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COMPARATIVE STUDY OF THE ANTIBACTERIAL ACTIVITY OF ALGERIAN HONEYS AND MANUKA HONEY TOWARD PATHOGENIC BACTERIA FROM BURN WOUND INFECTIONS

Objective. *Honey is an extremely promising agent in the treatment of infected wounds of burned patients. This study aims to evaluate the antibacterial activity of 14 Algerian honey samples in comparison to Manuka honey towards pathogenic bacteria isolated from burn wound infections.* ***Methods.*** *The antibacterial effect of 14 Algerian honey samples and the Manuka honey was assessed against six multidrug-resistant bacteria: Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus, Staphylococcus saprophyticus, and Enterococcus faecalis. Well agar diffusion, microdilution broth assay, and time-kill assay were used to evaluate the effects of honey samples on the growth of pathogenic bacteria.* ***Results.*** *The results obtained show that all tested honey samples have good antibacterial effects and there is no significant difference between Algerian honey samples and Manuka honey, except honey samples H12 and H13. The Gram-positive bacteria were more susceptible to honey samples than Gram-negative bacteria. The inhibitory diameters were between 14 to 38 mm for Gram-positive bacteria and from 8 to 28 mm for Gram-negative bacteria. The minimal inhibitory concentration of Algerian honey was between 5 and 80% (v/v) and minimal bactericidal concentration was between 10 and 80 % (v/v). However, the minimal inhibitory concentration of Manuka honey was between 5 and 40% (v/v) and minimal bactericidal concentration was between 10 and 80% (v/v). The MBC/MIC ratio was from 1 to 2, which proves that both Algeria honeys and Manuka honey have a bactericidal effect rather than a bacteriostatic effect. A time-kill assay showed that the inhibition effect of honey samples started after the first 3 hours of incubation. Honey samples 3 and 7 inhibited the growth of S. aureus and S. saprophyticus in 15 hours; however, they inhibited the growth of the other pathogenic bacteria in 18 hours.* ***Conclusions.*** *This study proposes honey as an extremely promising treatment against multidrug-resistant bacteria from burn infections.*

Keywords: *antibacterial effect, burn infections, honey, Manuka, multidrug-resistant bacteria.*

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Burns are a global public health problem, responsible for approximately 180,000 deaths per year. The majority of them occur in low- and middle-income countries [1]. The situation is further complicated if the wounds are infected with a pathogenic microorganism. This occurs in 94% of burn patientswhen pathogenic microorganisms escape the host's defense [2]. It is the result of dynamic interactions between the host, a potential pathogen, and the environment. In the majority of cases, the death of a burned patient is most often caused by a bacterial infection [3]. Three mechanisms contributing to the occurrence of such infections are the loss of the skin barrier, invasive procedures, and immunosuppression related to the burn [4]. Due to the gravity of the infections, massive use of antibiotics remains mandatory for the patient, who selects the multidrug-resistant bacteria [5]. The increase in this resistance is reflected in hospital practice by an increase in morbidity and mortality [4, 6] and by an increase in hospitalization costs. Nowadays, antibiotic resistance has become a major public health problem [6, 7] requiring the research of new alternatives to overcome the antibiotic crisis.

The use of traditional medicine for the treatment of infectious diseases has been practiced for a long time, and the honey produced by *Apis mellifera* is one of the oldest treatments used against microbial infections [8—10]. Today it is an extremely promising treatment for infectious diseases, especially for burn patients [7]. It is secreted by honey bees from the nectar and/or honeydew of one or more plant species. Indeed, natural honey has good antibacterial activity against the most pathogenic bacteria including multidrug resistant bacteria [11, 12]. The antibacterial feature of honey is mainly due to its hyperosmolarity, which contributes to extracting the water contained in the oedemas and also in the bacteria causing their dehydration and elimination. However, even diluted honey samples remain active against bacteria, which is due to the production of hydrogen peroxide in the presence of water through the activation of glucose oxidase. The role of this enzyme is to oxidize glucose into gluconic acid and hydrogen peroxide, which is the main component responsible for the antiseptic and antibacterial activity of honey [13, 14]. In fact, within the hive, the biochemical transformation is a way to protect the immature honey. On the other hand, honey has mostly a low pH (between 3 and 4); bacteria cannot multiply in such an acidic environment. Some kinds of honey such as chestnut honey and honeydew honey have a much higher pH between 5 and 6 and still have an antibacterial effect [6, 15]. Other constituents, namely methyl syringate or methylglyoxal, may contribute to the antibacterial activity of natural honey. The antibacterial effect of honey is strongly influenced by its floral source, geographical region, climate, harvesting conditions, and storage conditions [12]. Moreover, honey has anti-inflammatory and healing effects, which help to reduce the pain and inflammation caused by the burn and accelerate tissue reparation. It stimulates the growth of epithelial cells and fibroblasts by regenerating skin tissue. This is due to its strong osmolarity, which makes honey attract water, drains lymph and plasma toward the outside, and contributes to eliminating the debris and cleaning the wound [6, 16].

Manuka honey is a monofloral honey type produced by *Apis mellifera* bees that visit the Manuka tree (*Leptospermum scoparium*) in Malaysia [17] and New Zealand [18]. The antibacterial activity of Manuka honey has been extensively studied [8, 19—21]. However, few studies have been conducted on Algerian honey, and there are no published data on the therapeutical effects of most of the Algerian honey types. Therefore, the objective of this study is to conduct a comparative study of the antibacterial activity of 14 Algerian honey samples to Manuka honey toward pathogenic bacteria isolated from burn wound infections.

Materials and methods. Honey samples. Algerian honey samples were collected in September 2020 from different localities in the North-Eastern part of Algeria. These regions presented a rich floral diversity. All honey samples were raw, natural, and without heating; they were collected in sterile dark glass bottles. Manuka honey was purchased from the supermarket; it had a unique Manuka factor (UMF 15+ equivalent to methylglyoxal (MGO 514+). The pH and color of honey samples were checked and recorded (Table 1). Honey samples were stored at room temperature (24 ± 4 °C) in a dark and dry place until analyzed. The following honey concentrations were prepared in sterile distilled water: 2.5, 5, 10, 20, 40, and 80% (v/v), along with undiluted honey.

Selection of multidrug-resistant bacteria. Swabs were taken from skin-infected wounds of burned patients in the burn unit of the Ibn Sina Hospital, Annaba, Algeria. The collected swabs were streaked on blood agar and Mac Conkey agar plates for bacterial identification. The plates were incubated at 37 °C for 24 hours. Further identification of the microorganisms responsible for the infections was done by conventional methods of microbiology (Gram staining, oxidase, and catalase test, and analytical profile index (API 20E, API 20NE, API STAPH, and API 20 STREP) (Biomerieux, Paris, France). An inoculum of each bacterial strain was prepared, and the turbidity of the suspension was adjusted to achieve 0.5 McFarland (equivalent to that of 1.5×10^8 colony-forming units (CFU)/mL). All bacterial strains were subjected to antibiotic susceptibility tests by Kirby Bauer's disc diffusion method according to the Clinical and laboratory Standards Institute [22] using Mueller Hinton agar medium (Difco, MD, USA) according to their antibiotic resistance profile; only bacterial

Table 1. **The pH, color, floral and geographical origin of tested honey samples**

Honey samples	pH	Color	Floral source	Geographical source
Manuka	3.65	Brown	*Leptospermum scoparium*	New Zealand
H1	3.42	Cream	*Eucalyptus sp, Pinus sp*	El-Taref
H2	3.11	Brown	*Ceratonia siliqua, Hedera helix, Erica arborea*	Annaba
H3	4.02	Dark brown	*Quercus faginae, castanea sativa, Eucaliptus globulus*	Skikda
H4	3.27	Brown	*Quercus faginae, castanea sativa, Myrtus communis*	Jijel
H5	3.86	Cream	*Salvia officinalis, Linum usitatissimum, Myrtus communis*	Bejaia
H6	3.12	Cream	*Citrus:C.maxima, C. sinensis*	Blida
H7	3.18	Dark brown	*Artimisia herba alba, Thymus vulgaris, Lavandula*	Tebssa
H8	3.16	Brown	*Rosmarinus officinalis, Lavandula angustifolia,*	Khenchela
H9	4.12	Dark brown	*Anthemis pedunculata, Crataegus monogyna, Pistacia lentiscus L.*	Setif
H10	3.97	Cream	*Thymus hirtus, Marrubium vulgare*	M'Sila
H11	3.46	Cream	*Ruta graviolens, Pituranthos scoparius,*	Batna
H12	3.67	Brown	*Zizyphus vulgaris, Xanthium strumarium, Ziziphus lotus, Euphorbia bupleuroides*	Djelfa
H13	3.50	Cream	*Rosmarinus officinalis, thymus vulgaris*	Constantine
H14	3.22	Dark brown	*Rosmarinus officinalis, Thymus vulgaris, Ecballium elaterium*	Oum El Bouaghi

strains that showed multidrug resistance were selected. Tested antibiotics were those commonly used for the treatment of burn wound infections, namely oxacillin, ticarcillin, piperacillin, cefotaxime, ceftazidime, imipenem, ciprofloxacin, amikacin, gentamycin, tobramycin, and vancomycin.

Antibacterial effect assays. ***Agar well diffusion assay.*** Honey samples were screened for their antimicrobial activity against six multidrug-resistant strains: *Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia, Staphylococcus aureus, Staphylococcus saprophyticus,* and *Enterococcus faecalis*. Agar well diffusion assay was performed according to Molan et Russell (1988). Wells of 6 mm in diameter were prepared in Mueller Hinton agar plates. The plates were inoculated with bacterial suspension, and 50 µL of the tested honey was added to each well. A well filled with sterile water served as a negative control. The cultures were incubated at 37 °C for 24 hours. The results were recorded as inhibitory diameters around the wells [23].

MIC and MBC determination. The minimum inhibitory concentrations (MIC) were determined using sterile 96-well microtitre plates (Fisher Scientific, UK). A volume of 100 µL of test strain inoculum was added to 100 µL of honey at different concentrations (from 100 to 2.5%) in each well. The control wells containing only broth (negative control) or only bacteria and broth (positive control) were also evaluated. The cultures were incubated at 37 °C for 24 hours. MIC values were indicated by the lowest concentration where no growth was detected.

The minimum bactericidal concentrations (MBC) were determined by inoculation onto nutrient agar plates (Difco, MD, USA) an aliquot of 100 µL of MIC mixtures that showed no bacterial growth. After incubation at 37 °C for 24 hours, the MBC values were determined as the minimum dilution of honey with no visible colony growth in the nutrient agar plates.

Time-kill assay. A time-kill assay was performed to assess the effect of honey on the viability and growth of pathogenic bacteria. Briefly, a single colony-forming unit (CFU) was inoculated in nutrient broth for 24 hours at 37 °C with constant stirring at 150 rpm. Each culture was adjusted to 0.5 on the McFarland scale and inoculated at a cell density of 10^6 CFU/mL in two tubes of Mueller Hinton broth (1 mL). In the first tubes, 1 mL of tested honey (40% w/v) was added. The second tube was used as a control culture. During the incubation at 37°C with constant stirring at 150 rpm, broth aliquots (10µL) were collected every 3 hours, diluted in saline solution, and inoculated on Mueller Hinton agar plates. The number of CFUs in each culture was calculated using a colonies' counter after incubation for 24 hours at 37°C.

Data analysis. All analyses were carried out in triplicates. The inhibitory diameters were performed from the averages of all samples reading mean±standard deviation (SD) using GraphPad Prism software version 7.00 for Windows (GraphPad Software, La Jolla California USA). One-way analysis of variance (ANOVA) followed by a Dunnet test was performed to compare the antibacterial effect of the 14 Algerian honey samples to Manuka honey. Differences were considered significant at the level of $P < 0.05$.

Results. Selection of multidrug-resistant bacteria. The susceptibility of selected bacteria to antibiotics is reported in Table 2. Six non-repetitive pathogenic strains were isolated, three of which were Gram-negative bacteria (*E. coli, P. aeruginosa,* and *K. pneumoniae)* and three — Gram-positive bacteria (*S.aureus, S. saprophyticus,* and *E. faecalis*). These bacterial strains were resistant to the most of tested antibiotics. Gram-negative bacteria were resistant to all tested antibiotics; however, *S. saprophyticus* was susceptible to amikacin, gentamicin, and vancomycin. Gram-negative bacteria had an outer membrane that protected them. They inhibited the penetration of antibiotics by using special pumps in their cell walls.

OXA: oxacillin, AMO: amoxicillin, TIC: ticarcillin, PIP: piperacillin, CEF: cefotaxime, CEZ: ceftazidime, IMI: imipenem, CIP: ciprofloxacin, AMI: amikacin, GEN: gentamycin, TOB: tobramycin, SXT: sulfamethoxazole-trimethoprim, VAN: vancomycin, R: resistant, S: susceptible, ND: not determined.

Antibacterial activity. The results of the evaluation of the antibacterial effect of 14 Algerian honey samples in comparison to Manuka honey by using a well diffusion assay are represented in Fig. 1. As seen, all honey samples have good antibacterial activity comparable to that of Manuka honey. The inhibitory diameters are between 14 to 38 mm for Gram-positive bacteria and from 8 to 28 mm for Gram-negative bacteria. Data analysis showed that there were no significant differences between Manuka honey and other honey samples, except for honey samples H12 and H13. Gram-positive bacteria are more susceptible than Gram-negative bacteria.

The results of the determination of the MIC and MBC values are represented in Table 3. MIC values are between 5 and 80 % (v/v) for Gram-negative bacteria and between 5 and 20% for Gram-positive bacteria. However, MBC values are between 10 and 80 % (v/v). For Manuka honey, the MIC values are between 20 and 40% (v/v) for Gram-negative bacteria and between 5 and 20% (v/v) for Gram-positive bacteria. MBC values are between 40 and 80% (v/v) for Gram-negative bacteria and between 10 and 20% (v/v) for Gram-positive bacteria. The MBC/MIC ratio is from 1 to 2. This ratio is important to distinguish between bacteriostatic honey, which inhibits bacterial multiplication without killing the bacteria, and bactericidal honey, which kills the bacterial cell.

The time-kill assay was performed to assess the effect of honey samples on the growth and viability of the pathogenic bacteria. The results are represented in Fig. 2. The inhibition effect of honey samples started after the first 3 hours of incubation. Most of the honey samples inhibited bacterial growth within 24 hours. However, honey samples 3 and 7 inhibited the growth of *S. aureus* and *S. saprophyticus* in 15 hours, they inhibited the growth of the other pathogenic bacterial strains in 18 hours. The growth of Gram-negative bacteria was inhibited in 21 hours by honey samples 3, 7, and 9. Within 24 hours of incubation, all honey samples inhibited the growth of the pathogenic bacteria and no bacterial colonies were observed on the culture medium.

Discussion. The skin is the first line of defense against external attacks; with the destruction of the skin covering in burn patients, they are classified as immune-compromised and subject to colonization by pathogenic microorganisms. Wound infection occurs beyond 48 hours and dominates all other causes of mortality. The complication in burn patients is most often related to the infection with multidrug-resistant bacteria. Honey, thanks to its high viscosity, low pH, and

Table 2. **Susceptibility of pathogenic bacteria to antibiotics**

Pathogenic bacteria	Susceptibility to antibiotics												
	OXA	AMO	TIC	PIP	CEF	CEZ	IMI	CIP	AMI	GEN	TOB	SXT	VAN
E. coli	ND	R	ND	R	R	R	R	R	R	R	R	R	ND
P. aeruginosa	ND	R	R	R	R	R	R	R	R	R	R	R	ND
K. pneumoniae	ND	R	ND	R	R	R	R	R	R	R	R	R	ND
S. aureus	R	ND	ND	R	R	R	ND	R	R	R	R	R	R
S. saprophyticus	R	ND	ND	R	R	R	ND	R	S	S	R	R	S
E. faecalis	R	ND	ND	R	R	R	ND	R	R	R	R	R	R

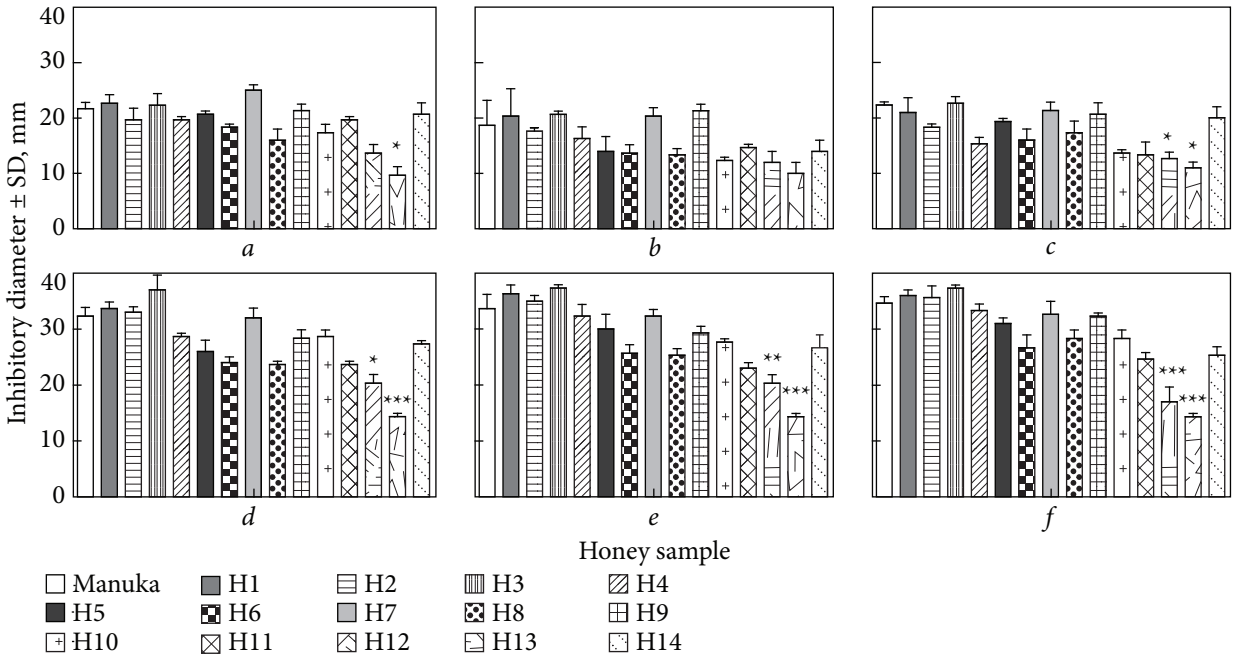

Fig. 1. Comparative inhibitory diameters (mm ±SD) of 14 Algerian honey samples to Manuka honey against multidrug-resistant bacteria from burn wound infections, (*a*) *E. coli,* (*b*) *P. aeruginosa,* (*c*) *K. pneumoniae,* (*d*) *S. aureus,* (*e*) *S. saprophyticus,* (*f*) *E. faecalis*

Note: *indicates that there is a statistically significant difference between Manuka honey and an Algerian honey sample.

Table 3. **MIC and MBC values of honey samples against the pathogenic bacteria, % (v/v)**

Honey samples	*E. coli*		*P. aeruginoa*		*K. pneumoniae*		*S. aureus*		*S. saprophyticus*		*E. feacalis*		*MBC/MIC*
	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	
Manuka	20	40	40	80	40	80	10	20	5	10	05	10	2
H1	20	40	20	40	40	80	10	20	5	10	05	10	2
H2	20	40	40	80	40	80	10	20	5	10	05	10	2
H3	10	20	20	40	20	40	05	10	5	10	05	10	1
H4	40	80	40	80	40	80	10	20	5	10	10	20	2
H5	40	80	40	80	40	80	20	40	5	10	10	20	2
H6	40	80	40	80	40	80	20	40	20	40	10	20	2
H7	10	20	20	40	20	40	05	10	5	10	05	10	2
H8	40	80	40	80	40	80	10	20	20	40	10	20	2
H9	40	80	40	80	20	40	20	20	5	10	05	10	2
H10	40	40	40	80	40	80	20	40	5	10	20	40	2
H11	40	80	40	80	40	80	20	40	20	40	20	40	2
H12	40	80	80	80	40	80	20	40	20	40	20	40	2
H13	40	80	80	80	40	80	20	40	20	40	20	40	2
H14	20	40	20	40	20	40	10	20	5	10	10	20	2

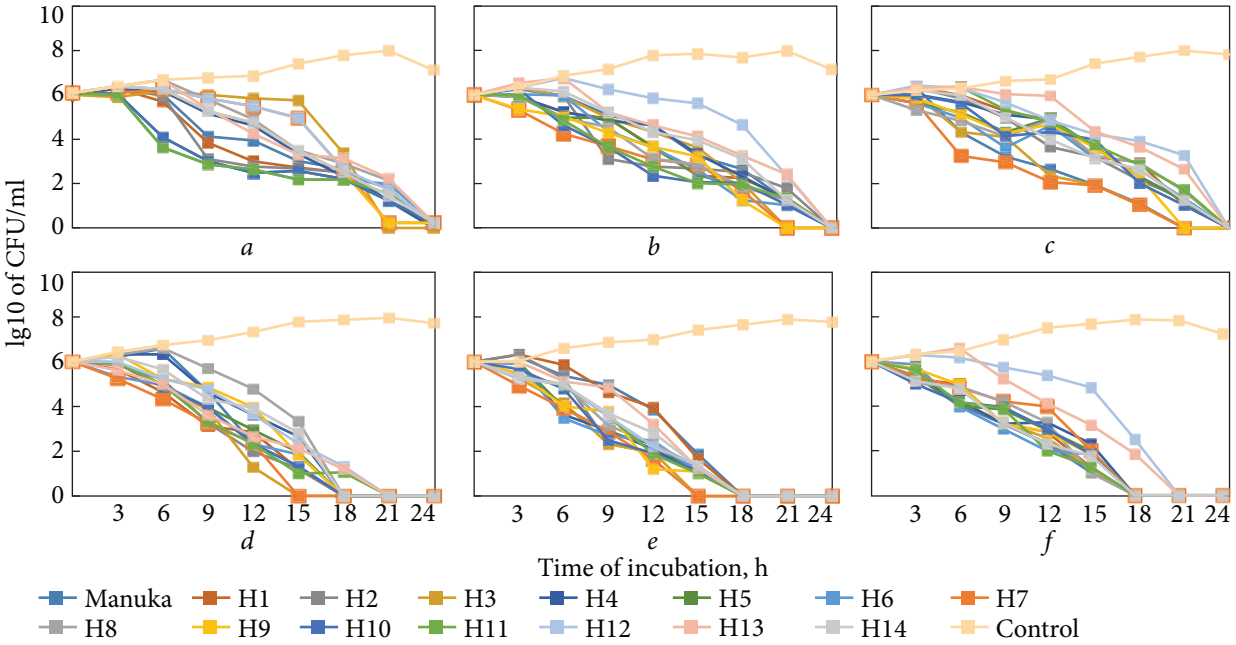

Fig. 2. Comparison of time-kill curves of 14 Algerian honey samples to Manuka honey against multidrug-resistant bacteria from burn wound infections: (a) *E. coli,* (b) *P. aeruginosa,* (c) *K. pneumoniae,* (d) *S. aureus,* (e) *S. saprophyticus,* (f) *E. faecalis*

hydrogen peroxide content, can act as a barrier and provide a moist environment, which promotes wound healing. Honey can treat wound infections due to its dual antimicrobial and healing properties. In this study, a comparison of the antibacterial effect of Algerian honeys with that of Manuka honey was carried out against multidrug-resistant bacteria from wound burn infections [6, 8].

14 Algerian honey samples were used to compare their antibacterial activity to Manuka honey toward six multidrug resistant strains. As shown in Fig. 1, all honey samples have good antibacterial activity comparable to that of Manuka honey. Compared to Gram-negative bacteria, Gram-positive bacteria are more susceptible. This may be due to the absence of an external membrane in Gram-positive bacteria, while Gram-negative bacteria have an external lipid layer that protects them from the aggression of the external environment and is probably responsible for their greater resistance to antibacterial agents. Such a finding has already been reported by many authors [20, 25, 26]. *P. aeruginosa* is a less susceptible pathogenic bacterium to honey samples. It is characterized by genetic flexibility and sometimes is surrounded by a pseudo-capsule called slime that protects it from environmental aggression [6, 27].

From Table 3, the MIC and MBC of the 14 Algerian honey samples are very similar to those of Manuka honey. The MBC/MIC ratio ranges between 1 and 2. This ratio is crucial to distinguish between bactericidal honey, which kills the bacterial cell, and bacteriostatic honey, which prevents bacterial multiplication without killing the bacteria. According to O'Neill and Chopra, (2004), when the MBC/MIC ratio is less than or equal to 4, the antimicrobial agent has a bactericidal effect, therefore, all tested honey samples exhibited a bactericidal effect on the tested pathogenic bacteria [28]. The bactericidal activity of honey is related to hydrogen peroxide. In most cases, the peroxide activity can be easily destroyed by heat

or in the presence of catalase. However, Manuka honey known as «non-peroxide honey» retains its antimicrobial activity. Several other components may contribute to non-peroxide activities, such as the presence of methyl syringate and methylglyoxal, which have been widely studied in Manuka honey [29]. However, many other constituents may contribute to the antimicrobial properties of honey, such as polyphenols and flavonoids, which exhibit a wide range of biological effects and act as natural antioxidants. It has been demonstrated previously that there is a strong positive correlation between the polyphenolic contents and the therapeutical effects of honey [12, 30, 31]. Phenolic acids can also add acidity to the honey, which contributes to its flavor, stability, and antibacterial properties [12].

Previous comparative studies of the antibacterial effects of different honey samples to Manuka honey have shown that there is no significant difference between Ulmo honey [32], Malaysian Tualang honey [29], Polish honeydew [33], Western Australian honey [34], Buckwheat honey[26], and Saudi Shaoka honey [35] compared to Manuka honey. However, a study by Abbas et al. (2014) has shown that Manuka honey has a more antibacterial effect against *P. aeruginosa, S. aureus, Proteus mirabilis,* and *Klebsiella. spp* than Clover Egyptian honey [24]. However, Moghadam et Khaldi (2021) have shown that Iranian honey exhibits more inhibitory effects than Manuka honey against *Acinetobacter baumannii* and the same average of inhibitory effects against *K. pneumoniae* and *E. coli* [36]. Also, Sherlock et al. (2010) have demonstrated that Ulmo honey samples from Chile have more antibacterial effects against *P. aeruginosa, E. coli,* and *S. aureus* than Manuka honey [37]. In addition, Alzahrani et al. (2012) showed a more potent microbial action of Manuka honey towards *S. aureus* than other light honey samples such as acaciaand lavender [38]. Indeed, there is a high discrepancy in the data on the levels of the antibacterial activity of different honey samples among researchers. The similarity or divergence of their results may be due to several reasons. Honey contains different levels of active compounds, including polyphenolic content and flavonoids, which strongly depend on the geographical and botanical origin of honey samples as well as on harvesting, processing, and storage conditions [14, 39]. Variation in experimental conditions and the susceptibility of bacterial strains can also lead to discrepancies in results [40].

The time-kill experiment was used to determine how honey samples affect the pathogenic bacteria's growth and viability. The results showed that after the initial 3 hours of incubation, the inhibitory effect of honey samples begins. Within 24 hours, most honey samples inhibit the bacterial growth. Similar results have been reported by Jantakee and Tragoolpua (2015), i.e, honey at 50 % (v/v) affect significantly the growth of *S. aureus*. Shenoy et al. (2012) have also reported that honey at 50% (w/v) could eliminate *P. aeruginosa* strains within 24 hours. According to Molan (1992), the bactericidal effect of honey varies from several to 40 hours; it depends on the duration of incubation, the concentration of honey, and the tested bacteria [41—43].

Conclusions. It has been demonstrated that Algerian honeys have as good antibacterial activity as Manuka honey has against multidrug-resistant bacteria from burn wound infections. Gram-positive bacteria were shown to be more susceptible to honey than Gram-negative bacteria. Since no resistance to honey has been described until today, it is becoming a good treatment against pathogenic bacteria, especially those of burn wound infections. This is attributed to the synergy of several factors conferring good antibacterial activity to natural honeys including hydrogen peroxide, low pH, osmotic effect, and richness in bioactive substances. Further studies are needed to determine the bioactive substances in Algerian honey samples as well as the mechanism of action and the factors responsible for the antibacterial effects.

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ПОРІВНЯЛЬНЕ ВИВЧЕННЯ АНТИБАКТЕРІАЛЬНОЇ АКТИВНОСТІ АЛЖИРСЬКОГО МЕДУ ТА МЕДУ МАНУКА ДО ПАТОГЕННИХ БАКТЕРІЙ, ВИДІЛЕНИХ З ІНФІКОВАНИХ ОПІКОВИХ РАН

Мед є надзвичайно перспективним засобом у лікуванні інфікованих ран у пацієнтів з опіками. **Мета** дослідження — оцінити антибактеріальну активність 14 зразків алжирського меду в порівнянні з медом Манука щодо патогенних бактерій, виділених з інфікованих опікових ран. **Методи.** Оцінювали антибактеріальну дію 14 зразків алжирирського меду та меду Манука щодо шести полірезистентних бактерій: *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Staphylococcus saprophyticus* та *Enterococcus faecalis*. Для оцінки впливу зразків меду на ріст патогенних бактерій використовували дифузійний агаровий метод, метод мікророзведення бульйону та метод часового кіллу. **Результати.** Отримані результати показали, що всі досліджувані зразки меду мають добру антибактеріальну дію, і не було виявлено суттєвих відмінностей між зразками алжирського меду та меду Манука, за винятком зразків H12 та H13. Грампозитивні бактерії були більш чутливими до зразків меду, ніж грамнегативні бактерії. Інгібуючий діаметр становив від 14 до 38 мм для грампозитивних бактерій та від 8 до 28 мм для грамнегативних бактерій. Мінімальна інгібуюча концентрація алжирського меду становить від 5 до 80 об. %, а мінімальна бактерицидна концентрація — від 10 до 80 об. %. Однак мінімальні значення інгібуючої концентрації меду Манука знаходяться в межах від 5 до 40 об. %, а мінімальні значення бактерицидної концентрації — в межах від 10 до 80 %. Співвідношення MBC/MIC становить від 1 до 2, що свідчить, що як алжирський мед, так і мед Манука мають бактерицидну, а не бактеріостатичну дію. Тест Time-kill показав, що інгібуючий ефект меду починається після перших трьох годин інкубації. Зразки меду 3 та 7 пригнічують ріст *S. aureus* та *S. saprophyticus* через 15 год, а ріст інших патогенних бактерій через 18 год. **Висновки.** Це дослідження пропонує мед як надзвичайно перспективний засіб для лікування опікових інфекцій з полірезистентими бактеріями.

Ключові слова: *антибактеріальна дія, опікова інфекція, мед, манука, полірезистентні бактерії.*