



UNIVERSIDAD NACIONAL AGRARIA LA MOLINA  
FACULTAD DE ZOOTECNIA



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de Produccion Animal – APPA 2008 –  
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# **Avances sobre evaluacion y control de calidad de alimentos de origen animal**

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# The citations of “quality” in literature

Sources: CAB Abstracts (from 1989 to August 2008)  
(WebSPIRS Version 5.12 Build 20060224)\*

| <b>Words</b>        | <b>Citations (no.)</b> |
|---------------------|------------------------|
| <b>Food quality</b> | <b>221.606</b>         |
| <b>Food safety</b>  | <b>29.433</b>          |
| <b>Traceability</b> | <b>1.315</b>           |

\* Accession date: 8<sup>th</sup> October 2008

# Outline

Concepts of safety and quality in food of animal origin

## **Safety**

Integrated approach (from farm to table)

Risk analysis (assessment, management and communication)

Precautionary principle

## **Quality**

New aspects of the nutritional value ("functional foods", "nutraceutical foods", CLA)

Sensorial quality (properties influencing the consumers choice)

Extrinsic attributes (animal welfare, environmental impact..)

## **Traceability**

Potential tracers and new approaches

**Conclusion and role of the scientific research**

# From quantity to quality !

The main objective of the agricultural and animal productions was initially aimed to satisfy humans' needs from a quantitative point of view, with respect to different food products.

At least, in EU and developed countries the food markets were saturated.

However, out of a total world population of 6 billions, about 800 million people are at the moment malnourished, mainly in developing countries (EAAP, 2002).

([www.eaap.org/round\\_table\\_cairo\\_english.htm](http://www.eaap.org/round_table_cairo_english.htm))

# The quality in a globalised trade

In the last years some important changes as the globalisation of trades, the changes of people lifestyle, the food emergencies (as BSE, dioxin, melamine) had as effects:

the fall of the real prices of agricultural products

rural depopulation due the increase of intensive systems

obesity in epidemic proportions

increase of food scares



**Consequently, in developed countries the demand for high-quality products, especially in terms of healthiness, has increased.**

# Quality concept

The concept of quality has been defined in many ways and differs between countries.

Quality = all the characteristics of food products valued by the consumer (stated and implicit needs)

It is therefore a holistic and multifactor concept integrating:

nutritional traits

sensorial properties

traceability

social considerations

safety

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# Food safety

Food safety refers to the absence of adverse health effects due to the presence of biological and chemical contaminants in food products.

Safety is a **preliminary** attribute of food, i.e. an essential precursor of quality

# Food quality in the EU

**White paper on food safety**  
Commission of the European Communities  
Brussels, 12 January 2000

*"Assuring that the EU has the highest standards of food safety is a key policy priority for the Commission. This White Paper reflects this priority. A radical new approach is proposed. This process is driven by the need to guarantee a high level of food safety."*

([http://ec.europa.eu/dgs/health\\_consumer/library/pub/pub06\\_es.pdf](http://ec.europa.eu/dgs/health_consumer/library/pub/pub06_es.pdf))

# White Paper as a model of food safety legislation: why?

The agro-food sector is of major importance for the European economy as a whole:

Annual production of food and drink of about 600 billion €

The food and drink industry is the third-largest industrial employer (2.6 million employees)

The agricultural sector has an annual production of about 220 billion €

Exports of agricultural and food and drink products are worth about 50 billion €

# White paper on food safety



Comprehensive and integrated approach



from farm to fork  
across all food sectors  
involving all member States

# Food safety

The primary responsibility of the different operators

Farmers

Feed producers

Feed manufacturers

Breeders

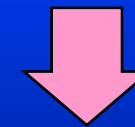
Food manufacturers

Food operators

*(transport, storage, commerce...)*

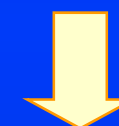
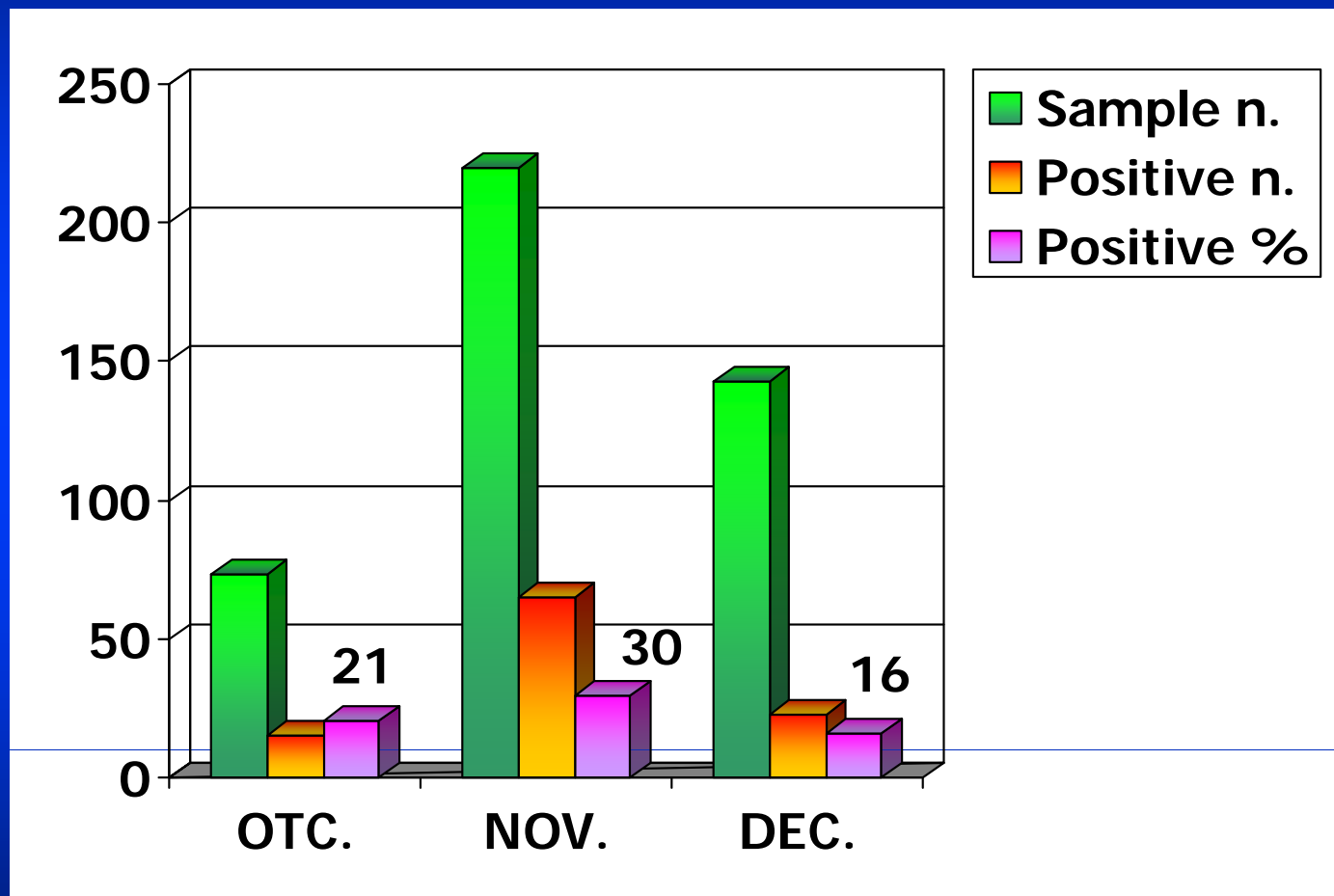
Consumers

*(storage, handling, cooking...)*



# Food safety

## The primary responsibility: the case of M1 aflatoxin



Survey on the milk contamination in Veneto Region in 2003.

The sample with a level of AFM1 higher than 50 ppt are positive

# Food safety

"General Food Law"

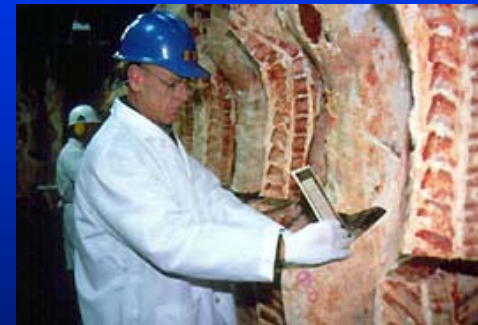
Regulation EC n. 178/2002

## Objectives

laying down the general principles and requirements of food law

establishing the European Food Safety Authority (EFSA)

laying down procedures in matters of food safety



([http://ec.europa.eu/dgs/health\\_consumer/library/pub/pub06\\_en.pdf](http://ec.europa.eu/dgs/health_consumer/library/pub/pub06_en.pdf))

# European Food Safety Authority: 17 panels



Contaminants in the food chain



Additives and products or substances used in animal feed



Dietetic products, nutrition and allergies



Animal health and welfare



Biological hazards

# European Food Safety Authority: risk communication

EFSA assesses possible risks related to melamine in composite foods from China  
25/09/2008

Following recent events in China, the European Commission asked the European Food Safety Authority (EFSA) to provide urgent scientific advice on health risks for European consumers related to the possible presence of melamine[1] in composite foods containing milk or milk products originating from China. EFSA's scientists today issued .....



*On Google: 8.550.000 web pages for melamine*

**General Food Law [ Reg. (EC) No. 178/2002 ]**

**Feed hygiene**

Reg (EC) No. 183/2005

etc.

etc.

**Others, e.g.**

Identification  
marking

GMO's

etc.

**Feed/food control**

Reg. (EC) No. 882/2004

**Others, e.g.**

Trichinae

TSE's

etc.

**H1  
Hygiene foodstuffs**

Reg. (EC) No. 852/2004

Reg. (EC) No. 2074/2005

**H2  
Hygiene of foods of  
animal origin**

Reg. (EC) No. 853/2004

Reg. (EC) No. 2076/2005

**H3  
Official controls of  
foods of animal origin**

Reg. (EC) No. 854/2004

**H4  
Animal health rules**

Dir. 2002/99/EC

Feed business operator

Food business operator

Competent authorities

# Food safety

## Risk Analysis

(assessment, management and communication)

Of course, food production and supply can never be free of risk.

We can and should minimize risks as far as possible, but "zero risk" is not an attainable goal



The objectives of the food chain are:

maximize safety

minimize risk

(ensure quality)

# Food safety

## Risk Analysis

Risk assessment

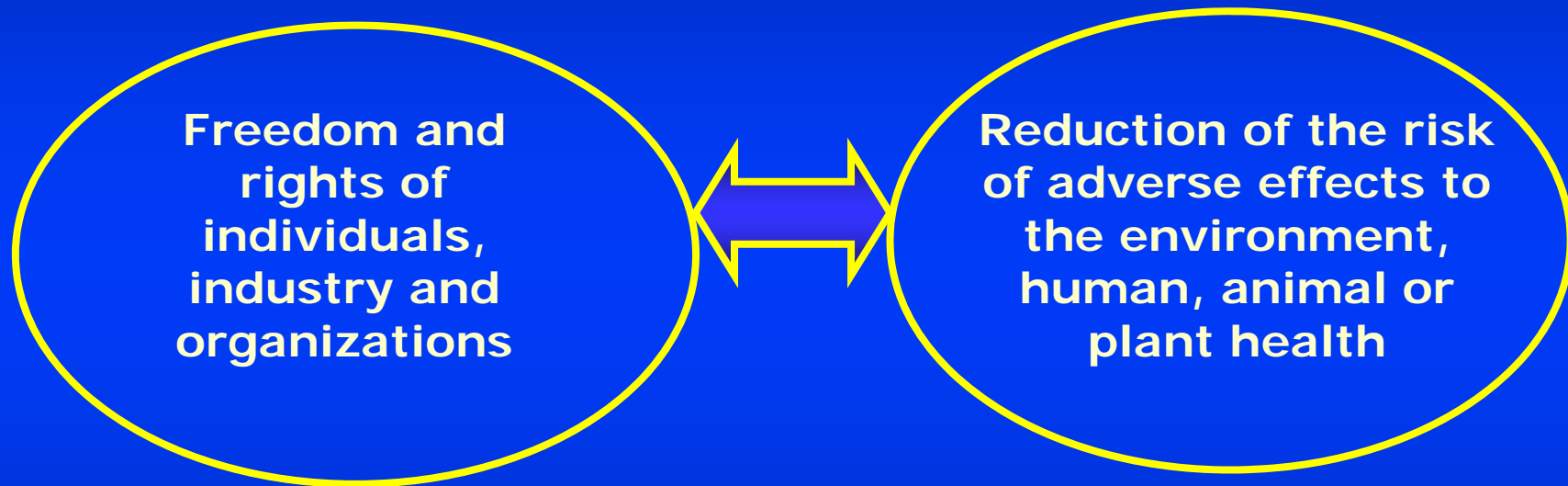
Risk management

- Precautionary principle
- Substantial equivalence principle

Risk communication

# Food safety

## The precautionary principle



Recourse to the precautionary principle presupposes that potentially dangerous effects have been previously identified, and the risk remain undetermined

# Food safety

## The precautionary principle: the GMO case

### Directive 18/2001 and following integrations

Details on the trials to evaluate chemical composition, nutritive value, allergenic effects and toxicity of GMOs. Short and long-term effects of GMOs on the human safety and on environment must be controlled and monitored and the results must be available to consumers.



The cultivation and commercialization of GMOs plants are not regulated and indirectly banned in EU. The GMO-free food chains are increasing.



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## **Traceability**

Potential tracers and new approaches

**Conclusion and role of the scientific research**

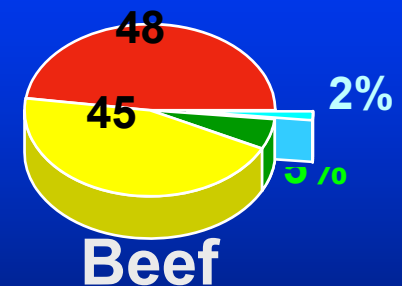
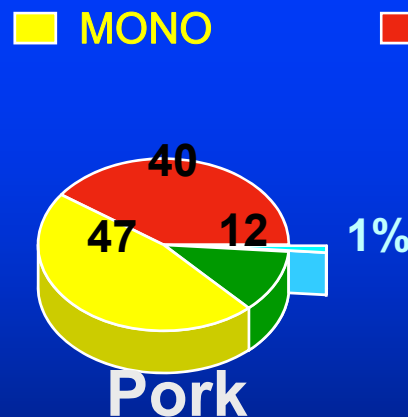
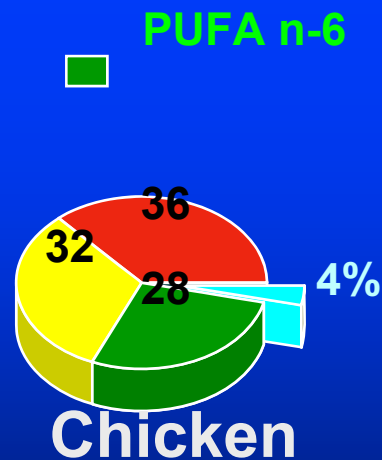
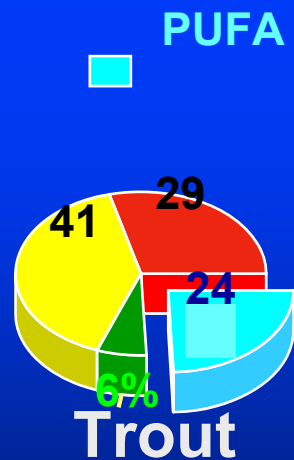
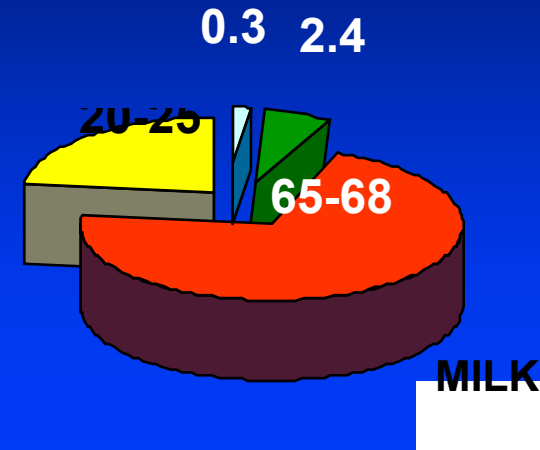
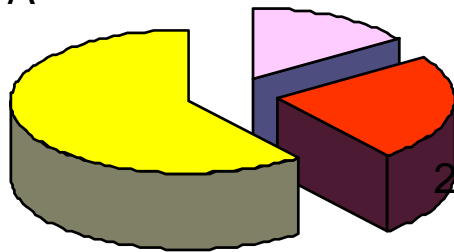
# Fatty acid profile of different food of animal origin

Recommended nutritional supply for human health

**MUFA**  
60% total FA

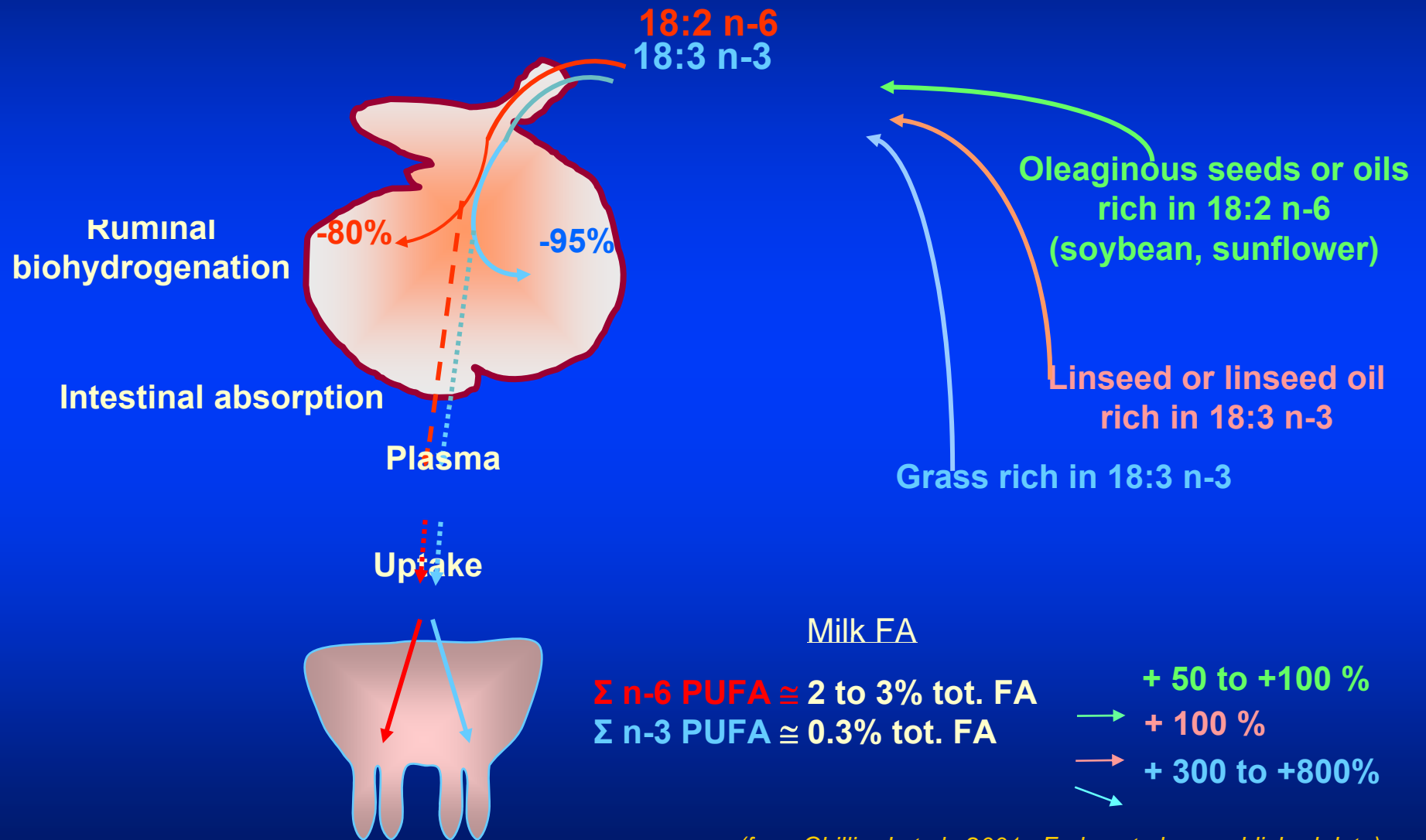
**PUFA**  
15% total FA (n-6/n-3 < 4)

**SFA**  
25% total FA



Too much saturated fat

# How to increase levels of PUFA in milk?



(from Chilliard et al., 2001 ; Ferlay et al., unpublished data)

## Food quality: bioactive compounds in fat milk

| Components        | Fat content in milk | Biological activity                |
|-------------------|---------------------|------------------------------------|
| Butiryc acid      | 3-4.5%              | Anticarcinogenic                   |
| Vitamin E         | 33 ppm              | Antioxidant                        |
| $\beta$ -carotene | 5.2 ppm             | Antioxidant                        |
| Vitamin D         | 0.015 ppm           | Calcium adsorption                 |
| $\omega$ 3 PUFA   | 1%                  | Prevention of heart diseases       |
| Phospholipids     | 1%                  | Anticarcinogenic                   |
| Essential PUFA    | 3-5%                | Plasmatic membrane functionality   |
| MUFA              | 20-25%              | Low plasmatic level of cholesterol |
| Vaccenic acid     | 1-5%                | Anticarcinogenic                   |
| CLA               | 0.5-2%              | Anticarcinogenic ....              |

## Food quality: the role of C.L.A. (Conjugated linoleic acid) on the cancer incidence (Bauman et al., 2001)

**Table 14.3. Incidence of mammary tumours in rats fed on diets containing differing concentrations and sources of CLA and treated with a chemical carcinogen<sup>a</sup>.**

| <i>Treatment group</i>        | <i>Dietary CLA<br/>g/100 g</i> | <i>Tumor incidence</i> | <i>Tumor numbers</i> |
|-------------------------------|--------------------------------|------------------------|----------------------|
| Control                       | 0.1                            | 28/30 (93%)            | 92                   |
| CLA-enriched butter           | 0.8                            | 15/30 (50%)            | 43                   |
| CLA Supplement 1 <sup>b</sup> | 0.8                            | 16/30 (53%)            | 46                   |
| CLA Supplement 2 <sup>c</sup> | 0.8                            | 17/30 (57%)            | 48                   |

<sup>a</sup>Rats were fed treatment diets for four weeks and then given a single dose of a carcinogen (methylnitrosourea). After carcinogen administration, rats were fed on a diet containing maize oil without CLA and were killed 24 weeks later. Adapted from Ip *et al.* (1999).

<sup>b</sup>9,11 CLA.

<sup>c</sup>Mixture of CLA isomers (8-10, 9-11, 10-12 and 11-13).

# Conjugated linoleic acid (CLA)

*cis-9,trans-11* CLA

*trans-10,cis-12* CLA

**Anticarcinogenic**

**Immune modulation**

**Antiatherogenic**

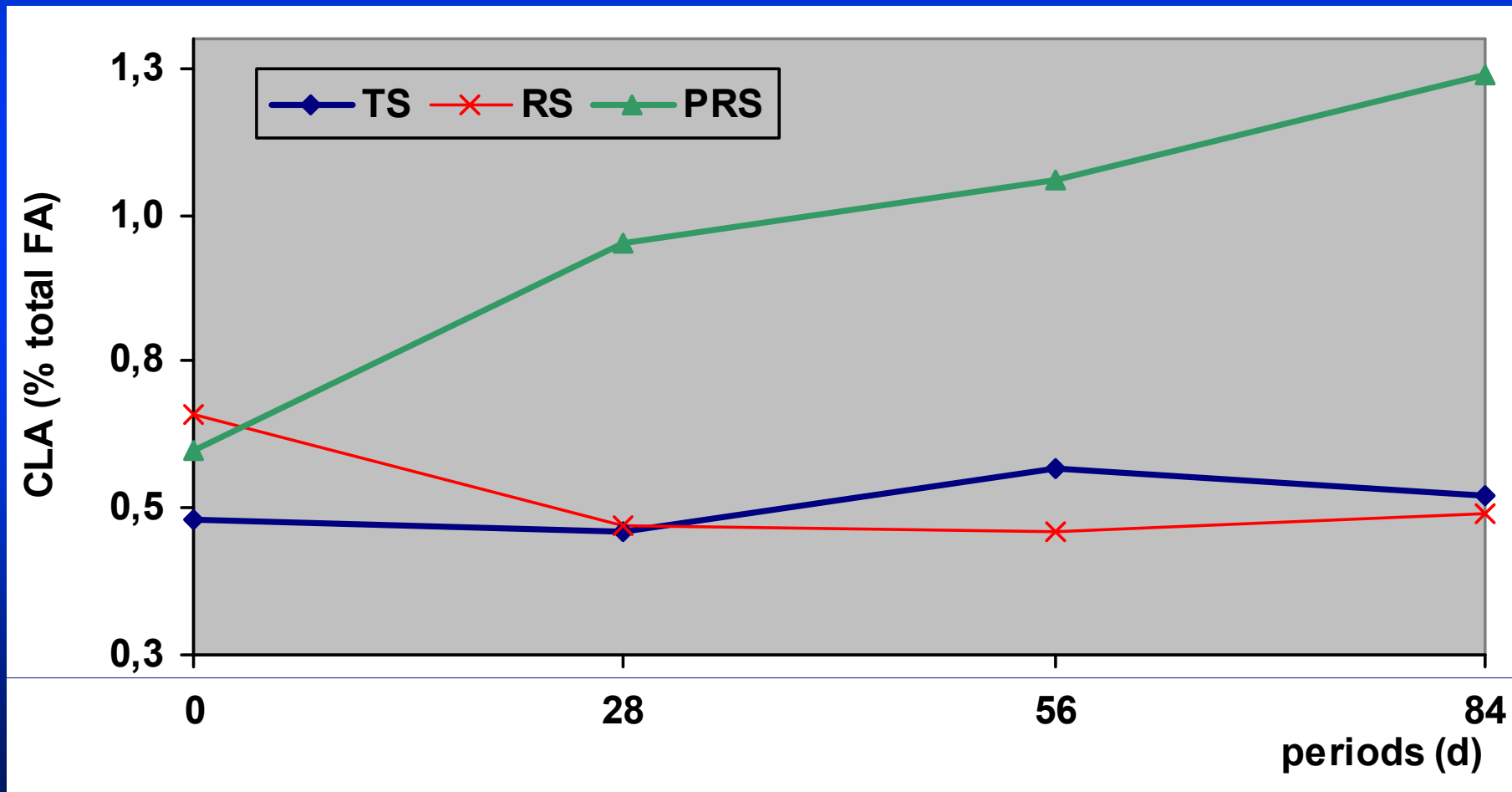
**Improved bone mineralisation**

**Antidiabetic  
(type II diabetes)**

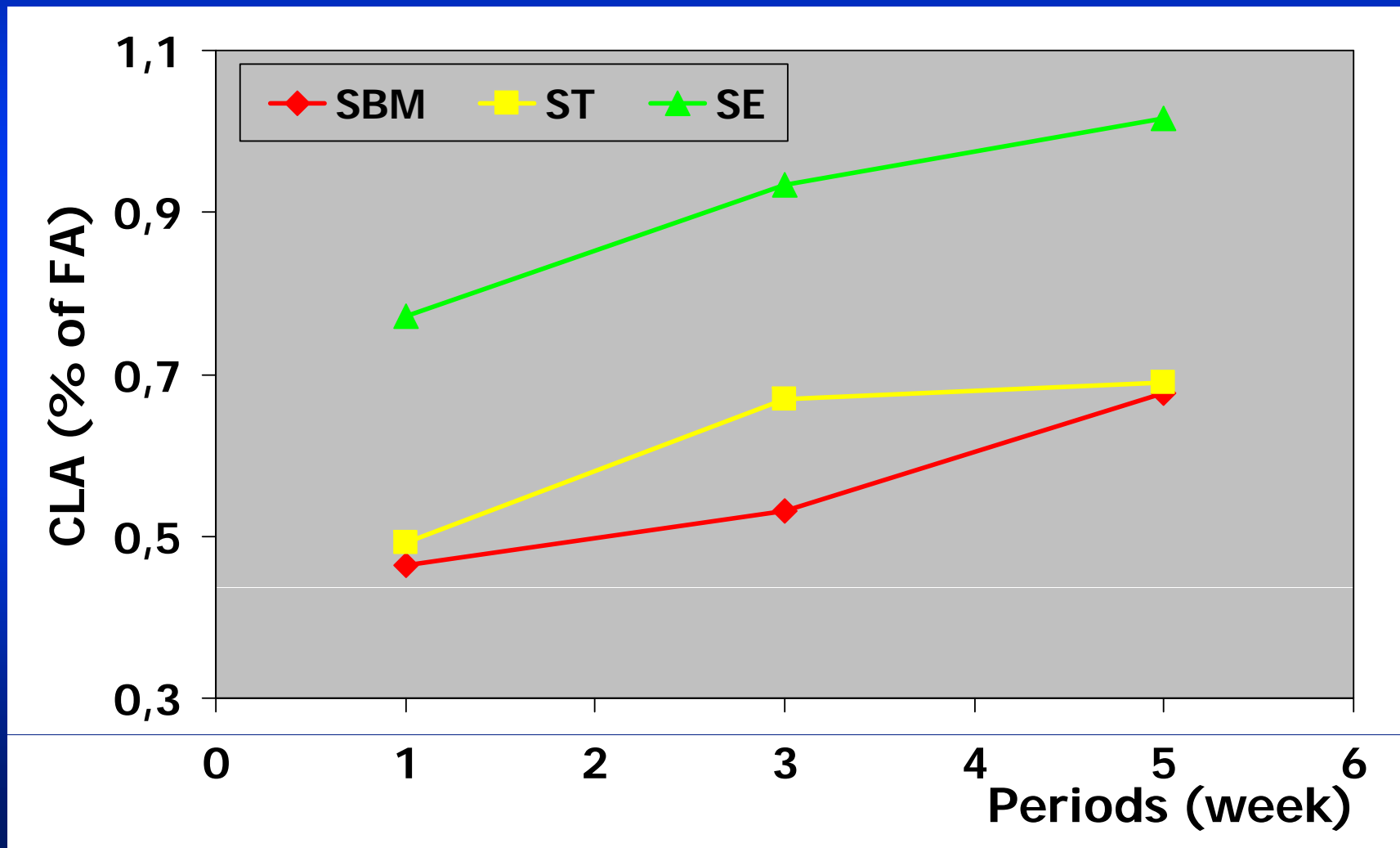
**Altered nutrient partitioning**

Ruminant products (milk and meat) are naturally rich in CLA, but how can we increase and control its level?

**CLA content in milk produced by cows at pasture (PRS) and with total mixed ration with the addition of toasted (TS) or raw (RS) soybean (Bortolozzo, Bailoni et al., 2003)**



**CLA content (% of total FA) in milk produced by cows fed TMR with the addition of soybean meal (SBM), toasted (ST) or extruded (SE) soybean (Bailoni et al., 2004)**



# Sensorial properties: factors affecting the colour of meat

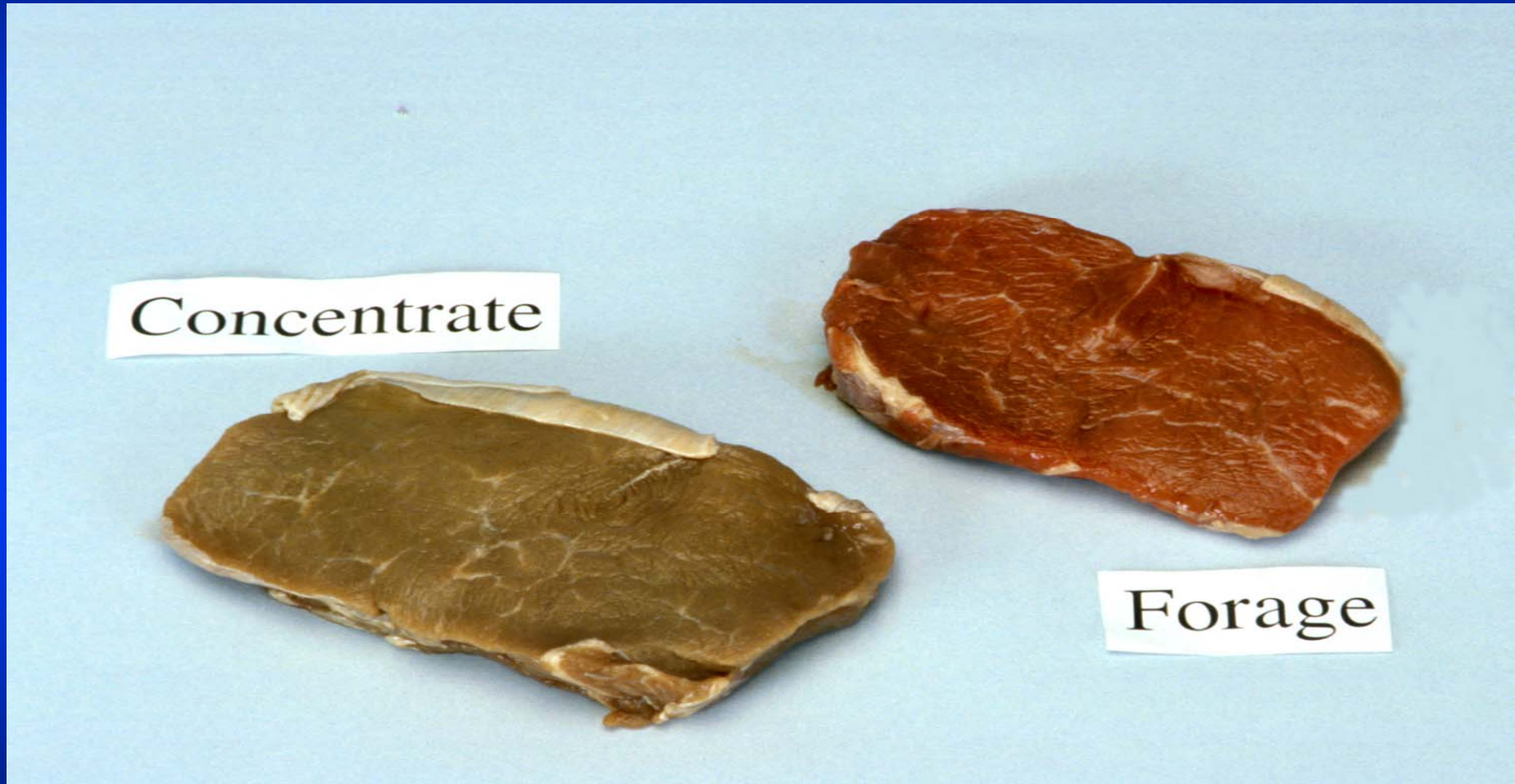
Colour determination  
Portable Spectro-photometer  
(model CM 508C: Minolta)

Registration of data by  
software

LAB system parameter



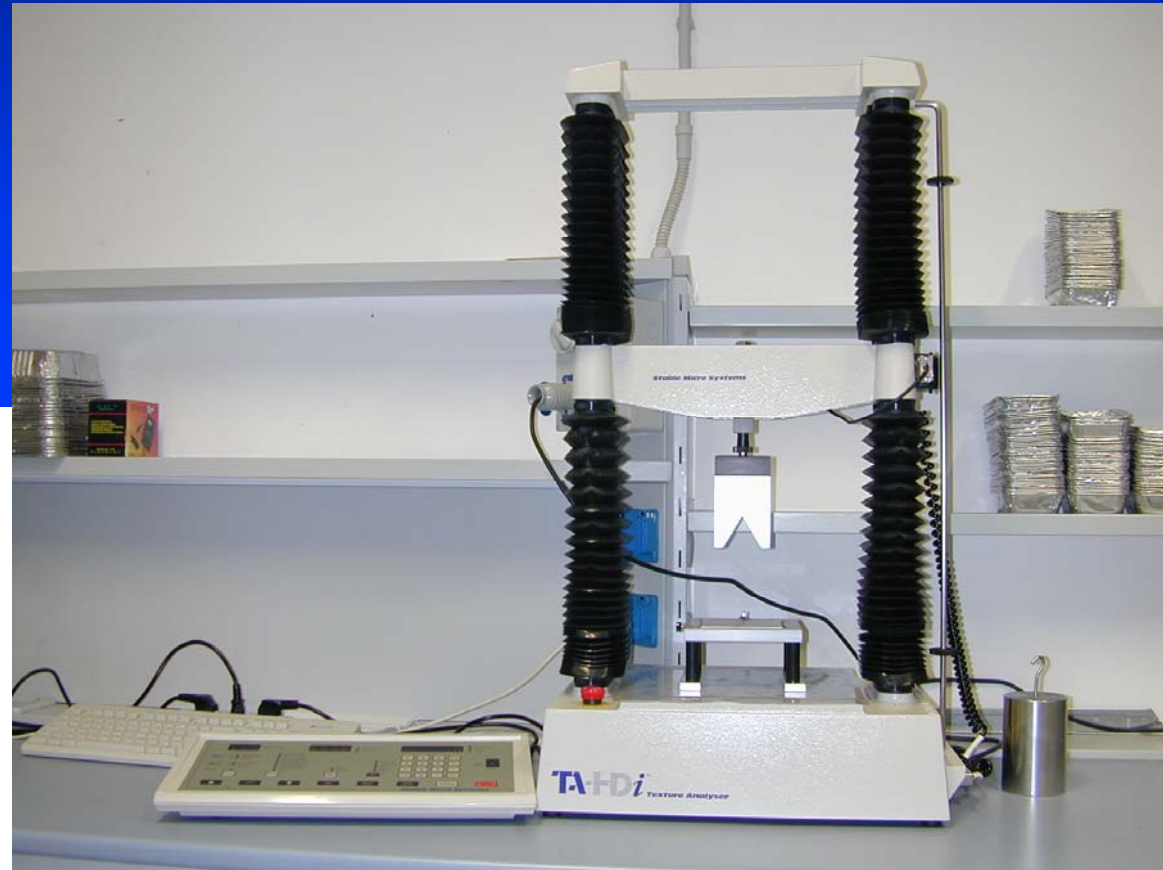
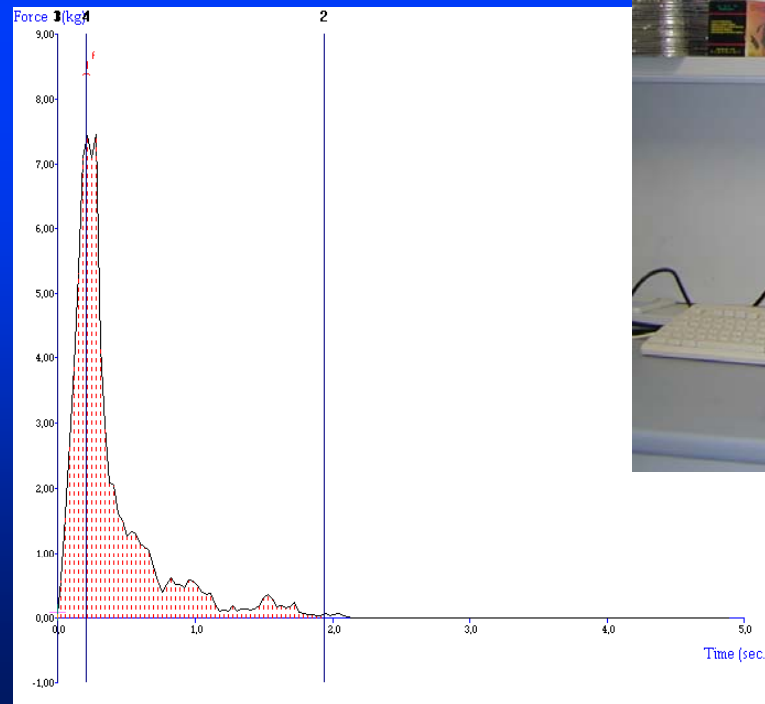
# Sensorial properties: factors affecting the colour of meat



Animal feeding (addition of selenium and vitamin E)  
Modified atmosphere packaging (extension of shelf life)

# Sensorial properties: factors affecting the tenderness

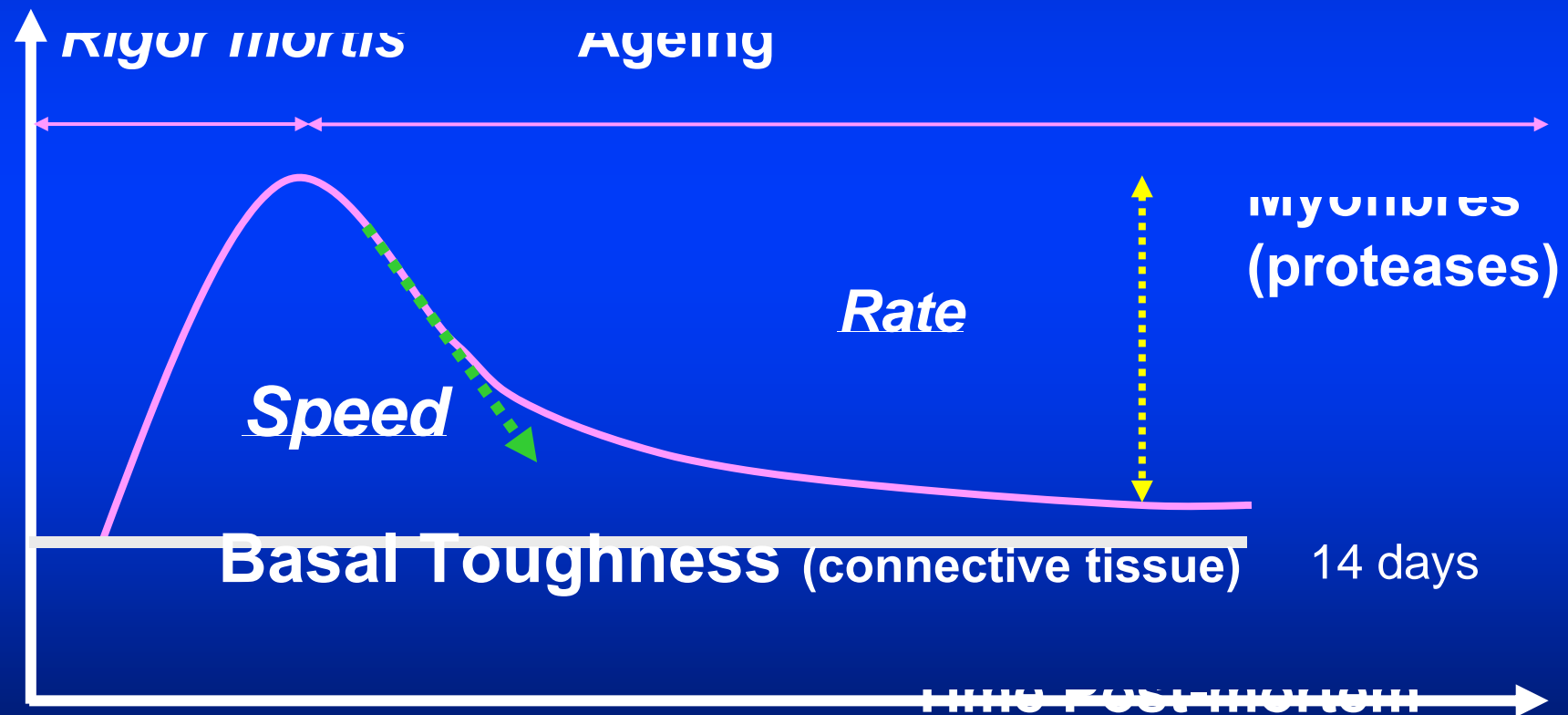
Dynamometer  
T.A. HDI/100  
(EN.CO.)



Pattern of tenderness analysis

# Sensorial properties: factors affecting the tenderness of meat

Toughness



# Sensorial properties: the flavour of milk



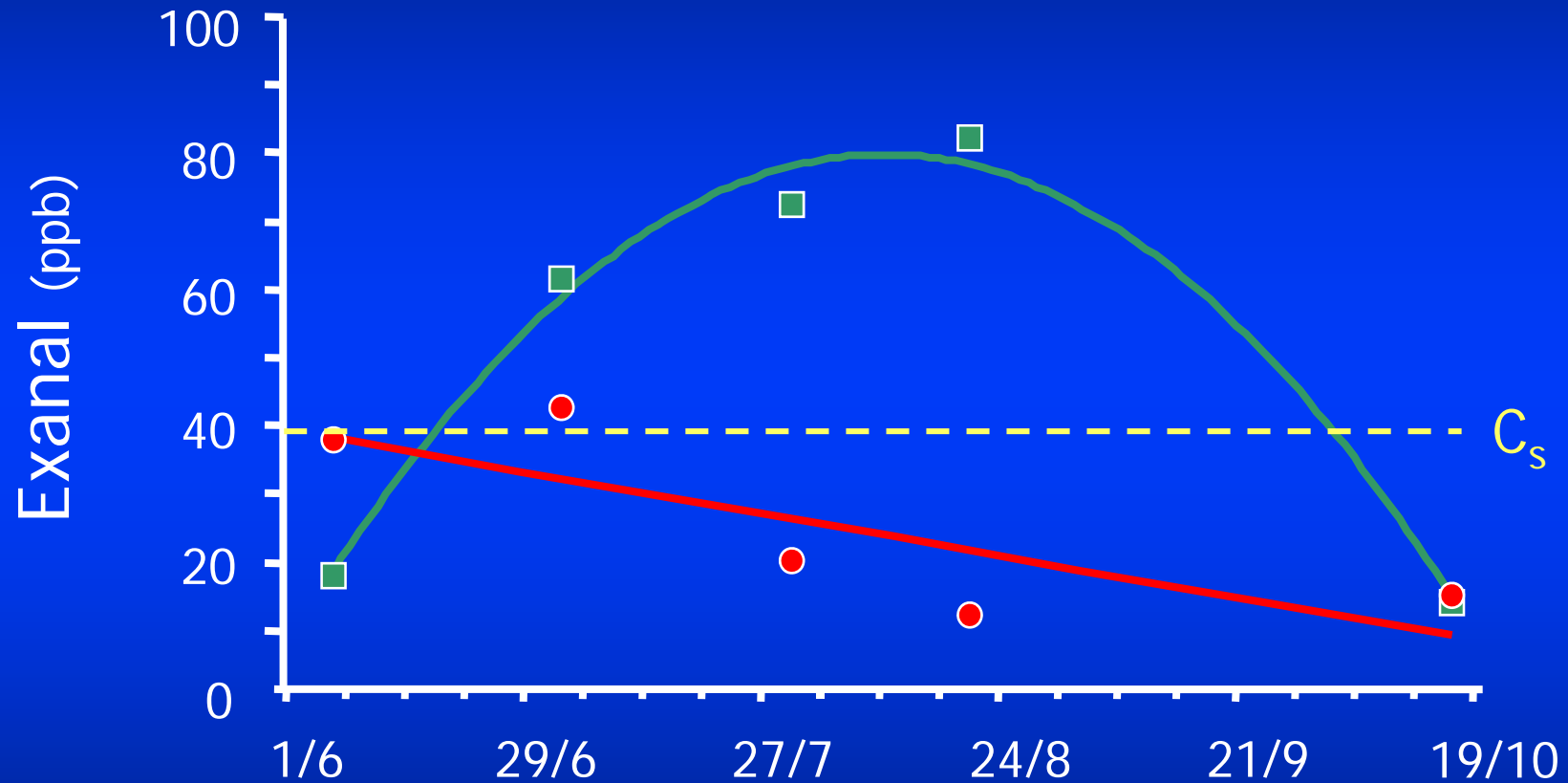
1) Purge and trap

2) Transfer line

3) Cold trap

4) GC

# Effect of feeding on milk flavour (Bailoni et al., 2000)



● Stall housing  $R^2 = 0.639$

■ Pasture  $R^2 = 0.986$

## **Extrinsic quality attributes: animal welfare**

**Many consumers equate good animal welfare standards with good food standards in general, and higher food quality**

**Europe is clearly leading the word in the promotion of animal welfare**

## Animal welfare: the case of the veal calves in EU



Close and individual  
barns

Feeding based on milk  
replacers

Multiple boxes  
Feeding based on milk  
replacers and solid feeds



## Extrinsic quality attributes: environmental impact

The European Directive 91/676/EC, aiming to prevent or reduce the nitrate pollution, stated that each member state must identify the vulnerable areas where the load of N of livestock origin cannot exceed 170 kg/ha/year. In not vulnerable areas the N load must be lower than 340 kg/ha/year.

At the present new feeding and management strategies are evaluated to reduce nitrate pollution and to avoid a reduction of the number of reared animals.

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# Traceability

Ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution (EU Reg. 178/2002)

From 1<sup>st</sup> January 2005 it is mandatory in all agri-food sectors.

***TRACEABILITY OF FOOD ALONG THE CHAIN***  
***(Quality pathways of products)***  
***QUALITY CONTROL***

***LOGISTIC TRACEABILITY IN DISTRIBUTION***  
***(Quantity pathways of products)***  
***RISK MANAGEMENT***



# Traceability

Development of analytical tools to quantify specific compounds (tracers) in the product, animal tissues or fluids

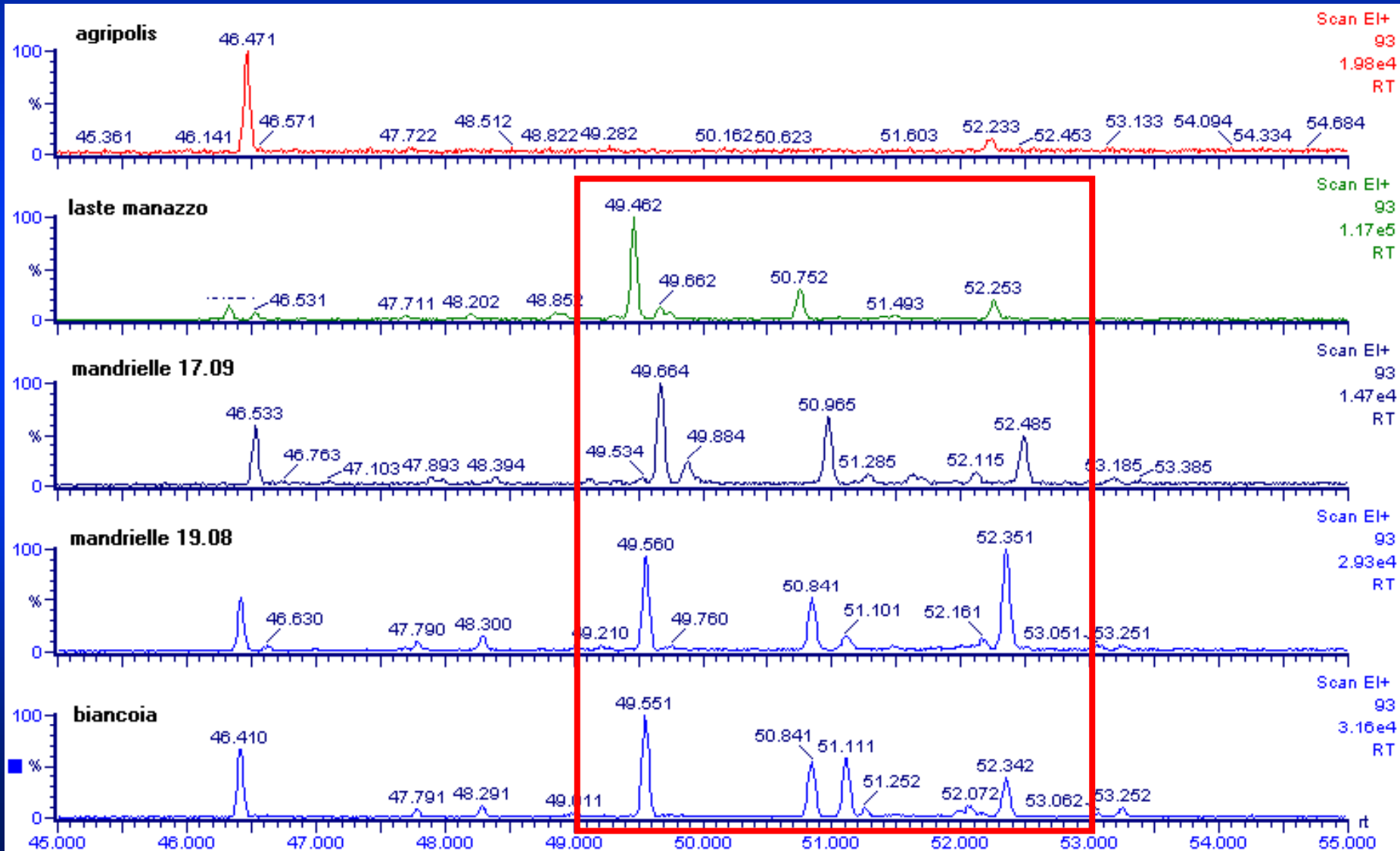
|                   |   |
|-------------------|---|
| Plant biomarkers  | Carotenoids, terpenes, flavonoids   |
| Metabolic markers | Fatty acid composition<br>Volatile compounds  |
| Physical markers  | H, O Isotopes: geographical origins (latitude, altitude)<br>C, N Isotopes: alimentation |
| New approaches    | Genomics  |

# Traceability

Plant biomarkers

Terpenes

Favaro, Bailoni et al., 2005 J. Dairy Sci. 88:3426

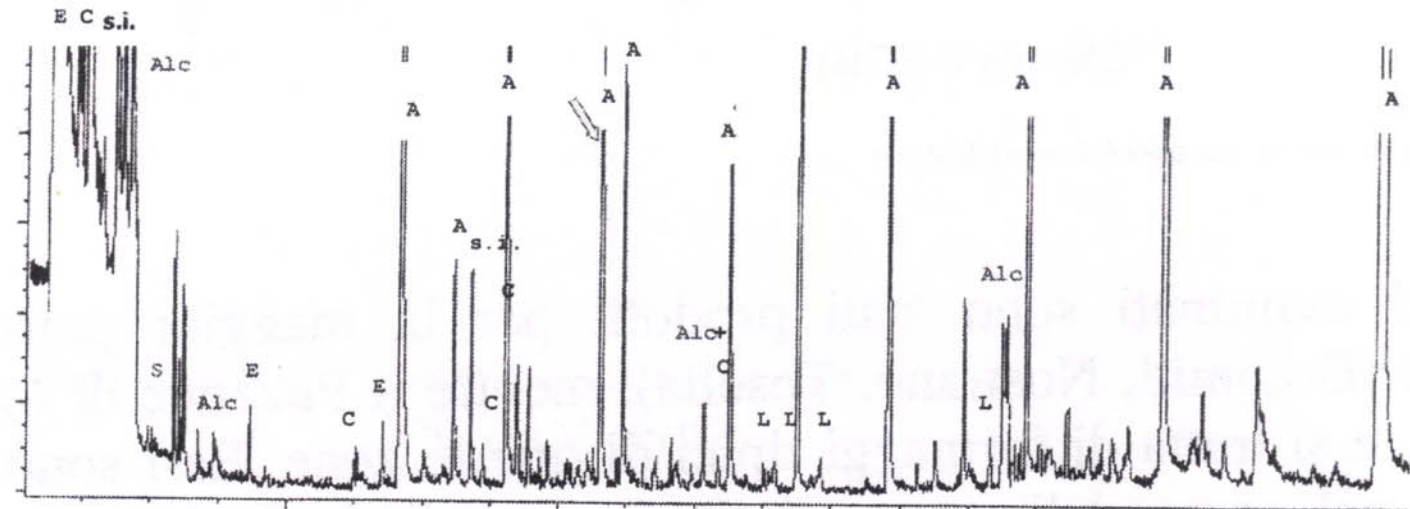


# Traceability (from food to feed)

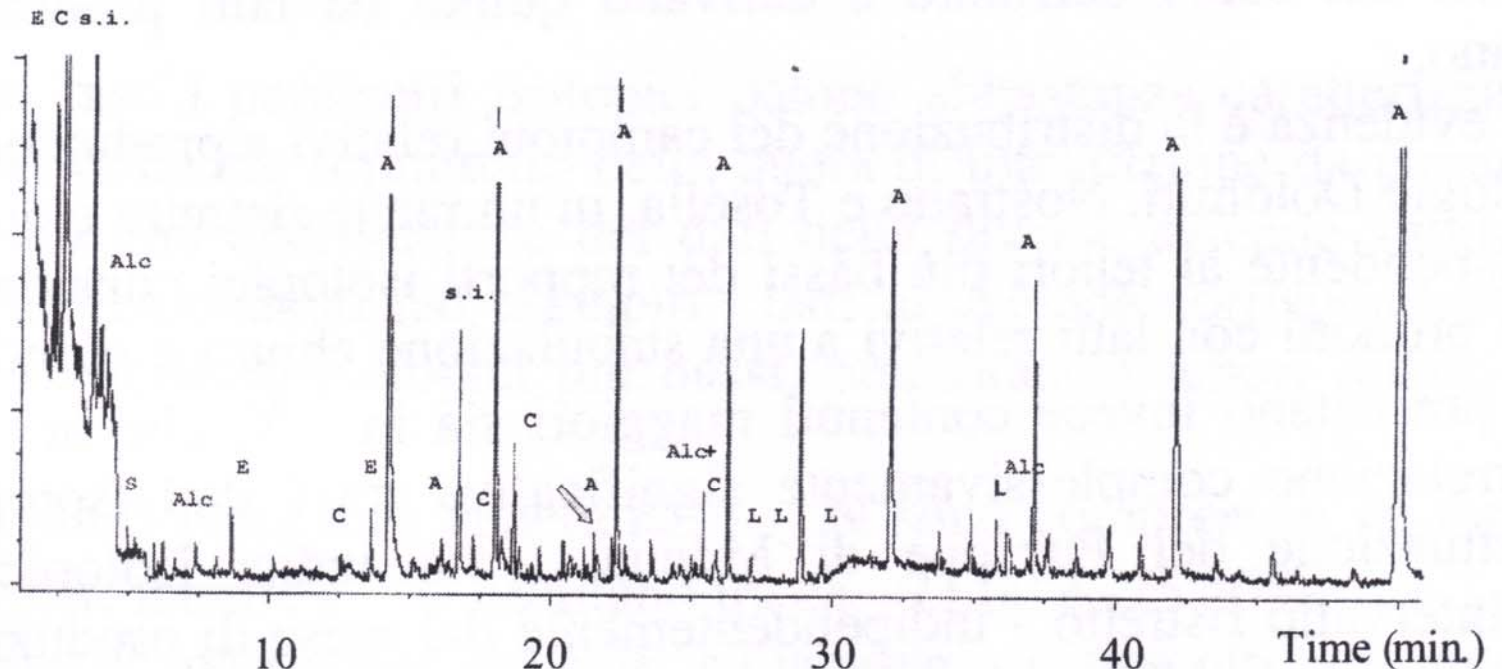
Metabolic markers

Volatile compounds

Puzzone  
di Moena



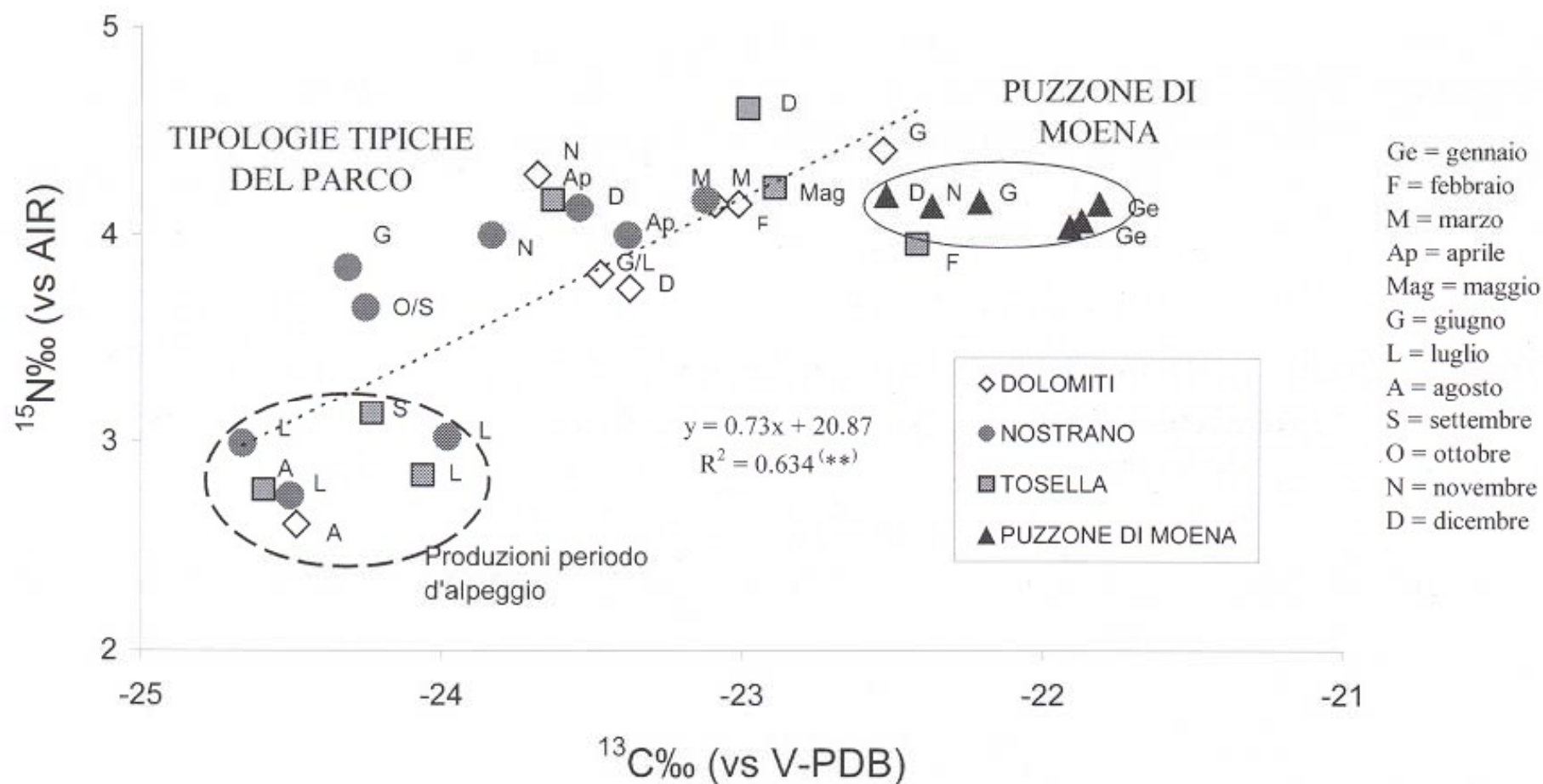
Nostrano



# Traceability

## Physical markers

Isotopes (Camin and Versini, 2001)  
 $^{15}\text{N}$  and  $^{13}\text{C}$  in cheeses



# Traceability

The next challenge

Great variability of the response.

Need to combine different methods  
or different markers



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# What does enhance quality of animal products mean?

Human nutrition has evolved:

from the prevention of deficiencies

to a system oriented to promote human health

For consumers, the products should be

safe

healthy

traceable

consistent

## The future trends for research on quality and safety of animal products are:

1. Extra-nutritional roles of food (promoters of health, respecting animal welfare and environment)
2. Willingness of consumer to pay more for quality should be careful investigated (i.e., interdisciplinary approach to food science, social, economical and nutritional aspects)



*Muchas gracias por  
la vuestra atención!*