WHAM evidence summary: sugar dressing for wound healing and treating wound infection in resource limited settings

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CLINICAL QUESTION

What is the best available evidence for sugar dressing improving wound healing and for reducing signs and symptoms of wound infection?

SUMMARY

Granular/crystalized white sugar is readily accessible at low cost in most geographic regions. It has been used as a wound treatment for hundreds of years because it is sterile, non-toxic, absorbs fluid and has some antimicrobial properties[1]. Sugar is most often used in its granular form, packed into a wound cavity and secured with a wound dressing. Alternatively, it is ground into a powder, combined with glycerine or petroleum jelly and applied as a paste[1, 2]. There was no evidence comparing the effectiveness of sugar to modern dressings that promote moist wound healing. *Level 1* evidence[3, 4] at high risk of bias showed sugar dressing was associated with acceptable wound healing rates[3, 4] and reduction in wound infection[4], but might not be as effective as Edinburgh University Solution of Lime (EUSOL)[3] or honey[4], which are both commonly used in settings with limited resources. *Level 3*[5-7] *and 4*[8-15] evidence at moderate or high risk of bias provided evidence that sugar dressing might promote healing[5, 6, 8, 9, 11-15], improve the wound bed tissue[5, 9, 13-15], and reduce bacterial infection[6, 12-15], wound pain[5], and wound malodour[7, 10].

CLINICAL PRACTICE RECOMMENDATIONS

All recommendations should be applied with consideration to the wound, the person, the health professional and the clinical context.

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Sugar dressing could be considered for use as a natural wound dressing to reduce signs and symptoms of infection and to promote healing when there is limited access to modern wound dressings (Grade B).

SOURCES OF EVIDENCE: SEARCH AND APPRAISAL

This summary was conducted using methods published by the Joanna Briggs Institute[16-18]. The summary is based on a systematic literature search combining search terms related to sugar dressing and wound healing. Searches were conducted for evidence reporting use of granulated sugar in human wounds published up to December 2022 in English in the following databases: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline (Ovid), Google Scholar, Embase (Ovid), AMED and Health Internetwork Access to Research Initiative (Hinari, access via Research4Life) and Cochrane Library. Studies on other sugar sources (e.g., honey) or sugar combined with povidone-iodine (Knutson's formula) were not eligible for inclusion (excepting when reported as a comparator). Levels of evidence for intervention studies are reported in Table 1.

BACKGROUND

Sugar has been used since the late 1600s as a wound cleanser and the early 1700s as a treatment to promote wound healing[1, 22]. It is readily accessible at a very low cost in most geographic regions. In its granular/crystalized form, sugar consists of glucose and fructose, bound together to form sucrose (a disaccharide)[13, 26]. Sugar is present as a monosaccharide in other natural treatments, including honey, saps and fruit[22]. In its crystalized form, sugar's mechanism for wound healing is different than that of honey and fruits. Crystalized sugar is sometimes used in combination with povidone-iodine to treat wounds[29-33], and is commercially marketed as a sugar-povidone-iodine paste in some countries. The evidence for sugar in other natural forms (e.g., honey) and in combination

with povidone iodine is not reported in this evidence summary, excepting as a comparator to sugar dressing.

There are several mechanisms through which granular white sugar is presumed to promote wound healing. First, sugar is hygroscopic; that is, it absorbs moisture from the environment around it, contributing to reduction in wound exudate[22, 28]. This also leads to mechanical debridement through slough adherence to the sugar dressing for removal without damage to healthy tissue[1, 3, 22]. In addition, sugar's hygroscopic property contributes to autolytic debridement[13], and reduction of edema in the wound bed and surrounding tissues[1, 13].

Sugar increases osmolality of the wound environment, which influences water level activity. This mechanism attracts lymphocytes and macrophages to the wound bed[1], and can inhibit the growth of bacteria[5, 7, 25, 26]. Sugar also releases hydrogen peroxide at low, non-toxic levels, which further inhibits bacteria activity[7, 13, 27]. Invitro studies have demonstrated sugar's activity against a range of bacteria, including *S. aureus, P aeruginosa, S. faecalis, E. coli, K. pneumoniae,* and *C. albicans*[5, 8, 25]; and this was supported in an in-vivo study reported below[4]. In comparison to many other antiseptics, sugar has low toxicity and lowers the wound bed pH to around 5.0, which is more conducive to healing than an alkaline pH[1, 7].

CLINICAL EVIDENCE ON SUGAR DRESSING

Studies reporting clinical outcomes for treatment with sugar dressings are summarized in Table 2.

Sugar dressing for promoting wound healing

An RCT[3] (n = 50 wounds) that was at high risk of bias compared sugar dressing to EUSOL dressing for treating traumatic, contaminated wounds associated with bone injuries. EUSOL is a traditional hypolochlorite made from chlorinated lime and boric acid[34]. In both groups the wounds were lavaged with normal saline. The sugar group received granulated white sugar plus a gauze dressing. The EUSOL group received a 30-minute EUSOL soak followed by packing with EUSOL gauze. Both groups received concurrent systemic antibiotics based on culture and sensitivity of organisms in the wounds. After four weeks both groups had good healing rates, but the EUSOL group showed superiority (77% healed versus 66% healed, p < 0.05). The EUSOL group had a 1.23 times higher likelihood of achieving healing within four weeks. The EUSOL group also had superior outcomes on other measures including wound size and wound bed tissue type[3] (*Level 1*).

A second RCT[4] (n = 40) that was at high risk of bias compared sugar dressing to a honey dressing in open or infected wounds in children and adults. Debris was removed using saline and gauze, then wounds were either packed with granulated sugar or with honey-soaked gauze. Dressings were initially performed daily, increasing to weekly based on wound condition. After two weeks of treatment, the median healing rate was higher in the honey group (3.8 cm^2/week versus 2.2 cm^2/week, p = not reported). Median time to complete healing was shorter in the honey group (31.5 days [range 14 – 98] versus 56 days [range 21 – 133]). Both treatments were considered effective. Honey was reported as superior; however, no statistical analysis was reported to support this conclusion[4] (*Level 1*).

In a proof-of-concept study at high risk of bias[5], 22 wounds of mixed etiology were treated with a sugar dressing for three weeks. At baseline, the wounds had sloughy/necrotic tissue and moderate to heavy exudate levels. Wounds were cleansed, packed with granulated sugar and an absorbent pad applied, either daily or twice daily. There was progressive improvement in wound bed appearance for all the wounds over the short study period, and a reduction in mean wound area (baseline mean: 34.7 cm^2 [range 6–144]; 3-week mean: 28.9 cm^2 (range 4.63 – 142.4])[5] (*Level 3*).

Several case studies[8-11] at high risk of bias reported successful healing of hard-to-heal wounds with various sugar preparations. In one[8], two people with complex abscesses that had previously failed to heal with surgical debridement and EUSOL gauze packing achieved complete healing within six weeks of commencing treatment with sugar paste (powdered sugar combined with polyethylene glycol and hydrogen peroxide)[8]. Quatraro et. al. (1985)[9] reported that packing diabetic ulcers (n = 15) with sugar replaced every 3 to 4 hours was associated with rapid wound bed granulation (5 to 6 days) and complete healing within 12 days[9]. Another case report[10] described the use of sugar paste replaced daily to reduce wound malodour and heal multiple, sloughy, partial thickness leg ulcers in one person. Finally, Tanner et. al. (1988)[11] reported

Table 1: Levels of evidence for clinical studies

Level 1 evidence	Level 2 evidence	Level 3 evidence	Level 4 evidence	Level 5 evidence
Experimental designs	**Quasi-experimental designs**	**Observational – analytic designs**	**Observational – descriptive studies**	**Expert opinion/ bench research**
1.c RCT[3, 4]	None	3.c Cohort study with control group[19, 20] 3.e Observational study without a control group[5-7]	4.c Case series[12-15] 4.d Case study[8-11, 21]	5.b Expert consensus/ non-systematic literature review[1, 22-24] 5.c Bench research[25, 26] 5.c Single expert opinion[2, 27, 28]

Table 2: Summary of the evidence for traditional sugar dressing/paste

Study	Country	Sugar treatment and comparators (number wounds)	Type of wounds	Treatment duration	Clinical outcome measures	Level of evidence
Bajaj et. al. (2009)[3]	Nepal	Crystal sugar (n = 25) EUSOL dressing (n = 25)	Traumatic, contaminated wounds	4 weeks	Complete healing Wound size Wound bed slough Wound bed granulation tissue Exudate level	1
Chiwenga et. al. (2009)[7]	Malawi	Sugar paste (n = 71)	Malodorous wounds	10 days	Wound odour Discomfort score	3
De Feo et. al. (2000)[12]	Italy	Crystal sugar (n = 11)	Mediastinal wounds with deep infection	Up to 70 days	Mortality Complete healing	4
Franceschi et. al. (2017)[6]	Italy	Glucose powder in paste (n = 50)	Hard-to-heal leg ulcers of mixed etiology	Up to 6 months	Time to heal Presence of bacterial infection	3
Gordon et. al. (1985)[8]	UK	Sugar paste (n = 2)	Abscesses	6 weeks	Complete healing	4
Lisle (2002)[10]	UK	Sugar paste (n = 1 person with 4 VLUs)	Sloughy venous leg ulcers	3 months	Wound size	4
Mphande et. al. (2007)[4]	Malawi	Crystal sugar (n = 18) Honey-soaked gauze (n = 22)	Open or infected wounds of mixed etiology	Up to 5 months	Time to heal Presence of bacterial infection ASEPSIS score Pain score	1
Murandu et. al. (2011)[5]	UK	Crystal sugar (three types; n = 22)	Mixed etiology wounds	3 weeks	Wound size Wound appearance Exudate level Wound odour Pain score	3
Naselli et. al. (2017)[21]	Italy	Crystal sugar (n = 1)	Infected surgical wound	30 days	Wound pain	4
Quatraro et. al. (1985)[9]	Italy	Crystal sugar (n = 15)	Diabetic ulcers	2 weeks	Granulation tissue formation Complete healing	4
Ruhullah et. al. (2013)[13]	Nepal	Sugar paste (n = 14)	Infected sacral pressure injuries	5-14 days	Wound appearance	4
Szerafin et. al. (1991)[14]	Hungary	Crystal sugar (n = 15)	Mediastinal wounds with deep infection	2-3 weeks	Presence of bacterial infection	4
Tanner et. al. (1988)[11]	UK	Sugar paste (n = 4)	Infected abdominal wounds	4-8 weeks	Presence of bacterial infection Complete healing Financial cost	4
Trouillet et. al. (1985)[15]	France	Crystal sugar (n = 19)	Mediastinal wounds with deep infection	2-3 weeks	Wound appearance Presence of bacterial infection	4

four cases in which sugar paste was applied to infected abdominal wounds to achieve healing within 4 to 8 weeks. In this report, thicker sugar paste was applied directly to open wound beds, and a thinner sugar paste (with increased volume of polyethylene glycol and hydrogen peroxide) was installed into abscess cavities with a syringe and catheter[11] (*Level 4*).

Sugar dressing for signs and symptoms of wound infection

In an observational study[6] (n = 50) at high risk of bias, hard-to-heal leg ulcers were selected for trial of a 60% sugar powder and 40% petroleum jelly paste preparation. At baseline, wound swabs were taken, with results showing bacterial presence in 100% of ulcers. Treatment was wound cleansing with tap water (no debridement performed), weekly application of the sugar paste, bandaging and etiological-based management (e.g., compression therapy or conservative hemodynamic correction of venous insufficiency [CHIVA]). A second wound swab was performed at 30 to 40 days; 100% of ulcers were bacteria-free. Complete healing rate was 96%, with a mean healing time of 109 days[6] (*Level 3*).

Another observational study[7] (n = 71) at high risk of bias explored sugar paste to manage wound odour and pain. Malodorous wounds selected for treatment had a mean baseline odour score of 5.45 that reduced to 2.94 at ten days of treatment (score rated from 1 to 10, where 10 was worst odour). Patient-rated discomfort reduced from a mean of 6.73 to 3.87 (score from 1 to 10, where 10 was worst pain)[7] (*Level 3*).

A case series[12] (n = 11) at high risk of bias reported outcomes for mediastinal wound infection following cardiac surgery when treated with sugar dressing. On detection of wound infection, surgical exploration, debridement and povidone iodine irrigation were performed, and the wound was surgically closed. However, wound infection did not resolve for any participants. The sternal wound was re-opened, and sugar dressing was performed up to four times daily until complete healing or flap reconstruction. Mean time to resolution of infection (based on microbiological assessment) after sugar dressing commenced was 11.22 ± 1.6 days. Mean duration of sugar dressing was 44 ± 27.8 days[12] (*Level 4*). In a later report[19, 20] at moderate risk of bias, the researchers compared this cohort to two other cohorts with mediastinal wound infection following cardiac surgery that received different treatments based on a range of standardized protocols at the time of their admission. Mortality rates were significantly better for sugar dressing versus conservative treatment/closed irrigation (30.6% versus 2.4%, $p < 0.05$), but mortality was higher for people treated with sugar dressing versus negative pressure wound therapy (1.8% versus 2.4%, $p < 0.05$)[19]. However, all the people in this study were critically ill and it was not evident that the type of dressing influenced mortality outcomes (*Level 3*). Other small case series at high risk of bias[13-15] achieved similar clinical outcomes in both surgical wounds[14, 15] and chronic wounds[13] using sugar dressing[14, 15] or paste[13] to resolve local wound infection, debride the wound bed and promote granulation in preparation for surgical repair (*Level 4*).

The RCT[4] comparing sugar to honey dressings evaluated signs and symptoms of infection with microbiological assessment, ASEPSIS score and pain assessment (categorically described as no pain, moderate pain or severe pain). Both groups showed similar reduction in signs and symptoms of wound infection. After one week of treatment, the percent of wounds treated with sugar that returned positive cultures reduced from baseline (52% to 39%). The median ASEPSIS score for sugar-treated wounds showed a reduction in the first three weeks (8.3 points/week) and the percent of people describing severe pain during dressing changes or with movement also reduced[4] (*Level 1*).

In the short proof-of-concept study described above, Murandu et. al. (2011)[5] reported resolution of signs and symptoms of infection (i.e., exudate, malodour and wound pain). Malodour completely resolved by seven days of treatment in all 11 wounds that were assessed as malodorous at baseline. All 22 wounds had moderate-to-heavy exudate levels at baseline; exudate decreased in the first week and was absent or minimal for all wounds by trial end. Pain requiring opiates was reported by five people at baseline, and this resolved within three days of treatment[5] (*Level 3*).

CONSIDERATIONS FOR USE

Preparation and use of sugar dressing

The studies included in this evidence summary used various methods to apply sugar to the wound. Some researchers[5, 9, 15] packed granular white sugar directly into the wound cavity and

Table 3: One method for applying sugar to a wound

Applying granulated sugar to the wound bed[24]
Use a non-touch technique to perform wound care.
After removing the previous dressing, irrigate the wound thoroughly to remove all sugar until the wound bed is clean.
Dry the wound with a sterile compress.
Clean the surrounding skin.
Fill the wound cavity with granulated sugar using a sterile gauze packet as a funnel to assist pouring.
Distribute the sugar evenly around the wound bed.
Cover the sugar with a fluffy sterile gauze.
Secure with a dry dressing and crepe bandage.

retained it with gauze, absorbent pad, dry gauze or adhesive dressing (see Table 3 for an example of a recommended application method[24]). Muranda et. al. (2011)[5] described using yellow paraffin to build a 'ridge' around wounds in awkward anatomical locations (e.g., heels) to further assist in retaining sugar in the wound. In these studies, packing sugar directly into the wound required replacement of the sugar dressing at least twice daily to maintain a well-packed wound cavity[5, 9, 15], because sugar combines with wound exudate and drains from the wound[7]. Other researchers describe the addition of glycerin or petroleum jelly to make a sugar paste that could more easily be retained in the wound[6-8, 13] and had a consistency that eased application[7].

Adverse effects

- Some people reported a burning pain on application of sugar dressing that resolved quickly[5, 7]. Sugar has also been reported to cause itching of the peri-wound skin.[24] These effects are thought to occur due to the drying effect sugar has on the wound bed and might be reduced by using a sugar paste in preference to granular sugar[28].
- Evidence on the effect of topically applied sugar on blood sugar levels in people with diabetes is mixed. Sugar is a disaccharide (i.e., glucose and fructose combine to form sucrose) that is absorbed through the intestines, so theoretically it should not influence blood sugar levels when applied to a wound bed[1, 23, 35]. Some studies explored and confirmed that applying sugar to a wound does not influence blood sugar levels[5, 15]; however, there was one case report in which raised blood sugar level was observed[1, 22], and in another study people with diabetes were given higher insulin doses[20].
- There is one report of acute kidney failure associated with sugar paste[23]. In some of the reports[12, 14, 15], people who had a wound treated with sugar dressing died; however, these people had serious disease and death was likely not related to the sugar dressing.

Other considerations

- White granulated sugar is considered sterile. Care should be taken to guarantee the product used is not contaminated and that sterility is maintained (e.g., if powdering the sugar).
- The evidence in this summary came from settings with limited access to wound care resources. Consider the medico-legal implications of using a sugar dressing in resource-rich settings.
- Optimal frequency of sugar dressing replacements is twice daily[7, 13, 21, 26] to maintain sufficient osmolality and hydrogen peroxide production to sustain inhibition of bacteria[22, 27]. However, this is rarely possible in resource-limited settings[7]. Numerous studies reported wound dressing frequencies of up to 5 to 7 days[4, 6, 7, 13], particularly after wound exudate reduces.
- Patient and health practitioner satisfaction levels were reported to be high in one study, and in this study feasibility of people performing their own sugar dressing in the community was demonstrated[5].
- Sugar is reported to have a lower attraction to flies than honey, which may be a consideration when selecting a wound dressing in resource-limited settings[28].
- Sugar paste was prepared by a hospital pharmacy from by using powdered, additive-free sugar combined with polyethylene glycol and hydrogen peroxide[11], with ratio of ingredients varying based on the viscosity required for ease of application. Hydrogen peroxide is not recommended for use in cavity wounds and sterility might not be maintained when powdering the sugar.
- A cost comparison that considered cost of dressing materials and community nursing time for a four-month treatment regime in the 1980s in the UK reported a sugar paste dressing to be a cheaper option than gauze or paraffin gauze[11].

CONFLICTS OF INTEREST

The author declares no conflicts of interest in accordance with International Committee of Medical Journal Editors (ICMJE) standards.

ABOUT WHAM EVIDENCE SUMMARIES

WHAM evidence summaries are consistent with methodology published in Munn Z, Lockwood C, Moola S. The development and use of evidence summaries for point of care information systems: A streamlined rapid review approach, Worldviews Evid Based Nurs. 2015;12(3):131-8.

Methods are outlined in resources published by the Joanna Briggs Institute[16-18] and on the WHAM Collaborative website: http://WHAMwounds.com. WHAM evidence summaries undergo peer-review by an international, multidisciplinary Expert Reference Group. WHAM evidence summaries provide a summary of the best available evidence on specific topics and make suggestions that can be used to inform clinical practice. Evidence contained within this summary should be evaluated by appropriately trained professionals with expertise in wound prevention and management, and the evidence should be considered in the context of the individual, the professional, the clinical setting and other relevant clinical information.

REFERENCES

1. Biswas A, Bharara M, Hurst C, Gruessner R, Armstrong D, Rilo H. Use of sugar on the healing of diabetic ulcers: A review. J Diabetes Sci Technol, 2010; 4: 1139 - 45.
2. Bitter CC, Erickson TB. Management of burn injuries in the wilderness: Lessons from low-resource settings. Wilderness Environ Med, 2016; 27(4): 519-25.

3. Bajaj G, Karn NK, Shrestha BP, Kumar P, Singh MP. A randomised controlled trial comparing EUSOL and sugar as dressing agents in the treatment of traumatic wounds. Tropical Doctor, 2009; 39(1): 1-3.
4. Mphande AN, Killowe C, Phalira S, Jones HW, Harrison WJ. Effects of honey and sugar dressings on wound healing. J Wound Care, 2007; 16(7): 317-9.
5. Murandu M, Webber M, Simms M, Dealey C. Use of granulated sugar therapy in the management of sloughy or necrotic wounds: A pilot study. J Wound Care, 2011; 20(5): 206-16.
6. Franceschi C, Bricchi M, Delfrate R. Anti-infective effects of sugar-vaseline mixture on leg ulcers. Veins and Lymphatics, 2017; 6(2).
7. Chiwenga S, Dowlen H, Mannion S. Audit of the use of sugar dressings for the control of wound odour at Lilongwe Central Hospital, Malawi. Tropical Doctor, 2009; 39(1): 20-2.
8. Gordon H, Middleton K, Seal D, Sullens K. Sugar and wound healing. Lancet, 1985; 2(8456): 663-5.
9. Quatraro A, Minei A, Donzella C, Caretta F, Consoli G, Giugliano D. Sugar and wound healing. Lancet, 1985; 2(8456): 665.
10. Lisle J. Use of sugar in the treatment of infected leg ulcers. Br J Community Nurs, 2002; 7(6 Suppl): 40, 2, 4, 6.
11. Tanner A, Owen E, Seal D. Successful treatment of chronically infected wounds with sugar paste. Eur J Clin Microbiol Infect Dis, 1988; 7(4): 524-5.
12. De Feo M, Gregorio R, Renzulli A, Ismeno G, Romano GP, Cotrufo M. Treatment of recurrent postoperative mediastinitis with granulated sugar. J Cardiovasc Surg, 2000; 41(5): 715-9.
13. Ruhullah M, Sanjay S, Singh H, Sinha K, Irshad M, Abhishek B, Kaushal S, Shambhu S. Experience with the use of sugar paste dressing followed by reconstruction of sacral pressure sore with V-Y flap: A reliable solution for a major problem. Medical Practice and Reviews 2013; 4(4): 23-6.
14. Szerafin T, Vaszily M, Péterffy A. Granulated sugar treatment of severe mediastinitis after open-heart surgery. Scand J Thorac Cardiovasc Surg, 1991; 25(1): 77-80.
15. Trouillet JL, Chastre J, Fagon JY, Pierre J, Domart Y, Gibert C. Use of granulated sugar in treatment of open mediastinitis after cardiac surgery. Lancet, 1985; 2(8448): 180-4.
16. Aromataris E, Munn Z (editors). Joanna Briggs Institute Reviewer's Manual. https://reviewersmanual.joannabriggs.org/ The Joanna Briggs Institute, 2017.
17. Joanna Briggs Institute Levels of Evidence and Grades of Recommendation Working Party. New JBI Grades of Recommendation. Adelaide: Joanna Briggs Institute, 2013.
18. The Joanna Briggs Institute Levels of Evidence and Grades of Recommendation Working Party. Supporting Document for the Joanna Briggs Institute Levels of Evidence and Grades of Recommendation. www.joannabriggs.org: The Joanna Briggs Institute, 2014.
19. De Feo M, Vicchio M, Santè P, Cerasuolo F, Nappi G. Evolution in the treatment of mediastinitis: single-center experience. Asian Cardiovasc Thorac Ann, 2011; 19(1): 39-43.
20. De Feo M, Gregorio R, Della Corte A, Marra C, Amarelli C, Renzulli A, Utili R, Cotrufo M. Deep sternal wound infection: the role of early debridement surgery. Eur J Cardiothorac Surg, 2001; 19(6): 811-6.
21. Naselli A, Accame L, P. B, Loy A, Bandettini R, Garaventa A, Alberighi O, Castagnola E. Granulated sugar for adjuvant treatment of surgical wound infection due to multi-drug-resistant pathogens in a child with sarcoma: a case report and literature review. Le Infezioni in Medicina, 2017; 4(35): 358-61.
22. Pieper B, Caliri M. Nontraditional wound care: A review of the evidence for the use of sugar, papaya/papain, and fatty Aacids. J Wound Ostomy Cont Nurs, 2003; 30: 175–83.
23. Valls L, Altisen M, Poblador R, Alvarez A, Biosca R. Sugar paste for treatment of decubital ulcers. J Pharm Technol, 1996; 12: 289 - 90.
24. International Committee of the Red Cross (ICRC). ICRC Nursing Guideline 3: Sugar Dressing. IN: ICRC Nursing Guidelines. Geneva, Switzerland: ICRC; 2021.
25. Chirife J, Herszage L, Joseph A, Kohn ES. In vitro study of bacterial growth inhibition in concentrated sugar solutions: microbiological basis for the use of sugar in treating infected wounds. Antimicrob Agents Chemother, 1983; 23(5): 766-73.
26. Middleton KR, Seal DV. Development of a semi-synthetic sugar paste for promoting healing of Iinfected wounds. In: Wadström T, Eliasson I, Holder I, Ljungh Å, editors. Pathogenesis of Wound and Biomaterial-Associated Infections. London: Springer London; 1990. p. 159-62.
27. Molan P, Cooper R. Honey and sugar as a dressing for wounds and ulcers Tropical Doctor, 2000; 30(4): 249-50.
28. Tovey F. Honey and sugar as a dressing for wounds and ulcers. Tropical Doctor, 2000; 30: 1.
29. Di Stadio A, Gambacorta V, Cristi MC, Ralli M, Pindozzi S, Tassi L, Greco A, Lomurno G, Giampietro R. The use of povidone-iodine and sugar solution in surgical wound dehiscence in the head and neck following radio-chemotherapy. Int Wound J, 2019; 16(4): 909-15.
30. Knutson RA, Merbitz LA, Creekmore MA, Snipes HG. Use of sugar and povidone-iodine to enhance wound healing: five year's experience. South Med J, 1981; 74(11): 1329-35.
31. Nakao H, Yamazaki M, Tsuboi R, Ogawa H. Mixture of sugar and povidone - Iodine stimulates wound healing by activating keratinocytes and fibroblast functions. Arch Dermatol Res, 2006; 298(4): 175-82.
32. Shimamoto Y, Shimamoto H, Fujihata H. Topical application of sugar and povidone-iodine in the management of decubitus ulcers in aged patients. Hiroshima Journal of Medical Sciences, 1986; 35(2): 167-9.
33. Topham J. Sugar paste and povidone-iodine in the treatment of wounds. J Wound Care, 1996; 5(8): 364-5.
34. Haesler E, Carville K. WHAM evidence summary: traditional hypochlorite solutions. WCET® Journal, 2023; 43(1): 35-40.
35. Bogdanov S, Jurendic T, Sieber R, Gallmann P. Honey for nutrition and health: a review. J Am Coll Nutr, 2008; 27(6): 677-89.

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