Table 5.3 Typical composition of dairy ingredients used in confectionery.

Ingredient	Protein (%)	Fat (%)	Lactose (%)	Minerals (%)	Moisture (%)
Anhydrous milk fat	0.0	99.8	0.0	0.0	0.1
Butteroil	0.0	99.5	0.0	0.0	0.3
Skim milk powder	33.4	0.8	54.1	7.9	3.8
Whole milk powder	25.0	26.8	39.1	5.8	3.3
High-fat powder (55%)	15.6	54.8	24.3	3.5	1.8
Buttermilk powder	31.6	7.8	50.0	7.4	3.8
Formulated milk powder	12.0	27.4	52.0	5.9	2.7
Whey powder Standard	12.6	0.9	74.5	7.5	4.5
Demineralized[a]	11.0	1.2	82.6	1.2	4.0
Milk crumb	7.6	31.0[b]	7.9[c]	1.7	1.3
Lactose	0.3	0.0	99.3	0.34	0.06

[a] Products with lower levels of demineralization are available.

[b] Includes milk fat and cocoa butter.

[c] Total carbohydrate content 55.8%, including 47.9% sucrose.

5.3.1 Milk fat ingredients

5.3.1.1 Anhydrous milk fat and butteroil

The composition of AMF, the most common milk fat ingredient used in chocolate, is shown in Table 5.3. Butteroil (BO) is similar to AMF in composition and in the way it is manufactured, but has just slightly different fat and moisture contents (Table 5.3). AMF can be prepared using two methods, either from fresh cream or from churned butter. The first method involves centrifugal concentration of heavy cream (40% fat) to a more concentrated cream (75–80% fat). The concentrated emulsion is then inverted from its native oil in water emulsion to a water in oil emulsion using a homogeniser. The water in oil emulsion in further concentrated to butteroil (95.5% fat) using centrifugation. The second method starts with traditionally churned butter as the raw material. The butter is melted and then the fat phase is separated from the aqueous phase. Centrifugation is used to concentrate the product to butteroil (95.5% fat). The production of AMF starts with butteroil, obtained from either method. A vacuum treatment is applied to reduce the moisture content from 0.5% in butteroil to 0.2% for AMF. AMF is typically packed into drums, or in larger bulk packs that contain 1 ton of AMF.

The guidelines for the composition and other properties of AMF according to the Codex Alimentarius (Codex, 1999a) are shown in Table 5.4. AMF is not permitted to contain antioxidants, whereas other milk fat products may contain certain antioxidants up to the levels specified in the Codex standard.

Table 5.5 shows the shelf life of typical dairy ingredients. The main cause of the deterioration of AMF is oxidation. Anhydrous products are not generally susceptible to deterioration resulting from bacterial growth as the moisture content is too low to support micro-organisms. The oxidation of AMF is measured

Table 5.4 Guidelines for the composition and other properties of AMF.

Measured property	Typical AMF specification
Minimum milk fat (% m/m)	99.8
Maximum water (% m/m)	0.1
Maximum free fatty acid (% m/m as oleic acid)	0.3
Peroxide value (milli-equivalents of O_2/kg of fat)	0.3
Taste and colour	Acceptable for market requirements after heating a sample to 40–45°C (104–113°F)
Texture	Smooth and fine granules to liquid depending on temperature
Maximum copper (mg/kg)	0.05
Maximum iron (mg/kg)	0.2

Codex (1999a) standard for milk fat products CODEX STAN A-2–1973, rev. 1-1999.

using the peroxide value. Peroxide values are typically 0.10–0.15 meq O_2/kg in good quality AMF. However, care needs to be taken in using a direct correlation between peroxide value and the shelf life of AMF. The compounds detected in the peroxide value test are intermediates in the oxidation reaction, in the later stages of oxidation, when oxygen is limited, these compounds will have been decomposed to give rise to off-flavours and will be low in concentration themselves. Therefore the peroxide value may be low, but the flavour of the fat may be poor.

Mechanisms that can be used to reduce the rate of oxidation and thereby enhance the shelf life of AMF are:

- Removing the oxygen by flushing with nitrogen,
- Using oxygen barrier packaging,
- Maintaining an appropriate storage temperature [often chilled to 4 °C (41 °F) or frozen],
- Avoiding the presence of oxidation catalysts.

It is nearly impossible to remove all of the oxygen from AMF to prevent oxidation, therefore controlling the storage temperature to reduce the rate of oxidation is recommended for products in which a long shelf life is required.

Copper and iron are catalysts in the oxidation reaction. Their involvement in the oxidation of AMF can be reduced by using stainless steel processing equipment. However, copper processing vessels are often used in chocolate manufacture and are thought to enhance the reaction in chocolate, resulting in the formation of desirable flavour compounds in chocolate and confectionery products. Some wrapping and packaging materials and inks may contain oxidation-catalysing substances. AMF should be kept away from such materials.

5.3.1.2 Milk fat fractions

The traditional high cost of cocoa butter and the legislative constraints on the fats that can be used in chocolate have resulted in considerable interest in replacing cocoa butter with milk fat fractions. Milk fat fractions may also be