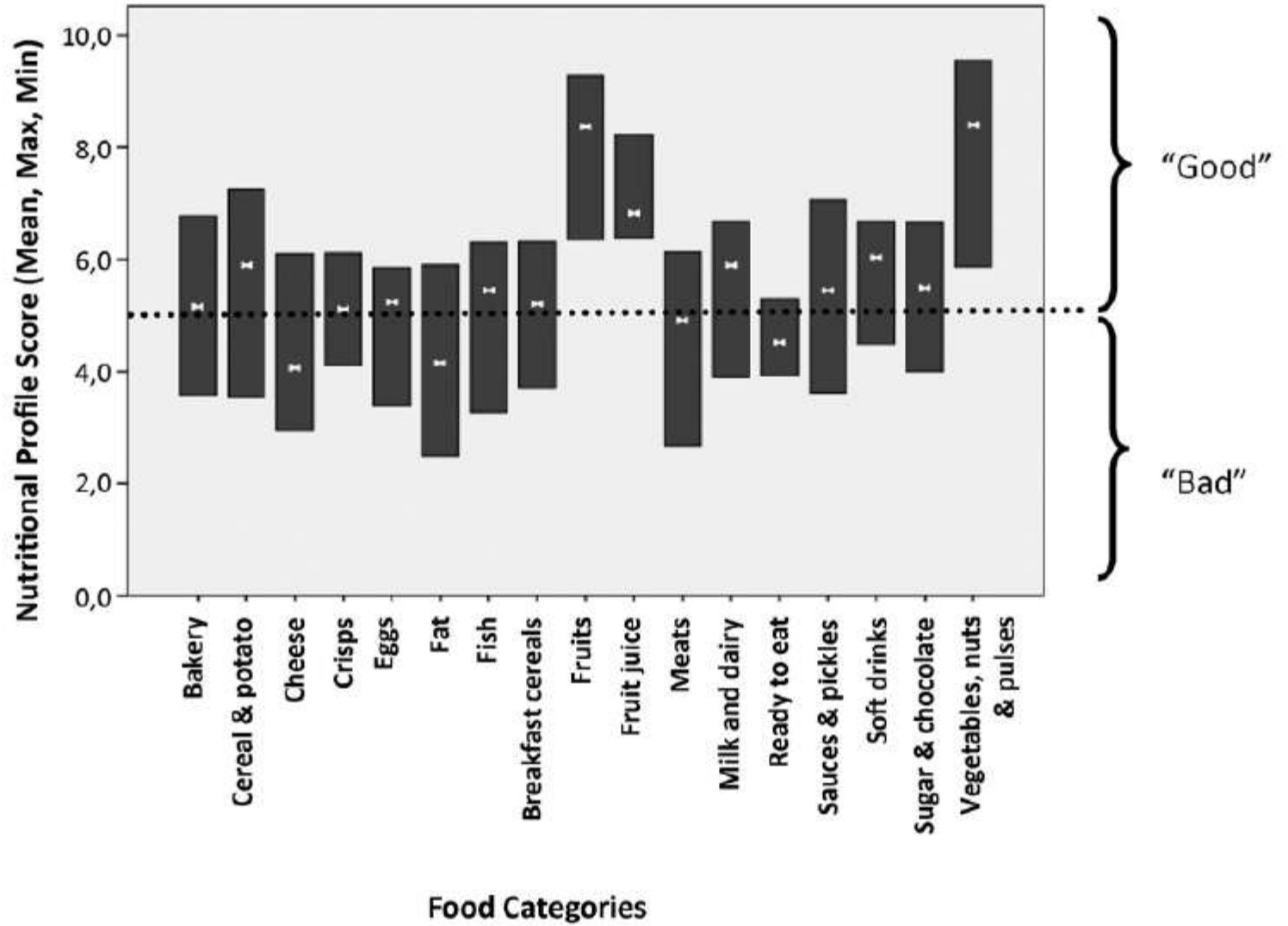


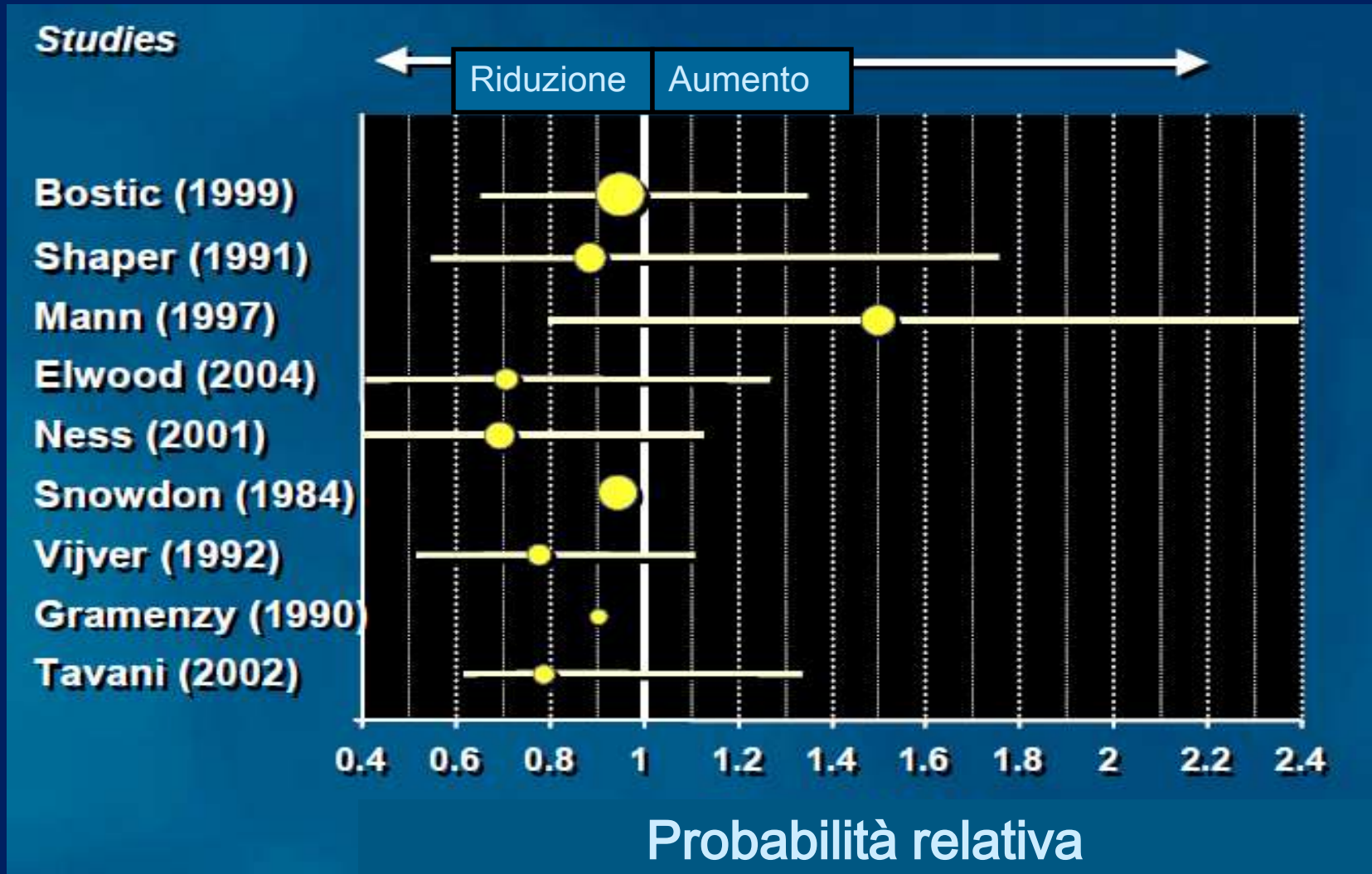
**Proprietà nutrizionali del pecorino.  
Frazione lipidica ed effetti sul metabolismo  
dell'uomo.**

**Sebastiano Banni**

**Dip. di Scienze Biomediche  
Università degli Studi di Cagliari.  
[banni@unica.it](mailto:banni@unica.it)**



# Prodotti lattiero-caseari e incidenza di malattie cardiovascolari



Modificato da Elwood et al. (2004) *Eur J Clin Nutr.* 58:718

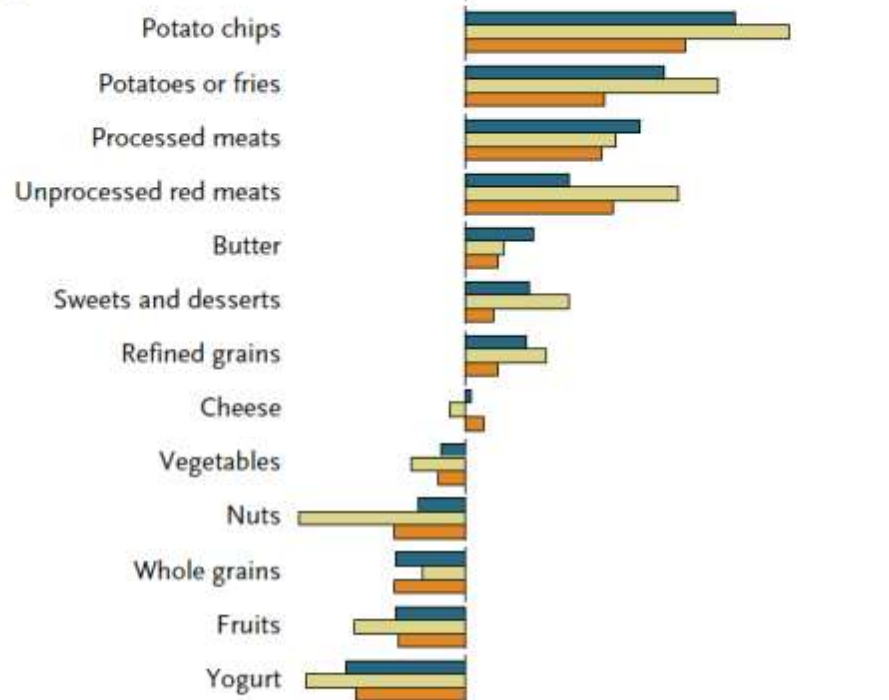
N Engl J Med 2011;364:2392-404.

ORIGINAL ARTICLE

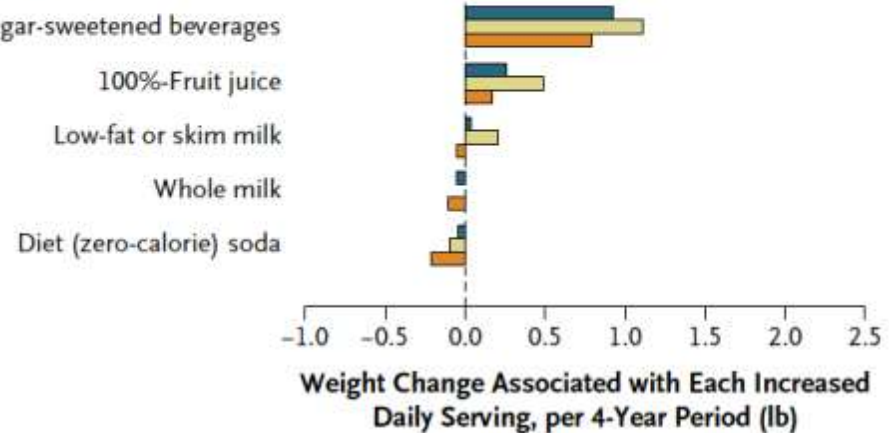
# Changes in Diet and Lifestyle and Long-Term Weight Gain in Women and Men

Dariusz Mozaffarian, M.D., Dr.P.H., Tao Hao, M.P.H., Eric B. Rimm, Sc.D.,  
Walter C. Willett, M.D., Dr.P.H., and Frank B. Hu, M.D., Ph.D.

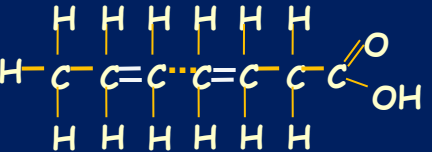
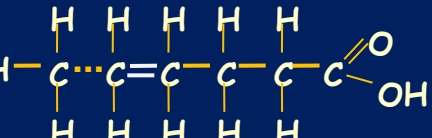
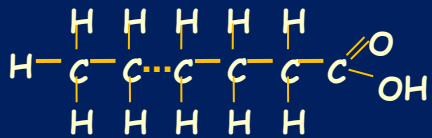
## Foods



## Beverages

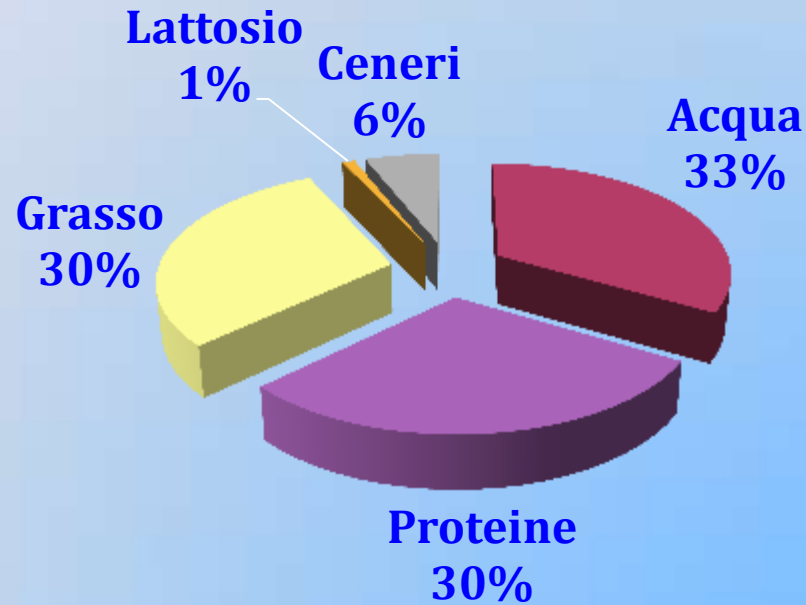


# Composizione dei grassi del latte



Acidi grassi	Vacca	Bufala	Pecora	Capra
saturi	68.3	66.5	72.1	79.1
monoinsaturi	25.6	30.4	22.4	19.1
polinsaturi	6.1	3.2	5.4	1.8
saturi IC	46.9	46.1	44.4	44.9

# Formaggio di pecora



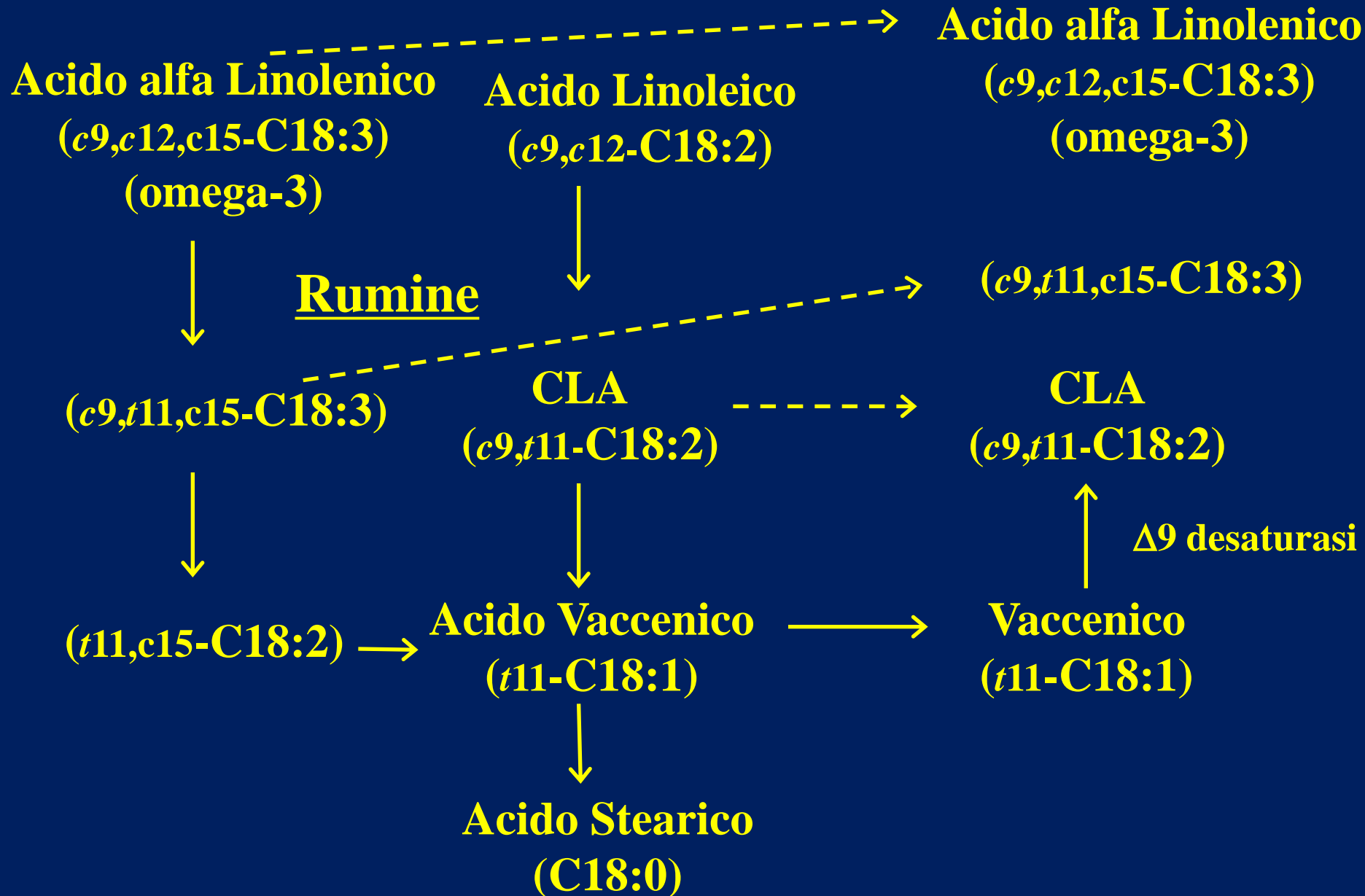
400 diversi tipi di acidi grassi



Dipendenti dalla dieta dell'animale

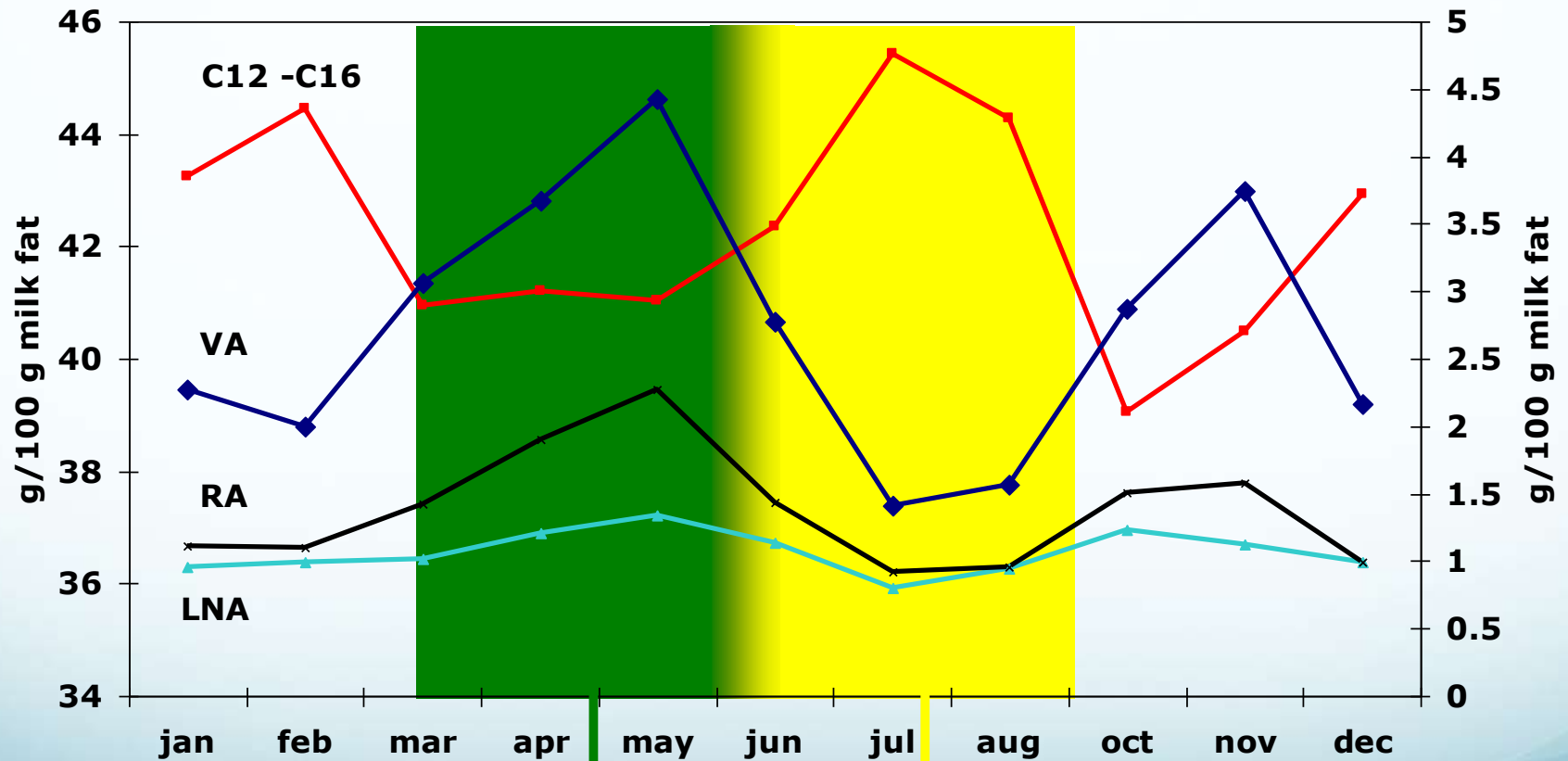
## Dieta (erba fresca)

## Carne e latte





# La stagionalità delle produzioni, conseguente ai parti dei mammiferi erbivori concentrati a fine inverno, garantisce una produzione di latte con caratteristiche nutrizionali ottimali



Max. pasture availability

Min. pasture availability

# Studio "CASU"

Studio nutrizionale su soggetti con lieve ipercolesterolemia relativo alla capacità di prodotti lattiero-caseari naturalmente ricchi in acido linoleico coniugato (CLA) di abbassare i livelli plasmatici del colesterolo LDL rispetto a prodotti di controllo non arricchiti.

Progetto FISR "Qualità dei prodotti di origine animale e salute umana: miglioramento della frazione lipidica e minerale del latte e dei latticini di vacca, pecora e capra al fine di accrescere il valore nutraceutico e la sicurezza di questi alimenti" Coordinato da Prof. Secchiari

## Dip. Scienze Biomediche

Az. Ospedaliera Brotzu

Dott. S. Pintus,  
Dott. P. Pintus,  
Dott.<sup>ssa</sup> D. Pistis.

Prof. **Sebastiano Banni**, Dip. Scienze Biomediche.

Dott.<sup>ssa</sup> **Gianfranca Carta**,

Dott.<sup>ssa</sup> **Elisabetta Murru**, Dott.<sup>ssa</sup> **B. Batetta**,

Dott.<sup>ssa</sup> **Lina Cordeddu**, Dott.<sup>ssa</sup> **F. Sanna**,

Dott.<sup>ssa</sup> **Elena Giordano**, Dott.<sup>ssa</sup> **S. Uda**,

Dott.<sup>ssa</sup> **Annarita Sirigu**. Dott.<sup>ssa</sup> **S. Accossu**.

Estensione del Progetto

Camera di Commercio Provincia di Cagliari

Ulteriori collaborazione

Dot.t. Guido Almerighi e Dott.a Monica Giambalvo

U.O. Obesità ASL 8

# Studio "CASU"

## Criteri d' inclusione

Uomini > 18 anni e donne in menopausa;  
Colesterolo tot >200 mg/dl e <300 mg/dl;  
Trigliceridi  $\leq$  250 mg/dl;  
HDL  $\leq$  70 mg/dl;  
apoE: e3e3;  
BMI  $\leq$  30

Ai 42 pazienti (19M e 23F) età media  $53.5 \pm 9.6$  è stato chiesto di non modificare le proprie abitudini alimentari per tutta la durata del trattamento.

# Composizione in acidi grassi del pecorino

Fatty Acids	% in cheese fat		g/90 of cheese	
	CTRL	ENCH	CTRL	ENCH
total SFA	59.3	45.9	13.6	10.0
short chain (c4-c10)	16.6	11.3	3.8	2.5
c12:0	2.9	1.8	0.7	0.4
c14:0	8.5	6.1	1.9	1.3
c16:0	20.5	16.0	4.7	3.5
c18:0	10.5	10.5	2.4	2.3
Total cis MUFA	19.0	21.2	4.3	4.6
c16:1n-9	0.3	0.3	0.1	0.1
c18:1n-9	18.6	20.9	4.3	4.5
Total trans MUFA	3.4	10.6	0.8	2.3
c18:1 t11 (VA)	1.7	6.3	0.4	1.4
Total PUFA n-6	2.3	2.3	0.5	0.5
c18:2n-6 (LA)	2.2	2.2	0.5	0.5
Total PUFA n-3	0.6	2.1	0.1	0.5
c18:3n-3 (ALA)	0.6	2.1	0.1	0.5
Total trans PUFA	0.4	1.6	0.1	0.3
Total CLA	1.0	2.8	0.2	0.6
c9,t11 CLA	0.8	2.5	0.2	0.5

# modello sperimentale

90g/die Formaggio ricco in CLA;  
3 sett  
Wash out; 3 sett

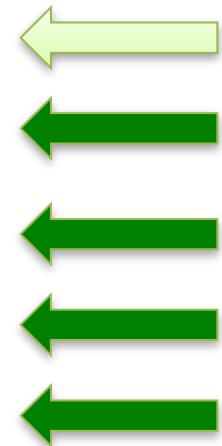
45g/die Formaggio ricco in CLA; 3 sett  
↓  
Wash out; 3 sett

45g/die Formaggio Controllo; 3 sett  
↓  
Wash out; 3 sett

90g/die Formaggio Controllo; 3 sett  
↓  
Wash out; 3 sett

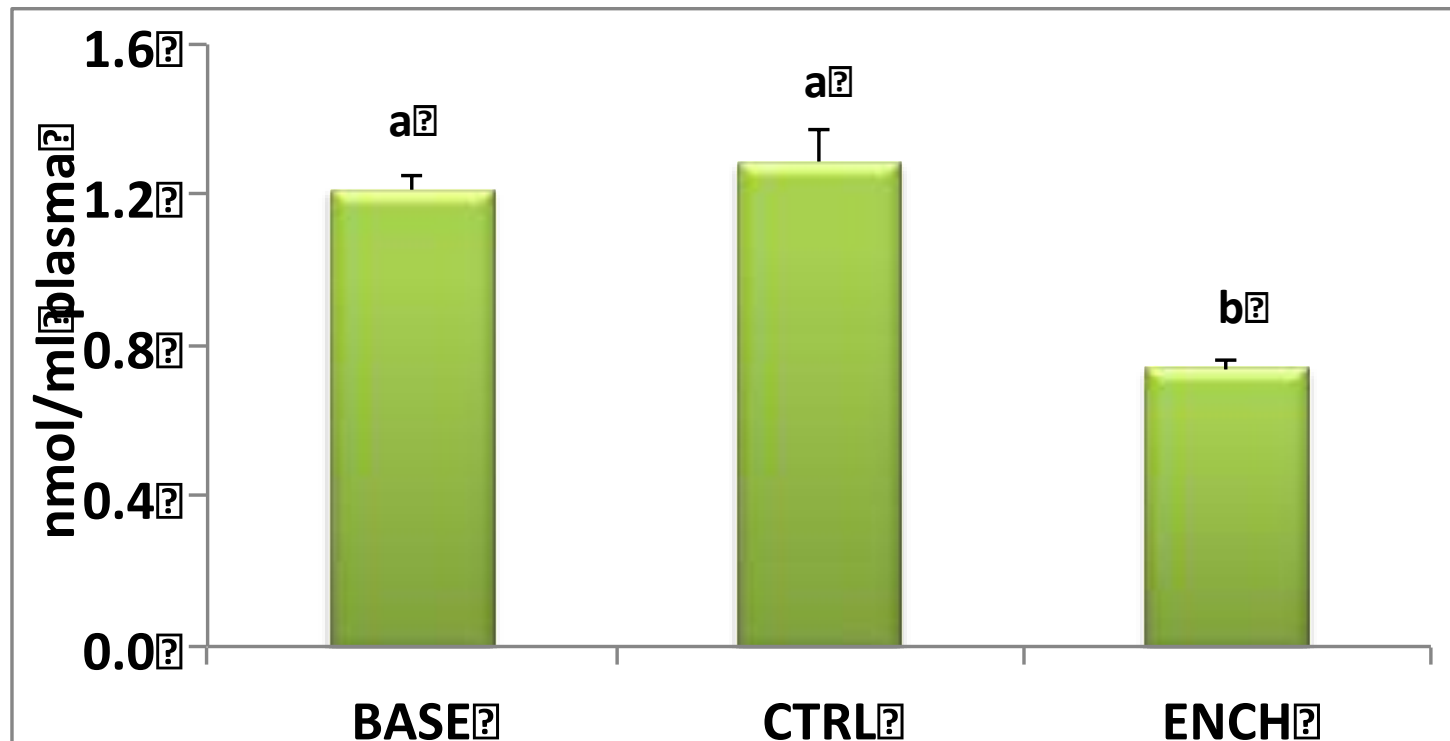


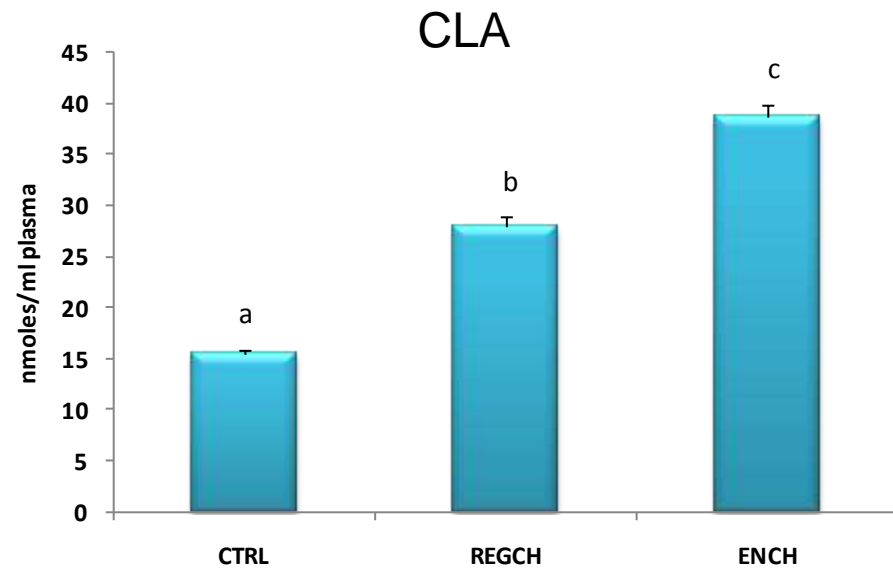
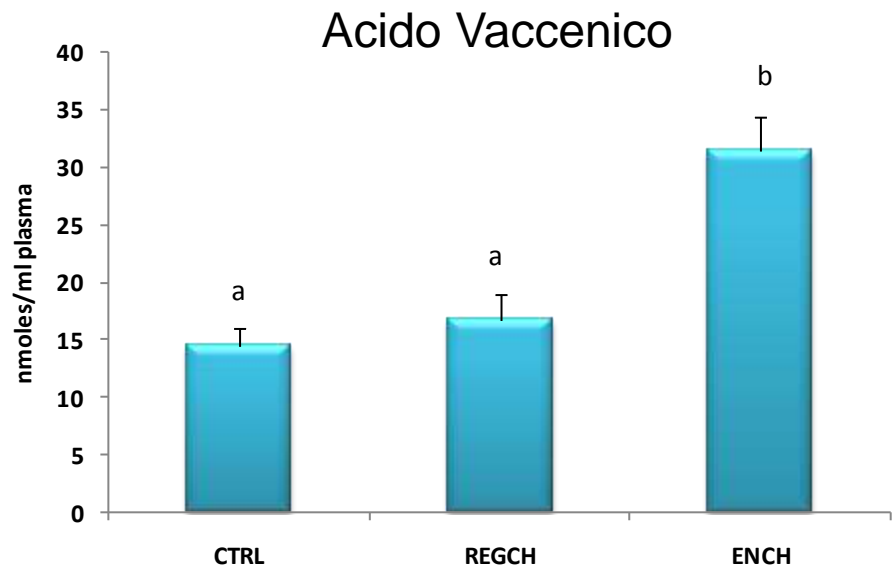
	Baseline	REGCH	ENCH
BMI (Kg/m <sup>2</sup> )	26.64 ± 2.83	26.30 ± 3.18	26.03 ± 3.21
Tot chol. (mg/dL)	243.52 ± 18.54 <sup>a</sup>	256.29 ± 31.96 <sup>a</sup>	230.80 ± 18.41 <sup>b</sup>
C-LDL (mg/dL)	165.88 ± 16.2 <sup>a</sup>	170.55 ± 26.03 <sup>a</sup>	154.79 ± 13.26 <sup>b</sup>
C-HDL (mg/dL)	55.36 ± 9.46 <sup>a</sup>	61.84 ± 11.48 <sup>b</sup>	56.54 ± 10.42 <sup>a</sup>
C- non HDL (mg/dL)	188.17 ± 19.44 <sup>a</sup>	188.74 ± 41.95 <sup>a</sup>	174.27 ± 18.38 <sup>b</sup>
tot/HDL	4.54 ± 0.98	4.25 ± 0.81	4.23 ± 0.92
TAG (mg/dL)	111.81 ± 52.06	120.29 ± 87.92	111.71 ± 69.70
Glycemia (mg/dL)	99.33 ± 12.17	96.97 ± 8.05	98.98 ± 12.85
Creatinine (mg/dL)	0.99 ± 0.16	0.96 ± 0.13	0.97 ± 0.15
Uricemia (mg/dL)	5.14 ± 1.13	5.14 ± 3.02	4.89 ± 1.06





# Livelli di lipoidroperossidi plasmatici come marker di stress ossidativo

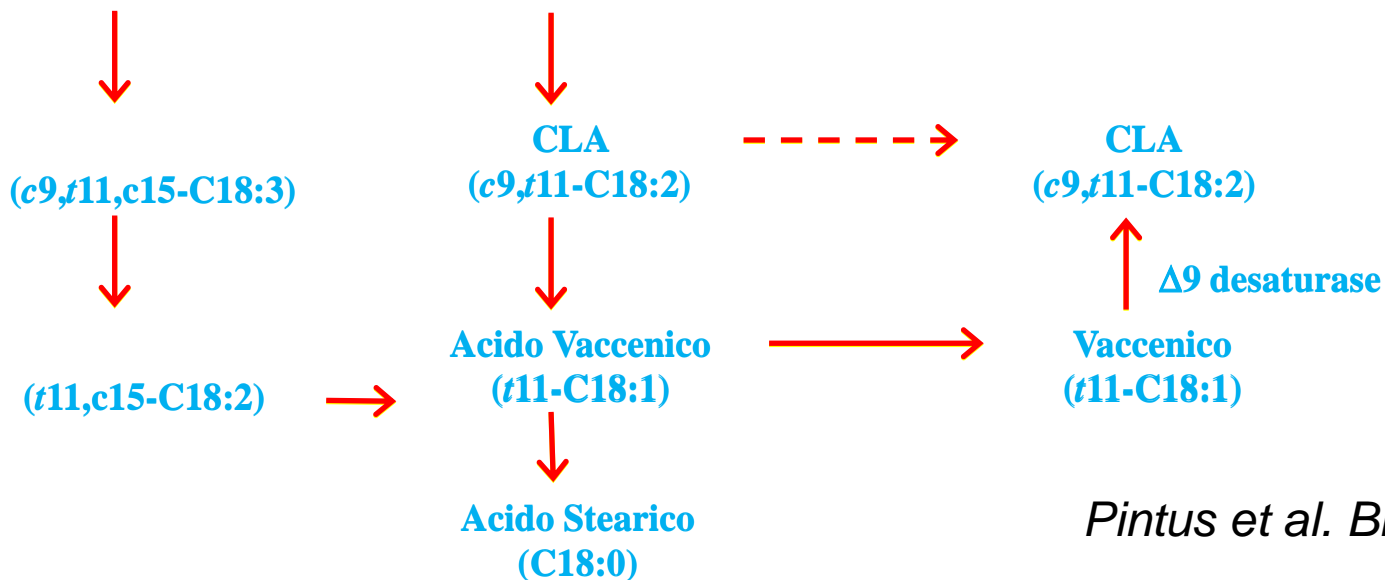




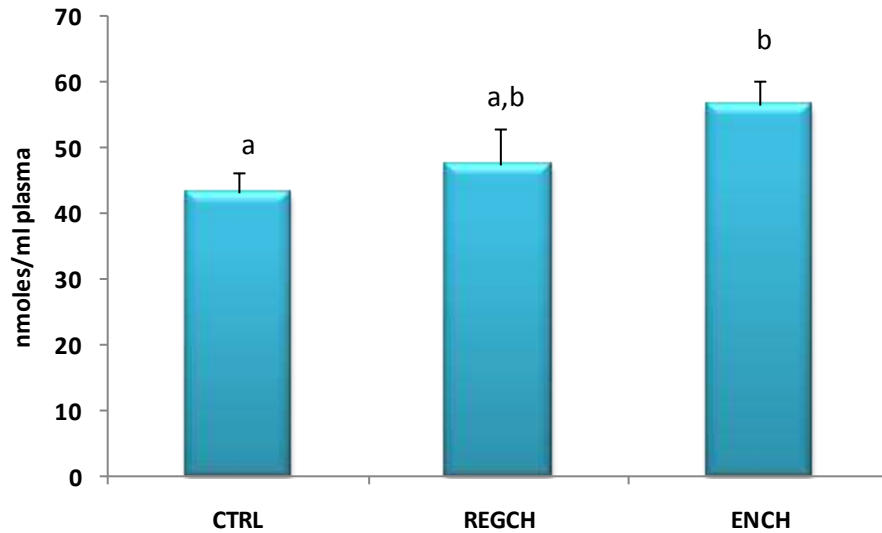
Acido Linolenico  
(c9,c12,c15-C18:3)

Acido Linoleico  
(c9,c12-C18:2)

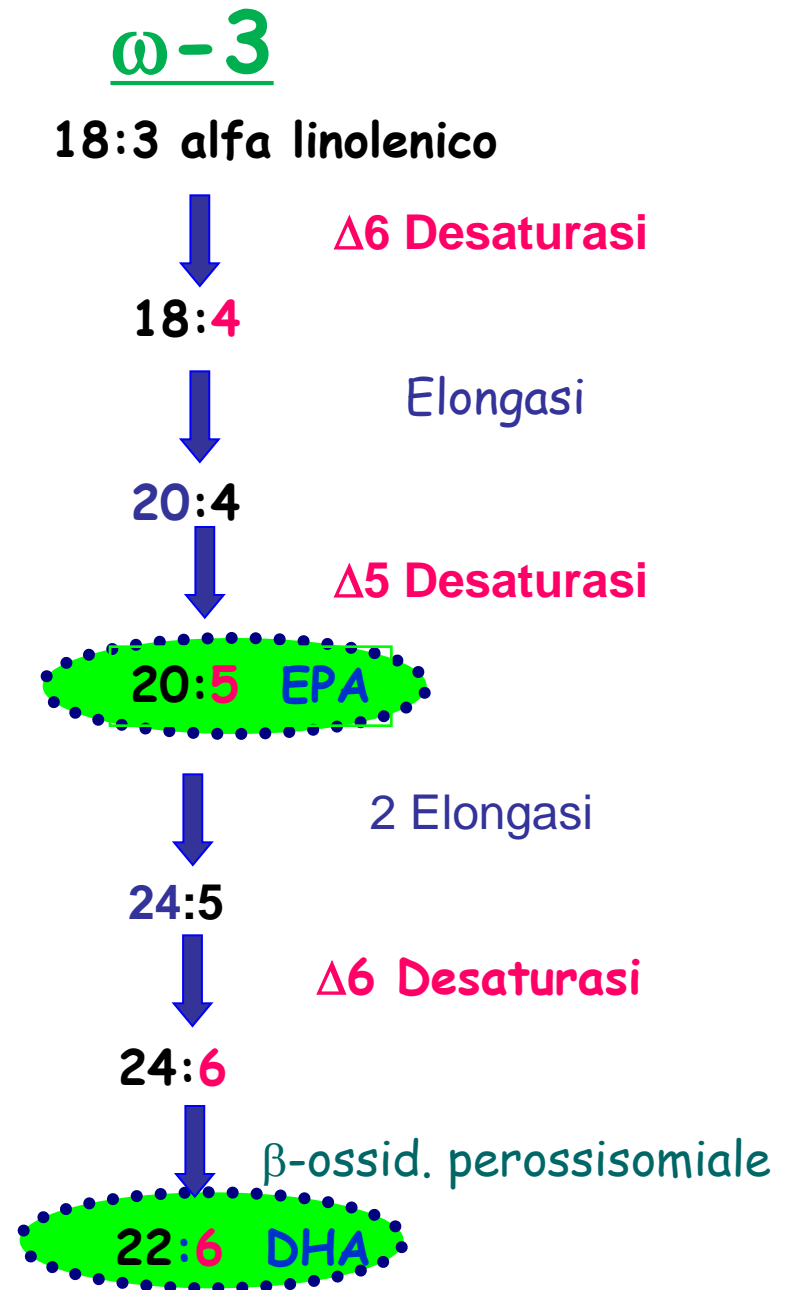
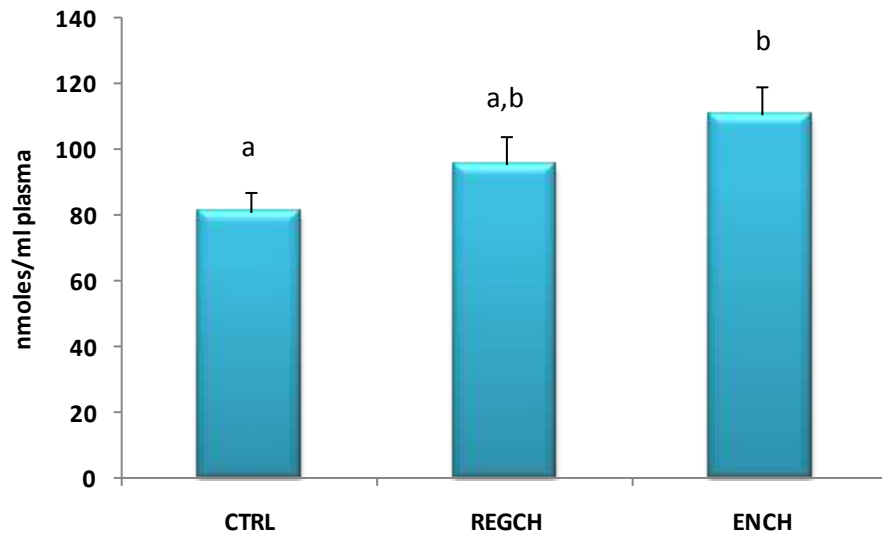
Rumine



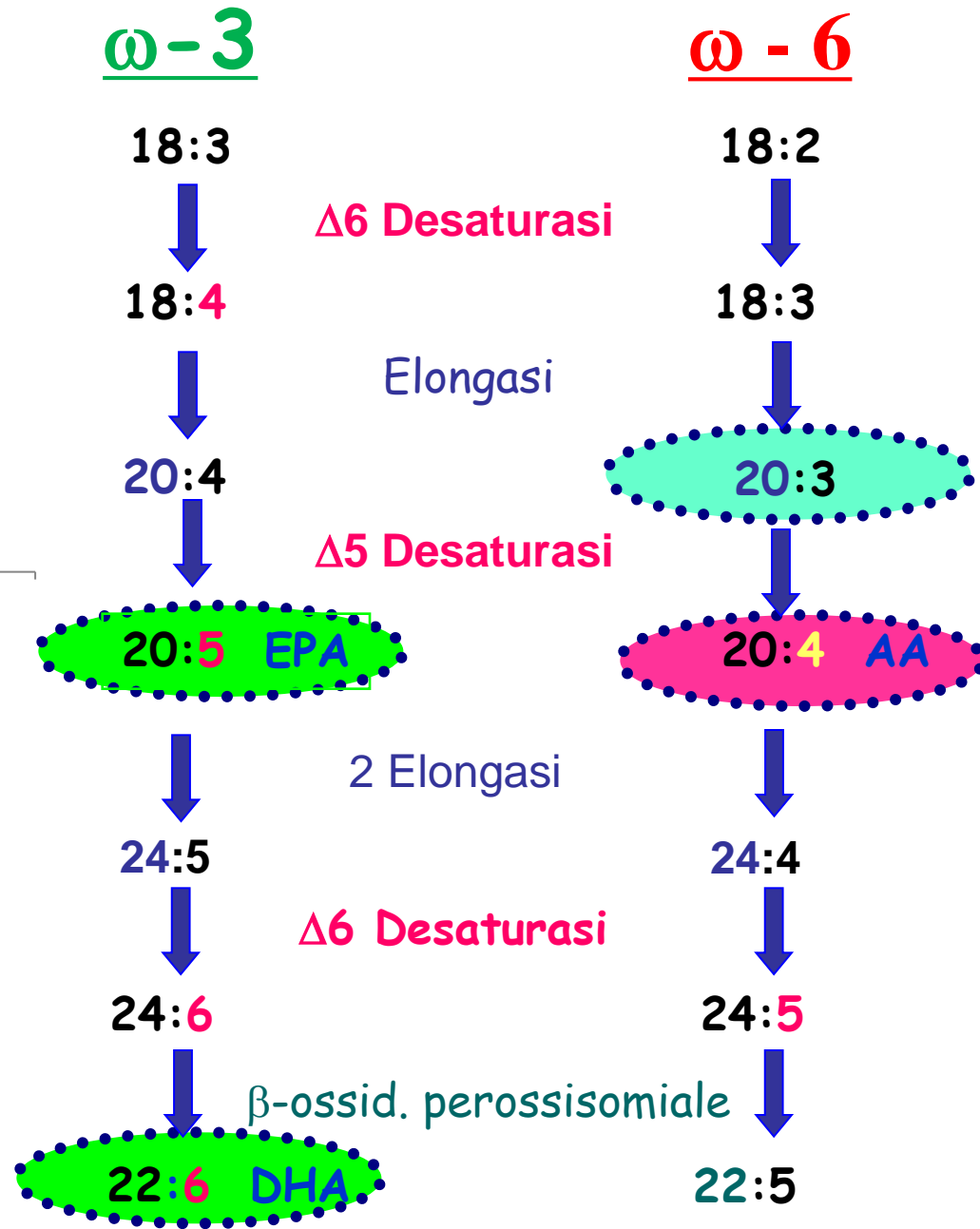
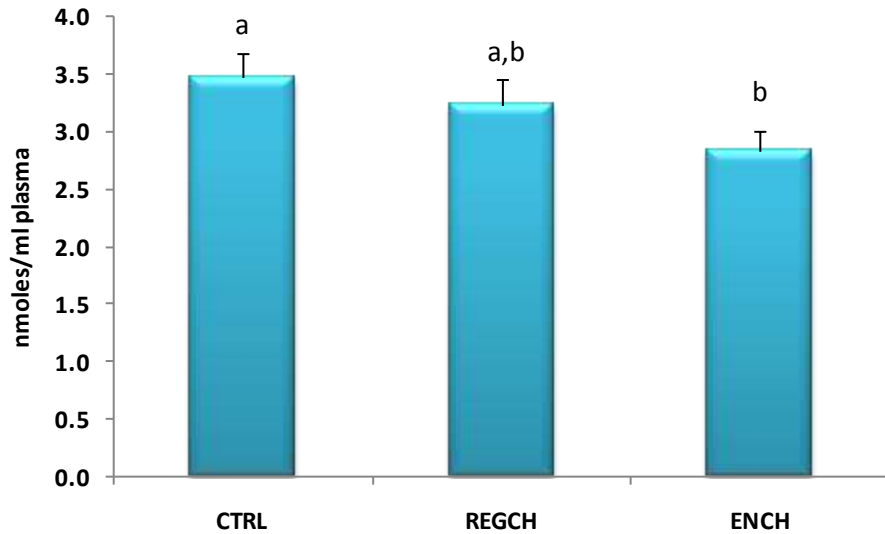
## Alfa linolenico



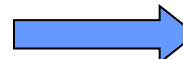
## EPA



Omega-6/omega-3



# endocannabinoidi



Aumento  
Della Fame  
Riduzione del  
metabolismo  
energetico

5

RAPPORTO  
OTTIMALE  
NELLA DIETA

1

Funzione  
cerebrale  
e visiva

Acido  
arachidonico

DPA

Omega-6

Grassi Animali

Omega-3

Oli vegetali

EPA

DHA

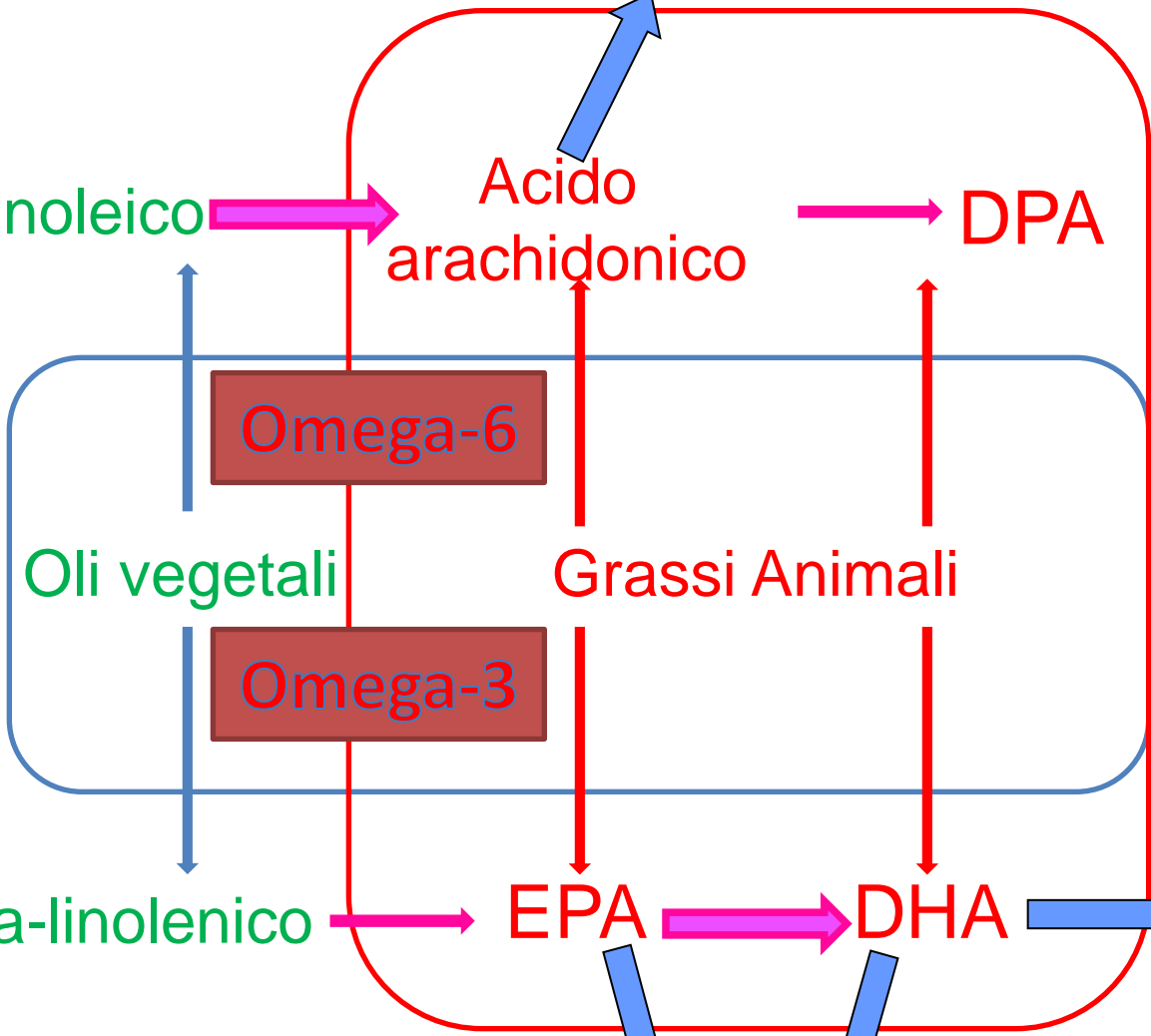
attività

Antiinfiammatoria antiproliferativa

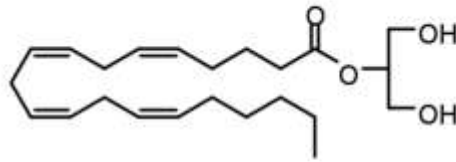
Acido linoleico



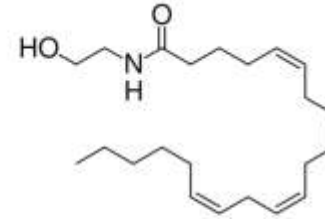
Acido alfa-linolenico



# ENDOCANNABINOIDI



**2-arachidonil glicerolo (2-AG)**

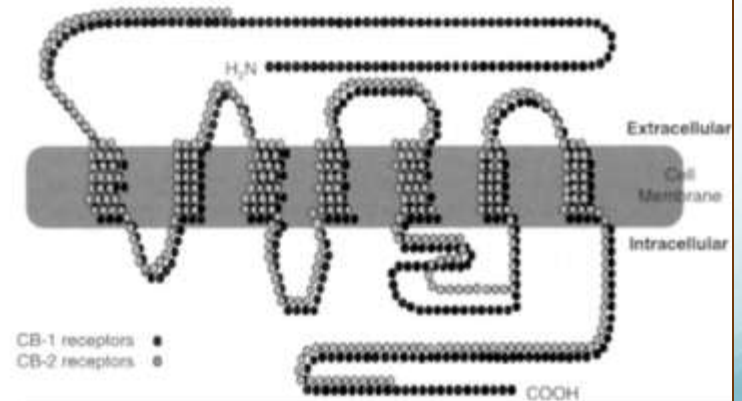


**anandamide (AEA)**



- **Bilancio energetico**
- **Comportamento alimentare**
- **Metabolismo lipidico**
- **Resistenza insulinica**

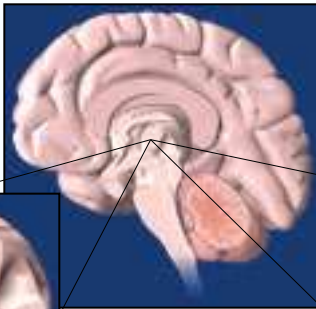
Ligandi endogeni dei recettori CB1 e CB2



# TARGET CENTRALI E PERIFERICI E IPERATTIVITÀ DEL SISTEMA ENDOCANNABINOIDE

**Cervello**

**Tessuti Periferici**



**Ipotalamo:**  
↑ Fame

**Nucleus accumbens:**  
↑ Motivazione

**Aumento introduzione di cibo**  
**Aumentato accumulo grassi**

**Tessuto adiposo**

**Fegato**

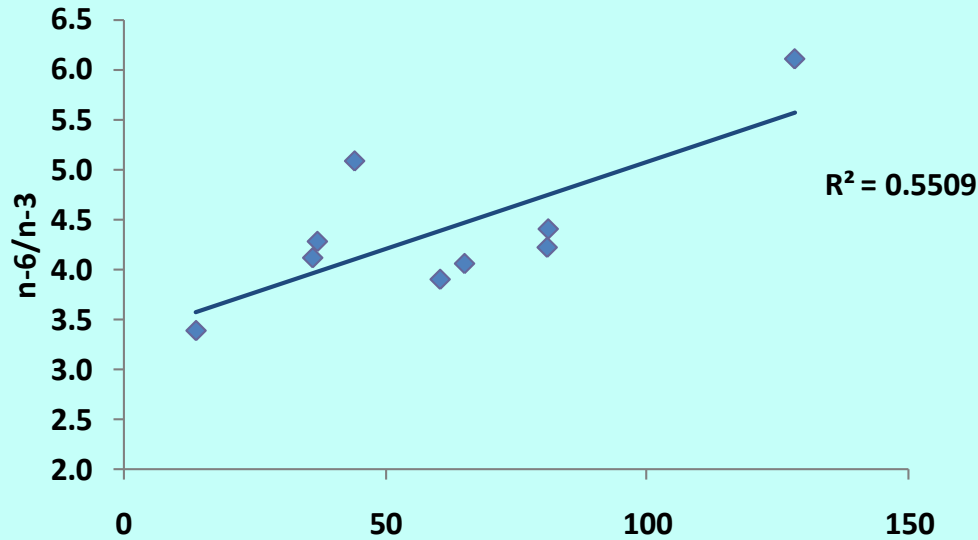
**Tratto GI**

**Muscolo**

↑ Insulino Resistenza  
↓ HDL-colesterolo  
↑ Trigliceridi  
↓ Uptake glucosio  
↓ Adiponectina

**SINDROME METABOLICA**

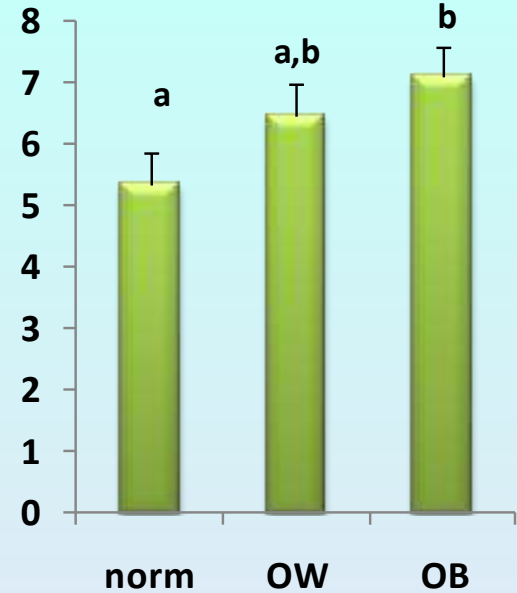
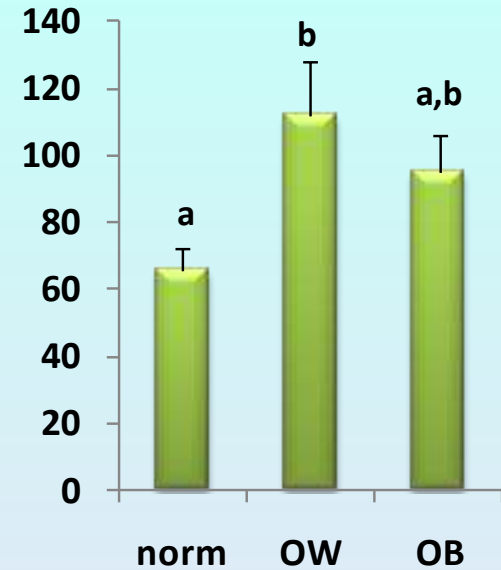
### correlation between n-6/n-3 ratio and endocannabinoid in KO treated obese patients



#### 2-AG

endocannabinoid (pmoles/ml plasma)

#### AEA





# Fosfolipidi

Sn-1

Sn-2

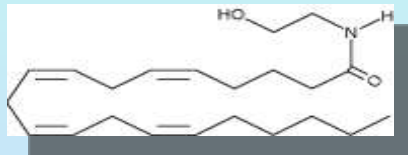
20:4

20:4

**anandamide**

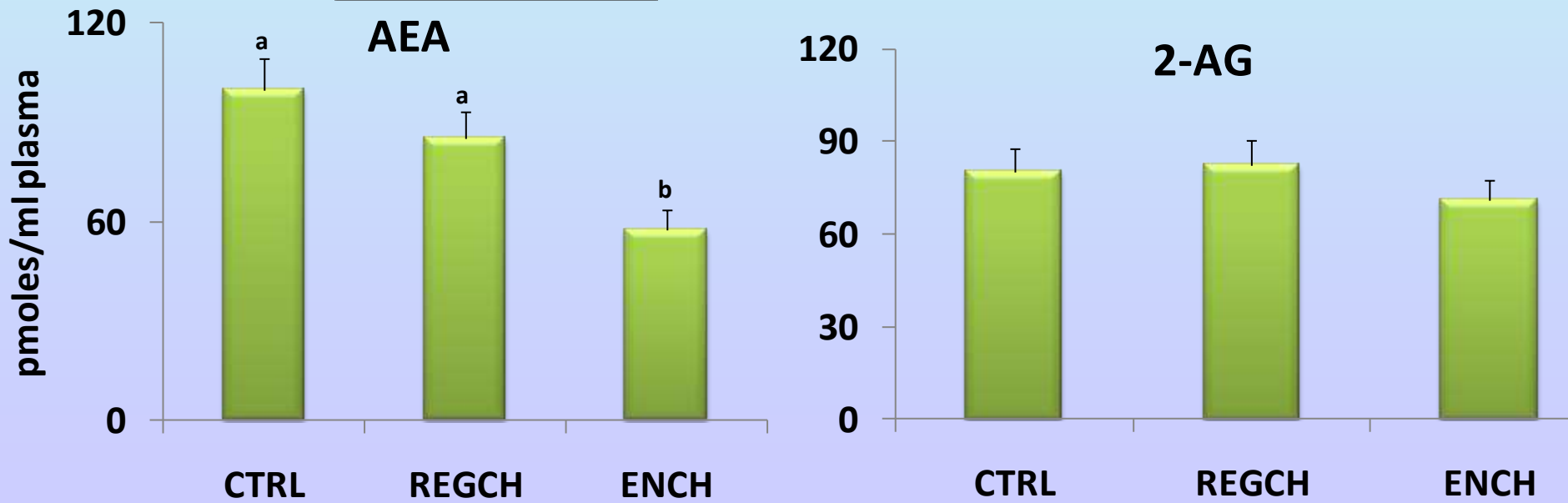
**2-AG**

**endocannabinoidi**

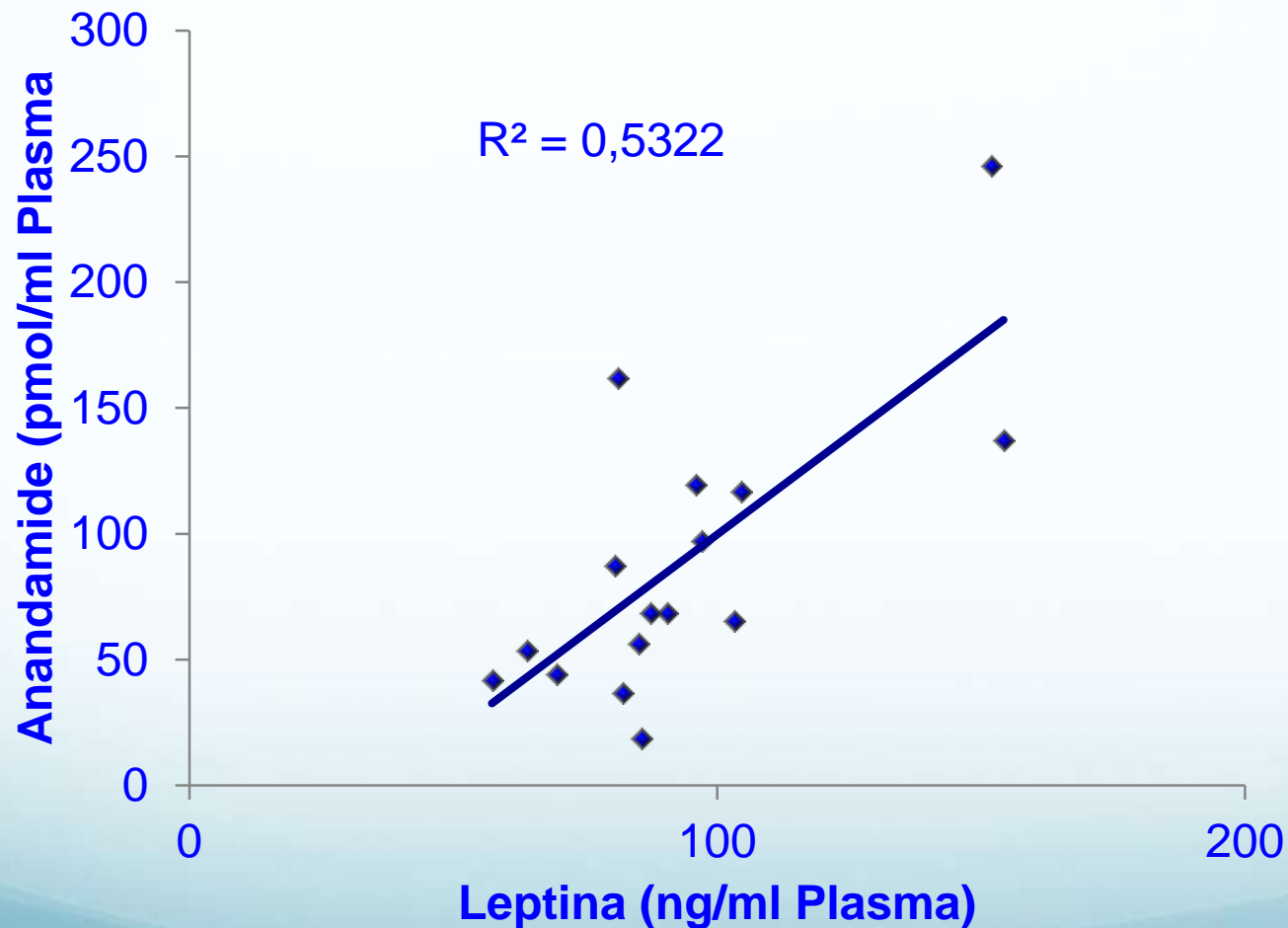


**AEA**

**2-AG**



# Correlazione tra livelli dell'endocannabinoide anandamide e leptina in pazienti ipercolesterolemici alimentati con il formaggio arricchito





The Journal of Nutrition

**Nutrient Physiology, Metabolism, and Nutrient-Nutrient Interactions**

J. Nutr. 141: 1626–1634, 2011.

# **Increased Consumption of Dairy Foods and Protein during Diet- and Exercise-Induced Weight Loss Promotes Fat Mass Loss and Lean Mass Gain in Overweight and Obese Premenopausal Women<sup>1–4</sup>**

Andrea R. Josse,<sup>5</sup> Stephanie A. Atkinson,<sup>6</sup> Mark A. Tarnopolsky,<sup>7</sup> and Stuart M. Phillips<sup>5\*</sup>

## The association between dairy product consumption and cognitive function in the National Health and Nutrition Examination Survey

Keigan M. Park<sup>1\*</sup> and Victor L. Fulgoni III<sup>2</sup>

***.....there were associations observed between 20- and 59-year-old consumers of total dairy foods and a higher SDST percentile score and a calculated global cognitive percentile score compared with nonconsumers.***

***A similar significant association was observed with cheese consumers. In adults over 60 years of age, an association between total dairy product consumption and higher DSST percentile scores was also observed.***

***These findings highlight the need for additional research on how dairy products may affect cognition and by what mechanisms, through its nutrients or other components.***

Stato infiammatorio cronico  
Attivazione cronica sistema  
immunitario

Stimolazione  
produzione  
eicosanoidi

Alto  
Rapporto  
n-6/n-3

Phospholipids

Sn1

Sn2

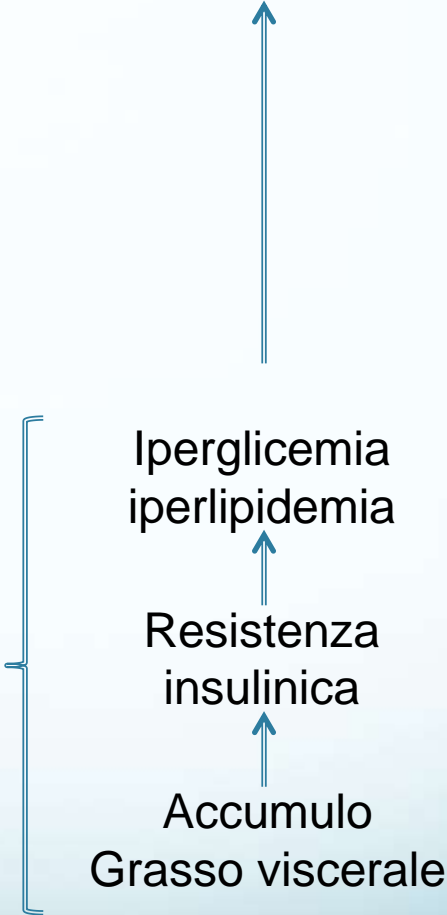
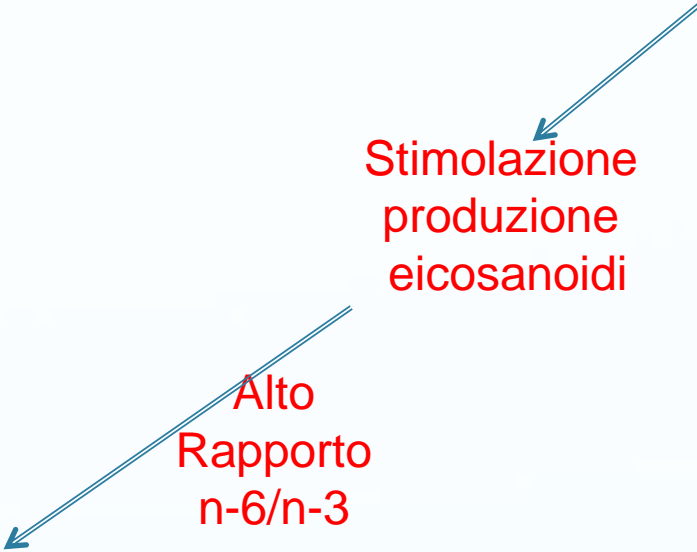
↑ 20:4

↑ Eicosanoidi  
proinfiammatori

Iperglicemia  
iperlipidemia

Resistenza  
insulinica

Accumulo  
Grasso viscerale



Stimolazione  
produzione  
endocannabinoidi

Stato infiammatorio cronico  
Attivazione cronica sistema  
immunitario

Stimolazione  
produzione  
eicosanoidi

Alto  
Rapporto  
n-6/n-3

Phospholipids

Sn1

Sn2

20:4

20:4

↑ Eicosanoidi  
proinfiammatori

↑ endocannabinoidi

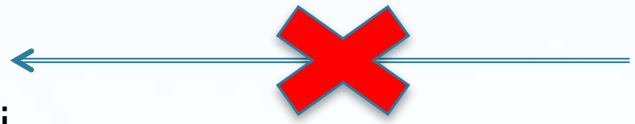
Iperglicemia  
iperlipidemia  
Resistenza  
insulinica  
Accumulo  
Grasso viscerale

↑ anandamide

↓ 2-AG

Stimolazione  
produzione  
endocannabinoidi

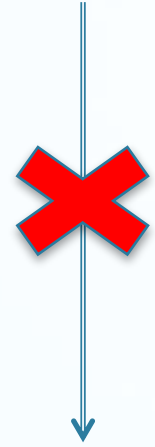
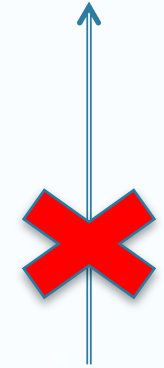
Stato infiammatorio cronico  
Attivazione cronica sistema  
immunitario



ALA+CLA  
VA

Stimolazione  
produzione  
eicosanoidi

Aumento  
Rapporto  
N-3/n-6



Phospholipids

Sn1

Sn2

↓ 20:4

↓ 20:4

↓ anandamide

↓ 2-AG

↓ Eicosanoidi  
proinfiammatori

↓ endocannabinoidi

Iperglicemia  
iperlipidemia  
Resistenza  
insulinica  
Accumulo  
Grasso viscerale

Apporto alimentare  
di formaggi  
ricchi in CLA



Miglioramento del profilo  
colesterolemico, del rapporto  
omega-6/omega-3 e del tono  
endocannabinoide



Metabolismo osseo,  
apporto proteico,  
apporto vitaminico.



Studi futuri:  
Individuazione di  
popolazioni responsive  
per la Valutazione di  
una eventuale riduzione  
del rischio  
cardiovascolare



# Self-perceived lactose intolerance results in lower intakes of calcium and dairy foods and is associated with hypertension and diabetes in adults<sup>1-4</sup>

*Theresa A Nicklas, Haiyan Qu, Sheryl O Hughes, Mengying He, Sara E Wagner, Herman R Foushee, and Richard M Shewchuk*

Am J Clin Nutr 2011;94:191-8.

# *Un particolare ringraziamento.....*

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