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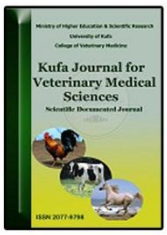

Evaluation of anti-bacterial activity of *Capparis spinosa (*Al-Kabara *) and Aloe vera* extracts against Isolates Bacterial Skin Wound Infections in -vitro and in-vivo

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Abstract:

The aims of study was to investigate the antimicrobial activity of the *flower* extract of *Capparis spinosa*, gel and leaf extract of *Aloe vera* were tested against isolated bacterial from skin infection *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pyogenes, Pseudomonas aeruginosa and Escherichia coli*. Part I, evaluation is done in-vitro by using hole plate method for appearance zone of inhibition. Antimicrobial susceptibility test showed that the *C. spinosa was* 100% effective against gram positive isolates and 90% activity against gram negative isolates, *A. vera* leaf was 20% effective against the entire tested gram positive as well as 15% effective against gram-negative isolates. *A. vera* gel showed 100% activity against gram negative and 74.6% against all tested gram positive isolates. Also it was found that mixture containing of Aloe vera, *C. spinosa* showed prominent antibacterial activity against gram negative and positive. Part II, evaluation is done in-vivo by study the effectiveness of *flower* extract of *C. spinosa* and gel of *Aloe vera* on the treatment of skin wounds inflamed by *S. aureus* suspension in rabbit. And from result the mixture can be used in the treatment of sun burns, rashes, burns, purulent wounds and other skin infections.

تقييم الفعالية المضادة للبكتريا لخلاصة أزهار نبات الكُبر ونبات الصبار ضد البكتريا المعزولة من إصابات جلدية في الزجاج وفي الحي

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الخلاصة:

إن الهدف من هذه الدراسة هو لتحقيق الفعالية المضادة لإزهار نبات الكُبر، وهلام الصبار وخلاصة ورق نبات الصبار ضد البكتيريا المعزولة من إصابات جلدية بالمكورات العنقودية الذهبية، المكورات العنقودية الجلدية، العقدية المقيحة، الزائفة الزنجارية، والاشريشيا والقولونية. وتم التقييم في الزجاج باستخدام طريقة الحفر في الأطباق لقياس مناطق تثبيط النمو. أظهرت خلاصة أزهار نبات فعالية بنسبة 100٪ ضد العزلات الموجبة لصبغة كرام ، و 90٪ ضد نشاط العزلات سلبية الكرام، أما خلاصة أوراق نبات الصبار أظهرت نسبة 20٪ ضد كل من العزلات الموجبة و15% ضد العزلات السالبة لصبغة كرام وأظهر هلام الصبار نشاطاً بنسبة 100٪ ضد العزلات السلبية كرام و 74.6٪ ضد العزلات الموجبة. كما أظهر مزيج خلاصة أزهار الكُبر مع هلام الصبار نشاطا بارزاً ضد الجراثيم السالبة والموجبة لصبة كرام .أما التقييم في الحي فكان من خلال دراسة فعالية خلاصة أزهار الكُبر وهلام الصبار في علاج الجروح الجلدية المخمجة تجريبيا بعالق المكورات العنقودية الذهبية في الارانب ومن نتائج الدراسة يمكن استخدام هذا الخليط في علاج حروق الشمس، والطفح الجلدي والحروق والجروح المتقيحة والالتهابات الجلدية الأخرى.

Introduction:

In cultures worldwide, natural products such as medicinal plants, minerals, and materials from animal sources were used as traditional remedies by man due to their healing properties.(1) The origin of many effective drugs is found in the traditional medicinal practices and in view of this it is very important to undertake studies pertaining to screening of the medicinal plants for their proclaimed biological activity. Numerous studies have been conducted with the extracts of various plants, screening antimicrobial activity as well as for the discovery of new, antimicrobial compounds (2,3) *Capparis spinosa* (locally called 'Al-Kabara') is one such plant established to have highly diverse economic and medicinal value in different system of medicines like in Unani, Chinese, Ayurvedic and Greco-Arabi System of medicines. *C. spinosa* is well known with its common name 'Capers' in different countries. Traditional medicine, based largely on herbs, still supports the primary healthcare of more people worldwide than 'conventional' or western medicine (4). *Capparis spinosa* possess incalculable number of pharmaceutical and ethnobotanical importance that contains important bioactive agents and has the potential of producing useful biochemical compounds valuable for various pharmaceutical and food industries (5). Various parts of *C. spinosa* are also used as drug to treat different diseases. It was also observed that in some areas of the Central region (Iraq), the dried fruits of *C.spinosa* were taken orally with a glass of water for curing hypertension and diabetic complications by the traditional healers. The tea prepared by *C. spinosa* buds and leaves was found to be a popular remedy against cold and related infections. The pastes prepared from the root bark of this plant are used externally to treat swollen joints, skin rashes, burns, wounds and dry skin. The unopened buds of capers were used externally to treat eye infections (6). *C. spinosa* also showed profound antimicrobial and photoprotective activity. New anti-inflammatory and antioxidant compounds, lignin glucosides, 1H-indolealkaloid glucosides, and phenolic glucosides were isolated from flower buds and of another capers species *Capparis tenera* (7). *Aloe vera* (family- Liliaceae) is a stem less plant. *Aloe vera* juice is of great medicinal importance and traditionally used as anti-inflammatory agent and in cosmetic industry. It is claimed to be useful in the treatment of Burns, Heat rashes, Allergy, Eczema, Psoriasis, Dermatitis as well as balnea, vaginal yeast infection. *Aloe vera* its thick leaves contain the water supply for the plant to survive long periods of drought (8). When a leaf is cut, an orange-yellow sap drips from the open end. When the green skin of a leaf is removed a clear mucilaginous substance appears that contains fibres, water and the ingredient to retain the water in the leaf. This is called the gel. *A. Vera* gel consists of 99.3% water. The remaining 0.7% is made up of solids with glucose and mannose constituting for a large part. These sugars together with the enzymes and amino acids in the gel give the special properties as a skin care product. The gel stimulates cell growth and as such enhances the restoration of damaged skin. It moisturizes the skin because it has a water holding capacity. This moist on the skin and also has a cooling effect (9).

The aim of the present study was to evaluate the effects of *A. vera* gel, leaf extract and flower extract of *Capparis spinosa* on *Staphylococcus aurous* skin infection. Also it was found that ointment containing mixture of *Aloe vera, C. spinosa*, showed prominent antibacterial activity. The results obtained with *A. vera* and *C. spinosa* were compared with five different standard antibiotics.

Material and Methods:

Part one: *In vitro*

Plants Materials: *Capparis spinosa* **,** *Aloe vera*

Fresh *Capparis spinosa* were purchased from a local market in Baghdad during (June - August 2010). Later these plant flowers were washed under tap water, and then dried in room temperature at shade. The dried flowers were crushed to a fine powder by an electrical grinder. The plant classification was done in the Ministry of Agriculture/ State Board for Seeds Testing and Certification S.B.S.T.C in Abu Graib /Baghdad at certificate No. 3870 in 20 / 11 / 2010.

Preparation of Crude Organic Solvent Extract of *Capparis spinosa* Plant

Organic solvent extraction of the *C. spinosa* flower was carried out by using ethanol (95% ethyl alcohol) which is considered as very effective in extracting the active ingredients of the plant according to method described by (10) This was done by using Soxhlet apparatus, which consists of an electric heater with a thermostat regulator upon which a round bottom glass flask placed that fitted to an extraction unit. The extracting unit contains the solvent and cellulose (thumble) located inside it that contains the dry plant powder. A distiller unit is fitted on to the extraction unit. For condensation of vapor solvent, 50 g. of plant flower powder was put inside the thumble and 500 ml of 95% ethanol was put inside the flask. The extraction was carried out for 24 hours by heating temperature that kept the solvent at 50-60 C^o until a clear and colorless solvent appeared in the extracting unit. After that, the extract was dried by using an electric oven at temperature 40-45 C^o until dry extract was obtained. The dry extract was placed in an incubator under 38-40 C^o for complete dryness of the sample .The final extract was kept frozen at –20 C^o until use.

***Aloe vera* gel and extracts**

A. vera plants was collected from Local Gardenm , Baghdad. The gel was taken from the leaves into a clean container and used as such (11). While the leaves from which the gel has been drained were air dried (50 g), extraction of the leaves *A. vera* was carried out by using chloroform as the solvent. which is considered as very effective in extracting the active ingredients of the plant according to method described by (12) This was done by using Soxhlet apparatus like above.

A

B

Figure (1)
A: *Capparis spinosa flower*
B:*Aloe vera* plant removal of *A. vera* gel from the leaf

Detection of the Phytochemicals Components of *C. spinosa and Aloe vera.*

Phytochemical screening for alkaloids, steroids, triterpenoids, glycosides, carbohydrates, flavonoids, tannins, phlobatannins, antiquinones and saponins by using standard procedures to identify the constituents, These detection was carried out according to (13,14,15).

Collection of samples

Skin infection isolates were obtained from septic wounds, purulent wounds and burns patients undergoing injury dressing at different Baghdad hospitals. Wound exudates were obtained from the infected sites of each patient with sterile cotton swabs and applied to freshly prepared slants of nutrient agar and Mannitol Salt agar (Oxoid). The cultures were then transferred to the laboratory where they were incubated at 37C^{o} for 24 hr. (16,17).

Bacterial isolates, culture media and species identification

Colonies growing on slants were streaked on top of freshly prepared plates of Mannitol Salt agar and Brain Heart Infusion agar and incubated again. Primary characterization of isolates was based on the Gram stain, morphological and cultural characteristics. Identification also includes growth on different media including Nutrient agar and Brain Heart Infusion agar, fermentation on Mannitol Salt agar (Oxoid).Catalase and coagulase tests were also performed for biochemical characterization (18).

Determination of antibiotic resistance profile

Skin isolates were subjected to antibiotic resistance screening by disk diffusion method. For this purpose inocula were prepared by diluting overnight cultures in sterile sodium chloride (0.9%) suspension and then match with the 0.5 standard Mac Farland index. Bacterial suspensions were then plated onto Mueller-Hinton agar (Oxoid) and the commercially available antibiotic discs were placed on lawn of culture and the plates were incubated over night at 37C^{o} (19,20). Sensitivity, intermediate sensitivity, and resistances were determined by the zone of complete growth inhibition around each disk according to reference standards. The following antibiotic discs were used: methicillin (10 ug), bacitracin (15 ug), vancomycin (30 ug), novobiocin (30 ug) and erythromycin (15 ug).

Antimicrobial susceptibility testing of *C. spinosa and A. vera*

Anti-microbial activity was checked by agar gel diffusion method. The cultures were grown in nutrient broth and incubated at 37C^{o}, for 24 hrs. After incubation periods was over, 0.1 ml of culture was seeded in 25 ml molten nutrient agar butts, mixed and poured into sterile petri plates and allowed to solidify. The plates were allowed to gel for an hour. Wells (6 mm diameter) were made with the aid of flamed cork borer on the surface of the agar plates. About 0.1 ml. (100 ug/ml.) of each of the gel, leaf extract of *Aloe vera*, flower extract *of C. spinosa* and mixture of the gel and flower extract *of C. spinosa* were delivered into each of the wells. These were incubated at 37C° for 24 h. The presence of zones of inhibition was regarded as the presence of antimicrobial action. From the inhibition zones seen, antimicrobial activity was expressed in terms of average diameter of the zones of inhibition measured (11).

Part two: *In vivo*

A total number of 40 rabbits (local breed) were used in this investigation. Their age range between 4-6 months, their weights ranged between 1.5 - 2.0 kg. They were divided into 16 groups (n= 5 / group), and kept at a temperature between 23-28C. The animals were housed in metal cage (30 x 70 x 60 cm) individually in an air-conditional room. All Animals in all groups will make skin incision (30 mm) by scrable above the first layer of muscle in the flank area of the body. Group (A), (B),(C) and (D): skin incision infected with

1 ml of *Staphylococcus aureus* suspension which contain 1.5×10^8 cell/ml, and following the infection wounds (24hr) were group (A)treated with flower extract *of C. spinosa* 5gm, once daily for (7) days, group (B) treated with *A. vera* gel, 5gm once daily for (7) days, group (C) treated with mixture of flower extract *of C. spinosa* , *A. vera* gel, 5 gm, once daily for (7) days, and group (D) leave infected without treatment.

Results and Discussion:

Part I: *In vitro* study

Extraction of *C. spinosa and A. vera*

Extraction result of *C. spinosa* flower with 95% ethanol gave a deep green color extract with plant powder yield percentage of 18 % ,the result is almost similar to the results of (21) who found that the percentage recovery of ethanolic extract was 16.6% from fine *C. spinosa* leaves and flowers powder which was extracted by using a soxhlet apparatus. The near similarity in yield percentage may be attributed to the same solvent which was used in the present extraction. The results of extraction yields of chloroform extract of *A. vera* leaves this was 9.6%, most components of this plant are organic compounds which easily dissolves in an organic solvent. However, percentage yield of the crude extract was observed to be generally low, and might even be smaller when these bioactive agents are to be obtained in their pure form, this situation give an evidence that are at low concentration is very low in the plant. It is clear that chloroform extracts gave higher yield percentages, this result is similar to the result of (12) who found that the percentage recovery of chloroform extract was 8.6% from *A. vera* leaves powder which was extracted by using a soxhlet apparatus.

Detection of the Phytochemicals Components of *C. spinosa and Aloe vera.*

Active components and phytochemical screening in *C. spinosa* flower extract, *A. vera* gel and leaf extract of *Aloe vera* results of detection were listed in table (1). The plant leaves extract screening showed the presence of the following phytochemicals; alkaloid, phenols, steroids, saponins, flavonoids, tannins and terpenoids, glycosides

The phytochemical screening results show that the *A. vera* leaves contains alkaloids, tannins, flavonoids, carbohydrates, and terpenoids, steroids, glycosides.These compounds may be responsible for their medicinal uses. Hassan, *etal* (2010) and Ejoba (2012) (22,23) referred that the initial screenings of plants *C. spinosa* and *A. vera* respectively for possible antimicrobial activities typically begin by using crude aqueous or alcoholic extractions and it can be followed by various organic extraction methods. Since nearly all of the identified components of the plant which are known by their activity against microorganisms are aromatic or saturated organic compounds, they are most often obtained through ethanol and chloroform extraction.

Table (1): Results of phytochemical analysis of the *C. spinosa flower and Aloe vera* leaves.

Variable tested	***C. spinosa flower***	***Aloe vera* gel**	***Aloe vera* leaves**
Alkaloids	+++	++	+
Flavonoid	++	+	+
Steroids	+	+	+
Terpenoids	+	+	+
Tannins	++	+	-
Phenols	++	+	+
Saponins	++	-	-
Glycosides	+	+	+
Carbohydrates	+	+	+
Antiquinones	+	+	+

+ = positive , ++ = good present, +++= strongly presnt, – = not detected

C. spinosa and Aloe vera plant has been used for an array of ailments, including skin diseases. Different studies report the effectual use of *C. spinosa* and *Aloe vera* plant when functioning topically for the healing of burns, sunburns, inflammatory skin disorders and wounds (24,25). The present study was designed to identify the antibacterial activity of *C. spinosa* and *A. vera* leaf and gel and mixture which was also compared with five standard antibiotics against clinical isolates from community acquired skin infections. The antibacterial activity was monitored using agar-well diffusion and agar disc diffusion method; activity was determined by noting the zones of inhibition around the wells or discs (26). Table 2: showed that the percentage of gram-positive isolates was as follows: *Staphylococcus aureus* (47.4%), *Staphylococcus epidermidis* (22.96%) and *Streptococcus pyogenes* (11.11%) while the percentage of gram negative isolates includes: *Pseudomonas aeruginosa* (14.81%) and *Escherichia coli* (3.7%).Table 3: showed the diameter of zone inhibition of *C. spinosa flower, A. vera* leaf and gel against gram positive and gram-negative clinical skin infection isolates.

Table 2. Percentage of gram positive and gram-negative clinical skin infection isolates.

Isolate	**Total number of organism**	**Total percentage**
Gram Positive	**110**	
Staphylococcus aureus	64	47.40
Staphylococcus epidermidis	31	22.96
Streptococcus pyogenes	15	11.11
Gram Negative	**25**	
Pseudomonas aeruginosa	20	14.81
Escherichia coli	5	3.70

Table 3: Diameter of zone inhibition of *C. spinosa flower, A. vera* leaf and gel against gram positive and gram-negative clinical skin infection isolates.

Material	Zone of inhibition ((Mean)mm+SE)				
	S. aureus	***S. epidermidis***	***S. pyogenes***	***P. aeruginosa***	***E. coli***
***C. spinosa* flower**	28.33±0.66	26.25±0.16	25.15±0.60	22.31±0.26	20.22±0.11
***A. vera* gel**	18.24±0.10	19.12±0.32	16.21±0.66	25.17±0.23	27.33±0.61
***A. vera* leaf**	12.24±0.12	10.11±0.30	10.21±0.64	8.17±0.22	12.33±0.51
***C. spinosa* + gel**	27.29±0.72	28.28±0.14	29.53±0.41	27.33±0.26	30.31±0.45

Table 4 showed the comparative study of *C. spinosa, A. vera* leaf and gel with standard antibiotics. The results showed that *C. spinosa was* 100% effective against gram positive isolates and 90% activity against gram negative isolates, *A. vera* leaf was 20% effective against the entire tested gram positive as well as 15% effective against gram-negative isolates. *A. vera* gel showed 100% activity against gram negative isolates *E.coli* is more sensitive to *Aloe vera* gel. This is because *Aloe vera* might be dissolving lipid content which is present in Gram –ve *E. coli*. and 74.6% against all tested gram positive isolates. This result could be responsible for the popular use of *C. spinosa*, *A. vera* gel and leaf to relieve many types of gastrointestinal irritations (6,27), since *S. aureus* form part of the normal microbial flora of the skin, upper respiratory tract and intestinal tract (1).

Table 4. Comparative study of *C. spinosa , A. vera* leaf and gel with standard antibiotics against gram positive and gram-negative clinical skin infection isolates.

Antibiotic	Gram positive (%)	Gram negative
Methicillin	70.2	68.4
Bacitracin	30.2	52.7
Vancomycin	85.1	75.2
Novobiocin	55.8	66.4
Erythromycin	50.9	45.2
C. spinosa	100.0	90.0
A. vera Leaf	20.0	15.0
A. vera Gel	74.6	100.0

A. vera and *C. spinosa* has been used as a cosmetic and medical remedy since ancient times and has gained increasing popularity in recent years. Despite its widespread use, reports of allergic reactions are rare (28). Also the gel is also said to promote wound healing due to the presence of some components like anthraquinones and hormones, which posses antibacterial antifungal and antiviral activities (29). However, most of the constituents are found in the gel and not in the leaf, hence the gel is likely to be more active than the leaf. The gel possesses 100% inhibitory effect on *P. aeruginosa* while the leaf had less effect. *P. aeruginosa* is known to cause skin infection especially at burns sites, wounds, pressure sores and ulcers. Traditionally attributed to the limited permeability of the *P. aeruginosa* outer membrane, it is now clear that the organism's intrinsic multidrug resistance also owes much to the operation of broadly specific antimicrobial efflux systems (30). The inhibitory effect of the gel of *A. vera* on the growth of *P. aeruginosa* gives an explanation of its reputation as a healing plant for burns.

Who attributed the antibacterial activity of *C. spinosa and A. vera* to its composition of bioactive secondary metabolites that produced definite pharmacological and physiological action, some of the most importants include; alkaloid, flavonoids, phenol, tannins, saponins, steroids and terpenoids which have antibacterial activity with different mechanisms of action (31). Many medical plants exert their beneficial effect through the addative or synergistic action of several chemical compounds acting at single or multiple target sites associated with physiological processes as pointed by (32), that may explain the difference in diameter of inhibition zone between the extract and the antibiotics.The results are in agreement with (33) who referred that ethanol extracts exhibited high inhibitory activity on the test organisms, this can be deduced to the ability of ethanol to extract more of the essential oils and secondary plant metabolites which are believed to exert antibacterial activity on test organisms. So this may explains the difference in inhibition zone diameter against *E. coli* and *S. aureus*.

Part II: *In vivo*: (Open wound)

Clinical signs

In all Animals in all groups, making skin incision (30 mm) by scarble to destroy skin defenses and contaminated *S. aureus* suspension,and after 24 hrs. showing the inflammation signs, swelling redness, hotness and presence of pus with excitement signs (Figure 3). *C. spinosa* flower treated rabbit didn't show any excitement because extracts of *C. spinosa* was found to possess marked anti-inflammatory activity and analgesic activity (34). Rabbit treated with mixture of *C. spinosa* and gel of *A. vera*, after 5 -7 days showed complete healing and presence of hair, without scar tissue (Figure 4). *C. spinosa* and gel of *A. vera* treated group show partial healing with formation of scar tissue after 7 days (Figure 5), in comparison with control group the wound has been found severe inflammation (swelling, redness and hotness, pus) and exiguity of food consumption (Figure 6). No bacterial infections were detected in any treated wounds after 14 days, which may reflect hygienic standards in the original surgical procedure. This experimental model therefore may not be representative of wound healing in infected tissue. This results are in agreements with previous reports (35), the finding of the present study indicate that *C. spinosa* increased the formation of granulation tissue, density and activation of fibroblasts, keratinization in the surface of wound, thickness of epidermis and thickness of collagen fibers. Moreover, keeping with earlier reports,(36) *C. spinosa* and gel of *A. vera* decreases infection, inflammation, edema and dehiscence. As well, *C. spinosa* increases the rate of wound healing, which confirms previous reports (37) .

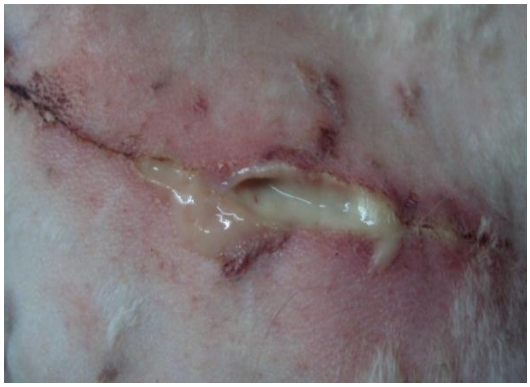

Figure (3). Skin of rabbit, after 24 hours of infection with *S aureus* Showed inflammation and presence of pus.

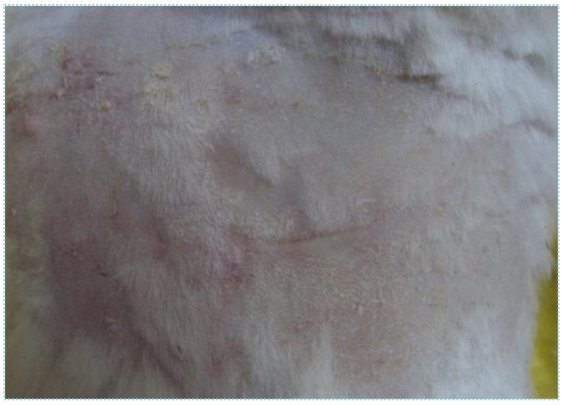

Figure (4). Skin of rabbit, after 7 days treated with mixture of *C. spinosa* and gel of *A. vera* Showed complete healing and growing hair

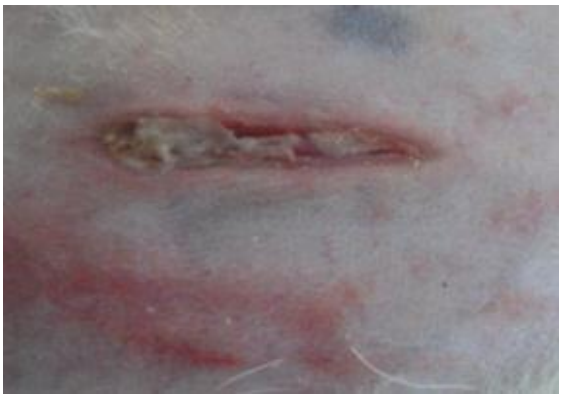

Figure (5). Skin of rabbit, after 7 days of treated with *C. spinosa* Showed partial healing and presence of less scar tissue.

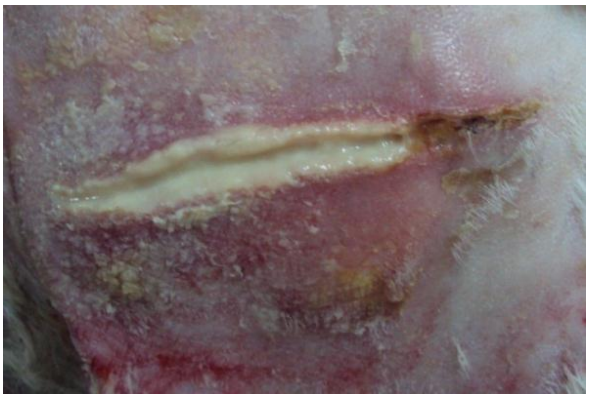

Figure (6). Skin of rabbit, non treated after 14 days of infection with *S aureus* Showed still inflammation pus, swelling, and reddness.

The attributed the antibacterial activity of *C. spinosa* flower and gel of *A. vera* due to its composition of bioactive secondary metabolites that produced a definite pharmacological and physiological action, some of the most important include; alkaloid, flavonoids, phenol, tannins, saponins, steroids and terpenoids. Alkaloid antibacterial activity may be due to its ability to react with amino, carboxyl, sulfhydryl and hydroxyl groups in bacterial protein as well as nucleic acids, it is highly reactive chemical compounds that combines with proteins to give intermolecular cross-links and intercalate with DNA (38). Tanninic substances are capable of precipitating gelatin from solution, a property is known as astringency. It was reported to prevent the development of microorganisms by precipitating microbial protein and making nutritional proteins unavailable for them (39). Phenolic compound is mostly hydrophobic, it has a hydroxyl group (-OH). The importance of this group on antimicrobial activity is well known, the site(s) and number of hydroxyl groups on the phenol group are thought to be related to their relative activity to microorganisms (40). The high activity of the phenolic

components may be further explained in terms of the alkyl substitution into the phenolic nucleus, which is known to enhance the antimicrobial activity of phenols. The introduction of alkylation was proposed to alter the distribution ratio between the aqueous and non-aqueous phases, including bacterial phase, by reducing the surface tension or altering the species selectivity. It was suggested that plant products act via two main mechanisms of action; the first is related to the general hydrophobicity of plant products, which facilitates their adhesion to the bacterial surface inducing un-stabilization (41). The second mechanism is the inactivation of different molecules of the bacteria such as enzymes or receptors by their adhesion to specific sites (42). Flavonoid antibacterial activity is probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell walls, more lipophilic flavonoids may also disrupt microbial membranes. One of the important flavonoids is catechins, which inhibited *Vibrio cholerae*, *Streptococcus mutans*, *Shigella*, and other bacteria and microorganisms (43). Many researchers are preferring the use of plant extract instead of antibiotics was due to attenuation of pathogens virulence by plant extract as opposed to the direct killing of pathogenic bacteria with antibiotic as a strategy to combat infections is an interesting concept. The idea that anti-pathogenic molecules that prevents for instance the production of toxins or abolish the ability of bacteria to adapt to the host environment would give a competitive advantage to the host immune system to allow clearance of the infectious organism. It is also anticipated that such virulence attenuators would not affect non-pathogenic bacteria communities or exert a selective pressure for the development of resistance as seen from the pressures exerted by conventional antibiotics that targeted vital bioprocesses in bacteria (44,45,46).

Conclusion the present study is based on the current detailed ethnopharmaceutical survey and literature review, it is concluded that *C.spinosa* and *A. vera* is a multipurpose plant having diverse economic and medical importance. *C. spinosa and A. vera* has been found to be used for the treatment of more than ten different human ailments in different traditional medicine systems. Besides medicinal significance, various parts of *C. spinosa and A. vera* were found to have food value, potential culinary value, and possessed cosmetic ingredients. It is worthy to conclude that *C. spinosa* provide key resources for raw materials for pharmaceutical, aromatic and food industries, hence it is called "Plant of the Millennium".

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