Organic Materials Review Institute

Genetic Engineering Considerations in

the Evaluation of Inputs for

Organic Farming and Food Processing

A Policy in Development

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Disclaimer
This is a position paper based on work reviewed by the OMRI Advisory Council and Board of Directors to assist the OMRI Review Panel in evaluating brand name products for the OMRI List. It represents OMRI's current policies, but is subject to continuing revision. It has been prepared to encourage dialogue and understanding among the organic community, and to provide some direction in a controversial, and complex subject.

OMRI is interested in receiving comments from the public, other organizations, and the organic community on the positions described. OMRI anticipates continuing to modify policies on GMOs as more information becomes available. Comments should be sent or electronically mailed to:

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This paper includes the following:
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Executive Summary
The organic community now shares a global consensus that Genetic Engineering (GE), Genetically Modified Organisms (GMOs), and their products have no place in organic production, processing, and handling. As organic farming has grown, so has the use of GMOs, as defined by organic standard setting bodies. This dynamic has made the difficult task of determining what is GE or a GMO product even more complex and controversial. Too broad an interpretation of what is and is not GMO will eliminate a large number of inputs and minor ingredients currently used by organic farmers. On the other hand, too narrow of a view one subverts the demands of consumers that organic provide food products that have not been genetically engineered and fails to provide the ecological safeguards expected of organic farming.

Principles
OMRI proposes the following principles guide the decisions:
1. Prohibit intentional release of any genetically modified organism in an organic farming system.
2. Protect organic soil, crops, livestock, and processed food products from genetic pollution by preventing transfer of viable DNA or contamination by any living GE organisms to crops, livestock or into the organic production system.
3. Ensure food additives used in organic production, processing, and handling are not from genetically modified or genetically engineered sources.
4. Avoid the application and use of inputs and ingredients from GE sources.

Implications
- Crops from transgenic plants and products from transgenic livestock are excluded from organic production systems by existing standards.
- Direct products of recombinant DNA methods, such as killed microbial pesticides, enzymes from genetically engineered bacteria, and GE agricultural products are clearly prohibited.
- Crop production inputs made from commodities and products that may or may not incidentally be derived from GMOs will require a case-by-case review by the OMRI Review Panel and Advisory Council according to a flow-chart and decision tree. Such a review will ask a series of questions as to whether or not the genetically engineered nature of the product may have an adverse effect on the organic integrity of the land, crop, animal, food, or fiber that is produced or handled with the GMO product.
- Manure from conventionally raised animals may be used in organic crop production as long as the animal producing the manure is not itself transgenic.
- Feed for organic animals must be organically produced from non-GE sources. Nutritional supplements fed to organic livestock that are explicitly allowed from non-organic sources, such as vitamins, minerals, and probiotics must be from non-GE sources.
- Beneficial organisms, animal health care products, and fermentation products must be produced from non-GMOs, but may be cultured in conventional media from commodity sources.
- Processing aids and incidental ingredients that modify the food and are in direct food contact cannot be from GMOs. Processing aids not in direct contact with the organic ingredients and that do not modify the food in question are not considered to be part of the organic food system.

OMRI recognizes that this subject is controversial, and welcomes questions, comments, and suggestions. As both the organic community and genetic engineering continue to evolve, we have to recognize that we must co-exist for the foreseeable future. Organic producers, processors, consumers, and certifiers need clear, consistent, and practical guidelines and interpretations if we are to continue to produce organic food.
OMRI’s Operating Manual
The OMRI Operating Manual provides policy information to the public, manufacturers (product suppliers), and certifier subscribers. It includes instructions to applicants as to what the requirements are for product application. The following changes were approved as Interim Policy by the OMRI Board and will be incorporated into the next edition (December 2000). These changes are effective immediately with the understanding that the policy may be modified as more information is acquired and as the technology and market evolve.

Genetic Engineering
OMRI does not list brand name products directly produced through genetic engineering.

“Genetically Engineered” (GE) is defined as made with techniques that alter the molecular or cell biology of an organism by means that are not possible under natural conditions or processes. Genetic engineering includes recombinant DNA, cell fusion, micro- and macro-encapsulation, and the following results when achieved by recombinant techniques: gene deletion and doubling, introduction of a foreign gene, and changing the positions of genes. It does not include traditional breeding, conjugation, fermentation, hybridization, in-vitro fertilization, or tissue culture.

“Directly produced” means that products are derived from genetic engineering techniques, cannot be produced otherwise, and have a potential to express the trait that has been added by such techniques.

When reviewing products for crops and livestock, OMRI asks the following key questions about all ingredients to determine if a product is directly produced and therefore prohibited. If any of these are answered yes, the product will be considered a direct GE product:

1) Is the product a live organism, and either genetically modified or derived from a genetically engineered organism (see “genetically engineered” definition above)?
2) Can rDNA be transferred from the brand name product to a live organism?
3) Is the brand name product made in such a way that requires the source organism to be genetically engineered?
4) Is the source’s GE trait expressed in the final product? (e.g., Bt toxin in GE cottonseed flour)

Examples of direct products for crop and livestock use that are considered to be genetically engineered:

- Living genetically modified organisms.
- Encapsulated products that result from gene transfer into killed microbes.
- A GE crop by-product that expresses the genetically engineered trait. For example, cottonseed meal that contains the Bt gene and is applied directly to a crop as an insect feeding stimulant.
- Feed additives for livestock that contain GE agricultural products.

Examples of indirect products for crop use that are not considered to be genetically engineered:

- Substrate for a non-GE microbe, enzyme, etc., that may contain non-organic commodity crops (i.e., corn, soy).
• Oils derived from non-organic or non segregated source crops (OMRI considers that the GE traits will not be expressed in a refined product)
• Manure from non-organic animals.
• Crop products such as soy meal used for fertilizer, unless evidence of a risk of GE trait expression is found. (e.g., new evidence of risk of Bt toxin persistence in soil)

When reviewing products for processing, OMRI asks the following key questions about all ingredients to determine if a product is directly produced and therefore prohibited. If any of these are answered yes, the product will be considered a direct GMO product:

1. Is the product a live organism, and either genetically modified or derived from a genetically engineered organism (see “genetically engineered” definition)?
2. Does the product contain modified DNA that will be incorporated into a product for human consumption?
3. Is the brand name product made in such a way that requires the source organism to be genetically engineered?
4. If the GMO component is an incidental additive, is it in direct contact with the final product?
5. Is the GMO component intact (not consumed or biologically transformed)?

Additional Considerations
After a product passes through the above questions and is considered to not be genetically engineered, OMRI will consider specific factors related to use and application.

Crops:
• Is the product used in a way to avoid direct contact with the edible parts of the crop?
• Is the product composted or otherwise metabolized by a non-GE organism before application?
• Is the product processed in some way that denatures or metabolizes the GE protein?

If the answer to any of these questions is ‘No,’ OMRI may consider the modified trait to be expressed in the final product and therefore prohibited as a direct product of a GE.

Livestock:
• Is any ingredient a GE product?
• Is the product for health care?
Note: Genetically engineered animal medications are unresolved by OMRI at present.

Application Requirements
Applicants must supply supporting documents to verify the claim that this product is “a non-GE product.” This includes varieties or cultures used as sources for a given ingredient; appropriate tests to identify rDNA sequences or traits; and source ingredient and final product labels. See the appendix for a sample GE declaration.

GMOs and the OMRI Generic Materials List
OMRI annually publishes a booklet containing OMRI listings for generic materials used in organic production, processing, and handling, as well as the OMRI Brand Names Product List. The following changes to the generic listing for Genetically Engineered Organisms in crops, livestock,
and processing sections were approved by the OMRI Board and will be incorporated into the OMRI 2001 list.

**P  Genetically engineered organisms:** The use of genetically engineered organisms or their direct products are prohibited in any form or at any stage of production, processing or handling. OMRI currently uses this definition of genetic engineering, “made with techniques that alter the molecular or cell biology of an organism by means that are not possible under natural conditions or processes. Genetic engineering includes recombinant DNA, cell fusion, micro- and macro-encapsulation, and the following results when achieved by recombinant techniques: gene deletion and doubling, introduction of a foreign gene, and changing the positions of genes. It does not include traditional breeding, conjugation, fermentation, hybridization, in-vitro fertilization, or tissue culture.” Also referred to as “Genetically Modified Organisms” or GMOs.

**Additions to the OMRI Operating Manual Glossary**
Definitions related to the GMO decision tree

**Culture** - A microorganism, tissue, or organ growing on or in a media.

**Genetic Engineering (GE)** - Refers to a variety of methods used to genetically modify organisms or influence their growth and development by means that are not possible under natural conditions or processes and are not considered compatible with organic production. Such methods would include recombinant DNA, cell fusion, micro- and macro-encapsulation, and the following results when achieved by recombinant techniques: gene deletion and doubling, introducing a foreign gene, and changing the positions of genes. Such methods would not include the use of traditional breeding, conjugation, fermentation, hybridization, in vitro fertilization, or tissue culture.

**Genetically Modified Organism (GMO)** - A life-form that is the product of genetic engineering.

**Ingredient** - Any substance used in the preparation of an agricultural product that is still present in the final commercial product as consumed.

**Media** - The substance in which an organism, tissue, or organ exists.

**Processing Aid** - Includes: (a) substances that are added to a food during the processing of such food but are removed in some manner from the food before it is packaged in its finished form; (b) substances that are added to a food during processing, are converted into constituents normally present in the food, and do not significantly increase the amount of the constituents naturally found in the food; and (c) substances that are added to a food for their technical or functional effect in the processing but are present in the finished food at insignificant levels and do not have any technical or functional effect in that food. (From 21 US CFR §101.100, US FDA.)

**Substrate** - The portion of a media metabolized by an organism.

**Trait** - A phenotypic attribute that includes both external and physiological characteristics of an organism as determined by its inherited genes, by genetic modification, or as modified by its environment.
**Decision Tree**

To help the OMRI Review Panel, Advisory Council, and Brand Name Product Suppliers, OMRI has designed Decision Tree Flow Charts.¹ These are to be used in the OMRI decision making process of listing brand name products to identify whether specific crops, animals, farm inputs, processing aids, or ingredients meet the definition of a directly produced genetically engineered organism or derivative.

OMRI does not, at the present time, have quantitative rejection levels for GMOs found as contaminants in either GMO-free or organic sources of ingredients.

**Narrative Explanation to Accompany Decision Tree Questions**

Questions on the tree are in *italics*; non-italic text is a descriptive narrative.

1A. Do all of the organisms used to make the product qualify as non-GMO according to OMRI’s Standards?
   
   If any ingredient is directly produced from or by a GMO, then proceed to next question. For example, a fertilizer containing soybean meal that was not segregated as non-GMO could contain some GE source material.

1C. Is the final product a live organism?
   
   This includes live cultures, bacteria, fungi, plants, and animals.

1E. Can DNA be *Is DNA likely to be* transferred from the product to a live organism?
   
   This is a difficult question to answer absolutely in most cases. For example, corn oil from a commodity source used as an adjuvant is unlikely to transfer intact DNA to a crop. A residue of intact GMO crop for instance, present in incidental amounts as original substrate for a microbe produced for pest control might be present in the product.

1G. Is the product made in such a way that requires the source organism to be genetically engineered?
   
   If the ingredient or product is derived from an organism that could be either GMO or non-GMO, e.g., a soy derivative, the answer is no. If it is from an organism that can only be GE, such as a novel bacteria engineered to produce a certain protein or enzyme, the answer is yes, so it is prohibited.

1I. Is the source’s GMO trait expressed in the final product?
   
   While traits may appear in some products used as inputs, they may not appear in others. If a plant has been genetically engineered to produce a pesticide such as the Bt toxin, and the cottonseed meal contains Bt, then the trait is in the final product. If the soybean’s GMO trait is herbicide resistance, then a meal applied as a nitrogen source does not express that trait. If a fungus is genetically modified to more efficiently produce an enzyme, then the enzyme is the trait and the final product as well.

For Crops:
2A. Is the product applied to soil, crop, or neither?
   This is based on a difference between direct contact with the plant rather than being cycled through the soil.

2B. Applied to Soil
   Plant by-products from conventional commodity sources--such as soybean meal or cotton gin trash--are generally reviewed as non-GMOs when applied to soil.

2C-2E. Is the product applied directly to soil or is it composted first?
   Composting is considered a biological process where non-GMOs consume and metabolize any potential GMOs. See the OMRI definition for composting.

2F. Does the GMO trait cause detectable, measurable adverse impact on soil organisms?
   If a product’s GMO trait remains in the product after it is applied to the soil, and that trait can be shown to harm soil organisms, then the product proceeds to 2L, prohibited.

2G. Product is not applied to either crop or soil.
   If the product is a production aid used outside the organic farming system, then it is evaluated as a non-GMO.

2H. Applied to Crop.
   Items such as soy oil or cottonseed flour used as spray adjuvants, or amino acids used as chelating agents for micronutrients may come into direct contact with organic food without an intermediate stage. For this reason, some applications might be considered the direct application of a GMO.

2I. Is the protein removed, denatured, or deactivated before application?
   If there is no protein (2J), then the risk related to the release is considered insignificant.

2L. Does the intact protein pose a potential risk to human health or the environment?
   If an intact protein is present in the final product (2K), then the Advisory Council may be asked for its opinion as to whether or not this poses a risk to either human health or the environment--e.g., exposure to the Bt toxin from a GMO source or allergenicity.

2M. Evaluate as a non-GMO.
   If a product does not meet any of these criteria, it will then be evaluated as a non-GMO. The Advisory Council may be asked for its opinion as to whether or not any material that does not fit the flowchart is a GMO or GMO derivative, particularly with respect to steps 2F and 2I.

2N. Prohibited.
   Products that are considered GMOs after this series of tests are prohibited.

For Livestock:
Livestock considerations are more complex because they rely on the outcomes of both crop production and processing.

3A. Does the product fit in any allowed category for livestock nutrition, health care, or as a production aid?
To be considered any further, the product must fit into a category that is allowed for organic production—either livestock nutrition, health care, or a production aid. A growth hormone would be prohibited, even if derived from a non-GMO source organism.

3B. Nutrition
This includes all products that are defined as livestock feed additives.

3F. Health Care / Production Aid
All other materials allowed in organic livestock production follow this branch of the flowchart. This includes animal drugs, parasiticides and pest controls, and all production aids.

3C. Is the material an allowed [or regulated] non-organic feed additive?
Feed ingredients must be organic or be on the allowed or regulated list.

3G. Is the material natural or an allowed [or regulated] synthetic medication?
Health care products must either be natural or on the list of allowed or regulated synthetics in order to qualify for administration to organic livestock.

3H. Is the active ingredient a GMO product?
If the active ingredient is a GMO derivative, then the product is considered a GMO and is prohibited.

3E and 3I. Review as non-GMO
Products that do not have any of the identified characteristics associated with GMOs are evaluated as non-GMOS. The Advisory Council may be asked for its opinion as to whether any feed ingredient, livestock health care product, or livestock production aid may be considered a GMO or GMO derivative.

3J. Prohibit
Products that are considered GMOs using this criteria are then prohibited. Exceptions can be made only in declared emergencies. This would include a weather-related feed shortage that permits the temporary feeding of non-organic feed, or an epidemic where the use of a vaccine is required by considerations of public health. Products allowed on an emergency basis will not be OMRI listed, but are under jurisdiction of certification agent (inspection body).

For Processing:
4A. Is the product an Allowed [or regulated] Non-organic Ingredient or a Processing Aid?
Non-ingredients include processing aids and incidental additives as defined by US Food and Drug Administration regulations at 21 CFR.

For allowed [or regulated] non-organic ingredients (4B):
4D. Is the potentially GMO portion consumed or biologically transformed by a non-GMO to an incidental amount?
If some portion of the product may be from a GMO source, but is biologically transformed by fermentation or digestion so that intact DNA from a GMO is found only in incidental amounts, then the answer is yes. For example, if the media used to culture a non-GMO fermentation organism contains some GMOs, then the culture or its products would be considered a non-GMO.
For processing aids (4C):

4E. Is the substance made exclusively by or from a GMO?
If the substance was produced only using a GMO source organism, even though non-GMO sources are theoretically possible, then it would be prohibited. For example, microbially derived chymosin is available only from a GMO source.

4F. Are any GMO or potentially GMO additives or carriers put in the product before the ingredient is added to organic processed product? and
4G. Is a GMO or GMO-derived product added to the ingredient as a carrier, filler, or incidental ingredient?
If carriers and fillers may be used in greater volume than a non-organic ingredient, and are added after a fermentation step, the non-GMO policy may apply to what are otherwise considered incidental ingredients. The re-introduction of GMOs before standardization and packaging may negate all the steps taken to avoid the use of GMOs as direct ingredients and in processing aids.

Decision Tree Examples

CROPS

1) Cottonseed Meal
Cottonseed meal is frequently used as an adjuvant to attract and stimulate the feeding of certain target pests of *Bacillus thuringiensis*, particularly lepidoptera. Cotton has been genetically engineered to express several traits, including tolerance to the herbicides glyphosate (Roundup®) and bromoxinil (Buctril®). More importantly, cotton is also genetically engineered to express the Bt toxin. If cottonseed flour or meal is an additive combined with classical, non-GMO Bt for field use, the flow chart makes the following determination:

1A. Cottonseed meal may be produced from a GE source, so the answer is "No" and the review continues to 1C.
1C. The product is not a live organism, so the review continues to 1E.
1E. The probability of DNA transfer is practically nil, therefore the review continues to 1G.
1G. Non-GE cotton can and is grown, therefore continue to 1I.
1I. The GE trait of herbicide resistance is not be transferred directly to the crop to which the flour is applied. However, cottonseed flour could still contain the Bt toxin and this could be a matter of testing. Unless a formulator can document that the cottonseed flour comes from a certified organic source, or demonstrate that a source of cottonseed flour does not contain pesticides— including Bt—then that feeding stimulant adjuvant cannot be listed by OMRI. If the cottonseed flour is certified organic or the test(s) turn(s) are negative, then proceed to 2A.
2A. The additive is applied to crops. Proceed to 2I.
2I. The protein is still in the product. Proceed to 2L.
2L. Since the protein was not removed or rendered non-viable, and Bt trait might be expressed in final product (no determination from testing or audit trail of a non-GMO source), this product would be prohibited.

2) Manure from livestock fed GMOs
1A. Feed inputs are GMO derived, not the livestock, so go to 1C.
1C. While most of the grains would be milled in a way to denature the seed, it is conceivable that undigested whole grains could potentially end up in manure. Therefore, a case could be made to
prohibit at this point. However, one could reasonably assume that the incidental contamination is akin to pollen drift. If this is the case, go to 1E.

1E. Again, the undigested feed in manure, but would not be a transfer per se. A greater concern is the use of antibiotic resistant GMO rhizobial bacteria applied to alfalfa. This organism has perhaps the greatest potential risk of horizontal gene transfer to pathogenic organisms in livestock. Supposing, however, that this is considered incidental, go to 1G.

1G. Livestock produces manure whether or not the grain they are fed is genetically engineered. Go to 1I.

1I. Is the GMO trait expressed in final product? None of the traits of any feed ingredients are directly expressed in the manure. Growers and certifiers concerned about undigested grains becoming volunteers that could contaminate subsequent crops might want to consider composting before application.

3) Soy meal as fertilizer – The trait of ‘Roundup Ready-ness’ is not expressed in soy meal used as a nitrogen source. Therefore, it is not considered a GMO and is allowed for use as a soil amendment.

4) Vegetable oil as adjuvant – Evaluated as a non-GMO and allowed at 2I-->2J.

LIVESTOCK

1) Probiotic Carriers

A number of commercial products are marketed as “probiotics.” These may be fed routinely as part of an animal’s ration as digestive aids. Such a product would be considered a feed additive. Others are administered in a single dose or episodically to confer or boost immunity. These make animal drug claims and are evaluated as health care products.

For example, a probiotic composed of five non-GMO species of bacteria has a carrier made of non-organic soybean meal, molasses, and corn gluten meal; certified organic wheat and whey; and a non-active dried yeast. Several of these components may or may not come from a GMO source. Soybeans, corn, and yeast may all be genetically engineered. The most common trait found in soybeans is tolerance for the herbicide glyphosate. Corn is most commonly genetically engineered to express the Bt toxin.

1A. The soybean meal, corn, and yeast are all potentially from GMO sources, proceed to 1C.

1C. The soybean meal, corn gluten meal, and yeast are all considered to not be alive. Proceed to 1E.

1E. DNA transfer is debatable, and the OMRI Advisory Council is asked for its opinion. Assuming that the answer is "No," proceed to 1G.

1G. Soybean meal and corn gluten meal can be produced from soybeans and corn that are not genetically engineered, so proceed to 1I.

1I. Herbicide tolerance is not expressed in the final product. However, Bt might be expressed in the corn. Perhaps of greatest concern is the nature of the undisclosed yeast – various GMO yeast cultures could be used to enhance production of amino acids, vitamins, and enzymes. Assuming that none of these are present, then the product being used in livestock production will proceed to 3A.

3. The product could be used in either nutrition or health care. OMRI has received applications for both, the difference being the claims that can be made on the label and whether or not they have received a NADA (New Animal Drug Application) from the FDA. If a product is routinely fed, as is the case when mixed with vitamins and minerals, it is considered nutritional use and evaluated at 3C.

3C. Probiotics appear on the proposed US National List. However, corn gluten meal, soybeans, and yeast do not. Soybeans and corn in particular are considered “feed” and as such in the context of animal nutrition would be required to be from organic sources, and would not qualify to be listed on the OMRI list. Carriers used in formulations of micro-organisms must be from organic sources in a feed additive in order to be listed by OMRI without restrictions.
3D. Are all allowed non-organic ingredients non GMO? Non-GMO yeast is an allowed non-organic ingredient. If either the probiotics or the yeast is GMO, then the product is prohibited. If not, then the product is reviewed as a non-GMO.

2) Animal Drugs
Alternatively, if the product is considered an animal drug, the evaluation goes from 3A to 3G.

3G. Probiotics are natural, as are corn gluten meal, soybeans, and yeast used as carriers and substrate for micro-organisms. Because the yeast is inactive, it is not truly a “probiotic” in its mode of action. Soybeans and corn would not be considered “feed” if the dosage was limited to the treatment of a specific illness. Probiotics administered for therapeutic and immune-system stimulation purposes would be considered inoculants for the purposes of organic certification. If the probiotic is registered with FDA as approved for health care label claims, it will be reviewed as a health care material, and proceed to 3H.

3H. As long as none of the active probiotic organisms are genetically engineered, the finished product is not considered a GMO. If any of the active organisms is genetically engineered, then the formulation is prohibited.

3) Vaccines from GE sources are unresolved at this point. OMRI suggests that certifiers may allow them on an emergency basis or in situations where they are required by quarantine or public health regulations, but OMRI will not list such products for routine use pending further deliberations.

PROCESSING
1) Yeast. *Saccharomyces cerevisiae* may be cultured from natural sources, or may be genetically ‘enhanced’ through recombinant techniques. Those that are genetically modified by rDNA techniques would be prohibited at step 1C, while those that are not would be reviewed as non-GMOS.

Yeast foods may be natural, synthetic, GMO, or a combination of the three. The NOSB recommended the prohibition of petroleum as a yeast food, and implied the same for ammonium phosphate. However, at this point, yeast cultured on a commodity corn / soybean substrate would arguably be acceptable, even if a certain percentage of that substrate would be GMO.

2) Chymosin. Enzymes may be derived from naturally occurring bacteria, protozoa, or plants, including a number that can be used to produce cheese. Those derived from non-pathogenic, non-rDNA sources are allowed. The NOSB recommended that the National List include enzymes derived from from animal sources—such as rennet and other enzymes used to make cheese. Chymosin and other enzymes expressly produced by rDNA organisms are prohibited at 1H --> 1J.

As with yeast, the use of rDNA grains or other nutrient sources in the substrate would not necessarily cause the enzyme to be prohibited, and the product would then be reviewed as a non-GMO at 4H.

3) Citric Acid. Citric acid may be produced using strains of a fungus, *Aspergillus niger*, that has been altered by gene doubling to produce greater amounts of citric acid than possible from non-altered strains. At step 1G, the question is asked: Is the product made in a way that requires the source organism to be genetically engineered? In this case, the product is only derived from GMOs, so the answer could be yes, prohibit.

Food Chemicals Codex assay requires citric acid to be not less than 99.5% pure to be labeled as such. If the citric acid is not from an altered strain, then citric acid would pass through the decision tree to 4D,
which asks: Is the potentially GMO portion consumed or biologically transformed by a non-GMO to an incidental amount? This question should be understood to mean that only incidental amounts of non-transformed GMOs might remain in the product.

4) **Substrate used to produce citric acid.** *Aspergillus* spp. fungi can produce citric acid by fermenting large quantities of a crude sugar. Molasses is the typical substrate, but high fructose corn syrup may also be used. If the fungi were not from a GMO source, but the base substrate was from non-segregated corn that is likely contaminated with GMO varieties, should the citric acid be considered GMO?

Running through the decision tree: proceed to 4D. A non-GMO fungus and proceeds to 4H biologically transform the corn substrate, where the final product is reviewed as a non-GMO ingredient.

5) **Lactic Acid Bacteria** from dairy cultures—such as *Lactobacillus* spp.—excrete lactic acid. These organisms may be genetically modified through various techniques. Such a direct application of genetic engineering would not be allowed for use as an ingredient in an organic food product at either 1H or 1J. Dairy cultures are allowed non-organic ingredients (4A) and may be cultured on conventional dairy products as a growth media (4F and example 6 below). Products that are twice removed from a GMO (culture produces bacteria, bacteria produces acid) are not considered direct products of GMOs (4H).

6) **Lactic Acid Substrate** is composed primarily of whey. Commodity sources may contain whey made from milk produced by cows treated with BST and fed GMO grains. However, as long as the lactic acid bacteria that ferment the whey are not GMOs, go to 4J. The lactic acid produced can be used as an allowed non-organic ingredient or processing aid.

7) **Corn Starch** appears on the allowed non-organic ingredient list so proceeds to 4B. High-amylose varieties used to make cornstarch are classically bred (non-GMO) hybrids that are identity preserved, and are commonly segregated. It is possible to test for certain GMO traits in the sources. Corn must be wholly derived from non-GMO sources to pass from 4D to 4F to determine if any GMO carriers or fillers are added to dilute the product. If so, it will be prohibited at 4I. If not, it will proceed to 4H where it can be evaluated as a non-GMO ingredient.

8) **Tocopherols** from soybeans follow a similar path to 4D. If the soybeans test negative at 4D, they can then proceed to 4F to evaluate if any incidental additives that contain GMOs are introduced. If not, they are evaluated as non-GMOs at 4H. If so, they are prohibited at 4I.