VERSENE™ EDTA Food-Grade Chelating Agents

Trace Metal Control for Food Applications

Do Your Food Products Exhibit the Common Symptoms of Trace Metal Reactions Listed Below?

- Discoloration
- Off-odors
- Color loss
- Loss of clarity
- Crystal formation
- Rancidity
- Off-flavors
- Precipitation
- Vitamin degradation
- Reduced shelf life

Trace amounts of soluble copper, iron, or another metal could be the cause

By accelerating undesirable chemical reactions, trace amounts of soluble iron, copper, and other metals can degrade the quality, shelf life, and value of food products. Flavor, color, clarity, stability, and vitamin content can all be affected. Even though trace metals can be found in practically all processed foods, they are often overlooked as the cause of these problems.

Almost any food product can be affected

Because trace metals occur naturally in all plant and animal tissues, are normally found in processing water, and can also be introduced by processing equipment, the potential for undesirable metal-catalyzed reactions is widespread. In many instances, uncontrolled metal ions can affect a food's flavor, quality, nutritional content, consumer appeal, and ultimate value.

Emulsified products are particularly vulnerable

One major problem is the metal-catalyzed oxidation of fats and oils. Emulsified products are particularly sensitive. In products such as salad dressings, mayonnaise, sauces, and spreads, as little as 0.5 to 1.0 ppm copper or iron can oxidize fatty oils, leading to rancidity. Color changes, off-flavors, and emulsion instability can also occur. In reduced-fat and low-fat products of this type, flavor stability is particularly delicate.

Seafood, pickles, canned vegetables and beverages also suffer

In canned seafood, naturally high levels of copper, zinc, tin, and iron combine with organics to cause discoloration, rancidity, off-flavors, and off-odors. The formation of struvite crystals (magnesium ammonium phosphate) in canned seafoods results from high concentrations of magnesium.

Trace amounts of copper and iron in pickled cucumbers can lead to problems with color, flavor, and texture. In canned beans, trace metals contribute to darkening, graying and skin breakage during retort and storage. In potato processing, iron combines with naturally present compounds to darken or gray the potato flesh. This problem occurs in both frozen and canned potatoes. Other canned vegetables are subject to similar effects.

In beverages, 0.05 ppm copper or iron can lead to flavor loss, color fading, and degradation of formulation ingredients, especially vitamins.

Ascorbic acid has been shown to degrade rapidly in the presence of trace quantities of copper.

How VERSENE food-grade EDTA products stop metal ion reactions from degrading the value of food products

Chelating agents (sometimes referred to as sequestering agents) inhibit undesirable reactions in foods by complexing metal ions. The resulting structure, called a chelate, immobilizes the metal ion and prevents it from reacting with other components in the system. For the food problems described in this brochure, only EDTA chelating agents provide effective metal ion control under typical food conditions. EDTA (ethylenediaminetetraacetate) forms highly stable complexes with metal ions and is a cost-effective solution due to its effectiveness at remarkably low concentrations. Use of EDTA in food products is regulated under the U.S. Food, Drug and Cosmetic Act. Table 1 on page 5 summarizes applications where VERSENE CA and VERSENE NA food-grade EDTA products are cleared for use in foods.

EDTA locks up troublesome metal ions in a highly stable complex

Soluble trace metals in the aqueous component of food exist as positively charged ions. Each of these ions has a number of

coordination sites (associated with molecular orbitals) which are referred to as "reactive sites." Copper and iron ions, the most frequent troublemakers in foods, often have either four or six reactive sites.

Figure 1 illustrates how the EDTA molecule can block up to six reactive sites on a metal ion, completely deactivating the ion. Equally important, the intrinsically strong, five-sided ring structures in this complex are highly stable, even under heat and light, and over a wide pH range. In foods, this can translate into longer shelf life even in adverse conditions.

VERSENE™ food-grade EDTA products can help you reduce ingredient costs

Because they are so efficient, VERSENE CA and VERSENE NA food-grade EDTA can provide the protection you need at low concentrations. Typical use levels are from 30 ppm in beverages, 70 ppm in sauces and dressings, and 150 to 300 ppm in canned products.

VERSENE products offer greater pH and heat stability

The stability of complexes formed by chelating agents and metals is a critical factor in ensuring food product quality. If the complexes are not stable, they can break down during or after processing, freeing the metals to react with foods. The heat and pH stability of EDTA chelating agents make them highly effective metal ion control agents under typical food conditions. EDTA is stable up to 400°F, which means metals remain complexed under the temperature conditions most commonly associated with food processing operations. What's more, EDTA-metal complexes remain stable throughout the typical food pH range. EDTA-metal complexes even remain stable under combined conditions of low pH and high temperatures.

VERSENE food-grade EDTA products have no equal

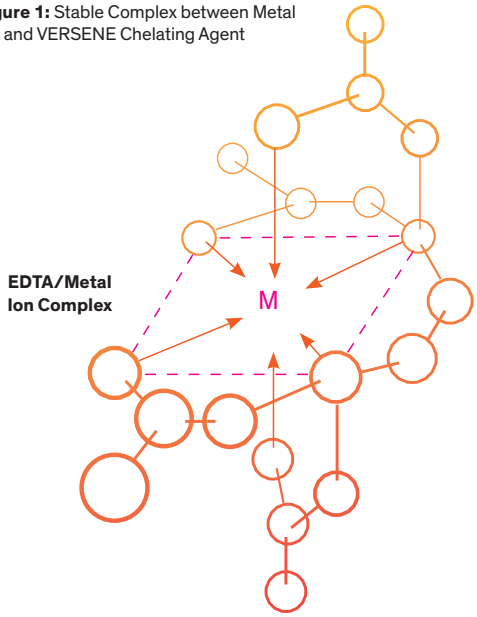
To prevent oxidation, degradation, and trace metal catalyzed reactions in foods, an extreme level of control is required. The best measure of this is in the stability constant of the complex. High stability constants mean stronger, more thorough control. In practical terms, this higher strength is required and only EDTA can provide it.

Although citric acid, phosphates, and lactates are sometimes promoted as metal ion control agents in food applications, Figures 2 and 3 show that these materials are nowhere near as strong as EDTA in the typical food pH range and are particularly ineffective for copper and iron – the metals which can cause most degradation problems. The data shows why EDTA is clearly the only effective solution to metals problems.

VERSENE products are also used in indirect food applications

In addition to the direct uses for VERSENE food-grade EDTA products, a number of indirect food uses for other VERSENE chelating agents are allowed by the FDA and USDA. For example, VERSENE products are used for scale removal in food processing lines. This technique is widely practiced in the brewing industry to remove calcium-derived precipitates (beer stone). Unlike acid cleaning, flushing with a VERSENE chelating agent removes the scale without attacking system components. Dairy, meat, sugar, and other food processing facilities also use cleaning solutions that incorporate VERSENE chelating agents to clean processing equipment.

Figure 1: Stable Complex between Metal Ion and VERSENE Chelating Agent



Complex between metal ion and EDTA - This illustration shows how the EDTA molecule can block up to six reactive sites on a metal ion, deactivating the ion. The highly stable ring structures contribute excellent pH, heat, and light stability to these complexes.

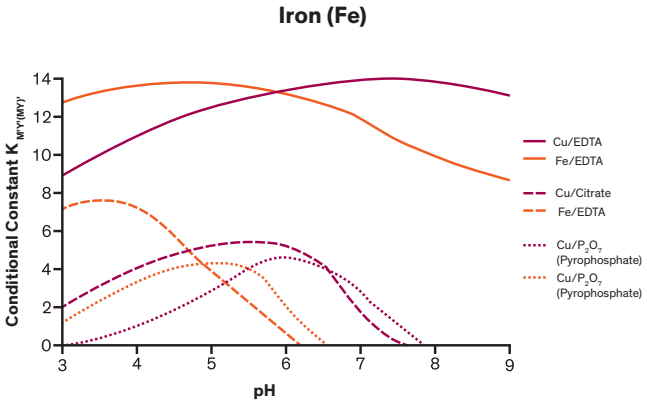


Figure 2: Conditional stability constants versus pH for iron complexes with EDTA, citrate, and pyrophosphate

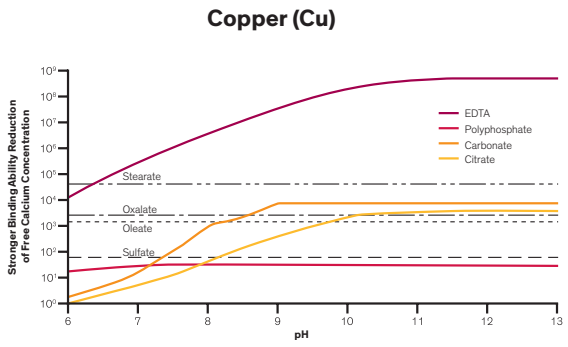


Figure 3: Conditional stability constants versus pH for copper complexes with EDTA, citrate, and pyrophosphate

Other indirect food applications include food packaging materials; cleaning, sanitizing, and laundering formulations; lubricants; and a number of others. For more information and a complete listing of indirect food uses for VERSENE™ products, call the phone number for your region listed on the back of this brochure.

Where to use VERSENE CA and VERSENE NA chelating agents
Listed on the next page are specific U.S. FDA-allowed uses as well as a number of uses in which EDTA has demonstrated utility but which are not currently allowed by the FDA. Several applications are allowed in Europe by EU regulations. These are noted in Table 1. Clearances for food-grade EDTA exist in Canada, Japan, and many other countries. Contact Dow at the numbers on the back of this brochure for more information. New product applications require that a petition be filed with the FDA. If you are interested in developing an application for EDTA in food, our Technical Service and Development team for VERSENE products will be happy to assist you in your developmental work.

Two versatile food-grade products to meet your needs
The availability of two VERSENE food-grade EDTA products gives you excellent formulating flexibility. Both products are white crystalline powders which dissolve readily in water. Both are essentially odorless, colorless, and tasteless at recommended use levels. And, both products are certified by the Orthodox Union as Kosher and Pareve for Passover use.

VERSENE CA food-grade EDTA is highly purified calcium disodium EDTA which meets all requirements for Calcium Disodium EDTA as specified in the Food Chemicals Codex.

VERSENE NA food-grade EDTA is highly purified disodium EDTA which meets all requirements for Disodium EDTA as specified in the Food Chemicals Codex and for Edetate Disodium as specified n the U.S. Pharmacopeia.

Unsurpassed quality and consistency through our total quality assurance plan
Quality is the standard achieved by products that give you the same result every time. That's the standard we set for VERSENE chelating agents. It's a standard maintained by everyone involved in our chelating agent business, from our sales, marketing, and technical service representatives through our teams of manufacturing, packaging, and shipping personnel.

At the heart of this program is a dedicated quality assurance plan that helps us maintain the highest possible quality and consistency for VERSENE products. Every aspect of production and distribution is carried out according to a formalized quality control plan which documents each action that must be taken to meet predetermined product specifications. VERSENE CA and NA food-grade products are produced under current Good Manufacturing Practices (cGMP) and are certified by the Orthodox Union as Kosher and Pareve.

VERSENE food-grade EDTA products are packed in 100-pound fiber drums which are sealed and locked with tamper-evident locks to further ensure their integrity and purity.

We'll help you get the most out of VERSENE products

The sophisticated PIMIC™ modeling service – This exclusive Dow service is based on a proprietary metal ion control computer modeling program that helps our Technical Service and Development experts understand the impact of proposed chelant treatment programs on the specific metals in your system. The PIMIC service is based on the principles of solution equilibrium chemistry. A computer program at the heart of the PIMIC service draws on a database of 2,700 equilibrium reactions to calculate which chelant or combination of chelants will most effectively inactivate the metal ions in your system. The result is valuable data that can minimize your laboratory work and help you determine the best route to take to solve your problem. To put the PIMIC service to work on your problem, contact your Dow Technical Service and Development representative.

Table 1: Applications for VERSENE™ CA and VERSENE NA Chelating Agents

Application	FDA Allowed Uses[1]	EU Cleared Uses[2]	Potential Uses	Typical Benefits of EDTA
Dressings, Sauces & Spreads	• Salad dressings • Dressings • Sauces • Sandwich spread • Mayonnaise • Oleomargarine • French dressing	• Emulsified sauces • Minarine	• Toppings • Dips	• Improves flavor retention and shelf life by inhibiting oxidation of fatty oils (rancidity)
Beans	• Canned chickpeas • Canned kidney beans • Canned red beans • Canned pink beans • Dry limas • Canned black-eyed peas • Dry pinto beans • Fava beans • Other bean varieties	• Canned and bottled pulses and legumes	• Peas	• Improves natural color retention during processing and storage
Potato Products	• Frozen white potatoes • Canned white potatoes • Potato salad			• Inhibits end-stem graying in canned potatoes • Inhibits after-cooking darkening in frozen potatoes • Improves shelf life and flavor retention in potato salads
Beverages	• Carbonated beverages • Distilled spirits • Beer		• Teas • Fruit juices • Vegetable juices • Sports drinks • Fruit drinks	• Stabilizes color, flavor, clarity, and vitamin content
Seafood	• Canned clams • Canned crabmeat • Canned shrimp • Canned gefilte fish	• Canned and bottled fish, crustaceans and mollusks • Frozen and deep frozen crustaceans	• Canned fish • Canned lobster • Fresh and frozen fish fillets • Fresh shrimp	• Inhibits discoloration and off-flavors caused by iron, zinc, tin, and copper • Retards formation of struvite crystals (magnesium ammonium phosphate) • Slows spoilage of fresh/frozen products
Pickled Vegetables	• Pickled cabbage • Pickled cucumbers		• Other pickled vegetables	• Promotes retention of color, flavor, and texture • Reduces pigment bleaching • Protects fresh taste after opening
Fruits & Vegetables	• Canned mushrooms • Dried bananas • Strawberry pie filling	• Canned and bottled mushrooms and artichokes	• Fresh or canned pineapples • Fresh mushrooms • Canned corn • Canned sweet potatoes and yams • Other fresh or canned vegetables	• Inhibits surface darkening and discoloration • Improves flavor retention
Miscellaneous Food Uses	• Hard-cooked egg products • Pecan pie filling • Cooked sausages • Spice extracts • Non-nutritive sweeteners • B12 vitamin solutions		• Lard • Dairy products • Fresh/frozen, and processed beef, pork, chicken, turkey	• Longer shelf life • Better retention of color, flavor, texture, and nutritive value

Expert technical support – In addition to valuable lab services, we also provide dedicated technical service support for VERSENE™ products. This support is available to food technologists and food processing personnel who need assistance with product development in the lab, or in solving a production problem in the plant. Dow's technical support experts for VERSENE food-grade products thoroughly understand food technology and are equipped to determine the optimum, lasting solution to your metal ion problem. Our more than 40 years of experience with food applications for EDTA have provided us with an extensive database of information. If you are interested in pursuing an application for EDTA that is not currently cleared by the FDA, we are prepared to provide you with formulation advice and other technical support necessary to develop your application for FDA approval.

Safety Data Sheets (SDS) provide detailed information on safety and handling considerations for each VERSENE food-grade product. These sheets are available on request, are included with each product order, and are also shipped with samples. Please call the phone number for your region listed on the back page of this brochure to request copies of these SDS.

Comprehensive technical and application literature – Detailed and up-to-date information about specific food applications for VERSENE food-grade products is provided in a series of technical data sheets published by Dow. These sheets include information on the use of EDTA in dressings and sauces, canned vegetables, seafood, beverages, and pickled foods. To obtain information about these and other applications, call the phone number for your region listed on the back page of this brochure, or ask your Dow representative.

Our excellent distribution network – our network of national and independent distributors is the largest in the industry. This means that when you specify VERSENE food-grade EDTA products, you get the advantages of local inventories, convenient quantities, and distributor service tailored to your needs.

For more information, complete product literature, and samples

Find out more about how VERSENE food-grade EDTA products can help you protect the value of your food products. We'll be happy to answer your questions, provide additional applications literature, and send samples of VERSENE products for your evaluation. Call the phone number for your region listed on the back of this brochure today. Because the sooner you get started formulating with VERSENE, the sooner you'll start getting reliable, cost-effective protection against detrimental metal ion reactions.

Why EDTA is the only answer for metal ion control in foods

- Protection for the flavor, quality, and nutritive value of your foods
- The only chelants effective under typical food conditions
- Improved shelf life and consumer appeal
- No added flavor or color
- Excellent temperature, light, and pH stability
- Effectiveness at low concentrations helps you to reduce ingredient costs
- A long history of success in many food applications

Why Dow is your best source for food-grade EDTA products

- Unsurpassed quality and consistency of all VERSENE™ products
- Two food-grade products – VERSENE CA and VERSENE NA
- The PIMIC modeling service
- Expert technical support
- Comprehensive technical and applications literature
- Our excellent distribution network

For specific applications information literature and samples of VERSENE products, contact us

Contact Dow at the numbers below for more information on VERSENE food-grade EDTA products. We'll be happy to send you the latest information for your specific application as well as samples for your developmental work. If you have questions, a technical representative will be glad to assist you.

For more information, contact us at your convenience:

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