# CHAPTER 1
# Traditional chocolate making

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## 1.1 History

As early as 1900 BC cocoa was being used as a beverage by the Mokaya people in Mexico (Powis *et al.*, 2007). Cacao trees were subsequently cultivated by the Aztecs of Mexico long before the arrival of the Europeans. The beans were prized both for their use as a currency and for the production of a spiced drink called "chocolatl". The Aztec Emperor Montezeuma is said to have drunk 50 jars or pitchers per day of this beverage, which was considered to have aphrodisiac properties, a belief still held as late as 1712, when *The Spectator* newspaper advised its readers to be careful how they meddled with "romances, chocolate, novels and the like inflamers …". The chocolate was prepared by roasting the cocoa beans in earthenware pots, before grinding them between stones. The mixture was added to cold water, often with other ingredients such as spice or honey, and whipped to a frothy consistency (Whymper, 1912).

The first cocoa beans were brought to Europe by Columbus as a curiosity, but were later exploited commercially by Don Cortez as a new drink (Minifie, 1980). The Spaniards preferred their drink sweetened, and in this form its popularity spread to Central and Northern Europe. In 1664 it was mentioned in England in Pepys' *Diary*, but was essentially still restricted to the wealthy. The introduction of milk into this chocolate drink was first recorded in the UK in 1727, by Nicholas Sanders (Cook, 1984), although his reasons for doing so are uncertain.

A mixture of the ground cocoa beans and sugar would not by itself produce the solid chocolate so familiar to the modern consumer. Instead it would give a very hard substance which would not be pleasant in the mouth. In order to enable it to melt easily, it is necessary to add extra fat. This can be obtained by pressing the cocoa beans and removing some of the fat content, known as cocoa butter. The ability to extract this fat was developed in 1828 by Van Houten of Holland, and it had a double advantage: the expressed fat was used to make the solid chocolate bars, while the remaining lower-fat cocoa powder could still be

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incorporated into a drink. This "drinking chocolate" was in fact usually preferred, as it was less rich than the original high-fat mixture.

Van Houten's development is even more remarkable when one considers that his factory and presses were entirely operated by manpower. In 1847, however, in Bristol (UK) Fry used recently developed steam engines to power the first factory to produce tablets of plain chocolate.

The solid form of milk chocolate is normally attributed to Daniel Peter of Vevey in Geneva (Switzerland) in 1875. In Switzerland, water-powered machines were able to operate for long periods at an economic rate. This enabled the extra water from the milk to be driven out of the chocolate without incurring a large extra cost. Chocolates with moisture contents of above about 2% are normally unacceptable as they have poor keeping qualities, as well as a poor texture. The page of the notebook where he wrote his original recipe is shown in Figure 1.1. In 1908 his invention of milk chocolate was disputed, so this notebook was taken to a lawyer, who placed his stamp at the top of the page.

Over the years many different flavours of both milk and plain (dark) chocolate have been developed. Sometimes there has been a definite policy to develop a "house" flavour within a company, for example in Cadbury's Dairy Milk, or the Hershey Bar. At other times the flavour is adjusted to complement the centre of the sweet to be coated with chocolate. A very sweet centre such as a sugar fondant may be best complemented by a relatively bitter chocolate and vice versa. For milk chocolate, one of the biggest flavour differences is between the chocolates made from milk powder which are predominantly found in Continental Europe, and the "milk crumb" ones of the UK and parts of America. Milk crumb (see Chapter 6) is obtained by dehydrating condensed milk and cocoa mass. This was developed where milk production was very seasonal. As cocoa is a natural antioxidant, it was possible to improve the keeping properties of the dehydrated form of milk over extended periods without refrigeration. The drying process also produced a distinct cooked flavour, not normally present when the milk is dried separately.

Table 1.1 summarises some of the important dates connected with the history of cocoa and chocolate.

## 1.2 Outline of the process

Chocolate has two major distinguishing characteristics: its flavour and its texture. Although many different flavours of chocolate exist, all must be free from objectionable tastes and yet incorporate at least some of the pleasant ones, which the consumer will associate with the product. A primary feature of the texture is that it must be solid at a normal room temperature of 20–25 °C (70–75 °F) and yet melt rapidly in the mouth at 37 °C (98.5 °F), giving a liquid which appears smooth to the tongue. The processing of chocolate is related to obtaining these

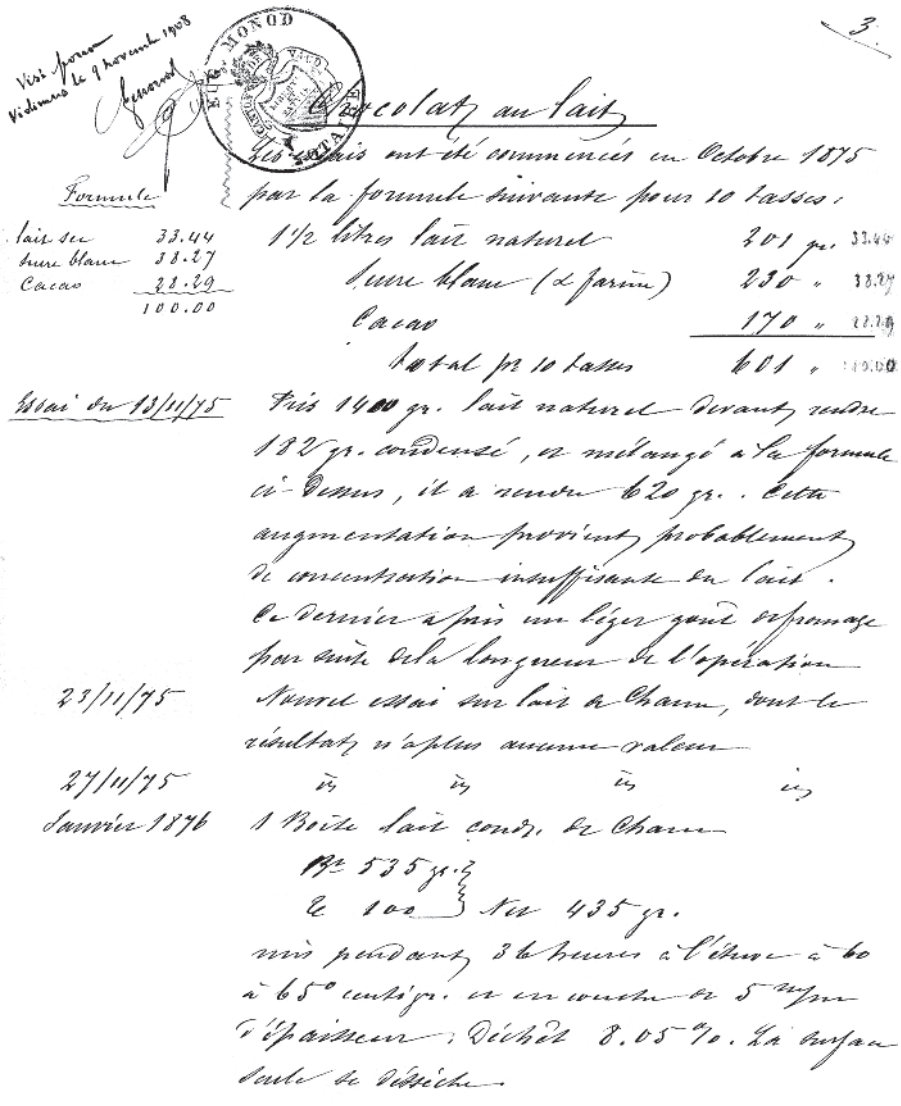


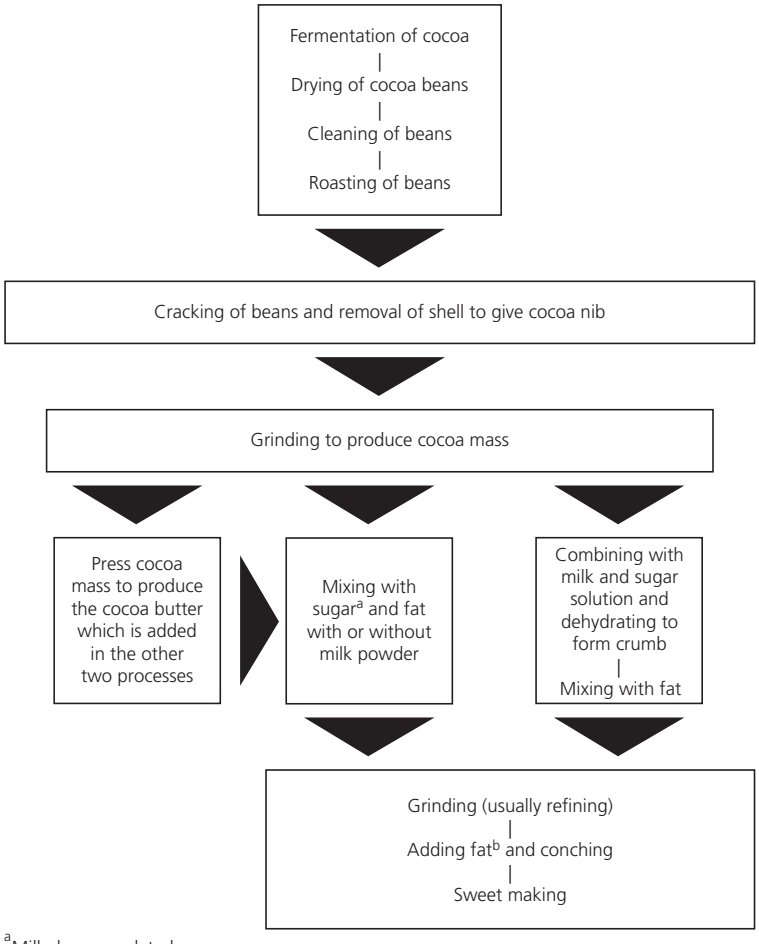
**Figure 1.1** Page from Daniel Peter's notebook showing the original milk chocolate recipe. Source: Nestlé historical archives. Reproduced with permission of NESTEC S.A./Nestlé S.A.

two criteria and is therefore devoted either to developing the flavour of the product – using a raw bean would produce a very unpleasant taste – or treating it so that the liquid chocolate will flow properly and be free from large gritty material.

Although many different methods of chocolate-making exist, most traditional ones are based on the process outlined in Figure 1.2 and briefly described below. Further details are given in the relevant chapters of the book.

**Table 1.1** Some important dates in the history of cocoa and chocolate.

| Date | Event |
|---|---|
| 1519 | Cortez discovered that cocoa had been cultivated by the Aztecs more than 3000 years |
| 1528 | Cortez introduced a chocolate drink to Spain |
| 1606 | Chocolate drinking spread to Italy |
| 1615 | Chocolate drinking reached France |
| 1657 | First chocolate house established in London |
| 1727 | Nicholas Sanders invented a milk chocolate drink |
| 1746 | First cocoa planting in Bahia |
| 1765 | First chocolate company established in North America |
| 1828 | Van Houten patented the cocoa press |
| 1847 | Fry's factory established in Bristol to produce eating chocolate |
| 1875 | Daniel Peters manufactured milk chocolate |
| 1988 | World cocoa grindings exceeded two million tonnes |




[a] Milled or granulated
[b] Cocoa butter and/or lecithin

**Figure 1.2** Schematic diagram of traditional chocolate-making process.

### 1.2.1 Preparation of cocoa nib – flavour development

The cocoa tree produces pods containing a pulp and the raw beans. The outer pod is removed together with some of the pulp and the beans are fermented. This enables chemical compounds to develop inside the beans, which are the precursors of the flavour in the final chocolate. Failure to carry out this stage properly cannot be rectified by processing at a later date. This is also true of the subsequent stage, when the fermented beans are dried. Poor control here can give rise to moulds, which give a very unpleasant-flavoured product, even if the fermentation has been carried out correctly. Similarly where beans are accidentally contaminated with smoke from a faulty drier, the resulting cocoa will be unusable. In addition, correct transport conditions are required when the beans are moved from the country of growing to that of chocolate manufacture.

On arrival in the processing factory, it is necessary to clean the beans to remove metal and stones and other extraneous material that might contaminate the product. Further flavour development is subsequently obtained by roasting the beans. This also loosens the shell round the outside of the bean and enables them to break more easily. (Some chocolate manufacturers prefer to heat the surface of the beans, to facilitate shell removal and to carry out the full roasting of the cocoa bean centres, either as whole pieces or as a liquid following grinding. This is described more fully in Chapter 3.) The beans are then broken and the relatively lighter shell particles removed by a winnowing action. The presence of shell in the final chocolate is undesirable as it will impair the flavour, as well as causing excessive wear to the subsequent grinding machine. It should also be noted that the shell content of chocolate is legally restricted in some markets. In some countries the shell itself has found a use in horticulture.

### 1.2.2 Grinding – particle size reduction

Up to this stage the cocoa is in discrete pieces, several millimetres in diameter. Subsequent processing may take several forms, but all require the solid cocoa particles, sugar and any milk solids to be broken so that they are small enough not to be detected on the tongue. The actual size depends upon the type of chocolate and the market in which it is sold, but in general the vast majority of particles must be smaller than 40 microns (0.0015 inch). The unground ingredients used to make dark chocolate are shown in Figure 1.3.

The most common method of achieving this is by the use of roll refiners. In order to enable the chocolate ingredients to pass through the refiner, however, it is necessary to get them into a paste form. This may be done in a variety of ways. One of the most common is to grind the nib to form cocoa mass, which is a liquid at temperatures above the melting point of cocoa butter, 35 °C (95 °F). This usually involves hammer mills, disc mills, ball mills, three-roll refiners or a combination of the four. The sugar can then be added in a granulated or milled form and the two mixed with extra fat (and milk powder if milk chocolate is being manufactured). The mixing may include some grinding, and traditionally a melangeur

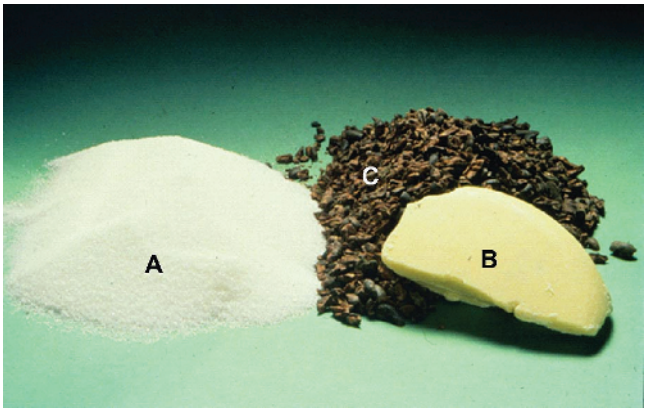



**Figure 1.3** A picture of the unmilled ingredients used to make dark chocolate. A is sugar, B is cocoa butter and C is cocoa nibs.

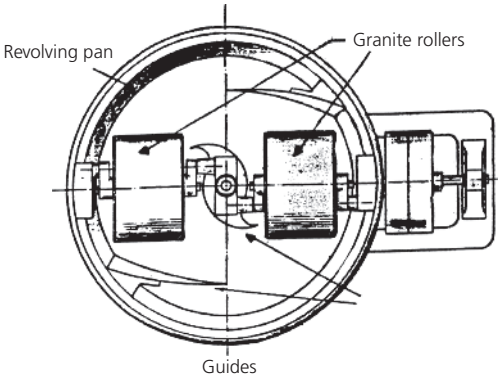



**Figure 1.4** Diagram of melangeur pan.

pan was employed for the purpose. This machine has a rotating pan, often with a granite bed, on which two granite rollers rotate. Scrapers ensure mixing by directing the material under the rollers (Figure 1.4). The modern requirement for continuous higher throughput methods has often lead to the mixing and grinding being carried out separately. Probably the most widely used, is to mix the initial ingredients into a paste and then grind this on a two-roll refiner. This gives a sufficient amount of crushing and mixing to provide a particle size and consistency suitable for feeding to the five-roll refiner (see Chapter 9).

Where chocolate crumb is used, this dehydrated mixture of condensed milk and cocoa mass is normally preground to a maximum size of 2 mm (0.1 inch). This is then crushed and mixed with fat in order to provide a suitable paste for processing in a refiner.

The most widely used alternative method is to mill the solid ingredients (i.e. sugar, milk powder and/or crumb) separately and then mix with the liquid components (cocoa mass, cocoa and cow's butter and lecithin) in the conche.

This may result in different flavours from when all the ingredients are processed together. Niediek (1994) attributes this to the fact that, when sugar particle are broken, the surface becomes very reactive and is able to pick up any flavour components in the vicinity. These will be different if the cocoa is present, as in the combined milling, rather than if the ingredients are ground separately.

### 1.2.3 Conching – flavour and texture development

Although the fermentation, drying and roasting are able to develop the precursors of chocolate flavour, there are also many undesirable chemical compounds present. These give rise to acidic and astringent tastes in the mouth. The object of conching is to remove the undesirable flavours, while developing the pleasant ones. In addition, the previous grinding process will have created many new surfaces, particularly of sugar, which are not yet covered with fat. These uncoated surfaces prevent the chocolate flowing properly when the fat is in a liquid state. Because of this the chocolate cannot yet be used to make sweets and does not have the normal chocolate texture in the mouth. The conching process (Chapter 10), therefore, coats these new surfaces with fat and develops the flow properties, as well as modifying the flavour.

This is normally carried out by agitating the chocolate over an extended period in a large tank, known as a conche. The mixing continuously changes the chocolate surface and this, coupled with some heating and ventilation, enables the volatile components to escape and the flavour to be modified. Some manufacturers prefer to limit the conching time by restricting the conching process to primarily one of liquefying the chocolate. This is made possible by treating the cocoa mass at an earlier stage, in order to remove some of these less desirable volatile chemicals.

## 1.3 Concept of the book

Chocolate making was, for over 100 years, a traditional industry governed by craftsmen who developed individual methods of working, as well as “house” flavours for products. With increasing economic demands for higher throughputs and less labour, the industrial manufacture of chocolate has become more and more mechanized. There has also been an increased application of science and technology to control production plants and enable them to operate efficiently. In this situation the equipment manufacturers are introducing new machinery, whilst the literature abounds with new methods of manufacture and patents for “improved” techniques. Certain basic principles of chocolate making exist, however, and the aim of this book is to show what these are and how they can be related to the processes used in its manufacture. It has been intended to avoid making the book a catalogue of a selected number of machines and products. In order to try and achieve this and to give the book as wide a coverage as possible, authors have been chosen from a range of industries and research institutions in

Europe, North America and Australia. Chapters have deliberately been kept relatively short, and to a certain extent they follow the order of processing described in this chapter.

Certain topics have been divided into two, for example the chemical changes involved during conching have been presented separately from the physical and engineering aspects, as most authorities tend to concentrate predominantly on one or other of these aspects of conching. In addition to the technical side, plant hygiene, intellectual property and nutritional values have become increasingly important within the chocolate industry. Chapters have therefore been included to provide an overview of these subjects.

The manufacture of chocolate goods would not exist but for the consumer. What is seen on the market shelves is seldom the chocolate itself, but usually the container. For this reason the packaging, marketing and legal requirements for the product is of considerable importance and chapters on these three topics are included in the book.

Every author has contributed to the book as an individual. Each chapter, therefore, is the author's responsibility and may or may not be in agreement with the theories or principles adopted by the company by whom he or she is employed, or by the editors. As the chapters were written concurrently with little contact between the authors, several topics were duplicated. This has been minimised where possible, but retained where authors have given additional or even contradictory information. The latter is bound to occur owing to the present incomplete understanding of the processes involved. Minor differences in machinery or ingredients can produce major changes in the product. Each author, therefore, is merely reflecting his own experience within the wide range of combinations possible in chocolate making. The multinational authorship of the book highlighted the differences in terminology and units found throughout the industry. For example, the term "refinement" means flavour development in some countries and grinding in others. For this reason, and to aid people unfamiliar with the industry, a glossary of terms has been included at the end of book. The units given are those with which the author is most familiar, but frequently the most widely used alternative is also quoted. In addition, some of the more commonly used physical constants associated with chocolate making have been included in this edition.

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