THE MURRAY'S CHEESE COLIN MING MEMORIAL CCP® SCHOLARSHIP APPLICATION

SCHOLARSHIP DETAILS

Murray's Cheese will cover the full costs for one (1) person outside of Kroger and Murray's to complete the following:

1. Participate in Murray's signature CCP® training program (remote participation welcome)
2. Sit for the ACS CCP® Exam
3. Attend the ACS conference (including exam fees, conference attendance, travel to conference, and hotel accommodations)

APPLICATION PROCESS

This scholarship will enable a qualified and deserving applicant who embodies Colin's characteristic traits of **inspirational leadership, kindness, warmth and professional poise** to take the CCP Exam and attend the annual American Cheese Society Conference, with extensive training and expenses covered by Murray's Cheese.

Our internal application process for the CCP training program & scholarship is robust and reflects the learning environment and demanding workload candidates can expect to encounter in exam preparation. As such, the application incorporates several components, including:

- **Personal Information** – Applicant fills out form.
- **Eligibility Requirements** – Applicant fills out form.
- **Personal Statement** – Applicant writes personal statement (500 or fewer words), which should address the following:
    - Why is applicant qualified to win the scholarship?
    - What applicant's intentions are in terms of career growth after the CCP® Exam?
    - How applicant's work and personal values align with Colin's work ethic and vision (as described above)?
- **Reading Comprehension Exercise** – Applicant reads article and responds to prompts in writing
- **Diagnostic Quiz** – Applicant takes online diagnostic quiz modeled after the CCP exam (30 questions).
- **Lecture & Quiz** – Applicant listens to online short lecture & takes online quiz (10 questions)
- **Technical Reading Assignment & Quiz** – Applicant reads technical article & takes online quiz (10 questions)
- **Two (2) Letters of Recommendation** – Applicant should provide one recommendation from a peer, and one recommendation from a supervisor/manager.

All items above should be submitted together. Please note that this application is the first step in applying to the Certified Cheese Professional program. Once accepted by Murray's & Kroger, there is an ACS-specific application to be submitted directly to the American Cheese Society. Acceptance to the Certification program is at the discretion of ACS.

If interested, please review the ACS Eligibility Requirements (p. 3-5), download & complete this application (including the online components), save and submit to ScholarshipApplications@murrayscheese.com

DEADLINES	
What	**When**
Murray's Scholarship Window Open	**16 February 2024**
Window closes (this application DUE)	**1 March 2024**
Scholarship recipients notified	**w/o 11 March 2024**

APPLICATION CHECKLIST

*****ALL COMPONENTS OF THIS APPLICATION MUST BE COMPLETED*****

- **ONCE FINAL, SEND TO SCHOLARSHIPAPPLICATIONS@MURRAYSCHEESE.COM MANAGER COPIED ON THE EMAIL**
- *If you require printed versions of the diagnostic or lecture quizzes, request via greselda.powell@murrayscheese.com or kathleen.serino@murrayscheese.com*

#	COMPONENT	PAGE	COMPLETE?
1	Personal Information	4	☐
2	Acknowledgement release & signature	4	☐
3	Applicant Eligibility	6	☐
4	Applicant industry experience tracker	6	☐
5	Personal Statement *(submit 1 statement)*	8	☐
6	Reading Comprehension Selection	9-12	☐
7	Reading Comprehension Prompts	13	☐
8	Technical Reading: "How the Cheesemaking Process Influences Melt & Stretch"	14-16	☐
9	Technical Reading Quiz *(10 questions)*	←Link	☐
10	Lecture: The Word on Curd, Whitney *(11 mins)*	←Link	☐
11	Lecture Quiz *(10 questions)*	←Link	☐
12	Diagnostic Quiz *(30 questions)* *Time limit: 150 Minutes, no pauses, plan accordingly*	←Link	☐
13	Two (2) Letters of Recommendation	N/A	☐
13	Ready to email completed application to scholarshipapplications@murrayscheese.com	N/A	☐

PERSONAL INFORMATION:

Full Name (First & Last) *Write your preferred FIRST NAME*	
Pronouns *(e.g., She/Her/Hers)*	
Job Title	
Company	
Best Contact Email Address *Double check your Junk inbox for emails from Murray's!*	
Best shipping address	
Best Contact Phone Number	
T-Shirt Size *(circle one of these unisex sizes)*	XS☐ S☐ M☐ L☐ XL☐ 2XL☐ 3XL☐ 4XL☐
Do you have food allergies? *(If yes: list them; if no: skip; this is for catering planning)*	Yes ☐ No ☐
Do you have any barriers to accessing technology regularly, such as a computer, access to reliable internet, or email? *This will help us set you up for success if selected*	Yes ☐ No ☐
If yes to the above, please circle all that apply	☐ Access to computer ☐ Access to reliable internet ☐ Access to a printer ☐ Other

I acknowledge:

- **Everything I have submitted in my personal application is correct.**
- **The Murray's CCP® Training Course is equivalent to a college level study course, which may involve significant personal study to best prepare for the ACS CCP® Exam.**

_____

Signature **Date**

Applicant Eligibility

COMPONENT	COMPLETE?
Meets ACS Eligibility criteria *(see pgs. 5-6)*	Yes ☐ No ☐

APPLICABLE INDUSTRY EXPERIENCE			
Paid or unpaid, work experience or formal education, continuing education, or professional development in the past 6 years			
Position Title or Program	**Length (# years, months)**	**Avg. Hrs./Week**	**Total**
GRAND TOTAL EXPERIENCE HOURS:			

*********See Next Pages for guidance on ACS Eligibility Criteria for ACS Certification Exams******

OVERVIEW: ACS ELIGIBILITY CRITERIA FOR ACS EXAMS

Four thousand (4,000) hours documentable paid or unpaid work experience in the cheese profession during the past six years. Acceptable examples are provided below.

OR

Two thousand (2,000) hours documented paid or unpaid work experience in the cheese profession during the past six years, AND
Two thousand (2,000) hours of any combination of work experience and formal education, continuing education, or professional development. Acceptable examples are provided below.

CALCULATING ELIGIBLE HOURS OF EXPERIENCE

4,000 hours = 40 hours/week x 50 weeks x 2 years = 2 years full-time work equivalent, accumulated over the past six calendar years. If your job did not relate directly to cheese 100% of the time, then prorate your hours to reflect the time you worked with cheese. Detailed documentation need not be presented at time of application but is subject to random audit.

Work Timeline	Year taking Exam
2014	2020
2015	2021
2016	2022

WORK EXPERIENCE

All acceptable work experience should be reported in hours of actual employment (whether full-time or part-time). Fractional responsibility (i.e., working in an establishment where 50% of work is cheese-related) should be pro-rated appropriately. Employer name and dates of employment for each claimed work experience should be listed separately, totaling a minimum of 2,000 and a maximum of 4,000 hours for this section of the application. Work that is unrelated to the cheese profession or is purely administrative or supportive service in the cheese field (e.g., custodial, clerical, accounting) is not acceptable.

ACCEPTABLE WORK EXPERIENCE

- Cheese-making/manufacturing
- Cheese sales or commerce (retail, wholesale, importing, exporting) includes sales/account representative or manager for food distributor.
- Cheese-related writing, consultation, or teaching at the professional level
- Trainer/educator in the cheese field
- Management of a cheese program or extensive work with cheese in a dining establishment

FORMAL EDUCATION

Formal education includes credit-bearing college courses on cheese-related topics or those directly applicable to the cheese field (including cooking, gastronomy, dairy science, restauration) offered by accredited educational institutions (including universities, junior colleges, culinary schools, Wisconsin Cheese Master's program, other agricultural degree programs on cheese making). There is no time limitation on this type of education; it may have been earned at any time in the past.

All acceptable educational or professional development time should be reported in hours of actual classroom, service, or other activity time involved. Reasonable preparation time may be included in reported hours of involvement, as appropriate. Each activity should be reported separately, noting the name of the activity; provider, recipient of service, etc.; month and year of completion; and claimed hours. Hours claimed for this section may be between 0 and 2,000.

CONTINUING EDUCATION AND PROFESSIONAL DEVELOPMENT

Continuing education includes short courses of varying length on cheese-related topics or those directly applicable to the cheese field which are non-credit bearing, offered by knowledgeable persons in the cheese profession. Professional development includes engaging in activities in the cheese profession (other than work experience reported above) that demonstrate professional knowledge or commitment.

Continuing Education and Professional Development must have been earned within 6 years of the examination year.

ACCEPTABLE CONTINUING EDUCATION AND PROFESSIONAL DEVELOPMENT

- Cheese education seminars and workshops
- Adult education programs
- Stand-alone classes
- Seminars at conferences
- Active mentoring of one or more developing cheese professionals
- Preparing and presenting occasional lectures or articles for professionals or public on cheese-related topics
- Teaching classes at any of the above-listed educational programs, if not creditable as "employment"
- Attainment of ServSafe or similar certification of competence in cheese or related area
- Presenting at industry conferences, either serving on panels, organizing panels, etc.
- Participation in educational sessions at an ACS or similar cheese-oriented conference
- Volunteer work/committees/task forces for ACS or similar cheese-oriented organization
- Serving on boards or committees at cheese related organizations such as Cheese Guilds, ACS, NASFT, Milk Marketing Boards, etc.
- Authoring books and articles on cheese related topics published by a secondary source.
- Media appearances on cheese-related topics
- Development of a cheese-related marketing plan
- Development of a new cheese-related product
- Development of a novel program (e.g., in-house Affinage, etc.)

***********See Next Pages for the Application for the Murray's CCP® Training Program************

PERSONAL STATEMENT:

In 500 words or less, respond to the following questions on why you should be considered for The Murray's Cheese Colin Ming CCP scholarship. What are your intentions in terms of career growth after the CCP exam? How do your work and personal values align with Colin's work ethic and vision (as described above)?

NOTE: You may write your response below in type or submit a handwritten statement, which can be attached at the end of your application.

READING COMPREHENSION:

Assignment: Read the following article from Culture & then head to page 12 for further instructions.

Cheese Styles: American Cheddar

Liz Thorpe | January 27, 2022

This article is from: Jan./Feb. 2022 (Cheese Styles)

Beehive Barely Buzzed

Photographed by Nina Gallant | Styled by Chantal Lambeth

First things first: “Cheddar” is a verb, and cheddaring is a specific step that can be taken during cheesemaking. Cheddar cheese begins with the basic steps common to all cheesemaking: acidification, coagulation, cutting, and stirring. It’s the cheddaring, or formation of curd slabs, that makes this cheese different. As whey is drained from the vat, islands of cheese curd are exposed and begin knitting together into a solid mat. Sometimes this occurs at the bottom of the vat, and other times on a nearby tabletop. The warm curd-mat is then cut into smaller slabs that are stacked, unstacked, and restacked with the intention of pressing out additional whey and delivering a firmer, drier curd. Simultaneously, acidity develops during the cheddaring process, and when it reaches a ballpark pH of 5.2 to 5.5, the slabs are milled—run through a sausage grinder of sorts—into finger-sized batons. The milled curd is salted, which slows the development of acidity, and then formed and pressed for aging.

This traditional method is named for the town of Cheddar in Somerset, England, where the cheese originated. (The earliest recorded mention of cheddar appears in an account of the English King Henry II, who purchased 10,240 pounds of cheddar in 1170 at one farthing per pound, or about £2 per ton.) Plentiful salt supplies and an abundance of moderate- to high-acid milk meant that the English cheese did not require the intensive curd cutting and high temperature cooking necessary for Alpine cheeses such as Gruyère and Comté. Unlike those aged cow’s milk cheeses, cheddar took on a sharper, saltier flavor with a texture not so much smooth and bendy as firm and chunky.

The durable and long-lasting Somerset cheese that was well suited for transportation to London’s urban markets was also a food fit for the burgeoning American colonies. Although the Pilgrims of Plymouth Colony began importing cows to Massachusetts in 1623, it was the arrival of the Puritans and the 1629 establishment of the

Massachusetts Bay Colony that secured cheddar as the dominant American cheese. As land prices rose and farmers moved north and west, the cheese of Somerset followed. Before the 20th century advent of processed cheese food known as “American cheese,” cheddar was the national standard.

Cabot Clothbound Cheddar Cabot Creamery/The Cellars at Jasper Hill

Although it’s effective, traditional cheddaring is slow and labor intensive, making the process expensive and less scalable for factories interested in producing increasingly larger amounts of cheese. Very few American cheesemakers still cheddar and mill their curd; notable exceptions include Beecher’s Handmade Cheese in Seattle, Washington, Shelburne Farms in Shelburne, Vermont, and Fiscalini Farmstead Cheese in Modesto, California. These days, most cheddar is made using a process called “stirred curd.”

Curd stirring is a quicker, more “efficient” cheesemaking process wherein the classic stacking and unstacking methods, followed by milling, are replaced by the practice of draining curd slabs on an open table. The curds are then cut and stirred to remove whey, reach target acidity, and prepare the curd for forming—this means that a cheddar doesn’t necessarily need to be cheddared. The FDA however allows a cheese to be labeled cheddar if it merely conforms to prescribed levels of moisture and milk fat. And those levels can be reached with either of the two different cheesemaking techniques.

In the past ten years English cheddar (also known as clothbound or bandaged cheddar) entered the American food lexicon. Radically different from block cheddar in appearance, texture, and flavor, clothbound cheddar is formed into cylinders weighing anywhere from 15 to 50 pounds, then wrapped in permeable cheesecloth and aged in temperature- and humidity-controlled cheese caves. (The first English cheddars were actually aged in subterranean caves that dot the Somerset countryside). The resulting wheels arrive at market in cloth wrapping the color of potato skins, with a drier, more crumbly paste, compared to the moist pliability of block cheddar. The flavors are never as mild as that of young block cheddar, nor do they approach the aggressive prickle many Americans know as “extra sharp.” Instead, they are celebrated for their earthy aroma, not unlike that of a root cellar, and rustic flavor profile, which can be vegetal or toasted, nutty or downright candied.

So what makes a cheddar a cheddar? Once the answer was simple; according to English tradition only cheeses made within 30 miles of Wells Cathedral were considered authentic cheddars. Certainly that definition no longer applies, nor does the classic cheesemaking technique of cheddaring. If anything, what matters most is the milk profile and culture blend that are present from the beginning. After that, it’s up to the

individual intention of cheesemakers, which is what makes American cheddar a fascinating and expanding landscape worth tasting through again and again.

Widmer's 6 Year Aged Cheddar

Age Related

Just as time and culture ratios transform block cheddar without the aid of oxygen, clothbound cheddars begin to assume their full glory during 9 to 14 months in the open air of aging caves. By the time **Cabot Clothbound** leaves the creamery for maturing at the Cellars at Jasper Hill, they've been cooled for two to three days and pressed into a fine cheesecloth with a weave like muslin. At The Cellars the first step of aging is a brushing with melted lard. (Beecher's uses melted butter for its **Flagship Reserve.**) For the next thirty days the wheels are flipped daily to ensure even moisture distribution and the beginning formation of a rind.

The wheels are then deposited on pine shelves in an enormous aging room kept at precisely 52°F and a relative humidity of 88–92 percent. In the aging room, the thin layer of lard acts as both a semipermeable membrane, allowing some moisture evaporation, and a food supply for ambient molds that colonize the rind. Over time, the molds dapple each wheel in an abundance of gray, brown, white, and ocher fluff, continuing to break down the exterior of the cheese and enabling more air exchange. These naturally developed rinds also attract cheese mites, which feast upon molds and impart a honeyed aroma to the dank cave smells. Although diatomaceous earth is approved for the control of cheese mites, most American artisan cheddar makers choose to manage these microscopic pests by brushing the wheels regularly, a tedious and costly undertaking.

Tasting Notes

Cabot Clothbound
Cabot Creamery/The Cellars at Jasper Hill
Vermont
Browned butter and caramel notes are underlined with a noticeable tang. Texture varies with age but tends to be open, and slightly crumbly.

Beecher's 4-Year Aged Flagship
Beecher's Handmade Cheese
Washington

Mellow, savory flavors include boiled eggs and buttered toast, with hints of butterscotch. Ever so lightly crumbly.

Shelburne 2-Year Cheddar
Shelburne Farms
Vermont
This ivory colored, blockstyle cheddar is relatively high in moisture with a smooth, close texture. Complexity, breadth, and piquancy define the flavor.

Fiscalini Bandage Wrapped Reserve
Fiscalini Farms
California
Made with traditional cheddaring techniques, this clothbound has a firm, crumbly paste with slightly smoky flavor and earthiness to finish.

Widmer's Six Year Old
Widmer's Cheese Cellars
Wisconsin
Sharp and salty, mild hay flavor, very tangy with a creaminess on the finish; texture is slightly crumbly.

Barely Buzzed
Beehive Cheese
Utah
Smooth-textured with a nutty flavor that endures. The dark rind results from rubbing with a finely-ground mixture of espresso coffee beans, lavender, and vegetable oil to impart a complex earthiness.


Liz Thorpe

Liz Thorpe owns cheese consulting company The People's Cheese and is the author of *The Cheese Chronicles*. Find her at lizthorpe.com, on Instagram @lizthorpecheese, and on Twitter @LizCheese.

Reading Comprehension Response Section

Assignment: After reading the above article from Culture*, answer the below prompts. Informal responses (e.g., note-taking style) are acceptable.*

NOTE: You may write your response below in type or submit handwritten responses, which can be attached at the end of your application.

- **What is the cheesemaking technique that differentiates cheddar from other cheeses?**
- **What is the modern-day cheddar making process that is different from the traditional technique?**
- **Why is this modern-day process used?**
- **Of the Tasting Selection cheeses, which best represents your ideal cheddar & why?**

TECHNICAL READING ASSIGNMENT & RESPONSE

Assignment: Read the following article from Dairy Pipeline about cheese making, then return to page 2 to begin the Technical Reading Quiz (link provided on page 2)

********Article begins on next page**********

EST. 1962 Murray's CHEESE

THE MURRAY'S CHEESE COLIN MING MEMORIAL CCP® SCHOLARSHIP APPLICATION

CENTER FOR DAIRY RESEARCH

DAIRY PIPELINE

A TECHNICAL RESOURCE FOR DAIRY MANUFACTURERS | FALL 2021 | VOL. 33, No. 3

HOW THE CHEESEMAKING PROCESS INFLUENCES MELT AND STRETCH

Cheese is a very versatile food with a wide array of flavors and textures. Cheese can also be made to have a range of different functional characteristics like melting/non-melting. There is a whole spectrum of cheese melt – complete melt (typical pizza cheese), restricted melt (cheese in sausage/meats) and non-melting (cooking cheeses). Cheese melt and stretch has been especially important in recent years as pizza consumption has increased as well as other frozen or packaged foods that utilize cheese as an ingredient (burritos, calzones, etc.).

So, what do we mean when we talk about cheese melt? A chemist will say melt occurs when a substance changes from a solid or crystalline state to a liquid. A food scientist will describe melt as the ability to flow or spread. Typically, we think of cheese melting from high heat, perhaps during baking or grilling. However, some cheeses, like ripened Camembert or Limburger, melt or flow at refrigeration temperature.

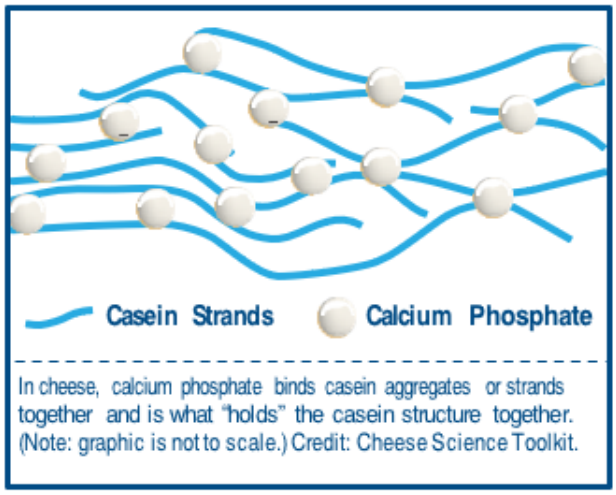
Casein Network

The ability of cheese to melt and stretch depends on the interactions of the caseins, the major protein found in milk. Cheese is essentially a spongy matrix of fats, serum or whey, and minerals held together by casein molecules (or aggregates). The melt and stretch properties are based on the number of interactions between casein molecules. We will get into this in more detail, but casein aggregates or strands are held together by bound calcium phosphate in casein network. The fewer the interactions, or the less bound calcium phosphate in the casein network, the greater the melt. Cheese stretch requires an intact, interconnected casein network. If there are very few interactions between casein molecules (or aggregates), there will be less stretch and the melted cheese will be more fluid or "soupy," lacking good stretch. Stretch is the result of casein–casein interactions that are broken easily but also readily reform at different locations in the casein network. For instance, think of holding a piece of warm Mozzarella, take one end in each hand and gently pull it apart. The casein molecules are grabbing and releasing each other while sliding past as you pull the cheese.

Stretch is the ability of the casein network in the cheese to maintain its integrity and not break when pressure is applied to the cheese. We see Mozzarella stretch on a baked pizza but stretch also takes place in cooler temperatures, for instance a Swiss Cheese developing eyes is an example of cheese stretch.

CENTER FOR DAIRY RESEARCH CDR UW

What's Inside:



In cheese, calcium phosphate binds casein aggregates or strands together and is what "holds" the casein structure together. (Note: graphic is not to scale.) Credit: Cheese Science Toolkit.

There are several factors we need to review to understand the casein to casein interactions. Each has an influence on melt and stretch, and there is a great deal of interplay. First, we need to consider the cheese composition, or casein density. Then, there is the amount of interplay between casein molecules partly due to the bound calcium phosphate. These interactions are strongly influenced by pH and temperature. Finally, there is dissolution or breakdown of the casein molecule – proteolysis.

Cheese Composition and its Impact on Melt and Stretch

What's in milk and cheese? There is protein (casein and whey proteins), fats (triglycerides and fatty acids), carbohydrates (lactose, etc.), minerals (calcium, phosphate, etc.) and water. Most of the casein in milk is in micelles or "bundles" of casein molecules. When we make cheese, we add a coagulant to the milk which causes the casein micelles to group together and form casein aggregates or strands. The spaces or pores between the casein aggregates are filled with serum (whey) and milkfat. When the cheese is cut, individual curds begin to shrink as they release the serum. Stirring, heating and acid development also drives serum out of the curd particles. During this time, as the pH of the curd decreases, the casein micelles within the casein aggregates are rearranging and forming new associations. Casein molecules begin to fuse together and form continuous networks or strands of casein molecules, which is necessary for cheese stretch. However, if there is too much acid development, the casein molecules will "disconnect" and reform into aggregates. There is less contact or interactions among the casein aggregates at low pH (<5.0) and therefore less stretch.

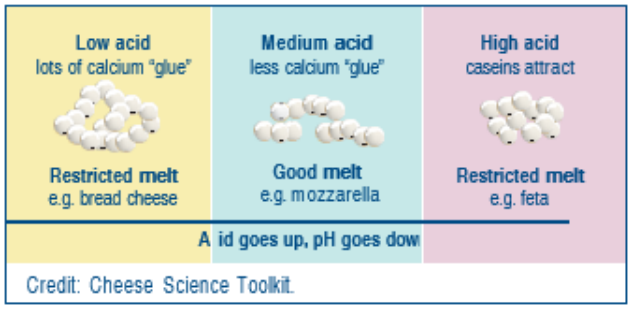
Fat also plays an important role in cheese melt and stretch. In general, higher fat cheeses melt and stretch easier than lower fat cheeses because fat helps dilute the casein network. Milkfat globules surround the casein aggregates but do not interact with them. The milkfat globules separate some of the casein strands, which decreases the number of interactions between casein aggregates. This weakens the casein network and produces a cheese that will melt and stretch more readily and at a cooler temperature than a lower fat cheese.

Typically, lower moisture cheeses will have less melt - think of a young Gouda, which has a higher moisture content compared to an aged Gouda, which is lower in moisture. However, increasing moisture does not guarantee an increase in melt and stretch. For instance, Cottage Cheese is about 80% water but doesn't stretch because of its low pH (~4.6). When the pH is low (<5.0), the casein molecules have equal positive and negative charges and this cause them to stick together resulting in a cheese that will not stretch or melt.

Raising the salt content can also impact the melt/flow of cheese. Salt reduces the hydration of the caseins structure and causes a tightening of the casein network, resulting in a cheese with reduced melt and flow (e.g. Parmesan or Pecorino Romano).

Acidity and Stretch/Melt

Acidity plays a very important role in the ability of cheese to melt and stretch because pH will determine how much bound calcium phosphate is retained in the casein structure. Calcium phosphate binds casein aggregates together and is what "holds" them together when a cheese is stretched. The actual pH at which cheese will begin to melt or stretch depends on the casein content and the amount of bound calcium phosphate in the casein network.



Credit: Cheese Science Toolkit.

Cheeses with a higher pH (~6.3) have more bound calcium phosphate in the casein network, which cause the caseins to be bound or "glued" together, resulting in less melt and stretch. Cheeses with a higher pH include Juustoleipa (Bread Cheese), Queso Fresco and Queso Panela. ↓↑

As the pH decreases (~5.2-5.4), some of the calcium phosphate is dissolved from the casein network and is replaced by hydrogen H+. This results in a balance of bound and unbound calcium phosphate that allows for a cheese to melt and stretch. Cheeses in the ~5.2-5.4 pH range have good melt and stretch and include Low Moisture Part Skim Mozzarella, Whole Milk Mozzarella, Colby, and Muenster.

However, if the acidity drops to ~4.6 then most of the calcium phosphate is dissolved from the casein structure. As mentioned previously, when the calcium phosphate is dissolved, the charge of the casein molecules will cause them to stick together. Cheeses with low pH include Cottage Cheese, Feta and Cream Cheese.

As we discussed earlier, cheeses with a higher fat content will stretch and melt more readily because of the milkfat globules that are dispersed into the casein network, which limit the interactions between casein strands. So, higher fat cheeses may require a higher bound calcium content (higher pH) to achieve the desired stretch and melt. Likewise, lower fat cheeses, which have a dense casein structure, may require a lower pH to reach the correct bound calcium content to allow the cheese to stretch and melt properly.

In a higher pH cheese, like Juustoleipa, there is more bound calcium phosphate in the casein network, which restricts the melt and stretch of the cheese.

Proteolysis Impact on Melt and Stretch

Proteolysis is the breakdown of proteins into smaller peptides or amino acids. It occurs, typically during aging, when the bonds within the casein molecule are broken by residual rennet or by the acitivity of microorganisms. Proteolysis essentially chops apart the casein network, which results in a cheese that will readily melt but will have limited stretch. Remember, for good stretch, an intact casein network is needed to form strands.

Proteolysis can be slowed down by using less coagulant so that there will be less residual rennet. When making cheeses like Swiss, Parmesan, or Romano, higher cook temperatures can be used to inactivate some of the coagulant. Similarly, when making Mozzrella, a high stretching water temperature can be used to inactive some of the coagulant.

Mold or surface ripened cheeses are examples of cheese that intentionally undergo extensive proteolysis. After aging, these cheeses will essentially melt and flow at room temperature but, of course, have no stretch because the casein network is too broken down to stretch.

Buffering Impact on Melt and Stretch

In addition to proteolysis, another important process occurs during aging: buffering. The "buffering" phase occurs when bound calcium is displaced with hydrogen (H+) and the hydration of the casein. Buffering make take several days to complete and at this time the pH of the cheese will raise or "buffer" up. The loss of bound calcium phosphate in the casein is pH dependent. The lower the pH of the cheese, the faster the hydration and the faster you'll see changes in the melt. This process is important for the increase in the melt and stretch in very young cheese.

Calcium phosphate loss also depends on the pH of the milk at set and the pH of the cheese at drain. The lower the pH at each of these steps, the less bound calcium. For instance, let's say we have two cheeses - "Cheese A" and "Cheese B." Both cheeses have similar finish pHs around 5.4. However, Cheese A has good stretch and melt but Cheese B has bad stretch and melt. To understand what happened, we have to look back at the acid development of the two cheeses. When we look back, we will see that in the case of Cheese B, not enough acid was developed early in the cheesemaking process, resulting in more bound calcium phosphate. This is a common problem in the industry, people are rushing the cheesemaking process and not allowing enough time for the pH to drop sufficiently before adding the coagulant.

In summary, cheese melt and stretch all comes back to the cheese's casein network. Cheese composition, pH, and aging all impact a cheese's casein network and, ultimately, the melt and stretch of a cheese. Understanding these interactions and how these different factors interplay is essential to developing a cheese that achieves the intended functional attributes like melt and stretch. R

Sources
Johnson, M. 2000. The Melt and Stretch of Cheese. Dairy Pipeline. Volume 12, Number 1.

Polowsky, P. 2017. Melt and Stretch. CheeseScience.Org. 9/20/2021
https://www.cheesescience.org/melt.html