

Corn Steep Liquor

Summary

Support the minority position: Corn steep liquor is a synthetic chemical mixture produced by a process in which sulfur dioxide is added to a fermentation process to break disulfide bonds.

More Detail

Corn Steep Liquor and the Evaluation of Materials

Corn steep liquor is a byproduct of wet corn milling, in which corn is processed by steeping in a series of vats containing a dilute solution of sulfurous acid (sulfur dioxide in water). The principal products of wet corn milling are the starch, gluten, germ, and fiber from the corn grain, which are used for various food, feed, and industrial products. Corn steep liquor contains the soluble amino acids in corn, and is therefore considered a rich source of nitrogen.

The issue of determining whether CSL is synthetic or non-synthetic may appear to be a technical issue for experts to decide, of no interest to the organic consumer. But the synthetic/nonsynthetic determination really is a foundational issue in the determination of allowable inputs in organic production. The Organic Food Production Act creates a preference for nonsynthetic over synthetic inputs. Nonsynthetic inputs are presumed to be allowed unless petitioned and found to be unacceptable. Synthetic inputs are presumed to be prohibited unless petitioned and found to be acceptable.

The determination itself of whether an input is synthetic does not always determine whether that input is allowable in organic, but a determination that a material is synthetic ensures that the NOSB carries out its responsibility to review and evaluate whether the use of that synthetic material meets the law's standards of sustainability. Organic integrity is built on the principle of objective review and transparency to ensure that the organic consumers' expectations are being met and that there is a level playing field for all those engaged in organic production.

The explanation of the minority position of the Crops Committee on corn steep liquor is a lesson in the application of OFPA to the evaluation of materials considered for use in organic production.

The Minority Position

The minority's position that CSL must be defined as a synthetic product is actually very straightforward and follows the policies and history of longstanding positions of the NOSB. Simply put, the process of making CSL --the wet milling countercurrent process-- is different than the natural practices that are defined in our standards, expressly because the process requires adding a synthetic chemical to an otherwise natural steeping/lactic acid fermentation process to effect a chemical change, necessary for the end product to be created. So, even

though this process involves corn and a steeping process, the end result would not get that product to where its manufacturer wants without the introduction of a synthetic chemical that breaks chemical bonds and manipulates corn to turn it into something else with distinct functionality. And USDA researchers at the Agricultural Research Service (who do not have a financial interest in this discussion) have confirmed to the Crops Committee that CSL could not be created naturally with biological activity alone or as is allowed in what we have until now understood to be the nonchemical processes, as stated in the organic Rule: “cooking, baking, curing, heating, drying, mixing, grinding, churning, separating, extracting, slaughtering, cutting fermenting, distilling, eviscerating, preserving, freezing, chilling, or otherwise manufacturing and includes the packaging, canning, jarring, or otherwise enclosing food in a container.”

The question is not whether CSL is a good product.

The question before us is whether CSL is synthetic since it is created through chemical change which requires the introduction of a synthetic chemical ingredient. We have been told that CSL is composed of proteins, amino acids, carbohydrates, organic acids (such as lactic acid), vitamins, minerals and water. All this is true. We are told that these components are all readily utilized by animals and microorganisms. And, we’re told that CSL is a nutrient rich product that has been safely used as a component in livestock feed, fertilizers, and soil conditioners for many years.

The minority does not dispute this. However, all these valuable assets do not make CSL nonsynthetic. The minority believes that this is really all you need to know: a synthetic chemical introduced into a mixture with an agricultural material forces a change in the chemistry of that agricultural material in a way that would not occur through natural means. You don’t really need to go further than that. However, we can shift to the underlying policy of the NOSB that establishes CSL as a synthetic product and all future products that we should review to ensure that the standards of the statute and National List are met. What follows are the policies as they apply to CSL.

We come to the minority opinion by following the NOSB’s process

The minority opinion is based on the policies of the NOSB and the standards that have been developed over time. Here is our thinking, as it relates to the policies and definitions of the type of chemical change (brought on by the introduction of a chemical substance, or not occurring as a result of some natural process).

The classification of materials recommendation adopted by the board in November 2009 established three guiding principles for determining whether a substance is synthetic or nonsynthetic

The classification of a material is determined by both the source of the inputs and the process used to make the material.

The same material can be agricultural, non-synthetic or synthetic depending on source and process.

If a material is processed such that it is classified as synthetic then the material is classified as synthetic regardless of source. A material of this type would most correctly be referred to as an “agriculturally sourced material which has been processed in such a way as to classify the material synthetic.” Materials that are manufactured in full compliance with the final rule are outside the scope of this principle; their status with regards to use in organic is not affected by this recommendation.

These guiding principles are central to the classification of corn steep liquor. We have a material whose source is nonsynthetic, however, the source is only the first issue of concern under current standards. The process adopted by the board requires us to look at the processing applied to the source material as well. In this case, corn is an agricultural material (nonsynthetic), and the standard requires an assessment of the wet milling process to which the corn is subjected to determine whether it should be classified as synthetic.

The NOSB’s classification of materials recommendation also stated:

It is our intent through this recommendation that a material would be classified as synthetic when:

The source of the material is not “from mineral, plant, or animal matter” (from the definition of nonsynthetic) and is not a “substance created by naturally occurring biological processes” (from the definition of synthetic) or;

The process used to manufacture the material is synthetic (per the definition of synthetic and clarifying definitions in our recommendation) or;

The material contains, at a significant level, a synthetic substance not on the National List of allowed synthetics. (p.5 of 13, Nov. 2009)

In April 2010, the board adopted an addendum to the classification of materials recommendation that sought to clarify the application of the guiding principles. It said, in part:

It is our belief that chemical changes that occur when an agricultural material is processed by itself, or in combination with other agricultural materials, the resulting material should continue to be classified as agricultural. Clearly chemical change happens in these cases, if looked at from a purely chemistry perspective, but from a consumer perspective these materials are agricultural. The committee differentiates between these cases and those when an agricultural material is processed with a non-agricultural material, whether synthetic or non-synthetic. In these latter cases, if chemical change occurs, the resulting material would be classified as synthetic. (p.1 of 19, April 2010)

OFPA defines synthetic:

Synthetic is defined as “a substance that is formulated or manufactured by a chemical process or by a process that chemically changes a substance extracted from a naturally occurring plant, animal, or mineral sources, except that such term shall not apply to substances created by naturally occurring biological processes” (§2103 (21)).

And chemical change is defined,

Chemical Change An occurrence whereby the identity of a substance is modified, such that the resulting substance possesses a different distinct identity (see related definition of “substance”) *Processing, as defined in §205.2, of agricultural products using materials allowed on the applicable section of the National List (i.e., §205.601 for crops, §205.603 for livestock and §205.605 / §205.606 for handling), does not result in chemical change as it applies to classification of materials.* (April 2010, underlined rejected by NOP)

And substance,

Substance An element, molecular species, or chemical compound that possesses a distinct identity (For example, a distinct identity may be demonstrated through the material having a separate Chemical Abstract Service (CAS) number (in some cases the same material may have multiple CAS numbers), Codex International Numbering System (INS) number, or FDA or other agency standard of identity). (p.10 of 19, April 2010)

All of this is background to the following questions:

1. Is corn steep liquor a different substance from corn, or anything contained in corn? (If yes, chemical change has occurred.)
2. Is breaking disulfide bonds of the corn protein matrix a necessary part of the countercurrent wet milling process that results in corn steep liquor as a by-product?
3. Does the sulfur dioxide (a synthetic substance) that is added to the wet milling process break the disulfide bonds in creating the by-product (CSL)?

If the answer to all these questions is “yes,” the classification of materials policy defines CSL as synthetic.

And, to follow our policy through to its conclusion, regardless of any of the above questions, the policy requires the following assessment:

4. As a result of added sulfur dioxide to the manufacturing process, are there significant residues of sulfur dioxide in corn steep liquor?

If the answer is “yes,” then CSL is synthetic. If it were the case that no chemical change to the source material had occurred as a result of the use of sulfur dioxide, yet if the process of producing CSL results in significant (Nov. 2009) residues of sulfur dioxide, then the policy requires a determination that the CSL is synthetic.

We support the minority position on corn steep liquor and the reasoning in the minority report. There are also procedural issues around this decision that need to be addressed.

Committee Process

First of all, we are disappointed that the majority opinion did not address the fact that the committee had received input from USDA/ARS researcher David Johnston, PhD, who is considered an expert on wet corn milling and they did not explain why they had decided to ignore his input in favor of the views of a person who clearly has a financial interest in the decision. This kind of neglect in writing up a decision makes the decision appear arbitrary and capricious.

Two of us at Beyond Pesticides talked with Dr. Johnston before he talked with the committee. We located Dr. Johnston because he was the corresponding author on a paper concerning enzymatic wet milling, a new process he is helping to develop that would drastically reduce the use of SO₂, and hence the pollution caused by its release.

A crucial issue in determining whether corn steep liquor is synthetic is the role of the synthetic chemical sulfur dioxide in the traditional wet corn milling process. Dr. Johnston explained that the addition of SO₂ has three purposes: (1) prevent the growth of some microbes, (2) slow the growth of other microbes, and (3) act on the corn to break disulfide bonds, which helps release the starch. We asked about Dragan Macura's claim that the breakdown of the corn is caused entirely by the action of the lactic acid bacteria. Dr. Johnston said (1) without breaking the disulfide bonds, there would be poor recovery of starch and (2) the lactic acid bacteria cannot break the disulfide bonds.

Is breaking of disulfide bonds "chemical change"? Dr. Johnston said that when disulfide bonds are broken, a covalent bond is broken, and another bond formed. That would seem to be a chemical change. Disulfide bonds to come and go easily, depending on exposure to oxygen. In this case, not only is the bond broken, but SO₂ binds to a side chain and is thus added to the protein.

In addition to ignoring the input of an invited expert, the report of the majority position is full of "determinations" that do not follow from the other expert advice that the committee has sought. The committee asked a number of questions of S&T in order to determine whether chemical change occurs during wet corn milling as a result of the addition of sulfur dioxide. The committee quotes the findings of S&T from the Technical Report:

"The major objectives for corn steeping are to induce chemical and physical changes in the kernel by leaching the soluble components from the corn." It goes on to say that "sulfur dioxide is added at rates of 0.1 to 0.2 percent and is used to cleave disulfide linkages, resulting in the degradation of the corn protein that encapsulates the starch granules." (TR 99-102)

The committee then referred to a presentation by Dragan Macura of AgroThrive (a company that sells products made from CSL), saying, "Throughout the detailed discussion it became clear that the sulfur dioxide was added at the end of the process to stop the fermentation process (a

biological process) and prevent putrefaction.” Why does the NOP pay for scientific input into the decision-making process if it is to be overruled—without any explanation—by the opinions of someone with a vested interest in the outcome of the decision? Nowhere in the majority’s decision do they explain the basis of their conclusion—the evidence they rely upon to reject the judgment of their own experts.

Finally, as pointed out in the minority report, the question of whether CSL is synthetic or not depends not only on the issue of chemical change, but also on the issue of significant residues of the synthetic additive in the final substance. The terminology of the majority—referring to SO₂ as a “processing aid” is inappropriate here because “processing aids” are used in producing food rather than agricultural inputs.¹ The guidance on classification requires the board to consider the issue of significant residues, not sidestep it. Recent research, such as DeFrain et al² shows the sulfur level in CSL measured at 1.90%, compared to 0.14% for corn³. This, it seems, is a significant level.

More information about CSL can be found in the Crops Committee section of the [NOSB meeting packet](#).

You may submit comments at the [Regulations.gov website](#). Please identify your comments with “CC: corn steep liquor.” You will have 20 minutes to type comments of 2000 *characters* or less, or you may upload a file. You may see a list of all comments that have been submitted on all proposals [here](#).

¹ § 205.2 Processing aid. (1) Substance that is added to a food during the processing of such food but is removed in some manner from the food before it is packaged in its finished form; (2) a substance that is added to a food during processing, is converted into constituents normally present in the food, and does not significantly increase the amount of the constituents naturally found in the food; and (3) a substance that is added to a food for its technical or functional effect in the processing but is present in the finished food at insignificant levels and does not have any technical or functional effect in that food.

² J. M. DeFrain, J. E. Shirley, E. C. Titgemeyer, A. F. Park* and R. T. Ethington, 2002. A Pelleted Combination of Raw Soyhulls and Condensed Corn Steep Liquor for Lactating Dairy Cows, J. Dairy Sci. 85:3403–3410

³ David Johnston, personal communication, January 31, 2001.