

The Technology of Cake Making

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Preface to the First Edition

Several excellent books have appeared dealing with confectionery raw materials; likewise, there are recipe books sufficient to satisfy the requirements of the trade. In presenting this book, it has been the aim of the authors to give such data as will enable the reader to obtain a good working knowledge of the materials and processes they are employing in everyday practice. Emphasis is laid upon the necessity for the production of articles of the highest degree of uniformity and quality; consequently, special attention is devoted to the methods used for evaluating raw materials and for the technical control of processes, and, also, it is shown how the various methods of preparation of the raw materials may influence the finished product.

It has not been the intention of the authors to prepare a recipe book, but rather to deal with fundamentals, so that with this knowledge recipes can be built up as occasion demands. However, summaries of standard recipes have been introduced, and these will act as a guide to the student.

The book will be found to cover the range of work required for students qualifying for the National Diploma Examination and the City and Guilds of London Examination in Confectionery, Final Grade.

The authors' thanks are due to the following firms who have so kindly provided data and illustrations, rendering it possible to produce some entirely new features: Messrs. Artoflex and Co., Ltd., London; Baker Perkins, Ltd., Peterborough; Wm. Gardner and Sons (Gloucester), Ltd.; J. Harrison Carter, Ltd., Dunstable; The Morton Machine Company, Wishaw; The Peerless Electrical Manufacturing Company, Ltd.; C. O. Ericson Engineering Company.

In conclusion, the authors wish to express their gratitude to those who have generously given their assistance, advice and criticism, and especially to Mr. J. T. Parker of the National Bakery School, and to Mr. H. P. Buttrick, A.I.C., for his valuable collaboration in the preparation of the chapter on aeration.

E. B. Bennion
J. Stewart

Woodford
August 1930

Preface to the Fifth Edition

Under a new editorial management the name of this book has been changed to *The Technology of Cake Making* to bring it in line with modern concepts. The same pattern of the previous editions however, has been followed, although the scope has once again been extended to include packaging and wrapping of flour confectionery products, and more references and suggestions for additional reading matter. Reorientation of the chapter on the testing of raw materials and quality control has been carried out together with updating and some extension of technical information on many of the raw materials.

In all this work we have had the cooperation and assistance of many colleagues and friends in the trade, and in particular our thanks must be expressed to I.A.F. Wheal for the chapter on packaging; R.A. Knight of the F.M.B.R.A. and their library services generally; K.R. Christopher for the preparation of samples of Torten gateaux; G. Charman for information on cream fancies, and other members of the staff of the National Bakery School of the Polytechnic of the South Bank, London. Also to H. J. Barnes of Bush Boake Allen for information on spices and fruit pastes; Ian L. King of British Bakels for information on fruit paste and flan jellies; M. A. Brown of Soya Foods Ltd.; Loders and Nucoline Ltd. and S. P. Lambert of Craigmillar for very helpful comments when reading the text. Also to The Arkady Co., 'Bakery Management,' Oakes Ltd. Baker Perkins Ltd., Hoadley and Sons Birmingham, Cox Denholm Ltd., A.M.F. Ltd., Tweedy Ltd., John Pelkman Engineering Co. and the Gilbert Group for illustrations and the Proceedings of the British Chapter A.S.B.E. and of the Cake and Biscuit Alliance Technologists Conferences which have been extensively consulted.

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Hampshire 1973

E. B. Bennion
G. S. T. Bamford

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The mass production of flour confectionery has developed with such rapidity that it has become increasingly necessary for all those engaged in the industry, in whatever branch, to have a good working knowledge not only of the materials they are using and of all the processes they are employing but of all those details so necessary for the production of a regular article of the highest quality.

Science has been a most important factor in bringing about this change, making it possible for large-scale production of most of the ordinary types of confectionery to be carried out by mechanical means. Further, with the great progress which has been made in the preparation of the raw materials, and especially of the wide range of products which in many cases have replaced the older staple products, it is very necessary that those who are called upon to use them should know exactly what they are using, how these products function when used in different ways, and the results which can be obtained.

Alongside this development, the craftsman confectioner finds an increasing demand for his products.

For those who are purchasing the raw materials, it is important to know first of all of what the real product consists, in order that the value of a substance as a substitute can be truly assessed.

There are many substances sold as 'substitutes' which cannot really be given such a name; they are to be considered rather as products of an alternative, and in some cases a more specific, nature. There are others of more doubtful value which should be investigated very carefully before purchasing and precise information should be obtained from the manufacturer as to their composition and function.

There are moreover many brands of the same type of product and so many varieties with a wide range of prices that too much knowledge cannot be gained by those who are going to use them to advantage in their manufacture.

To all those who are entering the mass-production confectionery industry

the best advice that can be given is to gain a knowledge of chemistry and physics, for the fundamental principles of both have a very wide application to all matters connected with the large scale manufacture of products of good and constant quality. The training of a first class craftsman confectioner may not require such scientific knowledge, but nevertheless regard must be paid to modern production techniques, new or improved raw materials and the economic manufacture of high quality products. A sound course of study in flour confectionery production is as important to the craftsman as it is to the technician.

DEFINITION AND CLASSIFICATION

The generic term 'flour confectionery' is used to include biscuits, cakes, and pastries of all kinds, as well as several baked products, difficult to classify precisely, which hover doubtfully in the ill-defined region between 'bread' and 'cake'.

'Confectionery' is a word now usually employed as a collective term for sweetmeats of various kinds. These are usually divided, for ease of reference, into two main groups: 'sugar confections', such as sweets, candies, and chocolates; and 'flour confections'. Modern usage has confined the term 'flour confectionery' almost entirely to *baked* products (a few of which, like meringues, contain no flour), but it is convenient to observe that many types of cakes and boiled or steamed puddings contain similar ingredients in almost identical proportions.

The following classification was worked out by S. W. Butterworth in collaboration with the late J. J. Devlin. Nearly all flour confections may be conveniently regarded as being derived from one or another of three basic flour and water mixtures:

- (1) the fluid batters that result from mixing flour and water in about equal weights;

- (2) the plastic-elastic doughs that result from kneading flour with half its own weight of water;

- (3) the stiff plastic pastes formed when flour particles are held together with a minimum of water (in most of the items in this group a considerable proportion of fat is usually incorporated).

From these three basic intermediates (which may conveniently be referred to as 'batters', 'doughs', and 'pastes' respectively) it is possible to develop in a logical sequence nearly all the main varieties of products created by the art and craft of the flour confectioner.

The table on page 4 shows in a simplified form the relationships of the three main streams of products. It also indicates the main ingredient variations which bring about the changing character of the confection concerned. The table does not show how processing alterations can give rise to new varieties, nor does it illustrate adequately the very important effects capable

of being produced by apparently minor changes of highly active ingredients, such as chemical aerating agents.

A table of this kind can be elaborated very considerably to show minor ingredient and processing changes. It can also be enlarged to show the importance of composite confections in which several basic intermediates are used: cakes with a pastry base and a batter filling, for example. Some confections can be fitted into the scheme linking the main streams. A typical example of this kind is Swiss or sponge roll which is an extension of stream one as eggs and sugar are increased, linking with stream two. Many confections are 'decorated' after baking with such materials as cream, chocolate, fondant, fruit or nuts, and the like, and these additions substantially affect the composition of the finished cakes.

It should also be remembered that many of the leaner kinds of confections, such as scones and fermented small goods, are not 'rich' in eggs, sugar, and fat, but are none the less very pleasant to eat when properly made and baked. Indeed, simple varieties are often more attractive than rich, highly decorated types of cakes.

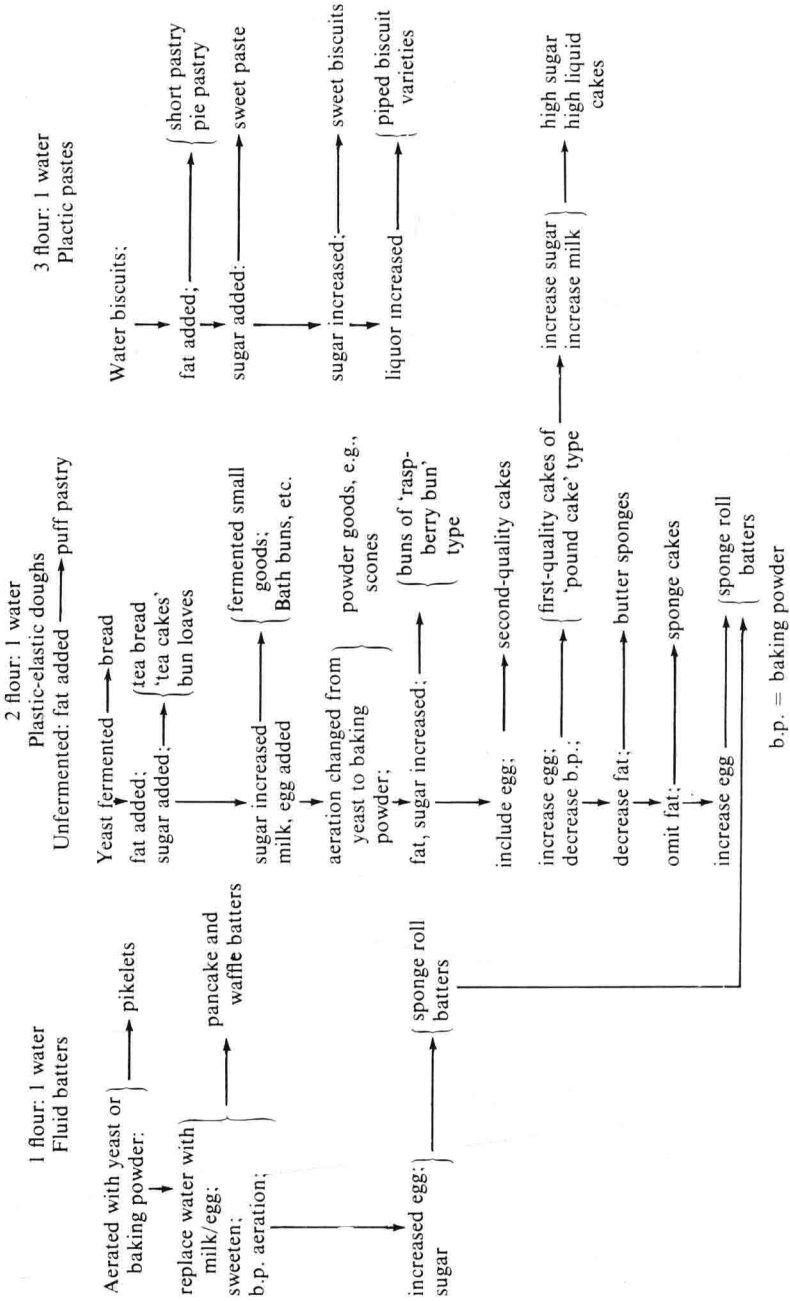
In this instance the object of the table is not to display fine technical differences (however fascinating these may be to the confectioner), but to reveal a pattern in flour confectionery that may help in a more fundamental understanding of the subject.

Similarly the formulae given in each chapter are basic and are used to illustrate the general composition of a particular class of product. In addition all the quantities are given both in British Standard Units and in parts per 100 parts of flour. This latter basis makes for easy translation into metric units when metrication is finally introduced. Indeed, in any recipe, so far

PERCENTAGE PROPORTIONS OF THE MAJOR RAW MATERIALS IN THE PRINCIPAL BASIC FLOUR-CONFECTIONERY FORMULAE

	Fer- mented small goods	Scones	Richer powder goods	Ortho- dox cake	High sugar high liquid cake	Sponge cakes	Puff paste	Short paste	Sweet paste
<i>Flour</i>	51	49	45	30.5	22.7	31	42.2	52.5	54
<i>Fat</i>	8	9	17	17.5	13.7	—	31.5	26.25	27
<i>Sugar</i>	8	9	17	22.0	29.6	31	—	—	10.5
<i>Eggs</i>	3	—	4.5	29.5	33.2	38	—	—	8.5
<i>Liquor</i>	27	30	14			—	26.3	19.7	—
<i>Baking powder</i>	—	3	2.5	0.5	0.8	—	—	1.55	—
<i>Yeast</i>	3	—	—	—	—	—	—	—	—

The above table shows the raw materials composition of the main groups of flour confectionery products.



as manufacture is concerned, it is the proportion of one ingredient to another which is important. It matters not at all what the unit is, and a simple method of conversion to grammes for small batches is to reduce all weights to ounces and multiply by thirty.

LEGISLATION

The extensive legislation which governs the manufacture and sale of food generally and baked products in particular has had to lay down various definitions for flour confectionery. To date there are no regulations controlling the composition of flour confectionery as such, although separate regulations govern the nature and use of many of the ingredients used in their manufacture. In fact definitions of flour confectionery differ in the legislation.

The labelling of Food Regulations 1970—coming into force in January 1973 states that: 'Flour Confectionery means any solid or semi-solid product complete in itself suitable for consumption without further preparation or processing other than heating, of which the characteristic ingredient, apart from any filling, is ground cereal, whether or not flavoured, coated with or containing any carbohydrate sweetening matter, chocolate or cocoa; and includes shortbread, sponges, pastry, pastry cases, crumpets, muffins, macroons, ratafias, meringues and petit fours, but does not include pharmaceutical products, bread, biscuits or any product containing a filling which has as an ingredient any meat or fish'.

Under the Weights and Measures Act 1963 bun loaves and chollas are classed as flour confectionery and the most recent Code of Practice (1970) defines a bun loaf as a loaf made in accordance with a recipe containing, per 100 parts by weight of flour:

- (a) not less than 5 parts by weight in all of either liquid whole egg (or its equivalent in dried egg) or added fat or both of these ingredients, and
- (b) not less than 10 parts by weight in all of either or both of these ingredients, together with sugar.

No textbook of this nature could hope to cover all the relevant legislation adequately, and in any case much of it would almost certainly be out of date very quickly. Britain's entry into the Common Market will also affect future legislation.^{1,2} Suffice it here to state that the relevant legislation is quite extensive ranging through the Food and Drugs Acts, the Trade Descriptions Acts, the Weights and Measures Acts and various Codes of Practice, not to mention the Factories Acts which lay down conditions of work.

The reader is advised to keep abreast of current legislation which is published by H.M.S.O. or initially through such other various very useful sources of information as the F.M.B.R.A. or the Trade Press.

HYGIENE IN THE BAKERY

Under the Food Hygiene (General) Regulations 1970, the necessary provisions that must be made in all places handling food are specified. Not only do these provisions apply to equipment and premises but also to those engaged in the handling of food.

PERSONAL HYGIENE

Every person handling food must:

- (a) keep as clean as reasonably practicable all parts of his person liable to come into contact with food;
- (b) wear clean and washable overclothing, or overalls likely to come into contact with open food such as bakery products;
- (c) keep any open cut or abrasion on any exposed part of his person covered with a suitable waterproof dressing;
- (d) refrain from spitting;
- (e) refrain from smoking or using snuff.

It is important that all persons, before starting work in a bakery, should change into suitable overalls or protective clothing with appropriate cover for the head, and wash their hands. Ideally, hot and cold showers and towels should be available so that all production staff can take a shower before changing into their working clothing. Provision should also be made for a drying-room in which outdoor clothes can be placed during working hours and working garments can be left after work. The regulations state that accommodation for clothing and footwear must be *used* in addition to being provided.

BAKERY HYGIENE

In the bakeries themselves hand driers or towels must be provided by each sink at which workers are likely to wash their hands. Foot baths should also be provided, and the care of the feet stressed as being a matter of primary importance. Many firms today have either full-time or visiting chiropodists to deal with this side of welfare work.

All wall surfaces should be as simple as possible, free from unnecessary projections, and finished with non-absorbent materials such as tiles or hard-gloss paint. They should preferably be light in colour to give the maximum light reflection.

Plant and equipment with which the food is likely to come into contact should be constructed of such materials and designed in such a way that they can be easily cleaned.³ Further, they should be constructed whenever practicable of material of a non-absorbent nature. This particularly applies to tables, containers, and trays. Stainless steel, aluminium alloys, or plastics are now widely used for these. If wooden tables are used, then a hard wood such as beech is best, but such tables must be kept in a sound state of repair to prevent any risk of contamination of the food while being processed.

Before work is commenced, tables and machines should be brushed or wiped down, since dust will always settle on them in between working periods. Further, on occasion, scraps of dough are sometimes left by a previous shift, and these will cause trouble if worked into newly made dough. Each person should be responsible for seeing that the table on which he is working and the utensils he is using are kept in a clean and tidy condition as soon as each job is completed.

Clean working not only makes for better production but eliminates waste, which means financial loss. Working tables should be kept cleaned down between the production of various items. All waste collected should be removed from the food room and not allowed to accumulate. Floors should also be kept swept during working hours, and in larger bakeries a special staff should be employed for this purpose. Attention to this is essential if clean working conditions are to be maintained. Vacuum installations are necessary to remove dust from less-accessible places. Unless these precautions are taken, spoilage of food, trouble with flies and wasps, and outbreaks of food poisoning can occur.

STORAGE OF FOOD

The food hygiene regulations dealing with the storage of food apply to those foods consisting of meat, fish, gravy, or imitation cream or products prepared from or containing any of those substances or any egg or milk. They do not apply to bread, biscuits, or pastry by reason of the use of egg or milk as an ingredient thereof introduced prior to baking or to butter, margarine, shortenings, cooking fats, or beef suet. Food coming under the above category must be kept either at a temperature of 145° F (63° C) or above, or below 50° F (10° C).

Ingredients should not be stored in the bakery, but should be drawn from stores as required, and should be placed, weighed down for each mixing, in suitable clean containers. Perishable ingredients, such as yeast, cream, eggs, and milk, should not be left unduly long in the bakery, yeast should be drawn from the store as required and any surplus returned before it has had a chance to dry out. An organized rotation of stocks is essential; routine checks should be made at least weekly.

COMMON CAUSES OF FOOD POISONING

The commonest cause of food poisoning is by bacteria of the *Salmonella* group. These may be transmitted from the droppings of domestic animals, mice, hens, and ducks and through flies which have been in contact with such excreta; also by the human hands if unwashed after using the toilet, or through the use of certain raw materials, such as unpasteurized egg products and coconut.

The other cause is by *Staphylococci*, which are carried in the nose and

throat, infected cuts or scratches, pimples, or boils. They can be transferred to food by coughing and sneezing or from unprotected wounds.

Both of these groups of bacteria are destroyed by heating, so that baked goods are normally rendered safe from such infection, but unbaked products and additions after baking, such as filling creams, are liable to contamination, and can become a means of infection of finished products.

Keeping cooked products warm in hot chambers can cause the rapid multiplication of these organisms, which can so easily gain access to prepared foods. It is for this reason that all meat products must be stored at temperatures above 145°F (63°C), or below 50°F (10°C).

Occasional outbreaks of paratyphoid have been traced to workers who are typhoid carriers being employed in food-producing establishments, particularly in the handling of goods containing imitation cream or cream fillings.

AVOIDANCE OF CONTAMINATION OF BAKERY PRODUCTS

With the stringent regulations today concerning the purity of food products, every effort has to be made to see that no contamination occurs during manufacture or after baking to the point of sale; further, it is essential to see that all products have a reasonable shelf life. To ensure these conditions, constant supervision of ingredients and working conditions is essential. Contamination may take the form of foreign matter, such as fragments of wood, hairs and fibres, particles of glass, stones, pieces of metallic substances, nails, screws, nuts and bolts, grease pellets, rodent pellets, cigarette ends and ash, fragments of nail varnish, medical dressings, pencils, and foreign taints such as creosote, paint, linseed, mustiness.

Wood fragments may come from boxes in which raw materials have been packed. Because of this source of trouble, wooden boxes are not now being used today to any extent; some firms will not accept any wooden containers on their premises. Wooden trays which begin to wear and which soften after washing can also be a source of trouble—hence the use of metal, plastic and board trays for safety. Likewise, wooden tables and equipment can be a source of trouble unless kept in a state of good repair.

Hairs and fibres gain access from jute sacks, and so these are being replaced by paper sacks for flour and sugar and polythene liners for many materials.

Human hairs still present a problem, but the use of suitable headgear should reduce this to a minimum.

Stones in dried fruit always present a problem despite the most efficient system of cleaning and preparation. Rigid standards are now prescribed in some exporting countries to reduce the risk from this source. The use of electro-magnetic tables reduces the incidence of trouble from metallic particles, particularly if this is followed by a 'Cintel' detector unit.

In the past *nails* frequently gained access from boxes used for fats and

dried fruits, but with the introduction of hardboard sealed with adhesives this source of trouble has been largely eliminated. *Metallic stapling* is not allowed by many firms to be used with packages, since these fine wires can easily get into the finished product and are not easily detected until the food enters the mouth.

Particles of glass are always a source of trouble, and it is always difficult to ascertain how they gain access. Today in many bakeries the use of glass utensils is forbidden, all colours and essences being packed in plastic bottles, and plastic vessels being used for measures. Cracked windows should always be replaced before any pieces of glass can fall out, and no drinking glasses should be carried into the bakery.

Nuts and bolts are sometimes found in goods after the engineers have been carrying out repairs on plant, so one should always check up after any alterations or adjustments have been carried out. Better still to take adequate precautions such as the erection of sheeting or other means of shielding during repair work.

Grease pellets from chains in provers or conveyors sometimes gain access to goods and may be mistaken for *rodent droppings*. Ultra-violet light will always show whether these contain mineral oil, for a fluorescent effect will be obtained. Microscopic examination will show the presence of hairs if rodent pellets are suspected.

Under the hygiene regulations the use of water-proof adhesive dressings is required to eliminate the risk of *medical dressings* dropping into batters or mixings. Despite all normal precautions, accidents do occur, and workers should be instructed to inform the foreman should any dressing get lost during working time so that a complete check can be carried out before the goods leave the bakery.

The use of *nail varnish* by female workers should be forbidden, since under normal working conditions it can flake off, and particles can gain access to batters. Smoking is forbidden by law, but despite this, *cigarette ends* are found in baked products from time to time, and often have dropped from a jacket pocket where they have been placed after a 'break' period. To overcome this possibility, no outside pockets should be allowed in jackets or overalls worn by workers in the production section of the bakery.

Buttons from overalls are sometimes found in baked products, and some firms do not allow the use of buttons, but instead have tapes fitted which must be tied to effect a fastening. Self adhesive nylon fastenings are coming into more common use.

Pencils, small weights, and scrapers all get lost in a bakery, and care should be taken to see that these are not placed where they are likely to get into mixings. If a *scraper* gets misplaced every effort must be made to find it before production proceeds.

Foreign taints which have been picked up during transit are sometimes found in raw materials. The storekeeper should be trained to examine all

goods for stains and foreign odours before issuing them from stock, since this may eliminate much trouble later. Flour may be musty, and this may not show up until it is sieved for use or even until the goods are baked; fats and ingredients containing a considerable quantity of natural oils may become rancid; eggs may be musty, and this may not show up until they are whisked, when only an odd egg in a large mixing is responsible for the taint. Moths and maggots are always a potential source of trouble with nuts and dried fruits, and the only way to deal with this is really at the source, by insisting on hygienic methods of preparation and gas treatment with methyl bromide, followed by packing in suitable containers and storing under controlled temperature conditions.

In the case of walnuts and other nuts, pieces of broken shell can cause trouble, and so a proper inspection of the nuts before use is essential.

All staff should be trained to use and develop their sense of smell and powers of observation, so that unconsciously they are carrying out a critical examination of their raw materials, mixings in the course of preparation, and finished products as they come from the oven and finishing room.

SAFETY

No person should be allowed to operate any machine until he understands the working of it and is declared proficient in handling it by some responsible authority. This is a compulsory provision of the Factories Act as far as women and young persons are concerned but it should apply to all operatives.

Adequate fencing of transmission machinery and every dangerous part of other machinery must be provided and such guards must be of substantial construction, they should be fitted with automatic cut outs so that unless they are in position, the machine cannot be operated. Likewise machines should never be cleaned when in motion. These provisions apply particularly to power pastry brakes, automatic pie machines and high speed cake mixers.

Fire fighting equipment must also be provided and kept fully maintained in every factory. Fire alarms must be provided, exits conspicuously marked and gangways kept clear.

Steam boilers, steam pans and steam tube ovens must be fitted with specified safety devices which must be properly maintained¹. Floors, steps and passages must be kept in a good state of repair and hand rails provided on stairs. All accidents involving absence from work for more than three days must be entered in the general register and reported to the District Inspector.

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2. N. Chamberlain, 'Effects of Common Market Raw Materials', *Bakery Management*, March 1972, 11, 18, 32.