

ALBEMARLE CORPORATION
Petition to add DBDMH as a processing aid to the List of Allowed Substances
in the National Organic Program

This petition contains Confidential Business Information. This includes "trade secrets" related to the production process and quality control tests and data. This information is commercially valuable, used in Albemarle business and maintained in secrecy.

Introduction

Hypobromous acid (HOBr) derived from 1,3-dibromo-5,5-dimethylhydantoin (DBDMH, CAS No. 77-48-5) exhibits antimicrobial effects in water. It is used as a post-harvest intervention in the beef industry, and results from laboratory studies and commercial trials have shown a reduction in *E. coli* and *Salmonella* levels¹ with HOBr from DBDMH. It can be used to control bacterial numbers on beef hides, carcasses, heads and organs. This chemistry is also used in the poultry processing industry.

DBDMH is a stable white to off-white granular solid. In water, DBDMH undergoes a hydrolysis reaction to form two molecules of hypobromous acid (HOBr) and one molecule of dimethylhydantoin (DMH). During use, DBDMH is placed into a flow-through chemical feeder. The aqueous output of this feeder is mixed with a separate stream of water to dilute the HOBr to the desired level, and supply a constant stream of HOBr to the DBDMH application system. The water flow to the feeder and the water flow for dilution can be controlled to achieve the proper dilution to obtain the desired HOBr concentration.

Hypobromous acid is the active antimicrobial agent in the water applied to the beef. The oxidizing action of hypobromous acid kills the bacteria. After undergoing chemical reduction during use (disinfection), the hypobromous acid converts to an inactive bromide ion (Br⁻). The DMH by-product remains in the water, serves no additional function and does not react further.

The application of HOBr to beef results in a one-time reduction in the microbial load of the meat but does not have an ongoing antimicrobial effect and does not affect the characteristics of the meat.

The U.S. Food and Drug Administration (FDA) Food Contact Notification (FCN) 792 authorizes the use of DBDMH at a level not to exceed that needed to provide the equivalent of 300 parts per million (ppm) available bromine on beef hides, carcasses, heads, trim, parts and organs. With respect to poultry processing, FDA has issued FCS notifications authorizing the use of DBDMH in chiller water (FCN 334), inside-outside bird washer (FCN 357), off-line reprocessing (FCN 357), water for disinfecting carcasses and their parts and organs (FCN 453), and ice intended for poultry processing (FCN 775).

The U.S. Department of Agriculture Food Safety and Inspection Service has listed DBDMH on Directive 7120.1 Safe and Suitable Ingredients Used in the Production of Meat, Poultry and Egg Products.

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Reviews and approvals from other government organizations

1. DBDMH has an effective Food Contact Notification (FCN) for use on beef meat, heads, carcasses, trim, parts, and organs. The FDA assigned FCN 792 for this application.
2. DBDMH has effective FCNs for use in poultry chillers, inside-outside bird washers (IOBW's), on-line reprocessing systems, scalding, ice, and in poultry process water. The associated FCN listings are 334, 357, 453, and 775.
3. DBDMH has an effective Food Contact Notification (FCN) for use as an antimicrobial agent in water applied to pig, goat and sheep carcasses and their parts and organs. The FDA assigned FCN 1102 for this application.
4. DBDMH has an effective FCN for use as an antimicrobial additive in process water for fruits and vegetables, and as an antimicrobial component of shell egg wash solutions. The FDA assigned FCN 1118 for this application.
5. DBDMH has been accepted by the United States Department of Agriculture's Food Safety Inspection Services (FSIS) for use in the production of meat, poultry, and egg products. It is listed in FSIS Directive 7120.1 Safe and Suitable Ingredients used in the Production of Meat, Poultry, and Egg Products.
6. DBDMH is cleared by the FDA for use as a slimeicide in the manufacture of paper and paperboard that contact food (21 CFR 176.300).
7. DBDMH has an Environmental Protection Agency (EPA) pesticide registration for use as a disinfectant in recreational water treatment applications such as swimming pools, hot tubs and spas, and salon foot spas. The EPA product registration number is 3377-61.
8. DBDMH has an EPA pesticide registration for use as a biocide in industrial water treatment applications such as recirculating cooling towers, once-through cooling water systems, brewery pasteurizers, pulp and paper mills, and decorative fountains. The EPA product registration number is 3377-62.
9. The EPA completed its reregistration review of the available data and public comments received related to the preliminary risk assessments for the antimicrobial halohydrantoin. Based on its review, EPA published a Reregistration Eligibility Decision (RED) and determined that halohydrantoin is eligible for reregistration. DBDMH is one of the halohydrantoin covered by the RED. The supporting documents for the RED can be found in the Docket EPA-HQ-OPP-2004-0303 at: <http://www.regulations.gov>.
10. The Health Products and Food Branch of Health Canada has reviewed the use of DBDMH as an antimicrobial on beef and poultry. They have provided Letters of No Objection for these uses in Canada.
11. The Food Safety Directorate of the Canadian Food Inspection Agency also provided a Letter of No Objection for use of DBDMH as an antimicrobial treatment for beef.
12. Food Standards Australia New Zealand (FSANZ) has published a draft amendment to the Australia New Zealand Food Standards Code allowing DBDMH as an antimicrobial washing agent for treating all foods. FSANZ notified the public of the amendment in Food Standards Notification Circular 22/11. A link to the notification circulars is as follows:
<http://www.foodstandards.gov.au/foodstandards/changingthecode/notificationcirculars/>.

Product label follows on the next page



(1,3-dibromo-5,5-dimethylhydantoin)

A post-harvest antimicrobial for pathogen reduction on beef hides, carcasses, heads and organs.

FOR INDUSTRIAL USE ONLY

DIRECTIONS FOR USE

This product should only be used in applications and in a manner specified on the label.

This product is an effective post-harvest antimicrobial wash when applied to beef hides, carcasses, heads and organs.

This product must be dissolved in water in an approved feeder before being used in any application.

The concentration of this product should never exceed 300 ppm available (total) bromine in the water being directly applied to beef products.

Water containing a maximum of 300 ppm available (total) bromine may be reused on raw beef product at its point of origin or upstream from its point of origin in the process and must be in compliance with 9 CFR 416.2 (g).

Total bromine levels should be monitored periodically during the day using a suitable bromine test kit to ensure desired residuals are maintained.

Bovibrom is a trademark of Albemarle. Elanco® and the diagonal bar are trademarks of Eli Lilly and Company. Manufactured for Elanco by Albemarle.

Manufactured by:



451 Florida Street • Baton Rouge, LA 70801

AH0558
01 82 41 01

In case of emergency endangering life or property with this product, call (225) 344-7147.

SAFETY
Causes irreversible eye damage and skin burns. Do not get in eyes, on skin or on clothing. Wear chemical goggles or safety glasses, protective clothing and rubber gloves. May be fatal if swallowed. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Harmful if absorbed through skin. Harmful if inhaled. Avoid breathing dust. Remove contaminated clothing and wash clothing separately before reuse. Consult MSDS and follow directions.

PHYSICAL AND CHEMICAL HAZARDS

BoviBrom is a strong oxidizing and brominating agent. Do not mix with other chemicals. Mix only with water. Do not add this product to any dispensing device containing remnants of another product. Such use may lead to a violent reaction leading to fire or explosion. Avoid contact with aldehydes, strong reducing agents, acids and ammonia-containing products.

STORAGE AND DISPOSAL

Keep this product dry in original tightly closed container when not in use. Store in a cool, dry, well-ventilated area away from heat and flame.

Sweep or shovel spills into appropriate container for disposal. Material that can't be used according to label directions should be disposed of in a properly permitted industrial landfill. Do not reuse container. Rinse thoroughly before discarding in trash.

Distributed by:



2001 West Main Street • P.O. Box 708 • Greenfield, IN 46140
(800) 428-4441 • www.ElancoFoodSolutions.com

Net Contents: 50 lb

Elanco Food Solutions, a division of Elanco Animal Health

Physical properties and chemical mode of action

In addition to the physical properties listed on the MSDS, DBDMH has the following properties:

Appearance: Free-flowing, white to off-white nugget with a mild halogen odor.

Bulk density: 0.587 g/ml

Mode of action: Hypobromous acid (HOBr) is an oxidizing antimicrobial. Hypobromous acid kills microorganisms by inhibiting certain essential bacterial enzymes or causing lysis of cell walls.

Chemical interactions with other substances: Please see Section 10. Stability and Reactivity, Materials to avoid on the MSDS.

Toxicity and environmental persistence: We do not expect any DBDMH or its by-products to be released to the environment due to its manufacture or use. During use the hypobromous acid is converted to an inactive bromide ion. The DMH remains in the water and is carried out in the waste stream.

Environmental impacts: In approving DBDMH, the FDA in their Environmental Decision Memo (Finding of No Significant Impact) determined that its issuance of the Food Contact Notification (FCN 792) would not have a significant impact on the quality of the human environment and therefore required no environmental impact statement⁵. Evidence supporting this finding is a matter of public record. The FDA Finding of No Significant Impact letter can be located by Food Contact Number in the following web site:

<http://www.accessdata.fda.gov/scripts/fcn/fcnNavigation.cfm?rpt=opaListing>

Effects on human health:



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Direct contact with DBDMH is unlikely as the product is diluted/dispensed via a chemical feeder. We provide the following information on the acute effects of the material.

Acute Oral - Defined LD50 (Guideline OPPTS 870.1100): The acute oral defined LD50 of DBDMH is 448 mg/kg of body weight. DBDMH was administered by single gavage of a water or carboxymethylcellulose suspension to Sprague-Dawley rats (5 male, 5 female) at dose levels of 250, 500, 1000, and 5000 mg/kg. No deaths or abnormal signs occurred in the 250 mg/kg group. Two animals in the 500 mg/kg group died on days 7 and 13 respectively. All animals in the 1000 mg/kg group and all but two of the 5,000 mg/kg group died in the first day. The two remaining 5000 mg/kg animals survived to study end on day 17, but showed either weight loss or signs of hypoactivity.

Acute Dermal - Limit Test (Guideline OPPTS 870.1200): The single dose acute dermal LD50 of DBDMH is greater than 2000 mg/kg of body weight when applied to the skin of Sprague-Dawley rats as a moistened powder. The product was applied to the skin of 5 male and 5 female rats for 24 hours. All animals survived and gained weight during the 14-day observation period. Other than dermal irritation (erythema and edema and/or eschar) there were no signs of gross toxicity, adverse pharmacologic effects or abnormal behavior. No gross abnormalities were noted for the animals necropsied at the conclusion of the 14-day observation period.

Primary Skin Irritation - (Guideline OPPTS 870.2500): DBDMH is classified as corrosive to the skin, due to evidence of corrosion to the skin of one of three New Zealand albino rabbits following a 4-hour exposure to moistened powder. Dermal irritation was evaluated by the method of Draize, et al. Because corrosivity had been anticipated, one animal was tested initially, and the other two started only after the first animal did not show corrosion. The first animal showed well-defined erythema and edema, which decreased from 48 hours to Day 10 of the test. The second and third animals were terminated at the 72-hour observation when the third animal showed severe erythema, edema, eschar and evidence of corrosion. The second animal showed no irritation by 24 hours after exposure. The Primary Dermal Irritation Index (PDII) calculated for this test substance was 4.3.

Dermal Sensitization - Buehler Method (Guideline OPPTS 870.2600): DBDMH is not considered to be a contact sensitizer. DBDMH (0.75% w/w suspended in distilled water) was applied topically to young adult Hartley albino guinea pigs (20 male, 20 female) once weekly over a three-week induction period. Twenty-seven days after the first induction dose, a challenge dose of the highest nonirritating concentration (0.5% w/w solution in distilled water) was applied to a naive site, and scoring for erythema was made 24 and 48 hours after dosing. A naive control group (ten animals) was treated with the test article at challenge only. No animals had an erythema score of greater than 0.5 at the 24- or 48- hour reading in the test group or naive control group at challenge. Historical response to the positive control substance 1-chloro-2,4-dinitrobenzene (DNCB) showed that the animals were capable of showing sensitization.

Effects on soil organisms, crops or livestock: We do not expect any DBDMH or its by-products to be released to the environment due to its manufacture or use. During use the hypobromous acid is converted to an inactive bromide ion. The DMH remains in the water and is carried out in the waste stream. We provide the following summaries for DBDMH on aquatic organisms.

Static Aquatic Toxicity Data

Oncorhynchus mykiss Rainbow Trout: The 48-hour EC50 value for rainbow trout tested under static conditions was 0.178 mg Cl₂/L (0.4 mg of material/L). Five concentrations of DBDMH (0.0588, 0.118, 0.235, 0.470, & 0.940 mg Cl₂/L) were tested using moderately hard fresh water (130-160 mg/L as CaCO₃) in 10 L aquaria. A minimum of 10 rainbow trout (5 per replicate) were tested per concentration; with instantaneous biomass loading of 0.0567 grams of fish/liter. No mortality was observed during the 96-hour test in concentrations lower than 0.235 mg Cl₂/L; 100% mortality was observed at 24 hours in the concentrations of 0.470 and 0.940 mg Cl₂/L. In the 0.235 mg Cl₂/L concentration, one replicate had 80% mortality at 24 hours and the other replicate had 100% mortality. No further deaths occurred after the 24-hour observation.

Daphnia Magna Waterflea: The estimated 48-hour EC50 value for *Daphnia magna* under static conditions was 0.321 mg Cl₂/L (0.7 mg of material/L). Five concentrations of DBDMH (0.0588, 0.118, 0.235, 0.470, & 0.940 mg Cl₂/L) were tested in moderately hard water (130-160 mg/L as CaCO₃). Ten daphnids were used per concentration replicate. Observations of immobility/mortality were made at 24 and 48 hours. No deaths nor abnormal signs occurred at 0.0588 mg Cl₂/L. One animal in one replicate died in the 0.118 mg Cl₂/L group at 24 hours. No animals died in the 0.235 mg Cl₂/L test group, but three animals in one replicate were observed to be quiescent at 48 hours. All animals in the 0.470 mg Cl₂/L were dead at 24 hours, and all animals in the 0.940 mg Cl₂/L died, half at 24 hours, and half by 48 hours.

MSDS

A Material Safety Data Sheet is provided on the following pages. A substance report for DBDMH from the National Institute of Environmental Health Studies does not exist.



1,3-Dibromo-5,5-Dimethylhydantoin

Material Safety Data Sheet

Revision Date: 25-Aug-2010
Supersedes 27-Jan-2009

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name 1,3-Dibromo-5,5-Dimethylhydantoin
Chemical Name 1,3-Dibromo-5,5-dimethylhydantoin
Chemical Family Brominated Imidazolidine Dione
CAS-No 77-48-5
Formula C5H6Br2N2O2
Synonyms DBDMH
General function Oxidizer. Brominating agent

Emergency Telephone Numbers +1-225-344-7147

For Non-Emergency 800-535-3030

	NFPA	HMIS
Health	3	3
Flammability	1	1
Physical Hazards	1	1

2. HAZARDS IDENTIFICATION

Danger

Emergency Overview

Causes irreversible eye damage and skin burns.
 May be fatal if swallowed
 Harmful by inhalation
 Harmful in contact with skin

Potential Health Effects

Eyes Causes irreversible eye damage
Skin Causes burns. May be absorbed through the skin in harmful amounts
Inhalation Harmful by inhalation.
Ingestion May be fatal if swallowed.

See Section 11 for additional Toxicological information.

Occupational Exposure Limit See Section 8

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No	Weight %
1,3-Dibromo-5,5-dimethyl hydantoin	77-48-5	>98

4. FIRST AID MEASURES

Ad Lib	
Eye contact	If medical advice is needed: Have product container or label at hand. If in eyes, hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.
Skin Contact	If on skin or clothing, take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.
Inhalation	If inhaled, move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or doctor for further treatment advice.
Ingestion	If swallowed, Call a physician or Poison Control Center immediately. Do not induce vomiting without medical advice. Have person sip a glass of water if able to swallow. Never give anything by mouth to an unconscious person.
Notes to Physician	Treat symptomatically

5. FIRE-FIGHTING MEASURES

Combustion/explosion hazards	No information available
Suitable Extinguishing Media	Carbon dioxide, dry chemicals, foam, water spray (fog).
Hazardous Combustion Products	Oxides of carbon. Bromine.
Protective Equipment and Precautions for Firefighters	Toxic fumes may be present; use of respirator suggested.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	Avoid contact with skin, eyes and clothing. Ventilate the area. Do not breathe dust.
Environmental precautions	Prevent spilled substance from entering water supplies or water courses. Do not discharge into drains or the environment, dispose to an authorized waste collection point.
Methods for Clean-up	Sweep up and shovel into suitable containers for disposal.

7. HANDLING AND STORAGE

Handling	Handle in accordance with good industrial hygiene and safety practice. Wear personal protective equipment. Avoid dust formation.
Storage	Store in well-ventilated, cool (<120F), dry area, away from heat or flame. Store in containers made of HDPE, LDPE, or PP. Do not store in metal or fiberboard containers. Close container when not in use. Avoid exposure to moisture.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls	Ensure adequate ventilation, especially in confined areas.
Personal Protective Equipment:	
Eyeface Protection	Chemical goggles. Face-shield.
Skin Protection	Rubber gloves resistant to chemical permeation
Hand protection	Gloves resistant to chemical permeation.
Respiratory protection	Whenever workplace conditions warrant, wear properly fitted, approved respirator with high-efficiency (dust/fume/mist) filter cartridges.
Other information	Wear suitable protective clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Flash point	Not applicable.
Flammable limits (LEL, UEL)	No data available
Form	Solid
Vapour pressure	No data available
Color	White/Off-white
Density	~1.0 g/cm ³ (Packed Bulk)
Odor	Halogen
Vapor density	No data available
pH	6.0-7.0(1% slurry in pH 7 water)
Water Solubility	~0.1%
Boiling Point	No data available
Melting/freezing point	>200 °C(Decomposes)
Molecular Weight	286
Viscosity, dynamic	No data available
Viscosity, kinematic	No data available
Oxidizing Properties	Oxidizer

10. STABILITY AND REACTIVITY

Stability	Stable.
Conditions to Avoid	Avoid extremely high heat and flame.
Materials to avoid	This product is a strong oxidizing and brominating agent. Avoid contact with reducing agents, acids, ammonia-containing products, organic materials (such as aldehydes and alcohols) and other oxidizing agents (such as calcium hypochlorite). Avoid contact with common metals such as aluminum, iron, copper, brass and steel. Contact with incompatible materials can promote the exothermic decomposition of the product.
Hazardous decomposition products	Carbon oxides. Bromine.
Hazardous Polymerization	None under normal processing.

11. TOXICOLOGICAL INFORMATION

Routes of exposure	No information available
Health and hazardous information	
Acute toxicity	Causes burns. Harmful if absorbed through skin.
Skin contact	Possible risks of irreversible effects.
Eye contact	Harmful by inhalation.
Inhalation	Not expected to be a sensitizer.
Skin sensitization	No information available
Carcinogenic effects	No information available
Mutagenic Effects	No information available
Reproductive Effects	No information available
Target Organ Effects	No information available
Chronic Effects	None known
Aspiration Hazard Statement	No information available
Signs and Symptoms of Overexposure	No information available
LD50 Oral:	448mg/kg of body weight (rat) (Albino Sprague-Dawley)
LD50 Dermal:	>2000mg/kg of body weight (rat) (Albino Sprague-Dawley)
Other data	SKIN IRRITATION, Rabbit (albino New Zealand): Product is considered corrosive to the skin. DERMAL SENSITIZATION, Guinea pig (albino Hartley): Not a contact sensitizer

12. ECOLOGICAL INFORMATION

EC50	EC50/48h/Daphnia =0.7mg/L
EC50	EC50/48h/Rainbow Trout = 0.4mg/L
Ecotoxicity effects	Very toxic to aquatic organisms
Persistence/Degradability	No information available
Bioaccumulation/ Accumulation	No information available
Mobility in Environmental Media	No information available
Other adverse effects	No information available

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method Dispose in a safe manner in accordance with local/national regulations.

14. TRANSPORT INFORMATION

DOT

Proper Shipping Name	Oxidizing Solid, N.O.S. (1,3-Dibromo-5,5-dimethylhydantoin)
Hazard Class	5.1
UN No.	1479
Packing Group	II
Description	UN 1479, Oxidizing solid, N.O.S. (1,3-Dibromo-5,5-dimethyl hydantoin), 5.1, II

IMDG/IMO

IMO Class	5.1
Packing Group	II
UN-No	1479
IMO Labelling and Marking	5.1
Proper Shipping Name	Oxidizing solid, N.O.S. (1,3-Dibromo-5,5-dimethyl hydantoin)
EmS	F-A, S-Q
Marpol - Annex II	Not applicable
Marpol - Annex III	Unregulated
Transport Description	UN 1479, Oxidizing solid, N.O.S. (1,3-Dibromo-5,5-dimethyl hydantoin), 5.1, II

IATA/ICAO

IATA/ICAO Class	5.1
Packing Group	II
UN-No	1479
IATA/ICAO Labelling/Marking	5.1
Passenger Aircraft	Maximum net quantity per package: 5 kg
Cargo aircraft only	Maximum net quantity per package: 25 kg
Proper shipping name	Oxidizing solid, N.O.S. (1,3-Dibromo-5,5-dimethyl hydantoin)
Transport Description	UN 1479, Oxidizing solid, N.O.S. (1,3-Dibromo-5,5-dimethyl hydantoin), 5.1, II

15. REGULATORY INFORMATION

International Inventories	TSCA	DSL	NDSL	AICS	ENECS	ELINCS	ENCS	KECL	PICCS	CHINA	NZIoC
1,3-Dibromo-5,5-Dimethylhydantoin	X	X	-	X	X	-	X	X	X	X	X

(X) Complies (-) Does not Comply

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazardous Categorization

Chronic Health Hazard	No
Acute Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Reportable and Threshold Planning Quantities

No ingredients have RQs or TPQs under SARA or CERCLA.

State Regulations

No components subject to "Right-To-Know" legislation in the following States; California, Massachusetts, New Jersey, and Pennsylvania.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazards

E Corrosive material
D1B Toxic materials

16. OTHER INFORMATION**Prepared By**

Health & Environment Department
Albemarle Corporation

FOR ADDITIONAL NONEMERGENCY PRODUCT INFORMATION, CONTACT:

HEALTH AND ENVIRONMENT DEPARTMENT
ALBEMARLE CORPORATION
451 FLORIDA ST.
BATON ROUGE, LA. 70801
(800) 535-3030

Revision Date:

25-Aug-2010

Revision Number:

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The information contained herein is accurate to the best of our knowledge. The Company makes no warranty of any kind, express or implied, concerning the safe use of this material in your process or in combination with other substances.

Research Information

Albemarle is not aware of any research containing contrasting positions to those presented in this petition.

Food Safety Justification

Beef processors are under increasing pressure to reduce food-safety risk. The Food Safety Inspection Service of USDA has declared six additional serogroups of *E. coli* (O26, O45, O103, O111, O121 and O145) as adulterants in non-intact raw beef and will add these to its existent routine sampling program for meat from animals harvested on or after March 5, 2012².

Independent research has confirmed the efficacy of HOBr against all six newly named serotypes at application rates compatible with the final wash and other high-volume washes used in beef processing³.

HOBr derived from DBDMH is added to otherwise untreated process water in commercial beef-processing plants to reduce the risk to the consumer from pathogenic *E. coli* and *Salmonella*. In the most common example, the final wash (aka "bone wash") cabinet is used to apply 35 to 50 gallons of HOBr solution (<300 ppm as Br₂) per carcass at ambient temperatures and pressures of or near 100 psi. These parameters preempt the use of the final wash cabinet as an intervention step and serve to remove blood, bone dust and other loose debris from the carcass following the slaughter dress procedure. While well suited for DBDMH, these cabinet parameters are not appropriate for the application of the commonly accepted antimicrobials on the National Organic Program List of Allowed Substances (7 CFR 205.605). Lactic and peracetic acid solutions are examples of approved and commonly used antimicrobials that are commercially applied at much smaller volumes (< 1 gallon per carcass⁴). These chemistries are not economically feasible to add to final-wash process water nor advisable due to corrosion and/or odor concerns, and therefore, not suitable alternatives to HOBr for the aforementioned intervention opportunity.

Chlorine Comparison

The formation and use of HOBr as a biocide is analogous to that of the NOP-approved hypochlorous acid (HOCl) in the chlorination of water. Both hypohalous acids are oxidizing agents which interrupt metabolic processes in micro-organisms resulting in death to the cell. However, there are differences in the chemistries that favor HOBr as a beef-processing antimicrobial.

In the presence of nitrogen-based compounds such as the proteins in meat tissue, both HOCl and HOBr form haloamines. While monochloramine is significantly less biocidally active than free chlorine (HOCl), mono- and di-bromamines are active biocides that show disinfection properties that are similar to free bromine (HOBr)¹⁵. Other relevant advantages include that HOBr retains its activity under more alkaline conditions than does HOCl and the rate of decay of bromamines is much faster than that of chloramines resulting in less environmental impact in effluents¹⁵.

Commercial Acceptance

Hypobromous acid is a widely accepted antimicrobial intervention in the beef industry and rapidly gaining acceptance in the poultry industry due to its efficacy and functionality in high-volume washes. HOBr does not alter the quality or nutritive value of the food product and has not negatively impacted the safety of workers, the quality of the workplace or the environmental acceptability of water discharge at plants where DBDMH has been used. DBDMH is a simple, accessible food-safety technology appropriate for both small and large plants. The addition of HOBr from DBDMH to 7 CFR 205.605 would remove a significant food-safety driven barrier that may otherwise prevent plants from becoming organic certified.

Corrosion study

Concrete corrosion study included on the following pages.

BoviBrom Advantage

Less Corrosive to Plant and
Equipment



Concrete Corrosion Study Method

- Test Article
 - 3500 psi concrete
 - aged 30 days prior to test
 - 6" x 12" cylinders
- Cylinders were immersed in the test solutions for 30 days.
- The test solutions were replaced based on pH change for the lactic acid or residual drop for the Bovibrom.

Source: Albemarle Corporation. Unpublished



2

Compression Strength (psi) of Concrete Cylinders After 30 Days Aging in Solution

	2.5% Lactic Acid	5.0% Lactic Acid	300 ppm BoviBrom	Water Control
Replicate 1	2,630	2,700	4,460	4,330
Replicate 2	2,940	2,840	4,740	4,110

Source: Albemarle Corporation. Unpublished



3

Concrete Corrosion Study



Source: Albemarle Corporation. Unpublished



4

Enlarged picture from the above slide.



Corrosion Study of DBDMH in Poultry Processing

- Test coupons of 304L and 316L stainless steel were installed in a poultry plant.
- The coupons were exposed to HOBr concentrations ranging from 60-100 ppm for one set and 450-500 ppm for the second set. The exposure time was 312 hours.
- Typical plant operations involved production runs from approximately 6 AM until midnight in a system with continuous aqueous flows. During the downtime from midnight until the start of the next shift, the test coupons remained in place and were still immersed in the disinfectant solution but there was no dynamic flow.
- Visual and microscopic inspection showed no indication of localized (pitting or crevice attack) corrosion.
- Weight loss was used for a general corrosion rate. This was calculated to be a very low 0.1 mpy.

Source: Albemarle Corporation. Unpublished



Corrosion Comparison of HOBr to HOCl

	High Chlorine	Reduced Chlorine	HOBr
Free Halogen (as Cl ₂ , ppm)	0.5	.15	.11
Total Halogen (as Cl ₂ , ppm)	-	.22	.15
Mild steel corrosion, mpy	3.6 ^a	4.1 ^a	0.5 ^b
Admiralty brass corrosion, mpy	.8	.2	.3
Time period	Historical	July 1995	Aug 1995

^aModerate pitting

^bVery slight pitting

Source: Nalepa CJ, Moore RM, Golson GL, Wolfe TW, and Puckorius PR, Material Performance, 1996 35(7) 42.



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References

¹Kalchayanand, N, TM Arthur, JM Bosilevac, DM Brichta-Harhay, MN Guerini, SD Shackelford, TL Wheeler & M Koochmaria. 2009. Effectiveness of 1, 3-Dibromo-5,5-Dimethylhydantoin on Reduction of Escherichia coli O157:H7- and Salmonella-Inoculated Fresh Meat. *J. of Food Prot.* 72(1):151-156.

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