Modificación del perfil lipídico de quesos artesanales por bacterias lácticas autóctonas

Dra. Carina Van Nieuwenhove

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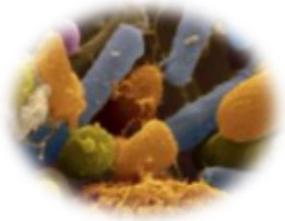
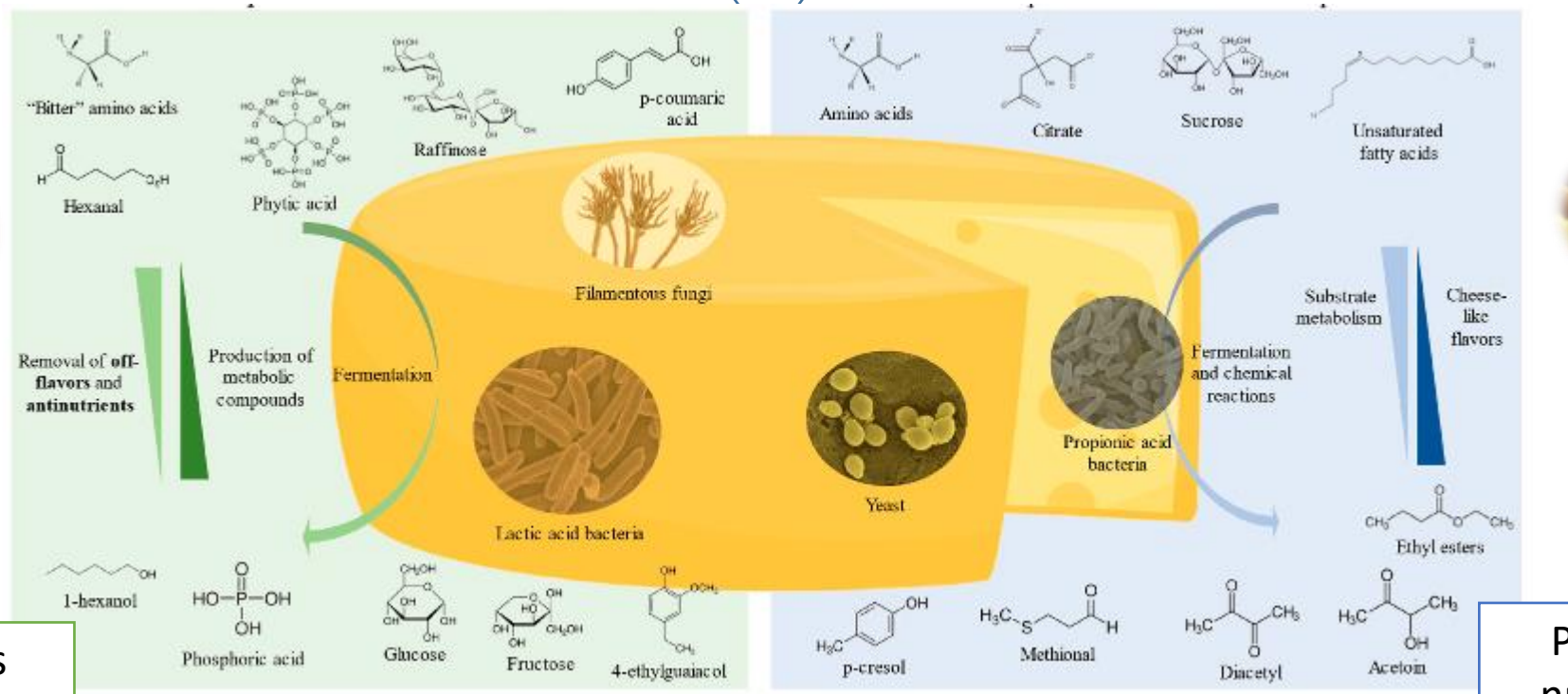
Quesos y microbiota





Compuestos antinutricionales Off-flavor

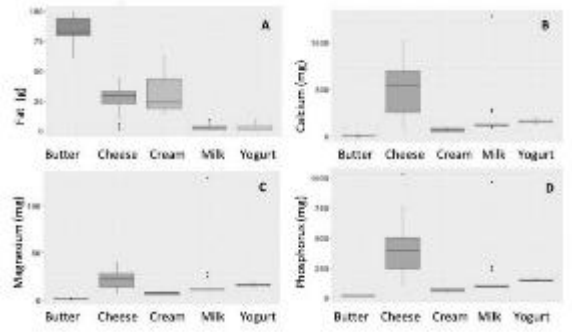
Propiedades nutricionales, sensoriales y funcionales

Consumo de lácteos y efectos en la salud

Efectos adversos

Efectos benéficos

- Reduce inflación y lipoperoxidación
- Aporta vitaminas y minerales
- Disminuye riesgo de CVD
- Fuente de pre y probióticos



nutrients
MDPI

Review

Consumption of Dairy Foods and Cardiovascular Disease: A Systematic Review

Annalisa Giosuè [1,†], Ilaria Calabrese [2,†], Marilena Vitale [3], Gabriele Riccardi [1] and Olga Vaccaro [2,*]

nutrients
MDPI

Review

Dairy Consumption and Metabolic Health

Claire M. Timon [1], Aileen O'Connor [2,3], Nupur Bhargava [2,3], Eileen R. Gibney [2,3,*] and Emma L. Feeney [2,3]

CULTIVO INICIADOR (SLAB)

- Fermentación de carbohidratos
- Producción de ácido láctico
- Descenso del pH
- Degradación de caseínas
- Flavor durante la maduración

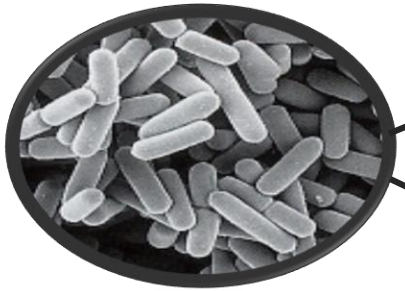
Propósito tecnológico

Lactococcus; Streptococcus; Lacticaseibacillus; Lactobacillus; Leuconostoc

CULTIVO ADJUNTO (NSLAB)

- Compuestos del flavor
- Producción de metabolitos bioactivos (cultivos funcionales)
- Metabolismo durante la maduración

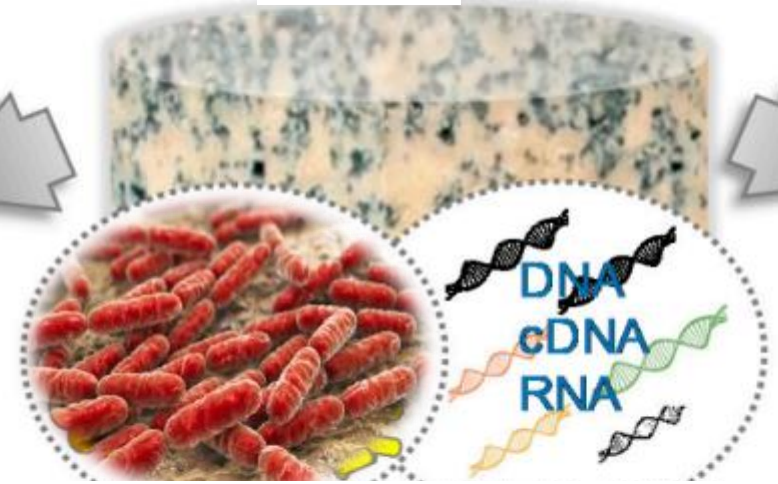
Propósito funcional



Cultivos comerciales

Cultivos autóctonos ⋯▶ Adaptación a la matriz

Bacterias lácticas y Fermentación



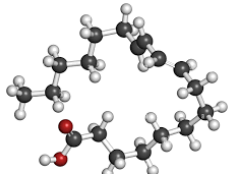
Cultivos lácticos y metabolismo

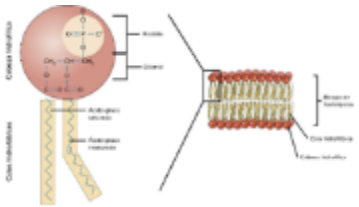
- Monosacáridos → Exopolisacáridos
- Proteínas → Peptidasas → Péptidos bioactivos
- Glutamina → GABA
- Lípidos → Compuestos del flavor
- Lípidos → Ácidos grasos derivados
- Glucosamina Ribulosa → Vitaminas
- Lactosa → Ácidos orgánicos

Lípidos de la leche

Mezcla compleja de compuestos con más de 400 AG, importantes desde el punto de vista nutricional, económico y funcional de los productos lácteos.

FUNCIÓN





- Energía
- Vehiculizar vitaminas (A, D, K y E)
- Sabor
- Suministros de AG esenciales y funcionales
- Función estructural

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Lípidos de la leche

Mezcla compleja de compuestos con más de 400 AG, importantes desde el punto de vista nutricional, económico y funcional de los productos lácteos.

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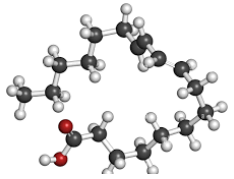

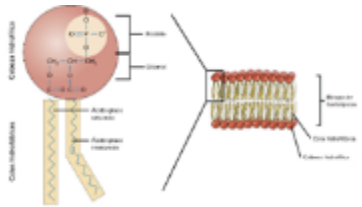

- Energía
- Vehiculizar vitaminas (A, D, K y E)
- Sabor
- Suministros de AG esenciales y funcionales
- Función estructural

- 0,4 % MAG
- 0,6 % DAG
- 97-98 % TAG
- 0,4 % Colesterol
- 1 % FL

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FOSFOLÍPIDOS (Esfingomielina)

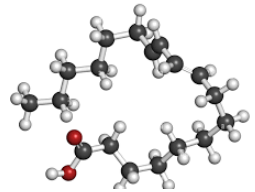
AG OMEGA 3

AG OMEGA 6

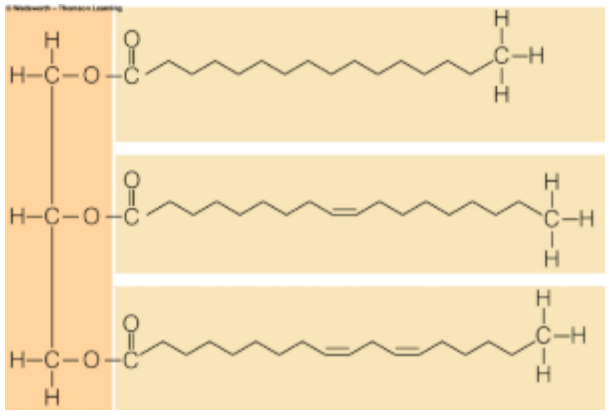
LÍPIDOS BIOACTIVOS

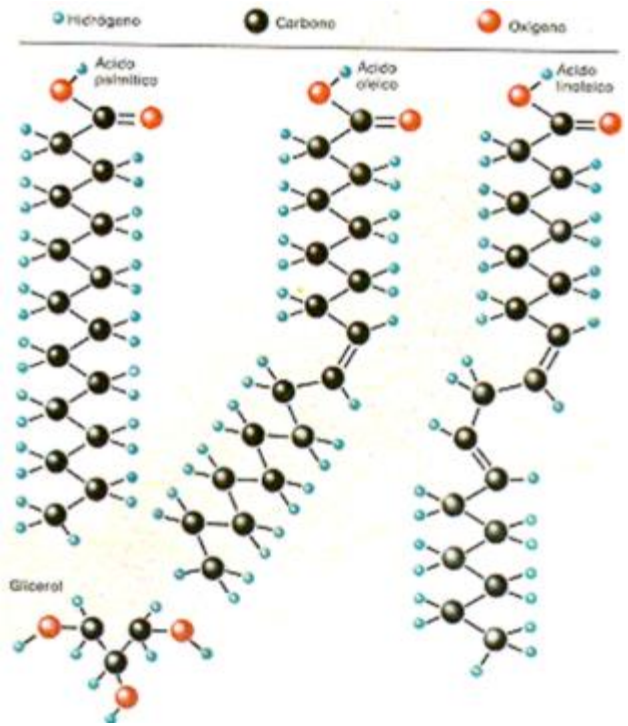
AG CADENA CORTA

AG CONJUGADOS

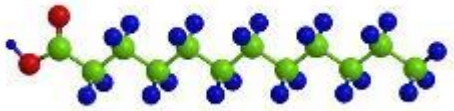


Triglicéridos

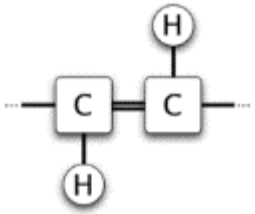




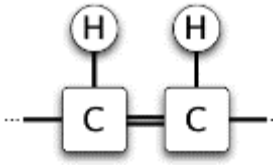
Ácidos grasos

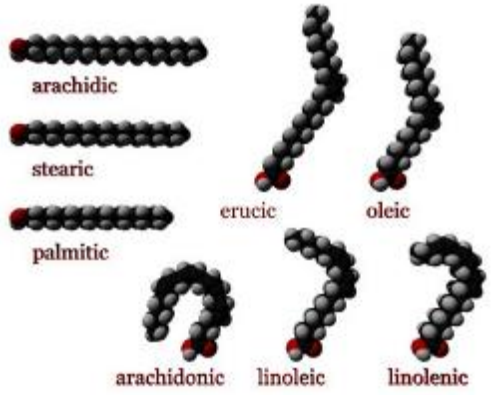


- **Saturados (C-C)** — **SFA**
- **Insaturados (-C=C-)** — **UFA**
  - **Monoinsaturados** — **MUFA**
  - **Poliinsaturados** — **PUFA**



cis, trans





LÍPIDOS DE LA LECHE

3-11 %

0,6 % DAG | **0,4 % MAG** | **97-98 % TAG** | **1 % FL** | **0,4 % Chol**

Perfil de ácidos grasos de rumiantes:

- **AG cadena corta:** 4-8 carbonos
- **AG cadena media:** 10-16 carbonos
- **AG de cadena larga:** > 16 carbonos

  AG esenciales: LA y LNA

  Pobre en EPA y DHA

  (0,1 g/100 g FA)

65-70 % SFA
25-30 % MUFA
3-5 % PUFA

DIETA

METABOLISMO

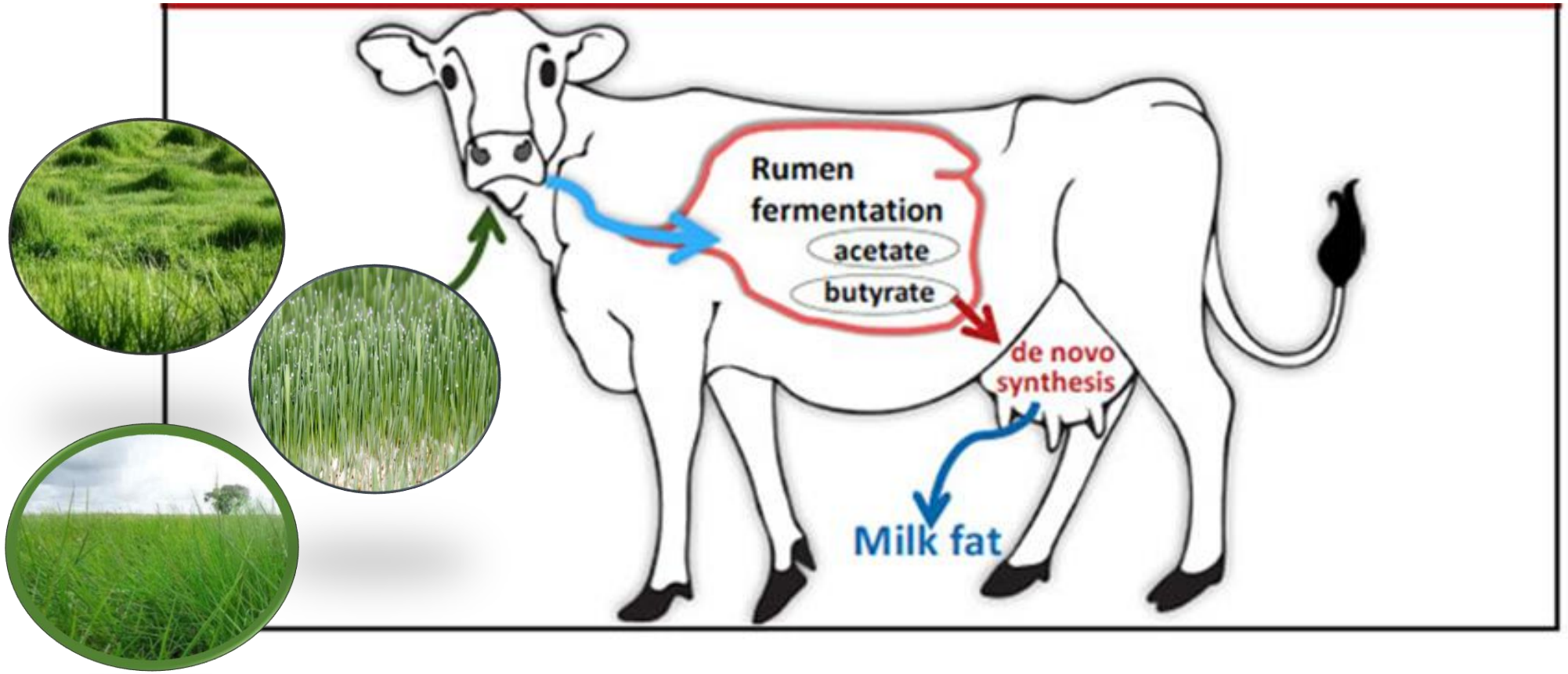
Los lípidos de los rumiantes provienen….

RUMEN

GLÁNDULA MAMARIA

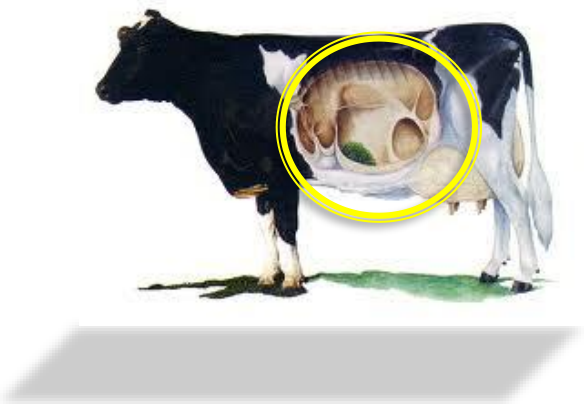
BIOHIDROGENACIÓN

SINTESIS *DE NOVO* Y DESATURACIÓN

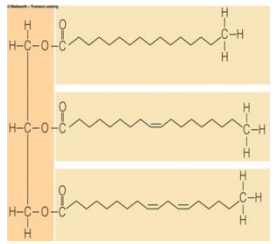


BH de lípidos

Procesos digestivos en rumiantes



LÍPIDOS



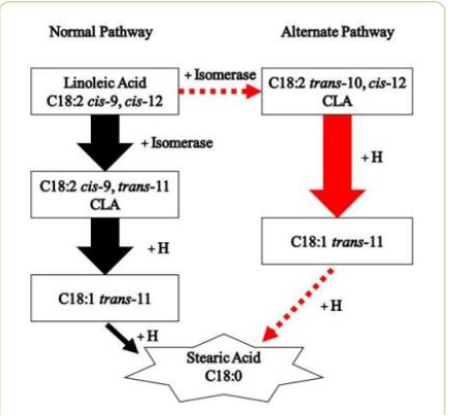
Lipasas

Ácidos grasos

Glicerol

C18:1 C18:2 C18:3

Biohidrogenación



Ácido linoleico (C18:2)

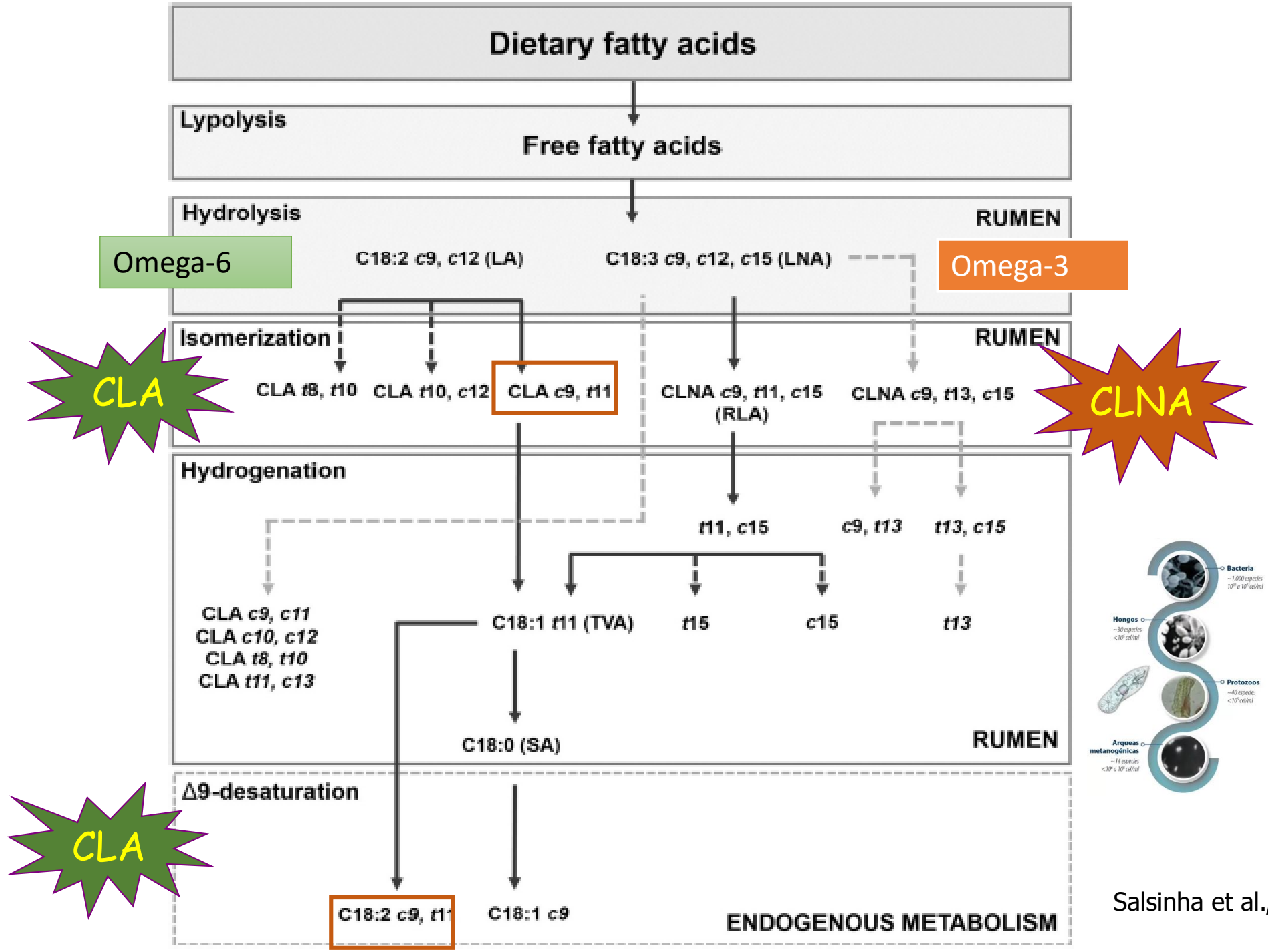
Ácido linolénico (C18:3)

Ácido esteárico (C18:0)

Ácido linoleico conjugado- CLA

Ácido linolénico conjugado- CLNA

Biohidrogenación: Ácidos grasos conjugados

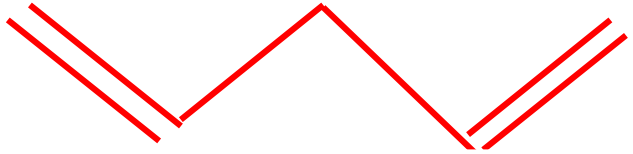


Salsinha et al., 2018

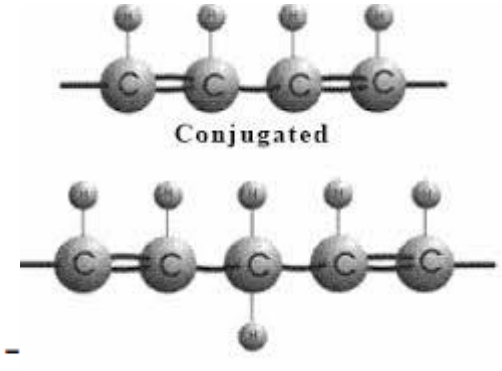
Ácidos grasos conjugados

"Isómeros conjugados de ácidos grasos poliinsaturados"

Grupo metileno



- CH = CH - CH2 - CH = CH -



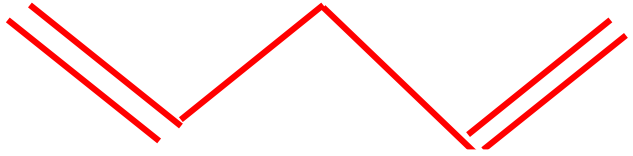
Enlace conjugado

- CH = CH - CH = CH -

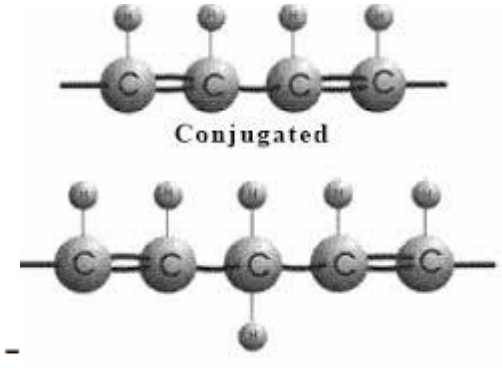
Ácidos grasos conjugados

"Isómeros conjugados de ácidos grasos poliinsaturados"

Grupo metileno



- CH = CH - CH2 - CH = CH -



Enlace conjugado

- CH = CH - CH = CH -

Ác. Linolénico n-3 → **CLNA**

Ác. Linoleico n-6 → **CLA**

>10: metab. plantas y síntesis en rumen

>56: metab. microbiano, tejidos y proc. industriales

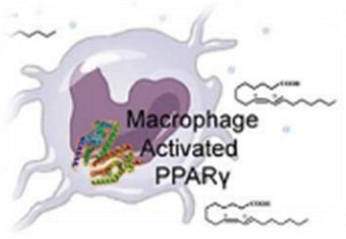
Disminución de grasa corporal

Regulación lipídica

t10,c12

C9, t11

t9,t11



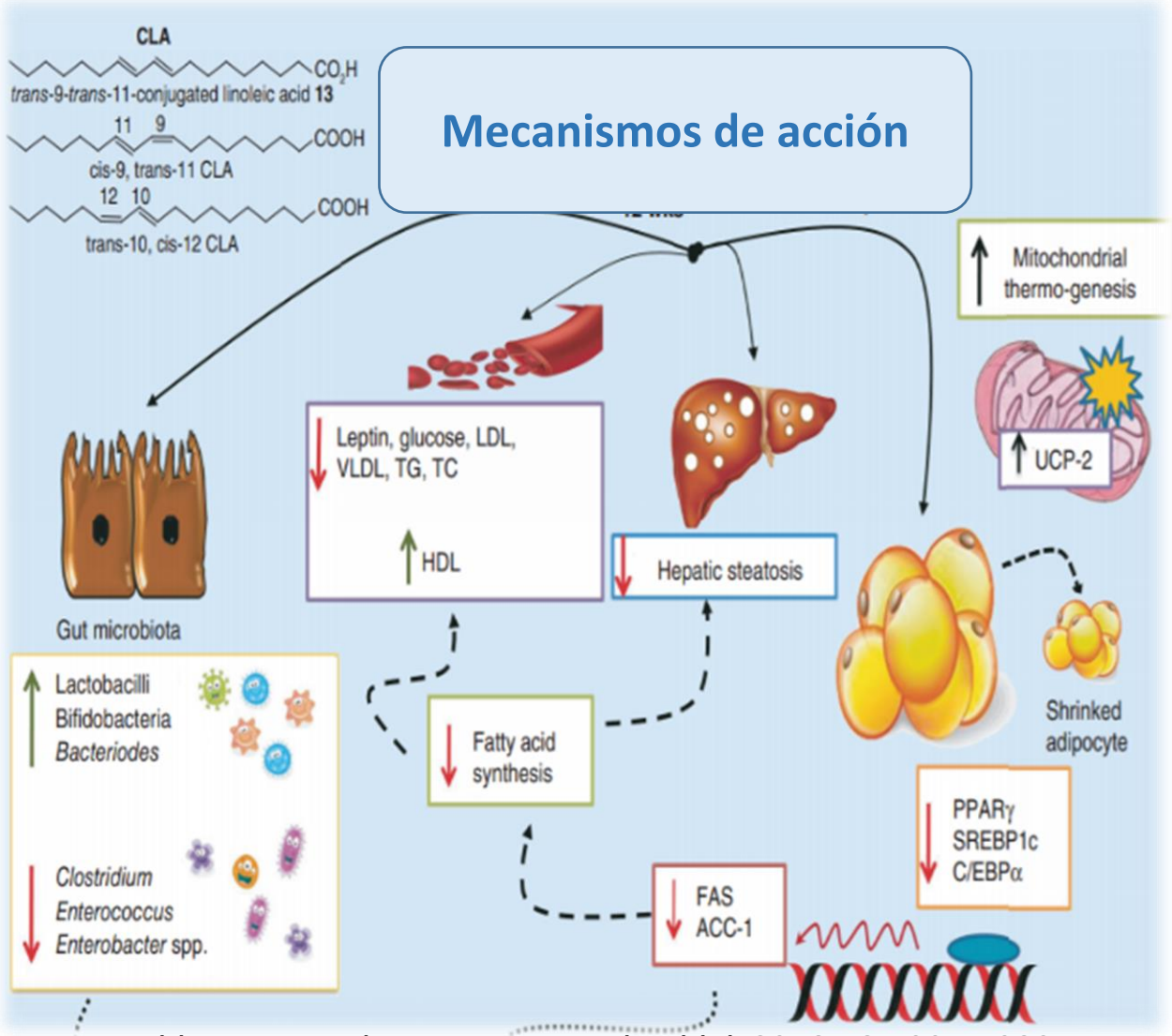
Anti-carcinogénico

Antinflamatorio

Inmunomodulador

Cardioprotector

Mecanismos de acción



Dahiya DK, Puniya AK. *Future Microbiol*. 2018;13:1007-1020

Lácteos: fuente natural de CLA

	Cow	Buffalo	Sheep	Goat
Fat (g/100 g)	3.3.–6.4	5.3–15.0	4.0–9.0	3.0–7.2
			% of total FAs	
SFAs	55.0–73.0	62.0–74.0	57.0–75.0	59.0–74.0
MUFAs	2.0–30.0	24.0–29.0	23.0–39.0	19.0–36.0
PUFAs	2.4–6.3	2.3–3.9	2.6–7.3	2.6–5.6
CLA	0.2–2.4	0.4–1.0	0.6–1.1	0.3–1.2
ω-6	1.2–3.0	1.74–2.0	1.6–3.6	1.9–4.3
ω-3	0.3–1.8	0.2–1.4	0.5–2.3	0.3–1.48

Dosis diaria recomendada: 0,6-3 g/día

QuesArte
RED PARA EL FOMENTO DE LA CALIDAD E INOCUIDAD EN QUESERÍAS ARTESANALES EN IBEROAMÉRICA

CONAHCYT
CONSEJO NACIONAL DE HUMANIDADES CIENCIAS Y TECNOLOGÍAS

CIAD Centro de Investigación en Alimentación y Desarrollo

CYTED

Table 2. Fatty acid profile of milk from alpaca (*Vicugna pacos*), llama (*Lama glama*), guanaco (*Lama guanicoe*), and vicuna (*Vicugna vicugna*) compared with fatty acid profile of milk from an Asian camel, the dromedary (*Camelus dromedarius*).

	South American camelids				
	Domestic species		Wild species		
Fatty acid (g/100 g of FAME)	Alpaca	Llama	Guanaco	Vicuna	Asian camel: dromedary*
4:0	0.07±0.01a	0.08±0.01a	0.05±0.01a	0.14±0.02b	NA
6:0	0.73±0.03a	0.58±0.03b	0.66±0.09ab	0.75±0.06ab	NA
8:0	0.81±0.03a	0.60±0.01b	0.66±0.05b	0.69±0.03b	0.35±0.15
10:0	1.51±0.08a	0.82±0.07b	1.20±0.17a	1.45±0.15ac	0.27±0.12
12:0	0.61±0.04b	0.47±0.03a	0.92±0.09c	0.63±0.05a	3.11±1.09
14:0	11.24±0.65a	12.20±1.22a	10.14±1.20a	10.26±0.28a	12.0±1.8
14:1	1.83±0.12a	3.04±0.33b	2.31±0.32ab	3.10±0.12b	1.70±0.52
15:0	0.13±0.01b	0.12±0.01b	0.89±0.09b	1.65±0.36c	0.75±0.06
16:0	27.19±1.42a	27.98±1.49a	25.80±2.00a	28.43±1.05a	22.8±1.5
16:1	7.99±0.94a	8.22±0.75a	7.08±0.73a	7.93±0.46a	8.30±1.21
17:0	0.45±0.02a	0.52±0.04a	0.61±0.15a	0.53±0.06a	0.55±0.09
17:1	1.37±0.13a	1.25±0.18a	0.85±0.25a	1.13±0.16a	0.76±0.07
18:0	11.42±0.65a	11.12±0.92a	11.38±1.57a	10.13±0.79a	13.83±1.70
18:1 *trans*-11	2.30±0.19a	2.60±0.39ab	2.80±0.33ab	2.98±0.10b	NA
18:1 *trans*-9	1.10±0.09a	1.04±0.11a	1.76±0.13b	1.04±0.14a	NA
18:1 *cis*-9	25.13±1.19a	24.07±2.21a	24.35±2.06a	20.38±2.23a	29.4±2.3
18:2 *cis*-9, *cis*-12	2.39±0.11a	1.47±0.10b	3.81±0.35c	2.74±0.23a	2.83±0.33
18:3 *n*-3	2.06±0.24a	2.05±0.17ac	3.57±0.53b	2.13±0.32a	0.20±0.03
CLA *cis*-9, *trans*-11	1.05±0.08a	1.31±0.13a	1.04±0.10a	1.32±0.12a	0.80±0.15
CLA *trans*-10, *cis*-12	ND	0.08±0.02a	ND	0.08±0.01a	0.06±0.02
22:0	0.37±0.04a	0.14±0.02b	0.12±0.01b	0.08±0.01b	NA
24:0	0.14±0.00a	0.14±0.02a	0.10±0.01a	0.12±0.00a	NA
SFA	54.71±2.11a	54.66±2.84a	52.44±2.16a	54.71±0.77a	55.0±3.0
UFA	45.79±2.13a	45.14±2.80a	47.78±1.77a	42.74±1.92a	NA
MUFA	39.79±2.34a	40.22±2.52a	39.35±1.44a	36.56±2.32a	40.8±2.8
PUFA	5.50±0.22ab	4.92±0.27b	8.42±0.39c	6.18±0.56a	4.26±0.54
SFA/UFA	1.21±0.10a	1.22±0.14a	1.10±0.08a	1.28±0.10a	NA
Atherogenicity index	1.61±0.18a	1.72±0.22a	1.41±0.15a	1.64±0.09a	NA
Desaturase index					
14:1/14:0	0.16±0.03a	0.25±0.03b	0.23±0.05ab	0.38±0.03c	0.14±0.03
16:1/16:0	0.29±0.04a	0.29±0.04a	0.28±0.04a	0.28±0.02a	0.36±0.04
CLA/vaccenic	0.46±0.10a	0.53±0.08a	0.37±0.09a	0.47±0.06a	NA

NRC Research Press

ARTICLE

Comparison of the nutritional value and fatty acid composition of milk from four South American camelid species

	Cow	Buffalo	Sheep	Goat
Fat (g/100 g)	3.3.–6.4	5.3–15.0	4.0–9.0	3.0–7.2
			% of total FAs	
SFAs	55.0–73.0	62.0–74.0	57.0–75.0	59.0–74.0
MUFAs	2.0–30.0	24.0–29.0	23.0–39.0	19.0–36.0
PUFAs	2.4–6.3	2.3–3.9	2.6–7.3	2.6–5.6
CLA	0.2–2.4	0.4–1.0	0.6–1.1	0.3–1.2
ω-6	1.2–3.0	1.74–2.0	1.6–3.6	1.9–4.3
ω-3	0.3–1.8	0.2–1.4	0.5–2.3	0.3–1.48

Lácteos: fuente natural de CLA



Los quesos sin cultivos lácticos seleccionados reflejan la concentración de CLA de la leche

Fatty Acid	Cow Cheeses			Sheep Cheeses			Goat Cheeses		
n	10			10			10		
	Mean	±SD	Min–Max	Mean	± SD	Min–Max	Mean	±SD	Min–Max
*cis*9*trans*13 C18:2	0.19 ^{c}	0.02	0.16–0.23	0.31 ^{a}	0.05	0.27–0.43	0.23 ^{b}	0.03	0.18–0.28
*cis*9*trans*12 C18:2	0.18 ^{b}	0.01	0.17–0.20	0.26 ^{a}	0.03	0.22–0.32	0.21 ^{b}	0.04	0.16–0.29
*trans*9cis12 C18:2	0.03 ^{a}	0.02	0.01–0.05	0.03 ^{a}	0.03	0.01–0.09	0.14 ^{a}	0.05	0.07–0.23
*trans*11*cis*15 C18:2	0.22 ^{a}	0.08	0.12–0.32	0.22 ^{a}	0.14	0.06–0.50	0.14 ^{b}	0.07	0.05–0.31
*cis*9*cis*12 C18:2	1.55 ^{b}	0.08	1.42–1.66	2.22 ^{a}	0.60	1.00–2.81	2.07 ^{a}	0.36	1.65–2.70
C20:0	0.16 ^{b}	0.01	0.15–0.18	0.25 ^{a}	0.10	0.14–0.49	0.17 ^{b}	0.03	0.12–0.22
C20:1	0.11 ^{a}	0.01	0.11–0.12	0.02 ^{b}	0.03	0.01–0.11	0.05 ^{b}	0.05	0.02–0.10
*cis*9*cis*12*cis*15 C18:3	0.48 ^{b}	0.11	0.33–0.60	0.56 ^{a}	0.19	0.37–0.75	0.34 ^{b}	0.07	0.22–0.51
*cis*9*trans*11 C18:2 (CLA)	0.65 ^{a,b}	0.12	0.47–0.83	0.75 ^{a}	0.32	0.49–1.51	0.48 ^{b}	0.10	0.37–0.64

Interacción entre SLAB y NSLAB

Lactosa
Proteínas
Citrato
Grasa

Sales
Temporatura
pH

SLAB

L-Lactate

NSLAB

D-Lactate

Triglycerides

Bacteriocins
Autolysis

Enzymes

Released
esterases

Free fatty
acids

Metabolizados:
AGCM
AGCL
CLA

Flavor

CO_2

caseins

Large and
intermediate-
size peptides

Small Peptides

Released
peptidases

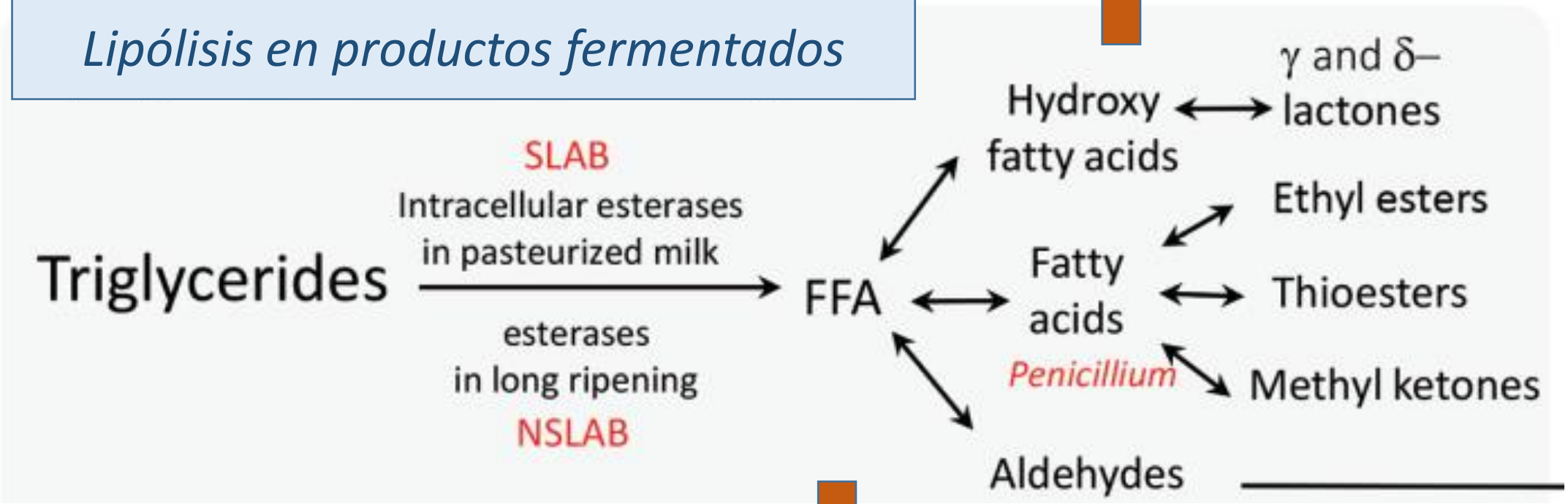
Free amino
acids

Fermentation

Ripening

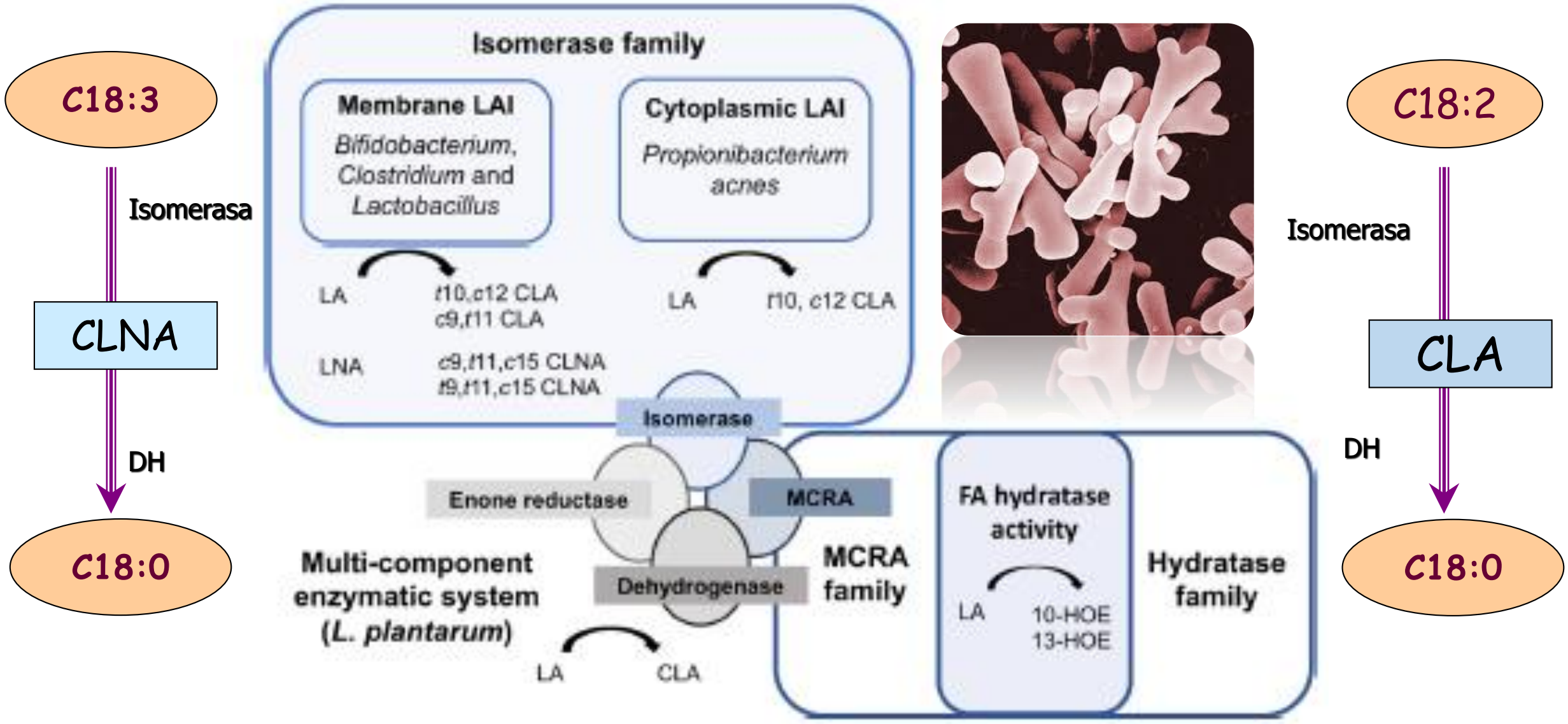
Propiedades sensoriales

Lipólisis en productos fermentados



Propiedades funcionales

Producción de CLA: sistema de multicomponentes ?



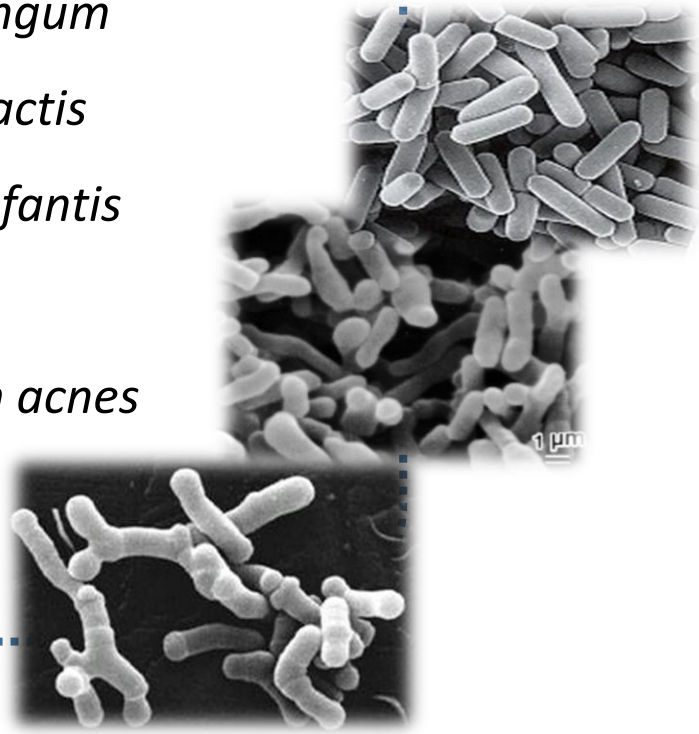
Salsinha et al., 2018.

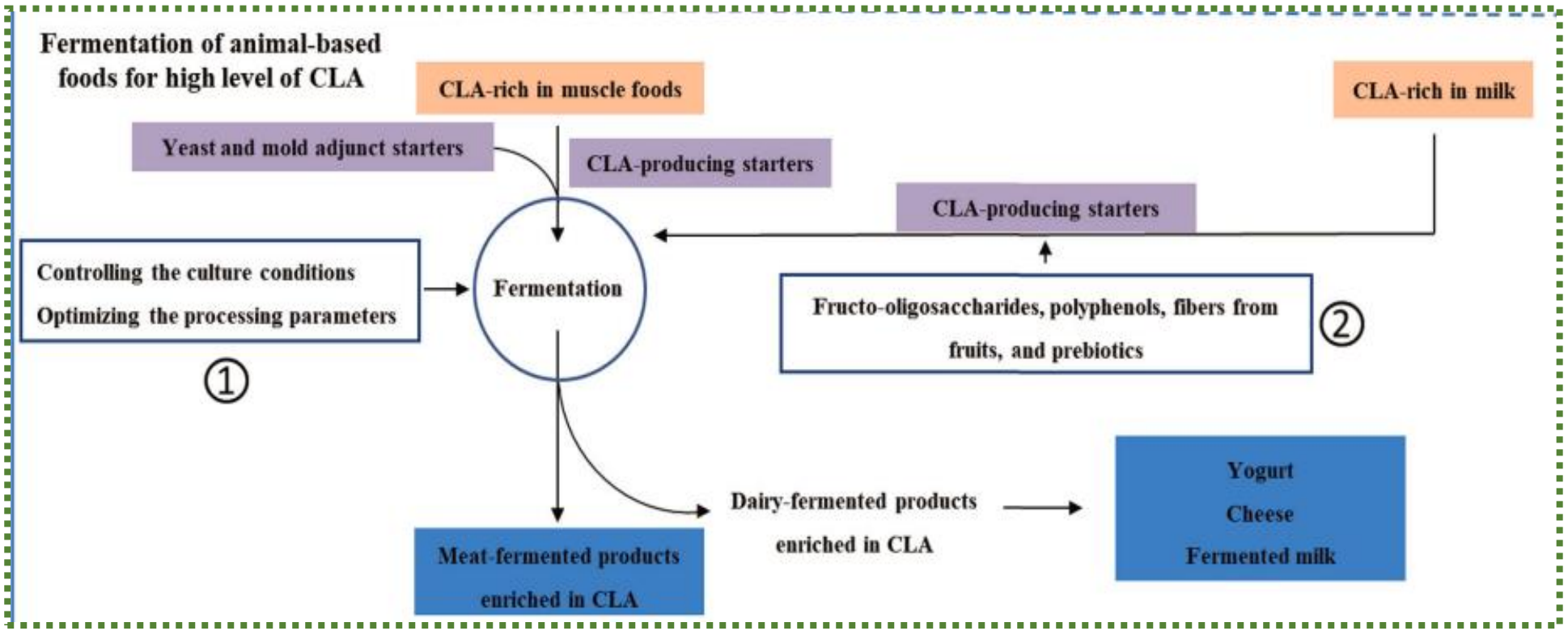
AG conjugados y Bacterias

- *Lactiplantibacillus plantarum*
- *Lactobacillus acidophilus*
- *Limosilactobacillus reuteri*
- *Lactococcus lactis*
- *Enterococcus faecium*
- *Pediococcus acidilactici*
- *Streptococcus salivarius*
- *Leuconostoc mesenteroides*

- *Bifidobacterium breve*
- *Bifidobacteriun longum*
- *Bifidobacterium lactis*
- *Bifidobacterium infantis*

- *Propionibacterium acnes*

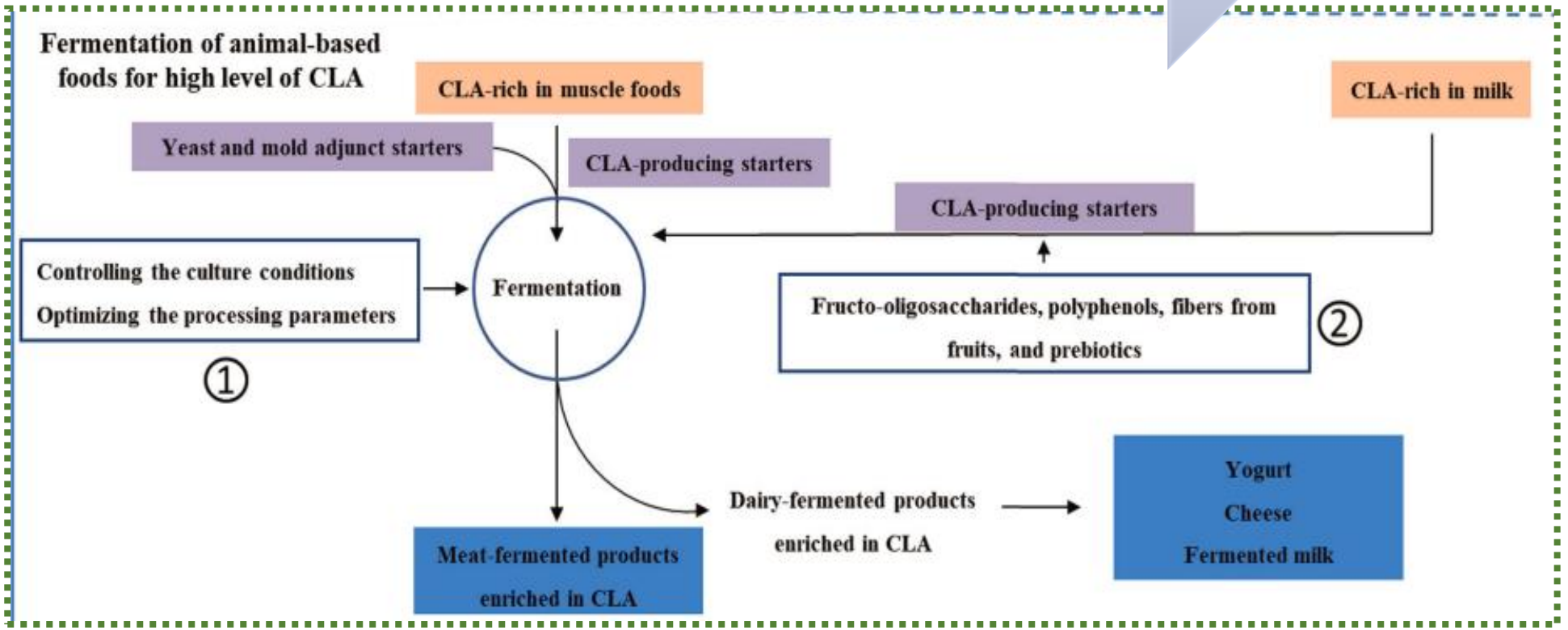



Fermentation of animal-based foods for high level of CLA
CLA-rich in muscle foods
CLA-rich in milk
Yeast and mold adjunct starters
CLA-producing starters
CLA-producing starters
Controlling the culture conditions
Optimizing the processing parameters
①
Fermentation
Fructo-oligosaccharides, polyphenols, fibers from fruits, and prebiotics
②
Dairy-fermented products enriched in CLA
Yogurt
Cheese
Fermented milk
Meat-fermented products enriched in CLA

Selección de cultivos adjuntos

Metabolismo bacteriano en la matriz

Incremento de CLA en el producto final



Aislamiento- Caracterización y aplicación

Small Ruminant Research 101 (2011) 84–91

Contents lists available at SciVerse ScienceDirect

Small Ruminant Research

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Sheep and goat's dairy products from South America: Microbiota and its metabolic activity☆

R.B. Medina[a,b,*], R. Oliszewski[a,b], M.C. Abeijón Mukdsi[a], C.P. Van Nieuwenhove[a,b], S.N. González[a,b]

doi: 10.1111/j.1471-0307.2010.00588.x

ORIGINAL RESEARCH

Incidence of autochthonous Argentinean mixed starter cultures in ripening of slurry cheese models

RUBEN OLISZEWSKI,[1,2]* CARINA VAN NIEUWENHOVE,[1] SILVIA GONZÁLEZ[1,2] and ADRIANA PÉREZ CHAIA[1,2]

[1]*Centro de Referencia para Lactobacilos (CERELA-CONICET), Chacabuco 145, 4000- Tucumán, Argentina, and*
[2]*Universidad Nacional de Tucumán. Av. Roca 1900, CP 4000- Argentina*

Journal of Food Composition and Analysis 40 (2015) 86–94

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Journal of Food Composition and Analysis

journal homepage: www.elsevier.com/locate/jfca

Original Research Article

Influence of autochthonous cultures on fatty acid composition, esterase activity and sensory profile of Argentinean goat cheeses

Natalia Taboada[a,1], Carina Van Nieuwenhove[b,*], Soledad López Alzogaray[a,1], Roxana Medina[b]

"Cultivos funcionales"

- ✓ Actividad Esterasa / Lipasa
- ✓ Poder de Acidificación
- ✓ Producción de compuestos bioactivos:

Ácido linoleico conjugado (CLA)

Letters in Applied Microbiology ISSN 0266-8254

ORIGINAL ARTICLE

Conjugated linoleic acid conversion by dairy bacteria cultured in MRS broth and buffalo milk

C.P. Van Nieuwenhove, R. Oliszewski, S.N. González and A.B. Pérez Chaia

Table 1 Conversion rate of linoleic acid into CLA in MRS broth

Strain	CLA production (%)*
Streptreptococcus thermophilus CRL728	33·9
Lactactobacillus case C12	35·9
Lact. acidophilus CRL730	23·8
Lact. casei CRL87	17·0
Lact. rhamnosus C14	34·5
Lact. acidophilus Q42	20·0
Bifidobacterium bifidum CRL1399	24·8
Lact. bulgaricus CRL423	ND

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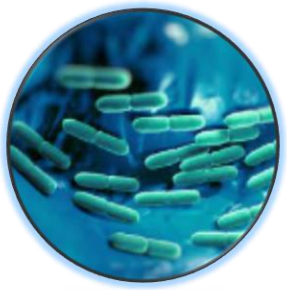
Lact. rhamnosus C14	34·5
Lact. acidophilus Q42	20·0
Bifidobacterium bifidum CRL1399	24·8
Lact. bulgaricus CRL423	ND

Table 3 CLA production in buffalo milk at different linoleic acid levels

Linoleic acid (μg ml^{-1})	CLA production (μg ml^{-1})				% conversion			
Lactactobacillus casei	*Lactactobacillus rhamnosus*	*Bifidobacterium bifidum*	*Streptreptococcus Thermophilus*	*Lact. casei*	*Lact. rhamnosus*	*Bif bifidum*	*Strep. thermophilus*	
200	115·8	190·2	78	105	57·9	95·1	39	52·5
400	175·2	36·3	90	101·4	43·8	9·1	22·5	25·4
800	25·5	79·8	30·3	198·6	3·19	10	3·8	24·8
1000	46·2	18·3	20·4	96·9	4·6	1·8	2·0	9·7

Sustrato

La producción de CLA varía con la concentración de sustrato


Raw milk → Sample 1

↓

Pasteurization (65 °C- 30 min)

↓

Starter + adjunct culture (0.5 + 0.5% innoculum)

↓

Bovine rennet (0.04%, v/v)

↓

Cutting and moulding

↓

Salted

↓ → Sample 2 (day 1)

Ripening → Sample 3 (day 15)

Fig. 1. Protocol of cheese-manufacturing.

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Food Research International 40 (2007) 559–564

FOOD RESEARCH INTERNATIONAL
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Influence of bacteria used as adjunct culture and sunflower oil addition on conjugated linoleic acid content in buffalo cheese

Carina P. Van Nieuwenhove, Rubén Oliszewski, Silvia N. González, Adriana B. Pérez Chaia *

Table 3
Long chain fatty acid composition in buffalo cheeses

Fatty acid	*L. casei*		*L. rhamnosus*		*B. bifidum*		*S. thermophilus*		Raw milk
	Day 1	Day 15	Day 1	Day 15	Day 1	Day 15	Day 1	Day 15	
C14:0	95.9 ± 8.7	85.5 ± 7.6	65.1 ± 7.3	78.5 ± 6.4	93.7 ± 10.1	77.3 ± 8.3	72.9 ± 5.5	75.4 ± 4.9	81.5 ± 7.2
C16:0	344.9 ± 22.3	326.9 ± 19.2	222.8 ± 18.9	293.4 ± 17.6	333.3 ± 22.1	324.2 ± 20.7	282.9 ± 19.3	291.0 ± 19.6	295.7 ± 21.4
C18:0	109.9 ± 9.8	118.5 ± 7.4	181.3 ± 11.2	145.1 ± 8.3	105.4 ± 6.5	137.4 ± 7.6	155.6 ± 9.1	157.8 ± 6.6	121.4 ± 7.5
C18:1 t11	63.7 ± 4.3	59.2 ± 6.5	36.5 ± 4.3	37.4 ± 3.9	60.8 ± 5.5	59.7 ± 5.8	42.6 ± 4.6	40.1 ± 4.1	43.4 ± 3.9
C18:1 c9	254.1 ± 15.1	266.9 ± 12.6	286.7 ± 17.8	296.8 ± 16.5	226.7 ± 11.4	278.6 ± 19.4	257.9 ± 16.2	265.4 ± 15.9	268.2 ± 11.2
C18:2	20.7 ± 2.3	19.9 ± 2.1	15.2 ± 1.2	18.4 ± 1.9	17.5 ± 2.2	19.7 ± 1.2	14.5 ± 4.1	12.7 ± 2.2	17.3 ± 1.8
C18:3	3.9 ± 0.5	2.8 ± 0.7	2.8 ± 9.6	3.2 ± 0.9	4.1 ± 1.0	2.7 ± 0.4	3.4 ± 0.8	4.0 ± 0.3	3.9 ± 0.8
CLA	4.3 ± 0.2^{ac}	5.0 ± 0.1^{bc}	3.9 ± 0.1^{ac}	4.6 ± 0.1^{ad}	4.3 ± 0.1^{ac}	6.3 ± 0.1^{bd}	5.9 ± 0.1^{bc}	6.3 ± 0.1^{bc}	4.4 ± 0.1^{a}
SFA (%)	61.4	60.0	62.1	58.9	62.5	59.5	61.2	61.5	61.0
MUFA (%)	35.4	36.8	35.3	38.1	33.8	37.3	36.0	35.8	36.0
PUFA (%)	3.2	3.2	3.6	4.0	3.7	3.2	3.8	3.7	3.0

Table 5
Long chain fatty acid composition in buffalo cheeses manufactured with sunflower oil addition

Fatty acid	*L. casei*		*L. rhamnosus*		*B. bifidum*		*S. thermophilus*		Raw milk
	Day 1	Day 15	Day 1	Day 15	Day 1	Day 15	Day 1	Day 15	
C14:0	71.3 ± 7.6	74.2 ± 6.8	84.6 ± 9.1	77.4 ± 6.7	75.4 ± 7.1	74.1 ± 8.3	93.1 ± 10.5	75.4 ± 8.0	72.6 ± 6.6
C16:0	313.2 ± 23.5	311.6 ± 20.3	297.9 ± 21.7	328.9 ± 26.2	324.1 ± 23.3	306.2 ± 19.1	321.0 ± 24.0	323.0 ± 27.2	302.4 ± 22.7
C18:0	138.9 ± 11.1	137.3 ± 10.1	113.9 ± 9.6	138.8 ± 12.6	140.3 ± 8.1	131.9 ± 10.0	124.3 ± 11.2	139.5 ± 8.5	126.9 ± 9.9
C18:1 t11	71.9 ± 10.4	64.3 ± 8.2	49.1 ± 10.2	54.2 ± 5.7	62.8 ± 8.8	70.4 ± 9.1	55.8 ± 12.1	51.2 ± 8.5	48.8 ± 7.2
C18:1 c9	247.8 ± 18.1	249.6 ± 14.4	234.7 ± 13.9	290.5 ± 19.6	261.4 ± 18.1	241.6 ± 20.0	253.4 ± 21.2	284.1 ± 12.1	275.3 ± 15.1
C18:2	23.8 ± 2.4	21.7 ± 3.0	23.4 ± 4.2	21.2 ± 1.1	25.4 ± 3.4	23.3 ± 2.4	23.7 ± 1.3	20.3 ± 2.1	21.1 ± 3.1
C18:3	4.8 ± 1.9	4.1 ± 0.4	5.2 ± 0.9	4.2 ± 1.0	5.3 ± 0.6	4.4 ± 0.7	4.4 ± 2.0	5.2 ± 0.2	5.6 ± 1.3
CLA	6.2 ± 0.3^{ac}	5.5 ± 0.2^{ac}	6.9 ± 0.2^{bc}	5.7 ± 0.1^{bd}	6.6 ± 0.2^{bc}	6.2 ± 0.2^{bc}	5.4 ± 0.1^{ac}	5.4 ± 0.1^{ac}	4.9 ± 0.1^{a}
SFA (%)	59.6	60.3	60.8	59.2	59.8	59.7	60.8	58.8	58.5
MUFA (%)	36.4	36.1	34.8	37.4	36.0	36.3	35.4	37.7	37.8
PUFA (%)	4.0	3.6	4.4	3.4	4.2	4.0	3.8	3.5	3.7

Table 5
Long chain fatty acid composition in buffalo cheeses manufactured with sunflower oil addition

Fatty acid	*L. casei*		*L. rhamnosus*		*B. bifidum*		*S. thermophilus*		Raw milk
	Day 1	Day 15	Day 1	Day 15	Day 1	Day 15	Day 1	Day 15	
C14:0	71.3 ± 7.6	74.2 ± 6.8	84.6 ± 9.1	77.4 ± 6.7	75.4 ± 7.1	74.1 ± 8.3	93.1 ± 10.5	75.4 ± 8.0	72.6 ± 6.6
C16:0	313.2 ± 23.5	311.6 ± 20.3	297.9 ± 21.7	328.9 ± 26.2	324.1 ± 23.3	306.2 ± 19.1	321.0 ± 24.0	323.0 ± 27.2	302.4 ± 22.7
C18:0	138.9 ± 11.1	137.3 ± 10.1	113.9 ± 9.6	138.8 ± 12.6	140.3 ± 8.1	131.9 ± 10.0	124.3 ± 11.2	139.5 ± 8.5	126.9 ± 9.9
C18:1 t11	71.9 ± 10.4	64.3 ± 8.2	49.1 ± 10.2	54.2 ± 5.7	62.8 ± 8.8	70.4 ± 9.1	55.8 ± 12.1	51.2 ± 8.5	48.8 ± 7.2
C18:1 c9	247.8 ± 18.1	249.6 ± 14.4	234.7 ± 13.9	290.5 ± 19.6	261.4 ± 18.1	241.6 ± 20.0	253.4 ± 21.2	284.1 ± 12.1	275.3 ± 15.1
C18:2	23.8 ± 2.4	21.7 ± 3.0	23.4 ± 4.2	21.2 ± 1.1	25.4 ± 3.4	23.3 ± 2.4	23.7 ± 1.3	20.3 ± 2.1	21.1 ± 3.1
C18:3	4.8 ± 1.9	4.1 ± 0.4	5.2 ± 0.9	4.2 ± 1.0	5.3 ± 0.6	4.4 ± 0.7	4.4 ± 2.0	5.2 ± 0.2	5.6 ± 1.3
CLA	6.2 ± 0.3^{ac}	5.5 ± 0.2^{ac}	6.9 ± 0.2^{bc}	5.7 ± 0.1^{bd}	6.6 ± 0.2^{bc}	6.2 ± 0.2^{bc}	5.4 ± 0.1^{ac}	5.4 ± 0.1^{ac}	4.9 ± 0.1^{a}
SFA (%)	59.6	60.3	60.8	59.2	59.8	59.7	60.8	58.8	58.5
MUFA (%)	36.4	36.1	34.8	37.4	36.0	36.3	35.4	37.7	37.8
PUFA (%)	4.0	3.6	4.4	3.4	4.2	4.0	3.8	3.5	3.7

Table 6
CLA content in buffalo cheeses manufacture with or without (control) sunflower oil addition

Strain	Days	Control		SO addition	
		mg/g of fat	mg/100 g cheese	mg/g of fat	mg/100 g cheese
L. casei	1	4.33	77.8	6.20	108.2
	15	5.05	80.9	5.49	117.6
L. rhamnosus	1	3.88	68.8	6.96	115.5
	15	4.60	94.3	5.74	125.7
B. bifidum	1	4.26	71.3	6.57	116.3
	15	6.25	108.6	6.25	118.4
S. thermophilus	1	5.90	125.0	5.39	88.5
	15	6.30	129.1	5.41	94.5

Results of CLA content were expressed in mg/g of fat and mg/100 g of cheese on cheeses manufactured under normal conditions and after SO addition.

La adición de aceites vegetales mejora la producción de CLA en los quesos

JOURNAL OF MEDICINAL FOOD
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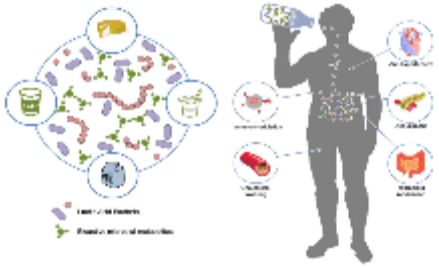
DOI: 10.1089/jmf.2010.0061

Effect of Functional Buffalo Cheese on Fatty Acid Profile and Oxidative Status of Liver and Intestine of Mice

Carina P. Van Nieuwenhove,[1,2] Paola Gauffin Cano,[1] Adriana B. Pérez-Chaia,[1,2] and Silvia N. González[1,2]

[1]*Center of Reference for Lactobacilli, CONICET; and* [2]*National University of Tucumán, Tucumán, Argentina*

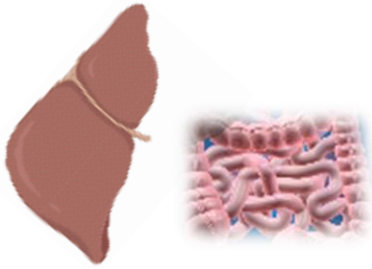
Estudios funcionales



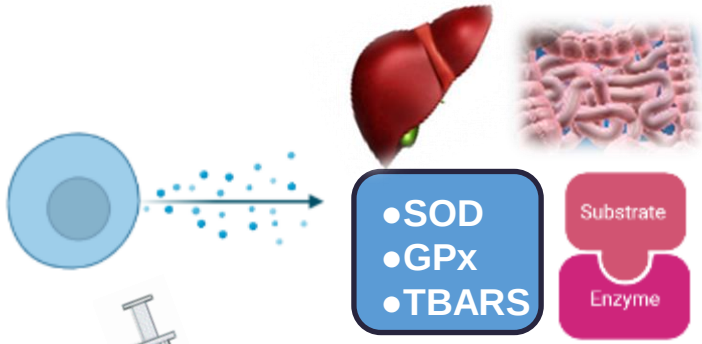
28 días

Consumo alimento

Peso corporal



Peso y perfil de ácidos grasos



DMH (15 mg=kg)

TABLE 1. CHEMICAL COMPOSITION OF FOODS

	Content (mg/100 g of product)			
	Commercial diet (group A)	*Buffalo milk (group B)*	L. rhamnosus *cheese (group C)*	L. casei *cheese (group D)*
Protein (%)	23.0	4.3	22.4	20.3
Fat (%)	5.0	8.7	20.8	18.6
Carbohydrates (%)	6.0	4.7	0.6	0.8

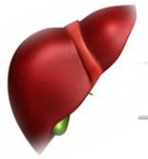
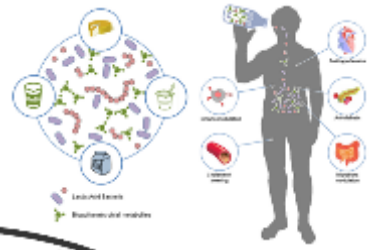
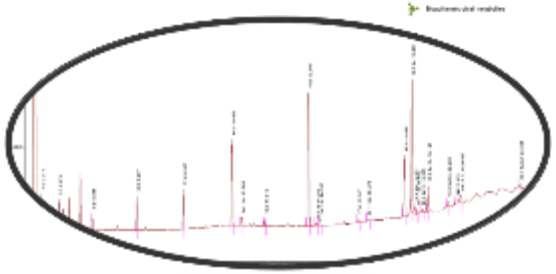


TABLE 4. LIVER WEIGHT AND FATTY ACID PROFILE

	Group			
	A	*Leche*	*Q + L. casei*	*Q + L. rhamnosus* C14
Wet weight (g)	0.96 ± 0.02^{a}	1.02 ± 0.01^{a}	1.00 ± 0.02^{a}	0.98 ± 0.04^{a}
Fatty acid				
$C_{14:0}$	0.67 ± 0.05^{a}	0.84 ± 0.12^{a}	0.66 ± 0.18^{a}	0.65 ± 0.07^{a}
$C_{16:0}$	6.22 ± 0.63^{a}	8.43 ± 0.74^{b}	10.05 ± 0.29^{b}	9.57 ± 0.56^{b}
$C_{16:1}$	0.71 ± 0.04^{a}	0.62 ± 0.08^{a}	0.91 ± 0.07^{b}	0.89 ± 0.05^{b}
$C_{18:0}$	4.93 ± 0.51^{a}	2.25 ± 0.28^{b}	2.93 ± 0.28^{b}	2.51 ± 0.45^{b}
$C_{18:1}$ *cis*-9	10.0 ± 0.98^{a}	10.97 ± 1.55^{a}	14.7 ± 1.15^{b}	13.5 ± 0.90^{b}
$C_{18:2}$	0.35 ± 0.08^{a}	0.38 ± 0.02^{a}	0.41 ± 0.01^{a}	0.31 ± 0.06^{a}
$C_{18:3}$	0.25 ± 0.07^{a}	0.23 ± 0.07^{a}	0.07 ± 0.01^{b}	0.06 ± 0.01^{b}
*c*9,*t*11-CLA	ND	0.08 ± 0.01^{a}	0.13 ± 0.02^{b}	0.15 ± 0.01^{b}
*t*10,*c*12-CLA	ND	ND	0.01 ± 0.00	0.02 ± 0.00
$C_{20:5}$	0.09 ± 0.02	0.08 ± 0.01	0.10 ± 0.03	0.12 ± 0.02
$C_{22:6}$	0.11 ± 0.03	0.10 ± 0.02	0.09 ± 0.02	0.11 ± 0.02
SFAs	12.82	11.53	13.64	12.73
MUFAs	10.71	11.59	15.67	14.39
PUFAs	0.80	0.87	0.80	0.75





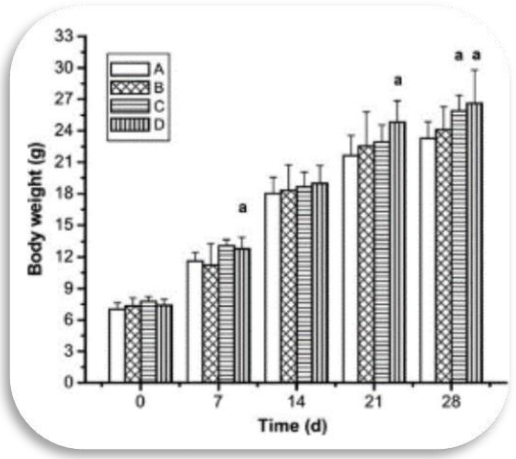


TABLE 5. INTESTINE WEIGHT AND FATTY ACID PROFILE

	Group			
	A	*Leche*	*Q + L. casei*	*Q + L. rhamnosus* C14
Wet weight	1.56 ± 0.08	1.61 ± 0.03	1.62 ± 0.02	1.64 ± 0.02
Fatty acid				
$C_{14:0}$	0.37 ± 0.03^{a}	0.68 ± 0.06^{bc}	1.79 ± 0.30^{bd}	1.92 ± 0.14^{bd}
$C_{16:0}$	6.56 ± 0.41^{a}	8.86 ± 0.53^{b}	9.88 ± 1.10^{b}	9.57 ± 0.75^{b}
$C_{16:1}$	0.84 ± 0.08^{a}	0.91 ± 0.12^{a}	0.65 ± 0.11^{b}	0.51 ± 0.98^{b}
$C_{18:0}$	4.12 ± 0.32^{a}	2.50 ± 0.26^{b}	3.79 ± 0.82^{a}	2.81 ± 0.27^{b}
$C_{18:1}$ *cis*-9	8.93 ± 1.05^{a}	12.76 ± 0.59^{b}	12.6 ± 2.60^{b}	11.5 ± 0.70^{b}
$C_{18:2}$	0.38 ± 0.05^{a}	0.30 ± 0.03^{b}	0.45 ± 0.06^{c}	0.46 ± 0.06^{c}
$C_{18:3}$	0.22 ± 0.03^{a}	0.30 ± 0.02^{a}	0.08 ± 0.01^{b}	0.07 ± 0.01^{b}
*c*9,*t*11-CLA	ND	0.05 ± 0.00^{a}	0.15 ± 0.02^{b}	0.11 ± 0.03^{b}
*t*10,*c*12-CLA	ND	ND	0.02 ± 0.00	0.01 ± 0.00
$C_{20:5}$	0.07 ± 0.02	0.05 ± 0.01	0.08 ± 0.02	0.07 ± 0.02
$C_{22:6}$	0.10 ± 0.02	0.08 ± 0.03	0.07 ± 0.03	0.09 ± 0.02
SFAs	11.05	12.04	15.45	14.20
MUFAs	9.67	13.67	13.25	12.01
PUFAs	0.77	0.78	0.83	0.80

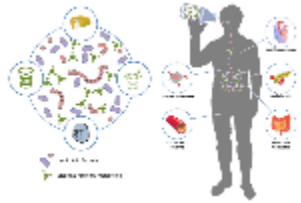
TABLE 6. THIOBARBITURIC ACID–REACTIVE SUBSTANCES IN MOUSE TISSUES

	Control				*DMH treatment*			
Tissue	*A*	*B*	*C*	*D*	*A*	*Leche*	*L. casei*	*L. rhamnosus.* C14
Liver	37.9 ± 4.3^{a}	34.0 ± 3.9^{ab}	30.0 ± 3.1^{bc}	31.6 ± 3.2^{abc}	38.1 ± 3.5^{a}	35.7 ± 4.2^{ab}	31.3 ± 3.7^{bc}	32.6 ± 1.9^{bc}
Intestine	13.5 ± 1.3^{a}	10.7 ± 1.0^{b}	10.8 ± 0.9^{b}	10.1 ± 0.8^{b}	18.9 ± 2.7^{a}	15.4 ± 1.2^{ac}	14.9 ± 2.1^{ac}	11.1 ± 2.3^{bc}

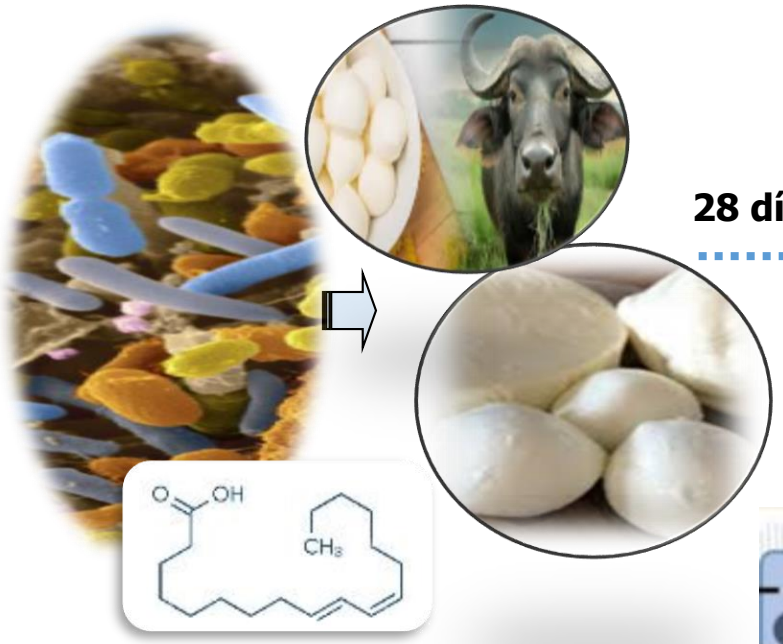
Disminución del estrés oxidativo inducido químicamente (DMH)

TABLE 7. ANTIOXIDANT ENZYMES IN MOUSE TISSUES

	Control				*DMH treatment*			
Enzyme, tissue	*A*	*B*	*C*	*D*	*A*	*Leche*	*L. casei*	*L. rhamnosus.* C14
SOD (U/g of tissue)								
Liver	1.60 ± 0.51^{a}	1.79 ± 0.49^{a}	1.72 ± 0.60^{a}	2.01 ± 0.25^{a}	2.18 ± 0.14^{a}	1.81 ± 0.10^{a}	1.88 ± 0.09^{a}	2.11 ± 0.11^{a}
Intestine	0.75 ± 0.07^{a}	0.71 ± 0.04^{a}	0.69 ± 0.03^{a}	0.70 ± 0.04^{a}	0.89 ± 0.18^{a}	0.81 ± 0.15^{a}	0.74 ± 0.12^{a}	0.72 ± 0.13^{a}
CAT (K/g of tissue)								
Liver	3.27 ± 1.91^{a}	3.53 ± 1.01^{a}	2.79 ± 0.43^{a}	2.90 ± 0.27^{a}	3.07 ± 0.62^{a}	2.89 ± 0.46^{a}	2.43 ± 0.38^{a}	2.55 ± 0.81^{a}
Intestine	0.72 ± 0.08^{ac}	0.69 ± 0.06^{ac}	0.83 ± 0.06^{bc}	0.89 ± 0.09^{b}	0.83 ± 0.13^{a}	0.80 ± 0.10^{a}	0.76 ± 0.11^{a}	0.71 ± 0.09^{a}

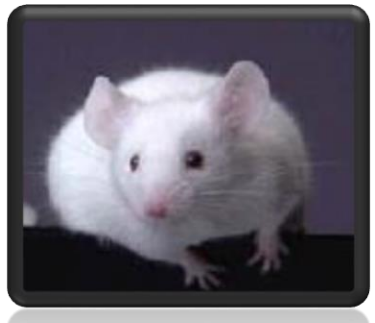


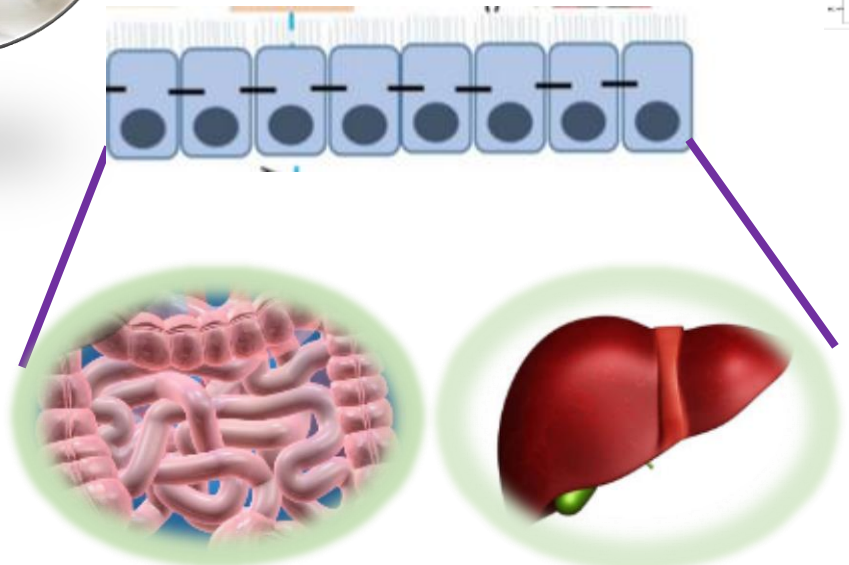
90-125 mg CLA/100 g de producto - 20 % de grasa



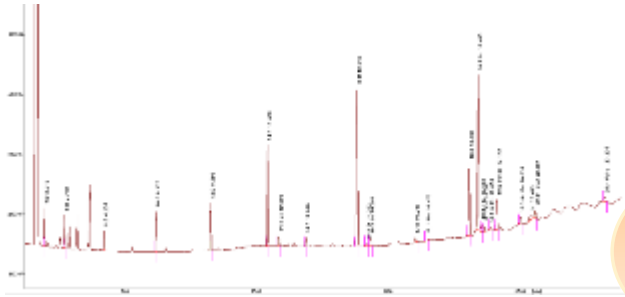
Selección de cultivos "funcionales"

28 días





Consumo de quesos ricos en CLA: incremento 2 y 3 veces en el contenido de CLA en hígado e intestino, respectivamente.



↑ CLA
↓ LNA

↑ Sistema antioxidante

Cultivos autóctonos

microorganisms MDPI

Article

Effect of *Lactiplantibacillus plantarum* on the Conversion of Linoleic Acid of Vegetable Oil to Conjugated Linoleic Acid, Lipolysis, and Sensory Properties of Cheddar Cheese

Awais Khan [1], Muhammad Nadeem [1], Fahad Al-Asmari [2], Muhammad Imran [3,*], Saadia Ambreen [4], Muhammad Abdul Rahim [3,5], Sadaf Oranab [6], Tuba Esatbeyoglu [7], Elena Bartkiene [8,9] and João Miguel Rocha [10,11,12,*]

Aceite vegetal (fuente de LA) + SLAB comercial

+ *Lactipantibacillus plantarum*

(Reemplazan grasa láctea por aceite vegetal)

	100 % grasa leche	97% + 3%	94% +6%	91% + 9%	
Attribute	**Control**	**T_1**	**T_2**	**T_3**	**T_4**
Moisture%	40.52 ± 1.03 [a]	41.22 ± 1.05 [a]	40.16 ± 1.02 [a]	41.11 ± 1.06 [a]	40.85 ± 1.02 [a]
Fat%	30.47 ± 0.9 [a]	29.91 ± 0.9 [a]	30.17 ± 0.9 [a]	30.37 ± 0.9 [a]	29.78 ± 0.9 [a]
Protein%	26.19 ± 0.7 [a]	26.37 ± 0.7 [a]	26.14 ± 0.7 [a]	26.65 ± 0.7 [a]	26.88 ± 0.7 [a]
pH	5.24 ± 0.2 [a]	5.22 ± 0.2 [a]	5.21 ± 0.2 [a]	5.23 ± 0.2 [a]	5.22 ± 0.2 [a]

[a] All means mentioned in the rows of moisture, fat, protein, and pH showed a non-significant ($p > 0.05$) variation.

100 % grasa leche **97% + 3%** **94% +6%** **91% + 9%**

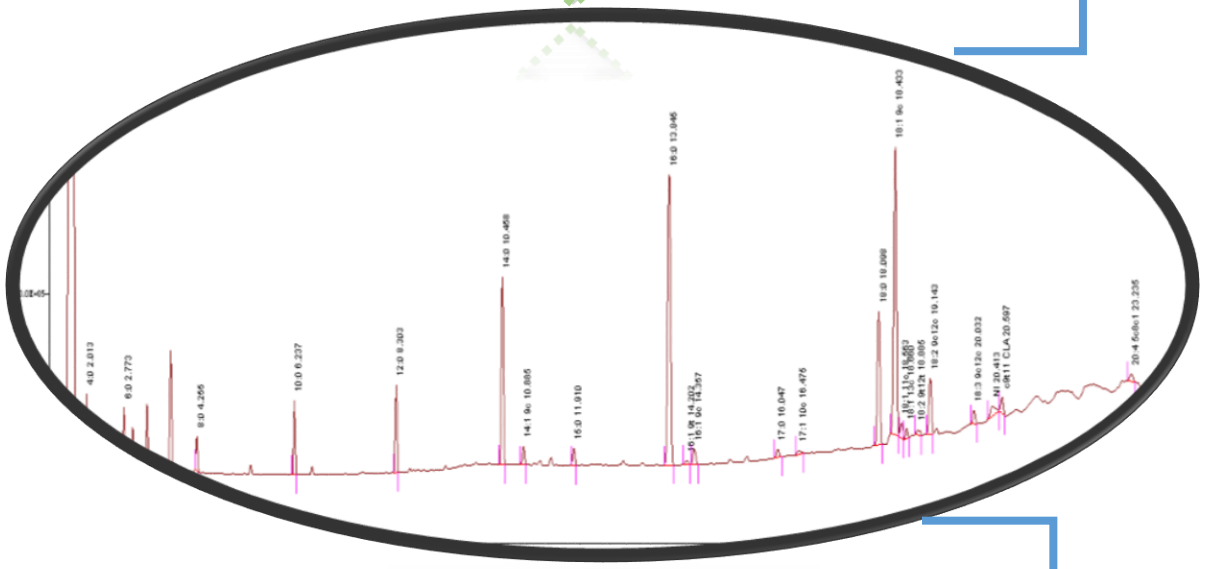
Fatty Acid	Control		T_1		T_2		T_3		T_4	
	0-Day	90-Days	0-Day	90-Days	0-Day	90-Days	0-Day	90-Days	0-Day	90-Days
C4:0	1.89 ± 0.01 a	1.90 ± 0.01 a	1.85 ± 0.02 a	1.80 ± 0.01 a	1.79 ± 0.03 a	1.75 ± 0.02 a	1.77 ± 0.01 a	1.70 ± 0.02 b	1.78 ± 0.02 a	1.72 ± 0.01 b
C6:0	2.36 ± 0.03 a	2.32 ± 0.06 a	2.34 ± 0.04 a	2.28 ± 0.05 a	2.26 ± 0.01 a	2.23 ± 0.01 a	2.25 ± 0.04 a	2.13 ± 0.01 a	2.21 ± 0.01 a	2.10 ± 0.01 b
C8:0	2.51 ± 0.06 a	2.49 ± 0.05 a	2.48 ± 0.03 a	2.42 ± 0.07 a	2.40 ± 0.04 a	2.25 ± 0.03 b	2.37 ± 0.02 a	2.23 ± 0.02 b	2.31 ± 0.03 a	2.18 ± 0.06 b
C10:0	2.77 ± 0.10 a	2.74 ± 0.10 a	2.75 ± 0.07 a	2.70 ± 0.09 a	2.67 ± 0.02 a	2.62 ± 0.02 b	2.75 ± 0.04 a	2.61 ± 0.07 b	2.70 ± 0.04 a	2.57 ± 0.02 c
C12:0	2.94 ± 0.12 a	2.93 ± 0.13 a	2.93 ± 0.11 a	2.87 ± 0.02 a	2.86 ± 0.22 a	2.74 ± 0.06 b	2.83 ± 0.06 a	2.70 ± 0.08 b	2.77 ± 0.03 a	2.53 ± 0.07 c
C14:0	11.25 ± 0.23 a	11.13 ± 0.02 a	10.65 ± 0.16 b	10.49 ± 0.24 b	10.33 ± 0.17 b	9.98 ± 0.42 b	9.14 ± 0.16 c	8.55 ± 0.02 d	8.51 ± 0.20 d	7.66 ± 0.11 e
C16:0	26.74 ± 0.29 a	26.25 ± 0.74 a	25.16 ± 0.33 b	24.75 ± 0.45 c	24.37 ± 0.31 c	23.38 ± 0.51 d	22.74 ± 0.31 e	21.27 ± 0.52 f	21.20 ± 0.08 f	18.41 ± 0.28 g
C18:0	8.19 ± 0.15 a	8.13 ± 0.20 a	7.81 ± 0.17 b	7.44 ± 0.35 b	7.16 ± 0.10 c	6.62 ± 0.09 d	6.11 ± 0.09 d	5.43 ± 0.19 e	5.35 ± 0.13 e	4.11 ± 0.16 g
C18:1	23.94 ± 0.34 a	21.17 ± 0.16 c	23.51 ± 0.54 a	22.98 ± 0.77 b	22.36 ± 0.29 b	21.87 ± 0.39 c	20.19 ± 0.37 d	19.13 ± 0.22 e	18.98 ± 0.09 f	16.14 ± 0.18 g
C18:2	2.56 ± 0.21 e	1.87 ± 0.16 g	2.52 ± 0.09 e	2.18 ± 0.04 f	5.98 ± 0.05 d	1.34 ± 0.42 h	8.25 ± 0.24 c	0.98 ± 0.17 j	11.49 ± 0.12 b	1.11 ± 0.02 i
Δ9*c*,11*t*-18:2	0.23 ± 0.09 f	0.37 ± 0.02 e	0.22 ± 0.03 f	0.58 ± 0.10 d	0.22 ± 0.02 f	1.12 ± 0.03 c	0.21 ± 0.01 f	1.34 ± 0.04 b	0.26 ± 0.04 f	1.91 ± 0.03 a
Δ10*t*,12*c*-18:2	0.10 ± 0.06 f	0.16 ± 0.01 e	0.11 ± 0.01 f	0.42 ± 0.02 d	0.08 ± 0.01 f	0.79 ± 0.15 c	0.07 ± 0.01 f	1.12 ± 0.02 b	0.12 ± 0.02 f	1.54 ± 0.06 a
Δ9*c*,11*c*-18:2	0.09 ± 0.02 f	0.14 ± 0.03 e	0.08 ± 0.01 f	0.47 ± 0.05 d	0.07 ± 0.01 f	0.91 ± 0.01 c	0.09 ± 0.02 f	1.05 ± 0.01 b	0.10 ± 0.03 f	1.48 ± 0.02 a
Δ9t, 11c-18:2	0.05 ± 0.01 f	0.09 ± 0.01 e	0.06 ± 0.01 f	0.29 ± 0.06 d	0.06 ± 0.01 f	0.48 ± 0.05 c	0.11 ± 0.01 e	0.92 ± 0.02 b	0.15 ± 0.01 e	1.39 ± 0.1 a
Δ10c,12*t*-18:2	0.08 ± 0.02 f	0.17 ± 0.01 e	0.19 ± 0.02 e	0.31 ± 0.02 d	0.05 ± 0.01 g	0.35 ± 0.03 c	0.09 ± 0.01 f	0.68 ± 0.03 b	0.10 ± 0.05 f	1.18 ± 0.01 a
Δ8,9,11,10,12c-c18:2	0.03 ± 0.01 f	0.05 ± 0.02 f	0.06 ± 0.02 f	0.15 ± 0.01 d	0.04 ± 0.01 f	0.27 ± 0.02 c	0.05 ± 0.01	0.51 ± 0.01 b	0.09 ± 0.06 e	1.10 ± 0.02 a
Δ8,9,11,10,12t-t18:2	0.04 ± 0.01 f	0.07 ± 0.01 e	0.08 ± 0.01 e	0.12 ± 0.01 d	0.05 ± 0.01 f	0.21 ± 0.01 c	0.07 ± 0.02 e	0.38 ± 0.01 b	0.13 ± 0.02 d	0.82 ± 0.04 a
C18:3	0.58 ± 0.02 a	0.41 ± 0.01 c	0.56 ± 0.1 a	0.39 ± 0.03 c	0.53 ± 0.03 a	0.31 ± 0.02 d	0.49 ± 0.04 b	0.24 ± 0.02 e	0.25 ± 0.01 e	0.15 ± 0.01 f
∑ CLA	1.18 ± 0.02 f	1.46 ± 0.04 e	1.36 ± 0.09 e	2.73 ± 0.03 d	1.10 ± 0.01 f	4.44 ± 0.11 c	1.18 ± 0.06 f	6.24 ± 0.15 b	1.20 ± 0.03 f	9.57 ± 0.19 a

Ácidos grasos y funcionalidad de alimentos

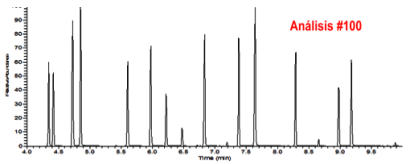
Cultivo iniciador /adjunto

Adaptación a la matriz

Producción de compuestos

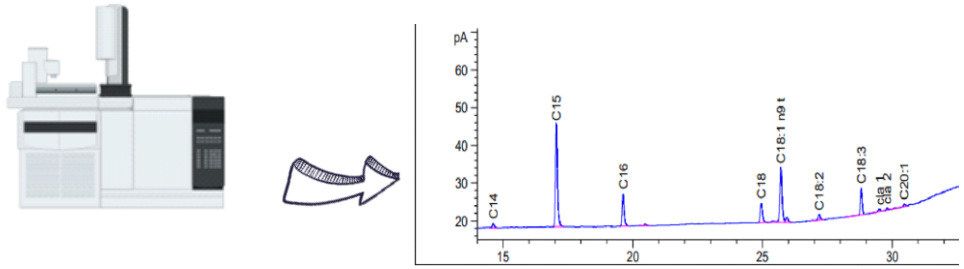


Ácidos grasos saturados:
Producción de AGCC
Producción de AGCM



Ácidos grasos insaturados
Producción de AGC
Procesos de desaturación

Índices derivados del perfil de ácidos grasos



$$AI = \frac{C12:0 + (4 \times C14:0) + C16:0}{MUFA + PUFA}$$

Índice aterogénico

$$TI = \frac{C14:0 + C16:0 + C18:0}{0.5 \times MUFA + 0.5 \times PUFAn - 6 + (3 \times PUFAn - 3) + \left(\frac{PUFAn-3}{PUFAn-6}\right)}.$$

Índice trombogénico

$$HH = \frac{(C18:1n9 + C18:2n6 + C18:3n3 + C20:4n6 + C20:5n3)}{(C14:0 + C16:0)}$$

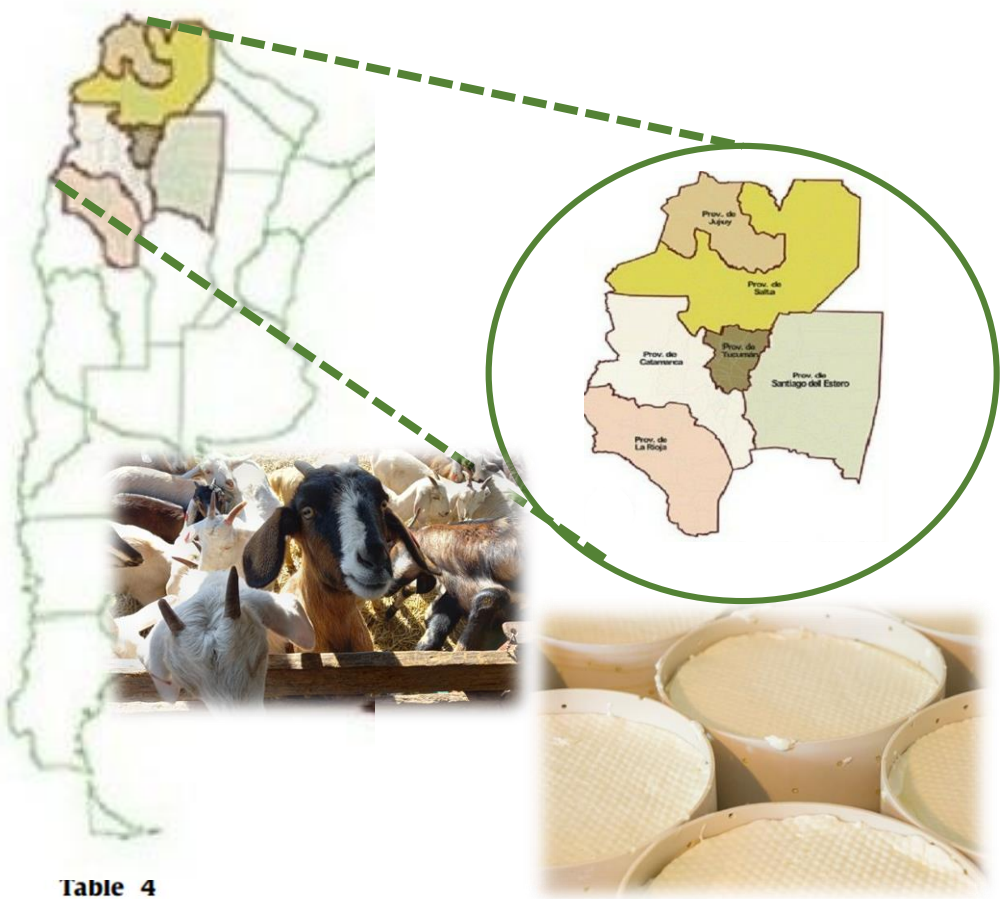
Índice hipo/hipercolesterolémico

$$HPI = \frac{\sum UFA}{[C12:0 + (4 \times C14) + C16]}$$

Índice promotor de la salud

$$DFA = UFA + C18{:}0$$

Ácidos grasos hipocolesterolémicos



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Original Research Article

Influence of autochthonous cultures on fatty acid composition, esterase activity and sensory profile of Argentinean goat cheeses

Natalia Taboada[a,1], Carina Van Nieuwenhove[b,*], Soledad López Alzogaray[a,1],

Table 4
Lactic acid bacteria (LAB) in goat cheeses.

Cheeses[b]	Day of ripening	Lactic acid bacteria (Log cfu/g of cheese)[a]	
		Mesophilics	Thermophilics
CC	1	7.45 ± 0.30^{A}	7.27 ± 0.25^{A}
	60	8.30 ± 0.30^{B}	8.10 ± 0.25^{B}
CS	1	7.44 ± 0.25^{A}	7.28 ± 0.30^{A}
	60	8.04 ± 0.30^{B}	8.16 ± 0.30^{B}
CA	1	7.39 ± 0.20^{A}	7.17 ± 0.32^{A}
	60	8.19 ± 0.33^{B}	8.12 ± 0.33^{B}

Strain composition of autochthonous cultures.

Strains	Starter culture (%, *v*/*v*)	Starter culture plus adjunct culture (%, *v*/*v*)
L. rhamnosus UNSE308	30	30
L. delbrueckii subsp. *bulgaricus* UNSE309	30	30
S. thermophilus UNSE314	20	18
S. thermophilus UNSE321	20	17
L. plantarum UNSE316	0	1.25
L. plantarum UNSE317	0	1.25
P. pentosaceus UNSE22	0	1.25
P. pentosaceus UNSE253	0	1.25

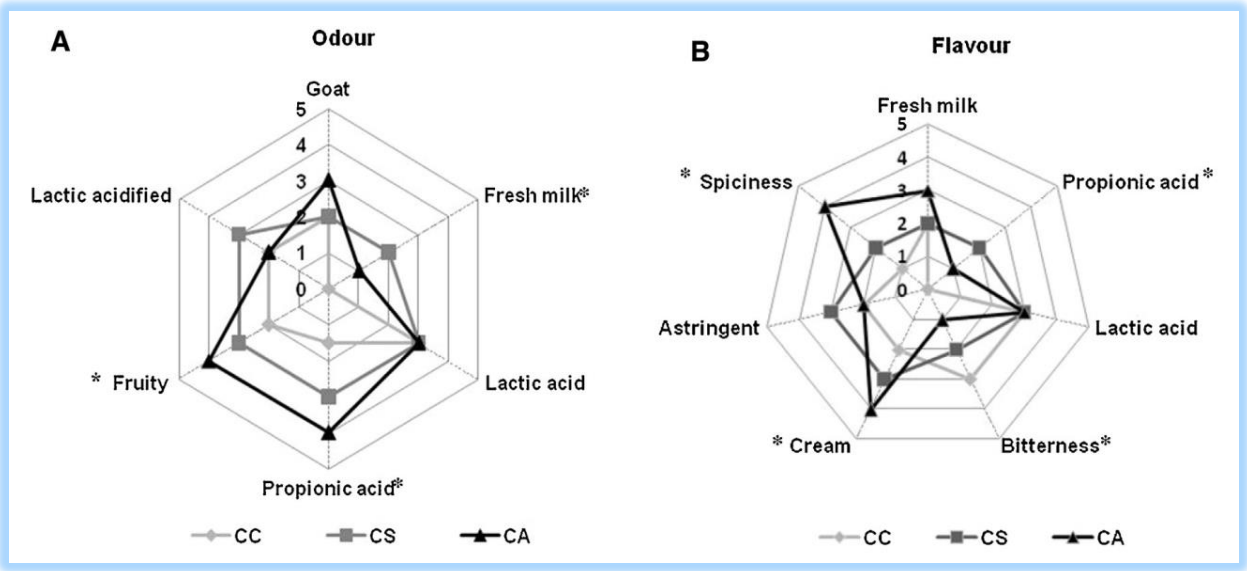
Table 5
Fatty acids composition of semi hard goat milk cheeses.[a]

Fatty acids (%)	Cheeses samples[b]					
	1 day			60 days		
	CC	CS	CA	CC	CS	CA
C4:0	0.14 ± 0.03^{D}	0.15 ± 0.03^{D}	0.12 ± 0.04^{D}	0.39 ± 0.02^{C}	0.52 ± 0.03^{B}	0.68 ± 0.02^{A}
C6:0	1.05 ± 0.21^{B}	1.30 ± 0.14^{B}	1.30 ± 0.18^{B}	1.05 ± 0.11^{B}	1.17 ± 0.05^{B}	1.73 ± 0.18^{A}
C8:0	1.65 ± 0.06^{C}	1.88 ± 0.22^{B}	1.93 ± 0.10^{B}	1.93 ± 0.13^{B}	2.77 ± 0.12^{A}	2.60 ± 0.12^{A}
C10:0	9.76 ± 0.10^{A}	6.68 ± 0.25^{C}	9.63 ± 0.35^{A}	8.85 ± 0.64^{B}	8.09 ± 0.20^{B}	8.93 ± 0.20^{B}
C12:0	5.00 ± 0.12^{A}	5.40 ± 0.08^{A}	4.70 ± 0.11^{B}	4.24 ± 0.25^{B}	3.42 ± 0.27^{C}	3.71 ± 0.14^{C}
C14:0	12.05 ± 0.77^{A}	12.55 ± 0.49^{A}	11.60 ± 0.42^{A}	9.60 ± 0.53^{B}	8.68 ± 0.20^{C}	7.69 ± 0.13^{D}
C14:1	0.59 ± 0.04^{A}	0.61 ± 0.07^{A}	0.57 ± 0.02^{A}	0.63 ± 0.21^{A}	0.36 ± 0.02^{B}	0.37 ± 0.02^{B}
C15:0	0.82 ± 0.03^{A}	0.88 ± 0.03^{A}	0.81 ± 0.12^{A}	0.96 ± 0.49^{A}	0.92 ± 0.49^{A}	0.85 ± 0.44^{A}
C16:0	23.35 ± 0.63^{B}	23.33 ± 0.72^{B}	24.80 ± 0.59^{A}	25.46 ± 0.69^{A}	25.27 ± 0.13^{A}	25.78 ± 0.53^{A}
C16:1	1.38 ± 0.05^{A}	1.43 ± 0.07^{A}	1.48 ± 0.12^{A}	1.39 ± 0.14^{A}	0.40 ± 0.02^{C}	0.52 ± 0.02^{B}
C17:0	0.95 ± 0.04^{A}	0.69 ± 0.09^{B}	0.93 ± 0.05^{A}	0.62 ± 0.02^{B}	0.51 ± 0.02^{C}	0.50 ± 0.02^{C}
C17:1	0.31 ± 0.03^{A}	0.35 ± 0.03^{A}	0.31 ± 0.04^{A}	0.39 ± 0.02^{A}	0.38 ± 0.02^{A}	0.36 ± 0.02^{A}
C18:0	12.95 ± 0.21^{A}	12.16 ± 0.33^{A}	12.0 ± 0.42^{A}	11.74 ± 1.77^{A}	11.16 ± 0.53^{A}	10.79 ± 0.23^{A}
trans-10-C18:1	0.21 ± 0.05^{A}	0.22 ± 0.03^{A}	0.19 ± 0.04^{A}	0.16 ± 0.03^{A}	0.16 ± 0.02^{A}	0.14 ± 0.04^{A}
trans-11-C18: 1	1.98 ± 0.04^{A}	2.00 ± 0.10^{A}	1.40 ± 0.12^{AB}	2.0 ± 0.64^{A}	2.0 ± 0.35^{A}	2.0 ± 0.50^{A}
*cis*9-C18:1	23.31 ± 0.35^{C}	25.61 ± 0.42^{B}	24.30 ± 0.70^{B}	26.08 ± 0.49^{B}	27.90 ± 0.30^{A}	27.84 ± 0.36^{A}
C18:2 n6t	0.10 ± 0.02^{C}	0.10 ± 0.02^{C}	0.08 ± 0.01^{C}	0.22 ± 0.03^{B}	0.26 ± 0.05^{A}	0.33 ± 0.03^{A}
C18:2	2.01 ± 0.10^{A}	1.71 ± 0.04^{B}	1.61 ± 0.09^{B}	1.65 ± 0.15^{B}	2.15 ± 0.02^{A}	1.93 ± 0.12^{A}
C18:3	1.02 ± 0.14^{C}	1.51 ± 0.07^{B}	0.83 ± 0.06^{C}	1.17 ± 0.35^{B}	1.89 ± 0.09^{A}	1.46 ± 0.14^{B}
cis-9,*trans*-11-CLA[c]	0.52 ± 0.02^{C}	0.60 ± 0.03^{B}	0.64 ± 0.03^{B}	0.60 ± 0.02^{B}	1.07 ± 0.02^{A}	1.04 ± 0.05^{A}
*trans*10,*cis*12-CLA	n.d	0.06 ± 0.01	n.d	n.d	n.d	n.d
TOTAL CLA	0.52 ± 0.02^{C}	0.66 ± 0.03^{B}	0.64 ± 0.03^{B}	0.60 ± 0.02^{B}	1.07 ± 0.02^{A}	1.04 ± 0.05^{A}
Saturated fatty acids SFA	68.25 ± 7.48^{A}	65.52 ± 7.80^{A}	68.29 ± 7.69^{A}	65.31 ± 6.27^{A}	63.00 ± 7.59^{A}	63.70 ± 7.55^{A}
Monounsaturated fatty acids MUFA	27.97 ± 9.33^{A}	30.41 ± 10.77^{A}	28.42 ± 9.65^{A}	30.85 ± 9.93^{A}	31.40 ± 12.24^{A}	31.34 ± 13.75^{A}
Polyunsaturated fatty acids PUFA	3.99 ± 0.73^{B}	4.30 ± 0.70^{A}	3.48 ± 0.58^{B}	4.00 ± 0.31^{B}	5.77 ± 0.88^{A}	5.10 ± 0.70^{A}
Δ9-desaturase index (C14)	0.047 ± 0.01^{B}	0.046 ± 0.01^{B}	0.047 ± 0.01^{B}	0.061 ± 0.01^{A}	0.047 ± 0.01^{B}	0.046 ± 0.01^{B}
CLA desaturase index	0.21 ± 0.01^{B}	0.23 ± 0.01^{B}	0.31 ± 0.01^{A}	0.24 ± 0.01^{B}	0.32 ± 0.01^{A}	0.31 ± 0.01^{A}
Atherogenicity index	2.41 ± 0.61^{A}	2.29 ± 0.64^{A}	2.39 ± 0.62^{A}	1.96 ± 0.32^{A}	1.67 ± 0.34^{B}	1.66 ± 0.32^{B}
DFA[g]	44.91	46.87	43.90	46.59	48.33	47.23
SFA:UFA	2.14	1.89	2.14	1.88	1.69	1.75
PUFA:SFA	0.058	0.065	0.051	0.06	0.09	0.08
MUFA:SFA	0.41	0.46	0.42	0.47	0.50	0.49

Table 6
Conjugated linoleic acid (CLA) content in goat dairy products.

CLA content[a] (mg/100 g sample)	Day of ripening	Samples[b]	
		1	60
cis-9,*trans*-11-CLA	Cheese CC	172.7 ± 6.6^{A}	229.7 ± 7.65^{B}
	Cheese CS	222.9 ± 11.14^{A}	427.5 ± 18.99^{B}
	Cheese CA	216.3 ± 10.13^{A}	417.0 ± 20.04^{B}
cis-9,*trans*-11-CLA	Goat milk	23.0 ± 2.54	

Sensorial



Nutrición- Funcionalidad

Tecnológico

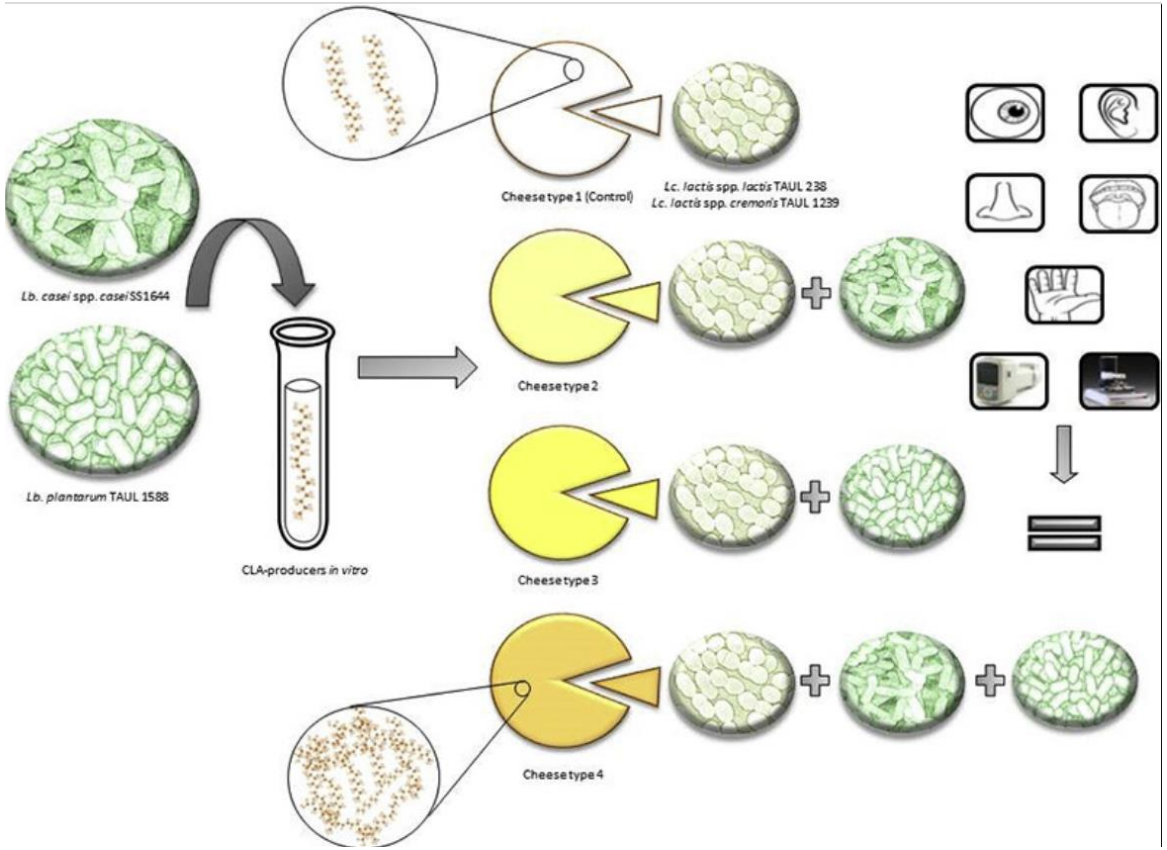
Table 7
Specific esterase activity (EA)[a] in goat cheeses.

Cheeses[b]	Day of ripening	Substrate α-naphthyl derivative			
		Acetate (C2)	Propionate (C3)	Butyrate (C4)	Caprylate (C8)
CC	1	7.77 ± 1.20^{A}	6.45 ± 1.20^{B}	10.75 ± 1.10^{A}	11.04 ± 1.45^{A}
	60	8.04 ± 0.30^{A}	14.97 ± 0.80^{A}	12.79 ± 1.40^{A}	13.88 ± 1.25^{A}
	Ratio EA_{60}/EA_0	n.a.[c]	2.32	n.a.	n.a.
CS	1	8.64 ± 1.20^{B}	7.93 ± 0.80^{B}	7.53 ± 1.25^{B}	6.23 ± 0.20^{B}
	60	18.55 ± 1.40^{A}	23.74 ± 1.40^{A}	19.89 ± 1.40^{A}	16.37 ± 1.25^{A}
	Ratio EA_{60}/EA_0	2.15	2.99	2.64	2.63
CA	1	10.03 ± 1.10^{B}	9.52 ± 1.30^{B}	11.99 ± 0.90^{B}	12.83 ± 1.40^{B}
	60	18.60 ± 1.30^{A}	16.29 ± 1.10^{A}	20.11 ± 1.30^{A}	23.58 ± 1.30^{A}
	Ratio EA_{60}/EA_0	1.85	1.71	1.68	1.84

Frin (2018), doi:10.1016/j.foodres.2018.09.016

CLA-producing adjunct cultures improve the nutritional value of sheep cheese fat

E. Renes, P. Gómez-Cortés, M.A. de la Fuente, D.M. Linares, M.E. Tornadijo, J.M. Fresno



Cepas autóctonas (iniciador)
Lact. lactis TAUL 238
Lact..lactis subsp. cremoris TAUL 1239

Cepas autóctonas CLA+
L. plantarum TAUL 1588
L. casei subsp. casei SS 1644

8 meses

Cultivos adjuntos (2, 3 y 4)

- ✓ ↓ SFA (C12:0, C14:0 , C16:0)
- ✓ ↑ CLA
- ✓ ↑ Vaccénico
- ✓ ↑ Omega-3

Cultivos adjuntos (4)

- ✓ ↑ C6:0, C8:0 y C10:0

Perfil de AG más saludable, sin modificar el contenido lipídico

QuesArte
RED PARA EL FOMENTO DE LA CALIDAD E INOCUIDAD EN QUESERÍAS ARTESANALES EN IBEROAMÉRICA

CONAHCYT
CONSEJO NACIONAL DE HUMANIDADES CIENCIAS Y TECNOLOGÍAS

CIAD
Centro de Investigación en Alimentación y Desarrollo

CYTED

CLNA

c9,t11,c15

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Production of conjugated dienoic and trienoic fatty acids by lactic acid bacteria and bifidobacteria

V. Terán [a], P. Luna Pizarro [b], M.F. Zacarías [c], G. Vinderola [c], R. Medina [a,d], C. Van Nieuwenhove [a,d,]*

CLA

t9,t11

Strain	MRS medium					
	CLA (µg/mL)			Total production (%)	CLNA (µg/mL)	Total production (%)
	c9,t11	t10,c12	t9,t11		*c9,t11,c15*	
***L. acidophilus* CRL44**	ND	ND	5.61	1.12±0.02	3.09	0.62±0.11
***L. plantarum* CRL41**	ND	ND	ND	ND	3.08	0.62±0.02
***L. plantarum* CRL100**	ND	ND	4.19	0.84±0.03	10.38	2.08±0.03
***L. plantarum* CRL355**	ND	ND	ND	ND	2.68	0.54±0.02
***L. sakei* CRL1468**	8.79	4.57	7.26	4.12±0.22	12.26	2.45±0.19
***L. sakei* CRL1470**	11.72	5.22	7.50	4.88±0.34	13.89	2.78±0.06
***L. salivarius* EFL9**	ND	ND	0.35	0.07±0.01	ND	ND
Lactococci						
***L. lactis biovar-diacetylactis* CRL967**	ND	ND	2.52	0.50±0.03	4.91	0.98±0.04
***L.* lactis biovar-diacetylactis CRL1061**	ND	ND	4.88	0.98±0.03	3.06	0.61±0.02
Bifidobacteria		ND				
***B. animalis subsp. lactis* INL2**	20.30	ND	44.08	12.88±0.25	327.18	65.44±0.45
***B. animalis subsp. lactis* INL4**	ND	ND	0.94	0.19±0.03	17.26	0.62±0.00
***B. longum* LM7a**	25.62	ND	45.05	14.14±0.30	81.52	16.30±0.18
***B. dentium* LM8a**	ND	ND	2.40	0.48±0.02	3.57	0.71±0.01

Condiciones *in vitro*

CLNA en quesos es casi despreciable

Consideraciones finales …….

Desafíos
Producción de CLA / CLNA

Cepa dependiente

- Tolerancia Sustrato
- Enzimas hidrolíticas
- Isomerasas

Sustrato/ matriz

- Adición de aceites
- Concentración máxima
- Combinación de cultivos

Maduración

- Quesos frescos vs quesos madurados

Tecnologías combinadas

- Alimentación
- Uso de subproductos
- Co-cultivos

Alcanzar dosis efectivas para beneficio del consumidor

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MUCHAS GRACIAS….

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