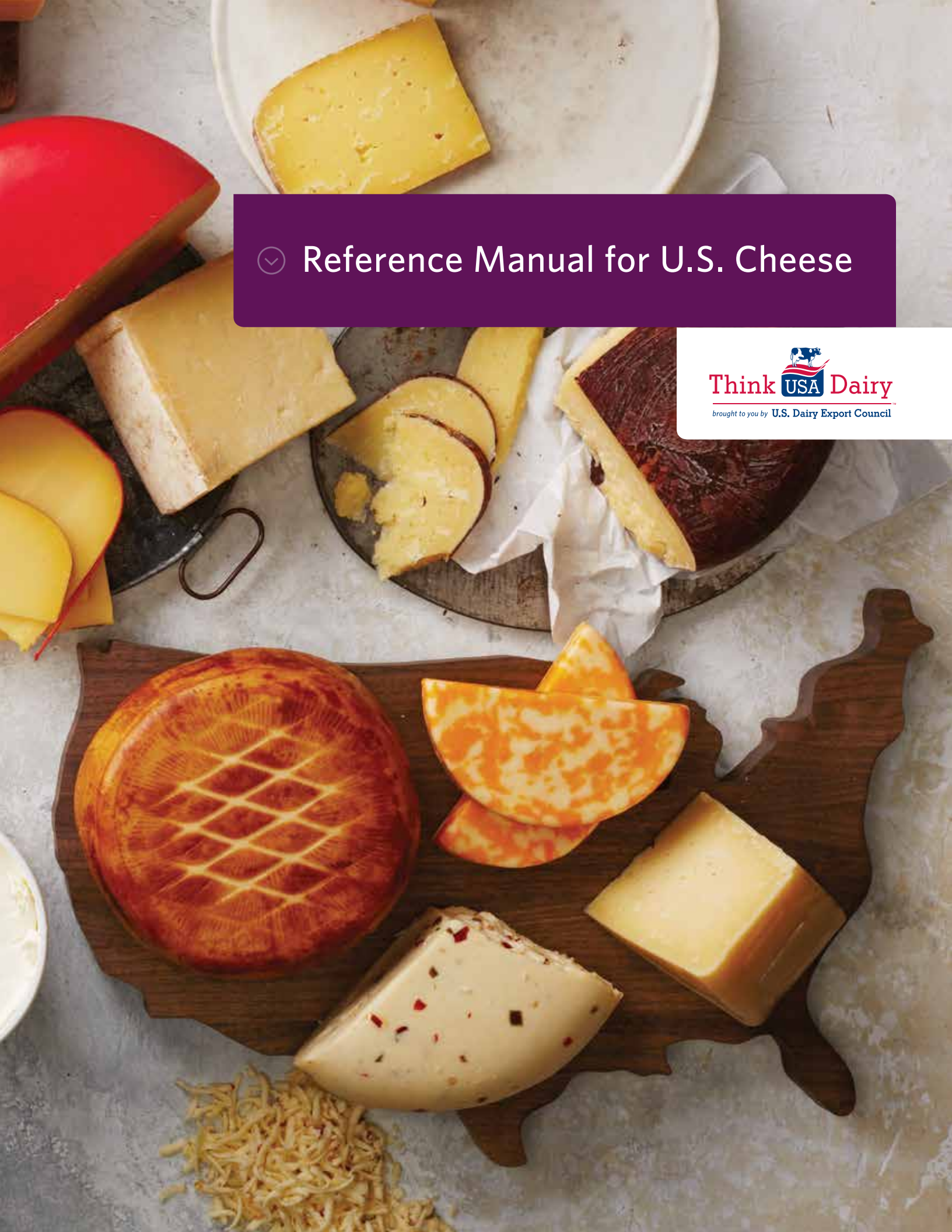


Reference Manual for U.S. Cheese

Think USA Dairy

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Introduction



ACKNOWLEDGEMENTS

The U.S. Dairy Export Council (USDEC) wishes to extend its appreciation to all the individuals, companies and associations who contributed to the development, review and production of this manual.

This reference manual is designed to guide and educate international buyers and end-users on purchasing and using U.S. cheese. It is an information resource that includes:

- A description of the U.S. cheese industry.
- Definitions of cheese varieties.
- Descriptions of the processes used to produce and handle cheese.
- Discussions of the functional and nutritional properties of cheese.

U.S. DAIRY EXPORT COUNCIL (USDEC)

The U.S. Dairy Export Council (USDEC) is a non-profit, independent membership organization that represents the global trade interests of U.S. dairy producers, proprietary processors and cooperatives, ingredient suppliers and export traders.

Founded in 1995 by Dairy Management, Inc., USDEC's mission is to enhance demand for U.S. dairy products and ingredients by securing access and assisting suppliers to meet market needs that facilitate sales. Activation occurs through research and collaboration with members, government, academia and numerous related organizations whose common goal is to ensure the health and vitality of the U.S. dairy industry. USDEC, together with its network of overseas offices, also works directly with global buyers and end-users to accelerate customer purchasing and innovation success with quality U.S. dairy products and ingredients.



U.S. Dairy Export Council
Ingredients | Products | Global Markets

Dairy Management Inc., the farmer-funded marketing, promotion and research organization, is USDEC's primary funder through the dairy checkoff program. The U.S. Department of Agriculture's (USDA) Foreign Agricultural Service provides export market development support, and membership dues fund the Council's trade policy initiatives.

The Council's headquarters are in Arlington, Virginia (adjacent to Washington, DC) and can be contacted at:

U.S. Dairy Export Council
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Arlington, VA 22201, USA
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Fax: +1-703-528-3705
ThinkUSAdairy.org

Global Presence

USDEC has an extensive network of staff and representatives around the world, from Asia to the Middle East and North Africa, Latin America and the United States. Representing the needs of its members as well as global buyers, end-users and food & beverage industry stakeholders, USDEC proudly serves as a comprehensive resource for actionable U.S. dairy information.

USDEC representative offices are key to sharing timely insights about the U.S. dairy industry, its wide product offerings and the

multifaceted nutritional and functional benefits of U.S. dairy products and ingredients. This is accomplished through one-on-one meetings, marketing events such as seminars, workshops and trade missions, participation in trade shows and conferences, as well as public relations and health professional engagement efforts.

Services Designed to Boost Global Sales of U.S. Dairy Products and Ingredients

- **Market Access and Regulatory Affairs:** A team of experts monitors the regulatory climate around the world to identify changes to tariffs, product standards, import requirements and other market access matters to facilitate trouble-free transactions.
- **Trade Policy:** Trade policy professionals work to achieve the best possible outcome for U.S. dairy products in trade negotiations and resolve ongoing trade disputes and threats to U.S. dairy export growth.
- **Global Marketing:** The global marketing team works on driving demand and preference for U.S. Dairy through marketing services that accelerate customer success in the marketplace, essentially paving the way for the U.S. industry to capture the untapped potential of the global market.
- **Strategy and Insights:** The strategy and insights team seeks out market opportunities for U.S. dairy products and, through research, collaboration and an adept grasp of market dynamics, develops specific strategies for U.S. suppliers to capitalize on those opportunities.

Our Members

USDEC builds on collaborative industry partnerships with processors, trading companies and others to increase global demand for U.S. dairy products. Since USDEC was founded in 1995, membership has grown to more than 120 companies and now represents 80% of U.S. dairy processors. USDEC's wide range of member companies and their dedicated staff are committed to fulfilling the dairy product needs of customers around the world, whether in Shanghai, Sao Paulo, Mexico City, Berlin, Riyadh, Chicago or any corner of the world. VisitThinkUSAdairy.org for a complete list of our members and to search for U.S. cheese suppliers.



ThinkUSAdairy.org: U.S. Dairy Resources at Your Fingertips

ThinkUSAdairy.org is an online and on-the-go resource tailored to the unique needs of global buyers, foodservice professionals and food manufacturers.

The website provides an inside look for buyers into the U.S. dairy industry and its extensive portfolio of products. It enables them to search for U.S. suppliers based on specific needs and product attributes (see "Discover U.S. Dairy" and "Supplier Search"). But that's not all! End-users can learn more about the current culinary trends and nutrition facts related to dairy and find inspiration on how to use U.S. cheese (see "Using Dairy" and "Nutrition & Trends").

Finally, our new smartphone- and tablet-friendly site now enables on-the-go access to this wealth of information.

Please visit ThinkUSAdairy.org today to learn more about U.S. Dairy!



1 The U.S. Dairy Industry and Export Initiatives



1.1 OVERVIEW OF THE U.S. DAIRY INDUSTRY

With an ample and rising milk production capacity and competitive product portfolio, the U.S. dairy industry is well positioned and eager to fulfill the world's expanding appetite for dairy. Throughout the supply chain, from farm families and milk processors to product and ingredient manufacturers, the U.S. dairy industry is fully invested in being a long-term global supply and innovation partner that drives customers' business forward.

U.S. Dairy Farming Today

Advantageous land and resources, along with the adoption of modern and efficient farming practices, secure the United States' position as the world's largest producer of cow's milk. In 2015, the United States had 9.3 million cows and produced 94.6 million metric tons of milk across 45,000 farms. That's three times the milk production volume of New Zealand and Australia combined. The majority of U.S. dairy farms are family-owned and operated. With generations of experience, U.S. dairy farmers know that healthy, well-tended cows fed a nutritious diet consistently produce wholesome, high-quality milk. U.S. dairy farmers work closely with animal nutritionists and veterinarians to identify the right mix of feed ingredients to meet cows' nutritional requirements. In turn, the cow's powerful digestive system utilizes these dietary nutrients to produce wholesome, high-quality milk. Minimal season-to-season variance in feed quantity and nutrient composition ensures a steady milk supply throughout the year, in contrast to the cyclical volume typical of dairy cows that graze, as is common in some parts of the world.

Ample Growth Capacity

The United States has the land, infrastructure and technological resources in place to continue its expansion of milk production and dairy product offerings. Cumulative growth in U.S. milk production between 2005 and 2015 topped 14 million metric tons, outpacing other supplying regions. With U.S. milk production forecast to rise an additional 7.3% annually through 2019, this upward trajectory assures global customers



a reliable, long-term source of wholesome dairy products. This steady future milk and dairy production growth capacity sets the United States apart from constraints that other milk-producing regions experience. Moreover, this rising growth capacity is backed by the assurance of rigorous quality and safety standards. From stringent farm sanitation to state-of-the-art food manufacturing technology, the U.S. dairy industry carefully controls conditions to deliver world-class products and ingredients to customers. Individual farmer and processor efforts are supplemented by rigorous government oversight to further protect consumers.

World-Class Product Portfolio

The United States' nearly 1,300 registered manufacturing facilities—from the largest food production operations in the world to small, boutique facilities for hand-crafted specialty items—follow strict food safety procedures to create an incredible variety of wholesome, quality dairy products and ingredients.

The United States is the world's largest supplier and manufacturer of high-quality cheeses. U.S. cheese producers create more than 600 types of delicious cheeses in a range that includes European-style selections such as parmesan and mozzarella alongside American Originals such as monterey jack, colby and cream cheese. International competitions place U.S. specialty cheeses among the best in the world with consistent top honors for flavor, body and appearance. Likewise, the United States leads the world as a single-country source of skim milk powder, lactose and whey ingredients, which are available in a wide range of protein levels to suit customer needs. This includes whey permeate, sweet whey, whey protein concentrates, whey protein isolates and whey fractions. Additional rising U.S. dairy offerings—from ingredients such as milk proteins and milk permeate to products such as butter, yogurt, ice cream and other dairy desserts—combine to underscore the U.S. dairy industry commitment and ability to serve world markets.

Continuous, ample and on-the-rise milk production drives ongoing U.S. dairy industry investments in cutting-edge product research and processing capabilities to directly support an ever-expansive global product portfolio. Custom



development requests also spur U.S. product innovations, with examples in recent years such as gouda cheese, whole milk powder, milk protein concentrates and milk protein isolates. Ongoing development of value-added dairy offerings as well as next-generation products and ingredients ensure that U.S. dairy products continue to meet the changing needs of customers worldwide.

Food and beverage companies, chefs and foodservice menu developers, nutritional products manufacturers, importers and humanitarian organizations count on U.S. dairy products to delight and nurture consumers around the world. For more information on specific U.S. products, including production and export volumes, functional and nutritional attributes and key usage applications, visit ThinkUSAdairy.org.

Rising Global Presence

The dedication of American dairy farmer and processor communities reaches far beyond U.S. borders. Domestically focused a decade ago, the U.S. dairy industry today has embraced global markets and emerged as a leading dairy supplier worldwide. Today, one in seven tankers of milk leaving American farms is turned into products sold overseas. That's equivalent to 14.4 million metric tons of milk or the milk from 1.4 million U.S. cows. As global demand for dairy continues to rise, the U.S. dairy industry is meeting the challenge.

U.S. dairy suppliers today are attuned to global customers' needs, with sales efforts increasingly supported by offices and representatives around the world. The industry is also fully invested in delivering a product portfolio that meets the selection, specifications and packaging global customers seek. The result has been a sharp upward trajectory in exports, achieving back-to-back records each year from 2010 through 2014. This steady export growth affirms the United States' long-term commitment to collaborative partnerships with global customers.

1.2 COOPERATIVES WORKING TOGETHER (CWT)

Cooperatives Working Together (CWT) operates within the structure of the National Milk Producers Federation (NMPF), the membership organization for America's dairy cooperatives. CWT's funding comes on a voluntary basis from U.S. dairy farmers, both cooperative members and independent producers. Participation in the program is open to all U.S. cooperatives who are members of CWT.

Export Assistance Program

CWT provides assistance to member cooperatives to sell to foreign commercial markets. Export bids are accepted from member organizations to export eligible products. The range of dairy products eligible under this program is American-type cheeses (see below for eligible varieties), butter and whole milk powder.

Cheese Varieties Eligible for Export Assistance

- Cheddar
- Colby
- Gouda
- Monterey Jack

Eligible Packaging

- Bulk and retail packaging styles are eligible under CWT

Eligible Destinations

- Worldwide, excluding Canada and Mexico

CWT does NOT take ownership of any product. The export assistance activity generated by CWT is independent of any government programs.

For more information on CWT, please visit cwt.coop.

2 The U.S. Cheese Industry



2.1 OVERVIEW

As a buyer or an end-user of cheese, you are most likely looking for the best products or ingredients to set your business apart from the competition. The United States might not be the first place that comes to mind for your every cheese need. We invite you to rethink U.S. cheese and discover what makes the United States the best-suited future source for global cheese supply.

A Long-Standing Heritage

As a country of immigrants, many of our traditions reflect our ancestry, and one of those traditions is a love for cheese. Using Old World recipes and traditional methods, an industry was born with the first settlers. Today, the U.S. cheese industry is an international center of cheese making excellence and innovation. The United States offers hundreds of varieties and styles perfectly crafted to meet global customers' and consumers' desire for enjoyable, great-tasting cheese. While cheese is essential and beloved in many of the world's favorite foods, like pizza and cheeseburgers, it can also add a nice twist on international dishes. The U.S. cheese industry is proud of its heritage and strives to continuously innovate to meet the growing needs of its customers.

World's Largest Cheese Producer

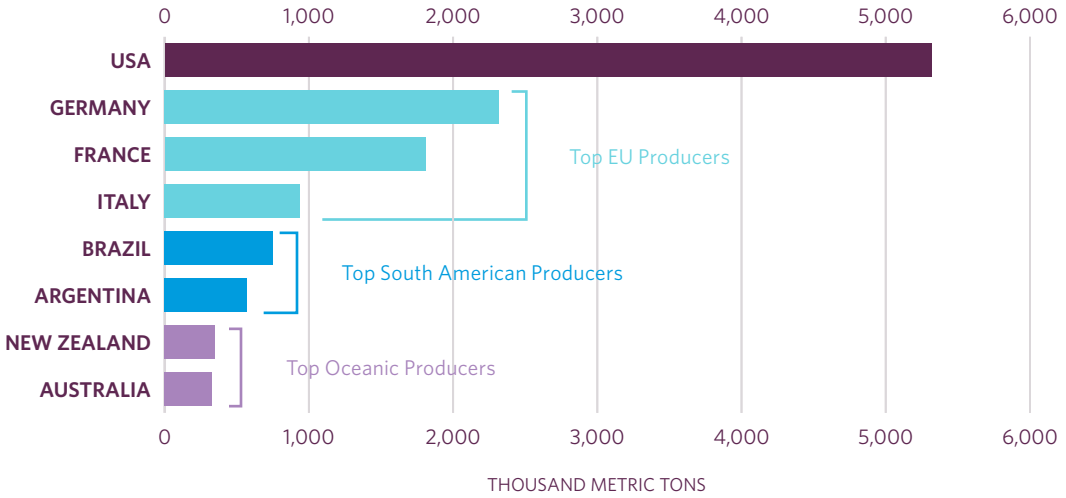
Almost a quarter of the world's cheese – over 5.1 million metric tons in 2014 – is manufactured in the United States, and production continues to grow. With the largest cow's milk supply in the world, an abundance of land, and investments in research and technology, the U.S. cheese industry is capable of unrestrained growth to meet customer demand.

Year-round cow's milk production guarantees product availability at any time of the year. With its state-of-the-art production facilities, the U.S. cheese industry has increased production by more than 1.1 million metric tons over the past decade. Customers have come to rely on this consistent supply of high-quality cheeses.

Variety at Your Fingertips

In the last couple decades, the U.S. cheese industry has enjoyed a renaissance of specialty cheese making. Over 600 varieties, types and styles of cheese are available from skilled U.S. cheese makers. These selections range from European-style favorites such as mozzarella, cheddar and parmesan to

Global Cheese Production 2015



Source: OECD, Eurostat, USDA

American Originals like monterey jack, colby and cream cheese. U.S. cheese makers continue to develop the art of cheese making to delight customers' palates worldwide. With hundreds of cheese types and flavors, buyers and end-users will find the cheese product that meets their needs.

U.S. Natural Cheese Production by Major Type (metric tons)

	2005	2010	2015
Mozzarella	1,369,419	1,578,247	1,812,488
Cheddar	1,381,629	1,467,367	1,539,265
Other American Cheese	345,697	478,245	590,321
Other Italian Cheese	355,611	424,686	495,752
Cream Cheese and Neufchâtel	324,224	337,864	397,480
Swiss	136,137	152,614	141,540
All Others	237,345	298,022	392,973
Total Natural Cheese	**4,152,067**	**4,739,055**	**5,369,819**

Source: USDA, NASS

Innovations in Research and Technology

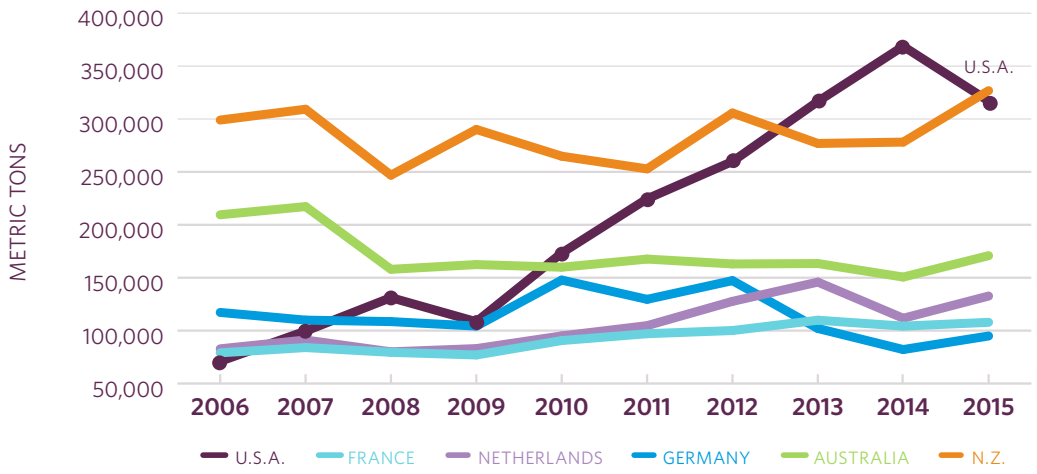
The U.S. cheese industry is well recognized for its advancements in cheese making research and technology. One example is the invention of IQF, or Individually Quick Frozen, mozzarella, which locks in the freshness of the cheese and stops the aging process, providing foodservice and industrial users with a consistent, high-quality product. Our industry is currently exploring innovative techniques to create reduced-sodium cheeses that meet high standards for taste, texture, moisture content and overall food safety.

Award-Winning Cheese Production

U.S. cheese makers are proudly competing alongside their European counterparts in globally recognized cheese competitions and are consistently winning top honors for their specialty and commodity cheeses. The United States won 83 medals at the 2015 World Cheese Awards and 247 at the 2016 World Championship Cheese Contest, accounting for 75% of the total medal count.



Global Cheese Exporters 2006–2015



Source: GTIS Global Trade Atlas

High Quality Standards

The United States has a long and enviable history of manufacturing safe cheese and dairy products. This is a responsibility that U.S. dairy farmers, dairy processors, processing equipment manufacturers and ingredient suppliers – working together with state and federal regulatory agencies – have taken very seriously. The U.S. dairy industry is a highly regulated industry with the U.S. Department of Agriculture (USDA) and the U.S. Food and Drug Administration (FDA) ensuring that U.S. cheeses meet some of the highest sanitation and quality standards in the world.

A Key Global Cheese Supplier

For the past 15 years, sales of U.S. cheese to international customers have grown more than 672%, with cheese exports skyrocketing from just over 12 thousand metric tons in 1991 to over 368 thousand metric tons in 2014.

The U.S. cheese industry is equipped for today's fast-paced business, focused on the future and willing to serve overseas customers as their partner in trade. While traditionally only part of a Western diet, over the past few decades, cheese has become a more familiar food in the diet of many cultures not customarily consuming it. As global appetites for cheese continue to grow, the U.S. cheese industry is well suited to supply the increased demand.To find a U.S. cheese supplier, visit our U.S. Dairy Supplier Directory at ThinkUSAdairy.org.



2.2 SAFETY OF U.S. CHEESE AND DAIRY PRODUCTS

BY DEAN SOMMER
Wisconsin Center for Dairy Research, Madison, WI

The United States has a long and enviable history of manufacturing safe cheese and dairy products. This is a responsibility that U.S. dairy farmers, dairy processors, processing equipment manufacturers and ingredient suppliers working together with state and federal regulatory agencies have taken very seriously. Cooperating together, they ensure safe and wholesome cheese and dairy products for consumers to enjoy.

The U.S. dairy industry is a highly regulated industry. The Food and Drug Administration (FDA) has overall regulatory authority for the production of safe foods, including cheese, in the U.S. Additionally, many cheese manufacturers voluntarily participate in a program administered by the United States Department of Agriculture (USDA) whereby cheese plants are regularly inspected and approved by that federal agency. Lastly, individual states also perform regulatory oversight of cheese manufacturing facilities and dairy farms.

As long ago as 1924, the U.S. Public Health Service recommended pasteurization as a means of controlling disease causing bacteria found in raw milk. At that time, the Public Health Service working with the dairy industry developed the Pasteurized Milk Ordinance (PMO) to serve as a model milk regulation. The PMO has been widely adopted and continues to be regularly updated through the efforts of the Public Health Service/FDA working together with state and local milk sanitation and regulatory agencies, dairy farmers, dairy processors, equipment manufacturers and educational institutions. The PMO is regarded as the United States' national standard for milk sanitation to provide for the protection of public health.

The U.S. cheese industry maintains a proven arsenal of safety-promoting technologies. These include milk quality management, pasteurization or heat treatment of milk for cheese making, lactic culture technology, adoptions of good manufacturing practices (GMPs) and widespread implementation of the food safety system known as HACCP (Hazard Analysis Critical Control Points). Additionally, many plants voluntarily participate in Global Food Safety Initiative (GFSI) certification programs including credible, rigorous food safety management programs such as BRC Global Standards or Safe Quality Food (SQF) Certification.

Safe milk begins on the farm, with healthy cows in clean environments. The vast majority of milk produced in the United States is classified as Grade A. Grade A requirements include a maximum aerobic plate count (APC) of 100,000 colony forming units per ml, and a maximum somatic cell count (SCC) of 750,000 per ml. Commonly, most milk at the farm would have an APC of less than 10,000 per ml and a SCC of less than 250,000 per ml. Milk must be cooled to 7°C (45°F) within two hours of completion of milking. Additionally, all shipments of raw milk must be tested for antibiotics, with any loads testing positive being destroyed. Typically, other raw milk quality tests are performed by the dairy processor, including odor, acidity, sediment and the presence of added water.

Pasteurization remains a widely used and effective processing step for the production of safe cheese. The vast majority of cheese made in the United States is made with pasteurized milk (milk is heated at 72°C/161°F for 15 seconds minimum). Some hard and semi-hard cheeses are made with a sub-pasteurization thermalization step known as heat treatment, where milk is typically heated to between 63 and 68°C (145 and 154°F) for 15 seconds or more. Cheeses made with this heat treatment must be held for 60 days at not less than 1°C (34°F) prior to sale. The combination of the sub-pasteurization thermalization together with the 60 day hold has also, over many years, been proven to be an effective technique for the production of safe cheeses.

Advancements in lactic culture technology have also contributed to the production of safe cheeses. The use of lactic cultures in defined strain blends has greatly improved the consistency of lactic acid production in cheese, with the resulting drop in pH to levels that are inhibitory to many pathogenic bacteria. The combination of low pH, metabolic competition provided by the lactic cultures, relatively high salt and reduced water activity provide considerable barriers in cheese to the growth of unwanted microorganisms, resulting in a product with remarkable resiliency with respect to safety.



The efficacy of these factors to provide inherent food safety conditions in many varieties of cheese has recently been confirmed in a cheese safety study done at the University of Wisconsin.[1]

The FDA has promulgated Good Manufacturing Practices (GMPs) that food companies, including cheese companies, are obligated to follow in order to produce safe products. GMPs outline practices for the safe handling of milk and cheese products throughout the entire production process. All cheese plant employees are trained in GMPs to prevent the post-pasteurization contamination of milk and to ensure the production of safe cheese.

Additionally, the principles of HACCP have been widely adopted in the U.S. cheese industry on a voluntary basis. HACCP is a food safety system designed to produce the safest food supply possible. It includes steps to identify potential hazards, identify critical control points, establish preventative measures, monitor techniques and corrective actions and develop verification systems. HACCP has provided the U.S. cheese industry with a powerful tool to ensure the safety of their products.

The FDA governs the limits for the presence of undesirable bacteria and other substances in cheese. For example, the FDA maintains a zero tolerance for bacterial pathogens such as *Salmonella spp., Listeria monocytogenes* and *Enteropathogenic E. coli.*

Additionally, cheese plants typically maintain specification sheets for all their cheeses, which include limits for indicator organisms such as coliforms (often less than 10 organisms per gram) as well as for spoilage organisms such as yeast and mold (often less than 100 per gram).

Most U.S. cheese companies have also addressed the issue of allergens. Keys to their allergen plans include monitoring of allergens in a food-processing environment, avoiding cross-contamination with known allergens and manufacturing products containing allergens at the end of a run.

Lastly, biosecurity has been a critical issue for the U.S. cheese industry since September 11, 2001. The U.S. government subsequently passed the Bioterrorism Act in 2002. As a result, all cheese and other food manufacturers have to register their plants with the U.S. government. Cheese manufacturers have taken many steps to safeguard their processes and products. Some examples include controlling the security of milk tankers picking up milk on the farm or delivering milk between processors, tightly controlling access to dairy plants, screening and positively identifying visitors to cheese plants, screening new employees, protecting water supplies, securing and sealing finished product trucks and developing systems to rapidly trace their ingredients and products.

U.S. DAIRY TRACEABILITY
Pinpoint and Protect

The United States dairy industry maintains an enviable record with respect to cheese safety. The process of governmental regulatory agencies working together with a committed dairy industry has resulted in an overall food safety system that provides wholesome, safe dairy products for the world to enjoy.

References

1. Leong, Wan Mei, et al, "Growth of *Listeria monocytogenes, Salmonella spp., Escherichia coli O157:H7,* and *Staphylococcus aureus* on Cheese during Extended Storage at 25°C." *Journal of Food Protection®* Number 8 (August 2014): Pages 1252-1440, 1275-1288(14).

2.3 TECHNOLOGY AND INNOVATION

BY DR. JOHN LUCEY
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AND EDITED BY DR. DAVID MCCOY
Dairy Insights LLC., Muskego, WI

Dairy research centers in the United States are developing new ways to satisfy the consumer's love for cheese with new cheese prototypes and processes that let cheese makers better control production, safety, shelf life, flavor and sodium content.

Manufacture of Lower Sodium Cheeses

Concerns about excess sodium in the diet has driven research into the manufacture of safe, high-quality, great tasting, lower sodium cheeses. A survey of over 1,600 commercial U.S. cheese samples demonstrated significant variation in sodium content, even within individual brands. It has also been determined that consumers can recognize as little as a 10% difference in salt content and have distinct preferences for the amount of salt. Researchers at the Wisconsin Center for Dairy Research, the Western Dairy Center, the Midwest Dairy Foods Research Center, the Southeast Dairy Foods Research Center and the California Dairy Foods Research Center have all been involved in developing new technologies to manufacture reduced and lower sodium cheeses. In general, it was found that potassium chloride could replace up to 25% of the sodium chloride on a molecule-for-molecule basis (molar basis). Even at that level of replacement, modification of manufacturing procedures and addition of bitter blockers or flavor intensifiers were needed to reduce metallic off-flavors and improve consumer acceptance.

When salt is replaced on a molar basis with potassium chloride, there appears to be no reduction in the safety of the cheeses and only minimal modifications in the manufacturing procedures. The Food Research Institute in Madison, with technical assistance and funding from the Innovation Center for U.S. Dairy, has completed a statistically designed study to update the 30-year-old data on safety of processed-type cheeses. Results from this study will be published in the summer of 2016. It should be useful in the development of lower sodium varieties of processed cheese type products in response to marketplace needs.



Development of a Novel Technique to Measure Sodium in Cheese

With funding from the Innovation Center for U.S. Dairy, researchers at the Wisconsin Center for Dairy Research developed a new method to rapidly and directly measure the sodium (salt) content of cheese. Traditionally, cheese manufacturers indirectly determine sodium by the analysis of chlorine. However, this approach does not work when salt replacers like potassium chloride are used, as the actual sodium content would be overestimated. In the mining industry, a technology called X-ray fluorescence spectroscopy (XRF) is used to rapidly measure sodium along with other elements. Researchers at the Wisconsin Center for Dairy Research successfully applied the XRF technology to cheese and validated the technology against reference methods for sodium analysis. Calibration curves for this technology were developed that could be used for estimating sodium content in any natural cheese variety. The method is rapid (<5 min) and does not

require any chemicals. Due to the presence of sodium-based emulsifying salts in processed cheese, specific calibration curves are needed that include the specific types of emulsifying salts used in that processed cheese. Industry members from the Innovation Center for U.S. Dairy have evaluated the technology and found that modified sample preparation techniques may be necessary, depending upon the type of cheese. Currently, this technology is being evaluated by the dairy industry and could be very beneficial in achieving better control of sodium levels during cheese manufacture.

Application of High Pressure to Modify Cheese Texture and Performance

Researchers at the Wisconsin Center for Dairy Research, in collaboration with the facilities at the American Pasteurization Company, a Milwaukee-based high pressure processing (HPP) company, have explored the application of high pressure to cheese. HPP is a novel, non-thermal treatment that can be applied to cheese after manufacture and when it is already packaged. This emerging technology is already used in the food and beverage industry to "pasteurize" juices and products like guacamole, where traditional heat treatments negatively impact the flavor. Low pressures can accelerate cheese flavor development and reduce ripening time (potentially providing cost savings due to a reduction in the time needed for aging to achieve the desired flavor development). High pressures can be applied to cheese to inactivate enzymes and reduce microbial numbers; both can help extend the shelf life. For example, after HPP treatment the shredability of mozzarella cheese can still be acceptable after six months of refrigerated storage. Other opportunities for high pressure include low sodium cheeses which are often acidic due to excessive starter fermentation related to the reduction in salt. HPP can also be applied to cheese to help with food safety concerns, which is a popular application in the meat industry. There are currently only a few dairy products using HPP in the market place, and ongoing research is focused on exploring its ability to help with cheese exports by extending shelf life.

Use of a New, Less Proteolytic Coagulant to Improve Cheese Quality

Recently, a new rennet was made commercially available to the dairy industry. It was discovered that the rennet (chymosin) produced by camels had very different characteristics than the calf chymosin. Camel chymosin actually clots cow's milk faster than calf chymosin and has less proteolytic activity on milk proteins. Thus, less rennet needs to be used for milk clotting. Researchers at the Wisconsin Center for Dairy Research have explored opportunities for this new type of rennet within the cheese industry. The limited proteolytic activity of camel chymosin on milk proteins was shown to significantly reduce bitterness in several types of cheeses, including low-fat and reduced sodium cheeses. Bitterness is a common defect in many cheese varieties; the use of camel chymosin would be beneficial if that is a concern. Extending the shelf life of cheese is an important topic for cheese manufacturers due to the demand for extended holding periods in the retail/distribution chain or to export cheese to international markets. Researchers have shown that use of camel chymosin could be helpful in cheese types that quickly become soft and thus have a short shelf life, e.g., fresh mozzarella, or even extending the performance shelf life (e.g., how long the cheese can be shredded) for functional cheeses like low-moisture, part-skim mozzarella. Many cheese companies are now using camel chymosin due to its different properties.

Quality and Safety of U.S. Cheeses

The U.S. cheese industry has an enviable record for quality and safety. Continuing research is investigating ways to further improve that record. Examples include:

1. The Northeast Dairy Foods Research Center has used pulsed light to reduce surface contamination of cheese.
2. The Western Dairy Center has identified *Lactobacillus wasatchensis* in the late-blowing of cheese (i.e. gas production in packaging).
3. The Midwest Dairy Foods Research Center and the Wisconsin Center for Dairy Research have both been involved in developing new technology for the reduction of biofilms in dairy processing and cheese making equipment to improve quality and safety of cheese.
4. The Innovation Center for U.S. Dairy is funding investigations into the control of *Listeria* in cheese and the cheese making environment. This work should be especially useful in the manufacture of high pH and surface ripened cheese.

2.4 THE IMPACT OF GEOGRAPHICAL INDICATIONS

Background

As a nation of immigrants, the United States is a melting pot of many cultures. As such, many American cheese companies have inherited their cheese making skills from European immigrants who came to America with a dream and their best cheese recipes. This is how the U.S. cheese industry started almost two centuries ago. They first made common cheeses from their homeland such as "parmesan" and "feta" – just to name a few – and to this day, they have continued these traditions. These cheeses became household favorites in the United States and have since won the hearts of many other nations. **However, today, an alarming situation is developing.** The names of some of the most popular U.S.-made cheeses are being threatened by the European Union's (EU) attempts to claim sole ownership of such names.

> Left unchecked, efforts by any group, to "own" generic terms will damage importers and end-users' sales of many popular food products around the globe.

Why should this matter to you?

These European efforts threaten to limit global supply options from the United States and other major dairy exporting countries. If that occurs, international cheese buyers would face a significantly restricted scope of future suppliers, thereby leading to higher costs. This could even force buyers to alter their current importing relationships and the business they have already developed. Ultimately, this would have commercial ramifications on buyers' market shares, business sales and profitability.



Many U.S. companies have joined in **an international effort to stop this over-reach on protected geographical indications** – that is, names of products associated with a particular geographic region. They are working with international allies from approximately a dozen countries to combat this threat to competitive global supply opportunities through the Consortium for Common Food Names.

It is important for end-users and importers that offer cheeses, meats and other products from a variety of countries to be aware of this issue and to support efforts to push back on the EU, because customers recognize and trust the names of their favorite products. When only European companies are allowed to market popular cheeses or other products by the names customers are familiar with, the result is less variety and less competition in the marketplace, hence higher costs and other negative business impacts for buyers, and ultimately consumers, due to the more limited range of supply options.

U.S. producers are not opposed to the concept of geographical indications (GIs), which protect the names of specialty products such as "Parmigiano Reggiano" from Parma, Italy, or "Gouda Holland." But when companies with rights to these GIs attempt to extend the protection to generic names like "parmesan," "gorgonzola," "asiago" and "provolone" – often as individual words within the GI – this is a clear over-reach that is designed to curtail competition.

The EU has been aggressively working in free trade agreements (FTAs) to inappropriately extend GI protections, and in some cases, has unfortunately succeeded. Specifically:

- **Korea:** Non-European cheese producers can no longer sell asiago, feta, fontina or gorgonzola in Korea – at least not under those names. The restriction is due solely to the EU's demands under its FTA with Korea. This restriction has impacted Korean importers by significantly constraining which countries and companies they can source these products from.
- **Singapore:** In its FTA negotiations with the EU, Singapore agreed to protect a lengthy list of GIs once those terms have undergone review by Singapore authorities. That list includes cheeses that Singapore companies have built up demand for – but existing supplier relationships have primarily been developed with countries not authorized by the EU to sell those products, so they are at risk of seeing restrictions imposed. For instance, importers of Danish and Australian feta could be forced to find new and more costly Greek suppliers of the cheese should Singapore acquiesce to protecting feta as a GI as part of this FTA.
- **Costa Rica:** Costa Rica presently restricts the use of parmesan and provolone to only Italian producers, despite long-standing use of those terms in Costa Rica, as well as elsewhere around the world. This decision has impacted local producers of those products who had been selling them in this country for decades, as well as more recent arrivals from the United States who had helped to further build demand for those types of cheeses by increasing the variety of available options.

The United States, among other countries, feels strongly about the issue of protecting common food names, in part because of its long history in producing many of these cheeses. Parmesan has been made in the United States for more than a century, and U.S. companies have won numerous international awards for their parmesans, fetas and other cheeses whose names are now threatened. The EU's efforts to restrain competition and global supply options stand in stark contrast to a global trend towards more open markets and growing variety options for buyers and consumers.

Left unchecked, efforts by any group to "own" generic terms will erode and damage sales of many popular food products around the globe. The U.S. Dairy Export Council, representing the U.S. dairy industry, is focused on the impact this could have for international cheese markets, but the issue also poses a particular risk to those in the meat, wine and produce sectors:

- Many **producers and exporters** will be forced to consider the difficult and costly effort of re-labeling and rebranding products, affecting marketability and diminishing the value of internationally recognized brands, all the while confusing consumers.
- **Importers and re-exporters** of market-leading cheeses and cheese brands, who would face legal action for importing cheeses with names protected by the EU from non-EU countries. They could suffer the loss of valuable markets they built over many years for their foreign principals, as well as consequent negative impacts on their return on past investments in building brands and on their current sales and profits.

- For **retailers,** the result will be fewer sales of favorite products and questions and comments from loyal consumers. There will be less variety of well-known cheeses and potentially smaller margins to the retailer.
- **Consumers** will no longer recognize familiar products and will become confused about their favorite products and brands. There will be fewer choices in stores, and higher prices could result in less competition within a recognizable product category.

How can you help?

The **Consortium for Common Food Names** (CCFN) is an independent, international, non-profit alliance that is working to stop attempts to monopolize common (generic) names that have become part of the public domain. The consortium seeks to foster the adoption of an appropriate model for protecting both legitimate geographical indications and generic food names. The U.S. Dairy Export Council and several leading U.S. cheese companies are founding members of CCFN, along with producers in Latin America, Australia and other regions.

As many nations have begun to introduce GI policies, food producers and retailers in these countries are also becoming interested in the protection of common terms.

Since its founding in 2012, CCFN has been very successful in raising awareness of this serious issue and pushing back on threats to common names. Visit CommonFoodNames.com to learn more about CCFN and its mission on behalf of global producers, buyers, end-users and consumers.

We also urge concerned companies – both producers and buyers – to join with CCFN in combating this growing threat to global supply options by either becoming members of CCFN or by requesting more information to facilitate their outreach to their own governments about this trade and competition concern. Either step can be initiated by contacting CCFN at info@commonfoodnames.com.

CFN Consortium for Common Food Names

Fontina



Feta



Gorgonzola



Provolone



Parmesan



Protect your right to choose where to source your cheese needs.

3 Quality Standards, Quality Assurance and Certifications



BY F. TRACY SCHONROCK
Schonrock Consulting, Fairfax Station, VA

3.1 U.S. DEPARTMENT OF AGRICULTURE INSPECTION PROCESS AND STANDARDS

When you buy U.S. graded or inspected cheese, you are assured it is a wholesome, high-quality product. The United States Department of Agriculture (USDA), Agricultural Marketing Service (AMS), Dairy Grading Branch provides this assurance. The U.S. Grade Standards, U.S. Specifications, and Commercial-Item-Descriptions used and the inspection and grading services provided by the USDA aid in the orderly marketing of cheese products. USDA-licensed inspectors and USDA cheese graders are assigned by the AMS to conduct these services, which include:

1. Plant survey services
2. Laboratory services
3. Product inspection and grading services

All of these services are performed at the plant where the cheese is produced or at a plant-controlled warehouse facility.

These services guarantee both the cheese maker and the cheese buyer that the product meets specific grade or contract requirements, has uniform quality and has good keeping quality. In order to have cheeses graded or inspected, the manufacturer must have their production facilities surveyed by the USDA.

3.2 PLANT SURVEY SERVICES

An experienced, highly trained USDA-licensed dairy inspector conducts the plant survey at least twice a year. The survey involves detailed checks of more than 100 items.

Some of the items on the dairy inspector's list include:

1. The plant surroundings must be clean to prevent bacterial or environmental contamination and maximize product safety.
2. Facilities must be of sound construction.
3. Areas such as the raw milk receiving, ingredient receiving, manufacturing, pasteurizing, packaging, supply storage and warehousing must have adequate lighting to facilitate inspection of products and the proper cleaning of equipment and facilities.
4. Incoming raw product is graded on a regular basis.
5. Incoming milk must be regularly analyzed to ensure high quality, product safety, and the absence of antibiotics.
6. All processing equipment must be of a sanitary design, properly maintained and properly cleaned to ensure the buyer that the cheese is protected from contamination.
7. Product handling practices, employee practices and process controls must be maintained to ensure product quality and safety.
8. Packaging and storage practices must be maintained to ensure that product quality and safety are maintained for the buyer.

Only after the milk is tested and approved can the cheese be produced. This guarantees a safe, fresh final product for the cheese buyer.

During this ongoing program, the inspector reviews records of the plant's cheese production process, which U.S. government regulations require cheese makers to create and retain for at least three months.

After a plant survey is complete, the inspector reviews the results with the plant management. Any deficiencies of public health significance observed are noted on the inspection report, discussed and corrected before approval is granted to the plant. All plants noted as having deficiencies are re-inspected prior to any certification.

Only plants that meet these requirements are granted an "Approved Status" and are eligible for grading, quality control and certification services. Cheese manufacturing plants that have been granted an "Approved Status" are listed in the quarterly published booklet, "Dairy Plants Surveyed and Approved for USDA Grading Service." It is available online from the United States Department of Agriculture at ams.usda.gov/dairy/grade.htm.

Plants, which are routinely surveyed, retain their "Approved" title as long as they continue to meet or exceed these stringent USDA standards.

All incoming milk is tested for:

- **Appearance and odor:** Milk should not show abnormal conditions, such as coarse sediment and curdling. Odor should be sweet and pleasing.
- **Somatic cell content:** Milk is rejected if somatic cell count exceeds 750,000 cells per ml.
- **Antibiotic residue:** Milk is rejected if antibiotic residues are detected.
- **Bacterial estimate:** Milk is rated "Undergrade" when its standard bacteria plate count exceeds 500,000 organisms per ml. Undergrade milk is not to be used to make cheese.

3.3 PRODUCT INSPECTION AND GRADING SERVICES

The USDA offers many inspection and grading services to provide assurance of wholesome and high-quality products. These services include but are not limited to confirmation of grade, compositional analysis, condition of container examination, test weighing and dispute resolution. The grader ensures the integrity of all samples and examines each sample to determine conformance to the grade standard or contract specification. The results of the evaluations for products that comply with the standard or specification are documented on an official USDA certificate.



To receive Product Inspection and Grading Services, the cheeses must be produced in a plant that has successfully conformed to the Plant Survey Service requirements and is found by the AMS to use satisfactory and sanitary manufacturing practices, equipment and facilities.

Once the cheese is produced, its moisture and fat (on a dry basis) are tested to ensure that they comply with U.S. government regulations, standards and specifications. After inspection, cheese is packaged under stringent U.S. government regulated standards.

Because of their large volume, monterey jack, colby, cheddar and swiss/emmentaler cheeses are routinely graded by the U.S. government. Grades are based on nationally uniform standards developed by experts in the AMS.

These four cheeses may be assigned a U.S. Grade of AA, A, B or C on the basis of their flavor, body, texture, color, finish and appearance. These grades certify that the product achieves an identified level of quality based on criteria developed for the specific variety of cheese. If these cheeses meet the U.S. grade standard requirements, they may display a USDA "Grade" shield on the packaging.

If, as in the case of all other cheeses, there is no established U.S. grade, the AMS can administer quality testing using AMS developed U.S. Specifications or Commercial-Item-Descriptions (CID), which ensure the safety and quality of these cheeses. If these cheeses meet the U.S. Specification requirements, they may display a USDA "Quality Approved" shield on the packaging.

USDA Cheese Grades

Grade AA

Product meets exacting standards, has a fine, highly pleasing flavor, a smooth, compact texture, uniform color and attractive appearance.

Grade A

High-quality product with pleasing flavor. There may be slightly more variation in flavor and texture versus Grade AA products.



Quality Approved

Cheese varieties covered by a U.S. Specification, such as mozzarella cheese or cottage cheese. They must meet exacting requirements specific to the type of cheese.

3.4 EXPORT CERTIFICATION SERVICES AND LABORATORY SERVICES

Export Certification Services

Export certifications or attestations are routinely required by importing countries to document that products are fit for human consumption, are produced under sanitary wholesome conditions, are free from animal diseases and are federally inspected. The USDA will issue a Sanitary Certificate only for cheeses produced in "Approved" plants. This Sanitary Certificate documents the name of the plant, the products that the plant is exporting and that the United States is free from the following herd diseases: Rinderpest, Foot and Mouth Disease and Contagious Bovine Plural Pneumonia. A cheese buyer/importer may request a copy of this Sanitary Certificate from the exporter. The USDA can provide export certifications meeting the requirements of most importing countries. The USDA Dairy Grading Branch is the authorized certification authority for dairy products destined for the European Union.

Laboratory Services

Laboratory services consist of analytical and quality control tests, including all chemical and bacteriological determinations essential for evaluation of class, quality, condition and keeping properties. Exacting laboratory tests guarantee the quality and wholesomeness of the product. Buyer specific characteristics can be tested and certified upon request.

Personnel

The men and women who perform these services are experienced, well-trained and under the supervision of the USDA. Many product graders and plant inspectors are college graduates with majors in dairy manufacturing, food science or food technology and have experience working in the dairy industry.

These stringent monitoring services ensure that the cheese buyer will receive a consistent product of the quality and functionality they desire. Any quality control deficiencies found during any phase of production must be corrected prior to receiving a grade or approval rating.

Resident Grading and Quality Control Service

Under certain circumstances, AMS may assign a resident grader to a cheese manufacturing facility. "Resident" means

that a full-time USDA-licensed dairy inspector/grader is located in the plant to closely monitor the entire cheese making process on a daily basis. This program is a combination of the plant survey service, the laboratory service and the inspection and grading service. Only plants that have been granted approval through a plant survey and have adequate laboratory facilities are eligible for the resident grading and quality control program.

3.5 CHEESE QUALITY CRITERIA

The following table provides a brief description of the important quality information of the most popular varieties or types of cheeses available. Body characteristics are determined by pulling a small piece of cheese or "plug" from a block of cheese or in the evaluation of a slice for sliced types. This is not intended as an all-inclusive listing. To obtain the complete U.S. Grade Standards, U.S. Specifications, or Commercial-Item-Description (CID) visit ams.usda.gov/dairy/stand.htm.

Quality Information of Popular Varieties or Types of Cheeses

CHEESE VARIETY OR TYPE	EVALUATION CRITERIA	QUALITY DESIGNATIONS	AGE AT EVALUATION
Cheddar	Flavor; Body and Texture; Color; Finish and Appearance	U.S. Grade AA U.S. Grade A U.S. Grade B U.S. Grade C	Minimum of 10 days
Colby	Flavor; Body and Texture; Color; Finish and Appearance	U.S. Grade AA U.S. Grade A U.S. Grade B	Minimum of 10 days of age and held at no lower than 10°C (50°F)
Cream Cheese *(including neufchâtel and related products)*	Flavor; Body and Texture; Color and Appearance; Milkfat; Moisture; pH; *Coliform (E.coli);* Yeast and Mold	Quality Assurance	*
Monterey Jack	Flavor; Body and Texture; Color; Finish and Appearance	U.S. Grade AA U.S. Grade A U.S. Grade B	Minimum of 10 days of age and held at no lower than 10°C (50°F)
Mozzarella *(including whole milk, part-skim, low-moisture, and low-moisture/part-skim types)*	Flavor; Body and Texture; Color and Appearance; Milkfat; Moisture; pH; Salt; Meltability	Quality Assurance	5 days at 5.5°C (42°F)
Pasteurized Processed Cheese *(including cheese food and cheese spread)*	Flavor; Body and Texture; Color and Appearance; Milkfat; Salt; Meltability	Quality Assurance	24 to 48 hours after cheese has cooled to storage temperature
Reduced-Fat Cheeses	Must contain 1/4 to 1/3 less fat than the traditional variety	Quality Assurance	*
Ricotta Cheese	Flavor; Body and Texture; Color; Finish and Appearance	Quality Assurance	Fresh
Shredded Cheeses *(including pizza blend, mozzarella, cheddar, reduced-fat cheddar)*	Flavor; Body and Texture; Color and Appearance; Milkfat; Moisture; pH; Salt; Meltability; Fines	Quality Assurance	10 days at 5.5°C (42°F)*
Swiss/Emmentaler	Flavor; Body and Texture; Color; Finish and Appearance (including eye development and distribution)	U.S. Grade A U.S. Grade B U.S. Grade C	Minimum of 90 days

**These cheeses shall meet the basic salient characteristics andage at the evaluation of the identified varietal cheese.*

3.6 ORGANIC CERTIFICATION

To satisfy the increasing desire of many consumers to purchase organically grown products, the USDA, AMS, Transportation and Marketing Programs administers the voluntary National Organics Program. The National Organics Program website, ams.usda.gov/nop/indexnet.htm, provides a simple, single source for review of the program regulations and policies, identifying qualified certifying agents, organic products producers, handlers and processors and links to obtain state information. Organic products which conform to the requirements may display the official USDA Organic Shield.

3.7 KOSHER AND HALAL CERTIFICATION

Suppliers can obtain voluntary kosher or halal certification from internationally recognized certification organizations. Due to the religious significance and sensitivity of the requirements for kosher or halal certification, buyers are encouraged to contact suppliers well in advance so that appropriate sources of cheese, with particular emphasis on the coagulation enzymes used, can be obtained. For additional information, please contact your supplier.

3.8 STATE DEPARTMENTS OF AGRICULTURE

Entities at the state level also certify processing plants.
For additional information, please contact your supplier.

3.9 QUALITY ASSURANCE OF U.S. CHEESES

Quality begins on U.S. dairy farms, which are inspected and approved by state regulatory officials with monitoring by the United States Department of Agriculture (USDA) and the United States Food and Drug Administration (FDA). Fresh milk, directly from the cow, passes through sanitized pipelines and is quickly cooled in refrigerated tanks to just below 4.5°C (40°F).

After it is sampled for microbial and quality analysis, the chilled milk is transported to dairy processing plants, where it is sampled and tested for safety, quality and freedom from antibiotics, before being unloaded from the truck.

Once inside the plant, the milk moves through sanitized pipes, tanks and vats as it is transformed into cheese and other dairy products. Virtually every U.S. cheese plant employs quality management programs to ensure that the finished product meets the highest attainable standards. Working cooperatively with the USDA, finished products must strictly adhere to rigorous quality assurance programs to ensure consumers receive the safest and highest quality dairy products in the world.

The USDA has established U.S. Grade Standards, U.S. Quality Specifications and Commercial-Item-Descriptions (CID) for most popular varieties of cheese to provide quality evaluations. All of these documents can be used by cheese buyers and brokers to ensure they are receiving the level of quality they desire. These documents can be viewed at ams.usda.gov/dairy/stand.htm.

U.S. Grade Standards are available for cheddar, colby, monterey jack and swiss/emmentaler cheese. Cheese produced by a USDA-approved plant that has been officially graded by a trained government grader may have a USDA grade shield placed on the product packaging to clearly identify that it has been inspected and graded and attest to its quality.

U.S. specifications are available for loaf and shredded lite mozzarella cheese; shredded cheddar cheese; loaf, sliced, shredded and diced muenster cheese; cottage cheese and dry curd cottage cheese; cream cheese, cream cheese with other foods and related products; reduced-fat cheddar cheese; ricotta cheese; and mozzarella cheeses. Cheese produced by a USDA-approved plant that has been officially evaluated by a trained government grader may have a USDA quality assurance shield placed on the product packaging to clearly identify that it has been evaluated for quality.

CIDs are available for pizza cheese blends, reduced-fat cheddar cheese, low-fat mozzarella cheese, cottage cheese and cream cheese, neufchâtel cheese and related products. Cheese produced by a USDA-approved plant that has been officially evaluated by a trained government grader may have a USDA certificate issued to identify that the product has been evaluated.

U.S. dairy products meet strict sanitation standards. From the time the milk leaves the cow until cheese is shipped to the consumer, U.S. dairy products are subjected to continuous monitoring and numerous quality assurance controls and tests conducted by the cheese maker and state and federal regulatory officials that help ensure its performance and shelf life.

Domestic and international end-users recognize the quality of U.S. cheese because they can count on rigorous testing and standards for quality.

3.10 ANALYTICAL TESTS

To ensure conformance to a standard of identity, the Food and Drug Administration (FDA) specifies certain analytical tests to be performed on a dairy food. The AOAC International has also developed various analytical tests to ensure that cheeses meet company and federal standards in terms of quality, safety and composition.

The following standard methods are commonly employed for cheese (AOAC International):

- **Moisture content:** AOAC method 926.08
- **Milkfat content:** AOAC method 933.05

For more information, please contact your U.S. cheese supplier or the U.S. Dairy Export Council.

3.11 U.S. FEDERAL STANDARDS OF IDENTITY

U.S. Federal Standards of Identity are established by the U.S. Food and Drug Administration (FDA). They include a much broader variety of cheeses compared with the U.S. Department of Agriculture (USDA) grade standards and ensure that U.S. cheeses meet the minimum requirements for major categories of cheese (e.g., hard, semi-soft) and also to qualify as specific varieties of cheese. U.S. Federal Standards of Identity help assure buyers around the world that they are getting the appropriate flavor, functionality and nutrient content they expect from specific cheese varieties. (Individual cheeses may vary somewhat depending on raw milk composition and manufacturing process. However, U.S. Federal Standards of Identity help ensure minimal variation in major components.) The Standards of Identity can be viewed by searching the appropriate section numbers at gpoaccess.gov/cfr.

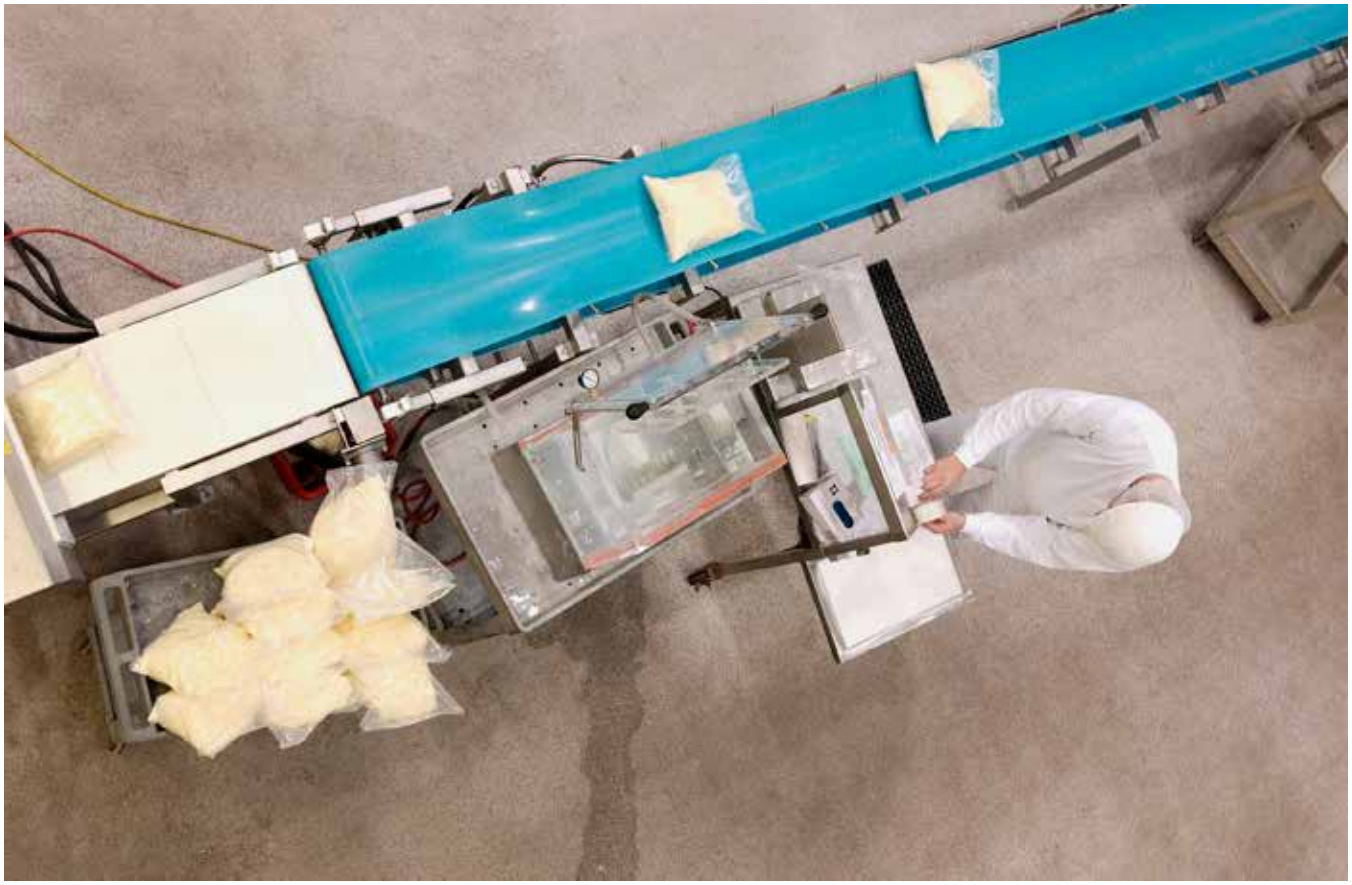
Federal Standards of Identity for U.S. Cheeses (Major Cheese Categories)

CHEESE	MAXIMUM MOISTURE	MINIMUM MILKFAT IN SOLIDS	MINIMUM AGE
Hard Grating	34%	32%	6 Months
Hard (Firm)	39%	50%	60 Days
Semi-Soft	39%< – <50%	50%	60 Days
Semi-Soft Part-Skim	50%	45%< – <50%	60 Days
Soft-Ripened		50%	60 Days
Asiago (Fresh)	45%	50%	60 Days
Asiago (Medium)	35%	45%	6 Months
Asiago (Old/Aged)	32%	42%	1 Year
Blue	46%	50%	60 Days
Brick	44%	50%	60 Days
Brie*	50%		
Camembert*	50%		
Cheddar	39%	50%	60 Days
Low-Sodium Cheddar	39%	50% 96 mg maximum sodium per lb.	60 Days
Colby	40%	50%	60 Days
Low-Sodium Colby	40%	50% 96 mg maximum sodium per lb.	60 Days
Cottage	80%	4%	
Low-Fat	82.5%	0.5–2%	
Dry Curd	80%	0.5%	
Cream Cheese	55%	33%	
Double Cream Brie*	50%	60–74%	
Edam	45%	40%	60 Days
Gorgonzola	42%	50%	90 Days
Gouda	45%	46%	
Gruyère	39%	45%	90 Days
Havarti*	36–39%	37–38%	
Limburger	50%	50%	60 Days
Monterey Jack	44%	50%	
Mozzarella	52%< – <60%	45%	
Low-Moisture	45%< – <52%	45%	
Low-Moisture/Part-Skim	45%< – <52%	30%< – <45%	
Part-Skim	52%< – <60%	30%< – <45%	
Whole Milk*	52%< – <60%	45%	
Muenster	46%	50%	
Neufchâtel	65%	20%< – <33%	

Federal Standards of Identity for U.S. Cheeses (Major Cheese Categories)

CHEESE	MAXIMUM MOISTURE	MINIMUM MILKFAT IN SOLIDS	MINIMUM AGE
Parmesan	32%	32%	10 Months
Pasteurized Processed Cheese	43%	47%	
Processed Cheese Food	44%	23%	
Processed Cheese Spread	44%–60%	20%	
Provolone	45%	45%	60 Days
Romano	34%	38%	5 Months
Swiss	41%	43%	60 Days
Triple Cream Brie*	50%	70%	

Source: Code of Federal Regulations, Title 21, Part 133
**Typical, not official composition*



Photography © 2015, Wisconsin Milk Marketing Board Inc.

4 Cheese Basics



4.1 MILK: THE PRIMARY INGREDIENT

BY DEAN SOMMER
Wisconsin Center for Dairy Research, Madison, WI

Fresh, clean milk is the most important ingredient in the cheese making process. The milk must be produced under the most sanitary conditions and must not contain any contaminants or inhibitory substances.

Cheese is a concentrated form of milk, containing milk protein, milkfat, minerals, salt and water. The general process of making a simple cheese begins with the addition of bacterial cultures and rennet to the milk. This coagulated mixture is cut to separate the cheese curds from the liquid whey. The curds are then typically salted and pressed to make cheese. This process of cheese making is followed by packaging and aging.

Many other dairy products also result from the transformation of fresh milk. (See Figure 1: Food Products from Milk.)

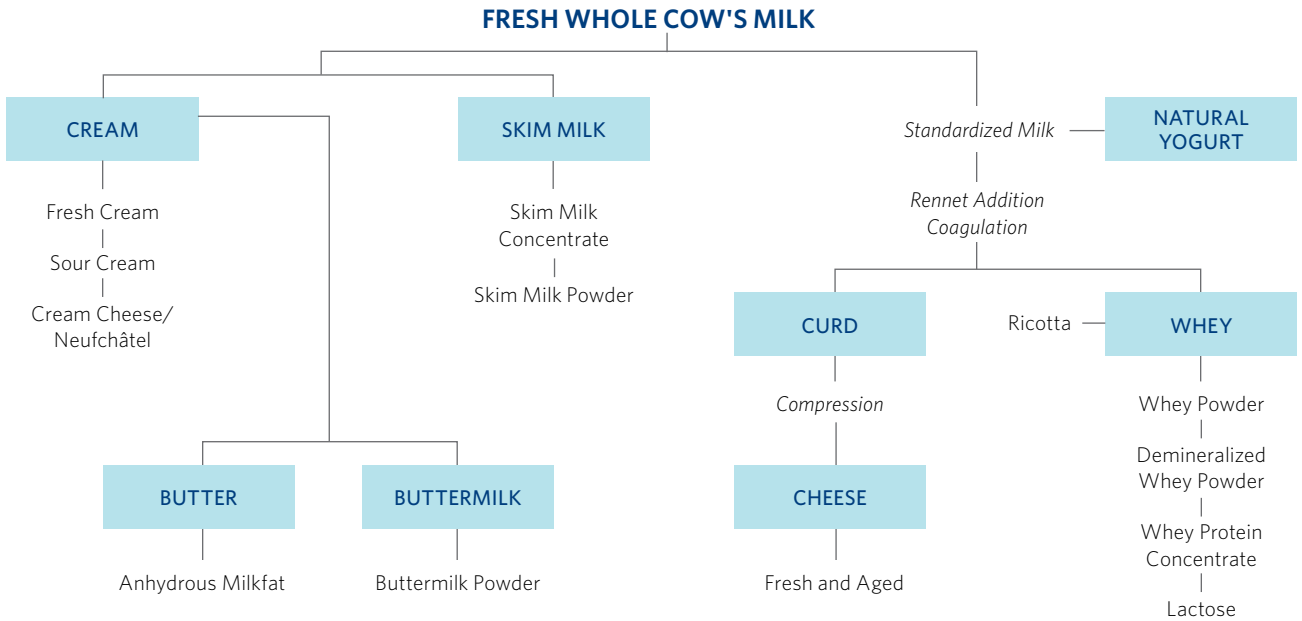
Testing and Control

Federal Standards for the composition of cheese and dairy products are contained in the U.S. Food and Drug Administration Code of Federal Regulations (CFR) 21, Parts 100 to 169. These regulations contain tables and technical composition data for a wide range of dairy products and are updated and revised as needed to ensure uniformity in the composition of cheese and dairy products from all manufacturers.

All milk is tested when it arrives at the manufacturing plant. Tanker loads of milk are evaluated visually and for any off odors. The sample of the milk is taken and evaluated for temperature and for the presence of any antibiotics prior to acceptance and unloading of the milk. Other samples are taken to test for compositional attributes, including milkfat, protein and solids content, as well as for quality parameters such as microbial and somatic cell counts.

Stringent U.S. government regulations require cheese makers to record the entire cheese making process and maintain these most records for at least one year after the cheese is manufactured. By doing this, regulatory authorities, including the U.S. Food and Drug Administration, the United States Department of Agriculture and the individual state Department of Agriculture can review these records to ensure that food safety regulations were properly followed.

Figure 1: Food Products from Milk



4.2 THE CHEESE MAKING PROCESS



BY DEAN SOMMER
Wisconsin Center for Dairy Research, Madison, WI

Transforming Milk into Cheese (Natural Cheese Making)

Standardization of Milk

Depending on the type of cheese being produced, the milk may be adjusted for fat and protein levels for consistency. Cream can be added or taken away to adjust the fat content of the cheese. Non-fat dry milk may be added to obtain the desired levels of protein.

Cheddar cheese is one of the most common types of cheese produced; following are the steps used in its manufacture. Other cheese types will vary from this standard, with changes in starter organisms, temperatures and handling of the curds.

The entire cheddar cheese making operation takes about four hours to complete, from the time the milk enters the vat to the time the cheese can be put into forms for pressing.

Cheddar and other cheeses can also be aged to enhance flavor development. The chart below shows typical aging times for flavor development of cheddar.

AGING TIMES

Mild	1 to 3 months
Medium	3 to 6 months
Sharp	6 months to 1 year
Extra Sharp	1 year or more

In the cheddar manufacturing process shown on the next pages, open-type vats are depicted. Many smaller plants and specialty cheese operators use the open-vat style. Most large operations today use entirely enclosed systems, which allow more automated operation and cleaning, the handling of larger volumes of milk and curd per day, as well as increased protection of the product during production due to the near total enclosure of the system. All operations must meet the same standards of sanitation in equipment and ingredients as well as the finished cheese or dairy product.

CHEDDAR MANUFACTURING PROCESS



Pasteurization of Milk

While all cheese is not made from pasteurized milk, most U.S. cheeses are. Pasteurization is the process of heating milk to a temperature where all pathogens are eliminated. The time and temperatures used to pasteurize milk include the most commonly used high temperature short time (HTST) method used in larger plants, which involves heating the milk to 72°C (161°F) for 15 seconds, or the less commonly used small batch method used in some smaller plants, which involves heating the milk to 63°C (145°F) for 30 minutes. After pasteurization, the milk is typically pumped into the cheese vat to begin the process of curd formation.

Cheese made from raw or unpasteurized milk must be aged for 60 days prior to sale. This provides for the complete elimination of undesirable bacteria that could be in the product due to competition from the starter culture as well as the harsh conditions within the cheese due to the high amounts of acid and salt present.



Addition of Starter Culture

Starter cultures, which are favorable bacteria that ferment the milk sugar (lactose) to produce lactic acid, are added to the milk. In addition to producing acid to drop the pH of the milk and resulting curd, they also help determine the final flavors in the cheese being produced.



Addition of Rennet and Cutting of the Curd

Rennet, a milk-clotting enzyme, is added to solidify the milk into a gel-like mass. After the milk has congealed and is of the proper consistency, the mass is cut with curd knives into small cubes. At this time, the liquid, called whey, separates from the curd, and the mass is then gently stirred and heated.



Heating the Curds and Whey

The curds and whey are heated to the proper temperature and stirred until the desired firmness is achieved. Then the whey is drawn off and further processed into dried sweet whey, whey protein concentrates, lactose or other whey products. The longer the curds and whey are stirred, the more whey will be expelled from the curd and the firmer and drier the curds and resulting cheese will be.

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CHEDDAR MANUFACTURING PROCESS (CONTINUED)



Matting the Curds, Cheddaring

Cheddar cheese has the distinction of having a step in the cheese making process called cheddaring. First, the curd is allowed to settle to the bottom of the vat underneath the whey. The curd begins to knit together into a solid mass, and the remainder of the whey is drained away. The curd is then cut into slabs, which are turned, stacked and rotated one on top of the other over the course of one to two hours. This results in a transformation of the curd structure into a chicken breast meaty type texture. The purpose of this is to produce cheese that has a close-knit texture and a waxy body with good elasticity and machineability as well as a cheese that will develop maximum flavor intensity and desirability during the aging process.



Milling the Cheese

Milling the slabs of curd is done with the aid of a curd mill, which cuts the slabs of curd into cubes about the size of a large peanut. After milling, the cheese curds are mixed and stirred with mechanical forks. This keeps the pieces of curd from matting together.



Salting the Cheese

Salt, ranging from 1 to 2% of the cheese weight, is added to improve flavor, suppress the growth of undesirable microorganisms, control moisture of final cheese by drawing out whey from the curd and assist in regulating the ripening process.



Hooping and Pressing

The cheese curds are moved into hoops (containers) to be formed and pressed into a compacted mass. Types of forms used are cylindrical forms ranging from 5 kg (11 lb.) to 35 kg (78 lb.), 18 kg (40 lb.) blocks, 227 kg (500 lb.) barrels and large blocks of 290 kg (640 lb.).

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Other Types of Cheese Making Procedures (Processed Cheese)

Pasteurized Processed Cheese, Pasteurized Processed Cheese Food and Pasteurized Processed Cheese Spread

Processed cheese is a cheese produced by mixing, with the aid of heat and emulsifying salts, one or more natural cheeses and sometimes other ingredients into a homogeneous, molten mass. The molten cheese must be heated to a minimum of 66°C (150°F) for 30 seconds. This hot mass of cheese can be filled into forms for blocks and then cooled, or extruded onto chill rolls and then cut for slices. Pasteurized processed cheese typically contains greater than 95% natural cheese, while pasteurized processed cheese food and cheese spread must contain in excess of 51% natural cheese. Due to the methods of manufacture and packaging of these types of cheeses, they are more stable than most natural cheeses and have a long shelf life.

Cold-Pack Cheese, Cold-Pack Cheese Food

This is a cheese product made by combining a single cheese or a group of cheeses with optional ingredients like vinegar or citric acid. This is done without the aid of heat and produces a homogeneous mass used as a spread. This is a cheese that has not been heated to stop the aging and ripening process. Many types of condiments, such as wine, peppers, horseradish, spices and herbs, can be added to create different varieties.

What makes cheeses so different from one another?

Consumers have an amazingly wide variety of U.S. cheeses from which to choose. These cheeses can differ in appearance, flavor, aroma, texture and how they function when used as ingredients in other food products. How is it that cheese makers can arrive at so many different cheeses from the same starting point, milk?

It is all about the recipe! Cheese manufacturers have learned over the centuries to utilize many techniques to produce distinctive cheese varieties. In some cases, cheese manufacturers modify the milk composition, for example by partially skimming some cream from the milk prior to cheese manufacture, which is done in cheeses such as low-moisture, part-skim mozzarella cheese or parmesan cheese. In other cheeses, cream may be added to the milk prior to cheese manufacture, such as in havarti, cream cheese or double and triple cream brie.

Microbial cultures are some of the most important tools a cheese manufacturer has to produce a specific cheese variety. As a group, these are commonly categorized as **ripened cheeses** and include:

- Blue or gorgonzola, for which blue mold spores are added to the milk prior to cheese manufacture to develop the blue veining and typical blue cheese flavor.
- Brie and camembert, which have white mold spores added to the milk prior to manufacture in order to develop the exterior covering of white mold growth.
- Washed rind cheeses like limburger, aged brick, gruyère and others are made by carefully washing the exterior surface of the cheese for weeks or months after initial manufacture with a salt brine smear solution containing specific microbial ripening organisms that ripen these cheeses from the exterior to the interior during the aging process. This results in the specific pungent aroma and flavor of this cheese variety.
- For cheeses such as romano, asiago, feta and provolone, additional enzymes called lipases are added to develop specific flavor profiles.
- Cheese varieties that have "eyes" are typically made by adding specific carbon dioxide gas-forming bacterial cultures. The eyes and flavor of swiss cheese come from a culture called Propionibacterium, which is added prior to cheese making. Similarly, for gouda and edam-style cheeses, cultures are added that ferment citric acid in the curd to produce the distinctive flavor and small eyes typically found in these cheeses.
- Finally for other cheese varieties such as mozzarella and provolone, an additional processing step is used to melt and stretch the curd with hot water to develop distinctive pasta filata texture and melt performance of the cheese.

Cheese varieties that are **unripened** typically have their own unique manufacturing procedures. Some are made by directly adding acid like vinegar to the milk with no cultures added; this would include fresh mozzarella cheese. Others are made by adding cultures and letting them produce acid over long periods

of time until the milk coagulates, such as what is done in cottage cheese and cream cheese.

Finally, other varieties like ricotta and queso blanco are made by adding an acid, like vinegar, and heating the milk to high temperatures, while a cheese like queso fresco is made with no added culture or added acid.

Cheese makers have leaned over many years to use different cheese making procedures, milk composition, cheese cultures, enzymes, acids and heat treatments, and this has resulted in the wide range of cheese varieties that consumers worldwide enjoy today.

4.3 CLASSIFICATION AND STANDARDS

BY REGI HISE
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and
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- A **category** is a family of cheeses that share similar characteristics.
- **Varieties** or **types** represent individual cheeses within the families.
- **Styles** refer to cheese shapes and sizes.

Cheese can be classified in a number of ways, including milk type, flavor and rind, origin by country or region and degree of hardness.

Degree of Hardness

Categorizing cheese by the degree of hardness is the most universal method. U.S. Federal Standards of Identity dictate the tolerances of moisture and milkfat that can be contained in cheese. Since the amount of moisture and fat in cheese significantly controls the properties of the cheese, using degrees of hardness stands on a legal definition.

Federal Standards of Identity

The Federal Standards of Identity for cheese and cheese products are defined by the Food and Drug Administration (FDA) and the Department of Health and Human Services (HHS). The standards for cheese are found in Title 21 Food and Drugs, Chapter 1, Subchapter B Food for Human Consumption, Part 133, Cheese and Related Cheese Products.

These Standards of Identity describe the major varieties of cheese and identify the procedures by which they are manufactured, the ingredients they may contain and their moisture and milkfat. For types of cheese not defined by a generic name in these standards, provisions are made for cheeses to be identified by their degree of hardness.

Cheese Grading

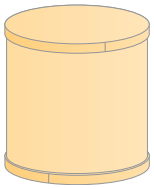
- **Flavor:** The overall cheese flavor must be pleasing and free from undesirable flavors and odors.
- **Body and Texture:** The cheese must meet the required standard and characteristics for the particular variety or category, such as soft, semi-soft, hard, pliable and resistant, waxy, supple, open or closed, grainy or coarse.
- **Color:** The cheese may be "uncolored," the natural cream milk color or a natural color specified by the FDA – usually a golden hue. If color is added, it may be to any degree that is recognized or requested in the market.
- **Finish and Appearance:** The cheese must have an appropriate coating to protect the cheese from damage or deterioration. The coating must also be characteristic of the product and present a good image to the buyer or consumer.

4.4 CHEESE STYLES AND PACKAGING TYPES

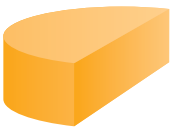
BY REGI HISE
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U.S. manufacturers produce cheese in a variety of shapes, sizes and packaging styles suitable for export. Some of the more popular styles are highlighted in this section. For more detailed information about specific products, please contact your U.S. cheese supplier.

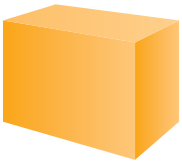
STYLES OF CHEESE



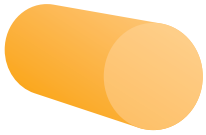
Barrel
Natural cheese curds usually packed in barrels weighing 227 kg (500 lb). Available for cheddar, colby and monterey jack.



Moon
A cross-section slice of a longhorn style (half moon is a half slice of a cross-section); thickness and weights can vary. Available for a variety of cheeses, such as cheddar, colby and monterey jack.



Block
Rectangular-shaped cheese weighing 18 kg (40 lb). Available for a variety of cheeses, such as cheddar, colby, monterey jack, swiss and mozzarella.



Longhorn
Cylinder-shaped cheese weighing 5.90 kg (13 lb). Available for a variety of cheeses such as cheddar, colby and monterey jack.



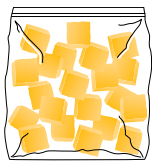
Daisy
Cylinder-shaped cheese weighing approximately 9 kg (20 lb). Available for cheddar.



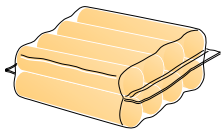
Wheel
Round-shaped cheese available for a variety of cheeses such as blue, gorgonzola, swiss, gruyère and romano.



Loaf
Blocks are cut into 2.27 kg (5 lb) pieces. Available for a variety of cheeses including cream cheese, pasteurized processed cheese, brick, mozzarella and muenster.



Cubed, Crumbled, Unique Shapes*
U.S. cheeses are also available cubed (semi-hard cheeses such as cheddar, colby), crumbled (blue cheese, feta), grated (hard cheeses such as parmesan) or custom-shaped (kids' snacks).



String Cheese*
Style of cheese extruded in the shape of a stick (3 g/1.5 oz). Convenient for pizza crust filler or as a snack. Available for a variety of cheeses, such as mozzarella, cheddar, colby, among others.



Sliced, Shredded, Grated Cheese*
Many cheeses are offered sliced, shredded or grated by U.S. cheese manufacturers. They are available in retail or bulk foodservice packaging for a wide variety of cheeses including semi-soft, edam and gouda, mozzarella, provolone, cheddar, swiss, hard cheeses and processed cheeses.

**These styles of cheeses are also available from U.S. suppliers. These are value-added cheese products designed for the convenience of the end-user, especially at retail and foodservice.*

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Packaging Options

The packaging of all cheeses at the plant is a critical step for U.S. manufacturers to ensure the integrity of the products and protect the cheese during handling.

In the United States, the packaging process is under stringent standards. A USDA-licensed cheese inspector must inspect and approve a dairy plant's packaging process before a cheese can be assigned a U.S. grade or approval rating. These USDA-licensed inspectors are assigned by the Dairy Division, a branch of USDA's Agriculture Marketing Service (AMS). They observe representative samples of the product packaging to ensure that cheese is packed under sanitary conditions. They also confirm that the weights recorded on the packages are accurate.

Vacuum Packaging

Various types of heat-shrink bags are used to package a wide variety of bulk cheeses. This helps reduce mold growth, and in cheddar it has been shown to prevent lactate crystal formation on the surface during aging.

Film Packaging

Plastic films provide excellent barriers to oxygen and moisture. Sometimes used as an alternative to wax for ripened cheeses, plastic films for this application can help save on cheese losses.

Wax Coatings

Paraffin wax is used to coat wheels and blocks of many U.S. specialty cheese varieties, including cheddar, brick, Italian-style hard cheeses and others. Specific colors of wax are sometimes used to indicate the age of the cheese. A second, flexible wax overlay is sometimes applied on top of paraffin wax.

Resealable Packaging

Resealable bags are often used for consumer and foodservice packages of shredded or cubed cheeses. Cream cheese is commonly offered in resealable cups or tubs. They offer extra convenience and help reduce waste or storage losses.



4.5 STORAGE

BY REGI HISE
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When storing cheese, a general rule is that low-moisture cheeses (less than 50% moisture) can withstand higher temperatures, while high-moisture cheeses (more than 50% moisture) should be kept cold. However, to maintain the high quality of cheese and maximize its shelf life, it is important to adhere to more specific storing, out-of-refrigeration and freezing guidelines.

Storing cheeses at proper temperatures and humidity levels reduces the risk of undesirable flavor development, oiling-off of the milkfat and growth of mold. Most cheeses are best stored at 65% humidity.

In the event that mold does grow on the surface of cheese, simply trim off the moldy sections of the cheese 1 cm (0.39 in) below the deepest mold penetration. This way, the quality of the remaining cheese is not affected. Varieties of mold-ripened cheeses such as blue, brie and camembert do not need to be trimmed.

Shelf Life

Moisture content and composition are the primary factors affecting the keeping quality of cheese. As a general rule, soft, high-moisture cheeses such as cottage cheese or fresh mozzarella have a shorter shelf life. Hard cheeses such as cheddar have a longer shelf life if handling and storage are carefully controlled.

Freshness Date

To help buyers estimate the projected shelf life of a particular cheese, manufacturers may mark retail packages of cheese with a freshness date. The freshness date, which is not required on packages by U.S. law, is a manufacturer's estimate of when the flavor and texture of the cheese is best. However, the cheese typically is safe to eat beyond this time.

This date also is important to cheese buyers when managing inventories of soft cheeses with storage periods of less than one month.

Out-of-Refrigeration Display

Bulk point-of-purchase product displays are proven to increase sales. Firm and hard cheeses like parmesan, romano and aged cheddar may be displayed out of refrigeration to promote cheese sales in a retail display, or as part of product demonstrations and samplings. Open or unrinded cheeses placed on bulk displays or near sampling stations should always be tightly wrapped in plastic film or in their original factory sealed packages. Products should not be placed in hot spaces near sunny windows or hot lights. Rotate the cheese that has been displayed. Only use for short periods of time before returning to the cooler, and always mark the piece as having been displayed out of refrigeration.

Freezing Cheese

Freezing cheese is not generally recommended because the freezing process can result in cheese with a grainy or mealy texture, making it more suitable for cooking applications than





cheese stand alone service. Most cheeses should not be frozen, but if it becomes necessary, some guidelines include:

- Cheese should be frozen as quickly as possible to -23°C (9°F).
- Frozen cheese should be thawed under refrigeration between 0 to 1°C (32 to 34°F) for several days.
- After cheese is thawed, it should be stored between 0 to 1°C (32 to 34°F) for up to three weeks prior to use. This process is known as "tempering" and ensures that the texture and melting performance of the cheese are not affected significantly by the freezing process.
- For the best flavor, cheese should not be frozen for more than six to nine months.

Some cheeses freeze better than others, and handling instructions vary by cheese variety. When mold-ripened cheeses – such as bloomy rind, blue and washed-rind cheeses – are frozen, the beneficial molds are killed and may not continue to grow after they are frozen and thawed. Before freezing any cheese, check with your distributor or cheese manufacturer regarding specific freezing guidelines.

U.S. cheese makers produce many cheese varieties that are intended to be stored frozen for long periods. They include mozzarella and pizza cheese as well as Individually Quick Frozen (IQF) cheeses, like shredded and diced mozzarella. Most cheeses that are frozen are used as ingredients in prepared foods and other foods intended to be cooked.

Recommended Storage for Specific Varieties of Cheese

Proper refrigeration greatly extends the usable shelf life of cheese. Storage guidelines vary with different types of cheese, but, as a general rule, cheese should be stored as cool as possible without freezing. Soft-fresh cheeses and more perishable cheeses can be stored at 1 to 2°C (34 to 35°F). Firm or harder cheeses can safely be stored at 1 to 4°C (34 to 39°F).

Soft Cheeses

Soft cheeses are classified into two groups: soft-fresh cheeses and soft mold-ripened cheeses. The moisture content for both exceeds 50%.

Soft-fresh cheeses, such as cottage, cream cheese and ricotta, will keep for approximately two to four weeks when refrigerated between 1 and 2°C (34 to 35°F). Warming these cheeses can cause flavor-related or microbiological spoilage, while freezing can cause textural damage.

Soft mold-ripened cheeses such as camembert, which is produced in the United States from cow's milk, should be refrigerated between 1 and 2°C (34 to 35°F). Under these conditions, soft mold-ripened cheeses will keep for approximately two months. Freezing is not recommended for soft cheeses because of their high moisture content.

Mozzarella Blocks

Blocks of mozzarella can be frozen and stored between -18 and -29°C (0 to -20°F) for one year without adverse effects. To ensure that the texture and melting performance of the cheese are not affected by frozen storage, it should be tempered between 0 and 1°C (32 to 34°F) for 10 days after the cheese is thawed. It takes up to 10 days to thaw a block.

IQF Mozzarella

Individually Quick Frozen (IQF) mozzarella cheese cubes or shreds may be stored for one year between -18 and -29°C (0 to -20°F). Thaw cheese between 0 and 1°C (32 to 34°F) for two days. Once the cheese has thawed, use within 10 days.

Semi-Soft Cheeses

Semi-soft cheeses are classified into three groups: bacteria-ripened cheeses, often referred to as washed-rind, mold-ripened cheeses like blue and those without added mold, referred to as dry-rind. Moisture content ranges from 44 to 52% for semi-soft cheeses without added mold, such as monterey jack, fontina, dry-rind brick and American muenster. These cheeses should be refrigerated between 1 and 2°C (34 to 35°F). At this temperature, these cheeses will keep for approximately two to three months. Flavor deterioration results from prolonged exposure to warmer temperatures. Freezing these cheeses is not recommended.

Washed-rind, such as limburger, and mold-ripened cheeses, such as blue, have a maximum moisture content of 50% and should be refrigerated between 1 and 2°C (34 to 35°F). Under these conditions, these cheeses will keep for approximately two to three months. When stored at warmer temperatures, they tend to soften and release moisture, and they may develop unwanted surface mold. The rate at which these quality defects appear varies with storage temperature. For example, defects are likely to occur after only a few days if cheese is stored at 7°C (45°F) or more. Semi-soft, washed-rind and other mold-ripened cheeses should not be frozen. The beneficial bacteria molds used in their







production may be killed by the freezing process and no longer active after they thaw.

Hard Cheeses

The moisture content for hard cheeses, such as cheddar, colby and swiss, range from 36 to 43%. Generally, hard cheeses intended to be aged for more than three months contain less moisture than mild flavor hard cheeses, which may be sold sooner.

Hard cheeses should be refrigerated between 1 and 4°C (34 to 39°F). Under these conditions, hard cheeses will keep for approximately 12 months or more. These cheeses can withstand short-term, out-of-refrigeration displays at a maximum temperature of 25°C (77°F) for two to three days. They are susceptible to body and textural changes, such as unsightly oiling-off of the milkfat, when exposed to warmer temperatures than 25°C (77°F).

Hard cheeses may be frozen at temperatures lower than -23°C (-9°F). Thawing hard cheese between -2 and 1°C (28 to 34°F) over a period of 10 days will limit textural changes. Like all frozen cheeses, these are best used in cooking applications.

Hard Grated Cheeses (also known as Very Hard Cheeses)

The moisture content of hard grating cheeses, such as parmesan and romano, is 34% or less before grating. Hard grating cheese may be stored at 1 to 4°C (34 to 39°F), but may be stored for extended times at temperatures lower than 25°C (77°F) and will maintain flavor and texture quality. These cheeses exhibit oiling-off at temperatures above 25°C (77°F).

Grated parmesan and romano have a maximum moisture content of 18% and do not require refrigeration as long as the container remains unopened. Under these conditions, these cheeses keep for approximately 12 months. After packages are opened, refrigerate grated cheeses at lower than 4°C (39°F).

Grated parmesan, romano or other hard cheeses can be frozen in foodservice or bulk packages. When thawed properly under refrigeration, it performs well in all applications.

Grated cheeses in retail or consumer size cans should not be frozen because when thawed, condensation often forms inside the container, causing the cheese to lump together.

Pasteurized Processed Cheese, Cheese Food and Cheese Spread

Pasteurized processed cheese is a modified form of cheese that is made by grinding, blending and heating one or more natural cheeses. Pasteurized processed cheese may have a maximum moisture content of 43%. The pasteurization or heating step of this process stops the action of enzymes responsible for the curing of cheese. Therefore, the shelf life of this cheese is extended.

If the cheese maker adds additional milk or cream to the blended cheese mixture, the product is classified as pasteurized processed cheese food and may have a maximum moisture content of 44%.

Pasteurized processed cheese spread has more added moisture than pasteurized processed cheese food, which makes it spreadable at room temperature. The maximum moisture content of pasteurized processed cheese spread is 60%.

The higher moisture content of pasteurized processed cheese, cheese food and cheese spread make them more susceptible to the effects of higher temperatures when opened. Once a package is opened, refrigerate remaining product between 0 and 4°C (32 to 39°F). If unopened, these cheese varieties will keep for approximately six to 10 months.

Unopened packages of pasteurized processed cheese, cheese food and cheese spread are relatively stable in storage lower than 25°C (77°F) and withstand out-of-refrigeration display without risk of spoilage. Therefore, frozen storage is unnecessary.

Cold-Pack Cheese

Cheese manufacturers make cold-pack cheese by grinding and blending one or more natural cheeses without the use of heat. This way, the cheese continues to age. Although cold-pack cheese is more perishable than pasteurized processed cheeses, the dairy processor can extend cold-pack's shelf life with an added mold inhibitor (sorbic acid, nisin, sodium propionate or calcium propionate). Cold-pack cheese products should be refrigerated between -1 and 1°C (30 to 34°F) and should not be frozen.

Storage Recommendations

Storage recommendations listed are for cheeses in original, factory sealed packaging. Storage temperatures and storage periods listed are general guidelines. Always consult your supplier for storage recommendations on specific cheese varieties and brands.

Storage Recommendations for Specific Cheese Varieties

CHEESE	TEMPERATURE °C	RELATIVE HUMIDITY (RH)	STORAGE PERIOD	MAXIMUM DISPLAY TIME[1]	FROZEN STORAGE POSSIBLE?
Blue	0 to 1	65	2 to 3 months	Refrigerate at all times	Yes
Brie	0 to 1	65	2 months	Refrigerate at all times	Yes
Brick	-1 to 1	65	2 to 3 months	Refrigerate at all times	Yes
Camembert	-1 to 1	65	2 months	Refrigerate at all times	Do not freeze
Cheddar	0 to 1	65	12 months	1 week	Yes
Cottage	-1 to 1	65	2 to 3 weeks	Refrigerate at all times	Do not freeze
Colby	0 to 3	65	6 months	1 week	Yes
Cold-Pack	-1 to 1	65	3 months	Refrigerate at all times	Do not freeze
Cream cheese	0 to 1	65	4 weeks	Refrigerate at all times	Do not freeze
Edam	0 to 1	65	6 months	Refrigerate at all times	Yes
Gouda	0 to 1	65	3 to 6 months	Refrigerate at all times	Yes
Grated cheese, dried[2]	0 to 4	65	12 months	Unlimited[3]	Do not freeze
Monterey Jack	-1 to 1	65	2 to 3 months	Refrigerate at all times	Yes
Mozzarella	0 to 1	65	1.5 to 2 months	Refrigerate at all times	Yes
Limburger	0 to 1	65	2 to 3 months	Refrigerate at all times	Yes
Neufchâtel	0 to 1	65	4 weeks	Refrigerate at all times	Yes
Parmesan	0 to 24	65	10 to 24 months	Unlimited	Do not freeze
Processed cheese	0 to 4	65	6 to 10 months	Unlimited[3]	Do not freeze
Processed cheese slices	0 to 4	65	6 months	Unlimited[3]	Do not freeze
Processed cheese food	0 to 4	65	6 to 10 months	Unlimited[3]	Do not freeze
Processed cheese spread	0 to 4	65	6 months	Unlimited[3]	Do not freeze
Provolone	0 to 1	65	3 to 12 months	Refrigerate at all times	Yes
Romano	0 to 24	65	5 to 12 months	Unlimited	Do not freeze
Swiss	0 to 4	65	8 to 12 months	1 week	Yes

[1] Maximum out-of-refrigeration display time at temperatures lower than 25°C.

[2] Cheese dried to 18% moisture or less.

[3] Unlimited out-of-refrigeration display time at temperatures lower than 25°C for unopened package. Refrigerate between 0 to 4°C after opening.

4.6 CUTTING AND HANDLING

BY REGI HISE
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Tools for Cutting and Slicing Cheese

The tools for cutting and slicing cheese vary depending on the density of the cheese to be cut. The following is an overview of all tools, from the hard-working essentials to the category-specific.

Cheese Knives:

1. **Double-Handled Cheese Knife**
   Cuts large blocks, wheels, or cylinders of semi-soft to hard cheeses and reduces the incidence of injury associated with using a knife that's too small for the job.
2. **Case Cutter/Package Opening Knife**
   Whether it is a case cutter or a small paring knife, be sure to use a separate tool to open boxes, plastic wrap or foil that covers the cheese to avoid cross-contamination.
3. **Paring Knife**
   Essential for any kitchen. The paring knife is used on all smaller pieces of cheese, for serving or trimming. Available in a variety of sizes and shapes, this knife is the most used piece of equipment in your arsenal, so choose one that fits your hand and style.
4. **Parmesan Knife**
   Part of a set for splitting a wheel of hard grating cheese, like parmesan. Also used to break off chunks of hard cheese for serving. Great visual appeal on a serving tray.
5. **Chef's Knife**
   Most versatile knife in the kitchen. Used for almost any cutting job. Be careful when cutting large pieces of cheese, as the tip of the knife is a dangerous place for the palm of your hand. In cases like these, use the double-handled knife.
6. **Soft Cheese (Brie) Knife**
   Serrated, flexible knife with cut-away style blade for cutting soft and soft-ripened cheeses. The serrations cut the bloomy rind while the cut-away metal face reduces the area to which the soft cheese may stick. The typical two-pronged knife tip is for serving the cheese after cutting.



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7. **Cheese Plane**
   An ideal serving tool for any semi-soft to firm cheese, delivering a paper thin slice. While tricky to master, this is the best tool for sampling. It delivers a small sample with a big surface area for flavor, while sealing the body of the cheese each time it is used. Also good for parties or small get-togethers.
8. **Spreader**
   Used to evenly distribute soft cheeses and spreads onto crackers, breads, sandwiches, vegetables and more.

Cheese Wires:

9. **Platform/Pull Wire Cutter**
   Ideal tool for large volume production. Works well with soft to semi-firm cheeses. It is not recommended for the harder grana-type cheeses.
10. **Fish Line Hand Cutters**
    Great for breaking down 18 kg (40 lb) blocks. Also for cutting soft cheeses, like cream cheese, brie or blue, as it leaves a clean edge. Fish lines do not kink or break as frequently as metal wires, and if they do break, new knots can be tied easily. They are also easy to clean and can replace metal wire hand cutters for many tasks.
11. **Cheese Cuber**
    Excellent for portioning cheese, either for recipes or large samplings. Can be used to produce many shapes and sizes.
12. **Metal Wire Hand Cutters**
    Available in varying lengths and strengths, these are ideal for breaking down larger pieces of firm to hard cheese. Care must be used not to kink the lines, as this renders them prone to breakage.

Techniques for Handling and Cutting Cheese

The Three "C's"

It is important to remember the 3 "C's" when dealing with cheese: clean, cold and covered.

- **Clean:** Keep everything clean that will come in contact with the cheese, including the cutting board, the cutting tools, your work station, your hands (preferably freshly gloved) and your wrap station. Because cheese easily absorbs other flavors, keep it away from other aromatic foods in the refrigerator.
- **Cold:** Most cheeses need to be kept between 1° to 4°C (34° to 39°F). The longer the cheese remains outside this temperature zone, the more the quality deteriorates.
- **Covered:** If you keep cheeses covered, even loosely, when working with them, you will reduce the chances of the abundance of mold in the air developing surface mold on the cheese. Plus, keeping cheese covered helps to maintain its cool temperature and slows moisture loss, both of which will adversely affect the cheese.





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Cutting Guidelines

The following are important guidelines to keep in mind when cutting or slicing cheese.

- Wear foodservice gloves to discourage mold growth. This prevents leaving fingerprints (particularly important with soft-ripened cheeses like brie and camembert) and prevents skin acids from affecting the cheese.
- Never cut more cheese than you can wrap in 15-30 minutes maximum. This will help prevent the cheese from molding, oiling off and drying out.
- Wrap cheese to be displayed for sale in plastic film immediately to keep air out and moisture in. Check all seams to ensure a tight fit and sealed coverage. If cutting cheese for immediate sale, it is best to wrap cheeses in wax paper or butcher paper, as plastic wrap has distinct odors and particularly softer cheeses can pick up flavors and aromas from the wrap.
- Do not reuse plastic film! A fine layer of oil from the cheese will prevent the wrap from clinging properly a second time, allowing air and mold spores access to the cheese.
- If aging or storing hard cheeses for longer than 30 days, it is important to physically turn the cheeses over regularly, at least twice a month, to keep natural oils evenly distributed throughout the cheese. This is true of whole wheels and cut pieces.
- After cutting dense cheeses like cheddar and gouda, draw the flat of the knife over the cut surface of the cheese to close up exposed pores and prevent further moisture loss.
- Blue cheeses and gorgonzolas may arrive to your location in vapor barrier bags (commonly called Cryovac) that keep virtually all air out. The molds will go to sleep under those conditions; so these cheeses are almost white when first opened. This will change rapidly as the cheeses are cut and wrapped. Keep the exposed time to air for these cheeses down to a minimum, as excessive mold development will adversely affect the appearance.
- It is important to follow cutting diagrams provided on the following pages until you are familiar with the proper ways to cut each shape to minimize waste or odd shapes, which are more difficult to sell.
- Always use the proper tools for the type of cheese with which you are working. This will help ensure proper procedures and better safety.

BLOCK

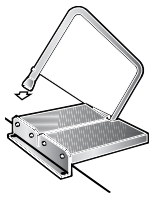
Cheddar, Monterey Jack, Mozzarella, Muenster, Swiss



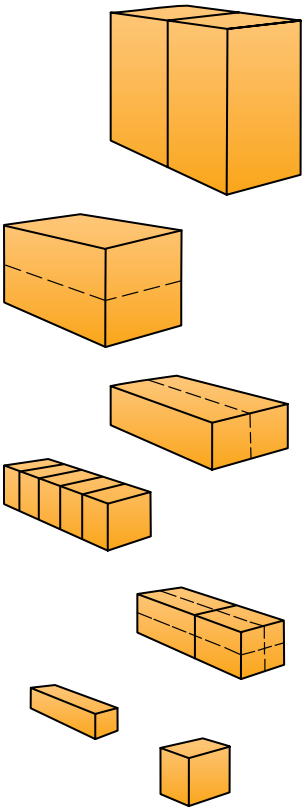
Paring knife



Fish line hand cutter



Stationary wire platform cutter



Break 20 kg (40 lb) blocks down to the size best suited to the application.

LOAF

Brick, Cream Cheese, Edam, Havarti, Monterey Jack, Muenster, Swiss



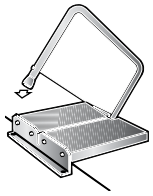
Chef's knife



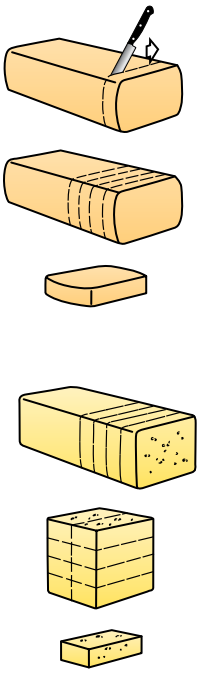
Paring knife



Fish line hand cutter



Stationary wire platform cutter



Note: Square loaves yield differently shaped pieces than rectangular loaves.

SOFT-RIPENED

Brie, Camembert



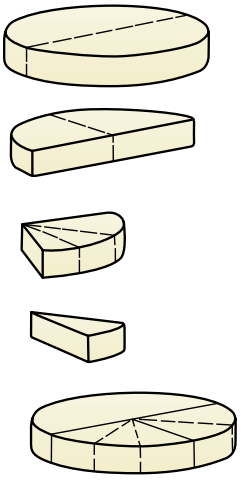
Paring knife



Chef's knife



Brie knife



Once you cut soft-ripened cheeses, they will not ripen as well. It is best to cut the whole wheel once you start.

Until you cut into these cheeses, leave them in the special wrap in which they were shipped. This wrap allows the cheese to breathe and continue to ripen.

WAXED WHEELS

Cheddar, Fontina, Gouda



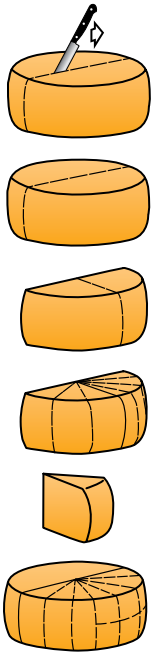
Double-handled cheese knife



Paring knife



Chef's knife



For waxed wheels, score through the wax with a paring knife first. Leave the wax on for cheese displays.

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BLUE WHEELS

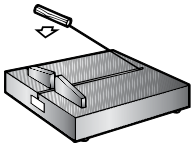
Blue, Gorgonzola



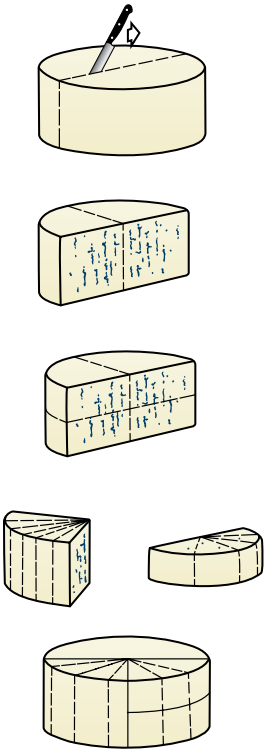
Paring knife



Fish line hand cutter



Pull wire cutter



Sanitize cutting boards and tools before and after cutting blue-veined cheeses.

HARD WHEELS

Asiago, Parmesan, Pepato, Romano



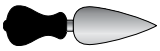
Paring knife



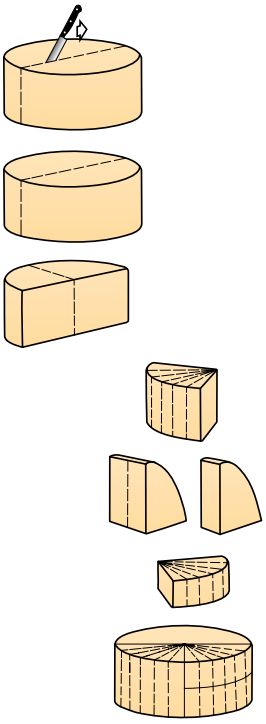
Double-handled cheese knife



Metal wire hand cutter



Parmesan knife



Before cutting, score through the wax or rind with a paring knife.

CYLINDER

Colby, Provolone, Smoked Gouda



Paring knife



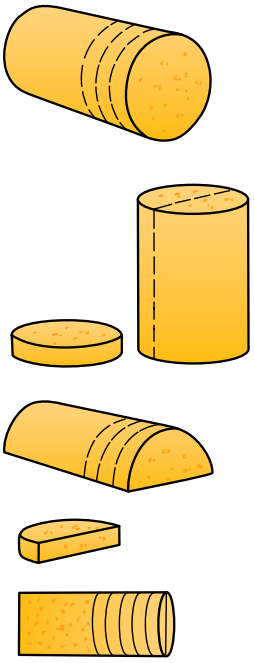
Chef's knife



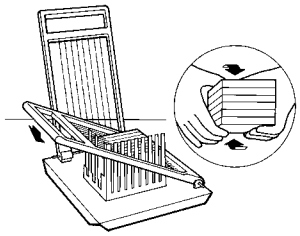
Double-handled cheese knife



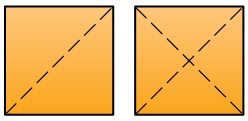
Fish line hand cutter



PORTIONS

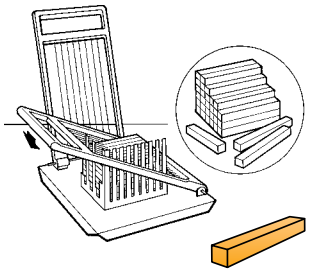


Cheese cuber

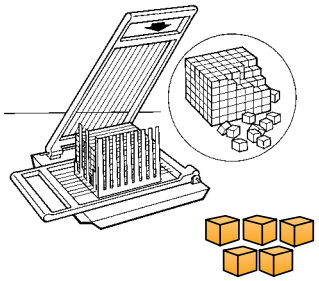


The first cut from the cuber forms slabs that can be cut in half to form small triangles.

Rotate the slabs away from you (as shown above) to prepare for the next step, cutting sticks.



The second cut on a cuber produces sticks.



The third cut from the cuber will produce potion-controlled cubes.

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When Cheese Molds

Molds are naturally occurring organisms in the atmosphere, and despite your best intentions and sanitation, molds can show up on your cheeses. If the mold is the normal greenish-bluish mold often found on cheeses, you can safely trim the mold off by removing about 1 cm (10 mm) of cheese beyond the mold. Change the wrap as well. This remaining piece of cheese can be safely eaten, but once it has molded, it is prone to mold again, so use it quickly, by reducing the price or sampling it. If the molds you encounter are unusual looking, either their color (pink or black) or their appearance, discard the cheese.

Receiving and Storing Cheese

When receiving cheeses, as with any perishable product, check the packaging for damage. Have any seals been damaged? Are there signs of seepage or leakage? What is the temperature of the product and delivery truck? If your cheeses are not vacuum-sealed or otherwise protected, is there any evidence that other products in the truck leaked onto your product? Most of this is common sense, but needs reinforcement.

Once in your hands, you have the responsibility for quality control. Cheeses need to be rotated on a FIFO (first in, first out) basis; this is extremely critical for soft-fresh and soft-ripened cheeses. If you do not follow this rule, you may have to discard a lot of product. The three enemies of cheese are: heat, dry condition and intense direct light (like direct sunlight or bright spotlights). Temperature is the most critical factor in preserving the quality of cheese. Keep most cheeses stored under 4° C (39° F).

Humidity is another important aspect of storing cheese. For most cheeses in vacuum packaging, the location in the cooler is not critical. But for cheeses that are either soft-ripened or naturally-rinded, it is important to remember that refrigerators are dehydrators as well; keep these cheeses out of the direct cooler fan, preferably in a covered area, to mitigate these effects. Losing water affects the quantity and quality of cheeses. If you are storing cheeses longer than one month, it is important to turn them over at least twice a month, to redistribute the oils, which migrate with gravity. Cheese should also be stored in as dark of a place as possible.





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Another concern is cross-contamination. When storing cheeses, it is best to separate blue and soft-ripened cheeses into different coolers. The molds on these cheeses will spread if not contained carefully. Keep these cheeses tightly wrapped and as far from each other and any other cheeses as you can. If possible, keep these cheeses in secondary containment, like a sealable plastic bin, to avoid any possible problems. It is also critical to follow sanitation procedures precisely when dealing with mold-ripened cheeses.

5 U.S. Cheese Selection



BY REGI HISE
Foodtrends, LLC, Madison, WI
and
MARK TODD
Research Resources, Monte Rio, CA

History of Cheese in America

America is a nation of immigrants, and many of our traditions reflect our immigrant ancestry. One of those traditions is a love for cheese. In fact, when the first pilgrims arrived in America, they brought cheese with them on the boat. As more people arrived in America and began to settle the land, they found rich soil and lush grasses that reminded them of their European homelands. Soon, they began farming the land, and as they grew grain for their breads, any surplus was stored for use over the long, cold winters. Cattle grazed on lush pasture grasses in the summer, hay and grain in the winter. This steady source of milk, cream and butter started our dairy traditions, and cheese making was soon to follow.

In addition to having a taste for cheese, many of our ancestors brought with them the expertise to make cheese. Using centuries-old recipes and traditional methods, they quickly began making cheese with any surplus milk available, first for themselves, and then for others. An industry was born, and it started a long tradition of cheese making in the U.S. that continues today. Our industry has pioneered research in dairy science and cheese making, yielding tremendous production efficiencies and an unparalleled safety record. Today, the United States is the largest cheese producing country in the world, crafting over 600 different varieties of cheese and over five million metric tons annually. Our cheese is top quality and consistently wins top honors at international competitions. We are justifiably proud of the heritage, craftsmanship and quality of the cheese that our cheese makers produce.

There are many ways to organize cheese varieties, including country of origin, milk type and so on. The most widely accepted method is by degree of hardness.

The following sub-sections are arranged in this manner, from soft and fresh cheeses through hard grated cheeses.



5.1 SOFT-FRESH CHEESES



Varieties include:

- Cottage cheese (various fat contents)
- Cream cheese (plain and flavored)
- Feta
- Mascarpone
- Neufchâtel (plain and flavored)
- Queso blanco
- Ricotta (whole milk, low-fat, fat-free)

Manufacturing Process

Soft-fresh cheeses are referred to as acid-set or direct-set, since the milk is usually coagulated with lactic acid, lemon juice, vinegar or a similar acid directly added to the milk, instead of rennet and enzymes.

Whey is drained from soft cheeses using gravity rather than mechanical pressure to help retain the velvety texture and higher moisture content. Many soft cheeses are packaged, often in tubs, without being cut, pressed into a form or aged.

Performance

Soft-fresh cheeses contain the highest moisture content of any cheeses. This makes them excellent ingredients for spreads and fillings. In most cases, these cheeses have a mild, delicate, creamy flavor much like the top-quality U.S. milk from which they are made.

Key Applications

Most soft cheeses, except feta and queso blanco, are spoonable/spreadable cheeses. In foodservice, prepared foods and end-user applications, they are widely used as a base for bread and snack spreads and dips. They are also popular in fillings for pasta and casseroles, appetizers and baked goods.

Feta and queso blanco are the low-moisture exceptions to the rule in this family of cheeses. Their crumbly texture and resistance to melting further separate them from the rest of this group. Traditionally used only in ethnic dishes, these cheeses are now used in salads, soups and a variety of hot entrées, even pizza.

Marketing Advantages

Superb consumer appeal; add value to baked goods, snacks and prepared foods. High consumer acceptance due to their mild taste and smooth, creamy texture.

Key Benefits in Foodservice and Prepared Foods

Excellent cold spreadability for dips, spreads and frostings. Creamy texture for use in pasta fillings, casseroles and a range of other fillings. Perfect flavor carrier. Versatile: works well in sweet or savory dishes. Can be used to bind other ingredients together and as texture agents. Low-fat, no-fat and reduced-calorie versions provide high-quality options for restricted diets.

Cream Cheese



Smooth, spreadable texture; mild, sweet/tart flavor. Excellent filling agent and bakery ingredient.

COLOR

Bright white to slightly off-white.

TEXTURE

Smooth, creamy, spreadable.

FLAVOR

Rich and creamy, a bit nutty with a sweet/tart finish. Available plain and in many sweet and savory flavors, including strawberry, pineapple, garden vegetables and garlic and herb, among others.

TYPICAL COMPOSITION

55% moisture; at least 33% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts quickly. Great flavor carrier, sweet or savory. Most often used in spreads, dips, sauces, frostings, bakery fillings, appetizer fillings, pastries and cheesecakes.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Also, proper FIFO (first in, first out) product rotation is extremely important. Depending on packaging and style, cream cheese may be held refrigerated for 90 to 180 days. Do not freeze.

CURING/AGING

Not cured or aged.



AN AMERICAN ORIGINAL

Developed in the late 1800s in the Philadelphia area.

Neufchâtel



Lower fat than cream cheese, but still with a smooth, spreadable texture; mild, sweet-tart flavor; excellent filling agent and bakery ingredient.

COLOR

Bright white to slightly off-white.

TEXTURE

Similar to cream cheese, with a somewhat firmer body.

FLAVOR

Mild, similar to cream cheese, but a bit more tart.

TYPICAL COMPOSITION

65% moisture; 20–30% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts quickly. Great flavor carrier, sweet or savory. Most often used in spreads, dips, sauces, frostings, bakery fillings, appetizer fillings, pastries and cheesecakes.

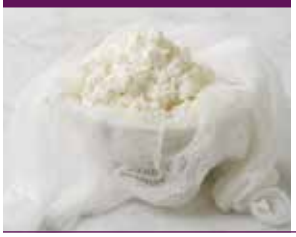
STORAGE/SHELF LIFE

High-moisture cheeses are more perishable than hard cheeses, so handling, storage and product rotation are critical. Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Also, proper FIFO (first in, first out) product rotation is extremely important. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Depending on packaging and style, neufchâtel may be held refrigerated 90 to 180 days. Freezing is not recommended.

CURING/AGING

Not cured or aged.

Cottage Cheese



Creamy, mild, milky flavor. Excellent in pasta fillings, bakery goods and salads.

COLOR

Bright white.

TEXTURE

Consists of soft, moist, individual curds. Available in large and small curd.

FLAVOR

Delicate, fresh milk flavor with a slightly acidic tang.

TYPICAL COMPOSITION

80% maximum moisture. Available in whole milk, 2%, 1% and fat-free.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Curds resist melting. Bake in cakes and breads for added taste and texture. Use in pasta stuffings. Serve with fresh fruit and in composed salads.

STORAGE/SHELF LIFE

High-moisture cheeses are more perishable than hard cheeses, so handling, storage and product rotation are critical. Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). They should be as cold as possible without freezing. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Do not freeze.

CURING/AGING

Not cured or aged.

Feta



Distinctive flavor and crumbly texture.

COLOR

White to off-white.

TEXTURE

Soft curd cheese that flakes apart and crumbles easily.

FLAVOR

Tangy, sharp, salty taste. The flavor intensifies as the cheese ages. Available plain or in a variety of savory flavors.

TYPICAL COMPOSITION

No Federal Standard of Identity exists for feta, but its moisture content places it in the family of soft-fresh cheese.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Resists melting. Crumbles easily by hand. Used on salads, in pastries and breads and Mediterranean cuisine.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 0 and 1°C (32 to 34°F) for 90 to 180 days. Brine can be replaced as needed at a ratio of one tablespoon of salt per cup of water. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Do not freeze.

CURING/AGING

Five days to one month.

Mascarpone



Excellent flavor carrier and creamy texture.

COLOR

Off-white to beige.

TEXTURE

Silky smooth, creamy, spreadable. Should not be grainy.

FLAVOR

Rich, mildly sweet, buttery.

TYPICAL COMPOSITION

While no Federal Standard of Identity exists for mascarpone, its minimum 70% milkfat makes this a triple cream cheese.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts easily, best with indirect heat. Best known as the creamy ingredient in tiramisu, the popular Italian dessert. Mascarpone is used in sauces, soups, tortes, spreads, frostings, desserts and baked goods.

STORAGE/SHELF LIFE

High-moisture cheeses are more perishable than hard cheeses, so handling, storage and product rotation are critical. Store at refrigerated temperatures between 1 and 3°C (34 to 37°F). These cheeses will pick up flavors and aromas quickly, so keep tightly covered. Also, proper FIFO (first in, first out) product rotation is extremely important. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Properly handled product may be held refrigerated up to 120 days. Do not freeze.

CURING/AGING

Not cured or aged.

Queso Blanco



Mild flavor and retains texture after cooking.

COLOR

Bright white.

TEXTURE

Firm and crumbly. Stays firm when heated.

FLAVOR

Mild with a tart finish. Somewhat salty.

TYPICAL COMPOSITION

No Federal Standard of Identity exists for queso blanco, but its moisture content places it in the family of soft-fresh cheese.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Resists melting to the point of browning. Can be cubed and browned for use as croutons in salads. Used extensively in Hispanic cuisine, primarily as an ingredient in savory, hot dishes.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 0 and 1°C (32 to 34°F) for up to 10 weeks. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Do not freeze.

CURING/AGING

Not cured or aged.

Ricotta



Perfect in Italian and vegetarian dishes, from pasta and casseroles to baked goods and desserts.

COLOR

Bright white.

TEXTURE

Soft and moist, sometimes slightly grainy. The texture varies with the milkfat content.

FLAVOR

Mild and milky, slightly sweet.

TYPICAL COMPOSITION

68–73% maximum moisture. Available in whole milk, part-skim and fat-free.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

The lower fat versions are more resistant to melting. Used extensively in stuffings for pasta, casseroles and baked goods. Popular in Italian and vegetarian cuisines.

STORAGE/SHELF LIFE

High-moisture cheeses are more perishable than hard cheeses, so handling, storage and product rotation are critical. Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to four weeks. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Do not freeze.

CURING/AGING

Not cured or aged.

5.2 SOFT-RIPENED CHEESES



Varieties include:

- Brie (single, double and triple cream and flavored)
- Camembert

Manufacturing Process

Soft-ripened cheeses are distinguished by the beneficial white *Penicilium Candidum* mold that forms the outer "bloomy rind." This mold allows the cheese to ripen from the outside in, as evidenced when cutting soft-ripened cheeses. The area nearest the rind softens first, becoming almost liquid, while the center remains firmer, even chalky. As these cheeses ripen, they continue to soften and develop more distinct flavors and aromas.

Performance

The body of these cheeses melts well, while the rind remains intact, so for most hot applications, the rind should be trimmed. For cold applications, it is recommended to consume the rind, as this is a major flavor component and the primary source of calcium in soft-ripened cheeses.

Key Applications

Soft-ripened cheeses are used in cold and melted applications, including sandwiches, cheese plates, appetizers, dips and spreads, gourmet-style pizza, quiches, soups, sauces, warm salad dressings and fondue.

Marketing Advantages

Well recognized cheeses by consumers, add distinction and help differentiate a dish. European-style gourmet appeal, premium quality image.

Key Benefits in Foodservice and Prepared Foods

Distinctive appearance and flavor make this cheese perfect for cheese plates and cold appetizers. The fact that they come from the U.S. ensures quality and attention to detail. All U.S. soft-ripened cheeses are produced with pasteurized milk, ensuring safety and quality.

Brie and Camembert



Gourmet appeal, with highest safety standards. Adds distinction and helps differentiate dishes.

COLOR

White, bloomy rind with cream-colored interior.

TEXTURE

Firm when young, becoming softer as the cheese matures. Older cheeses will begin to harden as they dry, but the cheese is far beyond its prime by then.

FLAVOR

Quite mild and buttery when young, becoming more flavorful as it ripens. Brie is also available with herbs. These cheeses are described as mildly earthy, with the aroma of the forest floor, mushrooms or fallen leaves. It is normal for a slight aroma of ammonia to be present. If the ammonia dominates, the cheese is past its prime.

TYPICAL COMPOSITION

No Federal Standard of Identity exist for soft-ripened cheeses, but the fat content varies with the type of brie produced, single, double or triple cream. Camembert is typically produced in the single cream version.

PERFORMANCE CHARACTERISTICS AND APPLICATION

The body of these cheeses melts beautifully in soups, sauces and warm dressings with the rind trimmed. A whole wheel of cheese can be wrapped in filo dough or puff pastry and baked for a hot appetizer. Other hot applications include gourmet-style pizzas, quiches and fondues. Cold applications include cheese plates, sandwiches, appetizers, spreads and dips.

STORAGE/SHELF LIFE

All cheeses should be inspected carefully when receiving them; this is particularly true of soft-ripened cheeses. Brie and camembert are overripe or mishandled if they have a strong smell of ammonia, a dry, cracked rind or numerous off-color mold spots on the rind. Also, it is important to remember that the mold on the surface requires air to continue to ripen. If possible, rewrap brie and camembert in its original wrapper. Otherwise, wrap in wax paper and store away from strongly flavored items in the cooler, as these cheeses pick up flavors quickly. The shelf life depends on the age and handling of the cheese before it arrives at your door. Refrigerate at 1 to 2°C (34 to 35°F). The total time from production to past prime is approximately 12 to 16 weeks. Do not freeze.

CURING/AGING

Approximately three weeks prior to shipment; the cheese continues to ripen in transit to the end-user.

5.3 SEMI-SOFT CHEESES



Varieties include:

- Brick, dry- and washed-rind
- Colby jack
- Fontina
- Havarti
- Limburger
- Monterey jack
- Muenster
- Pepper jack

Manufacturing Process

These cheeses share one important similarity in make procedure; they are all made with whole milk, sometimes with added cream, but never part-skim milk. This gives them their characteristic soft, creamy texture and great melting ability. There are two distinct styles of semi-soft cheeses, dry-rind and washed-rind. Washed-rind cheeses, also referred to as surface-ripened, are surface-treated with a bacterial smear and then washed with a solution to encourage the smear to grow. Washed-rind cheeses ripen from the outside in. Dry-rind cheeses are cured without a surface treatment.

Performance

Semi-soft cheeses can be shredded, sliced and cubed. Semi-soft cheeses melt well and lend themselves to hot applications, even microwave applications. They have some stretch, and they can be broiled and browned.

Key Applications

Their melting ability makes them ideal for sauces, soups, casseroles and roulades. They can be blended easily with other cheeses to build signature gourmet pizzas. Many are available flavored with a variety of items, from hot peppers to herbs and spices and more. They are also sliceable, making them perfect for sandwiches and consumer-ready snacks.

Marketing Advantages

Add value to products in a cost-effective manner. Excellent acceptability by children. Provides visual appeal when melted or browned. Dry-rind versions are mild and buttery and have universal appeal. Washed-rind versions have premium European-style image and gourmet appeal.

Key Benefits in Foodservice and Prepared Foods

Their mild flavor profiles make them excellent flavor carriers. Blend well with other semi-soft cheeses or with stronger flavored cheeses. Good slicing and shredding properties. Highly versatile cheeses, with applications from the cheese course to the oven and from fast-food to fine dining. Ready to use cubes, shreds and slices provide labor and cost savings.

Brick



Melts well and slices well for sandwiches. Washed-rind version brings full flavor to a dish and adds distinctive American flair to a cheese course.

COLOR

Dry-rind: Ivory to creamy yellow.

Washed-rind: Pale yellow when young, developing a beige to tan rind with ripening.

TEXTURE

Dry-rind: Smooth, open texture.

Washed-rind: Firmer when young, becoming softer and creamier with ripening.

FLAVOR

Dry-rind: Mildly sweet and nutty.

Washed-rind: Mild when young, more aromatic and full flavored with age. The rind may be trimmed on well-aged cheeses when it becomes too strong for most tastes but the body remains buttery and nutty with an earthy undertone.

TYPICAL COMPOSITION

44% maximum moisture, 50% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts easily for topper or use in casseroles. Sliceable for sandwiches. Shreddable for pizza applications. Washed-rind version is perfect for cheese course, pairs well with beers.

STORAGE/SHELF LIFE

Dry-rind: Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Properly handled product may be held refrigerated up to three months. If frozen, thaw from 1 to 2°C (34 to 35°F). Freezing is not recommended.

Washed-rind: Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). This cheese matures for approximately 12 to 16 weeks maximum. It is mild up to about five to six weeks, medium from seven to 10 weeks and fully aged after 10 weeks. It is important to store this cheese in breathable wrap, like its original foil/paper wrap, to ensure proper ripening. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Do not freeze.

CURING/AGING

Dry-rind: two to three months.

Washed-rind: Released about four to five weeks, or aged to specification.

AN AMERICAN ORIGINAL

Developed around 1875 in Wisconsin and patterned roughly after German beer käse, or beer cheese. Named for its shape and the method used to press the cheese, brick cheese is now made in many parts of the United States.

Colby Jack



Excellent melt properties when shredded or sliced. Colorful and flavorful addition to appetizers, salads and sandwiches. The orange and white mix is particularly popular with children.

COLOR

Mottled orange and white.

TEXTURE

Semi-soft, smooth and pliable. Creamier than colby, firmer than monterey jack, with uniform body that does not separate when shredded or sliced.

FLAVOR

Mild with a slight beef broth aroma. Buttery with mildly tart finish.

TYPICAL COMPOSITION

44% maximum moisture, 50% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts quickly when shredded. Excellent choice for toppings. Orange and white color shows well in sandwiches and salads. Also great to blend into premium pizza.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 3°C (34 to 38°F). Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Properly handled product may be held refrigerated for up to three months. Freezing is not recommended.

CURING/AGING

One to three months.

AN AMERICAN ORIGINAL

Made from blending colby with monterey jack, two cheeses developed in America.

Fontina



Excellent melt properties when shredded or sliced. Great melt and flow for pizza blend applications. Upscale ingredient in modern casserole, baked side dishes, soups and sauces.

COLOR

Pale straw yellow with either a pliable dark orange coating or red wax, depending upon style.

TEXTURE

Semi-soft; Italian-style soft and very pliable, with small open holes, Danish/Swedish-style pliable, uniform creamy body.

FLAVOR

Italian-style buttery, mildly earthy with a mellow finish; Danish/Swedish-style nutty, mildly earthy, with a tart finish.

TYPICAL COMPOSITION

42% maximum moisture, 50% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Excellent melting cheese with an upscale image. Good for soups, sauces, toppings, casseroles and gourmet pizzas. Perfect in fondue applications or raclette dishes.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Properly handled product may be held refrigerated for up to three months. Freezing is not recommended.

CURING/AGING

One to three months.

Havarti



Rich buttery flavor, popular with everyone. Ideal for melts and sandwiches.

COLOR

Pale, buttery yellow.

TEXTURE

Supple and creamy, with small mechanical holes throughout. Softer with age.

FLAVOR

Buttery with a hint of nuts. Slightly tart, particularly when young. Available plain and in a variety of savory flavors, including garlic and herb, dill, caraway, horseradish and others.

TYPICAL COMPOSITION

36–39% maximum moisture, 37–38% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Easily cut or sliced when well-chilled. Popular for sandwiches. Melts very easily. Ideal for casseroles, fondue and premium pizza blends.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). for up to three months. Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

Four to eight weeks.

Limburger



Flavorful addition to sandwiches, salads and casseroles. Limited but loyal audience.

COLOR

Creamy white body with distinctive ocher-colored rind.

TEXTURE

Creamy, smooth, becoming softer with maturity.

FLAVOR

Aromatic and spicy when younger to pungently earthy when fully ripe. The aroma is always stronger than the flavor in washed-rind cheeses, and trimming the rind reduces much of the aroma.

TYPICAL COMPOSITION

No Federal Standard of Identity exists for limburger, but its make procedure and moisture content places it in the family of semi-soft cheese.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts quickly when sliced. Good topper for grilled meats. Flavorful addition to salads. Slice for sandwiches. Pair with sweet fruits, like figs and dates or with shaved onions, mustard, dark rye bread and bock beer.

STORAGE/SHELF LIFE

Store at temperatures between 1 and 2°C (34 to 35°F). This cheese matures for approximately 12 to 16 weeks. It is mild up to about five to six weeks, medium from seven to 10 weeks and fully aged after 10 weeks. It is important to store this cheese in breathable wrap, like its original foil/paper wrap, to ensure proper ripening. Proper sanitation when handling this cheese will greatly increase its shelf life and quality. Do not freeze.

CURING/AGING

One to two months.

Monterey Jack



Mild flavor. Easily melted. Good slicing and shredding. Convenient forms and flavors.

COLOR

Creamy white.

TEXTURE

Semi-soft, pliable, creamy and smooth.

FLAVOR

Delicate and buttery with a slight tartness. Available plain and in many flavored versions, including hot peppers (pepper jack), herbs and spices.

TYPICAL COMPOSITION

44% maximum moisture, 50% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Excellent melting cheese. Good for soups, sauces, toppings, casseroles, nachos and gourmet pizzas. Also good slicing and shredding cheese for sandwiches and salads.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Properly handled product may be held refrigerated for up to three months. Freezing is not recommended.

CURING/AGING

One to three months.

AN AMERICAN ORIGINAL

Monterey jack is named after the first man to commercially produce and distribute the semi-soft cheese made in the California missions for many years. In 1882, David Jacks, a dairy owner and businessman from Monterey, California, began producing this cheese commercially and branded his shipping boxes with the city of origin and his last name, hence Monterey-Jacks became monterey jack. Now produced in many states including California, ironically, monterey jack is no longer made in Monterey. Monterey dry jack is an aged version of monterey jack which is considered a specialty cheese (refer to Section 5.15 for additional information).

Muenster



Excellent melt properties when shredded. Colorful and flavorful addition to appetizers, salads and sandwiches. The orange version is particularly popular with children.

COLOR

Creamy white interior, with a white or orange rind. Orange color is annatto, or achiote, a flavorless food coloring from the fruit and seeds of the Bixa Orlleana tree from Mexico and Central America. It is used extensively in Hispanic cuisine.

TEXTURE

Semi-soft, smooth and elastic. Firmer when young, creamier with age.

FLAVOR

Mellow flavor with a mild aroma. Becomes more savory with age.

TYPICAL COMPOSITION

46% maximum moisture, 50% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts quickly when shredded. Excellent choice for toppings. Orange rind version adds color to sandwiches and salads. Also great to blend into premium pizza.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 3°C (34 to 38°F). Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Properly handled product may be held refrigerated for up to three months. Freezing is not recommended.

CURING/AGING

Two to eight weeks.

Pepper Jack



Excellent melt properties when shredded or sliced. Colorful and flavorful addition to appetizers, salads and sandwiches. This cheese is a star in the foodservice arena, paralleling the rise of salsa as the condiment of choice in America.

COLOR

Creamy white with red and/or green peppers mixed throughout.

TEXTURE

Semi-soft, pliable, creamy and smooth with softened peppers.

FLAVOR

Delicate and buttery, and a bit sweet initially, finishing mildly warm to seriously hot depending on the type of pepper used and the preparation method. Typically containing jalapeño peppers, available from mild sweet peppers through intensely hot habanero peppers.

TYPICAL COMPOSITION

44% maximum moisture, 50% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Excellent melting cheese that adds additional flavor. Good for soups, sauces, toppings, casseroles, nachos and gourmet pizzas. Also good slicing and shredding cheese for sandwiches and salads.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F). Cut pieces should be wrapped tightly in barrier film and stored away from other pungent foods, as these cheeses will pick up flavors and aromas quickly. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Properly handled product may be held refrigerated for up to three months. Freezing is not recommended.

CURING/AGING

One to three months.

AN AMERICAN ORIGINAL

Pepper jack is an American Original dating back to at least 1981. It is based on another American Original – monterey jack.

5.4 BLUE-VEINED CHEESES



Varieties include:

- Blue cheese
- Gorgonzola, creamy style
- Gorgonzola, crumbly style

Manufacturing Process

When making blue and gorgonzola, the various blue molds are added directly to the milk. Stainless steel needles are used to pierce the body of the cheese to allow oxygen in and carbon dioxide out of the interior, enabling the mold to thrive. If the cheese has been in vacuum packaging for some time, it will appear almost completely white. As soon as the bag is removed, the cheese will begin to "blue-up" in a matter of hours.

Performance

Good melting cheeses, these are used most commonly for their crumbling properties. Thoroughly chilling these cheeses makes crumbling easier.

Key Applications

Their melting ability makes them ideal for sauces, soups and casseroles. They can be blended easily with other cheeses to build signature gourmet pizzas. They are crumbled into salads and used in dressings. Also traditional for the cheese course.

Marketing Advantages

These cheeses add big flavor to a dish with small cost and minimum fat for the calorie-conscious. Premium European image, gourmet appeal.

Key Benefits in Foodservice and Prepared Foods

Distinctive flavor adds unique intensity to sauces, dressings and a myriad of other dishes. Crumbly texture ideal for salads or for crumbling over hot or cold dishes.

Blue



Distinctive tanginess delivers maximum flavor for minimum cost.

COLOR

Creamy ivory with green-blue veining.

TEXTURE

Creamy to crumbly with open texture.

FLAVOR

Sharp and piquant flavors that intensify with age. Somewhat salty.

TYPICAL COMPOSITION

46% maximum moisture, 50% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Used like a spice in cooking. Melts well, crumbles beautifully for use over salads, in sauces, dressings and as a topping for grilled meats. Also popular on gourmet pizzas.

STORAGE/SHELF LIFE

Special care should be taken when handling blue-veined cheeses. After handling product, carefully clean anything that could have come in contact with it, as the molds can easily be transferred to almost any other perishable foods. Due to the fragile texture of these cheeses, use care to avoid crushing during storage. It is also a good idea to keep these cheeses away from high-moisture items in the cooler (milk, fresh cheeses, vegetables, etc.) as cross-contamination can occur. Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to one year. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Do not freeze.

CURING/AGING

Two months minimum, sometimes up to six months or more.

Gorgonzola



Distinctive earthiness delivers maximum flavor for minimum cost.

COLOR

Creamy ivory with gray-green to green-blue veining.

TEXTURE

Young/creamy style: Soft and creamy with natural brownish rind.

Aged/crumbly style: Drier than most blue cheeses, crumbly and a bit granular.

FLAVOR

Young/creamy style: Earthy and richly buttery.

Aged/crumbly style: Sharper than young version, but still more earthy than traditional blue cheeses.

TYPICAL COMPOSITION

42% maximum moisture, 50% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Young/creamy style: Melts well for soups and sauces, also excellent for spreads and dips. Ideal choice for cheese course.

Aged/crumbly style: Crumbly texture ideal for salads, pizzas and casseroles. Also great for baking.

STORAGE/SHELF LIFE

Special care should be taken when handling veined cheeses. After handling product, carefully clean anything that could have come in contact with it, as the molds can easily be transferred to almost any other foodstuff, referred to as cross-contamination. Due to the soft texture of the young/creamy style and the crumbly texture of the aged version, it is best not to store anything on top of them in the cooler. It is also a good idea to keep these cheeses away from high-moisture items in the cooler (milk, fresh cheeses, vegetables, etc.) as cross-contamination can occur. Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to one year. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Do not freeze.

CURING/AGING

Three months minimum, often six months to one year.

5.5 GOUDA AND EDAM



Varieties include:

- Gouda
- Smoked gouda
- Edam

Manufacturing Process

These cheeses are made in a similar process to semi-soft cheeses, but they use specific starter cultures and only the highest quality milk to produce these "sweet-curd" cheeses. The primary difference between the two is that gouda is made with whole milk, while edam is produced with part-skim. Flavored goudas have spices or herbs added to their curd, prior to pressing, smoked versions can be natural cheese wheels smoked in a smokehouse, or pasteurized processed cheese log with a brown coating with liquidized natural smoke essence on the rind.

Performance

These cheeses can be shredded, sliced and cubed. Gouda and edam melt well, but gouda, with its higher milkfat content, will flow when melted and resist browning, Edam will flow less and brown better. Edam, with its denser texture, is the better choice for slicing, but either one can easily be shredded.

Key Applications

Their melting ability makes them ideal for sauces, soups, casseroles and roulades. They can be blended easily with other cheeses to build signature gourmet pizzas. Gouda is available flavored with a variety of herbs, spices and more. Edam is sliceable, making it perfect for sandwiches and consumer-ready snacks. Smoked gouda is a popular snack cheese, and aged gouda is perfect for the cheese course. Aged gouda, with its robust nutty, caramel and butterscotch flavors and easy melting properties, is an excellent addition to sauces and cream soups.

Marketing Advantages

Add value to products in a cost-effective manner. Young versions are mild and buttery and have universal appeal. Aged versions have premium European-style image and gourmet appeal.

Key Benefits in Foodservice and Prepared Foods

Range of flavors and textures from part-skim edam to whole milk mild gouda, to aged gouda, as well as smoked and flavored. Ease of shredding and melting makes these cheeses a good topping choice for hot or cold applications. Good choice for casseroles or roulades. Popular in gourmet pizza blends.

Gouda



Mild flavor, excellent sandwich cheese.

COLOR

Pale, buttery yellow body typically with a red wax coating on mild gouda, yellow or clear denotes aged or flavored, black or brown indicates smoked. Rindless bulk gouda also exists for industrial applications.

TEXTURE

Creamy and smooth but dense, becoming somewhat waxy with age.

FLAVOR

Buttery, nutty, becoming somewhat caramel and butterscotch-like, not sharp with age. Available mild, aged, smoked and flavored with spices and herbs.

TYPICAL COMPOSITION

45% maximum moisture, 46% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts well, particularly well-suited for casseroles and fillings. Slices and shreds well for use on sandwiches or as a topper for hot or cold appetizers, entrées and vegetables. Flavored versions give signature taste to gourmet pizza blends. Any version is applicable for cheese course.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to three months. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

Two months or longer.

Edam



Mild flavor, excellent sandwich cheese.

COLOR

Pale, buttery yellow body typically with a red wax coating on mild edam.

TEXTURE

Firm, smooth, becoming somewhat waxy with age.

FLAVOR

Light buttery, nutty, becoming more nutty and rich with age.

TYPICAL COMPOSITION

45% maximum moisture, 40% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts well, particularly well-suited for top-melting. Slices and shreds well for use on sandwiches or as a topper for hot or cold appetizers, entrées and vegetables. Used in gourmet pizza blends.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to three months. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

Two months or longer.

5.6 PASTA FILATA CHEESES



Varieties include:

- Fresh mozzarella
- Individually Quick Frozen mozzarella (IQF)
- Low-moisture, part-skim mozzarella
- Low-moisture, whole milk mozzarella
- Part-skim mozzarella
- Provolone, mild, aged and smoked
- Pizza cheese
- String cheese
- Whole milk mozzarella

Manufacturing Process

Pasta filata cheeses are named for the unique process of pulling the curds while they are dipped in hot water. Made from cow's milk in the U.S., preparation of the curd is similar to semi-soft and firm cheeses, involving warming of the milk and the addition of starter cultures and enzymes. Once the curd has been heated and stretched, it is molded. In the case of mozzarella-style cheese, the molded cheese is immersed in cold water, cooled in brine and packaged. Provolone is often made with added lipase enzymes for a piquant flavor, ripened and in some cases, smoked.

Performance

Pasta filata and related cheeses have an elastic consistency, and excellent melting, stretching and browning properties. Used as filling for breaded appetizers and pastas, and in toppings for pizzas, pastas and other hot entrées.

Key Applications

Pasta filata cheeses work well in gratins, salads, sandwiches and stuffings. Their meltability makes them ideal for U.S.-style pizza, the number one use for mozzarella worldwide. Also popular as the hot appetizer "cheese sticks," breaded and fried. String cheese is extremely popular among children.

Marketing Advantages

Mild in flavor, these cheeses have near universal acceptance. Uniform and consistent melting properties ensure product quality and dependability. Browning qualities add visual appeal as a topper in many Italian-style dishes. Low-fat, low-calorie types of pasta filata cheese are ideally suited for diet products.

Key Benefits in Foodservice and Prepared Foods

Used in a wide range of hot applications, especially when excellent melting, browning properties are needed. Adds body and mouthfeel to many dishes. Wide range of mozzarella types and formulations to meet specific applications. Provolone is popular in hot and cold sandwiches. Pasta filata cheeses can be sliced, shredded and cubed. They perform well in the freeze-thaw-cook cycle. They work beautifully in frozen prepared dishes. IQF cheeses offer excellent storage and labor saving advantages.

Fresh Mozzarella



Excellent melt, flow and stretch for optimum coverage on hot entrées or pizzas; versatile in cold applications as well.

COLOR

Stark white.

TEXTURE

Delicate and pliable. Notable striation, easily strings.

FLAVOR

Fresh, milky and a bit tart. Very mild with sweet/tart finish.

TYPICAL COMPOSITION

52–60% maximum moisture, 45% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts, flows and stretches easily; resists browning. Slices well when cold. Typically found in salads (caprese), on pizzas (pizza margherita) or incorporated into appetizers.

STORAGE/SHELF LIFE

Store unopened at refrigerated temperatures between 0 and 1°C (32 to 34°F) for up to four to six weeks. Once opened, use container in seven days. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

None.

Individually Quick Frozen Mozzarella



Cost-effective way to control portions. Reduced labor costs. Reduced preparation, clean-up costs and waste.

Individually Quick Frozen (IQF) mozzarella and IQF cheese blends are products specifically designed to offer a high level of performance consistency. Virtually any variety of cheese can be quick frozen. IQF cheese is 100% natural. It has simply been shredded or diced and quick frozen to stop the aging process. Custom blends, featuring other types of cheese, are also available from the United States.

COLOR AND TEXTURE

Typical of the cheese(s) used for its manufacture.

FLAVOR

Typical of the cheese(s) used for its manufacture.

TYPICAL COMPOSITION

Typical of the cheese(s) used for its manufacture.

PRODUCT FORMS

Shredded, dried and free-flowing.

COOKING/PERFORMANCE CHARACTERISTICS

Highly consistent characteristics and cooking performance. Consistent appearance, browning, texture and melt.

TYPICAL APPLICATIONS/USES

U.S.-style pizza, hot sandwiches, Italian and Mexican-style dishes, baked goods, salads, stuffings and deli items. Frozen manufactured foods.

STORAGE/SHELF LIFE

This frozen product has a long shelf life. Cheese should be stored frozen. Follow manufacturers' instructions for thawing. Ensure proper sanitation when handling cheese.

Low-Moisture Mozzarella



Excellent melt, browning and stretch for pizza applications or on hot entrées. Available in a variety of labor- and cost-saving styles.

COLOR

Creamy white.

TEXTURE

Semi-soft and elastic. Creamier than part-skim version, firmer than whole milk style.

FLAVOR

Fresh, mild and delicate. More buttery than part-skim version.

TYPICAL COMPOSITION

46–52% moisture, 45% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Easier cold manipulation (shredding, slicing, etc.) than whole milk mozzarella. Melts slower and browns quicker than the whole milk version. Well-suited as pizza topping. Use in hot appetizers and entrées.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 0 and 1°C (32 to 34°F) for up to six weeks. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. If frozen, thaw between -2 and 1°C (28 to 34°F). For best texture and performance, thaw for at least 48 hours.

CURING/AGING

Five to 10 days.

Low-Moisture/Part-Skim Mozzarella



Excellent browning and stretch for pizza blend applications or in pasta stuffings. Available in a variety of labor- and cost-saving styles.

COLOR

Creamy white.

TEXTURE

Semi-soft and plastic bodied. Firmer than whole milk style.

FLAVOR

Fresh, mild and delicate.

TYPICAL COMPOSITION

45–52% moisture, 30–45% milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Easier cold manipulation (shredding, slicing, etc.) than whole milk mozzarella. Melts slower and browns much quicker than whole milk version. Well-suited in pizza topping blends. Use in entrées and pasta stuffings.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 0 and 1°C (32 to 34°F) for up to six weeks. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. If frozen, thaw between -2 and 1°C (28 to 34°F). For best texture and performance, thaw for at least 48 hours.

CURING/AGING

Five to 10 days.

Part-Skim Mozzarella



Excellent browning and stretch for pizza blend applications or in pasta stuffings. Available in a variety of labor- and cost-saving styles.

COLOR

Creamy white.

TEXTURE

Semi-soft and plastic bodied. Firmer than whole milk style.

FLAVOR

Fresh, mild and delicate.

TYPICAL COMPOSITION

52–60% moisture, 45% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Easier cold manipulation (shredding, slicing, etc.) than whole milk mozzarella. Melts slower and browns much quicker than whole milk version. Well-suited for blends for pizza topping blends. Use in entrées and pasta stuffings.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 0 and 1°C (32 to 34°F) for up to six weeks. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. If frozen, thaw between -2 and 1°C (28 to 34°F). For best texture and performance, thaw for at least 48 hours.

CURING/AGING

Five to 10 days.

Provolone



Excellent melt when shredded. Good for melting on grilled meats and sandwiches. Blend shredded provolone with mozzarella for more flavorful pizza blends. As provolone ages and becomes more intensely flavored, a smaller amount will give your pizza blend cost-effective distinction.

COLOR

Ivory to pale beige.

TEXTURE

Firm and smooth with distinctive striated texture when young, becoming more granular with age.

FLAVOR

Always made with whole milk. Fuller flavor than mozzarella, even when young. Becomes increasingly sharp and piquant with age. Also available smoked.

TYPICAL COMPOSITION

45% maximum moisture, 45% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts and stretches more easily than low-moisture or part-skim mozzarella. Shred for pizza topping. Melt on grilled meats, poultry and fish.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 0 and 1°C (32 to 34°F) for up to 12 months. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. If frozen, thaw between -2 and 1°C (28 to 34°F). For best texture and performance, thaw for at least 48 hours.

CURING/AGING

Four to 14 months.

Whole Milk Mozzarella



Excellent melt, flow and stretch for optimum coverage on hot entrées or pizzas. Available in a variety of labor- and cost-saving styles.

COLOR

Creamy white.

TEXTURE

Semi-soft and elastic. Creamier than part-skim version.

FLAVOR

Fresh, mild and delicate. More buttery than part-skim version.

TYPICAL COMPOSITION

52–60% moisture, 45% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts and stretches more easily than low-moisture or part-skim versions. Shred for pizza topping. Melt on grilled meats, poultry and fish.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 0 and 1°C (32 to 34°F) for up to six weeks. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. If frozen, thaw between -2 and 1°C (28 to 34°F). For best texture and performance, thaw for at least 48 hours.

CURING/AGING

Five to 10 days.

5.7 CHEESES FOR PIZZA AND BLENDS



Varieties include:

- Cheese for pizza
- Specialized blends

In addition to choosing from pasta filata cheese varieties and Individually Quick Frozen (IQF) cheeses to manufacture pizza, operators may also choose from pizza cheese blends that are generally made by a stirred curd process rather than a pasta filata process. Designed for pizza, they are selected for their flavor, functionality and cost advantages.

U.S. mozzarella is among the world's most popular topping for U.S.-style pizza, because it provides the right mix of flavor, melting, stretch and elasticity characteristics. Low-moisture/part-skim mozzarella is one of the most popular choices of cheese in food processing applications because of its firmer body, excellent browning, longer shelf life and excellent shreddability. Whole milk mozzarella, another popular ingredient, provides a smooth, creamy flavor and texture and superior melt and flow.

Pasteurized processed mozzarella is manufactured by heating and mixing mozzarella and other cheeses, among with other ingredients, as allowed by U.S. Federal Standards of Identity for pasteurized processed cheeses. It is used in applications requiring strict functional performance and a high degree of uniformity. Pasteurized processed cheeses generally provide uniform color, flavor and melting properties.

Provolone is a pasta filata cheese that is closely related to mozzarella and is used in pizza blends to increase flavor while maintaining attractive melt and stretch properties.

Application Benefits

The pizza segment is one of the largest cheese applications served by U.S. cheese manufacturers. U.S. cheeses are used in frozen pizza, refrigerated pizza, pizza kits and fresh pizza that is made and served at foodservice establishments all over the world. As U.S. and foreign pizza chains continue to expand their restaurant sites around the world, the demand for cheese and the need for high-performance cheese continue to grow. There is a growing variety of U.S. cheeses and blends designed and manufactured specifically for these applications.

Custom Pizza Blends

Many U.S. cheese suppliers offer specialized and customized pre-shredded cheese blends for pizza applications. These include blends of two, three or more cheeses with specific flavors, colors, price points and functional characteristics.

5.8 CHEDDAR AND COLBY



Varieties include:

- Cheddar
- Smoked cheddar
- Colby

Manufacturing Process

Cheddar is the name of the cheese, the name of the gorge in England where this cheese originated and the name of a step in the make procedure that differentiates this family of cheeses. Traditionally, the curds are pulled to the sides of the vat and the whey is drained. As the curds drain, they knit into a solid mass that is cut into slabs, turned, stacked and allowed to re-knit. This is called "cheddaring" the cheese. After a few turns, the slabs are milled and formed. These cheeses are then wrapped in cheese cloth and waxed. Today, only specialty cheddars are made in this fashion. Modern technology takes the guesswork out of cheddar making. The cheddars produced today in the United States are of consistently excellent quality with the ability to customize the flavor, texture and aging potential to meet the specific need.

Colby, named after its town of origin in Wisconsin, is made similarly to cheddar, except that the curds are cut smaller and rinsed after the whey is drained. This rinsing hinders the knitting of the curds, leaving small irregular openings in the body of the cheese. This process is rumored to have been an accident, as are many of the new cheese making techniques through the ages.

Performance

Colby and younger cheddars perform similarly under heat. They melt well when shredded or sliced as a topper for a dish going under the broiler. Excellent slicing and shredding properties.

Medium and aged cheddars perform better for most hot applications. They melt more completely, with less separation. Beyond a certain age, they become more problematic to slice, as the body of the cheese becomes more crumbly.

Key Applications

Colby and younger cheddars are ideal for shredding to top any hot or cold application, from salads to Hispanic foods and much more. Their slicing properties make them perfect for sandwich applications, hot or cold. Aged cheddars, with their superior melting ability, are ideal for sauces, soups and casseroles. They can be blended easily with other cheeses to build signature gourmet pizzas. They are shredded or crumbled into salads. Specialty cheddars are welcomed with any cheese course.

Marketing Advantages

Highest customer acceptance of these cheeses. The United States is the world's largest producer in quality and volume. These cheeses are high in calcium, a much-needed mineral in most diets.

Key Benefits in Foodservice and Prepared Foods

Available in a range of flavor, texture and performance options depending on the age of the cheese. Their versatility and consumer acceptance allows them to be used in a wide array of prepared foods. Melts well and can be used in frozen/microwaveable applications. Available cubed, shredded and sliced for cost-efficiency through labor savings and reduced waste.

Cheddar



Most popular cheese in the world. U.S. cheddar quality is world-renowned.

COLOR

Ivory or orange with the addition of annatto or achiote, a flavorless food coloring from the fruit and seeds of the Bixa Orlleana tree from Mexico and Central America; used extensively in Hispanic cuisine.

TEXTURE

Dense and smooth, more elastic when young, becoming more crumbly with extended aging.

FLAVOR

Mild when young, becoming sharper with age. Mature cheddar has been described as "beefy" or "brothy"; however, many people have a difficult time describing the flavor of cheddar. Also available smoked.

TYPICAL COMPOSITION

39% maximum moisture, 50% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts well. Aged cheese is ideal for cream soups and sauces, such as rarebits. Slices and shreds well for use on sandwiches or as a topper for hot or cold appetizers and entrées. Popular in pizza blends. Also available as "cheddarella," a blend of cheddar and mozzarella curds pressed together into one cheese. Well-matured specialty cheddars are popular on the cheese course.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to 12 months. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

Traditionally:

Mild: 30 to 90 days.

Medium: 90 days to six months.

Sharp: Six months or more. Beyond this point the years of age should be listed on the cheese. Currently available in the United States aged up to five years or more.

Colby



An American Original with a mild flavor; popular with children.

COLOR

Orange with the addition of annatto, or achiote, a flavorless food coloring from the fruit and seeds of the Bixa Orlleana tree from Mexico and Central America, used extensively in Hispanic cuisine.

TEXTURE

Firm, but softer and more elastic than cheddar. Open texture with tiny, mechanical holes.

FLAVOR

Similar to mild cheddar. Brothy and milky.

TYPICAL COMPOSITION

40% maximum moisture, 50% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts well. Particularly well-suited for top-melting. Slices and shreds well for use on sandwiches or as a topper for hot or cold appetizers and entrées.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to six months. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

One to three months.

AN AMERICAN ORIGINAL

Developed in the central Wisconsin town of Colby in 1874. The first batch was said to be a happy accident, as many new cheeses through the years have been.

5.9 SWISS CHEESES



Varieties include:

- Baby swiss
- Swiss
- Gruyère

Manufacturing Process

Swiss and baby swiss cheeses are made with a specific proprionic culture that gives off carbon dioxide. This is what forms the holes or "eyes" so familiar in these cheeses. Traditionally, swiss was made in 90.8 kg (200 lb) wheels because that was the biggest size one man could work and turn in the aging room. This large size was also a way for cheese makers in the Middle Ages to reduce their tax burden, as taxes on cheese were by the piece. Swiss is typically made with part-skim milk, which results in a firmer, more resilient body than baby swiss, typically produced with whole milk. Baby swiss is made in smaller sizes, with smaller and fewer eyes. Gruyère is the washed-rind member of the family, with a dense body and infrequent pea-sized holes. Gruyère is washed with a smear regularly, at decreasing intervals, throughout its many months of ripening. The washes are discontinued in time for the rind to dry out prior to shipping.

Performance

Swiss, available in a rindless version, has excellent slicing and shredding properties. It melts when shredded or sliced thin, but firms up after cooling. Baby swiss has good slicing and shredding properties, and melts readily in any application. Gruyère shreds well, melts readily and resists separation.

Key Applications

These cheeses are traditional in fondues, as well as soup toppers, ingredients in baked goods, soups, sauces, quiches, gratins, roulades, gourmet pizza applications and more. Wherever good melting and full flavor are required, this family has a cheese to fit the need. Aged gruyère is a favorite on the cheese board, too.

Marketing Advantages

World-class quality. Convenient rindless versions reduce waste and increase ease of slicing. European-style, gourmet appeal, particularly in the aged gruyère.

Key Benefits in Foodservice and Prepared Foods

Range of appealing flavors, from mild baby swiss to nutty swiss and earthy gruyère. These cheeses melt well and can be used in frozen/microwaveable applications. Add both flavor and texture to any hot entrée or side dish.

Baby Swiss



Mild flavor, excellent melting cheese. Natural in fondues and on hot or cold sandwiches.

COLOR

Pale, buttery yellow.

TEXTURE

Soft, smooth and silky with small eyes. Creamier than traditional swiss.

FLAVOR

Buttery, mild, creamy and somewhat sweet.

TYPICAL COMPOSITION

37.5–40.5% maximum moisture, 23–27% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts well. Particularly well-suited for soups, sauces, fondues, casseroles and fillings. Slices and shreds well for use on sandwiches or as a topper for hot or cold appetizers, entrées and vegetables. Because it is made with whole milk, it will remain softer after melting and cooling, referred to as "post melt chew," in hot sandwich applications such as a Reuben.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to six months. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

Two months.

AN AMERICAN ORIGINAL

Amish dairy farmers in Pennsylvania and Ohio are credited with producing the first baby swiss sometime between 1890 and 1900. The name "baby swiss" was chosen because this cheese is made in smaller sizes than traditional swiss, it is aged for less time and it has smaller holes or eyes than traditional swiss.

Swiss



Traditional in fondues and on hot or cold sandwiches. Distinctive nutty flavor and chewy texture play an important role in a wide number of popular dishes. Rindless varieties reduce trimming and waste.

COLOR

Ivory.

TEXTURE

Firm and elastic with large, dime-sized eyes. Traditionally made wheels of swiss have a very dense rind.

FLAVOR

Mellow, buttery and nutty.

TYPICAL COMPOSITION

41% maximum moisture, 43% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts well. Suited for sauces, fondues, casseroles and fillings. Slices and shreds well for use on sandwiches or as a topper for hot or cold appetizers, entrées and vegetables. Because it is made with part-skim milk, it has a slower melt and less flow than baby swiss, making it ideal for hot appetizers. It also gives fondue a chewier, more resilient body.

STORAGE/SHELF LIFE

The culture that produces the eyes continues to remain active in the cheese, producing carbon dioxide. This can result in a puffy package of swiss. This is not a defect or problem, but a natural occurrence. Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to one year. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

Two months or more, commonly about seven to nine months.

Gruyère



Traditional in fondues, quiches, on gratins and soups and more. Gourmet appeal.

COLOR

Ivory to pale yellow with a distinctive, pebbly brown rind.

TEXTURE

Dense, smooth and a bit waxy, with occasional pea-sized holes.

FLAVOR

As a washed-rind cheese, gruyère has a richer, earthier flavor than swiss. This earthiness becomes more pronounced as the cheese ages.

TYPICAL COMPOSITION

39% maximum moisture, 45% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Melts readily and resists separation; perfectly suited for sauces, fondues, casseroles and fillings. Slices and shreds well for use on sandwiches or as a topper for soups, hot or cold appetizers, gratins, entrées and vegetables. It also gives fondue its distinctive flavor. Perfect for gourmet pizzas. Aged version is ideal for cheese course.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to one year. Proper sanitation when handling these cheeses will greatly increase their shelf life and quality. Freezing is not recommended.

CURING/AGING

Three months minimum, commonly about six months or more. Rind washed regularly at decreasing intervals throughout the aging process. Produced in copper vats and traditionally aged on red spruce boards.

5.10 HARD CHEESES



Varieties include:

- Asiago
- Parmesan
- Romano
- Pepato

Manufacturing Process

The manufacture of hard cheeses is unique in a number of ways. The curd is cut much smaller than cheddar – the size of a kernel of wheat versus the size of an unshelled peanut. It is also cooked at a higher temperature than other cheeses. This results in a drier curd. The curd is pressed and either brined or dry salted. It is turned regularly and rubbed with vegetable oil.

Performance

Hard cheeses generally have longer shelf lives due to their low-moisture content. Ideal for grating. Freshly grated hard cheeses incorporate well into soups, sauces, stuffings, fillings and bread crumbs. Their low-moisture content makes them excellent in baked goods. These cheeses brown quickly on direct heat applications.

Key Applications

Hard cheeses are used as ingredients in a wide variety of food applications, including appetizers, breads, dressings, soups, pasta dishes, salads, rice, potato or vegetable dishes. They are also used for their more intense cheese flavor in applications such as chips, popcorn, crackers, dips and sauces.

Marketing Advantages

Longer shelf life. Rich in calcium, which facilitates positioning in the "nutrition marketing segment." Strong consumer recognition. Italian-style appeal and quality image.

Key Benefits in Foodservice and Prepared Foods

Intense cheese flavors. Easily grated and used in soups, sauces, pasta and pizza toppers, salads and more.

Asiago



Versatile as a topping/garnish, as well as an ingredient in many dishes. Labor-saving shredded and grated versions store for long periods.

COLOR

Ivory to light yellow.

TEXTURE

Fresh: Firm and elastic.

Medium: Dense and smooth.

Aged: Hard and granular, but softer than parmesan, due to higher milkfat.

FLAVOR

Mild when fresh. Buttery, nutty and sharper with age. Between parmesan and white cheddar.

TYPICAL COMPOSITION

Fresh: 45% maximum moisture, 50% minimum milkfat solids.

Medium: 35% maximum moisture, 45% minimum milkfat solids.

Aged: 32% maximum moisture, 43% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Freshly grated or shredded, asiago melts readily and incorporates evenly into soups, sauces, stuffings, baked goods, bread crumbs and garnishes. Perfect for gourmet pizzas and as a pasta topper.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 2°C (34 to 35°F) for up to one year. Proper sanitation when handling these cheeses will increase their shelf life and quality by reducing mold development. Shredded and grated hard cheese can be successfully frozen for extended periods. Thaw under refrigeration.

CURING/AGING

60 days to over 12 months.

Parmesan



Extremely versatile as a topping/garnish, as well as an ingredient in many dishes. Labor-saving shredded and grated versions store for long periods. Distinct flavor integral to Italian cuisine.

COLOR

Ivory to light yellow.

TEXTURE

Hard and granular. Drier with age.

FLAVOR

Buttery, nutty, somewhat sweet and slightly salty.

TYPICAL COMPOSITION

32% maximum moisture, 32% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Freshly grated parmesan melts readily and incorporates evenly into soups, sauces, stuffings, baked goods, bread crumbs and garnishes. Grated parmesan browns quickly under direct heat. Perfect for gourmet pizzas and as a pasta topper. Aged version ideal for cheese course.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 4°C (34 to 39°F) for up to two years. Proper sanitation when handling these cheeses will increase their shelf life and quality by reducing mold development. Shredded and grated hard cheese can be successfully frozen for extended periods. Thaw under refrigeration.

CURING/AGING

10 months minimum, available aged up to 20 months or more. The rind is brined or salt rubbed to make it harder. This retains more moisture inside the cheese as it ages.

Romano



Traditional pasta topper in Italian cuisine. Versatile and flavorful as a topping/garnish, as well as an ingredient in many dishes. Labor-saving shredded and grated versions store for long periods.

COLOR

Creamy white to ivory.

TEXTURE

Hard, granular.

FLAVOR

Sharp, piquant with an acidic tang. Much more assertive than parmesan. Romano is available studded with black peppercorns in a variety called pepato.

TYPICAL COMPOSITION

34% maximum moisture, 38% minimum milkfat solids.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Freshly grated or shredded romano melts readily and incorporates evenly into soups, sauces, stuffings, baked goods, bread crumbs and garnishes. Flavorful gourmet pizza topper. Traditional pasta topper in Italian cuisine.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between 1 and 4°C (34 to 39°F) for up to one year. Proper sanitation when handling these cheeses will increase their shelf life and quality by reducing mold development. Shredded and grated hard cheese can be successfully frozen for extended periods. Thaw under refrigeration.

CURING/AGING

Five months minimum for table cheese. 12 months minimum for grating.

5.11 PROCESSED CHEESES



Varieties include:

- Pasteurized processed cheese
- Pasteurized processed cheese food
- Pasteurized processed cheese spread
- Pasteurized processed cheese product
- Cold-pack

Manufacturing Process

Pasteurized processed cheese is made by mixing and heating natural cheese. The cooking temperature depends on whether the end-product is processed cheese, processed cheese food or processed cheese spread. Cold-pack cheese, which is similar in many ways to processed cheese, is not heated during processing. Another type of processed cheese, pasteurized processed cheese product, meets different moisture and fat levels from that of pasteurized processed cheese spread, and unlike the others mentioned above, it has no Federal Standard of Identity.

Key Benefits in Foodservice and Prepared Foods

Processed cheese products can be custom designed to deliver specific melting properties: from no-melt types to products designed for sauces and dips. The wide variety of formulations delivers cost-efficient solutions in fast-food applications. Premium processed cheese products offer uniqueness and lend themselves well to high-quality, consistent food preparations. Extended shelf life provides cost advantages.

Marketing Benefits

Superb product consistency ensures consumer satisfaction and repeat sales. Ingredient customization offered by suppliers facilitates end-product differentiation. Good nutritional properties and enrichment possibilities add extra appeal and value. Smooth texture and mild taste have strong appeal to children. Deliver "cheese appeal" in shelf-stable products.

Performance

Processed cheeses typically have a longer keeping quality compared with natural cheeses. Shelf-stable processed cheese products are also available, which may not require refrigeration. Processed cheeses are usually selected for their uniform flavor and performance. They are available with a wide range of melting and slicing characteristics and in a variety of color and flavor intensities, forms and package sizes.

Key Applications

Processed cheeses are used in nearly every application where natural cheeses are used, including cheese snacks, soups and sauces, baked goods, cheese stuffed entrées, sandwiches, vegetables in cheese sauce, meats, microwaveable foods and casseroles. Reduced- or fat-free types of processed cheeses are ideal in processed food applications such as fat-free soups, sauces, appetizers and baked and microwaveable entrées.

Pasteurized Processed Cheese



COLOR

The color of pasteurized processed cheese often reflects the types of natural cheese used in the cheese making process. Colors range from white to ivory, buttery or the golden color of cheddar. The color agent used is typically annatto, a natural vegetable color obtained from the mature seeds of the Bixa Orlleana tree.

TEXTURE

Smooth, dense and homogeneous. Slight plastic or gelatinous texture when cold. Smooth, creamy texture when heated. The addition of permitted vegetables, fruits, nuts or meats also affects texture.

FLAVOR

Pasteurized processed cheese flavors are buttery and rich and correspond to the different cheese varieties used during production. As a benchmark, "American" has a pronounced buttery and cheddary flavor. Other permitted ingredients and flavors will also determine the final flavors.

TYPICAL COMPOSITION

The base ingredient for pasteurized processed cheeses is natural cheese, and the moisture and milkfat composition of these cheeses will correspond to the individual varieties used in their production. They may be made using one cheese or a combination of different cheeses. The cheeses permitted include cheddar, brick, muenster, swiss and a variety of washed curd cheeses. In some styles, gouda and edam are also used. When used in the context of pasteurized processed cheese, the term "American" refers to a specific blend of cheddar, colby and a variety of washed curd cheeses. Vegetables, fruits, nuts, meats and other flavors are also permitted ingredients in certain types of pasteurized processed cheese.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

When cold, pasteurized processed cheese has a firm texture that can be easily sliced. When warmed or heated, it has a smooth, creamy texture, and melts quickly. As most natural cheeses are melted and then cooled they quickly become firm, a process known as post-melt chewiness. Pasteurized processed cheese melts quickly and stays soft much longer, with very little post-melt chewiness. Slices melt well and are most popular for grilled cheese and cheeseburgers.

STORAGE/SHELF LIFE

The pasteurization process yields cheeses with exceptionally long shelf lives. Recommended storage temperatures are from 0 to 4°C (32 to 39°F). Freezing is not recommended. When retained in the original factory sealed packaging, their shelf life is indeterminate and often measured in years. Some products are shelf-stable and require no refrigeration.

CURING/AGING

These cheeses are not typically aged or cured. They are ready for consumption immediately after processing and packaging.

Pasteurized Processed Cheese Food



COLOR

The color of pasteurized processed cheese food often reflects the types of natural cheese used in the cheese making process, and colors range from white to ivory, buttery or the golden color of cheddar. The color agent used is typically annatto, a natural vegetable color obtained from the mature seeds of the Bixa Orlleana tree.

TEXTURE

Smooth, dense, homogeneous. Slight plastic or gelatinous texture when cold. Smooth, creamy texture when heated. The addition of permitted vegetables, fruits, nuts or meats may also affect texture.

FLAVOR

Pasteurized processed cheese food flavors are buttery and rich and correspond to the different cheese varieties used during production. As a benchmark, "American" has a pronounced buttery and cheddary flavor. Other permitted ingredients and flavors will also determine the final flavors.

TYPICAL COMPOSITION

Pasteurized processed cheese foods have a maximum moisture content of 44% and a minimum milkfat content of 23%. The base ingredient for these cheeses is natural cheese. They may be made using one cheese or a combination of different cheeses. The cheeses permitted include cheddar, brick, muenster, swiss and a variety of washed curd cheeses. In some styles, gouda and edam are also used. When used in the context of pasteurized processed cheese food, the term "American" refers to a specific blend of cheddar, colby and a variety of washed curd cheeses. Vegetables, fruits, nuts, meats and other flavors are also permitted ingredients in some types of pasteurized processed cheese foods.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Pasteurized processed cheese foods have exceptional shelf life and good hot performance in cooking applications. They are the basis for many cheese sauces and dips, from nachos to macaroni and cheese. Their easy melting ability makes them ideal for stovetop, microwave or baking applications.

STORAGE/SHELF LIFE

The pasteurization process yields cheese foods with exceptionally long shelf lives. Recommended storage temperatures are from 0 to 4°C (32 to 39°F). Freezing is not recommended. When retained in the original factory sealed packaging, their shelf life is indeterminate and often measured in years. Some products are shelf-stable and require no refrigeration.

CURING/AGING

These cheeses are not typically aged or cured. They are ready for consumption immediately after processing and packaging.

Pasteurized Processed Cheese Spread



COLOR

The color of pasteurized processed cheese spread is meant to reflect the types of natural cheese used in the cheese making process. Colors range from white to ivory, buttery or the golden color of cheddar. The color agent used is typically annatto, a natural vegetable color obtained from the mature seeds of the Bixa Orlleana tree. Other permitted ingredients may also affect the color. One popular cheese spread is port wine with cheddar. The resulting cheese yields a ruby color similar to the port wine.

TEXTURE

Vegetable gums are often used in the cheese making process for pasteurized processed cheese spread. They help retain moisture in the spreads, and yield a soft, smooth, creamy texture. The addition of permitted vegetables, fruits, nuts or meats may also affect texture.

FLAVOR

Pasteurized processed cheese spreads are buttery and rich, and the flavors will correspond to the different cheese varieties used in their production. As a benchmark, "American" has a pronounced buttery and cheddary flavor. Other permitted ingredients and flavors will also determine the final flavors.

TYPICAL COMPOSITION

In pasteurized processed cheese spreads, the moisture content may range from 44 to 60%, and they have a minimum milkfat content of 20%. The base ingredient for these cheeses is natural cheese. They may be made from one cheese or a combination of different cheeses. The cheeses permitted include cheddar, brick, muenster, swiss and a variety of washed curd cheeses. In some styles, gouda and edam are also used. When used in the context of pasteurized processed cheese spread, the term "American" refers to a specific blend of cheddar, colby and a variety of washed curd cheeses.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Pasteurized processed cheese spreads are designed to spread smoothly and are the basis for many snacking or appetizer applications with crackers, breads or vegetables.

STORAGE/SHELF LIFE

The pasteurization process yields cheeses with exceptionally long shelf lives. Recommended storage temperatures are from 0 to 4°C (32 to 39°F). Freezing is not recommended. When retained in the original factory sealed packaging, their shelf life is indeterminate and often measured in years. Some products are shelf stable and require no refrigeration.

CURING/AGING

These cheeses are not typically aged or cured. They are ready for consumption immediately after processing and packaging.

Cold-Pack



A wide range of cheeses and seasonings offer many flavors from which to choose. Can be served cold for spreading on crackers or bread, or used in hot sauce applications.

COLOR

White, ivory, light yellow to orange, depending on cheese varieties used. Port wine or other ingredients also add unique colors.

TEXTURE

Smooth and spreadable.

FLAVOR

Mild to sharp. Flavors reflect the natural cheese varieties used to produce the cheese. Often flavored with spices, meats, fruits or vegetables. Port wine is also a popular flavor.

TYPICAL COMPOSITION

Cold-pack must contain the same amount of moisture as the cheese varieties used to produce it. No water can be added. If fruits, vegetables, meats or spices are used, the moisture is allowed to be 1% higher and the milkfat can be 1% lower than the cheese varieties used.

PERFORMANCE CHARACTERISTICS AND APPLICATIONS

Cold-pack was first used as a bar or pub snack that was spreadable. It is still most often used as a spread with crackers, breads or chips. Because the cheese is so finely chopped, it also melts well into sauce applications.

STORAGE/SHELF LIFE

Store at refrigerated temperatures between -1 to 1°C (30 to 34°F) for 90 to 180 days. Check specific code dates on packaging. Available in a vast array of sizes for retail and foodservice applications.

CURING/AGING

Not cured.

5.12 CHEESE POWDERS AND ENZYME MODIFIED CHEESES



Varieties include:

- Cheese powders
- Enzyme Modified Cheeses (EMCs)

Manufacturing Process

Cheese powders may contain one or more varieties of natural cheeses. Cheeses commonly used to create powders and dry blends include cheddar, blue, parmesan, romano and swiss-style cheeses. The base cheese, which may be blended with other ingredients and colors, is spray-dried to create a free-flowing powder with a low-moisture content (typically in the 3 to 5% range).

Some products are dehydrated in vegetable oils for easier application on chips, crackers and other dry snacks. Hard Italian-style cheeses (e.g., parmesan) can be dried after grating in tray or belt dryers to reduce moisture to less than 18%. After cooling, the cheeses are ground and packaged.

EMCs, which provide intense cheese flavor, are made from special blends of natural cheese with added lipases and other food-grade enzymes. Flavor concentrations 10- to 20-fold as high as that of the ripened cheeses develop in one to three days. The cheese paste is then heat-treated to stop the biochemical reaction and cooled. EMCs are available in paste form and dried form. EMCs offer significant savings and functional benefits in products such as cheese-flavored crackers and other bakery items.

Performance

Cheese powders are used as a primary flavor ingredient in prepared foods. When concentrated flavor is needed, enzyme-modified cheeses are a good option for standardizing natural cheese flavor.

Product Specifications

Most cheese powders have a moisture level of 4 to 5% max. Fat content varies as a function of the raw cheese material used and the amount of other ingredients that may be added as carriers. Similarly, salt content varies but is often in the 5 to 10% range.

Key Applications

Cheese powders, also called dried cheese or dehydrated cheese, are well-suited for use in low-moisture applications such as snacks, cereal-based products and prepared dry mixes. They are also used as a flavor component in a wide range of other processed foods, such as soups, cheese sauces, dips, salad dressings, frozen foods and bakery products. Reduced-fat, dried cheese blends are available for low-fat formulations.

Marketing Advantages

Cheese powders are ready-to-use and adaptable to many food processing systems. They can be customized for use with other dry ingredients and can be blended with dry ingredients and additives. They offer labor savings and cost effectiveness. Well-suited for value-added, extended shelf life products, cheese powders can be packed in modified atmosphere packs to obtain a storage life of a year or more.

Key Benefits in Foodservice and Prepared Foods

Cheese powders and enzyme-modified cheeses are used in snack coatings, dry mixes, salad dressings, sauces, soups, crackers and to enhance natural cheeses in seasonings and baked goods. U.S. cheese suppliers can create hundreds of dry cheeses and blends with different flavors, colors, functional properties and price points.

5.13 CUSTOM AND CONVENIENCE CHEESE PRODUCTS



Varieties include:

- Pre-blends
- Pre-cut cheese
- Shredded cheese
- Grated cheese
- Cheese sauce
- Portion Packaged cheese

Cheese Appetizers

U.S. cheese appetizers are gaining popularity around the world. They offer foodservice operators cost savings in terms of labor and waste reduction, as well as convenience and consistency. U.S. manufacturers offer a variety of batters and breadings, as well as many different shapes (sticks, balls, triangles and custom shapes). Cheese appetizers also include a range of vegetable, pasta and dough shells filled with U.S. cheese. Jalapeño peppers filled with U.S. cream cheese, for example, are a popular appetizer. Cheese appetizers are generally marketed as frozen products. They can be prepared in a variety of ways such as frying or cooking in convection or microwave ovens.

Manufacturing Process

Cutting, slicing, shredding, packaging or other processing of cheese is performed after the manufacturing process and any aging is completed. Convenience-forms of both natural and processed cheeses are available. Cheese sauces are aseptically processed, viscous liquids that are canned. Typically, ingredients used are natural cheeses, skim milk, whey, salt, stabilizers, emulsifiers and seasonings. Viscosity of the sauces can vary but is often in the 30-60,000 cps range at 21 to 27°C (70 to 81°F).

Key Benefits in Foodservice and Food Processing

Reduce on-site labor costs. Ensure greater consistency of finished products. Increase food processors' manufacturing efficiencies. Sauces are pumpable and provide good portion control. Extended shelf life, no need for refrigeration for cheese sauces.

Key Applications

These cheeses are selected primarily to reduce on-site labor and to ensure a greater consistency of finished product. Convenience cheeses are available for use with nearly every cheese application, from sandwiches and appetizers to meals, entrées and snacks. Cheese sauces are convenient as ready-to-use dips as well as for omelets, pasta, dressings, sauces and soups.

Cheese Concentrates

U.S. cheese suppliers have recently developed technologies that enable them to offer cheese concentrates. These can be used in liquid and dry applicatons. Added at low levels, cheese concentrates reinforce the flavor of sauces and can be used as an ingredient in pasteurized processed cheese products.

Cheese Sauces and Dressings

The popularity of cheese sauces derived from cheddar and other types of cheeses results from their convenience. Their main uses are omelets, nachos, pasta, side dishes, salad dressings, dips and toppings. They are increasingly used as fillings in pocket sandwiches, entrées and battered and breaded foods. Cheese sauces are formulated to have specific and desirable characteristics in terms of flavor, consistency, flow and behavior during cooking. U.S. manufacturers can design cheese sauces to meet very specific melting point requirements.

Cheese sauces are often thermally processed so they are shelf-stable until opened. Many varieties are also available in powder form. Most cheese sauces are formulated to be freeze-thaw stable and to be reheated in a microwave as well as convection ovens. U.S. cheeses are also a key flavoring agent in spoonable, pourable dressings and in powdered dressing mixes.

Cheddar, parmesan, blue, romano, cream and ricotta cheeses are often used in the manufacture of ready-to-use dressings. Dips are used with salty snacks, vegetables, meats and fruits. In the manufacture of premium dips, the major ingredients are sour cream, skim milk and stabilizers. U.S. cheeses are added to achieve a desirable flavor profile and for texture.

Shreds and Cubes

Using pre-cut cheeses helps reduce waste and labor costs during preparation and clean-up. U.S. manufacturers can supply customers with a very wide variety of sizes and shapes. The following are examples of pre-cut items. For more options, please contact your U.S. cheese supplier.

- **Cubes, square pieces and rectangular sticks:** These pieces are generally 1.5 to 2 cm thick and are cut to specified, consistent lengths. Mini cubes (dice-shaped shreds) are also available.
- **Standard shreds:** These shreds are approximately 0.2 to 0.3 cm around, with a length between 1.5 and 3 cm. These are also often referred to as bevel shreds.
- **Fine shreds:** These shreds are generally less than 0.15 cm around and 1.25 to 4.5 cm long. These are often referred to as fancy shreds.
- **Flat shreds:** They are 0.15 to 0.35 cm around, with a flat, "hand-shred" appearance.
- **Sandwich slices:** Slices are available in a variety of shapes (rectangular, moon, round, custom) and of varying dimensions to meet end-users' needs.

Cheese Seasonings

U.S. manufacturers offer a variety of seasonings in which cheeses play a key role as flavoring agents. Cheese seasonings are often applied on snacks. To achieve desirable adherence, appearance and other characteristics, other functional ingredients are typically added to seasonings. They include butter, whey solids, milk solids and buttermilk. Frequently, salt and spices are added to provide flavor.

Using Seasonings for Cheese-Flavored Snacks

The mesh size of seasoning powders needs to be compatible with the oil content of the snack. A coarse particle size of 40 to 100 is recommended for potato chips (36 to 38% oil). Corn-based chips require a much finer particle size, as their oil content is typically lower (18 to 22%). To maximize adhesion on fat-free snacks, a surface film needs to be created. In many snacks, a superior flavor profile can be achieved by incorporating cheese seasonings or cheese powders in the product formulation itself, rather than as a coating. Cheese crackers are a good illustration of this type of application.

5.14 CHEESE FOR SPECIAL NEEDS



Varieties include:

- Low-fat cheeses
- No-fat cheeses
- Low-sodium cheeses
- Kosher cheeses
- Halal cheeses
- Organic cheeses

Manufacturing Process

Specialized cheese products are available in a wide variety of natural and processed cheese forms. In producing Kosher, Halal, organic and nutrient-modified products, U.S. cheese makers follow established guidelines for production and inspection to meet the specific requirements of those claims.

Performance

Except for Kosher, Halal and organic products, which do not differ from traditional cheeses in terms of nutrient content or composition, other specialized cheeses, such as low-fat cheeses, may not function in exactly the same way as the traditional cheese varieties on which they are based. Please contact your U.S. cheese supplier for information on the functionalities of specific cheeses.

No-Fat and Low-Fat Cheeses

A variety of low-fat and no-fat cheeses developed for foodservice operators are available from the United States. Among the most popular and versatile varieties are cheddar, mozzarella, swiss and provolone. These products may offer the same functionality, such as stretchability and meltability, as full-fat cheeses. They help foodservice operators design low-fat dishes with an excellent nutritional profile and high consumer appeal.

Key Applications

There is a wide variety of specialized cheese products available for use in products targeting consumers with special needs or interests, including low-fat and low-calorie cheeses, Kosher, Halal and organic cheeses. These products, depending on their specific functionalities, may be incorporated into a wide range of foods, from crackers and other snacks to entrées, appetizers and desserts.

Marketing Advantages

Cater to the needs of specialized markets and consumers. Offer nutritional benefits of cheese while meeting requirements of special diets. Receive variety without compromising on convenience and quality.

Key Benefits in Foodservice and Food Processing

Allow chefs and food processors to benefit from the flavor, texture and functionality of cheese while creating foods that meet the special needs of specific consumers.

5.15 SPECIALTY CHEESES



U.S. specialty cheese production goes back centuries, with farmstead cheese making when European immigrants settled in America. Today, even though the United States alone produces a quarter of the world's cheese output in mostly large, state-of-the-art factories, specialty cheese making is still widely practiced and is currently the fastest growing segment of the American cheese market.

The size of U.S. specialty cheese factories is usually small, and production often times occurs in an open-vat environment. However, these factories are subjected to the same stringent level of inspection and quality assurance programs as larger facilities to ensure consumers' safety.

The range of specialty cheese varieties produced and available from the United States is quite broad. Every family of cheese includes specialty cheeses, whether it is a more high-end version of an everyday table cheese such as monterey dry jack, which is an aged version of monterey jack, or a new cheese uniquely crafted and/or named by American specialty cheese makers.

The following list, divided by degree of hardness, contains just a small sample of the specialty cheeses made in the United States. Some of them might be produced by more than one cheese maker, while some are specific brands.

Soft-Fresh

- Crème Fraîche
- Crescenza
- Fromage Blanc
- Mascarpone
- Quark (Plain & Flavored)
- Schloss*
- Feta (Plain & Flavored)

Soft-Ripened

- Brie
- Les Frères*
- Camembert
- Mt. Tam*
- ColoRouge*
- Pierce Point*
- Green Hill*
- Poudre Puffs*
- Hudson Valley Camembert*
- Tomme
- La Petite Crème*
- Velvet Rose*

Blue

- Amish Blue*
- Creamy Gorgonzola*
- Berkshire Blue*
- Maytag Blue*
- Buttermilk Blue*
- Mountain Top Blue*
- Point Reyes Blue*
- Oregonzola*

Semi-Soft

- Brick (Surface Ripened)
- Limburger
- Fontina
- Muenster
- Grand Cru Surchoix* (Gruyère)
- Red Hawk*
- Havarti (Plain & Flavored)
- Teleme Jack
- Knights Vail*

**Indicates Brand Name*

Gouda & Edam

- Aged Gouda
- Smoked Gouda
- Geliefde*

Pasta Filata

- Aged Provolone
- Oaxaca
- Burrini/Manteche
- Scamorze
- Fresh Mozzarella

Cheddar

- Naturally Bandaged Cheddars
- Raw Milk Cheddar
- Aged Cheddar (2–8 Years Old)

Swiss

- Grand Cru Surchoix* (Gruyère)
- Petite Swiss
- Pleasant Ridge Reserve*
- Raclette

Hard

- American Grana
- BellaVitano*
- Romanello*
- Monterey Dry Jack
- Sareanah*
- Pepato
- Stravecchio Parmesan*

**Indicates Brand Name*

Testifying of the resurgence of specialty cheese making in America, the American Cheese Society (ACS), an organization headquartered in Denver, Colorado (cheesesociety.org), was formed in 1982 by a group of American artisan and farmstead cheese makers. ACS is dedicated to promoting the growth of artisan, farmstead and specialty cheeses and their makers. By their definitions, the term artisan refers to unique, hand-made cheeses, produced with minimal mechanization. Farmstead refers to cheeses made on the same farm that produces the milk. Specialty indicates limited production and special attention to quality through the cheese making and curing process.

U.S. specialty cheeses have won many awards at international competitions such as the World Cheese Awards and the World Championship Cheese Contest. Over the years, while competing side-by-side with European cheese makers, the U.S. cheese industry has proven that it is a true contender to supply the world with safe, wholesome and high-quality cheeses.

Contact the U.S. Dairy Export Council for more information.



6 Cheese for Nutrition and Health



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6.1 OVERVIEW: CHEESE AS A SOURCE OF NUTRIENTS

Cheese is an important source of nutrients, providing significant amounts of high-quality protein and minerals, such as calcium. In addition, cheese intake confers several health benefits. Scientific evidence indicates that cheese helps to protect against dental caries and can be part of dietary patterns to reduce the risk of major chronic diseases, such as osteoporosis, obesity and cardiovascular disease. It is also well tolerated by individuals with lactose maldigestion. Cheese is made from milk, a food designed by nature for the exclusive purpose of delivering nutrition and health to mammals. Scientists have spent many years unlocking nature's secrets about milk and milk products. Some of the key findings related to the role of cheese in delivering nutrition and health are outlined in this section.

U.S. cheese is a concentrated source of many of milk's nutrients. A significant amount of milk's protein, minerals (e.g., calcium, phosphorus), fat and fat-soluble vitamins (e.g., vitamin A) are retained in the curd during cheese manufacturing, making cheese a good or excellent source of these nutrients. Because of this, cheese is considered a nutrient dense food, providing a high concentration of nutrients relative to its calorie content. As an example, in 2010, cheese contributed only 3.7% of the calories available in the U.S. food supply. Yet, this food provided 8.4% of the protein, 27.5% of the calcium, 11% of the phosphorus, 9.5% of the vitamin A, 4.8% of the riboflavin, and 6.5% of the vitamin B_{12}, in addition to other essential nutrients.

Although most U.S. cheeses provide a significant amount of protein and calcium, the nutrient content of specific cheeses can vary as a result of the type of milk or milk products used and how the cheese is made (e.g., manner of coagulation, length of aging). See Table 1 (Comparative Nutritive Content Per Serving of Cheese and Cheese Products) for a listing of the typical nutrient contents of cheese varieties.



Table 1: Comparative Nutritive Content Per Serving of Cheese and Cheese Products

(Per 100g)

	Energy, Kcal	Protein, g	Total Fat, g	Total Carbohydrate, g	Calcium, mg	Magnesium, mg	Phosphorus, mg	Sodium, mg	Potassium, mg	Zinc, mg	Riboflavin, mg	Vitamin B_6, mg	Folate, DFE	Vitamin B_{12}, µg	Vitamin A, RAE
Soft Cheeses, Fresh															
Cottage, Creamed	98	11.12	4.30	3.38	83	8	159	364	104	0.40	0.16	0.05	12	0.43	37
Cottage, Low Fat, 1% Milk Fat	72	12.39	1.02	2.72	61	5	134	406	86	0.38	0.17	0.07	12	0.63	11
Cottage, Dry Curd, Non-Fat	72	10.34	0.29	6.66	86	11	190	372	137	0.47	0.23	0.02	9	0.46	2
Cream	342	5.93	34.24	4.07	98	9	106	365	138	0.51	0.13	0.04	11	0.25	366
Feta	264	14.21	21.28	4.09	493	19	337	917	62	2.88	0.84	0.42	32	1.69	125
Mozzarella, Part-Skim	254	24.26	15.92	2.77	782	23	463	619	84	2.76	0.30	0.07	9	0.82	127
Mozzarella, Whole Milk	300	22.17	22.35	2.19	505	20	354	627	76	2.92	0.28	0.04	7	2.28	179
Neufchatel	253	9.15	22.78	3.59	117	10	138	334	152	0.82	0.16	0.04	14	0.30	241
Ricotta, Whole Milk	174	11.26	12.98	3.04	207	11	158	84	105	1.16	0.20	0.04	12	0.34	120
Soft Cheeses, Mold-Ripened															
Camembert	300	19.80	24.26	0.46	388	20	347	842	187	2.38	0.49	0.23	62	1.30	241
Semi-Soft Cheeses															
Brick	371	23.24	29.68	2.79	674	24	451	560	136	2.60	0.35	0.07	20	1.26	292
Edam	357	24.99	27.80	1.43	731	30	536	812	188	3.75	0.39	0.08	16	1.54	243
Gouda	356	24.94	27.44	2.22	700	29	546	819	121	3.90	0.33	0.08	21	1.54	165
Monterey	373	24.48	30.28	0.68	746	27	444	600	81	3.00	0.39	0.08	18	0.83	198
Muenster	368	23.41	30.04	1.12	717	27	468	628	134	2.81	0.32	0.06	12	1.47	298
Mozzarella, Low-Moisture, Whole Milk	318	21.60	24.64	2.47	575	21	412	710	75	2.46	0.27	0.06	8	0.73	197
Mozzarella, Low Moisture, Part-Skim	301	24.58	19.72	6.36	716	29	537	682	131	3.61	0.35	0.11	27	1.82	254
Provolone	351	25.58	26.62	2.14	756	28	496	876	138	3.23	0.32	0.07	10	1.46	236

	Energy, Kcal	Protein, g	Total Fat, g	Total Carbohydrate, g	Calcium, mg	Magnesium, mg	Phosphorus, mg	Sodium, mg	Potassium, mg	Zinc, mg	Riboflavin, mg	Vitamin B_6, mg	Folate, DFE	Vitamin B_{12}, µg	Vitamin A, RAE
Semi-Soft Cheeses, Mold-Ripened															
Blue	353	21.40	28.74	2.34	528	23	387	1146	256	2.66	0.38	0.17	36	1.22	198
Brie	334	20.75	27.68	0.45	184	20	188	629	152	2.38	0.52	0.24	65	1.65	174
Limburger	327	20.05	27.25	0.49	497	21	393	800	128	2.10	0.50	0.09	58	1.04	340
Hard Cheeses															
Cheddar	406	24.04	33.82	1.33	675	27	473	644	76	3.43	0.43	0.05	26	0.88	263
Colby	394	23.76	32.11	2.57	685	26	457	604	127	3.07	0.38	0.08	18	0.83	264
Gruyère	413	29.81	32.34	0.36	1011	36	605	714	81	3.90	0.28	0.08	10	1.60	271
Swiss	380	26.93	27.80	5.38	791	38	567	70	77	4.36	0.30	0.08	6	3.34	220
Hard Grating Cheeses															
Parmesan, Grated	420	28.42	27.84	13.91	853	34	627	1804	180	4.20	0.36	0.08	6	1.40	262
Romano	387	31.80	26.94	3.63	1064	41	760	1433	86	2.58	0.37	0.09	7	1.12	96
Pasteurized Processed Cheese															
Pasteurized Processed Cheese (American)	366	18.13	30.71	4.78	1045	26	641	1671	132	2.49	0.23	0.05	8	1.50	317
Pasteurized Processed Cheese Food (Swiss)	323	21.92	24.14	4.50	723	28	526	1552	284	3.55	0.40	0.04	6	2.30	237
Pasteurized Processed Cheese Spread (American)	290	16.41	21.23	8.73	562	29	875	1625	242	2.59	0.43	0.12	7	0.40	173
Cold-Pack Cheese															
Cold-Pack, American	331	19.66	24.46	8.32	497	30	400	966	363	3.01	0.45	0.14	5	1.28	-

USDA, ARS, 2015, USDA National Nutrient Database for Standard Reference, Rel. 27, Nutrient Data Laboratory Home Page, http://www.ars.usda.gov/ba/bhnrc/ndl

Specific Nutrients

- **Protein:** Cheese is an important source of high-quality protein. Protein is the major functional and structural component of all cells in the body. This nutrient functions as enzymes, membrane carriers and blood transport molecules and is a major component of muscles, blood cells, skin, hair, teeth and bones. Because protein in cheese is a "complete" protein containing all of the essential amino acids proportional to the body's need, cheese can complement a diet based on grain products, which contain "incomplete" protein. Cheese is a good source of high-quality protein, which is easily digestible. Emerging science supports the health benefits of protein, including dairy protein, in weight management, metabolic activity and healthy aging. Natural cheeses are typically gluten-free, with the exception of some cheeses with ingredients sourced from wheat, barley or rye.
- **Carbohydrate:** Aged cheeses, such as cheddar, contain little or no lactose, the major carbohydrate in milk. In the cheese making process, lactose is removed in whey and/or converted to acids during the ripening of the cheese. The range of lactose in some cheeses, such as processed and cottage cheese, is due to the addition of optional ingredients, such as non-fat milk and cheese whey.
- **Fat:** The fat, saturated fat and cholesterol content of cheeses vary, depending largely on the type of milk (e.g., whole, reduced-fat, low-fat, fat-free) used to make cheese. The fat content of cheese is largely responsible for its flavor and texture. As an example, a U.S. serving (28g) of cheddar cheese contains 10g fat, 5g saturated fat, and 29mg cholesterol. In contrast, a serving (113g) of non-fat dry curd cottage cheese contains 0.3g fat, 0.2g saturated fat, and 8mg cholesterol. In addition to lower fat cheeses, such as cottage, ricotta and part-skim mozzarella, manufacturers have developed a variety of cheeses reduced in fat. In the United States, cheeses labeled as low-fat must contain no more than 3g fat per serving. A reduced-fat cheese must contain at least 25% less fat than its traditional counterpart. Fat-free or non-fat cheese must contain less than 0.5g fat per serving.
- **Vitamins and Minerals:** The vitamin content of cheese depends on the milk used and the manufacturing process. Because most of the fat in milk remains in the curd, cheese contains the fat-soluble vitamins (e.g., vitamin A) of the milk used in cheese making. Water-soluble vitamins – thiamin, riboflavin, niacin, vitamin B_6, vitamin B_{12}, folate – remain in the whey. Therefore, their content in cheese may be influenced by how much whey is retained in the cheese. Some natural and processed cheeses are fortified with vitamin D_3 to help meet needs for this nutrient.
  Most cheeses are a good or excellent, natural source of several minerals, particularly calcium. However, the calcium content of cheese varies according to how the cheese is manufactured. For example, cheeses such as cheddar, brick, and swiss are excellent sources of calcium, whereas cottage cheese contains less calcium (see Table 2. Typical Calcium Content and Calcium Density of Major U.S. Cheeses). In general, cheeses that are high in calcium contain other minerals, such as phosphorus, in appreciable amounts.
- **Sodium:** Salt (sodium) plays a key role in cheese making by influencing moisture, texture, taste, functionality and food safety. A common consumer perception is that cheese contributes a high level of sodium to the daily diet. However, in the U.S. diet as an example, cheese only represents 7% of Americans' sodium intake. Therefore, in response to recommendations to reduce total dietary sodium/salt intake made by the 2010 and 2015 Dietary Guidelines for Americans and other health authorities, cheese manufacturers are working to increase the availability of lower sodium, high-quality cheeses. The sodium content of cheese varies, and cheeses such as swiss and cheddar generally contain less sodium than many processed cheeses. For most healthy people, sodium intake is not a cause for concern. For individuals who wish to lower their sodium intake, a variety of cheeses reduced in sodium are available. Low-sodium U.S. cheeses are defined as those containing 140mg or less sodium per serving; very low-sodium cheeses contain 35mg or less sodium per serving; and sodium-free cheeses contain 5mg or less sodium per serving.

6.2 CHEESE AS A CALCIUM SOURCE

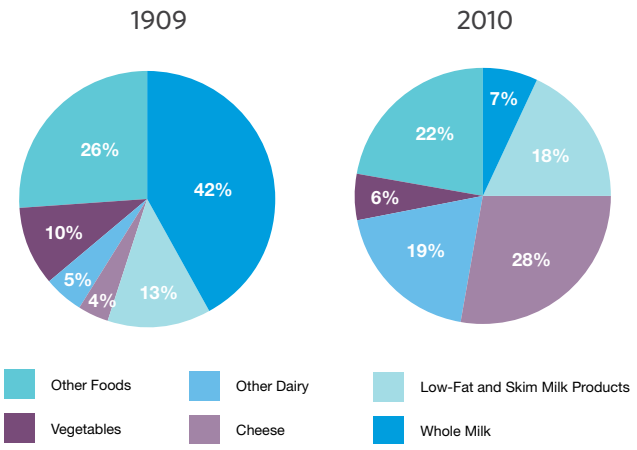
Over the years, cheese has made an increasing contribution to Americans' calcium intake. In 2010, cheese provided 28% of the calcium available in the U.S. food supply, a seven-fold increase from 4% in 1909 (Figure 1. Sources of Calcium in the U.S. Food Supply, 1909 and 2010). Cheese is the second highest ranked food source of calcium among both American children and adults. Most cheese varieties are good to excellent sources of calcium. Moreover, the calcium in cheese is readily available and well-absorbed. Calcium from other foods, such as whole grain products and some vegetables – like spinach – is not as readily absorbed. Therefore, global consumers who wish to increase their calcium intake should consider eating more cheese.

Adequate calcium intake helps to build and maintain bones and is important for the development of teeth. More than 99% of the body's calcium is found in bones and teeth. Calcium also aids in the contraction and relaxation of muscles, coagulation of blood, transmission of nerve impulses, activation of enzymes and stimulation of hormone secretions.

Overwhelming scientific evidence indicates that consuming adequate amounts of calcium-rich dairy foods, including cheese, may increase bone mass during the early years, help delay or minimize age-related bone loss and decrease the risk of osteoporosis in later adult years. Osteoporosis is a disorder in which decreased bone mass weakens bones and leads to fractures. Adequate calcium intake, especially from dairy foods, may also help reduce the risk of hypertension, obesity and perhaps colon cancer, among other disorders.

Dairy foods such as cheese are the best source of calcium because they contain large amounts of calcium along with other essential nutrients including protein, phosphorus, vitamin A and magnesium, which are important for optimal bone and overall health. In the United States, recognition of the unique nutrient package of dairy foods, including cheese, for strong bones has led several government and health professional organizations to recommend three servings of dairy foods (milk, cheese or yogurt) a day.

Figure 1: Sources of Calcium in the U.S. Food Supply, 1909 and 2010



Source: Nutrient Content of the U.S. Food Supply, 1909 and 2010, Center for Nutrition Policy and Promotion, U.S. Department of Agriculture

The 2015 Dietary Guidelines for Americans and the U.S. Department of Agriculture's MyPlate (choosemyplate.gov), which is the educational tool to help make healthy food choices consistent with the Dietary Guidelines, acknowledge the important role of dairy foods in the diet and recommend that Americans nine years of age and older consume three servings a day of fat-free or low-fat milk or equivalent milk products as part of a healthful diet. Equivalent amounts for 250ml of milk are 42g of natural cheese or 48g of processed cheese, or 170g of yogurt. On average, Americans age two and older consume less than one serving of cheese a day. In a consensus report, the National Medical Association, the nation's oldest and largest organization representing African American physicians, recommends that the American public, in general, and African Americans, in particular, consume three to four servings of low-fat milk, cheese and/or yogurt a day to help reduce the risk of nutrient-related chronic diseases, including osteoporosis. The American Academy of Pediatrics, in a report on optimizing bone health and calcium intake of children and adolescents, recommends two to three

250ml glasses of milk a day or the equivalent (e.g., cheese, yogurt) for children four to eight years of age, and four servings of milk or the equivalent for adolescents.

The U.S. dairy industry, with leading health professional organizations, launched a campaign called 3-Every-Day® of Dairy as a call to action to establish positive eating behaviors including three daily servings of calcium-rich milk, cheese or yogurt. This health and wellness campaign is supported by several health professional organizations, including the American Academy of Family Physicians, the American Academy of Pediatrics, the Academy of Nutrition and Dietetics and the National Medical Association. Table 2 compares the calcium nutritional density (mg of calcium/ 100 Kcal) of several U.S. cheeses.

Table 2: Typical Calcium Content and Calcium Density of Major U.S. Cheeses

U.S. CHEESE NAME	CALCIUM (mg/100g)	CALCIUM DENSITY (mg/100 Kcal)
Cream Cheese	98	29
Brie	184	55
Cottage, Creamed	83	85
Pasteurized Processed American	1045	285
Blue Cheese	528	150
Colby	685	174
Cheddar	675	166
Brick	674	182
Monterey Jack	746	200
Swiss	791	208
Provolone	756	215
Mozzarella, Low-Moisture, Part-Skim	716	238
Parmesan, Grated	853	203

Note: This information is provided for general information only. Content varies within a range for each cheese type.
Source: USDA Nutrient Database for Standard Reference, Release 27, 2015.

6.3 DENTAL HEALTH

Several varieties of cheese – aged cheddar, swiss, brick, blue, edam, monterey jack, mozzarella, brie, gouda and American processed cheese – have been shown to reduce the risk of dental caries (cavities). Cheese consumption may protect against root caries, a common form of dental caries in older adults. Consuming cheese immediately after meals or as a between-meal snack may be a practical way to help reduce tooth decay.

Dental caries result from the breakdown of tooth enamel (i.e., demineralization) by acid-forming dental plaque bacteria that ferment dietary sugars and starches. The acids decrease the pH at the surface of the tooth and dissolve calcium and phosphorus in the tooth enamel. If this process of demineralization (i.e., release of calcium and phosphorus in the tooth enamel) occurs at a faster rate than remineralization (i.e., replacement of calcium and phosphate), the teeth eventually form cavities. Findings from different types of studies demonstrate that cheese not



only prevents acid demineralization of tooth enamel, but it also promotes remineralization of caries lesions. A study measuring dental plaque pH following intake of dairy foods found that cheddar cheese had anti-cavity effects.

Researchers have suggested several possible mechanisms to explain cheese's protective effect against tooth decay. For example, consuming cheese may stimulate the flow of saliva, which has caries reducing properties. Cheese's protein, calcium and phosphorus, by neutralizing acids and remineralizing enamel, may contribute to this food's protective effect against tooth decay.

In fact, in the United States, the American Academy of Pediatric Dentistry (AAPD) and the American Dental Association recommend cheese as a nutritious snack. The AAPD encourages certain cheeses as a cavity-fighting food when eaten alone as a snack or at the end of a meal.

6.4 WEIGHT MANAGEMENT



The key to weight management is to balance total calorie intake with physical activity. A wide variety of cheeses of varied calorie and fat content are available to meet different calorie targets. For individuals on a reduced-calorie diet, naturally low-fat cheeses including part-skim mozzarella, ricotta and non-fat dry curd cottage cheese can be selected. Also, in recent years, U.S. cheese makers have produced lower fat cheeses that are reduced in calories yet have flavors and textures similar to other varieties traditionally higher in fat. Individuals can include full-fat cheeses in moderation in calorie-reduced diets by making dietary tradeoffs, for example, by balancing higher calorie foods with lower calorie foods.

Calories are not the only consideration in achieving a healthy weight. Because of cheese's nutrient density and, in particular, its high protein and calcium content, it is important to include this food in a weight control diet. Consuming calcium-rich dairy foods is emerging as an eating behavior that may play a beneficial role in controlling body weight and/or body fat. Increasing calcium, and particularly dairy products, including cheese, has been shown to help obese adults lose body weight and/or body fat when consumed as part of a reduced-calorie diet. Clinical trials have found that obese adults who consumed three to four servings of milk, cheese or yogurt a day while on a reduced-calorie diet lost more weight and body fat and gained more lean muscle mass than those who consumed usual weight loss diets. Studies in children and adolescents have shown that consumption of dairy foods (milk, cheese, yogurt) has a beneficial or neutral effect on body weight or body composition.

6.5 CARDIOVASCULAR HEALTH



Because current dietary advice to lower risk of cardiovascular disease focuses on reducing intake of saturated fat, consumers are often advised to eliminate cheese intake or consume lower fat cheeses. Yet, there is no conclusive evidence that intake of a single food, such as cheese, in moderation increases the risk of heart disease.

In recent years, findings from numerous studies have added to the conclusion of the 2010 Dietary Guidelines for Americans that, based on moderate evidence, intake of dairy products is associated with reduced risk of cardiovascular disease in adults. Although cheese is a source of saturated fat, emerging research findings are questioning saturated fat's role in increasing cardiovascular disease and suggesting that dairy foods, including cheese, have a neutral or potentially beneficial effect on heart health. Not all food sources of saturated fat are equal, and not all saturated fats have the same biological effects. Consumption of cheese appears to have a favorable effect on cardiovascular disease risk markers. Some studies have shown that compared to butter of similar fat content and composition, cheese intake lowers low density lipoprotein (LDL) cholesterol (i.e., the bad cholesterol) and increases high density lipoprotein (HDL) cholesterol (i.e., the good cholesterol). A diet with cheese as the primary source of saturated fat also has been shown to increase apo A-1 (main protein component of HDL), leading researchers to suggest that the cheese diet is less likely to increase cardiovascular disease risk than a low-fat, high-carbohydrate diet. Possible mechanisms for cheese's

effects remain to be established. However, cheese's high calcium content (which may inhibit fat absorption), fatty acid composition, protein or its food matrix may be involved.

Cheese in moderation can be included in dietary patterns such as the DASH (Dietary Approaches to Stop Hypertension) diet that helps to reduce risk factors for heart disease such as hypertension and blood levels of total and LDL cholesterol and homocysteine. The DASH diet is a low-fat diet including three servings a day of dairy foods (e.g., regular and low-fat cheeses, low-fat and fat-free milk and yogurt) and eight to 10 servings of fruits and vegetables per day.

Dairy products, including cheese, may have a beneficial role in reducing metabolic syndrome, a risk factor for cardiovascular disease and type 2 diabetes. Intake of cheese has been shown to be associated with a lower risk of metabolic syndrome, fewer metabolic syndrome risk factors and an improvement in individual metabolic syndrome components (triglyceride levels, waist circumference and blood pressure). One study found that frequent intake of cheese blunted soft drink's positive association with metabolic syndrome. Specific components in cheese, such as its fat (type of saturated fat, trans-palmitoleic acid, conjugated linoleic acid [CLA]), calcium, potassium and magnesium, and protein may provide protection against metabolic syndrome by reducing risk factors for this condition.

For individuals who wish to reduce their intake of fat or saturated fat, many reduced-fat varieties of U.S. cheese are available.

6.6 GASTROINTESTINAL HEALTH



Many cheeses – particularly natural, hard cheeses such as cheddar, swiss, colby and monterey jack – contain little or no lactose, the principle carbohydrate in milk. For this reason, cheese is an important source of calcium and many other nutrients found in milk for lactose maldigesters or persons who have difficulty digesting lactose or milk's sugar. Lactose maldigesters may have difficulty digesting lactose due to a deficiency of the enzyme, lactase, which is necessary to break down lactose. Lactose intolerance is the occurrence of gastrointestinal symptoms such as bloating and diarrhea resulting from the incomplete digestion of lactose. Studies demonstrate that most lactose maldigesters can consume aged cheeses without developing symptoms of intolerance. In fact, in the United States, a National Institutes of Health expert panel, the American Academy of Pediatrics, the National Medical Association and the 2010 Dietary Guidelines for Americans recommend aged cheeses for individuals with lactose intolerance to obtain the health and nutritional benefits associated with dairy foods.

Although some consumers believe that certain foods, including cheese, cause constipation, there is no scientific evidence to support this belief. To prevent and treat constipation, individuals should increase their intake of fiber from fruits, vegetables and whole grains, drink plenty of fluids and exercise regularly.

6.7 CHILD NUTRITION



Cheese is a nutrient dense food. The U.S. industry offers many varieties and convenient on-the-go forms (e.g., slices, sticks, shreds, cubes) to meet children's nutritional needs, tastes and lifestyles. Consuming cheese in moderation with meals or as snacks has several health benefits for children. Cheese provides energy and nutrients needed for growth and development, supports bone health, protects children's teeth from dental caries and possibly lowers body fat.

Cheese is an important source of nutrients such as calcium, protein, phosphorus, magnesium and vitamin A needed for bone health. Calcium is the most important nutrient to maximize peak bone mass, which may help reduce the risk of osteoporosis in later adult years. Unfortunately, a large majority of children and adolescents consume low intakes of dietary calcium. Nearly nine out of 10 teenage girls and seven out of 10 teenage boys in the United States do not meet dietary calcium intake recommendations. Adolescents' low calcium intake is of particular concern as it coincides with a period of rapid skeletal growth – the "window of opportunity" to optimize peak bone mass and protect against future risk of osteoporosis. Osteoporosis is often thought of as an older person's disease, yet its roots lie in childhood.

The American Academy of Pediatrics, recognizing the importance of adequate calcium intake to promote bone health in growing children, encourages intake of two to three servings a day of calcium-rich dairy foods including cheese for children aged four through eight years and four servings a day for adolescents. Dairy foods such as milk, cheese and yogurt are the preferred source of calcium because of their high content of calcium and because these foods also provide other essential nutrients.

Consuming cheese may help protect children against dental caries. Several varieties of cheese, including aged cheddar, swiss, blue, monterey jack, gouda, mozzarella and processed American cheese, have been shown under experimental

conditions to reduce the risk of tooth decay. The American Academy of Pediatric Dentistry recommends that children be served nutritious snacks, including cheese and other foods (e.g., vegetables, yogurt, chocolate milk), that protect teeth and contribute to overall nutrition and health.

Obesity among American children is a major public health concern. According to 2011-2012 data, nearly 17% of American children and adolescents aged two to 19 years are obese. Emerging scientific research in children demonstrates that an adequate intake of dietary calcium and dairy products, including cheese, is linked to a lower or neutral effect on body weight and body fat. Restricting cheese intake in an effort to control children's weight may therefore be counterproductive, as well as contribute to other health problems such as poor bone health.

Recognizing that schools are an important setting to help decrease obesity among children and improve children's eating habits, the U.S. Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity recommends increasing the availability of healthful snacks throughout the total school environment (e.g., vending machines, school stores). Adding cheese to school menu offerings may help increase children's consumption of fruits, vegetables and whole grains, which are recognized as under-consumed food groups. Cheese is a healthful snack for children and is available in many varieties in a range of calorie and fat levels. Snacking on a combination of nutrient-rich cheese and vegetables has been shown to help satisfy children's appetite and reduce their intake of calories compared to snacking on nutrient-poor snacks (e.g., potato chips).

Children learn by example. Parents, by consuming cheese and providing children with meals and snacks consisting of calcium-rich foods such as cheese, can help ensure that their children are getting enough calcium in their diets for bone and overall health.

References

1. Walther, B., A. Schmid, R. Sieber, et al. *Cheese in nutrition and health.* Dairy Sci. Technol. 88: 389-405, 2008.
2. Miller, G.D., J.K. Jarvis, and L.D. McBean. *Handbook of Dairy Foods and Nutrition.* 3rd edition. Boca Raton, FL: CRC Press. 2006.
3. Kosikowski, F.V., and V.V. Mistry. *Cheese and Fermented Milk Foods*. Volume 1. Origins and Principles. 3rd ed. Westport, CT: F.V. Kosikowski, 1997.
4. Center for Nutrition Policy and Promotion, U.S. Department of Agriculture. *Nutrient Content of the U.S. Food Supply*, 1909-2010. http://www.cnpp.usda.gov/USfoodsupply-1909-2010.
5. Dairy Research Institute®, NHANES 2003-2006. Ages 2+ years. Data Source: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, [2003-2004; 2005-2006]. http://www.cdc.gov/nchs/nhanes.htm.
6. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 27 (revised), May 2015. http://www.ars.usda.gov/ba/bhnrc/ndl.
7. Otten, J.J., J.P. Hellwig, L.D. Meyers (Eds). Institute of Medicine. Dietary (DRI) Reference Intakes. Washington, DC: The National Academies Press, 2006.
8. Rodriguez, N.R. Introduction to Protein Summit 2.0: continued exploration of the impact of high-quality protein on optimal health. Am. J. Clin. Nutr. 101: 1311S-1315S, 2015.
9. Special Supplement. Dairy Proteins: Nutrition, Product, and Market Benefits. J. Food Sci. 80 (S1): A1-A29, 2015.
10. U.S. Department of Health and Human Services, Food and Drug Administration. Lowfat and skim milk products, lowfat and nonfat yogurt products, lowfat cottage cheese: revocation of standards of identity; food labeling, nutrient content claims for fat, fatty acids, and cholesterol content of food. Final rule. Fed. Regist. 61(225): 58991 (Nov. 20), 1996.
11. Food and Drug Administration, U.S. Department of Health and Human Services. Food additives permitted for direct addition to food for human consumption; vitamin D_3. Final rule. Fed Regist. 70 (No.220): 69435-69458, Nov. 5, 2005.
12. Wagner, D., D. Rousseau, G. Sidhom, et al. Vitamin D_3 fortification, quantification, and long-term stability in Cheddar and low-fat cheeses. J. Agric. Food Chem. 56: 7964-7969, 2008.
13. Guinee, T.P. Salting and the role of salt in cheese. Int. J. Dairy Technol. 57: 99-109, 2004.
14. Johnson, M.E., R. Kapoor, D.J. McMahon, et al. Reduction of sodium and fat levels in natural and processed cheeses: scientific and technological aspects. Comprehens. Rev. Food Sci. & Food Safety 8: 252-266, 2009.
15. U.S. Department of Health and Human Services and U.S. Department of Agriculture. *Dietary Guidelines for Americans, 2010*. 7th Edition. Washington, DC: U.S. Government Printing Office, December 2010. http://www.dietaryguidelines.gov.
16. U.S. Department of Health and Human Services and U.S. Department of Agriculture. *2015-2020 Dietary Guidelines for Americans*. 8th Edition. December 2015. http://health.gov/dietaryguidelines/2015/guidelines/. O'Neil, C.E., D.R. Keast, V.L. Fulgoni III, et al. Food sources of energy and nutrients among adults in the US: NHANES 2003-2006. Nutrients 4: 2097-2120, 2012.
17. Keast, D.R., V.L. Fulgoni III, T.A. Nicklas, et al. Food sources of energy and nutrients among children in the United States: National Health and Nutrition Examination Survey 2003-2006. Nutrients 5: 283-301, 2013.
18. Institute of Medicine. Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: The National Academies Press, 2011.
19. U.S. Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General.* Rockville, MD: U.S. Department of Health and Human Services, Office of the Surgeon General, 2004.

20. Wooten, W.J., and W. Price. Consensus report of the National Medical Association. The role of dairy and dairy nutrients in the diet of African Americans. J. Natl. Med. Assoc. 96:1s-31s, 2004.
21. Golden, N.H., S.A. Abrams, and the Committee on Nutrition, American Academy of Pediatrics. Optimizing bone health in children and adolescents. Pediatrics 134: 1229-1243, 2014.
22. Kashket, S., and D.P. DePaola. Cheese consumption and progression of dental caries. Nutr. Rev. 60: 97-103, 2002.
23. Telgi, R.L., V. Yadav, C.R. Telgi, et al. In vivo dental plaque pH after consumption of dairy products. Gen. Dent. 61: 56-59, 2013.
24. American Academy of Pediatric Dentistry. Diet and dental health. AAPD Fast Facts 2014. www.aapd.org.
25. American Dental Association. Diet and dental health. http://www.mouthhealthy.org/en/az-topics/d/diet-and-dental-health.
26. Abargouei, A.S., M. Janghorbani, M. Salehi-Marzijarani, et al. Effect of dairy consumption on weight and body composition in adults: a systematic review and meta-analysis of randomized controlled clinical trials. Int. J. Obesity 30: 1485-1493, 2012.
27. Spence, L.A., C.J. Cifelli, and G.D. Miller. The role of dairy products in healthy weight and body composition in children and adolescents. Curr. Nutr. Food Sci. 7: 40-49, 2011.
28. Eckel, R.H., J.M. Jakicic, J.D. Ard, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J. Am. Coll. Cardiol. 63 (No. 25): 2960-2984, 2014.
29. Rice, B.H. Dairy and cardiovascular disease: a review of recent observational research. Curr. Nutr. Rep. 3: 130-138, 2014.
30. Chowdury, R., S. Warnakula, S. Kunutsor, et al. Association of dietary, circulatory and supplement fatty acids with coronary risk: a systematic review and meta-analysis. Ann. Intern. Med. 160: 398-406, 2014.
31. Qin, L.Q., J.Y. Xu, S.F. Han, Z.L., et al. Dairy consumption and risk of cardiovascular disease: an updated meta-analysis of prospective cohort studies. Asia Pac. J. Clin. Nutr. 24: 90-100, 2015.
32. de Souza, R.J., A. Mente, A. Maroleanu, et al. Intake of saturated and trans unsaturated fatty acids and risk of all cause mortality, cardiovascular disease, and type 2 diabetes: systematic review and meta-analysis of observational studies. BMJ 351: h3978, 2015.
33. de Goede, J., J.M. Geleijnse, E.L. Ding, et al. Effect of cheese consumption on blood lipids: a systematic review and meta-analysis of randomized controlled trials. Nutr. Rev. 73: 259-275, 2015.
34. Thorning, T.K., F. Raziani, N.T. Bendsen, et al. Diets with high-fat cheese, high-fat meat, or carbohydrate on cardiovascular risk markers in overweight postmenopausal women: a randomized cross-over trial. Am. J. Clin. Nutr. 102: 573-581, 2015.
35. Hjerpsted, J., E. Leedo, and T. Tholstrup. Cheese intake in large amounts lowers LDL-cholesterol concentrations compared with butter intake of equal fat content. Am. J. Clin. Nutr. 94: 1479-1484, 2011.
36. Hjerpsted, J., and T. Tholstrup. Cheese and cardiovascular disease risk: a review of the evidence and discussion of possible mechanisms. Crit. Rev. Food Sci. Nutr. 2015 Jan 20 [Epub ahead of print].
37. Appel L.J., T.J. Moore, E. Obarzanek, et al. A clinical trial of the effects of dietary patterns on blood pressure. N. Engl. J. Med. 336:1117-1124,1997.
38. Obarzanek, E., F.M. Sacks, W.M. Vollmer, et al. Effects on blood lipids of a blood pressure-lowering diet: the Dietary Approaches to Stop Hypertension (DASH) Trial. Am. J. Clin. Nutr. 74: 80-89, 2001.
39. Appel, L.J., E.R. Miller III, S.H. Lee, et. al. Effect of dietary patterns on serum homocysteine. Results of a randomized, controlled feeding trial. Circulation 102: 852-857, 2000.
40. Chen, S.T., N.M. Maruther, and L.J. Appel. The effect of dietary patterns on estimated coronary heart disease risk. Results from the Dietary Approaches to Stop Hypertension (DASH) Trial. Circ. Cardiovasc. Qual. Outcomes 3: 484-489, 2010.
41. Da Silva, M.S., and I. Rudkowska. Dairy products on metabolic health: current research and clinical implications. Maturitas 77: 221-228, 2014.
42. Hostmark, A.T., and S.E. Tomten. The Oslo Health Study: cheese intake was negatively associated with the metabolic syndrome. J. Am. Coll. Nutr. 30: 182-190, 2011.
43. Hostmark, A.T., and A. Haug. Does cheese intake blunt the association between soft drink intake and risk of metabolic syndrome? Results from the cross-sectional Oslo Health Study. BMJ Open 2 (6), Nov. 19, 2012.
44. Rice, B.H., C.J. Cifelli, M.A. Pikosky, et al. Dairy components and risk factors for cardiometabolic syndrome: recent evidence and opportunities for future research. Adv. Nutr. 2: 396-407, 2011.
45. National Institutes of Health Consensus Development Conference Statement. NIH Consensus Development Conference: Lactose Intolerance and Health. February 22-24, 2010. http://consensusnih.gov/2010/images/lactose/lactose_finalstatement.pdf.
46. Heyman, M.B. for the Committee on Nutrition, American Academy of Pediatrics. Lactose intolerance in infants, children, and adolescents. Pediatrics 118: 1279-1286, 2006.
47. American Medical Association. Lactose intolerance and African Americans: implications for the consumption of appropriate intake of levels of key nutrients. J. Natl. Med. Assoc. 101(10 Suppl.): 1S-23S, 2009.
48. National Digestive Diseases Information Clearinghouse. Constipation. NIH Publ. No. 13-2754. September 2013.
49. Bailey, R.L., K.W. Dodd, J.A. Goldman, et al. Estimation of total usual calcium and vitamin D intakes in the United States. J. Nutr. 140: 817-822, 2010.
50. Ogden, C.L., M.D. Carroll, B.K. Kit, et al. Prevalence of childhood and adult obesity in the United States, 2011-2012. JAMA 311:806-814, 2014.
51. U.S. Department of Health and Human Services. *The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity.* Rockville, MD: USDHHS, PHS, Office of the Surgeon General, 2001.
52. Donnelly, J.E., D.K. Sullivan, B.K. Smith, et al. The effects of visible cheese on the selection and consumption of food groups to encourage in middle school students. J. Child. Nutr. Manag. 3 (1), Spring 2010.
53. Wansink, B., M. Shimizu, and A. Brumberg. Association of nutrient-dense snack combinations with calories and vegetable intake. Pediatrics 131: 22-29, 2012.

7 Technical Guides



7.1 FLAVOR DESCRIPTORS AND FLAVOR

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A Language for Cheese Flavor

Like fine wine, cheeses tantalize every aspect of the palate. Today's diners can find cheeses served as a cheese course or part of the regular menu, and in a wider variety of dishes from appetizers to desserts. Whether offered as an opening to a five-course meal or the foundation for a sauce for a frozen pasta dish, U.S. cheeses can take the bland and make it extraordinary.

U.S. cheese makers turn pasteurized milk into some of the finest cheeses by culturing the milk, separating curds from whey, cutting, cooking and salting, and, finally, aging the product. Within the world of cheeses, there exist a myriad of flavors, and flavor profiles depend upon the fine differences that exist during processing and aging.

The amount of ripening and the culture used affect the cheese's flavor. Fresh cheeses, such as cream cheese, are ripened just briefly or not at all, while cheddar is a ripened, pressed cheese. Brie and blue cheese are ripened, pressed cheeses, which may be quick- or slow-ripened. Other ripened, heavily pressed cheeses, such as gouda, gruyère and parmesan-style hard, grating cheese, are cooked. Ripening the cheese for months or years at a time usually intensifies and modifies the flavor.

Cheeses can also be macerated in wine, brandy, beer or other beverages, or rubbed with a variety of herbs, spices, chilies and juices to enhance or impart unique flavors. Processed cheeses are manufactured by melting natural cheeses, adding salts and other dairy ingredients and flavorings. The selection of ingredients can result in very mild cheeses (made with young cheddar for example) to spicy, nacho-style cheeses.

Cheese rinds also play a key role in cheese development. The rind slows down drying and regulates the release of gases that occur with aging. Some rinds are more edible than others, and often times the rind has a stronger aroma than the cheese itself. In the United States, many types of cheeses can be manufactured and immediately wrapped, resulting in rindless products. This ensures a greater uniformity of flavor development and reduces waste.

Understanding and defining customers' expectations of flavor is necessary to deliver cheese flavor. For industrial users, understanding the linkage of specific flavors to volatile flavor compounds is required, and the development of a sensory language is helpful to achieving this goal. Methods to define and describe flavor are crucial for precise communication in both research and marketing. A flavor lexicon is simply a set of words, or language that can be used universally, and it is an important tool for international trade.

What is the cheese lexicon? It is a sensory language with universal intensities and references. Specific flavors are identified and then quantified using a 10-point scale. The language has been successfully applied to cheddar, American cheeses such as colby, monterey jack, cottage cheese and processed cheese, and Italian and Dutch cheeses. Because the language uses a universal scale (similar to using a common alphabet), multiple products can be directly compared – and results from sensory panels, obtained at different times and locations, can be compared objectively. The lexicon uses both qualitative and quantitative measures. In other words, it can tell what flavors are present and at what level or intensity. The intensities are anchored with solutions for the basic tastes (sweet, sour, bitter, salty, umami).

The lexicon is an analytical tool that scientists and cheese makers can use. It can be used for a variety of research applications. It has been used to document specific flavor differences between different cheddar, swiss and italian-style cheeses, to understand flavor changes during aging, and to identify sources of particular flavors (and off-flavors) in products. It is an important tool for cheese makers for quality assurance purposes; however the language is also extremely useful in conjunction with consumer testing to clarify specific consumer likes and dislikes. It can be used, for example, by marketing to identify niche markets and optimize customer acceptance. For example, studies using the cheese lexicon have helped identify six distinct market segments for cheddar cheese consumers. Each segment or consumer group was found to

have distinct preferences and expectations for cheddar cheese flavor. Similar studies have been applied to understand specific consumer preferences for sharp cheddar cheese and gouda cheese. Using the cheese lexicon can help retailers and chefs select the products that their target consumers will prefer, and help them educate such consumers – the same way consumers can learn to recognize, anticipate and appreciate differences in wines.

Texture is an important criterion that is often associated with flavor when describing cheese. It directly relates to the cheese's moisture content. The more water the cheese contains, the softer it is, though this varies slightly depending on how the cheese is made. Very soft, spreadable cheese may contain 80% water, whereas soft cheeses are made up of 50 to 70% water. Semi-hard cheeses may have a more rubbery texture and contain 40 to 50% water. Semi-hard blue contains the same water weight as a conventional semi-hard cheese, but has a crumbly texture. Hard cheeses tend to be firm and dense, containing 30 to 50% water. Some of these cheeses are so hard, they can only be consumed grated or melted.

The United States has witnessed an emergence of artisan cheeses. Many European cheese types are now made in the United States, primarily because European cheese artisans immigrated across the Atlantic. These cheeses feature a large array of quality and standards of identity, but still retain regional differences. For example, cheddar from Vermont is white, while Wisconsin cheddar is traditionally orange. And, because cheese makers may use different cultures and aging procedures, a wide variety of very fine products are available from different regions of the United States.

Because of their prominence in italian-style cooking, numerous italian-style cheeses are popular in the United States, including mozzarella, provolone, ricotta, parmesan-style grating cheeses, fontina and blue cheeses. A number of companies with European heritage are offering U.S.-made bries, goudas or gruyère, which have been judged in international contests as superior or equal on the basis of their flavor.

Mexican-style cheeses are becoming more prevalent and are now manufactured in the United States. Queso fresco, which does not melt and is crumbled on salad or any ambient application; queso blanco, a semi-soft, good-melting cheese used for quesadillas; cotija (salty, hard); oaxaca (fresh like mozzarella); and enchilado (a salty cow's milk cheese coated with chilies or paprika) are just a few examples of popular U.S. cheeses with a "south of the border" appeal and flavor.

Four categories are used to describe cheese. Though similar to terms used for wine and other foods, some are unique to cheese. Flavor, appearance, texture and aroma define and differentiate cheese types.

- **Flavor descriptors** (see Table 1: Excerpts from "Cheese Flavor Language") include cooked/milky, whey, diacetyl, caramelized, fruity, nutty, brothy, sweet, bitter, etc. Even though some of these terms may not sound appealing to the consumer, the presence of such flavors, in small amount, may be the very essence of a unique cheese—the same way, a small amount of musk creates the very unique appeal of a designer perfume.

- **Textures** include soft, hard, runny, crumbly and creamy. The ability of a cheese to melt under different conditions, described in this manual, is also important to the chef and foodservice operator.

- **Aromas**, which are more noticeable when cheeses are melted or warm, are often noted as musty, nutty, smoky, pungent or sour. Again, the use of the common descriptor language is useful in international trade to help select the U.S. cheese that will optimize consumer satisfaction in each market and segment.

- **Appearance** includes visible attributes of the cheese such as color, color intensity, color uniformity, presence and uniformity of holes (e.g., swiss cheese), and presence and uniformity of veining (e.g., mold-ripened cheeses). These attributes play a large role in consumer purchase decisions and subsequent acceptance, but they can also be used to evaluate and compare the quality of cheeses. For instance, a uniform color with no mottling is an indicator of quality with cheeses that have coloring added, such as cheddar.

Cream cheese, an American Original, is known for its bland flavor. For this reason, it is equally compatible in sweet (cheesecake, bakery fillings) and savory (pasta fillings, spreads) dishes and applications. It also serves as a base, to which small amounts of more pungent (blue, parmesan) cheeses can be added to the intensity level that consumers in different countries will appreciate. In some countries, cream cheese is a flavoring for candy and ice cream. Other mild cheeses, such as part-skim mozzarella or monterey jack, will deliver just the right intensity flavor consumers seek in prepared dishes such as pizza, gratins or enchiladas while providing a rich, delicious mouthfeel.

U.S. cheese makers are proud to offer an ever-widening variety of cheeses that meet the needs of a wide consumer base worldwide, from the most sophisticated cheese lovers to those who are just discovering the product and developing an appreciation for it. The U.S. Dairy Export Council (USDEC) and its member companies hold a variety of seminars and tasting events designed to help buyers and consumers understand cheese flavor. They also help the trade and manufacturers around the world use the latest science to maximize consumer satisfaction in their own markets, and promote their own image or business.

Table 1: Excerpts from "Cheese Flavor Language"

(Please refer to complete document referenced for further information)

FLAVOR	DEFINITION	CHEESES TO LOOK FOR
Cooked/milky	Aromatics associated with cooked milk.	Muenster, cream cheese, cottage cheese, mild cheddar, processed cheese
Whey	Aromatics associated with cheese whey.	Colby, monterey jack
Diacetyl	Aromatic associated with diacetyl. Think butter flavoring.	Colby jack, baby swiss, cream cheese
Milkfat	Aromatics associated with milkfat. Key aromatic in fresh cream and in fresh coconut.	Whole milk mozzarella, whole milk cottage cheese, cream cheese
Fruity	Aromatics associated with different fruits: most commonly pineapple, apple, pear and berry.	Parmesan, asiago, aged gouda
Nutty	The nut-like aromatic associated with different nuts.	Parmesan, aged gouda, aged cheddar, aged swiss
Free fatty acid	Aromatics associated with short-chain fatty acids.	Feta, aged provolone, brick, smear-ripened cheeses
Rosy/floral	Aroma associated with roses and other floral notes.	Aged cheddar, brie, camembert
Caramelized/ burnt sugar	Sweet aromatics associated with burnt or caramelized sugars.	Aged gouda
Bell pepper/ earthy	Earthy aroma associated with freshly cut bell pepper.	Farmstead cheddar
Sweet	Fundamental taste sensation elicited by sugars.	Parmesan, aged gouda, blue-veined cheeses, swiss
Salty	Fundamental taste sensation elicited by salts.	Aged gouda
Umami	Chemical feeling factor elicited by certain peptides and nucleotides.	Aged cheddar, swiss

Reference: Drake, M.A., McIngvale, S.C., Cadwallader, K.R., and Civille, G.V. 2001. Development of a descriptive sensory language for Cheddar cheese. J. Food Sci. 66:1422-1427.

7.2 SHELF LIFE

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From the beginning, cheese has been a means to extend the shelf life of nutritious milk components from the relatively few days of fluid milk to weeks, months and even years for various cheese varieties.

Cheeses vary widely in their methods of manufacture and their composition, and subsequently the shelf life of different cheeses has a broad range. For example, the shelf life of many fresh cheeses like cottage cheese can be measured in days or at best, a week or two while the shelf life of hard cheeses like parmesan may be measured in years.

The shelf life of a cheese variety is a function of three main factors: the inherent nature of the cheese variety itself and the hygienic conditions under which it was manufactured; the conditions the cheese was exposed to during packaging, aging, storage and distribution; and the handling of the cheese at the foodservice, retail or consumer level.

Cheese Variety and Manufacturing Conditions

Cheese varieties typically have a maximum lifespan that is dictated by their composition. The most important compositional factor is the moisture content of the cheese. A good rule of thumb is the higher the moisture content of a cheese, the softer the cheese will be and the shorter shelf life the cheese will have. Typically higher moisture cheeses have higher water activities, which allow increased activities of microbes and enzymes found naturally in cheese. Higher moisture content allow enzymes in the cheese, which are present naturally in the milk as well as in the added rennet and starter culture, to break down the protein structure of the cheese, which softens the cheese and, after a certain point, can result in undesirable flavor and texture.

Other compositional factors which affect shelf life include salt, acidity and culture selection. Salt acts as a preservative and increases shelf life. Lactic acid from the culture also acts as a preservative; however, excessive acid production can remove too much of the natural calcium phosphate from the cheese protein structure, which can result in a shorter shelf life. Different cultures have different abilities to produce enzymes that break down the cheese.

Lastly, the more hygienic the conditions under which the milk is produced and the cheese manufactured, the longer the shelf life of the cheese. Because of this, cheeses manufactured in the United States may have a longer shelf life than cheeses manufactured in less developed countries. Certain bacterial contaminants inadvertently introduced during milk production and cheese manufacturing can dramatically reduce the shelf life and quality of the cheese.

Cheese Shelf Life

DAYS/WEEKS → MONTHS/YEARS

Soft-Fresh	Soft-Ripened	Semi-Soft	Semi-Hard	Hard
• Cream Cheese	• Brie	• Monterey Jack	• Cheddar	• Romano
• Neufchâtel	• Camembert	• Brick	• Colby	• Parmesan
• Flavored Cream Cheese	• Blue Cheese	• Havarti	• Edam	• Asiago
• Cottage Cheese	• Gorgonzola	• Limburger	• Gouda	
• Ricotta		• Muenster	• Swiss	
• Feta		• Fontina	• Baby Swiss	
• Mascarpone		• Mozzarella	• Gruyère	
• Provolone				

Processed cheeses typically have a very long shelf life, months or years, due to the method by which they are made. Typically, processed cheeses are made by mixing together blends of natural cheeses along with emulsifying salts and other ingredients and heating the mixture to high temperatures. The combination of heat, salts and acids protects these cheeses from breakdown and gives them a long shelf life.

Packaging, Aging, Storage and Distribution

Even after the cheese is made, the way it is handled during packaging, aging, storage and distribution will significantly affect its shelf life. The packaging materials are designed to protect the cheese from physical contamination, especially from spoilage microbes. Additionally, the packaging materials prevent oxygen from reaching the cheese, which prevents mold growth since mold cannot grow in the absence of oxygen. That is why most cheeses are either vacuum packaged (often seen in cheese chunks) to remove all oxygen, or packaged in a modified atmosphere condition (typically seen in shredded cheese), where the oxygen has been flushed out of the package by a mixture of carbon dioxide and nitrogen.

Some cheeses, particularly shredded mozzarella and other pizza cheeses, can be packaged in a frozen (IQF or Individually Quick Frozen) state which dramatically increases the shelf life of the product. Research is currently ongoing at the University of Wisconsin to further investigate the effectiveness of low temperature storage of cheese on extending the shelf life of a number of cheese varieties.

The most important factor affecting cheese shelf life during aging, storage and distribution is temperature. Keeping the cheese temperature as cold as possible (0-3°C/32-38°F) will optimize shelf life. Keeping temperature fluctuations to a minimum will also increase shelf life by limiting enzymatic activity and minimizing moisture migration in the cheese, which occurs when cheese warms and cools repeatedly.

Lastly, minimizing intense fluorescent lighting will also increase shelf life of cheeses packaged in clear plastic films. This is because fluorescent lighting adds heat to the cheese and also degrades the color (annatto) used in colored cheeses like cheddar and colby cheese, resulting in an unsightly pinking defect as well as oxidized flavors.



Handling of Cheese at Foodservice, Retail or Consumer Level

Proper handling of cheese at this level can continue to extend product shelf life and ensure optimum quality and performance. Temperature remains the critical factor in extending product shelf life. Cheese should be stored at refrigeration temperatures (0-3°C/32-38°F) to slow down enzymatic activity and microbial growth.

Once a cheese package has been opened, the cheese is exposed to oxygen and mold growth may occur. Therefore, opened pieces of cheese should be used as quickly as possible. Cut pieces of cheese should be wrapped tightly in a barrier wrap to minimize drying, prevent contamination and slow mold growth by reducing oxygen contact with the cheese surface. Opened pieces of cheese should be stored away from other foods to prevent pick-up of odors.

Cheese can support the growth and survival of contaminants if mishandled. Therefore, it is critically important to ensure proper sanitation when handling cheese to prevent cross-contamination, paying particular attention to knives, slicers, cutting boards, hands and gloves.

7.3 TEXTURE AND HARDNESS

BY DR. JOHN A. LUCEY
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Texture

Cheese is an extremely versatile food product/ingredient that has a wide range of textures, flavors and end-uses. The texture and body of the large number of cheese varieties produced in the United States range from soft to firm, smooth/creamy to curdy, brittle to long, mechanically open to closed or cheese with eyes of various sizes. The physical properties of cheese are determined by the protein (casein) content, the type and strength of protein interactions, cheese composition and ripening reactions. Texture properties can change significantly during aging due to protein breakdown and chemical shifts in the calcium status.

Some Parameters that Affect the Physical Properties of Cheese

- **Composition:** The protein content of cheese is the dominant factor impacting the texture, with higher protein levels associated with harder texture. Higher moisture cheese is softer, smoother and more meltable than a similar cheese (e.g., age, pH, calcium content) that has a lower moisture content. Low-fat cheese tends to be harder and less meltable than a similar high-fat cheese unless corrective measures are taken by the cheese maker to alter these characteristics. Decreasing the fat content in cheese results in an increase in the protein content, which is the cause of the increased hardness (unless corrected). Legal compositional limits often determine the moisture and fat contents of a cheese variety, although there are many ingredient cheeses that have their own specific compositions, and they are classified as non-standard cheeses since they are designed to have specific industrial functionality.
- **pH (Amount of Acid):** Milk is a stable product because caseins have a net negative charge. Even if milk is gelled and made into a fresh cheese, without significant acid development, the curd does not stretch and melt. Acidification removes calcium crosslinking from within casein particles and makes them more flexible, which is important for stretch. A critical amount of acidification is employed in cheeses such as mozzarella so that it will have the desired melt, stretch and flow characteristics. If there is excessive acidification (e.g., pH < 4.9, e.g., cream cheese), the curd loses its stretch characteristics. The rate of acid development during cheese making controls the calcium content of cheese and this rate can be changed by altering the pH at critical points during the process, the use of calcium chelating acids (e.g., citric) and the use of a wash step to remove lactose/salts (e.g., colby, swiss cheese).
- **Temperature:** The texture of cheese is greatly impacted by temperature; cheese is firmer at lower temperatures and softer at higher temperatures. The marked variation in cheese texture with changing temperature is exploited to help with shredding/slicing cheese when it is cold so that it is firmer and therefore easier to cut cleanly. The softening that occurs at high temperatures is widely exploited for the use of cheese as an ingredient in a range of baked goods. Temperature affects the association of casein molecules as they expand at low temperatures, resulting in increased firmness while the caseins contract with increasing temperatures so the network firmness decreases.
- **Milk Heat-Treatment:** High-heat treatment of milk (greater than standard pasteurization conditions) or other dairy ingredients (e.g., buttermilk) that contain denatured whey proteins cause a high level of whey protein denaturation. The denatured whey proteins interact with casein and result in restricted melt and flow.

Unmelted Cheese Functionality and Performance

Unmelted cheese is subjected to a wide range of cutting and size reduction operations (e.g., shredding, slicing, grating, dicing, cubing, pureeing, crumbling, granulating, etc.) for foodservice or retail purposes. A number of functional attributes are important for these operations:

- **Firmness/Hardness:** Increased by low-moisture or low-fat contents, calcium chloride addition to cheese milk, and decreased by low calcium or low casein content in cheesemilk. For cheddar (and other medium to low-moisture cheeses), firmness (at refrigeration temperature) does not change much during aging in contrast to higher

moisture cheeses (e.g. mozzarella), which become softer and stickier with age. Cheeses that are not packaged in a moisture impermeable barrier lose moisture during aging and become firmer.

- **Brittleness (Short Texture):** Can be caused by low pH, reduced calcium content and/or excessive proteolysis (e.g., very mature cheddar cheese).
- **Machinability:** This is a general term for the ability of the cheese to be successfully cut/sliced/shredded by machine (e.g., wires, high-speed knives/blades, etc.). This attribute is influenced by cheese hardness (needs to be moderate to high), brittleness (should not be too "short" or it will be crumbly and will produce a lot of fines), and adhesiveness (if the curd is too adhesive, it will be sticky). Generally, firm cheese is rarely sticky. Machinability is influenced by cheese composition, pH, protein breakdown and temperature of operation. In practice, machinability is controlled by the empirical selection of a suitable range for these parameters for an individual cheese variety, e.g., some cheeses may be only suitable for shredding after a few days of ripening, while others may be shredded for up to a few months of ripening.

7.4 COOKING AND MELTING

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Cooking Ability and Melting

Melted cheese has found a vast number of applications, e.g., as a pizza topping, cheese slices on hamburgers, toasted sandwiches, filling, layers in lasagna and sauces. The end-users of cheese have specific requirements for what kind of melt performance they want from their cheese. U.S. cheese manufacturers can manipulate cheese performance to consistently meet these specifications. The functional properties of melted cheese are complex and we can distinguish at least seven important attributes, namely: flow, softening, shred identity, stretchability, blistering, browning and free oil formation.

- **Flow** (e.g., flow-off a pizza crust) increases with age (protein breakdown and the ongoing loss of calcium crosslinking within protein particles during ripening) and with increased moisture or fat content. There is very little flow in very low pH cheeses (e.g., pH < 4.9, as in cottage or cream). Flow is increased by a reduction in total calcium content. Cheeses with restricted flow can be achieved by high-heat milk treatment, use of heat and acid for coagulation (e.g., queso blanco), or very high pH (e.g., pH > 6.0, as in queso fresco). Processed cheese with restricted melt/flow can be achieved by the use of specific emulsifying salts, the use of high temperatures and long hold times during cooking or high levels of rework. Many Hispanic-style fresh cheeses are made in the United States, which soften when heated but do not melt and flow due to their high pH (e.g. pH ~ 6.6, as in panela); they are widely used as toppings on tacos, chili and burritos. The use of acid to precipitate hot milk is exploited

for a number of cheeses (e.g., ricotta), and these cheeses soften but do not flow. A wide range of cheeses can be supplied with different flow properties.

- **Softening** during heating happens in all cheeses; the extent depends on composition, age and pH. Caused by the reduction in the strength of the casein interactions with increasing temperature, some softening is due to the melting of fat.
- **Shred identity** after heating refers to individual shreds still being visible (obvious) after baking. Caused by lack of softening and especially restricted flow. Less common in aged cheeses, as flow increases with age. Can also be caused by excessive use of anticaking agents, as these ingredients may have very high melting points, and if they completely coat the shreds, they can inhibit flow.
- **Stretchability** of curd occurs during cheese making at a critical pH value; hot curd stretches when sufficient calcium crosslinking is lost from caseins during cheese making (e.g., pH ~5.2 in cultured mozzarella but occurs at pH ~5.6 in direct acid mozzarella). The direct addition of acid to the cheese vat is more efficient in the removal of calcium than the slow cultured product. The pH at which curd becomes suitable for stretching also depends on the extent of demineralization (e.g., by pre-acidification of milk with some lactic acid helps to remove more calcium crosslinking), and fat and casein contents. Low-fat or high casein (concentrated) milks require a lower pH during cheesemaking to get the curd to become suitable for stretching (too high a pH gives a tough curd that is difficult to stretch).

  Many cheeses are used as an ingredient/topping on pizza. Stretchability is the ability of the melted cheese to form fibrous strands that elongate without breaking under tension during ripening. Stretch "quality" is important, as many consumers do not want a few, long "strings." Thus, the length, tension and type of stretch (strings, feathering or fibrous) are important attributes. Many young cheeses exhibit stretch (e.g., cheddar), but during ripening, the stretch quality decreases and the cheese may become stringy. During aging of mozzarella, the length of stretch increases, but after three to four weeks cheese may be "soupy," and the strands are short as well as weak (low tension). In mozzarella, the high curd temperature in the cooker stretcher reduces bacterial numbers and lowers residual enzyme activity during ripening; these processing conditions help this high-moisture product have good melting functionality over a typical one-month refrigerated storage shelf life. Longer shelf life can be provided by U.S. suppliers by tailor-making cheese or storage conditions.

- **Tenting** refers to bulging of the cheese that may occur during baking or during a fork test due to the entrapment of water vapor. If this bulging occurs over a small area, it is referred to as blistering. In reduced- or low-fat cheeses, it in turn helps a tough surface "skin" to form; this skin dries out and can burn/brown/blacken during baking. Adjustments can be made to the cheesemaking process to reduce this issue.
- **Blistering** refers to small, visual bubbles on the pizza surface. It is influenced by the textural properties of cheese, which sometimes do not allow gas bubbles to escape from the surface (unlike a soft, "soupy" product).
- **Browning** occurs during baking when the color of some cheeses increases due to a Maillard-type reaction between reducing sugars (e.g., galactose) and proteins (especially amino acids). The color can range from light straw to golden brown to black, depending on the severity of the baking process and the type of oven used. Browning can be reduced by washing the curd, as this reduces the lactose content and selecting starter cultures so that all the residual sugars (especially galactose) are metabolized. Cheese with slight browning or completely white in color are often requested by consumers and can be supplied by U.S. companies.
- **Free oil formation** is the tendency of free oil to separate from the melted cheese and form oil pockets, particularly at the cheese surface. Excessive oiling-off leads to a greasy, shiny surface. Free oil increases with the age of cheese and with higher fat cheeses. Some free oil may be beneficial in helping to control browning and blister formation. Processed cheese has very little free oil.

The type of oven used for baking can have a major impact on cheese performance. Various heating methods, e.g., gas, electric or wood burning ovens, are used for pizza and other dishes. For pizza, various types of convection or forced air (fan assisted) ovens are common in foodservice operations, as they



give more rapid and even heating than conventional ovens. Combination ovens can be used in foodservice operations, where pizzas can be quickly baked by several different heating methods. One of the most popular systems used in foodservice is the Impinger® oven, where hot air under pressure surrounds the pizza and small jets of hot air are forced down on the cheese. This results in rapid heating as the cheese moves through the oven on a conveyor belt. The baking time can be adjusted by varying the speed of the conveyor belt. The jets of hot air also dry out the cheese surface and are more likely to result in blistering and browning. The trapped water vapor finds it harder to be released from the surface, which can lead to a bulging up of the cheese. As blisters are formed, they are more prone to drying-out, which favors the Maillard reaction, and as a result browning is greater in forced-air or Impinger® ovens. In conventional ovens, the baking process is slower, which is why forced-air or Impinger® ovens are so popular. For dishes like lasagna, very long cooking times in convection ovens can also lead to greater risk of the surface drying out, unless the dish is covered for some of the time. Microwave ovens are often used for quick reheating of foods, including pizza, but have the tendency to make the base either brittle or very soft, depending on the ingredients used. Also, the cheese itself can get tougher in a microwave than in a conventional oven. Some frozen pizza suppliers also provide accessories, e.g., a crisping sleeve, to help bake the pizza in a microwave. Depending on the type of oven, the heating temperature and cooking times for pizza and other cheese dishes vary. Sauces or fondues can be readily heated or reheated in a microwave. Accelerated cooking or reheating ovens are available that combine several heating technologies like convection heat, impingement air and microwave energy.

U.S. suppliers can provide cheese that can perform under very specific oven and heating regimes (temperatures and times). Many foodservice operations use blends of cheese in a variety of dishes and fast-food products. U.S. suppliers formulate these melts to consistently deliver the desired flow, stretch, color and flavor. They can provide cheese that is shredded, blended and grated and ready for foodservice operations. Most cheese will require refrigerated storage prior to use, and some will be shipped frozen. U.S. manufacturers can also slow down ripening changes, which facilitates shipment over long distances.

A Product Developer's Matrix of U.S. Cheese Functionality

If you are looking for...

SPECIFIC TEXTURAL PROPERTIES	CHEESE VARIETIES AND APPLICATIONS	TIPS FOR SPECIFYING
Spreadable Ingredient	U.S. cream cheese and other soft-ripened cheeses are widely used as sandwich and snack spreads and ingredients for other spreads. Processed cheeses can be tailored to deliver the right texture and consistency, e.g., in cracker sandwiches.	• Choose soft-ripened or processed cheeses. • Added ingredients can enhance the flavor of cheese spreads. • Consider other components that will be used with the cheese that may influence spreadability, moisture migration and shelf life. • Whipping or aeration is another option to increase spreadability.
Filling	Cheeses are widely used in fillings for baked goods, pastas, meats and snacks. Cheese varieties that do not need aging such as ricotta, cottage cheese, cream cheese, neufchâtel, mascarpone and processed cheese give the best consistency for fillings.	• Choose cheeses that are not aged for better filling consistency. • Use emulsifying salts to enhance the "machinability" for fillings that must flow or be pumped.
Extrudable Ingredient	Extruded cheese snacks must hold up to high heat, have good pumpability and limited oiling-off. Processed cheeses are good, consistent choices for these applications.	• Select a U.S. processed cheese manufacturer who can tailor a product to fit your particular flow or extrusion requirements.
No Melt	In some applications, a "curdy" consistency in melted applications is desirable. Consider cheeses with relatively high pH (above 5.6) or low pH (below 4.8), such as cottage cheese, ricotta or feta. Processed cheeses are also good choices for these applications.	• Select a cheese with a pH outside of the range 4.8 to 5.6, such as cottage, ricotta, feta or queso blanco. • The melting characteristics of other varieties can be altered during manufacturing. • Processed cheeses can be made with specific melt characteristics.
Restricted Melt	In many applications, such as on burgers, American-style pizza and appetizers, it is important to limit the flow of cheese to avoid leakage.	• Mozzarella is one of the most popular cheeses for melting applications. • For different flavor profiles, consider blending two or more varieties with different melt characteristics. • The melting characteristics of other varieties can be altered during manufacturing. • Processed cheese is another common selection for very restricted melt applications.
Free Flow, Cheese Sauce	For a cheese that flows more freely in casseroles or that melts as a sauce on an entrée or side dish, consider processed cheese. Natural cheeses or cheese powders can be used as ingredients in sauces, particularly for more intense flavor.	• Prepared cheese sauces are available from many U.S. cheese suppliers. • Provide your cheese supplier with detailed information about your application – including cooking method, temperature and hold conditions, and the desired flavor profile.
Stretch	Pasta filata cheeses, including U.S. mozzarella, are widely known for their stretching characteristics. Some other categories of cheese stretch to varying degrees. Most applications require the proper balance between the cheese's melt and stretch characteristics.	• U.S. mozzarella is widely used for its stretch functionality. • For different flavor profiles, consider blending other cheeses with mozzarella.
Microwave Meltability	Research has shown that different factors influence thermal vs. microwave meltability. Most lower fat or lower moisture cheeses generally do not melt as well in microwave applications.	• When possible, choose higher fat and/or higher moisture cheeses for microwave applications. • Know the type of oven(s) that will be used for cooking the product – convection, microwave or forced air.

Specific Color Development and Flavor Properties

If you are looking for...

SPECIFIC PROPERTIES	CHEESE VARIETIES AND APPLICATIONS	TIPS FOR SPECIFYING
Limited or No Maillard Browning	Since browning is due to residual sugars in cheese, many cheese types do not brown to any significant degree.	• Ask your U.S. cheese supplier for a mozzarella with reduced residual sugar and white baked appearance.
More Maillard Browning	Controlled Maillard browning is desirable on many pizzas. Under the right circumstances, U.S. mozzarella can be designed to provide the most authentic U.S.-style pizza browning effect.	• U.S. mozzarella is the best choice when controlled Maillard browning is desirable. Talk to your cheese supplier about tailor-making U.S. mozzarella, or any other cheese blend that is best for your total flavor system and baking method. • For baking applications, keep in mind that the baking oven type can alter color and flavor.
Intense Cheese Flavor	Aged cheeses, club cheeses and enzyme-modified cheeses are all used to boost flavor in prepared foods. They are frequently used in lower fat foods or other applications where the amount of cheese is limited.	• Talk to your cheese supplier about your specific applications to determine which high-flavored cheese or cheese blend or profile is best for your total flavor system. • For baking applications, keep in mind that the baking process can alter cheese flavors.
Mild Dairy Flavor	In applications such as filled pastas and desserts, a mild dairy flavor is the goal. Soft-ripened and unripened cheeses such as cottage, neufchâtel, mascarpone and cream cheese, colby, queso blanco and monterey jack all provide a mild creamy flavor.	• Sample a variety of mild-flavored cheeses for your specific application to see which one performs best. Avoid aged cheeses, which generally have a stronger flavor. Washed curd cheeses usually have milder flavors.
Unique/Signature Flavors	Less familiar specialty cheeses and custom cheese blends can be used to create unique flavors in all applications.	• Work with your cheese supplier to create a custom flavor profile or a blend of contrasting varieties for your application. • Pre-flavored cheeses are also available.

Specific Shelf Life and Delivery Properties

If you are looking for...

SPECIFIC PROPERTIES	CHEESE VARIETIES AND APPLICATIONS	TIPS FOR SPECIFYING
Ability to Freeze or Withstand Freeze-Thaw	While nearly all cheeses can be frozen, higher fat cheeses generally withstand freeze-thaw cycles better than lower fat varieties. Also, higher fat cheeses can reduce burning or blistering on frozen pizzas. Cream cheese becomes crumbly after freezing.	• Higher fat cheese generally holds up better to freezing. • For low-fat foods, ask your cheese supplier about lower fat cheeses that are most resistant to freeze damage.
An Extended Shelf Life	Shelf life is largely a function of the water activity and pH of the finished foods. Lower moisture cheeses, such as aged Italian-style cheeses, can help extend shelf life. Proper packaging, heat treatments and aseptic packaging also prolong shelf life.	• Choose lower moisture cheeses, such as aged cheeses or cheeses that are made specifically for long hold. • Ask your cheese supplier about packaging that can lengthen shelf life. Cheeses can be frozen or dried to provide very long term shelf-life.
Good Product Hold	Products must hold up well on a steam-table or under a heat lamp. Aged cheese varieties and no-melt varieties hold up the best.	• Talk to your supplier for proper cheese variety selection for foods normally subjected to these conditions.
Dispensability	Cheese ingredients that melt without clumping are critical for many successful soups and sauces. Complete dispersability for smooth applications requires an understanding of the specific performance of your cheese.	• Discuss ideal processing conditions with your U.S. cheese supplier.

Formulations for Specific Market Niches

If you are looking for...

SPECIFIC PROPERTIES	CHEESE VARIETIES AND APPLICATIONS	TIPS FOR SPECIFYING
Reduced-Fat or Low-Fat Cheeses (high protein)	Most cheese varieties are available in many fat level options.	• Talk to your cheese supplier about the fat level targets of your specific formulations.
Low Carbohydrate	Most cheeses contain little residual lactose or other carbohydrates.	• Consider natural cheeses such as U.S. cheddar, colby, monterey jack and mozzarella, all of which have or can be produced with very low levels of residual carbohydrates.
Enhanced Nutrition	Most cheeses are good or excellent sources of protein and calcium.	• For boosting calcium, select hard and semi-hard cheeses, such as cheddar and hard Italian-style cheeses. Nutritional profiles are readily available from your U.S. cheese supplier.
Appeal to Children	Many U.S. cheese suppliers have developed products especially for children with flavor and shapes that appeal to kids.	• Consider mild-flavored cheeses, such as American pasteurized processed cheese, as well as custom cheese shapes, string cheese and various fruit-flavored cheese. Unique flavors like chocolate are also available. • Visit ThinkUSAdairy.org for cheese suppliers that cater to the children's market.
Support for a Gourmet Image	Specialty cheeses and cheese blends can enhance a product's image and appeal across nearly all product categories, including snacks, entrées and desserts.	• Visit ThinkUSAdairy.org for suppliers of specific specialty cheese varieties and cheese blends. Cheeses made by a Wisconsin Master Cheesemaker® are also available.
Ethnic Cheeses	Ethnic cheeses must be true to their point of origin in flavor, texture, appearance and performance.	• The U.S. cheese industry produces cheese varieties consistent with their ethnic roots. Visit ThinkUSAdairy.org for names of cheese companies that manufacture specific, regional cheese varieties.
Reduced-Waste and/or Labor Savings	Convenience cheese such as pre-portioned packs, pre-blends, cheese slices or forms can save preparation/handling time and reduce waste.	• Talk to your supplier about the specific forms of cheese that will work best in your application.
Custom Formulation	Whether you want cheeses infused with certain flavors or cheese in different forms, sizes, blends, or with different specifications, U.S. cheeses are available tailor-made.	• Talk to your current supplier or visit ThinkUSAdairy.org for a list of custom cheese companies that can provide samples for evaluation.

7.5 FAT CONTENT

BY DR. NANCY AUESTAD
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The fat in cheese is a major source of the pleasing and unique flavors associated with the numerous varieties of cheeses around the world. During cheese ripening, a small amount of the fat is hydrolyzed to volatile shorter-chain fatty acids (butyric, caproic, caprylic and capric acids) along with longer-chain fatty acids. Together, these fatty acids contribute to the flavor of the different cheeses.

The fat content of cheese varies widely, due to the type of milk product (whole, low-fat or non-fat) and the processing steps used to make the cheese. For instance, non-fat, dry curd cottage cheese contains 0.3g of fat per 100g, and cheddar cheese contains 9.6g of fat per 100g. A high-fat cheese such as cream cheese, which is enriched with cream, contains more fat than protein. The amount of total fat, major classes of fatty acids and cholesterol in different cheeses is shown in Table 1.



About two-thirds of the fat (fatty acids) in many cheeses is saturated, followed by monounsaturated and smaller amounts of polyunsaturated fat. Although many countries have recommended to reduce the consumption of foods providing saturated fat in the diet to help reduce risk of cardiovascular disease, in many countries, evidence that cheese consumption does not lead to increases in serum cholesterol is emerging and raising questions about the effects of cheese and saturated fat on cardiovascular disease risk. Characteristics of cheese that may contribute to a growing body of evidence that cheese consumption as part of a healthy diet may not be linked to cardiovascular disease risk include the calcium, protein, and other fatty acids in cheese, fermentation effects in cheese making or the food matrix of cheese.

The soft, fresh cheeses vary most in their total calorie and fat content (Table 1). Cheeses such as cheddar, brie, blue, limburger, muenster, gouda and swiss are generally made from whole milk and have about the same amount of fat and protein. In addition to cheeses naturally lower in fat (e.g., cottage, ricotta, part-skim mozzarella), cheeses that are made to contain less fat are also becoming available. Through the use of novel technologies, processes and ingredients, flavor profiles of lower fat cheeses can be made similar to their full-fat counterparts and appeal to consumers.

In some countries, specific criteria need to be met for marketing claims such as reduced fat or low-fat cheese. In the United States, for example, to be labeled low-fat, a cheese must contain no more than 3g fat per serving and per 50g. To be labeled non-fat or fat-free, the cheese must contain less than 0.5g fat per serving and per reference amount customarily consumed, which is 30g for cheese. To be labeled reduced-fat, the cheese must contain 25% less fat per serving than its full-fat counterpart.

Cheese consumption contributes to the intake of dietary fat, which is important for the absorption and transport of the fat-soluble vitamins (A, D, E, and K) in the body. Cheese consumption, which varies around the world, also contributes to the dietary intake of several other nutrients that are important for good health. In the United States, for example, cheese contributes 4.6% of daily calories and 8.9% of total fat intake,



21.0% of calcium, 8.8% of protein, 11.4% of phosphorus, 9.2% of vitamin A, 7.6% of sodium, 7.5% of zinc and 6.6% of vitamin B_{12}.

The total combination of flavor and texture (largely due to the fat content) and nutrient contributions of cheese make it an excellent addition to the diet. Cheese not only tastes great, but is a convenient, portable and versatile food.

References

1. Auestad, N., J. S. Hurley, V. L. Fulgoni and C. M. Schweitzer. Contribution of food groups to energy and nutrient intakes in five developed countries. Nutrients 7:4593, 2015.
2. Carunchia Whetstine, M. E., M. A. Drake, B. K. Nelson and D. M. Barbano. Flavor profiles of full-fat and reduced-fat cheese and cheese fat made from aged Cheddar with the fat removed using a novel process. J. Dairy Sci. 89:505, 2006.
3. Cheese Projections: Consumption, per capita. OECD-FAO Agricultural Outlook, OECD Agriculture statistics (database). Annex. Table A.20.2, 2015.
4. Hjerpsted, J. and T. Tholstrup. Cheese and cardiovascular disease risk: A review of the evidence and discussion of possible mechanisms. Crit. Rev. Food Sci. Nutr.:Jan 20.0, 2015 (epub ahead of print).
5. Huth, P. J., V. L. Fulgoni, D. R. Keast, K. Park and N. Auestad. Major food sources of calories, added sugars, and saturated fat and their contribution to essential nutrient intakes in the U.S. diet: Data from the National Health and Nutrition Examination Survey 2003–2006. Nutrition Journal 12: 116, 2013.
6. Qin, L. Q., J. Y. Xu, S. F. Han, Z. L. Zhang, Y. Y. Zhao and I. M. Szeto (2015). Dairy consumption and risk of cardiovascular disease: an updated meta-analysis of prospective cohort studies. Asia Pac. J. Clin. Nutr. 24:90, 2015.
7. Quick Reference Guide, Nutrition Claims for Dairy Products. Dairy Research Institute, Innovation Center for U.S. Dairy, 2011.
8. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 27. Version Current: May 2015. Internet: http://www.ars.usda.gov/ba/bhnrc/ndl. Accessed, September 9, 2015.
9. U.S. Food and Drug Administration. Guidance for Industry: A Food Labeling Guide. Revised January 2013. http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm2006828.htm. Accessed, November 14, 2015.

Table 1: Comparative Total Lipid (Fat), Fatty Acid and Cholesterol Composition of Cheeses

Per 100g of cheese

	Kcal	Total Fat, g	Total SFA, g	Total MUFA, g**	Total PUFA, g***	Total Cholesterol, mg
Soft, Fresh						
Cottage, Creamed	98	4.3	1.7	0.8	0.1	17
Cottage, Dry Curd	72	0.3	0.2	0.1	0.0	7
Cream	195	19.3	12.0	5.6	0.7	66
Feta	264	21.3	14.9	4.6	0.6	89
Mozzarella, Part-Skim	254	15.9	10.1	4.5	0.5	64
Mozzarella, Whole Milk	300	22.4	13.2	6.6	0.8	79
Neufchâtel	253	22.8	12.8	5.8	1.0	74
Ricotta, Whole Milk	174	13.0	8.3	3.6	0.4	51
Soft, Mold-Ripened						
Camembert	300	24.3	15.3	7.0	0.7	72
Semi-Soft						
Brick	371	29.7	18.8	8.6	0.8	94
Edam	357	27.8	17.6	8.1	0.7	89
Gouda	356	27.4	17.6	7.7	0.7	114
Monterey Jack	373	30.3	19.1	8.8	0.9	89
Muenster	368	30.0	19.1	8.7	0.7	96
Mozzarella, Low-Moisture, Whole Milk	318	24.6	15.6	7.0	0.8	89
Mozzarella, Low Moisture, Part-Skim	301	19.7	11.5	5.1	0.9	65
Provolone	351	26.6	17.1	7.4	0.8	69

	Kcal	Total Fat, g	Total SFA, g	Total MUFA, g**	Total PUFA, g***	Total Cholesterol, mg
Semi-Soft, Mold-Ripened						
Blue	353	28.7	18.7	7.8	0.8	75
Brie	334	27.7	17.4	8.0	0.8	100
Limburger	327	27.3	16.7	8.6	0.5	90
Hard						
Cheddar	406	33.8	19.4	8.4	1.4	102
Colby	394	32.1	20.2	9.3	1.0	95
Gruyère	413	32.3	18.9	10.0	1.7	110
Swiss	380	27.8	17.8	7.3	1.0	92
Hard Grated						
Parmesan, Grated	392	25.8	16.4	7.5	0.6	68
Romano	387	26.9	17.1	7.8	0.6	104
Pasteurized Processed						
Pasteurized Processed Cheese (American)	366	30.7	18.1	8.2	1.3	100
Pasteurized Processed Cheese Food (Swiss)	323	24.1	15.5	6.8	0.6	82
Pasteurized Processed Cheese Spread (American)	290	21.2	13.3	6.2	0.6	55
Cold-Pack						
Cold-Pack	331	24.5	15.4	7.2	0.7	64

*SFA = Saturated Fatty Acids
**MUFA = Monounsaturated Fatty Acids
***PUFA = Polyunsaturated Fatty Acids

Source: U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 27 (revised). Version Current: May 2015. Internet: http://www.ars.usda.gov/ba/bhnrc/ndl. Accessed, September 9, 2015

7.6 CALCIUM CONTENT

BY DR. NANCY AUESTAD
Nutrition Insights LLC, St. George, UT

Most cheese varieties are good to excellent sources of calcium, and the use of cheese as an ingredient in prepared foods and menu items is an excellent way to help meet calcium requirements for good health. Consuming cheese as part of a healthy diet is an efficient and effective way to add calcium and other important nutrients to a person's diet.

Calcium, the most abundant mineral in the body, is well recognized for its role in helping to build and maintain strong bones. Nearly all (99%) of the body's calcium is in bones and teeth. Bone undergoes continuous remodeling, meaning that throughout life, bone tissue is continually resorbed and new bone is formed. During periods of growth in children and adolescents, bone formation is greater than resorption, but in adults, these processes are about equal. In older adults, especially postmenopausal women, bone breakdown is greater than bone formation, leading to bone loss and increased risk of osteoporosis.

Calcium is also important for muscle function, nerve transmission, intracellular signaling and hormonal secretion with only 1% of the body's calcium used to support these important metabolic functions. Serum calcium levels are very tightly regulated and do not vary with changes in dietary intakes.

Dairy foods (milk, yogurt and cheese) are rich, natural food sources of calcium. The calcium in dairy foods, including cheese, is readily available and more highly absorbed than that from other foods, especially plant sources. Non-dairy sources of calcium include vegetables, such as spinach, Chinese cabbage, kale and broccoli; however, large amounts would be needed to provide similar amounts of bioavailable calcium to that in dairy products. In some countries, foods such as fruit juices and drinks, tofu and cereals may be fortified with calcium.

The calcium content of cheese is largely influenced by the acidity at coagulation and the degree of expulsion of whey from the curd. In ripened whole milk cheeses (e.g., cheddar, swiss, brick) the calcium and phosphorus largely remain in the curd. Cheese coagulated by lactic acid (e.g., cottage cheese) retains less calcium because the calcium salts are removed from the casein as casein is precipitated. The calcium content of cheeses varies widely. For example, a hard grating cheese such as parmesan, which is typically used in small amounts, contains 1184mg per 100g, cheddar contains 675mg and blue cheese 528mg, while dry curd cottage cheese contains 86mg per 100g. The amount of calcium in different cheeses is shown on Table 2 per 100g.

References

1. Auestad, N., J. S. Hurley, V. L. Fulgoni and C. M. Schweitzer. Contribution of food groups to energy and nutrient intakes in five developed countries. Nutrients 7:4593, 2015.
2. Fulgoni, V. L., 3rd, D. R. Keast, N. Auestad and E. E. Quann. Nutrients from dairy foods are difficult to replace in diets of Americans: Food pattern modeling and an analyses of the National Health and Nutrition Examination Survey 2003-2006. Nutr. Res. 31:759, 2011.
3. IOM (Institute of Medicine). 2011. Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: The National Academies Press.
4. Miller, G.D., J.K. Jarvis and L.D. McBean. Handbook of Dairy Foods and Nutrition. 2nd ed. Boca Raton, FL., CRC Press, 2000.
5. U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 27. Version Current: May 2015. Internet: http://www.ars.usda.gov/ba/bhnrc/ndl.
6. Dietary Guidelines Advisory Committee. 2010. Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010, to the Secretary of Agriculture and the Secretary of Health and Human Services. U.S. Department of Agriculture, Agricultural Research Service, Washington, DC, Appendix E-3.6. Milk Group and Alternatives: Food Pattern Modeling Analysis.

Table 2: Comparative Total Calcium Content of Cheeses

Per 100g of cheese

	CALCIUM mg/100 g
Soft, Fresh	
Cottage, Creamed	83
Cottage, Dry Curd	86
Cream	96
Feta	493
Mozzarella, Part-Skim	782
Mozzarella, Whole Milk	505
Neufchâtel	117
Ricotta, Whole Milk	207
Soft, Mold-Ripened	
Camembert	388
Semi-Soft	
Brick	674
Edam	731
Gouda	700
Monterey Jack	746
Muenster	717
Mozzarella, Low-Moisture, Whole Milk	575
Mozzarella, Low-Moisture, Part-Skim	716
Provolone	756

	CALCIUM mg/100 g
Semi-Soft, Mold-Ripened	
Blue	528
Brie	184
Limburger	497
Hard	
Cheddar	675
Colby	685
Gruyère	1011
Swiss	791
Hard Grated	
Parmesan, Grated	1184
Romano	1064
Pasteurized Processed	
Pasteurized Processed Cheese (American)	1045
Pasteurized Processed Cheese Food (Swiss)	723
Pasteurized Processed Cheese Spread (American)	562
Cold-Pack Cheese	
Cold-Pack	497

Source: U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 27 (revised). Version Current: May 2015. Internet: http://www.ars.usda.gov/ba/bhnrc/ndl. Accessed, September 9, 2015.

7.7 PROTEIN CONTENT

BY DR. NANCY AUESTAD
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Protein supports many functions in the body. Protein has a role in normal growth and development, the health of muscles, bones, skin and nerves, and functioning of the immune system and other tissues. In addition, a growing body of research indicates that consuming higher protein diets may help modulate appetite and satiety, help dieters retain more muscle and lose more fat during periods of weight loss and help older adults slow the loss of skeletal muscle that occurs with age, a condition known as sarcopenia. Consumers are becoming more aware of protein's many benefits, and many are seeking ways to increase protein in the diet.



Protein comes from a variety of foods. Animal sources include meats, dairy products (milk, cheese and yogurt), fish and eggs, and vegetarian sources include whole grains, pulses, legumes, soy and nuts. Animal foods generally contain higher quality protein than plant foods. An important aspect of protein quality from a nutritional standpoint is the composition of amino acids, which are the basic building blocks needed for the body to synthesize muscle and other tissues. The amino acid composition of different cheeses is shown in Table 4.

The digestibility of protein also factors into its quality. There are several methods for rating protein quality. One widely used method has been the Protein Digestibility-Corrected Amino Acid Score (PDCAAS), which rates proteins from 0 to 1 (0 represents the lowest quality and 1 represents the highest). With this method, milk and the major milk proteins (casein and whey) have a score of 1.00, beef scores 0.92, black beans 0.75, peanuts 0.52, wheat 0.42 and wheat gluten 0.25. The high PDCAAS score for milk and dairy's proteins indicates its proteins are well-digested and its mix of amino acids helps meet human requirements for indispensable amino acids. PDCAAS, however, has limitations. A 2013 report by an Expert Consultation of the Food and Agriculture Organization of the United Nations (FAO) recommended that the Digestible Indispensable Amino Acid Score (DIAAS) replace PDCAAS as the preferred method of measuring protein quality. In 2014, a subsequent FAO working group recommended further developing DIAAS and creating a robust database for foods and diets to allow for implementation of the new protein quality method.

Casein is the most abundant type of protein in cheese. Cheese is made by draining off the whey after coagulation of casein, the major protein in milk. In cheddar cheese, for example, more than 95% of the protein is casein (Table 3). The method of coagulation used and the degree of ripening can influence the overall protein make-up in cheese. In some of the soft cheese varieties (e.g., camembert, limburger), much of the protein is converted to water-soluble compounds, including peptides, amino acids and ammonia. In hard cheeses (e.g., cheddar and swiss), less protein hydrolysis occurs than in soft cheeses. In acid-coagulated cheese (e.g., cottage cheese made with a starter culture); on the other hand, the protein is isoelectric

casein. This protein is not greatly hydrolyzed or digested before use. Acid-coagulated cheeses treated with a high temperature (e.g., ricotta) contain three types of milk protein (casein, lactoglobulin and lactalbumin) in appreciable amounts.

Table 3: Sample Partition of Protein and Other Macronutrients in Making Cheddar Cheese

NUTRIENT	% IN CURD	% IN WHEY
Water	6	94
Total Solids	48	52
Casein	96	4
Soluble Proteins	4	96
Fat	94	6

Source: Adapted from Chapter 2, Dairy Science and Technology (1985).

As part of a healthy diet, cheese can be an important source of dietary protein. In the United States, for example, cheese (including natural and processed cheese, cottage cheese and ricotta cheese) accounts for 7.1 to 9.7% of the total daily protein intake, depending on age group. Cheese may contribute even higher proportions of protein in countries like France, where cheese consumption is higher. Cheese, which can be eaten alone or used in food mixtures, is a versatile, convenient source of high-quality protein that can help individuals meet their protein goals.

References

1. Fondation de technologie laitière du Québec. 1985. Dairy Science and Technology: Principles and Applications, Pr De L'Universite Laval.
2. Food and Agriculture Organization of the United Nations (FAO). 2013. Dietary Protein Quality Evaluation in Human Nutrition: Report of an FAO Expert Consultation. FAO Food and Nutrition paper No. 92. Rome.
3. Food and Agriculture Organization of the United Nations (FAO). 2014. Research Approaches and Methods for Evaluating the Protein Quality of Human Foods: Report of FAO Expert Working Group. Rome.
4. Keast, D. R., V. L. Fulgoni, T. A. Nicklas and C. E. O'Neil. food sources of energy and nutrients among children in the United States: National Health and Nutrition Examination Survey 2003-2006. Nutrients 5:283, 2013.
5. Mamerow, M. M., J. A. Mettler, K. L. English, S. L. Casperson, E. Arentson-Lantz, M. Sheffield-Moore, D. K. Layman and D. Paddon-Jones. Dietary protein distribution positively influences 24-h muscle protein synthesis in healthy adults. J. Nutr. 144:876, 2014.
6. O'Neil, C. E., D. R. Keast, V. L. Fulgoni and T. A. Nicklas. Food sources of energy and nutrients among adults in the US: NHANES 2003-2006. Nutrients 4:2097, 2012.
7. Soenen, S., E. A. Martens, A. Hochstenbach-Waelen, S. G. Lemmens and M. S. Westerterp-Plantenga. Normal protein intake is required for body weight loss and weight maintenance, and elevated protein intake for additional preservation of resting energy expenditure and fat free mass. J. Nutr. 143:591, 2013.
8. US Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 27. Version Current: May 2015. Internet: http://www.ars.usda.gov/ba/bhnrc/ndl.
9. Westerterp-Plantenga, M. S., S. G. Lemmens and K. R. Westerterp. Dietary protein - its role in satiety, energetics, weight loss and health. Br. J. Nutr. 108:2: S105, 2012.

Table 4: Comparative Total Protein and Amino Acid Content and Distribution in Cheeses

Per 100g of cheese

		INDISPENSIBLE AMINO ACIDS								DISPENSIBLE AMINO ACIDS									
	Total Protein	Tryptophan	Threonine	Isoleucine	Leucine	Lysine	Methionine	Cystine	Phenylalanine	Tyrosine	Valine	Histidine	Arginine	Alanine	Aspartic acid	Glutamic acid	Glycine	Proline	Serine
Soft, Fresh																			
Cottage, Creamed	11.1	0.15	0.50	0.59	1.12	0.93	0.27	0.07	0.58	0.60	0.75	0.33	0.50	0.38	0.91	2.60	0.22	1.23	0.64
Cottage, Dry Curd	10.3	0.14	0.47	0.55	1.04	0.87	0.25	0.06	0.54	0.56	0.70	0.30	0.46	0.36	0.84	2.42	0.21	1.14	0.59
Cream	2.7	0.04	0.12	0.16	0.26	0.21	0.07	0.03	0.13	0.13	0.18	0.07	0.10	0.09	0.21	0.57	0.06	0.26	0.15
Feta	14.2	0.20	0.64	0.80	1.40	1.22	0.37	0.08	0.68	0.67	1.07	0.40	0.47	0.64	0.78	2.42	0.10	1.38	1.17
Mozzarella, Part-Skim	24.3	0.34	0.92	1.16	2.37	2.46	0.68	0.14	1.27	1.40	1.52	0.91	1.04	0.74	1.76	5.68	0.46	2.50	1.42
Mozzarella, Whole Milk	22.2	0.52	0.98	1.14	1.83	0.97	0.52	0.12	1.01	1.04	1.32	0.52	0.52	0.71	1.63	4.46	0.52	2.35	0.74
Neufchâtel	9.2	0.11	0.36	0.50	1.01	0.88	0.29	0.06	0.45	0.47	0.61	0.27	0.36	0.28	0.79	2.01	0.22	1.03	0.58
Ricotta, Whole Milk	11.3	0.13	0.52	0.59	1.22	1.34	0.28	0.10	0.56	0.59	0.69	0.46	0.63	0.50	1.00	2.45	0.30	1.07	0.58
Soft, Mold-Ripened																			
Camembert	19.8	0.31	0.72	0.97	1.84	1.77	0.57	0.11	1.11	1.15	1.28	0.68	0.70	0.82	1.29	4.19	0.38	2.35	1.11
Semi-Soft																			
Brick	23.2	0.32	0.88	1.14	2.24	2.12	0.57	0.13	1.23	1.12	1.47	0.82	0.87	0.67	1.59	5.52	0.44	2.58	1.29
Edam	25.0	0.35	0.93	1.31	2.57	2.66	0.72	0.26	1.43	1.46	1.81	1.03	0.96	0.76	1.75	6.15	0.49	3.25	1.55
Gouda	24.9	0.35	0.93	1.31	2.56	2.65	0.72	0.25	1.43	1.45	1.81	1.03	0.96	0.76	1.74	6.14	0.49	3.25	1.54
Monterey Jack	24.5	0.32	0.87	1.52	2.34	2.04	0.64	0.12	1.29	1.18	1.64	0.86	0.93	0.69	1.57	5.99	0.42	2.76	1.43
Muenster	23.4	0.33	0.89	1.15	2.26	2.14	0.57	0.13	1.24	1.12	1.48	0.83	0.88	0.68	1.60	5.56	0.44	2.59	1.30
Mozzarella, Low-Moisture, Whole Milk	21.6	0.30	0.82	1.04	2.11	2.19	0.60	0.13	1.13	1.25	1.35	0.81	0.93	0.66	1.56	5.06	0.41	2.22	1.26
Mozzarella, Low-Moisture, Part-Skim	24.6	0.57	1.09	1.26	2.02	1.07	0.57	0.13	1.12	1.16	1.47	0.57	0.57	0.78	1.81	4.94	0.57	2.61	0.81
Provolone	25.6	0.35	0.98	1.09	2.30	2.65	0.69	0.12	1.29	1.52	1.64	1.12	1.02	0.71	1.74	6.24	0.43	2.77	1.47

		INDISPENSIBLE AMINO ACIDS								DISPENSIBLE AMINO ACIDS									
	Total Protein	Tryptophan	Threonine	Isoleucine	Leucine	Lysine	Methionine	Cystine	Phenylalanine	Tyrosine	Valine	Histidine	Arginine	Alanine	Aspartic acid	Glutamic acid	Glycine	Proline	Serine
Semi-Soft, Mold-Ripened																			
Blue	21.4	0.31	0.79	1.12	1.92	1.85	0.58	0.11	1.09	1.30	1.56	0.76	0.71	0.64	1.44	5.18	0.41	2.10	1.12
Brie	20.8	0.32	0.75	1.02	1.93	1.85	0.59	0.11	1.16	1.20	1.34	0.72	0.74	0.86	1.35	4.39	0.40	2.46	1.17
Limburger	20.1	0.29	0.74	1.22	2.09	1.68	0.62	0.11	1.12	1.20	1.44	0.58	0.70	0.67	1.48	4.51	0.41	2.44	1.14
Hard																			
Cheddar	24.0	0.56	1.07	1.23	1.98	1.05	0.56	0.13	1.10	1.13	1.43	0.56	0.56	0.77	1.77	4.83	0.56	2.55	0.80
Colby	23.8	0.31	0.85	1.48	2.28	1.98	0.62	0.12	1.25	1.15	1.59	0.83	0.90	0.67	1.53	5.81	0.41	2.68	1.39
Gruyère	29.8	0.42	1.09	1.61	3.10	2.71	0.82	0.30	1.74	1.78	2.24	1.12	0.97	0.96	1.65	5.98	0.53	3.87	1.72
Swiss	26.9	0.40	1.04	1.54	2.96	2.59	0.78	0.29	1.66	1.69	2.14	1.07	0.93	0.91	1.57	5.70	0.51	3.69	1.64
Hard Grated																			
Parmesan	35.8	0.48	1.32	1.89	3.45	3.31	0.96	0.24	1.92	2.00	2.45	1.38	1.32	1.05	2.24	8.21	0.62	4.18	2.07
Romano	31.8	0.43	1.17	1.69	3.07	2.94	0.85	0.21	1.71	1.78	2.18	1.23	1.17	0.93	1.99	7.30	0.55	3.72	1.84
Pasteurized Processed																			
Pasteurized Processed Cheese (American)	18.1	0.23	0.77	0.94	1.72	1.52	0.48	0.11	0.94	0.92	1.19	0.55	0.52	0.61	1.55	4.07	0.36	1.79	1.09
Pasteurized Processed Cheese Food (Swiss)	21.9	0.32	0.71	1.01	1.94	2.18	0.57	0.14	1.11	1.20	1.31	0.89	0.92	0.55	1.35	4.55	0.36	2.23	1.06
Pasteurized Processed Cheese Spread (American)	16.4	0.24	0.63	0.83	1.78	1.51	0.54	0.11	0.93	0.89	1.37	0.51	0.55	0.60	1.10	3.48	0.31	2.32	1.04
Cold-Pack																			
Cold-Pack	19.7	0.29	0.64	0.91	1.74	1.95	0.51	0.13	1.00	1.08	1.18	0.80	0.82	0.49	1.21	4.08	0.32	2.00	0.95

Source: U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 27 (revised). Version Current: May 2015. Internet: http://www.ars.usda.gov/ba/bhnrc/ndl. Accessed, September 9, 2015

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