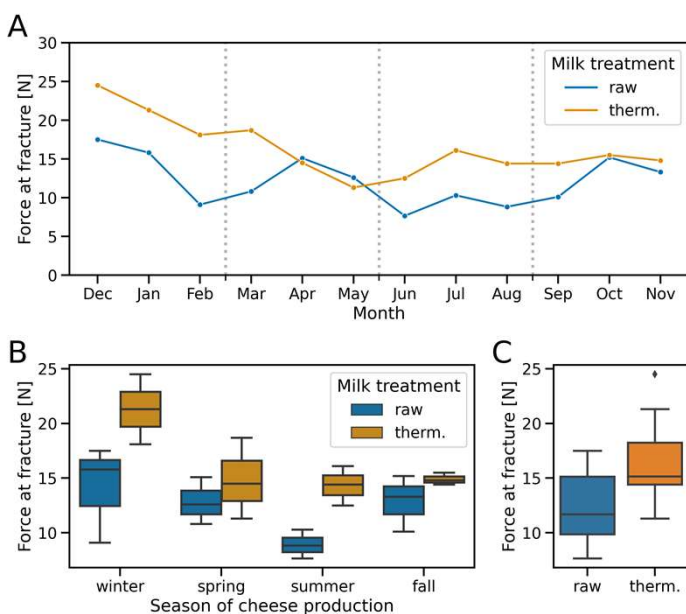


# The force at fracture in semi-hard cheese depends on the milk treatment and the season

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## Introduction

Cheese made from raw milk enjoys great popularity. Within the framework of the Swiss Center of Excellence for Raw Milk Products trials with Vacherin Fribourgeois PDO were carried out during a whole year. Vacherin Fribourgeois PDO was produced monthly from raw and thermized milk at the Grangeneuve cheese dairy. Chemical and rheological analyses were performed and evaluated in the mature cheeses (120 days old). The analysis focused on the differences between the cheeses made from raw milk and the cheeses made from thermized milk, as well as on the differences between the seasons.

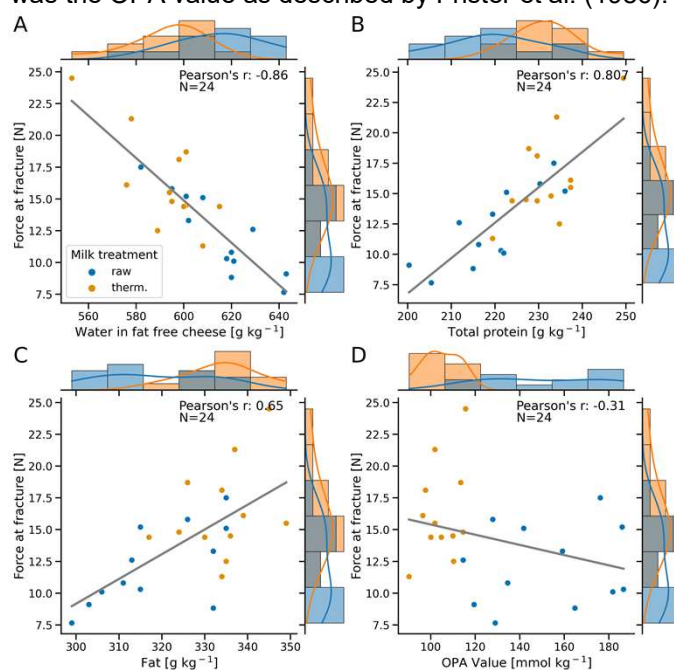


**Figure 1:** Force at fracture for 24 Vacherin Fribourgeois PDO made from raw (n=12) and thermized (n=12) milk, respectively.

**A)** Progression during the year, **B)** grouped by season and **C)** grouped by milk treatment.

## Methods

The uniaxial compression test was performed on a Zwick universal testing machine. Briefly, the standardized cylinder of cheese was compressed either to 80% of its height or until its fracture at  $15 \pm 1$  °C with a constant crosshead speed of  $50 \text{ mm min}^{-1}$ . Fracture force was determined in N. Fat content was determined using the Gerber van Gulik method. Water content was determined with the dry loss method. Total protein content was calculated from Kjeldahl nitrogen content ( $\text{TN} \times 6.38$ ). The measure of the free amino acid content of the cheeses was the OPA value as described by Frister et al. (1986).



**Figure 2:** Scatter plots for **A)** water in fat free cheese, **B)** total protein, **C)** fat and **D)** OPA values on the x-axis and force at fracture on the y-axis. Pearson correlation coefficient (r) and number of samples (N) are shown in the upper right of the plots.

## Results

- The force at fracture of Vacherin Fribourgeois PDO made from raw and thermized cow's milk was significantly different between the two groups (t-test,  $p=0.008$ ).
- The differences of the force at fracture between the four seasons were not statistically significant for the entire dataset and the cheeses made from raw milk as determined by One-way ANOVA, however for the cheeses made with thermized milk we found a significant difference between cheeses manufactured in winter and in summer (One-way ANOVA & Tukey HSD,  $p=0.046$ ).
- The water content of the cheeses has shown a strong negative correlation ( $r=-0.86$ ), while the total protein content of the cheeses has shown a strong positive correlation ( $r=0.807$ ) with the force at fracture.

## Summary

The force at fracture in Vacherin Fribourgeois PDO varies depending on the thermal treatment of the milk and the season. We have found a strong negative correlation between the water content of the cheese dough and the force at fracture. Another known factor that strongly influences the rheological properties is the protein content, or rather the proteolysis. The total protein content showed a strong positive correlation with the force at fracture, while proxies for proteolysis (OPA value) showed only weak negative correlations.