

**FOOD INDUSTRIES
MANUAL**

FOOD INDUSTRIES MANUAL

20th Edition

edited by

ANTHONY WOOLLEN
B.Sc., A.R.C.S., F.R.I.C., F.I.F.S.T.

CHEMICAL PUBLISHING CO., INC.
200 PARK AVENUE SOUTH, NEW YORK, N.Y.

Food Industries Manual, 20th Edition

© 2011 by Chemical Publishing Co., Inc. All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except as permitted under Sections 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600, or on the web at copyright.com. Requests to the Publisher for permission should be addressed to the Publisher, Chemical Publishing Company, through email at info@chemical-publishing.com.

The publisher and the author make no representations or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation warranties of fitness for a particular purpose.

ISBN: 978-0-8206-0128-1

Chemical Publishing Company:
www.chemical-publishing.com
www.chemicalpublishing.net

First American Edition - Chemical Publishing New York 1970

Printed in the United States of America

Preface to Twentieth Edition

Techniques of food manufacturing, handling and packaging have advanced significantly in the seven years since the last edition of **FOOD INDUSTRIES MANUAL**. These advances are reflected in this, the twentieth edition, which has been largely written from scratch.

The basic arrangement of previous editions, which has satisfactorily stood the test of time, has been retained. Some of the contents of previous editions have been rearranged into more logical sequence. Jams and jellies have been taken out of the section on Confectionery and incorporated in a new section on Preserves. The section on Fish Processing has been considerably enlarged. Storage, Refrigeration and Handling have been combined into one section. A new section on Nutrition makes its appearance, incorporating in more readable form the tables at the end of the previous edition devoted to Vitamins and Composition of Foods, and providing additional information on this important subject.

It is considered that these and other changes improve the overall balance. The result is an encyclopaedia of practical food technology compiled by specialists of international repute, each of whom is a practitioner in close touch with current developments in his field.

My thanks are due to the contributors who have given without stint their knowledge and time; and acknowledgment is made of the work of the late T. Crosbie-Walsh, F.R.I.C., originator of the **MANUAL** and Editor of earlier editions.

ANTHONY WOOLLEN
23 January 1969

List of Contents

	<i>Page</i>
Preface	v
List of Figures	viii
List of Tables	ix
<i>Chapter</i>	
I Baking: J. F. Herringshaw (A.R.C.S., Ph.D., F.R.I.C.)	1
II Canning and Freezing: D. A. Herbert (F.R.I.C., F.I.F.S.T., M.I.Biol.) and J. D. Felmingham (B.Sc., F.R.S.H., F.I.F.S.T., M.Inst.Pkg.)	13
III Confectionery: R. Lees (M.R.S.H., A.I.F.S.T.)	57
IV The Dairy Industry: J. G. Davis (D.Sc., Ph.D., F.R.I.C., F.I.F.S.T., F.R.S.H.)	75
V Dehydration: C. G. Tucker (B.Sc., F.I.C.I., F.I.F.S.T.)	159
VI Fats and Fatty Foods: P. Brown (M. Inst. Inf. Sci.) and I. D. Morton (Ph.D.)	185
VII Fish Processing: C. L. Cutting (Ph.D., B.Sc.)	213
VIII Fruit Juices and Fruit Juice Beverages: J. Shacklady (B.Sc., A.R.I.C., F.I.F.S.T.)	248
IX Meat and Meat Products: Fergus Hill (Ph.D.)	280
X Flour and Flour Milling: J. F. Herringshaw (A.R.C.S., Ph.D., F.R.I.C.)	303
XI Nutrition: A. E. Bender (Ph.D., B.Sc., F.R.I.C.)	326
XII Packaging: F. A. Paine (B.Sc., F.R.I.C., M.Inst.Pkg., A.M.I.O.P.)	348
XIII Preserves: J. R. Blanchfield (B.Sc., A.R.C.S., F.R.I.C., F.I.F.S.T., M.R.I.P.H.H.)	389
XIV Pickles and Sauces: J. R. Blanchfield (B.Sc., A.R.C.S., F.R.I.C., F.I.F.S.T., M.R.I.P.H.H.)	422
XV Storage, Refrigeration and Handling: Frank H. Slade (C.Eng., M.I.Mech.E.)	460
Index	499

List of Figures

<i>Figure</i>	<i>Page</i>
4.1 Curves showing true acidity values for acid solutions that are being neutralized by an alkali	76
4.2 Titration curves of phosphoric and citric acid	76
4.3 Titration curves of various types of milk	76
4.4 Standardization of fat content of cream (or milk)	145
10.1 Typical Alveographe curve	304
10.2 Curve A shows dough of marked stability but poor distensibility; curve B is indicative of a soft runny dough	304
10.3 Curves from doughs made from various wheaten flours	304
10.4 Typical Amylograph curves	305
10.5 Farinograph curve	313
12.1 Types of paper bags	352
12.2 Difference between exposing paper side and polymer side of a polyethylene laminate to a high relative humidity	354
12.3 Types of tins	356
12.4 Some typical types of carton based on the tube	358
12.5 Some lock-style hinged lid trays	359
12.6 Constant motion cartoning machines—horizontal	360
12.7 Constant motion cartoning machines—vertical	360
12.8 Behaviour of some substrates of different surface characteristics	363
12.9 Thickness and weight of various materials	373
12.10 Vacuum-sealed bottle closures	377
12.11 Types of pressure-resistant bottle closures	378
12.12 Alternative methods of making pouches	384
12.13 Alternative methods of making sachets	384
12.14 Thermo-forming	384
12.15 Open mouth and valve sacks	386
13.1 Jam manufacture, with atmospheric pressure batch-boiling	404
13.2 Jam manufacture, with batch vacuum-boiling	405
13.3 Bakery jam manufacture, with continuous vacuum evaporation	406
13.4 Jam manufacture, with continuous boiling at atmospheric pressure	408
13.5 Jam cooling tray	409
13.6 Handling of citrus fruits for marmalade manufacture	416
13.7 Part of a pectin molecule chain	419
14.1 Typical time/temperature curves for batch pasteurization of pickled beetroot	426
14.2 Brine strengths and salt concentrations	441
14.3 Sequence of operations in the making of tomato purée	451

List of Tables

<i>Table</i>	<i>Page</i>
2.1 Typical processing times and temperatures for bottled fruit	30
2.2 Comparing Brix and specific gravity scales	53
2.3 Corrections to be applied to Brix readings	54
3.1 Boiling points of sucrose	71
3.2 Factors relating the concentration of confectioners' glucose and invert sugar solutions to that of sucrose solutions boiling at the same temperature	71
3.3 Variation in the boiling point of water with change in barometric pressure	71
3.4 The effect of the geographic situation on the boiling point of water	72
4.1 Accuracy of routine tests	75
4.2 Bacteria: predominant flora of milks	81
4.3 Typical composition of milk of five main breeds of cow	81
4.4 By-products of butter, cream and cheese	85
4.5 Methods of making—summary of fundamental cheese-types	88
4.6 Typical acidities in cheese manufacture	88
4.7 Physical properties of different varieties	89
4.8 Nutritive value of common foods	91
4.9 Analysis of common types of English cheese	96
4.10 Enzymes in cheese	97
4.11 Cheese in England and Wales	101
4.12 Simple bacteria	106-7
4.13 The composition of bovine colostrum	109
4.14 Composition, average, of milk and fluid milk products	109
4.15 Average composition	111
4.16 Range of analysis	111
4.17 Advantages and disadvantages of milk containers	112
4.18 Effect of temperature on bacterial growth	112
4.19 Relation between count and keeping quality	113
4.20 Milk flow chart	113
4.21 Dairy industry data	114
4.22 Dairy industry data	114
4.23 Classification of flavours in milk	121
4.24 Preponderance of feed flavours in milk	121
4.25 Comparative incidence in each season and per cent of total observations each season	122
4.26 Creameries handling liquid milk only. Tests for producers' milk	125
4.27 Other tests in creameries handling milk only	125
4.28 Manufacturing creameries	125
4.29 Analytical properties requiring rapid estimation in the dairy industry	126
4.30 Composition of milk of various mammals	130
4.31 Role of constituents in various types of dairy product	130

LIST OF TABLES

4.32 Average relationship between colony counts and methylene blue reduction times	131
4.33 Special applications of the microscope in the dairy laboratory	131
4.34 Approximate composition of one pint of milk	134
4.35 Predominating micro-organisms in milk held at different temperatures	141
4.36 One-hour reading at moderate atmospheric temperatures	143
4.37 Inter-relationship of practical tests and the conditions controlling plastics behaviour	144
4.38 Testing of milk supplies	150
5.1 Reduction in bulk and weight achieved by dehydration	160
5.2 Average of losses of nutritive constituents from cabbage during serial scalding and drying	177
5.3 Average nutritive values of dried vegetables	177
5.4 Peeling losses for spherical potatoes	179
6.1 Composition and constants of fatty acids	200-1
7.1 Temperature coefficient of growth of marine bacteria of the types responsible for fish spoilage	216
7.2 Sensitivity of fish quality to temperature	216
7.3 Time taken by cod and haddock fillets to develop a certain trimethylamine value	216
7.4 Chilled storage of fish	218
7.5 Average yield of edible flesh and approximate composition of raw fish flesh	219
7.6 Storage life of fish in cold store	228
7.7 Results of amine determinations during the storage of haddock	229
7.8 Results of amine determinations during the storage of dogfish	229
7.9 Results of amine determinations during the storage of perch	229
7.10 Mineral composition of fish flesh	233
7.11 Mineral elements in shellfish and crustaceans	233
7.12 Free amino acids of cod and herring	234
7.13 Brine strengths	242
7.14 Per cent relative humidities	242
7.15 Description of the chief types of smoke-cured fish	243
7.16 Typical vitamin A and D contents of fish liver oils	246
7.17 Typical values for some water-soluble vitamin contents of some common fishes	246
7.18 Vitamin content of edible flesh of fish	246
8.1 Indication of acids found in fruit	248
8.2 Chemical composition of fruit juices	258
9.1 Average weights of various essential oils equivalent to 1,000 oz of dried herb or spice	290
9.2 Recommended quantities of M.S.G.	296
10.1 Percentage of total flour particles of specific diameters	315
10.2 Range of data for wheat	323
10.3 Range of protein content and quality of wheat	323

LIST OF TABLES

10.4	Analyses of commercial wheatfeed	324
11.1	Composition of food per 100 grams	344-5
12.1	Use of adhesives in food packaging	349
12.2	Examples of foil laminate use	350
12.3	Types of package for vending machines	351
12.4	Comparison of polythene barrels and wooden casks	353
12.5	Some typical packs for biscuits	355
12.6	Product requirements of typical baked goods	355
12.7	Size range and dimensional limits for built-up body tins and cans	357
12.8	Typical can sizes	358
12.9	Types of casks for different wines	362
12.10	Effect of humidity on various types of sugar confectionery	364
12.11	Moisture contents after dehydration of typical dried foods	367
12.12	Maximum permissible E.R.H. for various unpackaged foods	367
12.13	Data on the permeability of various materials	371
12.14	Yield, heat-seal temperatures and water vapour transmission rates	371
12.15	Effect of creasing on water vapour transmission rate	372
12.16	Comparative costs of equal areas of various barrier materials	372
12.17	A comparison of some properties of the common flexible packaging materials	372
12.18	Adhesives for laminating	380
12.19	Costs of packaging milk in bottles and non-returnable cartons	381
13.1	Fruit contents of sulphited fruit pulps	393
13.2	Minimum fruit content of jam	400
15.1	Rate of production of carbon dioxide and heat by various fruits and vegetables	473
15.2	Materials-handling objectives	481
15.3	Cold storage data for perishable foodstuffs	494-5

Baking

Compiled by

J. F. HERRINGSHAW, A.R.C.S., Ph.D., F.R.I.C.

ACETIC ACID

A 12 per cent aqueous solution of acetic acid is used as a preventative of the bacteriological disease of bread known as 'rope'. It is used in a proportion of 1 pint per sack (280 lb) of flour.

Kirby, Atkin and Frey^{1,2} reported that acetic acid is very toxic to bread moulds at low pH values; at pH values 5.5 to 6.0 the initial growth is retarded but the effect upon the ultimate growth is slight.

ACIDITY

The relatively rapid increase which occurs in the acidity of a yeasted dough is due to carbon dioxide dissolving in the aqueous phase. Factors which have a slower effect upon the acidity are the production of acid phosphates by the action of phytase on phytin, and the production of organic acids by the yeast. Amos³ investigated the possibility of bacteria contributing to the march of acidity in fermenting doughs and concluded that the microflora of wheat flour plays no significant part in straight dough systems of panary fermentations but that one member of it, *S. lactis*, produces some acid in long sponge systems.

AERATION

The aeration of baked goods is achieved in three ways: by yeast fermentation; by chemical action; by the entrapment of air. (See ALBUMEN; BAKING POWDER; EGGS; FERMENTATION; AMMONIUM CARBONATE.)

ALBUMEN

Albumen is the clear jelly-like material surrounding the yolk of a fresh egg. It represents about 58 per cent of the weight of the whole egg. It is mainly water in which is dissolved a complex mixture of proteins and a small proportion of mineral salts.

When albumen is whisked, it entraps air to form a stable and stiff foam, and egg whites are, therefore, used as an aerating agent by the confectioner. They are used in the production of meringues, macaroons, and royal icing.

Dried albumen is available. It may be produced by a fermentation process or by straight drying. The latter does not usually form such a good foam as the fermentation product nor does it keep so well.

AMMONIUM CARBONATE

Commercial ammonium carbonate, which is a mixture of ammonium bicarbonate and ammonium carbamate, is known as 'Vol' in the confectionery trade. Under the action of heat it decomposes into carbon dioxide,

ammonia, and steam and thus acts as an aerating agent. A disadvantage of Vol is that freshly baked goods made with it have a smell of ammonia.

AMMONIUM CHLORIDE

Ammonium chloride is a yeast food, being a readily available source of nitrogen for the organism. It is an ingredient of some bread improvers.

BAKING POWDER

Baking powder is a mixture containing chemicals used for the aeration of various types of confectionery. The active ingredients are sodium bicarbonate and an acid substance, which in the presence of water will react with the bicarbonate to produce carbon dioxide. The relative proportions of bicarbonate and acid body must be such that the bicarbonate is fully neutralized but the residue of acid is not excessive. In addition to these two chemicals, a baking powder contains an inert filler, such as a starch. The acid bodies mainly used in baking powder are acid sodium pyrophosphate, acid calcium phosphate, and cream of tartar. The amount of acid calcium phosphate or acid sodium pyrophosphate needed in a baking powder is about 1.3 times the proportion of sodium bicarbonate that is present, and the amount of cream of tartar required is about 2.2 times the bicarbonate content of the mixture.

The aerating powers of baking powders are fixed by a Statutory Instrument, S.R. & O. 1946 No. 157. According to these regulations, baking powder must yield not less than 8 per cent of available carbon dioxide and not more than 1.5 per cent of residual carbon dioxide, the available and residual carbon dioxide being determined as specified in the schedule to the Order. Golden raising powder must yield not less than 6 per cent of available carbon dioxide and not more than 1.5 per cent of residual carbon dioxide. The methods of determining the residual and available carbon dioxide prescribed by the Order are:

(1) A sample of 2 g of baking powder or Golden raising powder, as the case may be, shall be treated with 25 ml of water and evaporated to dryness on a boiling-water bath and subsequently treated with a further 25 ml of water and evaporated in like manner. The residual carbon dioxide is the weight evolved thereby when the sample so treated is further treated with excess of dilute sulphuric acid at room temperature, the evolution being completed either by boiling or by means of reduced pressure.

(2) The available carbon dioxide shall be determined by ascertaining the difference between the total carbon dioxide and the residual carbon dioxide; and the total carbon dioxide shall be determined by ascertaining the

weight evolved when the baking powder or golden raising powder, as the case may be, is treated with excess of dilute sulphuric acid at room temperature, the evolution being completed either by boiling for 5 min or by means of reduced pressure.

BISCUITS

Most types of biscuits call for the use of a weak flour of low protein content. The gluten should be rather distensible in nature. Good biscuit flours can be obtained from English wheat, if the weak varieties are chosen and they are milled in sound condition. If the gluten is elastic instead of being distensible, the biscuit doughs may 'creep'. The distensibility of the gluten in a biscuit flour can be increased by treatment with sulphur dioxide (the final amount present must not exceed 200 ppm) or with a proteolytic enzyme.

The main ingredients in most types of biscuit are flour, sugar, fat, and water or milk, but the relative proportions in which these ingredients are used differ according to the variety of biscuits being made. In most instances the aeration is accomplished by means of baking powder.

The dough ingredients and the doughing liquor are mixed together mechanically to give a uniform but stiff dough. This dough is passed between rolls until it has acquired a uniform texture and thickness. After passage through further rolls for a final control of the thickness, the dough sheet passes under a cutter which stamps out the biscuit shapes. These are then baked in a travelling oven. The moisture content of the finished biscuit is in the region of 3 per cent.

The wide spread between the compositions of different types of biscuit dough is reflected in the range of analytical data for the various kinds of biscuit. Macaroon and ginger nuts may contain from 45 to 50 per cent of sugar, whereas water biscuits and cream crackers will contain less than 1 per cent. Golden puff and short cake biscuits may contain from 25 to 30 per cent of fat compared with less than 10 per cent in Abernethies and water biscuits.

BREAD

Bread is a baked aerated dough, the primary ingredients of which are flour, yeast, salt, and water. Often fat is also included in the dough mix. The yeast ferments the sugars natural to the flour and those produced by diastatic activity and thereby evolves carbon dioxide, which aerates the dough.

The majority of the bread produced in Britain is made from white flour but wholemeal and wheatmeals are also used for bread production. Speciality breads, such as malt, germ and protein-enriched breads are also available, usually under proprietary names. The composition of breads of all types is controlled by the Bread and Flour Regulations, 1963.

BREADMAKING

Bread is produced by making a dough from wheat flour and aerating this with carbon dioxide produced by yeast fermentation. Salt is included in the dough because it regulates the rate of fermentation, toughens the gluten, and prevents the bread from being insipid in taste.

The proportion of water needed to make the dough

varies with the nature of the flour but usually it is in the region of 15 gal per 280 lb of flour.

The proportion of salt used also varies but it is common practice to use about 5 lb per 280 lb of flour.

The proportion of yeast needed depends upon the proposed duration of the fermentation and can be calculated approximately by dividing 12 by the number of hours that will elapse between the mixing of the dough and the placing of the dough in the oven.

The water used to make the dough is brought to a temperature that will give the finished dough a temperature of 24 to 27° C (75 to 80° F), the exact temperature required depending upon the proposed length of the fermentation. The necessary water temperature can be arrived at by subtracting the temperature of the flour from twice the desired dough temperature.

When bread is to be made by what is known as the straight dough system, the required proportions of flour, yeast, salt, water, and any other dough ingredients, such as fat, sugar, bread improvers, are mixed together until a homogeneous dough is obtained and this is then covered over and allowed to ferment in bulk. When about three-quarters of the proposed bulk fermentation time has passed, the dough is very thoroughly kneaded or 'knocked-back', so as to expel much of the gas and to tighten up the dough. It is then covered once more and allowed to complete its bulk fermentation.

At the completion of the bulk fermentation, the dough is divided into pieces of the required weight, an operation known as 'scaling', and each of these pieces is moulded into a ball. After a short period in which they can recover from the action of the scaling and rounding up, the dough pieces are moulded into the shape required for the type of bread that is to be made.

These finally moulded dough pieces are placed in baking tins and allowed a fermentation period, which is known as the 'final proof', so that they can become once more inflated with gas, since much of the old gas will have been expelled during the moulding operation. The proving period normally occupies from 25 to 40 min, according to the type of bread being made.

At the end of this final proof the tins containing the dough pieces are placed in the oven and baked. The baking temperature is 232 to 260° C (450 to 500° F), and the baking time from 40 to 55 min.

Bread is also made on what is known as the sponge system. In this type of method some of the flour, part of the water, and the yeast are mixed together and allowed to ferment for perhaps 12 to 16 hr. The dough is then broken down with the remainder of the water, the salt is added and the remainder of the flour used to re-form a dough. This is allowed to ferment for 1½ to 2 hr and is then scaled, moulded, proved, and baked. A long sponge process calls for the use of less yeast than is required for a straight dough system.

A method known as the flying sponge system involves making a slack batter with almost all the water and an equal weight of flour and including in this all the yeast but very little salt. After a fermentation period of 1 to 1½ hr the remainder of the flour and the salt are incorporated and fermentation continued for 2 to 2½ hr.

On the 'delayed salt' method, the salt is omitted from the initial dough mix and, on a three hour system, is added and thoroughly mixed in about one hour before the end of the bulk fermentation.

Modern developments in the technology of bread-making are particularly concerned with the elimination of bulk fermentation. In the most important of these, ripening of the dough, which can only be reached slowly by fermentation, is attained very rapidly by the expenditure of intense mechanical work during mixing.

Continuous breadmaking is exemplified by the 'Do-Maker' process.³ The ingredients of the dough are automatically fed in correct proportions into a continuous dough mixer, the yeast being metered in the form of a suspension in a nutrient medium. The yeast suspension is prepared several hours in advance of its delivery to the mixer and is accordingly in a very active state when incorporated in the dough. The dough being continuously extruded from the mixer passes to a 'dough developer', which it is subjected to intense mechanical treatment, which fully ripens it. The continuous cylinder of dough emerging from the developer is automatically cut into lengths, each of which drops into a baking pan *en route* to the oven.

The Chorleywood Bread Process⁴ is a batch method and requires less specialized plant. A dough is prepared that differs from traditional formulations in that (i) more yeast is employed, (ii) fat must be present, (iii) 75 ppm of ascorbic acid or a combination of ascorbic acid and potassium bromate is used as oxidizing improver and, (iv) an extra gallon of water per sack (280 lb) of flour is added. The dough is then subjected to intense mechanical mixing, the work expended being 5 Wh per lb of dough over a period of 5 min. The dough is then divided, allowed an intermediate proof of 10 min, and the baking process completed in the normal way.

More recently, processes are being developed in which rapid ripening of the dough is achieved by chemical means alone.⁵ For example, the use of suitable combinations of ascorbic acid, potassium bromate, and fat will produce good quality bread on a very short system and such processes have been used on a large scale in Australia for some time. Probably the best combination is one of *L*-cysteine and potassium bromate, but at the time of writing, cysteine is not permitted as an additive in bread.

BREADMAKING PLANT

In most bakeries the flour is not run directly into the mixer but first passes through a sifter as a safeguard against foreign bodies, such as pieces of string or labels, being found in the bread. A widely used flour sifter consists of a spiral brush operating inside a semi-circular sieve.

Tempering tank

The tempering tank is fed with cold water and hot water and is fitted with a thermometer and a stirrer; it is used to prepare the doughing liquor at the required temperature. It is fitted with a gauge, which enables a known volume to be discharged from the machine.

Dough mixer

An older type of machine is the rotary drum mixer. It consists of a slowly revolving horizontal cylinder which tumbles the dough through a grid of horizontal steel bars. A disadvantage of this machine is that the progress of the mixing cannot be assessed visually without

stopping the machine and removing the watertight cover.

The machine most widely used at the present time is the open pan mixer. It consists of a steel bowl in which one or more metal arms perform a kneading action, and usually the pan revolves while the mixing operation is in progress. Open pan mixers with removable bowls avoid the necessity for taking the mixed dough out of the bowl, since the latter can be wheeled away from the mixing arms and used as a fermenting vessel. The bowl is wheeled back under the mixing arms when the knocking-back operation has to be performed.

High-speed mixers resemble the old rotary drum mixers, but the container remains stationary while the internal grid revolves at high speed. Because of the heat produced during the mixing operation these mixers are often fitted with a cooling jacket.

Dough divider

Dough dividers are machines that perform automatically the operation of 'Scaling', that is, dividing the dough mass into pieces of equal weight. The ideal arrangement would be a machine that divides by weight but all existing machines divide by volume. The machines carry a number of boxes or pockets and these are filled with dough by means of a plunger and their contents are then discharged. Such machines furnish dough pieces of constant weight only as long as the density of the dough remains unchanged. It is necessary, therefore, for the weights of the discharged pieces to be periodically checked while the machine is in operation.

Handing-up machine

This is a machine for moulding dough pieces into round shapes as they leave the divider. The best known type consists of a hemispherical shaped tunnel that spirals around a finely corrugated cone. This cone revolves and in so doing carries the dough pieces through the tunnel and discharges them at the top in a nicely rounded condition.

Final moulder

The handing-up machine can be employed as a final moulder for those types of bread where a rounded shape is required. Another type of final moulder, of which there are numerous modifications, consists of two moving bands, one of which travels faster than the other. A piece of dough fed into one of these machines leaves it in the form of a cylinder.

The type of final moulder used in the plant bakery where tin bread is being produced is the spindle moulder. The machine contains two or more rapidly revolving spindles each of which rotates a piece of dough against a band or a roller until it forms a tight roll. The roll is then discharged between two moving canvas bands, which give it a final shaping.

Prover

A prover is an enclosed space in which the temperature and relative humidity of the air are controlled and in which the finally moulded dough pieces are allowed to re-inflate themselves with gas before being baked. In some bakeries the proving space is essentially a cupboard fitted with shelves or boxes carried by endless belts, while in others it takes the form of a room into

which the dough pieces are brought on wheeled racks.

In plant bakeries automatic provers are used. The doughs in canvas slings or in tins move slowly in a series of horizontal or vertical paths through an enclosure, the air in which is controlled for temperature and humidity.

Oven

Ovens used in bakeries are shallow, rectangular chambers capable of being heated to and maintained at an appropriate temperature. The smaller ovens are usually peel ovens, i.e. ovens in which the bread is set and removed by long-handled spades known as peels. A larger type of oven is the drawplate, the sole of which is mounted on runners and can be withdrawn from the oven when loading and unloading is to be performed. In plant bakeries the ovens are automatic. They may be fitted with swinging tins, which traverse the ovens slowly in a series of vertical paths or with a travelling sole, which consists of an endless flexible metal band.

Ovens may be fired with coal or coke, with oil, or with electricity. An older type of coke- or coal-fired oven is the side flue oven in which flames and hot gases of combustion pass through the baking chamber. These ovens must be brought to a solid heat before baking commences because flames cannot be drawn through the oven while it contains bread.

One form of externally heated oven is constructed so that the hot products of combustion are led into flues that surround the oven but do not enter the baking chamber. In another form the heat is applied externally to the ends of steam tubes, the major portions of which are inside the oven. Automatic travelling ovens are usually oil- or gas-fired and the heating may be by hot air or by steam tubes.

BUNS

Buns are usually made by preparing a ferment preparatory to dough making. A breadmaking flour is more suitable for the production of buns than is a cake flour. A suitable method would be to make a ferment with the following ingredients:

water	1 quart
milk powder	2 oz
sugar	2 oz
yeast	3 oz
flour	8 oz

This ferment should have a temperature of 32° C (90° F) and should be left for half an hour. It should then be doughed up by adding to it:

flour	4 lb
salt	$\frac{1}{2}$ oz
fat	12 oz
sugar	10 oz
currants	1 lb

The resulting dough should be allowed to ferment for 90 min at a temperature of from 27 to 29° C (80 to 82° F). A lower temperature with a higher proportion of yeast is preferable to the use of a higher temperature. In the early stages of fermentation the dough should be knocked-back in order to prevent chilling and it is advisable to perform this operation once every 20 min.

The final proving is performed in steam at about 31° C (88° F). The buns are baked at a temperature of from 211 to 220° C (420 to 460° F).

CAKE

The basic ingredients of cakes are flour, shortening, eggs, sugar and milk. Eggs will aerate approximately their own weight of flour and consequently if more flour than eggs is used in a cake recipe, baking powder must be added to aerate the surplus flour.

Twenty-five years ago a typical recipe for good quality cake was:

flour	100 parts
shortening	35 "
eggs	40 "
sugar	95 "
baking powder	2.5 "
milk	60 "

but modern formulae call for the use of more shortening and eggs and less milk and baking powder. An example is:

flour	100 parts
shortening	65 "
eggs	90 "
sugar	95 "
baking powder	0.6 "
milk	30 "

Cake batters are prepared usually by either the sugar batter or the flour batter method. The former procedure, which is known also as the creaming method, is preferable when high-class cakes are being made but the flour batter method is more suitable for the production of cheap cakes with a low egg content.

The sugar batter method is performed by creaming together the fat and the sugar at medium speed for about 10 min, adding the egg in stages while the mixing is continued, and finally making several alternate additions of flour and milk. The egg should be brought to a temperature of about 21° C (70° F) before being added to the mix or the batter may curdle.

In the flour batter method the shortening and the flour are creamed together until a fluffy mass is obtained. The eggs and sugar are whipped together and the resulting foam is then carefully blended into the creamed fat and flour. The milk is then added in small portions.

Cake batters are baked at temperatures between 149 and 208° C (300 and 425° F) depending upon their richness, their weight and their moisture content. Richer batters of high sugar content require less heat than those made on leaner formulae.

CAKE FLOUR

Cake flours are usually medium to weak in strength; the use of strong flours would result in a tough product. Medium strength flours are used for the heavier cakes such as most fruit cakes; the weaker flours are better for layer cakes and the like. For many purposes, so-called 'high-ratio' cake flour is demanded. This is specifically intended for cakes with a high ratio of sugar plus liquid to flour, the extreme example being 'angel food'. Such a flour is obtained by taking the finest fraction of a

patent flour milled from a weak grist and treating it with gaseous chlorine, a process which modifies both the gluten and the starch. Alternatively, a suitable cut from an air-classification plant may be chlorinated.

CAKE PREMIXES

The retail sale of cake premixes has not made much headway in the U.K., but bulk sales for catering purposes have been reasonably successful. Most types require the addition of water only, and therefore contain flour, fat, sugar, milk powder, dried egg, baking powder, flavourings, and colour. Provided that the baking qualities of the dried egg are satisfactory, the critical ingredients are the fat and the flour. The fat must have the correct plasticity and must not be susceptible to rancidity. So-called '100-hour' fat (fat which is free from rancidity after aeration for 100 hr at 100° C (212° F)) is usually specified, and this stability is usually achieved by the addition of permitted antioxidants. As the premixes are normally used for the lighter type of cakes, high-ratio flour is commonly used. To ensure freedom from festination, the flour or the complete mix is entoleted.

CARAMEL

Caramel is produced by the controlled heating of cane-sugar (or glucose) to about 190° C (352° F). It may be added principally as a flavouring agent or as a colouring agent and is used for both purposes in flour confectionery. It is the only colouring matter that is permitted in bread.

CORNFLOUR

This is maize starch and it is used for the manufacture of custard powders (which are coloured and flavoured cornflours) and also as an ingredient of some proprietary sponge mixtures and cake flours.

CREAM OF TARTAR

Cream of tartar, i.e. acid potassium tartrate, is used as the acid ingredient in some baking powders. The salt is only slightly soluble in cold water but dissolves readily in hot water and, therefore, when it is used in conjunction with sodium bicarbonate as an aerating agent, the bulk of the gas evolution is delayed until the goods reach the oven.

One hundred parts of cream of tartar will neutralize 45 parts of sodium bicarbonate.

CREAM POWDER

A cream powder is a preparation containing an acid phosphate intended for use as an acid ingredient of aerating mixtures. The neutralizing values of such preparations are often adjusted to be equal to that of cream of tartar.

CRUMB SOFTENERS

A number of substances have been recommended as dough ingredients for the purpose of enhancing the softness of the crumb of bread. The best known of these

are of the emulsifier type and as such are included in the Emulsifiers and Stabilizers in Food Regulations, 1962. Those permitted in bread are stearyl tartrate and partial glycerol esters, e.g. glyceryl monostearate (G.M.S.).

CRUMPETS

A suitable recipe for crumpets is:

flour of medium strength	4½ lb
water	2 quarts
milk powder	3 oz
salt	1½ oz
yeast	2 oz

The water is used at about 38° C (100° F) and the batter sponge is allowed to ferment for 1½ hr. One pint of warm water containing ½ oz of sodium bicarbonate is then well mixed throughout the sponge, after which it is allowed to recover for 10 min. The batter is then poured into hoops that have just been placed onto a well-polished hot plate. When the shiny wetness disappears from the top of the crumpets, the hoops are turned over so that the surfaces of the crumpets initially at the top become cooked. The baking time required is about 4 min.

CRUST COLOUR

The colour of the crust of bread is due in part to a reaction between sugar and protein or protein degradation products. It is, therefore, related to the amount of sugar remaining in the dough at the completion of the fermentation. If the maltose figure of a flour is high, the residual sugar will be high and the colour of the crust of the bread made from the flour will accordingly be pronounced. If, however, the maltose figure is low, the crust will be pale.

Any factor which affects the amount of sugar remaining in a dough when the dough goes to the oven will affect the crust colour of the bread; under-fermentation leaves an excess of sugar and thus gives rise to a high crust colour, while over-fermentation will use up more than the normal amount of sugar and will produce a pale crust.

DIASTATIC ACTIVITY

The diastatic activity of a flour is its ability to convert some of its starch into sugar. It is a factor of considerable importance in breadmaking, where aeration depends upon the fermentation of sugar by yeast, but sugar-forming power is of no importance in processes depending upon chemical action or the incorporation of air for aeration. Dextrin-forming power, which is related to the activity of alpha-amylase is, however, significant even when the aeration is chemical, if the goods are boiled and not baked. A high dextrin-forming power can in these circumstances cause doughy streaks and stickiness in the goods.

See DIASTATIC ACTIVITY in section on FLOUR AND FLOUR MILLING.

DOUGHS

The two main proteins of wheat flour, gliadin and glutenin, have the power of uniting in the presence of

water to form a complex which has elastic properties. This complex is termed gluten. This property of gluten formation is not possessed by any other cereal flour and hence wheat flour is the only one which gives an elastic dough capable of holding gas and expanding under its pressure.

When wheat flour is mixed with water the gluten that is formed takes the shape of a network of interwoven strands, and these serve as the girderwork of the dough. The strength and elasticity of the dough will depend upon the number of gluten strands that are present and upon their physical properties. Hence, the dough properties are to a large extent determined by the proportion of protein in the original flour and the nature of that protein.

A wheat-flour dough can be inflated if gas is produced within it. Such gas can be produced either by incorporating yeast in the dough, which will ferment the sugars naturally present and evolve carbon dioxide, or by including in the dough chemical substances that will react together to liberate carbon dioxide.

If a dough that has been suitably aerated in either of these ways is baked, it will become 'set' and the outcome will be a light, well-aerated product. If the dough contains little more than yeast, flour, salt, and water, the resulting product will be bread, whereas if the dough contains fat, sugar, eggs, and spices, it will be confectionery.

DOUGHNUTS

Doughnuts fall within the category of buns, but they are cooked by being roasted in fat instead of being baked in an oven. A plain bun dough is prepared (*see* page 4) and the scaled pieces flattened. Jam is placed in the middle of each flattened piece and the dough folded over so that the jam is enclosed. The pieces are then proved in the absence of steam, after which they are fried to a light golden colour in hot fat.

The doughnuts are drained and then rolled in caster sugar. Ring doughnuts are made by flattening out each scaled piece and cutting a ring from the centre with a cutter.

The fat must be hot enough to form a crust on the doughnut almost immediately; if it is not hot enough the doughnut will be greasy.

EGGS

Eggs are used as aerating agents in confectionery work because they have the power of entrapping air when they are whisked, thereby forming a stiff and stable foam.

A fresh egg consists of about 12 per cent shell, about 58 per cent egg white or albumen, and about 30 per cent yolk. The average compositions of the whites and yolks are:

	Whites per cent	Yolks per cent
moisture	87.0	50.0
protein	12.5	16.0
fat	0.3	32.0
mineral salts	0.6	0.8

The foaming property of eggs is due mainly to the albumen, or white; yolks alone cannot be beaten into

a stiff foam because of their high fat content. The value of the egg yolks lies in their ability to colour, flavour, and shorten the goods in which they are used. Whole eggs are able to aerate their own weight of flour and if a smaller proportion of egg than this is used, the additional aerating power required can be provided by baking powder.

Shell eggs are seldom used except on the small scale; the labour and loss of material involved makes their use generally uneconomic. Frozen whole eggs, i.e. shelled eggs preserved by freezing, have been used for many years. With the advent of compulsory pasteurization, doubts were expressed as to the baking qualities of pasteurized egg; but it has been shown that pasteurization has little if any deleterious effect. Provided that the egg is not stored for long periods in the frozen state, and thawing is carried out carefully, frozen egg will behave satisfactorily in a wide range of baked goods. Only in products where the performance of the egg is very critical, e.g. in baked custards and éclair cases, are difficulties likely to be encountered. In many of the larger plants, *liquid* whole egg is delivered in bulk from refrigerated tankers.

Dried egg has the advantage of requiring very little storage space, but it varies considerably in its aerating power. A.F.D. (accelerated freeze-dried) egg is of very good quality and as it is usually gas-packed it stores well without refrigeration.

ENZYMES

An enzyme is a substance which has been derived from living matter and which, when present in only a minute proportion, can initiate or accelerate a given chemical action without undergoing chemical change itself. Enzymes have been called organic catalysts.

Enzymes are markedly specific in their action. Thus, an enzyme which can effect the breakdown of protein will have no effect upon starch, and conversely a starch-degrading enzyme does not act upon protein.

Wheat flour contains a starch-splitting enzyme which is known as *beta*-amylase. This enzyme splits off units of the sugar maltose from the outer chains of the starch molecule, leaving behind a compound known as erythro-dextrin, which has many starch-like properties. The reaction does not proceed in dry flour, but as soon as flour is made into a dough the *beta*-amylase initiates the production of maltose from starch. Hence, when the yeast has utilized the sugars pre-existing in the flour, it has a reserve supply to which it can turn and is thus enabled to go on producing gas.

Beta-amylase is unable to act upon normal sound starch and the extent to which it can produce maltose from a flour is dependent, therefore, upon the proportion of damaged starch granules in that flour. All commercial flours contain damaged starch granules because some degree of damage is unavoidable during the milling process, but the extent of the starch damage varies with the mill making the flour.

Flour that is made from sprouted wheat contains in addition to *beta*-amylase a significant proportion of another diastatic enzyme known as *alpha*-amylase. *Alpha*-amylase is present to only a small extent in the flour from sound wheat. *Alpha*-amylase can cause the degradation of the residual erythro-dextrin left behind

when *beta*-amylase has chopped maltose units off the outer surfaces of the starch molecule. The degradation products that result from this action can be acted upon by *beta*-amylase. Hence, the joint action of *alpha*- and *beta*-amylase will lead to a greater production of sugar than the action of *beta*-amylase alone.

If sufficient sprouted wheat is used in a blend to give flour of a high *alpha*-amylase activity, the results may be disastrous. The low molecular weight dextrans produced by the action of the *alpha*-amylase on the starch can give rise to a marked stickiness in the crumb of the final loaf and in severe cases may lead to the loaf collapsing on leaving the oven. *Alpha*-amylase is very active at a temperature as high as 60° C (140° F) and hence the detrimental effect of this enzyme is mainly exercised after the dough reaches the oven. For this reason a flour high in *alpha*-amylase will suffer more severely when baked in a slack oven for a long time than when baked quickly in a hot oven. This influence of baking conditions upon the severity of damage from *alpha*-amylase activity explains why trouble from an excess of this enzyme has been encountered to a much greater degree in Irish soda bread than in yeast bread. Soda bread is baked at a lower temperature than yeast bread, from 200 to 220° C (390° to 430° F) instead of from 230 to 260° C (450° to 500° F), and for a considerably longer time (from 1¼ to 1½ hr instead of from 45 to 55 min), thereby offering much more scope for the *alpha*-amylase to produce the gummy dextrans which give rise to stickiness in the crumb.

Wheat also contains proteolytic enzymes. A protein-degrading enzyme isolated by Bales and Hale⁶ and Hale⁷ proved to be of the papain type. Opinions have differed on the question of whether proteolytic action plays any part in dough ripening. It has been shown by Amos⁸ and Samuels⁹ that there is a slow but progressive liberation of amino acid in a dough and Amos has emphasized that although the quantity of amino nitrogen set free is small, it does not follow that the physical changes which accompany this rupture of the protein molecule are also small.

Oxidizing enzymes also exist in flour and these enzymes are responsible for the darkening of the colour that occurs when wetted flour is exposed to the air. They cause atmospheric oxygen to unite with complex constituents of the flour to produce dark-coloured oxidation products. These oxidases are concentrated in the bran and the germ, and hence the lower the grade of a flour the greater the rate at which darkening proceeds after it has been wetted.

FLAVOURINGS

Probably the most widely used flavour of the confectioner is vanilla; this may be added as vanilla essence (an alcoholic extract of the vanilla bean) or as a solution of synthetic vanillin. Cocoa and chocolate are also used frequently and primarily for the flavour they impart, but they differ from most other flavouring in that they also contribute substance, food value and colour to the finished product.

Most of the other flavourings added are spices and seasonings, essences and oils, or synthetics. The most common of the spices used are; allspice, angelica, caraway seed, cinnamon, cloves, ginger, mace and nutmeg,

and poppy seed; others like anise are used only occasionally or like saffron are used only in certain parts of the country. Many of the spices are also available as oils and essences; other important flavourings in this group include the oils of almond, orange, lemon, lime, and peppermint.

Advances in the technology of synthetic flavourings suggest that they will gradually supplant almost all 'natural' flavourings, including those of substances added in larger quantities for other reasons, e.g. butter and honey.

FONDANT

Fondant is a mixture of invert sugars prepared by heating sugar and water to a temperature of from 115 to 120° C (240 to 245° F) and adding glucose or a weak acid to accelerate the inversion. A suitable procedure would be to boil 12 lb of sugar and 3 pints of water and to add to this 2 lb of glucose or ¼ oz of cream of tartar.

GLUCOSE

Confectioners' 'glucose' is manufactured by the acid or enzymic hydrolysis of starch; the resulting product is not pure glucose but this sugar mixed with maltose and dextrans.

A high grade 'glucose' should give a clear bright solution when mixed with water and should yield no sediment. It should contain no unaltered starch.

GLYCERINE

Glycerine is used in confectionery as a sweetening agent and also as a means of keeping cheap cakes moist. It would be used in the proportion of about 1 oz per lb of fat in the formula.

GLYCERYL MONOSTEARATE (G.M.S.)

Glycerol is a tri-hydric alcohol and when each molecule of glycerol is combined with three molecules of fatty acid, whether the same or different acids, the result is a fat. Glyceryl monostearate in which one molecule of glycerol is combined with only one molecule of the fatty acid, stearic acid, has, therefore, been described as a 'super glycerinated fat'. It is used as an ingredient of bread doughs, because it has a softening effect upon the crumb and tends to delay staling. (See CRUMB SOFTENERS.)

HUMIDITY

The humidity of the atmosphere is the weight of water vapour contained in unit weight of the air. If this weight is expressed as a percentage of the maximum weight of water vapour that the unit weight of the air can retain at the temperature in question, the resulting figure is known as the relative humidity. Whether any material tends to dry out or to absorb moisture depends upon the relative humidity of the atmosphere to which it is exposed, and for each substance there is a relative humidity with which it is in equilibrium. Packeted flour will tend to lose moisture, and hence lose weight, when stored in very dry air, but will pick up moisture, and

therefore gain weight, if exposed to air of high relative humidity.

The water content of a dough is relatively high and hence a dough will tend to lose moisture from the surface and to form a skin, unless the air to which it is exposed has a high relative humidity. This is a matter that requires attention when a dough is being proved.

ICING

Water icing is used for covering cheap cakes. It can be made by mixing into boiling water sufficient icing sugar to give a consistency similar to that of fondant, such as is used for piping. Water icing can be coloured with liquid colouring matter as desired.

Royal icing is prepared with icing sugar and egg albumen. About 7 lb of icing sugar are required for each pint of egg albumen. Sometimes a little acetic acid is added to toughen the albumen but this must be used with care or the icing may be hard and bitter.

INVERT SUGAR

Invert sugar is a mixture of dextrose and laevulose. It occurs naturally in ripe sweet fruit but the commercial article is prepared from sucrose by the action of the enzyme invertase or by acid treatment. It is used, often mixed with glucose, as a sweetening agent in cheap confectionery.

KNOCK-BACK

When a bread dough has completed about three-quarters of its bulk fermentation, it should be given a very thorough mixing in order to expel the old gas and to stretch the dough and make it more elastic. This operation is known as 'knocking-back' the dough. It is an essential operation if good bread is to be produced.

LECITHIN

Lecithin belongs to the class of substances known as lipoids, which are combinations of fat with nitrogen-containing substances and phosphorus. Commercial 'lecithin' is extracted from soya bean and is available in an emulsified form for use as a bread improver. Added to a dough at the rate of 1 lb per sack, it causes the dough to feel silkier and produces also a silkier and softer crumb, which has enhanced keeping properties.

MACAROONS

Confectionery goods made from almonds, sugar, and whites of eggs are called macaroons. Macaroon goods require to be baked in a steady oven at a temperature of from 170 to 175° C (350 to 370° F). Too much heat will cause the goods to flow out.

MALT BREAD

There are many types of malt bread, which range from lightly malted white bread to heavily malted brown bread with a sticky crumb. Many of these breads contain ingredients additional to the malt or malt flour, such as fat, milk powder, and golden syrup.

Kent-Jones and Mitchell¹⁰ give the following as a typical formula for malted brown bread:

wheatmeal	28 lb
brown malt flour	2 lb
salt	8 oz
golden syrup	8 oz to 1 lb
fat	8 oz to 1 lb
yeast	8 oz
water	7 quarts (approximately)

The dough, which should have a temperature of from 24 to 26° C (76 to 78° F), is given a bulk fermentation of 1½ hr with a knock-back at the end of 1 hr. The dough is baked for about 50 min in an oven at from 204 to 215° C (400 to 420° F). Some malt breads contain fruit.

MARZIPAN

See section on CONFECTIONERY.

MERINGUES

Meringues are confections made from a mixture of sugar and white of eggs, which are beaten together to give a very light product. The method used to prepare meringues depends upon the kind of article that is to be made, and there are three main methods. In the cold meringue method the white of egg is beaten and the sugar added cold. Very hot meringue is made by making the sugar very hot and beating it along with the white at the beginning. Italian meringue is made by beating the egg white very stiff and then boiling the sugar before adding it.

MILK AND MILK BREAD

Milk is used in breadmaking as liquid whole milk, skimmed milk, or as dried products derived from these. Milk is a bread improver and for this purpose liquid milks are added at the rate of 4 to 8 gal and powders at the rate of 5 lb per sack of flour. Apart from some increase in the nutritive value of the bread, the main effects of such additions are the production of a softer dough, improvement in crumb texture, and the production of a thin crust.

Larger additions are required to produce the various milk breads. Milk bread must now contain not less than 6 per cent of *whole* milk solids (dry basis); bread containing not less than 6 per cent (dry basis) of skimmed milk solids should be described as skimmed milk bread, separated milk bread, or lactein bread.

MUFFINS

Muffins are often associated with crumpets but they are very different from the latter goods, although they are baked, like crumpets, on a hot plate. Muffins are thick but well aerated dough cakes which do not have the toughness of crumpets.

<i>Formula</i>	
medium strength flour	5 lb
salt	1 oz
sugar	½ oz
yeast	2 oz
water	2 pints
milk	1¼ pints

The dough is well mixed and should be moderately warm, e.g. water at 38° C (100° F) should be used. It is allowed to lie for an hour and then it is thoroughly kneaded and allowed to ferment for a further half-hour. At the end of this second period of fermentation, the dough is divided into pieces weighing about 2½ oz each. The scaled pieces are proved for about 30 min and are then baked on a hot plate kept at only a moderate temperature. When the goods have been baked sufficiently on one side they are turned over. If the hot plate is at too high a temperature, the middle of the muffin is liable to be underbaked.

OAT CAKES

Oat cakes can best be made from a meal of medium particle size. Often about 15 per cent of wheat flour is mixed with the oatmeal to make the dough easier to handle. Sometimes a pinch of bicarbonate is included in the mix.

<i>Formula</i>	
oatmeal (or 3½ lb oatmeal plus ½ lb flour of good strength)	4 lb
lard	2 oz
salt	1 oz

The fat is rubbed into the meal which is then made into a bay. Into this is placed the salt, and warm water is then used to make the meal into a dough. The dough should be made fairly soft as it will tighten. It is scaled into pieces weighing about 6 oz, each of which is moulded up round. These are then rolled until they are about ¼ in thick and about 8 inches in diameter. The use of some dry meal may be required to prevent sticking. The rolled pieces are baked on one side until they are nearly done and are then turned over. They are removed from the plate when they begin to curl during the baking of the second side and are placed on a rack over the plate where they undergo drying and toasting. Alternatively they can be placed on a clean baking sheet and dried for a few minutes in the oven.

PIKELETS

These are made from a crumpet batter which has been thinned down. It is poured on to a hot plate without hoops and allowed to run out into a thin cake of 5 to 6 inches in diameter. The plate must be really hot. When the shiny wetness from the top of the cake disappears, the pikelets are turned in the same way as crumpets.

PRESERVATIVES

In bread, the following substances may be added as preservatives: acetic acid, monocalcium phosphate (A.C.P.), and sodium diacetate to prevent the onset of 'rope' (q.v.) propionic acid and certain of its salts to inhibit mould growth. Rope is only likely to be troublesome in the summer months, as is mould formation unless the bread is sliced and wrapped.

The Preservatives in Food Regulations, 1962, permit the presence of up to 1,000 ppm of propionic acid or sorbic acid and certain of their salts in flour confectionery other than biscuits. All these materials inhibit mould

growth, but in cakes sorbic acid is the most effective. Wrapped cakes are particularly vulnerable to mould growth, and the judicious use of sorbic acid can extend the time required for the onset of visible mould growth by about 50 per cent.

PROTEIN-ENRICHED BREADS

The addition of say 14 lb of dry gluten per sack of flour in a normal breadmaking process produces a loaf containing about 16 per cent of protein (dry basis). The physical effects of the addition are an increased specific volume and improved crumb characteristics. Such breads, provided they contain not less than 16 per cent of protein (dry basis) are termed gluten breads. By making greater additions of gluten and by modifying the breadmaking formula, high-protein breads, which must contain not less than 22 per cent of protein (dry basis), can be produced; these have a still higher specific volume.

Breads of these types are manufactured particularly for the slimming market. Their calorific value per unit weight is virtually the same as for ordinary bread, but their calorific value per unit volume is much less and bread is normally eaten by volume.

In a somewhat different class are the starch-reduced breads, rolls etc. To qualify for this description, the carbohydrate content to dry basis must be less than 50 per cent. This is normally achieved by fairly massive additions of dry gluten, and above average additions of skimmed milk powder and of fat. The specific volume of the products varies, but on a weight basis the calorific value is generally higher than that of ordinary bread because of the increased fat content.

PUFF PASTE

If properly made, puff paste will consist of alternate layers of flour and butter. Some margarines are particularly suitable for use in the preparation of puff paste, but a mixture of margarine and butter is often preferred. A flour of only moderate strength is needed but it should give a dough possessing good distensibility.

The amount of butter used should lie between 12 and 16 oz for each 1 lb of flour, while the amount of water employed should be such that the consistency of the dough is approximately the same as that of butter after it has been handled. The paste should be made with cold water and should be handled on a cold slab and kept covered with a damp cloth between manipulations.

One method of preparing the paste is to make a dough from the flour using about one-quarter of the total butter in its preparation. After the dough has lain for about 10 min, it is rolled out and the remaining butter, in the form of small lumps, is distributed over about two-thirds of it. The unbuttered third is folded over half the buttered portion and the folded portion then turned over on top of the remaining buttered third. The folded dough is rolled out again and refolded as before. The dough can be left to lie for 20 to 30 min, being covered with a damp cloth during this period, and it is then given two more foldings. In some instances a total of six folds, or turns, are given to the dough, but a good recovery period should always be allowed between each pair of foldings.

ROPE

Bacteria of the *B. mesentericus* group are common to soil and thus found on wheat. Despite the rigorous cleaning processes performed in a mill, some of these bacteria are transmitted to flour during the milling operation. These bacteria form spores, which are a resting stage, and these spores are to be found in all flour, although usually the contamination is not high. Unfortunately, the spores of the mesentericus organism are very resistant to heat and survive the temperature of the baking process with the result that some, if only a few, rope spores are to be found in any loaf of bread. If bread is kept warm and under conditions which preclude marked loss of moisture, the spores of the mesentericus organism will turn into vegetative bacteria and these will multiply. As the organisms increase in number, the crumb of the bread will assume a yellowish-brown tint, become very sticky, and acquire a smell of decaying fruit. These are the signs of the bread disease 'rope'.

In Britain rope occurs only during the summer months and only then in bread that has been kept for several days in an atmosphere of fairly high humidity.

The tendency for bread to become ropy when submitted to conditions favourable to the development of the organism is influenced by the conditions under which the bread has been fermented, baked, and cooled. Bread made on a short fermentation system is less liable to become ropy than bread made on a long, slow fermentation process.

Bread that has been thoroughly baked out is less liable to become ropy than bread that has received only a moderate baking in a slacker oven. Rapid cooling of the bread will diminish the likelihood of its becoming ropy. Protracted cooling is tantamount to giving the organisms in the bread a preliminary incubation.

The rope bacteria cannot thrive if the medium in which they are present is sufficiently acid to have a pH of 5.0. An inimical pH can be obtained in bread by incorporating in the dough 1 pint of 12 per cent acetic acid or 1½ lb of 80 per cent acid calcium phosphate per sack.

RUSKS

If an attractive rusk is to be made the dough should be richer than an ordinary bread dough. A suitable formula is:

flour	7 lb
fat	1 lb
sugar	6 oz
malt	2 oz
whole-milk powder	8 oz
salt	1 oz
yeast	3½ oz
water	4 lb

The dough should be allowed to ferment for 1¼ hr, given a good knock-back, and allowed to lie for a further ¼ hr. It should be baked in sandwich tins but less dough should be put in the tins than is used with ordinary bread doughs and a longer proof should be given. After being baked, the loaves should be kept for 2 days, cut into slices of about ½ inch in thickness, and baked to a light-brown colour in a cool oven.

SCONES

Formula for fruit scones:

soft flour	4 lb
baking powder	4 oz
fat	12 oz
sugar	12 oz
salt	¾ oz
eggs	4
fruit	10 oz
milk	About 1¾ pints

If plain scones are required they may be made on a rather richer (A) or a cheaper (B) formula:

	A	B
flour	4 lb	4 lb
baking powder	3 oz	4½ oz
fat	16 oz	8 oz
salt	¾ oz	¾ oz
sugar	14 oz	8 oz
eggs	4	nil
milk	about 1½ pints	about 2 pints

The fat is creamed up with the sugar and the eggs then worked in. The remaining ingredients are added and the whole worked up into a dough of medium consistency. The dough is scaled and the pieces moulded up round. They are then flattened into pieces about 6 inches in diameter and 1 in thick and placed on a greased baking tin. Each round is divided into four pieces by making two cuts through the dough at right-angles. The pieces are washed with egg wash and baked at a temperature of 230° C (450° F).

SHORT PASTE

For the best type of short paste work good butter was always used but good short paste can be made with a good margarine. Various formulae for short paste are available. The richest formulae contain a good proportion of egg, while a cheap short paste contains none.

	Rich formula	Cheap formula
flour	4 lb	3 lb
butter	2 lb	—
fat	—	½ lb
caster sugar	—	½ lb
egg yolks	10	—
baking powder	—	1 oz
water	About 4 gills	About 3½ gills

The fat is rubbed into the flour and the mixture made into a bay. The eggs and the water are added and the ingredients mixed together. The paste is stored in a cool place for an hour or two or preferably overnight.

SHORTBREAD

A formula for good shortbread is:

flour	4 lb
butter	2 lb
sugar	1 lb
salt	1¼ oz
eggs	3

The eggs should be mixed with the sugar, then the butter rubbed in and the flour by degrees. The baking temperature should depend upon the size of the pieces which are being baked, the temperature lying between 195 and 225° C (380 and 440° F).

SHORTENING

'Shortenings' are hydrogenated fats. They can be 'tailor made' for specific purposes in confectionery work.

SODA BREAD

In Eire a large proportion of the flour is used for the production of soda bread which is a chemically aerated bread. The aeration is accomplished by adding sodium bicarbonate to the flour and making the mixture into a dough with butter milk. The acid of the butter milk and the bicarbonate react to release carbon dioxide. The dough is baked in an iron pot, often in a peat fire when the bread is made domestically.

A weak flour sufficiently highly treated to reduce the elasticity of the gluten gives the best results.

SODIUM BICARBONATE

Sodium bicarbonate is widely used in the confectionery trade. It is the ingredient with which an acid body is mixed in baking powders and in self-raising flour. It reacts with acid to liberate carbon dioxide and this gas produces the desired aeration in the goods. Sodium bicarbonate will release carbon dioxide if heated on its own but it then leaves an alkaline residue of sodium carbonate in the goods, which gives them an objectionable taste and causes the flour to assume a deep yellow colour.

SOYA FLOUR

Soya flour is milled from the soya bean, a legume which is widely grown in the Far East. It has a protein content in the region of 45 per cent, an oil content of about 25 per cent, and contains about 2 per cent of lipoids. Two disadvantages attaching to unprocessed soya flour as an ingredient of food preparations are the rapidity with which rancidity may develop because of the high oil content, and the beany and rather bitter taste. These two defects can be dealt with by suitable steam treatment, which removes the taste and diminishes the tendency for rancidity to develop. Trouble from rancidity can also be avoided by removal of the oil.

Soya flour has been advocated as an ingredient of bread doughs on the grounds that it helps to maintain moistness and freshness in the bread. It has a deadening effect on the dough, however, and this restricts the proportion in which it can be employed in ordinary white bread to about 2 lb per sack. Special breads are, however, made which contain much higher quantities of soya flour, but they are characterized by a loaf of small volume that shows a close texture in the crumb.

SPONGE GOODS

Well-made sponge goods are a profitable line for the confectioner. The ingredients required are: a hard

grained sugar, a soft weak flour, and eggs. Plain sponges can be made by beating together 3 lb of eggs and 2 lb 10 oz of sugar until the mixture is firm and then mixing lightly into 2 lb 6 oz of flour. The mixture is filled into moulds and baked in a solid oven at 204° C (400° F). If sponge fingers are to be made the sugar should be reduced to 2 lb and the flour increased to 2½ lb.

STALING

As bread ages it loses flavour and aroma and becomes harsh and crumbly. At one time it was thought that this staling was due to loss of moisture from the loaf but it has been shown that bread will stale even when stored under conditions that prevent loss of moisture.

The basic cause of bread staling is a change in the nature of the starch. In fresh bread the starch exists in what is known as the *alpha* form. At temperatures below 55° C (131° F) *alpha* starch is unstable and some of it changes into a *beta* form until an equilibrium mixture is attained. The composition of the equilibrium mixture is determined by the temperature, the lower the temperature the greater the proportion of *beta* starch in the equilibrium mixture.

Alpha starch has a greater water-holding capacity than *beta* starch, and hence the change from *alpha* to *beta* starch is accompanied by an extrusion of water from the starch. This water may be taken up by the gluten.

Above 55° C (131° F), *alpha* starch is stable and does not change to *beta* starch, and hence bread stored at this temperature will not stale. This is not a practical solution to the problem, since bread kept at this temperature will be very prone to develop rope.

Staling can be delayed also by storing bread at -20° C (-4° F). The reason is not that the equilibrium is disturbed but that the rate of transformation at this temperature is so extremely slow that it is of no practical significance.

SUGAR

Different types of sucrose are used for different purposes.

Sugar nibs—a very coarse sugar—are used to sprinkle on the top of bath buns.

Granulated sugar, which has a hard grain, is employed in the making of macaroon goods but it should not be used in other goods where eggs are the only moistening agents.

For most purposes fine caster sugar is used, and particularly for working with eggs or creaming with butter.

Icing sugar is used for making water icing or royal icing.

Dark sugars, such as demerara, are useful in dark-coloured cakes because they aid the colour while they also add to the flavour.

VIENNA BREAD

Whether or not a loaf is a Vienna loaf is not determined by its ingredients or by the technique by which it has been produced, but by its characteristics. The most distinctive characteristic of a Vienna loaf is its very crisp, thin, and highly glazed crust, of a light golden brown colour. Another feature of a Vienna loaf or roll is that it does not have an unbroken surface; the loaf or roll

is either cut on the upper surface or is moulded into such a shape that the upper surface is not continuous. The vesiculation of the crumb of Vienna bread is coarser than that of ordinary bread, and gas holes are present. In order that the crust characteristics may be obtained, the dough must be baked in an ample supply of steam and it is usual to effect the baking on the sole of the oven.

VIENNA OVEN

A Vienna oven has less depth than an ordinary bread oven and it has a sole which slopes up from the front to the back of the oven. The reason for this is that it ensures that steam is retained in the oven even when the door is opened, as an ample supply of steam is essential for the production of good Vienna bread.

VOL

See AMMONIUM CARBONATE.

WHEATMEAL

Meals (wheatmeals and wholemeals) need to be treated differently from white flours in the bakery. They usually require two or more gallons of water per sack over the proportion needed for white flour and are best suited by a bulk fermentation of $1\frac{1}{4}$ to $1\frac{1}{2}$ hr. Ample salt is required and the inclusion of fat may enhance crumb consistency. The dough temperature must be well below that employed for white flour doughs and a temperature of 22 to 23° C (72 to 74° F) is recommended. A suitable formula would be:

meal	70 lb
salt	$1\frac{1}{2}$ lb
yeast	$1\frac{1}{4}$ lb
water	$4\frac{1}{4}$ - $4\frac{1}{2}$ gal

The dough should be finished at a temperature of 23° C (74° F) and should be allowed to ferment for 1 hr. It should then be given a thorough knock-back and allowed to ferment for a further 15 min. The dough should then be scaled, moulded, and proved. It is important that full proof should not be given; meal doughs should always go to the oven on a rising proof. The dough should be well baked.

Speciality meals, that is meals that contain additional ingredients such as germ or diastatic malt, may require special treatment, but the recommended procedure will be supplied by the proprietors of the meal.

YEAST

Yeasts are unicellular plants, the cells of baker's yeast (*Saccharomyces cerevisiae*) being about $\frac{1}{3,600}$ inch in diameter. They normally reproduce by 'budding', in which process a daughter cell grows from the parent cell and eventually assumes an independent existence, although it may remain attached to the parent cell. Yeasts are able to utilize sugar for their energy requirements

and in so doing they produce carbon dioxide and alcohol as waste products. It is upon this property of yeast that its use as an aerating agent depends.

Yeast is most active at a temperature of 22 to 29° C (72 to 85° F). Its activity is impaired at a temperature of about 40° C (110° F), and at a temperature of 50 to 60° C (125 to 130° F) yeast is killed. If yeast is to be maintained in good condition it should be wrapped in a damp cloth and kept in a cool place or preferably stored in a refrigerator at 4° C (40° F).

A rough check upon the relative activities of samples of yeast can be made by incorporating them in a series of doughs made under identical conditions, i.e. same flour, same amount of water, etc., placing these doughs in graduated cylinders, and noting the height to which they rise in a given time. For more accurate work the Zymotachygraphe can be used.

YIELD

The yield of bread obtained from a flour is determined by the amount of water used in the dough and the losses which occur during fermentation and baking. If the latter two factors are reasonably constant in a bakery, then yield is determined by the water absorption of the flour being used. This is naturally influenced by the moisture content of the flour but, in the absence of wide fluctuations in moisture content between different consignments of flour, water absorption is governed by the wheat blend, the amount of damaged starch, and the chemical treatment that a flour has received.

REFERENCES

- ¹ Kirby, G. W., Frey, C. N., and Atkin, L., *Cereal Chem.*, 1935, **12**, 244.
- ² Kirby, G. W., Frey, C. N., and Atkin, L., *Cereal Chem.*, 1937, **14**, 865.
- ³ Anon., *Northwestern Miller*, 1957, **257**, 13.
- ⁴ Chamberlain, N., Collins, T. H., and Elton, G. A. H., *Baker's Digest*, 1962, **36**, 52.
- ⁵ Coppock, J. B. M., *Milling*, 1966, **146**, 317; Pace, J., and Stewart, B. A., *ibid.*, 317; Chamberlain, N., Collins, T. H., Dodds, N. J. H., and Elton, G. A. H., *ibid.*, 319.
- ⁶ Balls, A. K., and Hale, W. S., *Cereal Chem.*, 1938, **15**, 622.
- ⁷ Hale, W. S., *Cereal Chem.*, 1939, **16**, 605.
- ⁸ Amos, A. J., *Chem. and Ind.*, 1942, **61**, 117.
- ⁹ Samuels, L. W., *Biochem. J.*, 1935, **29**, 2331.
- ¹⁰ Kent-Jones, D. W., and Mitchell, E. F., 'Practice and Science of Breadmaking': Northern Publishing Co. Ltd., Liverpool, *3rd Edition*, 1962.
- ¹¹ Richter, V. F. A., 'Vienna Bread': Maclaren & Sons Ltd., London, 1948.

GENERAL READING

- Bennion, E. B., 'Breadmaking', O.U.P., *4th Edition*, 1967.
- Bennion, E. B., Stewart, J., and Bamford, G. S. T., 'Cake Making': Leonard Hill, 1966.
- Kent-Jones, D. W., and Amos, A. J., 'Modern Cereal Chemistry': Food Trade Press, *6th Edition*, 1967.
- Kent-Jones, D. W., and Mitchell, E. F., 'The Practice and Science of Breadmaking': Northern Publishing Co., *3rd Edition*, 1962.
- Kirkland, J., 'The Modern Baker, Confectioner and Caterer', Vols. 1 to 6: Gresham Publishing Co., 1909.
- Ptyler, E. J., 'Baking Science and Technology': Siebal Publishing Co., 1952.

Index

A

Acerola, 248
Acetic acid, 1, 9, 18, 423
 preservation by, 422
Acetoglycerides, 185, 191
Acetyl value, 185
Acid calcium phosphate, 1, 9, 303
Acidity
 expressed as hydrogen ion concentration, 34
 importance of, in canning, 33
 in cheesemaking, 87
 of cream, 77
 of dough, 1
 of fruit juices, 248
 of fruits and vegetables, 13, 35
 of milk, 77
 reagents for determining, 78
Acid phosphates, production in dough, 1
Acid potassium tartrate (*see* Cream of Tartar)
Acid sodium pyrophosphate, 1, 303, 321
Acids, for jelly manufacture, 411
Adenosine triphosphate (ATP), 326
Adhesives, 348–349
Adhesives for laminating, 380
Adipose tissue, 326
Adsorbents for moisture removal, 462
Aeration
 of baked goods, 1
 of dough, 2
Aerosols, 349
AFD (*see* Freeze drying)
Agar-agar, 57
Agar sausage method, 298
Agene, 303
Air conditioning, 461–463
Alanine, 326
Albumen, 1
Alcohol in fruit juices, determination of, 249
Alginates, 57
Alkyl p-hydroxybenzoates, 438
Allergy, 326
Almonds, 68
Alpha-amylase, 5, 6
Aluminium, 13
 foil, 349–351
 foil, as insulating material, 476
Alveographe, 303
Amino acids, 326
Aminopterin, 327
Ammonium carbonate in baking, 1
Ammonium chloride in baking, 1
Ammonium persulphate, 304, 316
Amylases, 304
Amylograph, 305
Anaemia, 327
Analysis, thermal, 209
Anchovies, 213
 'Angel food', 4
Angular stomatitis, 327
Animal foods, 13
Animal protein factor, 327
Annatto, 78, 218
Anorexia nervosa, 327
Antibiotics
 in fish preservation, 213
 in meat processing, 280
 in milk, 79
Antioxidants, 185
 for fish, 213

 in cake flour, 5
 synergism of, 209
Anti-spattering agents, 168
Anti-tailing devices, 57
Apoferritin, 327
Appeal to the cow test, 79
Apple juice, 253
Apples
 canning of, 14
 cider, classification of, 259
 for jam manufacture, 393
 for manufacture of fillings, 396
 freezing of, 45
 prepared, refrigerated storage of, 15
Arachidonic acid, 327
Arginine, 327
Ariboflavinosis, 327
Ascorbic acid
 as flour improver, 305
 effect of, in meat products, 281
 in breadmaking, 3
 in fruit juices, determination of, 249
 loss of, from vegetables, 177–178
 oxidase, 327
Aseptic filling, 79
Ash in fruit juices, determination of, 250
Aspartic acid, 327
Atomizers, 165
Atwater factors, 327
Autocap closure, 30
Autolysis of fish, 213
Automatic control, 463
Automation in dairying, 79
Avidin, 327
Avitaminosis, 327

B

Babassu oil, 202
Bacon
 composition of, 344
 curing of, 286–287
 smoking of, 299–300
Bacteria
 butyric acid, 85
 count tests for, 138, 144
 in meat products, tests for, 298
 in milk, plate count for estimating, 138
 lactic acid, 294–295
 of dried milk, 133
 of fish, 214, 216
 of milk, 81, 104, 141
 of wheat, 10, 305
 simple, classification of, 106–107
 taints in milk caused by, 123
 thermoduric, 135
 thermophilic, 54, 135
Bacteriological control, in canning, 16
Bacteriophage, 80
Bacteriology (*see* Microbiology)
Bags, 352–353
 filling and closing equipment for, 353
Bake-in-trays, 353
Baking, 1 *et seq.*
Baking powder, 1, 303
Barley, 306
Barrels, 353
Batters, for cake, 4
Beans
 canning of, 16
 freezing of, 46
 in tomato sauce, 17
 runner, 16
Beef
 composition of, 344
 dark cutting, 287
 extract, 281
Beer, canning of, 19
Beetroot, 17
 for pickling, 456
 pickled, 425–426
 pickled, adverse effects of sulphur dioxide in, 438
Benzoic acid, 18
 in fruit juices, 275
 in fruit juices, determination of, 250
Benzoyl peroxide, 306
Beriberi, 328
Beta-amylase, 6
Beverages (*see also* Fruit juices and Soft Drinks)
 bottling of, 254–256
 canning of, 18
 carbonated, 257
 flavouring compounds for, 271
 non-Excisable, 273
Bilberries, canning of, 19
Biocytin, 328
Bioflavonoids, 328
Biological oxygen demand, 81
Biological value, 328
Bios, 328
Biotin, 328
Birs dryer, 266
Biscuits, 2
 Abernethie, 2
 flour for, 2
 ingredients of, 2
 packs for, 355
Bitot's spots, 328
Bitterness in dairy products, 81
Bitty cream, 81, 148
Bixen, 78
Blackberries, canning of, 19
Blackcurrant juice, 253
Blackcurrants
 canning of, 19
 for jam manufacture, 392
Blanching, 20, 46, 159–160
Bleaching
 of fats, 186
 of flour, 306
Bloater, 214
Bloom, of chocolate, 73
Board, packaging, 361
Boil-in-bag packs, 49, 354
Boiled sweets, 57
Bone meal, 295
Bones, fat extraction from, 295
Borneo tallow, 203
Bottles, 254, 376–378
 brown, 82
 caps for, foil, 351
 filling of, 256
 milk, 111, 112
 milk, cleaning of, 81, 104
 one-trip, 377
 scanning of, 255
 washing of, 255
Bottling
 of beverages, 254–256
 of cider, 260
 of fruit, 30
Botulinum cook, 34

- Botulism, 33, 214, 236
 Boxes
 rigid paperboard, 386
 tin, 356, 358
 Brandies, 256
 Brazil nuts, 68
 Bread, 2
 as sausage filler, 288
 colour of, 5
 emulsifier applications in, 191
 ingredients of, 2
 malt, 8
 manufacture of, 2
 milk, 8
 milk solids in, 81
 moulds, and acetic acid, 1
 packs for, 355
 protein-enriched, 9
 protein, quality of, 326
 soda, 11
 staling of, 11
 starch reduced, 9
 vienna, 11
 yield, 12
 Breadmaking, 2
 Breakfast cereals, 307
 Break middlings, 307
 Break rolls, 307, 318
 Breeds of dairy cattle, 81
 Brine
 preservation of vegetables by, 453-454
 refrigerating, 464
 strength, 242
 strength, determination of, 440-441
 tanks, 282
 systems, 469
 Brining of fish, 28
 Brisling, 29, 215
 Brix, 256
 Brog tool, 178
 Browning of dehydrated vegetables, 181
 Browning reaction, 82
 Brussels sprouts
 canning of, 20
 freezing of, 46
 Buckling, 215
 Buffer value, 82
 Buns, 4
 Burners, gas, 64
 Bushel weight, 307
 Butter, 82-84
 additives for, 78
 body, 84
 churning, 83
 colour, 78, 82, 86
 composition of, 82, 344
 confectionery, 58
 cultures, 82
 definition of, 128
 dehydrated, 160
 faults in, 83
 flavour of, 82, 83, 193
 grading, 83
 legislation, 127
 low temperature storage of, 140
 manufacture, 83
 packaging of, in foil, 350
 ratio, 85
 setting of, 84
 spreadability, 84
 taints arising in, 120
 yield, 84
 Buttermilk, 85
 Butyric acid, 85
 By-products from dairying, 85
- C**
- Cabbage
 nutrient losses of, during scalding, 177
 red, for pickling, 456
 red, pickled, 438
 requirements for dehydration, 181
 Cabinets, retailers', for frozen foods, 49
 Cacao beans
 fermentation of, 62
 winnowing of, 74
 Cacao butter (*see also* Cocoa butter), 58
 crystallizing of, 73
 Cacao moth, 58
 Caerphilly cheese, 90
 Cake, 4
 canning of, 20
 emulsifier applications in, 191
 moisture content of, 186
 packs for, 355
 Calcium chloride in cheesemaking, 92
 Calcium phosphate, 321
 Calcium requirements in diet, 328
 Calorie, 329
 Calorimeter, 329
 Candied fruits, 59
 Canned foods
 gases in, 31
 nutritive value of, 40
 spoilage of, 51
 tin in, 55
 Canning, 13 *et seq.*
 acidity, importance of, in, 33
 agitation, effect of, in, 34
 aseptic, 15
 of carbonated beverages, 257
 of fruit fillings, 397-398
 of fruit juices, 256
 temperature control in, 54
 Cans, 20, 356-358
 aluminium, 13
 beverage, 19
 clinking of, 22
 coding of, 22
 cooling of, 23, 34
 corrosion of, 13, 19, 22, 24, 27, 36, 38,
 39, 43, 44, 50, 55
 deformation of, 23, 34
 drying of, 26
 easy-open, 13
 exhausting of, 27
 for fish packs, 30
 filling of, 27
 for condensed and evaporated milk, 39
 for dehydrated vegetables, 178
 headspace in, 32
 headspace gases in, 31
 heat penetration into, determining, 33
 incubation of, 35
 lacquers for, 35
 peaking of, 23, 34
 reforming of, 50
 seaming of, 26
 sizes of, 21
 sulphur staining of, 25
 testing of, 54
 vacuum in, 55
 Canthaxanthin, 329
 Capillary fragility, 329
 Caps (*see* Closures)
 Capsules, gelatin, 357
 Caramel, 5, 59, 427
 Carbohydrates, 329
 Carbohydrates
 in fish, 215
 Carbonation of beverages, 257
 Carbon dioxide
 as factor in can corrosion, 24
 cooling vehicles by, 49
 determination of, 1
 from baking powder, 1
 in dough, 1
 in beverages, determination of, 250
 in headspace gases, 32
 production by stored fruit and vegetables,
 473
 solid, 491
 storage of fish, 215, 217
 Carcasses, cooling and preparation of,
 297
 Carnitine, 329
 Carob juice, 257
 Carotenal, 330
 Carotene, 86, 307, 330
 Carotenoids, 330
 in fish, 215
 Carrots
 canning of, 21
 peeling of, 180
 requirements for dehydration, 181
 Cartons and cartoning systems, 359-361
 Cartons
 for frozen foods, 48
 for milk, 86
 Casein, 86, 138
 Cases, fibreboard, 361-362
 Casings, sausage, 282-284
 Casks, 257, 362
 Catalysts for fat hydrogenation, 186
 Cat foods, 14
 Catalase, 86
 Cattle, dairy, 81
 Cauliflower
 canning of, 21
 brined, 454
 Caviar, 216
 Celery, 21
 Cellulose ethers, 445
 Centrifugal, 308
 Centrifugation of fruit juices, 261
 Cereals
 breakfast, 307
 composition of, 344
 starch in, 322
 Chalk (*creta praeparata*), 308, 331
 Chayen process for fat extraction, 295
 Cheese, 86-102
 blue-veined, 81
 colouring of, 78
 composition of, 344
 continuous production of, 99
 definition of, 128
 dressing of, 97
 effect of low temperatures on, 141
 English, composition of, 96
 enzymes in, 97
 film wrapping of, 99, 100
 grading, 99, 143-144
 industry, corrosion in, 119
 legislation, 127
 manufacture, 87
 nutritive value of, 90, 91
 packaging of, 99-102, 350, 362
 pasteurizing of milk for, 136
 renneting of, 88, 141-143
 rheological definitions of, 89
 rheological properties of, 144
 rindless curing of, 99
 ripening of, 87, 98, 141, 143
 soft, 95
 starters, 87, 93, 146-148
 storage of, 98
 treatment of, 96
 varieties, 88-96
 Cherries, canning of, 21
 Cheshire cheese, 91
 Chewing gum, 59
 Chicken, composition of, 344
 Chilling of fish, 216-217
 Chloride in fruit juices, determination of,
 251
 Chlorination, 22, 24
 Chlorine
 as flour improver, 308
 determination of, in cooling water, 24
 Chlorine dioxide, 308, 316
 Chlorotex, 24

- Chocolate
 conching of, 61
 crumb, 67
 emulsifier applications in, 191
 enrobing with, 62
 grinding of, 67
 manufacture of, 60
 refining of, 69
 tailing, prevention of, 57
 tempering of, 73
- Choline, 330
- Chorleywood bread process, 3
- Chromatography, 187-188
- Churns, 86, 116
 cleaning of, 103, 116
 sterility test on, 104
- Cider, 258-260
- Citric acid, 18, 60, 330
- Citrin, 330
- Citrovorum factor, 330
- Citrus juices, 260
- Clarification of milk, 104
- Cleaning
 in dairying, 103-104, 117
 in-place, 104, 117
- Cleaning procedures in factories, 430
- Clinching, 22
- Closing temperature, 22
- Clostridium botulinum*, in canning, 33
- Closures
 autocap, 30
 foil, 351
 for cans, types of, 357
 for fruit juices, 262
 for glass containers, 377-378
 phoenix, 52
- Clot-on-boiling test, 108
- Coccarboxylase, 331
- Cocoa beans, 60
 roasting of, 70
- Cocoa butter, 188
 substitutes for, 188
- Coconut, 68
- Coconut oil, 62, 202
- Cod in white sauce, 29
- Cod-liver oil, 331
- Code of Practice, 22
 fish freezing, 218
 for apple purée, 15
 for beans in tomato sauce, 17
 for canned butter beans, 16
 for canned fruit and vegetables, 14, 35
 for canned fruit salad, 31
 for canned soups, 50
 for cheese film wrapping, 100
 for horseradish sauce, 440
 for spreads, 52
- Coding of cans, 22
- Coeliac disease, 331
- Coenzymes, 331
- Cold storage (*see* Storage)
- Coliform test, 108
- Collapsible tubes, 364
- Colostrum, 108, 109
- Colour, measurement of, 188
- Colours
 in beverages, determination of, 251
 bread, 5
 confectionery, 61
 for canned products, 23
 for fruit juice beverages, 262
 for margarine, 188
 for pickles, 426-427
 for preserves, 390
 for sausages, 284
 for smoked fish, 218
 for table jellies, 411
- Comminution of fruit, 262
- Compressed air for dairies, 80
- Compressors, refrigeration, 466, 482
- Conching, 61
- Condensers, 173
 refrigeration, 482
- Conditioner for wheat, 308
- Confectionery, 57 *et seq.*
 boiled, 57
 equilibrium r.h. of, 62
 moulding of, 68
 packaging of, 364
 rollers, batch, 57
 sugar, effect of humidity on, 364
- Connective tissue, 285
- Containers (*see* Packaging)
- Control of equipment, 471
- Conveying, bulk, 464, 465
- Conveyors (*see also* Elevators)
 belt, 463
 chain, 465, 466
 flight, 487
 maintenance of, 479
 overhead chain, 483
 pneumatic, 465, 484
 portable, 485
 powered, 485
 roller, 489
 screw, 465, 491
 spiral, 491
 steel band, 465-492
 wheat, 309
 wheel, 496
 wire belt, 496
- Cookers, continuous, 33
- Cooking fat, 189
- Cooling
 of cans, 23, 24
 of vegetables, 161
- Cooling water, 24
- Copper, 331
 vessels in jam manufacture, treatment of, 407
- Cordials, 265
- Cork, 476
- Corn oil, 203
- Corned beef, canning of, 38
- Cornflour, 5
 in saucemaking, 444, 446
- Corrosion (*see also* Cans), 24, 115-119
- Cottage cheese, 91-94
- Cottonseed oil, 194, 202
- Cranes, 468
- Cream, 113, 114
 acidity of, 77
 bitty, 81, 148
 canning of, 25
 composition of, 344
 confectionery, 61
 definition of, 128
 neutralization of lactic acid in, 133
 powder, 5
 synthetic, 149
- Cream cheese, 94
- Cream crackers, 2
- Cream of Tartar, 5
 in baking powder, 1
- Crumb, milk, 67
- Crumb softeners, 5
- Crumpets, 5
- Crust colour, 5
- Cryptoxanthin, 331
- Crystallizing, wet, 73
- Cucumbers, pickled, 455
- Curd
 cutting of, 89
 fruit, 394-396
 milling of, 90
 piling of, 90
- Curing of bacon and ham, 286-287
- Curing salts, 37
- Cut-out, 25
- Cyanide, fumigation with, 58
- Cysteine in breadmaking, 3
- Cystine, 331
- D**
- Dairies, design of, 79
- Dairy industry data, 114
- Dairy products, definitions of, 128
- Dairying, 75 *et seq.*
 by-products from, 85
 legislation, 126-129
- Defrosting, 468
- Dehydrated foods, compression of, 160
- Dehydration, 159 *et seq.*
 control apparatus for, 161
 freeze, 167-168, 169-173, 174
 of fish, 220
 of fruit, 173
 of fruit juices, 265-266
 of meat, 163-174
 of milk, 131
 roller, 132
 spray, 132
- Dehydrofreezing, 161
- Density of sugar solutions, 53
- Derbyshire cheese, 95
- Desiccants for containers, 367
- Detacher, 310
- Deterioration (*see* Spoilage)
- Detergents, 266
 for dairying, 103, 114, 147
- Dextrose, 61, 65
- Diastatic activity, 5, 310
- Diet
 bland, 328
 calcium in, 328
 Hay, 334
 Karell, 336
 Kempner, 336
 ketogenic, 336
 Lenhartz, 336
 Meulengracht, 337
 Sippy, 341
 sodium-free, 341
- Diethyl pyrocarbonate, 267
- Digestibility, 332
- Diphenyl, 267
- Dirt in milk, test for, 151
- Disc separator, 311
- Disinfectant for dairies, 105
- Disinfection of cooling water, 24
- Disintegrator, 311
- Distensibility of gluten, 2
- Dividers, dough, 3
- Dog foods, 14
- 'Do-Maker' bread process, 3
- Dorset Blue cheese, 95
- Double seams, 26
- Dough
 biscuit, 2
 elasticity of, 312
 machines for, 3, 4
 mechanical working of, 3
 moisture content of, 8
 pH of, 316
 physical properties of, 6
 production of acid phosphates in, 1
 ripening of, 3
 testing, 303, 312
 yeasted, acidity of, 1
- Doughnuts, 6
- DPD, 24
- Dragees, 68
- Dresser, flour, 311
- Drinks, 276
- Drives for conveyors, 463
- Drugs, appetite depressant, 327
- Drums, 366
- Dryers, 162-168
- Drying
 of air, 462
 of cans, 26
 of foods (*see* Dehydration)

Duck, composition of, 344
 Dummy pulp, 416
 Dunlop cheese, 95
 Dunst, 311
 Dust collectors, 311
 Dust separation, 465
 Dye absorption methods for protein, 138
 Dyspepsia, 332

E

Effluent from canneries, 26
 Effluent recovery plant for wheat, 311
 Egg
 albumen, 1
 bulk, handling requirements of, 430
 composition of, 344
 composition and properties of, 6
 dehydrated, nutritive value of, 175
 dehydrated, palatability of, 175
 dried, 6
 frozen, 6
 in baking, 6
 packaging of, 368
 Elasticity, 144
 Elevators, 469-471
 Embryo of wheat grain, 312
 Emulsification, 190
 Emulsifiers, 190-192
 for ice-cream, 195
 in crumb softeners, 5
 Endosperm of wheat grain, 312
 Enrobing, 62
 Enrichment, 332
 Entoleter, 312
 Enzymes, 6, 25, 267
 action of, in can corrosion, 24
 action of, in wheat flour, 6
 activity of in fruit juices, determining
 251
 clarification of fruit juices by, 261
 clotting of milk by, 88, 141-143
 fat digesting, 196
 for tenderizing meat, 300
 in cheese, 97, 141
 in oats, stabilization of, 319
 in pickle manufacture, 427
 proteolytic, in flour, 2, 7
 starch degrading, 304
 Ergosterol, 332
 Erythorbic acid, 332
 Erythrosine, 23, 31
 Essences, 63, 267
 Essential oils, 63, 267, 287, 290
 Essential fatty acids, 192, 332
 Ester recovery, 268
 Ethylene oxide, fumigation with, 59
 Evaporation of fruit juices, 263
 Evaporators, 263
 Exhaust boxes, 27
 Exhausting of cans, 27
 Expansion valves, 483
 Explosion hazard of starch, 67
 Extensograph, 312
 Extensometer, 312

F

Factor 3, 333
 Factory environment for pickle manufacture, 429
 Factory ships, 222
 F.A.O., 221
 Fans, 168
 Farina as sausage filler, 288
 Farinograph, 312
 Fat
 extraction from bones, 295
 in dairy products, standardization of, 145
 in milk, 119, 145

Fats, 185 *et seq.*
 bleaching of, 186
 composition of, 200-201
 confectionery, 62
 cooking, 189
 de-acidification of, 189
 degumming of, 189
 density of, 189
 deodorizing of, 189
 differential thermal analysis of, 209
 digestibility of, 190
 dilatometry of, 190
 emulsification of, 190
 flavour of, 193
 hardness of, measuring, 194
 hydrogenation of, 186-187, 194
 identification agents for, 195
 interesterification of, 195
 iodine value of, 196
 liquid/solid ratio in, 197
 measuring spreadability of, 84
 melting point of, 199
 of fish, 222-223
 peroxide value of, 206
 plasticity of, 207
 preservatives in, 207
 refining of, 207
 refractive index of, 207
 Reichert-Meissl, Polenske and Kirschner
 values of, 207
 saponification value of, 208
 slip point of, 209
 smoke, fire and flash points of, 209
 thiobarbituric acid value of, 210
 thiocyanogen value of, 210
 unsaponifiable matter in, 210
 vegetable, in dairy products, 120, 152
 Fatty acids, 192-193
 essential, 192, 332
 in fish fats, 222-223
 metabolism of, 328
 non-esterified, 338
 titre of, 199
 Feeders, constant weight, 467
 Fermentation
 aeration by, 1
 brining of vegetables, 453-454
 in dough, 1, 2
 of apple juice, 259
 of fruit juices, 270
 of milk, 78
 Fermentograph, 313
 Ferritin, 333
 Fibreboard, 361
 Figs, 27
 Filling
 of cans, 27
 of jam, 409
 of pickled vegetables, 458
 Filling machines, 368-370
 Fillings
 fruit, 396-398
 whipped, emulsifier applications in,
 191
 Films
 for shrink wrapping, 387
 packaging, heat sealing of, 378-379
 packaging, permeability of, 371
 Filth test, 313
 Filtration of fruit juices, 262, 270
 Final proof, 2
 Finnan haddock, 223
 FIRA extruder, 84
 FIRA gauge, 56
 Fish, 213 *et seq.*
 amino acids in, 234
 angle of repose of, 213
 antibiotic preservation of, 213
 autolysis of, 213
 bacteria of, 214, 216
 biology of, 214
 canning of, 28
 carbohydrates in, 215
 carbon dioxide storage of, 215, 217
 carotenoids in, 215
 chilling of, 216-217
 classification of, 217
 cold storage of, 218, 227-228
 composition of, 218-219, 345
 dehydration of, 168
 demersal, 220
 density of, 220
 dielectric thawing of, 228
 dried, discoloration and toughening of,
 221
 drifting for, 220
 drying of, 220
 elasmobranch, 221
 ensilage of, 221
 fat content of, 222-223
 fingers, 223
 freezing, 47, 227-228, 239
 freshness tests for, 228-229
 heat transfer in, 230
 hygiene in handling of, 226, 230
 industry, 224
 industry, Government departments in-
 volved in, 229
 industry, weights and measures in, 246
 irradiation of, 231
 livers, 232
 marinating of, 232
 meal, 224-225
 meal, spontaneous combustion of, 225
 minerals in, 232-233
 muscle structure, 233
 nitrite dipping of, 225
 nitrogen factor of, 233
 nitrogenous extractives of, 233
 nomenclature of, 234
 nucleic acids of, 234
 nucleotides of, 235
 oils, 203
 oils, test for rancidity of, 239
 packaging of, 370
 parasites and diseases of, 235
 pelagic, 235
 pH of, 235
 phosphatides of, 235
 physical properties of, 235
 poisoning from, 236
 polyphosphate dipping of, 228
 potted, 236
 pre-packaging of, 236
 processing machinery, 224
 protein concentrate (FPC), 225
 proteins in, 236
 public health inspectors and, 219
 purines in, 237
 quality grading of, 237-239
 roes, 239
 salting of, 240-241
 sausage, 226
 scales, 241
 seine-netting for, 241
 smoked, colours for, 218
 smoked, types of, 243
 smoking of, 241-242
 spoilage of, 213, 216
 steroids and sterols in, 242
 'stinker', 243
 storage life of, 228
 swim bladder of, 244
 tester, 226
 thawed, drip in, 228
 transport of, 244
 trawling for, 244
 trimethylamine (TMA) in, 244-245
 vitamins in, 246
 water content of, 246
 Flame peeling, 42, 180
 Flash 18 process, 16

- Flat sours, 51, 55
 Flavoproteins, 333
 Flavouring compounds, 271
 Flavours
 confectionery, 63
 for ice-cream, 195
 for yoghurt, 155–156
 in baking, 7
 in milk, 120–123
 for meat products, 289–291
 Flexible packaging materials, 370–373
 Flies and fly control, 226
 Flour, 313
 addition of chalk to, 308
 ageing of, 303
 alpha-amylase activity, measurement of, 305
 analysis of, 305
 ascorbic acid improvement of, 305
 ash content of, 305
 bleaching of, 306
 cake, 4
 chlorine treatment of, 5
 colour of, 308
 composition of, 344
 damaged starch content of, 310
 darkening of, 7
 diastatic activity of, 5, 310
 enrichment, 312
 extraction of, 312
 fluorine in, 314
 grade of, 315
 granularity of, 315
 Hagberg test for, 315
 heat treatment of, 316
 improvers, 303, 304, 305, 308, 316, 320
 iron in, 316
 malt, 317
 maltose figure of, 318
 moisture in, 319
 pests of, 320
 pH of, 316
 phytase in, 320
 protein content, determining, 320
 purification of, 319
 reduction of, 319
 self-raising, 321
 strength, 322
 sulphur dioxide and, 323
 wheat, enzymes in, 6
 wheat, for confectionery, 73
 Fluids, transfer of, 493
 Fluidized bed freezing, 472
 Fluidized handling, 471–472
 Fluidizing, 163
 F_0 value, 34
 Foam drying of milk, 133
 Foaming, 63
 Foaming agents, 63, 66
 Foam-mat drying, 266
 Foil, aluminium, 349–351
 Folic acid, 333
 Fondant, 7, 63
 Foods
 acid, 326
 canned (*see* Canned foods)
 composition of, 344–345
 dehydrated (*see* Dehydrated foods)
 fatty, 185 *et seq.*
 freeze-dried, 167–174
 freeze-dried, packaging of, 374
 freeze-dried, packaging of, in foil, 350
 frozen (*see* Frozen foods)
 gluten-free, 334
 maximum permissible ERH of, 267
 multipurpose, 335
 nutritive values of, 91
 spoilage of, 366
 vended, packaging for, 351
 Formol titration method, 138
 Fortification of milk, 123
 Freeze concentration, 264
 Freeze-drying, 167–174, 266
 of milk, 133
 Freezer burn, 48
 Freezers, 48
 air blast, 461
 Freezing, 13
 contact plate, 468
 cryogenic, 48, 468
 fluidized bed, 472
 of fruit for jam manufacture, 394
 mechanism of, 45
 methods of, 47
 of fish, 47, 227–228, 239
 of fruit, 45
 of meat, 47, 289–291
 of poultry, 47
 of vegetables, 46
 quick, 44
 Freezing point test for milk, 123–124
 Frozen foods
 history of, 44
 nutritive value of, 40
 packaging of, 48
 storage and transport of, 49
 Fructose, 65
 Fruit
 acidity of, 35
 bottling of, 30
 browning of, 20, 25
 candied, 59
 canning of, 31
 citrus, for marmalade, 415–417
 cocktail, 31
 composition of, 345
 comminuted, 262
 curds, 394–396
 dehydrated, nutritive value of, 175
 dehydration of, 173
 discoloration of, during canning, 25
 dried, moisture contents of, 367
 fillings, 396–398
 for jam manufacture, 391–394
 for thick sauces, 448
 for yoghurt manufacture, 156
 freezing of, 45
 in pickle manufacture, 428
 juice, for jelly manufacture, 411
 maturity of, 272
 milling of, 273
 packing of, 274
 peeling of, 42
 pulp, sulphited, 393
 salad, canning of, 31
 storage of, 472–473
 sulphiting of, 173
 Fruit juices, 248 *et seq.*
 acids in, 248
 analysis of, 249–253
 blending of, 254
 canning of, 18
 chemical composition of, 258
 citrus, 260
 classification of, 261
 closures for, 262
 concentration of, 263–264
 construction materials for, 264
 de-aeration of, 265
 dehydration of, 265–266
 extraction of, 268–270
 fermentation of, 270
 filtration of, 270
 frozen, 271
 legislation, 271
 pasteurization of, 274
 preservatives for, 275
 processing, enzymes for, 267
 storage of, 276
 varietal factors of, 278
 Fruit pie fillings, 31
 Fruit salad, canning of, 31
 Frying, 194
 Frying oils, 193
 Fumigation, 314
 of cacao, 58
 Fungal amylases, 314
- ## G
- Gadoid, 229
 Galactosaemia, 333
 Gases in canned foods, 31
 Gelatin, 64, 410
 Gelatin, clarification of fruit juices by, 261
 Gelling agents, 68
 Gelling in sauces, 446
 Germinal brush, 314
 Gervita, 289
 Ghee, Vansapati, 211
 Gherkins, pickled, 428
 Ginger, preserved, 69
 Ginger nuts, 2
 Glandular products, 293
 Glass
 as dairy material, 118
 in packaging, 376–378
 presence of, in factories, necessary precautions, 429
 Glass wool, 476
 Glassine, 375
 Gliadin, 5, 315, 320
 Gloucester cheese, 95
 Glucose, 7
 confectioners', 61
 liquid, 66
 metabolism of, 332, 335
 syrup, 64, 399
 Glues, 348
 Glutamic acid (*see also* MSG), 334
 Gluten, 6, 315
 in biscuit doughs, 2
 Gluten breads, 9
 Glutenin, 5, 315, 320
 Glycerol, 7
 Glycerol esters, 191
 Glyceryl monostearate, 7, 64
 Glyceryl monostearate, in bread, 5
 Glycine, 334
 Glycogen, 334
 Glycolysis, 334
 GMS (*see* Glyceryl monostearate)
 Goitre, 334
 Golden puff biscuits, 2
 Golden raising powder, 1
 Golden syrup, 72
 Gooseberries
 canning of, 32
 for jam manufacture, 393
 Grape juice, 271
 Gravitational movement, 473
 Greengages, canning of, 32
 Groundnut oil, 203
 Guar gum, 64
 Gum arabic, 65
 Gum tragacanth, 445, 447
 Gums, 64
 in sauce manufacture, 445
- ## H
- Haemosiderin, 334
 Haff disease, 334
 Hagberg test, 315
 Halphen test for cottonseed oil, 194
 Ham
 canning of, 38
 composition of, 344
 curing, 286–687
 flavour of, 289
 Handing-up machine, 3
 Handling, 460 *et seq.*
 equipment, maintenance of, 478–480

- Handling—*contd.*
 equipment, overhead, 483
 integration of, with factory layout, 476–477
 of materials, 480–481
 Hardness measurement, 194
 Headspace in cans, 32
 Headspace gases, 31
 Heat exchangers, scraped surface, 490
 Heat sealing equipment, 378–379
 Heat sterilization, 32
 Heat units, 474
 Herbs (*see* Spices)
 Herring, canning of, 28
 Hesperidin, 334
 Histidine, 335
 Hoists, 474–475
 Homogenization of milk, 124
 Honey, 65
 Horseradish sauce, 440
 Hot iron test for cheese, 90
 HTST pasteurization, 135
 Humectants, 65
 Humidifiers and dehumidifiers, 462
 Humidity, 7, 475
 importance of, in cheesemaking, 98
 Husking separator, 316
 Hydrocooling, 475
 Hydrogen, in headspace gases, 32
 Hydrogenation
 catalysts for, 186
 of fats, 186–187, 194
 selectivity in, 208
 Hydrogen ion concentration (*see* pH)
 Hydrogen swells, 22, 24, 32
 Hydrol, 65
 Hydroseal sterilizer and cooler, 409
 Hydroxymethylfurfural in fruit juices, determining, 251
 Hydroxyproline, 335
 Hygiene
 in canneries, 35
 in curing houses, 282
 in fish handling, 226, 230
 in fruit processing factories, 276
 in milk distribution, 104–105, 108
 in pickle manufacture, 428–430
 Hypercalcaemia, 335
 Hypervitaminosis, 335
- I**
- Ice-cream, 195
 emulsifier applications in, 191
 overrun, 206
 Ice
 for fish chilling, 231
 flake, 471
 production of, 460
 Icing, 8, 71
 royal, 1, 8
 Illipe butter, 58, 62, 203
 Impact grinder, 316
 Improvers
 baked goods, 192
 flour, 303, 304, 305, 308, 316, 320
 Incaparina, 335
 Incubation of cans, 35
 Inositol, 335
 Instant milk power, 133
 Instrumentation
 for freeze-drying, 171
 of retorts, 34
 Insulation and insulating materials, 475–476
 Intrinsic factor, 335
 Invert sugar, 65
 Invertase, 65
 Iodine, 335
 Iodine value, 196
 Irish stew, canning of, 37
- Iron, 335
 in flour, 316
 Irradiation
 of fish, 231
 of meat, 293–294
 Isinglas, 244
 Iso-acids, 196
 Isoleucine, 336
 Isoriboflavine, 336
- J**
- Jam (*see also* Preserves), 399–410
 bakery, 389, 406
 cooker, continuous, 407
 diabetic, 391
 jelly, 412–413
 manufacture, fruit for, 391–394
 Jellies
 confectionery, 57
 table, 72, 410–411
 Jelly formation by pectin, 69
 Jelly stock, 294
 Junket, 86
- K**
- Katadyn process, 271
 Kedgeree, canning of, 30
 Kefir, 78
 Ketone bodies, 336
 Kiln, Torry, 29, 242
 Kipper, 231
 Kippers, canning of, 29
 Klondyking of herrings, 231
 Knock-back, 8
 Kumys (koumiss), 78
 Kwashiorkor, 336
- L**
- Labels, 379
 Laboratory control (*see also* Quality control), 124
 Lacquers for cans, 35
 Lactic acid, 65, 133, 423
 bacteria, 294–295
 Lactoglycerides, 191
 Laminates, 379–381
 barrier properties of, 353
 foil, 350
 Lancashire cheese, 95
 Lard, 203
 Lecithin, 8, 65, 120, 186, 196, 235
 structure, sources and uses of, 196
 Legislation
 animal foods, 14
 antibiotics for fish preservation, 213
 antioxidants, 185
 baking powders, 1
 bread and flour, 2, 322
 canned meat products, 36
 cheese, 96
 colours, 23, 390
 comminuted fruit beverages, 262
 creta praeparata in flour, 308
 crumb softeners, 5
 dairy industry, 126–129
 edible gelatin, 410
 emulsifiers, 191–192
 fish products, 231
 flour enrichment, 312
 fluorine in food, 314
 fruit curds, 394
 fruit juice products, 271
 fruit pulps for manufacturing, 393
 ice-cream, 195
 iron in flour, 316
 jam manufacture, 399–400
 labelling of fruit fillings, 398
- margarine, 197
 marmalade, 415
 meat product composition, 284
 meat treatment, 281
 milk, 111, 123, 126–129, 151
 mincemeat, 417
 preservatives, 9
 preservatives in fats, 207
 preservatives in meat products, 297
 preservatives in pickles and sauces, 438
 preservatives in soft drinks, 272
 preservatives in tomato puree, 28, 29
 release agent, 412
 salad cream, 439
 soft drinks, 18
 sulphiting of fruit, 173
 tomato ketchup, 450
 vitamins in flour, 323
 vitamins in margarine, 211
 wheatmeal, 324
 Leicester cheese, 95
 Lemon curd, 394
 Leucine, 336
 Linoleic acid, 336
 Lipases, 196
 Lipoic acid, 336
 Lipoids, 8
 Liqueurs, 65
 Liquid sugars, 72
 Liquids, filling of, 368
 Liquorice paste, 66, 73
 Liver, composition of, 344
 Lloyd's Rules, 478
 Locust bean gum, 64
 Lozenges, 66
 Luncheon meat, canning of, 37
 'Luxus konsumption', 337
 Lycopene, 337
 Lye peeling, 42, 179
 Lysine, 337
- M**
- Macaroni, 317
 Macaroons, 8
 albumen in, 1
 composition of, 2
 Macedoine of vegetables, canning of, 35
 Machinery
 batch rolling, 57
 blanching, 159
 bottle washing, 255
 butter churning, 84
 can reforming, 50
 centrifuges for fruit juices, 261
 cheese packaging, 102
 chocolate grinding, 67
 chocolate refining, 69
 conching, 61
 drying, 162–168
 enrobing, 62
 evaporating, 263
 filling, 256
 fish processing, 274
 freeze drying, 171
 freezing, 47
 fruit milling, 273
 hand-seaming, 32
 milk dehydration, 131
 milk pasteurization, 135–136
 strigging, 19
 vegetable pre-treatment, 182
 vegetable peeling, 179
 winnowing, 74
 Magnesium, 337
 Magnetic separator, 317
 Maillard reaction, 82, 221, 337
 Malic acid in jelly manufacture, 411
 Maltose test for diastatic activity, 310
 Manganese, 337
 Mango chutney, 432

- Marasmus, nutritional, 337
 Margarine, 197-198
 anti-spattering agents for, 186, 192
 cake, 186
 colours for, 188
 emulsification of, 190-192
 emulsifier applications in, 191
 pastry, 206
 vitamin A addition to, 211
 Marinating of fish, 232
 Markers for antibiotics, 79
 Marmalade, 415-417
 Marshmallow, 66
 Marzipan, 66
 Mastitis milk, 75
 Materials for dairy equipment, 115-117
 Materials handling, 480-481
 Matzka process, 272
 Mayonnaise (*see also* Salad cream), 198
 Meal
 fish, 224-225
 meat and bone, 295
 Meals (grain), 12
 Meat, 280 *et seq.*
 ageing of, 280
 colour of, 284
 canning of, 36
 composition of, 285, 344
 cooking vessels for, 286
 dehydrated, 161
 dehydrated, fat stability in, 168
 dehydrated, nutritive value of, 176
 dehydration of, 173-174
 extract, production of, 281
 flavour of, 289
 freeze-dried, 280
 freezing of, 47, 291-293
 irradiation of, 293-294
 meal, 295
 packing tables for, 296
 pale exudative, 296
 prepacking of, 297
 products, preservatives for, 297
 products, quality control of, 297
 products, storage of, 300
 storage, of, 467
 vitamins in, 301
 tenderizing of, 300
 tenderness, measurement of, 301
 water holding capacity of, 301
 Melangeurs, 67
 Membrane permeation, 264
 Meringues, 8
 albumen in, 1
 Metabolic rate, basal, 328
 Methionine, 337
 Methylene blue test for milk, 130
 Methyl ketones, 130
 Microbiology
 of dried milk, 133
 of fish, 214
 of milk, 106-107, 134-135
 of tomato purée, 452
 of vegetable brining, 453
 Microscope, applications of in dairying, 131
 Microwave
 blanching, 160
 catering, 381
 thawing of fish, 228
 Middlings, 318
 Milk
 abnormal, 75
 acidity, determination of, 78
 acidity of, 77
 acidophilus, 78
 alcohol test for, 78
 antibiotics in, 79
 aseptic filling of, 79
 bacteria of, 81, 141
 bottle caps, 351
 bottling of, 81
 bulk collection of, 82
 bulgaricus, 82
 canning of, 38
 cartons for, 86
 chloride content of, 102
 clarification of, 104
 colour of, 86
 composition of, 108, 109, 134, 344
 condensed and evaporated, 109-111
 consumption and distribution of, 113, 115
 containers for, 111, 112
 coolers, 116
 cooling of, 112
 copper in, 116
 crumb, 67
 definition of, 128
 dehydration of, 174
 diseases borne by, 115
 dried, 131-133
 dried, definition of, 128
 dried, in confectionery, 67
 dried, nutritional loss in, 82, 133, 176
 dried, solubility of, 145
 equipment and materials for, 115
 evaporated, definition of, 128
 fat in, 119, 145
 fermentation of, 78
 filled, 120
 filling level variations of, 120
 flavours in, 120-123
 fortification of, 123
 for yoghurt, requirements of, 153
 freeze-drying of, 133
 fruit flavours for, 272
 heat stability of, 124
 homogenization of, 124
 humanizing of, 134
 in breadmaking, 8
 legal aspects, 126-129
 liberation of H₂S by, 118
 low fat, 129
 nutritive value of, 133-134
 of mammals, composition of, 130
 packaging, costs of, 381
 pasteurization of, 134-137
 pasteurized, improving keeping quality of, 137
 powder, 82, 131-133
 powder, compression of, 161
 powder, instant, 133
 products, rheology of, 143
 protein in, determination of, 138, 150
 protein precipitates, 112
 quality payment for, 139
 radioactively contaminated, 139
 recombined, 139
 ropy, 144
 salts in, 144
 skim, 129
 solids-not-fat, 144
 spoilage of, 140
 standardization of, 145
 staphylococci in, 145
 sterilized, 148
 supplies, quality of, 139, 148
 supplies, testing of, 148
 sweet curdling of, 148
 sweetened condensed, canning of, 32
 sweetened condensed, definition of, 128
 sweetened condensed, in confectionery, 67
 taints in, 120-123
 test: added water, 150
 test: bacterial count, 138, 144
 test: clot-on-boiling, 108
 test: coliform, 108
 test: fat, 150
 test: freezing point, 123-124
 test: inhibitory substances, 124
 test: methylene blue, 130
 test: phosphatase, 138
 test: resazurin, 143
 test: sediment, 151
 test: solids-not-fat, 150
 test: total solids, 150, 151
 test: turbidity, 148
 tests, accuracy of, 75, 76, 125
 tests, analysis of results of, 126
 tests in creameries, 125
 tests, standardization of, 126
 UHT, 151
 Millerator, 318
 Milling
 of flour, 318-319
 of fruit, 273
 of oats, 319
 Milt, 232
 Mincemeat, 417-419
 Mint products, 433
 Mixers, dough, 3
 Mixograph, 319
 Moisture
 adsorbents for removal of, 462
 in wheat and flour, determination of, 319
 resistance, measurement of, 381
 Molasses, 72
 Molybdenum, 338
 Monoglycerides, 199
 Monosodium glutamate (MSG), 295
 Moulders, dough, 3
 Moulding starch, 67
 Moulding units, 68
 Moulds, 39
 in cheese, prevention of, 100
 Muffins, 8
 Muscle contraction, 296
 Mushrooms, 39
 Mutton, composition of, 344
- N
- Niacytin, 338
 Nicotinic acid, 338
 in meat products, 281
 Nisin, 44, 281
 Nitrate, detinning of cans by, 55
 Nitrite
 in curing pickles, 287
 treatment of fish with, 225
 Nitrogen
 balance, 338
 in fruit juices, determination of, 251
 in headspace gases, 32
 liquid, for freezing, 45, 48
 liquid, freezing fruit by, 394
 liquid, freezing with, 468
 packing dehydrated eggs in, 175
 packing dehydrated vegetables in, 178
 Nobbing of fish, 28
 Nuoc Mam, 235
 Nutrient losses in canning, 20, 40
 Nutrition, 326 *et seq.*
 Nutritive value
 of canned foods, 40
 of common foods, 91
 of dehydrated foods, 174-178
 of fish, 218, 219
 of frozen foods, 40
 of milk, 133-134
 of whey, 152
 Nuts, 68
 composition of, 345
 Nyctalopia, 338
- O
- Oakes mixing system, 66
 Oat cakes, 9
 Oats, 319
 Oedema, 338
 Oils (*see also* Fats), 199-206

- Oils—*contd.*
 essential, 63, 267, 287, 290
 fish, test for rancidity of, 239
 neutralizing of, 199
 winterizing of, 211
 Oleoresins, 287, 289–290
 Olive oil, 204
 Onions
 peeling of, 434
 pickled, 434–435, 455
 Oranges for marmalade, 415
 Orotic acid, 338
 Osmosis, reverse, 263
 Osteomalacia, 338
 Oven, vienna, 12
 Ovens, baking, 4
 Overrun, 206
 Oxygen
 corrosion by, in canning, 27
 in headspace gases, 31, 32
 in-pack scavenging of, 367
 protection against, 383
- P**
- Package forming, filling and closing machines, 385
 Packaging, 348 *et seq.*
 bags, 352–353
 board, 361
 boil-in-bag, 49, 354
 cartons and cartoning systems, 359–361
 cases, 361–362
 of cheese, 362
 closures for fruit juices, 262
 collapsible tubes, 364
 confectionery, 364
 containers, aluminium, 351
 containers, composite, 364
 containers, desiccants for, 367
 containers for fish, 219
 containers, foil, 351
 containers, glass, 376–378
 containers, glass, for preserves, 398
 containers, moulded thermoplastic, 382
 containers, outer shipping, 383
 containers, paper, for liquids, 385
 containers, shipping, plastic, 385
 containers for yoghurt, 156
 convenience, 365
 of dehydrated foods, 366–367
 of dehydrated vegetables, 178
 design of, 365
 of dried minced meat, 174
 drums, 366
 films, for cheese, 100
 films, heat sealing of, 378–379
 foamed plastics for, 374
 for baked goods, 355–356
 for protection against oxygen, 383
 for retail market, 386
 for vending machines, 351
 function of, 375
 glassine for, 375
 laminates, 350–353
 materials, flexible, 370–373
 moulded pulp, 382
 multi-packs, 382
 odour in, 383
 of bakery jam, 389
 of bakery mincemeat, 419
 of cheese, 99–102
 of fish, 370
 for freeze-dried foods, 71
 of freeze-dried foods, 374
 of frozen foods, 48, 374
 of fruit curds, 395
 of fruit and vegetables, 375
 of margarine, 198
 of milk, 111, 112
 of table jellies, 412
 of wet fish, 236
 opening devices for, 383
 paper, 354, 363
 paper, greaseproof, 378
 pouches and sachets, 384
 sacks, 386
 shrink wrapping, 386
 vacuum, 387
 Palatability of dried eggs, 175
 Pallets and palletization, 385, 484
 Palm kernel, 62
 Palm kernel oil, 204
 Palm oil, 62, 204
 Pan work, 68
 Panthenic acid, 338
 Paper
 for bags, 352
 coated, 363
 coated, barrier properties of, 354
 greaseproof, 378
 kraft, 379
 vegetable parchment, 387
 waxed, 387
 Para-amino benzoic acid, 339
 Parsnips, canning of, 41
 Passion fruit, 274
 Pasta, 317
 composition of, 344
 Pastes, meat and fish, 52
 Pasteurization
 of canned products, 32, 33
 of fruit juices, 274
 of milk, 134–137
 of pickles and sauces, 435–436
 Peaking of cans, 23, 34
 Peanuts, 68
 Pears, canning of, 41
 Peas
 canning of, 41
 freezing of, 46
 processed, 42
 requirements for dehydration, 181
 Pectin, 68, 274, 419–420
 content, estimation of, 420
 in diabetic jams, 391
 enzymic destruction of, 267
 in fruit juices, determination, 252
 gel formation, 401
 Pectinesterase activity in fruit juices, determining, 251
 Peeling
 of fruit and vegetables, 42
 of onions, 434
 of vegetables, 179–180
 Pellagra, 339
 Pepsin in cheesemaking, 142–143
 Peroxide value, 206
 Pests of wheat and flour, 320
 Pet foods, 13
 pH (*see also* Acidity), 13, 34, 35, 82, 235, 316
 in fruit juices, determination of, 252
 in jam manufacture, control of, 402
 of pectin gels, 401
 Phage, 80
 Phenylalanine, 339
 Phenylketonuria, 339
 Phoenix closure, 52
 Phosphate bond energy, 339
 Phosphatase test, 138
 Phospholipids, 207
 Phosphoric acid, 18
 Phosphorus, 339
 Phrynoderma, 339
 Physin, 339
 Phytase, 1, 320
 Phytic acid, 320, 339
 Phytin, 1
 Piccalilli, 436–437
 Pickles, 422 *et seq.*
 colours for, 426–427
 for curing pork, 286, 297
 factory environment requirements for manufacturing, 429
 fruit for, 428
 hygiene in manufacture of, 428–430
 mixed, 433
 pasteurizing of, 435–436
 preservatives in, 438
 quality control in manufacture of, 431–432
 spicing of, 441–442
 spoilage of, 442–443
 stabilizers and thickeners for, 443–445
 sweet, 447–449
 vegetables for manufacture of, 453–456
 vinegar, 457–458
 Pie
 apple, 15
 fillings, fruit, 31, 396–398
 Pies, containers for, foil, disposable, 351
 Pikelets, 9
 Pilchards, canning of, 29
 Pitching point in cheesemaking, 89
 Plansifter, 320
 Plant, for breadmaking, 3
 Plums
 canning of, 42
 for jam manufacture, 392
 gumming of, 32
 Polyglycerol esters, 192
 Polyphosphates
 in meat canning, 37
 in meat curing, 287
 Pork
 composition of, 344
 preparation of, for curing, 296
 Porridge, 307
 Potassium, 340
 Potassium bromate, 3, 316, 320
 Potato
 flakes, 163
 flour, as sausage filler, 288
 granules, drying of, 163
 Potatoes
 canning of, 43
 composition of, 345
 nutrient losses during scalding, 177
 peeling losses of, 179
 peeling of, 179–180
 requirements for dehydration, 181
 Pouch, plastic, 13
 Poultry
 canning of, 43
 freezing of, 47
 storage of, 467
 Powder, baking (*see* Baking powder)
 Powders, filling of, 369
 Premier jus, 205
 Premixes, cake, 5
 Preservation by acetic acid, 422
 Preservatives
 for soft drinks, 275
 in bread and cakes, 9
 in canned products, 44
 in canned soft drinks, 18
 in fats, 207
 in pickles and sauces, 438
 in soft drinks, legislation regarding, 272
 for meat products, 297
 Preserves, 389 *et seq.*
 bakery, 389
 colours for, 390
 glass containers for, 398
 quality control in manufacture of, 413–415
 Pressing of fruit pulps, 269
 Process control testing, 414, 432
 Proline, 340

Propionic acid, 9
 Propylene glycol esters, 192
 Protein
 amino acids and quality of, 326
 concentrate from fish (FPC), 225
 crude, 340
 defining nutritional value of, 330
 efficiency ratio, 340
 equivalent, 340
 in fish, 236
 in milk, determination of, 138, 150
 reference, 340
 score, 340
 stripping, 320
 of wheat, 320
 of wheat flour, 5
 Prover, 3
 Proving of dough, 2, 3
 Provitamin, 340
 Prunes, 44
 Psychrophils, 139
 Pudding, apple, 15
 Puff paste, 9
 Pumping pickle, 297
 Purée
 apple, 15
 tomato, for beans, 17
 Purifiers, 319

Q

Quality control
 in canning, 16
 in dairying, 124
 in the fish industry, 237-239
 in pickle and sauce manufacture, 431-432
 in preserves manufacture, 413-415
 of meat products, 297
 of tomato purée, 452-453
 Quick freezing (*see also* Freezing), 44

R

Radioactivity, milk contaminated by, 139
 Rancidity
 in dairy products, 85
 in fats, measurement of, 206
 in fish oils, test for, 239
 Rapeseed oil, 205
 Raspberries
 for jam manufacture, 392
 canning of, 49
 freezing of, 45
 Raw materials, quality tests on, 413-414, 431
 Recombined dairy products, 139
 Reconstitution of freeze-dried foods, 172
 Reduction rolls, 319
 Reference man, 340
 Reference woman, 340
 Refining of chocolate, 69
 Refrigerants, 487-489
 Refrigeration, 460 *et seq.*
 absorption systems for, 460
 in the dairy industry, 139
 liquid receivers, 478
 mechanical, 481-483
 steam jet, 491
 systems, characteristics of, 466
 systems, coefficient of performance of, 467
 units of, 495
 Relative humidity, equilibrium, of confectionery, 62
 Release agent for table jellies, 412
 Release agents, slab, 70
 Rennet, 89, 93, 141-143
 Rennin (*see* Rennet)
 Resazurin test, 143
 Respiratory quotient, 340
 Retinal, retinene, retinoic acid, retinol, 340

Retorting, 33
 Retorts, instrumentation of, 34
 Rheology of milk products, 143
 Rhubarb, canning of, 50
 Rice, 321
 as sausage filler, 288
 Rice bran oil, 205
 Rickets, 341
 Rigor mortis, 280, 296
 Ripening
 of butter, 83
 of cheese, 87, 98, 143
 Roasting of cocoa beans, 70
 Roll tube method for bacterial count, 144
 Roller drying, 132
 Roller mills for chocolate, 67
 Rope, 1, 9, 10, 303, 306, 316
 Ropy milk, 144
 Rose-hip products, 275
 Royal icing (*see* Icing)
 Rubber, cellular expanded, 476
 Rubble reel, 321
 Rusk, 288
 Rusks, 10
 Rutin, 341
 Rusting (*see* Corrosion)
 Rye, 321

S

Sacks, 386
 Safflower seed oil, 205
 Salad cream, 439-440
 adverse effects of sulphur dioxide in, 438
 Salad oil, 208
 Salt, 298
 in breadmaking, 2
 in cured meats, 37
 in the fish industry, 240
 iodized, 335
 for pickles and sauces, 440
 Salting of fish, 240-241
 Sandwich spread, 440
 Sanitizers (*see also* Detergents), 114, 115
 Sardine, 241
 Sardines, canning of, 29
 Sauce
 apple, 15
 for canned fish, 29
 gelling in, 446
 tartare, 440
 tomato, for herring, 28
 Sauces, 422 *et seq.*
 gums for, 445
 pasteurizing of, 435-436
 preservatives in, 438
 spicing of, 441-442
 spoilage of, 442-443
 stabilizers and thickeners for, 443-445
 stability of, 445-447
 for sweet pickles, 448
 syneresis in, 446
 thick, 448-449
 thin, 449
 Worcester, 449
 Sausages, 298-299
 casings for, 282-284
 colours for, 284
 composition of, 344
 cooling and drying of, 300
 fillers for, 287-289
 frankfurter, 283
 skinless, 283
 sulphur dioxide in, 297
 Scalding (*see* Blanching)
 Scaling of dough, 2, 3
 Scheidmost, 276
 Scones, 10
 Scourer, 321
 Scratch rolls, 322
 Screenings, 322

Scutellum, 322
 Seaming of cans, 26, 32
 Sea water, 241
 Semolina, 321
 for macaroni, 317
 Separator, cyclo-pneumatic, 310
 Serine, 341
 Sharps, 322
 Shea butter, 203
 Shortbread, 10
 Shortcake biscuits, 2
 Shortening, 11, 208-209
 pumpable, 209
 Short paste, 10
 Shrink wrapping, 386
 Siderophilin, siderosis, 341
 Sild, 241
 canning of, 29
 Slab release agents, 192
 Slag wool, 476
 Slaty beans, 70
 Slaughtering, 296
 Sleepy cream, 83
 Slice curing, 299
 Smoking
 of cured meat, 299-300
 kiln, Torry, 29
 of fish, 29, 241-242
 Smoky beans, 70
 Soda bread, 7, 11
 Sodium, 341
 Sodium benzoate in canned products, 44
 Sodium bicarbonate, 1, 11, 321
 Sodium carboxymethyl cellulose, 445
 Sodium diacetate, 9
 Sodium nitrite in cured meats, 37, 44
 Soft drinks (*see also* Fruit juices and Squashes)
 canning of, 18
 carbonated, 18
 preservatives for, 275
 preservatives, legislation regarding, 272
 Sorbic acid, 9, 100, 213
 in pickles and sauces, 438
 in table jellies, 411
 Sorbitan esters, 192
 Sorbitol, 70
 in diabetic jams, 391
 Soup
 canned, 50
 dehydrated, 161, 180
 powders, precooked, 163
 Soyabean oil, 205
 Soya flour, 11
 as sausage filler, 288
 Spaghetti, 317
 in tomato sauce, canning of, 51
 Specific dynamic action, 341
 Specific gravity scales for syrups, 53
 Specific gravity, determination of, 252
 Spectroscopy, N. M. R., 197
 Spices, 289-291
 in baking, 7
 dry soluble, 442
 for thick sauces, 448
 for thin sauces, 449
 in pickles and sauces, 441-442
 in vinegar, 424
 Spinach
 canning of, 51
 freezing of, 46
 Spiral separator, 322
 Spirometer, 342
 Spoilage, 366
 of canned foods, 51
 of canned fruit, 39
 of canned milk, 39
 of fish, 213, 216
 of milk, 140
 of pickles and sauces, 442-443
 Sponge goods, 11

- Sponge system, 2
 Sprats, canning of, 29
 Spray drying, 132, 165-166, 266
 Spreads, meat and fish, 52
 Squashes, 276
 Stabilizers
 in pickles and sauces, 443-445
 for fruit fillings, 397
 for ice-cream, 195
 Stackburn, 52
 Staining of cans (*see* Cans, corrosion of)
 Stainless steels, 264
 Staling, 11
 Staphylococci in milk, 145
 Starch, 322
 confectionery, 70
 damaged, effect on baking of, 310
 explosion hazard of, 67
 in baking powder, 1
 moulding, 67
 stabilizers in pickles and sauces, 444
 stability of, in bread, 11
 Starters
 cheese, 87, 93, 146-148
 cheese, destruction of, 80
 culture, testing of, 81
 Steam
 blanching by, 20
 ejectors, 172
 for can sterilization, 15
 injection, exhausting by, 27
 jet refrigeration system, 491
 peeling by, 42, 180
 Stearyl tartrate, 5, 191
 Sterilants for dairying, 118
 Sterilization
 by heat, 32
 of canned products, UHTST, 15
 of fruit juice equipment, 276
 of jam, 409
 of milk, 148
 Sterilizers
 flame, 33
 hydrostatic, 33
 Sterility of churns, test for, 104
 Steroids, 342
 Sterols, 209, 342
 Stilton cheese, 96
 Stitch pumping, 38
 Storage, 460 *et seq.*
 controlled atmosphere, 473
 frozen, 466
 live, 478
 of cans, 52
 of dehydrated foods, 180-181
 of fish, 218, 227-228
 of frozen foods, 49
 of fruit juices, 276
 of fruit and vegetables, 472-473
 of jam, 409
 of meat products, 300
 of pickles and sauces, 443
 Stores, jacketed, 476
 Stoves, confectionery, 63
 Straight dough system, 2
 Strawberries
 canning of, 52
 freezing of, 45
 for jam manufacture, 391
 Streptococcus lactis factor, 342
 Streptogenin, 342
 Strigging machine, 19
 Struvite, 243
 Sucrose, 70
 fatty acid esters of, 192
 Sugar, 11
 boiling, 71
 Brix scales for, 53
 brown, 71
 demerara, in cakes, 11
 explosion hazard of, 71
 granulated, use of, 11
 icing, 71
 in beverages, determination of, 252
 in jam manufacture, 401-402
 invert, 8, 65
 syrups, 53, 72
 white, 70
 Sugar nibs, 11
 Sulphiting, 181
 of fruit, 173
 Sulphur dioxide
 effect of, on flour, 323
 in beverages, determination of, 253
 in canned products, 44
 in fruit juices, 275
 in meat products, 297
 in pickled red cabbage, 438-439
 in pickles and sauces, 438
 in preserves, 393
 treatment of biscuit dough with, 2
 Sunflower seed oil, 205
 Superheating, 492
 Surface area of body, 342
 Sweets (*see* Confectionery)
 Synergism, 209
 Syneresis in sauces, 446
 Syrup
 analysis of, 249-253
 bottling, 277
 for jelly manufacture, 410
 glucose, 399
 soft fruit, 277
 substitute, 254
 sugar, 53
- T**
- Tablets, compressed, 61
 Tachysterol, 342
 Taints in dairy products, 120-123
 Tallow, 206
 Tankers, milk, 116
 Tank linings, 300
 Tannins in beverages, determination of, 253
 Tartaric acid, 72
 Teleosts, 244
 Tempering of chocolate, 73
 Tempering tank, 3
 Tenderness of meat, 301
 Tenderometer, 41
 Tetrapak, 86
 Thermometers, 73, 492
 Thiaminase, 244
 Thickeners (*see* Stabilizers)
 Threonine, 342
 Thyroglobulin, 342
 Thyroid gland, 342
 Tin in canned foods, 55
 Tinsplate, 24
 Tocopherols, 210
 Toffee, 59
 Tomato
 juice, 277
 ketchup, 450-451
 purée, 451-453
 purée for beans, 17
 sauce for herring, 28
 Tongue, canning of, 37
 Torry kiln, 29, 242
 Tragacanth, 64
 Transport, refrigerated road, 489
 Treacle, 72
 Triglycerides, 210
 Trucks
 hand, 474
 industrial, 475
 maintenance of, 479
 powered, 485-487
 Tryptophan, 343
 Turnips, canning of, 55
- Tuxford's index, 343
 Twaddell hydrometer, 441
 Tyrosine, tyrosinosis, 343
- U**
- UHT milk, 151
- V**
- Vacuum in cans, 55
 Vacuum drying, 167, 174
 Vacuum packing, 387
 Vacuum production (*see* Exhausting)
 Vacuumizing of canned apple products, 15
 Valine, 343
 Vanilla, 7
 Vanillin, 73
 Vegetables
 acidity of, 35
 blanched, cooling of, 161
 blanching of, 20
 brine preservation of, 453-454
 canning of, 56
 composition of, 345
 debrining of, 456
 dehydrated, 160
 dehydrated, nutritive value of, 176-178
 for piccalilli, 437
 for pickle manufacture, 453-456
 freezing of, 46
 nutrient loss from, during processing, 176
 nutritive values of, 177
 peeling of, 42, 179-180
 selection and preparation of, for dehydration, 181
 storage of, 472-473
 washing of, 182
 Vending machines, 152, 351
 Venting of retorts, 33
 Vermicelli, 317
 Vienna bread, 11
 Vinegars, 423-425
 Viscosity, determination of, 253
 Vitamers, 343
 Vitamin A, 211, 215, 332, 338, 343
 Vitamin B group, 338, 343, 346
 Vitamin B₁₂, 335, 346
 Vitamin C (*see also* Ascorbic acid), 278, 332, 346
 in blackcurrants, 19
 in brussels sprouts, 20
 in rose-hip products, 275
 Vitamin D, 209, 211, 332, 346
 Vitamin E, 210, 346
 Vitamin H, 328
 Vitamin K, 347
 Vitamin P, 334, 347
 Vitamins, 211, 343, 346-347
 fat soluble, 333
 in fish, 246
 in meat, 301
 in wheat, 323
 losses of, in dehydration, 175-178
 Vol, 1, 12
 Votator, 66, 211, 490
- W**
- Walnut ketchup, 458
 Walnuts, 68
 pickling of, 456, 458
 Washer for wheat, 323
 Washing (*see* Cleaning)
 of vegetables, 182
 Water
 cooling, treatment of, 24
 effect of pressure on b. pt. of, 72
 for canning, 56
 hardness of, 56
 in breadmaking, 2

Water—*contd.*
 in pickle and sauce manufacture, 458
 metabolic, 337
 Water biscuits, 2
 Wensleydale cheese, 96
 Wet-strength paper, 247
 Wetzel grid, 347
 Whale oil, 206
 Wheat, 323
 aleurone cells of, 303
 bacteria of, 10
 bacterial content of, 305
 bran, 306
 breaking of, 318
 cleaning of, 318
 conditioning of, 308, 309, 318
 diseases of, 311
 divides, 311
 flour, for confectionery, 73
 germ, 312
 germ, composition of, 314
 heat treatment of, 316
 impurities in, 317

moisture in, 319
 pests of, 320
 scalping of, 319
 scouring of, 321
 steam-treated, 322
 vitamins in, 323
 washing, 323
 Wheatfeed, 324
 Wheatmeal, 12, 324
 Whey, 152-153
 corrosion by, 119
 draining of, 90
 sweetened condensed, in confectionery, 67
 Whizzer, 324
 Wholemeal, 324
 Wine, casks for, 362
 Winnower, 74
 Worcester sauce, 449

X

Xanthophylls, 347
 in fish, 215

in flour, 308
 Xerophthalmia, 347

Y

Yeast, 12
 action on bread dough, 2
 for cider fermentation, 260
 Yeasts
 in fruit juices and syrups, 279
 spoilage of canned foods by, 56
 Yoghourt, 153-156
 definition of, 128
 fat content, minimum, 145
 packaging of, in foil, 350

Z

Zeaxanthin, 347
 Zymotachygraphe, 12, 324