Food Science Sourcebook

Second Edition

Part 1

HERBERT W. OCKERMAN

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Part 1

Terms and Descriptions

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Food Science Sourcebook

Dedicated to Frances

Preface to second edition, titled *Food Science Sourcebook*

It was realized, even prior to the printing of the first edition, that a book of this magnitude would never be complete and that at some point a line must be drawn and data currently available must be organized. This was done to get the first edition into print. However, prior to its printing, revisions and new data were becoming available for inclusion in the second edition (now titled *Food Science Sourcebook*), which includes most of the information in the first edition plus twelve additional years of collecting data.

The author wants to thank the many readers, colleagues, and students who have made suggestions on how the manuscript could become more useful. Most of the suggestions have been incorporated into this edition. Like the first edition, the second edition is certainly also not complete, and the author would certainly appreciate communications from readers and colleagues for suggestions and recommendations on how additional editions might be improved.

HERBERT W. OCKERMAN
Columbus, Ohio

Preface to first edition, titled *Source Book for Food Scientists*

The *Source Book for Food Scientists* materialized as the result of accumulating current data and relevant facts in the field of food science and technology. Since reference sources are often scattered, there has been a need for a one-volume data book of this type. A number of my colleagues have urged me to make my data bank available to others, hence this volume.

Such a book could be organized as follows: a dictionary interpretation of terms used in food science and technology; tabular material giving detailed information on food composition and properties; chemical formulas and structures; uses of foodstuffs; harvesting; slaughtering and related information concerning the meat industry . . . , in fact, almost any and every type of subject one might encounter dealing with food.

I have organized the material in two parts. Part 1 covers what I call my "personal dictionary" of pertinent information. Part 2 contains the tabular and general information that broadens the base of Part 1 with factual data.

I have found it invaluable. My earnest desire, now that the material is to be published, is that it will equally serve other food scientists and technologists working in various capacities in industry, government, and the academic community.

I wish to acknowledge the encouragement given me by Dr. Donald K. Tressler, President, AVI Publishing Company, and to express my appreciation for his belief and support in this project.

It is also a special pleasure for me to acknowledge the editorial assistance provided by Mrs. Lucy Long, Senior Editor at AVI, and to Mr. Gessner Hawley, Editor of the *Condensed Chemical Dictionary* and Co-editor of the *Encyclopedia of Chemistry*. It was their collaboration and assistance that transformed a very rough draft into a publishable manuscript. However, errors of omission or commission are mine alone to bear.

I would also like to thank the scores of publishers and authors who have granted me permission to reprint their copyrighted materials. Thanks are also extended to the many authors and contributors to government publications for information obtained from those sources. Specific acknowledgement is noted for each source as it appears in this book.

I also wish to extend grateful thanks to my wife, Frances, for her assistance in typing and proofreading. Her patience and help contributed much to the completion of this book.

This is the First Edition of the *Source Book* and I would greatly appreciate communications from readers for suggestions or recommendations on how to improve it and also to call to my attention errors that may be corrected in the next printing.

HERBERT W. OCKERMAN
Columbus, Ohio

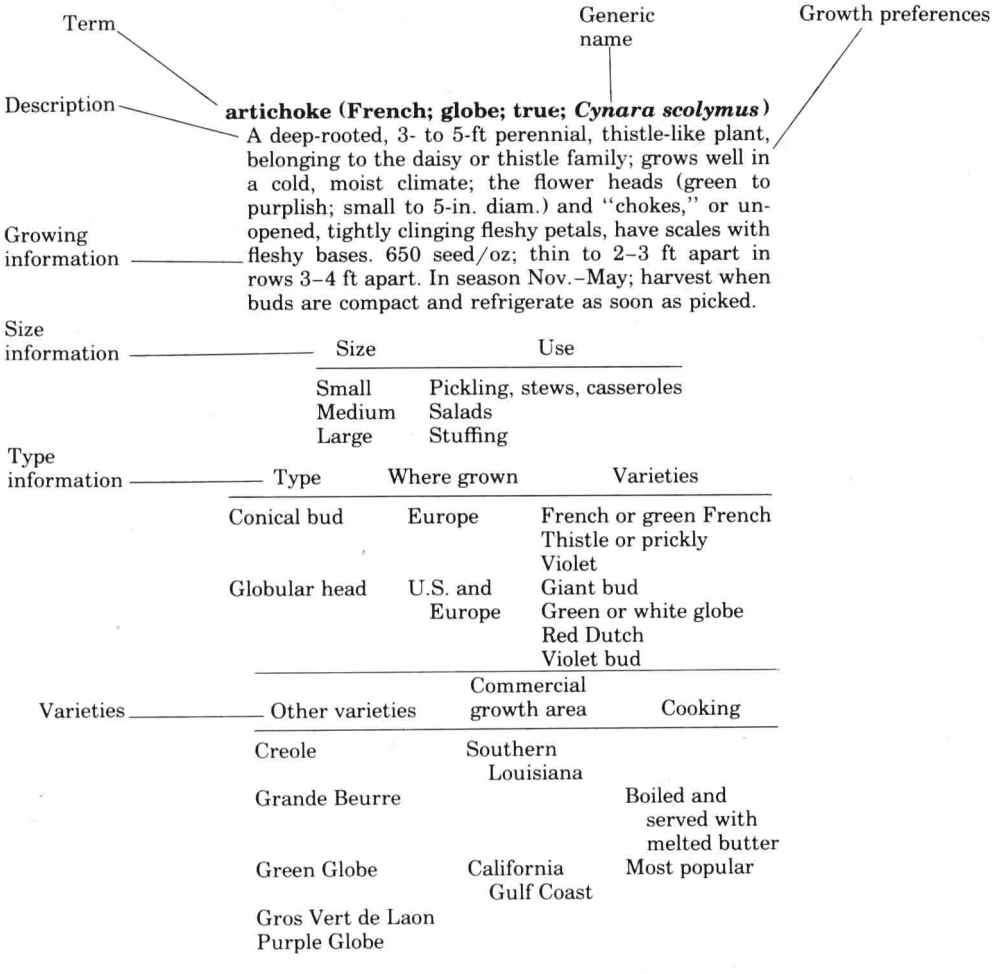
Jan. 1, 1978

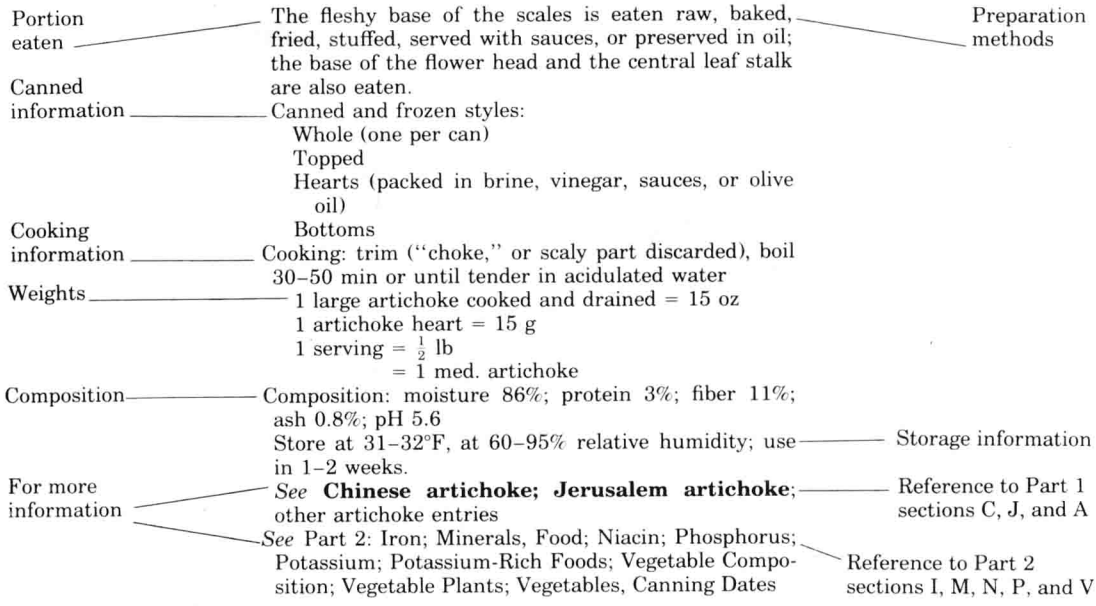
How to Use The *Food Science Sourcebook* (important to obtain maximum utilization of this book!)

For ease of retrieval, this book has been organized into two parts. *Start your search in Part 1* and this, if necessary, will lead you to Part 2 by extensive cross-references. Part 1 consists of dictionary terms and descriptions wherein the definition usually contains detailed information on the subject and, where feasible, some data concerning its use or properties. With the majority of these *Sourcebook* terms and description in Part 1, there is a reference to Part 2, giving a list of subjects for further information. (See the breakdown of the **artichoke** entry below.)

Part 2 is composed of alphabetical sections containing food composition, properties, and general data designed as the basis for the initiation of a broader search for further information relevant to the dictionary term given in Part 1. Part 2 is, in truth, a "data book" of tables, figures, charts, formulas, etc.

Part 1 will lead the reader to a pertinent, appropriate section in Part 2, or one can refer to Part 2 independently of the Part 1 dictionary description because it is organized alphabetically; however, some information will be missed if the second approach is used.





Other ready-reference material that is to be found in the book:

Inside the front cover is a table for temperature conversion from Fahrenheit to Celsius or vice versa.

Inside the back cover will be found conversion factors for units of weight, units of liquid measure, oven temperatures, and units of volume.

And following is a list of the most-often-used abbreviations for quick reference.

Common Abbreviations

NOTE: Where the abbreviation denotes either the singular or plural, the spelled-out version of the abbreviation carries an asterisk (*).

A	ampere*
AAAS	American Association for the Advancement of Science
AOAC	Association of Official Analytical Chemists
apoth.	apothecary
approx.	approximately
atm	atmosphere
at. no.	atomic number
at. wt.	atomic weight
avg.	average
avdp.	avoirdupois
bp	boiling point
Brit.	British
Btu	British thermal units
bu	bushel*
cal	calorie*
°C	Centigrade or Celsius
ca.	circa or about
cc	cubic centimeter* (also cm^2)
CAMP	computer assisted menu planning
CFN	Council on Food and Nutrition of the American Medical Association
cg	centigram*
chem.	chemical or chemistry
cl	centiliter*
cm	centimeter*
CP	chemically pure
cps	cycles per second
cu.	cubic
cwt	hundredweight
d	density
dc	direct current
deg	degree*
df	degrees of freedom
dg	decigram*
diam.	diameter
dag	dekagram*
dal	dekaliter*
dl	deciliter*
dm	decimeter*
dwt	pennyweight
doz	dozen*
dr	dram*
e.g.	for example
EMF	electromotive force
equiv. wt.	equivalent weight
°F	Fahrenheit
FAO	Food and Agricultural Organization, United Nations
FDA	Food and Drug Administration
ffa	free fatty acid*
fl	fluid
FNS	Food and Nutrition Service, US Department of Agriculture
FNB	Food and Nutrition Board of the National Academy of Science–National Research Council
fp	freezing point
fpm	feet per minute
fps	feet per second
ft	foot*
g	gram*
gal	gallon*
gpm	gallon* per minute
gr	grain*
h	hectare*
hg	hectogram*
Hg	mercury
hhd	hogshead*
hp	horsepower
h	hour*
i.d.	inside dimension
i.e.	that is
imp	imperial
in.	inch*
IU	International Units

J	joule*
K	kelvin
kcal	kilocalorie*
K_{eq}	equilibrium constant
kg	kilogram*
km	kilometer*
kW	kilowatt*
l	liter* (more often spelled out to avoid misinterpretation with numeral one)
lat	latitude
lb	pound*
m	meter*
M	Molal
max.	maximum
MDR	minimum daily requirement (no longer used; see RDA)
med.	medium
mg	milligram*
MHz	megahertz
mi	mile*
MID	Meat Inspection Division, US Department of Agriculture
min.	minimum
ml	milliliter*
mm	millimeter*
mo.	month*
mol. wt.	molecular weight
mp	melting point
mps	meters per second
mV	millivolt*
No.	number (when followed by numeral)
NFE	nitrogen free extract
NIH	National Institutes of Health
NMR	nuclear magnetic resonance
NPU	net protein utilization
NPV	net protein value
NRC	National Research Council
NSF	National Science Foundation
o.d.	outside dimension
opt.	optimum, optional
oz	ounce*
PER	protein efficiency ratio
pk	peck*
ppm	parts per million
ppt	precipitate; parts per trillion
prob.	probable
psf	pounds per square foot*
psi	pounds per square inch*
psia	pounds per square inch atmosphere*
pt	pint*
qt	quart*
r	correlation
R	Réaumur
rd	rod*
RDA	recommended daily allowance
RH	relative humidity
rpm	revolutions per minute
s	second*
sig.	significant
sp.	specific
sp. gr.	specific gravity
sq.	square
tbsp	tablespoon*
temp.	temperature
tsp	teaspoon*
USDA	United States Department of Agriculture
USP	*US Pharmocopeia*
vit.	vitamin (rarely used)
vol.	volume
wt.	weight
yd	yard*
yr	year*

Contents

Part 1

Terms and Descriptions

A

A 1) Abbreviation for absolute temperature. 2) Abbreviation for acre

Å Abbreviation for angstrom

a_w *See* **water activity**

a *See* **ampere**

a- Prefix meaning not or without

-a Latin suffix making some words singular and others plural

aalrauchmettwurst Pork salami

aarey A semihard, buffalo's-milk cheese

aarlborg A clear, schnapps-type spirit with a high alcohol content

AAS Atomic absorption spectrometry

ab- Prefix meaning away from

abacaxi *See* **pineapple**

abaisse A thin, undercrust pastry

abalone [awabi; muttonfish; ormer; paua; sea-ear; *Haliotis cracherodii*; *H. iris* (paua from New Zealand); *H. rufescens*; *H. splendens*; *H. tuberculata* (Channel Islands)] A large (1-ft) mollusk or Pacific sea snail with a single, flattened shell. The "foot," or central muscle, is eaten and is somewhat tough (if overcooked) but has a delicate clamlike flavor. The meat is firm, creamy white, and mild. It is available fresh, dried (brined, cooked, smoked, and then sun-dried), dry shredded, dry powder, salted, canned (in brine), frozen, and as soup. It may be used in chowders, soups, canapés, sandwiches, and for stir-frying. The shells are a source of mother of pearl and blister pearl.

Composition: moisture 76%; protein 19%; fat 0.5%; carbohydrate 3.5%; ash 1.6%

See Part 2: Minerals (Trace), Food

abampere

1 abampere = 10 amperes (A)

See **ampere**

A-band Dark bands (anisotropic) in muscle fiber; they contain all the myosin and the ends of the actin filaments.

abandon *See* **expire**

abattoir Slaughterhouse

abbaye de citeaux A rich, creamy, soft, French, monk's cheese

abbot A fish called an angle shark (*Squatina squatina*) or anglerfish (*Lophius piscatorius*)

abcoulomb

1 abcoulomb = 2.998×10^{10} statcoulomb

ABC's Letter- and number-shaped pasta that is $\frac{1}{4}$ in. tall

abdominal Refers to the stomach, or belly, between the thorax and pelvis

abductor A muscle that draws a limb, wing, or other body appendage away from a medial position

abdug Sour diluted milk that is often salted, has spices and herbs added, or is sweetened

abe nego A red palm oil

Aberdeen A soft, mellow, creamy, Scottish cheese

Aberdeen-Angus Commonly refered to as Angus. Solid black breed of beef cattle that has no horns; origin, Northeastern Scotland; imported into America by G. Grant of Victoria, Kansas.

See Part 2: Beef and Dual-Purpose Cattle; Gestation Periods

Aberdeen-Angus crosses

Angus × Horned European breeds → nearly always polled
× Brahman → 95% female polled
× red-bodied cattle → black with white markings of the other breed
× white Shorthorns → blue-gray (mixture of white and black hair)
× Charolais → black or "smokey" white

Aberdeen-Angus-Hereford cross Offspring will be polled and have a white face and black body; if two of the above offspring are crossed, the following ratio of offspring will result:

27 polled, white face, black body
9 horned, white face, black body
9 polled, entirely black
9 polled, white face, red body
3 horned, entirely black
3 horned, white face, red body
3 polled, colored face, red body
1 horned, colored face, red body

Aberdeen-Angus, Red Red color is inherited as a single, one-gene recessive trait in Angus cattle.

Red × Red → always Red

aberdeen buttery A wheat-flour roll

abertam A golden, hard, salty, pressed, German cheese made from sheep's or goat's milk

abfarad

1 abfarad = 1×10^9 farads (F)
= 1×10^{15} microfarads (μF)

See **farad**

abhenry

1 abhenry = 1×10^{-9} henry (H)
= 1×10^{-6} millihenry (mH)

See **henry**

abifo Chindanda made from maize flour and plantain

abijau An alcoholic beer

abiu A South American fruit whose edible pulp (eaten stewed or grilled) is covered with a red capsule

ablongo Steamed chindanda made from maize or rice and plantain; flavored with onions, pepper, and ginger

abnormal Not normal; unnatural; not typical; unusual or irregular

abodoo An acidic maize dumpling

abohm

1 abohm = 1×10^{-6} ohm (Ω)
= 1×10^{-15} megohm ($M\Omega$)

See **ohm**

abolo Acetic, steamed or baked maize dumpling (wheat flour may be added)

abomasum (glandular stomach; true stomach) The fourth section of the ruminant stomach, which is located on the right side; often called the true stomach or rennet bag; it functions very much like the entire monogastric stomach; a bovine abomasum may have a capacity from 2 to 5 gal

abondance (tomme d'abondance) A 20- to 40-lb paste to semihard, cow's-milk cheese, with a washed rind, small holes, and mild to full fruity flavor, that is produced in France and aged 2–3 months

abongo An acidic-maize, sugar, and palm-oil dumpling

abrey A nonalcoholic, sour drink made from white sorghum

abricot Brandy distilled from fermented apricot juice

abricotine A sweet apricot (*Prunus armeniaca*) liqueur. A French liquor made from brandy, fresh apricot pulp, and apricot kernel. A cordial made from brandy and apricot extract

Abruzzi A variety of rye

abscess Pus in any tissue or organ

abscissa (*x* axis) Horizontal axis on rectangular coordinates

abscission Detachment or separation of a fruit from a tree or shrub. Treatment with chemicals before harvesting aids this separation.

absinth(e) (*Artemisia absinthium*) 1) An herb (wormwood) grown for its aromatic oil, which is used as a condiment; an alcoholic liquor can be made from its leaves. *See* **wormwood.** 2) A strong (high alcohol content), dry liqueur or elixir flavored with wormwood, aniseed, licorice, or fennel. It also contains a habit-forming drug.

absinth(e) oil *See* **wormwood**

absolute alcohol Contains about 99.8% alcohol; can be made as follows:

1. Heat crystalline copper sulfate until it is a white powder
2. Add to commercial alcohol (96%) until it no longer turns blue
3. Filter into a clean, dry, tightly capped bottle

absolute temperature (A)

°K (kelvin) = °C + 273.16
°R (Rankine) = °F + 459.69

See Part 2: Temperature (Conversion Table)

absolute value ($|n|$) A number without a + or − sign

absolute zero −459.69°F; −273.16°C

absorption Penetration of a liquid into the fine structure of a solid, the liquid being retained within the solid. Cellulosic materials (absorbent cotton, paper) readily absorb liquids. Absorption of nutrients by the intestinal walls is an important factor in metabolism; transfer of substances or nutrients from the gastrointestinal tract (intestine) to the blood or lymph systems, e.g., from the alimentary tract by digestion or from tissue. Retention or holding of oil or fat by a food. The word also means the tendency of a material to accept energy in the form of certain wavelengths of light (absorption band). *See also* **spectrophotometric analysis**

aburage Fried bean curd *See* **tofu**

abutilon A vegetable plant; its flowers or leaves are eaten

abvolt

1 abvolt = 1×10^{-8} volt (V)

See **volt**

ABY agar *See* Part 2: Microorganism, Media

ac *See* **alternating current**

Ac Symbol for the element actinium

a.c. Latin for before meals

acacia A shrub; its young flowers [blossoms of acacia (wattle)] are used in making fritters or for food flavoring.

acacia gum *See* **gum arabic**

acar (achar) 1) General term for pickle, sometimes hot. 2) Pickled fruit. 3) Pickled vegetables

accelerated freeze-drying Freeze-drying with expanded metal (or spikes) between the drying surface of the frozen food and the heating platens

accelerated rancidity test Any test to determine the relative shelf life of fats or food by increasing the development of rancidity. This is usually done by abnormally increasing the temperature, light, and/or oxygen level. *See* **active oxygen method**

accelerator A device used to produce electron beams that can be used in food irradiation

acceptable quality level (AQL) A level of lot quality expressed as a percentage defective that is acceptable

acceptance A draft on which the debtor indicates by the word "accepted" the debtor's intention to pay

acceptance number The maximum number of defects acceptable in a lot

acceptance sampling plan A procedure for accepting a lot based on inspection of a sample from the lot

acclimation Adjustment to new surroundings

accoub Mediterranean vegetable; edible thistle

Parts eaten	Used as	Similar to
Buds	Parboiled vegetable	Potatoes
Root	Salsify substitute	Salsify
Shoots	Asparagus substitute	Asparagus

accra Yeast-batter fritters containing fish, meat, vegetables, or fruit

Accum, Frederick A German food chemist who applied chemistry to food problems in the 1800s and wrote *Culinary Chemistry* and *A Treatise on Adulterations of Food*

aceda A thick porridge gruel made from sorghum or millet

aceitunas Olives

acelga *See* **beet, silver**

acerola cherry (West Indian cherry, Barbados cherry) A tropical berry (*Malpighia punicifolia*; *M. glabra*) high in vitamin C (1700 mg ascorbic acid/100 g pitted fruit); it resembles a cherry but is an entirely different fruit.

Composition	Pulp & skin (%)	Juice (%)
Water	92	94
Protein	0.4	0.4
Fat	0.3	0.3
Carbohydrate	7	5
pH		3–3.5

See Part 2: Fruit Storage I

acesulfame K Artificial sweetener used in Europe

acetabulum Hip joint cavity; socket or cavity that receives the head of another bone

acetal [$CH_3CH(OC_2H_5)_2$] A volatile liquid used as flavoring

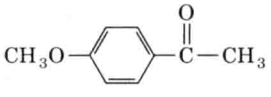
acetaldehyde (ethanal) (CH_3CHO) Found naturally in many foods and added to others as a flavoring agent; sp. gr. 0.804–0.811 at 0°/20°C, 99% pure

Storage: closed container in a cool (less than 15°C) place

acetaldehyde phenethyl propyl acetal pepital Synthetic fruit flavoring

acetamide (CH_3CONH_2) Normal constituent of some foods and also a nitrogen excretory product of mice

acetanisole (*p*-methoxyacetophenone)

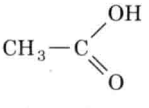


Used as a flavoring agent in foods; mol. wt. 150.18

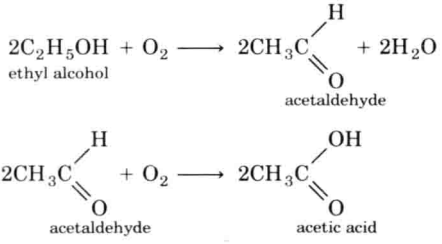
Storage: full, tight, glass containers in a cool, dark place

acetate differential agar *See* Part 2: Microorganism, Media

acetic acid (ethyl acetate)



A saturated carboxylic acid occurring as a free fatty acid in natural fat; found in vinegar (4–12%); formed by the bacterial fermentation (*Acetobacter aceti*) of alcohol:



mol. wt. 60.03, equiv. wt. 60.03

Commercial grades	mol/l	g/l	% by wt.	Sp. gr.	*N*
Acetic acid	6.27	376	36	1.045	6.27
Acetic acid, glacial	17.4	1045	99.5	1.050	17.4

Can be obtained also by destructive distillation of wood and by reaction of carbon monoxide with methanol. Used in preserving and as acidifiers (pH control) and flavoring agents in food (particularly in dairy products)

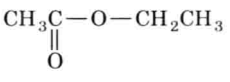
580 ml of 99.5% CH_3COOH to dilute to 10 l, approx. normality 1.00

Storage: tight container

See Part 2: Concentration of Commercial Strengths of Acids and Bases; Normal Solutions; pH, Standard Solutions; Reagents, Normal Solutions

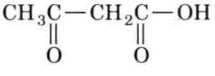
acetic bacteria *Acetobacter*

acetic ether (ethyl acetate)



Artificial fruit essence

acetoacetic acid



Product of incomplete oxidation of fatty acids *See* **acetone bodies**

Acetobacter A rod-shaped (2-μm long) microorganism that occurs in pairs of long or short chains; they are important in the carbon cycle, the production of vinegar, and the oxidation of ethanol to acetic acid and acetate or lactate to carbon dioxide and water.

See Part 2: Spoilage, Carbohydrate Foods

acetoin (acetyl methyl carbinol; dimethylketol) ($CH_3CH(OH)COCH_3$) Used as a flavoring agent in food

Storage: full, tight, glass container in a cool place

See **acetyl methyl carbinol**

acetomel A syrup made from equal parts of honey and vinegar

Acetomonas A rod-shaped (3-μm long) obligate aerobic microorganism that oxidizes ethanol to acetic acid;