

Agroecological transition and compliance with PDO specifications

A living lab case study in Fourme de Montbrison cheese

Agroecological transition helps address climate and societal demands, but its effects on PDO dairy products remain poorly documented. In Fourme de Montbrison cheese, the ongoing transition — pasture-based diets and a switch from Holstein to Montbéliarde cows — was accompanied by a rising rate of low fat in dry matter nonconformities, exceeding 10% of production since 2018. Through a living lab with all stakeholders, this study identified the origins of the issue and tested possible solutions, showing that transition can have unexpected long-term effects on product quality.

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Agroecological transition is a key strategy to address climate and societal demands, but its effects on animal-derived products — including PDO dairy products — remain poorly documented. Fourme de Montbrison is a blue-type PDO cheese made with unskimmed cow's milk from the French Massif Central area at altitudes ranging between 600 and 1300 m a.s.l., Fig 1). In this area, farm agroecological transition started 20 years ago: cows were switched to pasture-based diets and from the Holstein to the Montbéliarde breed. In parallel, since 2012, the rate of cheese fat content nonconformities has risen steadily, exceeding 10% of total production since 2018 (Fig 3), with a risk of fines for the producers.

A living lab was set up in 2023, co-conceived with all stakeholders of the Fourme de Montbrison PDO association, to identify the origin of the low fat content (> 52 g/100 g dry matter required) and test possible solutions.



Fig 1: Fourme de Montbrison cheese

A two-level co-constructed study

First came a diagnostic phase to identify the problem, followed by an operational phase aimed at solving it.

The diagnostic phase was developed in collaboration with local stakeholders (dairies and farmers) through a series of meetings and data collection and analysis involving farmers, cheesemakers and researchers. This diagnostic phase revealed that most of the nonconformities occurred in spring and early summer when cows were at pasture. Two potentially problematic steps were identified with stakeholders at processing and farm levels,



Fig 3: Milk sampling on-farm,

Processing level: 36 vat milks, the related wheys and the ripened cheeses were sampled and analysed in spring in order to check whether fat losses were susceptible to occur during cheesemaking. Milk fat content and milk fat-to-protein ratio (FPR) were the major determinants of cheese fat content revealing that the low cheese fat content issue was mostly related to milk composition.

Farm level: two groups of 10 farms were compared: FPR– (milk fat to protein ratio below 1.2 in spring, or a rapid decrease at turnout to pasture) vs FPR+ (milk fat to protein ratio above 1.2 all year round). Bulk milk and grazed herbage were sampled and analysed, and farming practices were surveyed.

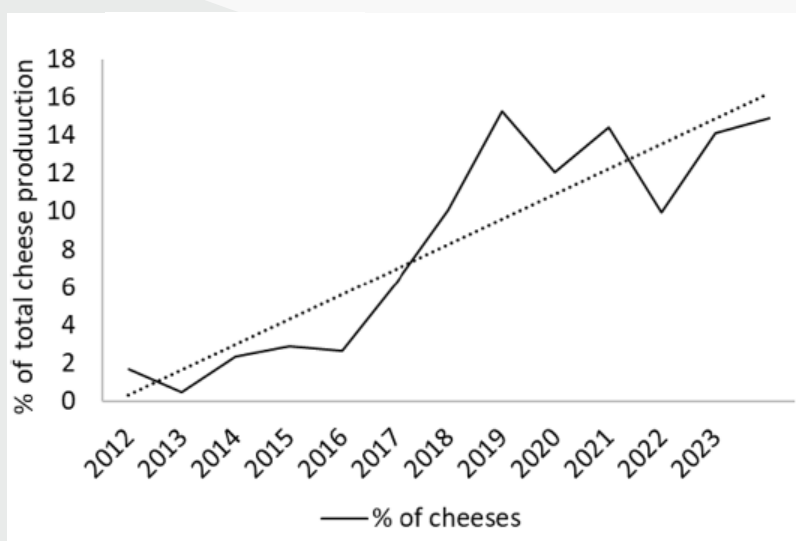


Fig 2: Rate of low cheese fat content nonconformities (below the minimum specification-set threshold of 52 g/100 g of DM) on total production of Fourme de Montbrison PDO cheese from 2011 to 2024. The dotted line represents the fitted regression.

A Protected Designation of Origin (PDO) specification is an official document that defines the conditions under which a product may carry the PDO label. It sets compulsory rules covering the geographical area, animal breeds and feeding practices, and the production process, as well as product standards such as shape and composition.

Farm level findings :

The proportions of Holstein and Montbéliarde cows in the herd were positively and negatively related to milk fat to protein ratio, respectively. The farms with a low fat to protein ratio applied a more intensive rotational grazing system. They offered young herbage in spring that was highly digestible and rich in protein and water-soluble carbohydrates but low in physically effective fibre, which resulted in lower milk fat content and fat to protein ratio. These farms also used less grass silage and more hay in the diet than the farms with a higher fat to protein ratio.

	FPR- farms	FPR+ farms	
Milk composition			
Milk fat-to-protein ratio (FPR)	1.18	1.28	***
Fat content (g/L)	39.4	42.0	***
Protein content (g/L)	33.5	32.8	†
Urea (mg/L)	308	276	†
Herbage characteristics			
Interval between 2 grazing cycles (d)	19	26	†
Crude protein (g/kg DM)	200	174	**
Acid Detergent Fiber (g/kg DM)	256	277	*
Organic matter (%)	75.3	71.9	**

Table 1: Milk composition and grazed grass characteristics of farms with a low or high fat to protein ratio (FPR- and FPR+)

***P < 0.001; **P < 0.01; *P<0,05; †P < 0.10.

Key messages:

Agroecological transition maximised the use of grass while sustaining milk production, but had unforeseen long-term effects on cheese characteristics.

Increasing the proportion of grass in cows' diets instead of maize silage pushed farmers to offer young grass with high nutritional value in order to maintain milk yield, but this resulted in lower milk and cheese fat content.

Operational phase on-farm:

During the subsequent meetings, four possible solutions were discussed with stakeholders: (1) supplementing hay at pasture with mobile hay racks, (2) delaying herbage utilization to a later phenological stage, (3) introducing Jersey cows to increase milk fat, or (4) slowing concentrate fermentation by substituting corn cob silage with corn flour. Solutions 1 to 3 were considered unfeasible by farmers due to fragmented and scattered plots, milk yield losses, and strategic and financial constraints. Only solution 4 was tested on 4 farms against 4 control farms in spring 2024. All 8 farms were among the FPR- farms, Changing the concentrate type had no effect on milk composition and fat to protein ratio, which remained low in all farms. The solution considered the most feasible was not effective, confirming the need for deeper research.

This is the first study reporting a conflict between agroecological transition and PDO specifications. Most PDO specifications were devised in the 1980s–2000s and may need greater flexibility (technical and administrative) to remain viable under fast-changing climatic and societal contexts, without changing their original aim of preserving traditional production systems.

Based on these results, the Fourme de Montbrison PDO association successfully filed for a revision of the specifications, lowering the minimum cheese fat in DM threshold to 50 g/100 g DM (Ministerial Decree of 9 March 2025).

The living lab effectively increased stakeholder participation and engagement: farmers, cheesemakers and researchers co-designed the experiments, monitored them, and discussed the results together.

However, co-construction also has limits: the practices stakeholders considered feasible are not always the most effective ones, and well-documented solutions are not always applicable on commercial farms.

Key messages:

- Agroecological transition can have unexpected long-term effects on product quality.
- PDO specifications can conflict with agroecological practices.
- Living labs increase engagement, but do not guarantee effective solutions.
- The Fourme de Montbrison association successfully revised its specification: the minimum fat content threshold was lowered to 50 g/100 g dry matter in 2025.



Fig 6: Montbéliarde cow grazing.



Fig 7: Fourme de Montbrison cellar,

Coppa et al. (2026), J. Dairy Sci. 109:7141–7154