NOSB NATIONAL LIST
FILE CHECKLIST

PROCESSING

MATERIAL NAME: **#6 Carbon Dioxide**

✓ **NOSB Database Form**

✓ **References**

✓ **MSDS (or equivalent)**

✓ **FASP (FDA)**

✓ **TAP Reviews from:** **Joe Montecalvo, Rich Theuer**

NOSB/NATIONAL LIST
COMMENT FORM
PROCESSING

Material Name: #6 Carbon Dioxide

Please use this page to write down comments, questions, and your anticipated vote(s).

COMMENTS/QUESTIONS:

---

1. In my opinion, this material is:
_____ Synthetic _____ Non-synthetic.

2. Should this material be allowed in an "organic food" (95% or higher organic ingredients)? _____ Yes _____ No
(IF NO, PROCEED TO QUESTION 3.)

3. Should this substance be allowed in a "food made with organic ingredients" (50% or higher organic ingredients)? _____ Yes _____ No

TAP REVIEWER COMMENT FORM for USDA/NOSB

Use this page or an equivalent to write down comments and summarize your evaluation regarding the data presented in the file of this potential National List material. Complete both sides of page. Attach additional sheets if you wish.

This file is due back to us by: August 8

Name of Material: Carbon Dioxide

Reviewer Name: DR. Joseph Montecalvo Jr.

Is this substance Synthetic or non-synthetic? Explain *(if appropriate)*

Synthetic

If synthetic, how is the material made? (please answer here if our database form is blank)

This material should be added to the National List as:

✓ Synthetic Allowed ____ Prohibited Natural

or, ____ Non-synthetic (Allowed as an ingredient in organic food)

____ Non-synthetic (Allowed as a processing aid for organic food)

or, ____ this material should not be on the National List

Are there any use restrictions or limitations that should be placed on this material on the National List? See USES

Please comment on the accuracy of the information in the file: good

Any additional comments? (attachments welcomed)

Also used as a propellant for aerosols foods (i.e. whipped cream, cheeseffrat) Also used as a cryogenic freezing operations for foods.

Do you have a commercial interest in this material? ____ Yes; ✓ No

Signature [signature] **Date** 7/30/95

Please address the 7 criteria in the Organic Foods Production Act:
(comment in those areas you feel are applicable)

(1) the potential of such substances for detrimental chemical interactions with other materials used in organic farming systems;

none

(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;

little

(3) the probability of environmental contamination during manufacture, use, misuse or disposal of such substance;

none

(4) the effect of the substance on human health;

As a Respiratory Stimulant

(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;

little

(6) the alternatives to using the substance in terms of practices or other available materials; and

none

(7) its compatibility with a system of sustainable agriculture.

with limitations

TAP REVIEWER COMMENT FORM for USDA/NOSB

Use this page or an equivalent to write down comments and summarize your evaluation regarding the data presented in the file of this potential National List material. Complete both sides of page. Attach additional sheets if you wish.

This file is due back to us by: August 8

Name of Material: Carbon Dioxide

Reviewer Name: R THEUER

Is this substance Synthetic or non-synthetic? Explain (if appropriate) EITHER!

If synthetic, how is the material made? (please answer here if our database form is blank)

GOOD INFO ATTACHED

This material should be added to the National List as:

____ Synthetic Allowed ____ Prohibited Natural

or, ✓ Non-synthetic (Allowed as an ingredient in organic food)

✓ Non-synthetic (Allowed as a processing aid for organic food)

or, ____ this material should not be on the National List

Are there any use restrictions or limitations that should be placed on this material on the National List?

NON-SYNTHETIC

Please comment on the accuracy of the information in the file:

GOOD

Any additional comments? (attachments welcomed)

Do you have a commercial interest in this material? ____ Yes; ✓ No

Signature [signature] **Date** 8/28/95

Please address the 7 criteria in the Organic Foods Production Act:
(comment in those areas you feel are applicable)

(1) the potential of such substances for detrimental chemical interactions with other materials used in organic farming systems;

PLANTS NEED CARBON DIOXIDE

(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;

NO ISSUE

(3) the probability of environmental contamination during manufacture, use, misuse or disposal of such substance;

BY-PRODUCT, SO CAPTURING CARBON DIOXIDE IS A POSITIVE

(4) the effect of the substance on human health;

NO ISSUE - SAFE AT LEVELS USED

(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;

OK

(6) the alternatives to using the substance in terms of practices or other available materials; and

NONE

(7) its compatibility with a system of sustainable agriculture.

OK

NOSB Materials Database

Identification

Common Name	**Carbon dioxide**	Chemical Name	
Other Names			
Code #: CAS		Code #: Other	
N. L. Category	Non-agricultural	MSDS	◉ yes ○ no

Chemistry

Family	
Composition	CO_2.
Properties	colorless, odorless gas or white opaque solid.
How Made	Can be recovered from flue gases from coal burning, from synthetic ammonia and hydrogen plants, from fermentation of sugars, by a lime-kiln operation, from sodium phosphate manufacture, or from natural carbon dioxide gas wells. All of these processes are in commercial use and which is used is determined by local individual conditions. (details of each process are in the Kirk-Othmer Encyclopedia of Chemical Technology).

Use/Action

Type of Use	Processing
Specific Use(s)	carbonation of beverages.
Action	acts as a preservative to inhibit growth of mold and bacteria, as well as being a flavor enhancer.
Combinations	

Status

OFPA	
N. L. Restriction	
EPA, FDA, etc	
Directions	
Safety Guidelines	
State Differences	
Historical status	
Internationl status	

OFPA Criteria

2119(m)1: chemical interactions Not Applicable

2119(m)2: toxicity & persistence Not Applicable

2119(m)3: manufacture & disposal consequences

2119(m)4: effect on human health

2119(m)5: agroecosystem biology Not Applicable

2119(m)6: alternatives to substance

2119(m)7: Is it compatible?

References

Kirk-Othmer Encyclopedia of Chemical Technology, 3rd. Ed.

see also attached.

CARBON DIOXIDE REFERENCES

AU: Moyler,-D.A.; Browing,-R.M.; Stephens,-M.A.
TI: CO2 extraction of essential oils. V. Nutmeg and mace oils.
SO: Dev-food-sci. Amsterdam : Elsevier Scientific Publications. 1994. v. 34 p. 145-170.
CN: DNAL TX541.D33

AU: Balaban,-M.O.; Arreola,-A.G.
TI: Supercritical carbon dioxide applied to citrus processing.
SO: Trans-Citrus-Eng-Conf. Florida : Florida Section, American Society of Mechanical Engineers, 1955-. 1991. v. 37 p. 16-37.
CN: DNAL 389.9-C49

AU: Gill,-C.
TI: The super solvent.
SO: PennState-Agric. University Park, Pa. : Pennsylvania State University. Fall 1991. p. 19-20.
CN: DNAL S451.P4P45

AU: Balaban,-M.O.; Arreola,-A.G.; Marshall,-M.; Peplow,-A.; Wei,-C.I.; Cornell,-J.
TI: Inactivation of pectinesterase in orange juice by supercritical carbon dioxide.
SO: J-Food-Sci-Off-Publ-Inst-Food-Technol. Chicago, Ill. : The Institute. May/June 1991. v. 56 (3) p. 743-746, 750.
CN: DNAL 389.8-F7322
AB: Single strength orange juice was treated with supercritical carbon dioxide (CO2) and the effect of process time, temperature and pressure on pectinesterase (PE) activity was determined. PE could be inactivated with supercritical CO2 below temperatures necessary for thermal inactivation. Higher pressure, temperature and longer treatment time resulted in more inactivation.

AU: Wei,-C.I.; Balaban,-M.O.; Fernando,-S.Y.; Peplow,-A.J.
TI: Bacterial effect of high pressure CO2 treatment on foods spiked with Listeria or Salmonella.
SO: J-Food-Prot. Ames, Iowa : International Association of Milk, Food, and Environmental Sanitarians. Mar 1991. v. 54 (3) p. 189-193.
CN: DNAL 44.8-J824
AB: Studies were carried out to assess the use of high pressure CO2 treatment for controlling pathogenic microorganisms in model food systems. Listeria monocytogenes suspended in distilled water was completely killed after CO2 treatment at 6.18 MPa (61.2 atm) and 35 degree C for 2 h. Contrary to CO2 treatment, the use of N2 at these experimental conditions failed to exert bactericidal effect. High pressure CO2 treatment at 13.7 MPa (136.1 atm) and 35 degrees C for 2 h was shown to effectively kill Salmonella in spiked chicken meat (> 95%) and egg yolk (> 100%), and kill Listeria in spiked shrimp (> 99%), orange juice (> 99%), and egg yolk (> 99.4%). High pressure CO2 treatment technique could possibly be applied to reduce microbial load in some food systems.

AU: Haas,-G.J.; Prescott,-H.E.-Jr.; Dudley,-E.; Dik,-R.; Hintlian,-C.; Keane,-L.
TI: Inactivation of microorganisms by carbon dioxide under pressure.
SO: J-Food-Saf. Trumbull, Conn. : Food & Nutrition Press. 1989. v. 9 (4) p. 253-265.
CN: DNAL TP373.5.J62

AU: Mazza,-G.; Siemens,-A.J.
TI: Carbon dioxide concentration in commercial potato storages and its effect on quality of tubers for processing.
SO: Am-Potato-J. Orono, Me. : Potato Association of America. Feb 1990. v. 67 (2) p. 121-132.
CN: DNAL 75.8-P842

AU: Dziezak,-J.D.
TI: Innovative separation process finding its way into the food industry.
SO: Food-Technol. Chicago, Ill. : Institute of Food Technologists. June 1986. v. 40 (6) p. 66-69. ill.
CN: DNAL 389.8-F7398
AB: Abstract: A technological process is described, using carbon dioxide in its supercritical state to selectively extract and fractionate desirable components from a food mixture in 1 step. The basic supercritical process is illustrated schematically and discussed. Various supercritical processing applications (e.g., the production of supercritically decaffeinated tea) are described. The energy savings of supercritical fluid extraction for the food industry are cited.(wz).

AU: Daniels,-James-A.; Krishnamurthi,-Rajagopalan; Rizvi,-Syed,-S.H.-Rizvi.
TI: A Review of effects of carbon dioxide on microbial growth and food quality.
SO: J-Food-Prot. Ames, Iowa : International Association of Milk, Food, and Environmental Sanitarians. June 1985. v. 48 (6) p. 532-537. ill., charts.
CN: DNAL 44.8-J824
AB: Extract: Carbon dioxide is effective for extending the shelf-life of perishable foods by retarding bacterial growth. The overall effect of carbon dioxide is to increase both the lag phase and the generation time of spoilage microorganisms; however, the specific mechanism for the bacteriostatic effect is not know. Displacement of oxygen and intracellular acidification were possible mechanisms that were proposed, then discounted, by early researchers. Rapid cellular penetration and alteration of cell permeability characteristics have also been reported, but their relation to the overall mechanism is not clear. Several researchers have proposed that carbon dioxide may first be solubilized into the liquid phase of the treated tissue to form carbonic acid (H2CO3), and investigations by the authors tend to confirm this step, as well as to indicate the possible direct use of carbonic acid for retarding bacterial spoilage. Most recently, a metabolic mechanism has been studied by a number of researchers whereby carbon dioxide in the cell has negative effects on various enzymatic and biochemical pathways. The combined effect of these metabolic interferences are thought to constitute a stress on the system, and result in a slowing of the growth rate. The degree to which carbon dioxide is effective generally increases with concentration, but high levels raise the possibility of establishing conditions where pathogenic organisms such as Clostridium botulinum may survive. It is thought that such risks can be minimized with proper sanitation and temperature control, and that the commercial development of food packaging systems employing carbon dioxide will increase in the coming years. (author).

AU: Schultz,-W-G; Schultz,-T-H; Carlson,-R-A; Hudson,-J-S
TI: Pilot-plant extraction with liquid CO2 [carbon dioxide]. [Food processing]
SO: Food-Technol, June 1974, 28 (6): 32-34, 36, 88. Ref.
CN: DNAL 389.8-F7398

MATERIAL SAFETY DATA SHEET
CARBON DIOXIDE, SOLID

SECTION I - Product Identification

PRODUCT NAME: CARBON DIOXIDE, SOLID
COMPANY NAME: LIQUID AIR CORP. CHEMICAL FAMILY: CARBONATE
DATE: OCTOBER 1, 1985 EMERGENCY TELEPHONE: (415)977-6500

SECTION II - Hazardous Components

FORMS CARBONIC ACID THE THE PRESENCE OF WATER.

SECTION III - Physical Data

BOILING POINT: SUBLIMATION POINT = -109.3 F VAPOR PRESSURE: @ 70 F = 844.7 PSIA
SOLUBILITY IN WATER: @ 68 F BUNSEN COEFFICIENT = .8704
LIQUID DENSITY AT BOILING POINT: SOLID DENSITY = 95.64 LB/FT3
GAS DENSITY AT 70 F 1 ATM: @ 70 F = .114 LB/FT3 FREEZING POINT: -69.83 F @ 75.1 PSIA
APPEARANCE AND ODOR: WHITE OPAQUE SOLID; COLORLESS, ODORLESS GAS

SECTION IV - Fire and Explosion Hazard Data

FLASH POINT: NONE GIVEN AUTO IGNITION: NONE GIVEN
FLAMMABLE LIMITS % BY VOLUME: NONE GIVEN
EXTINGUISHING MEDIA: NONFLAMMABLE, INERT GAS
ELECTRICAL CLASS: NONHAZARDOUS
SPECIAL FIRE FIGHTING PROCEDURES: USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS TO PREVENT RUPTURE. THIS MATERIAL IS NON-COMBUSTIBLE. IT CAN BE USED AS A FIRE EXTINGUISHING AGENT PRIMARILY FOR ITS SMOTHERING EFFECT (REDUCTION OF OXYGEN CONCENTRATIONS SO IMMEDIATE ATMOSPHERE CANNOT SUPPORT COMBUSTION).
UNUSUAL FIRE AND EXPLOSION HAZARDS: NOT EFFECTIVE FOR USE ON FIRES INVOLVING CHEMICALS THAT HAVE THEIR OWN OXYGEN SUPPLY (I.E., CELLULOSE NITRATE); OR ON FIRES INVOLVING REACTIVE METALS (SUCH AS, POTASSIUM, SODIUM, MAGNESIUM, AND ZIRCONIUM), OR THEIR HYDRIDES AS THESE MATERIALS CAN DECOMPOSE CARBON DIOXIDE.

SECTION V - Health Hazard Data

EFFECTS OF OVEREXPOSURE:
INHALATION: NERVOUS SYSTEM CONTROL OR RESPIRATION IS DEPENDENT ON THE CO2 LEVEL BREATHED IN AIR. BY REDUCING THE OXYGEN LEVEL IN AIR, CO2 CAN CAUSE SUFFOCATION. SYMPTOMS INCLUDE: HEADACHE, DIZZINESS, SHORTNESS OF BREATH, MUSCULAR WEAKNESS, DROWSINESS AND RINGING IN THE EARS. HIGH CONCENTRATIONS PRODUCE A FAINT ACID TASTE AND CAN CAUSE PARALYSIS OF THE BREATHING CONTROL CENTERS OF THE NERVOUS SYSTEM: 2% BY VOLUME IN THE ATMOSPHERE WILL CAUSE A 50% INCREASE IN BREATHING RATE; 3%, A 100% RATE INCREASE; >4% PRODUCES LABORED BREATHING AND IS DANGEROUS FOR EVEN A FEW MINUTES OF EXPOSURE; >12% CAUSES RAPID UNCONSCIOUSNESS; A FEW HOURS EXPOSURE AT 25% RESULTS IN DEATH.
EMERGENCY FIRST AID: PROMPT MEDICAL ATTENTION IS MANDATORY. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.
INHALATION: CONSCIOUS PERSONS SHOULD BE ASSISTED TO AN UNCONTAMINATED AREA AND INHALE FRESH AIR. QUICK REMOVAL FROM THE CONTAMINATED AREA IS MOST IMPORTANT. UNCONSCIOUS PERSONS SHOULD BE MOVED TO AN UNCONTAMINATED AREA, GIVEN MOUTH-TO-MOUTH RECESSITATION AND SUPPLEMENTAL OXYGEN. ASSURE THAT VOMITED MATERIAL DOES NOT OBSTRUCT THE AIRWAY BY USE OF POSITIONAL DRAINAGE. MEDICAL ASSISTANCE SHOULD BE SOUGHT IMMEDIATELY.

FROSTBITE: FLUSH AFFECTED AREAS WITH LUKEWARM WATER. DO NOT USE HOT WATER. A PHYSICIAN SHOULD SEE THE PATIENT PROMPTLY IF THE CRYOGENIC "BURN" HAS RESULTED IN BLISTERING OF THE DERMAL SURFACE OR DEEP TISSUE FREEZING.

SECTION VI - Reactivity Data

STABILITY: STABLE
CONDITIONS TO AVOID: CO_2 IS STABLE UNDER ORDINARY CONDITIONS OF USE & STORAGE IT DOES NOT POLYMERIZE. IT DOES CAUSE VIOLENT POLYMERIZATION OF ACRYLALDEHYDE OR ETHYLENEIMINE. IT DECOMPOSES TO CO AND O_2 WHEN HEATED ABOVE 1700 C. THIS WEAKLY ACIDIC MATERIAL WILL REACT WITH ALKALINE MATERIALS TO FORM CARBONATES AND BICARBONATES.
INCOMPATIBILITY: AN EXPLOSION CAN OCCUR WHEN CO_2 CONTACTS MIXTURES OF SODIUM PEROXIDE WITH ALUMINUM OR MAGNESIUM. REACTIVE METALS (SUCH AS ALKALI METALS, MAGNESIUM, ALUMINUM, TITANIUM, OR ZIRCONIUM), THEIR HYDRIDES, AND MATERIALS LIKE DIETHYL MAGNESIUM, MOIST CESIUM OXIDE, OR LITHIUM ACETYLIDE WITH AMMONIA CAN IGNITE IN A CO_2 ATMOSPHERE. DRY ICE CAN FORM SHOCK SENSITIVE MIXTURES WITH SODIUM, POTASSIUM, OR SODIUM-POTASSIUM ALLOY.
HAZARDOUS DECOMPOSITION PRODUCTS: CARBON MONOXIDE

SECTION VII - Spill and Disposal Procedures

SPILL: EVACUATE AREA OF MAJOR SPILL OR RELEASE OF CO_2. NOTIFY SAFETY PERSONNEL PROVIDE VENTILATION. CLEAN-UP PERSONNEL NEED SPECIAL TRAINING AND PROTECTION AGAINIST CONTACT WITH COLD MATERIALS OR EXCESSIVE INHALATION OF GASEOUS CO_2.
DISPOSAL: ALLOW GAS TO BLEED OFF AT A MODERATE RATE OR SOLID TO SUBLIME TO A WELL VENTILATED AREA.

SECTION VIII - Protective Equipment

RESPIRATORY PROTECTION: POSITIVE PRESSURE AIR LINE WITH MASK OR SELF-CONTAINED BREATHING APPARATUS SHOULD BE AVAILABLE FOR EMERGENCY USE.
PROTECTIVE GLOVES: LOOSE FITTING, INSULATED
EYE PROTECTION: SAFETY GOGGLES OR GLASSES
OTHER: SAFETY SHOES, SOLID CO_2 HANDLING "TONGS"

SECTION IX - Storage and Handling Precautions

HANDLING: PROVIDE APPROVED SUPPLIED-AIR OR SELF-CONTAINED RESPIRATORS FOR USE IN NON-ROUTINE OR EMERGENCY SITUATIONS WITH EXPOSURE ABOVE THE TLV. A FULL FACE PIECE IS REQUIRED FOR CONCENTRATION >10%. PROVIDE STANDBY PERSONS WITH RESCUE EQUIPMENT WHERE WORK IS REQUIRED AT >15% CO_2 IN AIR.
STORAGE: IN AN AREA WHERE THERE IS ADEQUATE VENTILATION SO AS TO PREVENT THE ACCUMULATION OF CARBON DIOXIDE VAPORS ABOVE THE TWA.

SECTION X - Transportation Data and Additional Information

NA

(TM) and (R) : Registered Trademarks N/A = Not Applicable OR Not Available
The information published in this Material Safety Data Sheet has been compiled from our experience and data presented in various technical publications. It is the user's responsibility to determine the suitability of this information for adoption of necessary safety precautions. We reserve the right to revise
Copyright by Manufacturer
LICENSE GRANTED TO MAKE UNLIMITED COPIES FOR INTERNAL USE ONLY
by OREGON STATE UNIVERSITY