which may explain these interesting effects of soy protein on lipid metabolism [62].

The phytoesterol (1.275%) and fiber (17.166%) content of sesame seed in this context could be important in cholesterol elimination and an increase in hepatic bile acid content [11]. Although globulin fractions of sesame seed has been shown to be hypocholesteraemic and induce HMG-CoA reductase activity in hypercholesteraemic rats [63]. The present study shows that whole seed preparation could effectively bring down the cholesterol levels.

It is also clear that group fed a soy/sesame combination (G5) showed a significant increase in HDL concentration as compared to groups fed soy or sesame only. It is well documented that while low-level HDL-cholesterol is positively correlated with a high risk for CAD, an increase in HDL-C level is found to be beneficial. Epidemiological studies have shown that high HDL-
cholesterol concentration could potentially contribute to its anti-atherogenic properties, including its capacity to inhibit LDL-oxidation and protect endothelial cells from the cytotoxic effects of oxidized LDL [64]. Presently, sesame seed powder administration raised HDL-C levels in hypercholesteraemic animals. While dietary fibers are not known to elevate HDL-cholesterol levels, flavonoids are reported to increase the HDL-cholesterol concentrations. The sesame seed flavonoids (0.0446%) could thus have contributed to an increase in HDL-cholesterol concentrations [65,66].

In conclusion: Observation of this study indicated that supplementation of animal diet with either soy milk or sesame seeds powder or combination of them has significant beneficial effects on adriamycin injected rats, through the improvement of lipid profile and reduction of elevated cardiac disease biomarkers levels.

References


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