

Sugar Confectionery and Chocolate Manufacture

Sugar Confectionery
and
Chocolate Manufacture

R LEES

E B JACKSON



CHEMICAL PUBLISHING CO., INC., NEW YORK, N. Y.

Sugar Confectionery and Chocolate Manufacture

© 2011 by Chemical Publishing Co., Inc. All rights reserved. This book is protected by copyright. No part of it may be reproduced, stored in a retrieval system or transmitted in any form or by any means; electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of the publisher.

ISBN: 978-0-8206-0241-7

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

© 1973 R. Lees and E.B. Jackson

First Edition:

Leonard Hill Books - 1973

First American Edition:

Chemical Publishing Company, Inc. - New York 1975

Second Impression:

Chemical Publishing Company, Inc. - 2011

Printed in the United States of America

Contents

	<i>Page</i>
FIGURES	xiii
PLATES	xv
PREFACE	xvii
1 BASIC TECHNICAL CONSIDERATIONS	1
1.1 Introduction	1
1.2 Moisture and Total Solids Content	1
1.3 Total Solids and Total Soluble Solids	5
1.4 Sugars and Sugar Solubility	5
1.5 Equilibrium Relative Humidity	7
1.6 Acid Content	8
1.7 pH	9
1.8 Gelling Agents	11
1.9 Viscosity	11
1.10 Texture	12
1.11 Crystallisation	13
2 SUGARS AND RELATED MATERIALS	15
2.1 Cane and Beet Sugar	15
2.2 Honey	20
2.3 Glucose Syrup	22
2.4 Starch Hydrolysates	34
2.5 Liquid Sucrose and Mixed Sugar Syrups	36
2.6 Dextrose	37
2.7 Fructose	40
2.8 Maltose	40
2.9 Invert Sugar	41
2.10 Invertase	41
2.11 Lactose	42
2.12 Caramel	42
2.13 Spray Dried Caramel	43
2.14 Sorbitol	44

vi CONTENTS

	<i>Page</i>
2.15 Glycerine	45
2.16 Malt Extract	46
3 COCOA BEANS	47
3.1 Growth	47
3.2 Types	47
3.3 Sources	48
3.4 Cocoa Fruit	48
3.5 Harvesting	51
3.6 Pulp	51
3.7 Fermentation	51
3.8 Drying	53
3.9 Diseases of Cocoa	53
3.10 Storage of Cocoa Beans	54
3.11 Storage Pests	54
3.12 Chocolate Flavour and Aroma	55
3.13 Bean Quality	55
4 FATS AND RELATED INGREDIENTS	57
4.1 General	57
4.2 Borneo Illipé (Illipé-Butter, Borneo Tallow)	58
4.3 Coconut Oil	58
4.4 Groundnut Oil (Peanut Oil, Earthnut Oil)	58
4.5 Palm Oil	59
4.6 Palm Kernel Oil	59
4.7 Butter	59
4.8 Off-flavours in Fats	61
4.9 Antioxidants	61
4.10 Oilseed Lecithins	62
4.11 Lecithin YN and other Synthetic Viscosity Reducing Agents	62
4.12 Glyceryl Monostearate	63
4.13 'Span' and 'Tween' Esters	64
4.14 Release Agents	64
4.15 Acetoglycerides	64
4.16 Waxes	65
5 MILK AND MILK PRODUCTS	66
5.1 Milk	66
5.2 Condensed Milk	66
5.3 Condensed Whey	69
5.4 Dried Milk Powders	69
5.5 Sodium Caseinate	72
5.6 Lactose	72
5.7 Butter	72

	<i>Page</i>
6 GELLING AND WHIPPING AGENTS; GUMS	73
6.1 Confectionery Starches	73
6.2 Modified Starches	80
6.3 Types of Maize Starch	81
6.4 Zein	83
6.5 Pectin	83
6.6 Gelatine	86
6.7 Agar Agar	89
6.8 Whipping Agents	90
6.9 Egg Albumen	90
6.10 Gelatine Hydrolysate	91
6.11 Whipping Agents based on Milk Protein	91
6.12 Whipping Agents based on Soya Proteins	92
6.13 Carrageenan	93
6.14 Chicle	93
6.15 Jelutong—Pontianak	96
6.16 Guar Gum	96
6.17 Arabinogalactan (Larch Gum)	96
6.18 Quince Seed Gum	96
6.19 Properties of Whipping, Gelling and Thickening Agents	96
7 FLAVOURING AND COLOURING AGENTS	97
7.1 Flavourings	97
7.2 Essential Oils	98
7.3 Essences	99
7.4 Fruit Juices	99
7.5 Fruit Purees or Pulps	99
7.6 Powdered Flavours	100
7.7 Artificial Cherries	100
7.8 Dates	100
7.9 Date Syrup	101
7.10 Figs	101
7.11 Ginger	101
7.12 Liquorice	102
7.13 Nuts	103
7.14 Almonds	103
7.15 Brazil Nuts	105
7.16 Cashew Nuts	105
7.17 Sweet Chestnuts	106
7.18 Coconut	106
7.19 Hazel Nuts	107
7.20 Macadamia Nuts	108
7.21 Pecan Nuts	108

viii CONTENTS

	<i>Page</i>
7.22 Peanuts	108
7.23 Pistachio Nuts	109
7.24 Walnuts	109
7.25 Sultanas	110
7.26 Currants	110
7.27 Raisins	110
7.28 Vitamins	111
7.29 Confectionery Acids and their Salts	112
7.30 Citric Acid	113
7.31 Sodium Citrate	113
7.32 Tartaric Acid	114
7.33 Cream of Tartar	114
7.34 Lactic Acid	114
7.35 Calcium Lactate	115
7.36 Acetic Acid (Ethanoic Acid)	115
7.37 Malic Acid	115
7.38 Benzoic Acid	115
7.39 Sodium Benzoate	115
7.40 Sorbic Acid	117
7.41 Sodium Propionate	117
7.42 Colour	117
8 COCOA, CHOCOLATE AND RELATED PRODUCTS	119
8.1 Sequence of Processes	119
8.2 Cleaning	119
8.3 Roasting	119
8.4 Chocolate Recipes	124
8.5 Milk Crumb	126
8.6 Winnowing	128
8.7 Cocoa Powder	130
8.8 Mixing/Melangeur Process	132
8.9 Refining	133
8.10 Conching	136
8.11 The Tempering of Chocolate	139
8.12 The Application of Span 60 and Tween 60 in Sweet Dark Chocolate	146
8.13 Moulding	151
8.14 Fat Migration	153
8.15 Storage of Chocolate	153
8.16 Nutritional Value of Chocolate	154
8.17 Bulk Deliveries of Chocolate	154
8.18 Liqueur Chocolates	155
8.19 The Tropical Warehouse Moth	159

	<i>Page</i>
9	BOILED SWEETS 161
9.1	Characteristics 161
9.2	The Production of High-boiled Sweets 166
9.3	Chemical Changes during Boiling 167
9.4	Invert Sugar in High-boiled Sweets 168
9.5	Batch Cooking 168
9.6	Batch Type Early Vacuum Process 169
9.7	Recipes for High-boiled Confections 169
9.8	Lettered or 'Seaside' Rock 172
9.9	Continuous Dissolving Methods 176
9.10	Continuous Cooking Methods 177
9.11	Continuous Vacuum Cooking 181
9.12	Deposited High-boiled Sweets 183
9.13	Pump Filling 186
9.14	Powder Filling 187
10	CARAMELS, TOFFEES AND FUDGE 191
10.1	Caramels and Toffees 191
10.2	Modifications to the Basic Recipe 192
10.3	Dulce de Leche 192
10.4	Caramel Recipe Compilation 193
10.5	Continuous Manufacture of Caramels 198
10.6	Properties of Caramels 201
10.7	Packaging and Storage 203
10.8	Export Caramels 203
10.9	Fudge 206
10.10	Variations on Basic Vanillin Fudge 206
10.11	Composition of Fudge 208
11	FONDANTS, CREAMS AND CRYSTALLISED CONFECTIONERY 211
11.1	Fondants, Creams and Crystallised Confectionery 211
11.2	Production of Fondant 212
11.3	Creams 213
11.4	Composition of Creams and Fondants 215
11.5	Wet Crystallisation 218
11.6	Candied Fruit and Peel 219
11.7	Crystallised and Preserved Ginger 222
12	GUMS, JELLIES AND PASTILLES 226
12.1	Production 226
12.2	Processes for Gums and Jellies 227
12.3	Modification of Recipes for Continuous Production 232
12.4	Starch Drying and Conditioning 232
12.5	Glazing of Gums 234

X CONTENTS

	<i>Page</i>
12.6 Starch Moulding Machines of the Mogul Type	236
12.7 Other Points in Production	238
12.8 Starch, Gum Jellies and Pastilles by Atmospheric Cooking Methods	239
12.9 Starch Jellies for Continuous Production	239
12.10 Gelatine Jellies	240
12.11 Production of Gelatine Jellies	241
12.12 Fruit Pastilles	243
12.13 Tablet Jellies	244
12.14 Jelly Drops	251
12.15 Gum Arabic Gums	251
12.16 Turkish Delight	254
12.17 Agar Jellies	257
12.18 The Use of Powdered Pectins in Confectionery Manufacture	260
12.19 Low Methoxyl Pectin Jellies	265
13 LIQUORICE AND CREAM PASTE	269
13.1 Liquorice	269
13.2 Methods for Manufacturing Liquorice Paste	269
13.3 Properties of Liquorice Paste	271
13.4 Composition of Liquorice	272
13.5 Processing Liquorice Paste	274
13.6 Cream and French Paste	279
13.7 Processing Cream Paste	280
13.8 Composition of Cream Paste	281
13.9 Extrusion of Cream Paste	282
13.10 Liquorice Allsorts	283
14 TABLETS, LOZENGES AND EXTRUDED PASTE	286
14.1 Tablets	286
14.2 Slugging	287
14.3 Tablet Composition	287
14.4 Manufacture of Tablets	289
14.5 Lozenges	291
14.6 Composition of Lozenges	292
14.7 Production of Lozenges	293
14.8 Sweet Cigarettes	294
14.9 Production Control for Sweet Cigarettes	296
15 MARSHMALLOW AND NOUGAT	299
15.1 Marshmallow Confections	299
15.2 Frappé based on Egg Albumen, containing Starch	300
15.3 Gelatine Marshmallow	302
15.4 Continuous Production of Marshmallow using Gelatine	303

	<i>Page</i>
15.5 Egg Albumen Marshmallow	308
15.6 Modification of Recipes for Continuous Production	309
15.7 Nougat	316
15.8 Nougat using Egg Albumen	317
15.9 Nougat using Gelatine	317
15.10 Nougat using a Vertical Planetary Mixer	318
15.11 Nougat using Pressure Beating	319
15.12 Nougat using Malto-dextrins	320
15.13 Continuous Production of Nougat	321
16 OTHER CONFECTIONERY TYPES	324
16.1 Panning	324
16.2 Hard Pan Work	325
16.3 Polishing	328
16.4 Silver Coating	329
16.5 Chocolate Coating	330
16.6 Soft Panning	330
16.7 Chewing Gum	332
16.8 Sugarless Chewing Gum	336
16.9 Bubble Gum	336
16.10 Marzipan and Persipan	337
17 CALCULATING SUGAR CONFECTIONERY AND CHOCOLATE RECIPES	340
17.1 Calculation of Recipes from Analytical Results	340
17.2 Effect of Inversion	343
17.3 Effect of Milk Solids	343
17.4 Effect of Moisture Loss on Jelly Goods	344
17.5 Replacement Weight of Scrap Syrup	344
17.6 Calculation of Probable Analytical Composition from the Confectionery Recipe	345
17.7 Calculation of Syrup and Crystal Phase	348
17.8 Sugar Content of the Syrup Phase	349
17.9 Calculation of Boiling Temperature	350
17.10 Calculation of Chocolate Recipes	351
17.11 Count (Number of Confections) per Unit Weight	356
17.12 Determination of Equilibrium Relative Humidity (e r h)	357
18 GENERAL REFERENCE TABLES	360
19 GLOSSARY	364
APPENDIX	369
INDEX	371

List of Figures

	<i>Page</i>
1 Basic crystal shape of sucrose	13
2 Glucose syrup manufacture (batch process)	24
3 Manufacture of dextrose	39
4 Production of sweetened condensed milk	68
5 Microscopic appearance of six common starches	73
6 Wet milling of maize	79
7 Starch drying	80
8 Manufacture of modified starches	81
9 Manufacture of pre-gelatinised starches	81
10 Treatment of cocoa beans	120
11 Manufacture of cocoa powder	121
12 Flow sheet for chocolate manufacture	122
13 Manufacture of milk crumb	127
14 Single-stream continuous tempering and enrobing of chocolate	142
15 Sollich tempering unit feeding enrober	144
16(a) Otto Hansel sugar cooker	168
16(b) Early vacuum cooker design	169
17 Formation of lettered 'rock'	173
18–20 Letters for 'rock'	174
21 Theegarten 01 continuous dissolver	176
22 Microfilm cooker	178
23 Moisture content of microfilm cooked sugar	179
24 Take-off points on a candy maker	181
25 Baker Perkins continuous candy maker unit	182
26 Otto Hansel Sucromat vacuum cooker	183
27 Production of deposited boiled sweets	185
28 Baker Perkins continuous caramel plant	199
29 Check-list of caramel faults	205
30 Daniels unimix cooker	230
31 Votator heat transfer plant	231

xiv LIST OF FIGURES

	<i>Page</i>
32 Ter Braak jet cooking system	233
33 NID brushless candy cleaner	235
34 NID continuous sugar sanding machine	237
35 NID high-speed moulder	237
36 Production of table jellies	245
37 Check-list of table jelly faults: A (manufactured)	248
38 Check-list of table jelly faults: B (made up)	248
39 Check-list of liquorice faults	278
40 Check-list of tablet faults	290
41 (a) Production of lozenges	293
41 (b) Check-list of lozenge faults	295
42 Go-no-go gauge	297
43 Oakes mixing head	304
44 Whizolator for marshmallow production	306
45 Turbomat arrangement for marshmallow production	307
46 Continuous production of egg albumen marshmallow	310
47 Continuous production of extruded marshmallow	311
48 Batch production of nougat by Ter Braak Presswhip	321
49 Continuous production of nougat	321
50 Check-list of sugar-panned goods faults	331
51 Nomogram for calculating e r h of sugar syrups	357
52 Nomogram of cream paste sample	358

List of Plates

- 1 Split cocoa pod showing beans
- 2 Ter Braak Coolmix
- 3 Baker Perkins continuous microfilm cooker
- 4 Baker Perkins multi high-boiled sweet depositor
- 5 Baker Perkins continuous caramel plant
- 6 Ter Braak Presswhip
- 7 Steinberg twin spray unit in pan room

Preface

The authors had five objectives in preparing this book: (i) to bring together relevant information on many raw materials used in the manufacture of sweets and chocolate; (ii) to describe the principles involved and to relate them to production with maximum economy but maintaining high quality; (iii) to describe both traditional and modern production processes, in particular those continuous methods which are finding increasing application; (iv) to give basic recipes and methods, set out in a form for easy reference, for producing a large variety of sweets, and capable of easy modification to suit the raw materials and plant available; (v) to explain the elementary calculations most likely to be required.

The various check lists and charts, showing the more likely faults and how to eliminate them, reflect the fact that art still plays no small part in this industry.

To help users all over the world, whatever units they employ, most formulations are given in *parts by weight*, but tables of conversion factors are provided at the end of the book.

There also will be found a collection of other general reference data in tabular form; while the Glossary explains a number of technical terms, many of them peculiar to the industry.

This is a time of world-wide change in the structure of the sugar confectionery and chocolate industry. It is experiencing consolidation with a general movement towards larger manufacturing units employing less labour with higher investment and capital costs in automatic and continuous high-output production lines.

Many old-established factories have been closed because of mergers or takeovers or changing market pressures. But new, small vigorous companies have been formed to manufacture lines which the larger firms are finding uneconomic to produce in batch quantities. Confectionery packs offered under the retailer's own label are accelerating the change to more efficient

production to cope with the lower profit margins generally associated with this trade. New firms entering the industry have high sales potential provided a good product is offered, effectively packaged and efficiently marketed. Sales of confectionery products in the United Kingdom are considerable, as the following figures for 1971 show.

	<i>United Kingdom</i>		
	<i>Producers</i>	<i>Imports</i>	<i>Exports</i>
	£	£	£
Chocolate and chocolate confectionery	182 169 000	4 197 000	16 984 000
Chocolate crumb, cocoa butter and other cocoa products	12 402 000	20 136 000	3 666 000
Chocolate couverture and similar products	12 163 000	63 000	472 000
Medicated confectionery	1 810 000	—	187 000
Sugar confectionery	108 248 000	3 208 000	14 610 000

(Source: *Business Monitor*, June 1972, HMSO.)

Sales by United States manufacturers during 1970 were 1925 million dollars of which 770 million dollars were direct sales to retailers (Source: US Industrial Outlook, US Department of Commerce).

Sales of sugar confectionery and chocolate in 1968 in the EEC (the original 6) were £244 million and £388 million respectively (Economist Intelligence Unit Reports 95, 98, 101, 113).

Both authors acknowledge the help and encouragement of many friends and colleagues: to Alan Maiden who has given considerable encouragement and assistance over several years and especially of their wives for their patience and tact during the writing. Ronald Lees wishes to thank Mr. Frank Cruden, Editor of *Confectionery Production*, for permission to reproduce tables from his articles in that journal under the nom de plume John F. Ingleton. The following individuals most kindly gave information and permission to reproduce illustrations:

- Dr. J. Buckle, H.P. Bulmer Co. Ltd., Hereford, England.
- Mr. B. W. Minifie, Knechtel Laboratories Ltd., Saltford, Bristol, England.
- Mr. J. W. Mansvelt, Lenderink Co., N.V., Schiedam, Holland.
- Dr. A. M. Maiden, CPC (United Kingdom) Ltd., Esher, Surrey, England.
- Mr. P. Fawcett, CPC (United Kingdom) Ltd., Esher, Surrey, England.
- Mr. J. Reid, E. T. Oakes Ltd., Macclesfield, England.
- G. A. Steele, Baker Perkins Ltd., Peterborough, England.
- Mr. C. Warren, Confectionery Development Ltd., Hemel Hempstead, Hertfordshire, England.
- The directors and staff of CPC (United Kingdom) Ltd., Manchester and Esher, England.

Information, illustrations and/or photographs on machinery and manufacturing process are warmly acknowledged also from the following companies:

Bramigk and Co. Ltd., London, E.3.
Cadbury Schweppes Ltd., Bournville, Birmingham.
Otto Hansel GmbH, Hannover, Germany.
Hamac Hansella, GmbH, Viersen, Germany.
R. Simons and Sons Ltd., Basford, Nottingham.
Norman Bartleet Ltd., London W14.
Gebr. er Braak N.V., Rotterdam, Holland.
Justus Theegarten, Koln, Germany.
Winkler Dunnebier, Neuwied/Rhein, Germany.
Sollich OHG, Bad Salzuflen, Germany.
Lenderink Co. N.V., Schiedam, Holland.
Bulmer Co. Ltd., Hereford, England.
E. T. Oakes Ltd., Macclesfield, England.
G. A. Steele, Baker Perkins Ltd., Peterborough, England.
Confectionery Development Ltd., Hemel Hempstead, Herts, England.

1

Basic Technical Considerations

1.1 INTRODUCTION

Some understanding of the chemical and other scientific properties of sugar confectionery and chocolate is important for the technologist; notably in overcoming faults that may have developed in the product; in the preparation of matching recipes; for detecting wrong blending of ingredients or incorrect processing conditions; and in the maintenance of high standards of quality.

Throughout the book reference is made to such general scientific concepts as moisture content, pH, etc. This introductory chapter is intended to describe briefly the more important of these and their significance to the properties of confectionery.

1.2 MOISTURE AND TOTAL SOLIDS CONTENT

The amount of water left in a sugar confectionery product depends on the type of raw materials used and on the extent of the processing during manufacture. When water is heated under normal atmospheric conditions it will boil at 100° C (212° F); but this boiling temperature is increased when sugar is present in solution. For a fixed concentration of sugar, under standard conditions of atmospheric pressure, a solution will always boil at the same temperature. Conversely if a sugar solution is boiled to a fixed temperature under standard conditions the remaining liquor will always contain the same percentage concentration of sugar and water. The increase in boiling temperature for varying concentrations of sucrose is shown in Table 1.

The effect of other sugars (which are described in Chapter 2) in raising the boiling point is shown in Table 2 and the effect of boiling under vacuum in Table 3.

Before the general availability of thermometers, a number of crude tests were used to determine boiling level. To enable the reader to use older recipes, these are set out in Table 4.

2 SUGAR CONFECTIONERY AND CHOCOLATE MANUFACTURE

TABLE 1. Boiling Point of Sucrose (Cane or Beet Sugar) Solutions

<i>Sucrose Concentration</i> %	<i>Boiling Point</i>	
	°C	°F
40	101·4	214·5
50	102	215·5
60	103	217·5
70	105·5	222
75	108	227
80	111	232
85	116	241
90	122	252
95	130	266

The presence of other raw materials, such as fats, non-sugar milk solids, starch etc., does not significantly affect the boiling temperature. It is therefore possible to determine the boiling points used in the manufacture of a competitor's confection through a knowledge of the composition and, in particular, the water content (see also §17.10).

A knowledge of the water (moisture) content of a raw material is important in developing confectionery recipes. In the United Kingdom it is necessary to incorporate more than 4% butterfat in any sweet which contains in its title the word 'butter'. If the weight of butter added was divided by the batch weight after processing, an erroneous value for the percentage butter content would be calculated, for butter contains some water and this must be taken into account when developing recipes which contain this ingredient (see also §17.2).

The water left in a confection can also influence its storage behaviour in a number of ways: e.g. whether or not the product will dry out or pick up moisture in store, and the extent of crystallisation occurring during its expected shelf life. Boiled sweets which contain more than 4·0% moisture will normally crystallise (grain) while in store. Average moisture content for a range of sugar confectionery products and raw materials is shown in Table 5.

TABLE 3. Effect of Boiling under Vacuum

<i>Approximate Total Solids Value</i> %	<i>Open Boil Temp.</i>		<i>Vacuum Cooking</i>		
	°C	°F	<i>Boiling Temp.</i> °C	°F	<i>Vacuum</i> lb/in ²
96	143·4	290	129·5	265	25
97	150	302	135	275	27
98	160·1	320	140·6	285	28

TABLE 2. Boiling Temperatures of Glucose Syrup and Invert Sugar Syrups and Mixtures thereof

Temperature		Glucose Syrup Concentration %	Ratio	Glucose Syrup Solids Invert Sugar			Invert Sugar Concentration %	
°C	°F			4:1	2:1	1:1		1:2
105.5	222	81.0	79.2	78.0	76.5	75.0	73.8	72.0
111.1	232	85.6	83.8	82.7	81.2	79.7	77.6	76.8
116.1	241	89.3	87.8	86.7	85.5	84.2	83.1	81.6
122.2	252	92.7	91.6	90.9	90.0	89.1	88.4	87.3
130.0	266	97.8	96.9	96.2	95.5	94.7	94.0	93.1

Index

- Accra beans, 48, 130
Acetic acid, 8, 50, 115, 339
Acetoglycerides, 64, 276, 278, 338
Acetylated waxy maize, 75
Acid content, 8
Acid drops, 9
Acid enzyme hydrolysis, 26, 33
Acid modified starch, 74
Acid strength, 9–10, 112–113
Acidity, 8–9
Acids, 112–117
Added cocoa butter, 353–356
Added milk solids, 343
Agar agar, 11, 89–90, 214, 216, 257–260
Agar jellies, 257–260
Air pockets, 190
Albumen, 42, 67
Alcohol solubility, 157
Alginate glaze, 277–278
Alkalinity, 9–10
Alkalisiation, 130–131
Allsorts, 282, 283, 285
Almonds, 103–104, 326
Ammoniated glycyrrhizin, 20, 98
Ammonium carbonate, 197, 208
Amylopectin, 75, 76, 82
Amylose, 22, 75
Analytical composition, 4, 5, 10, 345
Angel kisses, 300, 304, 311
Angelica, 220
Aniseed oil, 274
Anticaking agents, 18, 35, 257
Antioxidants, 61, 98, 196
Apparent viscosity, 138
Apple pectin, 85
Apple pulp, 99
Apple puree, 99
Apricot kernels, 337
Arabic gum, 75, 228, 253, 292
Aroma beans, 47, 48, 49, 124
Aroma concentrate, 99
Ascorbic acid, 112
Astringent beans, 56
Automatic tempering, 141
Axial length, 13
Bacteriological spoilage, 339
Bakers fondant, 216
Balling, 364
Base beans, 124
Basic fondant, 211–218
Batch process (glucose), 24
Batch weight, 340, 342
Baumé scale, 328, 364
BCH 'HK' Flowline, 270, 280
Bean varieties, 47, 48, 122, 124–125
Beeswax, 64, 328, 330, 335
Beet sugar, 2, 5, 15–20, 360, 363
Binding agents, 75, 273, 292
Binding properties, 31
Birds eggs, 331
Bitter almonds, 337
Bitter cocoa beans, 56
Black pod, 54
Blanching, 219, 220, 338, 364

- Blast freezing, 282
 Bleeding, 242, 258, 266, 335, 367
 Block juice, 102–103, 274
 Blocking, 364
 Bloom (strength), 11, 86, 364
 Bloom formation, 8, 64, 139, 140, 145, 365
 Blow (boiling), 4, 364
 'Bob' batch, 211–218
 Boiled sweets, 64, 112, 161–190, 344, 360
 Boiling points (syrups), 2, 34, 351
 Boiling temperature, 1, 2, 350, 351
 Boonton system, 327
 Bootlaces, 284
 Borneo Illipé, 58
 Borneo tallow, 58
 Boucher units, 86
 Brake, 282, 364
 Brazil nuts, 105
 Brix, 364
 Broken beans, 54, 55
 Brown sugar, 16, 19–20
 Bubble gum, 336–337
 Buffered pectins, 85, 260, 263
 Buffering (salts), 10, 16, 24, 113, 114, 218, 229, 245, 262, 339, 364
 Bulk delivery, 154–155
 Bulk density, 17, 363
 Bulk storage, 17, 154–155
 Buss Ko Kneader, 280
 Butadiene styrene polymers, 332
 Butter, 2, 59–61, 343, 345, 353–354
 Butter casing, 170, 342
 Butterscotch, 2, 170, 194, 346
 Butyl rubber, 332

 Cachous, 291
 Cadbury Starchless Depositer, 214–215
 Cake decoration, 216
 Caking, 17, 71
 Calcium salts, 209, 268, 334
 Canauba wax, 328, 330, 335
 Candied fruit, 45, 219–225
 Candied peel, 219–222
 Candy, 219–225, 364
 Candy maker, 179–181
 Cane sugar, 2, 5, 15–20, 360, 363
 Capacity, 363
 Capping, 289, 290
 Caramel (boiling), 4, 364
 Caramel (colour), 42
 Caramels, 42, 63, 67, 75, 98, 191–205, 360
 Caramel casing, 194
 Caramel centre, 186
 Caramel strips, 194
 Caramel whirls, 194
 Carboxymethyl cellulose gum, 216
 Carle and Montanari plant, 219
 Carageenan, 93
 Casein, 67, 196, 359
 Casson viscosity, 11, 12
 Cheesiness, 60
 Cherries, 100, 221
 Chew, 364
 Chewing gum, 327, 332–336
 Chewing mint, 194
 Chicle gum, 93, 332
 Chocolate, 112, 124–160, 351, 354, 355, 356, 363
 Chocolate aroma, 48, 49, 55, 122, 124
 Chocolate beans, 327
 Chocolate coating, 330
 Chocolate cream centres, 36
 Chocolate crumb, 125–128, 353
 Chocolate flavour, 48, 49, 55, 122, 124, 130, 135
 Chocolate fudge, 206
 Chocolate recipes, 125, 128
 Cigarettes (confectionery), 74, 294–298
 Cinder toffee, 171
 Citric acid, 8, 50, 113, 165, 261, 288, 359
 Citrus pectin, 85
 Clotted cream caramels, 192
 CMC, 216
 Coagulation (egg albumen), 90
 Coating chocolate, 124, 125
 Coating fondant, 192, 217
 Cocoa aroma, 48, 55, 122
 Cocoa beans, 47–56

- Cocoa butter, 50, 58, 123, 124, 125, 126, 128, 129, 130, 137, 140, 145, 153, 353–356
 Cocoa flavour, 48, 55, 122, 130, 135
 Cocoa liquor, 353–356
 Cocoa nib, 119, 129, 130
 Cocoa pod, 48
 Cocoa powder, 130–132
 Cocoa shell, 129
 Cocoa solids, 352–354
 Cocoa thrips, 54
 Coconut desert, 331
 Coconut flour, 297
 Coconut oil, 58
 Coconut roll, 280
 Cold flow, 201, 316
 Cold storage, 153–154
 Colour, 116–118
 Compressed tablets, 34, 286–290
 Conching, 128, 136–137
 Concreting, 17, 69, 71
 Condensed milk, 66–69, 195, 344
 Condensed whey, 69
 Confectioner's glucose, 364
 Continuous conversion, 27
 Continuous cooking, 166, 177, 178, 181
 Continuous dissolving, 176–177
 Conversion factors, 360
 Cooking temperature, 1, 2, 350, 351
 Cooking time, 273, 274
 Cooling curve, 78
 Cooling effect, 37, 43, 113
 Cooling tunnels, 282
 Corn starch, 74
 Cottonseed lecithin, 62
 Cough candy, 207
 Count lines, 272, 277
 Count/unit weight, 356
 Covering chocolate, 124, 125
 Crack (boiling), 364
 Cracking, 190, 339
 Cream of tartar, 16, 114, 343
 Cream paste, 45, 74, 271, 279–285, 360
 Creams, 211–218, 348, 351
 Criollo beans, 47, 50, 122
 Crumb, 125, 126–128, 353
 Crusted liqueurs, 155–159
 Crustless liqueurs, 155–159
 Crystal growth, 13
 Crystal phase, 213, 215, 348
 Crystal size, 37, 215
 Crystallisation, 5, 13, 31, 37, 213, 218, 272, 281
 Crystallisation zones, 13
 Crystallised fruit, 45, 219–225
 Crystallised ginger, 222–225
 Cupping, 217, 242, 259, 267
 Currants, 110
 Cut bean test, 55
 'Cutting' (of starch), 238
 Cyclone separation, 234

 Damping, 17
 Date syrup, 101
 Dates, 100–101
 DDT spray, 54
 Decoloration, 25
 Deformation, 259
 Degrees Baumé, 328, 364
 Degrees Bloom, 11, 87–88
 Degrees of Boiling, 4, 364–365
 Dehumidifying tunnels, 276
 Deposited high boilings, 183–186
 Depositing temperature, 228, 241
 Depositing time, 200, 228, 241, 262
 Dextrose, 21, 22, 29–33, 37–39, 217, 221, 288, 301, 316
 Dextrose Equivalent, 6, 22, 23, 27, 35
 Diacetyl, 60, 69
 Dissolving plant, 176, 177
 DM Value, 85
 Doctors (doctoring), 5, 6, 31–32, 162, 365
 Double sandwiches, 283
 Dragees, 329
 Dram, 360, 362
 Dressing, 132, 365
 Driamet system, 327
 Dried Milk, 69–72, 344, 351
 Drip feeding, 141
 Drops, 365
 Drum melting, 57
 Dry conching, 137
 Dryers, 232–233

- Drying cocoa beans, 53
 'Ducks web' test, 256
 Dulce de Leche, 192–193
 Dust explosions, 19, 234
 Dusting powder, 74, 256, 282, 293, 334, 365
 Dutch process, 130, 131
 Dyes, 116–118
- Earthnut oil, 59, 108, 109
 Easter eggs, 125
 Eastern fudge, 207
 Edinburgh rock, 171
 Egg albumen, 90, 198, 308, 317
 Egg frappé, 93, 209, 216, 300, 304, 365
 Emulsification, 197, 200, 231
 Engrossing, 325, 365
 Enrobe (enrobing), 64, 125, 139–150, 330, 365
 Enrobing chocolate, 124, 125
 Enrobing fondant, 192, 217
 Enzymic conversion, 26, 33
 Equilibrium relative humidity, 8, 202, 210, 213, 216, 281, 297, 339, 357
 Equivalent sugar concentration, 350
 Essence, 99
 Essential oil, 98
 Eur-o-matic beater, 308
 Expeller cake, 131
 Explosion hazard, 19, 234
 Export caramels, 203
 Extra hard (boiling), 4, 365
 Extruder, 275, 276
 Extrusion, 276, 279, 282, 297, 334
- False grain, 14
 Fat bloom, 64, 139, 140, 365
 Fat free cocoa solids, 352–354
 Fat loss, 123
 Fat migration, 153, 197
 Fat storage, 57
 Fats, 57–65
 'Fatty' batch, 168
 Feather, 4, 365
 Fermentation, 51–53, 55, 217, 303
 Figs, 101
- Fillers, 34
 Filling, 152, 187–188
 Fira degrees, 11, 86
 Flash dryers, 232–233
 Flavour beans, 47–49, 124
 Flavour intensifier, 35, 98
 Flavour precursors, 55
 Flavouring, 97–115, 165
 Flour, 272–273, 360, 363
 Flow, 365
 Fluff dried egg albumen, 91
 Fluid air bed drying, 287
 Fluid oz, 360
 Foam, 365
 Fondant, 209, 211–218, 300
 Fondant coating, 192, 217
 Forastero beans, 47, 50
 Former, 365
 Fourné, 217
 Frappé, 93, 209, 216, 300, 304, 365
 French paste, 271, 279–282, 331
 Frozen storage, 153–154
 Fructose, 40
 Fruit acids, 112–117
 Fruit bar, 110
 Fruit caramel, 300, 318
 Fruit drop, 9
 Fruit flavour, 98–99
 Fruit jellies, 89, 114, 238–265
 Fruit juice, 99
 Fruit pastilles, 112, 226, 228, 239, 243, 244
 Fruit pulp, 99
 Fruit puree, 99
 Fruit whirls, 194
 Fudge, 45, 92, 98, 206–210, 365
 Fudge icing, 207
 Fudging, 5, 161, 188, 195, 365
 Full cream milk, 344
- Gel, 365
 Gel strength, 10, 11
 Gelatine, 86–89, 228, 240, 273–274, 302, 317, 359
 Gelatine hydrolysates, 91
 Gelatine jellies, 240–252
 Gelatinisation, 77–78, 254, 255, 271, 272, 273, 275

- Gelatinisation temperature, 272
 Gelling agent, 11, 12, 73–90, 365
 Gilding, 329
 Gill, 360
 Ginger, 101–102, 222–225
 Glacé fruit, 219–225
 Glass, 365
 Glaze (glazing), 234–236, 277–278, 294, 332, 365
 Glidants, 288
 Gloss, 31, 189, 209, 218, 271, 272, 275, 277–278, 332
 Glossary, 364
 Glu, 365
 Glucose syrup, 5, 6, 7, 22–36, 162–164, 195, 201, 202, 340, 342, 363
 Gluten, 272
 Glycerine, 45, 281, 292, 336, 339, 359
 Glyceryl monostearate, 62
 Go-no-go gauge, 297
 Graco tablet system, 328
 Grade strength, 85
 Grain, 360
 Grained marshmallow, 306
 Graining, 5, 161, 188, 195, 365
 Granulation, 286–287
 Greasy, 168, 366
 Grinding, 131, 133–136
 Groundnut lecithin, 62
 Groundnut oil, 58, 108, 109
 Guar gum, 288
 Guillotines, 276
 Gum arabic, 75, 228, 253, 292
 Gum tragacanth, 75, 292
 Gums (confections), 74, 226–244, 251–254
 Gutta siak, 332

 Hard crack (boiling), 4, 366
 Hard panning, 324, 325–329
 Hard wheat flour, 272
 Hardened palm kernel oil, 59, 273
 Hardness index, 201
 Harvesting, cocoa beans, 51
 Hazeness, glucose syrup, 24
 Helios moulding plant, 236–237
 High amylose starch, 75, 216

 High boilings, 64, 112, 161–190, 344, 360
 High maltose glucose syrup, 164
 Honey, 20–21
 Horizontal beaters, 299
 Hundreds and thousands, 325
 Hydrol, 33, 273
 Hydrolytic rancidity, 61
 Hydroxymethylfurfural, 21, 22, 25
 Hyfoama, 309, 317

 Icing sugar, 18–19
 Illipé butter, 58
 In process inversion, 16, 114, 168
 Inclusions, 17
 Insecticide sprays, 54–55
 Instant milk, 70
 Inversion, 10, 16, 343, 366
 Invert sugar, 5, 6, 10, 21, 41, 162–163, 168, 261, 343, 359, 366
 Invertase, 36, 41, 42, 217
 Isoelectric point, 89

 Jam centre, 186
 Jellies, 74, 226–268
 Jelutong gum, 96, 332, 336
 Jelly beans, 240, 331
 Jelly strength, 11, 87, 88
 Jujubes, 240

 Kettle, 366

 Labile zone, 14
 Lactic acid, 8, 50, 114, 165, 261
 Lactose, 42, 67, 196
 Laevulose, 40
 Laevulose syrups, 301
 Lamination, 289, 290
 Large ball (boiling), 4, 366
 Large pearl (boiling), 4, 366
 Large thread (boiling), 4, 366
 Layered fudge, 207
 Layering, 272, 282
 Leaching, 366
 Leakage, 366
 Lecithin, 62, 67, 124, 139, 146
 Lecithin substitutes, 63
 Lecithin YN, 62

- Lettered rock, 172–176
 Light crack (boiling), 4, 366
 Light mineral oil, 200
 Lipase, 67
 Liqueur chocolates, 155–159
 Liquid milk, 66
 Liquid sugars, 36, 366
 Liquorice allsorts, 283, 285
 Liquorice centre, 187
 Liquorice juice, 102–103, 274
 Liquorice paste, 64, 74, 75, 103, 269–284, 360
 Liquorice rolls, 283
 Liquorice torpedoes, 327
 Long ton, 360
 Low methoxyl pectin, 260, 264, 265, 268
 Lozenges, 290–295
 Lubricants, 288, 290, 315
- Macadamia nuts, 108
 Magma, 16
 Maillard reaction, 196, 201
 Maize starch, 73
 Malic acid, 8, 115, 261
 Malt extract, 46
 Malto dextrins, 302
 Maltose, 5, 40–41
 Maltose syrup, 164
 Mannitol, 45, 336
 Marshmallows, 34, 89, 91, 299–315
 Marzipan, 104, 337–339
 Massecuite, 366
 Maturation, 281
 Mazetta, 304
 McIntyre plant, 137
 Medicated lozenges, 291
 Medium crack (boiling), 4, 366
 Melangeur, 132
 Menthol, 292
 Metastable zone, 14, 31
 Microfilm cooking, 177
 Microscopy, 272
 Milk crumb, 125, 126–128, 353
 Milk powder, 69–72
 Milk products, 66–72
 Milk protein, 91, 309, 317
 Milk solids, 343, 352, 353, 354
- Milk sugar, 42, 67, 196
 Mineral oil, 200
 Mint chews, 194
 Mint lozenges, 327
 Mogul plant, 231, 232, 234, 366
 Moisture, 1, 2, 17, 123, 228, 232, 340, 341, 342
 Moisture loss, 344
 Monkey nut, 108, 109
 Monoclinic crystals, 13
 Montelimar, 316
 Mottling, 209
 Mould spoilage, 6, 8, 50, 61, 103, 104, 117, 198, 213, 279, 288, 299, 338, 339
 Moulding chocolate, 125, 151–152
 Moulding starch, 74, 214, 232, 260
 Moulds (shapes), 214
 Musty beans, 56
- Nail rod, 284
 Negro kisses, 300, 304, 311
 Newtonian liquids, 11
 Nib, 129–130
 NID brushless cleaner, 235
 Nigerian beans, 130
 Non-Newtonian liquids, 11
 Nonpareil jellies, 283
 Nonpareils, 325
 Nougat, 92, 300, 316–323
 Novelties, 272, 277
 Nutritional value, 154
 Nuts, 103, 325
- Oakes beater, 303, 311, 321
 Off-flavour, 50, 60, 97
 Oilseed lecithin, 62, 124, 139, 146
 Okra gum, 301
 Open pan cooking, 166
 Optical rotation, 17, 88
 Orange slices, 240
 Oriental fruit toffee, 192
 Oxidative rancidity, 61
 Oxidised starch, 74, 75, 82
- Packaging, 128, 213, 279
 Palm kernel oil, 59
 Palm oil, 59

- Panning, 75, 104, 324
 Particle size, 18, 70
 Pastilles, 112, 226, 228, 239, 243, 244
 Pasting curve, 78
 Peach kernels, 337
 Peaches, 221
 Peanut oil, 58
 Peanuts, 108, 109
 Pearl (boiling), 366
 Pearl starch, 81
 Pears, 221
 Pecan nuts, 108
 Pectin, 83–86, 228, 260
 Persipan, 337–339
 pH, 9, 10, 12, 20, 53, 217, 227, 229, 255, 257, 261, 262
 Phosphoric acid, 261
 Piping chocolate, 125
 Pistachio nuts, 109
 Pitting, 326
 Plain chocolate, 354, 356
 Planetary mixers, 299, 303
 Plaster of Paris moulds, 214
 Plastic moulding mats, 214
 Plastic state, 366
 Plastic viscosity, 138
 Plasticisers, 335
 Plug, 283
 Plug tobacco, 284
 Polishing, 328, 330
 Polyisobutylene, 332
 Polyoxyethylene sorbitan monostearate, 64, 273
 Polyvinyl acetate, 332
 Potato starch, 73, 74, 78
 Powder filling, 187–188
 Powdered flavours, 100
 Powdered fondant, 215
 Powdered glucose syrup, 29
 Powder milk, 69–72, 344, 351
 Pregelatinised starch, 75, 80, 82, 197
 Premixing, 197, 200, 231
 Preserved fruit, 219–225
 Preserved ginger, 222–225
 Press cake, 130, 366
 Pressing, 130
 Pressure beater, 319
 Pressure relief vents, 19
 Presswhip, 320
 Prussic acid, 104
 Pulling, 112, 184, 366
 Pulp, 51, 99
 Pulverisation, 18
 Pump filling, 186
 Quince seed gum, 96
 Raisins, 110
 Rancidity, 60, 61, 339
 Rate of inversion, 10
 Rate of shear, 11
 Reconstitution (milk), 70–71
 Red hot poker, 284
 Red liquorice, 270
 Reducing sugars, 6
 Refining, 131–136, 338
 Refractometer, 5
 Relative humidity, 7
 Relative vapour pressure, 7
 Release agents, 64
 Residual moisture content, 184
 Reversion, 61
 Rice starch, 73, 74
 Rifle shot, 329
 Roasting, 55, 119, 121–124, 128, 130
 Rock, 172–176
 Roller dried milk, 70
 Rope, 366
 Rotary conching, 137
 Rubber mats, 214
 Saccharin, 20
 Sag value, 85
 Sago starch, 73
 Salt, 61, 98, 197, 274, 359, 363
 Sand (sanding), 236, 366
 Sandwiches, 283
 Saturation level, 13
 Scrap syrup, 344
 Screw feed, 276
 Seaside rock, 172–176
 Seed (seeding), 7, 13, 16, 68, 208, 213, 223, 366
 Setting temperature, 228

- Setting time, 87, 228
- Shade, 46
- Shell, 129
- Sherbet, 188
- Short ton, 360
- Silicone rubber, 214
- Silo storage, 17
- Silver coating, 329
- Silver leaf, 329
- Simon tubular dryer, 234
- Skimmed dried milk, 344
- Slaty cocoa beans, 55
- Slow set pectins, 260, 264
- Slugging, 287
- Slurrying, 254, 272–273
- Small ball (boiling), 4, 367
- Small pearl (boiling), 4, 367
- Smoky flavours, 56
- Snap, 151, 367
- Snowballs, 300
- Soak time, 87, 88
- Sodium benzoate, 339
- Sodium caseinate, 72
- Sodium citrate, 10, 113, 218
- Soft panning, 324, 330–332
- Softening, 203
- Solubility, 5–7, 157
- Soluble dextrin starch, 75
- Solution colour, 17
- Sorbitan esters, 146
- Sorbitan tristearate, 63, 64
- Sorbitol, 44–45, 206, 281, 300, 307, 334, 336, 339, 359
- Soufflé, 4, 367
- Sources of cocoa beans, 48, 50
- Soyabean lecithin, 62
- SoyafLOUR, 92, 198, 317
- Soya protein, 92, 198, 317
- Span, 64, 273
- Specific heat, 16
- Speckling, 190, 329
- Spherulitic crystals, 14
- Split beans, 122
- Spoilage, 6, 8, 50, 61, 103, 104, 198, 213, 279, 288, 299, 338, 339
- Spotting, 217, 329
- Spray dried caramel, 43
- Spray dried glucose, 29
- Spray dried milk, 70
- Stable zone, 14
- Starch, 73–83, 228, 363
- Starch gums, 239, 240
- Starch hydrolysates, 34–35
- Starch hydrolysis, 22
- Starch jet cooker, 232
- Stearates, 288
- Stearic acid, 286, 288
- Steinberg process, 327
- Stickiness, 189, 322
- Sticking, 190
- Stones, 360
- Storage, 17, 21, 36, 54, 57, 66, 68, 69, 71, 97, 103, 132, 153, 154, 209, 277, 363
- Stoving, 277, 344
- Striping, 184
- Sucromat, 181–183
- Sucrose, 5, 15, 16–20, 343, 344
- Sugar
 - Beet, 16–20
 - Brown, 16, 19–20
 - Cane, 16–20
 - Dextrose, 22–33, 37–39
 - Glucose syrup, 22–34
 - Icing, 18–19
 - Invert, 41
- Sugar bloom, 8, 140, 145, 367
- Sugar content, 349
- Sugar ratio, 261
- Sugar sanding, 236
- Sugar substitute, 20
- Sugar syrups, 36
- Sugared almonds, 326
- Sugarless chewing gum, 336
- Sulphur dioxide, 165
- Sultanas, 110
- Summer caramels, 192
- Supersaturation, 31
- Surface area, 133
- Sweat (sweating), 242, 258, 262, 266, 335, 367
- Sweet almonds, 337
- Sweet cigarettes, 294–298
- Sweetened condensed milk, 344
- Sweetness, 17, 31, 35, 36, 67, 69
- Swollen shoot, 54

- Syneresis, 242, 258, 266, 367
Syrup phase, 213, 215, 348, 349
- Table jellies, 89, 99, 114, 244–252
Tablet jellies, 89, 99, 114, 244–252
Tablets, 34, 286–290
Tailing, 232
Talc, 328, 332, 334
Tank storage, 36
Tapioca starch, 73, 74
Tartaric acid, 8, 50, 114, 165, 261, 288, 359
Telephone cable, 284
Temper (tempering), 13, 139–150, 367
Temper meter, 145
Temperature conversion, 360
Terpeneless oils, 98
Texture, 12, 204, 210, 272
Thin boiling starch, 74, 82
Thread (boiling), 4, 367
Toffee whirls, 194
Toffees, 63, 191–205
Total solids content, 2, 5
Total soluble solids, 5, 261
Tragacanth gum, 75, 292
Traying, 367
Treachle centre, 187
Tricalcium phosphate, 19
Trinitario beans, 47
Tropical warehouse moth, 159
Tubular dryers, 232–233
Turbomat, 307
Turkish delight, 74, 254–257, 265, 268
Turn, 366
Tween, 64, 273
Twists, 284
- Unimix cooker, 227
- Vacuum cooking, 166
Valpona strips, 54–55
Vanillin, 98, 130, 197, 206, 335
Violet cocoa beans, 55
Viscosity, 11, 21, 144, 202, 276
Viscosity reducing agents, 62–63
Vitamins, 198
Votator cooking, 230, 269, 275, 305
- Walnuts, 109
Wax paper, 246
Waxes, 64
Waxiness, 332
Waxy maize starch, 75, 80, 81, 198
Weeping, 242, 258, 266, 335, 367
Wet crystallisation, 218
Wet granulation, 286
Wet milling, 78–80
Wetting, 325, 367
Wheat flour, 272–273, 360, 363
Wheat starch, 73, 74
Whey, 69, 198, 208
Whip (whipping), 10, 89–93, 367
Whipping agents, 89, 90–93, 367
Whipping power, 10
Whizolator plant, 305
Winkler-Dunnebler plant, 234
Winnowing, 128–130
Witches broom, 54
Worm feed, 276
- Yeast, spoilage, 6, 339
Yield value, 11, 138
- Zein, 83

