ABSTRACT

Notwithstanding scientific advances, a significant number of the treatments in male infertility remained stayed vague. This study was aimed to study the impact of Alpinia Officinarum on sex hormones, serum antioxidant and biochemical markers in rats. Forty adult male rats, of (220 ± 10 g) were partitioned into five groups (each consists of eight rats). The primary group was negative control group (-ve) and fed on basal diet only. The other four groups were subcutaneously injected with a single dose of lead acetate (200 mg/kg b.w) to reduce fertility, then were divided into 4 subgroups: including control positive group, and 2nd, 3rd and 4th subgroup were fed on basal diet with supplementation of dried A. officinarum at (5, 7.5 and 10%) respectively for two month. The results revealed that, supplementation with A. officinarum caused a significant positive effects on testes which due to a significant increase in the levels of serum total testosterone, Follicular stimulating Hormone (FSH), Luteinizing Hormone (LH) and Superoxide Dismutase (SOD) levels while Malondialdehyde (MDA) level was diminished. In addition, liver functions and serum lipid profiles were significantly improved compared to the positive control group. In conclusion: Our findings provide a scientific evidence to substantiate A. officinarum in improving fertility in human which may be due to its potent antioxidant properties and androgenic activities.

Keywords: A. officinarum, Galangin, Lesser Galangal, Male infertility, Sex hormones, Blood biochemical.

INTRODUCTION

Infertility is one of the significant medical issues on the planet (Ghaliekhkandi, 2014). It is a multi-parametric phenomenon which more than 30 % of infertilities are related to a male factor 45% related to female and 25% related to both genders (Vincent et al., 2012). It is a typical issue going from 10% to 15% in various nations (Akhtari et al., 2015). Increasing reactive oxygen species (ROS) in seminal fluid might be one of the primary drivers of hazards to spermatozoa in idiopathic infertility (Khosrowbeigy et al., 2012). A few elements influence spermatogenesis and sperm quality for example drug treatment, chemotherapy, toxins (Adeeyo et al., 2011), air pollutions and insufficient vitamins intake (Barkhordari et al., 2013).

Traditional medicinal herbs are being used extensively in various part of the world, may be an alternative source of medicine for infertility enhancement and has excited scientists' advantage nowadays given its little or no side effects (Rabeh, 2016).

A. officinarum Hance (lesser galangal) is an important member of family Zingiberaceae (Saboo et al., 2014). It is an enduring herb with thick, crawling rosy dark colored rhizomes, lineolate taper decorative leaves, and pompous white blooms in racemes (Daniel, 2006). The rhizome of galangal looks like ginger in taste and appearance. It is a source of antioxidant and vitamins (A, B, and C) (Indrayan et al., 2009). A few examinations have detailed that dietary antioxidants, flavonoids and vitamins in diet can enhance sperm quality and thusly increase fertility rate in men (Haghighian et al., 2015).

A. officinarum has been utilized for sexual dysfunction medicine (Rezaeizadeh et al., 2009). It is normally utilized as a food additive (Liu et al., 2015) and has been as often as possible utilized for culinary purposes, it has been utilized in flavors, spices, curries, drinks and even tea (Lim, 2016). Also, the rhizomes have been utilized for stomachic, diseases of the liver and kidney, useful in headaches, rheumatic pains, cancer, diabetes, aphrodisiac and tonic, because of its health-promoting properties (Chouni and Paul, 2018).

Although, there are little investigations that have tended to assess its impacts on spermatozoa characteristics for this reason, the point of this examination was to explore the impact of A. officinarum on promoting sperm parameters and investigate the ability of A. officinarum in improving sex hormones of adult male rats.

MATERIALS AND METHODS

Materials

Plant material: Hance rhizomes (A. officinarum) were obtained from a Local market, Port Said, Egypt. Herbs were identified and authenticated by a plant taxonomist, Faculty of Science, Port Said University, Egypt.

Rats: Forty healthy adult male albino of Sprague Dawley strain rats (220±10g) were obtained from Helwan Farm, Ministry of Health and Population, Cairo, Egypt.

Chemicals: Kits for biochemical examination were bought from Biodiagnostic Company for Pharmaceutical and chemicals, Dokki, Egypt. Casein, vitamins, cellulose, minerals and methionine were obtained from Morgan Company for Chemicals, Cairo, Egypt.
Methods
Preparation of Herb: Fresh galangal rhizomes (A. officinarum) were washed under faucet water to expel the dirt and soil. The rhizomes were then sliced and dried at 40°C in oven and subjected to grinding for 10 min to make a fine powder (Dahui et al., 2014).

Chemical analysis:
A. officinarum was analysed by standard methods for moisture, protein, fat, ash and crude fibre according to AOAC. (2010). Potassium, Calcium and iron contents were also determined by using the atomic absorption spectrophotometer according to Subramanian et al., (2012). The total phenolic and total flavonoids contents of rhizome of A. officinarum were evaluated using a method described by Ao et al., (2009) and Hajjaghajalipour et al., (2016) respectively. Total Phenolic was expressed as mg of gallic acid equivalent (GAE) per 100g of sample, while, total flavonoids content was expressed in mg/g of Quercetin equivalent, per 100 g of sample.

Determination of (DPPH) scavenging activity: 1. 1-Diphenyl-2-pircyl-hydrazyl radical scavenging activity was determined according to Hwang and Do Thi, (2014).

Determination of Total Antioxidant Activity (TAA): TAA of A. officinarum was determined using 0.3ml of sample with 3mL of a reagent solution consisting of 0.6 M H₂SO₄, 28mM sodium phosphate and 4mM ammonium molybdate according to Nampoohiri et al., (2015).

Biological Study:
The basal diet was formulated according to Reeves et al., (1993). After acclimatization period, forty adult male rats were randomly divided into 5 experimental groups (8 rats/group) and the treatment was as follows:
The primary group was negative control group (-ve) and fed on basal diet only. The other four groups were subcutaneously injected with a single dose of lead acetate (200 mg/kg b.w) to reduce fertility (Acharya et al., 2003). One group of them was selected as a positive control group (+ve). The other three groups were fed on basal diet which supplementation of dried A. officinarum at (5, 7.5 and 10%) respectively.

At the finish of the experiment (8weeks) the rats were fasted for 12 hour, and after that sacrificed under ether anesthesia. Blood samples were gathered from medial canthi of the eyes of rats by means of fine capillary glass tubes in a centrifuge tube without any anticoagulant and centrifuged for 20 minutes at 3000r.p.m. to obtain serum.

Spermatozoa characteristics:
At the end of the study, semen samples were accumulated from the Cauda epididymis cautiously separated from the testes and then sperm was placed in the incubator for 15 min according to (Padmanabhan et al., 2008). Approximately, 10μl of the diluted sperm suspension was once transferred and allowed to stand for 5 min (Wyrobek et al., 1983). The cells which settled during this time were counted through a light microscope at 200X magnification (Seed et al., 1996).

Biological Assay:
Serum total testosterone level was determined by Wilke and Utley, (1987). Plasma, FSH and LH concentration were determined using a modified heterologous radioimmunoassay Bolt and Rollins, (1983) and Bernard et al., (1983) respectively. Oxidative stress markers: Malondialdehyde (MDA) and Superoxide Dismutase (SOD) were determined according to (Draper and Hadly, 1990 and Spitz and Oberley 1989) respectively. Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured according to Bergmeyer et al., (1978), alkaline phosphatase (ALP) was determined according to Belfield and Goldberg, (1971). Total cholesterol (TC) by the method of Fossati and Princke, (1982), HDL-cholesterol by Albers et al., (1983), triglyceride (TG) by Wahlefeld (1974).Calculation of LDL-c and VLDL-c by the equation of Fruchart (1982).

Statistical Analysis:
All statistical analysis was conducted with SPSS program at significant levels of P<0.05 (Sunilson et al., 2008).

RESULTS AND DISCUSSION
Results
Total of bioactive compounds (phenols, total flavonoids) and antioxidant activity content of A.officinarum were recorded in Table (1). It contains bioactive compounds and antioxidant activity being (49.42 mg GAE100g, 56.36 mg CE100g and 37.32 %), respectively.

Table 1. Antioxidant activity of Alpinia officinarum.  
<table>
<thead>
<tr>
<th>Sample Parameters</th>
<th>Alpinia officinarum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total phenols (mg GAE/100g)</td>
<td>49.42</td>
</tr>
<tr>
<td>Total flavonoids (mg CE/100g)</td>
<td>56.36</td>
</tr>
<tr>
<td>Antioxidant activity (DPPH, %)</td>
<td>37.32</td>
</tr>
</tbody>
</table>

GAE, Gallic acid equivalent; CE, Catchin equivalent.

Antioxidant activities of the ethyl acetate (EA) and water (WA) fractions were evaluated by free radical scavenging assays DPPH and by total antioxidant activity in Table (2). Results showed that the free radical scavenging activities of the EA fractions were found to be better than dried of A. officinarum. The DPPH radical scavenging abilities of EA fractions of A. officinarum were slightly less than that of gallic acid TAA of two EA fractions also showed better activity than the corresponding WA fractions. The higher antioxidant activity of EA fractions were due to its high amount TPC and TFC.

Table 2. Evaluation of antioxidant activity of ethyl acetate and water fractions by different methods.

<table>
<thead>
<tr>
<th>Plants</th>
<th>DPPH (μg/mL) IC50 values</th>
<th>TAA (mg of ascorbic acid/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.officinarum EA</td>
<td>4.8</td>
<td>650.7</td>
</tr>
<tr>
<td>A. officinarum WA</td>
<td>14.8</td>
<td>150</td>
</tr>
<tr>
<td>Gallic acid</td>
<td>1.4</td>
<td>660.4</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>7.3</td>
<td>155</td>
</tr>
</tbody>
</table>

(EA) ethyl acetate, (WA) water acetate

Results recorded in Table (3) shows the gross chemical composition of A. officinarum (100g) that includes of fat, protein, ash, fiber, moisture and carbohydrates were (2.26, 5.25, 3.22, 17.0,12.4 and 76.9%), respectively. The mineral content in (A. officinarum) contained substantially high amounts of potassium (K), calcium (Ca) and iron (Fe) (697.21, 129.85 and 0.30 mg/100 g), respectively.

Table 3. Gross chemical composition and some essential minerals of Alpinia officinarum.

<table>
<thead>
<tr>
<th>Fat Protein Ash Fiber Moisture Carb. K Ca Fe</th>
<th>(g/100g dry matter sample) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.26</td>
<td>5.25</td>
</tr>
</tbody>
</table>

| mg | mg | mg |

The impact of A. officinarum at different levels on spermatozoa characteristics in adult male rats are illustrated in Table (4). Lead acetate injection to rats significantly (P<0.05) increased in the mean value of serum total abnormal and significant decreased in normal and live level, compared to the healthy group. Moreover, there are a
significant changes at (P<0.05) in the levels of normal, total abnormal and live, between low and high levels of A. officinarum. It was obvious that spermatozoa characteristics didn’t change for the groups treated with 10% of A. officinarum as compared to the healthy group.

Table 4. Effect of Alpinia officinarum on spermatozoa characteristics in adult male rats.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Normal</th>
<th>Total abnormal</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (-ve)</td>
<td>83.1±6.12</td>
<td>16.8±3±11.05</td>
<td>61.6±6.22</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>58.6±6.37</td>
<td>4.1±3±2.37</td>
<td>33.9±6.23</td>
</tr>
<tr>
<td>A. officinarum (5%)</td>
<td>67.5±4.52</td>
<td>32.5±4.52</td>
<td>43.6±6.17</td>
</tr>
<tr>
<td>A. officinarum (7.5%)</td>
<td>71.1±8.103</td>
<td>28.8±3.27</td>
<td>49.0±2.09</td>
</tr>
<tr>
<td>A. officinarum (10%)</td>
<td>75.6±1.35</td>
<td>24.3±4.12</td>
<td>56.0±2.08</td>
</tr>
</tbody>
</table>

Values were expressed as Means ± SE.

Lead acetate injection to rats significantly (P<0.05) decreased in the mean value of serum total testosterone, FSH and LH in rats compared to the healthy group as recorded in table (5). It was observed that, the supplementation with A. officinarum at (5, 7.5 and 10%) caused a significant (P<0.05) increase in the concentration of serum total testosterone, FSH and LH in rats, compared to positive control group. There were significant changes in serum level of FSH and LH between all levels of A. officinarum.

Table 5. Effect of Alpinia officinarum on sex hormones in adult male rats.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Total testosterone (mg/dl)</th>
<th>FSH (µ/L)</th>
<th>LH (µ/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (-ve)</td>
<td>1.76±0.04</td>
<td>7.9±4.06</td>
<td>1.2±0.10</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>0.78±0.01</td>
<td>16.7±4.09</td>
<td>1.9±0.07</td>
</tr>
<tr>
<td>A. officinarum (5%)</td>
<td>2.4±0.21</td>
<td>19.8±6.08</td>
<td>2.2±0.10</td>
</tr>
<tr>
<td>A. officinarum (7.5%)</td>
<td>3.0±0.13</td>
<td>23.7±6.09</td>
<td>2.6±0.12</td>
</tr>
<tr>
<td>A. officinarum (10%)</td>
<td>5.2±0.57</td>
<td>23.7±6.09</td>
<td>2.6±0.12</td>
</tr>
</tbody>
</table>

Values were expressed as Means ± SE.

Table 6. Effects of Alpinia officinarum on malondialdehyde (MDA) and Superoxide Dismutase (SOD) in adult male rats.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>MDA (nmol/ml)</th>
<th>SOD (µ/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (-ve)</td>
<td>8.87±0.84</td>
<td>76.8±1.33</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>30.2±2.19</td>
<td>18.9±2.40</td>
</tr>
<tr>
<td>A. officinarum (5%)</td>
<td>22.7±2.19</td>
<td>31.4±1.89</td>
</tr>
<tr>
<td>A. officinarum (7.5%)</td>
<td>14.8±1.36</td>
<td>47.5±1.68</td>
</tr>
<tr>
<td>A. officinarum (10%)</td>
<td>102.7±7.14</td>
<td>60.7±2.28</td>
</tr>
</tbody>
</table>

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

Table 7. Effect of Alpinia officinarum on liver functions in adult male rats.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>AST (µ/L)</th>
<th>ALT (µ/L)</th>
<th>ALP (µ/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (-ve)</td>
<td>96.3±2.98</td>
<td>37.1±4.2</td>
<td>245.13±7.36</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>119.5±1.347</td>
<td>57.36±2.54</td>
<td>310.00±6.43</td>
</tr>
<tr>
<td>A. officinarum (5%)</td>
<td>108.6±3.47</td>
<td>44.2±1.22</td>
<td>302.06±4.61</td>
</tr>
<tr>
<td>A. officinarum (7.5%)</td>
<td>100.0±4.32</td>
<td>40.8±1.55</td>
<td>297.33±4.14</td>
</tr>
<tr>
<td>A. officinarum (10%)</td>
<td>102.7±7.14</td>
<td>38.1±1.96</td>
<td>253.24±12.43</td>
</tr>
</tbody>
</table>

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

Table 8. Effect of Alpinia officinarum on lipid profile in adult male rats.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>TC (mg/dl)</th>
<th>TG (mg/dl)</th>
<th>HDL-c (mg/dl)</th>
<th>LDL-c (mg/dl)</th>
<th>VLDL-c (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (-ve)</td>
<td>81.35±2.53</td>
<td>67.31±3.14</td>
<td>55.8±1.87</td>
<td>14.30±2.08</td>
<td>13.46±0.62</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>84.00±2.30</td>
<td>63.26±2.37</td>
<td>37.0±4.98</td>
<td>34.26±1.66</td>
<td>12.65±0.77</td>
</tr>
<tr>
<td>A. officinarum (5%)</td>
<td>68.15±3.16</td>
<td>59.7±1.87</td>
<td>43.0±6.19</td>
<td>13.13±1.89</td>
<td>11.95±0.37</td>
</tr>
<tr>
<td>A. officinarum (7.5%)</td>
<td>65.86±1.39</td>
<td>47.9±1.12</td>
<td>45.7±1.29</td>
<td>10.55±1.44</td>
<td>9.59±0.24</td>
</tr>
<tr>
<td>A. officinarum (10%)</td>
<td>59.96±2.49</td>
<td>45.2±1.18</td>
<td>44.6±1.69</td>
<td>6.28±0.74</td>
<td>9.05±0.23</td>
</tr>
</tbody>
</table>

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

Infertility is one of the serious issues which both male and female related variables are not yet unmistakably comprehended (Nassiri et al., 2009). These days it has been perceived that few infections are caused because of oxidative stress (Poljsak et al., 2013). Regardless of numerous accomplishments in modern medicine, side effects of synthetic chemical drugs are as yet the primary issue. Thus, there are growing interests to use of herbal medicine due to its lower side effects. Therefore, this study was intended to investigate the ability of A. officinarum to improve sex hormones of adult male rats.

The current results revealed that A. officinarum contains bioactive compounds and antioxidant activity. These results are agreed with Abdullah et al., 2015; Basri et al., 2017 and Rachkeere et al., 2018 who found that A. officinarum is rich in bioactive compounds such as flavonoids, phenolic acids, alkaloids and contains various flavones such as galangin, alpinin and pungency. Galangal rhizome is also being used in traditional medicine and as a wellspring of bioactive mixtures having therapeutic potentials.

Galangin, a flavonol of flavonoids, seems, by all accounts, to be the overwhelming constituent in all pieces of A. officinarum appearing antioxidants properties with several biological properties (Zhai et al., 2014; Zhang et al., 2014; Tan et al., 2015 and Honmore et al., 2016).

Table 3 showed the gross chemical composition of A. officinarum which contained fat, protein, ash, fiber, moisture and carbohydrates. Regarding the mineral content, Results also showed that A. officinarum have a high level of K, Ca and Fe. These results agreement with Wong et al., 2009; Indrayan et al. (2009) and Jaju et al., 2010 who found that, the rhizome was determined as moisture 12.5 %, protein 4.44 %, carbohydrate 78.9 %, fat 1.14 %, fibre 18.6 %, ash 3.04 % and ascorbic acid. Kasarkar and Kulkarni, 2012 mentioned that, rhizomes is a good source rich in vitamin (A, B), minerals (K, Ca), essential oils and antioxidant. The rhizome of galangal is widely utilized as a spice for food flavoring due to its characteristic fragrance and pungency. Galangal rhizome is also being used in traditional medicine (Shetty and Monisha, 2015 and Chouni and Paul, 2018).

Testosterone is known to be fundamentally engaged with the improvement of sperm cells Arikawe et al., 2012). Our outcomes were in a similar line with the finding by Islam et al. (2000); Esposito et al. (2004) and Al-Qarawi, 2005 mentioned that the extract of A. officinarum had a direct effect on the testes resulting in an increase in the number of spermatozoa, motility and level of testosterone production.

The results of preliminary phytochemical studies showed that the presence of polyphenolics are the most reported phytoconstituents showing a wide range of pharmacological effects including antioxidant activity and can improve the fertility potential of male (Srividy et al., 2010 and Nampoothiri et al., 2015).

Ravichandran, 2013 found that oral administration of A. officinarum has been reported to increase the sperm motility and sperm counts in male mice without any spermatotoxic effect. Mazaheri et al., 2014 mentioned that the application of A. officinarum has also significantly increased the sperm rate, viability and motility in male rats. Also, Shahdadi et al., 2014 and Fedder et al., 2014 indicate that A. galanga may enhance male fertility by elevating sperm quality, increase sperm percentage, viability, motility and testosterone hormone, and this extract did non cause an expansion in testicles weight of rats.

Low sperm count and motility and high rate abnormal spermatozoa level each have been associated with reduced fertility Raji et al., 2003). Also, Wang et al., 2003 showed that a positive relationship between oxidative stress‐induced sperm damage and increased caspase‐induced apoptosis in men with infertility. Several studies (Rimessi et al., 2016; Urquiza‐Martinez and Navarro, 2016 and Ojo et al., 2017) have demonstrated that oxidative stress in the seminal fluid, causes decreased sperm quality.

Flavonoids compounds separated from A. Officinum played a role in the protection against oxidative stress by promoting the expression of antioxidative proteins (Kacey et al., 2016). Also, Kolangi et al., 2019 noticed that A. officinarum can be effective in the improvement of sperm quality, sperm percentage and sperm count without causing adverse effects. It might be attributed to its antioxidant and scavenging activity against the ROS via its phytochemical mainly including galangin (Mahfouz et al., 2009; Kaushik et al., 2011 and Li et al., 2012).

Malondialdehyde is a by product of lipid peroxidation. Increased lipid peroxidation is considered as responsible factor for these changes in men infertile (Hesham et al., 2008). Also, our results were in a similar line with the finding by Kaushik et al., 2013 who found that, the extract (200 mg/kg) of A. galanga rhizomes decreased MDA and glutathione significantly and increased SOD and catalase in the rats.

Similar results were obtained by Jedlinska et al., 2006 and Tremellen, 2008) announced that the antioxidant effect as the major reason for sperm quality improvement. These results are agreed with (Lombardo et al., 2011; Zini and Al-Hathal, 2011 and Ghargozloo and Aitken, 2011). As of late, an oral supplement of various antioxidants was appeared to decrease the number of immobile sperm (Wirlein et al., 2012).

The obtained results revealed that, supplementation with different levels of A. officinarum improved of liver functions. These results agreed with Hemabharathy et al., 2009 observed that the hepatoprotective impact of the extract of A. galanga at 200 and 400 mg kg⁻¹ treated paracetamol induced hepatotoxicity in rats. Alagia et al., 2018 and Karunarathe et al., 2018 revealed that the oral administration of galangal extract did not produce any significant changes in ALT, AST levels indicating that there is no adverse impact of galangal on hepatocyte functions of rats.

Sivakumar et al., 2010 and Sivakumar and Anuradha, 2011 showed that galangin can reduce kidney and liver injury. Also, Xia et al., 2010; Shiv Kumar and Alagawadi, 2011; Iyer et al., 2013 and Kumar and Alagawadi, 2013) showed that galangin exerted improved the liver functions and lipid profile in serum.

Our results were in the same line with the finding by Shin et al., 2004; Jantan et al., 2005; Sivajothi et al., 2008 and Srividya et al., 2010 observed that the rhizomes
of *A. officinarum*, significantly reduces serum (TG) (TC) and increased the serum levels of (HDL) in hyperlipidemic mice. The results suggested the capability of *A. officinarum* in various lipid disorders particularly atherosclerosis.

Also, our results were in agreement with Prathapan et al., (2012) and Kaushik et al., (2013) demonstrated that the rhizomes of *A. galanga* lowered TC, TG and LDL, but increased HDL. Verma et al., (2015) mentioned that methanolic extract of aerial parts of *A. galanga* was effective in improving lipid profile in diabetic rats. Nampoothiri et al., (2017) showed that EA fractions of *A. officinarum* significantly inhibited the LDL oxidation, which indicated that they can prevent the oxidation and also are able to reduce the infectious effects caused by the oxidation of LDL cholesterol.

**CONCLUSION**

*A. officinarum* demonstrated as a beneficial impact on semen parameters in terms of sperm morphology and improving infertility, due to its antioxidant components. This plant may be promising in enhancing sperm healthy parameters without causing adverse effects. Due to these beneficial biological activities, these plants could be used in the development of functional foods and nutraceuticals after detailed in vivo and clinical trials.

**REFERENCES**


