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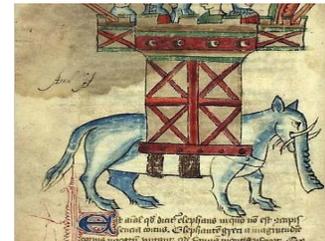
About Pepper Spray

By Deborah Blum | November 21, 2011 | 25

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One hundred years ago, an American pharmacist named Wilbur Scoville developed a scale to measure the intensity of a pepper's burn. The scale – as you can see on the widely used chart to the left – puts sweet bell peppers at the zero mark and the blistering habanero at up to 350,000 Scoville Units.

I checked the Scoville Scale for something else yesterday. I was looking for a way to measure the intensity of pepper spray, the kind that police have been using on Occupy protestors including this week's shocking incident involving peacefully protesting students at the University of California-

Davis.

As the chart makes clear, commercial grade pepper spray leaves even the most painful of natural peppers (the Himalayan ghost pepper) far behind. It's listed at between 2 million and 5.3 million Scoville units. The lower number refers to the kind of pepper spray that you and I might be able to purchase for self-protective uses.

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And the higher number? It's the kind of spray that police use, the super-high dose given in the orange-colored spray used at UC-Davis.

The reason pepper-spray ends up on the Scoville chart is that – you probably guessed this - it's literally derived from pepper chemistry, the compounds that make habaneros so much more formidable than the comparatively wimpy bells. Those compounds are called capsaicins and – in fact – pepper spray is more formally called Oleoresin Capsicum or [OC Spray](#).

But we've taken to calling it pepper spray, I think, because that makes it sound so much more benign than it really is, like something just a grade or so above what we might mix up in a home kitchen. The description hints maybe at that eye-stinging effect that the cook occasionally experiences when making something like a jalapeno-based salsa, a little burn, nothing too serious.



Photo courtesy: California Aggie

Until you look it up on the Scoville scale and remember, as toxicologists love to point out, that the dose makes the poison. That we're not talking about cookery but a potent blast of chemistry. So that if OC spray is the U.S. police response of choice – and certainly, it's been used with dismaying enthusiasm during the Occupy protests nationwide, as documented in [this excellent Atlantic roundup](#) - it may be time to demand a more serious look at the risks involved.

My own purpose here is to focus on the dangers of a high level of capsaicin exposure. But as pointed out in the 2004 paper, [Health Hazards of Pepper Spray](#), written by health researchers at the University of North Carolina and Duke University, the sprays contain other risky materials:

Depending on brand, an OC spray may contain water, alcohols, or organic solvents as liquid carriers; and nitrogen, carbon dioxide, or halogenated hydrocarbons (such as Freon, tetrachloroethylene, and methylene chloride) as propellants to discharge the canister contents.⁽³⁾ Inhalation of high doses of some of these chemicals can produce adverse cardiac symptoms, and

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Coffee brain

Video of the Week

of some of these chemicals can produce adverse cardiac, respiratory, and neurologic effects, including arrhythmias and sudden death.

Their paper focuses mostly, though, on the dangerous associated with pepper-based compounds. In 1997, for instance, researchers at the University of California-San Francisco [discovered](#) that the “hot” sensation of habaneros and their ilk was caused by capsaicin binding directly to proteins in the membranes of pain and heat sensing neurons. Capsaicins can activate these neurons at below body temperature, leading to a startling sensation of heat. Repeated exposure can wear the system down, depleting neurotransmitters, reducing the sensation of the pain. [This knowledge](#) has led to a number of medical treatments using capsaicins to manage pain.

Its very mechanism, though, should remind us to be wary. As the North Carolina researchers point out, any compound that can influence nerve function is, by definition, risky. Research tells us that pepper spray acts as a potent inflammatory agent. It amplifies allergic sensitivities, it irritates and damages eyes, membranes, bronchial airways, the stomach lining – basically what it touches. It works by causing pain – and, as we know, pain is the body warning us of an injury.

In general, these are short term effects. Pepper spray, for instance, induces a burning sensation in the eyes in part by damaging cells in the outer layer of the cornea. Usually, the body repairs this kind of injury fairly neatly. But with repeated exposures, studies find, there can be permanent [damage to the cornea](#).

The more worrisome effects have to do with [inhalation](#) – and by some reports, California university police officers [deliberately](#) put OC spray down protestors throats. Capsaicins inflame the airways, causing swelling and restriction. And this means that pepper sprays pose a genuine risk to people with asthma and other respiratory conditions.

And by genuine risk, I mean a known risk, a no-surprise any police department should know this risk, easy enough to find in the scientific literature. To cite just three examples here:

- 1) Pepper Spray Induced [Respiratory Failure](#) Treated with Extracorporeal Membrane Oxygenation
- 2) Assessing the [incapacitative effects](#) of pepper spray during resistive encounters with the police.
- 3) The Human [Health Effects](#) of Pepper Spray.

That second paper is from a law enforcement journal. And the summary for that last paper notes: *Studies of the effects of capsaicin on human physiology, anecdotal experience with field use of pepper spray, and controlled exposure of correctional officers in training have shown adverse effects on the lungs, larynx, middle airway, protective reflexes, and skin. Behavioral and mental health effects also*



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may occur if pepper spray is used abusively.

Pepper spray use has been suspected of contributing to a number of deaths that occurred in police custody. In mid-1990s, the U.S. Department of Justice cited nearly 70 fatalities linked to pepper-spray use, following on a 1995 report compiled by the American Civil Liberties Union of California. The ACLU report cited 26 suspicious deaths; it's important to note that most involved pre-existing conditions such as asthma. But it's also important to note a troubling pattern.

In fact, in 1999, the ACLU asked the California appeals court to declare the use of pepper spray to be dangerous and cruel. [That request](#) followed an action by northern California police officers against environmental protestors – the police were accused of dipping Q-tips into OC spray and applying them directly to the eyes of men and women engaged in an anti-logging protest.

“The ACLU believes that the use of pepper spray as a kind of chemical cattle prod on nonviolent demonstrators resisting arrest constitutes excessive force and violates the Constitution,” wrote association attorneys some 13 years ago.

Yesterday, the University of California-Davis announced that it was [suspending](#) two of the police officers who pepper-sprayed protesting students. Eleven of those students were treated by paramedics on scene and two were sent to a hospital in Sacramento for more intensive treatment.

Undoubtedly, these injuries will factor into another scientific study of pepper spray, another acknowledgement that top of the Scoville scale is dangerous territory. But my own preference is that we start learning from these mistakes without waiting another 13 years or more, without engaging in yet another cycle of abuse and injury.

Now would be good.

Cross-posted from [Speakeasy Science](#).



About the Author: Deborah Blum is a Pulitzer-Prize winning science writer and the best-selling author of *The Poisoner's Handbook: Murder and the Birth of Forensic Medicine* in *Jazz Age New York*. A professor of science journalism at the University of Wisconsin, she blogs about chemistry culture at [Speakeasy Science](#). Follow on Twitter [@deborahblum](#).

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[Post a comment](#) | [Read Comments \(25\)](#)[Like](#) 7k[25 Comments](#)[Add Comment](#)**1. rodestar99**

1:27 pm 11/21/2011

This officer should be arrested for civil rights violations. There have been people prosecuted for much less. It is everyone's right to demonstrate peacefully without some rent a cop abusing his authority.

[Link to this](#)**2. weatherguy**

1:38 pm 11/21/2011

I'm puzzled about the relationship between "pepper spray" and the Chemical Weapons Conventions. Yes, the convention allows the use of "Riot Control Agents" by law enforcement, but it isn't clear to me that these chemical weapons (e.g. pepper spray) can be used in non-riot control situations. Note that the US is a signatory to the convention. See <http://www.opcw.org/chemical-weapons-convention/> for the text of the convention.

[Link to this](#)**3. Mr. Peabody**

3:09 pm 11/21/2011

OC spray was intended to be a non-lethal but incapacitating agent. No surprise that in some cases there would be risks involved in using it. As a matter of policy, incapacitating agents should be limited to cases like riot control where they are really necessary.

What does the rest of the article have to do with science?

[Link to this](#)**4. D.Russnak**

3:37 pm 11/21/2011

As a person who has been exposed to pepper spray, (which hurts like hell by the way), I have to say, regardless of the damages, the fact of the matter is you can't go taking away every tool law enforcement has. People want to take their guns. Their non-lethal ammunition. Their tasers. We have taken away their nightsticks. Exactly how are police supposed to defend themselves, or us, from the reportedly growing numbers of violent offenders if we keep taking things away from them? I do think they should be taught proper restraint, but calling an unprovoked use of pepper spray a human rights

violation? That's ridiculous. We have a term for what that is already, 'excessive use of force'. Let's not blow the whole thing out of proportion, especially not when a pre-existing term covers what happened with perfect accuracy. No, it shouldn't have happened, but if people want to take a public stand like that then they had better be prepared to take the lumps that invariably come with it. If they're not then maybe they need to stay at home instead of whining like children with skinned knees. I'm not defending the officer by any means; what he did was unquestionably wrong. What I am doing is stating if you want to change the status quo then expect people to fight back. Expect them NOT to take the moral high ground. Change is a dirty business, and people on both sides will fight the fight as such. Truthfully, I'd rather have the occasional overzealous officer, who can be disciplined, or fired if need be, than a police force that's next to useless. If people don't like the effects of law enforcement's tool set then maybe we ought to put more work into giving them a set we can live with and less into pointing out all the flaws in the set they currently have. Or better still? Stop whining because we aren't getting our way, or because trying to change the world is hard or it can hurt. Yes. Pepper spray hurts. Yes it can cause serious injury or death. So can fire. Should we ban camping and barbecues and fireplaces because a few people are irresponsible with it? No. As is usually the case these days, these issues arise because people aren't taught things like responsibility, or self-control, and when they get out in the world and act up, everyone wants to blame everyone and everything except the person who should have known better. OR because most of these people DO know better, but since they know that everyone and everything will be held accountable for their behavior, except them, what reason do they have to act like responsible adults? None. It's all about accountability. Always has been, always will be. Finally, let's not overlook the fact that the vast majority of the time these tools are NOT used without provocation, and often, even if they're used in an excessive manner, it's usually provoked to some degree, even if not to the degree it is used.

[Link to this](#)

5. MikeTheHammer

3:53 pm 11/21/2011

Well, if the ACLU says its dangerous, then lets do away with it. That being the case, billy clubs and JHP rounds it is!

[Link to this](#)

6. outsidethebox

4:19 pm 11/21/2011

Ever see a three year old in a supermarket throw a fit, sit down on the floor and refuse to be moved? I have more than once. So what do you do when you have adults act like this? Personally if I was a policeman I'd much prefer the billy club

to the pepper spray.

[Link to this](#)

7. Dredd

6:03 pm 11/21/2011

Lets just call it SS juice ... sounds all mavericky huh?

All about SS juice:

<http://blogdredd.blogspot.com/2011/11/stockholm-syndrome-on-steroids-2.html>

[Link to this](#)

8. D.Russnak

6:17 pm 11/21/2011

I've also impaled my foot on a piece of glass that went so deep you could see the blood welling up under the skin on the top of my foot... I'd rather go through that again than the pepper spray...(No. I'm not accident prone but when they do happen they're never less than spectacular... [stapled thumb, flight of stairs, car accident in which the crash didn't hurt me but getting my stuff out of the back floorboard got my hand cut on a glass fragment, broken nose caused by an angry and confused cocaine addict, hit in the leg by a two inch thick branch so hard it broke {the stick not the leg}, fractured skull caused by falling off a car {the guy driving knew I was on his car and no, the plan did not involve the vehicle moving with me still on it, and no, prior to this I had no idea he had a problem with me}... the list goes on...])So Outside? While I understand you wanting to use a club, I can honestly say the spray is a better motivator. The only thing I've had that hurt worse was the fractured skull. (and as horrible as all that sounds, no limp, no deformities, no grotesque scars...)

[Link to this](#)

9. rm81dragon

6:54 pm 11/21/2011

When you engage in acts that you know can cause repercussions, well, expect those repercussions, plan for them. Hopefully, things will turn positive and you will get your point across peacefully and without pain. Civil disobedience in this country, however justified, is often met with non-lethal (most of the time) and painful repercussions. Following this vein of thought, in times of heightened emotion and fear from both parties involved, overreaction sometimes occurs which I believe this video is evidence of. So stand strong and accept what you know is a possibility – right or wrong.

With this said, you can take some precautions. What often happens is that after people are sprayed, they immediately douse themselves (namely their and each others faces) with water. Be VERY careful when flushing your eyes and face with water as it can also carry the contaminant down the front of your body. Water also often re-engages the effects of the spray, however, if that is the only way to get the spray off then use it. Don't wash the contaminant down the front of your body — think about it (what's on the anterior side of your body and inferior to your head? You guessed it! Your naughty bits). The BEST thing to use is Sudecon Wipes (purchase link below):

http://www.galls.com/style-SD084-general_catalog-sudecon-wipes-10-pack;jsessionid=D380380ABD867413015939C6564F1036

With these, you can wipe away most of the contaminant (use about two for the effected area). In 10 minutes or so you should be back to some sort of normal. Also, remember that the effects are ultimately transient and generally finite — the pain WILL stop. Be calm, don't get so hyped up that you tax an already effected and taxed respiratory system, i.e. freak out and hyperventilate. Concentrate on slowing your breathing, you are in control and know that the event will be over in most cases — barring an anaphylactic response and or the exacerbation of a previous medical condition. Stay peaceful, strive for calm (hard but necessary), know that there will be an end to the pain.

There are known repercussions to civil disobedience, however, your cause may very well be worth the short amount of pain and discomfort.

[Link to this](#)

10. RCWhitmyer
7:02 pm 11/21/2011

Better training and a serious review of each event to assure correct and appropriate use instead of disarming the police. Also review of departmental SOP should be done every few years to keep up with latest info on its use and alternatives that may be used.

[Link to this](#)

11. CKGhostwriter
7:51 pm 11/21/2011

@D.Russnak- I completely disagree with your take on this.

This was not “excessive force.” In truth, any amount of force, even the slightest bit of force, would have been “excessive,” considering the fact that the protesters were completely peaceful. Had the police officers picked up a protester to make an arrest, that would have been completely reasonable. But that is not what happened. The police officers who sprayed pepper spray committed a crime. That was assault. It goes well beyond mere “excessive force.” A badge and a uniform does not give you the right to assault people.

And for those saying “if you’re going to protest, you have to expect something like this might happen.” What does that even mean? That it makes what happened here acceptable? That, because they were protesting, they gave up their rights not to be assaulted? That’s ridiculous. Of course something like this might happen. But that cuts both ways. If police officers are going to assault people, they have to expect that something might happen. Like they will be fired and arrested. Just because the protesters know that something like this might happen does not mean that they have to just take it and not say anything. That’s nonsense. And to those who are casting these students as “whiners” and “criers,” I don’t know what videos you have been watching, because from what I’m seeing, that’s not how I would characterize them.

[Link to this](#)

12. D.Russnak

9:54 pm 11/21/2011

@CKGhostwriter- I’m glad that you disagree honestly. But do keep in mind; I did specifically state that what the officer did was NOT okay. My point is that people need to expect these things. It doesn’t make it right that this is normal, but it DOES make it the real world and these things happen here right or wrong. And again, having been exposed to the stuff; they aren’t whining or crying at the time because once it affects you the ONLY thing you can do is deal with it. You don’t have the ability to not react to it. They may not have whined about it later, and if not they should be commended for accepting it as something to have been expected. The whiners are the people who are trying to make a huge deal out of this in spite of the fact that, from a historical perspective, what they endured was extraordinarily mild.

[Link to this](#)

13. tucanofulano

10:15 pm 11/21/2011

? return to Billy Clubs and Electric Shock Cattle Prods ?

? you’d prefer live ammunition a.la. Kent State ?

[Link to this](#)

14. jyaroch

12:07 am 11/22/2011

Some commenters imply that the use of peeper spray, in the context of nonviolent resistance, it OK, because the police could have been even more violent. This is ridiculous. It is like saying that rape is OK because the rapist could have killed the victim instead. It is not OK.

Having said that, I do encourage the author to check the validity of the statement that “In mid-1990s, the U.S. Department of Justice cited nearly 70 fatalities linked to pepper-spray use”. This appears to come from this report: <http://www.ncjrs.gov/pdffiles1/nij/195739.pdf> While the statistic is cited widely on the Internet, the report does not actually say that. It says that 73 in-custody deaths linked to pepper spray were investigated, but only 2 were definitively causally linked to the pepper spray. The others were judged to have been caused by something else, even though pepper spray was used on most of the victims.

To be clear, I do not mean to imply that there is a significant difference here; the arguments put forth in the article remain valid. But I do think it is important to be clear about the findings of the relevant studies.

[Link to this](#)

15. jyaroch

12:16 am 11/22/2011

For additional perspective, here is the ACLU paper: http://www.aclu-sc.org/attach/p/Pepper_Spray_New_Questions.pdf

[Link to this](#)

16. Joyce Melton

12:43 am 11/22/2011

Amazing how many people want to point out that individual responsibility for civil disobedience has consequences — but ignore the fact that individual responsibility for the use of undue force also has consequences.

[Link to this](#)

17. srf21c

1:41 am 11/22/2011

The reflexive identification with authority and servile police state boot-licking evidence by several posters in the above comments is disgusting. Poster Dredd is dead-on with his

Stockholm Syndrome post.

Ask yourself how the riot police storm troopers and criminally corrupt American legal system meat grinder would have treated a student protester who attacked a dozen police officers with pepper spray in the same way.

[Link to this](#)

18. genevehicle

6:23 am 11/22/2011

@ jyaroch

Ok, I read the DOJ report and skimmed the ACLU report (it was quite long). The telling point here is whether or not the article accurately represented the risks of pepper-spray use. In my view it did.

The DOJ study did conclude that only two of the in-custody deaths (out of 63 deaths where spray was used) were attributed to severe asthmatic episodes brought on by the use of the spray. However, the ACLU report repeatedly quoted scientists, working for the state of California, that cautioned; “so little is known about how to identify the residue or artifacts of pepper spray that autopsy reports discounting it may do so without any basis”, and “in fact, testing methods that could identify pepper spray residue and establish a role in cause of death may not even exist.”

In short, the DOJ “study” was put together by a DOJ statistician, using available coroner reports. But, those reports are, according to scientists working for the CalEPA, at best, incomplete. In other words, many more the just those two deaths could very well have been attributable to the use of pepper spray. The coroners just didn’t know what to look for. When I take these facts into account I find it difficult to believe that the article overstated the risks involved in the use of pepper spray. And, I regard any attempts to assert the opposite to be misguided.

[Link to this](#)

19. gsledyard

10:20 am 11/22/2011

If you wish to assess the risks of pepper spray, just take a look at the “sample”. A typical drug test might have a sample of hundreds... thousands is a fairly large sample. OC Spray is used every year in the tens of thousands. This has been going on for years. So we are looking at a base sample of hundreds of thousands of instances.

The number of lasting injuries directly caused by OC is

miniscule when compared to the injury level caused by physical restraint of injured subjects and the officers attempting to restrain them. Every analysis done on the use of OC Spray shows that both the subjects and the officers are far safer since its inception than before.

Deaths and serious health episodes associated with the product almost always involve multitude of other risk factors that could have resulted in death or injury regardless of the method used to restrain the subject.

Finally, almost all OC instructors have been sprayed themselves multiple times and in many departments and agencies, anyone who carries OC Spray must be sprayed as part of training. No question it is REALLY unpleasant. I have been sprayed when I was certified as an OC Instructor. I wouldn't care to repeat the experience. But, in order to not be sprayed, one simply has to comply with the lawful orders of LE personnel. The political question of whether the civilian leaders of the police and security forces are legitimate or repressive in how they use law enforcement is another question entirely, But a return to archaic use of force models that deprive officers of this crucial tool will only result in more injuries to both subjects and officers alike.

[Link to this](#)

20. coyotee

12:56 pm 11/22/2011

The Greek Chancellor of UC Davis, Linda Katehi has now apologized for the torture that she has inflicted on peaceful protestors. Thankfully no one dies from her decisions. So in the mean time, might I suggest that she re-read her Sophocles and Seneca. Linda – brutal chancellor that she is – blinds, poisons and renders her students unable to speak – temporarily for now.

She then cries about her actions....although the tears could have been the result of the poisonous gas vapors still present in the atmosphere.

Perhaps she had a midnight dream with Oedipus and he suggested to blind the peaceful demonstrators – worked for him. Or maybe she channeled one of the numerous greek tragic plays where someone cuts their tongue out. In any case, let the greek chorus have their say and send Linda to her rightful fate. For sure this does not end well for her job or psyche.

[Link to this](#)

21. Fnarf

1:46 pm 11/22/2011

Your chart misspells an important word. The substance in chiles is “capsaicin”, not “capsaician”.

[Link to this](#)**22. fire-1**

4:38 pm 11/22/2011

I can agree with certain points from gsledyard. The use of OC in a training environment is not one of them. It implies that exposing officers to the chemical will make them more judicious in its use whereas the opposite is the actual effect. It makes them have the machismo response that “if I can tolerate it, survive it, then you can too” and “it’s not so bad as you make out – I did it”.

In the continuum of force training, the penultimate choice is deadly force. Small percentage lethal chemical warfare has to rank immediately below that if it’s to be considered realistically.

Gsledyard also makes a point of it being a political question whether the police goal in clearing protestors from sidewalks and streets is legitimate or repressive. Ghandi answered that question a long time ago.

[Link to this](#)**23. V.E.LovesScience**

5:43 pm 11/22/2011

What I would like to know is why these American-citizen kids on campus get chemical weapons shoved down their throats and yet there is such an insipid muddled response to immigrant cultist bullies quietly moving into the country from some far flung continent or dessert setting up shop in North America while sending lots of cash back home... Too bad these kids weren’t better organized like some religious organizations where by they would slyly talk out of both sides of their mouths at the same time, cry bigotry, and manipulate with the long view not the short one... and definitely not end up getting sprayed with this OC crap like barnyard animals in some stupid token show of maintaining civility. Tut tut tut... so vicious about, what, some young kids sitting on their duffs... take a good hard look at the great big World and stop the Red Herring BullCrap from distracting you from embedded realities here... Your country’s freedom to sit down on one’s duff and protest in a civilized nature is what separates you folks from the two-legged primitive marauding throwbacks of the World... This OC crap is simply chemical warfare being perpetrated on U.S. citizens...

[Link to this](#)**24. Bob32**

12:17 am 11/23/2011

The pictures of this assault on non resisting students

exercising free speech rights on public property will make the history books. It is not the way to deal with protests and does not reflect favorable on a country who extols its constitutional free speech rights. This aint about ordinary deoderant spray!

[Link to this](#)

25. genevehicle

12:34 am 11/23/2011

@gsledyard

Hmm.... I question your complete objectivity in this matter. However, assuming you capable of being objective, I would call your attention to the ACLU report previously referenced. It calls into question every single one of the points you used to support the continued use of pepper spray.

http://www.aclu-sc.org/attach/p/Pepper_Spray_New_Questions.pdf

[Link to this](#)

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