



# Molecular and Functional Properties of Milk

## Exam Question 09: Increased Protein Degradation

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Link to Git repo.: [https://github.com/DanishUnicorn/fp\\_exam\\_2025](https://github.com/DanishUnicorn/fp_exam_2025)



## Question 09

### Situation

You are the manager of a medium-sized Danish co-operative dairy plant in Northern Jutland and suspect an increased protein degradation occurring in your milk.

### Your task

Map out the reasons for this and determine which methods to use to prove that this is happening.

### Advice

Explain the possible reasons for protein degradation occurring in milk and which proteins are susceptible, and the consequences for this proteolysis in selected products. List the methods which you would use to determine this and what actions you would take to prevent it occurring in the dairy plant and at the farm level.

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# Synopsis for Question 09

## 1 Introduction

Milk is an important nutritional source for humans, and serves as the basis for a variety of dairy products. As the main ingredient in dairy products, the microbiological and compositional quality of the raw milk is of great importance and is directly correlated with the quality of the final dairy product [1].

Proteins play an essential role in determining texture, flavour, and functional properties. If the proteins present in milk are degraded, either enzymatically or due to microbial activity, product quality can suffer significantly [2]. Upholding a high standard for milk is therefore not only of importance with respect to consumer acceptance, but also of economic relevance [1].

## 2 Milk Composition

Milk is a complex liquid whose composition includes a variety of dilute salts, the simple sugar, mainly lactose, and vitamins where fat is emulsified as globules [3]. Proteins in milk is mostly present in the form of casein micelles, which are colloidal aggregates of thousands of molecules [4].

Though the protein content (approximately 3.2% [5]) of milk is relatively low, compared to that of fat globules [4], this synopsis will focus on proteins and their degradation in milk.

The milk protein content and composition is influenced by various factors, such as breed, lactation stage, genetic variants, and cell count [6]. Furthermore, the protein content of milk is divided into two major groups: caseins and whey proteins. Caseins make up approximately 80% of the total protein content, while whey proteins make up the remaining 20% [6]. The composition of milk casein proteins consists of  $\alpha_{s1}$ -casein,  $\alpha_{s2}$ -casein,  $\beta$ -casein, and  $\kappa$ -casein, in respective order [6]. The casein proteins are present in structures of micelles and are relatively hydrophobic fibrous proteins [4]. Of the existing whey proteins in milk, the major constituents are  $\alpha$ -lactalbumin,  $\beta$ -lactoglobulin, bovine serum albumin, immunoglobulins, and enzymes, in respective order [6].

## **3 Protein Degradation**

### **3.1 Reasons for Protein Degradation**

### **3.2 Susceptible Proteins**

## **4 Consequences of Proteolysis in Milk Products**

## **5 Methods**

### **5.1 Determining Protein Degradation**

### **5.2 Preventing Protein Degradation**

#### **5.2.1 Dairy Plant Level**

#### **5.2.2 Farm Level**

## **6 Conclusion**

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