Advances in Dairy Product Science & Technology
Advances in Dairy Products
Advances in Dairy Products

Edited by

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Part I

Ingredients for Dairy Products Manufacturing
1.1

Milk
Introduction

Milk composition is the result of breeding and feeding conditions. The traditional goal of milk producers is the highest yield of milk with the highest amount of protein and fat. The aim of milk processors is to have milk with differentiated composition able to provide nutritional and sensorial quality specific for each milk product (fluid milk, fermented milk, cheese, dried milk or milk ingredients) so as to increase the quality of the products and the efficiency of the processes.

The interest of milk producers may be sometimes in conflict with milk processors, despite the evidence that the supply chain needs a suitable milk to efficiently make a valuable milk product, to be recognized as such by consumers, willing to pay the right price for this reason.

It is first important to define milk protein, internationally considered as the product of total nitrogen by 6.38. IDF (1995) discussed if this definition should discount either the fraction called “nonprotein nitrogen” or the urea fraction, reducing the declared protein for milk and many milk products by 5% or 2.5%. Such a change could have significant implications with respect to payment to milk producers, animal breeding records, nutrition labeling, and the position of dairy products against competitive products such as soya.

The definition of milk protein may also divide the milk industry as the target protein, for most of cheese producers is casein, while for fluid or dried milk producers the values is the total protein content, as this is the content regulated by legal and nutritional issues.

Furthermore, the quality of proteins may be important as nutritional and well-being viewpoints are taken into account.

The method of evaluating the dietary quality of protein in human nutrition could change in the near future, as FAO is advocating the replacement of PDCAAS (Protein Digestibility Corrected Amino Acid Score) with the DIAAS (Digestible Indispensable Amino Acid Score). DIAAS measures the oro-ileal nitrogen balance by calculating the ileal digestibility of individual amino acids. In contrast, PDCAAS uses crude faecal digestibility values in measuring the oro-faecal nitrogen balance, which includes contributions from intestinal secretions and colonic bacteria, thus underestimating the protein available for absorption (FAO, 2014). The use of DIAAS would change the
ranking of the protein quality, determining a higher value of milk proteins when compared with other protein sources (Rutherfurd et al., 2015).

The protein content and a better score of the nutritional quality of milk proteins contribute to add value to milk products compared to other food proteins and as a direct consequence to add value to milk. So, today protein content is the first component of milk quality, determining its economic value.

Milk Composition and Systems of Payment According to Milk Utilization

Milk composition determines the technological properties and processability of several milk products, as cheese, butter, yogurt (Glantz et al., 2009) and powders. Milk composition is widely detailed in many books (e.g., Walstra et al., 2006; Mucchetti et al., 2006), with attention both to major and minor components. The amount of each component may vary in a more-or-less narrow range, but the range of variation and the distribution of the values are often unknown.

A robust record of the distribution of the values around the average values is up to date mainly for protein and fat, which measure is provided by legal requirements and by all the systems of milk payment according to quality. The average content of fat and protein of milk produced in 2014 by the 28 countries of the European Union, together with fat to protein ratio, are in Table 1.1.1. Differences among the average values are evident, considering that minimal and maximal values represent the average value related to the month of milk production and not the individual samples.

In 2014, Italian milk showed an average content of fat and protein of 3.77% and 3.35% respectively (Table 1.1.1). Looking at the distribution of the data of milk collected by one of the largest Italian companies (Granlatte, 2014) the average values resulting from more than 52,000 analyses of fat and protein were higher than the Italian values (3.93 and 3.41%, respectively), but more than 15% of the samples showed a fat and protein content lower than 3.70% and 3.20%, respectively.

Looking at the data of each country, the cumulative effect of different breeding, feeding practices and climates are clear. However, these gross data are useful for statistical aims, but they do not permit to discriminate the effect of the variables.

To be used, milk has to satisfy minimum legal requirements (Total Microbial Count TMC, Somatic Cell Count SCC, veterinary drugs and contaminant residues) (Table 1.1.1.2): the dairy must reject noncompliant milk.

Some dairies apply for some parameters, for example, aflatoxin residues, stricter limits than the legal ones (50 ppt): Fonterra refuses milk with a content higher than 25 ppt and starting from 20 ppt applies a demerit point (Fonterra, 2013), while Parmalat in Italy established an internal limit of 20 ppt for all its consumer products (Pinelli, 2005).

In addition to the minimal legal requirements, milk may be graded (and paid) according to its “quality,” usually measured according to one or more parameters (e.g., protein, casein, fat, lactose, TMC, SCC, thermoduric bacteria, spores, renneting properties, temperature at reception, etc.).

Furthermore, to be effectively graded, milk quality evaluation should consider its utilization, as it is evident that requirements for producing fluid milk, yogurt, cheese or other milk products may be very different.
### Table 1.1.1.1 Mean Values of Fat and Protein Content (% w/w) of Milk Produced in EU Countries (Eurostat, 2015).

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**28 EU Countries mean**  
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**SD**  
0.25  0.11  0.06
The use of different rules for fluid milk and cheese milk was traditional, as drinking milk was the reference product and cheese (when not covered by a specific standard of identity) was considered as the vent where the milk with lower characteristics might be convoyed. Up to the end of the last century in the United States, raw milk was differentiated into two standards: grade A milk used for fluid milk and grade B milk for cheese, butter, and dry milk (Chite, 1991). Grade B, as the letter clearly explains, was lower-quality milk, paid accordingly. Today, this distinction is disappearing, as grade A milk is about 99% of US milk produced, and it is used for all the milk products, with prices differently fixed according to four categories or classes of use (USDA 2015).

Class I. Grade A milk used in all beverage milks.
Class II. Grade A milk used in fluid cream products, yogurts, or perishable manufactured products (ice cream, cottage cheese, and others).
Class III. Grade A milk used to produce cream cheese and hard manufactured cheese.
Class IV. Grade A milk used to produce butter and any milk in dried form.

Butterfat, protein, and other nonfat/nonprotein solids represent variables differently affecting the price of each the four US milk classes (Jesse et al., 2008).

In Quebec (Canada), a five-class system is applied, including the class of milk ingredients (Bourbeau, 2010).

### Milk Payment Systems

According to Draaiyer and co-authors (2009), each system of milk payment based on quality, even the simplest, should be set as a function of one or more objectives:

- To avoid adulteration (e.g., milk dilution with water or other fluids);
- To increase yield of dairy products, as the yield of dairy products will depend on the amount of fat, protein and/or lactose and minerals present;

#### Table 1.1.2 Criteria for raw milk, according to European rules.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>CE Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Microbial Count (cfu/mL)(^a)</td>
<td>100000</td>
</tr>
<tr>
<td>Somatic Cell Count (cell/mL)(^b)</td>
<td>400000</td>
</tr>
<tr>
<td>Drug residues (µg/kg)(^c)</td>
<td>4 - 300</td>
</tr>
<tr>
<td>Aflatoxin M1 (µg/kg)(^d)</td>
<td>50</td>
</tr>
<tr>
<td>Lead (mg/kg)(^d)</td>
<td>0,02</td>
</tr>
<tr>
<td>Dioxins and PCBs (pg/g fat)(^d,e)</td>
<td>6</td>
</tr>
</tbody>
</table>

\(^a\) rolling geometric average over a two-month period, with at least two samples per month.
\(^b\) rolling geometric average over a three-month period, with at least one sample per month.
\(^c\) maximum residue limits of veterinary medicinal products in foodstuffs of animal origin.
\(^d\) maximum levels for certain contaminants in foodstuffs.
\(^e\) sum of dioxins and dioxin-like PCBs (WHOPCDD/ F-PCB-TEQ).
To promote hygienic quality of the milk and increase safety of dairy products, reducing the presence of pathogenic microorganisms, toxins, drugs, antibiotics, and other residues in the milk.

A payment system, which includes testing for selected parameters, with subsequent rejection and/or penalties or bonuses, is considered functional to improving milk quality.

Beside the quantity (volume or weight), the quality parameters considered in a milk payment system are related to composition (fat, protein, lactose, other solids, free fatty acids), to hygienic quality (total microbial count, thermotolerant count, spore count, mycotoxins, drugs, and residues), to physical properties (renneting ability, density, freezing point), and to aspects involved in animal health (somatic cell count).

Most dairies use simplified schemes, including only some of the cited parameters, and pay according to a milk standard composition (Table 1.1.1.3).

One of the prominent milk payment systems is the $A + B - C$ multiple component pricing system, where $A$ and $B$ are the monetary values per kilogram of milk fat and milk protein and $C$ is the penalty per liter of milk volume, responsible for higher delivery costs (Sneddon et al., 2013). The milk price is calculated according to the product of fat, protein, and other solids masses by their specific price (€/kg) (e.g., in the Netherlands, Ireland, Australia, New Zealand, Canada or United States) (Dairy Ireland, 2013; Dairygold, 2011; Royal Friesland Campina, 2014; Dairy Farmers of Ontario, 2015; CFR, 2015) eventually subtracted by a volume factor linked to delivery costs.

The system $A + B - C$ reduces the importance of the measure of freezing point, as the volume of milk has a negative value so it is senseless to add water to increase the milk volume delivered.

Alternatively, the system can act with a fixed price per liter/kg of milk integrated with a different premium or penalty for each percentage unit fat and protein above or below a base concentration as in Italy, Germany, or France (CLAL, 2015). In Italy, routine analyses carried out by sanitary controls with routine methods showed that about 11% of the samples resulted with a freezing point higher than the official value of –0.52°C (IZSLER 2015). Similar data were reported for Switzerland (Decrauzat, 2011).

When milk powder is the end product of milk processing, lactose becomes a key component, as in order to standardize milk, either lactose or UF milk permeate must be purchased, or fat and protein must be removed through centrifugal separation and membrane processing, adding costs (Sneddon et al., 2013).

Milk payment system used in the area of Parmigiano Reggiano cheese uses several parameters aimed to value the milk for its specific use, which is set, and economic values are fixed by the bargaining among each dairy and the milk producers delivering milk to the dairy.

Beside the usual ones, specific chemical and physical parameters are indexed as casein instead of total protein, aptitude to rennet coagulation, pH and titratable acidity, and urea (Malacarne et al., 2004).

Casein content is related to total protein content by an average index ranging from 0.774 to 0.782 in the years from 2008 to 2014 (IZLER, 2015).

Changes are mainly due to shifts of nonprotein nitrogen and milk urea nitrogen (MUN) content frequently caused by different feeding conditions.
Table 1.1.1.3: Minimum values of parameters used for milk payment below them monetary penalty or demerit point are applied.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>France</th>
<th>Italy</th>
<th>Denmark</th>
<th>Ireland</th>
<th>Ireland</th>
<th>Switzerland</th>
<th>Australia</th>
<th>New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (%)</td>
<td>3.2</td>
<td>3.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat (%)</td>
<td>3.8</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactose (%)</td>
<td></td>
<td></td>
<td></td>
<td>4.3</td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCC (Somatic Cell Count) / mL</td>
<td>250000</td>
<td>350000</td>
<td>400000</td>
<td>400000</td>
<td>300000</td>
<td>200000</td>
<td>400000</td>
<td>400000</td>
</tr>
<tr>
<td>TMC (Total Microbial Count) / mL</td>
<td>50000</td>
<td>100000</td>
<td>50000</td>
<td>50000</td>
<td>50000</td>
<td>60000</td>
<td>100000</td>
<td>50000</td>
</tr>
<tr>
<td>Thermoduric count/mL</td>
<td></td>
<td></td>
<td>1000</td>
<td>500</td>
<td>5000</td>
<td>1500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coliform /mL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spores/L</td>
<td>1000</td>
<td>500*</td>
<td>4000</td>
<td></td>
<td></td>
<td>2500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freezing Point (°C)</td>
<td>−0.502</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>−0.516</td>
<td></td>
<td>−0.513</td>
</tr>
<tr>
<td>Aflatoxin (ppt)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFA (Free Fatty Acids) (meq/100 g fat)</td>
<td>0.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: WEB documents from:
- UCAL (2013)
- CLAL (2015)
- Arla Foods (2015)
- DairyGold (2011)
- Glanbia (2011)
- Prolait (2012)
- Murray Goulburn (2014)
- Fonterra (2013)
Milk Payment Systems

MUN content is used as a diagnostic of protein feeding in dairy cows, as monitoring the adequacy of protein feeding is a tool to optimize the efficiency of nitrogen utilization by cows with respect to both milk protein production and nitrogen emissions into the environment (Nousiainen et al., 2004, Duinkerken et al., 2011). Average MUN content in Italy is usually lower than 23 mg/dL (IZLER, 2015), with a range from 10 to 40 mg/dL (Granterre 2014). These figures are comparable to data from Belgium (Dufresne et al., 2010), but higher than US data (Ishler, 2008).

Acidity of milk, measured as titrable acidity and/or pH, is a contractual parameter applied in France as a pass/nonpass criterion by Danone (FNPL, 2011), which required milk with pH in the range 6.65 to 6.85 or acidity below 16° Dornic (3.55°SH/50 ml).

Milk is often criticized for its low ratio of unsaturated to saturated fatty acids (FA). Composition of milk fat by dairy cow varies both by feeding and breeding. The ratio between unsaturated and saturated FA can be manipulated feeding cows with an increased intake of fresh grass or clover silage, eventually supplemented with high-fat oil seed cakes (Nousianen et al., 2007). This ratio can change from 0.47 to 0.41, as shown by July 2014 data of milk compared to December 2014, because the content of saturated FA decreased in summer while the unsaturated FA were constant (IZSLER, 2015). Also, as the genetic trend for milk fat concentration is declining, the proportion of saturated FA may decrease because the importance of mammary de novo synthesis of FA of milk fat is lowered (Nousianen et al., 2007).

Milk fat content may be manipulated by targeting feeding to increase the conjugated linoleic acid (CLA) and ω-3 FA content. Milk fat from grass-based diets may be poorer in short-chain FA and linoleic acid and richer in α-linolenic acid when compared to corn silage diets (Reviron et al., 2008).

To promote a change toward the increase of the ratio unsaturated to saturated FA, some cow-feeding policies (e.g., see Switzerland) introduced a significant premium for cheese-milk produced without maize silage (SMP-PSL, 2015).

In Italy, milk for Parmigiano Reggiano cheese must be produced without using any silage for feeding cows or detecting at the farm (Ministero Politiche Agricole, 2015). Use of silage may be checked by measure of the content of cyclopropylic acids (Caligiani et al., 2014).

Free fatty acids (FFAs) content of raw milk is an additional parameter present in some milk payment schemes (Table 1.1.1.3), and it is considered an indicator of dairy cow nutrition, bacterial contamination, and storage quality (Hanuš et al., 2008; Nousiainen et al., 2007).

Microbiological quality of milk may be differently evaluated according to milk utilization, considering additional counts beside TMC.

While TMC of 100,000 cfu/ml is the legal limit for most countries, large dairies often use 50,000 cfu/ml or less as the standard TMC value (Table 1.1.1.3). To obtain a bonus, milk should often have a count lower than 30,000 cfu/mL. TMC, however, is a general parameter, easy to detect with rapid and automated methods, but clearly it does not discriminate the presence of specific groups of microorganisms. For this reason, it is not a useful tool to differentiate milk according to its use for processing.

The average TMC content of milk produced in Lombardia (Italy) in 2014 is lower than 40,000 cfu/mL, with only 3.9% of the samples exceeding the limit of 100,000 cfu/mL (IZSLER, 2015). Out of the 52,000 samples analyzed by the dairy Granlatte in 2014, 68% showed a count less than 25,000 cfu/mL (Granlatte, 2014).
Thermoduric bacteria, mainly heat and highly heat resistant aerobic spore forming bacteria as *Bacillus* spp and *Paenibacillus* spp (Ranieri et al., 2012; Lücking et al., 2013; Burgess et al.; 2010, Scott et al.; 2007), represent a major concern for long life fluid milk and dried milk quality within the storage time (Gleeson et al., 2013). Anaerobic spore forming bacteria (*Clostridium* spp) (Vissers et al., 2006) are more relevant for hard cheese production. Some companies foresee as acceptable a count of thermoduric bacteria ranging between 500 and 5,000 cfu/mL (Table 1.1.1.3).

Count of spores, or more specifically of butyric spores (Table 1.1.1.3), is applied by some countries, including Italy, Switzerland, France, and Denmark, with tolerated values ranging from 300 to 4,000 spores/L of milk.

Italian dairies producing hard-cooked long-ripened cheeses as Grana Padano, Parmigiano Reggiano or Provolone Valpadana PDO cheeses, within 2007 paid milk according also to anaerobic spore count (ARAL, 2002), as spore germination of butyric clostridia is responsible of the late-blowing defect (Mucchetti et al., 2006). The limit, crossed when a levy was applied, was 500 spores/L, while a bonus was paid for milk with a count less than 300 spores/L. As the average count of butyric spore in the last years was less than 200 spores/L (Bolzoni, 2012), this parameter is not yet compulsorily applied by Grana Padano and Parmigiano Reggiano dairies, but each dairy opts for its use or not.

Some dairies apply also a limit for coliforms despite of this criterion is no more considered at present time by European legislation (EC Regulation 2073/2005). A count of 500 coliforms bacteria/mL is the limit fixed by Fonterra (New Zealand) before to apply demerit points. Counts performed by IZLER in Lombardy (Italy) showed an average value in the period from 2011 to 2014 around 2,000 cfu/mL (IZLER, 2015).

Surprisingly, psychrotrophic bacteria count is usually not considered as a parameter to be used for milk payment, even though their heat resistant enzymes are responsible for alteration of long life fluid milk (Poffè et al., 1988; Griffiths et al., 1981) and their growth may represent a serious defect both for fresh or ripened cheeses, as for blue discoloration of Mozzarella cheese (RAFFS, 2010, Caputo et al., 2015).

At the same time, temperature of milk delivery, usually less than 6°C, is a requirement common to all the countries, and specific dispensation is requested to deliver milk at higher temperature, according to technological reasons.

Control of temperature before processing is essential for the prevention of excessive microbial growth and/or milk acidification.

A key parameter used to assess and pay the milk quality is the somatic cell count (SCC). SCC of milk of uninfected udder quarters comprises 70% to 80% of white blood cells (neutrophils and mononuclear cells, as macrophages and lymphocytes) and epithelial cells deriving from the udder tissue itself. A change of the somatic cell count may be the indicator of the presence of animals with a poor health status and is usually related with a lower milk production. Other physiological factors as parity, lactation stage, and breed could also be the origin of an increased somatic cell count (Schukken et al., 2003).

SCC, obviously under the legal target value of 400,000/mL, is an additional parameter that could be differently evaluated for milk grading, according to specific milk utilization. It is well known that SCC high counts are negatively correlated with cheese yield, because of changes of milk composition (Politis et al., 1988; Hortet et al., 1998). However, polymorphonuclear leukocytes (PMN), a class of SCC, can interact with cheese
proteolysis because of the activity of cathepsin D (Le Roux et al., 2003). Kelly and co-authors (2000) hypothesized that PMN may be used as a marker for certain functional properties of milk, which could be used by processors to screen bulk milks.

Furthermore, SCC is associated with the urokinase type of plasminogen activators, able to convert plasminogen to plasmin, the native milk proteinase. Plasmin is part of a complex protease–protease activator–protease activator inhibitor–protease inhibitor–system in milk (Ismail et al., 2010). Proteolysis is a key quality factor for many ripened cheeses, and plasmin can play a significant role in cooked cheeses, where chymosin could be partially or totally inactivated by the curd-cooking process (Sheehan et al., 2007; Hayes et al., 2002).

The evidence on the role of plasmin in the age gelation of UHT milk is conflicting (Ismail et al., 2010), but UHT milk processors consider the inactivation of plasmin to a residual activity less than 1% (van Asselt et al., 2008) as one of the primary targets of the milk heat treatment. In any case, the ability of plasmin to hydrolyze casein is a factor reducing the shelf life of UHT and pasteurized milk, as showed by the increase of proteose-peptone fraction, also in pasteurized milk stored for 10 days (De Noni et al., 2007).

The presence of plasmin in casein and whey protein products, should be considered, as it could hydrolyze milk and/or other proteins in a system to which casein or whey protein are added as functional ingredients (Ismail et al., 2010).

A count of 200,000 to 250,000 SCC/mL is becoming a limit to avoid penalties, while values lower than 100,000 SCC/mL justify a bonus, as in the schemes of milk payment of several dairies (UCAL 2013, Prolait, 2012, Murray Goulburn, 2014). Italian data showed in 2014 an average value of about 275,000 SCC/mL (IZSLER, 2015), with 10.7% of the samples overpassing the limit of 400,000, while Granlatte (2015) showed an average of 247,000 SCC/mL with more than 35% of samples with a count lower than 200,000.

Other Parameters of Milk Quality Deriving from a Genomic Approach Proposed for Milk Payment Schemes

The design of milk with specific protein characteristics becomes more and more feasible for breeders (Caroli et al., 2009), because of the advances in genomics and proteomics.

An example is the breed selection, according to the ability to produce milk with the B variant of k-casein, characterized by the substitution of Thr 136 and Asp 148 with Ile and Ala, respectively (Grosclaude et al., 1972). These mutations are located in the so-called casein macro peptide (CMP) relatively close to several glycosylation sites (e.g., Thr 131) and probably affect the structure of the protein and glycosylation patterns. Presence of B allele of κ-Cn not only is associated with an increased cheese yield and quality, but also correlates with other valuable parameters of milk productivity as protein content and milk yield (Walsh et al., 1998). The frequency of kB-Cn is naturally higher than 50% in some breeds as Jersey, Bruna Alpina, or Normande (Walsh, 1999). Tests for rapid check of kB-CN are available (Summer et al., 2010).

Even B allele of β-lactoglobulin is associated to a higher casein number, and it is considered a useful parameter for cattle breeding selection (Hallén et al., 2008).
Other Aspects of Milk Quality for Specialty Dairy Products

Today, beside the question arising from the definition of milk protein and the proposed change of nutritional evaluation, the role of milk protein in human well being is being discussed and new trends in milk production and esteem can be induced.

The Role of Digestive Peptides from β-Casein and the A2 Milk

Some peptides produced by gastric and gut enzymes during human digestion by hydrolysis of β-casein A1, with the amino acid histidine at residue 67, for example, the casomorphin peptide β-CM-7 (Tyr-Pro-Phe-Pro-Gly-Pro-Ile) are believed to be potentially involved with some diseases, like cardiovascular diseases or type I diabetes (Bell et al., 2006). Other researches do not support these findings (Truswell, 2005, Clemens 2011). A scientific opinion by EFSA (2009) states, “Based on the present review of available scientific literature, a cause–effect relationship between the oral intake of BCM7 or related peptides and aetiology or course of any suggested non-communicable diseases cannot be established.”

Because of the potential relationship between opioid peptides and the pathogenesis of autism in children, there is increasing interest in the use of casein free diets for children with autism spectrum disorders. It was shown that autistic children have significantly higher levels of urine CM-7 than control children (Sokolov et al., 2014), overpassing the findings of Cass and co-authors (2008) that did not find opioid peptiduria by CM-7. However, in general it has to be remembered that the connection of cow’s milk to autistic spectrum disorders is lacking, and even a cause–effect relationship with type I diabetes mellitus has not been established because many factors may concur (Agostoni et al., 2011).

However, as the A2 variant of β-casein, with proline in position 67 does not favor or hinder the production of the peptide CM7. A2 milk is considered “safer” and alternative to the A1 milk produced by most of European dairy cow breeds. In late 1990s, the “The a2 milk company” started to produce at least 99% pure A2 milk in New Zealand (www.a2milk.com), and the worldwide movement toward the genetic selection of A2 cows continues, despite the lack of clear scientific demonstration of the benefits of A2 milk or concerns related to A1 milk.

A precautionary position is represented by Swinburn (2004), concluding a report to the New Zealand Food Safety Authority with the following: “As a matter of individual choice, people may wish to reduce or remove A1 β-casein from their diet (or their children’s diet) as a precautionary measure. This may be particularly relevant for those individuals who have or are at risk of the diseases mentioned (type I diabetes, coronary heart disease, autism and schizophrenia). However, they should do so knowing that there is substantial uncertainty about the benefits of such an approach.”

A2 milk is the key ingredient of some lines of infant formula (e.g., a2 Platinum Premium Infant Formula) (Synlait, 2015). The producer claims that A2 milk is easier for newborns to digest because of its greater similarity with human milk. Human β-casein, as sequenced by Greenberg and co-authors (1984), is however different from cow A2 variant.

Melatonin-Enriched Milk

A further example of milk production according to milk specific properties, in this case the milking management, is the intriguing case of the naturally melatonin-enriched
milk, obtained from the exclusive milking of night milk, as dark stimulates melatonin secretion into plasma and milk (Valtonen et al., 2003; Peukhuri et al., 2012). First produced in 1999 in Finland by a small company, the Ingman Dairy, as Night Time fluid milk (Mellentin, 2003), the product was transformed by Gnann (2006), which patented a method to at least double the natural milk melatonin content with the use of appropriate light regime. Melatonin content was further increased by low temperature under vacuum drying (www.nacht-milchkristalle.de). Synlait (2015) produces in New Zealand high-melatonin powdered milk.

Conclusions

The examples made in this chapter suggest that milk production can be addressed to different targets and that this perspective is not a future trend, but exists at the present time. In this perspective, milk composition should be observed as both a whole food able to give high-value traditional products (fluid milk, fermented milk, and cheeses) or a base for cracking its components to create functional ingredients.

References


