Figure 3.9 Petzholdt spindle mill containing steel balls for fine grinding of cocoa mass. Reproduced with permission of Hamburg Dresdner Maschinenfabriken GmbH.

The effect on colour is very complicated (Cook and Meursing, 1984; Dimmick and Hoskin, 1981; Kleinert, 1972; Richardson, 1982; Schenkel, 1973; Taneri, 1977). The chemistry of the formation of the cocoa colour is based on a class of components which is rather specific for cocoa: polyhydroxyphenols (tannins). These are based on a basic molecular structure, that is epicatechin.

In the course of cocoa bean growing, fermenting, drying, alkalising and roasting, these compounds oxidise, polymerise (see Figure 3.10) and react with many other cocoa constituents. Thus, the number of chromophoric groups in the molecules is increased, resulting in darker colours but also in various colour hues, depending on the reaction conditions. The alkalisation process requires a lot of experience and skill, in order to obtain end products with a consistent colour in combination with good flavour characteristics. Specifically for darker coloured cocoa powders, the so-called alkaline flavour should not be too strong.

Table 3.1 Quality parameters for cocoa mass (Source: Cargill Cocoa, 2007).

Parameter	Value	Method
Fat content	Minimum 53%[a]	IOCCC 37, 1990
Moisture	Maximum 2.0%	IOCCC 26, 1988
Total Plate Count	Maximum 5000 cfu/g[b]	IOCCC 39, 1990
Moulds	Maximum 50 cfu/g	IOCCC 39, 1990
Yeasts	Maximum 50 cfu/g	IOCCC 39, 1990
Enterobacteriaceae	Absent per gram	IOCCC 39, 1990
Escherichia coli	Absent per gram	IOCCC 39, 1990
Salmonella	Absent per 750 g	IOCCC 39, 1990

[a] May vary due to bean origin and harvest.
[b] cfu/g: colony-forming units per gram; an indication of the amount of live microorganisms present.

The process is carried out by adding a solution of an alkali (mostly potassium carbonate) to cocoa nibs. This process can be batch (when pressurised conditions are required) or continuous (under atmospheric conditions) as previously explained. Each process has its own advantages and disadvantages and will result in specific cocoa powders with individual flavour and colour characteristics.

Cocoa mass can be transported and stored either in liquid or in solid form (as a single block or as kibbled pieces) in 25 kg (56 lb) cardboard boxes with a polyethylene liner or a bag inside. Due to the cocoa butter properties and the presence of natural anti-oxidants, cocoa mass has a very good shelf-life. As a result cocoa mass can be stored for several weeks in liquid form or for more than 12 months as a solid, providing that it is kept under suitable conditions.

3.8 Cocoa butter

Cocoa mass usually contains some 47–56% of cocoa butter and this is physically extracted to produce both cocoa butter and powder. Both non-alkalised and alkalised cocoa masses can be pressed using horizontal hydraulic presses (see Figures 3.11 and 3.12). The pre-heated cocoa mass is transferred into the so-called pots (16–18 pots per machine) and when the pressure is increased the butter flows out of the press; the cocoa particles are retained and, in fact, act to filter the cocoa butter. The cocoa particles are compressed in the pots and form cocoa press cake. The remaining fat content of the cake (normally a minimum of 10% using horizontal presses) can be controlled and, when the required level is reached, the press opens and the cake falls out. Hydraulic pressures of up to 540 bar (540×10^5 N/m^2) may be used with cycle times of around 15 min. The pressing procedure is influenced by the previous processing (e.g. the degree of alkalisation and grinding).