

# 도포 숙성 치즈와 곰팡이 숙성 치즈의 관능적 특성 비교 분석에 관한 총설

The Investigation and Comparison of Sensory Attributes of Smear-Ripened and  
Mold-Ripened Cheeses; a Review

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## 요약

이 총설의 목적은 도포 숙성 치즈와 곰팡이 숙성 치즈의 제조 공정의 차이를 살펴보고 이들의 관능적 특성 차이에 관하여 비교 분석 하는 것이다. 도포 숙성 치즈와 곰팡이 숙성 치즈의 관능적 특성은 치즈의 품질 평가에서 가장 중요한 요소이다. 도포 숙성 치즈는 부드럽고 잘 부스러지는 질감을 가지고 있다. 그리고 블루 치즈와 비교하여 짠맛과 신맛이 강한 편이다. 반면에 블루 치즈 (곰팡이 숙성 치즈)는 산양유로 만들었을 때 더 부드럽고 크립과 같은 질감이 나며 냄새가 좀 더 강한 편이다. 블루 치즈는 좀더 산도와 짠맛, 쓴맛이 도포 숙성 치즈에 배하여 강한 편이며 좀 더 신선한 맛이 나는 것이 특징이다. 또한 도포 숙성 치즈와 곰팡이 숙성 치즈의 관능적 특성, 예를 들면 냄새, 맛, 질감 등은 치즈의 품질 평가에 아주 중요한 요소로 작용할 것이라 사료된다.

■ 중심어 : | 치즈 | 관능적 특성 | 도포 숙성 | 곰팡이 숙성 | 소비자 기호도 |

## Abstract

The objectives of this review are to be aware of the differences between the smear-ripened and mold-ripened cheeses and to compare the sensory attributes of smear-ripened and blue-vein cheeses. Sensory attributes of cheese occupy a prominent place for the desirable overall quality of smear-ripened and blue-vein cheeses. Smear-ripened cheeses characterized by a smooth and brittle texture. Furthermore, smear-ripened cheeses have common grittiness characteristics, also slightly salty and sour flavor compared to blue-vein cheeses. Blue-vein cheeses are characterized by a softer, creamy texture and stronger smells when goat milk is used. Blue-vein cheeses have a fresh, clean, somewhat salty and acid with a slightly bitter tastes compared to smear-ripened cheeses. Finally, the differences in sensory attributes of smear-ripened and blue-vein cheeses such as texture, aroma, and flavor, can make them useful to determine the quality of cheeses.

■ keyword : | Cheese | Sensory Attributes | Smear-ripened | Mold-ripened | Consumer References |

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## 1. Introduction

Sensory attributes of cheeses probably one of the most important indicators when assuring and assessing the functional properties of cheeses[1].

The sensory attributes of cheeses can be measured by objectively and subjectively and both measurements can decide the overall perception of cheeses[2].

The sensory attributes of cheeses can establish consumer perceptions especially on several sensorial features of cheese such as the presence of holes, tastes like a salty and buttery flavor, texture like hardness, chewiness, and creaminess, rancid flavor and other sensations[3]. All such sensory attributes determine the eating quality and consumer acceptability of cheeses.

There are more than 500 types of cheeses in the world and each type of cheese has its own specific manufacturing and ripening process. Therefore, it is no wonder each specific types of cheeses have their own specific textural and perceptual sensory attributes[2].

The recent import of cheese to South Korea is getting increased dramatically, over 10% increase per year. However, most imported cheeses are consumed as the cheese base for the process cheese so the original sensory attributes is not a big concern. However, Brie, Camembert, and Gorgonzola, which is micro-ripened cheese, are mostly consumed as it is in South Korea and their sensory attributes are to be important for consumers.

Smear-ripened and blue-vein cheeses are famous for the unique characteristics of sensory attributes but these cheese are only known as Brie, Camembert, and Gorgonzola in South Korea's market.

As these micro-ripened cheeses have a very unique, fermented flavor, such as taste, odor and color, Korean consumers are not familiar with the

these sensory attributes of the micro-ripened cheeses. The moldy and over-ripened flavor is considered as regarded as Korean consumers are not knowledgeable for these types of cheeses.

However, the micro-ripened cheeses are often in the center of the food safety issue as the *Listeria monocytogenes* outbreak is often associated with smear-ripened and blue-vein ripened cheeses[4]. Of course the most popular blue vein-cheeses in South Korea is Gorgonzola cheese and most of its application is an ingredient of pizza.

Therefore, the objectives of this review are to compare the general sensory attributes of various smear-ripened and blue-vein cheeses and to help the understanding of Korean consumers on the overall desirable quality of smear-ripened and blue-vein cheeses to enhance their application in Korean diet and to prevent foodborne diseases associated with micro-ripened cheeses.

## 2. Smear-Ripened Cheeses and blue-vein cheeses

When manufacturing cheeses, the sensory attribute is always involved in the important indicator to determine the quality of cheeses. The functionality of cheeses can be varied as each variety of cheeses have its unique manufacturing procedure and ripening profiles. Smear-ripened cheeses are traditionally produced on a small scale in a farmhouse environment in many European countries. Industrialized production are common in countries such as Denmark, France, Germany, and The Netherlands[4]. Smear-ripened cheeses develop red-orange smear on their surfaces during ripening. For this reason, they are also called red-smear cheeses or bacterial surface-ripened cheeses to

differentiate them from mold-ripened cheeses, although fungi (yeasts) develop on their surfaces[5].

The smear is a microbial mat composed of bacteria and yeasts and these microorganisms are mainly responsible for the development of the flavor characteristics of the cheeses[6][7]. In addition, smear-ripened cheeses have common grittiness unique characteristic during ripening[8]. Smear-ripened cheeses can be produced from any kind of rennet curd. Based on the used of rennet, smear-ripened cheeses can be divided into (semi-) soft (moisture 45 - 55%), semi-hard (moisture 45 - 50%) and hard cheeses (moisture 35 - 45%)[4]. Precise handling and storage of smear cheeses during ripening is essential to maintain the quality of cheeses. Ripening temperatures range from 14 °C to 19 °C, and the humidity should be at least 95 %[9].

Roquefort is the prototype of blue-veined cheeses, which originates from the community of Roquefort in the Aveyron Department in France. Roquefort cheeses are usually produced from sheep milk[10]. Blue-veined cheeses are the common name for these cheeses that develop an interior blue-green mold. Other well-known representatives of the blue-veined group of cheeses are British Stilton, Danish Blue and Italian Gorgonzola[10]. The milk is normally pasteurized at 70 °C, cooled to 31 - 32 °C and fed to the cheese vat with ripening period of 5 to 8 weeks at 9 - 12 °C and an RH of > 90 %[10].

The sensory attributes are critical and crucial aspect to be the widespread flavorful and food acceptance of consumer. Due to the integral nature of sensory perception with dairy foods, a sensory measurement is often the final step in many experiments or applications[1]. Therefore, the sensory attributes of smear-ripened and blue-vein cheeses are important information to determine the quality of cheese.



Fig. 1. Smear-Ripened Cheeses (photo: fotolia.com)



Fig. 2. Blue Vein Cheeses (photo: lafromagerie.co.uk)

Table 1. Common Blue Mold Cheese Varieties (adopted and modified from [11])

Name	Cheese Type	Moisture Content (%)	Ripening Temperature (°C) @ 90 % relative humidity
Cabrales	Blue-veined, semi-hard	30	8-12
Danablu	Blue-veined, semi-hard	47	8 -11
Gamonedo	Blue-veined, semi-hard ripened	45	10
Roquefort	Blue-veined	47	8-10
Stilton	Semi-soft blue	37 - 42	8-15

Table 2. Common Examples of Smear-Ripened Cheese Varieties (adopted and modified taken from [11])

Name	Cheese Type	Brining Conditions	Ripening Temperature (°C) @ 90 % relative humidity
Danbo	Semi-hard	1.5-3 days at 12 °C	18-20
Esrom	Soft	3-6 hours at 12 °C	16-18
Hohenheim Trappisten	Semi-hard	30 hours at 12 °C-14 °C	13-15
Marolles or Marolles	Soft	2-3 days	6-16
Vacherin Mont-d'Or	Soft	2-4 hours at 14 °C-20 °C	6-16

Table 3. Common Sensory Defects of Surface- and Mold-Ripened Cheese (courtesy of Center for Dairy Research, Madison, WI, U.S.A.)

	Body defects		Flavor defects	
Surface-ripened	Corky Crumbly Curdy Gassy Pasty	Pinholes Short Weak Mealy Open	Acid Bitter Fermented Fruity Metallic	Rancid Hi/low salt Unclean Whey taint yeasty Earthy
Mold-ripened	Acid spots Crumbly Curdy Gassy Mealy Open Pasty	Pinholes Short Sticky Runny Weak	Acid Bitter Chemical Feed Fermented Mushroom, oxidized	Metallic Rancid Hi/low salt Unclean Whey taint yeasty

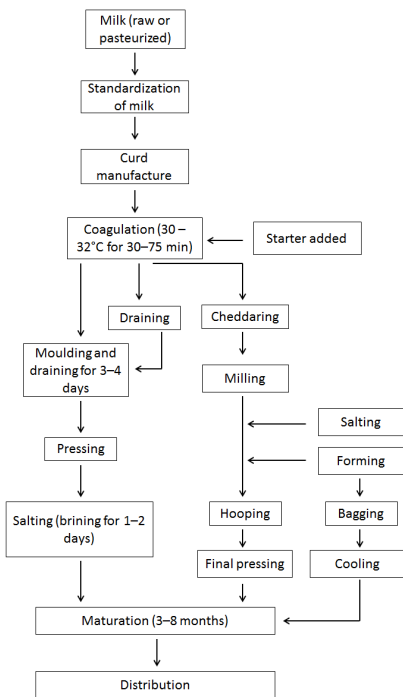


Fig. 3. The various processing ways of the production of hard and semi-hard cheese (Diagram figure was adopted and modified from [10]).

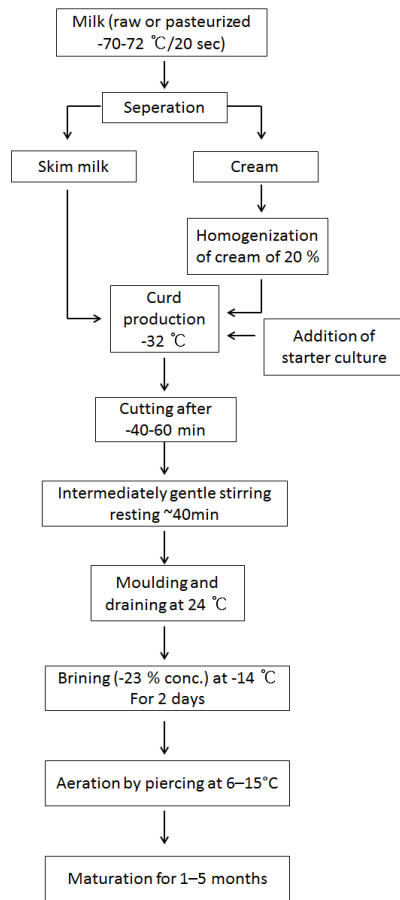


Fig. 4. The general diagram of the production of Blue Mold cheese (Diagram figure was adopted and modified from [10]).

#### 4. Differences in sensory attributes

There are a lot of varieties of smear-ripened cheese such as Danbo, Esrom, Epoisses, Hohenheim Trappisten, Marolles or Marolles, Reblochon or Reblochon de Savoie, and Vacherin Mont-d'Or. Each type of smear-ripened cheeses has a special unique taste and sensory characteristics[12]. Danbo is long-time-ripened pale yellow cheeses with a smooth and soft texture and somewhat brittle. The flavor of

Danbo cheese is mild, salty, slightly acidic and with a clear piquant flavor that comes from the surface microflora. Another yellow color smear-ripened cheese is Esrom, which has a uniform yellowish to white color[12]. Old Esrom cheeses have a slightly greasy surface. This is due to the breakdown of the outer skin. Esrom has a mild and acidic flavor. Furthermore, Esrom has aromatic flavor with clear notes of surface ripening and it become dominant as the cheese ages[12].

Epoisses is a red-smear soft cheese, over ripening. As maturation progresses, Epoisses's rind becomes smooth to slightly rippled, shiny and ivory-orange to brick-red. Epoisses also has a creamy texture and has been described as balanced, well-marked with fruity aroma[12]. The texture is smooth and not short or crumbly. Evenly distributed slit holes are typical for Hohenheim Trappisten cheese. The flavor is mild and slightly sour and becomes more intense with increasing maturation time[12].

Maroilles has a soft and smooth texture, also exhibits small mechanical and fermentative holes. The core texture is firmer and softens as increasing maturation progresses. Maroilles has a slight ammonia odor mixed with strong odors of mushroom, humid brick, and cellar[13]. Maroilles flavor is lactic (acidified milk) at the end when the minimum period of maturation was used, and stronger and more persistent (sulfur aroma) with increasing maturation period. Reblochon's has a soft and smooth texture and may exhibit a few small holes. Reblochon's flavor is creamy, characterized by a subtle nutty hazelnut aroma. Different aroma depends on whether Reblochon is made 'at the farm' and 'at plant', being generally more pronounced and persistent for the former. The taste of Vacherin Mont-d'Or is slightly salty and sour, which distinguished by an aroma of wood and spruce resin. It results from the ripening in

hoops of spruce bark and on spruce shelves[12].

Varieties of blue vein cheese are with lots of originations such as Cabrales, Danablu, Fourme d'Ambert, and Fourme de Montbrison, Gamonedo, Roquefort, and Stilton. The rind of Cabrales is natural, soft, thin, creamy and orangey brown or grayish. Some of Cabrales cheeses have reddish or yellow patches caused by microbial growth. The texture of Cabrales cheese is compact and creamy, with no eyes and medium-low stickiness. Greenish blue patches and veins on this cheese can be caused by *Penicillium* spp. Cabrales cheese has an intense, clean, pleasant smell, slightly lactic and penetrating, and stronger when goat milk is used. The cheese flavor is balanced and intense, not overly salty, nor bitter. The body of this cheese is slightly rough, with a very fine, almost imperceptible graininess[11].

Danablu is brine-salted cheese, which results in a white rind that is quite dry. The young cheese texture is brittle, and crumbly but becomes spreadable as it becomes more mature. In addition, the ripened Danablu cheese body is loose and evenly soft and creamy, sliceable and spreadable. Also, its firmer and shorter consistency moves towards the cheese rind. Danablu has a round, piquant taste, and the growth of blue mold gives aromatic nuances of the Danablu cheese. The taste of Danablu cheese may be sharp and slightly salty and acid with a slightly bitter tastes[11].

Fourme d'Ambert and Fourme de Montbrison Fourme's have a soft, firmer and smoother texture and also melts in the mouth. Fourme's flavor is characterized by a subtle blue aroma, less pronounced for Montbrison, and a milky/fruity flavor[11].

The texture of Gamonedo is loose with holes. The consistency of Gamonedo body is hard or semi-hard. It is firm but crumbles when cut. The main flavor of this cheese is smoky with a slight pungency.

Gamonedo cheese has buttery texture in the mouth, with a lingering aftertaste of hazelnuts. The aroma is a little smoky, but clear and penetrating, becoming more intense in ripe or mature cheeses[11].

Roquefort cheeses have a homogeneous and smooth texture. Also, Roquefort cheeses have melting texture in the mouth like butter. The odor of Roquefort cheese is persistent and intense. Roquefort rind is moist with pronounced, non-bitter, non-acid and not very salty flavor[11].

There are two types of Stilton (white and blue). Stilton has an open, slightly crumbly texture. In other hand mature Blue Stilton has a softer, creamy texture. Compared to Blue Stilton, white Stilton has a fresh, clean, acidic flavor; while Blue Stilton has a clean subtle, slightly sharp full flavor with a creamy taste. Mature Blue and/ or vintage blue Stilton has a stronger, more complex flavor with a creamy background[11].

## 5. Conclusions

Smear-ripened and blue-vein cheeses have the unique characteristics of sensory attributes which plays a crucial role in determining the cheese quality and consumer acceptance. Brie, Camembert, and Gorgonzola are most common types of smear-ripened and blue vein cheeses. Even if these types of cheeses are famous for the distinct flavor due to specific fermentation pathway, these three cheeses are consumed mostly in nature form, I.e., neither as cheese base nor as an ingredient.

Smear-ripened cheeses have a smooth and brittle texture. Also, smear-ripened cheeses have a slightly salty and sour favor compared to blue-vein cheeses. In other hand, blue-vein cheese has a softer, creamy texture and stronger smells when goat's milk is used.

Blue-vein cheeses have a fresh, clean, somewhat salty and acid with a slightly bitter tastes compared to smear-ripened cheese.

Both Smear-ripened and blue-vein cheese are ripened in relatively high temperature and humidity for the desirable microflora development. In case of consuming in South Korea, most Smear-ripened and blue-vein cheeses are imported and there is a high chance to get the growth of undesirable microflora due to longer shelf-life. The undesirable microflora can cause the defects in sensory attributes of mold-ripened cheese. Also the growth of *Listeria monocytogenes* in these types of cheeses is a very big concern in other countries but the awareness of this issue is a minimum in South Korea. That is why it is very important to be knowledgeable about the appropriate sensory properties of these cheeses especially in South Korea. Therefore, the importers of those cheeses in South Korea should be more careful about the protection of quality attributes. Also food safety issues of these types of cheeses should be addressed in future studies.

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