

Front-face fluorescence spectroscopy: A tool for differentiating sheep milk originating from different genotypes and feeding systems

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Outline

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Problem statement

- In the last few years, the economic situation in the world involved rising prices of soybean meal constituting the basic raw materials in concentrated food formulations for Tunisian livestock
- Although soybean meal has been well established as the main protein source for animal nutrition, scotch bean is recently becoming available in Tunisia
- Previous research studies using physico-chemical analyses have shown that scotch bean meal gave similar gain and feed efficiency as soybean meal did

Problem statement

SOLUTION

- Tacking this into account, the development of rapid techniques for monitoring changes in milk samples after substitution of soybean meal by scotch bean meal is of significance importance
- In this context, spectroscopic techniques such as fluorescence is considered to be fast, sensitive, non-destructive, rapid, environmentally friendly, relatively low cost, provide a great deal of information with only one test making suitable for on-line or at-line process control

Objectives

- The objective of the present presentation was:

Evaluate the feasibility of FFFS coupled with chemometric tools as a non destructive method to discriminate between 50 ewe's milk samples according to the:

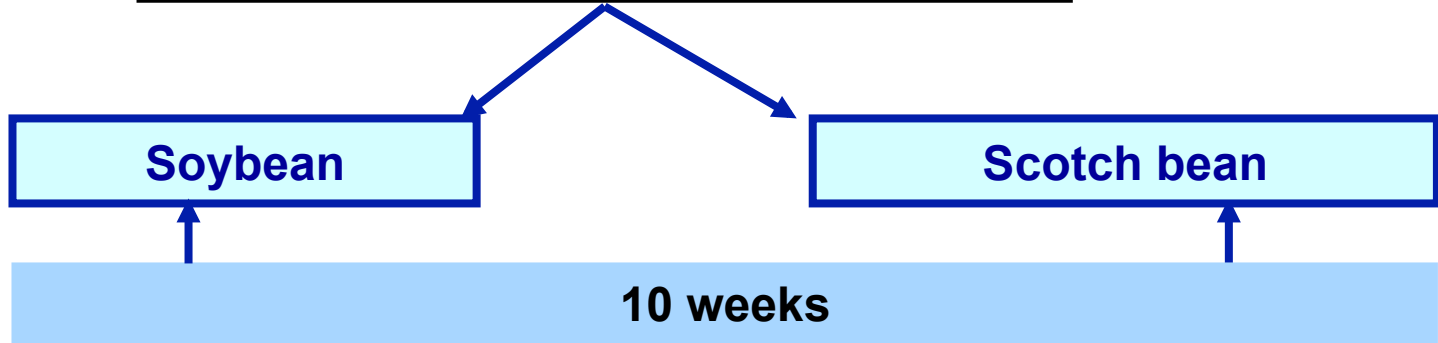
- **Feeding systems** (pasture, soybean and scotch bean meals)
- **Genotypes** (Sicilo-Sarde *versus* Comisana)

Materials and methods

Exp. 1 : Feeding system

12 **Sicilo-Sarde** ewes (42.2 kg) at their 3rd lambing were kept in individual **box** at 17 °C

*Rouissi et al. (2008)
Eur Food Res Technol.
226, 1021-1030*



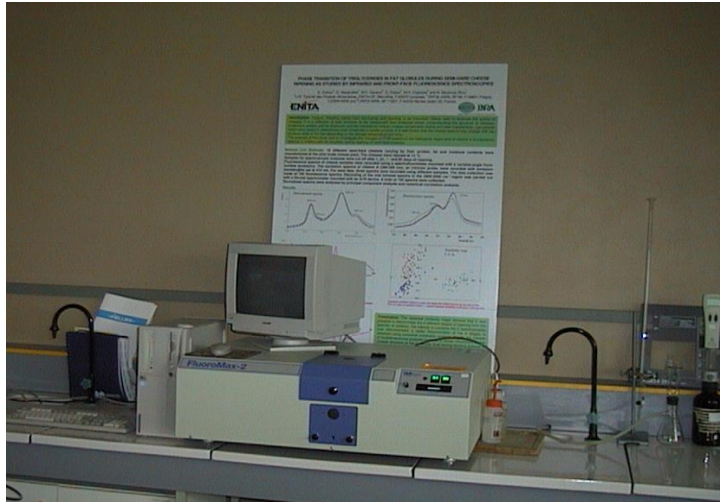
Exp. 2: Genotype

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Comis

Ingredients g.100 g ⁻¹	Soybean meal	Scotch bean meal
Barley	77	77
Soybean meal	20	0
Scotch bean meal	0	20
Vitamin and mineral premix	3	3

Materials and methods



- Physico-chemical parameters
- Milk samples were poured in 3 mL quartz cuvette and fluorescence spectra were recorded using FluoroMax-2 spectrofluorimeter (Spex-Jobin Yvon, Longjumeau, France)

Aromatic amino acid and nucleic acid (AAA+NA)

λ_{ex} : 250 nm; em. : 280-450 nm

Tryptophane (Trp) λ_{ex} : 290 nm; em. : 305-450 nm

Riboflavin (Rib) λ_{ex} : 380 nm; em. : 400-640 nm

Vitamine A (vit A) λ_{ex} : 322 nm; em. : 340-540 nm

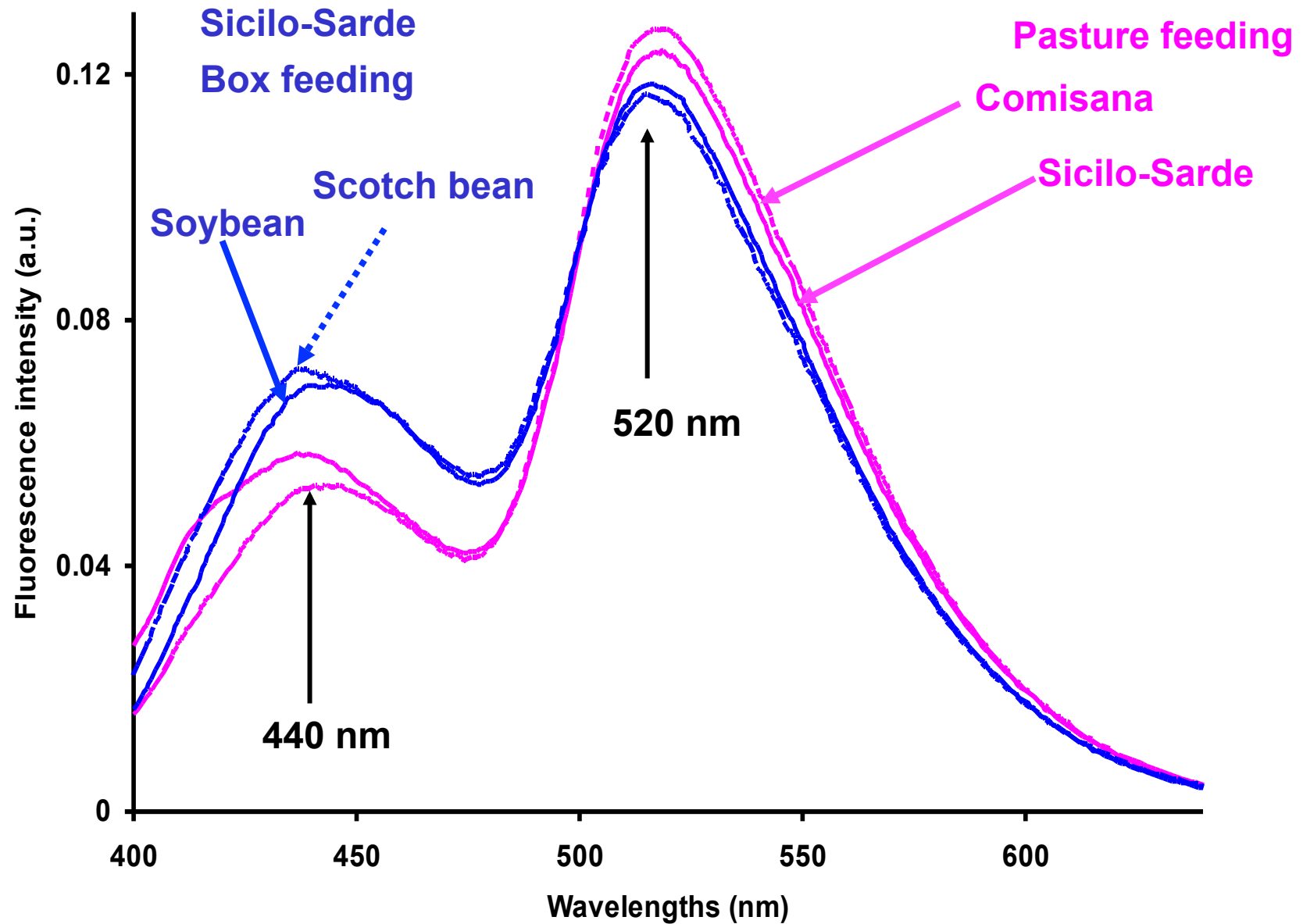
Vitamine A (vit A) λ_{em} : 410 nm; ex. : 280-350 nm

- For each sample, 3 spectra were recorded using different milk samples

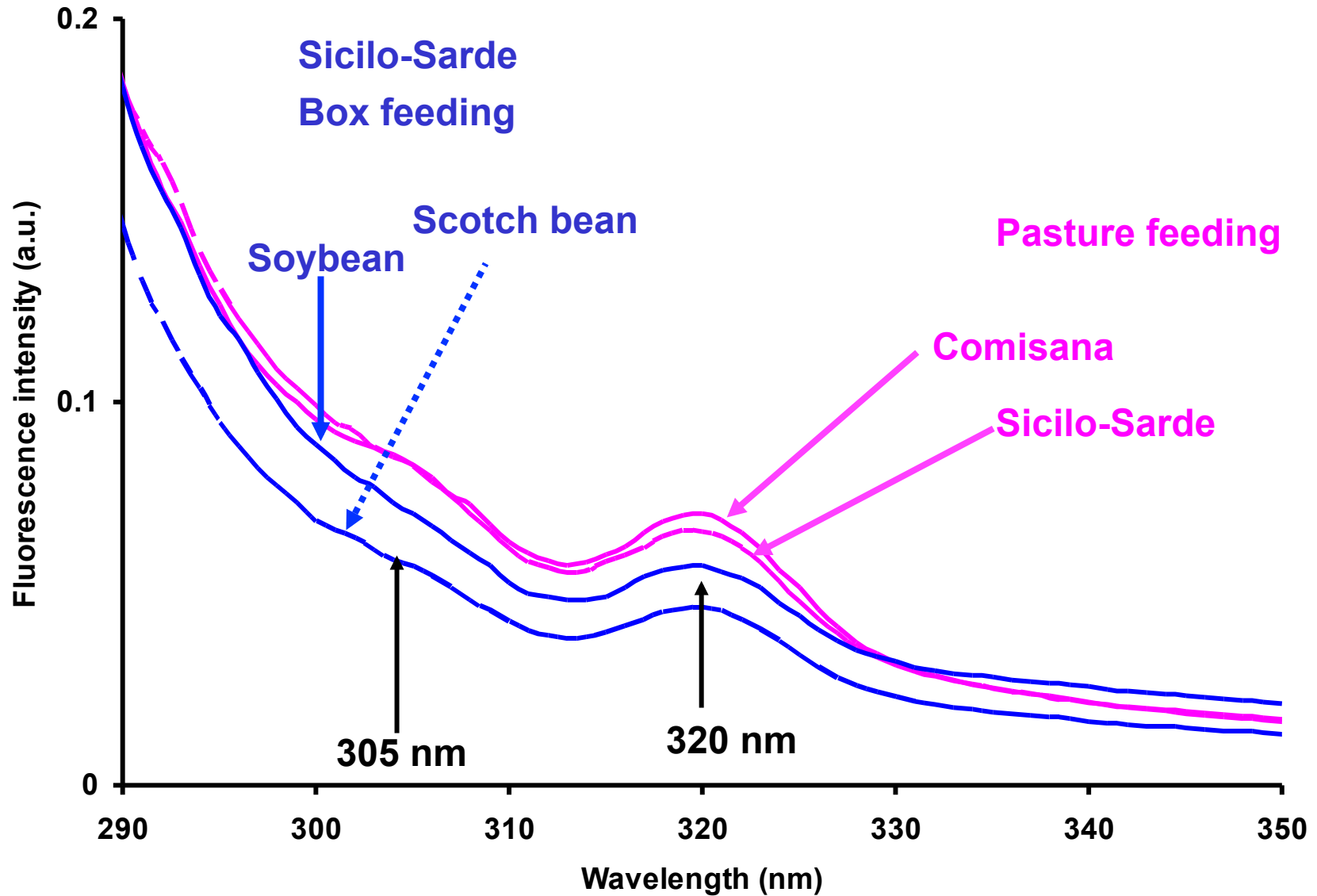
- Statistical analyses such as principal component analysis (PCA) and factorial discriminant analysis (FDA) were applied to the spectral data sets



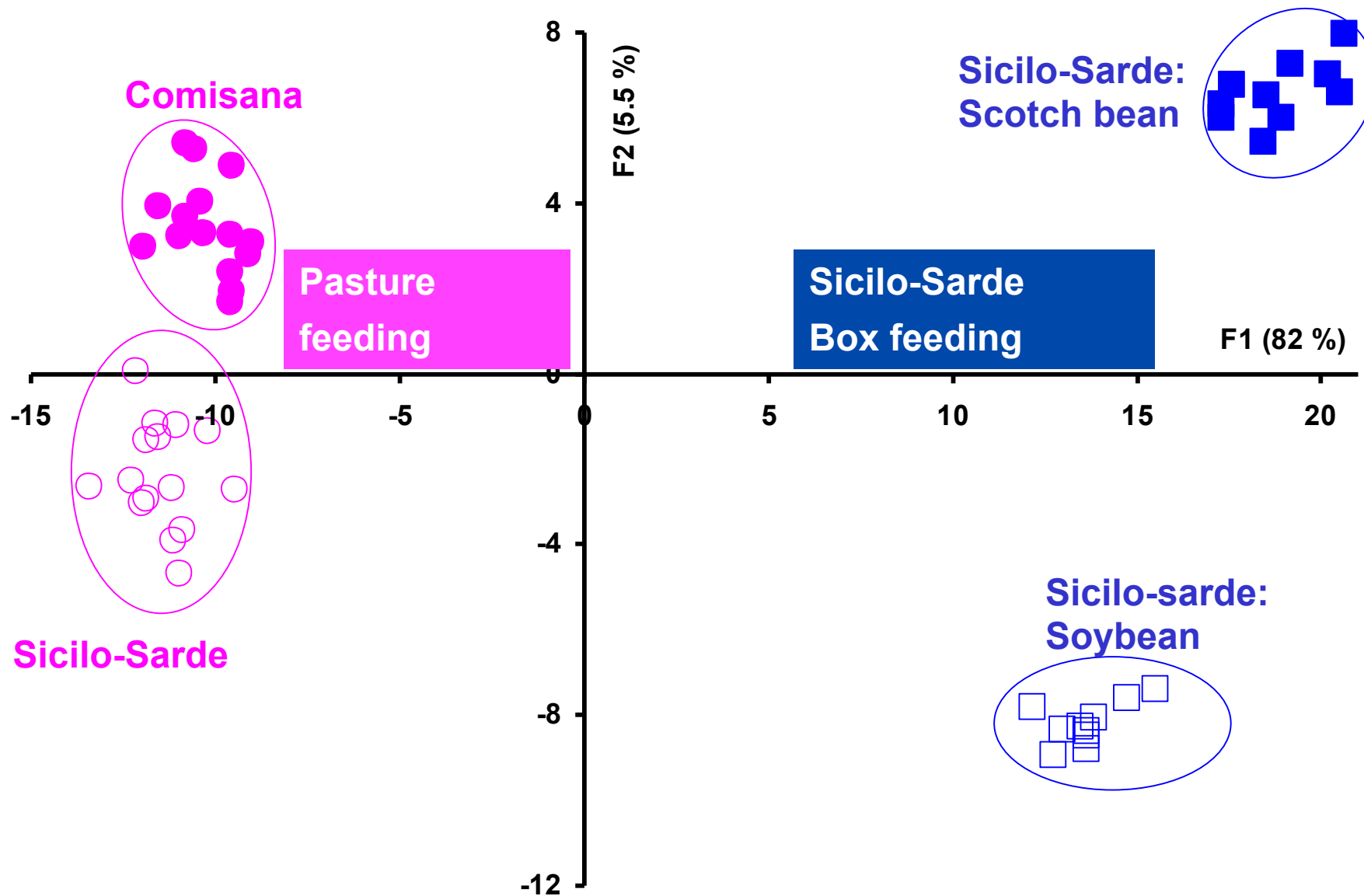
Results – Normalised fluorescence spectra of riboflavin spectra scanned on milk samples of 1 week



Results – Normalised fluorescence spectra of Vitamin A spectra scanned on milk samples of 1 week (em: 410 nm)



Discriminant analysis similarity map determined by discriminant factors 1 and 2: Concatenation



Classification table of milk samples throughout the lactation stage based on fluorescence spectra

Feeding system					
Observed predicted	Cpas	Spas	Ssco	Ssoy	% CC
Concatenation					
Cpas	14	1	-	-	93.3
Spas	3	12	-	-	80
Ssco	-	-	9	1	90
Ssoy	-	-	1	9	90
Total					88

C: Comisana; S: Sicilo-Sarde; pas: Pasture; sco: Scotch bean meal; soy: Soybean meal; CC: Correct classification

Classification table of milk samples throughout the lactation stage based on fluorescence spectra recorded on Sicilo-Sarde milks

Observed predicted	Ssco	Spas	Ssoy	% CC
Concatenation: Fluorescence				
Ssco	7	-	3	70
Spas	1	14	-	93.3
Ssoy	-	-	10	100
Total				88.6

S: Sicilo-Sarde; pas: Pasture; sco: Scotch bean meal; soy: Soybean meal; CC: Correct classification

Conclusions

- **The present investigation demonstrated the ability of FFS to monitor changes in ewe's milk according to both feeding system and genotype throughout the lactation period**
- **By using, separately, each fluorescence spectra recorded after excitation set at 250, 290, 322 and 380 nm and emission set at 410 nm, the discrimination of the investigated milk samples were not satisfactory for differentiating the groups**

Conclusions

- However, fluorescence spectroscopy demonstrated its ability to discriminate milk samples according to **both the feeding system and genotype** following the use of **concatenation** technique
- **88% of correct classification** was obtained from the FDA, with leave one-out cross-validation
- With only 50 independent samples, the current model is not very robust. More research is needed to test the accuracy of the concatenation technique applied to the fluorescence spectra



Thank you

Materials and methods

