



ACTIVA® General Information

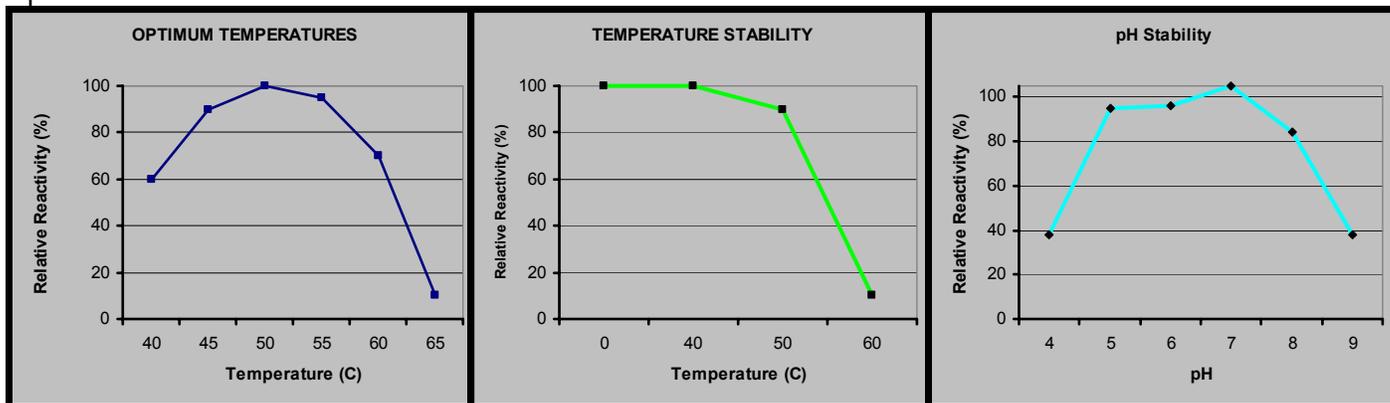
Transglutaminase Basics

What is *Activa* ?

Activa® transglutaminase, an enzyme with the ability to cross-link proteins. It is produced by a microbial fermentation of a naturally occurring organism. Various forms of transglutaminase are found in animal, plant and microbial sources. *Activa* is a calcium-independent form of the enzyme and this characteristic gives it certain advantages in many food systems.

How does it work ?

Activa transglutaminase is an enzyme with the ability to cross-link proteins through covalent bonds. The two amino acids that it uses to cross-link are glutamine and lysine. Any protein or combination of proteins that contains a sufficient amount of these two amino acids may be effectively cross-linked. This calcium independent form of the enzyme consists of 331 amino acids, with cysteine as the active center.



- Temperature Range 32 to ~150°F
- Optimum 122-131°F(50-55°C)
- Inactivated at different rates
- Depends on the conditions
- Optimal pH 6-7
- pH Range 4-9

Under what conditions does it function ?

Activa transglutaminase has a relatively wide range of application conditions:

- ◆ *Activa* is active over a fairly wide pH range and at pH values that are typical for many food systems.
- ◆ *Activa* is active over a broad temperature range, even during the early stages of cooking. This temperature range makes *Activa* more versatile for use in processes where some of the conditions may be extreme.
- ◆ Although active at higher temperatures, *Activa* is inactivated during cooking processes, when the temperature is sufficient. The inactivation temperature varies with the conditions and composition of the food system.

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Transglutaminase Basics (cont'd)

Reactivity of Activa® with Various Proteins

MILK	
Casein	Reacts very well
Na-Caseinate	Reacts very well
α-Lactalbumin	Reacts depending on conditions
β-Lactoglobulin	Reacts depending on conditions
EGGS	
Egg White Protein (ovalbumin)	Reacts depending on conditions
Egg Yolk Protein	Reacts well
MEAT	
Myoglobin	Reacts depending on conditions
Collagen	Reacts well
Gelatin	Reacts very well
Myosin (myofibrillar)	Reacts very well
Actin (myofibrillar)	Fair to poor reaction
SOYBEAN	
11S globulin	Reacts very well
7S globulin	Reacts very well
WHEAT	
Gliadin	Reacts well
Glutenin	Reacts well

Activa® Preparations

Activa transglutaminase has potential application in most food systems which contain protein. Using additional components, Activa can be customized for use in many other foods, even those with lower protein content. Current Activa preparations have been specifically designed for the following applications:

- ◆ **Activa RM** Specifically designed to restructure muscle foods such as red meat, poultry and seafood, this form also has application in other food products which have lower protein content. The main components of this preparation are: sodium caseinate, maltodextrin, and transglutaminase.
- ◆ **Activa TI** This preparation was designed to improve the general texture in many different systems which contained sufficient protein. The central components of this preparation are maltodextrin and transglutaminase.
- ◆ **Activa FP** Designed for flavoring and restructuring meat products. Works well as a slurry or when added during mixing or tumbling but is **not** intended for use as a dry sprinkle. Its principle components are hydrolyzed skim milk protein and transglutaminase.
- ◆ **Activa GB** Formulated to quickly bond meat product surfaces, Activa GB has little or no allergen concerns. It is for use either as a dry sprinkle or during mixing or tumbling but **not** as a slurry. GB is composed of maltodextrin, gelatin, silicon dioxide, and transglutaminase.

Please contact AFI LLC for the current approval and labeling status regarding the application that is of interest to you.

The information contained herein is correct and accurate to the best of our knowledge. All suggestions and recommendations are made without guarantee or representations relating to results. All formulations, recommendations and/or suggestions made herein should be evaluated in your own laboratories prior to commercial use. Our responsibility and the sole remedy for any and all claims arising from breach of warranty, negligence, or otherwise, is limited to the purchase price of the Ajinomoto Food Ingredients LLC Ingredients. Nothing herein should be considered a license or permit to allow the use of, or to infringe any patent owned by Ajinomoto Co., Inc., and any and all Subsidiaries and Affiliates, or other related parties.

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Regulatory Approvals

GRAS Approvals

FDA has determined that it does not disagree with the conclusions of an expert scientific panel which found *Activa* transglutaminase to be 'Generally Recognized As Safe' (GRAS) for use in all FDA regulated products. The FDA published this opinion as GRAS Notification GN 000095.

Until then, previous notices of a variety of food products including selected meat and poultry products, processed seafood, processed cheeses, natural hard cheeses (domestic), cream cheese, refrigerated yogurt, frozen desserts, vegetable protein dishes/vegetarian burgers/meat substitutes, pasta, bread products, pastry products (cakes, pies, doughnuts, etc.), ready to eat cereal products, pizza dough, and grain mixtures (burritos, tacos, etc.) using *Activa* at various levels can be found in GRAS Notices 4, 29 and 55.

FDA has also determined that the term 'enzyme' should be used in the ingredient statement of a product to indicate *Activa's* presence. Please note that the regulation limits the amount of enzyme which may be used to that amount needed to achieve the intended function, or GMP levels.

Meat and Poultry Approvals

Activa transglutaminase is approved for use in the following categories.

- ◆ All Modified Fat/Sodium processed meat products at levels up to 65 ppm transglutaminase.
Approved by USDA 2/28/98.
- ◆ All Non-standardized meat and poultry products at 65 ppm transglutaminase.
Approved by USDA on 5/15/98.
- ◆ Currently approved **Standardized Meat and Poultry Products**
 - Fabricated Steaks (CFR 319.15 (d)) *
 - Roast Beef Parboiled and Steam Roasted (CFR 319.18)*
 - Cured Pork Products (CFR 319.104)
 - Hams, shoulders, picnics, butts & loins
 - Hams includes 'Hams Water Added', 'Ham with Natural Juices', 'Ham and Water Product- X% of weight is added ingredients'
 - Frankfurter, Frank, Furter, Hotdog, Wiener, Vienna, Bologna, Garlic Bologna, Knockwurst, & similar products (CFR 319.180)
 - Poultry Rolls (CFR 381.159)
 - *- Name requires some indication that the product is made from more than a single piece of meat.

USDA has determined that *Activa* should be indicated on the product label using any of the following terms: 'enzyme', 'TG enzyme' or 'TGP enzyme'.

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Regulatory Approvals (cont'd)

Additional Approval in Formed Chicken Breast

Because of the characteristic of chicken breast to bind weakly at currently approved doses, Ajinomoto petitioned for increased use levels in chicken breasts using support data. USDA-FSIS responded and will allow *Activa* to be used at up to **100 ppm in this product**. The limit for other meat and poultry products still remains at 65ppm. A copy of the reference letter from USDA-FSIS is available upon request.

Seafood Approvals

Activa has also been accepted as a safe ingredient for use in processed seafood by the National Marine Fisheries Service, a division of the U.S. Department of Commerce.

- *Activa* is approved for use in all processed seafood products..
- The word 'enzyme' is the appropriate term to use in the ingredient statement.

Approvals in Mexico

- *Activa* is approved for use in food products within Mexico.

Approvals in Canada

- Health Canada published a proposed regulation in the Canada Gazette Part 1 on June 21, 2003 allowing the use of *Activa* transglutaminase in the following categories of food:
 - Prepared fish products (non-Standardized)
 - Simulated meat products
 - Cheese products (non-standardized)
 - Cream Cheese products (non-standardized)
 - Yogurt
 - Frozen Dairy dessert (non-standardized)
- On May 5th, 2004, Health Canada published the final approval of transglutaminase in the Canadian Gazette Part II will allow use of *Activa* in the above categories. Canadian processors can now sell products containing *Activa* transglutaminase.
- Although requested, Meat and Poultry products were not included in this initial approval. Ajinomoto is working with Canadian processors to develop a request for Interim Marketing Authorization to allow the manufacture meat products made using *Activa* products. Please contact us for additional information, or requests for possible additional approvals for use of transglutaminase.

Please contact Ajinomoto for the current approval and labeling status of your particular application.

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Activa® in Red Meat Applications

Activa® transglutaminase products can transform raw beef materials into value-added products without using excessive amounts of salt or phosphates. Lesser valued, tough cuts can be mechanically tenderized and formed into almost any natural shape by including *Activa* in the process. *Activa* can also provide improved portion control. Benefits include:

- Value addition to trim
- Raw restructuring muscles of any size
- Portion control
- Raw handling of restructured products
- Texture modification

Joined Whole Muscle

Activa can aid in the portion control of beef tenderloins by joining two tenderloins from head-to-tail, essentially eliminating the tapered ends. If traditional portioning of the large end of the tenderloin is desired, *Activa* can be used to recover value from the tenderloin tail through restructuring. *Activa* can also add value to trimmings from processing lines in steak cutting operations.

Restructured products can be portioned in a variety of ways which range from traditional shapes and thicknesses to thinner, sandwich-style slices and even into portion-controlled kabob items.

Through fiber alignment, thinner cuts of meat can be layered to create products that replicate the natural appearance and texture of whole muscle cuts.

Cold Formed Products

Activa has great potential for improving or maintaining the current texture of tenderized or flaked products. If a reaction time is allowed before heating or freezing, these products have texture superior to those formed in traditional ways.

Sausages

Activa's ability to cross-link protein enables processors to increase the bite characteristics of emulsion and coarse ground products. *Activa* is even more effective in reduced sodium systems where lower salt and phosphate levels typically do not allow adequate protein extraction. Inadequate protein extraction can result in undesirable product texture.

Ham and Roast Beef

The addition of *Activa* preparations can improve the slicing of a variety of products. In hams, where weak seams sometimes result in shattering during slicing, *Activa* increases the strength and improves slicing. In restructured roast beef, as in other traditional restructured products, *Activa's*

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Activa® in Red Meat Applications (cont'd)

cross-linking action can improve bite characteristics and increase yield.

Novel Applications

Restructured dry cooked products such as pastrami are also improved with *Activa* products. In addition to portion control, alternate raw materials such as trim and smaller pieces, can be used to create value-added products. In these applications, spice and other coatings can be applied to the restructured products before they are cooked.

- Bacon Wrapped Products: With the addition of *Activa*, bacon will adhere to the outside of steaks or restructured meat cuts. Because the adhesion is maintained throughout cooking, processors can avoid the potential liability involved in using wood skewers or metal pins.
- Restructured Portion Controlled Items: With *Activa* preparations, restructured items like fajita meat, kabobs and Philly-style sandwich meat (cheese steak) can be effectively produced. Gyros and other ethnic applications can also be made using *Activa* reducing the number of cone failures.

Cooked Products

Activa's cross-linking capabilities make it suited to cooked products. Leftover ends from slicing operation can be formed, cooked and sliced when *Activa* is included in the formulation.

Processing Conditions:

Unlike many other ingredients, *Activa* is compatible with a variety of processing equipment and processing flows. Depending on the preparation, *Activa* products can be introduced to meat products in several ways including:

- Slurry addition
- Marinade and dry addition
- Mixer addition
- Sprinkle addition

Depending on the desired texture, bind and handling characteristics, *Activa* can be adapted to most processing conditions.

NOTE: *Activa's* successful use in a product is also determined in part by which *Activa* preparation is used. The preceding applications are possible with a number of the different *Activa* products. Depending on your processing conditions, one product may be better suited for you. **Contact Ajinomoto Food Ingredients Technical Service to help determine which *Activa* product is the correct one to use in your particular application.**

Ajinomoto Food Ingredients LLC is currently seeking approvals on some of the applications cited in this literature. Many approvals have been granted while others are being reviewed. Please contact Ajinomoto for the current approval and labeling status regarding the application that is of interest to you.

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Seafood Applications

Fish

Using *Activa* transglutaminase makes portioning quick and easy, even on raw materials that vary in size.

- **Block/Formed Logs-Molded Products:** With the addition of *Activa*, processors can bond smaller pieces of fish into larger blocks/logs that may be cut for portion control. Or, the joined product could be shaped into forms that mimic some of the natural cuts of larger fish. Without the tapering found in natural fish cuts, these formed products allow uniform portioning. These formed products have the muscle grain, flake and texture which are essentially the same as natural fillets.
- **Pieces/Restructured Fillets/Married Fillets:** By adding *Activa*, two smaller fish portions or fillets can be joined (married). In this process, one side of each fillet is dusted with *Activa* RM or GB. The dusted surfaces are then placed together and allowed to react for a period of time. Pressure or vacuum packaging will also further improve the bind by removal of any trapped air. Essentially, the portion size is doubled while the bonding is maintained through the cooking process. Other combinations of processing methods may also be used to achieve this result; for example: a marinated product may be married using *Activa*.

Scallops

Although scallops are a very seasonal item with a great deal of variation in size, a consistently textured scallop that is easily portion-controlled can be produced using *Activa*. *Activa* also allows restructured scallops to be handled in their thawed state.

- **Reformed:** *Activa* enables the production of large scallops formed from smaller species, like Chilean, Calico, Chinese bay or Argentinean scallops. Additionally, they can be portion controlled into anything from the size of a sea scallop to giant “center of the plate” items.
- **Married Scallops:** The slurry method of adding *Activa* can be used to join 3 sea size scallops into a super scallop possessing natural fiber alignment.
- **Scallop Blocks:** *Activa* adds versatility to scallop processing by forming block items that can be portioned on fish processing equipment.



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Seafood Applications (cont'd)

Shellfish

- Shrimp: Married/Joined, Patties, Blocks (Best if blanched) – always a difficult food to portion given the variability in sizes during the harvest, shrimp can be processed into value-added patties with *Activa*.
- Calamari: *Activa* helps maintain portion control of calamari products. The texture of extruded calamari rings, which are steadily increasing in popularity, is also improved.
- Clams: With the addition of *Activa*, minced clams or clam pieces can be formed into patties or strips.

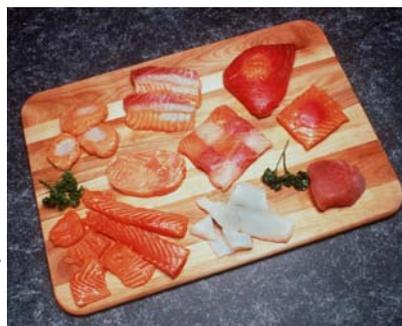
Surimi

- Block-Set Items: *Activa* is very effective in increasing the gel strength of products produced by the traditional Suwari process. *Activa* also allows use of less costly grades of surimi for the production of higher quality items.
- Lower Grade Items: *Activa* can be used to increase the gel strength of lower grade surimi, providing a more consistent product.

Combination Products

For marketers interested in creating innovative products, *Activa* is the ideal vehicle. Fish having different colors and textures can be joined to create novel products with texture and eating characteristics that make them appear to be naturally produced.

Depending on the desired texture, bind and handling characteristics, *Activa* can be adapted to most processing conditions. Successful adaptation is also determined in part by which *Activa* preparation is used.



Contact Ajinomoto Food Ingredients LLC for information on which preparation is best suited for your particular application.

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Poultry Applications

Activa® transglutaminase is very effective in binding applications across the full spectrum of poultry varieties. It is compatible with existing processes and equipment and provides the following benefits:

- Added value to trim
- Effective in raw restructuring
- Improves portion control
- Modifies texture
- Replicates appearance and taste perception of high quality, whole muscle chicken breast and thigh items
- Improves products containing mechanically deboned meat
- Creates new product opportunities

Restructured Breast and Thigh Products

Activa provides processors with the ability to add value to trimmings. New products can be manufactured that offer eating quality similar to that of whole muscle products. Manufacturers who include *Activa* in their formulations can forecast portioning operations in their plants to achieve production efficiencies.

Restructuring can be combined with marinating to add further value to poultry products. Restructured products can be stripped into fajitas, cubed into kabobs, or thinly sliced for Philly cheese steak. Ethnic specialties like shabu-shabu can also be made from restructured muscle. All of these maintain product integrity during the raw, frozen and/or thawed state.

Bacon Wrapped Turkey Medallions

Activa is also effective for restructuring turkey breast, tenders or breast trim into steak-like items that are bacon wrapped. In addition to the restructuring process, the adhesion qualities of *Activa* keep the bacon attached to the product throughout the cooking process. Processors can avoid the potential liability involved in using wooden skewers or metal pins.



Restructured Dry Cooked Items

Until the advent of *Activa*, producing a coated restructured product was a very difficult task, unless the coating step followed cooking. With *Activa*, muscle chunks can be joined into loaves and allowed to react. Product can then be cooked in the traditional way.

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Poultry Applications (cont'd)

Improvement of Co-Extruded Items

Because *Activa* has the ability to cross-link and strengthen the structure of meat products, it may be used to increase the strength of the meat portion of restructured products like Cordon Bleu. Specific preparation of *Activa* may even be able to help prevent the cook-out associated with the baking of these items.

Cold Formed Texture Improvement

When included in cold forming formulations (CO₂ chilled), *Activa* brings product texture much closer to that of whole breasts than the current standard. When allowed to react before or during cooking, this effect is even more pronounced.

Novel Applications

All of the previous applications can be applied to other poultry products including duck, emu, ostrich and other fowl for portion control and improved texture.

Activa also improves the texture of other soft textured items, including those containing MDM or reduced sodium products.

Depending on the desired texture, bind and handling characteristics, *Activa* can be adapted to fit most processing conditions. Its successful adaptation is also determined in part by which *Activa* preparation is used. Contact Ajinomoto Food Ingredients LLC for information on which preparation is best suited for your particular application.

Regulatory change: March 16, 2004

Because of the difficulty in binding chicken breast, *Activa* can now be used at levels up to 100ppm in restructured chicken breast only. Contact Ajinomoto Food Ingredients LLC for a copy of the letter allowing this change.

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