

## The chemical composition of argel (*Solenostemma argel*) and black seeds (*Nigella sativa*) and their antibacterial activities

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International Journal of Frontiers in Science and Technology Research, 2022, 03(02), 052–056

Publication history: Received on 08 October 2022; revised on 17 November 2022; accepted on 20 November 2022

Article DOI: <https://doi.org/10.53294/ijfstr.2022.3.2.0057>

### Abstract

Argel (*Solenostemma argel*) and Black seeds (*Nigella sativa*) are important spices available in Sudan and used in traditional medicine to prove health and to fight microbes. This work aim to determine the chemical composition of Argel (*S. argel*) and Black seed (*N. sativa*) and their antibacterial activities against *E. coli*. Plant samples and *E. coli* strain were brought from Wad Medani City, Gezira State, Sudan. The plant materials were used to run GC-MS analysis and antibacterial test using the standard methods. The results showed that, The main compounds identified from Argel polar extracted, were 3-pentanol, 2,2,4,4- tetramethyle-(15.61%), (3E.5E.7E)-6-Methyl-8-(2,6,6-trimethyl (13.28%), 4H-Pyran-4-one, 2,3-dihydro-3.5-hydroxy (11.8%), and 2,2-Dimethyl-3-[3-methyl-5-(phenylthio) (9.47%), while those of the Black seeds were hexanedecanoic acid (29.44%), Glycerin (18.45%), Octadecadienoic acid (Z,Z) (17.97%), and (R)-(-)-14-Methyl-8-hexadecyn-1-ol (11.95%). Also the aqueous extract of Argel leaves and Black seeds at concentrations of 5% revealed 6 mm and 0 mm inhibition zones, respectively, but the concentration of 25% produced inhibition zone of 17 and 18 mm, respectively, on *E. coli* isolate. The effort that seeks for cheap, safe and effective natural agents should be continued.

**Keywords:** Argel; Black seeds; Chemical composition; Antibacterial; *E. coli*

### 1 Introduction

Herbal medicine is the mainstay of the world population especially in the developing countries because of the general belief that herbal drugs are without any side effects besides being cheap and locally available.

Herbals are a seed, fruit, root, bark, bud or other substance primarily used for flavoring, coloring or preserving food, and they are a long times used in medicine, religious rituals, cosmetics or perfume production, or as vegetable. From these spices, Black seeds (*Nigella sativa*) and Argel (*Solenostemma argel*) are available in Sudan.

A black seed (*N. sativa*) of the family rarunculaceae is commonly called black cumin, fennel flower, black caraway seed, and HabbatueSawda [1]. This plant has been used as health remedy in traditional folk medicine for the treatment of numerous disorders, e.g., asthma, bronchitis, rheumatism, headaches, and dysentery [2], appetite loss, amenorrhea, and dysmenorrhoeal and treatment of worms and skin rash [3], fatigue improvement and energy recovery [4] and antibacterial [5].

Argel (*S. argel*) family Apocynaceae is desert plant of traditional medical used in folk medicine in different place in the world especially in Africa country [6]. *S. argel* is used as antispasmodic and anti-inflammatory [7], anti-oxidant [8], treatment of diabetes mellitus [9], and cancer [10], and jaundice and urinary tract infections [8] and also it used as

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antimicrobial agent[11]. Argel contains flavonoids and saponins in the different organs and alkaloids in the leaves and also phenolic glycosides [12].

*E. coli* organism is a gram- negative, motile, facultative anaerobic, rod shaped bacterium, is one of the most common hospital-acquired pathogens which could cause urinary tract infection, blood stream infection [13].

The objective of this work was to determine the chemical composition of Argel (*S. argel*) and Black seed (*N. sativa*) and their antibacterial activities against *E. coli*.

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## 2 Material and methods

### 2.1 Materials

The samples of Argel leaves and Black seeds were brought from the local market, Wad Medani City, Gezira State, Sudan. These samples were shade dried, crushed, then extracted with 99% ethanol and divided into two parts. The first was used directly to run the GC-MS analysis test, whereas the second was left to evaporate its ethanol solvent and then dissolved in distilled water (hydro-alcoholic extract) to be used against *E. coli* local strain.

### 2.2 Gas Chromatography (GC-MS)

The polar (ethanol extract) constituents of Argel leaves and Black Seed were analyzed using GC-MS technique which was carried it at Central Laboratory, University of Gezira. The instrument (GCMS-QP2010 Ultra, Shimazu Europa GmbH, Library: NIST 11s.lib) was used. The chemical constituent revealed from the GS-MS analysis along with their retention time, base peak, molecular weight, molecular formula and compound names were presented in the result sections.

### 2.3 Antimicrobial activity

The media used in this part was dispensed under aseptic conditions in laminar air flow cabinet type 11 (pretty R, Germany). The media contain essential nutrients for bacterial growth. The medium was prepared according to manufacturer's instruction by suspending 28 g of the dehydrated powder in one liter of distilled water, and boiling to dissolve the ingredients completely, then the pH was adjusted to 7.2 then sterilized by autoclaving at 121°C for 15 minutes, then poured into sterile Petri dishes in 25 ml amount under aseptic condition. Samples of *E. coli* bacteria were brought from Department of bacteriology, Faculty of Medical Laboratory, University of Gezira.

Five filter paper discs (5 mm diameter) each of which was saturated with one concentration of each extract (5%, 10%, 15%, 20% and 25%) and were placed onto quarter of agar plated uniformly seeded with the tested organism and in the middle. This procedure was performed under strict aseptic condition. Five replicates were done. The plates were incubation at 37°C for 24 hours. The diameter of each zone of inhibition was measured by transparent ruler, and the antibacterial activity was expressed as the mean diameter of zone inhibition (mm). All cultures (plates) were incubated aerobically at 37°C for 24 hr before reading of the results. The clear zone of the inhibition around the discs were measured (in mm) and recorded.

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## 3 Results

### 3.1 GC- MS for Argel leaves polar extract

Various components were detected from Argel leaves polar extract and were presented in Table (1), of which 3-Pentanol,2,2,4,4-tetramethyl- (15.61%), (3E.5E.7E)-6-Methyl-8-(2,6,6-trimethyl-1- (13.28%), 4H-Pyran-4-one, 2,3-dihydro-3.5-hydroxy- (11.8%), 2,2-Dimethyl-3-[3-methyl-5-(phenylthio) (9.47%) 1-(2,2-Dimethyl[1,3]dioxin-4-yl)ethanol(7.12%) and Card-20(22)-enolide, 3-[(2,6-dideoxy-4-O- (7.07%) were the main detected components.

**Table 1** Main compounds identified by GC-MS from the polar extract of Argel leaves

R.Time	Area%	Name	Mol. Form	Mol.Wt
8.205	15.61	3-Pentanol,2,2,4,4-tetramethyl-	C <sub>9</sub> H <sub>20</sub> O	144
9.855	7.12	1-(2,2-Dimethyl[1,3]dioxin-4-yl)ethanol	C <sub>8</sub> H <sub>16</sub> O <sub>3</sub>	160
12.177	11.80	4H-Pyran-4-one, 2,3-dihydro-3,5-hydroxy-	C <sub>6</sub> H <sub>8</sub> O <sub>4</sub>	144
16.838	5.76	2-Methyl-4-vinylphenol	C <sub>9</sub> H <sub>10</sub> O <sub>2</sub>	150
18.986	2.53	Trans-Linalool oxide (furanoid)	C <sub>10</sub> H <sub>18</sub> O <sub>2</sub>	170
22.542	4.42	1,2,4- Cyclopentanetrione, 3-(2-pentenyl)-	C <sub>10</sub> H <sub>12</sub> O <sub>3</sub>	180
27.327	4.33	Z-3-Methyl-2-hexenoic acid	C <sub>7</sub> H <sub>12</sub> O <sub>2</sub>	128
27.469	7.07	Card-20(22)-enolide, 3-[(2,6-dideoxy-4-O-	C <sub>36</sub> H <sub>54</sub> O <sub>14</sub>	710
33.766	9.47	2,2-Dimethyl-3-[3-methyl-5-(phenylthio)pent-	C <sub>16</sub> H <sub>22</sub> OS	262
39.172	13.28	(3E.5E.7E)-6-Methyl-8-(2,6,6-trimethyl-1-	C <sub>18</sub> H <sub>26</sub> O	258

### 3.2 GC- MS for Black seeds polar extract

Several components were detected from Black seeds polar extract and were presented in Table (2), of which Hexadecanoic acid, ethyl ester (29.44%), Glycerin (18.45%), 9,12Octadecadienoic acid (Z,Z) (17.97%), (R)-(-)-14-Methyl-8-hexadecyn-1-ol (11.95%), and 9,12Octadecadienoic acid, ethyl ester (10.33), were the main components detected by GC-MS from the black seeds polar extract.

**Table 2** Main compounds identified by GC-MS from the polar extract of Black seed leaves

R.Time	Area %	Name	Mol. Form	Mol.Wt
13.892	18.45	Glycerin	C <sub>3</sub> H <sub>8</sub> O <sub>3</sub>	92
26.397	1.98	Pentadecanoic acid, ethyl ester	C <sub>17</sub> H <sub>34</sub> O <sub>2</sub>	270
27.957	29.44	Hexadecanoic acid, ethyl ester	C <sub>18</sub> H <sub>36</sub> O <sub>2</sub>	284
30.614	17.97	9,12Octadecadienoic acid (Z,Z)	C <sub>18</sub> H <sub>32</sub> O <sub>2</sub>	280
34.504	2.03	Tricyclo[20.8.0.0(7.16)triacontane.1(22),	C <sub>30</sub> H <sub>52</sub> O <sub>2</sub>	444
34.722	10.33	9,12Octadecadienoic acid, ethyl ester	C <sub>18</sub> H <sub>32</sub> O <sub>2</sub>	280
38.697	11.95	(R)-(-)-14-Methyl-8-hexadecyn-1-ol	C <sub>17</sub> H <sub>32</sub> O	252
39.621	2.04	13-Docosamide, (Z)-	C <sub>22</sub> H <sub>43</sub> NO	337

### 3.3 Anti-bacterial activities

**Table 3** Inhibition zone (mm) *E. coli* treated with Argel leaves and black seeds polar extract through disc diffusion method

Concentration	Argel leaves	Black seeds
5%	6	0
10%	7	9
15%	11	13
20%	14	14
25%	17	18

Argel aqueous extract, at concentrations of 5%, 10%, 15%, revealed 6, 7 and 11 (mm) inhibition zone, respectively, on *E. coli*, while 20% and 25% concentrations showed inhibition zones of 14 and 17 mm, respectively (Table, 3).

Concerning Black seed aqueous extract (Table, 3), the concentrations 5%, revealed no inhibition zone, while 10%, 15%, 20% and 25% concentrations showed inhibition of 9, 13, 14 and 18 mm, respectively.

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## 4 Discussion

The improvement of the effective and safe drugs to deal with bacterial infections in addition to the phenomenon of resistance has revealed medical treatment, and the morbidity and the mortality from microbial disease have been reduced.

In this study, it was noticed that, Argel and Black seed extracts were effectively inhibited the growth of *E. coli*, and this can be due to their chemical composition.

*N. sativa* extracts were reported to have anti-microbial activity against a wide range of microbes, especially multiple-antibiotic resistant bacteria [5], and this may be due to its active compounds, of which it contains some alkaloids, including isoquinoline, nigellidine and nigellicine as was reported by Malik *et al.* [14].

In similar studies, Argel was reported as an antimicrobial [15] [11], antispasmodic [16], anti-inflammatory [7] and antioxidant [8]. Argel contains flavonoids and saponins in the different organs and alkaloids in the leaves and also phenolic glycosides [12]. These phytochemicals are mainly responsible for the biocidal and antimicrobial potentialities of this plant.

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## 5 Conclusion

The main compounds identified from Argel polar extracted, were 3-pentanol, 2,2,4,4-tetramethyl-(15.61%), followed by (3E,5H,7E)-6-Methyl-8-(2,6,6-trimethyl-1-cy-) (13,28%) and 4H-pyran-4-one, 2,3-dihydro complex (11.8%). Black seeds contained the hexanedecanoic acid (29.44%), 9, 12-Octadecadienoic acid, (17.95%), Glycerin (18.45%), and some other traces of active ingredients. Argel leaves and Black seeds at concentrations of 25% produced inhibition zone of 17 and 18 mm, respectively on *E. coli* isolate.

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## Compliance with ethical standards

### *Acknowledgments*

Thanks are for the staff member of Central Laboratory, University of Gezira, and Department of bacteriology, Faculty of Medical Laboratory, University of Gezira.

### *Disclosure of conflict of interest*

The authors declare no conflicts of interest regarding the publication of this paper.

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