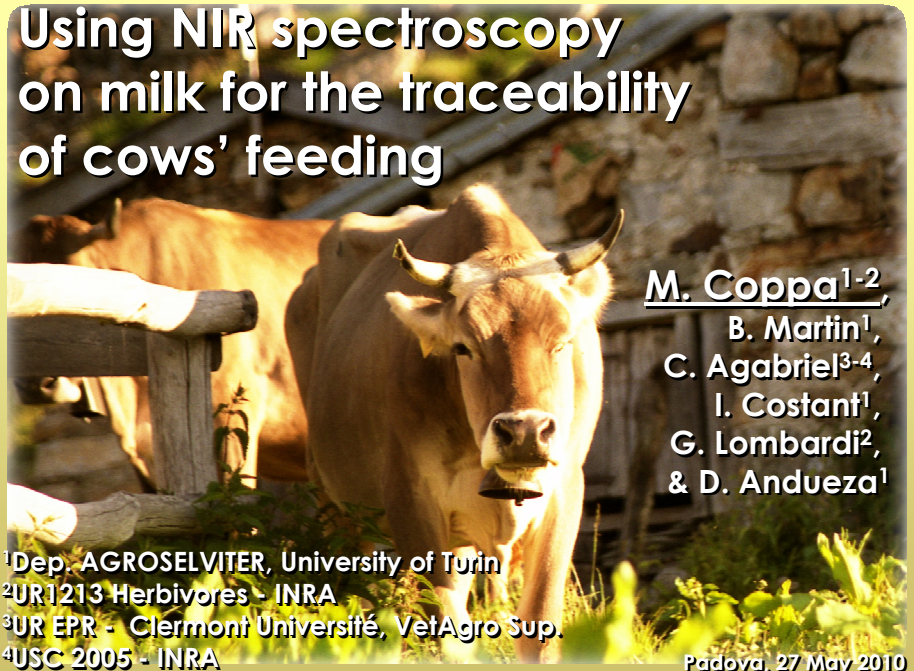
Using NIR spectroscopy on milk for the traceability of cows' feeding



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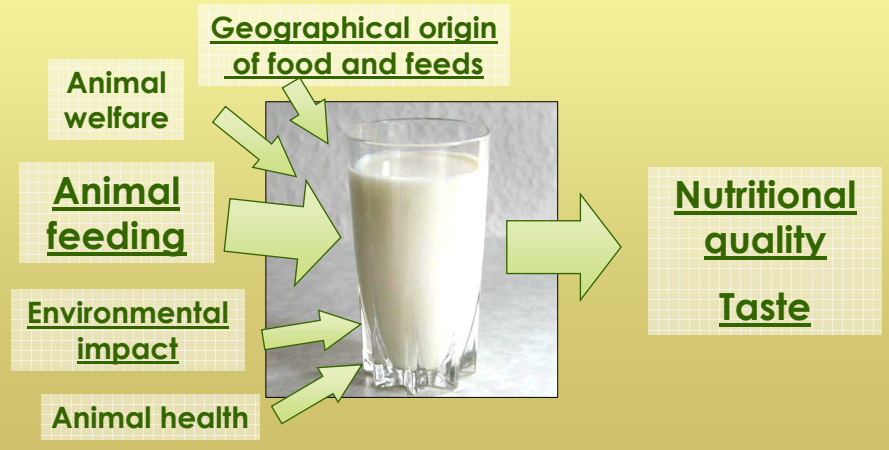
Context

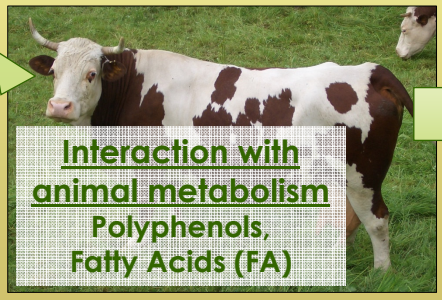
Growing consumer's demand of information about production conditions of animal products



Animal feeding

Feeding constituents

Direct transfer
Carotenoids, Vitamins
Volatiles compounds,
Terpenes



Interaction with animal metabolism
Polyphenols,
Fatty Acids (FA)

Milk color, taste, aroma, antioxidant power, atherogenicity

Chilliard et al., 2007; Noziére et al., 2006; Bendall et al., 2001

Cows' feeding

Maize silage

Intensives farming systems

Pasture

Extensive farming systems

+ Saturated FA	- Saturated FA
- Unsaturated FA	+ Unsaturated FA
- Carotenoids	+ Carotenoids
- Vitamins A and E	+ Vitamins A and E
- Polyphenols	+ Polyphenols
- Terpenes	+ Terpenes
- Yellow color	+ Yellow color
Sweet, cooked, intense aroma	Grassy, cowy/barny aroma

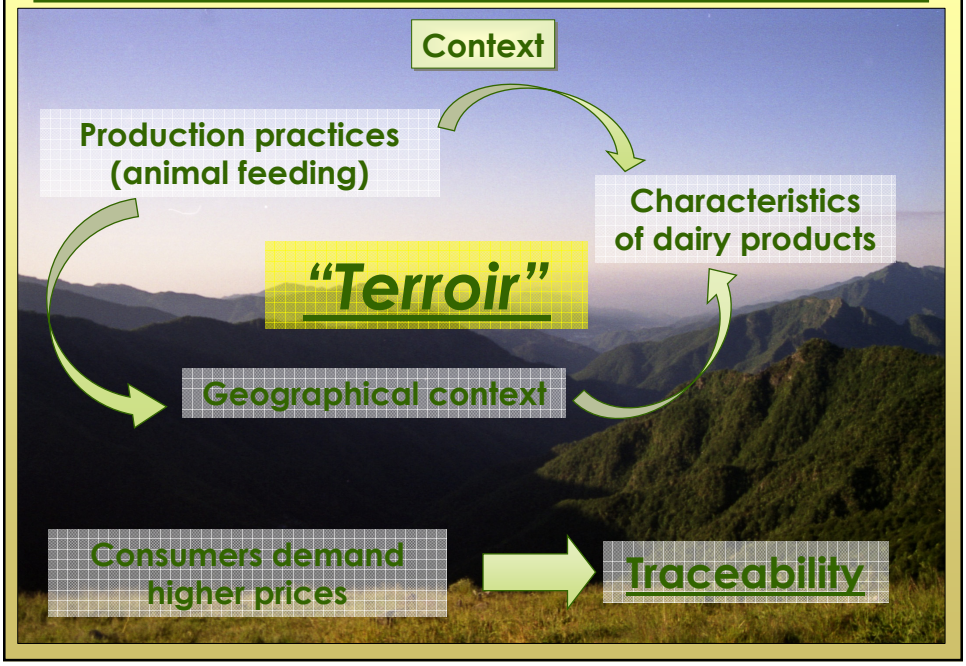
Chilliard et al., 2007; Croissant et al., 2007; Prache et al., 2005

Pasture

-	Biodiversity	++
++	Poaceae	-
++	Carotenoids	-
++	Yellow color	-
-	Dicotyledons	++
-	Polyphenols	++
-	Terpenes	++
-	ω3 fatty acids	++

Chilliard et al., 2007; Farruggia et al., 2006; Noziére et al., 2006

Mauro Coppa NIRS on milk for cows' feeding traceability



Objective

Test on milk the NIRs ability in tracing animal feedings:

Maize silage

Pasture

Lowland

Mountain

Alpine

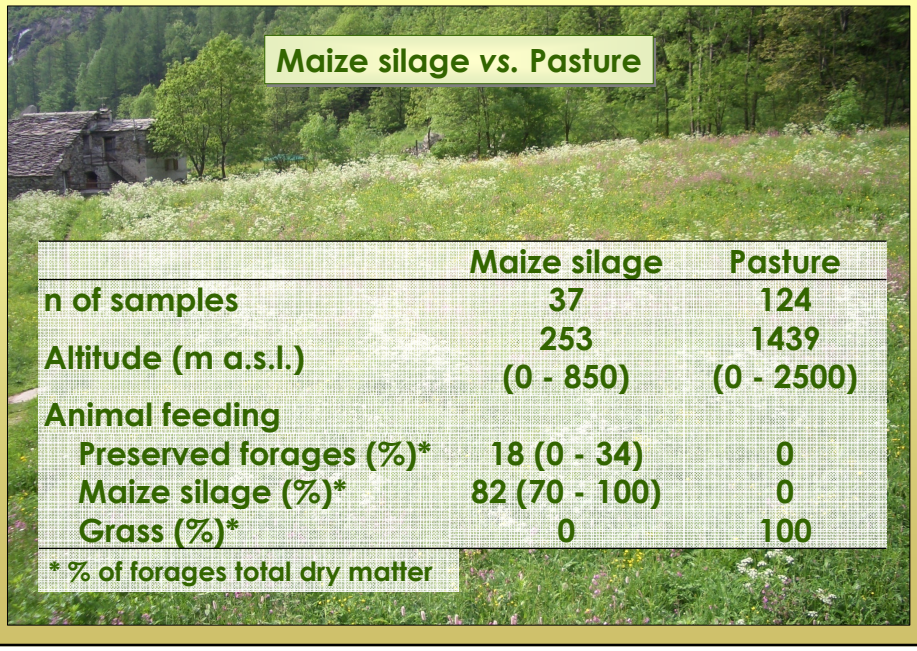
Materials and methods

445 milk samples
172 farms
2007 and 2008
France and NW Italy

Wide variety of production conditions:
- geographical origin
- altitude
- breeds
- feeding systems

Recorded data about:
- cows' feeding
- forage % in the diet
- forage preservation techniques

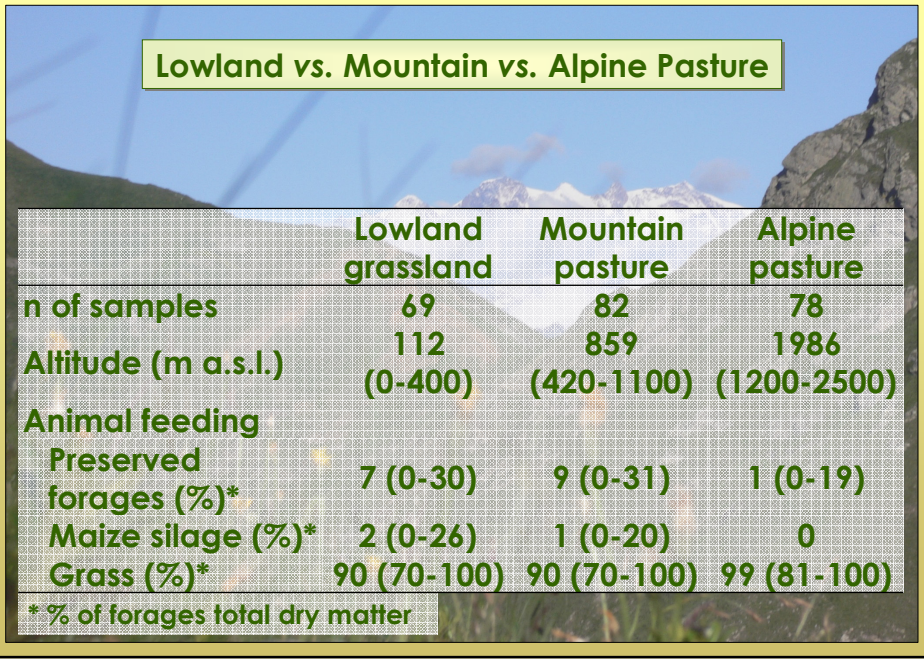
Maize silage *vs.* Pasture



	Maize silage	Pasture
n of samples	37	124
Altitude (m a.s.l.)	253 (0 - 850)	1439 (0 - 2500)
Animal feeding		
Preserved forages (%)*	18 (0 - 34)	0
Maize silage (%)*	82 (70 - 100)	0
Grass (%)*	0	100

* % of forages total dry matter

Lowland *vs.* Mountain *vs.* Alpine Pasture



	Lowland grassland	Mountain pasture	Alpine pasture
n of samples	69	82	78
Altitude (m a.s.l.)	112 (0-400)	859 (420-1100)	1986 (1200-2500)
Animal feeding			
Preserved forages (%)*	7 (0-30)	9 (0-31)	1 (0-19)
Maize silage (%)*	2 (0-26)	1 (0-20)	0
Grass (%)*	90 (70-100)	90 (70-100)	99 (81-100)

* % of forages total dry matter

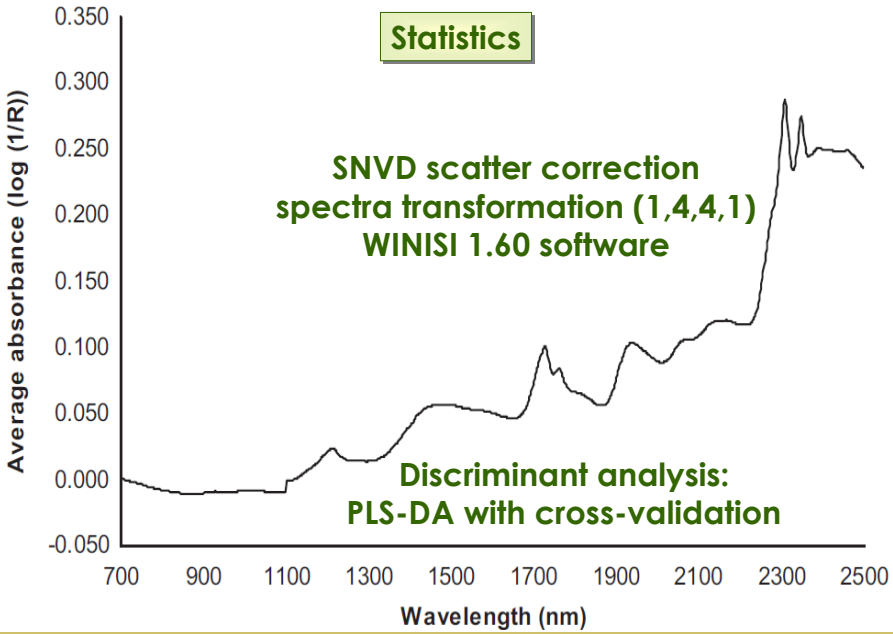
Milk sampling and analysis

Samples stored -18°C until analysis

Preparation: 2 h room temperature
0,5 ml on a glass microfiber filter (Wathman GF/A 55mm)
Oven-dried at 40°C for 24 h

Filter put in a 50mm Ø ring cup
Scan 2 nm intervals 400-2500 nm
(Foss NIRSystem model 6500)
Spectrum collected vi a ISIscan 2.21

Statistics



SNVD scatter correction
spectra transformation (1,4,4,1)
WINISI 1.60 software

Discriminant analysis:
PLS-DA with cross-validation

Maize silage *vs.* Pasture

Animal feeding	Predicted group membership	
	Maize silage	Pasture
Maize silage	37 (100.0%)	1 (0.8%)
Pasture	0 (0.0%)	123 (99.2%)

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Maize silage *vs.* Pasture

Great differences in FA profile:

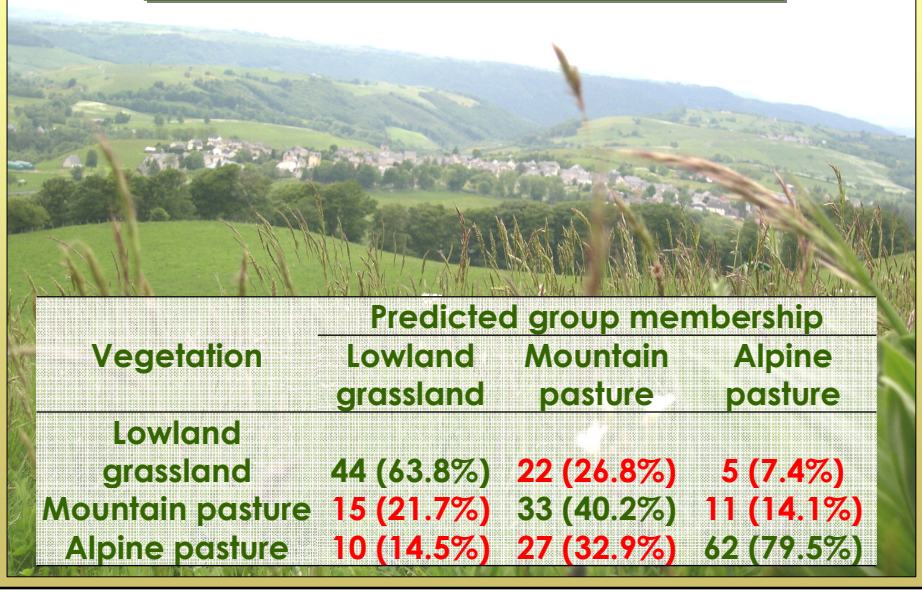
Pasture milk:
< Saturated FA
> Unsaturated FA

→ These FA reliably predicted by NIRs (Coppa et al., 2010)

Pasture milk:
> Carotenoids
> Yellowness

→ Yellowness and carotenoids reliably predicted by NIRS on cheese (Lucas et al., 2008)

Lowland *vs.* Mountain *vs.* Alpine Pasture



Vegetation	Predicted group membership		
	Lowland grassland	Mountain pasture	Alpine pasture
Lowland grassland	44 (63.8%)	22 (26.8%)	5 (7.4%)
Mountain pasture	15 (21.7%)	33 (40.2%)	11 (14.1%)
Alpine pasture	10 (14.5%)	27 (32.9%)	62 (79.5%)

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Lowland *vs.* Mountain *vs.* Alpine Pasture

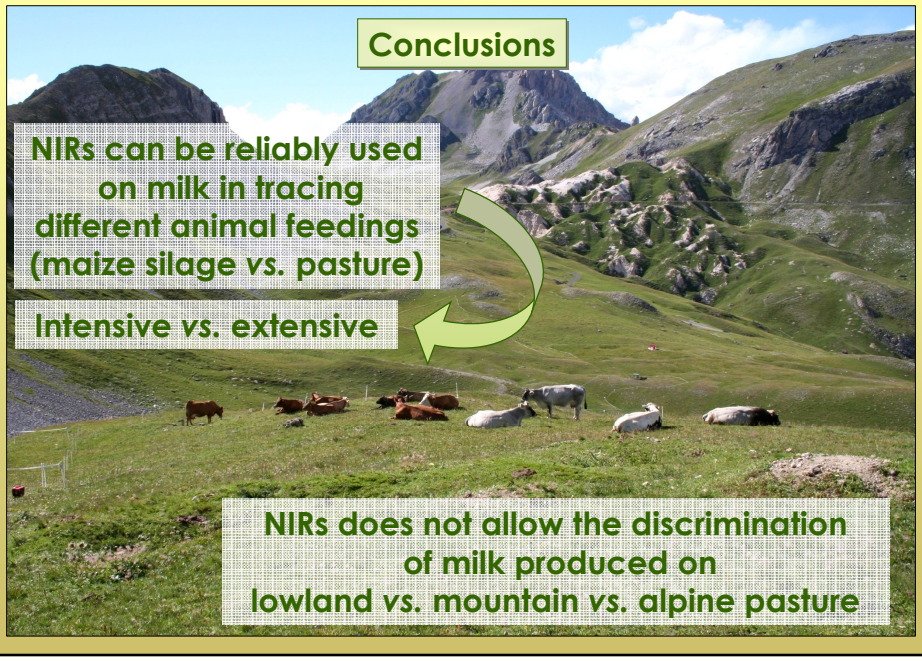
Important differences but in FA with low concentration (i.e. α-linolenic acid <1% of FA)

→ These FA not reliably predicted by NIRs (Coppa et al., 2010)

Great difference in terpenes, but very low concentrations

Yellowness depends more on herbage phenology and grazing management than on botanical composition

Conclusions



NIRs can be reliably used on milk in tracing different animal feedings (maize silage *vs.* pasture)

Intensive *vs.* extensive

NIRs does not allow the discrimination of milk produced on lowland *vs.* mountain *vs.* alpine pasture

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…thank you for the attention!