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Case Report

*Corresponding author
Fekadu Fullas, RPh, PhD
Clinical Pharmacist
UnityPoint Health - St. Luke's
Pharmacy Department
2720 Stone Park Boulevard
Sioux City, IA 51104, USA
Tel. (712) 266-6156
Fax: (712) 279-3372
E-mail: FeFuBal@aol.com

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The Use of Freshly Roasted Coffee Bean Powder in the Treatment of Burn Wound: A Case Report

Bisrat Hailemeskel, PharmD, RPh[1]; Fekadu Fullas, PhD, RPh[2*]

[1]Associate Professor & Co-Director of International Projects ((HUGIN, HUGISA), College of Pharmacy, Howard University, 2300 4th Street, NW, Washington, D.C. 20059, USA
[2]Clinical Pharmacist, UnityPoint Health - St. Lukes, Pharmacy Department, 2720 Stone Park Boulevard, Sioux City, IA 51104, USA

ABSTRACT

Introduction: Many patients use home remedies for various maladies. The effectiveness of these remedies is not always scientifically ascertainable. Some may be backed by limited scientific studies.
Case Summary: A few years ago, a five-year old girl in Addis Ababa, Ethiopia sustained heavy burns from spillage of boiling water. The child was taken to a local Emergency Department (ED) of a hospital for evaluation and treatment. The patient was discharged after the burn was treated and the wound was appropriately dressed. The mother was instructed to take the child to a clinic for follow-up. After four days of treatment at the clinic, no arrangement was made for visits during the weekend. Upon the advice of her neighbor, the mother decided to apply coffee powder from freshly roasted coffee beans to the wound. In the few days that followed, she observed significant improvement in the healing of the wound. She continued this treatment daily, *in lieu* of visits to the clinic. In about three weeks, the wound was completely healed. The mother who now lives in the USA recently contacted the Drug Information Center at Howard University (HU) inquiring about the merits of coffee powder in the treatment of burn wounds. A literature review revealed various studies confirming the potential effectiveness of powder prepared from freshly roasted coffee beans in the treatment of wounds.
Conclusion: A mother of a five-year old reported that treatment of a burn wound sustained by her child with powder from freshly roasted coffee resulted in healing. A literature review found some evidence to support the usefulness of this home remedy in wound treatment.

INTRODUCTION

The National Coffee Association and The Specialty Coffee Association of America conducts annual surveys regarding coffee consumption each year. Over 50% of over 18 years of age drink coffee every day. This represents over 150 million daily drinkers. About 30 million American adults drink specialty coffee beverages daily: mocha, latte, espresso, café mocha, cappuccino, frozen/iced coffee beverages and others. Among coffee drinkers, the average consumption in the United States is 3.2 cups of coffee per day, and men drink as much coffee as women.[1,2] The claimed main reason why majority of users consume caffeinated beverage daily is to improve mental alertness, concentration and fatigue.[3,4] Several epidemiological findings have also suggested that coffee consumption might be associated with a decrease in all-cause mortality.[5] Having originated in Ethiopia, coffee is a useful commodity and finds various applications locally.

Multiple studies have highlighted the beneficial effects in several disease conditions, such as type II diabetes mellitus, hepatitis C virus, hepatocellular carcinoma, nonalcoholic fatty liver disease and neurodegenerative disorders.[6-9] Long term coffee consumption has also been associated with prevention of cognitive decline, and reduced risk of developing stroke and neurodegenerative diseases (NDD).[10] The FDA has suggested that for healthy adults, caffeine

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intake up to 400 mg/day (about 5 cups of coffee) is not associated with adverse health effects.[11]

Although caffeine may disturb sleep and raise anxiety in sensitive individuals, it does not seem to lead to dependence. However, people experience withdrawal symptoms. Caffeine is also known to potentiate the effect of regular analgesic drugs for headache and migraine. For example, the ingredient caffeine in the product Excedrin® serves such purpose when taken to alleviate migraine headache symptoms.

Coffee powder has been reported to absorb water from wounds.[12] It has also been reported to facilitate wound healing.[13,14] Antibacterial activities of coffee have been demonstrated against Methicillin-Resistant *Staphylococcusaureus* (MRSA), *Streptococcus* spp.[15] and a range of gram-negative bacteria.[16]

CASE REPORT

A question was recently received at HU Drug Information Center from a mother whose daughter was burned by boiling water several years ago in her native country, Ethiopia. The five-year old girl was burned in her thighs on both legs after she tripped over and fell on a floor-top oven, where water was boiling in a cooking pan. The burn covered about 20% of her upper thighs. The mother immediately took the child to the closest local ED in Addis Ababa, Ethiopia, where work up was done properly. A clean gauze was wrapped around the entire wound area, and an instruction was given to the mother to take the child to the clinic daily for follow-up cleaning and wound care. Having noticed some improvement after four days of follow-up visits, the mother found out that the clinic was closed on the fifth day, which was on a Friday leading up to the weekend. While she was in desperation as to what to do next, the mother was advised by her neighbors to apply finely powdered freshly roasted coffee beans on the wound twice daily. She was also instructed to protect it from getting wet. Accordingly, she followed the advice. When she saw a significant improvement by the Monday that followed, she decided to stay home and continued the home remedy using of the coffee powder. According to the mother, the child's wound completely healed in about three weeks. Being curious about the result, she recently called HU Drug Information Center inquiring about any scientific merits in support of the use of ground roasted coffee beans for wound healing.

DISCUSSION

Burn wound can lead to serious infections if it is not treated timely. Although not specific to burn wounds, this literature review was done to look for any evidence from studies conducted on the use of coffee powder in the treatment of various types of experimental and other wounds.

In a study cited by Kenisa et al[13] when Robusta coffee powder was applied on rat-induced alloxan incision wound, it demonstrated clinically similar healing rate with medications that are commonly used in wound care, such as povidone iodine 10%. In another experiment by Kenisa et al[13] 20 male guinea pigs (*Caviacabaya*) with full-thickness wounds were treated with Robusta coffee beans extract ointment at concentrations of 22.5%, 45%, and 90%, while the control group was given ointment base material. The animals were then harvested on the fourth day. The Robusta coffee bean extract ointment-treated group showed an increase the number of lymphocytes, plasma cells, macrophages, fibroblasts, and blood vessels caused by the Constituents Chlorogenic Acid (CGA) and caffeic acid that are present in the coffee. The authors of the study concluded that Robusta coffee bean extract ointment enhanced the healing process of full thickness skin wound of *Caviacabaya*.

Coffee powder has also shown to increase wound healing efficacy when it is combined with other established antimicrobials. In a study published by Nebioglu-K et al.[14] N-Heterocyclic carbene (NHC)-silver complexes were synthesized from pyridine linked pincer legends and methylated caffeine. Pincer NHC-silver complexes were found to have more potent antimicrobial activity than the conventionally used silver antimicrobials. An NHC precursor derived from caffeine was found to have low toxicity, and the resulting silver complex showed antimicrobial activity against numerous pathogens including resistant organisms isolated from the lungs of patients with cystic fibrosis.

Bleeding after a minor cut, a postoperative procedure, or after an accident is a common incident. Because of the commonality of this complication, homeostasis is an important concept to address when considering wound healing. In addition to all the benefits of coffee in healing wounds, it can help stop the bleeding of small cuts. When there is a minor cut, the wound is washed and coffee grounds are applied to cover the cut area. It usually halts the bleeding immediately, because coffee powder on the wound helps to clot the blood, thus reducing the bleeding. If bleeding slows but doesn't stop, the process is repeated making sure the cut area is fully covered with grounds.[14]

Coffee powder absorbs water very fast; therefore it also plays a role by continuously absorbing wound fluids. With the presence of a thick layer of coffee powder, the fluid gets absorbed from the wound by creating negative pressure on the surface of the wound. The co-existence of both carboxylic acid and basic groups on the surface of coffee powder was hypothesized as an explanation for its adsorption behavior of materials including metals that are anionic.[12]

One of the many benefits of coffee in wound healing may be due to its antibacterial properties. Coffee has a strong inhibition against MRSA that is proven on agar plates, which may be due to phenolic acidity and hyperosmolarity formed when mixed with a liquid wound. Raman and colleagues investigated the antibacterial activities of decaffeinated and non-decaffeinated NESCAFÉ instant coffee against some pharyngitis-causing *Streptococcus* species – *Group A Streptococcus*, *Group B Streptococcus*, *Group D Streptococcus* and *Streptococcus pneumonia*

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at eight different concentrations.[15] The study utilized three sensitivity-testing methods: disc diffusion, well diffusion and coffee agar plate sensitivity testing. Zones of inhibition and growth on the plates were observed at 24 hours and 48 hours. The results showed inhibition of growth on coffee agar plate with all *Streptococcus* species. At the highest concentration of coffee solution used in the study (8 g/100 ml), growth inhibition was observed in all the four *Streptococcus* species-inoculated plates, with non-decaffeinated coffee acting much more strongly.

According to Daglia et al, roasted coffee also showed antibacterial properties against a range of Gram-negative bacteria.[16] On the basis of their findings, the activity was not affected by the brewing procedure. However, the degree of roasting and the coffee species affected significantly the antimicrobial activity. In a later study, the same researchers investigated the relationship between the inhibitory effect of brewed coffee on *Staphylococcus aureus* and the degree of roasting as determined by chemical indicators, confirming the influence of the degree of roasting on the inhibitory effect.[17] Dogazaki et al and Furuhata et al reported antibacterial activity of brewed coffee against a strain of *Legionella pneumophila*, bacteria involved in atypical respiratory infections, and identified caffeic, chlorogenic, and protocatechuic acids as the active substances.[18,19] According to Daglia et al[20] and Almeida et al[21] the growth of *Streptococcus mutans*, the major causative agent of dental caries in humans, was inhibited by coffee extracts and by the chemical compounds such as trigonelline, chlorogenic acid, caffeic acid, and protocatechuic acid that are found in coffee. The compounds trigonelline, caffeine, and protocatechuic acid have been reported as potential natural antimicrobial agents against *Nitrobacteria* and therefore could be used in foods as a natural preservative to control their growth.[22]

Treatment of chronic ulcers due to diabetes is a problem and usually leads to amputation. As a result of chronically elevated blood glucose, impaired wound healing is one of the many serious issues that can occur in diabetic patients. Impaired wound healing and vascular disorders are caused by diminished angiogenesis, decreased lymphangiogenesis, and destruction of endothelial cells. Coffee powder is one of the herbal medicines used as a traditional treatment of varying type of wounds including diabetic foot ulcer in rural areas of coffee plantation without any harmful complications. The best evidence regarding the healing properties of coffee powder in humans come from a series of studies done by a vascular surgeon.[23] Several experiments conducted over the years using powdered coffee beans have shown the efficacy of coffee in treating a variety of wounds effectively. Based on these experiments, it was shown that coffee beans powder promoted wound and helped to stop the bleeding from subcutaneous layer that was previously difficult to manage. In the studies, coffee powder was left on the wound tissue for many weeks without cleaning or wetting while adding the powder occasionally as needed until the wound was finally covered itself by epithelial cells. Coffee powder not only healed the wound faster but also decreased the frequency of wound dressing replacement. Less frequent wound dressing resulted in less disruption of the growth of new cells and reduced pain and discomfort associated with removal of dressing from the wound surface. Coffee powder appears to exemplify a new paradigm of thinking in the management of wounds.[24] The powder contains many antioxidants which help in wound healing. Coffee has been effectively used as a debarment agent in reduction of scarring upon healing.

When coffee was used in wound management, the coffee powder on the wound did not need to be cleaned every day and could be left on the wound for as long as 4 to 7 days without closed with gauze. However, the wound was covered with gauze to prevent spills littering the surrounding, especially in patients who are mobile. This eliminated frequent dressing change. By minimizing pain secondary to less frequent dressing changes, coffee powder was reported to be a cost-effective alternative with no observed adverse reactions. In addition, coffee powder application did not require skilled personnel, and could easily be done by anyone in some home settings. Depending on the magnitude of size and depth, the author reported that the drying of the coffee-treated wounds occurred at week 8, and closure of the skin epithelium occurred at the 12th-16th week.[24] It was hypothesized that wound healing in this manner was enhanced by antioxidants (phenolic acid), and that coffee within wound fluids formed a high hyperosmolar fluid is capable of killing pathogenic bacteria cells. Antioxidants absorb the free radical oxygen and reduce tissue damage. Unprocessed coffee beans are claimed to have 1,000 antioxidants which are more than the number found in green tea, or cocoa polyphenols.[24]

Caffeine may have the capacity to decrease the risk of diabetes and improve wound healing through its antioxidant properties and increasing the number of adenosine receptors. To investigate the effects of caffeine on processes involved in epithelialization, Ojeh et al[25] used primary human keratinocytes, HaCaTcell line and an *ex vivo* model of human skin. The investigators tested the effects of caffeine on cell proliferation, differentiation, adhesion and migration, processes essential for normal wound epithelialization and closure *in vitro*. They found that caffeine restricted cell proliferation of keratinocytes in a dose-dependent manner. Furthermore, scratch wound assays performed on keratinocyte monolayers indicated dose-dependent delays in cell migration. Using a human *ex vivo* wound healing model, the researchers also tested topical application of caffeine and found that it impeded epithelialization, thus confirming the *in vitro* data. The researchers concluded that caffeine may have an inhibitory effect on wound healing and epithelialization.

Caffeine acts as adenosine-receptor antagonist. Adenosine is a Purina nucleoside, which is a key local stimulator of cell proliferation and wound healing. Adenosine could be activated by interaction with specific adenosine A1, A2A, A2B, and A3 receptors. Caffeine is a nonselective antagonist of all the adenosine receptor subtypes and has demonstrated physiological effects in *in vitro* and *in vivo* studies. In addition, occupancy of

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adenosine receptors may accelerate wound healing and reduce pro-inflammatory cytokine secretion, including tumor necrosis factor-α and interleukin-6. Zeinab Bonyanian Z and Rose' Meyer RB.[25]

LIMITATIONS

Detailed information regarding the treatment received in the emergency department was not elicited from the mother whose child sustained the burn from boiling water many years ago in Addis Ababa, Ethiopia. The degree of burn could not also be determined based on the phone call received. The medical chart of the patient was not available to track the ED course and follow-up clinic visits. The literature search did not specifically focus on the use of coffee for burn wound treatment only.

CONCLUSION

A five-year old child who sustained an extensive burn wound on the thighs from boiling water was home-treated daily with topical application coffee powder prepared from freshly roasted coffee beans. The mother of the child reported the wound was healed in about three weeks. Literature review on the use of coffee powder in the treatment of wounds seems to support the claim.

CONFLICTS OF INTEREST

We declare that we have no conflicts of interest.

CONSENT

The mother of the five-old described in this case report has provided a written permission for publication of the case details.

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