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Clinical observations on antibacterial effect of honey as a surgical wound dressing agent

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Abstract

Objective: Antibacterial effect of honey as a wound dressing agent was assessed using *S. aureus* isolate as wound contaminant. Materials and method: Fifteen clinically healthy rabbits divided into three groups of five per group (gp. A:- untreated control; gp B:-honey treated and gp. C:- Penicillin/ Streptomycin treated) were used for the study. Laparotomy incisions were made and after suturing vital parameters and hematology as well as healing pattern, were observed on day zero and days 1,4,7,14 and 21 post surgery (p.s.). The weights were recorded on weekly basis. The data were statistically analyzed using analysis of variance (ANOVA) test. Results: Wheal formation was observed around the wound sites on groups A and B, but not in group C (between p.s day 1 and 2). From day 3 to 21 p.s., suppuration was evident in the untreated and honey treated groups but not in the antibiotic treated group. Scar tissue formation was quite evident in group B animals, mild in group A, but completely absent in group C. Wound dehiscence was observed in one of the five animals in group B, while fibrinous peritonitis was observed at post-mortem in 2 animals in each of groups A and B and 1 animal in group C. Culture of swabs collected from the wounds prior to contamination with *S. aureus* from the three groups yielded no growth. Swabs from animals in group C produced no growth on day 1 p.s. while those from groups A and B yielded extensive and scanty growth, respectively. Growth from swabs in group A became extensive from day 3 up to day 21 p.s. when the experiment was terminated. Similar findings were observed with swabs from group B animals. No growth was recorded in swabs collected from antibiotic treated group. Vital parameters (respiratory rate, rectal temperature), weight and haematological values were not significantly different ($P>0.05$) among the experimental groups throughout the period of the study. Conclusion: Honey did not prove to be an effective dressing agent in experimental *S. aureus* contaminated wound.

Key words: Antibacterial effects, honey, staphylococcus, wound contaminant.

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1. Introduction

The skin serves as an important barrier to the invasion of infective agents. During surgical operation, the integrity of the skin is physically broken. Surgical operation imposes stress on the patients. Stress, coupled with the disruption of the integrity of the skin reduces the natural body defence mechanism against invading microorganisms.

Staphylococcal organisms have been shown to be major bacterial agents inhabiting the skin of healthy animals and these bacteria are also often regarded as opportunistic pathogens. Disruption of skin integrity and the stress of surgery provide ample opportunities for these staphylococcal organisms to colonize and proliferate at the surgical sites. *Staphylococcus aureus* infections have been noted to account for over 85% of post-operative infections in large animals [1].

This organism was isolated from 60% of 380 septic operation wounds in Britain while coliforms alone or in combination with *S. aureus* were recovered from about 30% of these wounds [12]. Other reports have cited *S. aureus* as the principal bacterial agent in septic operation wounds [2 - 4]. Bacterial infection of surgical wounds (usually accompanied by suppuration) results in delayed wound healing [5]. In some cases total dehiscence of the surgical wound may occur.

Broad-spectrum systemic and topical antibiotics have been used to prevent/control this post-operative sepsis. Penicillin and streptomycin have been widely used to combat post-operative infection in farm animals [6]. Unfortunately, many wound contaminating bacteria such as *Staphylococcus* spp. have developed resistance to commonly available antibiotics [2]. Natural products such as honey have been shown to possess antibacterial properties [7]. The antibacterial property of honey has been attributed to a heat and light labile substance called inhibine [8]. Distillate of honey obtained from various geographical regions of the world had broad-spectrum antimicrobial properties [9]. They then concluded that the broad spectrum activity was therefore not attributed to any artifact that might originate from a specific geographical area.

Although the desirable properties of honey in the management of wounds date back to ancient times [10], only scanty information is currently available on the beneficial effect of this natural product on wound healing [6, 8,11-13]. Honey was found to be a more effective topical dressing agent than chlorhexidine and this natural dressing agent did not discomfort animals when applied directly on abdominal organs [6].

Honey is an affordable and readily available natural product and its effectiveness in combating wound contaminating bacteria will be of immense clinical significance. The aim of this study is to investigate the potential of honey as an effective dressing agent in an experimentally *Staphylococcus aureus* contaminated surgical wound.

2. Materials and methods

Fifteen clinically healthy rabbits of both sexes, aged between three and five months and weighing between 0.8 kg to 1.3 kg were used in the study. The rabbits were purchased from a local market in Nsukka. The animals were fed broiler finisher diet and water was given *ad lib*. The animals were acclimatized for a period of one month and during this period anticoccidial drug (embazine-forte (R)) was administered to the animals orally at dose rate of 0.5 g/l of water.

At the end of the acclimatization period, the rabbits were randomly assigned to three group of five animals each. Each animal underwent a ventral laparotomy. The anaesthesia and surgical

operation were performed following standard procedures. Atropine sulphate and chlorpromazine at doses of 0.02 mg/kg I M and 0.1 mg/kg IM were administered as pre-medicant and sedative respectively.

The peritoneum and muscles were sutured using chromic catgut size 2/0 in a simple continuous pattern while the skin was returned with silk 2/0 in a horizontal mattress suture pattern. Vital sign such as temperature and respiratory rates were monitored in all animals through out the experimental period.

Immediately after surgery, the surgical site on each rabbit was swabbed (with sterile swab stick), streaked onto blood agar and incubated at 37°C overnight. Thereafter, each surgical site was contaminated with an overnight broth culture of *Staphylococcus aureus*, being one of the *Staphylococcal* strains isolated from skin swabs of clinically healthy animals in the study area.

Group B rabbit were treated by topical application of honey (1 ml) over the surgical site while those in Group C received 0.3 ml of procaine penicillin/streptomycin sulphate combination topically. Animals in Group A were not treated and they served as the controls. None of the rabbits received any form of systemic antibiotic treatment. Daily dressing of the surgical wound with either honey or penicillin/streptomycin (groups B & C respectively) was continued for 7 days post-surgery. The surgical sites were observed for wheal formation and suppuration on days 1,3,7,10,14 & 21 post-surgery/contamination and scored as + or – if the observed parameter was present or absent respectively.

Swabs collected from the wound sites on the days indicated above were cultured for *S. aureus* organisms. The packed cell volume (PCV), total white blood cell (TWBC) counts and the weights of the rabbits were also determined on days 1, 3, 7, 10, 14 & 21 post-surgery. The mean PCV and TWBC values as well as the mean weights of the rabbits for the three groups were statistically analysed using Analysis of variance (ANOVA) statistic.

3. Results

The clinical observations on the surgical sites are presented on Table 1. Wheal formation around the wound sites was observed in rabbits from the untreated and honey treated groups (i.e. Groups A and B, respectively), but not in

Table 1.
Clinical observations on the surgical sites[a]

Observation	Untreated (Control) group	Honey treated group	Antibiotic treated group
Wheal formation (Day 1 and 2 p. s)	5/5	5/5	0/5
Suppuration (Day 3 - 21 p. s)	3/5	3/5	0/5
Scar tissue formation	4/5	2/5	0/5
Wound dehiscence and evisceration of intestines	0/5	1/5	0/5
Fibrinous peritonitis	2/5	2/5	1/5
Isolation of *S. aureus* from surgical site (Day 3 - 21)	5/5	5/5	0/5

[a] Values are as : No. of rabbits with stated observation/no. of rabbits in the group

Table 2.
Mean Packed cell volume (%) of experimental rabbits *

Day post-surgery	Untreated (Control) group	Honey treated group	Antibiotic treated group
0	35.6 ± 5.4	35.8 ± 4.2	34.4 ± 5.0
3	30.2 ± 2.6	26.6 ± 8.2	32.4 ± 4.5
7	35.2 ± 2.6	33.2 ± 1.8	35.8 ± 4.6
10	36.2 ± 2.4	33.8 ± 1.9	36.2 ± 4.4
14	35.6 ± 3.7	32.6 ± 2.7	35.4 ± 2.6
21	35.6 ± 5.3	32.8 ± 4.5	34.2 ± 4.0

* Values are expressed as mean ± SD; n=5

those from antibiotic treated group (i.e. group C). This observation was recorded on days 1 and 2 post-surgery. Suppuration was evident in surgical sites of 3 out of the 5 rabbits in each of groups A and B from days 3 post-surgery to end of the study (21 days post-surgery).

Scar tissue formation was observed in wounds of rabbits dressed with honey but not in those from the antibiotic treated group. Scanty scar tissue was recorded for wounds from animals in the untreated group. By the 14th day post-surgery, surgical sites of rabbits in the antibiotic treated group have completely healed. Wound dehiscence and evisceration of intestines was a complication observed in one of the animals from the honey treated group. Fibrinous peritonitis was also noted among the sacrificed rabbits (2 from untreated, 2 from honey-treated and 1 from antibiotic-treated group) at the end of the study.

In all the animals, swabs from the surgical sites prior to contamination with *S. aureus,* yielded no growth on blood agar. However, from day 1 to 21 post-surgery, *S. aureus* was isolated from swabs collected from rabbits in the untreated and honey-treated groups. Swabs from antibiotic-treated rabbits yielded no bacterial growth from day 3 post-surgery till the end of the study.

The mean PCV values of the three groups of rabbits at days 0, 1, 3, 7, 10, 14 and 21 post-surgery is presented in Table 2 while the mean total white blood cell count is shown in Table 3. The differences in the mean haematological (PCV and TWBC) values as well as the mean body weights of the rabbits post-surgery did not differ significantly ($p>0.05$) among the three groups.

4. Discussion

Wheal and scar tissue formation as well as fibrinous peritonitis are complications associated with delayed and poor wound healing process [5]. All delayed and poor healing processes are expected where wound contamination has taken place. These complications were observed in rabbits whose surgical sites were being dressed with honey but not in those dressed with penicillin/streptomycin combination.

The surgical sites were contaminated with *S. aureus,* a pyogenic bacterium. Although honey has been shown to possess antibacterial properties [6, 8], suppuration and attendant delayed and poor healing observed in rabbits treated with honey in this study indicates that the honey did not inhibit staphylococcal growth and multiplication at the surgical sites. The antibacterial action of honey was noted to be influenced by such factors as pH, concentration and purity of the honey [6]. In the present study, failure of the honey to inhibit *S. aureus* growth and multiplication may be due to inherent resistance of the *S. aureus* strain used or to the

Table 3.
Mean total leukocyte counts of experimental rabbits*

Day post-surgery	Untreated (Control) group	Honey treated group	Antibiotic treated group
0	6,600 ± 1,926.6	3,380 ± 1,675.4	6,780 ± 1,819.9
3	7,700 ± 1,848.0	7,600 ± 2,648.0	6,540 ± 2,281.0
7	7,990 ± 1,834.0	8,160 ± 2,385.0	8,340 ± 2,142.3
10	8,120 ± 1,892.7	8,620 ± 1,899.2	8,000 ± 1,721.9
14	8,320 ± 1,344.3	9,280 ± 1,071.0	8,300 ± 1,632.5
21	9,850 ± 2,466.8	8,300 ± 1,148.9	9,530 ± 2,050.0

* Values are expressed as mean ± SD; n=5

fact that the bacterial load on the surgical sites was quite high to be inhibited by honey.

Also, since the honey used was purchased from local markets, a possibility exists that the honey was adulterated (a common practice in the study environment) and therefore the concentration of the antibacterial substance greatly affected. It was demonstrated that wild honey was an excellent surgical dressing agent in dehorning and gastrointestinal surgery in goats [6]. However, in their studies, the surgical sites were not contaminated with any bacterial agent.

The non significant differences (P>0.05) in the means of the haematological values (PCV and TWBC) suggests that the infection was a localized rather than a systemic one. The results of this study have shown that the bacteriostatic/ bactericidal property of natural honey may not make it an effective wound dressing agent in wounds heavily contaminated by *S. aureus.*

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