

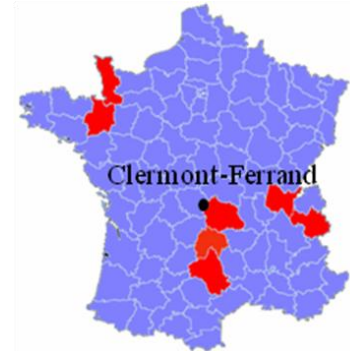


How feeding systems influence milk quality on French dairy farms?

M. Dutreuil, C. Hurtaud, B. Martin, C. Agabriel, V. E. Cabrera

Nutritional quality of food products including **milk** is an important concern for consumer **health**. Under this premise, a European project named Truefood was carried out in France, Slovenia, Slovakia and Norway.

In France, the project was conducted by the INRA in Clermont-Ferrand and studied milk in different areas of production (red marked on the map).



From January to September 2008, 25 dairy farms in Northwestern France were studied according to their feeding systems ("corn silage", "grass", and "corn silage + extruded flax seed"). Data were collected through a survey and 5 milk samplings at each of the 25 farms.

The objective of the study was to compare differences in milk composition (fat, protein, fatty acids) between feeding systems.

Farm size averaged 56 cows with no significant difference between the 3 feeding systems. Farms from the "corn silage + flaxseed" feeding system had the highest milk yield with 22,500 lb/cow/year (Table 1) and the highest stocking rate (0.73 cow/acre). Five of the farms from "grass" feeding system were organic farms.

Table 1 : Description of farms within each feeding system

	"Grass"	"Corn silage"	"Corn silage + Flaxseed"
Number of cows	54	60	43
Milk yield (lb/cow/year)	11,500 ^c	19,600 ^b	22,500 ^a
Farm size (acres)	168 ^b	222 ^a	200 ^a
Stocking rate (cow/acre)	0.49 ^b	0.65 ^a	0.73 ^a
Number of organic farms	5 ^a	0 ^b	0 ^b
Cow breed(s)	Holstein, Normande, Montbéliarde	Holstein	Holstein

a, b, c : Means within a row that have different superscripts are significantly different ($P < 0.05$).

The "grass" feeding system strategy maximized grass utilization. Winter diets were primarily composed of hay, grass silage and concentrate. In early March, cows started grazing and the quantity of concentrate and hay was reduced (Figure 1).

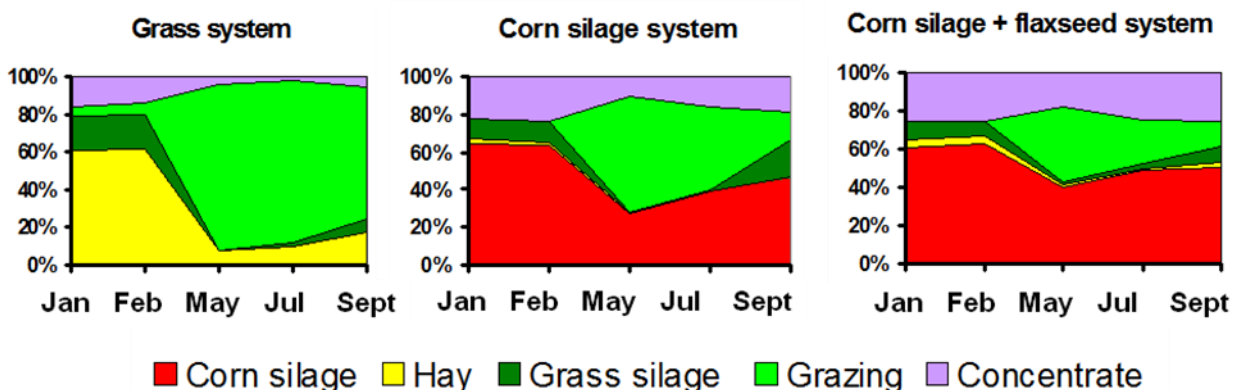


Figure 1: Description of feeding systems from January to September 2008

The “corn silage” and “corn silage + flaxseed” feeding systems were composed primarily of corn silage and concentrate in winter, with some grass silage added to increase fiber in the ration. Both of those two feeding systems did use pasture during the grazing season. The principal difference between the two corn silage-based feeding systems was the composition of concentrate. The “corn silage + flaxseed” feeding system used concentrate with extruded flaxseed and reduced the use of pasture compared to the “corn silage” feeding system (Figure 1).

Each feeding system influenced milk yield and milk composition. Milk from the “corn silage + flaxseed” feeding system was lower in protein (3.13%) and fat (3.87%) content than milk from the two other feeding systems (Table 2). This was in part due to a higher milk yield per cow (64 lb/cow/day) in the farms from the “corn silage + flaxseed” feeding system (Table 2).

Table 2: Description of milk composition from the 3 feeding systems

	“Grass”	“Corn silage”	“Corn silage + Flaxseed”
Milk yield (lb/cow/day)	35 ^c	57 ^b	64 ^a
Lactose content (%)	4.77 ^c	4.85 ^b	4.94 ^a
Protein content (%)	3.21 ^a	3.22 ^a	3.13 ^b
Fat content (%)	3.99 ^b	4.09 ^a	3.87 ^c

a, b, c : Means within a row that have different superscripts are significantly different ($P < 0.05$).

The most important difference in milk composition between the three feeding systems was the milk fatty acids (FA) composition.

What is a fatty acid (FA)?

A FA is a **lipid**. There are over 400 different FA in the cow’s milk. Those differ by their chemical composition and structure, which determines the milk fat **nutritional quality**.

Milk from “corn silage” feeding system had the highest amount of saturated FA (70.1%, Table 3) and the lowest amount of unsaturated FA, especially poly-unsaturated FA (2.9%), and was characterized by a high amount of C16 FA (31.5%) on average during the year.

Milk from the “grass” feeding system had low saturated FA (68.6%), and high amount of poly-unsaturated FA (3.5%), cis 9 trans 11 CLA (0.87%), C18:3 (omega 3) (0.78%), and branched-chain FA (1.94%). For “grass-based” milk, C18:2/C18:3 was very low and stable throughout the year (Figure 2).

Figure 2: Effect of season on milk C18:2/C18:3 for the 3 feeding systems

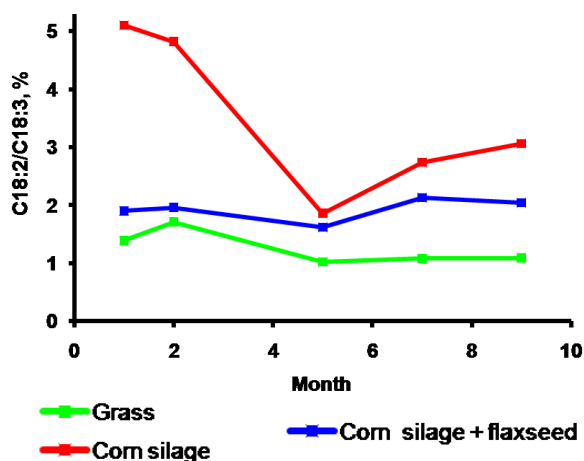


Table 3: Milk fatty acids (FA, %) composition from the 3 feeding systems

	“Grass”	“Corn silage”	“Corn silage + Flaxseed”
Saturated FA	68.6 ^b	70.1 ^a	64.7 ^c
C16 (palmitic acid)	29.2 ^b	31.5^a	26.9 ^c
Branched-chain FA	1.94^a	1.37 ^b	1.26 ^b
Mono-unsaturated FA	25.7 ^b	25.3 ^b	29.0 ^a
cis and trans C18:1 isomer	1.39 ^b	1.86 ^c	3.10^a
Poly-unsaturated FA	3.5 ^b	2.9 ^c	4.2 ^a
cis 9 trans 11 CLA	0.87 ^a	0.46 ^c	0.74 ^b
C18:3 (omega 3)	0.78^a	0.45 ^b	0.76^a
C18:2/C18:3 (omega 6/omega 3)	1.23 ^c	2.93 ^a	1.88 ^b

a, b, c : Means within a row that have different superscripts are significantly different ($P < 0.05$).

Milk from “corn silage + flaxseed” feeding system had the lowest amount of saturated FA (64.7%). The milk was characterized by a high amount of C18:3 (0.76%) and a high amount of cis and trans C18:1 isomer (3.10%), with a very stable milk composition throughout the year.

Take Homes Messages

- Milk from “grass” feeding systems appears to have positive nutritional properties based on what is known about the impact of milk fat composition on human health. Milk from "grass" feeding systems has greater unsaturated FA (especially cis 9 trans 11 CLA and C18:3) and lower and very stable C18:2/C18:3.
- The incorporation of grazing during summer improves milk fatty acids composition.
- The incorporation of flaxseed in feeding systems improves milk fatty acids composition on “corn silage” feeding systems.
- High variability in milk composition was observed between dairy farms, even with the same feeding system. This variability was accentuated throughout the seasons of the year for “corn silage” feeding systems.

Acknowledgments:

This study was financed by the European project Truefood, which is gratefully acknowledged. The authors also express their gratitude to all the farmers who took part of this study.