NOSB NATIONAL LIST
FILE CHECKLIST

PROCESSING

MATERIAL NAME: **# 9 Cultures, Dairy**

✓	**NOSB Database Form**
✓	**References**
____	**MSDS (or equivalent)**
____	**FASP (FDA)**
✓	**TAP Reviews from: Rich Theuer**

NOSB/NATIONAL LIST
COMMENT FORM
PROCESSING

Material Name: #9 Cultures, Dairy

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

COMMENTS/QUESTIONS:

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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: Sept 8, 1995

Name of Material: Cultures, dairy - YOGURT CULTURES

Reviewer Name: RC Theuer

Is this substance Synthetic or non-synthetic? Explain (if appropriate) YOGURT CULTURES - NON-SYNTHETIC

If synthetic, how is the material made? (please answer here if our database form is blank)
YOGURT CULTURES ARE NATURAL, NON-SYNTHETIC, NON-BIOENGINEERED, TO MY KNOWLEDGE.

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?

NONE (YOGURT CULTURES)

Please comment on the accuracy of the information in the file:
NEED SPECIFIC PRODUCTION INFO ON EACH CULTURE OR ENZYME

Any additional comments? (attachments welcomed)
IT IS ESSENTIAL TO ADDRESS EACH MATERIAL SINGLY, SINCE SOME MAY BE BIO-ENGINEERED AND THUS SYNTHETIC WITHIN MEANING OF THE ACT.

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;

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;

NONE – YOGURT FERMENTATION HAS A LONG HISTORY AS A "WAY OF "PRESERVING MILK"

(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;

GREAT. YOGURT HAS DOCUMENTED BENEFITS ON COLONIC BACTERIAL BALANCE

(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;

GOOD

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

BIOLOGICAL ACIDIFICATION REDUCES LACTOSE CONTENT; CHEMICAL ACIDIFICATION (LACTIC ACID) IS NOT AS GOOD

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

EXCELLENT, AND HAS BEEN FOR THOUSANDS OF YEARS.

NOSB Materials Database

Identification

Common Name **Cultures, dairy**

Chemical Name

Other Names cultures for butter, yogurt and cheese

Code #: CAS

Code #: Other

N. L. Category Non-agricultural

MSDS ○ yes ● no

Chemistry

Family

Composition See attached for list of organisms.

Properties rapid growth, usually in a specific temperature range. Many species produce flavor compounds, such as acetaldehyde, acetoin and diacetyl, which create the characteristic flavors of dairy product.

How Made Several methods of starter culture production are in use, the simplest being to use a sample of fermented food to inoculate the following batch. In commercial use, what is used is either a Daily Propagated Culture in liquid or freeze dried form, using frozen cultures or concentrates which are thawed as needed, or using Direct Vat Inoculation cultures. Most dairy plants have their own starter room where the starters are incubated and then provided for inoculation. Each type of dairy process has specific requirements for single strain or blend of culture species, time and conditions of inoculation.

Use/Action

Type of Use Processing

Specific Use(s) Used in making yogurt, cheese, some butter, and milk-derived products such as kefir.

Action In general, bacteria in cultures aid the preservation of food by utilization of carbohydrate in conversion to lactic acid. The resulting pH drop helps protect against spoilage organisms. Yogurt is formed by the synergistic relationship between the 2 strains of bacteria used: *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. These grow together in milk, with *S. thermophilus* releasing carbon dioxide to stimulate *L. bulgaricus*, and *L. bulgaricus* in return releasing amino acids from the milk proteins which speed the development of *S. thermophilus.*

Combinations

Status

OFPA

N. L. Restriction

EPA, FDA, etc FDA-GRAS

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

Fermented dairy products are claimed to be more nutritious because some ingredients are partly predigested. Heat treatment of milk is known to reduce the availability of lysine and damage Vitamin C, some B-complex, and sulfur amino acids. However the beneficial changes to the milk caused by the growth of lactic acid bacteria are considered to be of more nutritive value.

2119(m)5: agroecosystem biology Not Applicable

2119(m)6: alternatives to substance

ambient air starters: not reliable or controlable.

2119(m)7: Is it compatible?

References

Encyclopedia of Food Science, Food Technology and Nutrition. 1993. Academic Press, Ltd., San Diego, CA

See also attached.

DAIRY CULTURES REFERENCES

AU: Hayward,-Harry, 1869-; McDonnell,-M.-E. (Milton Earle), 1873-
TI: Commercial butter cultures.
SO: State College : Pennsylvania State College Agricultural Experiment Station, 1899. 22 p.
CN: DNAL 100-P381-no.44

AU: Farmer,-R.-S. (Ralph S.); Hammer,-Bernard-Wernick, 1886-
TI: Studies on the development of butter cultures for mixtures of organisms.
SO: Ames, Iowa : Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts, 1931. 24 p.
CN: DNAL 100-Io9-no.146

AU: Nelson,-Frank-Eugene, 1909-; Harriman,-L.-A.; Hammer,-Bernard-Wernick, 1886-
TI: Slow acid production by butter cultures.
SO: Ames, Iowa : Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts, 1939. p. 220-287
CN: DNAL 100-Io9-no.256

AU: Hammer,-Bernard-Wernick, 1886-; Patil,-V.-H. (Vishram Hari), 1898-
TI: Proteolysis by Streptococcus lactis with special reference to butter cultures and butter.
SO: Ames, Iowa : Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts, 1930. p. 60-91
CN: DNAL 100-Io9-no.123

AU: Fulga,-F; Eustatiu,-A; Cristescu,-A
TI: Seasonal variation in the citric acid content of cow's milk; its effect on the formation of diacetyl and acetoin in butter cultures
SO: Indus-Aliment-Bucuresti, Sept 1972, 23 (9): 492-494. Ref. Eng.sum.
CN: DNAL 389.8-IN26

AU: Sellars,-R-L
TI: Basic principles of lactic starter-cultures [Cheese]
SO: Mod-Dairy, Nov/Dec 1975, 54 (6): 25-26.
CN: DNAL 44.8-C162

AU: Kothari,-S-L; Nambudripad,-V-K-N
TI: Isolation and identification of stimulatory substance involved in the associative growth of cheese cultures
SO: J-Dairy-Sci, Apr 1973, 56 (4): 423-428. Ref.
CN: DNAL 44.8-J822

AU: Ruppert,-A-F
TI: Yogurt cultures and their effect on ready-made products
SO: Dtsch-Molk-Ztg, Feb 16, 1978, 99 (7): 212-215.
CN: DNAL 44.8-SU2

AU: Sellars,-R-L
TI: Profitable manufacture of yogurt and propagation of yogurt cultures
SO: Mod-Dairy, May 1973, 52 (5): 19-22.
CN: DNAL 44.8-C162

Table 1. Organisms used in the dairy industry

Group	Organism	Specific application
Mesophilic lactic acid bacteria	*Lactobacillus casei*	Flavour production and texture improvement; cheese
	Lactococcus lactis subsp. *cremoris*	Acid production; cheese
	Lactococcus lactis subsp. *lactis*	Acid production; cheese
	Lactococcus lactis subsp. *lactis* var. *diacetylactis*	Flavour production; cheese, fermented milks
	Leuconostoc lactis	Flavour production; cheese
	Leuconostoc mesenteroides subsp. *cremoris*	Gas production and flavour production
	Micrococcus varians	Enhances activity of thermophiles
	Pediococcus spp.	'Eyes' in Swiss cheese
	Propionibacterium shermanii	'Eyes' in Swiss cheese
Thermophilic lactic acid bacteria	*Bifidobacterium* spp.	Mild yoghurt, fermented milks
	Lactobacillus acidophilus	Yoghurt, fermented milks
	Lactobacillus delbrueckii subsp. *bulgaricus*	Flavour production; yoghurt
	Lactobacillus delbrueckii subsp. *delbrueckii*	
	Lactobacillus delbrueckii subsp. *lactis*	Acid production; cheese
	Lactobacillus helveticus	Acid production; cheese
	Streptococcus salivarius subsp. *thermophilus*	Acid production; yoghurt, cheese
Yeasts	*Debaromyces hansenii*	Deacidification of curd to encourage growth of *Brevibacterium linens*
	Kluyveromyces lactis	Flavour production and texture improvement; cheese
	Torulopsis spp.	Flavour production in soft cheese by proteases and lipases
	Rhodosporidium infirmominiatum	Pigmented surface coloration on cheese
Surface-ripening bacteria	*Arthrobacter globiformis*	Surface smear on cheeses
	Brevibacterium linens	Pigmented surface smear on cheeses
Moulds	*Aspergillus flavus*	Yellow-grey surface-ripened cheeses
	Chrysosporium merdarium	Sulphur-yellow surface-ripened cheeses
	Fusarium solani	White surface-ripened cheeses
	Geotrichum candidum	White surface-ripened cheeses
	Penicillium album	Grey-blue surface-ripened cheeses
	Penicillium camemberti	White surface-ripened cheeses
	Penicillium caseicolum	White surface-ripened cheeses
	Penicillium cyclopium	White surface-ripened cheeses
	Penicillium nalgiovensis	White surface-ripened cheeses
	Penicillium roqueforti	Blue-veined cheeses
	Scopulariopsis fusca	Beige surface-ripened cheeses
	Sporendonema casei	Red surface-ripened cheeses

Deep-frozen Cultures

Frozen cultures eliminate the need for daily propagation by the food manufacturer. A bottle is supplied containing inoculated, but unincubated, reconstituted skimmed milk which has been frozen. The cultures are shipped in an insulated box and need to be transferred to a freezer at −20°C as soon as they are received at the production site. Bulk starter is prepared by thawing and then clotting the bottle overnight and inoculating the clotted culture into the bulk starter medium.

Deep-frozen Concentrated Cultures

Frozen concentrated cultures are packed in aluminium ring-pull cans of 70 or 125 ml capacity. The suppliers ship them in insulated boxes containing solid carbon dioxide to maintain their temperature at approximately −70°C. On receipt they have to be transferred either to a special low-temperature freezer operating at −40°C or to a liquid nitrogen refrigerator. The shelf life at −40°C is between 1 and 3 months but in liquid nitrogen vapour

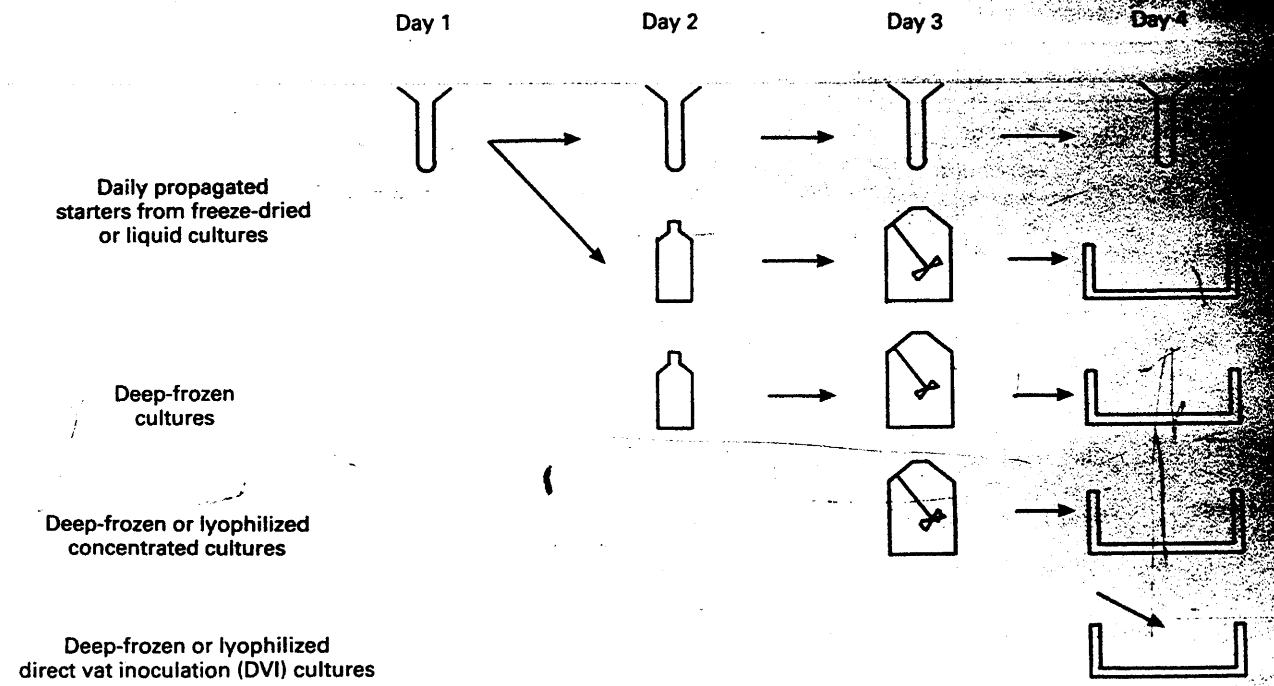

Fig. 1 Culture systems.

Table 4. Summary of the advantages of various culture systems

	Daily propagated starters from freeze-dried or liquid cultures	Deep-frozen cultures	Liquid-nitrogen-frozen concentrates	Lyophilized concentrates	Liquid-nitrogen- or low-temperature-frozen DVI cultures	Lyophilized DVI cultures
Cost of cultures per vat	Low	Medium	Medium	Medium	High	Medium
Level of technical skill required	High	High	Medium	Medium	None	None
Cost of culture storage	Low	Low	High	Low	High	Low
Level of phage relationship data available	None	High	High	High	High	High
Amount of planning required to manufacture starter (h)	72	48	24	24	None	None
Amount of culture performance data generated prior to use (fresh starter)	Fully tested	None	None	None	None	None
Amount of culture performance data generated prior to use (stock starter)	Fully tested	Fully tested	Fully tested	Fully tested	None	None
Level of technical support provided for system	None	High	High	High	High	High
Range of cultures available	Good	Good	Good	Adequate	Good	Adequate

DVI, direct vat inoculation.

risk of bacteriophage attack. Bacteriophage is a virus which attacks healthy bacteria by first adsorbing onto the surface of the bacterial wall, then injecting genetic material (deoxyribose nucleic acid; DNA) into the cell in which it multiplies to produce several dozen new virulent 'phages. These are liberated in the medium by the break-up (lysis) of the infected bacterium and are capable of infecting new cells. The latent period between the first 'phage–bacterium contact and liberation varies between 20 and 30 min and Fig. 2 shows how potent one 'phage particle can be.

It is for this reason that single-strain cultures are always used in pairs or triples. Suppliers offering these starters have carried out extensive work on the 'phage