

Re.: Ash as a neglected low-cost alternative for soap for hand washing (and disinfectant) relevant for Ebola prevention -- and some more suggestions

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To PhD Pierre Formenty

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Thank you for requesting more information on the mentioned topic.

Background and summary

It has not been possible to get sufficient funding, staff and local support for standard solutions to the current Ebola outbreak still growing exponentially. Additional, simple solutions are suggested in this text. Ebola in (and from) e.g. Guinea has mainly been spread at funerals, despite warnings, but availability of soap is a problem, particularly at funerals in Africa where anybody can visit, get meals and some steal the soap. Likewise, schools, public toilets and many poor homes are not having soap readily available. In Sierra Leone, only 19% of people wash hands with soap after contact with feces and 10% before eating and access to soap and WASH facilities is a big barrier, the situation in the schools is not better; however, many more wash hands without soap.¹

As an agronomist, I have studied the chemical and biological effects of wood ash from African kitchens in details. I later looked into the literature for its potential as substitute for soap and as indirect indications of its potential as disinfectant against Ebola. Ash has been tested as effective as soap for cleaning hand for bacteria in various comparable, scientific experiments; and half as effective in a study where users could not be compared directly – but still much better than water alone (references in main text). Ash is often an officially recommended substitute in developing countries. However, international (WHO) guidelines to the public for Ebola prevention appears based on guidelines for in theory well-equipped health professionals. From what I can Google, Ebola guidelines mentioning ash has only been used in countries where Ebola has been controlled (Nigeria and DRC Congo, e.g.^{2,3}).

I wrote the following paragraph at Wikipedia on *Hand washing*, but it was in October 2014 so only few may have noticed it⁴:

¹ <http://www.ncbi.nlm.nih.gov/pubmed/19008513>

² <http://reliefweb.int/report/democratic-republic-congo/combating-myths-and-misconceptions-defeat-Ebola>

³ <https://www.facebook.com/WaterGovNG/posts/684144891653599>; <http://thenews-chronicle.com/nigeria-succeeds-at-containing-Ebola/>

⁴ https://en.wikipedia.org/wiki/Hand_washing Sect. 2.2.

“Ash or mud as substitutes for soap in low-income communities

Many people in low-income communities cannot afford soap and use ash or soil instead. Ash or soil is more effective than water alone. They were found as effective against bacteria as soap in short-term experiments with bacterial contaminated hands in Bangladesh and India. However, the effect was intermediate between using soap and no soap in a non-experimental study also influenced by the social level of those actually using it in India. Some soil and ashes may be contaminated with microorganisms or toxic substances, but the risk may be very small at most sites.⁵ Like soap, ash is also not only cleansing but also a disinfecting agent (alkaline).⁶ WHO e.g. recommended ash or sand as alternative to soap when needed, e.g. after emergencies.⁷

Accordingly, in the Wikipedia page on *Hygiene*, I also wrote in October 2014:⁸

“The World Health Organization recommends hand washing with ash if soap is not available in emergencies,⁹ schools without access to soap¹⁰ and other difficult situations like post-emergencies where use of (clean) sand is recommended too.¹¹ Use of ash is common and has in experiments been shown at least as effective as soap for removing bacteria.¹² “

Further documentation of the efficiency of ash for hand washing can be found in recognized research journals, e.g.^{13, 14} and the reference no. 5 review most. To Google: soap ash hand washing journal also helps. An brief, referenced summary of research results up to 2009 showing similar effect of ash, soap and sometimes soil is found hear.¹⁵

⁵ Blomfield S F and Nath K J 2009: Use of ash and mud for hand washing in low income communities. The International Scientific Forum on Home Hygiene Accessed Oct. 2014 <http://www.ifh-homehygiene.org/best-practice-review/use-ash-and-mud-handwashing-low-income-communities>

⁶ Howard et al. 2002: Healthy Villages A guide for communities and community health workers CHAPTER 8 Personal, domestic and community hygiene. WHO. Accessed Oct. 2014. http://www.who.int/water_sanitation_health/hygiene/settings/hvchap8.pdf

⁷ WHO 2014: Water Sanitation Health. How can personal hygiene be maintained in difficult circumstances? Accessed Oct. 2014 http://www.who.int/water_sanitation_health/emergencies/qa/emergencies_qa17/en/

⁸ <https://en.wikipedia.org/wiki/Hygiene> Sect. 4.1

⁹ http://www.who.int/water_sanitation_health/publications/2011/tn5_treatment_water_en.pdf?ua=1

¹⁰ http://www.who.int/water_sanitation_health/publications/wash_standards_school.pdf?ua=1

¹¹ http://www.who.int/water_sanitation_health/emergencies/qa/emergencies_qa17/en/

¹² Baker et al. 2014 Association between Moderate-to-Severe Diarrhea in Young Children in the Global Enteric Multicenter Study (GEMS) and Types of Handwashing Materials Used by Caretakers in Mirzapur, Bangladesh. Am J Trop Med Hyg 2014 vol. 91 no. 1 181-189. Free full pdf at <http://www.ajtmh.org/content/91/1/181>

¹³ http://link.springer.com/article/10.1007%2F978-94-007-2752-3_41

¹⁴ [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(05\)67314-X/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(05)67314-X/fulltext)

¹⁵ <http://www.watersanitationhygiene.org/forum/phpBB3/viewtopic.php?f=40&t=235>

At Wikipedia's important *Ebola Virus Disease* page, no info on the possibilities for using ash if soap (or commercial disinfectants) was not permitted by editorial rules until WHO or e.g. CDC recommends specifically for Ebola prevention. However, I managed to cite official Canadian advice for prevention incl. treatment with heat, UV light, and correct sentences indicating infections came from animals and not usually people, and e.g. included that standard 'treatment' increased survival chances.¹⁶ Most was first corrected in October showing the need for better information on prevention.

Leading organization *generally* recommended washing hands with "soap or ash" in Africa

Washing hands in water with soap or ash was in *2013 strongly recommended for schools in Liberia* by Liberia WASH Consortium of Oxfam GB, Action Contre la Faim, Concern Worldwide, Tearfund and Solidarities' (now replaced by WaterAid) after consultations with the UK Department for International Development (DFID) and the Government of Liberia.¹⁷

By *UNICEF in Monrovia, washing hands with soap or ash was promoted*, but the ash option appeared often to be forgotten when searching in the text.¹⁸

*In Sierra Leone by UNICEF chief of WASH recommended washing hands with ash or soap with a smart bamboo-pipe-and-stick-plug water supply device*¹⁹. Likewise, "soap or ash" has been recommended officially in e.g. Nigeria, Congo, and by media in Togo and Nigeria to prevent spreading Ebola (accessed via Google October 2014, good key words includes soap ash Ebola hand washing country, add space before and after ' ash ' for in text search).

Hand washing with soap or ash has also been promoted recently by UNICEF in *Guinea Bissau* for cholera prevention²⁰ and by UNICEF in Kenya²¹ and almost all countries with WASH programmes²² and particularly and increasingly emphasized in Sierra Leone²³. USAID and Plan in Uganda included it in good illustrated guidelines that could be used with modifications like drawing plastic bags on hands of people taking care of sick or leaving such drawings out²⁴. USAID guidelines includes ash in general guidelines for moving forward in small step from people's current WASH practices²⁵.

Ash as an alkaline disinfectant and virus killer

¹⁶ https://en.wikipedia.org/wiki/Ebola_virus_disease

¹⁷ <http://www.shout-africa.com/top-story/liberia-celebrates-global-hand-washing-day/>

¹⁸ http://www.unicef.org/evaldatabase/files/3_Eval_of_WASH_interventions_in_urban_Slums_of_Monrovia_and_Buchanan_2011-2012.pdf

¹⁹ <http://www2.wsp.org/scalinguphandwashing/enablingtechnologies/index.cfm?Page=Search&DocID=349&sr=2>

²⁰ http://www.unicef.org/about/annualreport/files/Guinea_Bissau_COAR_2013.pdf

²¹ http://www.unicef.org/about/execboard/files/Kenya_CPD-CRR-2009-2013.pdf

²² http://www.unicef.org/evaluation/files/Evaluation_of_the_WASH_Sector_Strategy_FINAL_VERSION_March_2014.pdf

²³ http://www.unicef.org/evaluation/files/CATS_Evaluation_SIERRA_LEONE_Country_Report_FINAL.pdf

²⁴ <http://www.hip.fhi360.org/file/21856/Pg%20Unit%202.pdf>

²⁵ http://www.who.int/water_sanitation_health/hygiene/settings/Watsan_into_HIV_programs_annex2.pdf

Wood ash (2.5% 'concentration' in pure water suspension of virus) can dissolve and kill at least the studied virus for at least 10 minutes²⁶. However, such an ash concentration will only raise pH slightly in concentrated organic materials according to published Swiss experiments with compost, or my experiments in red Kenyan clay soil where even 7% ash e.g. stopped early root growth, but did not reach level near 10 unlike concentrated ash spots.²⁷ Alkaline substances can also be effective in presence of organic matter²⁸ and wood ash is mentioned as disinfectant in a WHO publication.²⁹ Alkalies as disinfectants are also discussed by Denver university, mentioning the benefits of weak (buffered) alkalis or acids and generally higher susceptibility of lipid containing virus compared to bacteria to disinfectants³⁰ Kitchen ash contains both strong and weak (e.g. bicarbonates) alkalis. I observed that many harmless Rhizobium root bacteria continued moving for several minutes in kitchen ash suspension under microscope, but they tend to tolerate high pH and salinity. Virus may be more sensitive, and solutions with pH above 10 is effective against e.g. foot and mouth disease virus³¹. Ebola virus may need a relatively low pH at the entry point^{32, 33}.

Alkaline detergents are effective against more types of dirt than other detergents, but the commercial types for cleaning should not be in skin contact for any length of time³⁴. See also³⁵.

Ash, high pH and possible damage to sensitive hands

However, damage to skin for some with sensitive skin when exposed to mush ash for long time, but it is also often used for dishwashing in rural Africa. An assistant of mine got small, painful cracks in the hands sifting dry kitchen ash for days and she does not tolerate most dishwashing soaps either. Still, the ash water will be painful in open wound and reportedly help them to heal fast. No problems for skin are mentioned in the studies on ash efficiency for hand washing, but in literature and warnings on alkaline soaps and detergents. Burning temperatures above 800°C are required for forming the highly alkaline CaO rather than CaCO₃, which is the bulk of the ash, I got analysed with X-ray diffraction analyses in African rural kitchen ash, while some CaO and KOH and bicarbonate was present too.³⁶ Temperatures varies much within an open fire. Burning leaves can produce a more alkaline ash for disinfectants than wood because it is higher in soluble potassium (K) than calcium (Ca).

²⁶ http://www.who.int/water_sanitation_health/hygiene/settings/hvchap8.pdf

²⁷ Mandal, T 2007 A new pH measurement method and effects of wood-ash on a Kenyan ferralsol soil on pH, salinity, phosphorus bio-availability, and tree legume growth. Faculty of Life Sciences Library
<http://www.worldcat.org/title/new-ph-measurement-method-and-effects-of-wood-ash-on-a-kenyan-ferralsol-soil-on-ph-salinity-phosphorus-bio-availability-and-tree-legume-growth/oclc/476729924>

²⁸ <http://www.biosch.hku.hk/clinicalwaste/Decontamination%20guidance.pdf>

²⁹ http://www.who.int/water_sanitation_health/hygiene/settings/hvchap8.pdf

³⁰ <http://www.ucdenver.edu/academics/research/AboutUs/health-safety/Documents/pdf/Disinfectants%20and%20Sterilization%20Methods.%20rev.09302013.pdf>

³¹ http://wildpro.twycrosszoo.org/S/virus/picornaviridae/Picornaviridae_FMDVirus/FMDVChemToxic.htm

³² <http://jvi.asm.org/content/80/8/4174.abstract>

³³ <http://www.ncbi.nlm.nih.gov/pubmed/24696482>

³⁴ <http://www.gsa.gov/portal/content/113006>. See also
<http://www.biosch.hku.hk/clinicalwaste/Decontamination%20guidance.pdf>

³⁵ <http://www.biosch.hku.hk/clinicalwaste/Decontamination%20guidance.pdf>

³⁶ Mandal, T 2007 A new pH measurement method and effects of wood-ash on a Kenyan ferralsol soil on pH, salinity, phosphorus bio-availability, and tree legume growth. Faculty of Life Sciences. University of Copenhagen.
<http://www.worldcat.org/title/new-ph-measurement-method-and-effects-of-wood-ash-on-a-kenyan-ferralsol-soil-on-ph-salinity-phosphorus-bio-availability-and-tree-legume-growth/oclc/476729924>

I found the pH of fresh dry ash from African farm kitchens was about 11 in 1:2.5 water ratio. Mixing with red soil can rapidly reduce pH e.g. to the level of hand soap.³⁷ I also found ash reacting with air and water in a test tube after about a week had a harmless pH of calcite about 8.3. I found such ash ineffective in cleaning very greasy hands, but the dirty gray ash did not remain on the hands if they were not greasy. Products of incomplete burning may be more or less risky in the long term (cancer), but are widespread even in food and air; fortunately, ash from an African fireplace differ much in pH and products from a forced ventilation furnace or building fire with much chemicals. Sharp particle among ash discarded as waste should also be avoided, and ash supplied in boxes or bottles near toilets, kitchens and sick people. The ash should not be exposed to rain unless it damage skin by frequent washing.

I can provide more information and, I have more results, have Kenyan soils in Denmark, and I am going to rural western Kenya Dec.-Jan. I am a freelancer with a so far rather open programme, but have mainly give priority to paid opportunities.

In a hand washing study from South Asia, others reported a pH ranged from 9.5 to 11.5; a suspension with a pH of 10.5 strongly reduced bacterial contamination in a suspension of ash water after 30 seconds while 60 were more effective (Baker et. al. 2014).³⁸

Other related information. Hand washing that damage skin even with frequent use of common soap on sensitive skin can make it hard to clean them properly³⁹ and soap that is not alkaline have no direct disinfectant property unless medicated. Applying oil or cream after washing is often recommended and using a bit of cooking oil could be recommended as well. Alcohol based hand disinfectants dries hands too unless a suitable lotion is included, an only work on apparently clean hands.

Disinfectants easily spoils most gloves virus protection and thin polyethylene or PVC gloves helps but are far from fully effective against tested virus⁴⁰. The effect was surprisingly low. Local people could be advised to take a thick, unbroken plastic bag or two on their hands may help, if they have to touch risky surfaces. Many bags in Africa are very thin and words for 'plastic' and 'paper' are mixed up in e.g. Kenya.

Advice on avoiding dusty sweeping with short brooms and uncovered faces is also relevant; and mist spraying can also do more harm than good (WHO Ebola guidelines). An alternative advice is needed, e.g. sprinkling ash water on the broom or rags, dust and cover the face, and wash the broom in ash waster rather than shaking it. Washing clay floors is not possible.

Discussion, conclusions, complementary ideas and perspectives

Accordingly, I suggest more types of information on prevention of transmission is spread, rather than simply repeating the same approximately ten sentences in various versions. Current methods incl. soap distribution can at the same time be continued.

Hand washing with clean ash if soap is not available should be promoted as documented in the bulk of this text.

Furthermore, fresh ash can when needed be poured on vomit, blood stains, dirty toilet floors, handles, etc. and remain and steered with a stick for some hours before being removed.

³⁷Mandal T and Nielsen N E 2004. Agroforestry Systems 64. [An improved low-input method for establishing](http://jpkc.scau.edu.cn/plantnutrition/papers/upload/20076122329788973.pdf)
<http://jpkc.scau.edu.cn/plantnutrition/papers/upload/20076122329788973.pdf>

³⁸<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4080560/>

³⁹[http://www.ajicjournal.org/article/S0196-6553\(06\)01160-6/abstract](http://www.ajicjournal.org/article/S0196-6553(06)01160-6/abstract).

⁴⁰<http://www.ncbi.nlm.nih.gov/pubmed/2400601>

Soap making can also be taught locally based on ash water (lye) and oil or fat but the hardening takes time and the reference does not cover all issues and solutions⁴¹.

In Senegal, people have found the Ebola prevention irrelevant for them because they do not eat bush meat, that so much focus have been on. However, soaking and washing fruits pollinated by fruit bats at a time other fruits are ripe, may also be a relevant message at least later when the current outbreak fades out. This may be relevant for fruits used within a few days. However, vitamin C is important for iron uptake at the same meal, iron deficiency is widespread among women at least, may reduce tolerance to the blood loss that is one of the causes of death from Ebola (but far from the only). Claims of benefits of very high doses vitamin C against virus infections is not approved by mainstream science.

In Guinea, most transfers in this outbreak were traced to funerals and touching bodies⁴². Exemptions to cultural rules can always be found according to an anthropologist with experience (same reference). Others experienced it helps to start listening when people are angry in an Ebola affected community.

Furthermore, most people who get sick or fever of unknown cause will need to be care for locally to start with at least. The frequent, oversimplified message soap kills Ebola virus can be modified, and the same can similar messages for ash, despite substances dissolving lipids with sufficient time can kill Ebola virus⁴³. An article by Regula et al. 2013 on Ebola virus structure and solubility is probably relevant for specialist.⁴⁴

However, if the standard solutions are not feasible or accepted, covering hands with a *double layer of plastic bags* (which users are unlikely to touch the face with) and washing hand with fresh clean wood ash can probably strongly reduce transmission rate to a point where the outbreak reduces.

Only in one link, I have seen a recommendation of using plastic bags if gloves are not available for caring for sick people. However, the need to use thick or double bags and wash hands well afterwards was not mentioned. Turning them inside out and burning after use was recommended. The volunteer from Sierra Leone complained too little soap was distributed⁴⁵.

Heat treatment. Boiling risky cutleries, towels, and bed sheets at least 5 minutes should be effective or about (30-) 60 minutes heating to 60 °C^{46 47}. The original source recommend 60 minutes for safe levels based on experiments, but the citing 30-60 minutes. Few know how to achieve this without special thermometers. Mixing boiling water and water kept indoor in the tropics of approximate 20 °C in 1:1 ratio give 60°C if the boiling water is not poured and the temperature maintained. I published on the method and can provide more details. Info on which surfaces and body fluids to focus on can be found in this article.⁴⁸ I also measured a dry black soil surface can reach 60°C in tropical sun and so can a black or transparent closed plastic container. Data can be googles for 'Sodis' water treatments e.g. on iron sheet roofs. At the same time, contacting professionals can be recommended.

Cooled suits. More ideas may be relevant for professional and organized volunteer caretakers too. An infection specialist and MD I talked, with mentioned the heat problem inside professional protection suits as a reason to people had to change often, got distracted and could wipe sweat or touch eyes with unclean hands. I was surprised that electric fans for ventilation were only mentioned for on-line in pressurized versions (which may not provide excess air for cooling) and mentioned as essential for Halloween-version. For Ebola unlike some other hazmat-

⁴¹ <http://www.wikihow.com/Make-Ash-Soap>

⁴² Wikipedia: See Ebola Virus Disease for reference

⁴³ <https://web.stanford.edu/group/virus/filo/prevention.html>

⁴⁴ <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3772975/>

⁴⁵ <http://www.worldcrunch.com/world-affairs/soap-and-pamphlets-with-anti-ebola-patrols-in-sierra-leone/ebola-quarantine-patrols-prevention/c1s17069/>

⁴⁶ Public Health Agency, Canada <http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/Ebola-eng.php>

⁴⁷ <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC271356/?page=3>

⁴⁸ http://jid.oxfordjournals.org/content/196/Supplement_2/S142.long

uses, I suppose filtered excess airflow e.g. from computer CPU fans can help. A camping cool bag refrigerator unit could also be considered installed in a bag-pack with its battery. Small closed or bags with ice could also be used inside suits

Cheap 'single use' film-type thermometers could also be distributed with good instructions to check fever early, and probably disinfected in a fresh as solution.

Outlook. A journal article in in French also summarize advice to practitioners (from 1998).⁴⁹ For a Sept. 2014 journal review of *tested control measures*, incl. challenging community mobilization and change of funeral practices, and current outbreak where the scale mainly differ, see⁵⁰. I did not notice new suggestions. However, “without drastic improvements in control measures, the numbers of cases of and deaths from EVD are expected to continue increasing from hundreds to thousands per week in the coming months” according to WHO September 2014.⁵¹ Humanitarian organisations runs out of funds, and low-cost solutions are also needed. Radio news programmes have reportedly been effective, while preliminary WHO endorsement of considering promising ideas is important to spread the good ones and avoid sensationalist ideas without realistic base.

I am aware the Ebola specialists are extremely busy now, and can assist with more targeted or polished information, and sending the text to more experts and organizations. I am both a volunteer scientist and technical writer, and as a freelance consultant allocate much more time if funding become available.

Best regards

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⁴⁹ <http://www.ncbi.nlm.nih.gov/pubmed/9791600>

⁵⁰ <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20899>

⁵¹ <http://www.nejm.org/doi/full/10.1056/NEJMoa1411100>