**Biological activities of essential oils of *Laggera aurita* (L. f.) Benth. ex C.B. Clarke (Asteraceae) and *Hyptis suaveolens* Poit. (Lamiaceae) from Burkina Faso**

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**ABSTRACT**

Essential oils have been increasingly studied as preservatives for the food industries due to their biological properties. Their antimicrobial and antioxidant functions have been proved and could serve as a source of agents to prevent food pathogens. The present study aims to evaluate antioxidant and antimicrobial properties of essential oils of two plants fluently used in Burkina Faso namely *Laggera aurita* and *Hyptis suaveolens*. The antioxidant activity was determined by total antioxidant capacity (TAC) using phosphomolybdate method. The antimicrobial activity was tested using the microdilution and agar diffusion methods, by determining the inhibition zone, the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). Antimicrobial activity was evaluated against seventeen (17) microorganisms. The results showed that the antioxidant potential of essential oilsfrom *L. autita* and *H. suaveolens* were 17.28 ± 1.13 mg EQ/mL and 14.85 ± 0.82 mg EQ/mL respectively. The results of antimicrobial activity of the essential oils from *L. aurita* revealed that the inhibition zone varied from 10.333 ± 0.471 mm to 46.167 ± 1.027 mm, the minimum inhibition concentration from 0.110 ± 0.039 % to 5.260 ± 0.000 % (v/v) and minimum bactericidal concentration varied from 0.877 ± 0.310 % to 4.383 ± 1.240 % (v/v). For the essential oils from *H. suaveolens*, the inhibition zone varied from 12.000 ± 1.633mm to 22.333 ± 0.471 mm, the minimum inhibition concentration from 0.137 ± 0.040 % to 4.383 ± 1.240 % (v/v) and minimum bactericidal concentration varied from 0.932 ± 0.542to 5.260 ± 0.000 % (v/v).These results demonstrated significant antimicrobial and antioxydant properties of the two essentials oils which could be recommended as natural molecules for food protection.

**Key words**: *Laggera aurita*, *Hyptis suaveolens*, essential oils, antimicrobial, antioxidant

**INTRODUCTION**

Studies showed that aromatic and medicinal plants are rich in secondary metabolites, so there is a link between the composition of the plant and its activity **(Asghari, *et al*., 2018)**. It was reported in several studies that the secondary metabolites of plants are responsible of many biological activities including the antioxidant, antimicrobial, anti-inflammatory, anticancer and enzyme inhibition activities **(Demirci *et al*., 2017; Djihane *et al*., 2017; Alothman *et al*., 2018; Saleem *et al*., 2019)**.Different aromatic plants are characterized by odorant and volatile molecules, which are called essential oils. Essential oils are natural molecules of complex mixture that possess several chemical structures synthesized by aromatic plants as secondary metabolites (**Bouyahya *et al*., 2017**). They are a source of bioactive molecules and are widely studied for their potential use as an alternative to synthetic products in the treatment of infectious diseases and various pathological conditions associated with oxidative stress (**Goudjil, *et al*., 2020**). Due to the existence and the diversity of essential oils in aromatic medicinal plants, the ethnic and traditional use including antioxidant, anti-inflammatory, antimicrobial and anticancer (**Yu, *et al*., 2016**) have attracted a growing interest. The use of essential oils as antimicrobial additives in food has been categorized as GRAS (Generally Recognized as Safe) by the US Food and Drug Administration and are rich sources of biologically active compounds, with known antimicrobial and antioxidant properties, which attracts interest as additives in the food industry (**Atarés and Chiralt, 2016**). However, their application as a food additive is the recent growing interest in view of their strong antimicrobial and antioxidant properties (**Calo, *et al*., 2015**). The basic approach to ensure food safety is to minimize the initial microbiological load and/or to inhibit the growth of the remaining microorganisms during post-harvest applications, like production and storage, by the use of an active packaging (**Yildirim *et al*., 2018**). In Burkina Faso, previous studies showed that the essential oils of *Laggera aurita* and *Hyptis suaveolens* have antioxidant and antimicrobial activities. They allowed the reduction of the microbial load of ground beef (**Mihin *et al*., 2019a; Mihin *et al*., 2019b**). The aim of the present study was to investigate more the antioxidant and antibacterial activities of essential oils of *Laggera aurita* and *Hyptis suaveolens* from Burkina Faso.

**MATERIAL AND METHODS**

**Preparation of plant materials**

The leaves from *L. aurita* and *H. suaveolens* were collected in different areas of Ouagadougou in Burkina Faso. After identification of the plants, the dry matter was reduced to powder and packaged in bags for extraction.

**Essential oil extraction**

The essential oil was extracted from the plant material by hydro-distillation according to the method described by **Baser and Buchbauer** (**2010**).

**Microbial strains**

The antimicrobial activity was tested using seventeen (17) microbial strains used as indicator microorganisms: *Escherichia coli*, *Salmonella enteridis* P167807, *Salmonella infantis* SKN 557, *Shigella flexneri* USCC 2007, *Shigella flexneri INU*, *Klebsiella pneumoniae* ATCC 9027 , *Yersinia enterocolitica 8A30 SKN 601*, *Bacillus subtilis ssp* ATCC 6051, *Staphylococcus aureus, Staphylococcus aureus CTM*, *Bacillus licheniformis*, *Bacillus spizizenii*, *Enterococcus faecalis* ATCC 19433, *Candida kefir, Mucor oviz, Saccharomyces cerevisiae* KVL 013 *and Candida tropicalis*. All microorganisms were kindly provided by , Centre de Recherche en Sciences Biologiques, Alimentaires et Nutritionnelles (CRSBAN) of University Joseph KI-ZERBO in Burkina Faso.

The bacterial strains were maintained as stock cultures at -80°C in Mueller-Hinton broth medium (Liofilchem, Italy) with 20 % (v/v) glycerol as cryoprotectant. The fungal strains were also maintained as stock cultures at -80°C in Sabouraud broth medium (Liofilchem, Italy) with 20 % (v/v) glycerol as cryoprotectant.

**Total antioxidant capacity determination by phosphomolybdate assay**

The total antioxidant capacity (TAC) of essential oils was evaluated by the phosphomolybdate method (**Veeraragavan *et al*., 2017**). It is based on the reduction of molybdates to molybdenum in the presence of the extracts, which gives a green color detectable by UV at a wavelength of 695 nm. An aliquot of 10 µL of each essential oils were mixed with 990 µL of reagent solution (0.6 M sulfuric acid, 28 Mm sodium phosphate and 4 mM ammonium molybdate). The tubes are screwed and incubated at 95 °C for 90 min. After cooling, the absorbance of the solutions is measured at 695 nm using a spectrophotometer against the blank which contains 990 µL of the reagent solution and 10 µL of water. It is incubated under the same conditions as the sample. In addition, quercetin was used as a positive control where the absorbance was measured in the same conditions as the samples. The total antioxidant capacities of the essential oils were expressed as milligram of quercetin equivalents/mL of extract (mg EQ/mL) based on the calibration curve. The tests were carried out in triplicate.

**Antimicrobial activity**

**Preparation of the inocula of bacterial and fungal strains**

The inocula of bacterial and fungal strains used as indicators were prepared before inoculating during the assays. A suspension of each bacterial strain was prepared in 10 mL of Mueller-Hinton Broth for 18 to 24 h at 37°C. Using the sterile diluent (physiological saline) (Liofilchem, Italy), the concentration was adjusted in each tube to about 1.0 × 108 CFU/mL comparable to that of the McFarland 0.5 standard according to **Lennette *et al*.** (**1987**). For the fungal suspension, each strain was prepared in Sabouraud broth (Liofilchem, Italy) for 48 to 72 h at 30°C. With a sterile diluent, the concentration was adjusted to about 1.0 × 106CFU/mL comparable to that of the McFarland 0.5 standard (**Lennette *et al*., 1987**).

**Agar diffusion method**

Petri dishes containing Sabouraud Chloramphenicol medium (for fungal strains) and Mueller-Hinton agar (for bacterial strains) were inoculated aseptically with the inocula. Seeding was done by flooding the Petri dish and the excess was aspirated. After drying the dishes, wells were cut with a sterile cork borer (diameter: 6 mm) in the agar. Five (5) μL of *Laggera aurita* essential oil and 10 µL of *Hyptis suaveolens* essential oil were added separately into the different wells (**Mihin *et al*., 2019a; Mihin *et al*., 2019b**). The different of volume explains by the strong activity of essential oil of *L. aurita*. The dishes were exposed at room temperature for one (1) hour before incubation to promote diffusion of essential oil on agar plate. The dishes were incubated at 37 °C for 24 hours for bacteria and at 30°C for 48 h for fungal strains. The presence of a clear zone around the well indicates the inhibition. The results were read by measuring the diameters of inhibition zones in mm (**Rhayour, 2002**).

The activity of essential oil was assessed according to the inhibition diameters values as described by **Negreiros *et al*.** (**2016**). The microbial strains were classified as non-sensitive when a diameter is less than 8 mm, sensitive from 9 to 14 mm, highly sensitive from 15 to 19 mm and extremely sensitive for more than 20 mm.

**Determination of minimum inhibitory concentration and minimum bactericidal concentration**

**Determination of minimum inhibitory concentration**

The determination of the minimum inhibitory concentration (MIC) was performed in a sterile 96-well microplate.

For bacterial strains, 190 μL of Muller-Hinton broth supplemented with tween 80 (0.5%) were introduced into the wells of line 1 and 100 μL into the other wells of the microplate from line 2 to line 12; then 10 μL of essential oil were added to the wells of line 1. The contents of the wells of line 1 were well mixed. 100 μL were collected from these wells (line 1) for cascade dilutions in the other wells (line 11) to the 0.004 % concentration.

The inoculum density was adjusted with sterile saline solution (NaCl 0.9 % w/v) to McFarland 0.5 corresponding to 108 CFU/mL. 100 μL of bacterial inoculum were added to all the wells except the wells in line 11 which contained only the essential oil and Muller-Hinton broth. Line 11 (without inoculum) served as a negative control. Line 12 containing Muller-Hinton broth and bacterial suspension served as a positive control. The microplates were closed and incubated for 18 to 24 h at 37°C ( **Yu *et al*., 2004; Obame, 2009**).

For fungal strains, Sabouraud broth supplemented with tween 80 (0.5%) was used. The same procedure as described previously was performed for experiment. The microplates were incubated at 30°C for 48 to 72 h.

Microbial growth is indicated by reading the optical density of culture (**Yu *et al*., 2004**). The lowest essential oil concentration inhibiting the microbial growth after incubation period was identified as minimum inhibitory concentration (MIC). The treatments were repeated three times and mean values calculated.

**Determination of minimum bactericidal concentration**

One hundred (100) microliter were taken from wells without detectable growth after 24 h of incubation at 37°C and seeded by spreading on Mueller-Hinton agar. The lowest concentration at which 99.99 % of bacteria cells were inhibited after 24 h of incubation was identified as minimum bactericidal concentration (MBC). Experiments were done in triplicate.

**Determination of ratio MBC/MIC**

**Evaluation of bactericidal and bacteriostatic capacity**

The antibacterial activity can be characterized with two parameters such as Minimum inhibitory concentration (MIC) and Minimum bactericidal concentration (MBC).

The ratio MBC/MIC allowed the determination of the bactericidal or bacteriostatic capacities of essential oil on the strains tested according to **Canillac and Mourey** (**2001**) and **Derwich *et al*.,** (**2010**):

Essential oil is bacteriostatic when MBC/MIC>4

Essential oil has bactericidal property when MBC/MIC≤4

**Statistical analysis**

Data was expressed as the mean ± SEM of at least three independent experiments. Variance analysis (ANOVA) was used and Turkey test was used for comparisons of means in case of significant difference. Significance was considered at *p* < 0.05. The statistical calculations were carried out by XLSTAT 2016.02.27444.

**RESULTS AND DISCUSSION**

**Rate of essential oil content of the plants**

The essential oils yield from *H. suaveolens* leaves were 0.215 ± 0.002 % and 0.222 ± 0.004 % from the leaves and flowers from *L. aurita.*

**Total antioxidant capacity**

The table 1 showed the total antioxidant activity of essential oils from*L. aurita* and *H. suaveolens*.

Table 1 : Total antioxidant activity of essential oils

|  |  |  |
| --- | --- | --- |
| **Essential oils** | **TAC (mg EQ/mL)** | **P value** |
| *Laggera aurita*  *Hyptis suaveolens* | 17. 28 ± 1.13  14. 85 ± 0. 82 | 0.039 |

Total antioxidant capacity of *L. aurita* and *H. suaveolens* were expressed as the number of equivalents of quercetin. The study revealed that the antioxidant activity of essential oils was 17.28 ± 1. 13 mg EQ/mL and 14.85 ± 0.82 mg EQ/mL respectively for *L. aurita* and *H. suaveolens*. The total antioxidant activity was expressed as milligram quercetin equivalent/milliliter of essential oils (mg QE/mL) based on the calibration curve; y = 0. 0099x – 0.021; R2 = 0. 9746. The data analysis showed a significative difference between the total antioxidant capacity of *L. aurita* and *H. suaveolens* with the p value of 0.039. The difference in antioxidant capacity could be attributed to the differences in their polyphenolic compounds (**Rostaei *et al*., 2018**). Organic compounds in the plants have been related to some biological activities including antioxidant activity (**Aras *et al*., 2018**). Furthermore, phenolic and flavonoid compounds are capable of metal chelating **(Taslimi and Gulçin, 2018; Bursal *et al.*, 2019**).

**Antimicrobial activity**

The antimicrobial activities of the essential oils against 17 microorganisms were determined using the microdilution and agar diffusion methods.

**Inhibitory capacity of essential oils from *Laggera aurita* and *Hyptis suaveolens***

The results of Inhibition diameters of the essential oil of *L. aurita*were presented in the figure 1.

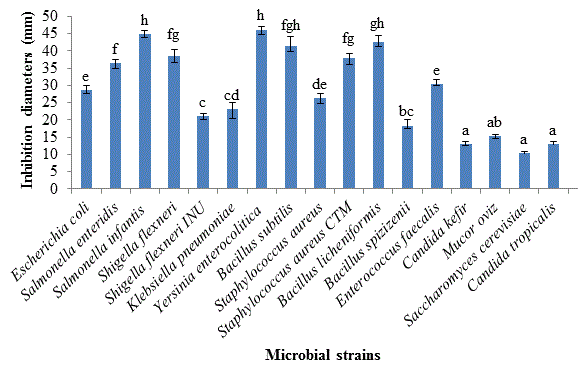


Figure 1 : Inhibition diameters of essential oil of *Laggera aurita*

The same superscript letters are not significantly different (p<0.05) according to the Turkey’s test

These results showed that essential oil of *L. aurita* has substantially antimicrobial activity against microorganisms evaluated. The greatest growth of inhibition halo using *L. aurita* essential oil was found on *Yersinia enterocolitica* (46.167 ± 1.027 mm), *Salmonella infantis* (44.833 ± 1.027 mm), *Bacillus licheniformis* (42.667 ± 1.700 mm) and *Bacillus subtilis* (41.333 ± 2.867 mm). The smallest diameter was observed with *Saccharomyces cerevisiae* (10.333 ± 0.471 mm). The essential oil of *L. aurita* showed antimicrobial activity on all strains tested. In general, the antimicrobial activity of *L. aurita* essential oil was more pronounced against Gram positive bacteria than Gram negative. These results corroborate with those of **Shahwar and collaborators** (**2012**) who showed that Gram-positive bacteria were more sensitive to *Laggera aurita* essential oil than Gram-negative ones. Our previous results showed that this essential oil had antimicrobial activity on eleven microbial strains and Gram-positive bacteria were more sensitive to *Laggera aurita* essential oil than Gram-negative ones (**Mihin *et al*., 2019a**).

The figure 2 shows the results of Inhibition diameters of the essential oil from *H. suaveolens.*

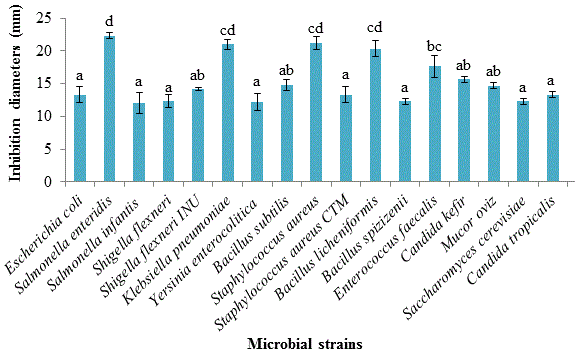


Figure 2 : Inhibition diameters of essential oil of *Hyptis suaveolens*

The same superscript letters are not significantly different (p<0.05) according to the Turkey’s test

These results showed that the essential oil extracted from *H. suaveolens* exhibited inhibitory activity against the tested strains. The largest diameter was obtained with *Salmonella enteridis* (22.333 ± 0.471 mm) followed by *Staphylococcus aureus* (21.167 ± 1.027 mm) and *Klebsiella pneumoniae* (21.000 ± 0.816 mm). The smallest diameter was found with *Saccharomyces cerevisiae* (12.333 ± 0.471 mm). The sensitivity of *H. suaveolens* essential oil was not related to bacteria nature. *Staphylococcus aureus* (Gram positive) and *Salmonella enteridis* (Gram negative) were more sensitive to the essential oil. Our previous results showed that essential oil of *H. suaveolens* had antimicrobial activity on eleven microbial strains (**Mihin *et al*., 2019b**).

According to these results we could conclude that the two essential oils showed an inhibitory activity on microbial strains. The importance of the action varied according to the microorganism tested and according to the essential oil.

**Minimum inhibitory concentrations of essential oils**

The minimum inhibitory concentrations of essential oils were presented in the table 2.

**Table 2**:Minimum inhibitory concentrations of essential oils

|  |  |  |
| --- | --- | --- |
|  | **Minimal inhibitory concentration (v/v %)** | |
| **Strains** | ***L. aurita*** | ***H. suaveolens*** |
| *Escherichia coli* | 0.877 ± 0.310ab | 2.192 ± 0.620bcd |
| *Salmonella enteridis* | 0.548 ± 0.156ab | 1.099 ± 0.305abc |
| *Salmonella infantis* | 0.275 ± 0.078a | 1.753 ± 0.620abc |
| *Shigella flexneri* | 0.110 ± 0.039a | 0.329 ± 0.000ab |
| *Shigella flexneri INU* | 0.548 ± 0.156ab | 0.548 ± 0.155ab |
| *Klebsiella pneumoniae* | 0.165 ± 0.000a | 0.165 ± 0.000a |
| *Yersinia enterocolitica* | 1.753 ± 0.620bc | 0.877 ± 0.310abc |
| *Bacillus subtilis* | 0.877 ± 0.310ab | 0.137 ± 0.040a |
| *Staphylococcus aureus* | 0.658 ± 0.000ab | 2.192 ± 0.620bcd |
| *Staphylococcus aureus CTM* | 0.439 ± 0.155ab | 1.099 ± 0.305abc |
| *Bacillus licheniformis* | 0.439 ± 0.155ab | 0.439 ± 0.155a |
| *Bacillus spizizenii* | 0.548 ± 0.155ab | 2.192 ± 0.620bcd |
| *Enterococcus faecalis* | 2.630 ± 0.000cd | 0.877 ± 0.310abc |
| *Candida kefir* | 5.260 ± 0.000e | 4.383 ± 1.240e |
| *Mucor oviz* | 5.260 ± 0.000e | 3.507 ± 1.240de |
| *Saccharomyces cerevisiae* | 5.260 ± 0.000e | 2.630 ± 0.000cde |
| *Candida tropicalis* | 3.507 ± 1.240d | 2.630 ± 0.000cde |

Different letters in the same column indicate significant difference (p<0.05).

For the essential oil of *L. aurita*, the MIC ranged from 0.110 ± 0.039 % to 5.260 ± 0.000 %. The highest MIC was obtained on *Candida kefir*, *Mucor oviz, Saccharomyces cerevisiae* (5.260 ± 0.000 %) and the lowest MIC on *Shigella flexneri* (0.110 ± 0.039 %).

For the essential oil of *H. suaveolens*, the MIC varied between 0.137 ± 0.040 % and 4.383 ± 1.240 %. The highest MIC was obtained on *Candida kefir* (4.383 ± 1.240 %) and the lowest MIC on *Bacillus subtilis* (0.137 ± 0.040 %).

**Minimal bactericidal concentrations of essential oils**

The table 3 showed the minimal bactericidal concentrations of essential oils.

**Table 3:** Minimal bactericidal concentrations of essential oils

|  |  |  |
| --- | --- | --- |
|  | **Minimal bactericidal concentration (v/v %)** | |
| **Pathogen Strains** | ***L. aurita*** | ***H. suaveolens*** |
| *Escherichia coli* | 2.192 ± 0.620 abc | 4.383 ± 1.240bc |
| *Salmonella enteridis* | 2.192 ± 0.620 abc | 3.507 ± 1.240abc |
| *Salmonella infantis* | 1.753 ± 0.620abc | 3.507 ± 1.240abc |
| *Shigella flexneri* | 0.877 ± 0.310ab | 1.315 ± 0.000ab |
| *Shigella flexneri INU* | 3.507 ± 1.240bc | 2.192 ± 0.620abc |
| *Klebsiella pneumoniae* | 1.648 ± 0.471ab | 0.932 ± 0.542a |
| *Yersinia enterocolitica* | 4.383 ± 1.240c | 1.753 ± 0.620ab |
| *Bacillus subtilis* | 1.753 ± 0.620abc | 1.099 ± 0.305ab |
| *Staphylococcus aureus* | 2.630 ± 0.000abc | 5.260 ± 0.000c |
| *Staphylococcus aureus CTM* | 2.192 ± 0.620abc | 2.192 ± 0.620abc |
| *Bacillus licheniformis* | 2.192 ± 0.620abc | 4.383 ± 1.240bc |
| *Bacillus spizizenii* | 2.192 ± 0.620abc | 4.383 ± 1.240bc |
| *Enterococcus faecalis* | 4.383 ± 1.240c | 3.507 ± 1.240abc |

Values in the same column with the same superscript letters are not significantly different (p<0.05).

For the essential oil of *Lagerra aurita*, the MBC ranged from 0.877 ± 0.310 % to 4.383 ± 1.240 %. The highest MBC was obtained on *Enterococcus faecalis* and *Yersinia enterocolitica* (4.383 ± 1.240 %) and the lowest MBC on *Shigella flexneri* (0.877 ± 0.310 %). For the essential oil of *Hyptis suaveolens*, the MBC varied between 0.932 ± 0.542 % and 5.260 ± 0.000 %. The highest MBC was obtained on *Staphylococcus aureus* (5.260 ± 0.000 %) and the lowest MBC on *Klebsiella pneumoniae* (0.932 ± 0.542 %).

Minimal fungicidal concentrations (MFC) were not determined due to the high minimal inhibitory concentrations obtained on the fungal strains.

**Ratio MBC/MIC of essential oils from *Laggera aurita* and *Hyptis suaveolens***

The Ratios MBC/MIC of essential oils were showed in the table 4.

Table 4: Ratio MBC/MIC of essential oils

|  |  |  |
| --- | --- | --- |
|  | **MBC/MIC** | |
| **Strains** | ***L. aurita*** | ***H. suaveolens*** |
| *Escherichia coli* | 2 | 2 |
| *Salmonella enteridis* | 3 | 3 |
| *Salmonella infantis* | 6 | 2 |
| *Shigella flexneri* | 7 | 3 |
| *Shigella flexneri INU* | 6 | 3 |
| *Klebsiella pneumoniae* | 9 | 5 |
| *Yersinia enterocolitica* | 2 | 1 |
| *Bacillus subtilis* | 1 | 8 |
| *Staphylococcus aureus* | 3 | 2 |
| *Staphylococcus aureus CTM* | 4 | 1 |
| *Bacillus licheniformis* | 4 | 9 |
| *Bacillus spizizenii* | 3 | 2 |
| *Enterococcus faecalis* | 1 | 3 |

The MBC/MIC reports made it possible to determine the bactericidal or bacteriostatic powers of the essential oils on all the strains tested. The interpretation of the MBC/MIC ratios is presented in table 5.

Table 5: Interpretation of the MBC/MIC ratios

|  |  |  |
| --- | --- | --- |
|  | **Interpretation of MBC/MIC** | |
| **Strains** | ***L. aurita*** | ***H. suaveolens*** |
| *Escherichia coli* | Bactericidal | Bactericidal |
| *Salmonella enteridis* | Bactericidal | Bactericidal |
| *Salmonella infantis* | Bacteriostatic | Bactericidal |
| *Shigella flexneri* | Bacteriostatic | Bactericidal |
| *Shigella flexneri INU* | Bacteriostatic | Bactericidal |
| *Klebsiella pneumoniae* | Bacteriostatic | Bacteriostatic |
| *Yersinia enterocolitica* | Bactericidal | Bactericidal |
| *Bacillus subtilis* | Bactericidal | Bacteriostatic |
| *Staphylococcus aureus* | Bactericidal | Bactericidal |
| *Staphylococcus aureus CTM* | Bactericidal | Bactericidal |
| *Bacillus licheniformis* | Bactericidal | Bacteriostatic |
| *Bacillus spizizenii* | Bactericidal | Bactericidal |
| *Enterococcus faecalis* | Bactericidal | Bactericidal |

The essential oils of *L. aurita* and *H. suaveolens* had bactericidal activity on 69.23 % and 76.92 % respectively of the strains tested. The bacteriostatic activity was respectively 30.77 % and 23.08 % for the oil of *L. aurita* and *H. suaveolens*. These two essential oils showed strong antibacterial activity on the strains tested. Both essential oils showed antimicrobial activity on all strains tested. Our previous studies showed that these essential oils had antimicrobial activity on eleven other microbial strains **(Mihin *et al*., 2019a; Mihin *et al*., 2019b**).

So active compounds of essential oils, essential oils destabilize the cellular structure, destroying membrane integrity and increasing permeability and disrupting cellular activities, as for example energy production and membrane transport (**Swamy *et al*., 2016**). The antibacterial action of the essential oil is related to the direct destruction or activation of molecular targets (**Bouyahya *et al*., 2017**). Phenolic compounds from plant extracts had a strong correlation with antioxidant and antimicrobial activities (**Pham *et al*., 2018**). The essential oils create damages in the cell by increasing the cell membrane permeability, changing cell morphology and decreasing ATP synthesis, because the membrane potential is the driving force of ATP synthesis **(Bajpai *et al*., 2012**). Several studies by microscopic visualization showed that essential oils can affect the membrane integrity and destroy the phospholipid bilayer **(Calo *et al*., 2015; Cui *et al*., 2018)**. The diverse efficacies of the various essential oils are also due to the contrasting antimicrobial properties of each single dynamic constituent, as well as their synergic impact (**Herman *et al*., 2019**). In addition, even though antimicrobial property of essential oils is often attributed to their major compounds, interactions between different major and minor constituents may also play an important role in essential oils antimicrobial activity and should not be ignored (**Marchese *et al*., 2017; Chouhan *et al*., 2017**).

**Conflict of interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**CONCLUSION**

The essential oils from *L. aurita* and *H. suaveolens* have presented a strong antimicrobial activity against all the microorganisms studied. The results obtained showed that these essential oils could be considered as natural antimicrobial and antioxidant sources.

The research outcomes demonstrate that these essential oils are good prospect as new antimicrobial agents and an alternative to synthetic antioxidant and could be used as food preservatives on further investigation.

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