


ORIGINAL ARTICLE

Outcomes of a honey and olive oil-based dressing material on wounds of women that have had a caesarean section in south-western Uganda

Joseph Ngonzi¹  | Brian Ssenkumba² | Nuriat Nambogo³ | Frank Ssedyabane⁴ | Arnold Kamugisha¹ | David Nkwangu⁵ | Thomas Okoth⁶ | Leevan Tibaijuka¹ | Edgar Mulogo⁵

¹Department of Obstetrics and Gynecology, Faculty of Medicine, Mbarara University of Science and Technology, Mbarara, Uganda

²Department of Pathology, Faculty of Medicine, Mbarara University of Science and Technology, Mbarara, Uganda

³Consortium for Affordable Medical Technologies, Mbarara University of Science and Technology, Mbarara, Uganda

⁴Department of Medical Laboratory Science, Faculty of Medicine, Mbarara University of Science and Technology, Mbarara, Uganda

⁵Department of Pharmacy, Faculty of Medicine, Mbarara University of Science and Technology, Mbarara, Uganda

⁶Uganda Industrial Research Institute (UIRI), Kampala, Uganda

Correspondence

Joseph Ngonzi, Department of Obstetrics and Gynecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda.

Email: jngonzi@must.ac.ug

Funding information

Grand Challenges Canada, Grant/Award Number: R-ST-POC-1808-17057

Abstract

Postpartum sepsis following caesarean sections among women in Uganda remains a risk. However, erratic supplies of standard dressing material make the risk a reality. Alternative wound dressing materials, therefore, remain a viable option. This study examined the outcome of a honey and olive oil-based dressing material on caesarean section wound healing. Using the Uganda Industrial Research Institute (UIRI), the study team created I-Dress, a wound dressing made of honey and olive oil. A case-series study was conducted on 25 women who received I-Dress following caesarean births at three health facilities in south-west Uganda. Vital signs (temperature, blood pressure, and heart rate) were measured, along with wound induration, dehiscence, and discharge. The primary outcome was the length of time it took for the wound to heal. The average age of the women who received I-Dress was 27.5 (± 4.8) years. Following the application of I-Dress, all of the women (100%) had no wound induration or dehiscence, with only two (13%) experiencing wound discharge. The vast majority of the women (88%) had never had a Caesarean section before. The mean time required for wound healing was 2.2 (± 0.7) days. The findings indicate that honey and olive oil-based dressings improve Caesarean section wound healing in terms of wound induration, dehiscence, and time to healing. These dressing materials can therefore supplement the standard dressing materials, especially in resource-constrained settings.

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial](https://creativecommons.org/licenses/by-nc/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2024 The Author(s). *International Wound Journal* published by Medicalhelplines.com Inc and John Wiley & Sons Ltd.

KEYWORDS

caesarean sections, dehiscence, postpartum sepsis, wound healing, wound induration

Key Messages

- Alternative wound dressing materials are a necessity in clinical practice in low income settings.
- We studied the outcomes of I-Dress, a locally prepared honey and olive oil-based dressing material on caesarean section wounds in 25 women.
- I-Dress significantly improves caesarean section wound healing.

1 | BACKGROUND

Postpartum sepsis is a leading cause of maternal mortality in resource-limited settings (RLS); in southwestern Uganda, it contributes to nearly one-third of maternal deaths.¹ Caesarean section is one of the most important independent risk factors for postpartum sepsis.^{2–4} At Mbarara Regional Referral Hospital (MRRH) in Uganda, puerperal sepsis was found to be the leading cause of maternal mortality in western Uganda accounting for 30.9% of maternal deaths.¹ Surgical site infection (SSI) is responsible for up to 3–15% of maternal morbidity.⁵ The prevalence of surgical site infections following caesarean delivery at MRRH is 15.5%. The average caesarean section (C-S) rate at Mbarara Regional Referral Hospital is 50%, almost higher than global estimates. Seventeen percent (17%) of these deliveries have positive blood or urine cultures, with acinetobacter species as the most common bacteria isolated. Eighty percent (80%) of the gram-negative micro-organisms isolated are systemic multidrug-resistant and cefepime non-susceptible.⁶ Forty-six percent (46%) of the mothers receiving surgical care at MRRH meet the World Bank's definition of extreme poverty (\$1.90/person/day).⁷

Honey is known to possess wound-healing activity as it offers antibacterial activity by enzymatically producing hydrogen peroxide, maintains a moist wound condition, and its high viscosity helps to provide a protective barrier to prevent infection.⁸ Honey also has potent antimicrobial activity against coagulase-negative staphylococci bacteria and may have a role in the treatment or prevention of infections by coagulase-negative staphylococci.⁹ As a dressing on wounds, honey provides a moist healing environment, rapidly clears infection, deodorizes, and reduces inflammation, edema, exudation and increases the rate of healing by stimulation of angiogenesis, granulation, and epithelialization and gives excellent cosmetic results.¹⁰

Olive oil has long been known to contain a variety of biologically active and health-promoting compounds.¹¹ All types of olive oil kill bacteria and this activity is

higher in virgin olive oils followed by pomace olive oils, because of less phenolic compounds.¹² Antimicrobial activity has been demonstrated in olive products and the anti-bacterial effect is correlated with the presence of olive glutaraldehyde-like compounds such as the dialdehydic form of decarboxymethyl elenolic acid either free (EDA), linked to tyrosol (TyEDA) or to hydroxytyrosol (HyEDA).^{13–16} The bactericidal activity of these substances is due to their dialdehydic structure, which is like those of commercial antiseptics such as glutaraldehyde.¹⁶ It has been found that some salt-free solutions from table olive oil and olive oil production processes are rich in these antimicrobial compounds, and they can exert bactericidal and antifungal activity against phytopathogenic microorganisms.¹² Olive-derived products are a very good source of natural antimicrobials and hence have a remarkable antimicrobial activity.¹⁷ This study examined the outcomes of a honey and olive oil-based dressing material on caesarean section wound healing.

2 | METHODS

2.1 | Design and setting

A case-series study was conducted on 25 women who received I-Dress following caesarean births at three health facilities in south-west Uganda. The health facilities were; Mbarara Regional Referral Hospital (MRRH), Rwekubo Health Centre IV and Kitagata District Hospital.

Mbarara Regional Referral Hospital (MRRH) is an approximately 300-bed academic hospital affiliated with Mbarara University of Science and Technology (MUST). MRRH is a teaching hospital located in southwestern Uganda and serving a population of 3 million people living in a predominantly rural, agrarian setting. Approximately 12 000 deliveries occur per year in this facility with a Maternal Mortality Ratio (MMR) of 400 per 100 000 live births and a caesarean delivery rate of 39% citation. The physician-to-patient ratio ranges from 1:8

during the day to 1:14 during the night. The nursing/midwife-to-patient ratios are approximately 1:25 during the day and 1:50 at night.

Kitagata District Hospital is the district hospital for Shema District. It has approximately 100 beds for inpatient care and provides a wide range of therapeutic and diagnostic services. It houses departments of Maternity, Child Health and a General Ward for both adult general surgery and internal medicine patients. The hospital also has a general outpatient department, pharmacy, laboratory and an ultrasound scan unit. The hospital registers about 3000 deliveries annually, the C/S rate is 25% citation and the hospital is staffed by 2 medical officers and 10 Midwives. The hospital's operating theatre performs numerous surgical operations, including Caesarean sections.

Rwekubo HCIV is a health centre four located in Isingiro District, south Western Uganda approximately 40 kms from Mbarara town. It has about 60 beds, registers averagely 700 deliveries a year. The C/S rate is about 35% citation and the health facility is run by two medical officers and about 4 midwives. Selection of participants: Consecutive sampling was used to recruit the participants. We recruited women who underwent elective caesarean delivery because they have a lower risk of infection.

3 | RECRUITMENT, PRODUCT DEVELOPMENT AND INTERVENTION

3.1 | Recruitment

The cases were recruited from among mothers on the maternity wards who had undergone caesarean delivery. At MRRH, 15 cases were recruited while at Kitagata and Rwekubo, five cases each were recruited. Consecutive sampling was used to recruit the participants. We recruited only women who underwent elective caesarean delivery because they have a lower risk of infection.

3.2 | Product development

Using the Uganda Industrial Research Institute (UIRI), the study team created I-Dress, a wound dressing made of honey and olive oil. UIRI is a government-owned parastatal whose primary objective is to carry out scientific and industrial research and help ensuring production of high quality marketable products in the country. UIRI also works hand in hand with other institutions to support innovators in developing, testing, and verifying their products before they get to intended end users. During the development of I-Dress, UIRI's technical team

provided support in designing the final product and running the sterility tests to ensure safety of the product on human skin and wounds. It also guided in the mixture and exact measurements of the product ingredients.

I-Dress was packaged in different sizes with a strapping that holds it onto the wound and skin to allow slow and continuous release of the active ingredients in honey and olive oil. Sterility for ready-to-use dressing was achieved using gamma irradiation (800 or 1000 grays) from the Uganda Cancer Institute (UCI). The irradiated product was tested for any presence of microorganisms at the Uganda Industrial Research Institute (UIRI) to ensure that sterility was achieved. I-Dress was also applied onto incisions experimentally made on guinea pigs and the efficacy was compared with standard-of-care gauze applied to another group of guinea pigs. The group that had I-Dress applied was found to have better clinical outcomes in terms of having a shorter time for the incision sites to heal and there was no evidence of infection or wound contamination among the group with I-Dress.

3.3 | Intervention

The I-Dress was applied to the women following caesarean delivery in the maternity wards. The women were assessed every 6 h for the following parameters: vital signs (temperature, blood pressure, heart rate), wound induration, wound dehiscence, wound discharge, and time to wound healing.

Assessments were conducted by midwives, medical officers, residents and obstetricians and gynaecologists. The women were observed for up to 3 days following caesarean delivery. The I-Dress wound material was removed on the third day just like the regular wound dressing material. The regular wound dressing material consisted in plain sterile gauze and adhesive tape to anchor the gauze onto the wound surface. The women were asked to come back at 2 and 4 weeks for a thorough examination, including a review of the parameters that were evaluated following the caesarean delivery. The clinical evaluation was performed by the clinical study staff at MRRH.

3.4 | Variable measurement and analysis

The independent variables that were measured included socio-demographic (age, residence, education, income and fertility), medical (parity, co-morbidities such as hypertension, diabetes and HIV), time to wound healing, presence or absence of wound healing, wound size and wound infection, uterus involution, lochia, length of stay

on the ward, antibiotic cover (Yes/No). The primary outcome was wound healing while the secondary outcome was time to wound healing and secondary infection after 3 weeks. Wound healing was operationalized by the following features such as proper wound apposition, no wound discharge, no induration. The data analysis was conducted using STATA version 17 software. Univariate analysis was performed to analyse socio demographic and medical variables, time to wound healing, and presence or absence of wound healing. The means of continuous variables were computed.

4 | RESULTS

The mean age was 27.5 years (SD 4.8 years). The majority of women were married 24 (96%), and subscribed to the Anglican faith. Most of the mothers had completed secondary education 10 (40%) as the highest level of education. Most of the mothers 22 (88%) were employed. Majority of the mothers were literate 22 (88%) as they were able to read and write. On Obstetric characteristics, the findings show that majority of the mothers 18 (72%) had had more than two previous pregnancies. All the mothers had completed the first and second antenatal care visits for the current pregnancy. Most of the mothers (88%) had not had a non-Caesarean section surgical operation before. The type of dressing mostly used in the previous C-Section was gauze 13 (52%) and most of the mothers had had at least two C-Sections 10 (40) as shown in Table 1.

4.1 | Previous wound dressing attributes

The mean number of days admitted at the health facility was 4.2 (SD \pm 1.7 days). The median number of days for wound healing was 14 days. The number of mothers who faced a challenge with wound healing following previous C-section were 40% compared to 60% who did not face any challenge. Majority of the mothers saw a health worker as an action after facing some challenges Table 2.

4.2 | Clinical outcomes

The clinical outcomes; the mean temperature was 36.4 (SD \pm 0.5) on the first day, 36.4 (SD \pm 0.4) on the second day, 36.4 (SD \pm 0.3) on the third day and 36.4 (SD \pm 0.3) on the fourteenth day. All mothers clinically did not show wound induration, dehiscence and only two experienced wound discharge on the second and fourteenth day, respectively. The mean time taken to wound healing was 2.2 (SD \pm 0.7) days Table 3.

TABLE 1 Socio-demographic and obstetric characteristics of mothers.

Characteristics	Category	n (%)
Age (SD)		27.5 (4.8)
Marital status	Single	1 (4)
	Married	24 (96)
Religion	Anglican	11 (44)
	Catholic	8 (32)
	Moslem	3 (12)
	Other	3 (12)
Education level	None	2 (8)
	Primary	7 (28)
	Secondary	10 (40)
	Other	6 (24)
Occupation	Employed	22 (88)
	Unemployed	3 (12)
Literacy	No	3 (12)
	Yes	22 (88)
Current pregnancy number	2 or less	7 (28)
	>2	18 (72)
Antenatal visits completed	Visit 1 (Yes)	25 (100)
	Visit 2 (Yes)	25 (100)
	Visit 3 (Yes)	22 (88)
	Visit 4 (Yes)	20 (80)
	Visit >4 (Yes)	9 (36)
Ever had a surgical operation not C-Section	No	22 (88)
	Yes	3 (12)
Number of C-Sections	One	8 (32)
	Two	10 (40)
	Three	3 (12)
	Four	3 (12)
	Five	1 (4)
Age at last C-Section: Mean (SD)		24.3 (\pm 4.3)
Type of dressing used at last C-Section	Cotton (Yes)	
	Cotton (Yes)	9 (36)
	Gauze (Yes)	13 (52)
	Bandage (Yes)	3 (12)
	Other (Yes)	1 (4)

Note: Continuous variables including Age and Age at last C-Section are presented as mean (standard deviation).

Abbreviations: C-section, Caesarean section; SD, Standard deviation.

Clinical outcomes following the application of the regular sterile gauze wound dressing material were also documented. The mean temperature was 36.9 (SD \pm 0.7) on the first day, 36.9 (SD \pm 0.5) on the second day, 37.3

TABLE 2 Wound dressing at last C-Section prior to use of I-Dress.

Parameter	Category	n (%)
Number of days admitted: mean (SD)		4.2 (1.7)
Number of days for wound healing		14 (10–18)
Faced challenge with wound healing for previous C-Section	No	15 (60)
	Yes	10 (40)
Action taken when the mother encountered a challenge with previous wound dressing	Saw a health worker (Yes)	5 (41.7)
	Home remedy (e.g. Herbs) (Yes)	1 (8.3)
	Home care (Warm water and salt solution) (Yes)	3 (25)
	Other (Yes): Honey	3 (25)
	Some from hospital	1 (4)

Note: Number of days admitted was presented as mean (standard deviation). Number of days for wound healing was presented as median (range). Abbreviation: SD, Standard deviation.

TABLE 3 Clinical outcomes following application of the I-Dress.

Parameter	Category	n (SD)
Vital signs: Temperature	Temperature at end of day 1	36.4 (0.5)
	Temperature at end of day 2	36.4 (0.4)
	Temperature at end of day 3	36.4 (0.3)
	Temperature at end of day 14	36.4 (0.3)
Time taken to wound healing		2.2 (0.7)

Note: All variables are continuous and they are presented as mean (standard deviation). Abbreviation: SD, Standard deviation.

(SD \pm 0.4) on the third day and 37.0 (SD \pm 0.4) on the fourteenth day. No woman clinically had wound induration, one woman had dehiscence and four experienced wound discharge on the second and fourteenth day, respectively. The mean time taken to wound healing was 2.2 (SD \pm 0.7) days Table 4.

Figures 1–3 show the I-Dress wound dressing material and packaging, including the Caesarean section wounds before and after the application of the dressing material.

TABLE 4 Clinical outcomes following application of the regular sterile gauze wound dressing material.

Parameter	Category	n (SD)
Vital signs: Temperature	Temperature at end of day 1	36.9 (0.7)
	Temperature at end of day 2	36.9 (0.5)
	Temperature at end of day 3	37.3 (0.4)
	Temperature at end of day 14	37.0 (0.4)
Time taken to wound healing		3.0 (0.9)

Note: All variables are continuous and they are presented as mean (standard deviation).

Abbreviation: SD, Standard deviation.

5 | DISCUSSION

We present results of the possible benefits of I-Dress. The clinical outcomes showed that for women who had the I-Dress placed on the incision wounds, the mean temperature was normal throughout the period of the I-Dress application and thereafter up to day 14. All the mothers did not show wound induration and dehiscence. This is an indication that application of I-Dress of the incision wounds was able to inhibit inflammation which would be evidenced by increased temperature. Olive oil products have been showed to have antimicrobial, antioxidant and anti-inflammatory abilities and are hence effective in enhancing caesarean section wound healing.^{13,18} The phenolic compounds in olive oil (in topical use) have anti-inflammatory effects, and the polyphenols are associated with neuroprotective and antiaging effect, so they can lead to the repair of epithelialized tissue that is effective in the wound healing process.¹⁹ Also, the squalene compounds in olive oil include vitamins K, D, E, beta-carotene, and ubiquinol 10, which have antioxidant properties.²⁰ Studies have also shown that olive oil, when applied topically, leads to angiogenesis by increasing the levels of intravascular endothelial growth factor (VEGF).²¹

The time to healing was 2.2 days shorter than the standard of care application. This is additional evidence of the potential of I-Dress to speed up healing of incision wounds. Earlier evidence suggested that Honey and olive oil, all components of I-Dress, promote wound healing by their antimicrobial activity, tissue regeneration ability, and its enzymatic generation of hydrogen peroxide.^{22,23} The presence of reactive oxygen species (ROS) such as hydrogen peroxide (H₂O₂) in honey and honey products has been shown to promote wound healing by encouraging cellular repair processes and tissue regeneration.^{24,25} Honey has also been shown to restore the susceptibility

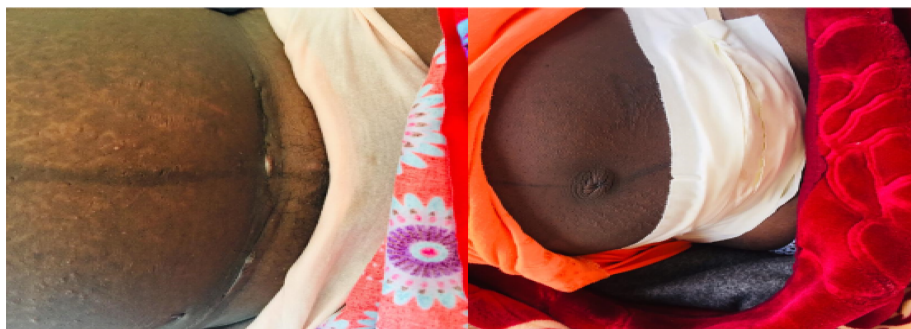


FIGURE 1 Caesarean wound before and after removal of I-Dress.



FIGURE 2 Photos of the I-Dress dressing.



FIGURE 3 I-Dress wound dressing package.

of antibiotic-resistant bacteria to antibiotics.^{26–29} In fact, prior studies suggested that honey considerably reduces the healing time of post-operative C-Section wounds.³⁰

It is important to note that the study population in this study were all immunocompetent adults with no underlying comorbidities and had at least completed the first two antenatal visits. These might have had a positive impact on the positive outcomes of the incision wound other than the intervention.

6 | CONCLUSION AND RECOMMENDATION

Honey and olive oil-based dressings have the potential to improve caesarean section wound healing in terms of wound induration, dehiscence, and reducing time to healing. These dressing materials can therefore supplement the standard dressing materials, especially in resource-constrained settings. We recommend a

randomized controlled trial to study the effectiveness and safety of I-Dress in a clinical setting.

ACKNOWLEDGEMENTS

We acknowledge the study participants and health workers of Mbarara Regional Referral Hospital, Kitagata District Hospital and Rwekubo Health Centre IV, as well as the staff at the Uganda Industrial Research Institute (UIRI).

FUNDING INFORMATION

This study was funded by the Grand Challenges Canada.

CONFLICT OF INTEREST STATEMENT

We, the authors declare that we do not have any competing interests.

DATA AVAILABILITY STATEMENT

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

ORCID

Joseph Ngonzi  <https://orcid.org/0000-0001-5253-9516>

REFERENCES

- Ngonzi J, Tornes YF, Mukasa PK, et al. Puerperal sepsis, the leading cause of maternal deaths at a tertiary university teaching Hospital in Uganda. *BMC Pregnancy Childbirth*. 2016;16:1-7.
- Declercq E, Barger M, Cabral HJ, et al. Maternal outcomes associated with planned primary cesarean births compared with planned vaginal births. *Obstetrics Gynecol*. 2007;109(3):669-677.
- Lubega A, Joel B, Justina LN. Incidence and etiology of surgical site infections among emergency postoperative patients in mbarara regional referral hospital, South Western Uganda. *Surg Res Prac*. 2017;2017(1):6365172.
- Ngonzi J, Bebell LM, Fajardo Y, et al. Incidence of postpartum infection, outcomes and associated risk factors at Mbarara regional referral hospital in Uganda. *BMC Pregnancy Childbirth*. 2018;18:1-11.
- Zuarez-Easton S, Zafran N, Garmi G, Salim R. Postcesarean wound infection: prevalence, impact, prevention, and management challenges. *Int J Womens Health*. 2017;9:81-88.
- Bebell LM, Ngonzi J, Bazira J, et al. Antimicrobial-resistant infections among postpartum women at a Ugandan referral hospital. *PLoS One*. 2017;12(4):e0175456.
- Anderson GA, Ilcisin L, Kayima P, et al. Out-of-pocket payment for surgery in Uganda: the rate of impoverishing and catastrophic expenditure at a government hospital. *PLoS One*. 2017;12(10):e0187293.
- Mandal MD, Mandal S. Honey: its medicinal property and antibacterial activity. *Asian Pac J Trop Biomed*. 2011;1(2):154-160.
- Cooper R, French V, Molan P. The antibacterial activity of honey against coagulase-negative staphylococci. *J Antimicrob Chemother*. 2005;56:228-231.
- Molan PC. Potential of honey in the treatment of wounds and burns. *Am J Clin Dermatol*. 2001;2:13-19.
- Ghanbari R, Anwar F, Alkharfy KM, Gilani A-H, Saari N. Valuable nutrients and functional bioactives in different parts of olive (*Olea europaea* L.)—a review. *Int J Mol Sci*. 2012;13(3):3291-3340.
- Medina E, Romero C, Brenes M, De Castro A. Antimicrobial activity of olive oil, vinegar, and various beverages against foodborne pathogens. *J Food Prot*. 2007;70(5):1194-1199.
- Gorzynik-Debicka M, Przychodzen P, Cappello F, et al. Potential health benefits of olive oil and plant polyphenols. *Int J Mol Sci*. 2018;19(3):686.
- Kouka P, Tsakiri G, Tzortzi D, et al. The polyphenolic composition of extracts derived from different greek extra virgin olive oils is correlated with their antioxidant potency. *Oxid Med Cell Longev*. 2019;2019(1):1870965.
- Romani A, Ieri F, Urciuoli S, et al. Health effects of phenolic compounds found in extra-virgin olive oil, by-products, and leaf of *Olea europaea* L. *Nutrients*. 2019;11(8):1776.
- Nikou T, Liaki V, Stathopoulos P, et al. Comparison survey of EVOO polyphenols and exploration of healthy aging-promoting properties of oleocanthal and oleacein. *Food Chem Toxicol*. 2019;125:403-412.
- Yakhlef W, Arhab R, Romero C, Brenes M, de Castro A, Medina E. Phenolic composition and antimicrobial activity of Algerian olive products and by-products. *Lwt*. 2018;93:323-328.
- Taheri M, Amiri-Farahani L, Haghani S, Shokrpour M, Shojaii A. The effect of olive cream on pain and healing of caesarean section wounds: a randomised controlled clinical trial. *J Wound Care*. 2022;31(3):244-253.
- Rosillo MÁ, Alcaraz MJ, Sánchez-Hidalgo M, Fernández-Bolaños JG, Alarcón-de-la-Lastra C, Ferrándiz ML. Anti-inflammatory and joint protective effects of extra-virgin olive-oil polyphenol extract in experimental arthritis. *J Nutr Biochem*. 2014;25(12):1275-1281.
- López Martín S, Bermúdez B, Montserrat-de la Paz S, et al. Membrane composition and dynamics: a target of bioactive virgin olive oil constituents. 2014.
- Kirkil C, Yigit MV, Özercan IH, Aygen E, Gültürk B, Artas G. The effect of ozonated olive oil on neovascularization in an experimental skin flap model. *Adv Skin Wound Care*. 2016;29(7):322-327.
- Shayan A, Sourinezhad H, Barzegar F, et al. The effect of olive oil and honey combination on episiotomy wound healing and pain relief: a randomized clinical trial. *Curr Womens Health Rev*. 2020;16(2):145-151.
- Yupanqui Mieses J, Vyas C, Aslan E, Humphreys G, Diver C, Bartolo P. Honey: an advanced antimicrobial and wound healing biomaterial for tissue engineering applications. *Pharmaceutics*. 2022;14(8):1663.
- Love NR, Chen Y, Ishibashi S, et al. Amputation-induced reactive oxygen species are required for successful *Xenopus* tadpole tail regeneration. *Nat Cell Biol*. 2013;15(2):222-228.
- Dunnill C, Patton T, Brennan J, et al. Reactive oxygen species (ROS) and wound healing: the functional role of ROS and emerging ROS-modulating technologies for augmentation of the healing process. *Int Wound J*. 2017;14(1):89-96.
- Jenkins RE, Cooper R. Synergy between oxacillin and manuka honey sensitizes methicillin-resistant *Staphylococcus aureus* to oxacillin. *J Antimicrob Chemother*. 2012;67(6):1405-1407.
- Müller P, Alber DG, Turnbull L, et al. Synergism between Medihoney and rifampicin against methicillin-resistant *Staphylococcus aureus* (MRSA). *PLoS One*. 2013;8(2):e57679.
- Liu M, Lu J, Müller P, et al. Antibiotic-specific differences in the response of *Staphylococcus aureus* to treatment with antimicrobials combined with manuka honey. *Front Microbiol*. 2015;5:779.
- Liu MY, Cokcetin NN, Lu J, et al. Rifampicin-manuka honey combinations are superior to other antibiotic-manuka honey combinations in eradicating *Staphylococcus aureus* biofilms. *Front Microbiol*. 2018;8:2653.
- Bocoum A, Riel SJV, Traoré SO, et al. Medical-grade honey enhances the healing of caesarean section wounds and is similarly effective to antibiotics combined with povidone-iodine in the prevention of infections—a prospective cohort study. *Antibiotics*. 2023;12(1):92.

How to cite this article: Ngonzi J, Ssenkumba B, Nambogo N, et al. Outcomes of a honey and olive oil-based dressing material on wounds of women that have had a caesarean section in south-western Uganda. *Int Wound J*. 2024;21(9):e70038. doi:10.1111/iwj.70038