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Re. CS: Chlorine materials, ethanol, isopropanol, hydrogen peroxide, soap-based algicides/demossers
HS: Peracetic acid (2016 sunset), acidified sodium chlorite, chlorine materials, hydrogen peroxide, ozone, phosphoric acid
LS: Ethanol, isopropanol, chlorine materials, hydrogen peroxide, iodine, peracetic acid, phosphoric acid

These comments to the National Organic Standards Board (NOSB) on its Spring 2015 agenda are submitted on behalf of Beyond Pesticides. Founded in 1981 as a national, grassroots, membership organization that represents community-based organizations and a range of people seeking to bridge the interests of consumers, farmers and farmworkers, Beyond Pesticides advances improved protections from pesticides and alternative pest management strategies that reduce or eliminate a reliance on pesticides. Our membership and network span the 50 states and groups around the world.

Sanitizers, disinfectants, and so forth

Often we see the NOSB *assuming* a need for strong chemicals as cleaners or disinfectants when none may be needed. We have seen this in our own investigations with personal care products using the biocide triclosan.[1] Research has shown that washing with ordinary soap and water is as effective as using soap containing triclosan. Furthermore, as pointed out by a 2010 report of EPA's Office of Inspector General (OIG), this problem is widespread —the OIG found that approximately 40% of all antimicrobial products have not been tested for efficacy, and one third of all products tested each year fail, without notification of users.[2] We need research into effective means of cleaning food contact surfaces and food containers with organic and natural cleaning methods, such as hot water or steam or materials more compatible with organic processing, including hydrogen peroxide or ozone. We need research on organic systems, including growing, harvesting, storing, and transporting crops in ways that avoid the need for rinsing in highly chlorinated water. However, it is very likely that we currently have all the non-chlorine tools we need. We need to do all this because organic, to the extent possible, should

[1] http://www.beyondpesticides.org/antibacterial/triclosan.php
[2] U.S. EPA Office of Inspector General, 2010. EPA Needs to Assure Effectiveness of Antimicrobial Pesticide Products, http://www.epa.gov/oig/reports/2011/20101215-11-P-0029.pdf.

become chlorine-free, given the human health and environmental hazards associated with its production, transporation, storage, use, and disposal.

The NOSB and NOP need to clarify whether chlorine is required by other statutes. In our informal conversations, we have been told that other laws require the use of chlorine in higher concentrations than those listed on the National List. If other laws specifically require the use of chlorine, then it must be allowed under the organic program, but if it is, the use should be included on the National List.

Some definitions

The following definitions are quoted from a guidance document produced by the Centers for Disease Control and Prevention for health care facilities.[3]

> *Sterilization* describes a process that destroys or eliminates all forms of microbial life and is carried out in health-care facilities by physical or chemical methods.
>
> *Disinfection* describes a process that eliminates many or all pathogenic microorganisms, except bacterial spores, on inanimate objects.
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> *Cleaning* is the removal of visible soil (e.g., organic and inorganic material) from objects and surfaces and normally is accomplished manually or mechanically using water with detergents or enzymatic products. Thorough cleaning is essential before high-level disinfection and sterilization because inorganic and organic materials that remain on the surfaces of instruments interfere with the effectiveness of these processes.
>
> *Sanitizer*: agent that reduces the number of bacterial contaminants to safe levels as judged by public health requirements. Commonly used with substances applied to inanimate objects. According to the protocol for the official sanitizer test, a sanitizer is a chemical that kills 99.999% of the specific test bacteria in 30 seconds under the conditions of the test.

The NOP regulations use these terms as if they are synonymous. Since organic practices depend on having a healthy balance of microbes rather than eliminating all of them, growers, certifiers, the NOSB, and NOP all need to be clear about when sanitizing is necessary and when cleaning is sufficient. Removal of all microbial life leaves surfaces available for colonization by spoilage or pathogenic organisms. If strong residual sanitizers are used, strong selection pressure is applied for the development of resistance to materials that may be needed in emergency medical situations.

The comments below maintain that the NOSB and NOP should eliminate use of chlorine-based materials and develop guidance for the appropriate use of alternative materials and practices.

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[3] Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008. http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf.

Chlorine-based disinfectants

Basic chlorine chemistry

Chlorine is the second most reactive element (after fluorine) in the halogen series. Halogens bond with hydrogen to form acids, are typically produced from minerals or salts, and are generally toxic. The middle halogens –chlorine, bromine, and iodine—are often used as disinfectants.[4]

Chlorine is a strong oxidizer and hence does not occur naturally in its pure (gaseous) form. Nearly all naturally occurring chlorine occurs as chloride, the ionic form found in salts such as sodium chloride. Gaseous chlorine is formed by running an electric current through salt brine.[5]

The high oxidizing potential of chlorine leads to its use for bleaching, biocides, and as a chemical reagent in manufacturing processes. Because of its reactivity, chlorine and many of its compounds bind with organic matter. In the case of bleaches, the reaction with chlorine destroys chemicals responsible for color. When used as a disinfectant, chlorine reacts with microorganisms and other organic matter. Similarly, the toxicity of chlorine to other organisms comes from its power to oxidize cells.[6]

The difference between chlorine and chloride

Chloride, the ionic form of chlorine, occurs naturally and is necessary for life. Synthetic chlorine compounds may be inert –in which case the chlorine is responsible for a lack of biodegradability—or toxic. Chlorinated organic compounds include pesticides ranging from DDT to 2,4-D, as well as contaminants like dioxins. Chlorine gas was the first poison gas used in warfare. The largest use of chlorine is in the manufacture of polyvinyl chloride (PVC).[7]

Chlorine gas reacts with water to produce hydrochloric acid (HCl), hypochlorous acid (HOCl), and hypochlorite (OCl^-). When hypochlorous acid reacts with ammonia, it forms chloramines, which are reactive enough to be used as disinfectants, but are more stable than hypochlorous acid and hypochlorite.

Another series of reactions creates chlorine dioxide, an extremely toxic and potentially explosive gas that dissolves in water, rather than reacting with it. Sodium chlorate is produced by electrolysis of hot salt water. Chlorine dioxide is produced by reacting sodium chlorate with a suitable reducing agent in a strongly acidic solution. Sodium chlorite may be produced from the chlorine dioxide solution under alkaline conditions using hydrogen peroxide. Acidifying the sodium chlorite solution produces chlorine dioxide for disinfection.

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[4] http://en.wikipedia.org/wiki/Halogen.
[5] http://en.wikipedia.org/wiki/Chlorine.
[6] http://en.wikipedia.org/wiki/Chlorine.
[7] http://en.wikipedia.org/wiki/Chlorine.

In addition to the purposeful production of toxic chlorine compounds, the manufacture and use of chlorine compounds results in the unintended production of other toxic chemicals. Disinfection with chlorine, hypochlorite, or chloramines results in the formation of carcinogenic trihalomethanes, haloacetic acids, and other toxic byproducts.[8] Disinfection with chlorine dioxide produces undesirable inorganic byproducts, chlorite and chlorate. Industrial production of chlorine compounds, use of chlorine bleach in paper production, and burning of chlorine compounds releases dioxins and other persistent toxic chemicals into the environment.[9]

The essential difference, then, is between chloride compounds and the toxic products and by-products of the chlorine chemical industry. Almost all of the former are naturally-occurring materials that do not share the characteristics of toxicity and undesired persistence of the latter. The fact that use of chlorine —as opposed to chloride— is so universally associated with the production of persistent toxic chemicals has led some environmental groups to seek a ban on chlorine-based chemicals. We believe that organic production should, for the same reasons, avoid the use of chlorine as much as possible. The allowance of chlorine in the rule reflects the fact that many organic growers —like most of the rest of us— depend on water sources that have been treated with chlorine. We don't believe that organic producers should have to filter chlorine out of the tap water they use for irrigating, cleaning equipment, washing vegetables, or cleaning food-contact surfaces. But they should not be adding more chlorine. Organic production and handling should be, to the extent possible, chlorine-free.[10]

Disinfection

Terminology relating to chlorine-based disinfection

In the past, we have seen some confusion over the terminology used to describe chlorine in treated water. This description may help:

> Reactive chlorine (RC) is the combined concentration of various chlorine species able to react and interconvert in a given system. It is essentially synonymous with total residual chlorine (TRC), combined residual chlorine (CRC), and total available chlorine (TAC). It includes free available chlorine (FAC; hypochlorous acid [HOCl] and the hypochlorite ion [OCl]; also referred to as free residual chlorine [FRC]) and combined available chlorine (CAC; organic and inorganic chloramines [NH_2Cl, $NHCl_2$, and NCl_3] or *N*-chloramides).[11]

[8] Alexander G. Schauss, 1996. Chloride – Chlorine, What's the difference? P. 4. http://www.mineralresourcesint.com/docs/research/chlorine-chloride.pdf.

[9] ATSDR, 1998. Toxicological Profile for Chlorinated Dibenzo-p-Dioxins. Pp. 369 ff. http://www.atsdr.cdc.gov/toxprofiles/tp104.pdf.

[10] The Organic Foods Production Act, §6518(m), lists three criteria that directly pertain to chlorine: (1) the potential of such substances for detrimental chemical interactions with other materials used in organic farming systems; (2) the toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment; (3) the probability of environmental contamination during manufacture, use, misuse or disposal of such substance;

[11] Canadian Environmental Quality Guidelines Canadian Council of Ministers of the Environment, 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Reactive Chlorine Species, p. 1. http://ceqg-rcqe.ccme.ca/download/en/208.

Chlorine disinfection in organic regulations

There is a history[12] of misunderstanding and misinterpretation of the original November 1995 NOSB recommendation on chlorine materials that has led to confusion and the allowance of uses of chlorine by NOP that were not permitted by the NOSB recommendation. In 1995, the NOSB intended to distinguish chlorine used to disinfect tools, equipment, and other hard surfaces from chlorine used in direct contact with food and crops.

In November, 1995, the NOSB approved the following recommendation concerning the use of chlorine:

> Chlorine Bleach (Calcium hypochlorite, sodium hypochlorite, chlorine dioxide) - Determined to be synthetic; Vote - Unanimous (2 absent).
>
> The NOSB's decision is to allow this material for use for organic crop production, organic food processing, and organic livestock production.
> Vote: 9 aye / 2 opposed / 2 absent.
>
> Annotation: Allowed for disinfecting and sanitizing food contact surfaces. Residual chlorine levels for wash water in direct crop or food contact and in flush water from cleaning irrigation systems that is applied to crops or fields cannot exceed the maximum residual disinfectant limit under the Safe Drinking Water Act (currently 4mg/L expressed as Cl2). This substance is to be reviewed again in two years.

With respect to the use in contact with food and crops, no direct use of chlorine is allowed by the 1995 recommendation, but use of tap water is allowed if the level of residual chlorine –the chlorine available for disinfection after the water has been disinfected—is less than the limit in the Safe Drinking Water Act (SDWA). So, tap water can be used to wash produce and irrigate crops, but more chlorine cannot be added for those purposes (with the exception of sprouts.)

With respect to the disinfection of tools, equipment, and hard surfaces, the NOSB simply allowed the use, taking the position that it is not appropriate for the NOP to prescribe the manner of use of these materials. However, the NOSB did state that any residues from such actions should not contact food or crops unless they also meet the SDWA standards.

The first confusion resulted when NOP, in translating the recommendation into regulations, omitted the underlined portion in the recommendation above in the listings on §603 and §605. Chlorine materials used for disinfection are listed in three places on the National List, all of which are subject to 2017 sunset:

> [Crops] §205.601 (a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems. (2) Chlorine materials—For pre-harvest use, residual chlorine levels in the water in direct crop contact or as water from cleaning irrigation systems applied to soil must not exceed the maximum residual disinfectant limit under the Safe Drinking

[12] The early history can be found in the 2003 NOSB recommendation "Measuring Effluent: Clarification of Chlorine Contact with Organic Food" http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELDEV3104548.

Water Act, except that chlorine products may be used in edible sprout production according to EPA label directions.
(i) Calcium hypochlorite.
(ii) Chlorine dioxide.
(iii) Sodium hypochlorite.

[Livestock] §205.603 (a) As disinfectants, sanitizer, and medical treatments as applicable. (7) Chlorine materials—disinfecting and sanitizing facilities and equipment. Residual chlorine levels in the water shall not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act.
(i) Calcium hypochlorite.
(ii) Chlorine dioxide.
(iii) Sodium hypochlorite.

[Handling] §205.605(b) Chlorine materials—disinfecting and sanitizing food contact surfaces, *Except,* That, residual chlorine levels in the water shall not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act (Calcium hypochlorite; Chlorine dioxide; and Sodium hypochlorite).

Since "residual chlorine" means (as defined above) the total active chlorine that is available during the use of the water, a straightforward reading would be that that organic producers and processors may use water that is allowable as tap water under the Safe Drinking Water Act –with the exception of cleaning crop production tools and irrigation systems (as long as the concentrated solution does not contact crops) and the use on sprouts.

The NOP guidance on use of chlorine materials,[13] in attempting to clarify the meaning of the regulations, creates greater confusion and permits far more chlorine than is allowed under the regulations and the recommendations on which they are based. NOP correctly states, "This annotation [in §205.605(b)] was originally crafted to acknowledge that levels of chlorine permitted in municipal drinking water were considered acceptable for organic food production and handling." NOP then cites the spring 2003 recommendation by the NOSB on the definition of "residual chlorine" means under the Safe Drinking Water Act. It continues,

> "The Organic Foods Production Act is not designed to function as a waste water regulation. Instead, it is a regulation designed to protect organic integrity. As such, processing operations must demonstrate compliance with the chlorine annotation by monitoring the chlorine content of the water which is in direct contact with organic products, not the wash water which is discharged from the facility."

However, NOP goes on to explain what this means in practice:

4.1 Crop operations:

[13] NOP 5026. Guidance: The Use of Chlorine Materials in Organic Production and Handling. http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5090760

1. Residual chlorine levels in the water in direct crop contact (when used pre-harvest) or as water from cleaning irrigation systems applied to soil should not exceed the maximum residual disinfectant limit under the SDWA.

2. Chlorine products may be used up to maximum labeled rates for disinfecting and sanitizing equipment or tools. No intervening event is necessary before equipment is used in contact with organic crops.

4.2 Livestock operations:
1. Residual chlorine levels in the water in direct food or animal contact (for example, drinking water) should not exceed the maximum residual disinfectant limit under the SDWA.

2. Chlorine products may be used up to maximum labeled rates for sanitizing equipment or tools (including dairy pipelines and tanks). Label instructions should be followed regarding requirements for rinsing or not rinsing prior to the equipment's next use.

4.3 Handling operations (includes on-farm post-harvest handling)**:**
1. For food handling facilities and equipment, chlorine materials may be used up to maximum-labeled rates for disinfecting and sanitizing food contact surfaces. Rinsing is not required unless mandated by the label use directions.

2. Water used in direct post-harvest crop or food contact (including flume water to transport fruits or vegetables, wash water in produce lines, egg or carcass washing) is permitted to contain chlorine materials at levels approved by the Food and Drug Administration or the Environmental Protection Agency for such purpose.

a. Rinsing with potable water that does not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA must immediately follow this permitted use.
b. Certified operators should monitor the chlorine level of the final rinse water, the point at which the water last contacts the organic product. The level of chlorine in the final rinse water must meet limits as set forth by the SDWA.
c. Water used as an ingredient in organic food handling should not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA, as required by the Organic Food Production Act (7 U.S.C. 6510(a)(7)).

The explanation for crop operations is an acceptable translation of the NOSB recommendation and the listing on §205.601, where the annotation refers only to water in contact with soil or water. However, the guidance for livestock –even though it is consistent with the NOSB recommendation—is inconsistent with the listing on §205.603, which does not refer to a use of a chlorine product outside the use of treated water, and states that the residual chlorine content in the water must not exceed the SDWA limit. Furthermore, the guidance for handling is inconsistent with both the NOSB recommendation and the regulations at §205.605(b) –

because it allows use of chlorine for purposes not allowed by the recommendations and food contact with chlorine above the SDWA limits.

We are thus starting from a point at which NOP –through both rulemaking and "guidance"– has allowed the use of synthetic substances beyond the uses allowed by NOSB recommendations. We have further recommendations, but first we will suggest corrected language that correctly translates the NOSB recommendation:

> [Crops] §205.601 (a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems. (2) Chlorine materials—For pre-harvest use, residual chlorine levels in the water in direct crop contact or as water from cleaning irrigation systems applied to soil must not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act, except that chlorine products may be used in edible sprout production according to EPA label directions.
> (i) Calcium hypochlorite.
> (ii) Chlorine dioxide.
> (iii) Sodium hypochlorite.
>
> [Livestock, corrected] §205.603 (a) As disinfectants, sanitizer, and medical treatments as applicable. (7) Chlorine materials—disinfecting and sanitizing facilities and equipment. Residual chlorine levels in the water <u>for wash water in direct crop or food contact and in flush water from cleaning equipment and surfaces that is applied to crops or fields</u> shall not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act.
> (i) Calcium hypochlorite.
> (ii) Chlorine dioxide.
> (iii) Sodium hypochlorite.
>
> [Handling, corrected] §205.605(b) Chlorine materials—disinfecting and sanitizing food contact surfaces, *Except,* That, residual chlorine levels in the water <u>for wash water in direct crop or food contact and in flush water from cleaning equipment and surfaces that is applied to crops or fields</u> shall not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act (Calcium hypochlorite; Chlorine dioxide; and Sodium hypochlorite).

Acidified Sodium Chlorite

[Handling] §205.605(b) Acidified sodium chlorite—Secondary direct antimicrobial food treatment and indirect food contact surface sanitizing. Acidified with citric acid only.

"Acidified sodium chlorite" (ASC) refers to a solution containing several active chlorine species that is formed when acid is added to sodium chlorite. The chlorine compounds contained in ASC include chlorite, chlorate, chlorous acid, and chlorine dioxide gas. The main active ingredient is considered to be chlorous acid, which is a strong oxidizing agent. Chlorine dioxide is very toxic. It is a severe respiratory and eye irritant. Chronic exposure to animals and workers has resulted in death. Repeated acute exposure to workers has caused eye and throat irritation, nasal discharge, cough, wheezing, bronchitis, and pulmonary edema. Repeated exposure may lead to chronic bronchitis.[14] "In addition, exposure to high levels of chlorine dioxide and chlorite in animals both before birth and during early development after birth may cause delays in brain development."[15]

The use of ASC is incompatible with organic production.

Alternatives to chlorine disinfection

To the extent that organic production requires a disinfectant other than the level of residual in finished drinking water, the NOSB should be looking at non-chlorine alternatives. The above-cited 2003 NOSB recommendation stated:

> The TAP reviews pointed out many ways in which chlorine is unsatisfactory for organic handling. Chlorine compounds and other halogens have been shown to produce trihalomethanes. It was the NOSB's opinion that while chlorine needs to be allowed in the handling of organic food out of concern for public health and safety, its use needs to be minimized and operators need incentives and clear guidance to develop viable alternatives that protect the public as effectively as chlorine, but are less harmful to food handlers and the environment.
>
> Toward that end, the NOSB has recommended other methods for disinfecting water in crop contact, including ozone, hydrogen peroxide, and periacetic acid. The review of chlorine should be prioritized in the re-review process in light of new information about alternatives, food safety, health effects, and application procedures. To the extent possible, the NOSB encourages the adoption of non-chemical and less toxic methods of disinfection of wash and chill water. This should be done with the full support and cooperation of the Food and Drug Administration's Center for Food Safety and Nutrition, and the Food Safety Inspection Service.

EPA's Design for the Environment (DfE) program has been investigating alternative disinfectants.[16] A DfE label on a disinfectant means that the product meets the following criteria:

- It is in the least-hazardous classes (i.e. III and IV) of EPA's acute toxicity category hierarchy;
- It is unlikely to have carcinogenic or endocrine disruptor properties;
- It is unlikely to cause developmental, reproductive, mutagenic, or neurotoxicity issues;
- It has no outstanding "conditional registration" data issues;
- EPA has reviewed and accepted mixtures, including inert ingredients;
- It does not require the use of Agency-mandated personal protective equipment;
- It has no unresolved or unreasonable adverse effects reported;

[14] CDC, Occupational health guideline for chlorine dioxide. http://www.cdc.gov/niosh/docs/81-123/pdfs/0116.pdf
[15] ATSDR, Public Health Statement for Chlorine Dioxide and Chlorite. *http://www.atsdr.cdc.gov/phs/phs.asp?id=580&tid=108.*
[16] http://www.epa.gov/pesticides/regulating/labels/design-dfe-pilot.html.

- It has no unresolved efficacy failures (associated with the Antimicrobial Testing Program or otherwise);
- It has no unresolved compliance or enforcement actions associated with it; and
- It has the identical formulation as the one identified in the DfE application reviewed by EPA.[17]

EPA has approved the following for use in DfE disinfectant products: citric acid, hydrogen peroxide, l-lactic acid, ethanol, and isopropanol.[18] DfE disinfectant product formulations and "inert" ingredients must also meet the DfE standard for safer cleaning products.[19] All of the approved DfE disinfectant active ingredients are on the National List. Citric and lactic acids are considered nonsynthetic, are listed on §205.605(a), and do not need to be listed in order to be used in crop or livestock production. In addition, the need for equipment to be clean must be distinguished from a need for disinfection, and disinfection is difficult to accomplish if a surface is not clean.[20]

Technical reviews on chlorine have identified the following alternative materials: ethanol and isopropanol; copper sulfate; hydrogen peroxide; peracetic acid--for use in disinfecting equipment, seed, and asexually propagated planting material; soap-based algaecide/demossers; phosphoric acid, ozone. The TRs also identified some alternative practices –steam sterilization and UV radiation.[21]

Conclusion: 2017 Sunset

The subcommittees must take into consideration the widespread impacts of chlorine manufacture, use, and disposal. They should try once more to clarify limitations on the use of chlorine. We recommend that all three listings for "chlorine materials" be replaced with the following language:

> **Chlorine materials, only as present as residual chlorine levels in water delivered by municipal or other public water systems, which shall not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act. Shall not be used in higher concentrations in direct contact with food, crops, or cropland.**
> **(i) Calcium hypochlorite.**
> **(ii) Chlorine dioxide.**
> **(iii) Sodium hypochlorite.**

The use of acidified sodium chlorite should be allowed to sunset.

[17] http://www.epa.gov/pesticides/regulating/labels/design-dfe-pilot.html.
[18] http://www.epa.gov/pesticides/regulating/labels/design-dfe-pilot.html.
[19] http://www.epa.gov/dfe/pubs/projects/formulat/dfe_criteria_for_cleaning_products_10_09.pdf.
[20] Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008. http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf.
[21] 2011 Crops TR and 2006 Livestock TR.

In addition, alternatives to chlorine are available, and to the extent that the NOSB believes that disinfection is necessary, it should recommend that NOP guidance promote those alternatives.

Non-chlorine sanitizers, disinfectants, and cleaners

Non-chlorine sanitizers that are up for sunset in 2017 include the following:

Alcohols: ethanol and isopropanol (crops and livestock)
Hydrogen peroxide (crops 2018, livestock 2017, and handling 2017)
Iodine (livestock)
Ozone (handling 2017, crops 2018)
Peracetic acid (crops 2018, handling 2016, livestock 2017)
Soap-based algicides and demossers (crops)

In addition, the following are permitted as topical antiseptics for livestock and will not be addressed here:
Chlorhexidrine
Copper sulfate
Iodine

Ethanol

Current listing:
§205.601(a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.
(1) Alcohols.
(i) Ethanol.

§205.603(a) As disinfectants, sanitizer, and medical treatments as applicable.
(1) Alcohols.
(i) Ethanol-disinfectant and sanitizer only, prohibited as a feed additive.

Ethanol may be manufactured from ethylene or by fermentation. The usual feedstock for fermentation is corn, so the use of genetic engineering is an issue. Ethylene is a hazardous gas. Hazards from the use of ethanol are low. Nonsynthetic ethanol, essential oils, and heat treatment are alternatives, as well as preventive management.

Ethanol is approved for use of EPA's Design for the Environment label for sanitizers.

The NOSB should investigate the availability of nonsynthetic ethanol from non-GMO fermentation organisms and feedstock, as well as the availability of organic ethanol. The NOSB should ask suppliers the question, "Would you be able to meet the need for nonsynthetic/non-GMO and/or organic ethanol if the demand for it were created by eliminating the listing for synthetic ethanol?"

Isopropanol

Current listing:
§205.601(a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.
(1) Alcohols. (ii) Isopropanol.

§205.603(a) As disinfectants, sanitizer, and medical treatments as applicable.
(1) Alcohols.
(ii) Isopropanol-disinfectant only.

Isopropanol is volatile and likely to escape to the environment, but its toxicity is low, and it is readily biodegradable. Nonsynthetic ethanol, essential oils, and heat treatment are alternatives, as well as preventive management. The CS summary also states that isopropyl alcohol can be produced by fermentation.

The NOSB should investigate the availability of nonsynthetic isopropanol from non-GMO fermentation organisms and feedstock, as well as the availability of organic isopropanol. The NOSB should ask suppliers the question, "Would you be able to meet the need for nonsynthetic/non-GMO and/or organic isopropanol if the demand for it were created by eliminating the listing for synthetic isopropanol?"

Hydrogen peroxide

Current listings:
§250.601
(a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.
(4) Hydrogen peroxide.

(i) As plant disease control.
(5) Hydrogen peroxide.

§205.603(a) As disinfectants, sanitizer, and medical treatments as applicable.
(13) Hydrogen peroxide.

§205.605(b) Synthetics allowed:
Hydrogen peroxide.

Hydrogen peroxide is relatively nontoxic in low concentrations, though it is a powerful oxidizer and may damage soil biota. Repeated exposure to vapor is harmful. It breaks down quickly to oxygen and water, and therefore does not have a residual effect.

The advantage of hydrogen peroxide is its nontoxic residue, but concentrated hydrogen peroxide is a powerful oxidizer. When the NOSB reviews needs for sanitizers, it should ask whether concentrated hydrogen peroxide is needed.

Iodine

Current listing:
§205.603 (a) As disinfectants, sanitizer, and medical treatments as applicable.
(14) Iodine.

Iodine is frequently formulated as iodophors –with surfactants or complexing agents. Iodophors containing nonylphenols (NPs) and nonylphenol ethoxylates (NPEs) are strong endocrine disruptors with impacts on many species, including gender changes. Breakdown of certain NPEs may lead to toxic effects in treated livestock and applicators. Organic alternatives include ethanol or essential oils for some uses. Other natural alternatives identified by the TR include udder washes containing essential oils, vinegar, natural acids, nisin for teat dips, and natural ethanol. Other substitutes include chlorhexidine, alcohols, hydrogen peroxide, essential oils, chlorine materials. EPA has approved the following for use in DfE disinfectant products: citric acid, hydrogen peroxide, l-lactic acid, ethanol, and isopropanol. Some disinfectant TRs identify some alternative practices for some uses–steam sterilization and UV radiation. The iodine TR says, "The risk of mastitis incidents is significantly reduced when producers maintain a clean and dry environment for the animals. Frequently changing the animal's bedding material and/or using inorganic bedding (i.e., sand) may also reduce environmental contamination with these bacteria (Petersson-Wolfe & Currin, 2011). In addition, providing a healthy, balanced diet to the animal and ensuring the cleanliness of milking implements are important steps for maintaining health udders."

The iodine listings should not permit iodophors containing APs and APEs. Since the listings cannot be annotated at sunset, iodine should be removed from the National List.

Ozone

Current listings:
§205.601 (a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.
(5) Ozone gas—for use as an irrigation system cleaner only.

§205.605(b)
Ozone.

Ozone is a strong oxidizer. It is generated on-site. Its principal advantage is that it does not leave toxic residues. However, if there are leaks in the system, it can be very hazardous to workers:

> During water treatment ozone gas is transferred to water. In treating recycled irrigation water, ozone that is not transferred to the water is released as off gas. The concentration of ozone in the off gas of these systems is above the concentration fatal to humans and may contain as much as 3,000 ppm ozone (US EPA, 1999). Off gas containing ozone should be captured and converted to oxygen before release into the

atmosphere. Ozone systems that inject directly into the irrigation lines use much lower concentrations of ozone and do not treat off gas.[22]

In crops, it is used for cleaning irrigation systems, but there are no restrictions on its use in handling. It may be used in cleaning produce or in levels of 1-2 ppm to produce an atmosphere for storage of produce that inhibits the growth of mold and bacteria. Although low, these concentrations are ten times the allowable limits in the workplace. Low levels of ozone in the atmosphere can trigger asthma attacks. The subcommittees should determine how much ozone escapes during its use, whether it is released into the soil in cleaning irrigation systems, and to what levels workers are exposed in the handling uses.

The advantage of ozone is its nontoxic residue, but ozone is a powerful oxidizer. When the NOSB reviews needs for sanitizers, it should ask whether ozone is needed.

Peracetic acid (periacetic acid)

Current listings:
§205.601(a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.
(6) Peracetic acid—for use in disinfecting equipment, seed, and asexually propagated planting material. Also permitted in hydrogen peroxide formulations as allowed in §205.601(a) at concentration of no more than 6% as indicated on the pesticide product label.

§205.601(i) As plant disease control.
(8) Peracetic acid—for use to control fire blight bacteria. Also permitted in hydrogen peroxide formulations as allowed in §205.601(i) at concentration of no more than 6% as indicated on the pesticide product label.

§205.603 (a) As disinfectants, sanitizer, and medical treatments as applicable.
(19) Peroxyacetic/peracetic acid (CAS #-79-21-0)—for sanitizing facility and processing equipment.

§205.605(b)
Peracetic acid/Peroxyacetic acid (CAS # 79-21-0)—for use in wash and/or rinse water according to FDA limitations. For use as a sanitizer on food contact surfaces.

Peracetic acid is a solution in equilibrium of hydrogen peroxide and acetic acid. Peracetic acid is a stronger oxidizer than chlorine dioxide and sodium hypochlorite, but weaker than ozone. It is more persistent and has higher residual activity than chlorine-based disinfectants, but its degradation products are less hazardous. Peracetic acid is an irritant of the skin, eyes, mucous membranes, and respiratory tract, but does not harm aquatic life or form carcinogenic and mutagenic compounds in breaking down like chlorine.

[22] Crops TAP 2002, lines 285-289.

Peracetic acid is another powerful oxidizer. When the NOSB reviews needs for sanitizers, it should ask whether peracetic acid is needed.

Soap-based algicides and demossers

Current listing:
§205.601(a) As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems.
(7) Soap-based algicide/demossers.

The materials on this substance leave questions unanswered. The original TAP review appears to have considered only potassium-based soaps, but the more recent TR considers both potassium- and ammonium-based soaps. Yet ammonium-based soaps seem to be limited to another use altogether by §205.601(d) "As animal repellents—Soaps, ammonium—for use as a large animal repellant only, no contact with soil or edible portion of crop."

Secondly, the use pattern is not defined. Although the materials included with the original TAP review and much of the discussion in the recent TR address a use in which the substance is sprayed on surfaces covered with algae or moss, the TR also discusses alternatives to use in ponds. This is important because while the use on surfaces like walkways and benches in greenhouses pose little environmental hazard, the use in a waterbody is quite different. As the TR says, "The acute and chronic toxicity of soap salts is markedly different for land- and water-dwelling organisms."

The listing of soap-based algicides and demossers must be clarified. They should not be allowed for application to water.

Phosphoric acid

Current listings:
§205.603 (a) As disinfectants, sanitizer, and medical treatments as applicable.
(20) Phosphoric acid—allowed as an equipment cleaner, *Provided*, That, no direct contact with organically managed livestock or land occurs.

§205.605(b) Phosphoric acid—cleaning of food-contact surfaces and equipment only.

Phosphoric acid is synthetic. It is used to remove deposits on equipment, so its use is slightly different from the above sanitizers. Among the acids used for the purpose, phosphoric acid is considered less corrosive than most. The production of phosphoric acid is dependent on phosphate mining and processing, which are polluting and produce hazardous and radioactive waste products. Contact of phosphoric acid with skin and eyes should be avoided because of its corrosivity. Phosphate pollution contributing to eutrophication of waterbodies receiving treated wastewater is a possible consequence of the use of phosphoric acid cleaners.

Phosphoric acid poses environmental use in manufacture and disposal, and health risks during use. Because its use is slightly different from the other materials examined here, there

may not be a more compatible substance in this list. We encourage the NOSB to continue to seek safer alternatives.[23]

Other sanitizing agents

Technical reviews for the above sanitizers and EPA's Design for the Environment (DfE) program have identified alternatives, including essential oils and natural acids.

EPA's DfE has approved **l-lactic acid and citric acid** as meeting its criteria for use as disinfectants.[24] While the DfE criteria are not the same as OFPA criteria, they do require that the materials be low-hazard and efficacious. Lactic acid and citric acid are both considered nonsynthetic and are listed on §205.605(a) with no restrictions as to use.

Essential oils are often cited as a class of natural disinfectants. The TR for hydrogen peroxide refers to the following essential oils and extracts: clove oil, melaleuca (tea tree) oil, and oregano oil, pine oil, basil oil, cinnamon oil, eucalyptus oil, helichrysum oil, lemon and lime oils, peppermint oil, tea tree oil, and thyme oil. Aloe vera contains six antiseptic agents active against fungi, bacteria and viruses. There is considerable research on essential oils as disinfectants that could be useful to organic producers. For example, an early review by Janssen et al described methods for screening.[25] A more recent review by Kalemba and Kunicka gave an updated review of screening methods and an overview of the susceptibility of human and food-borne bacteria and fungi towards different essential oils and their constituents.[26] Deans and Ritchie compared the potency of 50 different essential oils and the range of their antibacterial action against 25 genera of bacteria.[27] A review of the literature should be encouraged by the NOSB to encourage the use of safer materials more compatible with organic principles.

Practices that eliminate the need for disinfectants

Technical reviews have mentioned practices that eliminate the need for disinfectant materials. They include: hot water, steam, UV radiation, slow filtration for cleaning water. As pointed out at the beginning of these comments, "cleaning" is not synonymous with disinfection, and it is possible that in some cases, disinfection is not necessary at all.

Conclusion

While the uses of disinfectants vary so that no one method or material is likely to be effective in all cases, there are numerous alternative methods and materials that should allow organic producers and handlers to avoid the use of the most toxic materials –in particular, those containing chlorine. Regarding alternative materials for teat dips, the iodine TR says, "The

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[23] See "descalers" at http://www2.epa.gov/saferchoice/products.
[24] http://www.epa.gov/pesticides/regulating/labels/design-dfe-pilot.html.
[25] Janssen, A. M., Scheffer, J. J. C., & Svendsen, A. B. (1987). Antimicrobial activities of essential oils. *Pharmaceutisch Weekblad*, *9*(4), 193-197.
[26] Kalemba, D., & Kunicka, A. (2003). Antibacterial and antifungal properties of essential oils. *Current medicinal chemistry*, *10*(10), 813-829.
[27] Deans, S. G., & Ritchie, G. (1987). Antibacterial properties of plant essential oils. *International journal of food microbiology*, *5*(2), 165-180.

available information suggests that commercial antimicrobial products containing oxidizing chemicals (e.g., sodium chlorite, hypochlorite, iodophor), natural products composed of organic acids (e.g., lactic acid), and homemade products using vinegar (i.e., acetic acid) as the active ingredient may all be equally effective teat dip treatments.” The active ingredients identified by the DfE are safer and effective alternatives.

We have discussed many alternatives that are available for use by organic producers and handlers. Rather than simply proposing another renewal of the use of chlorine-based materials, the NOSB subcommittees should commission a TR that (1) determines what disinfectant/sanitizer uses are required by law, and (2) comprehensively examines more organically-compatible methods and materials to determine whether chlorine-based materials are actually needed for any uses. If there are uses for which chlorine is necessary, then the NOSB should include them in the National List and limit the use to those particular uses.

Thank you for your consideration of these comments.

Sincerely,

Teresa Ann Shistar

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Board of Directors