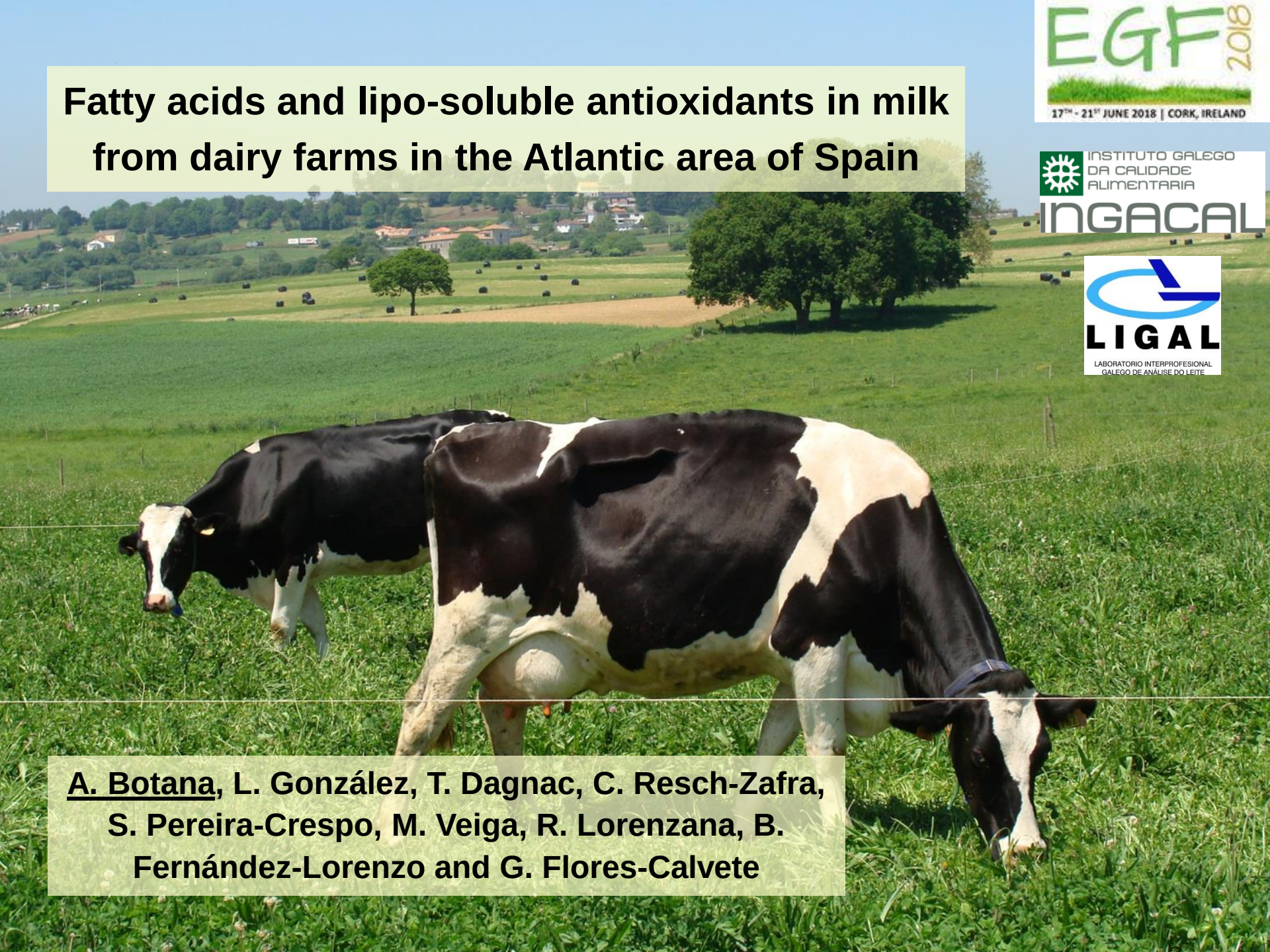
Fatty acids and lipo-soluble antioxidants in milk from dairy farms in the Atlantic area of Spain



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INSTITUTO GALEGO DA CALIDADE ALIMENTARIA
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Introduction – Galician dairy sector

Galicia region:

- Northwest of Spain.
- Humid temperate climate.
- Milk production of 2.7 M ton in 2017.
- 40% of total Spanish production.
- The number of Galician dairy farms was divided by a factor of 10 in last 30 years, passing from 100 thousand holdings to less than 9 thousand.

Introduction – Research focus

Key issues in the post-quota era for Galician dairy farms:

- Forage production capacity and land use.
- Reduction of milk production costs.
- Avoid negative environmental impacts.
- Explore the positive differentiation of milk produced in forage-based systems.
- Maintain the occupation of rural territory with dairy farms of increased resiliency.

Introduction – Dairy milk and human health

- Diet and human health:
  - Dairy products are an important source for many vital nutrients.
  - The decrease in the levels of saturated Fatty Acids and the increase in the levels of poly-unsaturated Fatty Acids are considered to have a positive effect on human health.
  - Bioactive Fatty Acids such as alpha-linolenic acid or rumenic acid are typically present in low percentages in milk but exert a significant biological positive impact in human health.
  - Dairy cow feeding has a greater influence on milk composition than other physiological or ambient factors.

Introduction – Line of work

Relationships between diet and milk quality in dairy farms and use of milk composition as a potential tracer of feeding systems:

- Gain insight on the relationships between feeding management and milk quality in typical diets of Galician farms.
- Explore how the use of pastures and forages modulates the fatty acid profile of dairy milk.
- Evaluate the potential of milk fatty acids and lipo-soluble antioxidants to trace the alimentary origin of milk.

The objective of the present work is to characterize the fatty acids profile and the lipo-soluble antioxidants contents in cow's milk from farms which followed typical feeding systems in Galicia .

Materials and methods

Farm data:

- 316 farms were interviewed with a survey model with questions to characterize the dairy production system.
- 37 farms were selected as representatives of the different systems.
- Visited five times between October 2013 and September 2014.
- Characterization of diet consumed by the lactating cows.
- Sampling of feed ingredients and tank milk.
- Diet composition was expressed in terms of percentage of each ingredient on the total dry matter consumed by lactating cows.

Materials and methods

Analysis:

- Tank milk samples were subjected to analysis for chemical composition by FTMIR in the official interprofessional laboratory of milk analysis (LIGAL).
- Milk Fatty Acids composition and lipo-soluble antioxidants were determined by Chromatography analysis (FID-GC for FA and HPLC for AO).
- 178 valid observations were available.
- Milk samples were allocated into groups identified by cluster analysis performed on the composition of the diets.
- An ANOVA analysis was performed on FA and AO milk content.

Results

Diet composition, milk yield, milk composition and concentrate use

	Fresh Grass	Grass silage	Grass-maize silage	Maize silage	*P*
n	33	85	40	20	
DMI (kg cow^{-1})	21.2 ^{d}	22.4 ^{c}	23.2 ^{b}	24.2 ^{a}	***
Diet composition (g kg^{-1} DM)					
Fresh grass	482 ^{a}	86 ^{b}	5 ^{c}	0 ^{c}	***
Grass silage	137 ^{c}	401 ^{a}	285 ^{b}	63 ^{d}	***
Maize silage	88 ^{c}	86 ^{c}	318 ^{b}	478 ^{a}	***
Dry forages	66 ^{a}	77 ^{a}	24 ^{b}	75 ^{a}	***
Concentrates	228 ^{b}	350 ^{a}	369 ^{a}	384 ^{a}	***
Milk Yield (kg cow^{-1} d^{-1})					
Milk (4% fat corrected)	24.9 ^{d}	27.9 ^{c}	30.1 ^{b}	32.8 ^{a}	***
Milk Solids (Fat+Protein)	1.80 ^{d}	2.02 ^{c}	2.19 ^{b}	2.39 ^{a}	***
Milk composition (g kg^{-1} milk)					
Fat	38.8 ^{ab}	37.7 ^{bc}	39.1 ^{a}	37.0 ^{b}	**
Protein	32.3 ^{ab}	32.0 ^{b}	32.8 ^{a}	32.7 ^{a}	*
Lactose	46.8 ^{b}	47.1 ^{ab}	47.4 ^{a}	47.3 ^{a}	*
Concentrate use					
kg cow^{-1} d^{-1}	4.9 ^{c}	7.9 ^{b}	8.5 ^{ab}	9.3 ^{a}	***
g kg^{-1} milk	196.0 ^{b}	283.3 ^{a}	285.7 ^{a}	284.0 ^{a}	***

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Results

Effect of diet type on fatty acid composition

	Fresh Grass	Grass silage	Grass-maize silage	Maize silage	*P*
n	33	85	40	20	
FA profile (g Kg^{-1} TFA)					
SFA	684.7 ^{bc}	680.3 ^{c}	700.5 ^{a}	697.3 ^{ab}	**
MUFA	267.7 ^{ab}	272.0 ^{a}	258.6 ^{b}	261.5 ^{ab}	*
PUFA	40.6 ^{a}	40.8 ^{a}	34.6 ^{b}	34.7 ^{b}	***
C18:1 *t*11	16.3 ^{a}	13.8 ^{b}	8.9 ^{c}	6.6 ^{d}	***
CLA *c*9-*t*11	8.9 ^{a}	8.0 ^{a}	5.6 ^{b}	4.7 ^{b}	***
C18:3 n3	6.3 ^{a}	5.2 ^{b}	3.2 ^{c}	2.7 ^{c}	***
FA ratios					
ω6 / ω3	2.6 ^{c}	3.5 ^{b}	4.3 ^{a}	4.3 ^{a}	***
*t*11 / *t*10 C18:1	6.4 ^{a}	4.4 ^{b}	3.0 ^{c}	1.4 ^{d}	***

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FA ratios					
ω6 / ω3	2.6 ^{c}	3.5 ^{b}	4.3 ^{a}	4.3 ^{a}	***
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Effect of diet type on the concentration of vitamins A and E, xanthophylls and carotene

	Fresh Grass	Grass silage	Grass-maize silage	Maize silage	*P*
n	33	85	40	20	
Vitamins (μg L^{-1} milk)					
Vit. A (retinol)	457.5 ^{a}	496.3 ^{a}	495.1 ^{a}	332.3 ^{b}	***
Vit. E (alpha-tocopherol)	1104.3 ^{a}	846.9 ^{b}	752.6 ^{bc}	661.1 ^{c}	***
Vit. E (ganma-tocopherol)	34.6 ^{c}	44.2 ^{b}	49.8 ^{b}	61.7 ^{a}	***
Xanthophylls (μg L^{-1} milk)					
Lutein	12.7 ^{a}	8.2 ^{b}	7.9 ^{b}	5.9 ^{b}	***
Zeaxanthin	1.8 ^{a}	1.1 ^{b}	1.1 ^{b}	0.8 ^{b}	***
β Cryptoxanthin	1.7 ^{a}	1.2 ^{b}	0.9 ^{b}	1.3 ^{ab}	**
Carotene (μg L^{-1} milk)					
(All-t-β+ 9-c-β) Carotene	103.8 ^{a}	82.2 ^{b}	62.2 ^{c}	50.9 ^{c}	***
13-*cis*-β-Carotene	5.1 ^{a}	3.6 ^{ab}	2.4 ^{b}	3.2 ^{b}	**

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Conclusions

- The type of diet influenced significantly milk composition, modifying strongly its FA profile and AO content.

- Milk from grass predominant diets, especially that based on fresh grass showed a better FA profile and higher lipo-soluble AO concentrations, indicating a more adequate fit with the actual requirements for a healthy human diet


Thanks for your attention