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## SUMMARY OF TAP REVIEWERS' ANALYSES

The N-Concentrate ("NIT-GRO®") derived from the Funki Manura process of physically separating and then distilling untreated, liquid, settled, swine waste that contains primarily ammonium bicarbonate (aka, acid ammonium carbonate, etc) is being petitioned for use as a liquid fertilizer as a nitrogen source in organic crop production.

- Two of the three TAP Report reviewers concluded that the Funki Manura N-Concentrate ("NIT-GRO®") that contains primarily ammonium bicarbonate (aka, acid ammonium carbonate, etc) as petitioned is a non-synthetic substance. The third concluded it is synthetic.

- One of the three TAP report reviewers recommended that the Funki Manura N-Concentrate ("NIT-GRO®") that contains primarily ammonium bicarbonate (aka, acid ammonium carbonate, etc) should be included on the National List without restriction(s).

- A second TAP Report reviewer recommended that the Funki Manura N-Concentrate ("NIT-GRO®") that contains primarily ammonium bicarbonate (aka, acid ammonium carbonate, etc) be included on the National List with the single restriction that "Disposal for waste by-products in manufacture should be accounted for."

- The third TAP Report reviewer recommended that the Funki Manura N-Concentrate ("NIT-GRO®") that contains primarily ammonium bicarbonate (aka, acid ammonium carbonate, etc) should not be included on the National List.

| **Synthetic / Nonsynthetic** | **Allow without restrictions?** | **Allow only with restrictions? (See Reviewers' comments for restrictions)** |
|---|---|---|
| **Synthetic ( 1 )** | **Yes ( 1 )** | **Yes ( 1 )** |
| **Non-synthetic ( 2 )** | **No ( 1 )** | **No ( 1 )** |

## IDENTIFICATION

**Common name:** Ammonium bicarbonate

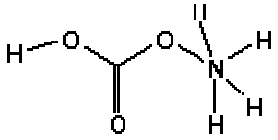
**CAS Registry Number:** 1066-33-7

** This Technical Advisory Panel (TAP) report was based upon the information available at the time this report was generated. This report addressed the requirements of the Organic Foods Production Act of 1990 (OFPA), as amended, to the best of the investigator's ability and was reviewed by experts on the petitioned substance. The substance was evaluated according to the criteria found in Section 2118 (7 U.S.C. 6517) and in Section 2119 (7 U.S.C. 6518) of the OFPA. Any recommendation(s) presented to the National Organic Standards Board (NOSB) was based on the information contained within the TAP report and the evaluation of that information relative to these criteria. The TAP report does not incorporate commercial availability, socioeconomic impact, or other factors related to the petitioned substance, which NOSB and USDA may want to consider in their decision process.*

**Chemical Formula:** $CH_2O_3.H_3N$

**Structural Formula:** $NH_4HCO_3$

**Chemical Structure:**



**Synonyms:**

1. ABC trieb
2. Acid ammonium carbonate
3. Ammonium acid carbonate
4. Ammonium bicarb
5. Ammonium bicarbonate
6. Ammonium bicarbonate (1:1)
7. Ammonium carbonate
8. Ammonium hydrogen carbonate
9. Ammonium powder
10. Ammonium sesquicarbonate
11. Baker's ammonia
12. Carbonate of ammonia
13. Carbonic acid, monoammonium salt
14. Crystal ammonia
15. Hartshorn[1]
16. Monoammonium carbonate
17. Powdered baking ammonia
18. Sal volatile
19. Smelling salts
20. Rock ammonia
21. Volatile alkali

## CHARACTERIZATION[2, 3]

**Properties:**

- **Melting Point:** $107.5^0$ C. (Decomposes at about $35^0$- $60^0$ C to water vapor, carbon dioxide, and ammonia.)
- **Molecular Weight:** 79.06 g
- **Density:** 1.6 g cm-3

- **Physical State:** White powder with a slight odor of ammonia.

- **Solubility:** Freely soluble (17.4% @ 20C (68F)) in water at 14 g/100 ml while insoluble in ethanol and acetone.[4] It dissolves in water to give a slightly alkaline solution. As with many ammonium salts, dissolution is endothermic which causes a drop in the water temperature.

## PRODUCTION

This ammonium bicarbonate physical separation process from stored, untreated, liquid swine waste is the Funki Manura process (MANURA® 2000) which begins with a three-stage slurry separation.

**1. Three-Stage Slurry Separation:**

- **First Stage – Mechanical Pre-Separation:** A decanter centrifuge performs a mechanical pre-separation with the fiber part (humus) being separated from the liquid phase of the stored, untreated, liquid swine waste.

- **Second Stage - Evaporation:** The liquid phase of the stored, untreated, liquid swine waste is concentrated by evaporation.

- **Third Stage – Cleaning of Distillate:** The distilled water that is produced is cleaned.

**2. Mechanical Pre-Separation:**

Stored, untreated, liquid swine waste is piped directly from the storage area to a holding tank with stirrer and then to a decanter centrifuge where the liquid portion of the waste is centrifuged off at 3,000 to 4,000 Gs. This physically separates the stored, untreated, liquid swine waste particles (organic and inorganic) to a dry substance content of 25-35%. The stored, untreated, liquid swine waste consists now of a fiber fraction called humus and a liquid phase fraction. The liquid phase is then piped to the MANURA® 2000 evaporation unit.

**3. Evaporation:**

The evaporation unit consists of three stages.

- **Stage 1 - Degasser:** The liquid phase is degassed after heating to $100^{o}$ C by blowing the boiling phase into a container causing it to "flash off" and split into a liquid fraction and a gas fraction. The ammonium bicarbonate is here dissociated physically by the $100^{o}$ C into $NH_3$, $CO_2$, and water vapor. Most of the liquid phase content of $CO_2$, $NH_3$, and fatty acids separate from the liquid phase, leaving a "slack" liquid phase. This slack liquid collects at the base of the degasser and is conveyed to the evaporation heat exchanger where concentration occurs. The gas fraction is conveyed to the gas scrubber. "Distillation" is an approved process for

preparing an agricultural product for market as per USDA NOP §205.270(a) "Organic Handling Requirements".

- **Stage 2 - Gas Scrubber:** The gas fraction from the degasser is conveyed with water vapor from the slack liquid phase in the evaporation heat exchanger through the evaporation unit gas scrubber. The remainder of the 100 $^{o}$ C gas mixture consisting mainly of water vapor, $CO_2$, and $NH_3$ is conveyed to the compressor where it is subjected to approximately 0.2 bar. This causes the temperature to rise to 105-106 $^{o}$ C. The superheated gas mixture is then conveyed to the condensation side of the evaporation heat exchanger.

- **Stage 3 - Evaporation Heat Exchanger:** The evaporation heat exchanger is designed as a "downflow" heat exchanger. The slack liquid is conveyed from the degasser to the boiling side of the heat exchanger where it is recirculated over the heating surfaces fast enough to avoid burning. The 100 $^{o}$ C hot liquid phase takes on additional heat from the condensation side. After passage through the compressor, the 105-106 $^{o}$ C gas mixture of water vapor, $CO_2$, and $NH_3$ is conveyed to the condensation side where the gas mixture rises. The temperature of the gas mixture falls as it releases heat to the slack liquid phase on the boiling side. When the temperature falls to 100 $^{o}$ C, the water vapor in the gas mixture condenses on the heating surfaces to drip down to a collector where the condensed distillate passes to the distillate cleaning unit. The remaining gas mixture consisting of $CO_2$, and $NH_3$ does not condense at 100 $^{o}$ C and can be blown up to the top of the condensation side. As this $CO_2$ and $NH_3$ mixture cools, the pathogen-free, N-concentrate ("NIT-GRO®") is formed with the nitrogen dissolved in water as the now re-associated, naturally-produced ammonium bicarbonate originally produced by natural processes from the stored, untreated, liquid, swine waste. The mixture returns to the boiling side of the evaporation heat exchanger where heat from the condensation side is used to further heat the boiling liquid phase to boil off yet more water vapor. This liberated water vapor is evacuated from the boiling side and conveyed to the gas cleaning stage together with the $CO_2$ and $NH_3$ from the ammonium bicarbonate from the stored, untreated, liquid swine waste to the degasser. The concentrated liquid phase is continuously tapped from the heat exchanger as NPK concentrate, and additional new liquid phase is introduced from the degasser.

The nutrient contents of the stored, untreated, liquid swine waste are separated into three fractions

- **Fraction 1 - Humus** – 15% of the stored, untreated, liquid swine waste

- **Fraction 2 - NPK Concentrate** – 13% of the stored, untreated, liquid swine waste

- **Fraction 3 - N Concentrate ("NIT-GRO®")** – 2% of the stored, untreated, liquid swine waste

## HISTORY OF USE

**Non-Organic Uses:** Ammonium bicarbonate is used as a food additive especially in baked goods. It is also used to produce a variety of other commercial products including:

- baking powders,
- fire-extinguishing mixtures,
- plastics and rubber in a wide variety of industries,
- compounding cleaners and polishes,
- chemical manufacturing,
- basic fertilizer, and
- fertilizer dressing as a source of ammonia.

**Organic Uses:** Ammonium bicarbonate is approved for use as a bait in insect traps only with no direct contact with crops or soil as per USDA/NOP § 205.601 "Synthetic substances allowed for use in organic crop production."

## CURRENT STATUS

***U.S. Regulatory Agencies:***

**EPA:**
The EPA regulates ammonium bicarbonate as a biopesticide active ingredient but does not list a fact sheet for ammonium bicarbonate as they do for most of the listed biopesticide active ingredients.[5]

The EPA granted an exemption effective March 24, 2004 for ammonium bicarbonate from the requirement of a tolerance for residues of the biochemical pesticide ammonium bicarbonate on all food commodities when applied / used according to its label instructions as a feeding attractant. This eliminates the need to establish a maximum permissible level for residues of ammonium bicarbonate.[6]

**OSHA:**
OSHA does not list ammonium bicarbonate.[7]

**FDA:**
The FDA recognizes ammonium bicarbonate used in human food as GRAS since 1983.

Code of Federal Regulations
Title 21, Volume 3
Revised as of April 1, 2003
CITE: 21CFR184.1135

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TITLE 21--FOOD AND DRUGS
CHAPTER I--FOOD AND DRUG ADMINISTRATION
DEPARTMENT OF HEALTH AND HUMAN SERVICES

PART 184--DIRECT FOOD SUBSTANCES AFFIRMED AS GENERALLY RECOGNIZED AS SAFE

Subpart B--Listing of Specific Substances Affirmed as GRAS

Sec. 184.1135 Ammonium bicarbonate.

(a) Ammonium bicarbonate ($NH_4HCO_3$, CAS Reg. No. 1066-33-7) is prepared by reacting gaseous carbon dioxide with aqueous ammonia. Crystals of ammonium bicarbonate are precipitated from solution and subsequently washed and dried.

(b) The ingredient meets the specifications of the Food Chemicals Codex, 3d Ed. (1981), p. 19, which is incorporated by reference. Copies are available from the National Academy Press, 2101 Constitution Ave. NW., Washington, DC 20418, or available for inspection at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC 20408.

(c) In accordance with Sec. 184.1(b)(1), the ingredient is used in food with no limitation other than current good manufacturing practice. The affirmation of this ingredient as generally recognized as safe (GRAS) as a direct human food ingredient is based upon the following current good manufacturing practice conditions of use:

(1) The ingredient is used as a dough strengthener as defined in Sec. 170.3(o)(6) of this chapter; a leavening agent as defined in Sec. 170.3(o)(17) of this chapter; a pH control agent as defined in Sec. 170.3(o)(23) of this chapter; and a texturizer as defined in Sec. 170.3(o)(32) of this chapter.

(2) The ingredient is used in food at levels not to exceed current good manufacturing practice.

(d) Prior sanctions for this ingredient different from the uses established in this section do not exist or have been waived.

[48 FR 52439, Nov. 18, 1983]

***International Certifiers:***

**European Union:** Ammonium carbonates (which include ammonium bicarbonate) have been allowed for use as "Others" in the European Union since 2001. "Others" include: acid, acidity regulators, anti-caking agents, anti-foaming agents, bulking agents, carriers and carrier solvents, emulsifying salts, firming agents, flavor enhancers, flour treatment agents, foaming agents, glazing agents, humectants, modified starches, packaging gases, propellants, raising agents, and sequestrants. [DAF/PCS, 2004][8]

Ammonium bicarbonate is approved as a food additive in the European Union, Australia, and New Zealand.[9]

**Japan:** Ammonium bicarbonate is not currently listed as an approved agricultural chemical for organic agricultural products in Japan.[MAFFJ, 2004][10]

**Canada:** Canada allows the use of ammonium carbonate (aka, ammonium bicarbonate) as bait in insect traps for cherry fruit fly only and for monitoring purposes only. It cannot be in contact with crop or soil. In fact they ban all ammonia products for use in crop nutrition including "… anhydrous ammonia, aqua ammonia, ammonium nitrate, ammonium phosphate, ammonium sulphate, and ammonium soaps."[11] But Canada does not list ammonium bicarbonate in their short list of specific ammonia products. This may be because the Canadian-listed ammonia compounds are quite toxic whereas ammonium bicarbonate is recognized as GRAS by the FDA since 1983 for use as a leavening agent, a pH control agent, a dough strengthener, and a texturizer in foods for human consumption.

**Codex Alimentarius:** Ammonium bicarbonate is not currently listed as approved for use in the production of organic foods. However, it does approve:

- "Slurry or urine. If not from organic sources, need recognized by inspection body. Preferably after controlled fermentation and/or appropriate dilution. "Factory" farming sources not permitted.[12]

## APPLICATION

The resulting ammonium bicarbonate-containing liquid fertilizer will be banded or incorporated into the soil by farmers growing crops such as grains, vegetables, fruit, and nuts. The high temperatures used in the USDA/NOP-approved physical separation processes kill all pathogens in the ammonium bicarbonate physically separated from the stored, untreated, liquid swine waste in the pathogen-free, N-concentrate ("NIT-GRO®") applied to the soil.

Once applied to the soil, the $NH_3$ in the ammonium bicarbonate is converted to a nitrate ($NO_3^-$) by soil organisms under warm and moist soil conditions. Negatively-charged particles (anions) in the soil attract positively-charged cations from the liquid in the soil onto exchange sites to exchange chemical and biological reactions to allow the soil to provide nutrients and food to the plants.

## INCOMPATIBILITIES

Ammonium bicarbonate is stable under normal storage and use conditions, but is incompatible with strong acids, strong bases, strong alkali metals, and strong oxidants.

## ORGANIC FOODS PRODUCTION ACT OF 1990 (OFPA), AS AMENDED

***7 USC 6517, NATIONAL LIST.***

"(a) **In General**. The Secretary shall establish a National List of approved and prohibited substances that shall be included in the standards for organic production and handling established under this chapter in order for such products to be sold or labeled as organically produced under this chapter.

(b) **Content of List**. The list established under subsection (a) of this section shall contain an itemization, by specific use or application, of each synthetic substance permitted under subsection (c) (1) of this section or each natural substance prohibited under subsection (c)(2) of this section.

(c) **Guidelines for Prohibitions or Exemptions**.

(1) **Exemption for Prohibited Substances**. The National List may provide for the use of substances in an organic farming or handling operation that are otherwise prohibited under this chapter only if

(A) the Secretary determines, in consultation with the Secretary of Health and Human Services and the Administrator of the Environmental Protection Agency, that the use of such substances

(i) would not be harmful to human health or the environment;

(ii) is necessary to the production or handling of the agricultural product because of unavailability of wholly natural substitute products; and

(iii) is consistent with organic farming and handling;

(B) the substance

(i) is used in production and contains an active synthetic ingredient in the following categories: copper and sulfur compounds; toxins derived from bacteria; pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and minerals; livestock parasiticides and medicines and production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers;

(ii) is used in production and contains synthetic inert ingredients that are not classified by the Administrator of the Environmental Protection Agency as inerts of toxicological concern; or

(iii) is but is not organically produced; and

(C) the specific exemption is developed used in handling and is non-synthetic using the procedures described in subsection (d) of this section."

Therefore, under 7 USC 6517 of the OFPA, as amended, it must be determined if the use of naturally-produced ammonium bicarbonate as a liquid fertilizer in organic crop production (vegetables, citrus, and non-citrus fruit, berries, field crops, ornamentals, greenhouse and nursery plants, lawns, and gardens for seed production) is consistent with subsection (C)(1) of 7 USC 6517.

If so, then this ammonium bicarbonate (aka, the pathogen-free, Funki Manura N-Concentrate or "NIT-GRO®") physically separated from stored, untreated, liquid swine waste using USDA/NOP-approved processes including settling, centrifugation, and distillation should be included in the National List.

## SECTION 2118 (7 U.S.C. 6517) AND SECTION 2119 (7 U.S.C. 6518) OFPA CRITERIA

**1. Is there environmental contamination during manufacture, use, misuse, or disposal? [§6518 m.3]**

The stored, untreated, liquid swine waste separation and distillation process is a closed system that should not cause any environmental contamination if properly operated and maintained. Distillation is an USDA/NOP-approved process.

The use of the ammonium bicarbonate solution in the N-Concentrate ("NIT-GRO®") makes nitrogen available to soil bacteria that in turn make the nitrogen available to plants. Pathogen-free, N-concentrate ("NIT-GRO®") containing the ammonium bicarbonate banded or incorporated into the soil will be converted by soil bacteria to an available nitrogen source for plants.

Any misuse will probably result from an over-application of the pathogen-free, N-concentrate ("NIT-GRO®") which will not cause any permanent harm because it will be diluted within reasonable time by natural processes including bacterial conversion and precipitation.

Disposal should be in accordance with local, state, and federal regulations and recommendations to avoid environmental contamination.

**2. Is the substance harmful to the environment? [§6517c(1)(A)(i);6517(c)(2)(A)i]**

The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") provides an available nitrogen source to soil bacteria that in turn convert it to an available nitrogen source for plants. Normal intended use will not harm the environment.

**3. Does the substance contain List 1, 2, or 3 inerts? [§6517c(1)(B)(ii); 205.601(m)2]**

The ammonium bicarbonate-containing, pathogen-free, N-Concentrate ("NIT-GRO®") does not contain any List 1, 2, or 3 inerts as per §6517c(1)(B)(ii); 205.601(m)2.[13] Ammonium bicarbonate is on the EPA List 4 – Inerts of Minimal Concern.[14]

**4. Is there potential for detrimental chemical interaction with other chemicals used? [§6518 m.1]**

Ammonium bicarbonate is stable under ordinary conditions of use and storage, but is incompatible with strong acids, strong alkali metals, strong bases, and strong oxidants.

**5. Are there adverse biological and reactions in the agro-ecosystem? [§6518 m.5]**

No, the ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is used by naturally-occurring soil bacteria to produce an available nitrogen source which is in turn used by plants.

**6. Are there detrimental physiological effects on soil organisms, crops, or livestock? [§6518 m.5]**

The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is converted by soil bacteria to an available nitrogen source for plants. Severe over-application may prove toxic to some or many soil bacteria and/or crops. Both soil bacteria and crops are be expected to recover in a reasonable amount of time relative to the degree of ammonium bicarbonate-containing, pathogen-free, N-Concentrate ("NIT-GRO®") over-application as it is diluted by natural means including precipitation and soil bacteria conversion with subsequent plant use.

The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is a skin, eye, and respiratory irritant to livestock. Ammonium bicarbonate-containing, pathogen-free, N-Concentrate ("NIT-GRO®") and all plant fertilizers are not intended to be ingested and/or absorbed by any animals. Any significant ingestion and/or absorption of ammonium bicarbonate-containing, pathogen-free, N-Concentrate ("NIT-GRO®") by any animal is likely to produce some degree of an acute toxicosis.

**7. Is there a toxic or other adverse action of the material or its breakdown products? [§6518 m.2]**

Ammonium bicarbonate reacts with acids to form carbon dioxide and with bases to form ammonia.

**8. Is there undesirable persistence or concentration of the material or breakdown products in the environment? [§6518 m.2]**

No, soil bacteria will convert the ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") into an available nitrogen source for plants.

**9. Is there any harmful effect on human health? [§6517c(1)(A)(i); §6517c(2)(A)(i); §6518 m.4]**

The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is a human skin, eye, and respiratory irritant. Ammonium bicarbonate can be absorbed into the body by inhaling an ammonium bicarbonate aerosol. Ammonium bicarbonate decomposes on heating above $35^{o}$ to produce water vapor, carbon dioxide, and ammonia fumes. Above $60^{o}$ C, it completely decomposes to water vapor, carbon dioxide, and ammonia which irritate both the eyes and the respiratory tract. Proper handling and post-exposure responses should keep all adverse human health effects minimal, temporary, and fully recoverable.

The reactions of ammonium bicarbonate with strong acids, strong bases, strong alkali metals, and strong oxidants pose some human health risk.

- **Inhalation:**
  Dust may cause irritation of the nose, throat, and lungs. Ammonia vapors released upon decomposition may cause irritation of the upper respiratory tract, with coughing, vomiting, and redness to the mucous membranes. Higher concentrations (> 1000 ppm) may cause restlessness, tightness in the chest, pulmonary edema, weak pulse, and cyanosis.

- **Ingestion:**
  Large oral doses may cause irritation to the gastrointestinal tract.

- **Skin Contact:**
  May cause exposure-dependant irritation with redness and pain.

- **Eye Contact:**
  May cause exposure-dependant irritation, redness and pain.

- **Chronic Exposure:**
  No information found.

- **Aggravation of Pre-existing Conditions:**
  No information found.[15]

**10. Is there a wholly natural substitute product? [§6517c(1)(A)(ii)]**

No.

**11. Is the substance used in handling, not synthetic, but not organically produced? [§6517c(1)(B)(iii)**

The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is characterized as a non-synthetic product in the USDA/NOP application for addition to the National List - but it is not used in handling.

**12. Are there any alternative substances? [§6518 m.6]**

Yes, organically-approved fertilizers are alternative substances as listed in USDA/NOP § 205.203 and USDA/NOP § 205.601.

**13. Is there another practice that would make the substance unnecessary? [§6518 m.6]**

See # 12 above.

**14. Is the substance consistent with organic farming and handling? [§6517c(1)(A)(iii); §6517c(2)(A)(ii)]**

The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is consistent with organic farming because it promotes and enhances biodiversity, biological cycles, and soil biological activity. It also emphasizes the use of management practices in preference to off-farm inputs.

These goals are met here by the ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") through the use of biological (physically separated - using USDA/NOP-approved processes - stored, untreated, liquid, swine waste broken down in time by soil bacteria) and mechanical methods (the ammonium bicarbonate in the pathogen-free, N-Concentrate "NIT-GRO®" is mechanically incorporated into the soil) as opposed to using synthetic materials to fulfill specific functions within the system.

The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is not used in handling.

**15. Is the substance compatible with a system of sustainable agriculture? [§6518 m.7]**

Sustainable agriculture integrates three main goals:

1. Environmental Health,

2. Economic Profitability, plus
3. Social and Economic Equity.

Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs.

The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is compatible with a system of sustainable agriculture because it utilizes an overabundant animal waste product in a safe, environmentally-friendly manner to produce marketable agricultural products while attaining social and economic equity by handling the animal waste in an odorless, closed system using USDA/NOP-approved processes so that later the various separated phases can be safely, usefully, and efficiently incorporated back into the environment.

**16. Is the substance used in production, and does it contain an active synthetic ingredient in the following categories:** The ammonium bicarbonate in the pathogen-free, N-Concentrate ("NIT-GRO®") is used in crop production as a liquid fertilizer.

**a. copper and sulfur compounds:** No.

**b. toxins derived from bacteria:** No.

**c. pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins, and minerals:** No.

**d. livestock parasiticides and medicines:** No.

**e. production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleaners**: No.

# Appendix

## More about the Funki Manura Process[16]

Ammonium bicarbonate (listed as "Ammonium" in the Technical Assistance Panel Review (TAP) application of "Ammonium") is physically separated using approved USDA/NOP-approved processes from stored, settled, untreated, liquid swine waste. The resulting pathogen-free, N-Concentrate, ("NITRO-GRO®") is herein petitioned for use as a liquid fertilizer as a nitrogen source in organic crop production.

This pathogen-free, liquid product contains 13% nitrogen and can be banded into the soil for optimum crop yields by using typical seeding or fertilizer injection equipment at rates that do not harm the seed. This Funki Manura N-Concentrate ("NIT-GRO®") will be of special interest to growers of fruit, vegetables, and rice.

Ammonia in solution in stored, settled, untreated, liquid swine waste slurry is neutralized by dissolved $CO_2$ to form ammonium bicarbonate.[17] Then simple settling, centrifugation, and distillation (all USDA/NOP-approved processes) are used in a closed system to physically separate and concentrate the ammonium bicarbonate that is then delivered as the liquid, pathogen-free, Funki Manura, N-Concentrate ("NIT-GRO®") for use as a liquid fertilizer for plants.

This physical separation occurs by heating the liquid phase containing the ammonium bicarbonate to about $105^0$ C which physically causes the ammonia bicarbonate to dissociate into water vapor, $CO_2$, and $NH_3$. The $CO_2$ and $NH_3$ are then re-associated by loss of heat back into ammonium bicarbonate during the following condensation part of this distillation / physical separation process.

The Funki Manura separation process was initially developed for use with swine production in The Netherlands. Relevant information about Funki Manura is readily available from multiple open sources.[18]

The two Funki Manura alternative technology solutions to processing raw, untreated, liquid swine waste in an environmentally friendly manner include:

- the MANURA® 2000, and
- the MANURA® Compact.

The two basic differences between the older MANURA® 2000 option and the newer MANURA® Compact option are as follows:

1. The older MANURA® 2000 option separates out a pure water fraction equivalent to approximately 75% of the raw input thereby reducing the mass balance of the K-Fraction (in the mass balance diagram for the MANURA® Compact) to approximately 13% of the raw input.

2. The cost of the MANURA® Compact is approximately 45% lower than the MANURA® 2000 and it is anticipated to have lower operational costs with respect to energy requirements.

Generically, the MANURA® process is comprised of two separate stages.

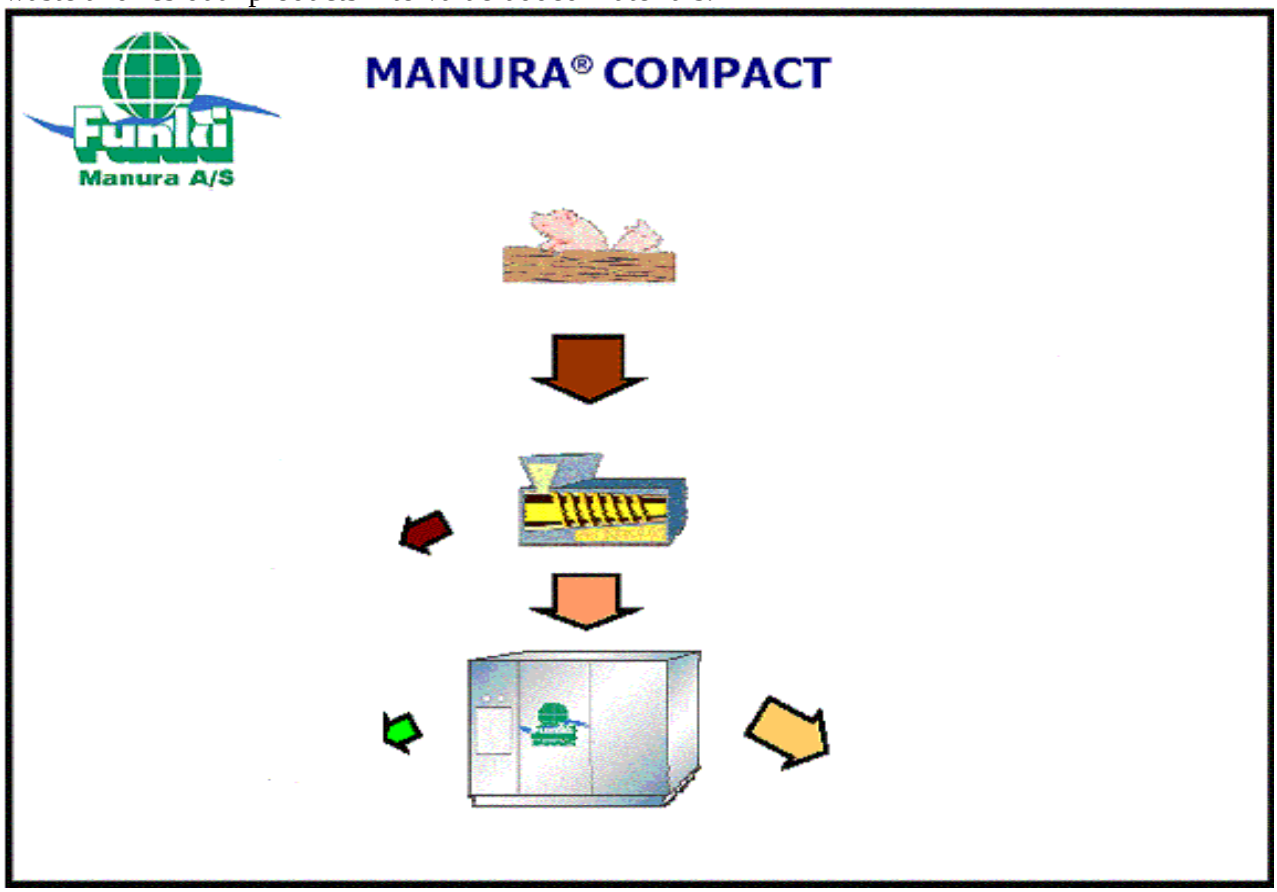
- First Stage: A decanter centrifuge performs a mechanical pre-separation with the fiber part being separated from the liquid phase.

- Second Stage: The liquid phase is physically concentrated using evaporation.

Pressurized, boiling, pre-separated, untreated, liquid swine waste is flashed through a nozzle into a degasser where all of the $CO_2$ converts from the liquid phase to a gas phase. Certain chemicals reform when the gas phase is cooled in the gas heat exchanger.

Funki Manura A/S is located in Denmark and is dedicated to the development of processes that enable livestock production without environmental hazards.

Funki Manura is offering USDA/NOP-approved physical processes that convert organic waste and residual products into value-added materials.



**1000 kg Raw Slurry**

**5.6 kg N = 100%**
**1.4 kg P = 100%**
**3.0 kg K = 100%**

**100 kg P-Fraction**

**1.1 kg N = 20%**
**1.0 kg P = 70%**
**0.5 kg K = 15%**

**20 kg N-Fraction**

**2.8 kg N = 50%**

**880 kg K-Fraction**

**1.6 kg N = 30%**
**0.4 kg P = 30%**
**2.5 kg K = 85%**

## Mass Balance Diagram for the MANURA®

**MANURA® 2000 Chemical Reactions**

First the water vapor condenses and thereafter the $NH_3$ will solute in the water..

(A) $H_2O$ (g) ->$H_2O$ (l)

(B) $NH_3$ (g) ->$NH_3$ (aq)

Because $NH_3$ is very water-soluble, there is a quick conversion from gas to an aqueous state with a parallel condensation of water and the solution of $NH_3$. When $NH_3$ is in solution with water it will act as a weak base.

(C) $NH_3$ (aq) + $H_2O$ (l) -> $NH_4$+ (aq) + OH- (aq)
$CO_2$ too will dissolve in water to form a weak acid.

(D) $CO_2$ (g) -> $CO_2$ (aq)

(E) $CO_2$ (aq) + $H_2O$ (l) -> $H_2CO_3$ (aq)

(F) $H_2CO_3$ (aq) + OH- (aq) -> $HCO_3$- (aq) + $H_2O$

Present in the liquid is now $HCO_3$- and $NH_4^+$
These two molecules will form aqueous ammonium bicarbonate $NH_4HCO_3$.

(G) $NH_4^+$ (aq) + $HCO_3$- (aq) -> $NH_4HCO_3$ (aq)

As a result the N-fraction will be an aqueous solution of ammonia and mainly ammonium bicarbonate (aka, ammonium hydrogen carbonate).

**MANURA® Seller Supply**

A highly-developed and fully-tested system for separation of ammonia ensures clean water for recycling, discharge, or irrigation.

**Separated Fractions.**

For the older MANURA® 2000, the four separated fractions are:

1. 75 % distilled water,
2. 13 % NPK-fertilizer,
3. 10 % humus, and
4. 2 % N-fertilizer.

For the MANURA® Compact, the three separated fractions are:

1) 88% NPK-fertilizer,
2) 10% humus, and
3) 2% N-fertilizer.

**Big Capacity.**

The Funki Manura systems have a capacity of 17,500 to 25,000 tons slurry per year, depending on the dry solid matter.

**Environmental Effect .**

- Utilization percentage of nitrogen in refined slurry about 85%
- Exact dosing of N, P and K by way of patented process
- No nitrogen evaporation from slurry tanks
- Large savings on transportation of nutrients
- Volume reduction of 75 to 85%, depending on option

**Operation.**

Stored, untreated, liquid swine waste slurry is pumped into a decanter centrifuge where the solid particles in the slurry are separated as humus with a dry matter degree of about 30%, thus binding approximately 70% of the phosphorous content in the untreated slurry.

The thin part of the slurry is pumped on into the dehydration part of the system where it is heated to approx. $100^0$ C. and degassed. The slurry then separates into two fractions - concentrate and nitrogen. Distilled water remains.

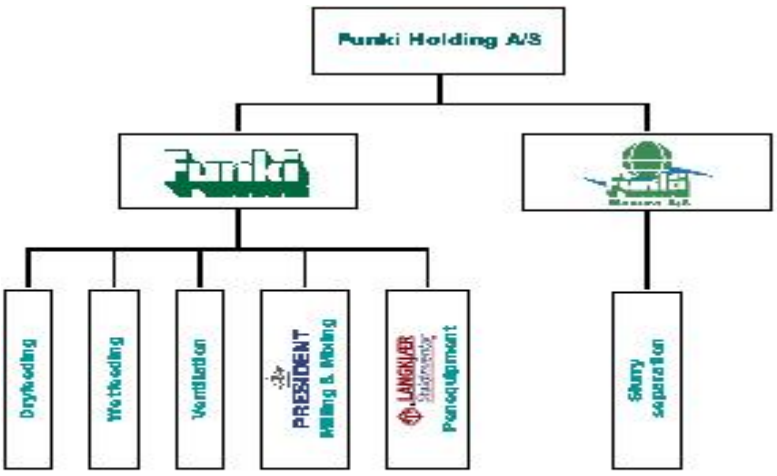
The dehydration process is based on a number of patented operations ensuring optimum utilization of the heat energy. Energy consumption is consequently kept on a minimum.

**Control.**

The control technique used allows remote monitoring and adjustment of the system. All operation parameters and adjustment functions can be controlled via modem or Internet.

**Compact.**

The Funki Manura separation system is physically very compact. With dimensions of 4 m x 5 m x 4 m the system can be installed in many existing buildings. A few tanks are needed for storing the fractions and perhaps the water in addition to the separation system.




*Technology Overview and Supply*

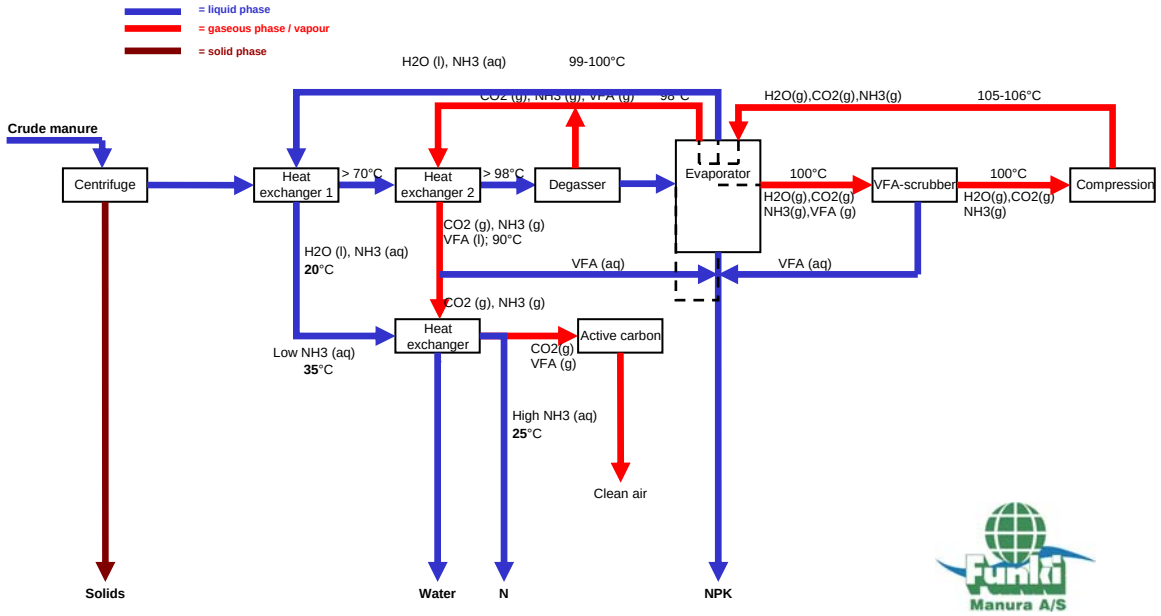
**More about the process**

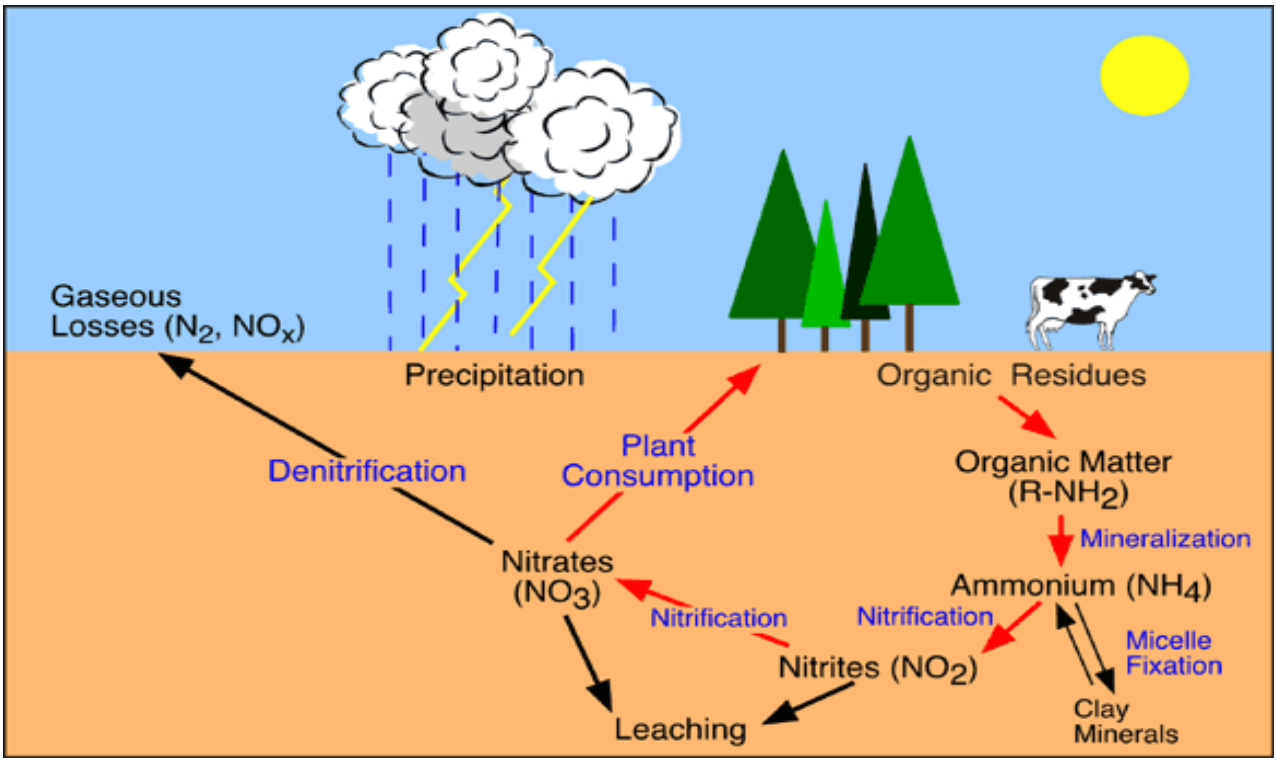
Funki Manura A/S Ellegårdvej 17 DK - 6400 Sønderborg.

**More about installing a Manura**

This website page was last updated on: July 22, 2003

## MANURA® 2000






**Cation-Exchange Capacity (CEC)[19]:**
Cation-exchange capacity is defined as the degree to which a soil can adsorb and exchange cations.

- **Cation:** A positively charged ion ($NH_4^+$, $K^+$, $Ca^{2+}$, $Fe^{2+}$, etc)
- **Anion:** A negatively charged ion ($NO_3^-$, $PO_4^{2-}$, $SO_4^{2-}$, etc)

Soil particles and organic matter have negative surface charges. Mineral cations adsorb to the negative surface charges or the inorganic and organic soil particles. Once adsorbed, these minerals are not easily lost when the soil is leached by water. They also provide an available nutrient reserve for plants. These minerals can then be replaced or exchanged by other cations by cation exchange.

Cation-exchange capacity is highly-dependent upon soil texture and organic matter content. The more clay and organic matter in the soil, generally the higher the cation-exchange capacity. Clay content is important because these small particles have a high surface-area-to-volume ratio. Different types of clays also vary in cation-exchange capacity. Smectites have the highest cation-exchange capacity (80-100 milliequivalents 100 $g^{-1}$), followed by illites (15-40 meq 100 $g^{-1}$), and kaolinites (3-15 meq 100 $g^{-1}$).

Examples of cation-exchange capacity (CEC) values for different soil textures are as follows:

| Soil texture | CEC (meq/100g soi) |
|---|---|
| Sands (light-colored) | 3-5 |
| Sands (dark-colored) | 10-20 |
| Loams | 10-15 |
| Silt loams | 15-25 |
| Clay and clay loams | 20-50 |
| Organic soils | 50-100 |

In general, the cation-exchange capacity of most soils increases with an increase in soil pH. Two factors determine the relative proportions of the different cations adsorbed by clays.

- First, cations are not held equally tight by the soil colloids. When the cations are present in equivalent amounts, the order of strength of adsorption is $Al^{3+} > Ca^{2+} > Mg^{2+} > K^{+} = NH_4+ > Na^{+}$.

- Second, the relative concentrations of the cations in soil solution help determine the degree of adsorption. Very-acid soils have high concentrations of H+ and $Al^{3+}$. In neutral to moderately alkaline soils, $Ca^{2+}$ and $Mg^{2+}$ dominate. Poorly drained arid soils may adsorb $Na^{+}$ in very high quantities.

**Base Saturation:**
The proportion of cation-exchange capacity (CEC) satisfied by basic cations ($Ca^{+2}$, $Mg^{+}$, $K^{+}$, and $Na^{+}$) is termed percentage base saturation (BS%). This property is inversely related to soil acidity. As the BS% increases, the pH increases. High base saturation is preferred but not essential for tree fruit production. The availability of nutrient cations such as $Ca^{+2}$, $Mg^{+}$, and $K^{+}$ to plants increases with increasing BS%.

Base saturation (BS%) is usually close to 100% in arid region soils. Base saturation (BS%) below 100% indicates that part of the cation-exchange capacity is occupied by hydrogen and/or aluminum ions. Base saturation (BS%) above 100% indicates that soluble salts or lime may be present, or that there is a procedural problem with the analysis.

**Cation-Exchange Capacity (CEC) and Nutrient Availability:**
Exchangeable cations may become available to plants. Plant roots also possess cation exchange capacity (CEC). Hydrogen ions ($H^{+}$) from the root hairs and microorganisms may replace nutrient cations from the exchange complex on soil colloids. The nutrient cations are then released into the soil solution where they can be taken up by the adsorptive surfaces of roots and soil organisms. They may also be lost from the system through drainage.

Additionally, high levels of one nutrient may influence uptake of another in a form of an antagonistic relationship. For example, $K^{+}$ uptake by plants is limited by high levels of

$Ca^{+2}$ in some soils. High levels of $K^{+}$ can in turn, limit $Mg^{+}$ uptake even if $Mg^{+}$ levels in soil are high.

**Anion Exchange (AEC):**
In contrast to cation-exchange capacity **(**CEC), anion exchange capacity (AEC) is the degree to which a soil can adsorb and exchange anions. Anion exchange capacity (AEC) increases as soil pH decreases. The pH of most productive soils in the U.S. and Canada is usually too high (exceptions are for volcanic soils) for full development of anion exchange capacity (AEC) and thus it generally plays a minor role in supplying plants with anions.

Because the anion exchange capacity (AEC) of most agricultural soils is small compared to their cation-exchange capacity **(**CEC), mineral anions such as nitrate ($NO_3^-$ and $Cl^-$) are repelled by the negatively-charged soil colloids. These ions remain mobile in the soil solution which makes them susceptible to leaching.

## ENDNOTES

[1] Baker's ammonia is a leavening ingredient called for in many old world recipes, especially those from Scandinavia. It is also called "Hartshorn". Unlike baking powder or soda, Baker's ammonia (ammonium bicarbonate) leaves no unpleasant alkaline off-flavor in baked goods. It is used for cookies, crackers and cream puff-type pastries, items which are small, thin or porous. It is not used for cakes or other large items because the ammonia gas cannot evaporate from these items. You will notice an odor of ammonia while baking, but this will quickly dissipate and the baked product will not have an odor or taste of ammonia. Goode Cookys from Gode Cookery URL:
http://search.netscape.com/ns/boomframe.jsp?query=hartshorn&page=6&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Dc3240ca460c78115%26clickedItemRank%3D57%26userQuery%3Dhartshorn%26clickedItemURN%3Dhttp%253A%252F%252Fwww.godecookery.com%252Fcookies%252Finfoba.html%26invocationType%3Dnext%26fromPage%3DNSCPNextPrev%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.godecookery.com%2Fcookies%2Finfoba.html

Ammonium bicarbonate is commonly called Hartshorn because it was historically prepared by distillation of the antlers from Harts (Red Deer). Pure Hartshorn is actually composed of a double salt of ammonium bicarbonate and ammonium carbamate.

Glossary. Materials used in 19th and 20th century Plaster Architecture. Museum of Fine Arts, Boston (2000) URL:
http://search.netscape.com/ns/boomframe.jsp?query=harts+english+red+deer&page=2&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Dc8807071bfe0976d%26clickedItemRank%3D15%26userQuery%3Dharts%2Benglish%2Bred%2Bdeer%26clickedItemURN%3Dhttp%253A%252F%252Fwww.plasterarc.net%252Fessay%252Fessay%252FCassarA2.html%26invocationType%3Dnext%26fromPage%3DNSCPNextPrev%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.plasterarc.net%2Fessay%2Fessay%2FCassarA2.html

[2] Ammonium Bicarbonate MSDS URL:
http://search.netscape.com/ns/boomframe.jsp?query=ammonium+bicarbonate&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3D5723a2a7c560c48a%26clickedItemRank%3D8%26userQuery%3Dammonium%2Bbicarbonate%26clickedItemURN%3Dhttp%253A%252F%252Fwww.basf.com%252Fbusinesses%252Fchemicals%252Fpdfs%252Fambicarb.pdf%26invocationType%3D-%26fromPage%3DNSCPResults%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.basf.com%2Fbusinesses%2Fchemicals%2Fpdfs%2Fambicarb.pdf

[3] Additional Ammonium Bicarbonate MSDS URL:
http://search.netscape.com/ns/boomframe.jsp?query=ammonium+bicarbonate&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3D5723a2a7c560e619%26clickedItemRank%3D9%26userQuery%3Dammonium%2Bbicarbonate%26clickedItemURN%3Dhttp%253A%252F%252Fwww.sciencekit.com%252Fcategory.asp_Q_c_E_440486%26invocationType%3D-%26fromPage%3DNSCPResults%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.sciencekit.com%2Fcategory.asp_Q_c_E_440486

[4] Chemfinder.com URL:
http://chemfinder.cambridgesoft.com/result.asp?polyQuery=1066-33-7

[5] PAN Pesticides Database – Chemicals URL:
http://search.netscape.com/ns/boomframe.jsp?query=codex+alimentarius+ammonium+bicarbonate&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3D4d6025969f856d9a%26clickedItemRank%3D3%26userQuery%3Dcodex%2Balimentarius%2Bammonium%2Bbicarbonate%26clickedItemURN%3Dhttp%253A%252F%252Fwww.pesticideinfo.org%252FDetail_Chemical.jsp%253FRec_Id%253DPC33859%26invocationType%3D-%26fromPage%3DNSCPTop%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.pesticideinfo.org%2FDetail_Chemical.jsp%253FRec_Id%253DPC33859

[6] EPA URL: http://www.epa.gov/

[7] OSHA URL: http://www.osha.gov/

[8] Organic-Research. "Plant Protection Products and Other Products (EC Reg. No. 2092/91: Annex II B & II F)." *Database of Organic Standards in the EU* 1998; http://www.organic-research.com/lawsregs/db/db_protection_int.asp

[9] List of Food Additives URL:
http://en.wikipedia.org/wiki/List_of_food_additives

[10] Ministry of Agriculture, Forestry and Fisheries of Japan. "Notification No. 59 of the Ministry of Agriculture, Forestry and Fisheries of January 20, 2000." *Japanese Agricultural Standard of Organic Agricultural Products* 2001; http://www.maff.go.jp/soshiki/syokuhin/hinshitu/organic/eng_yuki_59.pdf

[11] Certified Organic Associations of British Columbia. "Section 16: Livestock Materials List." British Columbia Certified Organic Production Operation Policies and Management Standards, Version 5; http://www.certifiedorganic.bc.ca/Standards/bk2v5sec16.htm

[12] Codex Alimentarius Commission. "Report of the Thirty-Second Session of the Codex Committee on Food Labeling." *Joint FAO/WHO Food Standards Programme* 2004; ftp://ftp.fao.org/docrep/fao/meeting/008/j2521e.pdf

[13] EPA Lists 1, 2,and 3 of Other (Inert) Pesticide Ingredients URL:
http://search.netscape.com/ns/boomframe.jsp?query=epa+list+1%2C2%2C3+inerts&page=1&offset=1&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3D14fd0405d9fa5a06%26clickedItemRank%3D1%26userQuery%3Depa%2Blist%2B1%252C2%252C3%2Binerts%26clickedItemURN%3Dhttp%253A%252F%252Fwww.epa.gov%252Fopprd001%252Finerts%252Flists.html%26invocationType%3D-%26fromPage%3DNSCPTop%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.epa.gov%2Fopprd001%2Finerts%2Flists.html

[14] EPA List 4 – Inerts of Minimal Concern URL:
http://search.netscape.com/ns/boomframe.jsp?query=epa+list+4+inerts+of+minimal+concern&page=1&off

set=1&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3D12fa8981defd3711%26clickedItemRank%3D2%26userQuery%3Depa%2Blist%2B4%2Binerts%2Bof%2Bminimal%2Bconcern%26clickedItemURN%3Dhttp%253A%252F%252Fwww.epa.gov%252Fopprd001%252Finerts%252Finerts_list4.pdf%26invocationType%3D-%26fromPage%3DNSCPSuggestion%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.epa.gov%2Fopprd001%2Finerts%2Finerts_list4.pdf

[15] MSDS Ammonium Bicarbonate URL:
http://search.netscape.com/ns/boomframe.jsp?query=msds+ammonium+bicarbonate&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3D14fd0405d9f3cf58%26clickedItemRank%3D2%26userQuery%3Dmsds%2Bammonium%2Bbicarbonate%26clickedItemURN%3Dhttp%253A%252F%252Fwww.jtbaker.com%252Fmsds%252Fenglishhtml%252Fa5616.htm%26invocationType%3D-%26fromPage%3DNSCPTop%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.jtbaker.com%2Fmsds%2Fenglishhtml%2Fa5616.htm

[16] Funki Manura URL:
http://search.netscape.com/ns/boomframe.jsp?query=funki+manura&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3D886a5a4d2c9b0fab%26clickedItemRank%3D4%26userQuery%3Dfunki%2Bmanura%26clickedItemURN%3Dhttp%253A%252F%252Fwww.kyodo-inc.co.jp%252Fenglish%252Fmachine%252Fe_manura.html%26invocationType%3D-%26fromPage%3DNSCPTop%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.kyodo-inc.co.jp%2Fenglish%2Fmachine%2Fe_manura.html

[17] Stevens, R. J. and Cornforth, I. S. "The Effect of Aeration on the Gases Produced by Slurry During Storage." J. Sci. Agric 1974, 25, 1249-1261

[18] Funki Manura URL:
http://search.netscape.com/ns/boomframe.jsp?query=funki+manura&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3D886a5a4d2c9b0fab%26clickedItemRank%3D4%26userQuery%3Dfunki%2Bmanura%26clickedItemURN%3Dhttp%253A%252F%252Fwww.kyodo-inc.co.jp%252Fenglish%252Fmachine%252Fe_manura.html%26invocationType%3D-%26fromPage%3DNSCPTop%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.kyodo-inc.co.jp%2Fenglish%2Fmachine%2Fe_manura.html

[19] Tree Fruit Research & Extension Center, Washington State University,1100 N Western Ave., Wenatchee, WA, 98801 USA URL:
http://search.netscape.com/ns/boomframe.jsp?query=Tree+Fruit+Research+%26+Extension+Center%2C+Washington+State+University&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Db69db380e1fc2dd4%26clickedItemRank%3D1%26userQuery%3DTree%2BFruit%2BResearch%2B%2526%2BExtension%2BCenter%252C%2BWashington%2BState%2BUniversity%26clickedItemURN%3Dhttp%253A%252F%252Fwww.tfrec.wsu.edu%252F%26invocationType%3D-%26fromPage%3DNSCPTop%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.tfrec.wsu.edu%2F

## Reviewer 1

*USDA Accredited Certifier, Midwest, USA*

Ammonium bicarbonate

### A. Comments on Database

The TAP report on Ammonium bicarbonate was very well done and contained a great deal of information helpful for this review. References to the brand name product: "NIT-GRO," however, are confusing and not appropriate. TAP reviews are for generic materials, not for brand name products. The TAP fails to clarify if there are any differences between generic Ammonium Bicarbonate and "NIT-GRO." This review is based on the information in the TAP, assuming that the two are the same.

### B. Evaluation of OFPA Criteria

[Include comments addressing all of the evaluation criteria below based on the information contained in the TAP report and on your interpretation of the Organic Foods Production Act (OFPA) of 1990 and the National List of Allowed and Prohibited Substances.]

Category 1: Impact of the Substance on Humans and the Environment

1. *What is the probability of environmental contamination during manufacture, use, misuse, or disposal of the substance [§6518(m)(3)]?*

Little probability. According to the TAP, Ammonium Bicarbonate is made by the stored, untreated, liquid swine waste the separation and distillation of liquid swine waste using a closed system that should not cause any environmental contamination if properly operated and maintained. Distillation is an USDA/NOP-approved process.

Its use should not pose environmental contamination if not over-applied. Although the TAP states that over-application will not cause any permanent harm because it will be diluted within reasonable time by natural processes including bacterial conversion and precipitation, however this reviewer feels that overuse could lead to high nitrate levels in some plants and contamination of wells and groundwater. Disposal should be done in accordance all applicable regulations and recommendations in order to avoid environmental contamination.

Obviously there is potential for environmental contamination during use and disposal, should the material be used improperly.

2. *Is the substance harmful to the environment [§6517(c)(1)(A)(i); §6517(c)(2)(A)(i)]?*

See # 1

3. *Does the substance contain List 1, 2, or 3 inert pesticide ingredients identified by U.S. EPA's Office of Pesticide Programs [§6517(c)(1)(B)(ii); §205.601(m)(2)]?*

The ammonium bicarbonate-containing, N-Concentrate ("NIT-GRO®") does not contain any List 1, 2, or 3 inerts. Ammonium bicarbonate, itself, is on the EPA List 4 – Inerts of Minimal Concern. As in #1, I am unsure if the information in "NIT-GRO" is the same as for generic Ammonium Bicarbonate.

4. *What is the potential of the substance for detrimental chemical interactions with other materials used in organic farming systems [§6518(m)(1)]?*

According to the TAP Ammonium Bicarbonate is stable under ordinary conditions of use and storage, but is incompatible with strong acids, strong alkali metals, strong bases, and strong oxidants. Again, this reviewer has concerns about nitrate contamination. Ammonium Bicarbonate, if allowed in organic production, should be restricted in a similar manner as Chilean Nitrate, to ensure it is not overused.

5. *Does the substance cause adverse biological and chemical interactions in the agroecosystem [§6518(m)(5)]?*

See Sections A and B 1-4 and 6.

6. *Does the substance cause detrimental physiological effects on soil organisms (including the salt index and soil solubility), crops, or livestock [§6518(m)(5)]?*

Yes. Over-application can be toxic to soil bacteria and microorganisms. Overuse could cause nitrate contamination of water and soil. It also may cause skin, eye and respiratory irritation in livestock. Ingestion of the substance is likely to produce acute toxicosis, according to the TAP.

7. *Do either the substance or its breakdown products/contaminants cause a toxic or other adverse action in the environment [§6518(m)(2)]?*

Ammonium bicarbonate reacts with acids to form carbon dioxide and with bases to form ammonia.

8. *What is the probability of an undesirable persistence or concentration of the substance or its breakdown products/contaminants in the environment [§6518(m)(2)]?*

Although soil bacteria will convert the ammonium bicarbonate into an available nitrogen source for plants, however in the case of over-use make contaminate the environment. The persistence and concentration would depend on the amount used and environmental factors that may break down the contaminants.

9. *Is the substance harmful to human health [§6517(c)(1)(A)(i); §6517(c)(2)(A)(i); §6518(m)(4)]?*

Yes. According to the TAP, Ammonium bicarbonate is a human skin, eye, and respiratory irritant. Ammonium bicarbonate can be absorbed into the body by inhaling an ammonium bicarbonate aerosol. Ammonium bicarbonate decomposes on heating above $35^{o}$ to produce water vapor, carbon dioxide, and ammonia fumes. Above $60^{o}$ C, it completely decomposes to water vapor, carbon dioxide, and ammonia which irritate both the eyes and the respiratory tract. Proper handling and post-exposure responses should keep all adverse human health effects minimal, temporary, and fully recoverable.

Category 2: Importance of the Substance for Organic Production

1. *Is the substance necessary to the production or handling of an agricultural product due to the unavailability of wholly natural substitute materials [§6517(c)(1)(A)(ii)]?*

No. There are many natural ways to provide nitrogen to the soil.

2. *Is the substance non-synthetic, but not produced organically, and used in handling [§6517(c)(1)(B)(iii)]?*

No.

3. *Would other available materials be suitable alternatives to using the substance [§6518(m)(6)]?*

Yes. Manures, green manures, fish emulsions, seaweeds, blood meal, soymeal, Chilean Nitrate, feather meal, legume-based rotations and many more alternatives exist and are either already on the National List or are wholly natural and have been used for an allowed in organic production for a long time.

4. *Would other practices either reduce or eliminate the requirement for the substance [§6518(m)(6)]?*

Yes, see 4 above.

Category 3: Compatibility of the Substance with Organic Production Practices

1. *Is the substance consistent with organic farming and handling [§6517(c)(1)(A)(iii); §6517(c)(2)(A)(ii)]?*

No. If there were no natural or approved materials that would supply nitrogen, then Ammonium Bicarbonate might be considered consistent. Since there are many alternatives, and since this material does have potential for environmental contamination and harm to human health and animals, this reviewer does not find the material consistent with organic farming and handling.

2. *Is the substance compatible with a system of sustainable agriculture [§6518(m)(7)]?*

Yes. This material could be considered sustainable. That alone, however, does not make it fit into the other necessary criteria for organics.

3. *Is the substance used in production, and does it contain an active synthetic ingredient in the following categories [§6517(c)(1)(B)(i)]:*

Ammonium is used in crop production as a liquid fertilizer.

a) *Copper and sulfur compounds?*

No.

b) *Toxins derived from bacteria?*

No.

c) *Pheromones, soaps, horticultural oils, fish emulsions, treated seed, and vitamins and minerals?*

No.

d) *Livestock parasiticides and medicines?*

No.

*e) Production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers?*

No.

***C. Conclusion--Summarize Why This Substance Should Be Allowed or Prohibited for Use in Organic Crop or Livestock Production***

This substance should not be allowed for use in Organic Crop Production for the following reasons:

- Natural and allowed alternatives exist
- There is potential for harm to the environments in its use and disposal
- There is potential for harm to human health and animals
- Use of Ammonium Bicarbonate may cause problems for organic farmers wishing to sell their crops to countries who do not allow this material in their organic standards or who prohibit the use of factory farm manure
- This reviewer is unsure whether or not the TAP was performed for generic Ammonium Bicarbonate or for just the brand-name product "NIT-GRO"

***D. Recommendation Advised to NOSB***

- Ammonium Bicarbonate is synthetic
- It should not be allowed for use in organic crop production.
- Should NOSB determine to allow this material, it should be restricted for use, in a manner similar to Chilean Nitrate, in order to prevent overuse, contamination or harm to health.

## Reviewer 2

*Ph.D., Professor of Chemistry, Gulf Coast, USA*

### A. Comments on Database

The ammonium carbonate presented in this report as "Pathogen-free, N-concentrate ("NIT-GRO®")" is a solution of "…ammonia and mainly ammonium bicarbonate…." (p.16 of TAP report). Therefore, it may not be sufficient to evaluate ammonium bicarbonate alone, because ammonia is declared present. Carbonic acid (H2CO3) may also be present from incomplete or equilibrium formation of ammonium carbonate. Therefore, the scope of the TAP report should be more clearly defined, rather than focusing on only ammonium bicarbonate.

The quality of the TAP report would be improved by clearly defining components involved in the "NIT-GRO®" ammonium carbonate solution. Furthermore, one manufacturing process should be evaluated at a time due to possible differences in the

final product to be used. The report should state why "NIT-GRO®" ammonium carbonate solution is considered non-synthetic. Information regarding cation-exchange capacity does not seem relevant, nor does the diagram on nitrogen-fixation cycles. Some facts presented in the TAP report appear to be redundant and not always in appropriate sections. In general, this report is hard to follow and could use better organization of salient facts.

**B. Evaluation of OFPA Criteria**

**Category 1**

B-1.1. The distillation system used is a closed system that will presumably provide the "NIT-GRO®" ammonium carbonate solution, as well as a solid fraction ("humus") as well as a poorly defined "NPK-Fertilizer" fraction. The disposal of "NIT-GRO®" ammonium carbonate solution is described to follow "…local, state, and federal regulations…." (p. 10 of TAP report). However, disposal of the solid fraction and the "NPK-fertilizer" are not specified, nor are environmental contamination concerns.

Misuse by over-application of "NIT-GRO®" ammonium carbonate solution is not anticipated to be a problem due to its degradation to harmless products by natural processes. However, storage in temperatures higher than 35º may cause decomposition to carbon dioxide (and other compounds) that could build pressure in sealed containers to the point of explosion.

B-1.2. The ammonium carbonate in "NIT-GRO®" ammonium carbonate solution will be converted by soil bacteria to an available nitrogen source for plants which is not harmful to the environment.

B-1.3. The "NIT-GRO®" ammonium carbonate solution does not have any List 1, 2, or 3 inserts.

B-1.4. "NIT-GRO®" ammonium carbonate solution is not capatible with strong acids or bases, strong oxidants, or strong alkali metals; none of which are used in ordinary conditions of use or storage.

B-1.5. Ammonium carbonate is not anticipated to pose any adverse effects on the agro-ecosystem. All plants in the crop-soils that are treated, will benefit from nitrogen fixation from the added "NIT-GRO®" solution.

B-1.6. As with most additives, severe over-application can have toxic effects. However, the over-application of the "NIT-GRO®" ammonium carbonate solution would not cause permanent damage because natural plant and soil organisms, as well as water treatment, would eventually process and dilute any excess material. Ammonium bicarbonate is a skin, eye, and respiratory irritant; however, this TAP report presents data that once applied to crop soil, the soil will act as an ion-exchange solid that will immobilize the

applied ammonium bicarbonate. This will prevent any airborne problems that would invoke topical irritation to animals. Furthermore, the application process of the "NIT-GRO®" ammonium carbonate solution (e.g. "banding in crop soil") will dilute the volume of ammonium bicarbonate that could be ingested by animals reducing any risks. Direct ingestion is unlikely, however, would result in toxic effects to animals. Note: the EPA regulates ammonium bicarbonate as a biopesticide active ingredient; however, the FDA recognizes ammonium bicarbonate as GRAS since 1983.

B-1.7. Ammonium bicarbonate can break down to form carbon dioxide under elevated temperatures (or mixed with strong acids, bases, oxidants, or alkali metals). If stored in sealed containers, pressure from carbon dioxide evolution may burst the container.

B-1.8. There should not be any persistence problems of ammonium bicarbonate which will be processed rapidly by soil organisms. Breakdown products of ammonium bicarbonate are carbon dioxide, water, and ammonia; none of which pose persistence problems due to quick evaporation.

B-1.9. Ammonium bicarbonate is a human eye, skin, and respiratory irritant. The ammonia breakdown product is also an irritant; especially on eyes or respiratory tract if inhaled as a vapor. The liquid nature of the "NIT-GRO®" ammonium carbonate solution should prevent any dust inhalation problems.

**Category 2**

B-2.1. There is no wholly natural substitute product reported.

B-2.2. The "NIT-GRO®" ammonium carbonate solution is characterized as a non-synthetic product, and produced by distillation which is a USDA/NOP-approved process. It is not used in handling.

B-2.3. Yes, organically approved fertilizers are alternative substances listed in USDA/NOP §205.203 and §205.601.

B-2.4. There are no practical practices, other than chemical replacement, for replacing nitrogen in depleted crop soils.

**Category 3**

B-3.1. The "NIT-GRO®" solution is consistent with organic farming and handling by using naturally derived products versus synthetic alternatives. Furthermore, this process is achieved on-site, eliminating fuel waste from transport, environmental pollution from automobile transport, and excessive packaging waste.

B-3.2. The "NIT-GRO®" solution is very compatible with a system of sustainable agriculture by recycling useful waste products from natural sources. This limits total

waste generation and removal promoting environmental health and economic profitability.

B-3.3. The "NIT-GRO®" ammonium carbonate solution does not have the following components:
a. copper or sulfur compounds
b. toxins derived from bacteria
c. pheromones, soaps, horticulture oils, fish emulsions, treated seed, vitamins, or minerals.
d. livestock parasiticides or medicines
e. production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleaners.

**C. Conclusion**

The use of the "NIT-GRO®" ammonium carbonate solution nitration of depleted crop soils should be allowed for Organic Crop Production. This recommendation is pursuant to adequate handling and disposal of the other by-products formed during the manufacture of the "NIT-GRO®" ammonium carbonate solution.

**D. Recommendation Advised to NOSB**

1. Substance is non-synthetic

2. Allow with restrictions

3. Restrictions: Disposal for waste by-products in manufacture should be accounted for.

## Reviewer 3

*Ph.D., Professor of Chemistry, Gulf Coast, USA*

**A. Comments on Database**

[Include comments on the quality and scope of the overall Technical Advisory Panel (TAP) report.]

Very comprehensive. Only quibble is that ammonium carbonate and bicarbonate are different (albeit very similar) substances

**B. Evaluation of OFPA Criteria**

[Include comments addressing all of the evaluation criteria below based on the information contained in the TAP report and on your interpretation of the Organic

Foods Production Act (OFPA) of 1990 and the National List of Allowed and Prohibited Substances.]

Category 1: Impact of the Substance on Humans and the Environment

10. *What is the probability of environmental contamination during manufacture, use, misuse, or disposal of the substance [§6518(m)(3)]?*

    Very unlikely – and whatever does happen is very "biodegradable"

11. *Is the substance harmful to the environment [§6517(c)(1)(A)(i); §6517(c)(2)(A)(i)]?*

    On the contrary – it is beneficial to the environment.

12. *Does the substance contain List 1, 2, or 3 inert pesticide ingredients identified by U.S. EPA's Office of Pesticide Programs [§6517(c)(1)(B)(ii); §205.601(m)(2)]?*

    No

13. *What is the potential of the substance for detrimental chemical interactions with other materials used in organic farming systems [§6518(m)(1)]?*

    Given that it is only incompatible with strong acids, bases and oxidants and extremely active metals, the potential is extremely low. Very few of these are approved for organic farming systems. Even if it did come in contact with, for example, HCl, the products (of an admittedly exothermic process) would be of minimal negative impact.

14. *Does the substance cause adverse biological and chemical interactions in the agroecosystem [§6518(m)(5)]?*

    No

15. *Does the substance cause detrimental physiological effects on soil organisms (including the salt index and soil solubility), crops, or livestock [§6518(m)(5)]?*

    Crops only if used excessively. Livestock would be effected.

16. *Do either the substance or its breakdown products/contaminants cause a toxic or other adverse action in the environment [§6518(m)(2)]?*

    No

17. *What is the probability of an undesirable persistence or concentration of the substance or its breakdown products/contaminants in the environment [§6518(m)(2)]?*

    Close to zero

18. *Is the substance harmful to human health [§6517(c)(1)(A)(i); §6517(c)(2)(A)(i); §6518(m)(4)]?*

    Ammonia is slightly harmful in high levels. However, the amounts of exposure under normal conditions would have little effect.

Category 2: Importance of the Substance for Organic Production

5. *Is the substance necessary to the production or handling of an agricultural product due to the unavailability of wholly natural substitute materials [§6517(c)(1)(A)(ii)]?*

    One could argue that it's close to being wholly natural!

6. *Is the substance non-synthetic, but not produced organically, and used in handling [§6517(c)(1)(B)(iii)]?*

    It is non-synthetic and not used in handling.

7. *Would other available materials be suitable alternatives to using the substance [§6518(m)(6)]?*

    There are other fertilizers available.

8. *Would other practices either reduce or eliminate the requirement for the substance [§6518(m)(6)]?*

    See above

Category 3: Compatibility of the Substance with Organic Production Practices

4. *Is the substance consistent with organic farming and handling [§6517(c)(1)(A)(iii); §6517(c)(2)(A)(ii)]?*

   Absolutely

5. *Is the substance compatible with a system of sustainable agriculture [§6518(m)(7)]?*

   Absolutely

6. *Is the substance used in production, and does it contain an active synthetic ingredient in the following categories [§6517(c)(1)(B)(i)]:*

   No to all

   a) *Copper and sulfur compounds?*

   b) *Toxins derived from bacteria?*

   c) *Pheromones, soaps, horticultural oils, fish emulsions, treated seed, and vitamins and minerals?*

   d) *Livestock parasiticides and medicines?*

   e) *Production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers?*

***C. Conclusion--Summarize Why This Substance Should Be Allowed or Prohibited for Use in Organic Crop or Livestock Production***

[Summarize how you arrived at your recommendation in Section D (below).]

This is a nice easy one. There is nothing really bad about ammonium bicarbonate other than the fact that it will readily produce ammonia. This in itself is great for organic farming as long as livestock/humans are not exposed to a large, enclosed excess. I should again stress that ammonium bicarbonate is different from ammonium carbonate although the 2 are incredibly similar.

***D. Recommendation Advised to NOSB***

[State whether the substance is synthetic or non-synthetic. State whether or not the substance should be allowed for use in organic crop or livestock production.]

Non-synthetic and it should be allowed for use.