

Magnesium chloride

Processing

Identification

Chemical Names Magnesium chloride

Other Names: Magnogene.

Double salt with magnesium sulfate: Nigari, Bittern

CAS Number: 7786-30-3

Other Codes: INS 511

Recommendation

| Synthetic / Non-Synthetic: | National List of Non-organic Ingredients | Suggested Annotation: |
|-----------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Non-synthetic (Consensus)</i> | <i>Allowed in 95%+ Allowed in 50%+ (Consensus)</i> | <i>Magnesium chloride evaporated from salt water or brine or extracted from bischofite is considered non-synthetic. Non-synthetic sources are allowed as non-organic ingredients in beancurd ('tofu') labeled as organic. The double salts of magnesium chloride and magnesium sulfate extracted from seawater, known commonly as 'nigari' or 'bittern,' must meet the Food Chemicals Codex requirements for both salts, with the exception of sulfate, and be labeled as containing both salts. (Consensus)</i> |
| <i>Synthetic (Consensus)</i> | <i>Not allowed in 95%+ Allowed in 50%+ (Consensus)</i> | <i>All sources other than the ones listed above are considered synthetic. Synthetic sources of magnesium chloride may be used to process fiber and textiles labeled as organic; and in food labeled as made with organic ingredients. (Consensus)</i> |

Characterization

Composition MgCl₂.6H₂O

Properties:

A colorless, deliquescent, odorless material crystals or flakes. Very soluble in water and freely soluble in alcohol. Solubility at 20° C. is 54.6 g/100cc.

How Made:

Occurs naturally as the mineral bischofite. It is manufactured as a by-product of the potash industry, from natural brines, from seawater, and in the presence of an organic reducing agent. Recovery from brines and from potash manufacture is achieved by concentrating the liquor by solar evaporation and then fractional crystallization of other salts. The resulting mixture of magnesium chloride and magnesium sulfate (Epsom salts) is traditionally called 'nigari.' Magnesium chloride can also be synthesized by reacting magnesium oxide, magnesium carbonate, magnesium ammonium chloride hexahydrate, or magnesium hydroxide with a solution of hydrochloric acid (Bryce-Smith, 1960 from Budavari, 1996), or as a by-product of potassium mining and fertilizer production (Tisdale et al., 1985).

Specific Uses:

Color retention and firming agent for canned vegetables; a coagulant of soy milk with magnesium sulfate (Epsom salts) to make tofu (bean curd); in infant formula; as a dressing agent in cotton fabrics. Used in sugar beet processing. Used as a disinfectant.

Action:

Coagulation of soymilk is a complex interaction of several variables (Hou et al., 1997). Combines with soluble proteins to denature and take them out of solution. Attacks fused silica when melted.

Combinations:

With magnesium sulfate (Epsom salts) in nigari. Also found in combination with potassium carbonate and magnesium sulfate as a potash magnesia double salt (Rose and Rose, 1979).

Status

OFPA

Non-synthetic, non-agricultural ingredient.

Regulatory

FDA-GRAS 21 CFR 184.1426.

Status among Certifiers

Many certifiers have adopted the NOSB's annotation in their recommendation to add magnesium chloride to the National List, but were confused about how to adopt and implement the NOSB's recommendation. That recommendation is that magnesium chloride, unrefined is considered non-synthetic and prohibited for use in processing organic food. Magnesium chloride, refined is considered synthetic and allowed to process organic food. Some certifiers are considering seawater extracted nigari to be 'refined' magnesium chloride in the absence of a clear standard and others are not.

Historic Use

The material has long been used in organic tofu production.

International

INS 511--Allowed for soy processing under IFOAM.

OFPA 2119(m) Criteria

- (1) The potential of such substances for detrimental chemical interactions with other materials used in organic farming systems. As this is a processing material, the substance is not used in organic farming systems.
- (2) The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment. See processor criteria 3 below.
- (3) The probability of environmental contamination during manufacture, use, misuse or disposal of such substance. This is considered below under item (2).
- (4) The effect of the substance on human health. This is considered in the context of the effect on nutrition (3) below as well as the and the consideration of GRAS and residues (5) below.
- (5) The effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock. As this is not released into the agroecosystem, there is no direct effect.
- (6) The alternatives to using the substance in terms of practices or other available materials. See discussion of alternatives in (1) below.
- (7) Its compatibility with a system of sustainable agriculture. This is considered more specifically below in the context of organic handling in (6) below.

NOSB Processing Criteria

A SYNTHETIC PROCESSING AID OR ADJUVANT may be used if;

1. An equivalent substance cannot be produced from a natural source and has no substitutes that are organic ingredients.
Some coagulant must be used to make tofu. The quality of tofu products is significantly influenced by the type of coagulant used (Tsai, et al., 1981). Magnesium chloride is available from non-synthetic and synthetic sources--see a description of various sources above in the 'How Made' section. Other tofu coagulants include calcium chloride, calcium sulfate and delta gluco lactone (Shurtleff and Aoyagi, 1990). The NOSB did not recommend that either calcium sulfate or delta gluco lactone be added to the National List of non-organic ingredients. Calcium chloride has been recommended, but all three of these coagulants produce a tofu with different textural qualities from nigari. Nigari and calcium sulfate are considered as the only two coagulants suitable for Chinese-style tofu. Of these two, calcium sulfate tofu is both harder and more brittle than nigari tofu (Hou, et al., 1997).
2. Its manufacture, use and disposal does not contaminate the environment.
Seawater extraction involves minimal impact on the environment. It is usually performed by solar evaporation. Synthesis from magnesium oxide made from magnesium carbonate involves the use of fossil fuels and hydrochloric acid. Manufacture from fertilizer by-products also involve the use of synthetic chemicals in reactions, principally the reaction of magnesium sulfate with hydrochloric acid or potassium chloride.
3. If the nutritional quality of the food is maintained and the material itself or its breakdown products do not have any adverse effect on human health.
Magnesium is beneficial to human health in the amounts used. The amount of chloride used in processing would fall below the levels that would be considered a health risk.
4. Is not a preservative or used only to recreate/improve flavors, colors, textures, or nutritive value lost during processing except in the latter case as required by law.
Magnesium chloride is not used as a preservative. Use of magnesium chloride as a firming agent helps foods to retain texture. While magnesium chloride creates other sensory effects, that is not its sole or primary purpose. Finally, magnesium chloride can serve as a supplemental source of magnesium.
5. Is Generally Recognized as Safe (GRAS) by FDA when used in accordance with Good Manufacturing Practices (GMP), and contains no residues of heavy metals or other contaminants in excess of the tolerances established by FDA.
Rat LD50 is 8.1 g/kg (Smyth, 1969 cited in Merck). There is no distinction between refined and unrefined magnesium chloride, only magnesium chloride that meets the standard of identity set in the Food Chemicals Codex. Because the NOSB raised concerns about the possible contamination of the seawater used to extract the brine, suppliers to organic processors may need to be required to implement strict quality assurance measures. The standard of identity for magnesium chloride sets a maximum contaminant level for ammonium (NH₄) at not more than 0.005%, arsenic (As) at not more than 3 ppm, heavy metals as lead at not more than 10 ppm, and sulfate at not more than 0.02%. Therefore, because nigari contains with it approximately 4% magnesium sulfate, its sulfate level prevents nigari from meeting the magnesium chloride standard of identity. The investigator contacted two basic producers and one distributor for data on heavy metal levels in their product, but was unable to obtain any test results.
6. Is compatible with the principles of organic handling.
Magnesium chloride is currently used as an ingredient in organic processed food products. Organic processors surveyed in 1991 rated nigari as 4.2 (5=highly compatible, 1=highly incompatible) (Raj, 1992); mined minerals rated 3.6 and acidic solutions rated 2.4. Therefore, nigari appeared in that survey at that time to be the coagulant most compatible with organic principles.

7. There is no other way to produce a similar product without its use and it is used in the minimum quantity required to achieve the process.

If magnesium chloride is not allowed by the NOSB tofu producers would have to label their tofu as being "made from organic soybeans" rather than "organic tofu." Under current NOSB recommendations, many if not most existing organic tofu makers would be put in a position of having to relabel their tofu as "tofu made from organic soybeans" rather than as "organic tofu."

Discussion

Condensed Reviewer Comments

Reviewer 1:

The NOSB should not prohibit the use of non-synthetic magnesium chloride for tofu production. It should consider restricting the use to non-synthetic, refined magnesium chloride to eliminate unacceptable levels of arsenic and lead which may be present in the unrefined material

Magnesium chloride seems to be less compatible with the philosophy of organic production for processed foods other than tofu. It is not integral to the production of canned foods and is used to preserve color and texture. These qualities could be better addressed by labeling the product with a date to indicate time best used by. The use of magnesium chloride should be restricted to those products such as tofu for which it is integral to the manufacture of the product.

Reviewer 2:

In summary, nigari would be the most preferable choice of material for use in organic systems, providing that it can be shown to contain levels of harmful components which are below those delineated by the Food Chemicals Codex for magnesium chloride. Next in order of preference would be refined magnesium chloride from other natural sources.

SUMMARY AND RECOMMENDATION (from Reviewer 2)

List magnesium chloride under 3 separate headings, as follows:

nigari - non-synthetic, regulated - Annotation: As a coagulant in soy processing only. Must be shown not to contain heavy metals or other contaminants (magnesium sulfate excluded) at levels comparable to those allowed for refined magnesium chloride used as a food additive.

magnesium chloride - non-synthetic, regulated - Annotation: As a coagulant in soy processing only, and only when nigari is not an available alternative. Must be refined to a degree which meets the Food Chemicals Codex requirements for maximum levels of allowable contaminants.

magnesium chloride - synthetic - prohibited

Reviewer 3:

I feel that if magnesium chloride/Nigari is prepared from a potash operation which separates, concentrates and crystallizes a potash magnesia double salt, then it is compatible with organic production and handling and should be classified as non-synthetic.

I would also like to propose that an annotation be developed which clearly states that magnesium chloride/Nigari must be derived from potash operations and its manufacture involve separation, concentration and drying (crystallization). All forms of magnesium chloride/Nigari clearly derived by synthesis with hydrochloric acid would be classified synthetic and possible prohibited.

Conclusion

The NOSB made separate decisions for “Refined” and “Unrefined” sources. Many organic processors and certifiers are unable to interpret the NOSB’s recommendation because neither 21 CFR 184.1426 nor the Food Chemicals Codex distinguishes magnesium chloride in this way. Food grade sources can be obtained from either seawater or bischofite, both of which appear to be non-synthetic. If the NOSB is concerned that the Food Chemicals Codex tolerances for contaminants are too high, these can be adjusted accordingly. The recommendation of one of the reviewers--that use be limited only to tofu--may merit discussion. Use in textiles and processed products labeled as made with organic ingredients need not meet as rigorous a standard as magnesium chloride used in food labeled ‘organic.’

References

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