EFFECT OF SILYMARIN AS NATURAL ANTIOXIDANTS AND
ANTIMICROBIAL ACTIVITY

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Abstract

Effect of silymarin as natural antioxidants and antimicrobial activity was main target of the present study. Physicochemical properties of the sunflower oil, and its fatty acid fractionated using GLC method were determined. The ratio between Σ PUFA / ΣSFA, MUFA / ΣPUFA and ΣUSFA / ΣSFA was 4.23, 0.49 and 6.29 respectively. Antioxidant activities of the silymarin were evaluated using Rancimat test at 100 °C and calculated at 25 °C using the temperature coefficient of 2.2 and the DPPH* radical scavenging method. The addition of the different concentrations of silymarin to sunflower oil (100 to 500ppm) led to clear increment in relative stability % and increasing index of sunflower oil (137.589 to 144.889% and 37.563 to 44.880) compared with BHT (107.329% and 7.317) at100°C respectively. The DPPH* radical scavenging activities (%) were increased with increasing silymarin concentration from 100 to 450 ppm from70.27±0.19% to 86.77± 0.0.2% respectively. Meanwhile 500ppm of silymarin slightly lowered its value to 83.78±0.15% than that of 300 to 450ppm (86.77±0.02%) still higher scavenging activity (%) compared with BHT (72.78±0.25%) at 200ppm. Antimicrobial activities of each concentration of silymarin were measured and the data indicated that different concentrations of silymarin had exhibited antimicrobial activities against gram-positive bacteria (Bacillus subtilis ATCC 33221,Bacillus cereus ATCC 33018,Bacillus cereus NRRLB 3711and Staphylococcus aureus ATCC 20231), gram negative bacteria (Escherichia coli ATCC69337, Escherichia coli 0157 and Pseudomonas aeruginosa, ATCC 9027 ), molds (Aspergillus niger NRRL326 , Aspergillus flavus MERCN 101, Aspergillus parasiticus and Penicillium sp.) and yeast (Geotericum candidum NNRRLY552 ). No antimicrobial activity of silymarin concentrations was noticed against either Saccharomyces cerevisiae NNRLY 3034 or Candida lipolytica NNRLY1095. The antimicrobial activity of silymarin was found to be increased in parallel with increasing the concentrations against all tested microorganisms strains. It could be concluded that, the silymarin can be used as natural antioxidants and antimicrobial activity in food industry.

Key word: Silymarin, natural antioxidants, antimicrobial activity, Rancimat DPPH , BHT, Sunflower oil.
Silymarin is a lipophilic extract from the seeds of milk thistle and is composed of three isomer flavonolignans, silybin, silydianin and silychristin. Silymarin content of milk thistle seed ranged from 4 to 6% based on dry weight. Silybin is the component with the greatest degree of biological activity and comprises 50–70% of silymarin (Ramasamy and Agarwal, 2008). Silymarin has free radical scavenging properties and its ability to enhance endogenous anti-oxidant defense systems in vivo. Silymarin has been shown to inhibit the growth of human prostate, breast and cervical cancer cells in test tubes. Silymarin can protect liver, brain, heart and other vital intra organs from oxidative damage for its ability to prevent lipid peroxidation and replenishing the reduced glutathione levels. (Das et al., 2008). Silymarin have anti-inflammatory and anti-arthritic effects due to excellent antioxidant property, scavenging free radicals which act as pro-inflammatory agents. Silymarin was found to be more effective in cases of developing arthritis compared to developed arthritis. Silymarin and silibinin hinder inflammatory process by inhibiting neutrophil migration and kupffer cell inhibition. They also inhibit the formation of inflammatory mediators viz. prostaglandins and leukotriens and release of histamine from basophils(Dixit et al., 2009). Silymarin is a strong antioxidant that has been proven to promote liver cell regeneration, to reduce blood cholesterol and to help prevent cancer (Vaknin et al., 2008).

The hepatoprotective action of silymarin is mainly through its anti-free radical and anticarcinogenic roles (Shaker et al., 2010), but it has also been ascribed other actions includes antioxidant, anti-lipid peroxidative, antifibrotic, anti-inflammatory immunomodulatory and liver regenerating activity. Silymarin has clinical applications in alcoholic liver diseases, liver cirrhosis, Amanita mushroom poisoning, viral hepatitis, toxic and drug diseases of the liver, psoriasis and in neuroprotective and neurotropic activity (Ghosh et al., 2010). Silymarin acts as a toxin blockade agent by inhibiting binding of toxins to hepatocyte cell membrane receptors .The toxicity of silymarin is very low, the oral 50% lethal dose being 10,000 mg kg$^{-1}$ in rats and the maximum tolerated dose being 300 mg kg$^{-1}$ in dogs (Abenavoli et al., 2010).Silymarin is not soluble in water and is usually administered in capsules as a standard extract (70–80% silymarin). Formulation of the phytotherapic extract (silymarin) in self-emulsifying pellets gave rise to a simultaneous improvement of the oral biodiversity of its main active compounds (Iosio et al., 2010). Silymarin has been shown to reduce liver fibrosis up to 30–35%, and in few cases it has reversed the liver fibrosis (Haddad}
etal., 2011). Silymarin has potent antioxidant properties, reduces and suppress harmful effects of solar ultraviolet radiation (UVR) (Altaei 2012). Silymarin is well tolerated in chronic HCV-infected patients. However, no evidence of salutary effects of oral silymarin has yet been reported based on intermediate endpoints (ALT and HCV RNA) in this population. Moreover, intravenous administration of silymarin should be further studied. (Zongguo et al., 2014). Silymarin have the potential to protect the cell from genotoxic damage, due to a lower value DNA in tail. Effective prevention against ROS production. Katerina et al., (2014). Silymarin cream was a novel, effective and safe treatment modality for melasma especially ineidermal and mixed types in Fitzpatrick skin phototype III, IV and V as it showed a significant improvement of melasma lesion. It was as effective as 50% glycolic acid peeling in the treatment of melasma without postinflammatory hyperpigmentation that occurred by glycolic acid peeling. (Elfar and El-Maghrraby 2015). Silymarin combined with grape seed extract had synergistic effect as antifibrotic therapy than single treatment with silymarin or GSE alone and GSE (200 mg/Kg) combined with silymarin had a good resultant effect. Nada et al.,(2015). Seeds of milk thistle contain small amounts of flavonoids (taxifolin) and approximately 20–35% fatty acids and other polyphenolic compounds (Ramasamy and Agarwal, 2008). A number of other flavonolignans have also been found in the seeds including isosilybin, dehydroxysilybin, desoxysilycristin, desoxysilydianin, silandrin, silybinome, silyhermin and neosilyhermin (Katerina et al. (2014). Therefore, milk thistle seed may possess anti allergic and anti-asthmatic activities (Dixit et al., 2009). Further in vivo studies are needed to determine whether milk thistle is safe or effective for people with forms of cancer (Das et al., 2008).

The main objective of the present study was to investigate effect of silymarin as natural antioxidants and antimicrobial activity substance.

MATERIALS AND METHODS

Materials
Sunflower oil: Refined bleached and deodorized sunflower oil (with no added antioxidants) was obtained from Cairo for Oils and Soap Company, Giza, Egypt. All the chemicals and reagents used were of analytical reagent grade and were purchased from Sigma (St. Louis, MO, USA) and Merck (Darmstadt, Germany) Company. Silymarin were purchased from Sigma (St. Louis, MO, USA) and Merck (Darmstadt, Germany) Butylated hydroxyl toluene (BHT):
BHT and 2, 2-diphenyl-1 picryl hydrazil (DPPH) was purchased from Sigma Chemical Co. (St. Louis, Mo 63178, USA).

Microbiological evaluation

Microorganisms: some bacterial strains representing gram–negative bacteria Escherichia coli ATCC 69337, Escherichia coli 0157, Pseudomonas aeruginosa ATCC 9027, and gram-positive bacteria Bacillus subtilis ATCC 33221, Bacillus cereus ATCC 33018, Bacillus cereus NRRLB 3711 and Staphylococcus aureus ATCC 20231 in addition to 3 strains of yeasts Saccharomyces cerevisiae NRRLY 2034, Candida lipolytica NRRLY 1095, Geotrichum candidum NRRLY 552, in addition to 3 strains of moulds Aspergillus flavus 101 MERCN, Aspergillus niger NRRL 326, Aspergillus parasiticus and Penicillium sp were obtained from MERCN Cairo (Microbial Collection Center, the Faculty of Agriculture, Ain Shams University). These microorganisms were checked for their purities likewise they were reactivated to obtain active microorganisms.

Used media

Nutrient agar medium. The medium was obtained from El Nasr Pharmaceutical Chemical Co., Egypt and Malt agar medium which used for yeasts and moulds growth was obtained from Biolifes, Milano, Italy

Methods

Physicochemical properties of the Sunflower oil:
The peroxide value, acid value, refractive was determined according to the method described in the A.O.A.C (2005).

Determination of fatty acids profile
Fatty acid profile of sunflower oil were esterified into their corresponding FAMEs using methanoleic NaOH and BF3 with methanolic (Boron triflouride) as described by A.O.A.C. (2005). Evaluation of antioxidant properties of Silymarin on sunflower oil

Determination of antioxidant activity of silymarin by Rancimat test
Sunflower oil (5g), was mixed separately with different amounts of silymarin 0, 100, 150, 250, 300, 350, 400, 450 and 500 silymarin and 200 ppm of BHT antioxidants and then exposed to the rancimat test using Metrohm Rancimat model 734 at 100°C and calculated at 25°C using the temperature coefficient of 2.2 for induction period at an airflow of 20 L/h. Measuring vessels, electrodes, connecting tubes and glassware were cleaned several times before the experiments (Farhoosh and Tavassoli-Kafrani 2011). The relative stability (%) and the increasing index were calculated using the following equations:
Relative stability (%) = \[ \frac{\text{Induction period of sample} \times 100}{\text{Induction period of control}} \]

Increasing index = \[ \frac{\text{Induction period of sample} - \text{Induction period of control}}{\text{Induction period of control}} \times 100 \]

**Determination of antioxidant activity of silymarin by (DPPH• test)**

The free radical scavenging activity of different concentration of silymarin were measured by the 2, 2-diphenyl-1 picryl hydrazil (DPPH•) method according to (Kekuda et al., 2010). The scavenging activity was calculated using the following formula:

\[ \text{DPPH scavenging activity %} = \left( \frac{A_{\text{blank}} - A_{\text{sample}}}{A_{\text{blank}}} \right) \times 100 \]

**Antimicrobial activity of Silymarin**

The effect of Silymarin on bacterial and yeast growth was studied by the Paper-Disc plate method according to Jiang et al., (2012) by measuring the inhibition zone in mm.

**RESULTS AND DISCUSSION**

**Physical and chemical properties of sunflower oil**

The physical and chemical properties of sunflower oil used in the present study were determined to define the identity of the oil, and insure that oxidative reaction has not begun. The obtained results are shown in Table (1). The acid values was 188 mg KOH/g oil where the low acid values (188-194 mg KOH/g oil) of the oil indicated its freshness state. Moreover, the physical and chemical properties of sunflower oil under study were found to be corresponding to the values approved by the Egyptian Standard (49-1993), for sunflower seed oil (refractive index: 1.4681, acidity (0.05 as % oleic acid), peroxide value 0.0 equivalent of active oxygen / kg. of oil, iodine value: 118, saponification value: 178, and unsaponifiable matter % not more than 1.5%). The above mentioned data revealed that no lipolysis and /or oxidative rancidity occurred in the oil under study. Therefore, the oil can be used in study and the previous obtained data were in harmony with the findings of (Firestone, 2005), Hilali et al., (2005) and Yunus et al., 2009).
Table 1. Physicochemical properties of the Sunflower oil.

| Parameter                          | Physiochemical properties of sunflower |
|------------------------------------|----------------------------------------|
| Odor                               | Acceptance                             |
| Color                              | Yellow                                 |
| Refractive index                   | 1.4681                                 |
| Acidity (as % oleic acid)          | 0.05                                   |
| Acid value (mg KOH/g oil)          | 188                                    |
| Iodine value                       | 118                                    |
| Peroxide value (meq O/kg oil)      | 0.00                                   |
| Unsaponifiable matter (g/kg)      | 1.5                                    |
| Saponification value (mg/g oil)    | 178                                    |
| FFA % (as Oleic acid)              | 0.11                                   |

**Fatty acids composition of sunflower oils**

The fatty acids composition of sunflower oil show in Table (2). The results indicated that sunflower oil contains five saturated fatty acids, i.e., merestic (14:0), palmetic (16:0), stearic acid (18:0) and arachidonic acid (C 20:0) in relative percentages of 0.13%, 8.03%, 4.32% and 0.96% respectively, comprising 13.67% of Saturated fatty acids (SFA). Moreover, there monounsaturated fatty acids (MUFA), i.e.(16:1),(18:1) and(20:1) showed relative percentages of 0.20%, 27.4 % and 0.48% resp., comprising 28.08% of Monounsaturated fatty acids (MUFA). Linoleic acid (C18:2) and α-Linolenic acid (C18:3) as resulted in a value of 55.1% and 2.79%, respectively, comprising 57.89 of Polyunsaturated fatty acids (PUFA).

In sunflower oil, the main fatty acid is Linoleic acid, followed by oleic, Palmitic and Stearic acids. Also, these results were confirmed by the ratio between Σ PUFA / ΣSFA, MUFA / ΣPUFA and ΣUSFA / ΣSFA ,(4.234, 0.485 and 6.289 ) respectively which showed that the oil had a high TU/ TS ratio (6.289). This means that sunflower oil is distinguished by containing fatty acids profile with high degree of unsaturation such as C18:2 (essential fatty acid). Moreover, the obtained data was in harmony with the findings Table(2) the fatty acid composition of sunflower oil. These results are agreement with Firestone (2005), Hilali et al., (2005) and Yunus et al., 2009).
Table 2. Fatty acids composition of sunflower oils

| Fatty acids (%) | Sunflower oil (%) |
|----------------|-------------------|
| Myristic acid (C14:0) | 0.13 |
| Palmitic acid (C16:0) | 8.03 |
| Arachidonic acid C20:0 | 0.23 |
| Stearic acid (C18:0) | 4.32 |
| Arachidic acid (C22:0) | 0.96 |
| ΣSaturated fatty acids (SFA) | 13.67 |
| (C16:1) | 0.20 |
| Oleic acid (C18:1) | 27.4 |
| Gadoleic acid (C20:1) | 0.48 |
| ΣMonounsaturated fatty acids (MUFA) | 28.08 |
| Linoleic acid (C18:2) | 55.1 |
| α-Linolenic acid (C18:3) | 2.79 |
| ΣPolyunsaturated fatty acids (PUFA) | 57.89 |
| Others | 0.36 |
| ΣPUFA / Σ SFA | 4.23 |
| ΣMUFA / ΣPUFA | 0.49 |
| ΣUSFA / ΣSFA | 6.29 |
| C18:2 / C18:3 | 19.75 |

Effect of different concentrations of the silymarin on oxidative stability of sunflower oil

The antioxidant properties of the silymarin on refined sunflower oil were determined by Rancimat test at 100 °C and calculated at 25°C using the temperature coefficient of 2.2. The obtained results are recorded in Tables (3). From these results, it could be found that addition of silymarin exhibited antioxidant activities of fresh sunflower oil compared with control sample.

The data in Table (3) showed that silymarin at level 100 to 500 ppm had highly antioxidant activity more than that of BHT at 200 ppm or control sample. The induction period of sunflower oil in the presence of 100 to 500 ppm silymarin increased the induction period to about 13.649 - 14.375 hr compared with that of 9.922 and 10.648 hr for control and BHT respectively.

Relative stability (%)and induction index (table 3) in parallel with those of induction period, for instance, the relative stability increased gradually from 137.56 to 145.36% due to silymarin concentration from 100-450 ppm while a slight decrease was found due to 500ppm silymarin (144.88%) compared with BHT.
EFFECT OF SILYMARIN AS NATURAL ANTIOXIDANTS AND ANTIMICROBIAL ACTIVITY

(107.32 %). Similar trend was found concerning increasing index which gradually increased from 37.56 to 45.36 due to 100-450 ppm silymarin concentration with slight decrease due to 500 ppm (44.88) compared with BHT (7.31)

The calculated induction period related in 5-8 months as a shelf life (25C) as a result of silymarin concentration.

Finally, from these data, it could be concluded that these results of the antioxidant properties of the silymarin on refined sunflower oil were determined by Rancimat test at 100 ºC and calculated at 25ºC using the temperature coefficient of 2.2 are in agreement with those observed by antioxidant activity of silymarin by DPPH test.

Table 3. Effect of different concentrations of the silymarin on oxidative stability of sunflower oil by Rancimat test at 100 ºC.

| Treatment       | Induction period | Relative stability (%) | Increasing index |
|-----------------|------------------|------------------------|------------------|
|                 | 100 ºC(hr)       | 25 ºC(months)          | 100 ºC | 25 ºC | 100 ºC | 25 ºC |
| Control (0ppm)  | 9.922            | 5.499                  | 100    | 100   | 0      | 0     |
| B.H.T (200ppm)  | 10.648           | 5.902                  | 107.32 | 107.32| 7.317  | 7.329 |
| Silymarin (100ppm) | 13.649       | 7.566                  | 137.56 | 137.58| 37.563 | 37.589 |
| Silymarin (150ppm) | 13.697       | 7.592                  | 138.047| 138.061| 38.047 | 38.061 |
| Silymarin (200ppm) | 13.794       | 7.646                  | 139.024| 139.043| 39.024 | 39.043 |
| Silymarin (250ppm) | 14.326       | 7.941                  | 144.386| 144.408| 44.386 | 44.408 |
| Silymarin (300ppm) | 14.423       | 7.995                  | 145.364| 145.39 | 45.364 | 45.39 |
| Silymarin (350ppm) | 14.423       | 7.995                  | 145.364| 145.39 | 45.364 | 45.39 |
| Silymarin (400ppm) | 14.423       | 7.995                  | 145.364| 145.39 | 45.364 | 45.39 |
| Silymarin (450ppm) | 14.423       | 7.995                  | 145.364| 145.39 | 45.364 | 45.39 |
| Silymarin (500ppm) | 14.375       | 7.968                  | 144.880| 144.899| 44.880 | 44.899 |

Antioxidant activity of silymarin by (DPPH* test)

The DPPH* scavenging activity (%) of the silymarin

The Free radical–scavenging capacities of silymarin compared with Butylated hydroxytoluene (BHT) at 200 ppm were measured by DPPH assay at different concentrations are given in Table (4). The DPPH radical scavenging activities (%) were increased with increasing silymarin concentration from 100 to 450 ppm in a range of 70.27±0.19% to 86.77±0.02% respectively. A high antioxidant activity was found for silymarin (86.77±0.02%) at 300 to 450 ppm compared with BHT (72.78±0.25%) at 200 ppm. The highest concentration of silymarin (500ppm)
resulted in lower value (83.78±0.15%) than concentration 300 to 450 ppm (86.77±0.02%) but were also it had higher scavenging activity (%) compared BHT (72.78±0.025%) at 200 ppm.

On the contrary, no remarkable radical-scavenging capacities had noted for silymarin at 300 to 450 ppm (86.77±0.02%). meanwhile 500 ppm concentration slightly decrease of the DPPH scavenging activity to 83.78±0.15%.

From the above-mentioned data the DPPH\textsuperscript{*} scavenging activity (%) of silymarin are in agreement with those found by Rancimat test at 100 °C and calculated at 25°C 

Table 4. DPPH scavenging activity (%) of the silymarin.

| Treatments                          | DPPH\textsuperscript{*} scavenging activity (%) |
|-------------------------------------|-----------------------------------------------|
| Butylated hydroxytoluene (BHT) 200 ppm | 72.78±0.25                                     |
| Silymarin (100 ppm)                 | 70.77±0.19                                     |
| Silymarin (150 ppm)                 | 73.71±0.11                                     |
| Silymarin (200 ppm)                 | 77.89±0.20                                     |
| Silymarin (250 ppm)                 | 82.80±0.01                                     |
| Silymarin (300 ppm)                 | 86.77±0.02                                     |
| Silymarin (350 ppm)                 | 86.77±0.02                                     |
| Silymarin (400 ppm)                 | 86.77±0.02                                     |
| Silymarin (450 ppm)                 | 86.77±0.02                                     |
| Silymarin (500 ppm)                 | 83.78±0.15                                     |

It could be concluded that the silymarin considered as good natural antioxidant which prolongs stability of sunflower oil and it may be a potent antioxidant activity for its stabilization

**Evaluation of antimicrobial activity of silymarin.**

The antimicrobial activities of different concentrations of silymarin were determined against seven bacterial two yeast and four mold strains. The different concentrations of silymarin that used were 100, 150, 200, 250, 300, 350, 400, 450 and 500 ppm. The diameter of inhibition zones was taken as a criterion of the antimicrobial spectrum. The obtained results are presented in Table (5). Data indicated that the different concentrations of silymarin exhibited antimicrobial activities against gram-positive bacteria (*Bacillus subtilis ATCC 33221, Bacillus cereus ATCC 33018, Bacillus cereus NRRLB 3711* and *Staphylococcus aureus ATCC 20231*), gram negative bacteria (*Escherichia coli ATCC69337, Escherichia coli 0157 and Pseudomonas aeruginosa, ATCC 9027*), molds (*Aspergillus niger NRRL326, Aspergillus flavus MERCN 101, Aspergillus parasiticus and Penicillium sp.*) and yeast (*Geotericum candidum NRRLY552*). No antimicrobial activity of the different
concentrations of silymarin was noticed against either Saccharomyces cerevisiae NRRLY 3034 or Candida lipolytica NRRLY1095 while different concentrations of silymarin exhibited antimalarial activity against all tested microorganisms strains. The antimicrobial activity activity against Geotericum candidum NRRLY 552 (21- 26mm inhibition zone). The antimicrobial activity of the different concentrations of silymarin was increased with increasing of the different concentrations of silymarin and showed higher activity against molds compared with Gram positive or negative gram.

In general, data in Table (5), indicated that different concentrations of silymarin had the most powerful antimicrobial and molds spectra against all tested microorganisms antimicrobial spectra (318.9, 331.9, 313.9, 352.5, 362.2, 369.5, 385.7, 392.2,and 402.3 ) which in parallel with the concentrations of silymarin from 100 to 500 ppm respectively.

Table 5. Antimicrobial activity of silymarin

| Organisms                        | Diameters of inhibition zones (mm)* of silymarin concentrations(ppm) |
|----------------------------------|---------------------------------------------------------------------|
|                                  | 100  | 150  | 200  | 250  | 300  | 350  | 400  | 450  | 500  |
| Gram positive bacteria           |      |      |      |      |      |      |      |      |      |
| Bacillus subtilis ATCC 33221     | 23   | 23.5 | 24.5 | 25   | 26   | 26.2 | 26.5 | 27.5 | 28   |
| Bacillus cereus ATCC 33018       | 22   | 23   | 23.5 | 24.5 | 25   | 26   | 26.2 | 26.5 | 27.5 |
| Bacillus cereus NRRLB 3711       | 22   | 23.2 | 23.7 | 24.7 | 25.2 | 26.3 | 26.5 | 26.8 | 27.6 |
| Staphylococcus aureus ATCC 20231 | 21   | 22   | 23   | 23.5 | 24   | 24.7 | 25.6 | 26   | 27   |
| Gram negative bacteria           |      |      |      |      |      |      |      |      |      |
| Escherichia coli ATCC69337       | 25   | 25.4 | 26   | 26.5 | 27.1 | 27.3 | 28   | 28.4 | 29   |
| Escherichia coli 0157            | 25.1 | 25.5 | 26.2 | 26.5 | 27.2 | 27.5 | 28   | 28.4 | 29   |
| Pseudomonas aeruginosa ATCC 9027 | 24.8 | 25.3 | 26   | 26.3 | 26.5 | 27   | 27.5 | 28.4 | 29.1 |
| Yeast                            |      |      |      |      |      |      |      |      |      |
| Saccharomyces cerevisiae NRRLY2034 | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Candida lipoLyticaNRRLY1095      | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Geotericum candidum NRRLY552     | 21   | 21   | 21.5 | 22   | 23   | 23   | 24   | 24.5 | 26   |
| Molds                            |      |      |      |      |      |      |      |      |      |
| Aspergillus niger NRRRL326       | 35   | 37   | 40   | 42   | 44   | 45.3 | 46   | 46.5 | 47   |
| Aspergillus flavus MERCN 101     | 37   | 41   | 43   | 44   | 45.5 | 46   | 46.5 | 47   | 48   |
| Aspergillus parasiticus          | 32   | 33   | 3.5  | 34   | 34.6 | 34.7 | 44.4 | 45.2 | 46.2 |
| Penicilium sp.                   | 31   | 32   | 33   | 33.5 | 34.1 | 35.5 | 36.5 | 37   | 37.9 |
| Total antimicrobial spectra      | 318.9| 331.9| 313.9| 352.5| 362.2| 369.5| 385.7| 392.2| 402.3|
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تأثير السليمرلين كمضاد أكسدة طبيعي ومضاد نمو الأحياء الدقيقة

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هذا البحث لدراسة مدى إمكانية استخدام السليمرلين كمضاد أكسدة ومضاد نمو الأحياء الدقيقة. كما تم تقييم الخصائص الفيزيوكيميائية لزيت دوار الشمس كمضاد نمو الشمس. كانت الأحماض الدقيقة كلاً من الليبيكول و مثيلك و استئناف أيها كانت نسب مجموع (الأحماض الدقيقة عديدة عدم التشبع / الأحماض الدقيقة المشعة)، الأحماض الدقيقة عديدة عدم التشبع، ومحتوى الأحماض الدقيقة في الزيت (137±89%)، و (142±89%).

ونتيجة لدراسة تأثير السليمرلين كمضاد أكسدة والمضاد نمو الأحياء الدقيقة، في درجة حرارة 0.01 م، و حسب درجه الحرارة على 0.25 م باستعمال معدل تصحيح 0.2 و طريقة DPPH. وجد أن النشاط المضاد للأكسدة باستخدام طريقة DPPH يزداد بزيادة التركيز من 0 إلى 500 جزء في المليون (p<0.01% إلى 0.02% على الترتيب). بينما يخفض عند تركيز 0.05 جزء في المليون (83.78±0.15% (اعلى من التركيز 0.50 جزء في المليون (86.74±0.32%)، ولكن جميع الترتيبات كان لها تأثير في قيمة مقدارها (BHT).

لذلك توصى الدراسة باستخدام السليمرلين كمضاد أكسدة طبيعي ومضاد نمو الأحياء الدقيقة، لعدة ابتكارات نتائج حميرة الخبز (Candida lipolytica NRRLY1095) ، النشط المضاد لنمو الأحياء الدقيقة. و Escherichia coli ATCC69337 ، Escherichia coli 0157، Penicillium sp و Aspergillus niger NRRL326) و الفطرات (Pseudomonas aeruginosa، ATCC 9027 و الخميرة (Penicillium sp و Aspergillus flavus MERCN101، Aspergillus par) .

المصادر

كلمات الدالة: السليمرلين، مضادات الأكسدة الطبيعية، النشاط المضاد لنمو الأحياء الدقيقة، BHT، DPPH، زيت دوار الشمس.