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Keywords: argan oil, mrsa, teicoplanin, tocopherol.

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Argan Oil as A Novel Anti-Methicillin Resistance *Staphylococcus Aureus* (MRSA), Iraq

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Abstract- Methicillin-resistant *Staphylococcus Aureus* (MRSA) infections are most medically threat, hard to treat infection among medical care units. MRSA isolates emerged from *Staphylococcus Aureus* strain how carry *mecA* gene which confer their resistance to methicillin. The standard drug of choice to resolve MRSA infections is vancomycin which late replaced by teicoplanin due to their renal toxicity. During this study 20 MRSA isolates were obtained from the Central Laboratory of Babylon Health Directorate and previously diagnosed as MRSA using both phenotypic (by VITEK 2 compact system) and genotypic (*mecA* gene detection) diagnostics methods. Teicoplanin disk diffusion were achieved according to CLSI 2012. Well diffusion method was used to test the effects of mixture of Argan Oil and 1.5 % H₂O₂ with ratios: (1:1, 1:2, and 2:1 Argan oil: 1.5% H₂O₂). The effect of the mentioned mixtures in addition to the effect of 1.5% H₂O₂ alone and Argan oil alone were tested using well diffusion method according to CLSI 2012. The results of inhibition zone for mixture were recorded and compared with the inhibition of teicoplanin. The results revealed ability of argan oil: H₂O₂ mixture with ration 2:1 to inhibit growth 80% of MRSA isolates and give inhibition zone similar to those of teicoplanin ≥ 14mm. This study concludes the satisfactoriness of use Argan oil as anti-MRSA medical oil with high level of safety and low level of uncomfortable effects.

Keywords: argan oil, mrsa, teicoplanin, tocopherol.

I. INTRODUCTION

Methicillin-resistant *Staphylococcus Aureus* (MRSA) is a bacterium accountable for several hard to treat infections among human. Any isolate of *S. aureus* that become resistant to β -lactam antibiotics, like penicillins (methicillin, dicloxacillin, nafcillin and oxacillin) and cephalosporins, called MRSA; while those isolates that incapable to resist these antibiotics are classified as methicillin-sensitive *Staphylococcus Aureus*, or MSSA [1]. *Staphylococcus Aureus* is one of the most frequent bacterial causes of

infections including endocarditis, osteomyelitis and abscesses and MRSA responsible for skin infection cause severe damage to the patient. The bacteriologist regard Methicillin-resistant *Staphylococcus Aureus* more virulent than methicillin-sensitive *Staphylococcus Aureus* aureus due to fact that the resistance cause MRSA infection more challenging to treat with usual types of antibiotics and thus more risky.

MRSA is particularly worrying in hospitals and nursing homes, where patients with open wounds, invasive devices, and weakened immune systems are at greater risk of infection than the general public [2].

Staphylococcus Aureus mainly colonize nostrils; open wounds, intravenous catheters, and the urinary tract are also potential sites for infection. MRSA are often classified as Hospital-Associated MRSA (HA-MRSA) or Community-Associated MRSA (CA-MRSA), dependent upon the situations of disease acquisition [3].

Medical oils, essential oils and Plant extracts have importance to use for different purposes. Essential oils have been searched for their antibacterial, antifungal, antiviral, insecticidal, anticancer and antioxidant properties [4]. All these plant oils were proved to have antibacterial activity which is mainly attributed to the presence of two plant phenolic compounds, thymol and carvacrol [5]. The anti-MRSA effects of many essential oils like thymus and eucalyptus oils were studied and the results revealed high sensitivity of MRSA to these oils using both disk and well diffusion methods and these effects attributed to the presence of thymol and eucalyptol in thymus and eucalyptus respectively [6].

Argan oil is a plant oil produced from the kernels of the Argan tree (*Argania spinosa L.*) that is endemic to Morocco. The fruits of the Argan tree are nut-sizes and may be round, oval or conical in shape. The fruits are covered by a thick peel which covers the fleshy pulp. The pulp surrounds a hard-shelled nut which represents approximately 25% of the weight of the fresh fruit. Contained within the nut are one to three Argan oil-rich kernels. Argan oil is extracted from the kernels, with yields varying from 30% to 55% depending on the extraction method used [7]. Argan oil consist of 42.8% oleic, 36.8% linoleic, 12% palmitic, 6% stearic and <0.5% Linolenic. Argan oil contains tocopherols (vitamin E), phenols, carotenes, squalene, and fatty acids, (80% unsaturated fatty acids). The main natural phenols in

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argan oil are caffeic acid, oleuropein, vanillic acid, tyrosol, catechol, resorcinol, epicatechin and catechin. Depending on the extraction method, argan oil may be more resistant to oxidation than olive oil [8].

Until yet few studies concern antibacterial effect of Argan oil published. The positive antipseudomonal effect of Argan oil against *Pseudomonas aeruginosa* isolated from burn was stated in Iraq previously [9]. While the antibacterial effect of argan oil against MRSA not stated otherwise, the current study aimed to study the effect of argan oil against MRSA using well diffusion method in comparison with first choice antibiotics to get rid MRSA infection, Teicoplanin.

II. MATERIAL AND METHODS

a) Bacterial Isolates

Twenty MRSA isolates were used in this study. All isolates obtained from the Central Laboratory of Babylon Health Directorate and previously diagnosed as MRSA using both phenotypic and genotypic diagnostics methods. For more confirmation all isolates were re-diagnosed using VITEK 2 compact system.

b) Well Diffusion Method

The virgin stock argan oils bring from Morocco and the mixture of Argan Oil and 1.5 % H₂O₂ were prepared with following ratios: (1:1, 1:2, and 2:1 Argan oil:1.5% H₂O₂). The effect of the mentioned mixtures in

addition to the effect of 1.5% H₂O₂ alone and argan oil alone were tested using well diffusion method. According to CLSI 2012[10], the MRSA isolate suspension was standardized with 0.5 McFarland and the streaked on Muller Hinton agar plates and the wells made using cork pooper after inoculation of each plate with MRSA isolate. Each plate contains five wells for 1:1, 1:2, and 2:1 Argan oil: 1.5% H₂O₂ I addition to 1.5% H₂O₂ alone and Argan oil alone. The results recorder as diameter of inhibition zone and then comparing the results with the diameter of inhibition zone of commonly used antibiotic for *Staphylococcus Aureus* treatment.

c) Disk diffusion Method

This method used to check the sensitivity of all MRSA isolates to teicoplanin according to CLSI 2012.

III. RESULTS

The effects of Argan oil on MRSA not studied in Iraq and most of Arabian countries yet. Effect of this oil on MRSA isolates were recorded as inhibition zone (mm) and the results revealed no effect of 1.5% H₂O₂ alone and Argan oil alone. The effect of Argan oil: An H₂O₂ mixture was positive and gives same results using different ratio (1:1, 1:2 and 2:1 of Argan oil: H₂O₂). The mean of inhibition zone were 13.2mm, 14mm and 14.4mm respectively (figure 1).

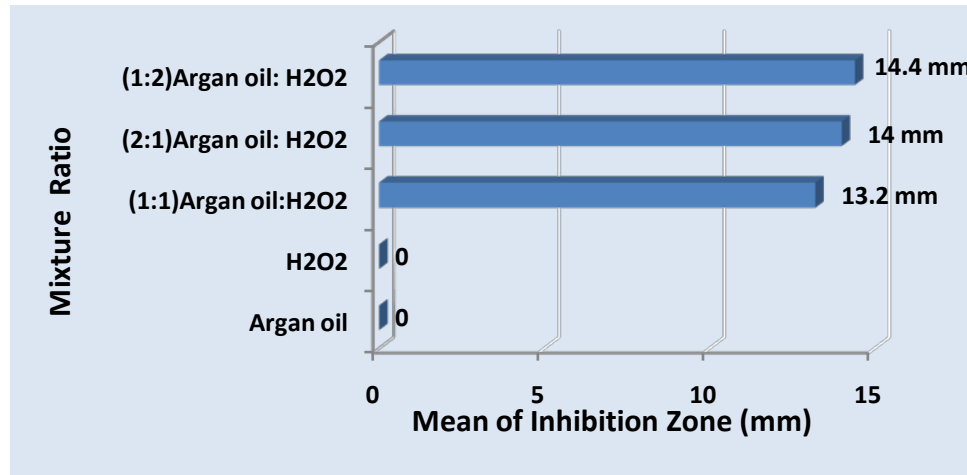


Figure 1 : Mean of inhibition zone diameter (mm)

The percentage of sensitivity of MRSA isolates were 0.00%, 0.00%, 45.00%, 80.00% and 70.00% for (Argan oil, 1.5% H₂O₂, 1:1, 2:1 and 1:2 ratio of Argan oil:H₂O₂ respectively) (figure2). All MRSA isolates show no sensitivity to argan oil alone and to H₂O₂ alone while 45%, 80% and 70% of isolates were sensitive to 1:1, 2:1 and 1:2 of Argan oil: H₂O₂ respectively.

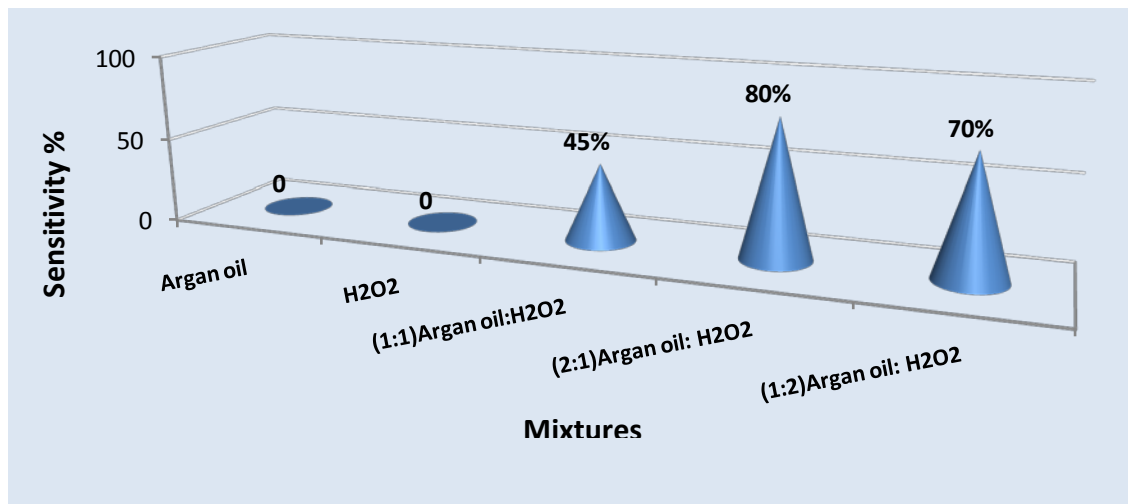


Figure 2 : Percentage of sensitive MRSA isolates toward argan oil mixtures

To increase the acceptability of Argan oil as anti-MRSA, the comparison of their effect with common antibiotics used to treat MRSA infections must be achieved. Both teicoplanin and vancomycin are effective against MRSA, but there is an apprehension that vancomycin may be more toxic, especially for the kidneys and so the comparison is with effect of teicoplanin and argan oil. The results display that all isolates (100%)

were sensitive to teicoplanin (inhibition zone $\geq 14\text{mm}$) while 6(30%), 16(80%) and 11(55%) of isolates were sensitive (give same results for teicoplanin (inhibition zone $\geq 14\text{mm}$)) to 1:1, 2:1 and 1:2 of Argan oil: H2O2 respectively table (1). The results show the similar effects of argan oil and teicoplanin especially for 2:1 Argan oil: H2O2 (high argan oil concentration mixture).

Table 1 : Teicoplanin and argan oil mixture effects on MRSA isolates

Agent	Inhibition zone (mm)	Sensitivity	
		No.	%
Teicoplanin	≥ 14	20	100
1:1 Argan oil:H2O2	≥ 14	6	30
2:1 Argan oil:H2O2	≥ 14	16	80
1:2 Argan oil:H2O2	≥ 14	11	55

IV. DISCUSSION

The central dogmas of using Argan oil as anti-MRSA agents that, herbal oil with great medical value, safe, cheap and available. The real needs to use medical or herbal oil emerged from the fact that there is little or no resistance along with reducing their disadvantageous side effects of the routine antibiotics [11]. There is no value for H2O2 as anti-MRSA and be used as solubilizer to facilitate dissemination and dispersion of Argan oil through the Muller Hinton agar plate and have the same effect as tween 20 [6].

The glycopeptides antibiotics vancomycin and teicoplanin remain the standards for treating most MRSA infections but the toxicity of vancomycin push the teicoplanin to be first choice against MRSA infections and the teicoplanin was superior in terms of antibacterial effects [12]. the great findings that the argan oil has similar in vitro effect of teicoplanin and can be used as safely alternative medication to get rid such infections.

Argan oil consists of 42.8% oleic acid, 36.8% linoleic acid, 12% palmitic acid, 6% stearic acid and 0.5% Linolenic acid. It is also contain Unsaponifiable

matter, Such as carotenes, tocopherols, triterpene alcohols, sterols, and xanthophylls. Specific health benefits of argan oils are attributed to its composition of unsaponifiable matter and high tocopherol content [13]. Gamma-Tocopherol composes 69% of Argan oil total tocopherol content. Because tocopherols and sterols can act synergistically, the specific combination of molecules found in the unsaponifiable matter is theorized to contribute to the therapeutic aspects of Argan oil [14]. Previous studied revealed great effect of Argan oil on *Pseudomonasaeruginosa* isolates in Iraq [9].

V. CONCLUSION

Current study reveal the beneficially effect of argan oil to treat MRSA infections beside their safety for human use and accessibility in addition to their role as antioxidants.

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