The future of buffalo breeding

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Stating the obvious

The animal is fundamental.

Get the animal right for profitable market(s) and then think about other investments.

Buffalo in Australian

Buffalo in Australian

SOUTH AUSTRALIAN
est. 2014
BUFFALO COMPANY

Buffalo in Australian

OLYMPUS
CHEESE

OLYMPUS CHEESE
50 YEARS
celebrating 50 years of cheese making
MADE IN BRISBANE SINCE 1974

Buffalo Milk Halloumi: vacuum-packed
Buffalo Milk Fetta: vacuum-packed

Buffalo in Australian

MALENY
BUFFALO

Buffalo cheesecake

Buffalo whey sourdough with buffalo cultured butter

Buffalo geymar/kaymak

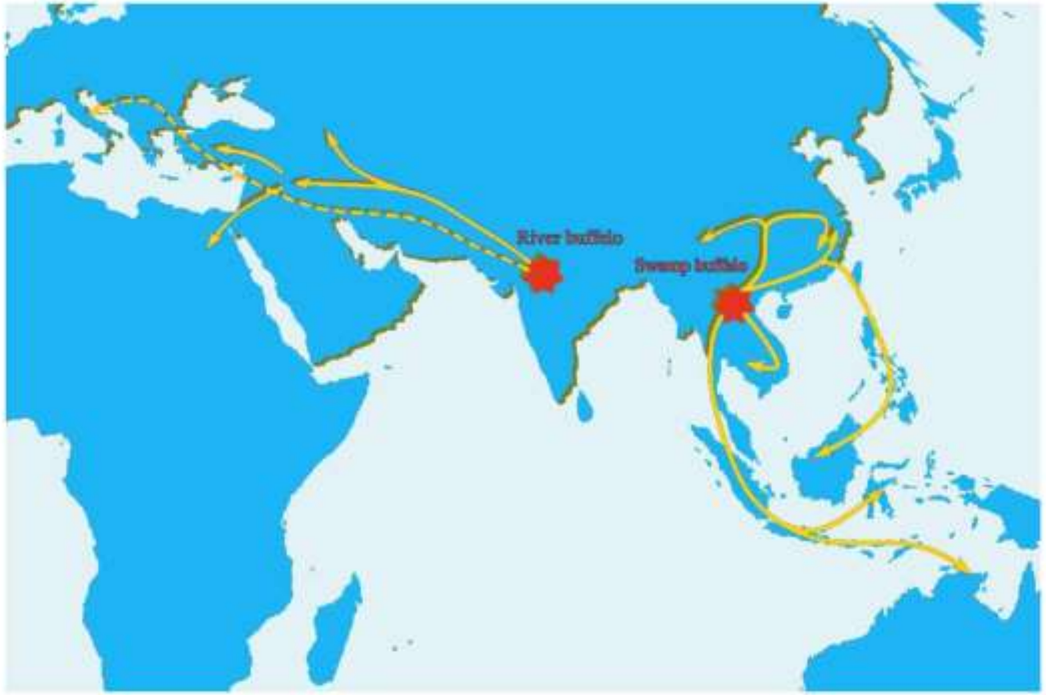
Buffalo salami

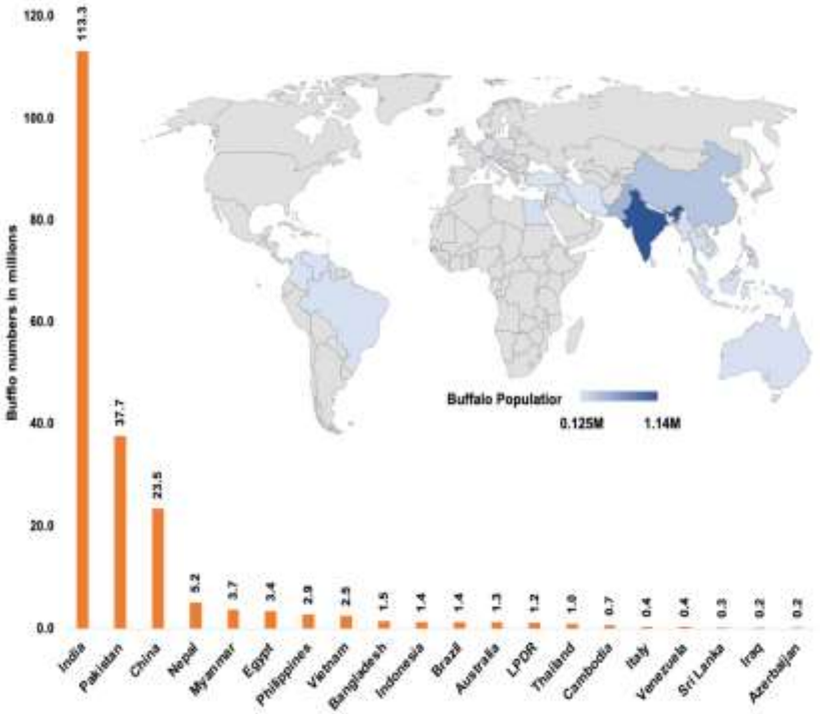
Buffalo rib fillet

Whole-Genome Sequencing and Characterization of Buffalo Genetic Resources: Recent Advances and Future Challenges
Animals 2021, *11*, 904

Buffalo fresh whole milk

Global	16%
South/Southeast Asia	35%

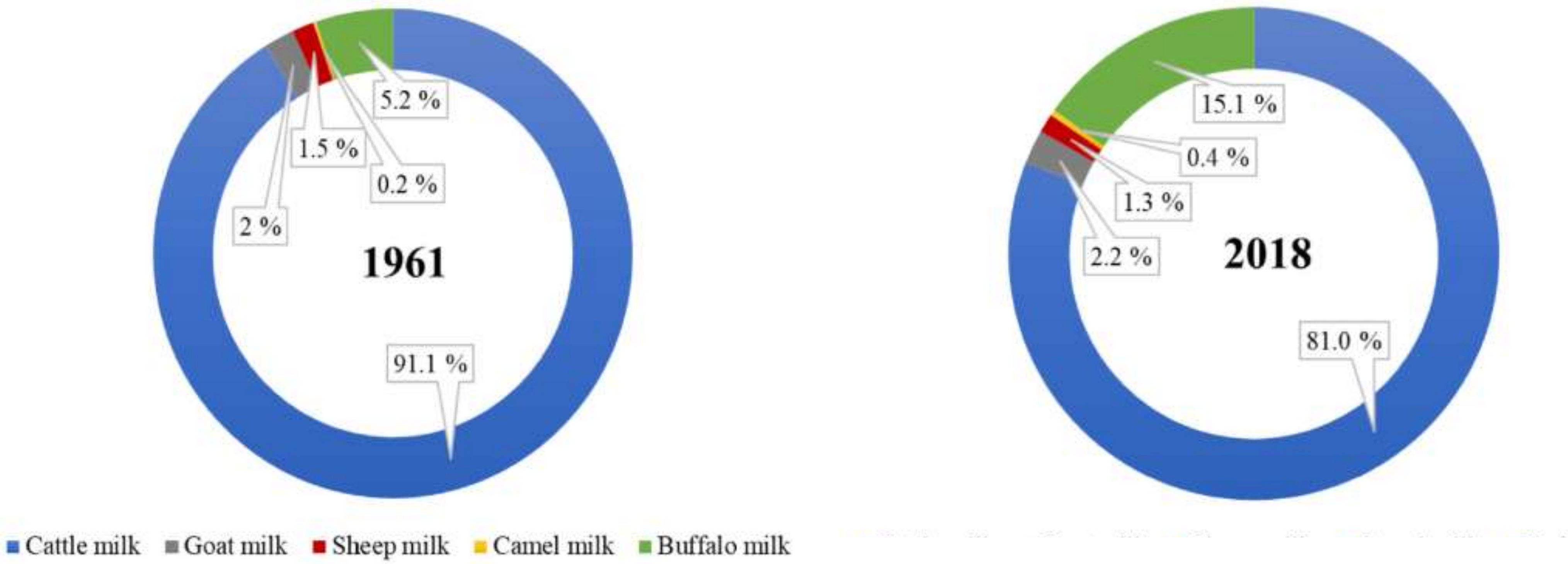




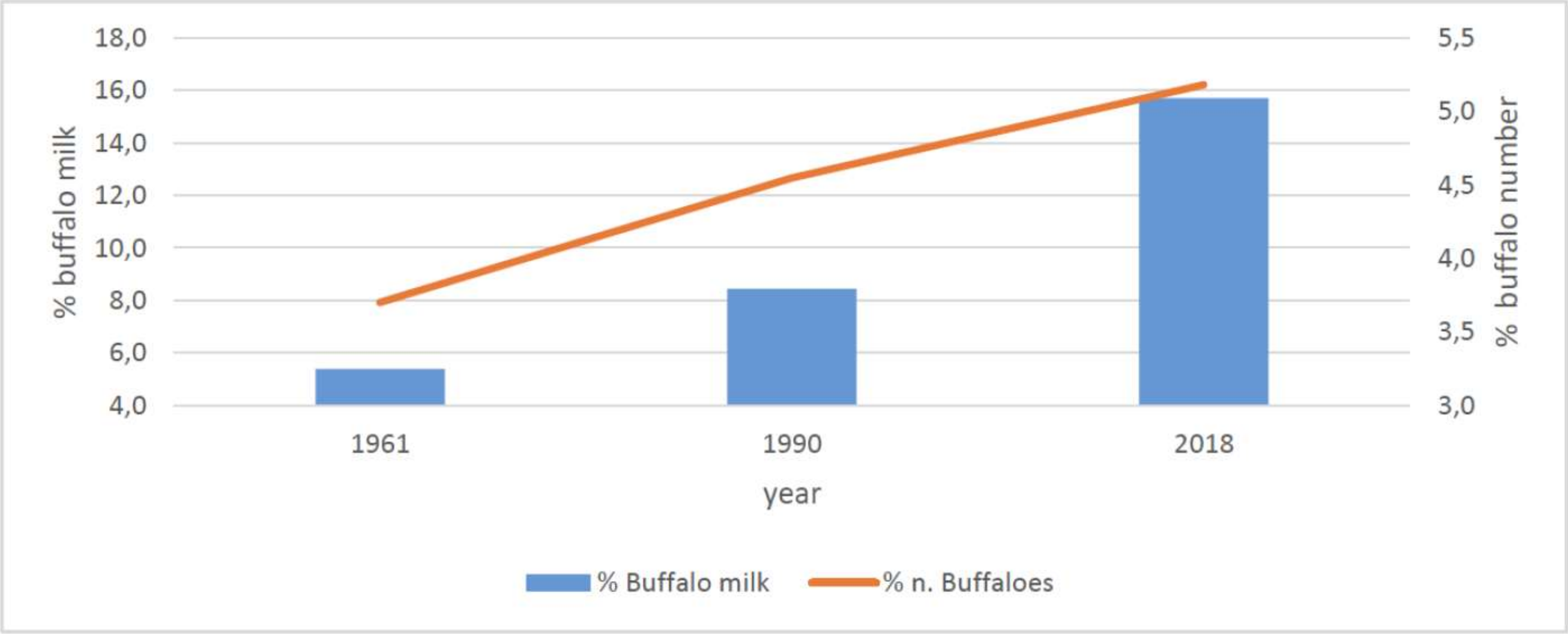
Current Trends in Buffalo Milk Production
Journal of Buffalo Science, 2020, 9, 121-132

World buffalo and cow milk production

year	buffalo milk		cow milk	
	tons	% buffalo milk	tons	% cow milk
1961	17.858.061	5.19	313.626.619	91.12
1970	19.593.886	5.00	359.280.844	91.67
1980	27.525.084	5.91	422.351.163	90.67
1990	44.076.214	8.13	478.539.902	88.22
2000	66.650.866	11.50	489.874.522	84.53
2010	92.468.193	12.78	601.868.328	83.18
2018	127.338.184	15.10	683.217.055	81.04


1961
91.1 %
2 %
1.5 %
0.2 %
5.2 %
2018
81.0 %
2.2 %
1.3 %
0.4 %
15.1 %
Cattle milk
Goat milk
Sheep milk
Camel milk
Buffalo milk

Number of buffalo 1961-2018
(% of total of dairy ruminants)



A review of megatrends in the global dairy sector: what are the socioecological implications?

Agriculture and Human Values (2023) 40:373–394

Global milk production trends 2021-2030

Year	Developed Countries (kt pw)	Developing Countries (kt pw)
2021	409,765	447,115
2030	435,996	583,695

Global milk production trends based on kilo of tonnes per week (OECD–FAO 2021)

Euromonitor International
2020

Competition   Plant-based 'milk'

First Generation

Beans
Soy Beans

Nuts
Almond

Second Generation

Nuts
Hazelnut
Cashew
Coconut

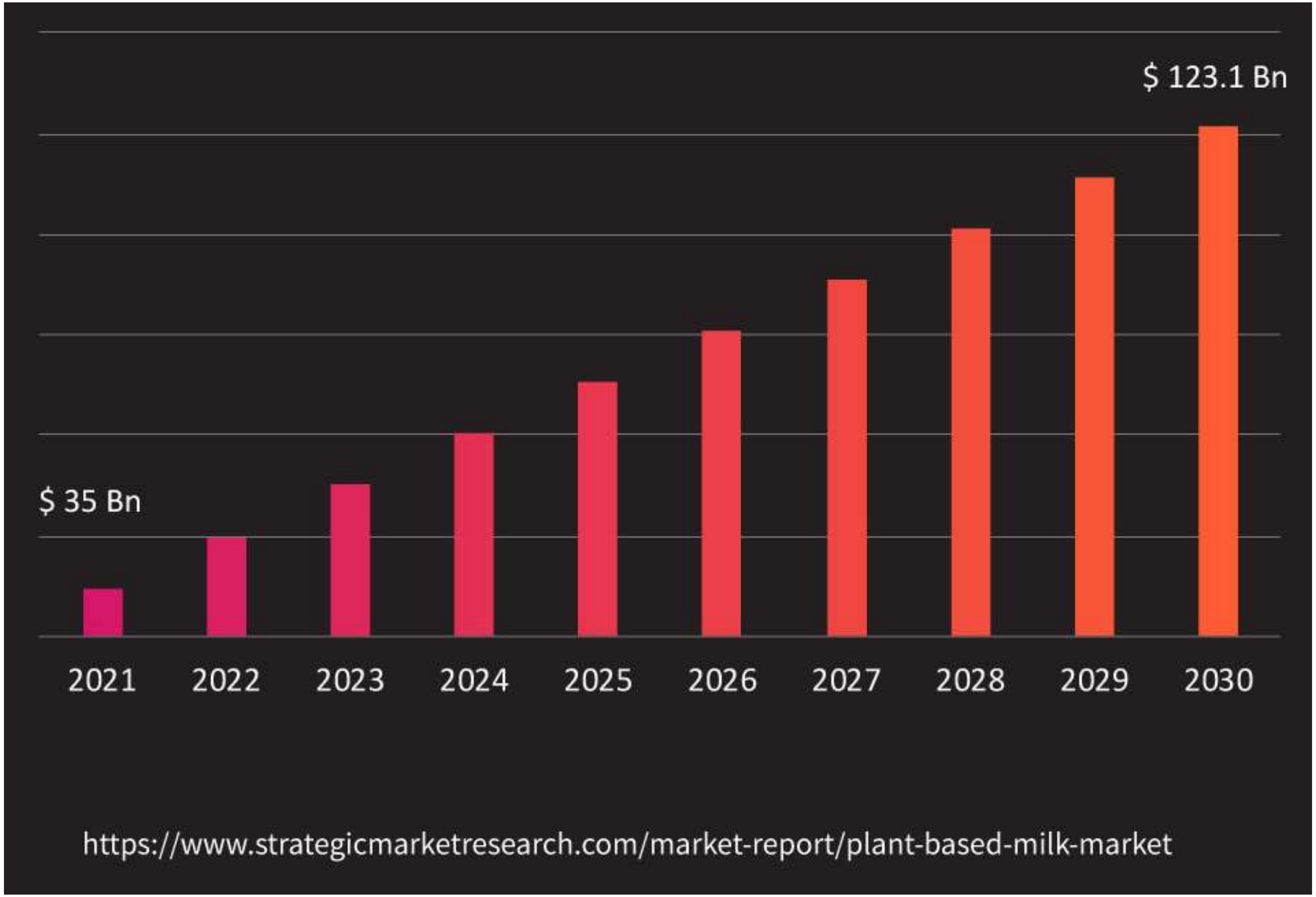
Grains
Rice
Oats

Third Generation

Pulses and Seeds
Peas
Hemp
Flaxseed

Competition

Projected global plant-based ‘milk’ 2021-2030



Competition

Laboratory-grown ‘milk’

PERFECT DAY Cargill Helping the world thrive hartman GROUP

The Growing Consumer Opportunity for Precision Fermentation

Company behind lab-grown milk protein eyes Canadian animal-free dairy market

Animal-free dairy is more environmentally sustainable than traditional dairy production, and it also doesn’t contain lactose, cholesterol or growth hormones.

Distinguishing features of buffalo milk

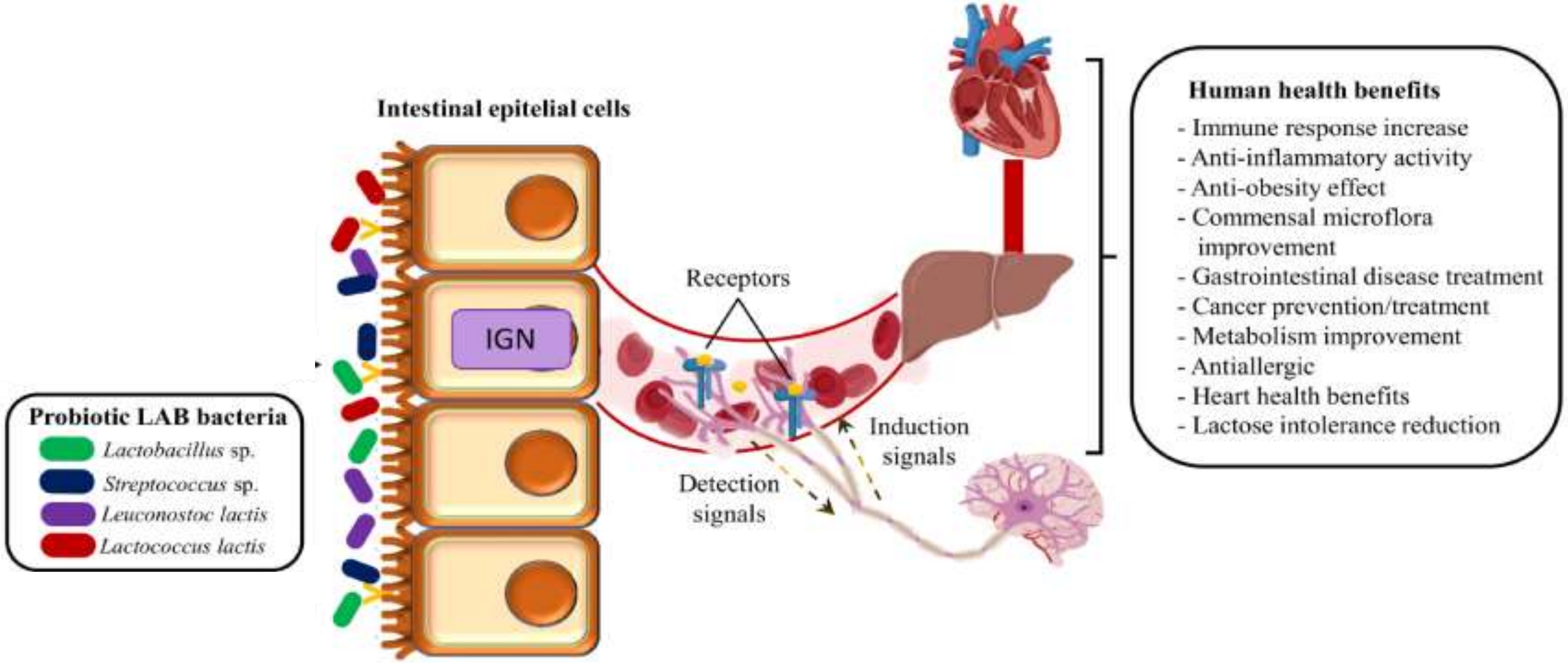
….points of product and market differentiation

Favourable fat profile
Functional biomolecules
Unique microbiota

Buffalo Milk as a Source of Probiotic Functional Products

Microorganisms **2021**, *9*, 2303

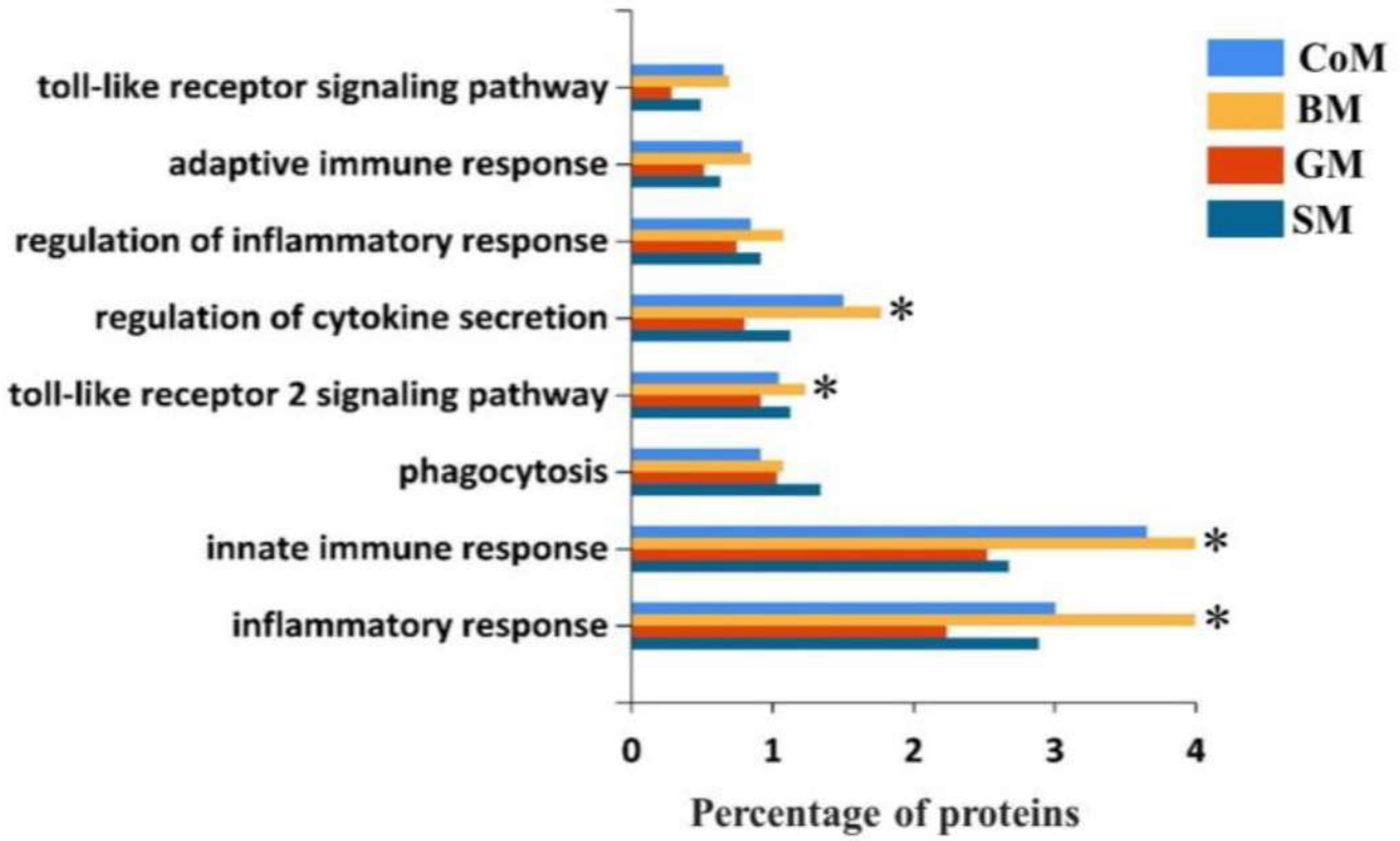
Health benefits of functional molecules from buffalo milk microbiota



Isolation and Characterization of Cow-, Buffalo-, Sheep- and Goat-Milk-Derived Extracellular Vesicles

Cells **2023**, *12*, 2491

Extracellular vesicles from buffalo milk are enriched with proteins implicated in immune responses



REVIEW: Potential of water buffalo in world agriculture: Challenges and opportunities
Applied Animal Science 35:255–268 2019

Challenges, constraints, solutions

*
Genetics is permanent, additive and can undergo continuing improvement.

Constraints / Challenges

- Genetic influence on economic traits *
- Threat of global warming and climate change
- Delayed puberty
- Poor estrus signs
- Longer post-partum anovulation
- Lower CR with AI
- Cryodamages to sperm

Solutions

- Education
- Innovative, transformative and translational research *
- Technology transfer

Non-genetic strategies

Effects of Nutritional Factors on Fat Content, Fatty Acid Composition, and Sensorial Properties of Meat and Milk from Domesticated Ruminants: An Overview
Animals **2024**, *14*, 840.

Nutritional factors that influence ruminant meat and milk production

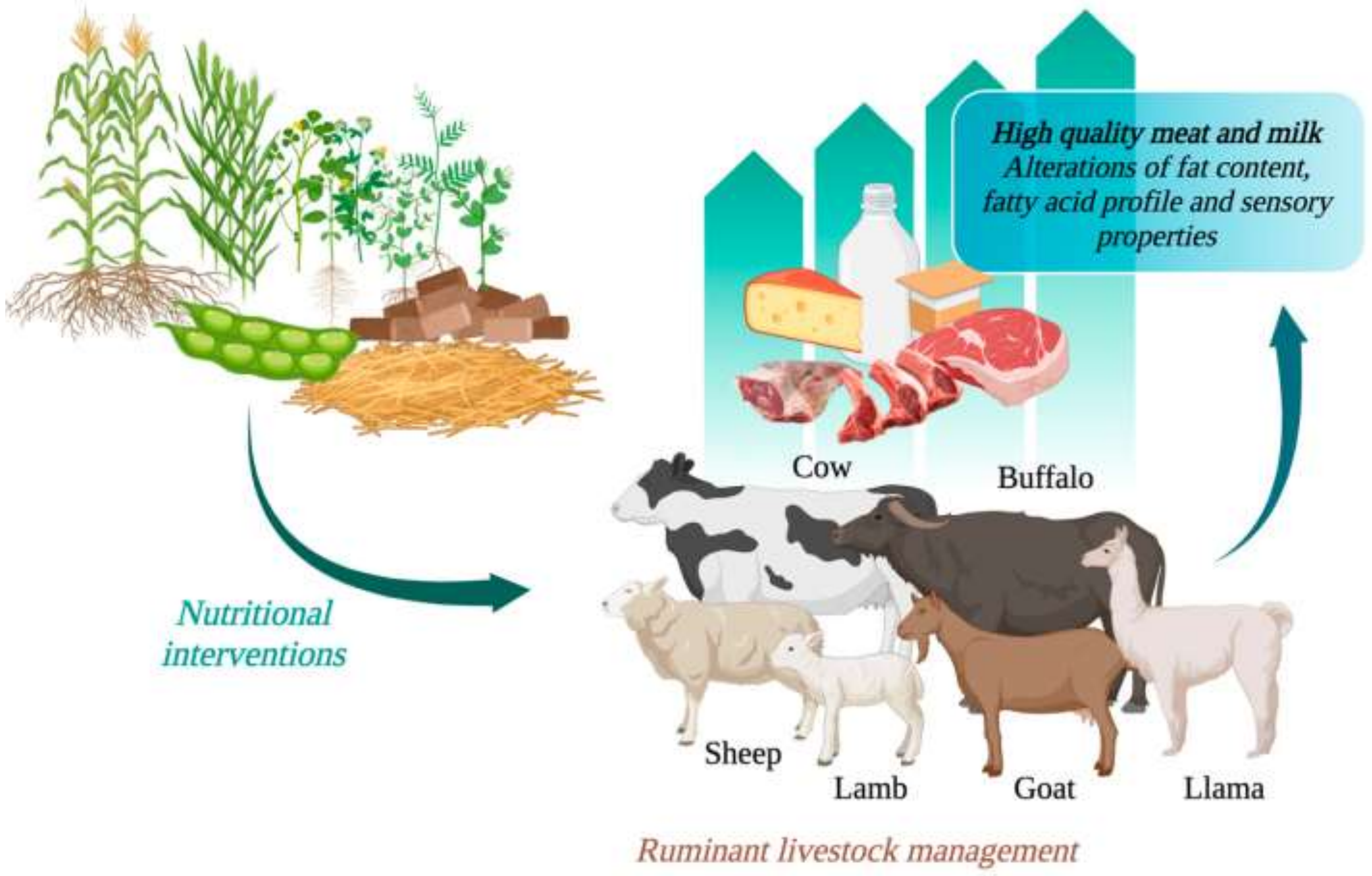
Effects of Nutritional Factors on Fat Content, Fatty Acid Composition, and Sensorial Properties of Meat and Milk from Domesticated Ruminants: An Overview

Animals **2024**, *14*, 840.

Feed sources in tropical farming systems for ruminant milk and meat production

Effects of Nutritional Factors on Fat Content, Fatty Acid Composition, and Sensorial Properties of Meat and Milk from Domesticated Ruminants: An Overview
Animals **2024**, *14*, 840.

Forage, roughage and supplements to optimize the quality and nutritional value of ruminant meat and milk



Green feed increases antioxidant and antineoplastic activity of buffalo milk:
A globally significant livestock
Food Chemistry 344 (2021) 128669

Milk composition of buffalo fed TMR or TMR + green feed

Functional biomolecules
(mg/L)

	TMR	TMR + green feed
L-carnitine	31.5 ± 0.7 [A]	42.0 ± 0.5 [B]
acetyl-L-carnitine	39.1 ± 0.5 [A]	49.8 ± 0.8 [B]
propionyl-L-carnitine	14.8 ± 1.3 [A]	21.1 ± 0.4 [B]
γ-butyrobetaine	4.8 ± 0.2	4.1 ± 0.2
δ-valerobetaine	18.2 ± 0.6 [A]	22.2 ± 0.5 [B]
glycine betaine	7.0 ± 0.02	7.2 ± 0.3

Fatty acids
(% of total fatty acid)

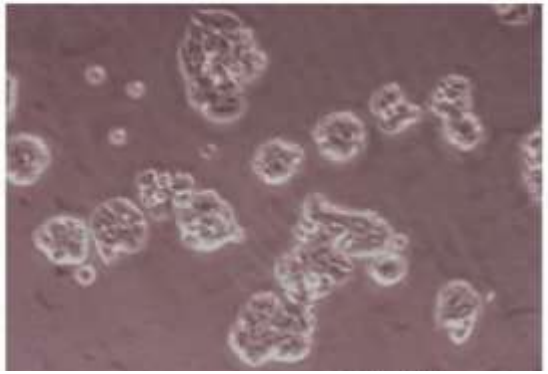
	TMR	TMR + green feed
Fatty acids		
SFA	76.0 ± 0.3 [A]	71.9 ± 1.1 [B]
MUFA	20.9 ± 0.3 [A]	23.5 ± 0.7 [B]
PUFA	3.1 ± 0.1 [a]	4.5 ± 0.4 [b]
PUFA/SFA	0.0 ± 0.0 [A]	0.1 ± 0.0 [B]
ω-3	0.3 ± 0.0 [A]	0.6 ± 0.0 [B]
ω-6	2.8 ± 0.1 [a]	3.8 ± 0.3 [b]
ω-6/ω-3	8.7 ± 1.1 [a]	6.0 ± 0.2 [b]
α-Linolenic acid C18:3 n3	0.3 ± 0.0 [A]	0.6 ± 0.0 [B]

Green feed increases antioxidant and antineoplastic activity of buffalo milk:
A globally significant livestock
Food Chemistry 344 (2021) 128669

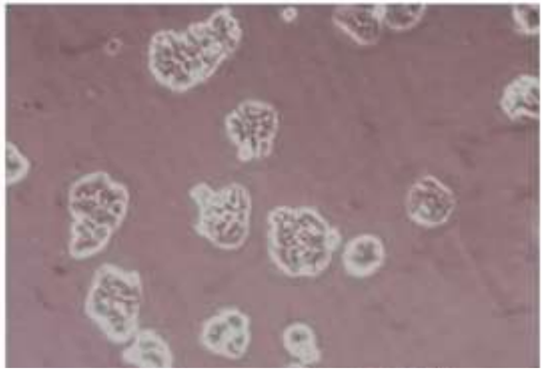
Anti-neoplastic activity of milk extract from buffalo fed TMR or TMR + green feed

human oral squamous carcinoma cells

TMR

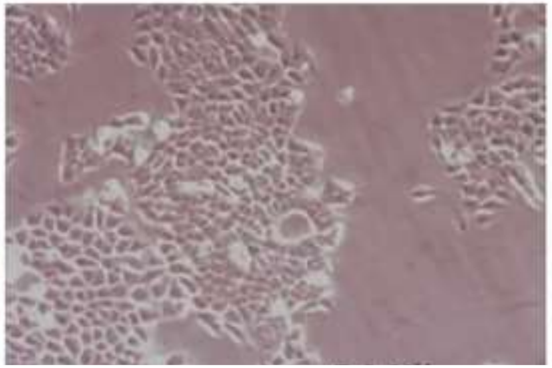


TMR + green feed

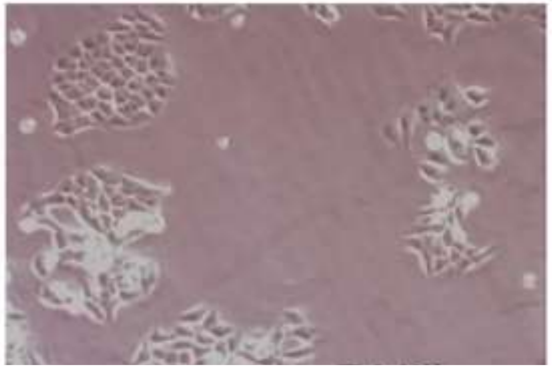


human colon cancer cells

TMR



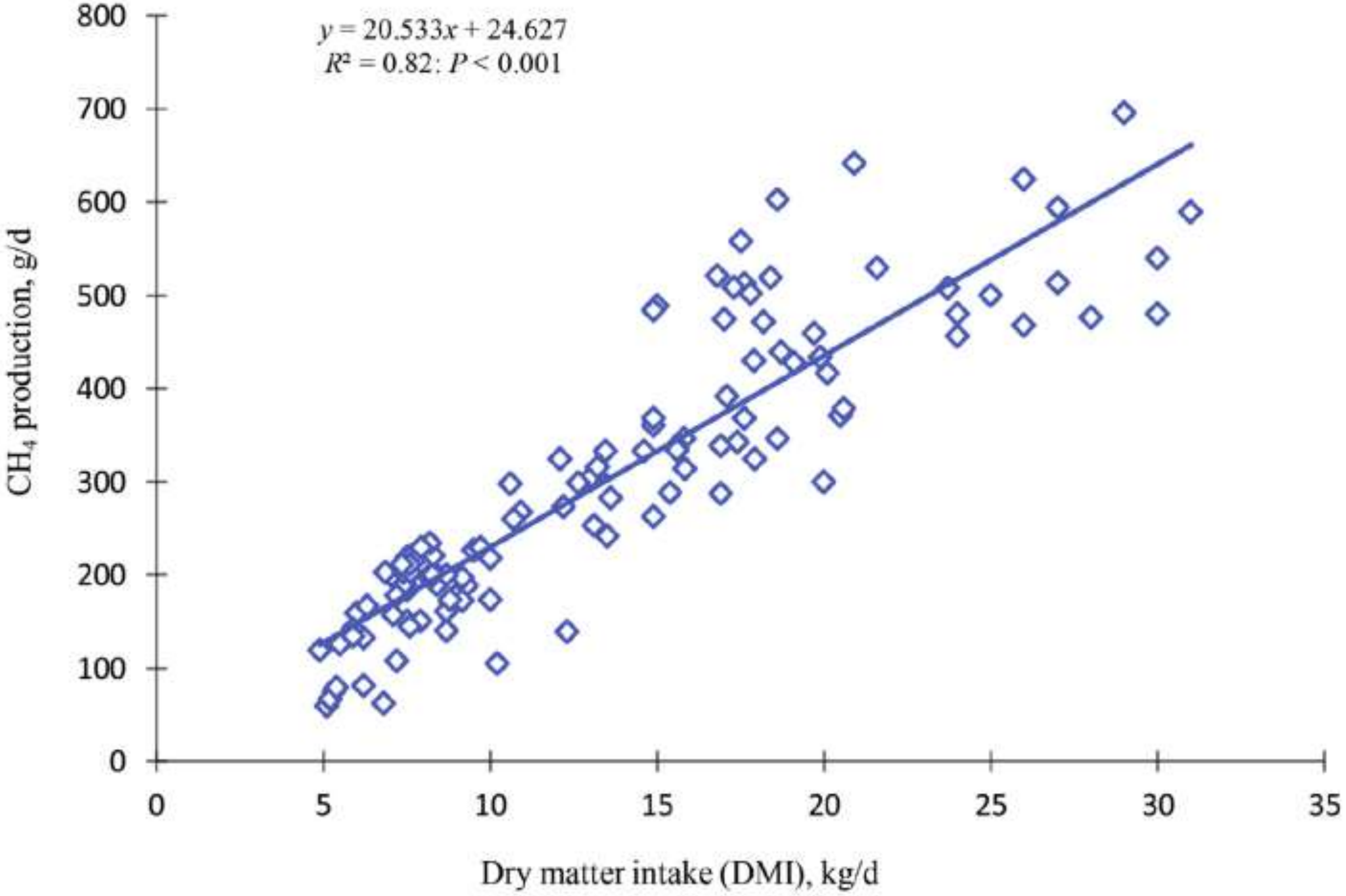
TMR + green feed



Methane challenge

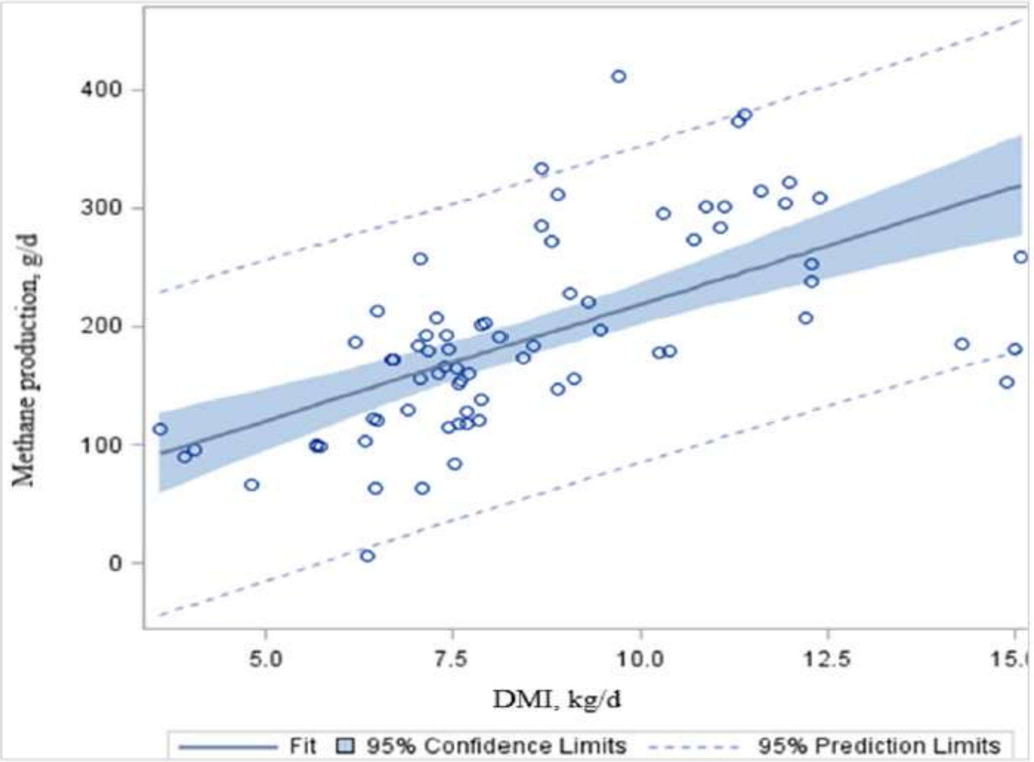
Dietary mitigation of enteric methane emissions from ruminants:
A review of plant tannin mitigation options☆
Animal Nutrition 6 (2020) 231–246

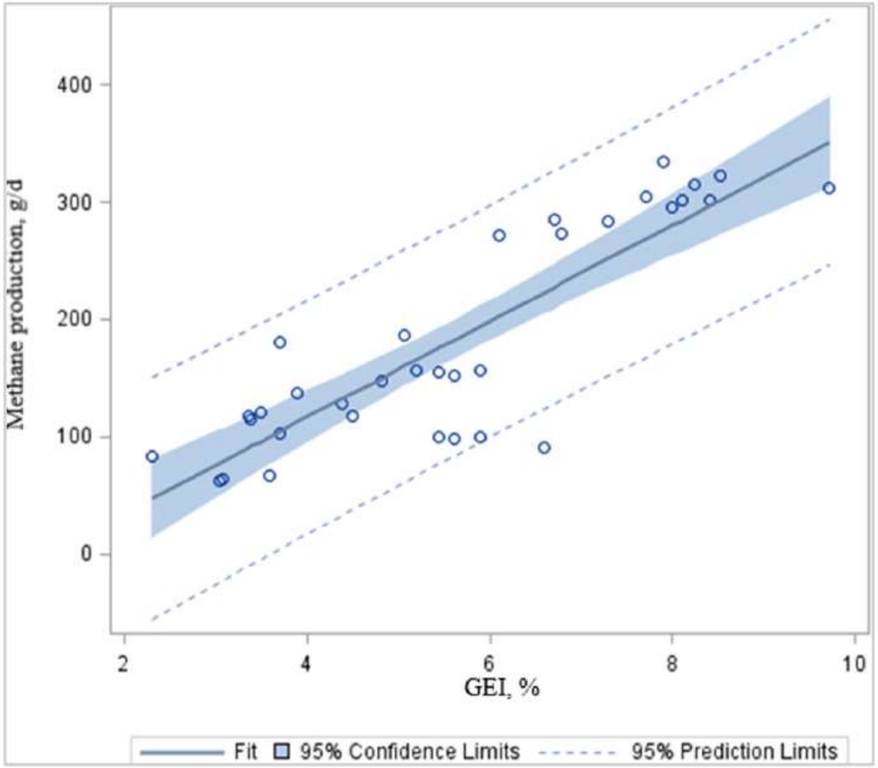
Dry matter intake (DMI) and methane production



Enteric Methane Emissions and Animal Performance in Dairy and Beef Cattle Production: Strategies, Opportunities, and Impact of Reducing Emissions
Animals **2022**, *12*, 948

Dry matter intake (DMI) and gross energy intake (GEI) and methane production in beef cattle



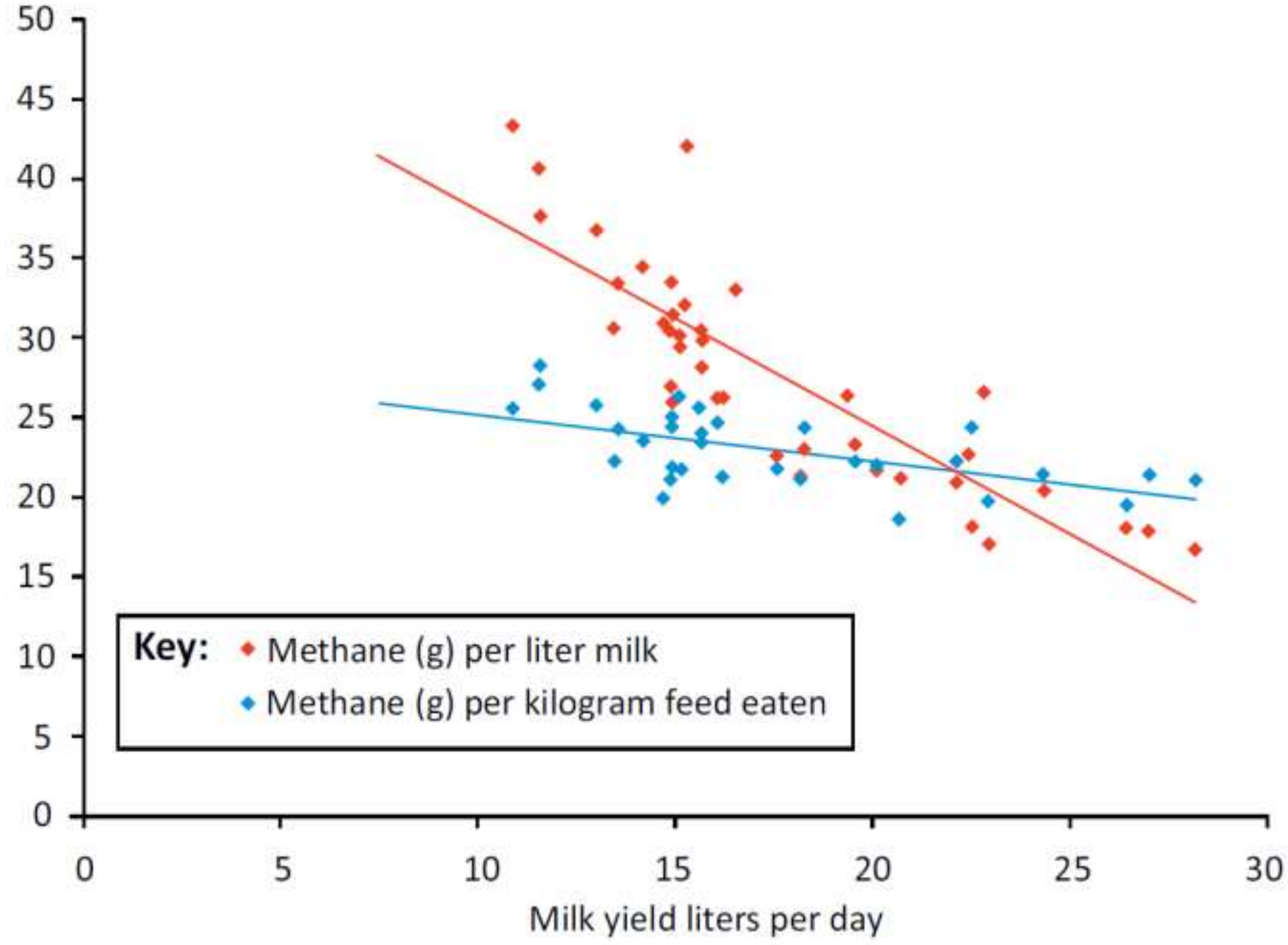


The future of livestock breeding: genomic selection for efficiency, reduced emissions intensity, and adaptation

Trends in Genetics, April 2013, Vol. 29, No. 4

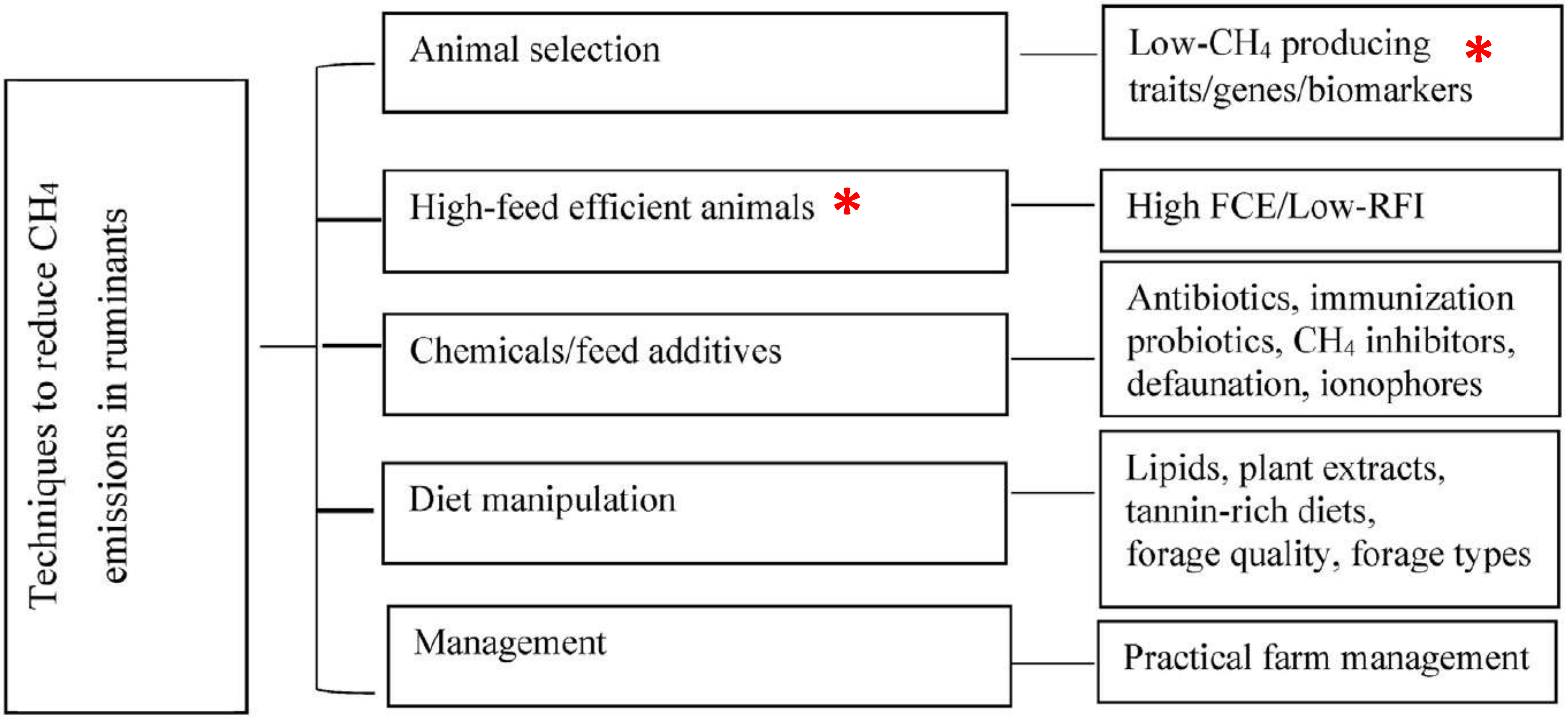
Efficiency of production and methane emissions

Methane emissions are closely linked to feed intake and more efficient animals dilute intake for maintenance over more units of product.



Dietary mitigation of enteric methane emissions from ruminants:
A review of plant tannin mitigation options*

Animal Nutrition 6 (2020) 231–246



Relationships between enteric methane production and economically important traits in beef cattle
Livestock Science 265 (2022) 105102

Methane production is phenotypically and genetically correlated with important production traits.

Knowledge of residual feed intake (RFI) / net feed efficiency (NFE) is highly important in future buffalo selection and breeding.

….genes linked with RFI/NFE

Genetic strategies

Reducing the cost of beef production through genetic improvement in residual feed intake: Opportunity and challenges to application[1]

J. Anim. Sci. 81(E. Suppl. 1):E9–E17 2003

Genetic correlations with residual feed intake (RFI) in Angus cattle

Genetic correlation	
Postweaning RFI with cow daily feed intake	**0.64**
Postweaning RFI and cow RFI	**0.98**

Genetics of buffalo milk production

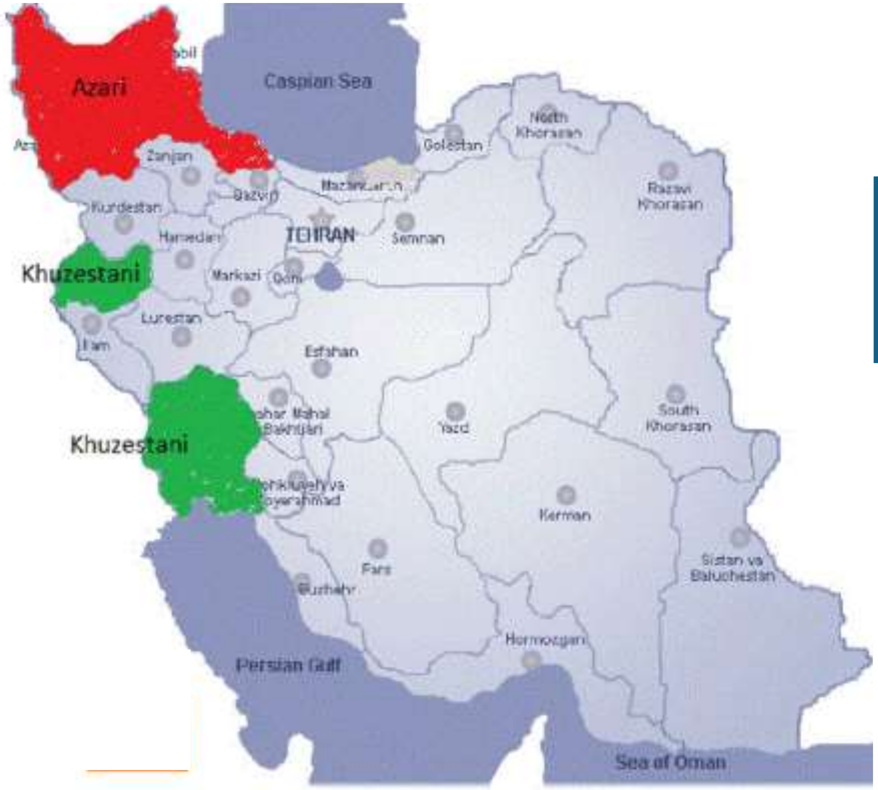
Whole-Genome Sequencing and Characterization of Buffalo Genetic Resources: Recent Advances and Future Challenges
Animals 2021, *11*, 904

Candidate genes associated with milk traits in buffalo

Trait	Candidate genes
Milk yield	*STAT1, STATSA, LEP, MC4R, OXT INSIG2, LALBA, BTN1A1, PRL, SCD, SREBF1*
Milk fat yield	*GHRL, A2M*
Milk fat (%)	*STAT1, TG, A2M, DGAT1, GHRL, LEP, MC4R, PRL, SCD, SREBF1*
Milk protein (%)	*CSNS1, DGT1, GHRL, ADRA1A, A2M MTNRIA, PRL, SPP1, INSIG2, MC4R*

A genome-wide scan for signatures of selection in Azeri and Khuzestani buffalo breeds

BMC Genomics (2018) 19:449



Candidate genes linked with milk production and composition in Azeri and Khuzestani buffalo

Putative candidate genes	***FBX09, NDFiP1, ACTR3, ARHGAP26, SERPINF2, BOLA-DRB3, BOLA-DQB, CLN8, MYOM2***

Polymorphism association and expression analysis of alpha-lactalbumin (LALBA) gene during lactation in Nili Ravi buffalo
Tropical Animal Health and Production (2020) 52:265–271

Genotype and allelic frequency of **polymorphisms** in alpha-lactoglobulin (*LALBA*) gene in Nili-Ravi buffalo

SNP ID	Chromosomal position	Change in nucleotide	Transition/ transversion	Allele frequency		Genotype frequency			HWE $P < 0.05$
LALBA1	34310913	G → A	Transition	A 0.3293	G 0.6707	AA 0.2683	AG 0.1463	GG 0.5854	0.0281*
LALBA2	34310940	C → G	Transversion	G 0.7073	C 0.2927	GG 0.2439	GC 0.1951	CC 0.5610	0.3262
LALBA3	34310958	A → G	Transition	G 0.7195	A 0.2805	GG 0.2683	GA 0.2195	AA 0.5122	0.0453*
LALBA4	34310984	A → G	Transition	G 0.6829	A 0.3171	GG 0.2683	GA 0.1951	AA 0.5366	0.0318*
LALBA5	34311015	G → A	Transition	A 0.6463	G 0.3537	AA 0.3871	AG 0.0645	GG 0.5484	0.0411*

Alpha- lactoglobulin is a bioactive milk protein

Associations between polymorphisms
of the *STAT1* gene and milk production traits in water buffaloes
J. Anim. Sci. 2016.94:927–935

Signal transducer and activation of transcription (*STAT1*) gene **polymorphisms** in buffalo

No.	Positions	Location	Types
SNP1	508	5′ UTR[1]	G > A
SNP2	1,079	Intron2	C > A
SNP3	1,901	Intron2	A > T
SNP4	2,338	Intron2	T > C
SNP5	2,965	Intron2	A > C
SNP6	3,173	Intron2	T > G
SNP7	3,328	Intron2	G > C
SNP8	3,666	Intron3	G > A
SNP9	4,007	Intron3	T > C
SNP10	5,558	Intron4	G > T
SNP11	5,842	Intron4	T > A
SNP12	11,938	Intron9	A > G
SNP13	15,642	Exon10	G > T
SNP14	29,924	Intron21	G > C
SNP15	30,303	Intron21	C > T
SNP16	31,908	Intron22	G > A
SNP17	33,403	Intron23	T > C
SNP18	38,379	3′ UTR	C > A

[1]UTR = untranslated region.

***STAT1* single nucleotide polymorphism (SNP)**	
305-day milk yield	**SNP4, SNP10**
Protein %	**SNP2, SNP5, SNP8, SNP9**

STAT1 protein activates the transcription of hundreds of genes

Novel Insight into the Role of Squalene Epoxidase (*SQLE*) Gene in Determining Milk Production Traits in Buffalo
Int. J. Mol. Sci. 2023, 24, 2436

Relationship of single nucleotide polymorphisms of squalene epoxidase (*SQLE*) gene to milk traits in Italian Mediterranean buffalo

SQLE haplotype combinations and milk traits

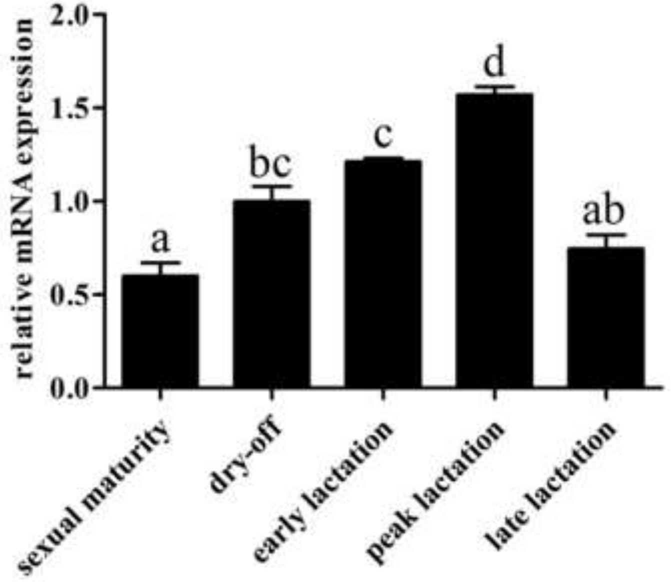
	H1H1	H1H3	H2H3	*p*-Value
FY (kg)	235.78 ± 3.44 [a]	226.97 ± 5.00 [ab]	225.02 ± 3.09 [b]	0.03
FP (%)	8.03 ± 0.07 [a]	7.73 ± 0.10 [b]	7.94 ± 0.06 [ab]	0.04
PY (kg)	133.33 ± 1.88 [a]	131.63 ± 2.73 [ab]	127.80 ± 1.69 [b]	0.04
PP (%)	4.57 ± 0.02	4.53 ± 0.03	4.57 ± 0.02	0.44

SQLE is a key enzyme in cholesterol synthesis

Molecular Characteristics and Polymorphisms of Buffalo (*Bubalus bubalis*) *ABCG2* Gene and Its Role in Milk Fat Synthesis
Animals **2023**, *13*, 3156.

ATP-binding cassette family G member 2 (*ABCG2*) gene and milk fat content in buffalo

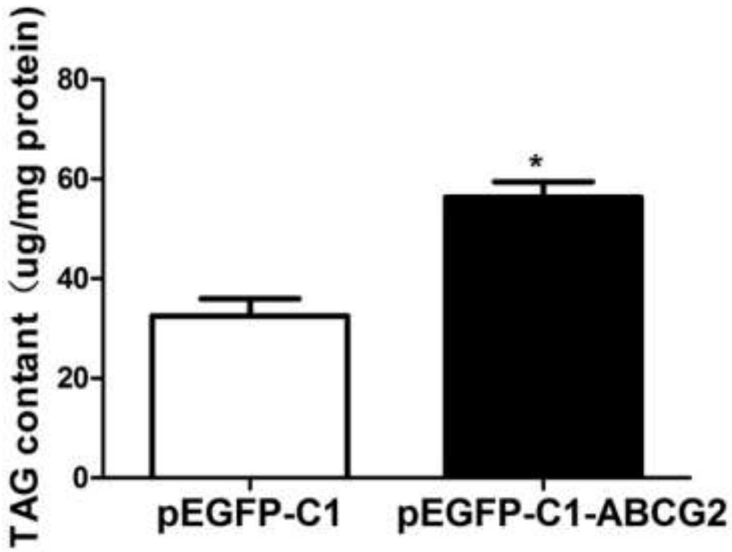
ABCG2 expression



Polymorphisms

SNP	Genotype
c.393 C>T	CC
	CT
	TT
c.471 T>C	TT
	TC
	CC
c.720 C>T	CC
	CT
	TT
c.861 G>A	GG
	GA
	AA
c.1290 C>T	CC
	CT
	TT

ABCG2-induced expression of liposynthesis-related genes and increased trigyceride (TAG) protein in buffalo mammary epithelial cells



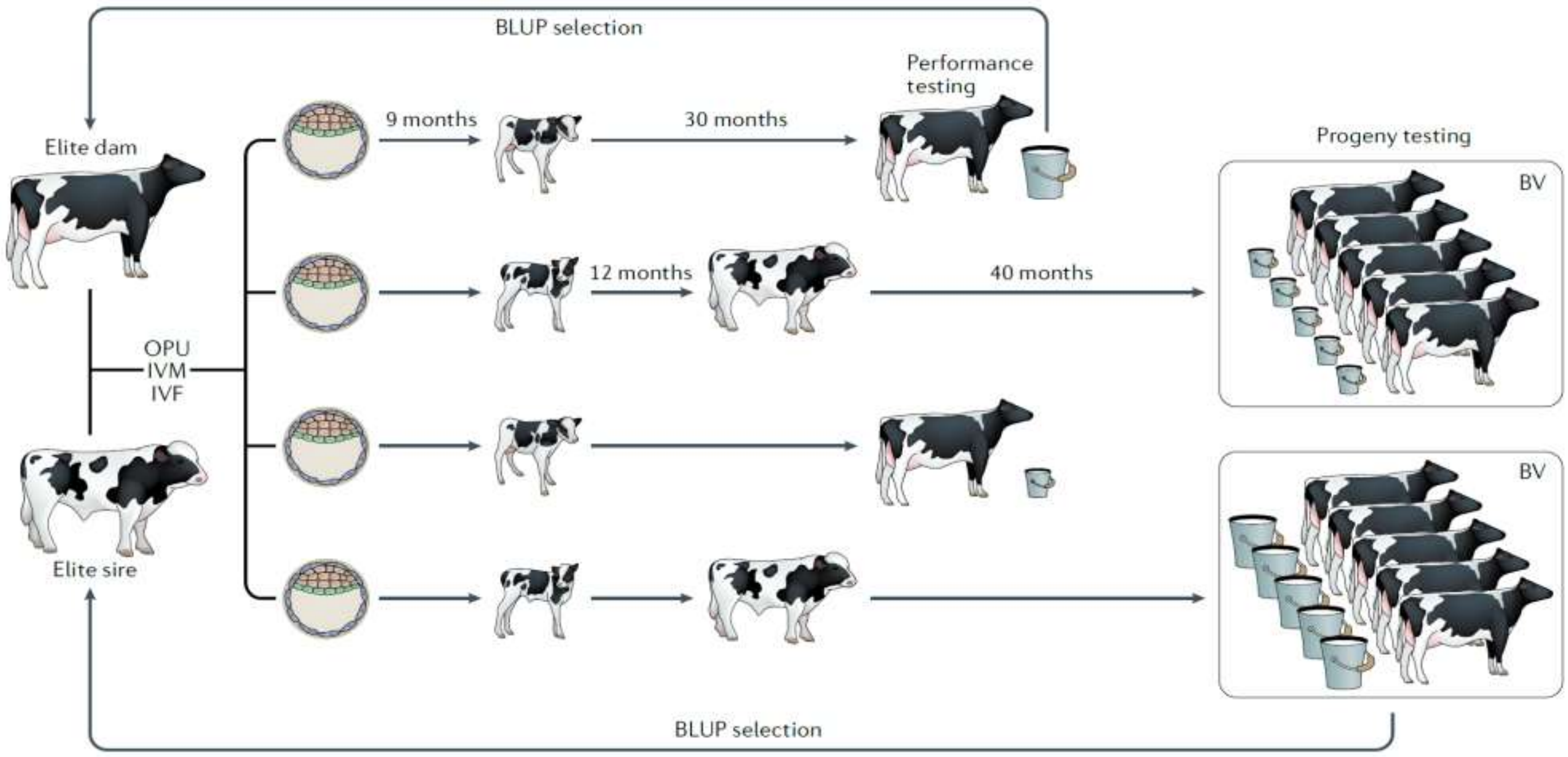
ABCG2 induces proteins involved in transport across cell membranes

Genomic breeding values

Harnessing genomic information for livestock improvement
NATURE REVIEWS | GENETICS
VOLUME 20 | MARCH 2019 | 135

Best linear unbiased prediction (BLUP) of breeding value (BV)

Environmental effects and pedigree information used to determine breeding value (BV)

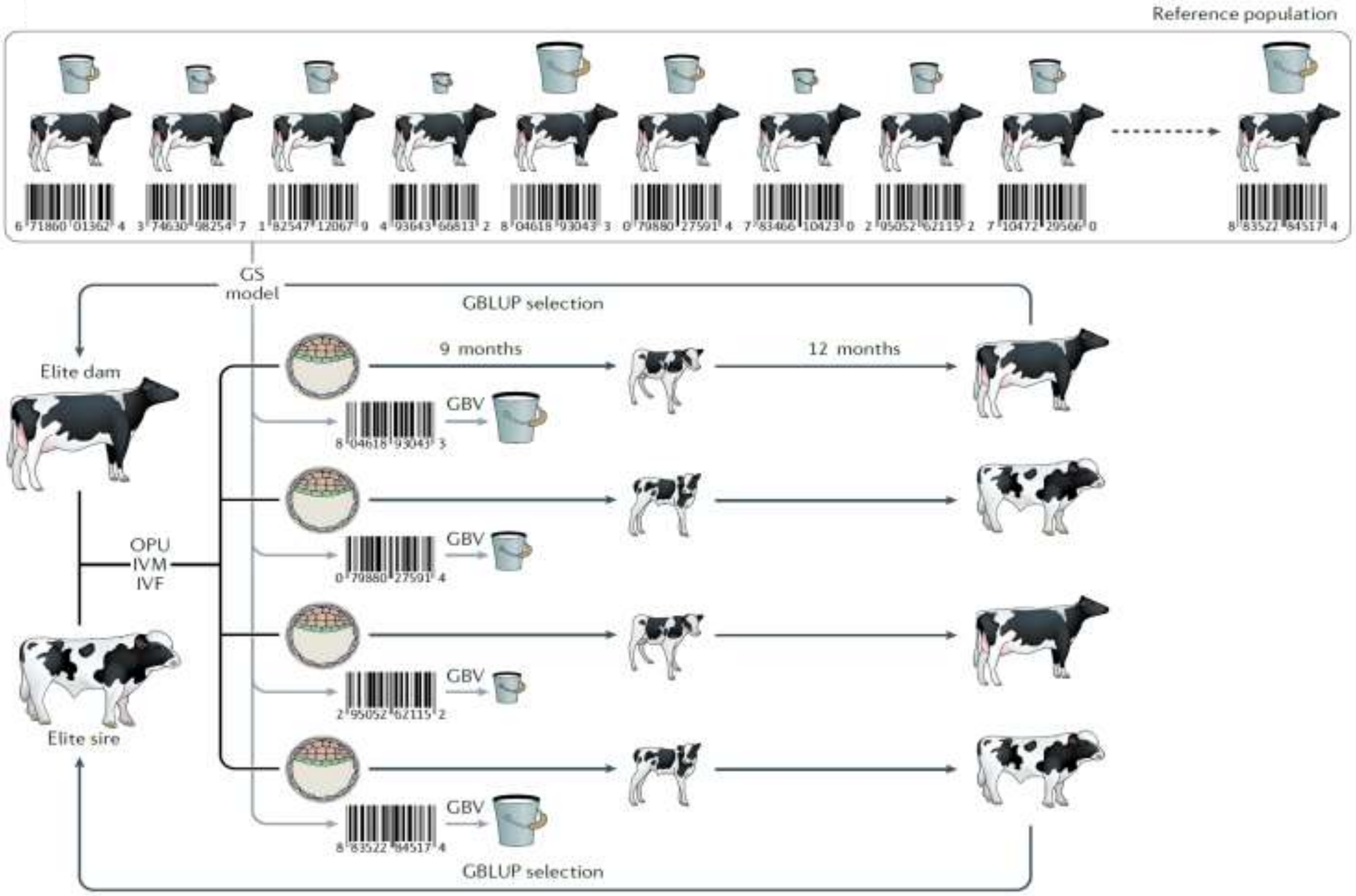


Harnessing genomic information for livestock improvement
NATURE REVIEWS | GENETICS
VOLUME 20 | MARCH 2019 | 135

Genomic best linear unbiased prediction (GBLUP) of breeding value (GBV)

Genotyping with genome-wide single nucleotide polymorphism (SNP) arrays to determine genomic breeding value (GBV)

Statistical models for genomic selection (GS) are trained on a **reference population** of animals that have both **SNP genotypes** and **phenotypic** information



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Associazione Nazionale Allevatori Specie Bufalina

Bufala Mediterranea Italiana: tecnologie innovative per il miglioramento Genetico

Milk characteristics

Characteristic	Heritability
Production	0.34
Fat kg	0.26
Fat %	0.24
Protein kg	0.31
Protein %	0.34

Bufala Mediterranea Italiana: tecnologie innovative per il miglioramento Genetico

Records		Years
Milk production	276,451 cows 743,904 lactations	1984-2019
Morphology	91,966 cows	2004-2022

Genomic investigation of milk production in Italian buffalo
ITALIAN JOURNAL OF ANIMAL SCIENCE
2021, VOL. 20, NO. 1, 539–547

Prediction accuracy with best linear unbiased prediction (BLUP) and single-step genomic best linear unbiased prediction (ssGBLUP) in Italian buffalo

Report 1

	BLUP	ssGBLUP
Milk	**0.60**	**0.77**
Fat	**0.55**	**0.72**
Protein	**0.57**	**0.76**

Including male and female genotypes improved breeding value accuracy in Italian buffalo

The present of Italian Mediterranean buffalo: precision breeding based on multi-omics data
ACTA IMEKO
December 2023, Volume 12, Number 4, 1 - 4

Prediction accuracy for milk production with BLUB and ssGBLUP in Italian buffalo

Report 2

	Mean	Minimum	Maximum
BLUP	**0.86**	**0.24**	**0.99**
ssGBLUP	**0.89**	**0.31**	**0.99**

Genetic gain

$$\Delta G = \frac{r \ * i \ * \sigma_g}{N}$$

r accuracy
i selection intensity
σ_g genetic variation
N **generation interval**

Harnessing reproductive technology

Harnessing genomic information for livestock improvement
NATURE REVIEWS | GENETICS
VOLUME 20 | MARCH 2019 | 135

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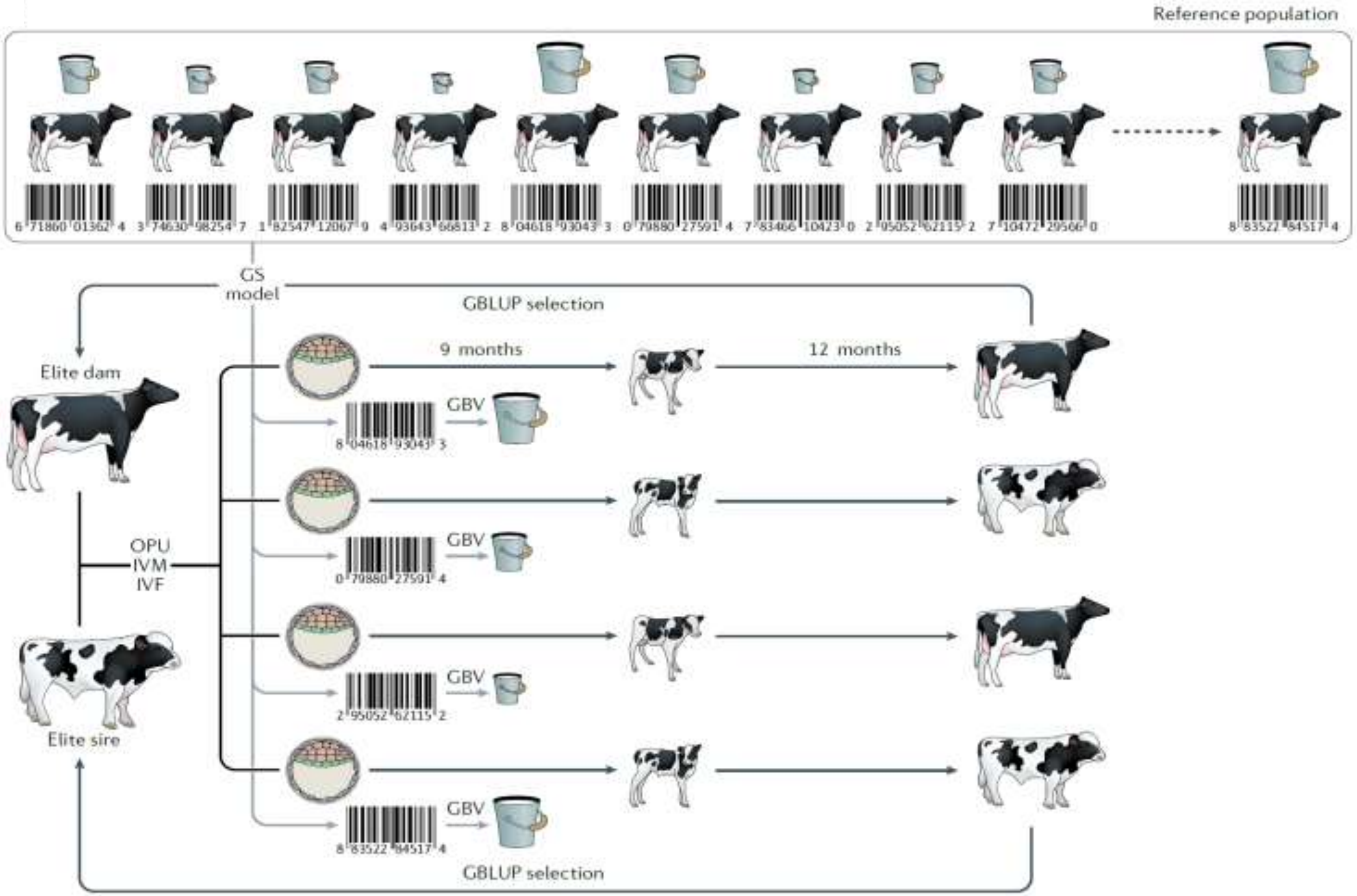
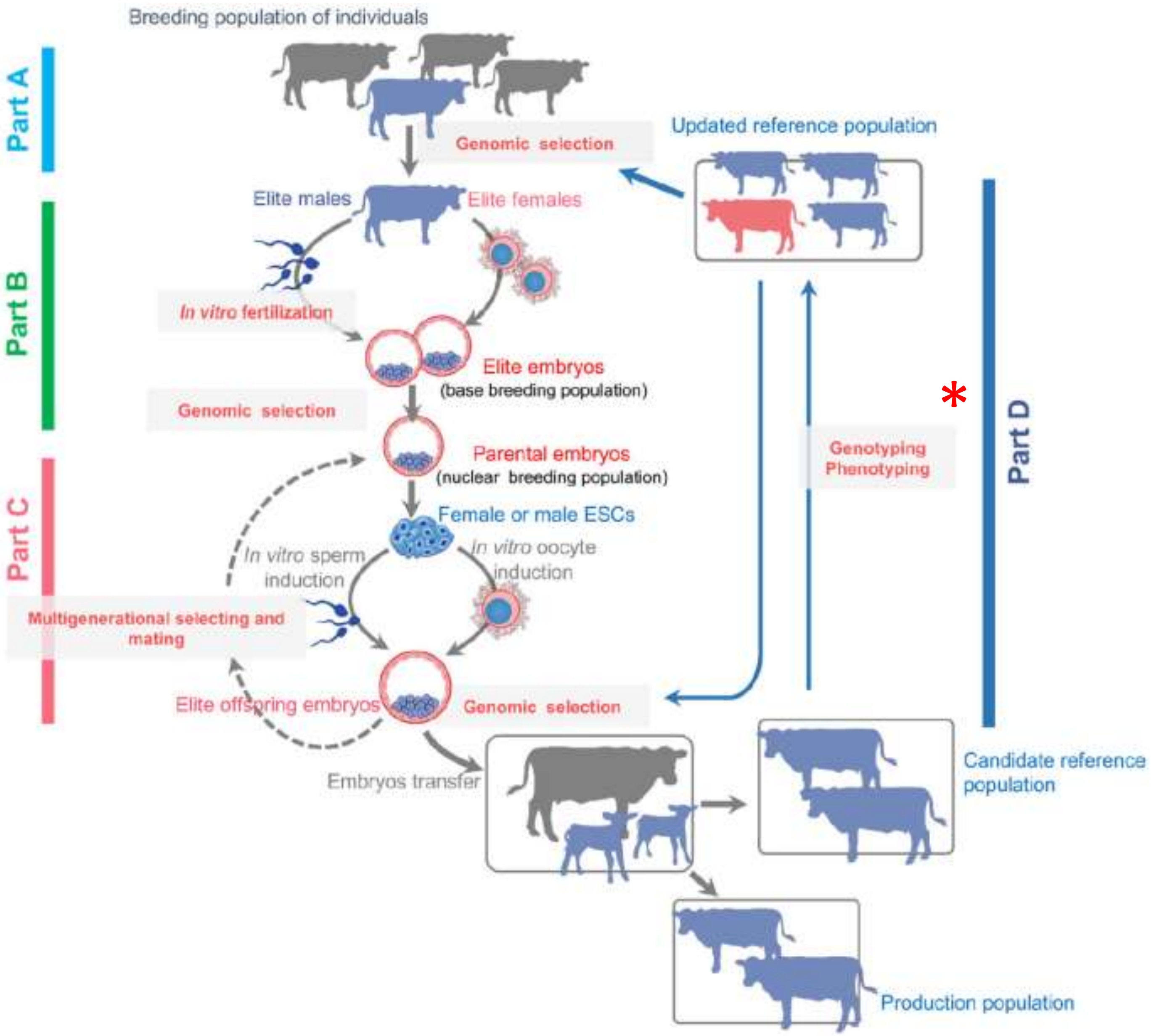


Revolutionize livestock breeding in the future: an animal embryo-stem cell breeding system in a dish

Journal of Animal Science and Biotechnology (2018) 9:90

Embryo-stem cell breeding system



Part A, nuclear breeding population
Part B, nuclear population of elite embryos
Part C, transgenerational breeding cycle from parental embryos and offspring embryos
Part D, reference population updating

Revolutionize livestock breeding in the future: an animal embryo-stem cell breeding system in a dish
Journal of Animal Science and Biotechnology (2018) 9:90

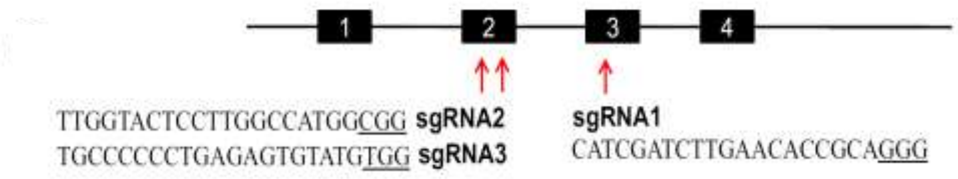
Comparisons of different breeding systems

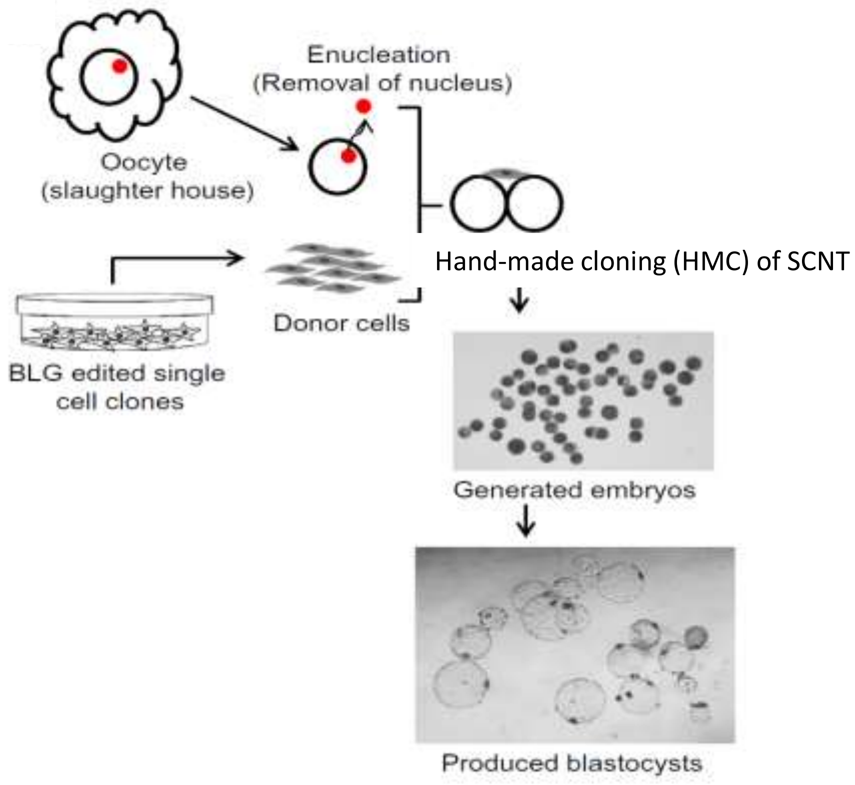
Major breeding elements	Conventional breeding	Genomic selection	Embryo-stem cell breeding
Breeding scheme	Yes	Yes	Yes
Pedigree record	Yes	Yes, can also reconstruct pedigree from genotyping data	Yes, can also reconstruct pedigree from genotyping data
Performance testing	Breeding animals	Only for reference population	Only for reference population
Reference population	No	Yes	Yes
Candidate breeding animal	Individual	Individual, embryo	Embryo
Generation transfer	Individual to individual	Individual to individual	Embryo to embryo
Breeding value	EBV	GEBV	eGEBV
Gametogenesis	In vivo gametogenesis	In vivo gametogenesis	In vitro induced gametogenesis
Fertilization /Embryo	In vivo fertilization and development; In vitro fertilization and culture	In vivo fertilization and development; In vitro fertilization and culture	In vitro fertilization and culture

CRISPR/Cas gene editing

CRISPR-mediated editing
of β-lactoglobulin (*BLG*) gene
in buffalo
Scientific Reports | (2024) 14:14822

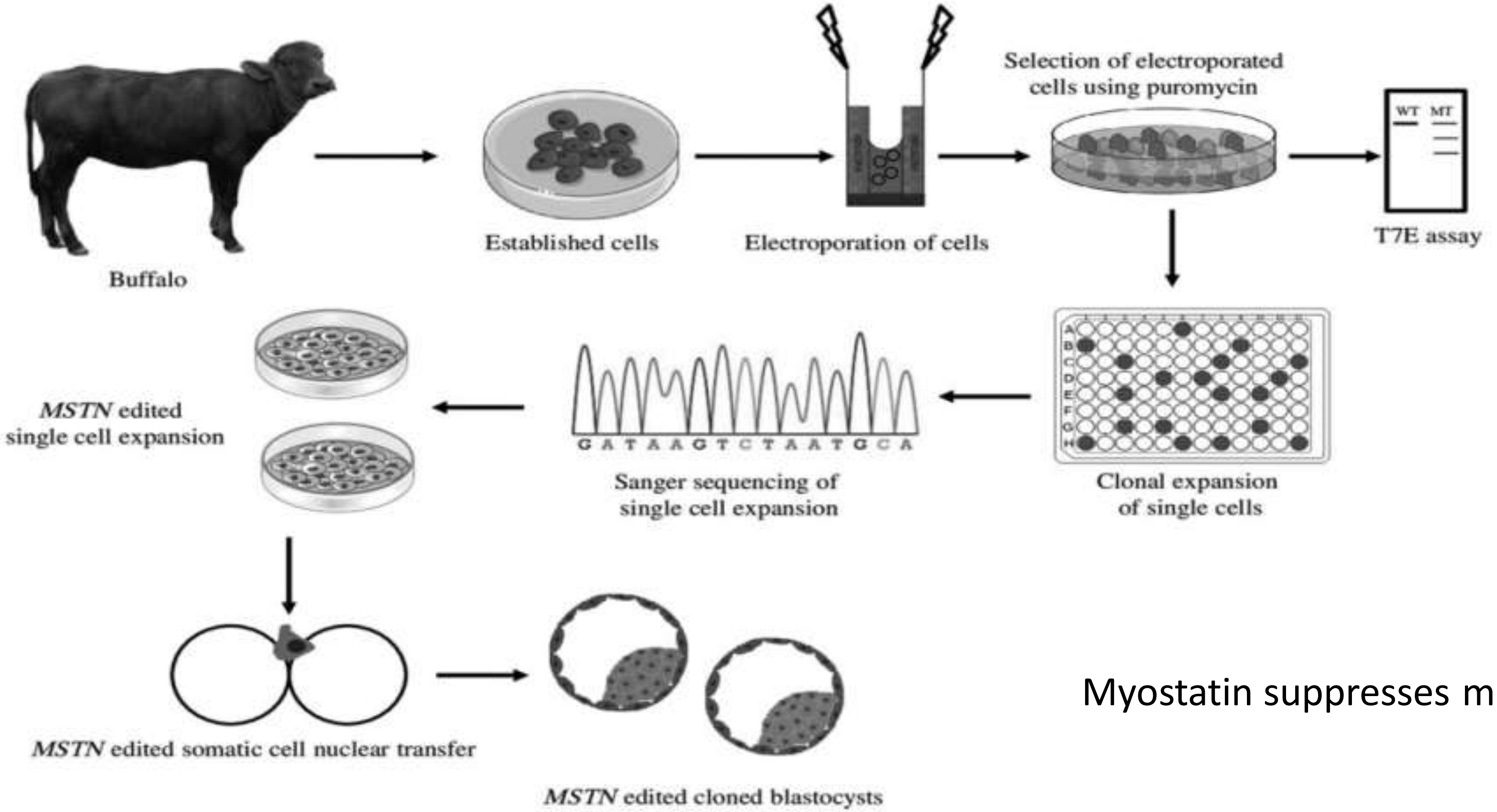
CRISPR/Cas editing of β-lactoglobulin gene exons 2 and 3 with single guide RNAs (sgRNAs) to reduce allergenic property of buffalo milk





Production of *MSTN* Gene-Edited Embryos of Buffalo Using the CRISPR/Cas9 System and SCNT
CELLULAR REPROGRAMMING
Volume 25, Number 3, 2023

CRISPR plasmids (pX459) containing sgRNAs targeting of myostatin (*MSTN*) gene in buffalo



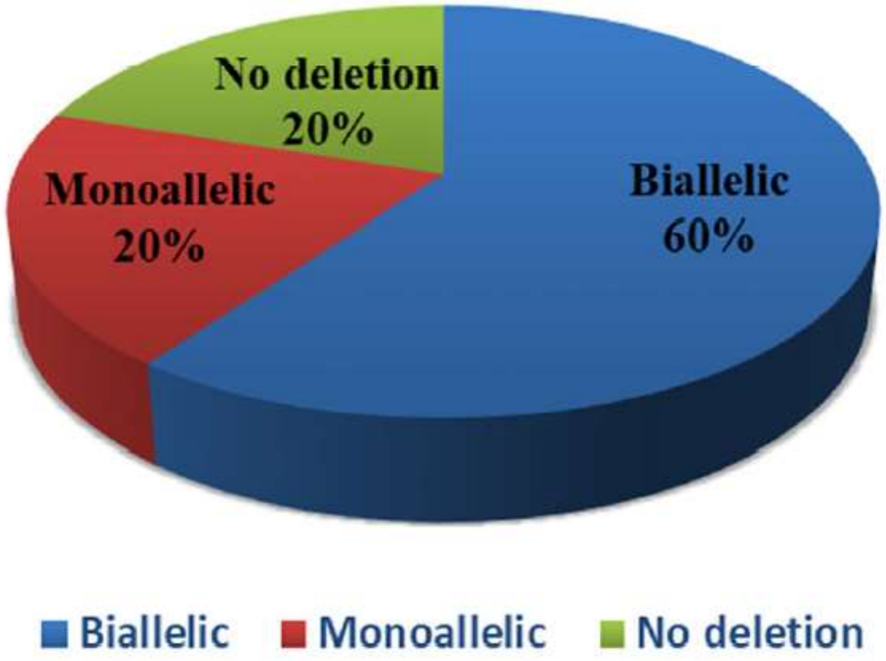
Myostatin suppresses muscle growth

Optimising Electroporation Condition for CRISPR/Cas-Mediated
Knockout in Zona-Intact Buffalo Zygotes

Animals **2024**, *14*, 134.

Efficiency of CRISPR/Cas knockout in buffalo zygotes

Embryo genotype (n=10)



Stating the obvious

The animal is fundamental.

Get the animal right for profitable market(s) and then think about other investments.

Future perspective

1. Ongoing refinement of animal and milk traits that have local and global importance.
2. Global reference populations to link phenotypes with genotypes.
3. Validation of global reference populations within and between breeds (Mediterranean, Murrah, Nili-Ravi)
4. Use information from reference populations for continued development and broad adoption of genomic breeding values.
5. Strategic use of reproductive technology to accelerate local and global genetic improvement.
6. Establish global consortium to coordinate, integrate and facilitate genetic improvement.
7. New differentiated products for changing global demographics and wealth distribution.

Acknowledgements

Buffalo Dairy Waste: From Waste to Resource

THE WHEY FACTORY

Francesco Addeo
Department of Agriculture
University of Naples Federico II – Portici
addeo@unina.it

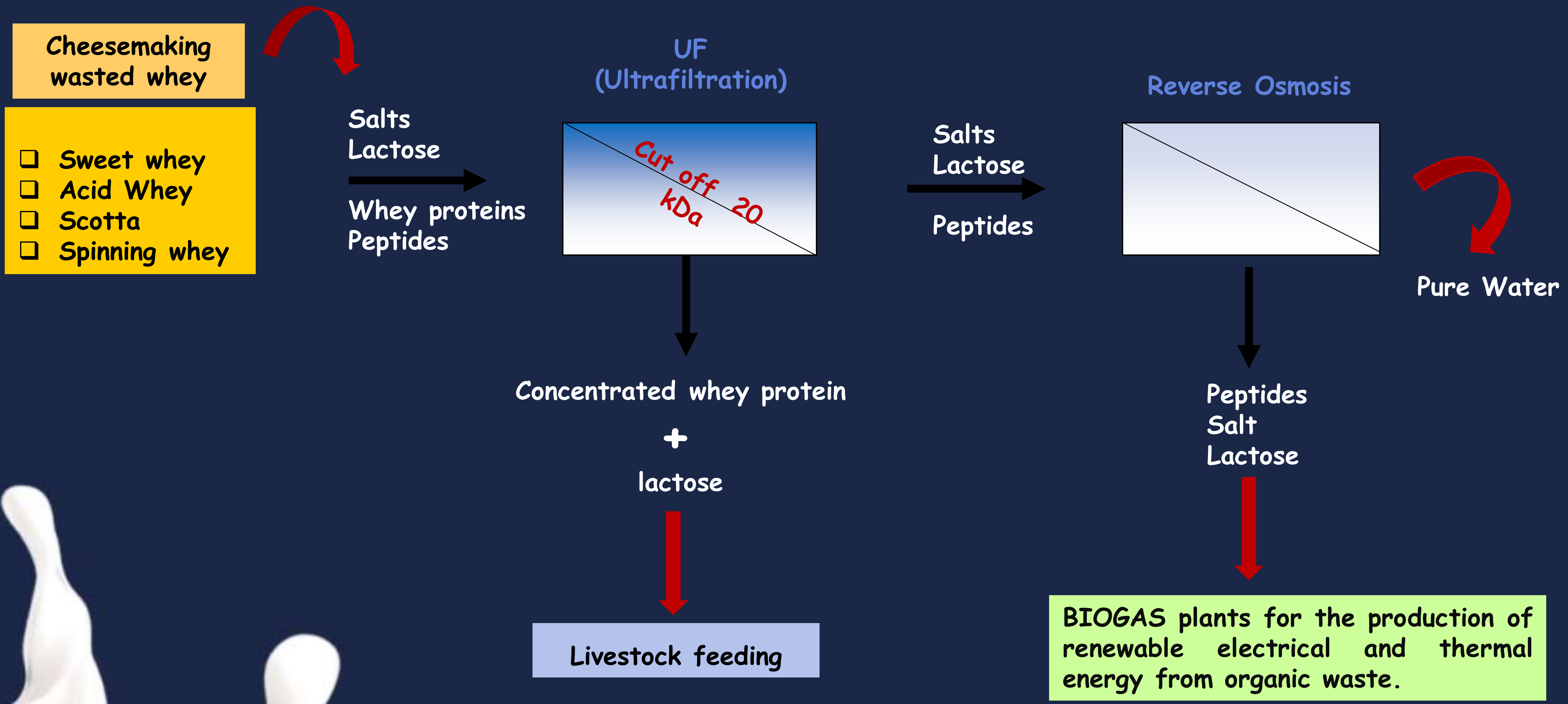
COLLABORATION BETWEEN RESEARCH CENTERS AND BUFFALO DAIRIES: RESULTS

We present the results of the collaboration between buffalo dairies and our research structures for an alternative utilization of dairy effluents, which traditionally were sent to wastewater treatment plants.

In dairies, there are four main effluents:

- sweet whey
- acidic whey
- unused whey starter
- spinning water
- deproteinized whey, known as 'scotta,' left over from Ricotta production

Whey Fractionation and Concentration Process Using Ultrafiltration and Reverse Osmosis



UNIONE EUROPEA

REGIONE CAMPANIA

POR CAMPANIA FESR 2014-2020

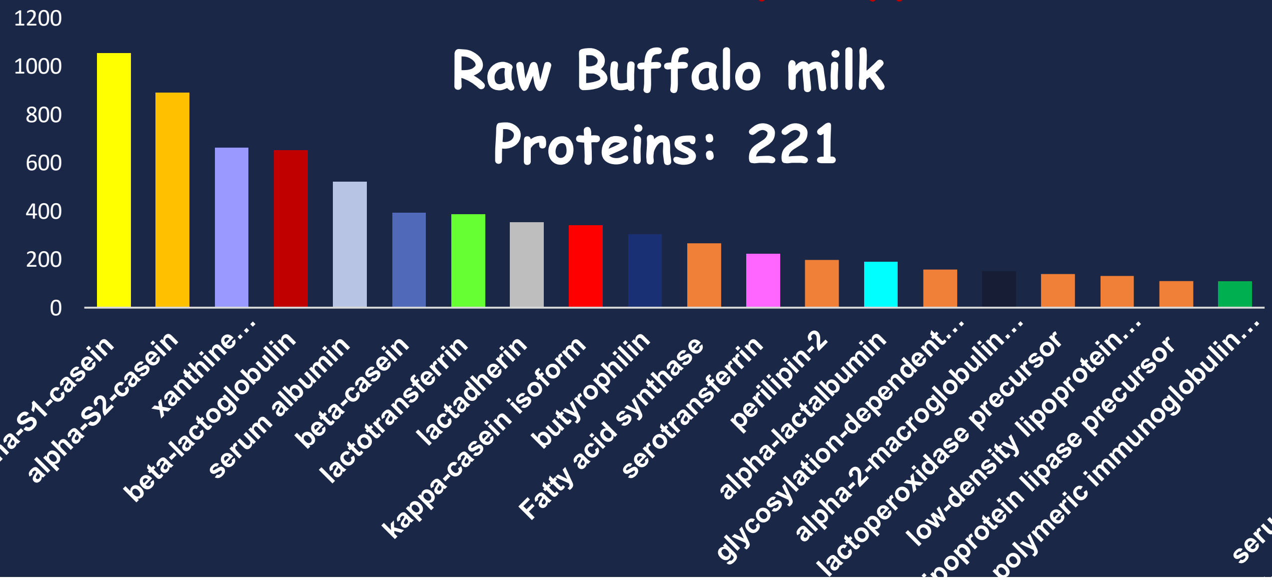
PROGETTO TRASFERIMENTO TECNOLOGICO E DI PRIMA INDUSTRIALIZZAZIONE PER LE IMPRESE INNOVATIVE AD ALTO POTENZIALE PER LA LOTTA ALLE PATOLOGIE ONCOLOGICHE – CAMPANIA TERRA DEL BUONO

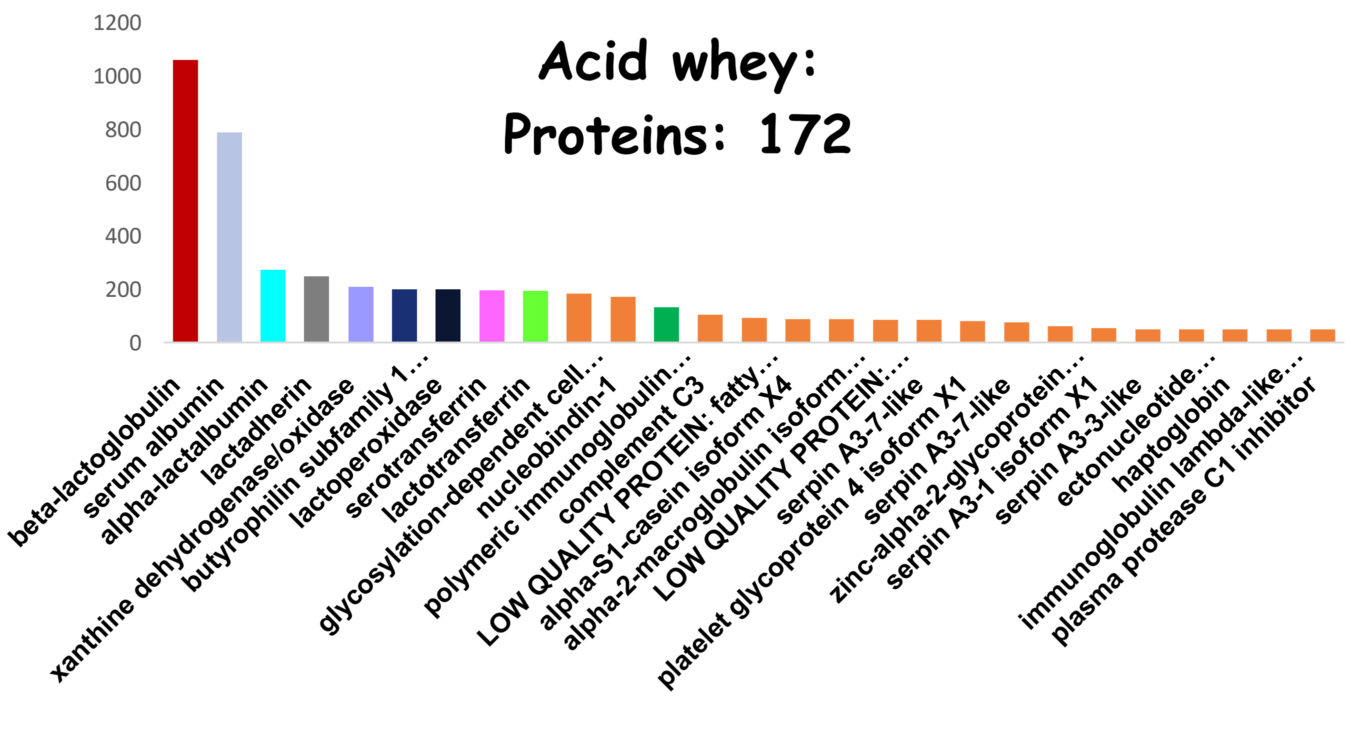
Decreto Dirigenziale n. 357 del 12/06/2017, BURC n. 47 del 12 Giugno 2017

PROGETTO IABUPO - INTEGRATORI ALIMENTARI DA SIERO BUFALINO PER IL TRATTAMENTO DI PAZIENTI AFFETTI DA PATOLOGIE ONCOLOGICHE: UN'OPPORTUNITÀ PER LA FILIERA BUFALINA IN UN'OTTICA DI ECONOMIA CIRCOLARE

An innovative project financed by the Campania region. The objective was to develop new uses for whey proteins, going beyond their use as animal feed. The project focused on creating supplements for cancer patients, turning a by-product into a valuable resource.

Molecular Characterization of Buffalo Milk and Whey: Proteins and Peptides Analysis





We analyzed buffalo milk and whey, recovering the four main types of effluents from the mozzarella production process. These fluids were fractionated, and we identified the protein and peptide compositions. In buffalo milk, we identified 221 proteins, 125 in sweet whey, and 172 in acidic whey.

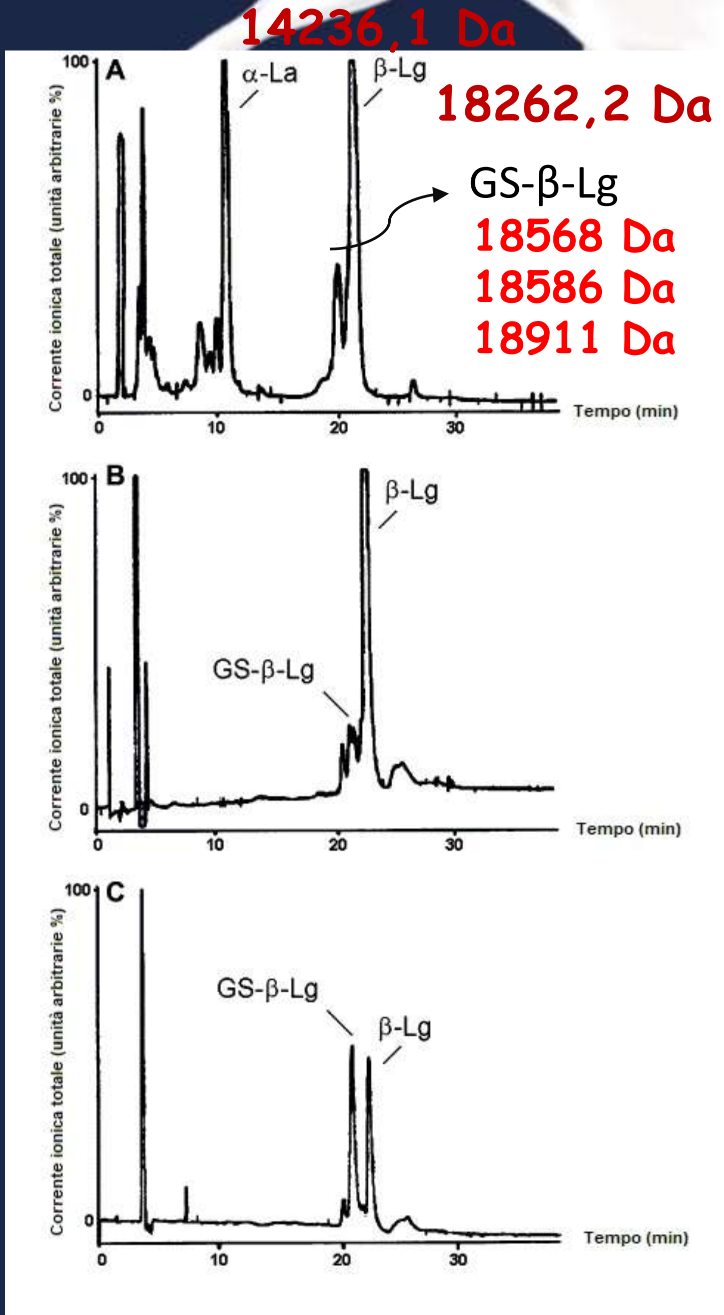
Functionalization of Whey Proteins with Bioactive Compounds: Glutathione as a Bioavailability Enhancer

GSSG
Molecular Weight 307.32

Wasted whey

Incubation time

0 min
30’ min
360’ min



This project aimed to use beta-lactoglobulin as a carrier for glutathione, a powerful antioxidant. Glutathione exists in two forms in the body: oxidized (GSSG) and reduced (GSH). We aimed to enhance glutathione's stability and absorption by binding it to beta-lactoglobulin. After six hours of reaction, the protein had bound approximately 50% of the available glutathione.

Buffalo Lactoferrin: Industrial Isolation and Health Applications

We isolated buffalo lactoferrin on an industrial scale.

Like bovine lactoferrin, buffalo lactoferrin carries two iron atoms and plays a key role in iron absorption and as a bacteriostatic agent.

The process is costly but offers promising health benefits and potential uses in nutraceuticals and cosmetics.

Functionalization of Buffalo Lactoferrin with Iron Ions: Enhancing Bioavailability

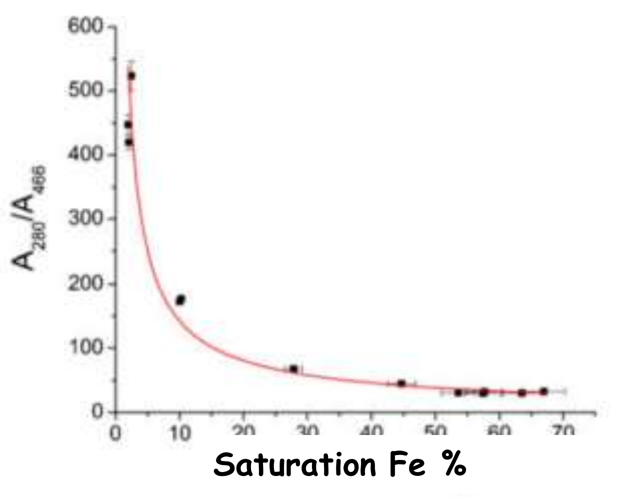
Functionalization with Fe^{+3} salts

Lactoferrin

sodium citrate treatment

Spectrophotometer

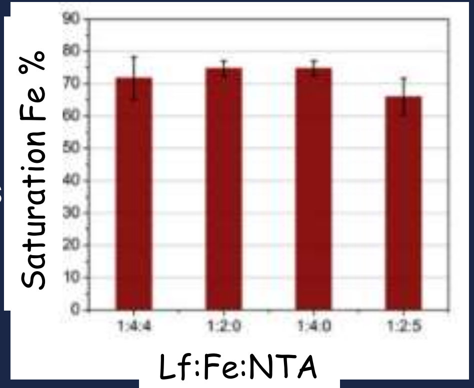
A280/A466



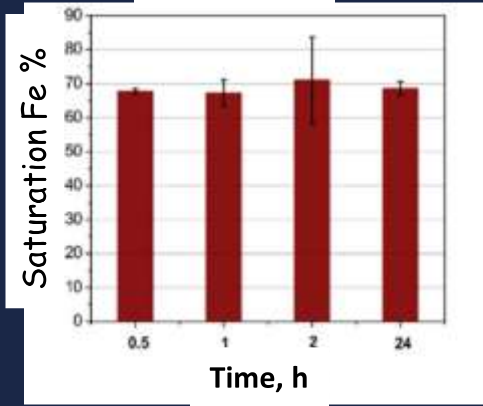
Dialysis

Change Lf/Fe/NTA concentration ratios

Spectrophotometer

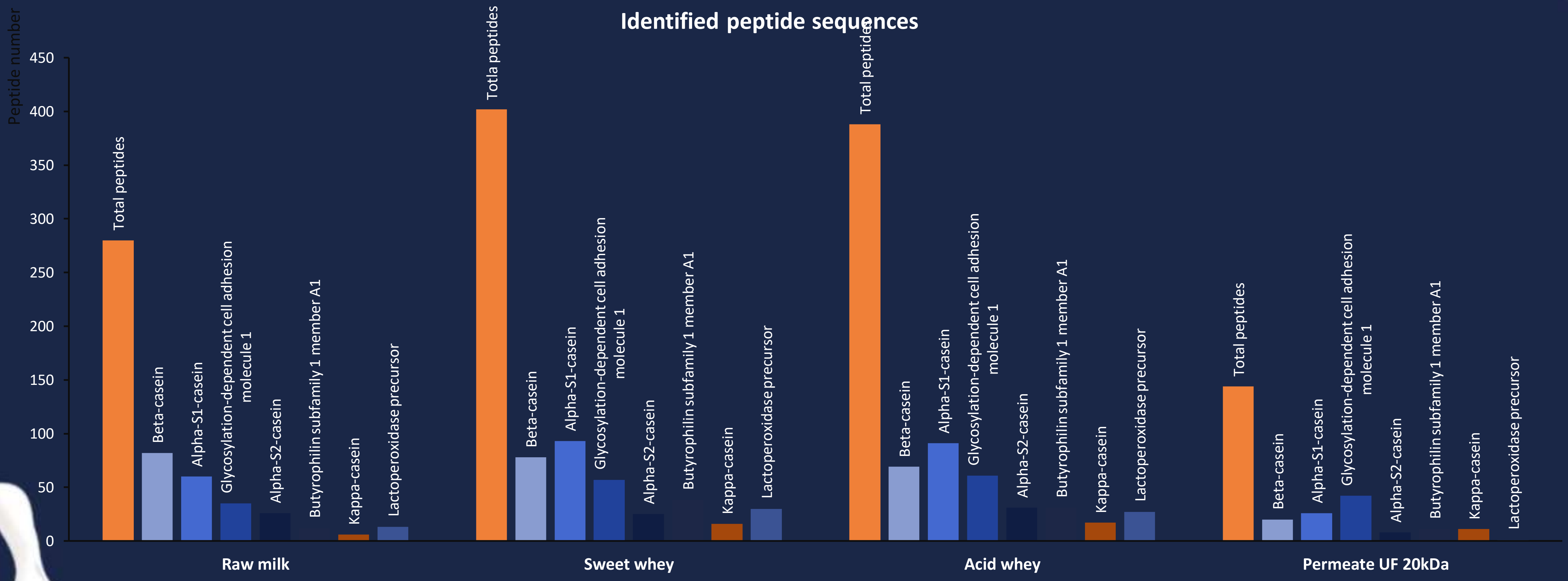


Change incubation times



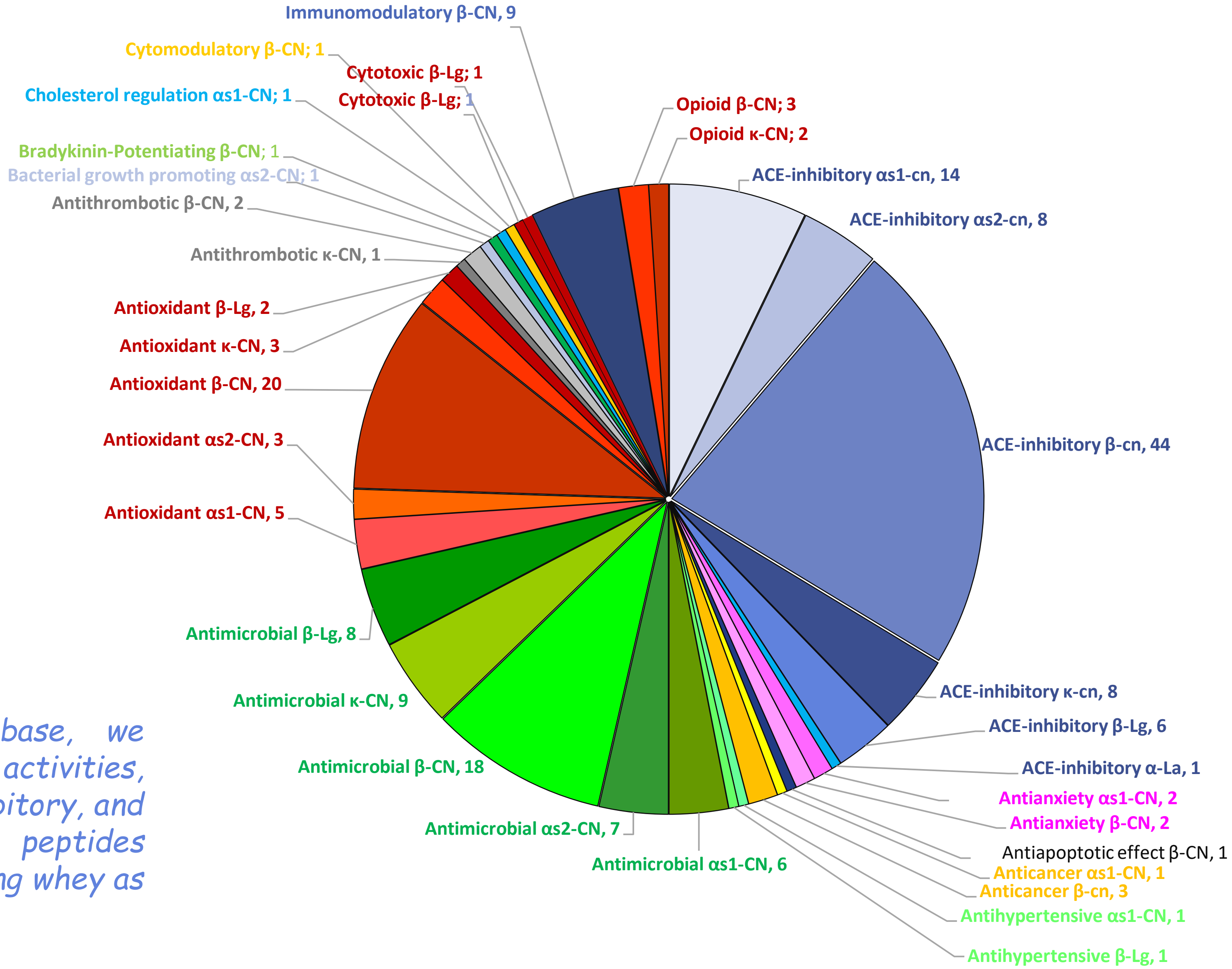
In this slide, we show the process of enriching buffalo lactoferrin with additional iron ions. This can support hemoglobin synthesis and prevent iron deficiency anemia. We optimized the conditions for iron binding, achieving a functionalization rate of over 85% at a pH of 5.0.

Peptide Profiles in Buffalo Milk and Whey: Identification and Origins



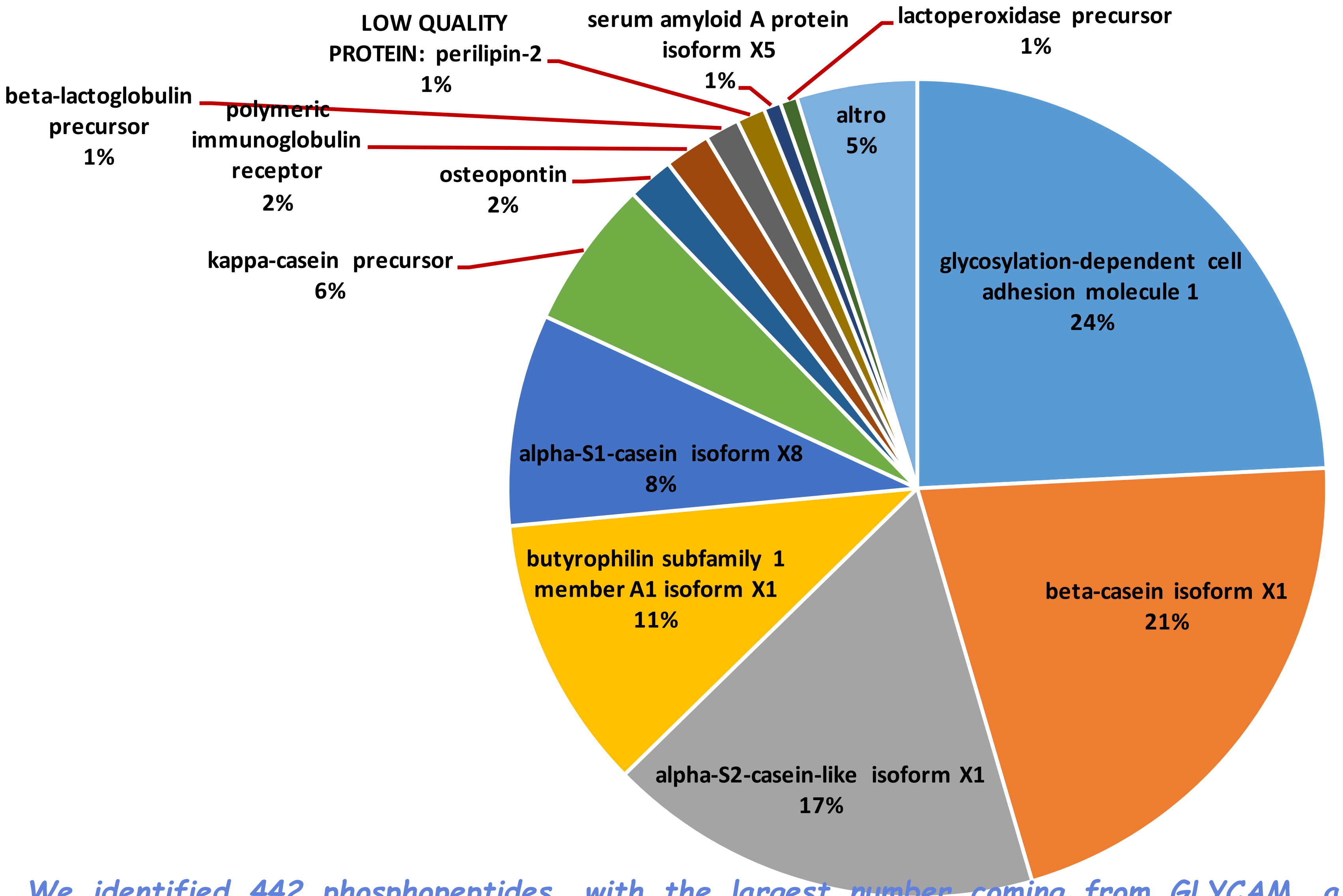
This slide provides an overview of the peptides identified in buffalo milk, sweet whey, acidic whey, and permeate. The total number of peptides was significantly higher in whey compared to milk and permeate. We also traced the origin of these peptides to understand their formation.

Bioactive Peptides in Whey: Potential Health Benefits



Using the Milk Bioactive Peptide Database, we identified peptides with various biological activities, including antimicrobial, antioxidant, ACE-inhibitory, and anticancer properties. These bioactive peptides highlight the potential health benefits of using whey as a base for functional beverages

Phoshopeptide Identification in Whey: Detecting Cold Storage Markers



We identified 442 phosphopeptides, with the largest number coming from GLYCAM, a protein associated with milk freezing and thawing. These phosphopeptides can be used as markers to determine if frozen milk was used in mozzarella production.

Phosphopeptides Applications: Nutraceuticals, Biomedical, and Food Additives

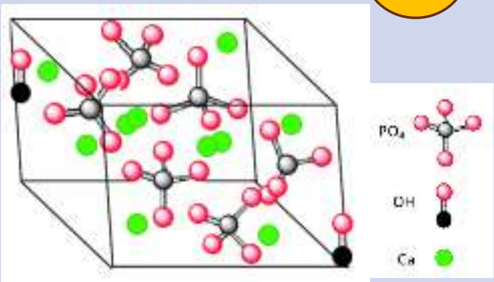
Patent n. 1404716

<<Preparation of a new product consisting of phosphopeptides immobilized on hydroxyapatite for nutraceutical and (other) innovative purposes>>

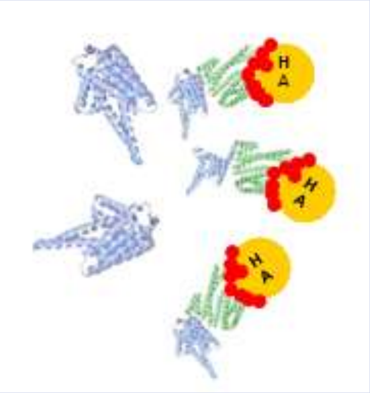
Key Claims of the Patent

- ***Selective Isolation:*** *A fast and efficient system for the selective isolation of phosphoproteins and casein phosphopeptides (CPP) in complexes with hydroxyapatite (HA).*
- ***Nutraceutical Formulation:*** *The HA-phosphopeptide complex forms the basis of a nutraceutical product for use as a food additive or in biomedical applications.*
- ***High-Value Food Ingredient:*** *The HA-phosphopeptide complex can be used to make milk a functional food, enhancing its health benefits.*
- ***Phosphopeptide Recovery:*** *Quantitative recovery of phosphopeptides from complex mixtures, ensuring selective recovery of phosphorylated proteins.*
- ***Edibility and Taste:*** *The matrix used for immobilizing phosphopeptides is edible and does not impart a bitter taste, making it suitable for the food industry.*
- ***Dental and Bone Health:*** *Use of the HA-phosphopeptide complex for mineralization of dental plaque, as an ingredient in toothpaste, and for increasing the bioavailability of minerals to prevent osteoporosis and other calcium-deficiency diseases.*
- ***By-Products:*** *The non-phosphorylated peptides can be used as bioactive peptides, such as casomorphins and antihypertensive peptides, or as a nitrogen source for microorganisms.*
- *Aquaculture: Application of the HA-phosphopeptide complex as a growth initiator for eggshell formation in aquaculture and in the artificial breeding of bivalve mollusks and coral.*

Hydroxyapatite HA



Protein and/or Peptide mixtures



Buffalo Whey Concentrate in Burrata Production: ALIFUN Project Prototype

UNIONE EUROPEA
Fondo Europeo di Sviluppo Regionale

Codice Progetto
ARS01_0078

ALIFUN
ALIMENTI FUNZIONALI

PON "Ricerca e Innovazione" 2014-2020 - Asse II; Area di specializzazione "Agrifood"

PROTOTIPO DI BURRATA DI BUFALA

Ingredienti-Ripieno: Crema di latte di bufala pastorizzato (>90°C), Proteine di latte di bufala, proteine del siero concentrate e idrolizzate. Involucro: latte di bufala pastorizzato, sieroinnesto naturale, sale, caglio.

Prodotto da Caseificio Cirigliana s.r.l.
Nello stabilimento in Via Saudina 20
81053 Riardo (Ce)

CIRIGLIANA
LA FILIERA BUFALINA

Ministero dell'Università e della Ricerca

PON RICERCA E INNOVAZIONE 2014 - 2020

FSC Fondo per lo Sviluppo e la Coesione

3 mg di peptidi / 100 mg di polvere

0,1 % di polvere di idrolizzato proteico

*This prototype burrata was developed using buffalo whey concentrate in collaboration with the Cirigliana dairy under the **ALIFUN** project. The product is enriched with hydrolyzed protein, enhancing its nutritional value.*

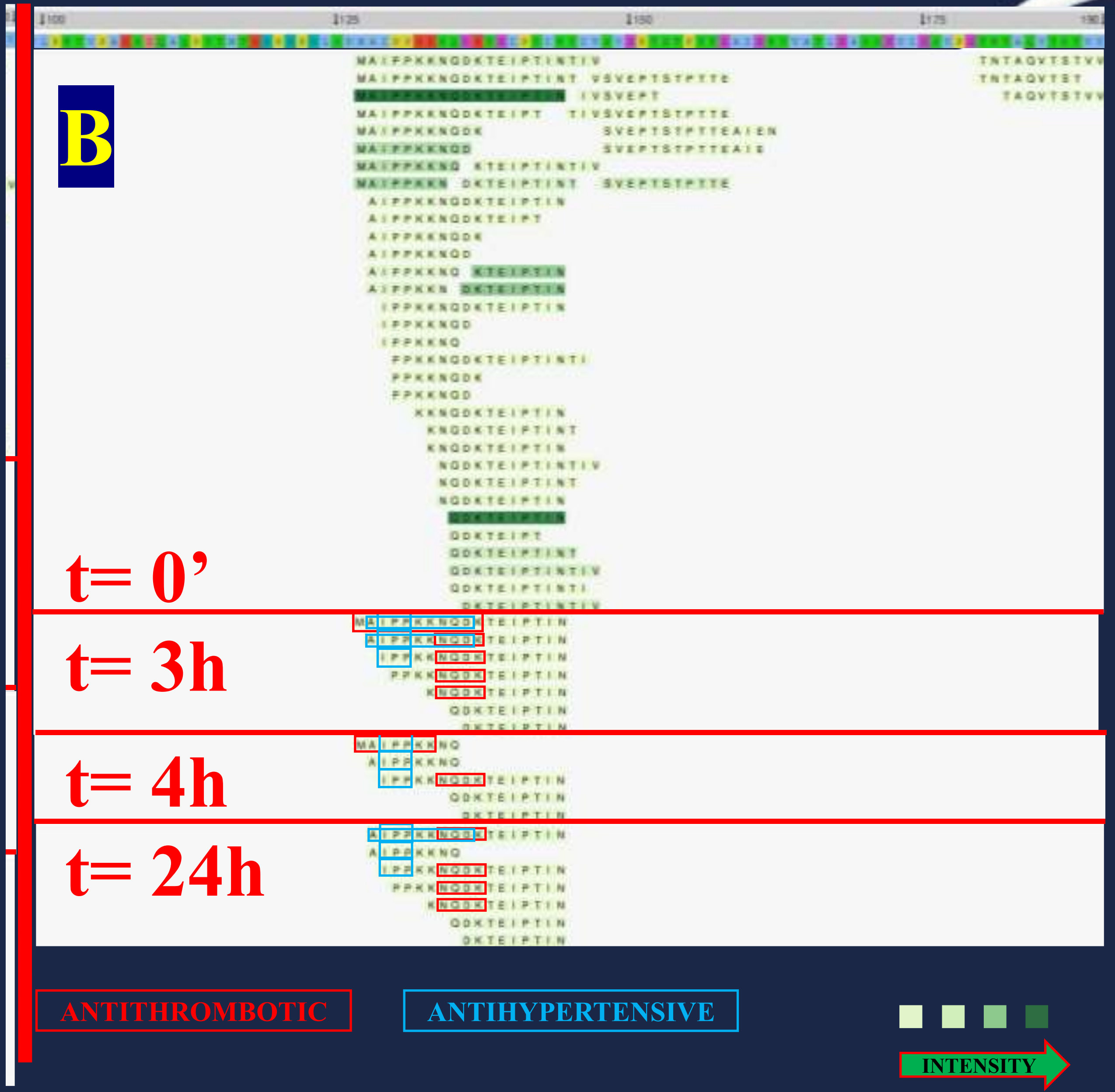
From Thesis to Market: Development of a New Buffalo Whey Product

ROMA, 28 marzo 2023
Hotel The Building
via Montebello 126 ore 14.30 - 17.00

Premio Granarolo, vincitore
Ferdinando Cropano, consegna
Gianpiero Calzolari, *Presidente Granarolo*

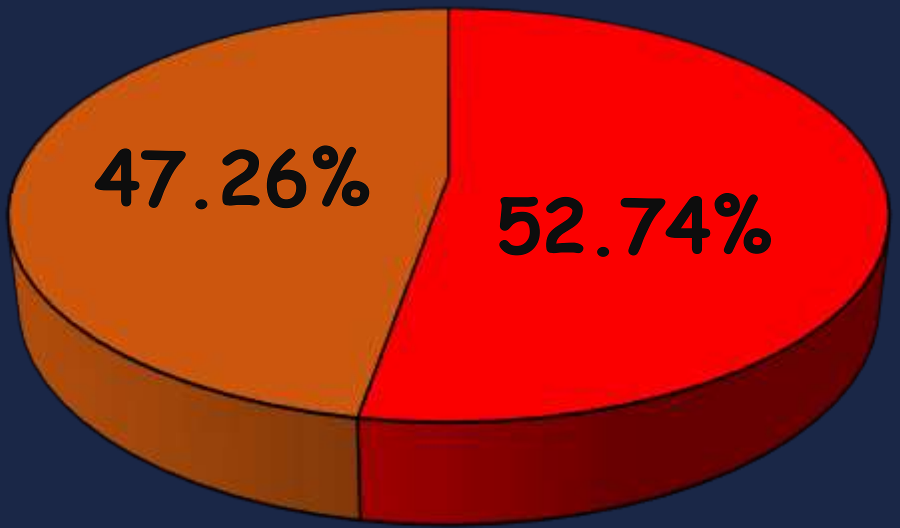
This innovative product originates from a university thesis by a student who developed a new product based on concentrated buffalo whey. The product was created by hydrolyzing whey proteins with non-human digestive enzymes, producing bioactive peptides.

PEPTIDES FROM ENZYMATIC HYDROLYSIS OF 12% WHEY PROTEINS

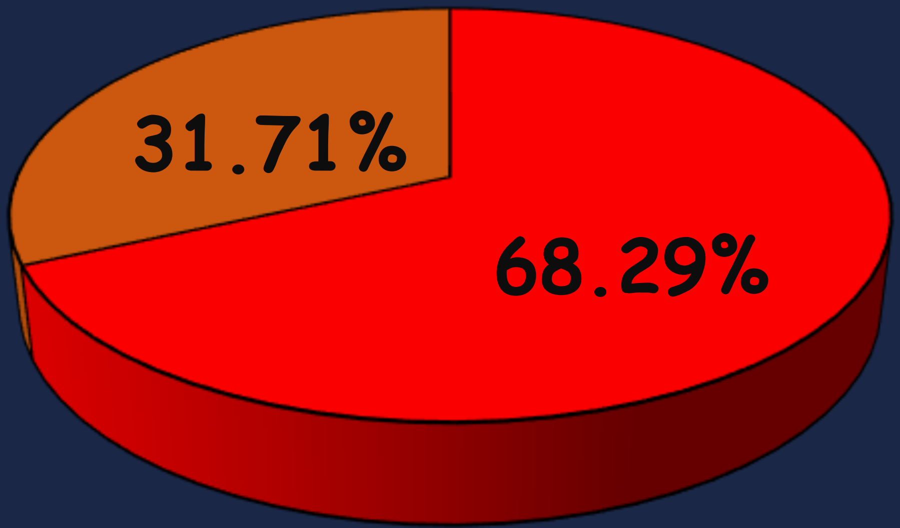


PEPTIDES IDENTIFIED IN SPRAY-DRIED AND 12% CONCENTRATED WHEY AFTER HYDROLYSIS WITH ALCALASE® Food grade

ACE-INHIBITORY



ANTITROMBOTIC



Whey proteins undergo progressive digestion during incubation with alcalase®.

The process leads to the formation of shorter peptides that include amino acid sequences recognized for their ***ACE-Inhibitory***, antithrombotic and antihypertensive activities.
The peptide content varies between spray-dried whey and concentrated whey.

Absorptomics: A New Frontier in Nutrition Science

ELSEVIER
Food Chemistry
Volume 385, 15 August 2022, 132663

In vivo absorptomics: Identification of bovine milk-derived peptides in human plasma after milk intake

Simonetta Caira [a], Gabriella Pinto [b], Gianluca Picariello [c], Paola Vitaglione [d], Sabrina De Pascale [a], Andrea Scaloni [a], Francesco Addeo [d]

ELSEVIER
Trends in Food Science & Technology
Volume 126, August 2022, Pages 41-60

Recent developments in peptidomics for the quali-quantitative analysis of food-derived peptides in human body fluids and tissues

Simonetta Caira [a], Gianluca Picariello [b], Giovanni Renzone [a], Simona Arena [a], Antonio Dario Troise [a], Sabrina De Pascale [a], Valentina Ciaravolo [a], Gabriella Pinto [c], Francesco Addeo [a d], Andrea Scaloni [a]

ELSEVIER
Food Chemistry
Volume 460, Part 1, 1 December 2024, 140477
Go to Food Chemistry on ScienceDirect

Beyond the gut: Investigating the mechanism of formation of β-casomorphins in human blood

Simonetta Caira [a], Antonio Dario Troise [a], Gianluca Picariello [b], Sabrina De Pascale [a], Gabriella Pinto [c], Marcella Pesce [d], Francesca Marino [e], Giovanni Sarnelli [d], Andrea Scaloni [a], Francesco Addeo [f]

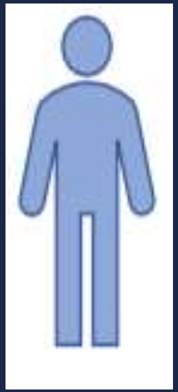
ELSEVIER
Journal of Functional Foods
Volume 113, February 2024, 106004

Ex vivo degradation of β-Casomorphin-7 by human plasma peptidases: Potential implications for peptide systemic effects

Sabrina De Pascale [a], Gianluca Picariello [b], Antonio Dario Troise [a], Simonetta Caira [a], Gabriella Pinto [c], Francesca Marino [d], Andrea Scaloni [a], Francesco Addeo [e]

Monitoring the absorption of peptides into the bloodstream of 10 volunteers who consumed "ravioli" pasta filled with high-protein buffalo ricotta,

Volunteers: 1,2 …..10



Ravioli» pasta (250 g)

Recipe:
- wheat flour
- buffalo ricotta contaning 10% milk
- eggs

Blood draw at different time points:
0,1,2,3,4,5,6,7,8, and 24h from the meal (250 g)

Peptides purification procedure

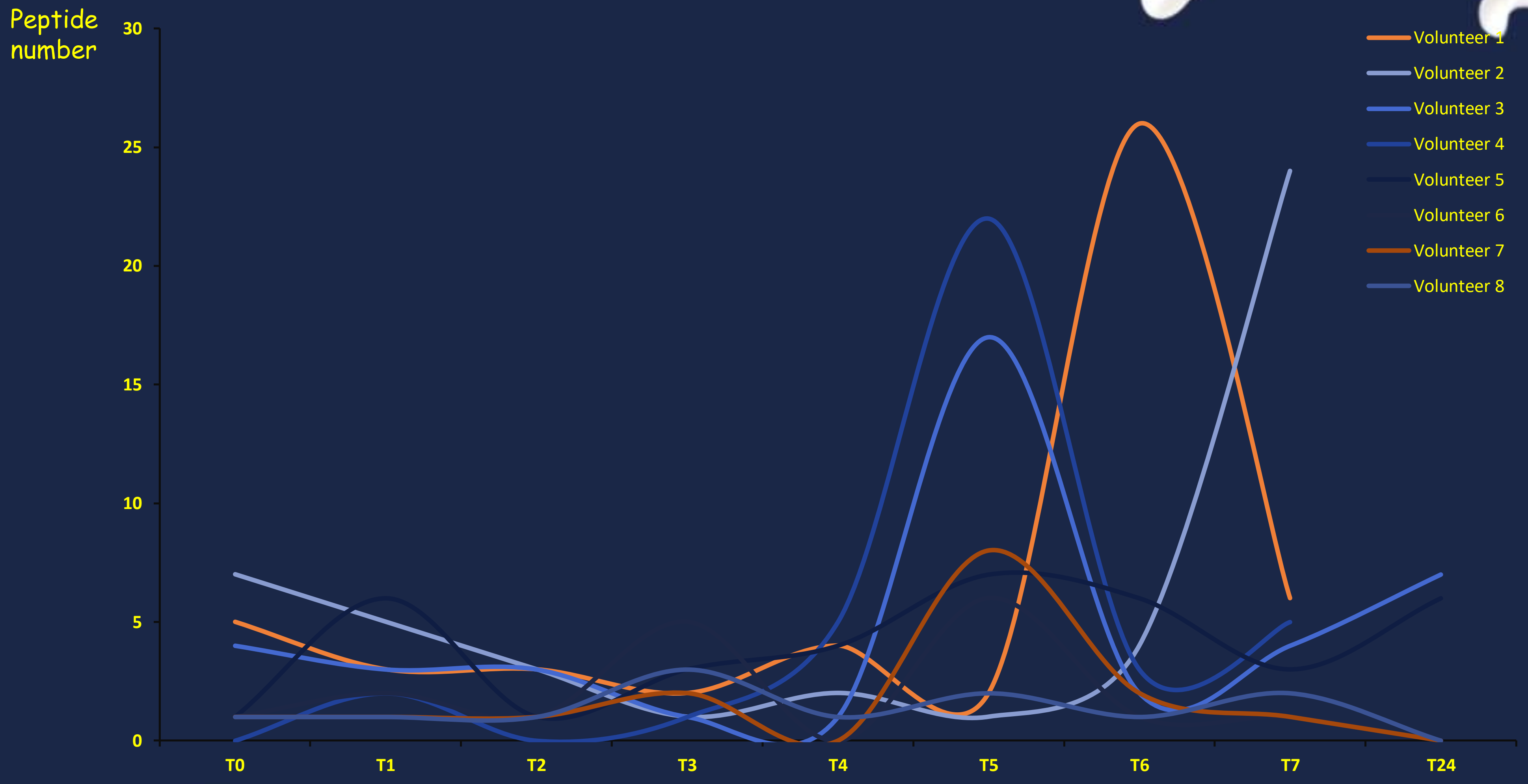
nanoLC-ESI-MS/MS

MaxQuant Raw Data processing

Peptigram visualization

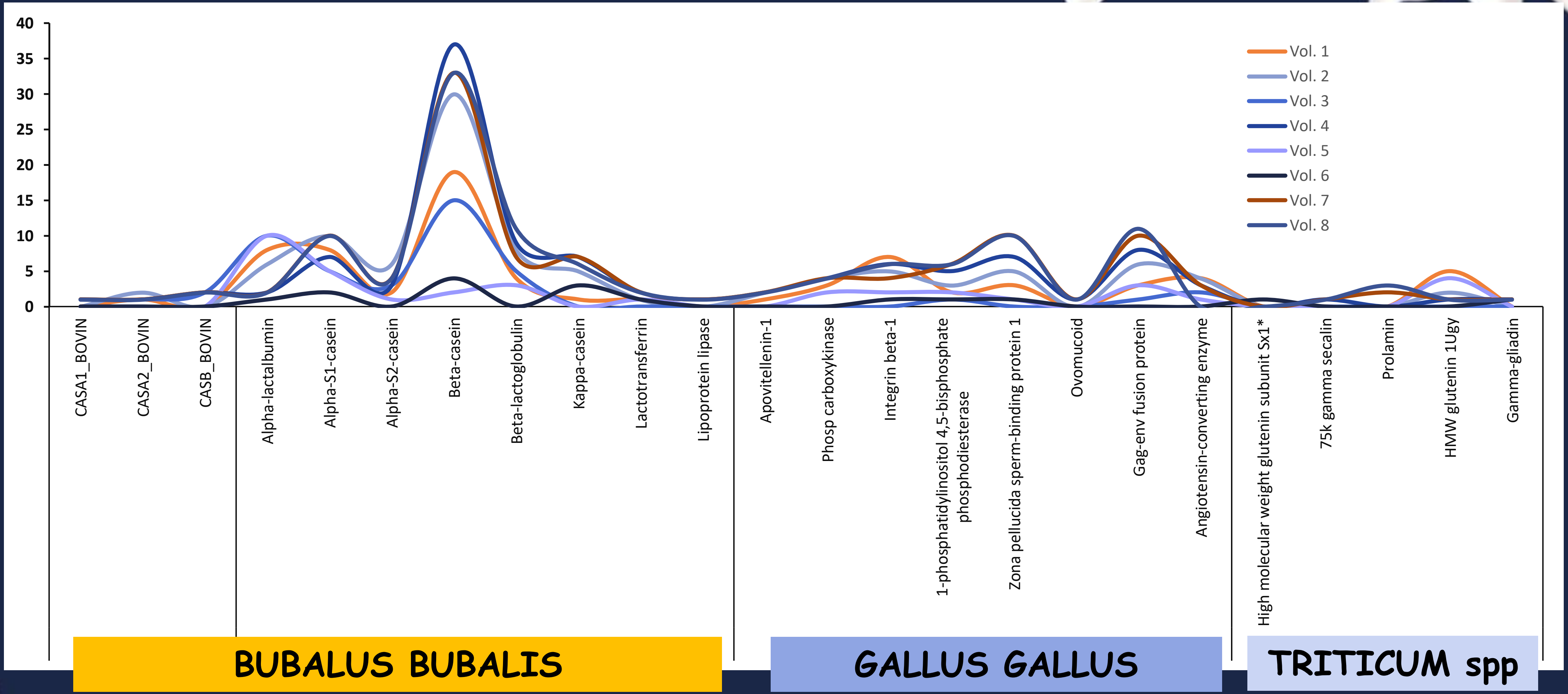
Identification of peptides from
- buffalo Ricotta cheese
- *wheat*
- *eggs*

Peptide Absorption Kinetics: Variability Among Volunteers



The results show significant variation in the number of circulating peptides between subjects, with the pe occurring between 5 and 7 hours after the meal. We also tracked peptide elimination through urine.

Origin and Circulation Time of Identified Peptides: Buffalo, Chicken, and Wheat Proteins



Comparison of Beta-Lactoglobulin and Alpha-Lactalbumin Peptides in Blood and Enzymatic Hydrolysates

Sequence	Mass	Description	species	Start	End
AIVQNNDSTE	1089,5	Alpha-lactalbumin	Buffalo	40	49
GYDTQ	582,23	Alpha-lactalbumin	Buffalo	35	39
KDLKDY	780,4	Alpha-lactalbumin	Buffalo	13	18
LACAAQAIIVT	1072,6	Beta-lactoglobulin	Buffalo	-6	4
DAQSAPLRVY	1118,6	Beta-lactoglobulin	Buffalo	33	42
LKPTPEGDLE	1097,6	Beta-lactoglobulin	Buffalo	46	55
KKIIAEKTKIP	1267,8	Beta-lactoglobulin	Buffalo	69	79
ALNENKVLVL	1111,7	Beta-lactoglobulin	Buffalo	86	95
DTDYKKY	931,43	Beta-lactoglobulin	Buffalo	96	102
LVRTPEVDDE	1171,6	Beta-lactoglobulin	Buffalo	122	131
LKALPMHIRLS	1277,8	Beta-lactoglobulin	Buffalo	140	150

We compared the beta-lactoglobulin and alpha-lactalbumin peptides identified in volunteers' blood with those generated through enzymatic hydrolysis. None of the peptides in the blood were identical to those produced by hydrolysis, demonstrating the unique activity of enzymatically derived peptides.

PROSALAB Project: Health-Promoting Products from Buffalo Milk

POR CAMPANIA FESR 2014/2020

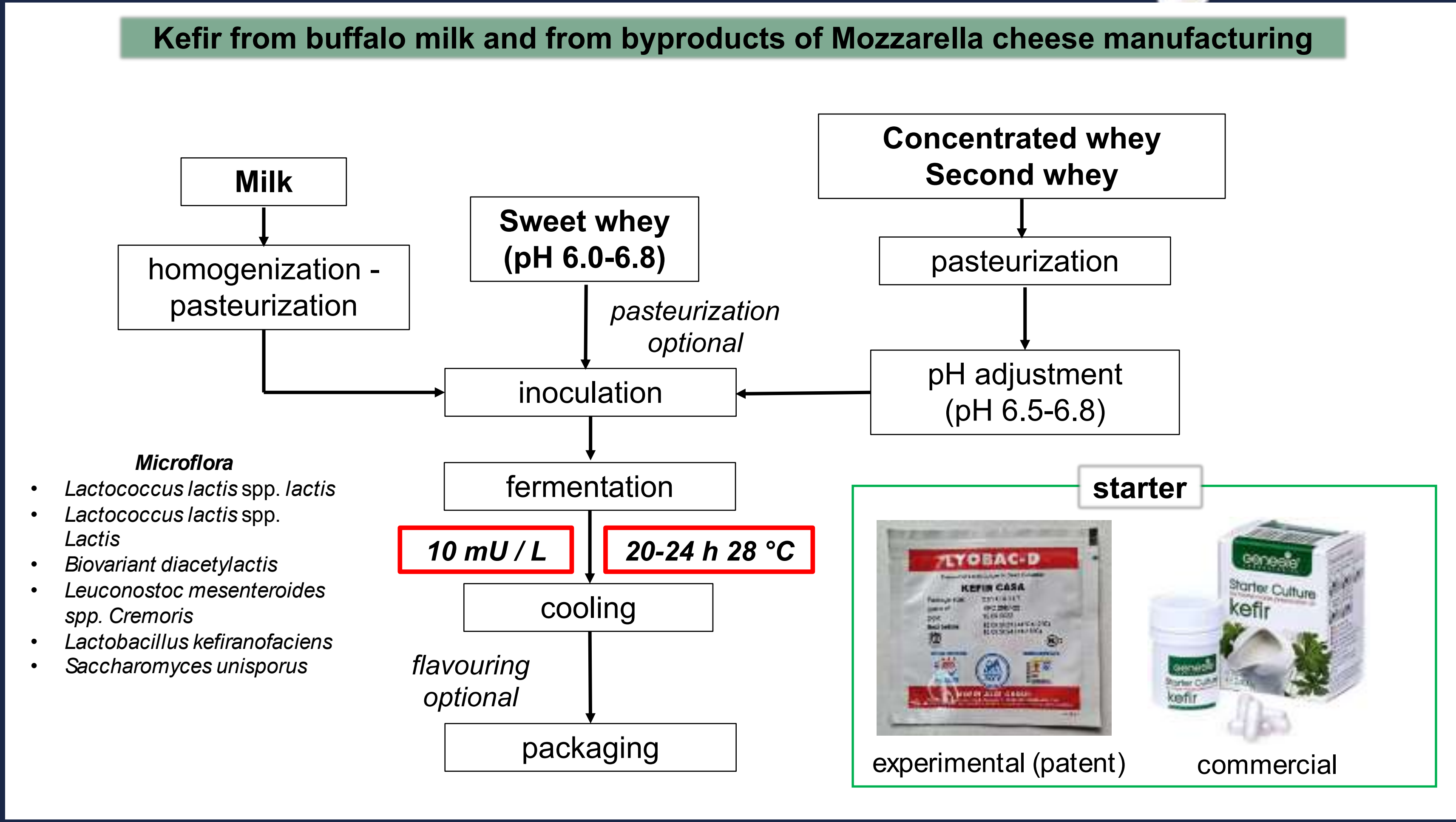
AVVISO PUBBLICO PER IL SOSTEGNO ALLE MPMI CAMPANE NELLA REALIZZAZIONE DI PROGETTI DI SVILUPPO SPERIMENTALE, TRASFERIMENTO TECNOLOGICO E INDUSTRIALIZZAZIONE

Progetto PROSALAB: **Nuovi PROdotti SAlutistici dal LAtte di Bufala sano**

Soggetto proponente: Aziende Agricole Associate (Cancello Arnone, Caserta)

As part of the PROSALAB project, developed with Azienda Agricole Associate, we created new health-promoting products from buffalo milk. One of the key innovations was the development of buffalo kefir, a fermented beverage with numerous health benefits.

Technology for Kefir Production from Buffalo Milk and Whey By-products



This slide outlines the technological process for producing kefir from buffalo milk and whey by-products. The process involves pasteurization, inoculation, fermentation, and optional flavoring before packaging, with the final product offering numerous health benefits.

Kefir Varieties and Health Benefits from Whey and Concentrated Whey

We expanded kefir production to include versions made from whey and concentrated whey. Buffalo whey kefir contains about 1% protein, making it a refreshing beverage, while kefir from concentrated whey provides a high-protein option, ideal for athletes.

Kefiran: The Key Difference Between Kefir and Yogurt

The key difference between kefir and yogurt is the presence of kefiran, a polysaccharide produced during kefir fermentation.

Kefiran has antioxidant, anti-inflammatory, and antimicrobial properties, and has attracted commercial interest for its potential health benefits.

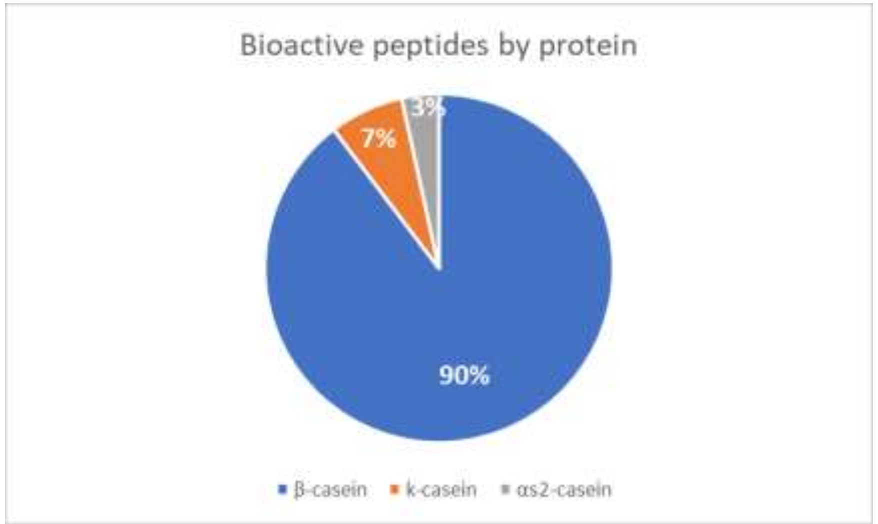
Kefiran Production from Ricotta Whey: A New Functional Ingredient.

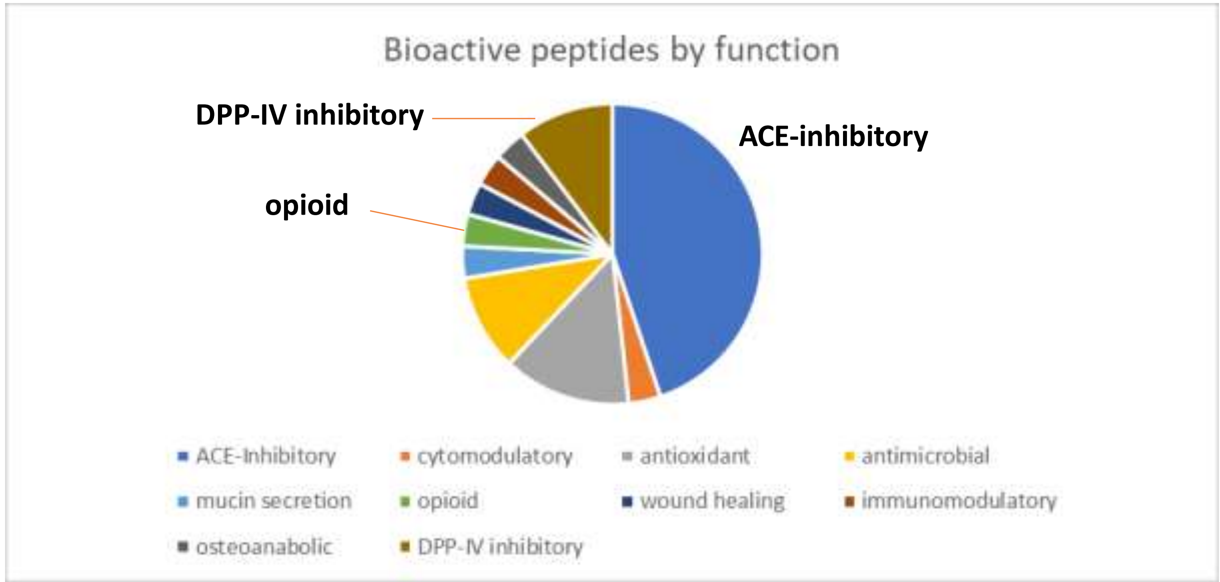
*Obtained by fermenting the deproteinized whey with a starter rich in **Lactobacillus kefiranofaciens**, we produced kefiran, which increased the viscosity of the liquid. This innovation has already attracted interest from the Probiotical company for use as a supplement and in cosmetics.*

Kefirani

Classification of bioactive peptides released in buffalo **milk kefir**

	Peptides	Species Homology	Functions	Protein IDs
Grouped Results:		Homo sapiens: 2 Bos taurus: 26 Bubalus bubalis: 1	ACE-inhibitory: 13 Cytomodulatory: 1 Antioxidant: 4 Antimicrobial: 3 Increase mucin secretion: 1 Opioid: 1 Wound healing: 1 Immunomodulatory: 1 Osteoanabolic: 1 DPP-IV Inhibitory: 2 Prolyl endopeptidase-inhibitory: 1	P05814: 2 P02666: 25 P02668: 1 A0A1L6KYI1: 1
Total Counts:	26	3	11	4

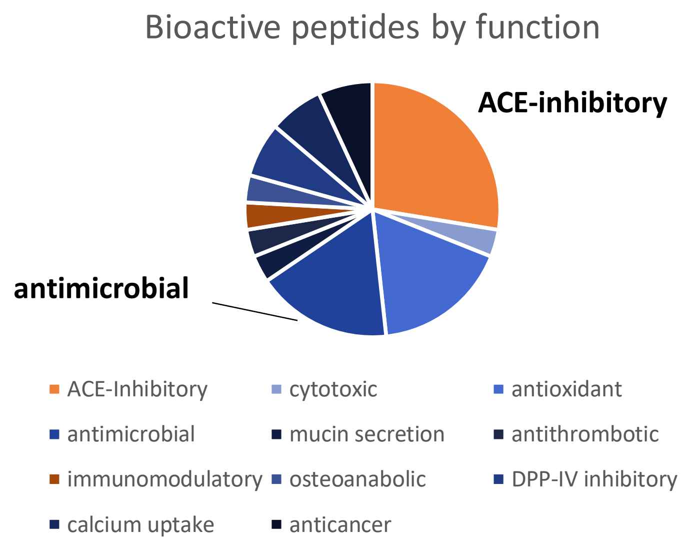


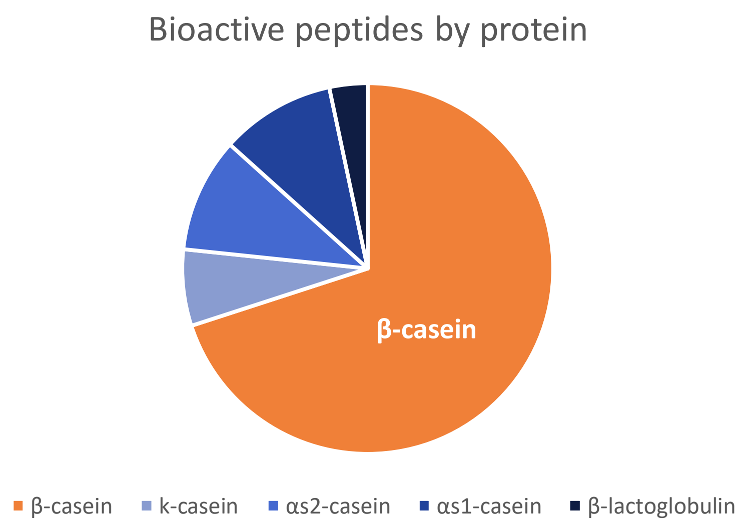


Bioinformatic search in:
Milk Bioactive Peptide Database
(https://mbpdb.nws.oregonstate.edu/)

Classification of bioactive peptides released in buffalo **whey kefir**

	Peptides	Species Homology	Functions	Protein IDs
Grouped Results:		Bos taurus: 26 Bubalus bubalis: 1 Bos spp: 1 Capra hircus: 1	Antioxidant: 5 Increase calcium uptake: 2 ACE-inhibitory: 8 Antimicrobial: 5 Prolyl endopeptidase-inhibitory: 1 Cytotoxic: 1 Antithrombitic: 1 Osteoanabolic: 1 DPP-IV Inhibitory: 1 Anticancer: 2 Antithrombotic: 1 Immunomodulatory: 1	P02662: 3 P02666: 20 P02754: 1 P02668: 2 A0A1L6KYI1: 1 A0A344X7B9: 1 P33048: 1
Total Counts:	25	4	12	7



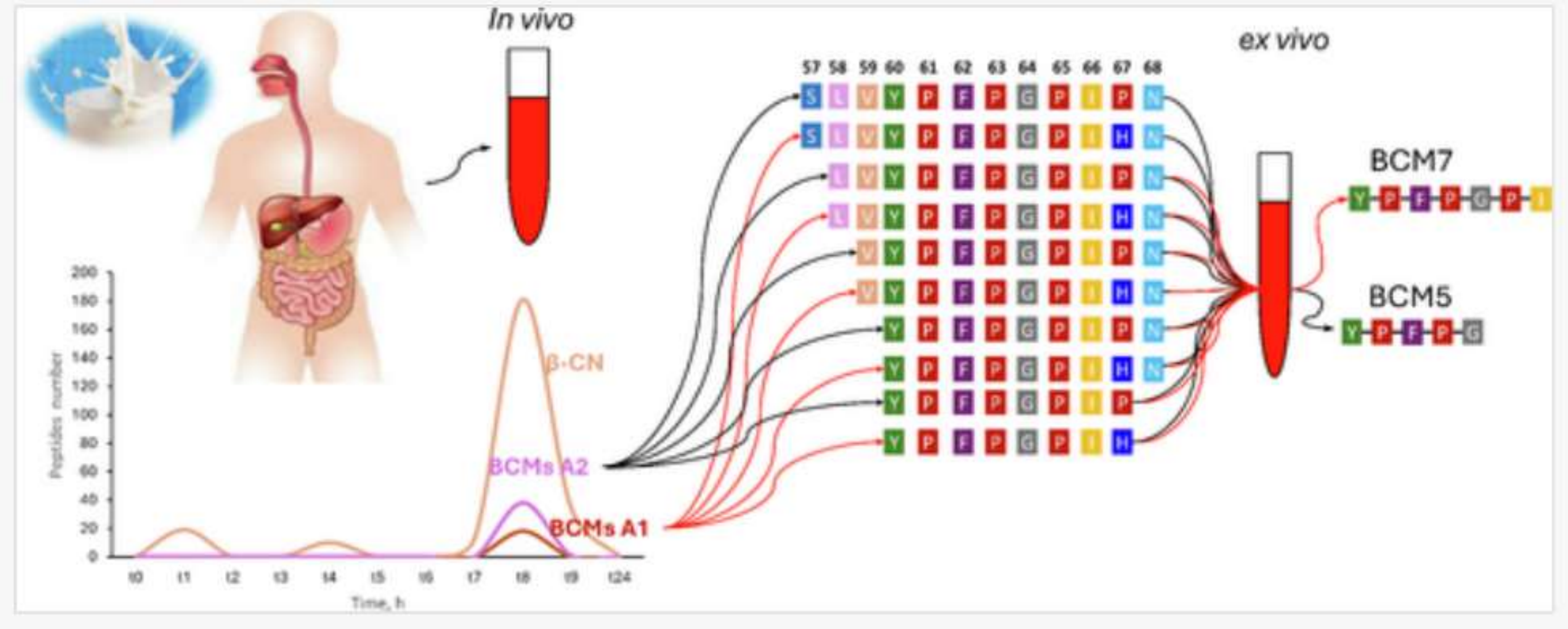


Bioinformatic search in:
Milk Bioactive Peptide Database
(https://mbpdb.nws.oregonstate.edu/)

CONCLUSIONS

- Buffalo dairy can make significant progress by closely collaborating with research institutes and universities.
- Scientific innovation combined with dairy tradition offers unprecedented opportunities to improve production processes and create new products with high added value.
- Scientific research can provide tools for optimizing resources, such as the use of whey and other by-products, while reducing waste and increasing sustainability.
- Furthermore, collaboration with researchers can pave the way for innovative products, such as buffalo kefir, phosphopeptides and kefirans, with applications not only in food but also in nutraceuticals and cosmetics.
- By working together, dairies and research institutes can not only respond to market needs, but also anticipate new trends, ensuring a future of growth and success for the buffalo sector.

Monitoring Peptide Absorption from Buffalo Ricotta in Human Blood



Food Chemistry
Volume 141, Issue 1, 1 November 2013, Pages 597-603

Analytical Methods

A signature protein-based method to distinguish Mediterranean water buffalo and foreign breed milk

Simonetta Caira [a], Gabriella Pinto [a], Valentin A. Balteanu [b], Lina Chianese [a], Francesco Addeo [a]

Anal Bioanal Chem (2016) 408:5609–5621
DOI 10.1007/s00216-016-9663-0

RESEARCH PAPER

Simultaneously tracing the geographical origin and presence of bovine milk in Italian water buffalo Mozzarella cheese using MALDI-TOF data of casein signature peptides

Simonetta Caira[1] · Gabriella Pinto[2] · Maria Adalgisa Nicolai[2] · Lina Chianese[2] · Francesco Addeo[2]

Received: 12 April 2016 / Revised: 18 May 2016 / Accepted: 20 May 2016 / Published online: 14 June 2016

Food Chemistry
Volume 230, 1 September 2017, Pages 482-490

Eventual limits of the current EU official method for evaluating milk adulteration of water buffalo dairy products and potential proteomic solutions

Simonetta Caira [b], Maria Adalgisa Nicolai [a], Sergio Lilla [a], Maria Grazia Calabrese [a], Gabriella Pinto [a], Andrea Scaloni [b], Lina Chianese [a], Francesco Addeo [a]

Food Chemistry
Volume 277, 30 March 2019, Pages 195-204

A non-canonical phosphorylation site in β-casein A from non-Mediterranean water buffalo makes quantifiable the adulteration of Italian milk with foreign material by combined isoelectrofocusing-immunoblotting procedures

Simonetta Caira [a], Gabriella Pinto [b], Maria Adalgisa Nicolai [b], Gianfranco Novi [a], Francesco Addeo [b], Andrea Scaloni [a]

A Genotyping Method for Detecting Foreign Buffalo Material in Mozzarella di Bufala Campana Cheese Using Allele-Specific- and Single-Tube Heminested-Polymerase Chain Reaction

by Rosario Rullo [1,*], Simonetta Caira [1], Ioana Nicolae [2], Francesca Marino [3], Francesco Addeo [4] and Andrea Scaloni [1]

1 Institute for the Animal Production System in the Mediterranean Environment, National Research Council, 80055 Portici, Italy
2 Research and Development Institute for Bovine, 077015 Balotesti, Romania
3 Department of Clinical Medicine and Surgery, Endocrinology Unit, University Federico II, 80131 Naples, Italy
4 Dipartimento di Agraria, Università degli Studi di Napoli "Federico II", 80055 Portici, Italy
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PRECURSORS OF BIOACTIVE PEPTIDES AFTER ALCALASE ACTION

PEPTIDE	MW (Da)	SOURCE	ACTIVITY	REFERENCE
QTPVV**VPP**F	982,54877	**β-CN** (f84-86)	ACE-inhibitory	Nakamura et al., (1995)
SQS**KVLPVP**Q	1081,6132	**β-CN** (f169-174)	ACE-inhibitory	Maeno et al., (1996)
SQS**KVLPVPQ**	1081,6132	**β-CN** (f169-175)	ACE-inhibitory	Maeno et al., (1996)
LQ**DKIHPF**	996,53927	**β-CN** (f47-52)	ACE-inhibitory	Gobbetti et al., (2000)
HK**EMPFPK**YPVEPF	1744,8647	**β-CN** (f108-113)	Antihypertensive	Pihlanto-Leppala et al., (1998)
MAIPPKKNQDKTEIPTIN	2037,0929	**κ-CN** (f106-116)	Antithrombotic	Fiat and Jollèe (1989); Jollès et al., (1986); Schlimme and Meisel (1995)
MAIPPKKN	897,51061	**κ-CN** (f106-112)	Antithrombotic	Fiat and Jollèe (1989); Jollès et al., (1986); Schlimme and Meisel (1995)
NQDKTEIPTIN	1271,6357	**κ-CN** (f113-116)	Antithrombotic	Fiat and Jollèe (1989); Jollès et al., (1986); Schlimme and Meisel (1995)
A**IPP**KKN	766,47012	**κ-CN** (f108-110)	Antihypertensive	Nakamura et al., (1995)
AIPPKKNQD	1009,5556	**κ-CN** (f128-136)	ACE-inhibitory	Shuang et al., (2008)
DTDYKKY**LLF**	1304,6653	**β-Lg** (f103-105)	ACE-inhibitory	Hernandez-Ledesma et al., (2002)
ALPMH**IR**	836,46908	**β-Lg** (f147-148)	ACE-inhibitory	Mullally et al., (1996)
HI**RL**SFNPT	1083,5825	**β-Lg** (f148-149)	ACE-inhibitory	Mullally et al., (1996)
ALPMHIR	836,46908	**β-Lg** (f142-148)	ACE-inhibitory	Mullally et al., (1997)
DKALK**ALPM**	985,56304	**β-Lg** (f142-145)	ACE-inhibitory	Murakami et al., (2004)
DAQSAPLRVY	1118.572	**β-Lg** (f49-58)	ACE-inhibitory	Tavares et al., (2011)
LVR**TPEVDDEALEK**	1612,8308	**β-Lg** (f141-151)	DPP-IV Inhibitory	Silveira et al., (2013)
LVR**TPEVDDEALEK**	1612,8308	**β-Lg** (f141-151)	Antimicrobial	Demers-Mathieu et al., (2013)

BUFFALO DAIRY PRODUCTS IN THE WORLD

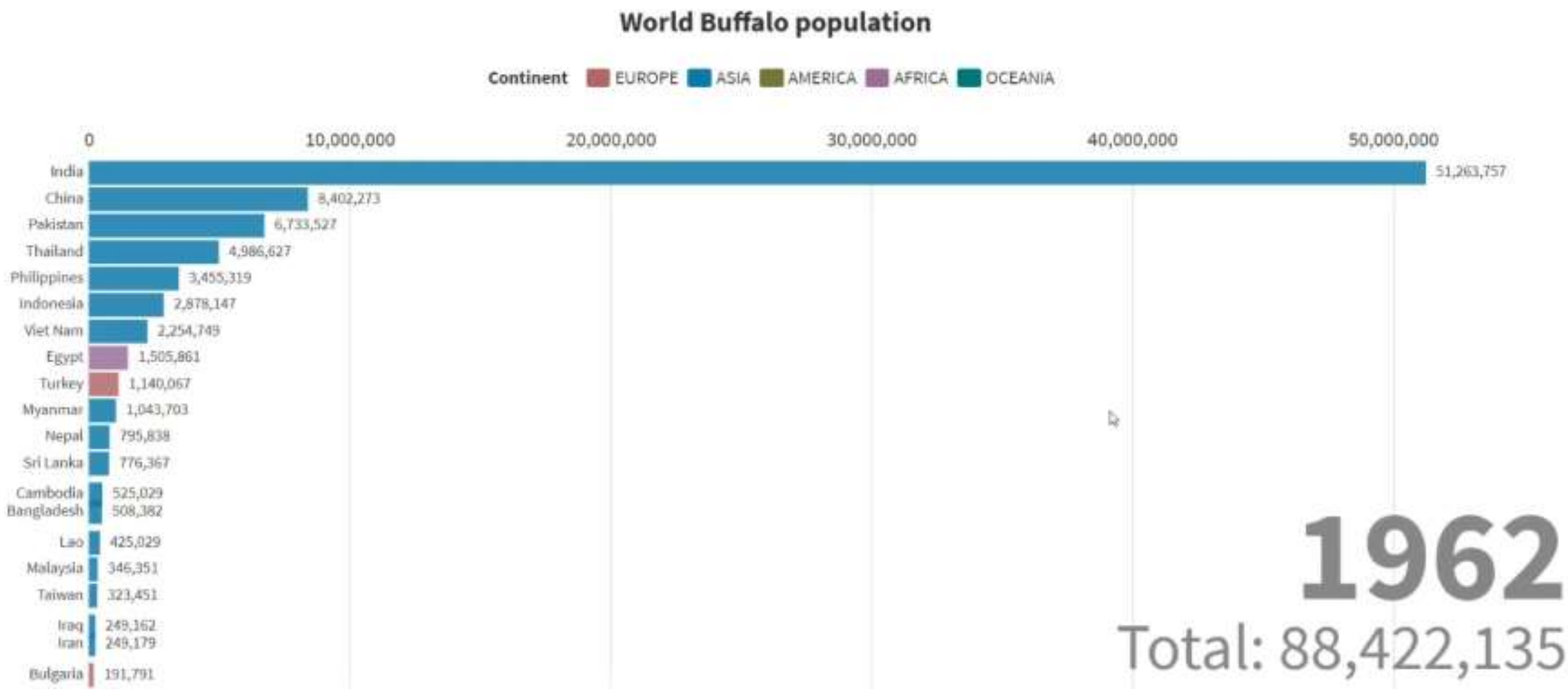
Antonio BORGHESE

General Secretary International Buffalo Federation, Former Director Animal Production Research Institute, Monterotondo – Rome, Italy

Corresponding e-mail: antonio.borghese@email.it – antonioborghese32@gmail.com

TARGET

Bubalus bubalis has a pivotal role in protein supplying and in the global economy, respecting sustainability


World Buffalo population
Continent EUROPE ASIA AMERICA AFRICA OCEANIA
0
10,000,000
20,000,000
30,000,000
40,000,000
50,000,000
India 51,263,757
China 8,402,273
Pakistan 6,733,527
Thailand 4,986,627
Philippines 3,455,319
Indonesia 2,878,147
Viet Nam 2,254,749
Egypt 1,505,861
Turkey 1,140,067
Myanmar 1,043,703
Nepal 795,838
Sri Lanka 776,367
Cambodia 525,029
Bangladesh 508,382
Lao 425,029
Malaysia 346,351
Taiwan 323,451
Iraq 249,162
Iran 249,179
Bulgaria 191,791
1962
Total: 88,422,135

Buffalo population and production in the most representative countries

(FAO, 2022)

	Head (mil)	Milk (T)
Asia		
India	111.856.246	94.383.692
Pakistan	43.676.000	36.445.000
China	26.876.707	2.905.807
Nepal	5.132.931	1.419.412
Philippines	2.774.471	36.444
Viet Nam	2.231.600	26.622
Myanmar	2.000.000	176.137
Bangladesh	1.508.000	35.714
Laos	1.208.634	---
Indonesia	1.170.209	91.426
Thailand	735.248	6.674
Africa		
Egypt	3.445.172	1.508.000
Americas		
Brazil	3.000.000	---
Venezuela	2.800.000	---
Colombia	485141	23
Europe		
Italy	416000	257.460
Bulgaria	20320	---
Romania	17900	---
Germany	11680	---
Oceania		
Australia	180.000	---
World	205141830	137.761.643

- Buffalo milk is utilized mostly as a drink following defattening, except in Italy.
- Different types of cheese are produced according to local traditions and processing techniques.

1. **Soft cheese** (water content > 45 percent): Karish, Mish and Domiati in Egypt; Madhfor in Iraq; Mozzarella in Italy; Alghab in Syria; Vladeasa in Romania.

2. **Semi-hard cheese** (water content 40-45 percent): Beyaz peyneri in Turkey.

Classification per water content

3. **Hard cheese** (water content < 40 percent): Braila in Romania; Rahss in Egypt; White brine in Bulgaria; Akkawi in Syria.

Types of coagulation

Spontaneous acidification (Domiati, Karish, Mish, in Egypt; Madhfor in Iraq; Alghab in Syria).

Adding starters, i.e. lactic bacteria cultures (Vladeasa, Beyaz peyneri) or natural whey cultures (Mozzarella).

Starters are also used in cheeses **where enzymatic coagulation prevails**, to favour rennet activity and following the processing stages (White brine cheese, Fresh cheese of Iraq, Braila).

Type of preserving

Some cheeses are consumed **FRESH**, i.e. only a few days after processing (Karish, Fresh cheese of Iraq, Mozzarella and Ricotta in Italy, Alghab)

Brine, to guarantee excellent conservation without expensive investments, such as refrigerators.

In Mish, acid buttermilk, skimmed milk and whey are added to the brine. In Domiati and Akkawi cheese, salt is added to the milk before processing

Ripening

dairy products processing

FAT-RICH MILK PRODUCTS: butter from buffalo cream displayed more stability than cow cream, due to the more solid fat. The texture of buffalo **ghee** is better than cow ghee due to its bigger grain size

HEAT-DESICCATED MILK PRODUCTS: Buffalo milk is preferred in India for heat-concentrated milk products like **khoa, rabri, kheer and basundi**.

HEAT-ACID COAGULATED MILK PRODUCTS: the quality of buffalo **paneer** is superior to the cow milk one.

FERMENTED MILK PRODUCTS: the buffalo superior body and texture of **dahi** could be attributed to the higher total solids content, especially fat and protein; **yoghurt** from buffalo milk is produced in many countries of Asia and in Europe.


paneer


dahi

dairy products processing

CREAMS: as **queshta mosakhana** in Egypt, **Gaymar** in Iraq, and **quishada** in Syria are obtained through different processing.

FROZEN MILK PRODUCTS: as **Ice creams**.

DEHYDRATED MILK PRODUCTS: buffalo milk is more appropriate for **tea and coffee whitener powders** production because milk and cream are intrinsically whiter and more viscous

RICOTTA and ALKARISH: produced from cheese whey and exploit the proteins lost in the whey (very rich in sulphurate amino-acids), are not produced in other countries

Gaymar

queshta mosakhana

Ice creams

QUALITY LABELS

Italy is the European country with the largest number of food products with designation of origin and geographical indication recognized by the European Union.

The EU's system of geographical indications favors the production system and the local economy protecting the environment, because the indissoluble bond with the land of origin requires the preservation of ecosystems and biodiversity.

It supports social cohesion of the entire community.

325 DOP, IGP, STG products

527 DOCG, DOC, IGT wines

……..more than one product, is a cultural value

Bocconcini

Mozzarella

Aversana

Treccia

Nodini

Provola Affumicata

Caciocavallo

Ricotta

Other European countries

Germany: good quality dairy products together with cosmetics

Bulgaria Istituto SHUMEN: white brine cheese, **yoghurt, kiselo miyako,** where lactic acid is fermented by *Lactobacillus bulgaricus* and by *Streptococcus thermophilous*

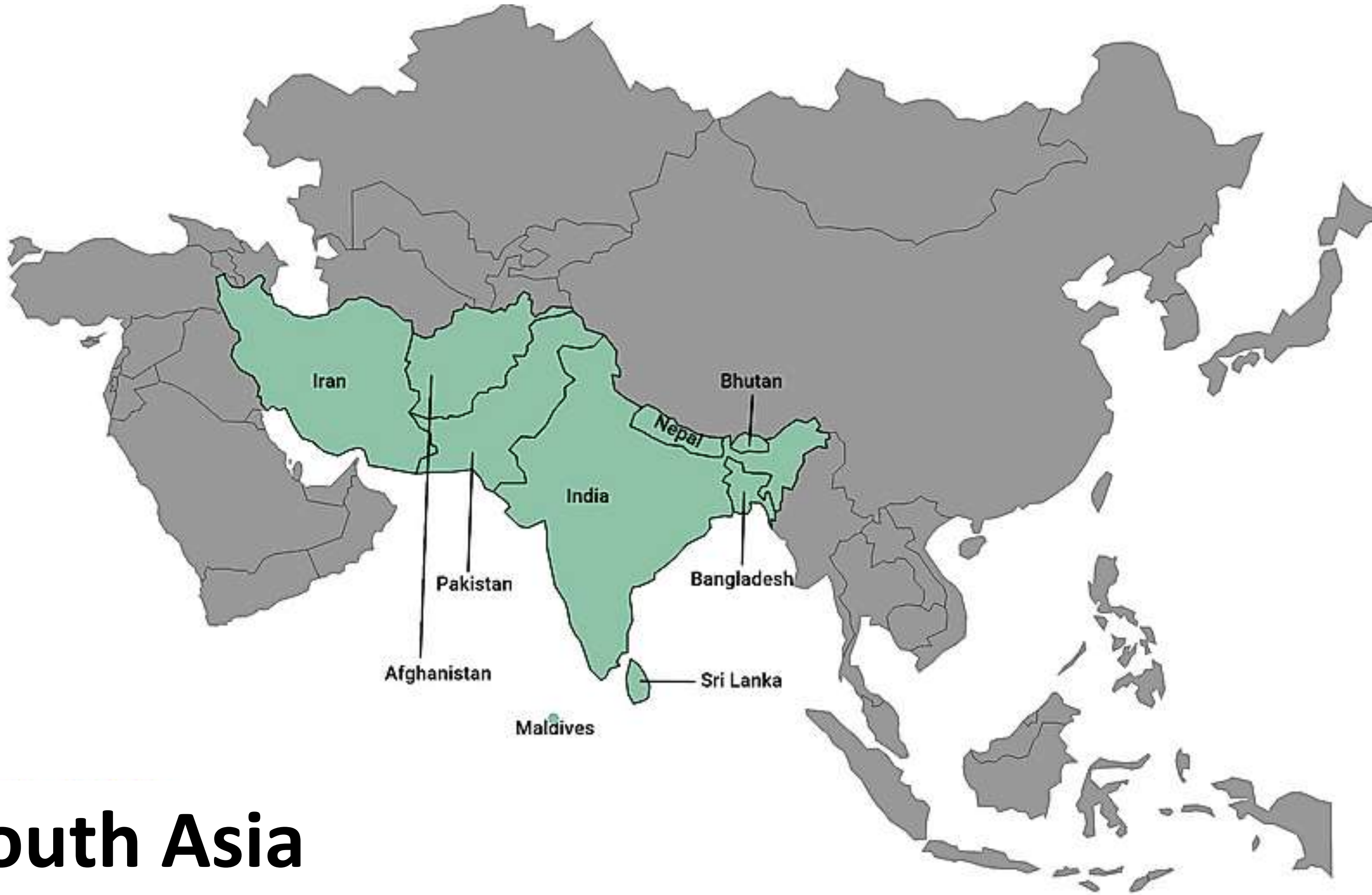
Macedonia: simple cheese in rural villages

Other European countries

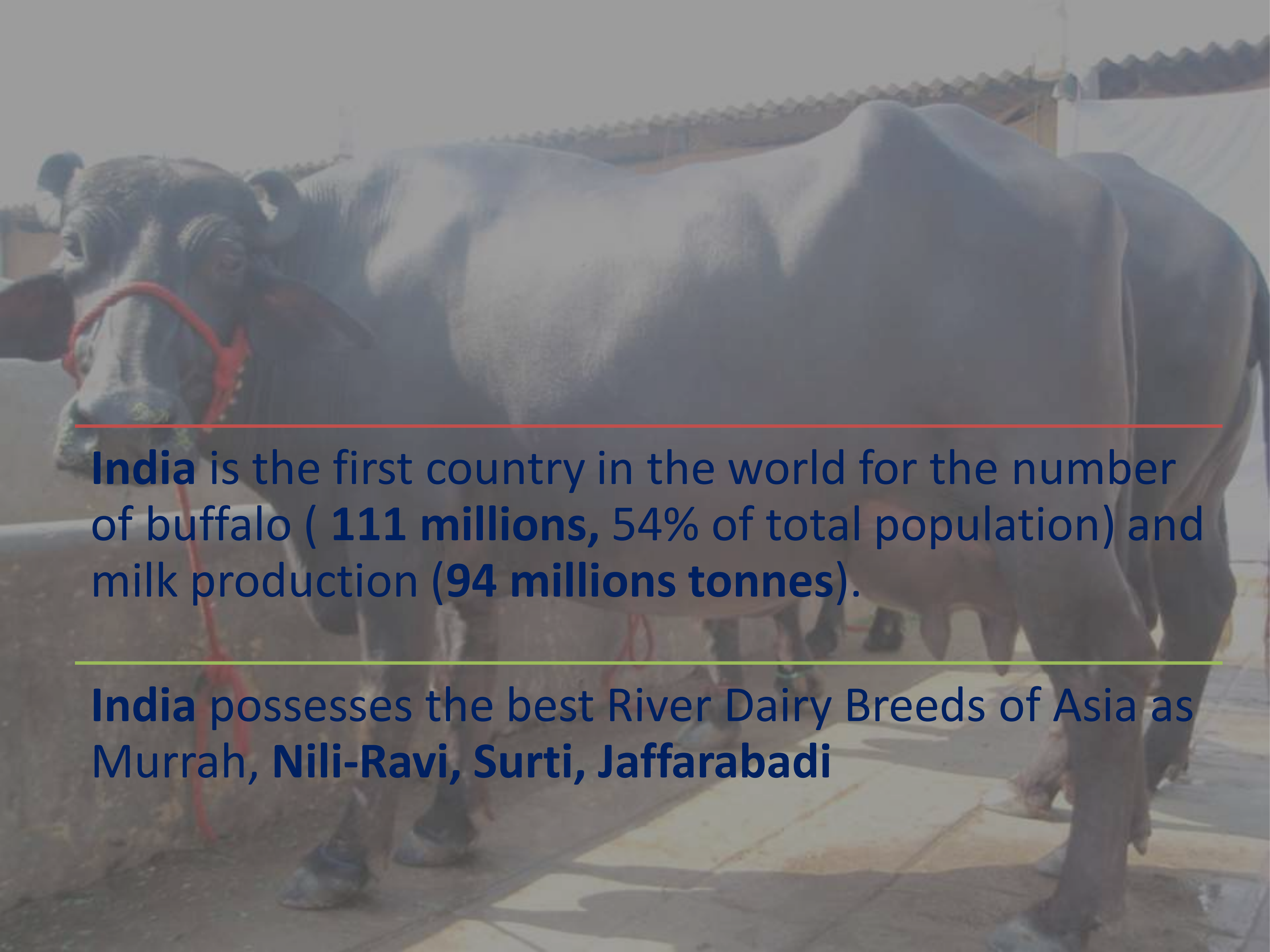
Greece: good quality yoghurt like Bulgaria

Hungary: Hungarian buffalo live free in National Park, a farm was founded in Mezotur with Mediterranean Italian to provide cheeses like Italy to the rich market in Budapest

Romania: Transilvania buffaloes live on pastures, a farm producing cheeses like Italy was founded by Transilvania Lactate to serve the market in Brasov


Iran
Bhutan
Nepal
India
Pakistan
Bangladesh
Afghanistan
Sri Lanka
Maldives

South Asia



India is the first country in the world for the number of buffalo (**111 millions,** 54% of total population) and milk production (**94 millions tonnes**).

India possesses the best River Dairy Breeds of Asia as Murrah, **Nili-Ravi, Surti, Jaffarabadi**

Pakistan is the second most important country with **42 millions head** and **36 million tons of** milk production

South asian products

The most quantity of milk is used for **direct consumption after skimming,** fat is used to produce **butter, ghee and cream. Dry milk, condensed milk, milk replacers** are very used in national market and for export, as different industrial utilizations.

Paneer is a cottage cheese, used in several vegetarian curry dishes in India and other countries.

The **National Dairy Research Institute of India** formulated different new functional dairy products such as probiotic cheese, sports drinks, low-cholesterol ghee, ice cream, and burfi for diabetics.

China and Southeast Asia

The buffalo in this area is **Swamp type,** with a total of 18 local breeds.

Guangxi Buffalo Research Institute in China, the Philippines Carabao Center has successfully developed buffalo milk cheeses and created a food market.

In **Indonesia, The Philippines, Vietnam and Thailand** in the past years, there was a decreasing trend in the swamp buffalo population.

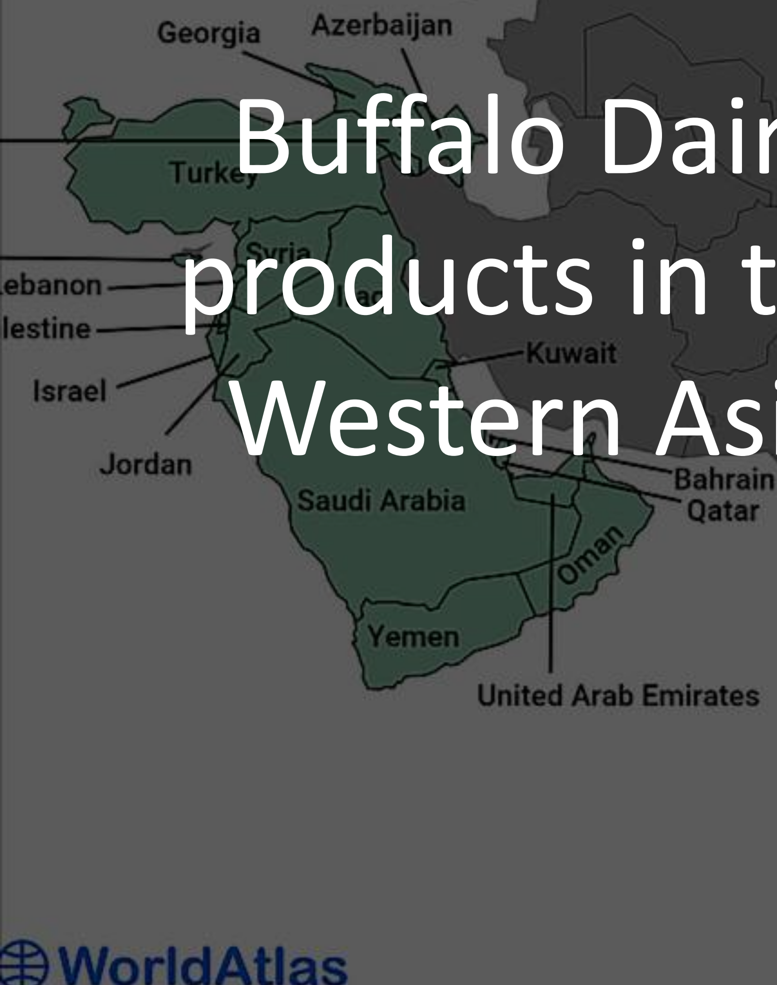
Papangan buffalo in the marshes (Borghese photo)

Milk putting in bamboo-cane

Dadiah

Sagon Puan

Buffalo Dairy products in the Western Asia



Dairy buffalo is important also in the Near East Asian Countries, as Turkey, Iraq and Iran.

The most appreciated products in Iran and Iraq are: yoghurt, Ayran, fresh cream, fresh cheese, butter, ice cream, rice pudding, churned yoghurt, dried whey, ghee, sweet and cake.

Skimmed milk is used also for direct consumption.

Mesopotamian buffalo in Tigris river (Jabbar Al Saedy photo)

Sweet, curd and fresh cheeses

(Khalid Al-Fartosi photo)

Buffalo Dairy products in the Americas

Today there is great enthusiasm about buffalo in America, particularly among buffalo breeders and livestock associations.

Buffalo numbers have significantly increased to about 6.7 million head (Patino, 2023), as buffalo is not bred only for meat purposes as in the past in extensive system.

In the recent years the emerging request of cheese market produced a developing interesting for milk purposes, similarly to Italian feeding style.

in South America, the buffalo dairy market is similar to the Italian one, with mozzarella, yogurt, cream, butter, and other cheeses.

Buffalo management in the humid savannah

Conclusions

Buffalo Mozzarella according to the Italian style is well-renowned and spread in all the countries

Buffalo milk is prevalently used fresh directly after being defattened. The fat is used to produce ghee for cooking. Often the milk is dehydrated to be conserved as milk powder.

Curd is used mixed to vegetables, cheese is not commonly used. The problem is the preservation in hot climate, particularly in the villages with no electricity.

Istituto Zooprofilattico Sperimentale del Mezzogiorno
Campania | Calabria

Buffalo dairy supply chain, present and future scenarios linked to new sustainability challenges

Antonio Limone

Ismea
Qualivita rapporto
2023

DATI ECONOMICI 2022

Campania DOP IGP

896 milioni €
valore economico

- 14% peso DOP IGP su agroalimentare
- 58 prodotti
- +9,4% su 2021
- 8° regione per impatto
- 9.082 operatori

COMPARTO CIBO	COMPARTO VINO	TERRITORI	FILIERE
793 milioni €	103 milioni €	Caserta 321 milioni €	Formaggi 54%
29 prodotti	29 prodotti	Napoli 296 milioni €	Paste alimentari 30%
+9,8% su 2021	+6,2% su 2021	Salerno 188 milioni €	Vino 12%
3° regione per impatto	13° regione per impatto	Benevento 58 milioni €	Ortofrutticoli 4%
4.552 operatori	4.530 operatori		

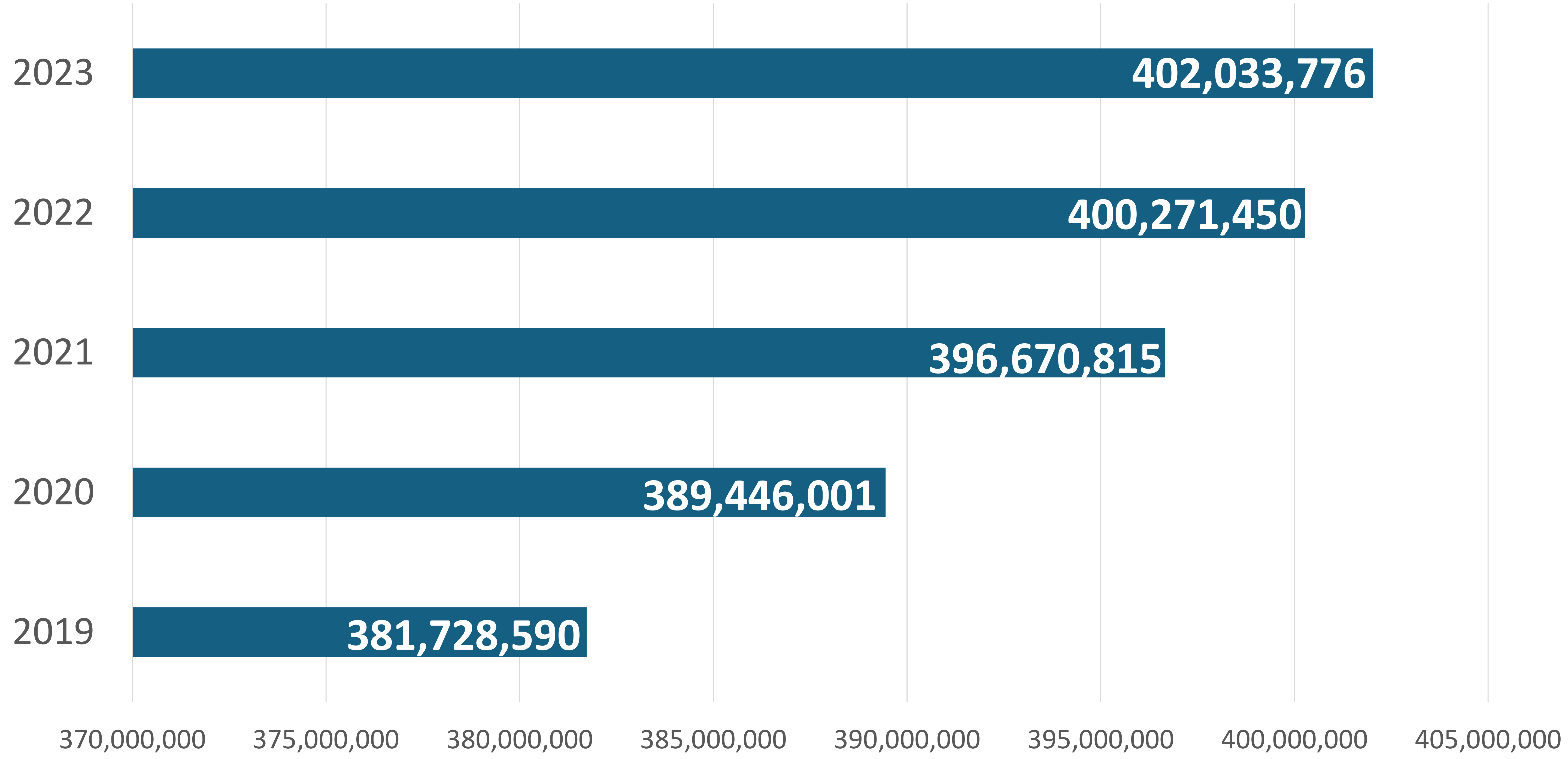
TAB. 07

Formaggi DOP IGP STG

Prodotto	PRODUZIONE CERTIFICATA (tonnellate) 2021	2022	Var 22/21	VALORE ALLA PRODUZIONE (milioni di euro) 2021	2022	Var 22/21	VALORE AL CONSUMO (milioni di euro) 2021	2022	Var 22/21	VALORE ALL'EXPORT (milioni di euro) 2021	2022	Var 22/21
Grana Padano DOP	203.290	202.051	-0,6%	1.460	1.734	+18,8%	2.517	2.722	+8,1%	922	1.006	+9,2%
Parmigiano Reggiano DOP	155.277	161.520	+4,0%	1.607	1.720	+7,0%	2.756	2.949	+7,0%	845	905	+7,0%
Mozzarella di Bufala Campana DOP	54.039	55.815	+3,3%	459	502	+9,4%	838	893	+6,6%	163	217	+33,7%
Pecorino Romano DOP	34.303	32.602	-5,0%	302	378	+25,1%	465	595	+27,8%	216	271	+25,8%

	Produzione Certificata (tonnellate)			Valore Alla Produzione (milioni di euro)			Valore al consumo (milioni di euro)			Valore all' Export (milioni di euro)		
	2021	2022	Var 22/21	2021	2022	Var 22/21	2021	2022	Var 22/21	2021	2022	Var 22/21
Mozzarella di Bufala Campana DOP	**54.039**	**55.815**	**+3,3%**	**459**	**502**	**+9,4%**	**838**	**893**	**+6,6%**	**163**	**217**	**+33,7%**

Buffalo milk production in Italy (Kg) declared per year (2019-2023)



Istituto Zooprofilattico Sperimentale del Mezzogiorno

Sistema Informativo Veterinario - Statistiche

Variazioni patrimonio nel tempo | Densità allevamenti e capi bovini e bufalini | Consistenza allevamenti e capi per orientamento produttivo | Consistenza allevamenti e capi per classe di consistenza | Consis

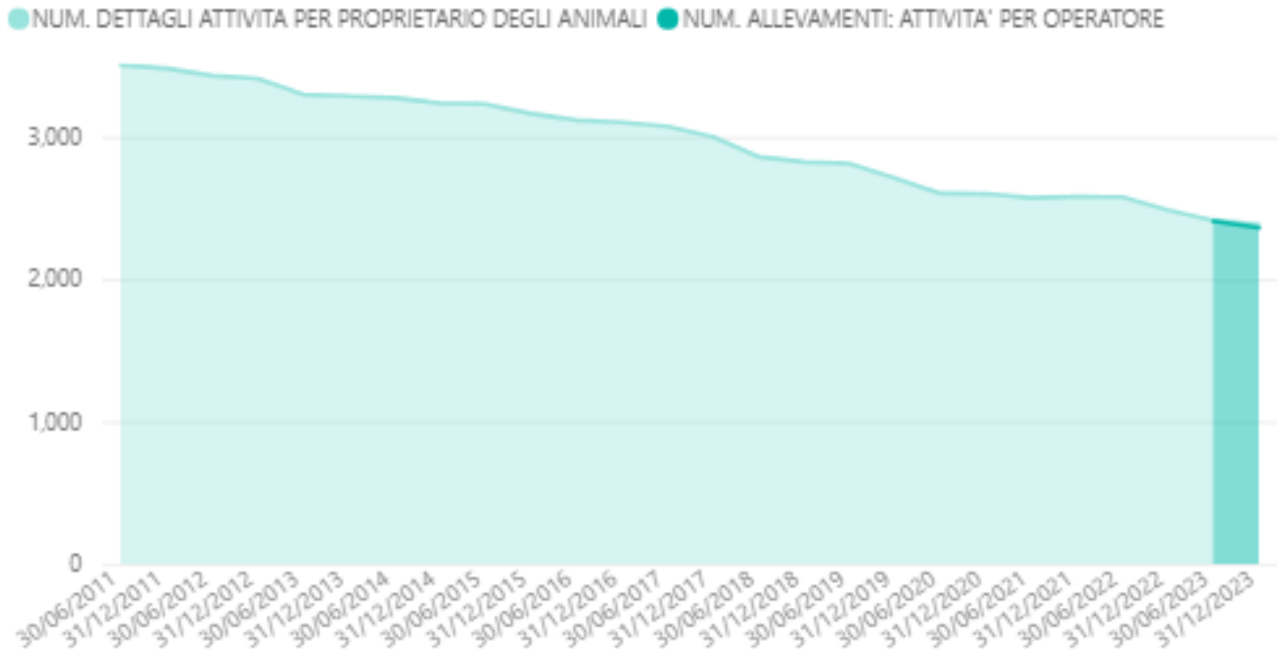
VARIAZIONE PATRIMONIO BOVINO E BUFALINO NEL TEMPO

SPECIE	REGIONE	ASL	PROVINCIA	COMUNE
BUFALINI	All	All	All	All

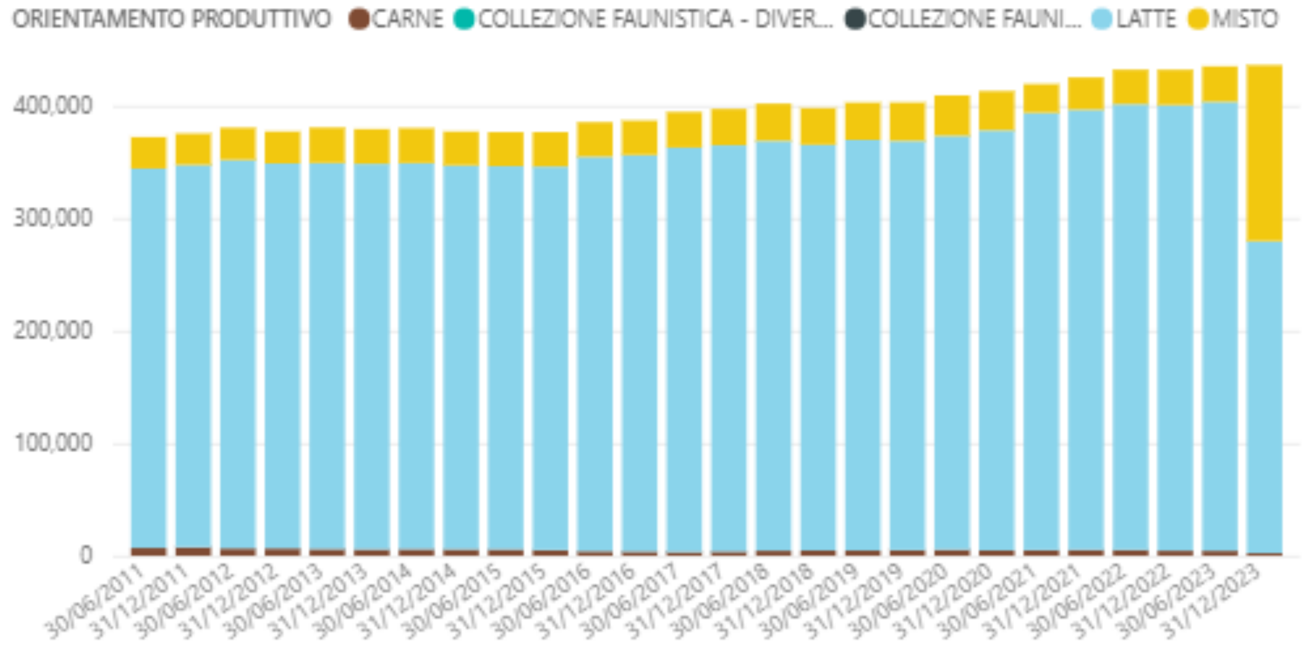
Fino al 30/11/2023 gli allevamenti sono distinti per codice aziendale, specie allevata e proprietario degli animali; dal 31/12/2023 gli allevamenti corrispondono alle attività dei singoli operatori (DL 134 del 05/08/2022)

ANNI VISUALIZZATI	ORIENTAMENTO PRODUTTIVO	TIPOLOGIA PRODUTTIVA	CLASSE CONSISTENZA	MODALITÀ ALLEVAMENTO
2011 – 2023	All	All	All	All

NUMERO ALLEVAMENTI

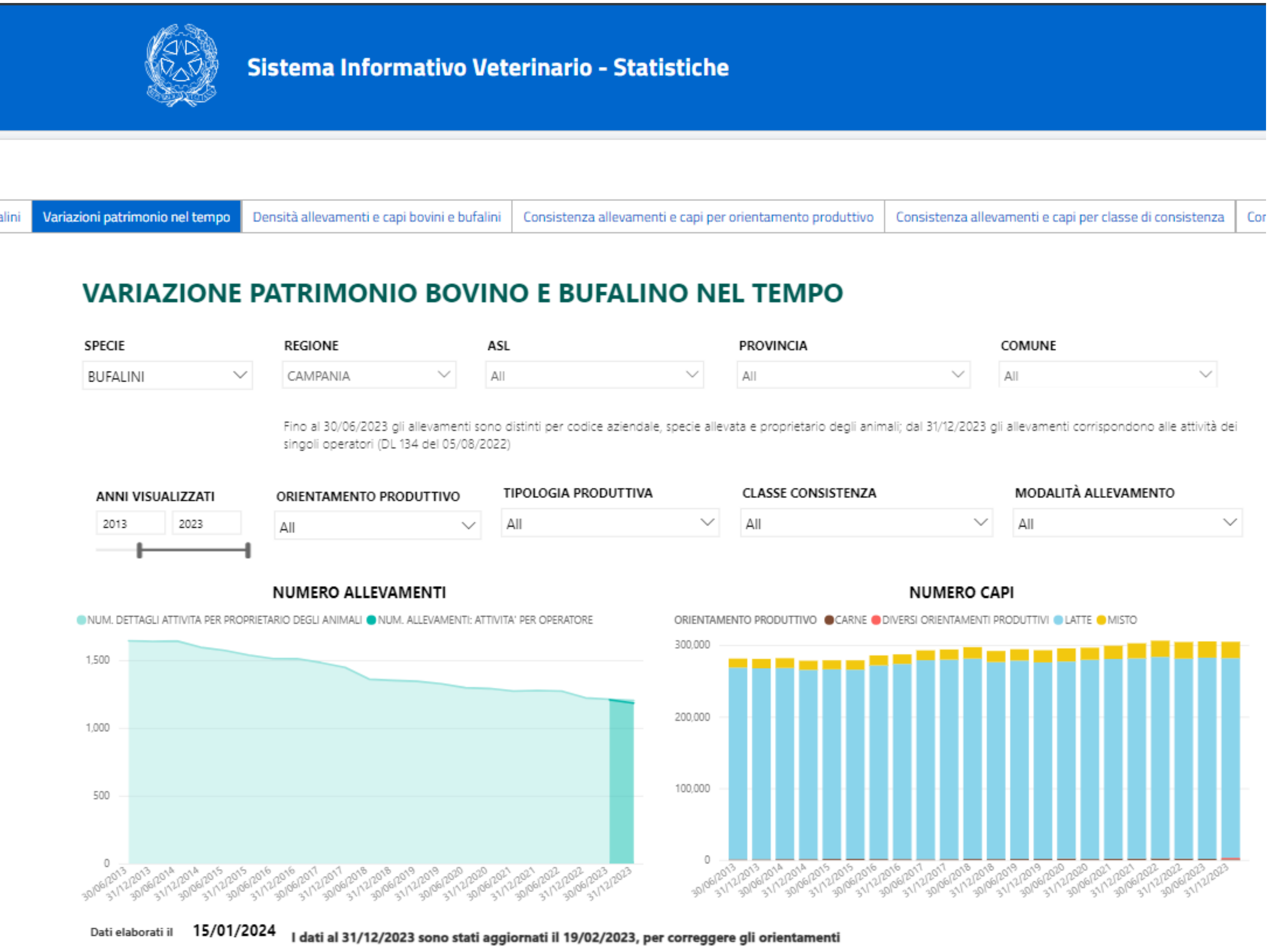


NUMERO CAPI



Dati elaborati il **15/01/2024**

Variazione patrimonio **Bufalino** Campano dal **2013 al 2023**



Numero totale Allevamenti	-21,62%
Numero totale capi Bufalini	+8,37%
Latte +Misti	+8,33%
Carne	+17,16%

"Dati forniti **dalla BDN dell'Anagrafe Zootecnica istituita dal Ministero della Salute presso il CSN dell'Istituto "G. Caporale" di Teramo**".

Sistema Informativo Veterinario - Statistiche

Variazioni patrimonio nel tempo | Densità allevamenti e capi bovini e bufalini | Consistenza allevamenti e capi per orientamento produttivo | Consistenza allevamenti e capi per classe di consistenza | Consistenza a

DENSITÀ ALLEVAMENTI E CAPI BOVINI E BUFALINI

DATA RIFERIMENTO
30/06/2024

DATA RIFERIMENTO: 30/06/2024
SPECIE: BUFALINI
ORIENTAMENTO PRODUTTIVO: All
TIPOLOGIA PRODUTTIVA: All
CLASSE DI CONSISTENZA: All
MODALITÀ ALLEVAMENTO: All

REGIONE: CAMPANIA

Fino al 30/06/2023 gli allevamenti sono distinti per codice aziendale, specie allevata e proprietario degli animali; dal 31/12/2023 gli allevamenti corrispondono alle attività dei singoli operatori (DL 134 del 05/08/2022)

REGIONE	NUMERO ALLEVAMENTI	NUMERO CAPI
CAMPANIA	**1,182**	**307,297**
AVELLINO	8	345
BENEVENTO	19	2,429
CASERTA	740	186,109
NAPOLI	16	4,342
SALERNO	399	114,072
Total	**1,182**	**307,297**

0.0869
DENSITÀ ALLEVAMENTI (N. ALLEV. PER KMQ)

ALLEVAMENTI

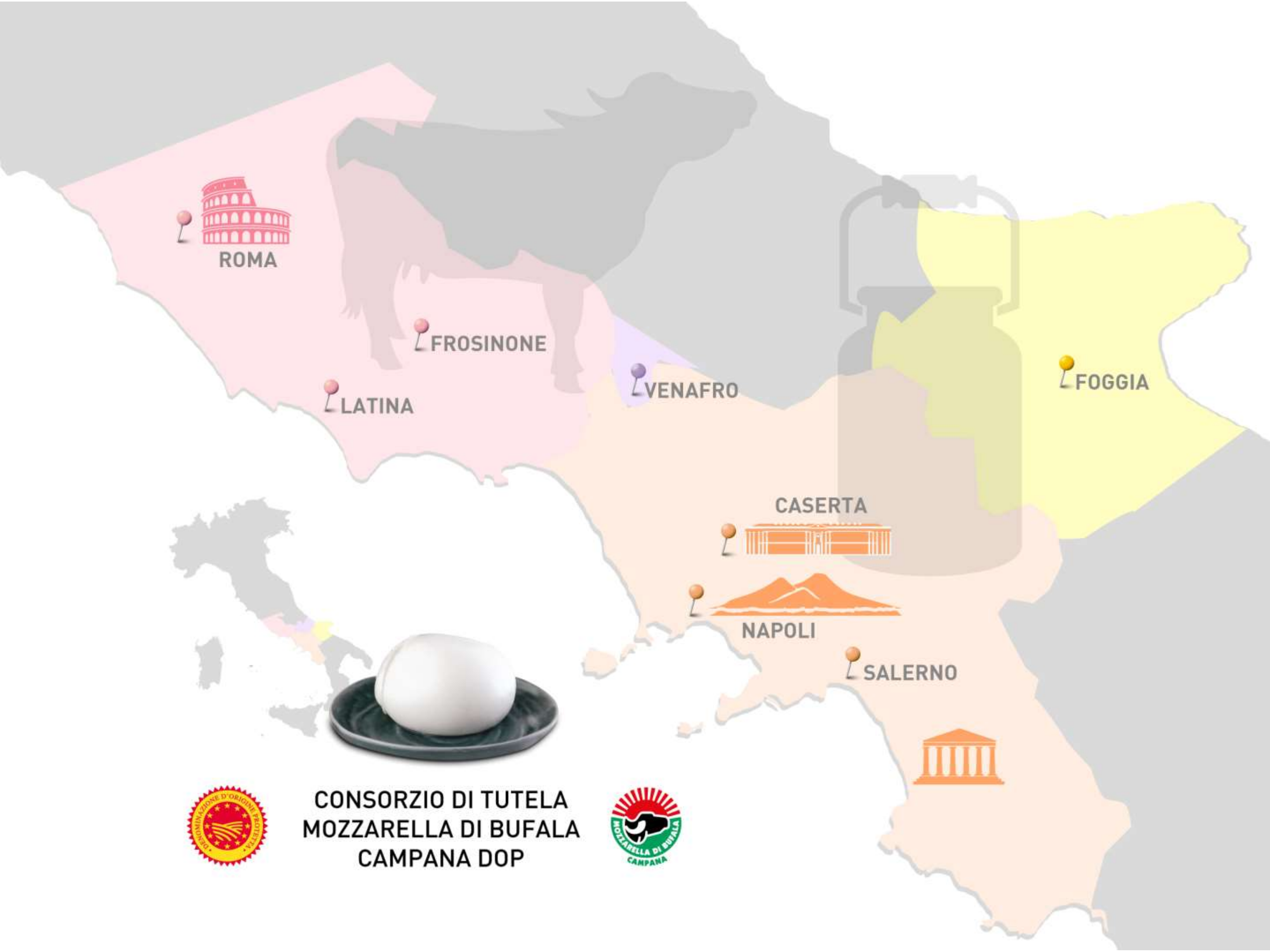
22.6028
DENSITÀ CAPI (N. CAPI PER KMQ)

CAPI

Densità allevamenti
CE 0,2804(n.allev per kmq
N all 740
SA 0,0811(n.allev per kmq
N all 399

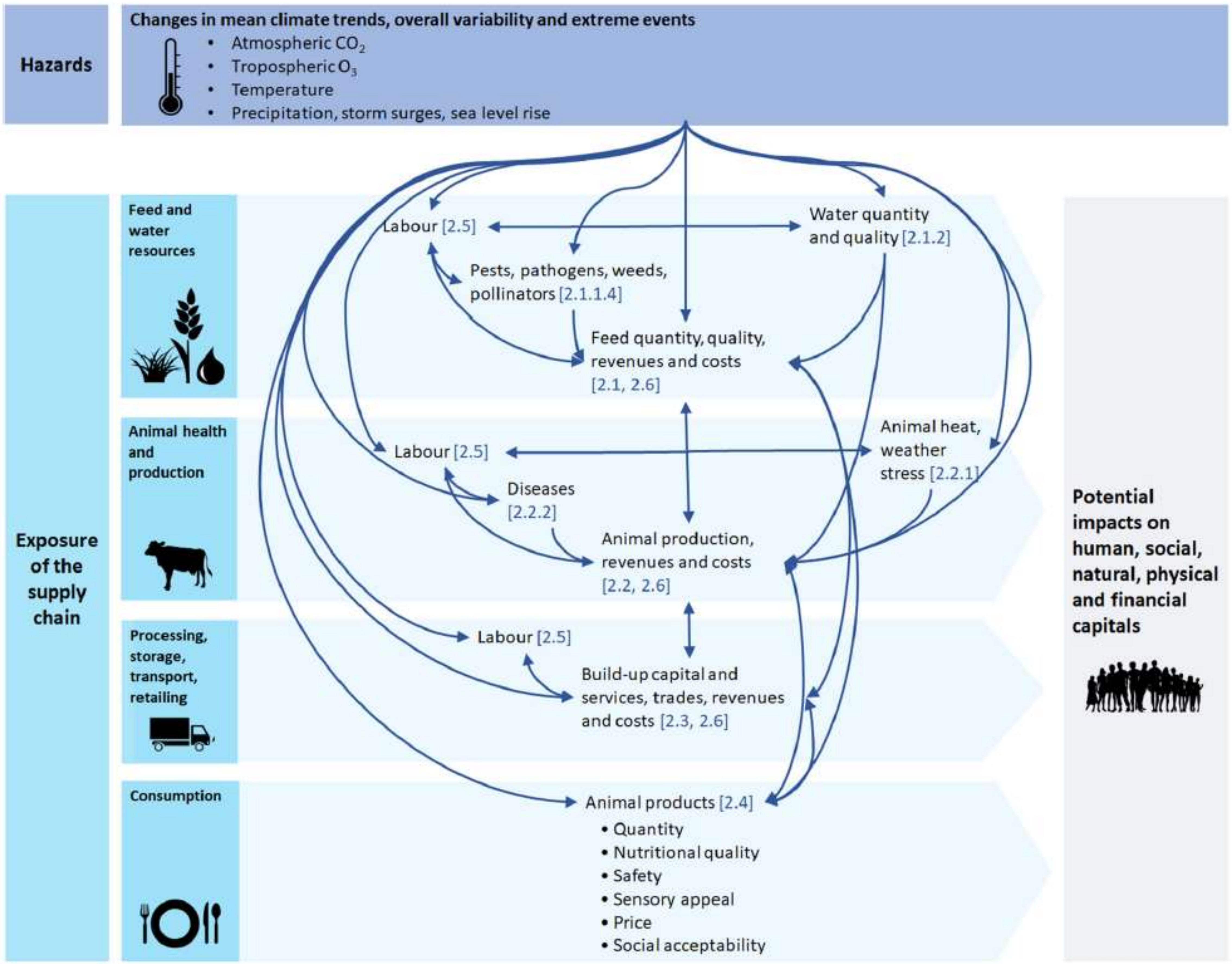
Densità Capi
CE 70,5124 (capi per kmq
N capi 186,109
SA 23,1734 (capi per kmq
N capi 114,072

Dati elaborati il **15/07/2024** **I dati al 31/12/2023 sono stati aggiornati il 19/02/2023, per correggere gli orientamenti**


ROMA
FROSINONE
LATINA
VENAFRO
FOGGIA
CASERTA
NAPOLI
SALERNO
CONSORZIO DI TUTELA
MOZZARELLA DI BUFALA
CAMPANA DOP

Mediterranean Region

Temperature rise larger than european average
Decrease in annual precipitation
Decrease in annual river flow
Increasing risk of biodiversity losse
Increasing risk of desertification
Increasing Water demand for agricolture
Decrease in crop yields
Increasing risk of forest fire
Increase in mortality from heatwaves
Expansion of habitats for disease-carrying insects
Decrease in hydropower potential



Godde et al 2021

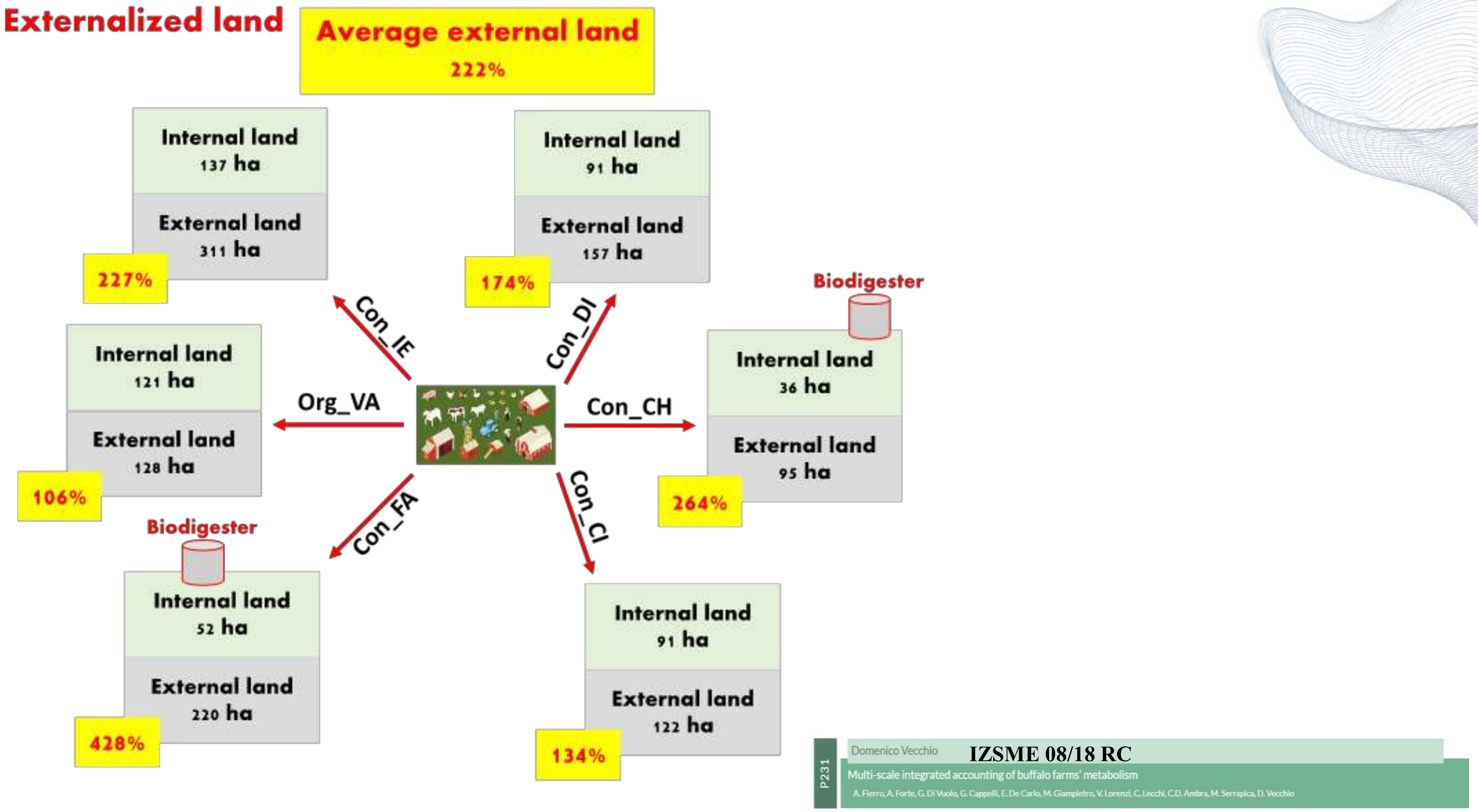
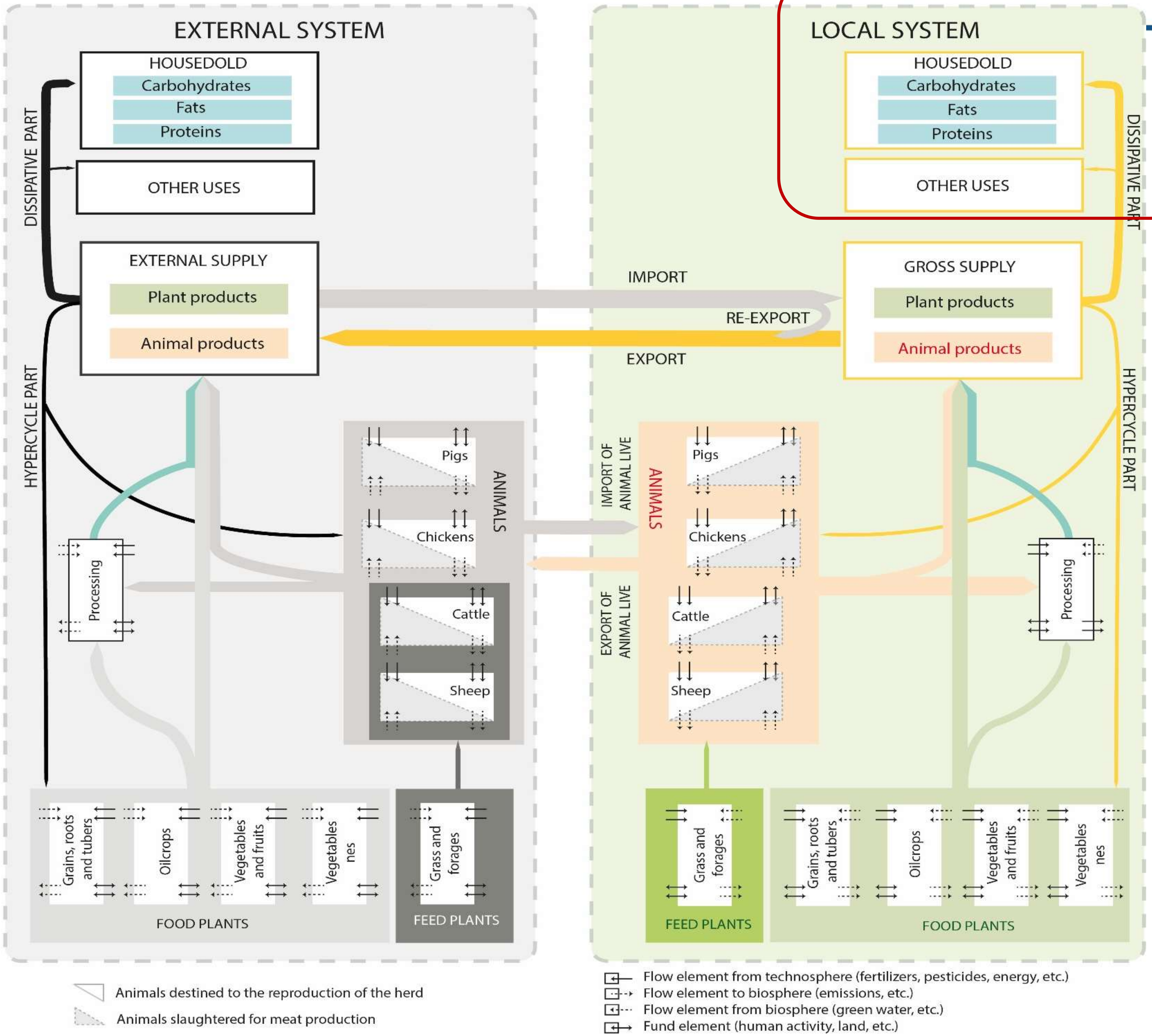


Figura 37 Contributo di utilizzo di terre intra-aziendali ed extra-aziendali per garantire il flusso di alimenti (foraggi e concentrati) alla mandria.

The MAGIC tool-kit

Virtual
supply systems

Externalized socio-economic and environmental pressures



Required supply
in the diet

Actual
supply systems

Local socio-economic and environmental pressures

The Drivers of Wildlife Interactions with Livestock

Global drivers of wildlife–livestock interactions

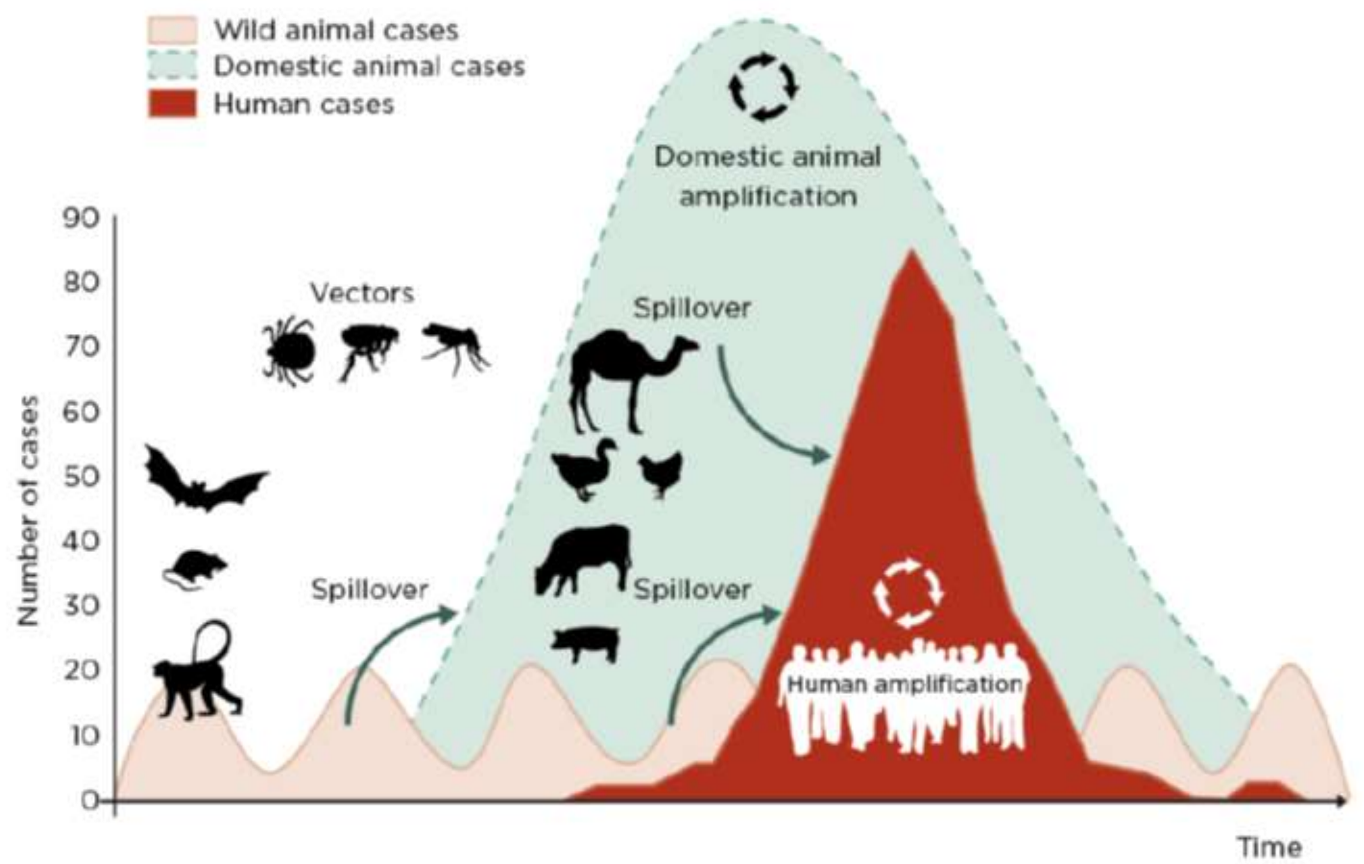
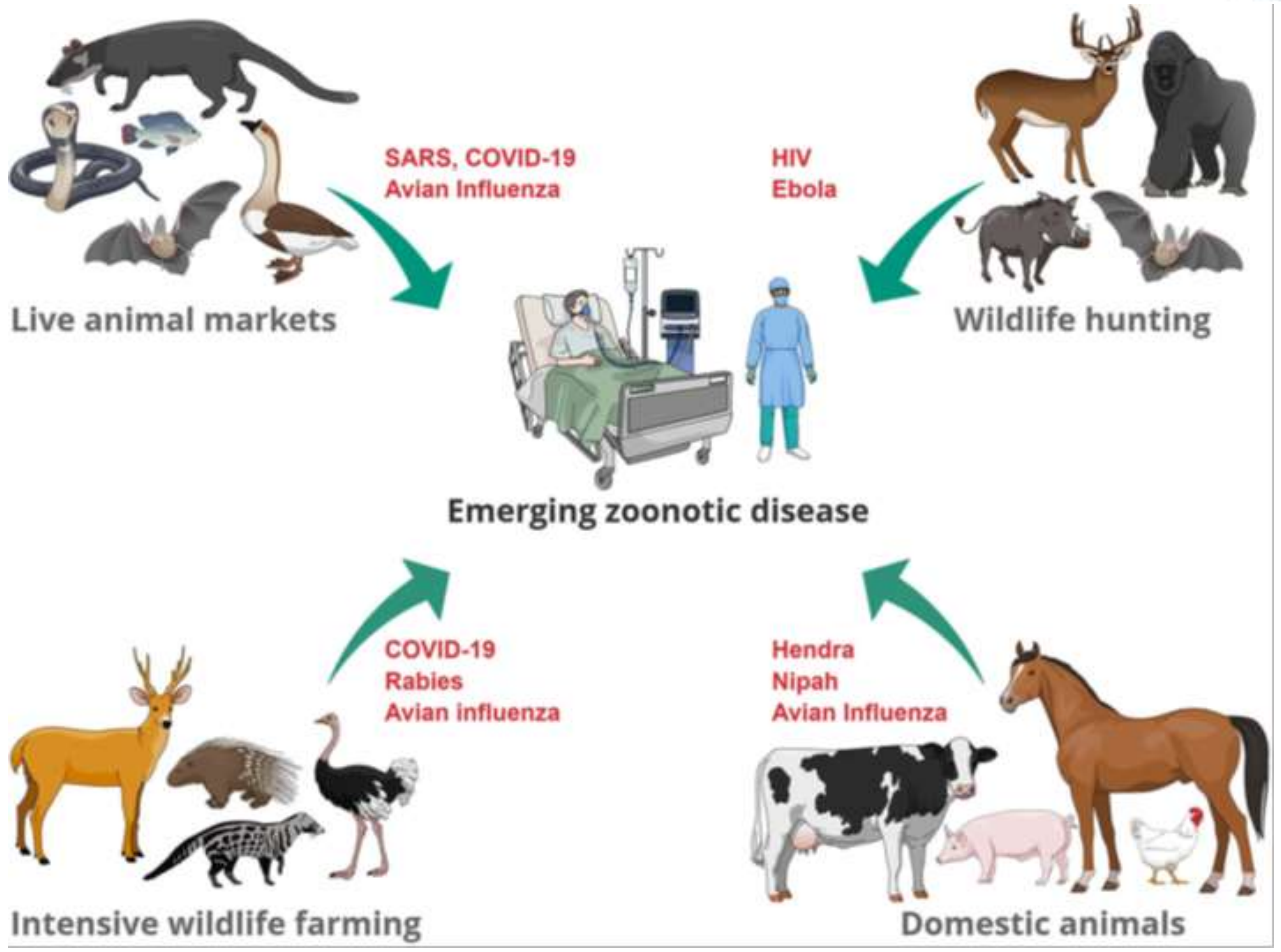


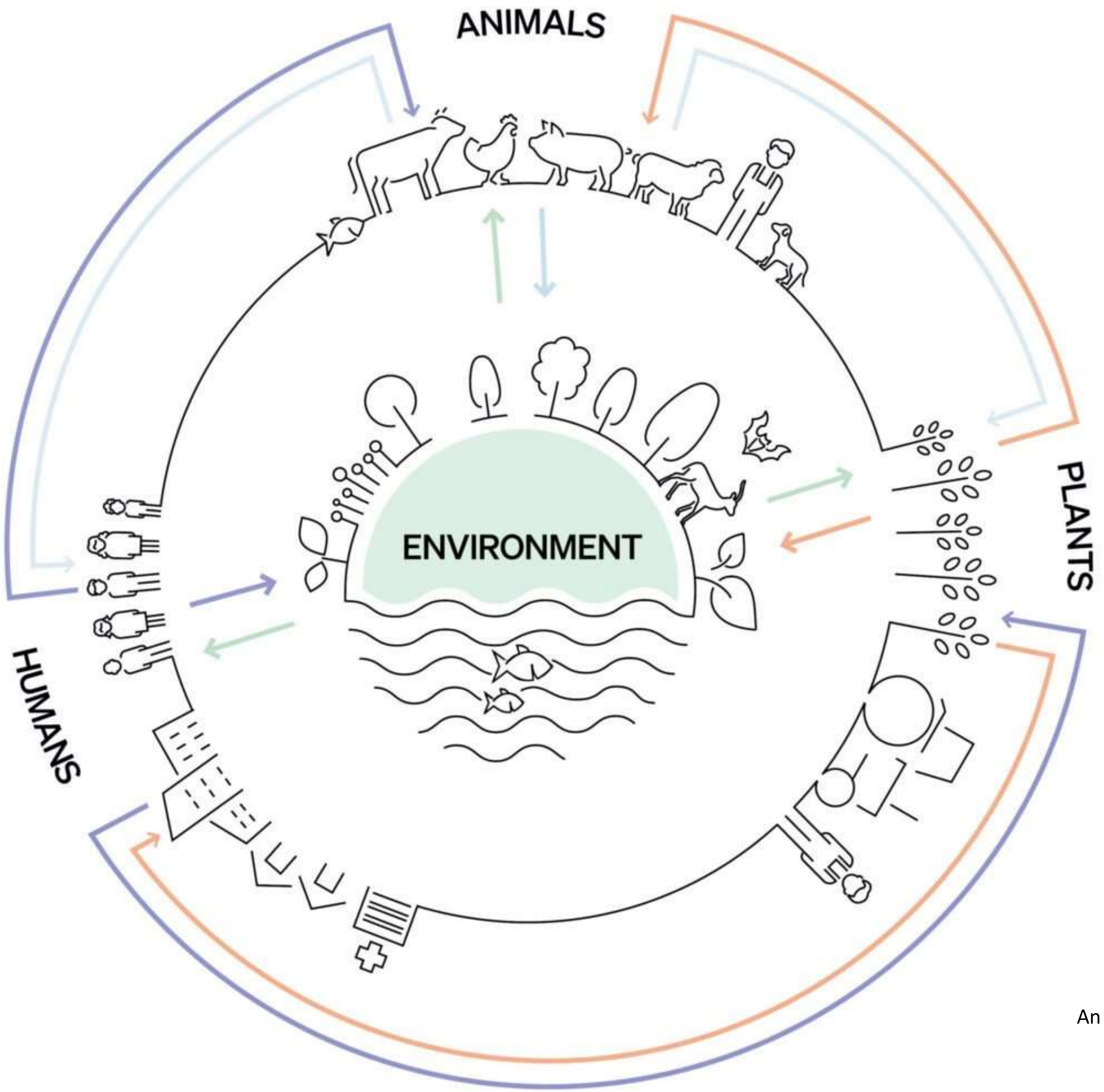
Figure 12: Transmission and amplification of zoonotic diseases. Transmission of a pathogen to people can occur directly from a wild animal or following an outbreak in livestock that amplifies the likelihood of transmissions to humans.

Source: Redrawn from Karesh, *et al.* (2012).



Magouras et al.2020.
doi:10.3389/fvets.2020.582743

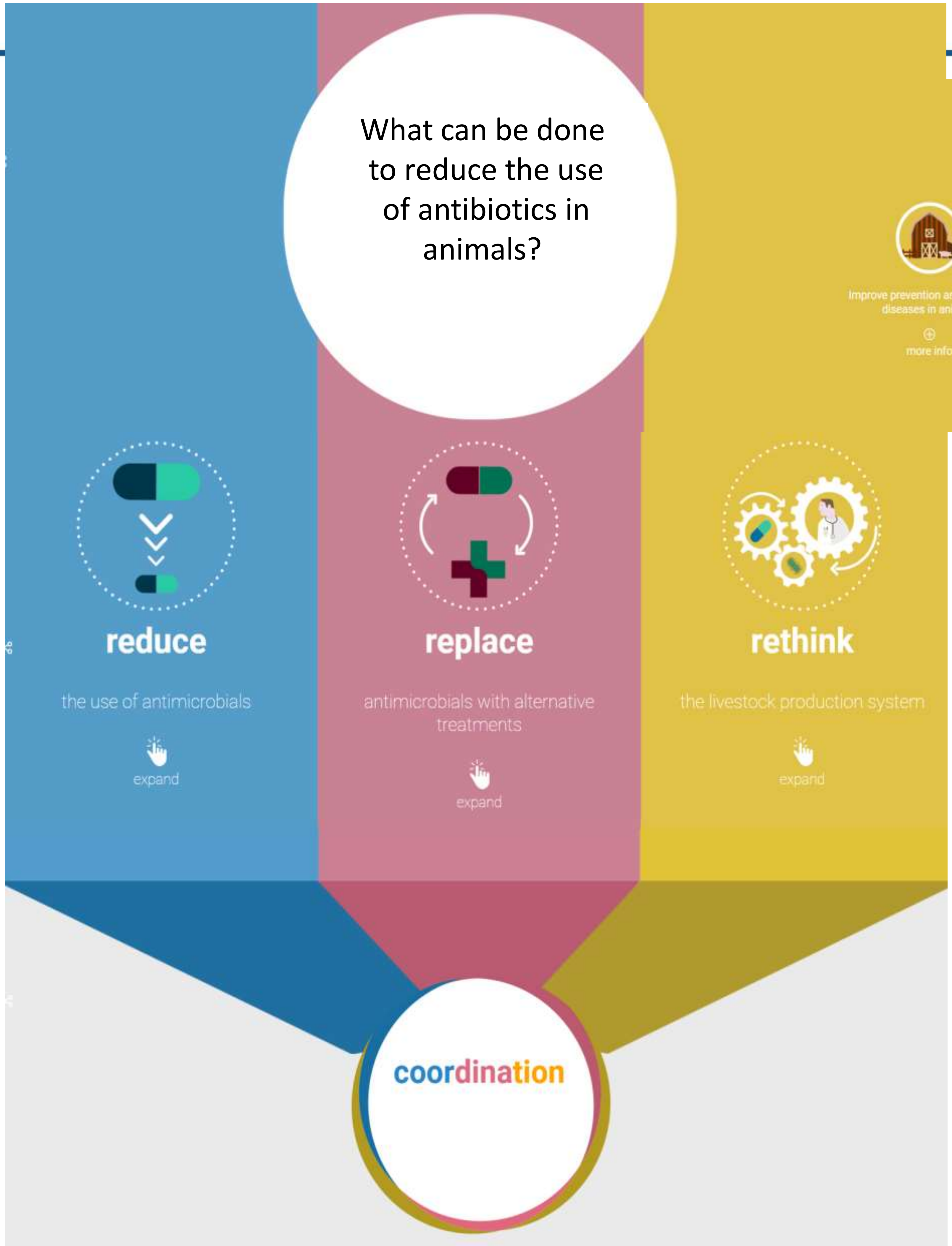
One Health and Zoonoses

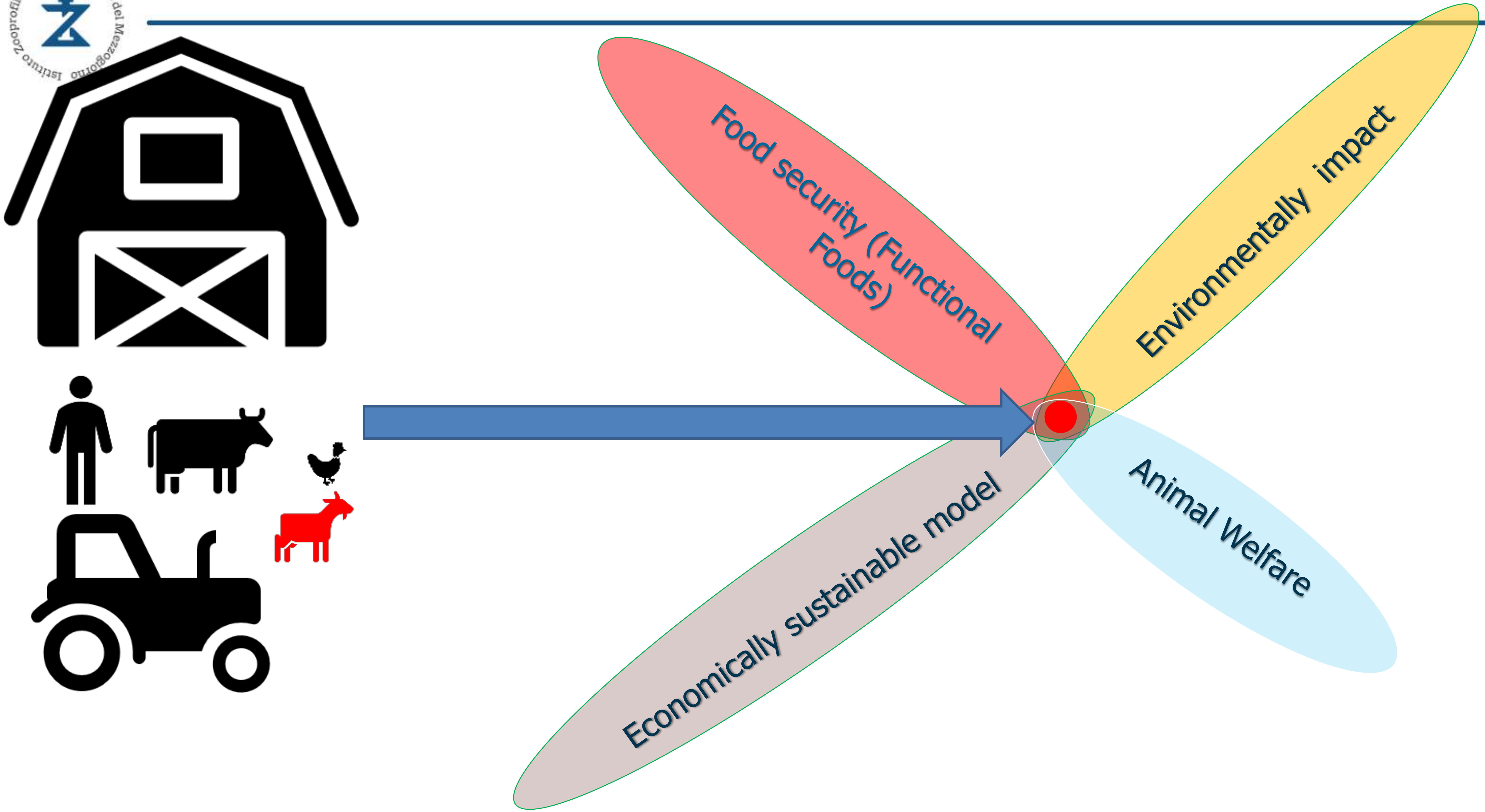


An illustration of the ecology of vector-borne diseases like the 2018 ebolavirus and 2019 coronavirus (Covid-19) by the artist Olaf Hajek.

Present & Future

What can be done to reduce the use of antibiotics in animals?





Food security (Functional Foods)
Environmentally impact
Animal Welfare
Economically sustainable model

System identity

Formal identity

VIABILITY
Internal techno-economic performance
Established by the relationships between funds and flows

Buffalo farm
output milk

Defined by means of the metabolic characterization ← What the system does
How the system works

FEASIBILITY
Internal performance
Established by the relationships with ecosphere

EXTERNALIZATION
Internal performance
Established by the relationships with external funds and flows

Semantic identity

DESIRABILITY
Normative and institutional features
Established by end use of the product and system's environmental pressure

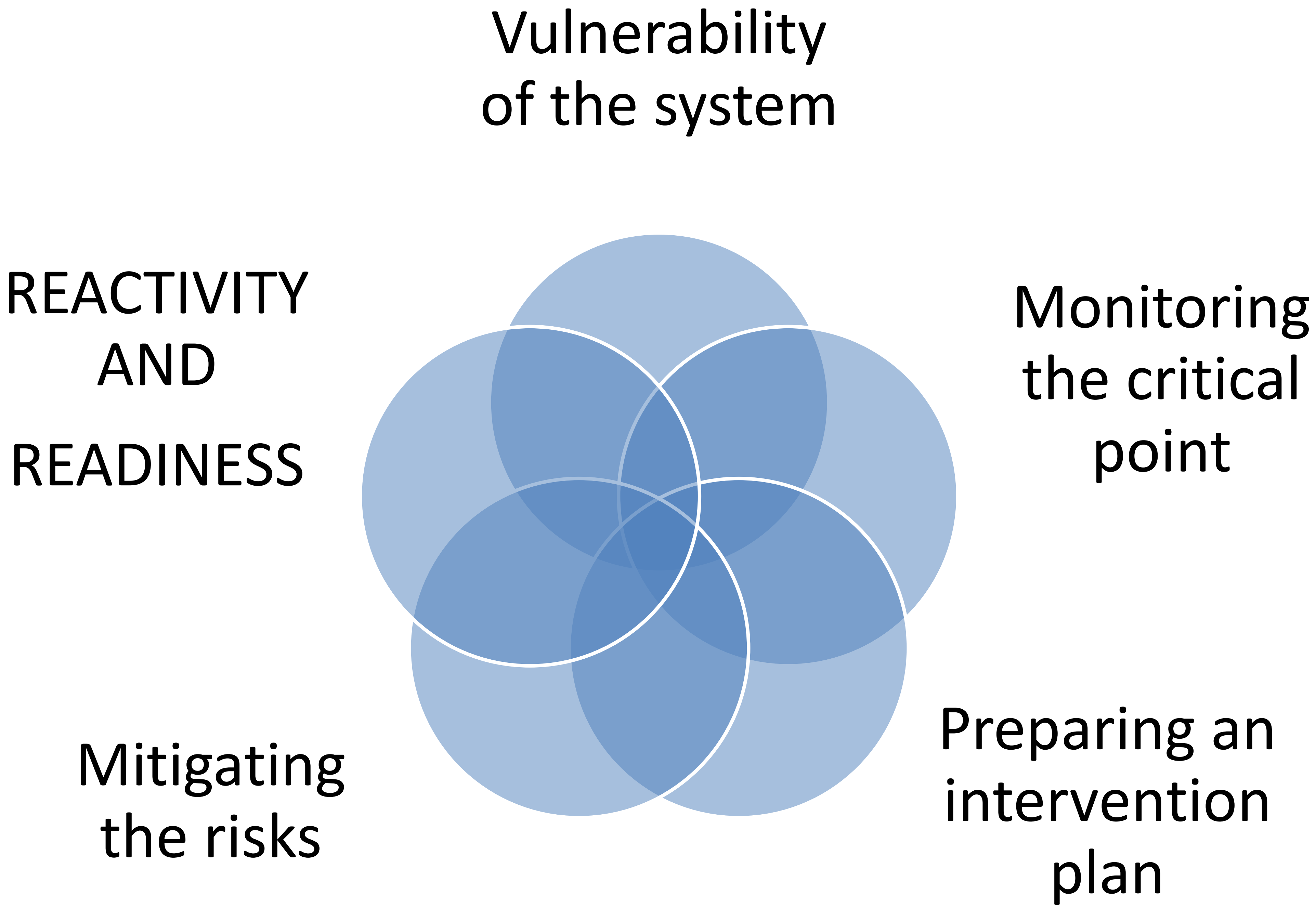
Why the system exists and works

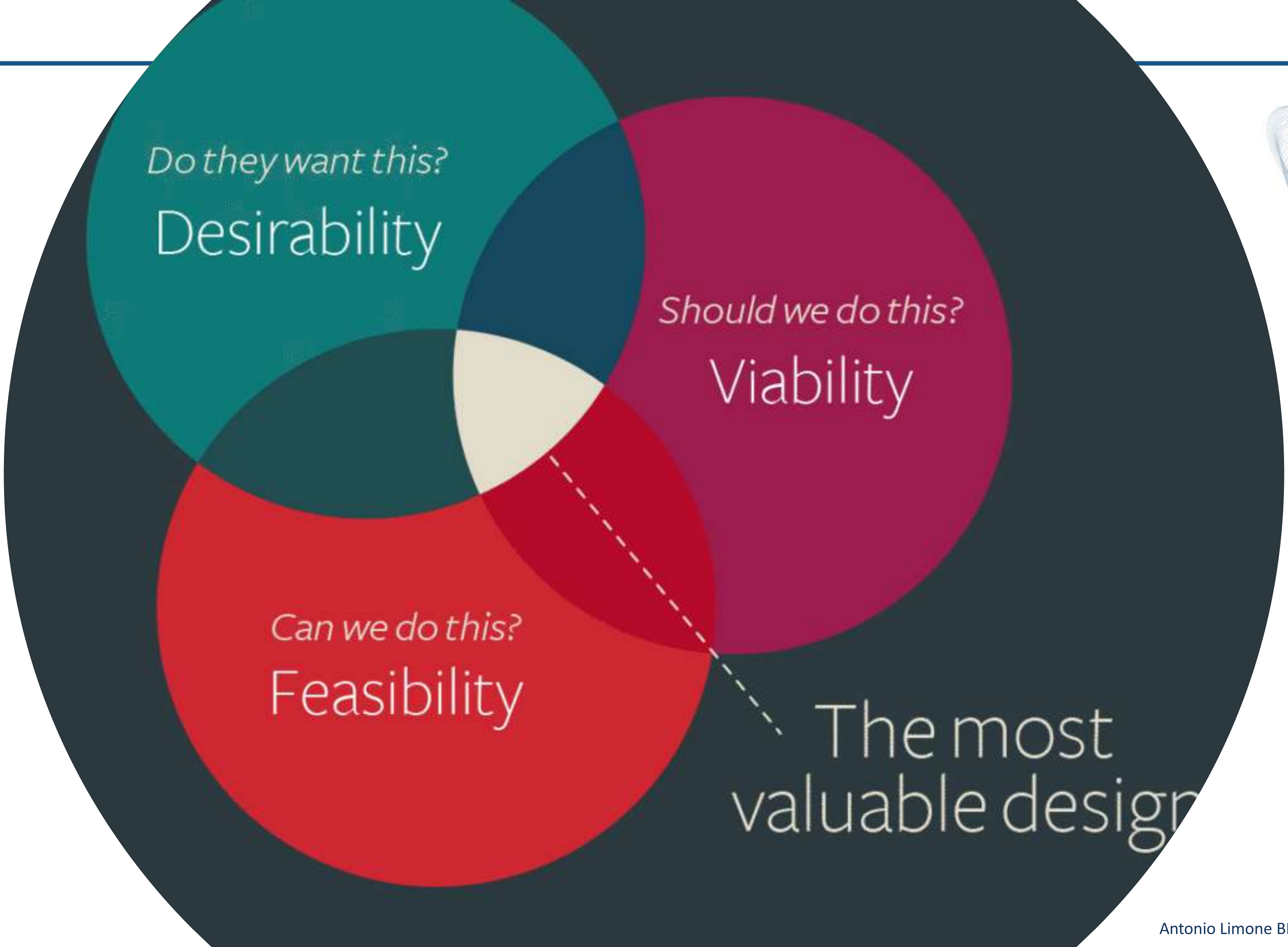
External identity
(milk to be transformed in a popular product and
profit of transformers)

Internal identity
(profit by means of
a traditional product)

Upward causation ⇄ Downward causation


DEFCON 1
DEFCON 2
DEFCON 3
DEFCON 4
DEFCON 5


Vulnerability of the system
Monitoring the critical point
Preparing an intervention plan
Mitigating the risks
REACTIVITY AND READINESS


Do they want this?
Desirability
Should we do this?
Viability
Can we do this?
Feasibility
The most
valuable desig

Istituto Zooprofilattico Sperimentale del Mezzogiorno
Campania | Calabria

THANKS

Antonio Limone

First International Conference on Buffalo Mozzarella & Milk Products (BMMP)

BUFFALO MILK – BLACK GOLD Opportunities and Challenges in Production and Marketing

Dr. R S Sodhi

President, Indian Dairy Association (IDA)

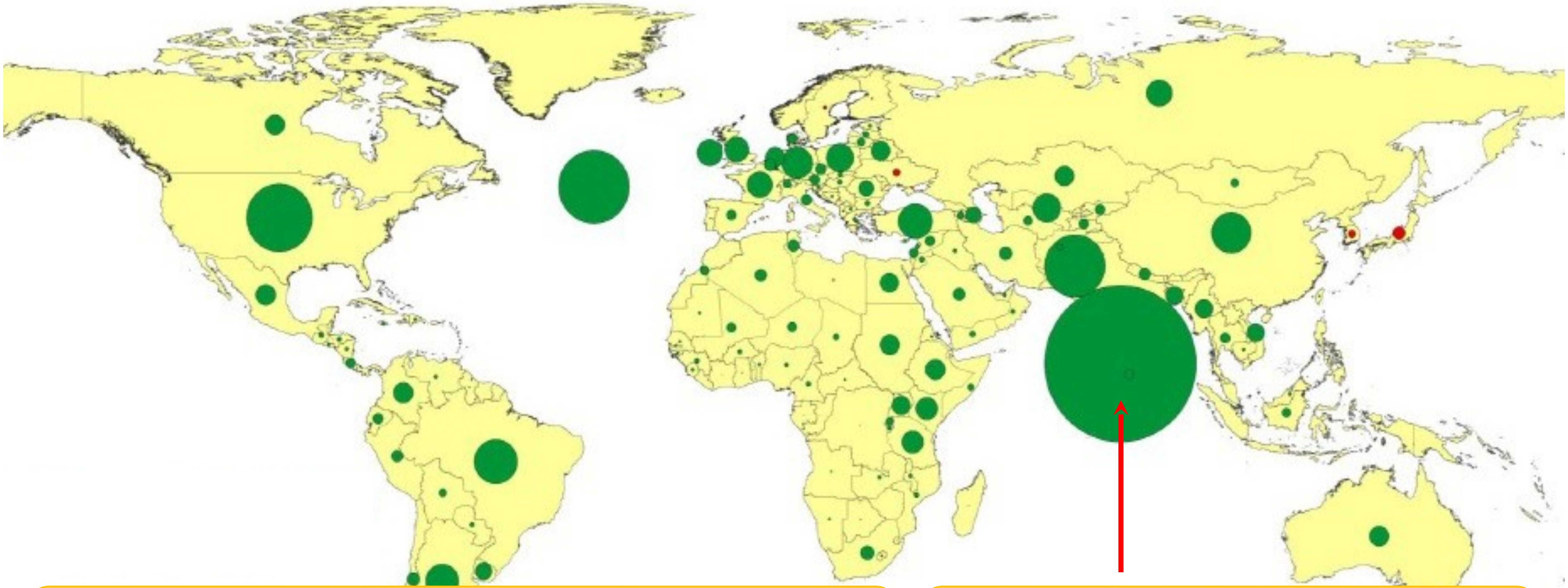
Chairperson, NIFTEM –T

25th SEPT. 2024, NAPLES,ITALY

Contents

World Dairy Scenario & India

World Milk Production (Year 2023)



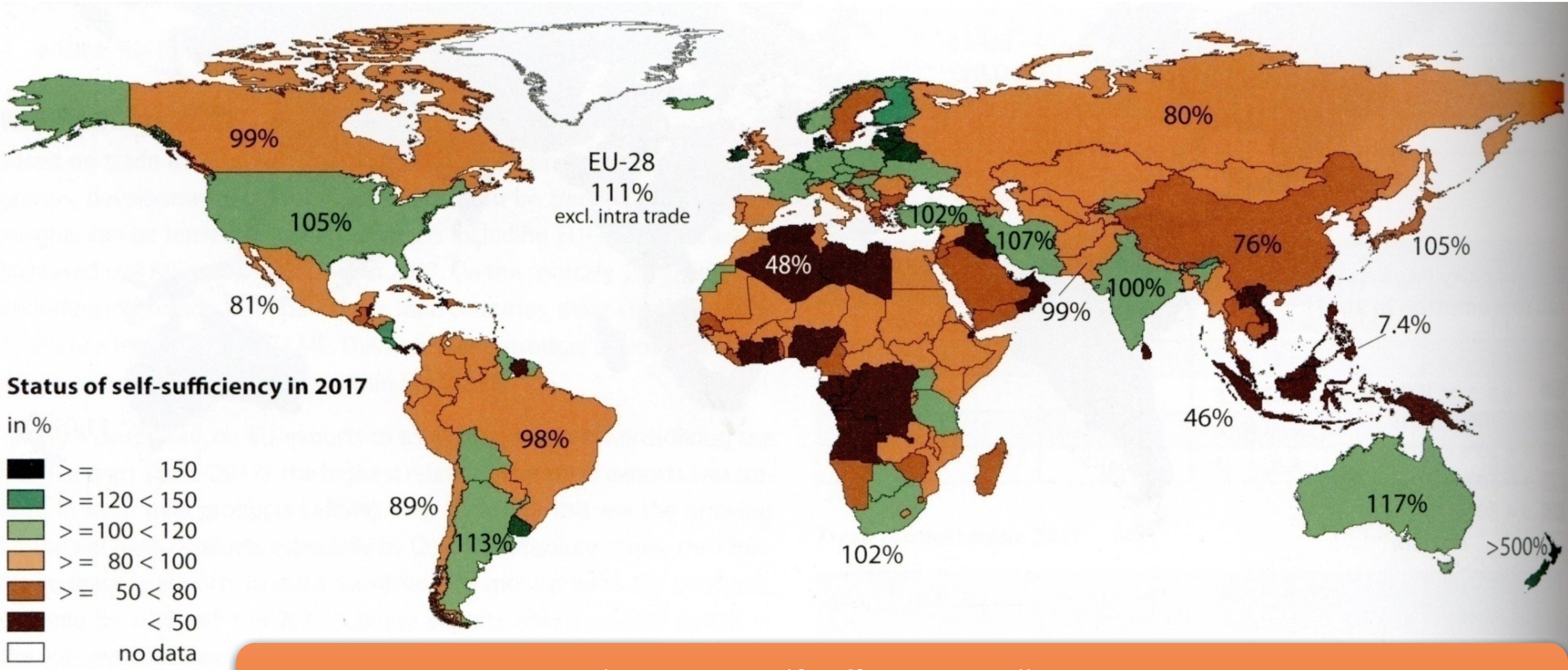
World milk production: **944 MMT**
World milk production growth: **1.8% of last 20 years**

INDIA No. 1 Milk Producer:
231 MMT (24% of world)

MMT: Million Metric Tonne

Source: FAO

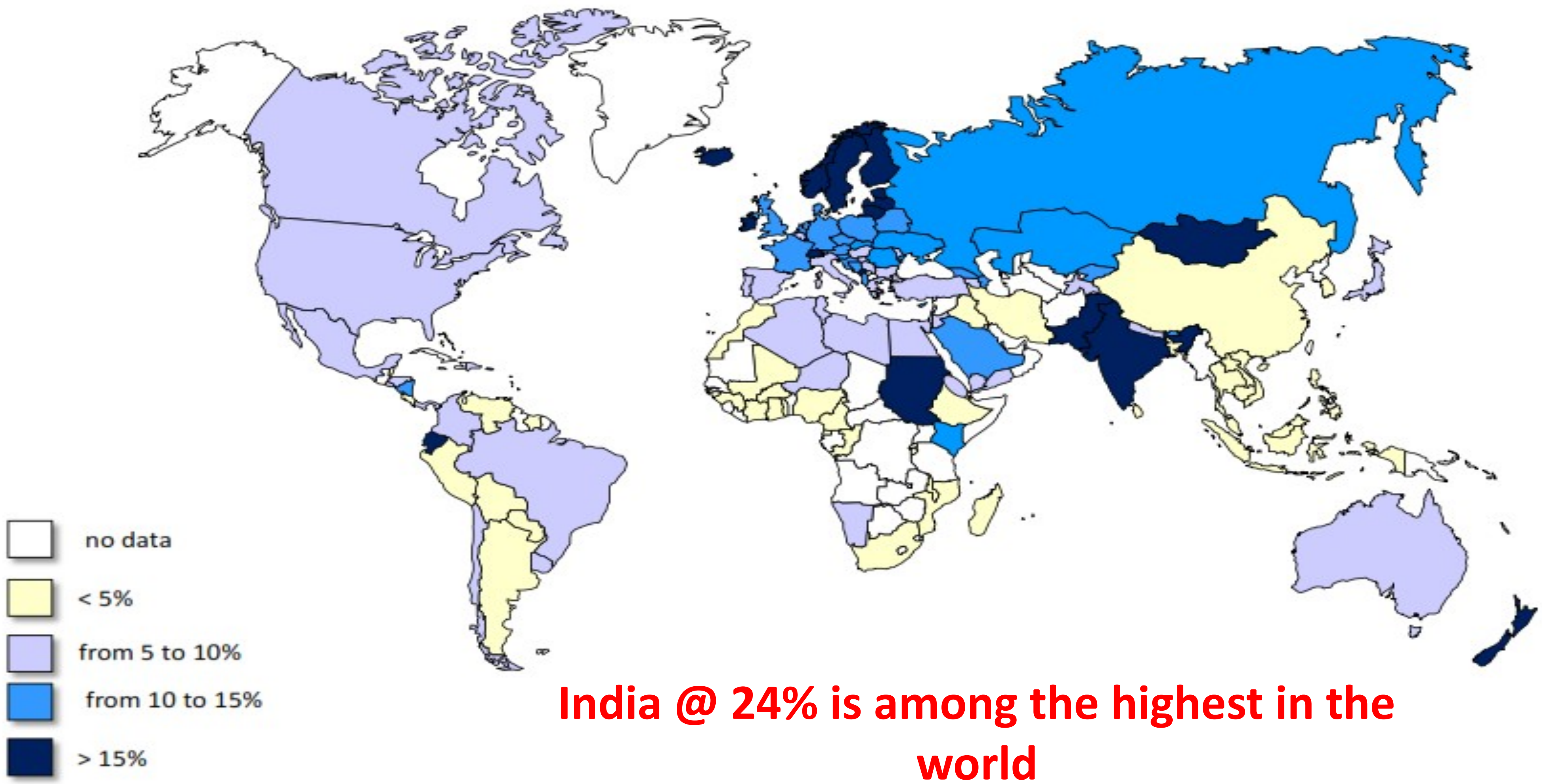
Status of Self Sufficiency for Milk



India is 100% self sufficient in Milk consumption.

- Huge potential for export in neighboring milk deficit nations

% Share of Dairy Sector in Total Agricultural Production

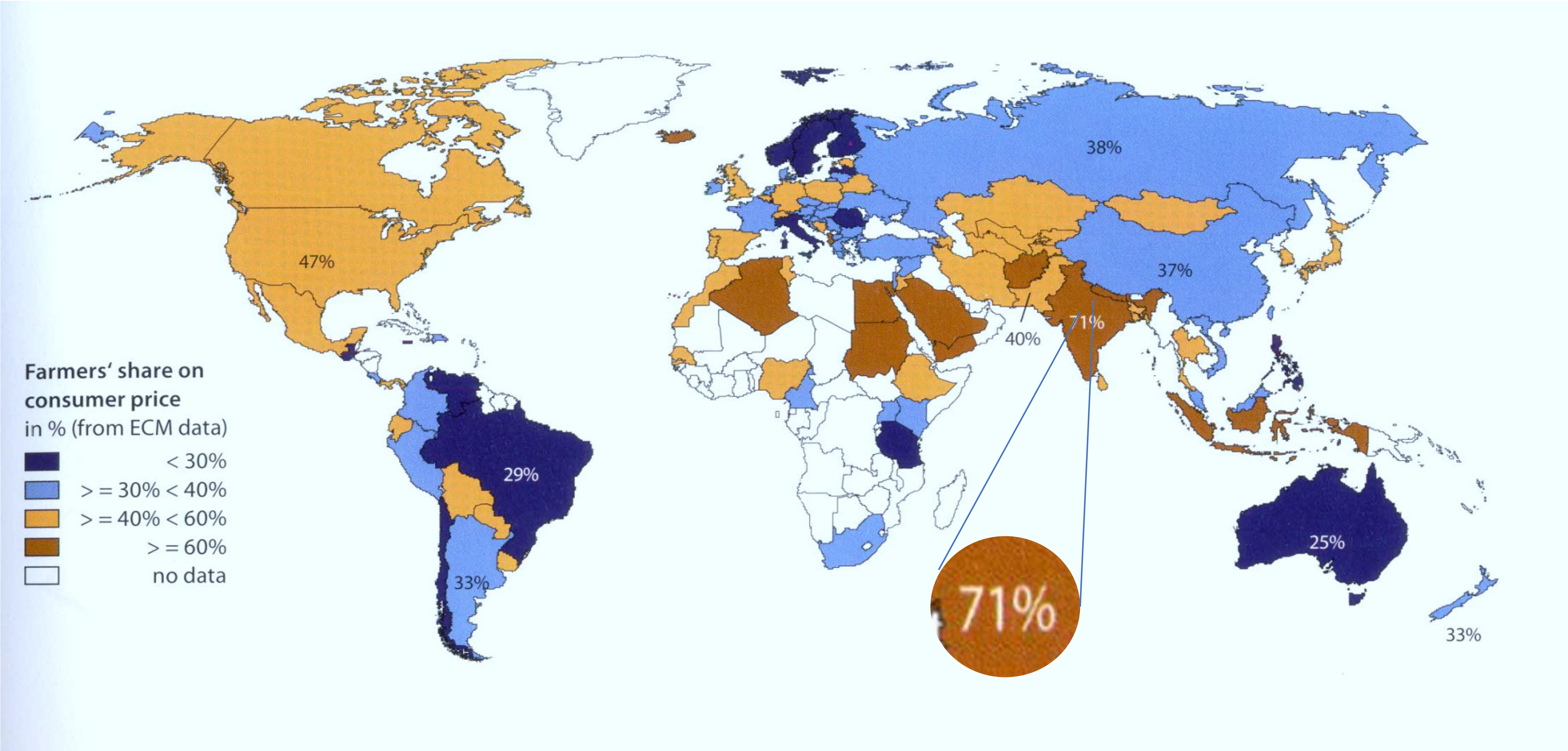


India @ 24% is among the highest in the world

India: Building World Dairy Leadership

Competitiveness of Indian dairy products

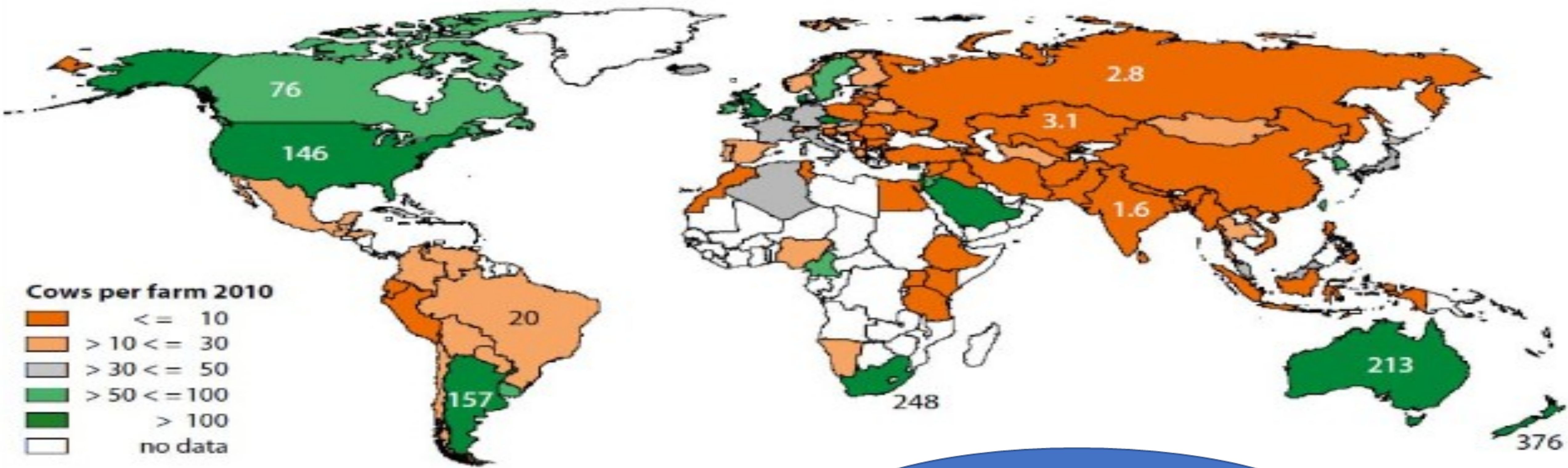
Farmer's share in consumer price



Indian Farmer has the highest share of consumer price

Source: IFCN

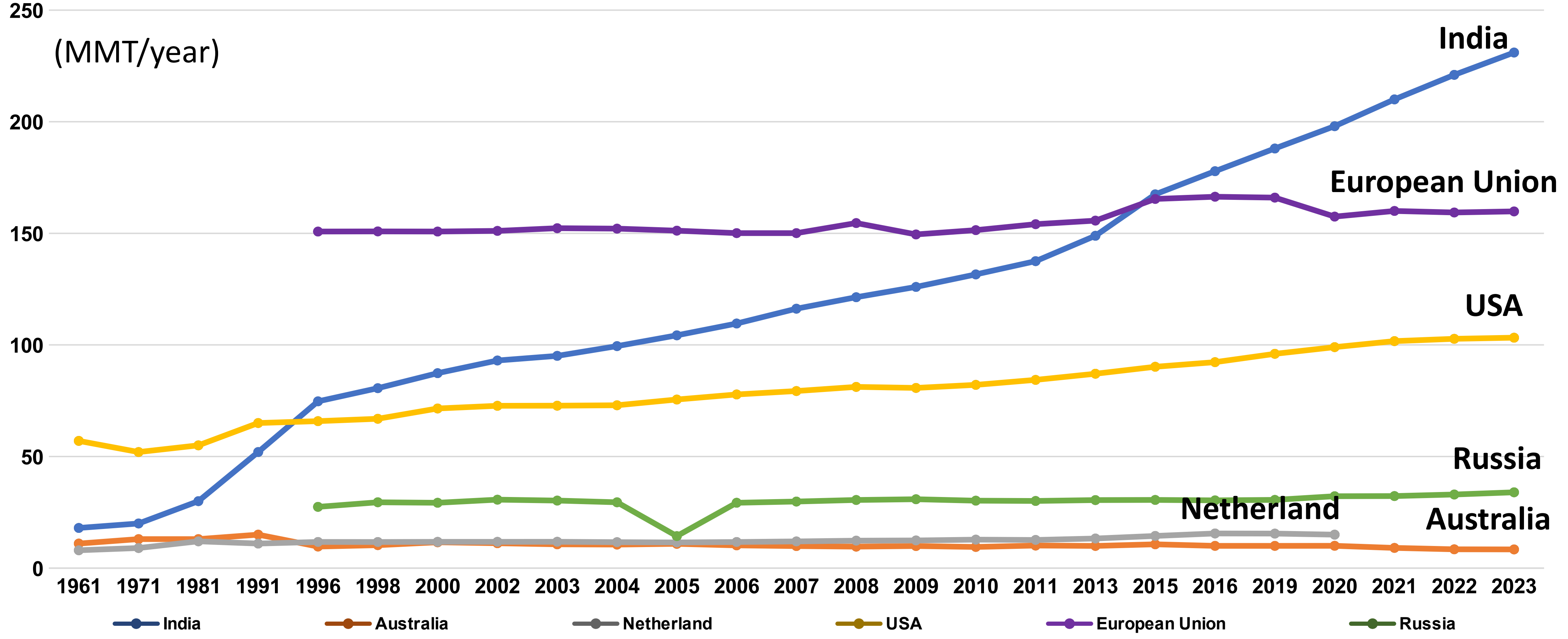
World Average Farm Size



World Average: 3
India Average: 1.6

Comparative Milk Production Growth

CAGR of last 15 years: **India: 4.9%** | USA: 2.3% | EU : 1.3% | AUS: 0.5% | Netherland: 2.7% | World: 1.3%



Milk production of India, Australia and Netherlands was almost similar in 1971

Source: FAO

Growth in Different Sectors and Major Products of Agriculture and their Share in Sectoral Growth between 1970-71 and 2020-21

Item	Compound Growth Rate %	Increase: times	Share in total increase in agri & allied output
1. All crops	2.46	3.38	52.59
Cereals	2.10	2.83	13.23
Paddy	2.08	2.80	6.66
Wheat	3.03	4.46	5.54
Maize	2.81	4.00	1.32
Pulses	1.68	2.30	2.36
Oilseeds	2.42	3.30	4.58
Condiment & spices	4.20	7.83	3.61
Fruits total	3.53	5.66	10.64
Vegetable total	3.43	5.41	6.08
2. Livestock	4.37	8.50	37.11
Milk	4.71	9.98	25.26
Poultry	6.42	22.45	6.30
3. Fishery	5.02	11.57	7.81
4. Forestry	0.55	1.31	2.49
5. Total Agriculture and allied	2.70	3.80	100.0
6. Human Population	1.84	2.50	--
7. Female bovine population	1.50	2.0	--

Consumption Trends Dairy V/s Bread, Pulses & Sugar

MILK > PULSES+BREAD+SUGAR

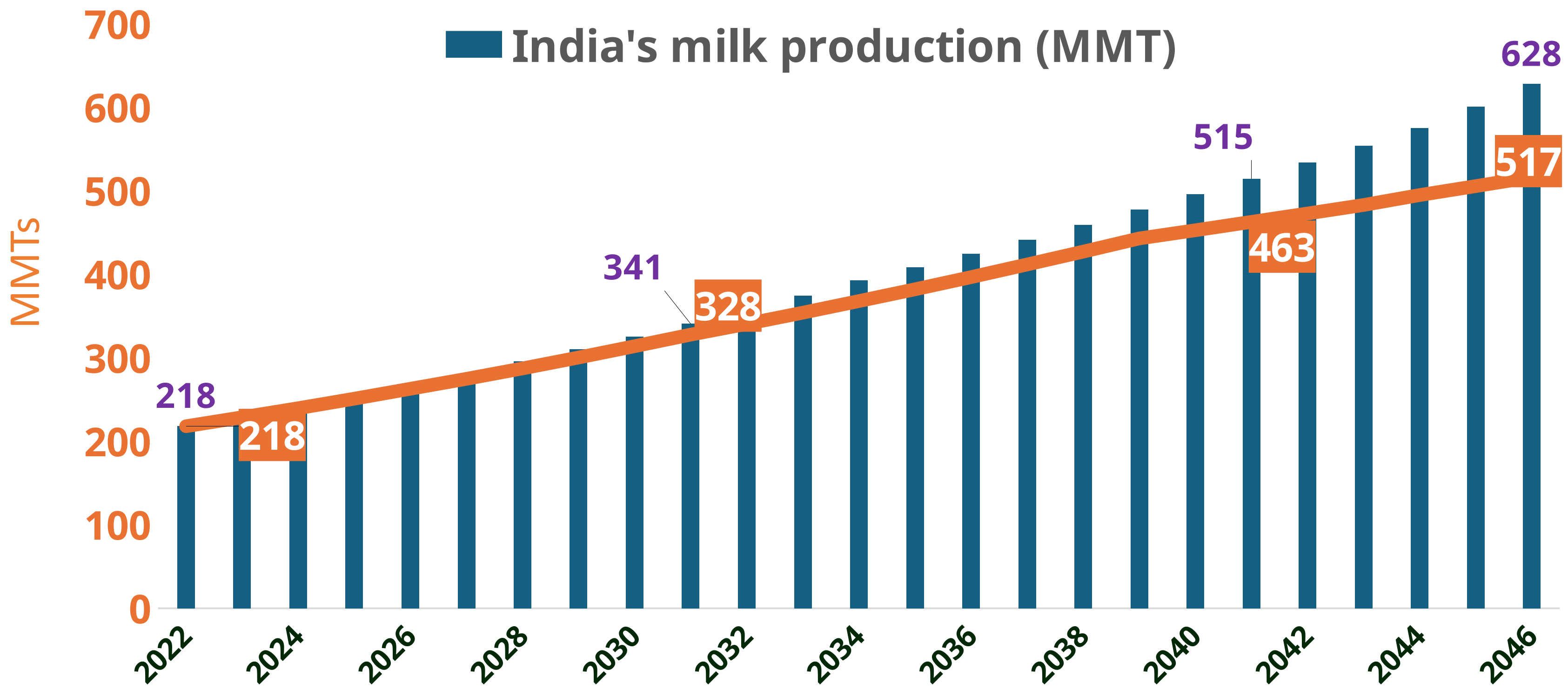
Item Groups	MPCE (Rs)		% Share in Total	
	Rural	Urban	Rural	Urban
Cereals & Substitute	185	235	4.91	3.64
Pulses & Their Products	76	90	2.01	1.39
Sugar & Salt	35	39	0.93	0.6
Roti+Dal+Chini	**296**	**364**	**7.85**	**5.63**
Milk & Milk Products	**314**	**466**	**8.33**	**7.22**

Growth of Indian Dairy Industry

Year	1972	1997	2023	2030	2048
Milk Production in MMT	24	71	231	330	628
% of World Milk Production	6	14	24	30	45
Per Capita Consumption Gram Per Person Per Day	110	214	466	550	852

By 2047, India will have export surplus of around 111 MMTs

In next 25 years, Milk Production of India will reach 628 MMTs, while demand for Milk and Dairy products will increase to 517 MTs



How did India succeed so spectacularly in Dairy Industry ?

The Amul Model

- Establishment of a direct linkage between milk producers and consumers by eliminating middlemen
- Milk Producers (farmers) control procurement, processing and marketing
- Professional management

INDIA

Indian dairy cooperatives ensure that their farmers get **70%-86%** of Consumers Rupee spent on Milk & Milk Products

OTHER COUNTRIES

In USA, producers get **38%** of consumers' money spent on milk

In UK, producers get only **36%**





The Consumer

↑

State Co-op. Milk Mktg. Fed.

↑

Dist. Milk Co-op. Union

↑

Village Dairy Co-op.

↑

Milk Producer

By harnessing the collective power of our 80 million Smallholder Dairy Ecosystem

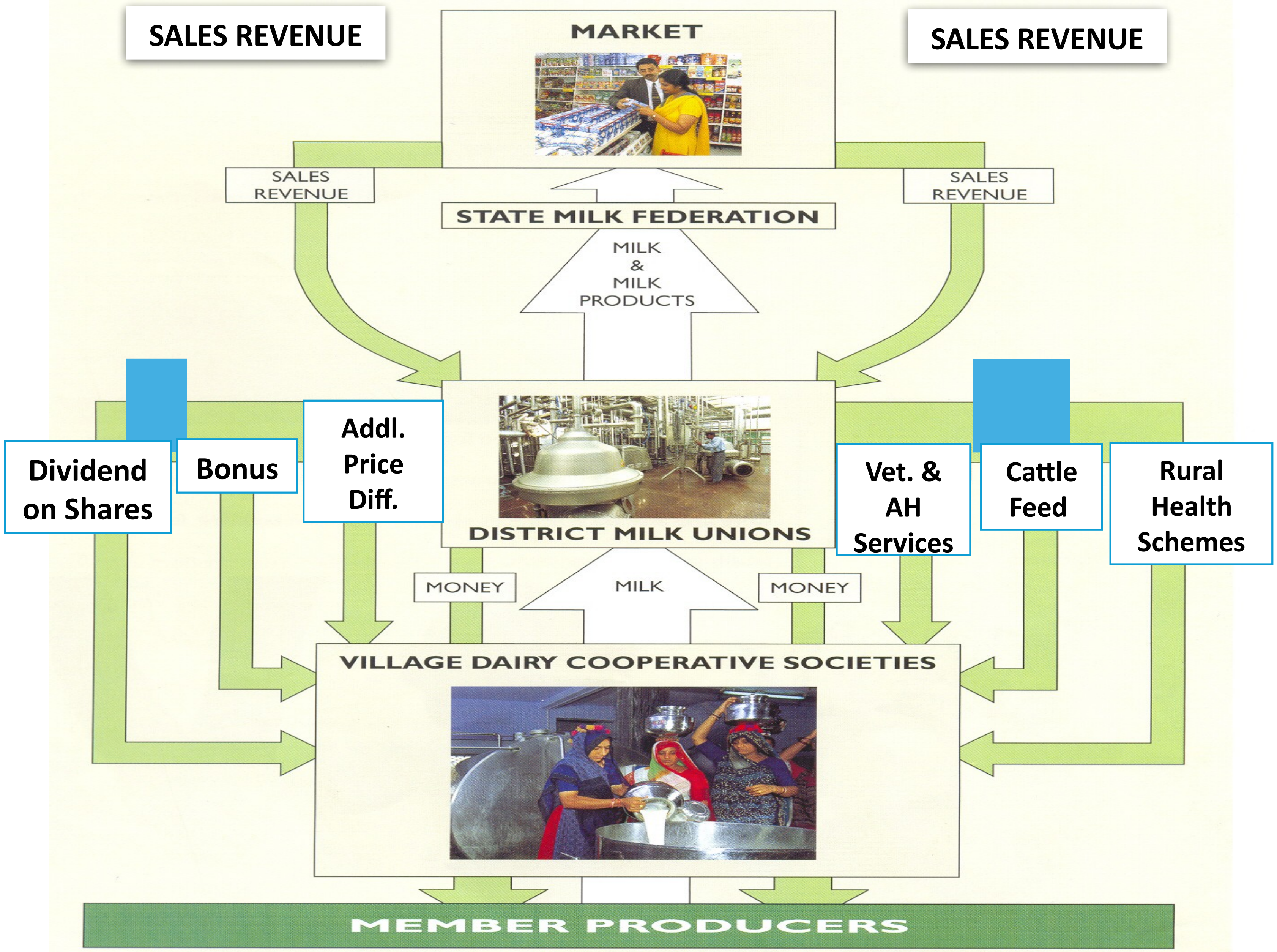
The Amul Model

GCMMF in Gujarat

18 District Unions in Gujarat

18,559 VDCS in Gujarat

3.6 million in Gujarat



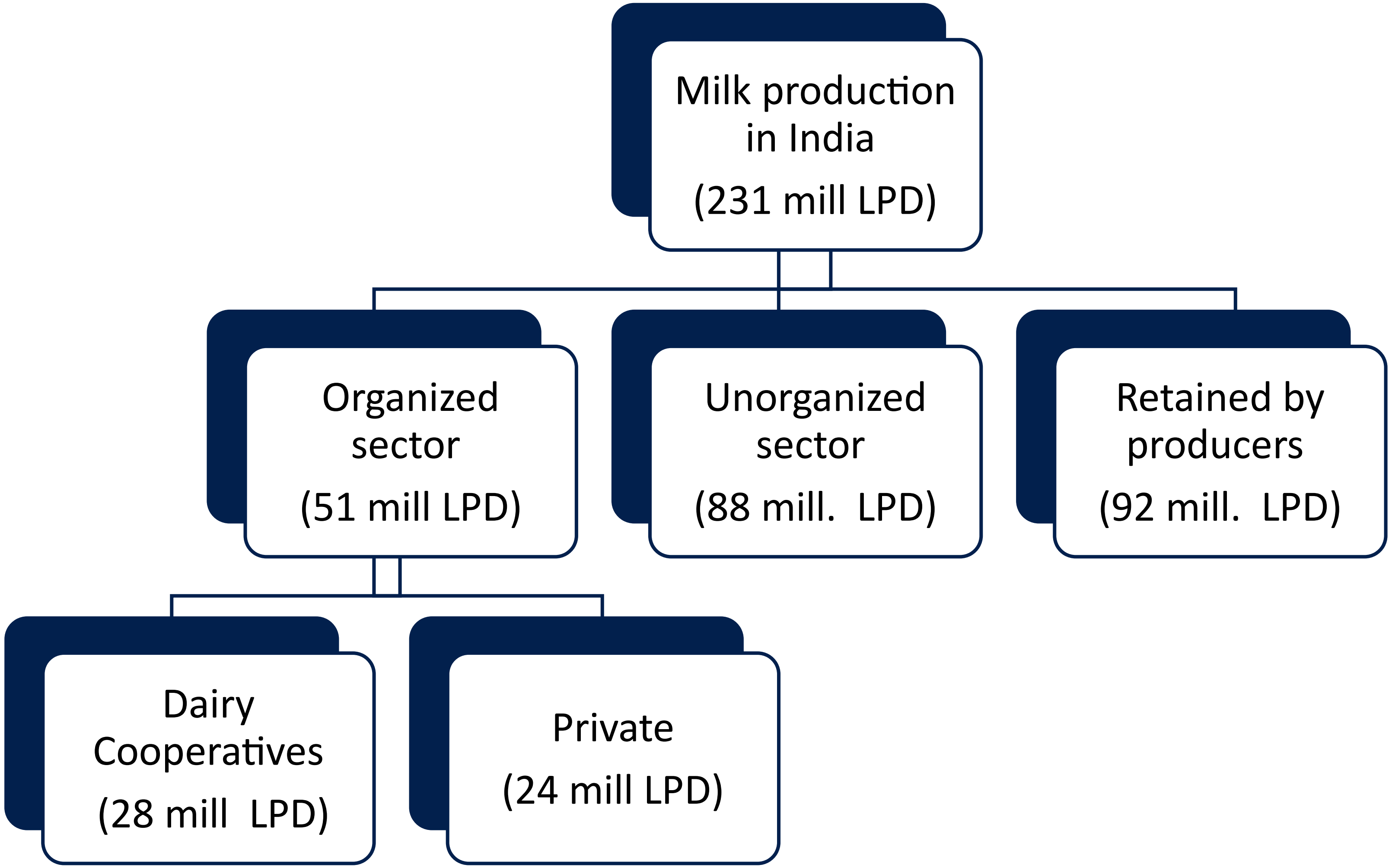
28 State Fedns. in India

222 District Unions in India

228374 VDCS in India

18million in India

Milk Production in India



Reasons for Success of White Revolution

- Vision -1970 self-sufficiency or *“Atma Nirbharta”*
- Farmer’s owned very efficient supply chain
- Selfless dedicated leadership
- Livelihood partial or major for 80 million families
- Very detailed planning, meticulous execution and monitoring OF
- Engaging best of the professionals
- Long-term investment in infrastructure rather than subsidies
- Emphasis on marketing and branding
- Technology integration and innovation and digitalization

BUFFALO MILK

World Buffalo Milk Production

Ranking of countries with the highest buffalo milk production

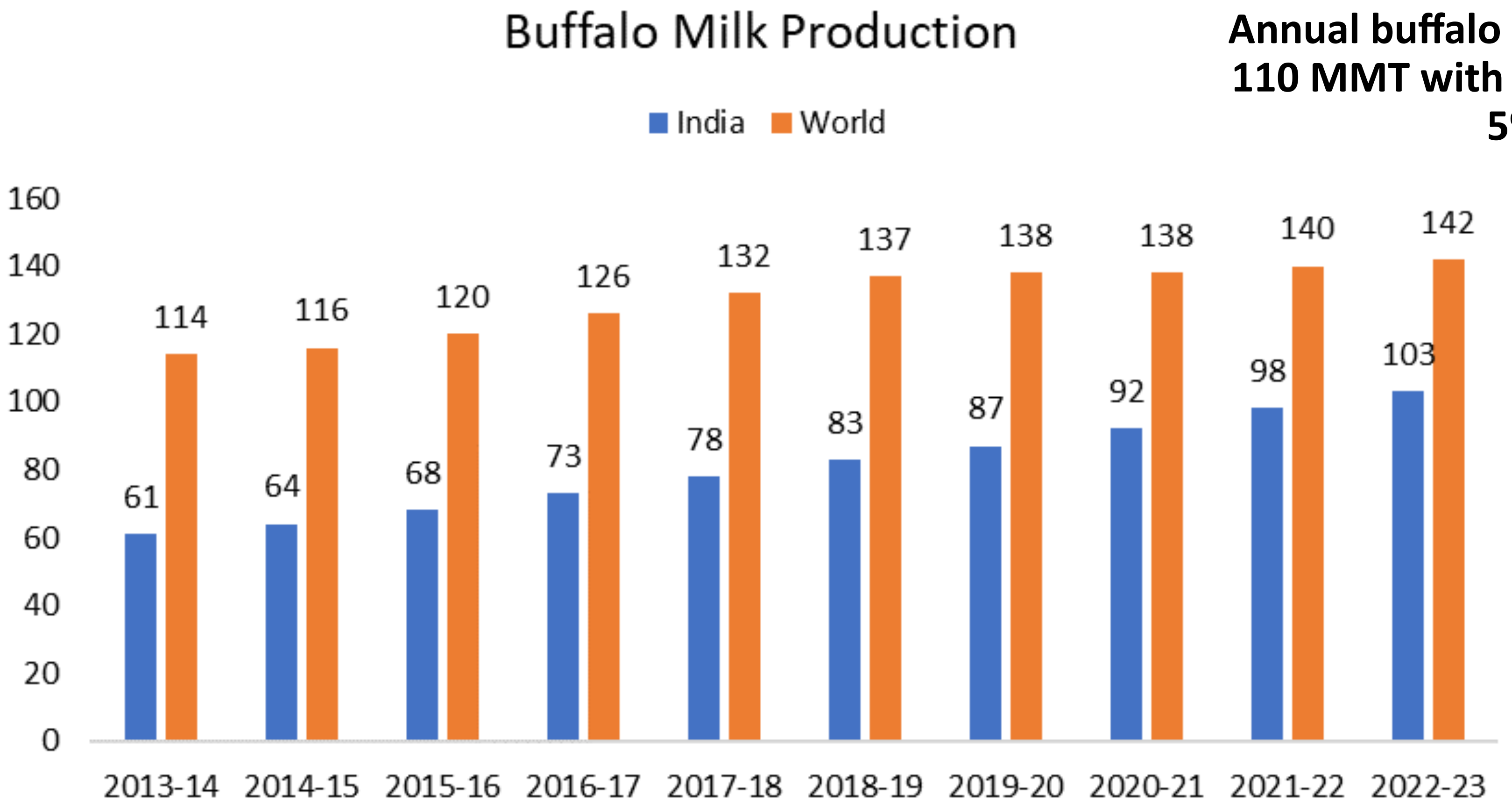
Country	Pound	% of Top 20
India	£ 202,82,50,40,000	68.78
Pakistan	£ 75,77,49,94,020	25.70
China	£ 6,45,59,40,865	2.19
Egypt	£ 5,49,94,24,590	1.19
Nepal	£ 3,02,67,33,821	1.03
Myanmar	£ 45,13,95,945	0.15
Iran	£ 28,21,91,360	0.10
Sri Lanka	£ 16,21,85,075	0.06
Turkey	£ 17,49,16,755	0.06
Indonesia	£ 18,84,37,690	0.06
Bangladesh	£ 7,89,03,350	0.03
Iraq	£ 7,93,24,432	0.03
Vietman	£ 5,99,89,913	0.02
Bulgaria	£ 2,91,00,984	0.01
Romania	£ 3,19,66,900	0.01
Netherlands	£ 61,72,936	0.00
Syria	£ 1,36,24,552	0.00
Georgia	£ 1,40,61,066	0.00
Malaysia	£ 1,69,55,732	0.00

India produces ~70% of the world's buffalo milk

Source: Discover Food

Buffalo Milk Production: World vs India

Country	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
India	61	64	68	73	78	83	87	92	98	103
World	114	116	120	126	132	137	138	138	140	142
	53%	55%	57%	58%	59%	60%	63%	67%	70%	73%



Annual buffalo milk production of over 110 MMT with a consistent CAGR of 4-5% in India

Source: FAOSTAT

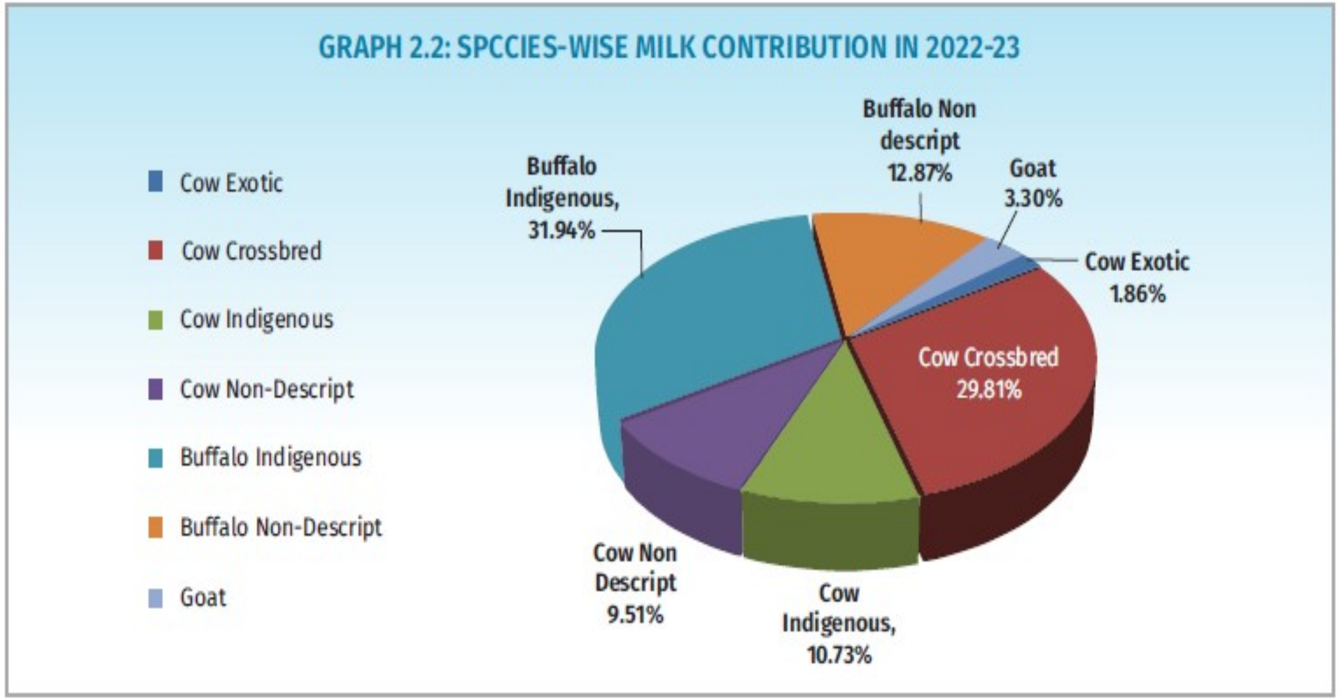
Largest Bovine Population In The World : 310 Million

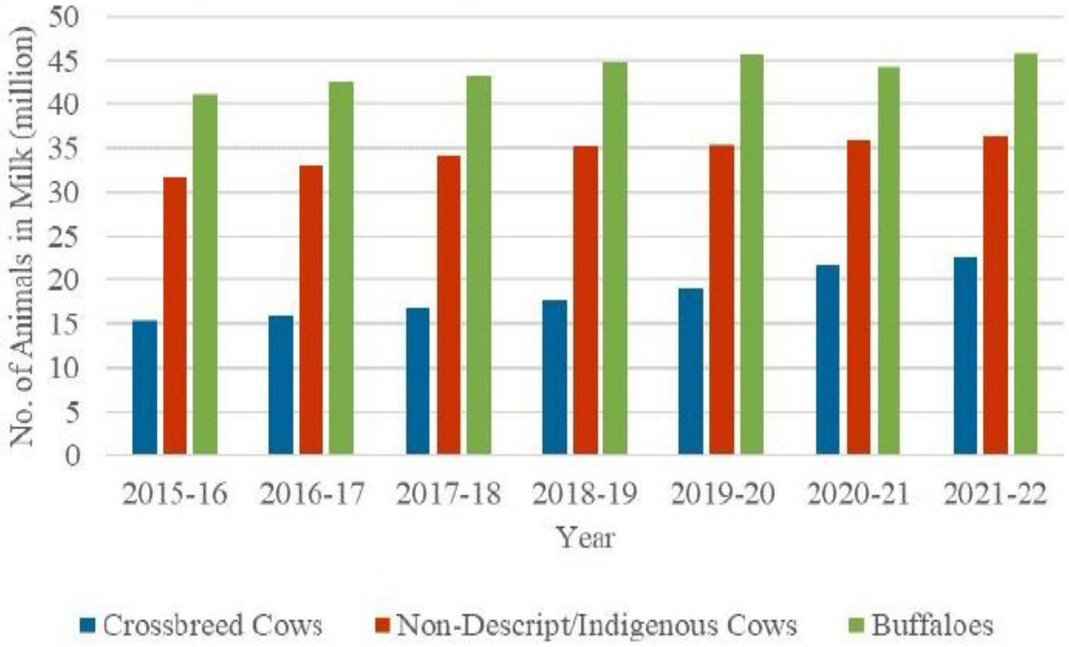
51%
Milk Solid Basis

110 Million
45%
of total milk production

+

200 Million
55%
of total milk production





Source: BAHS 2023

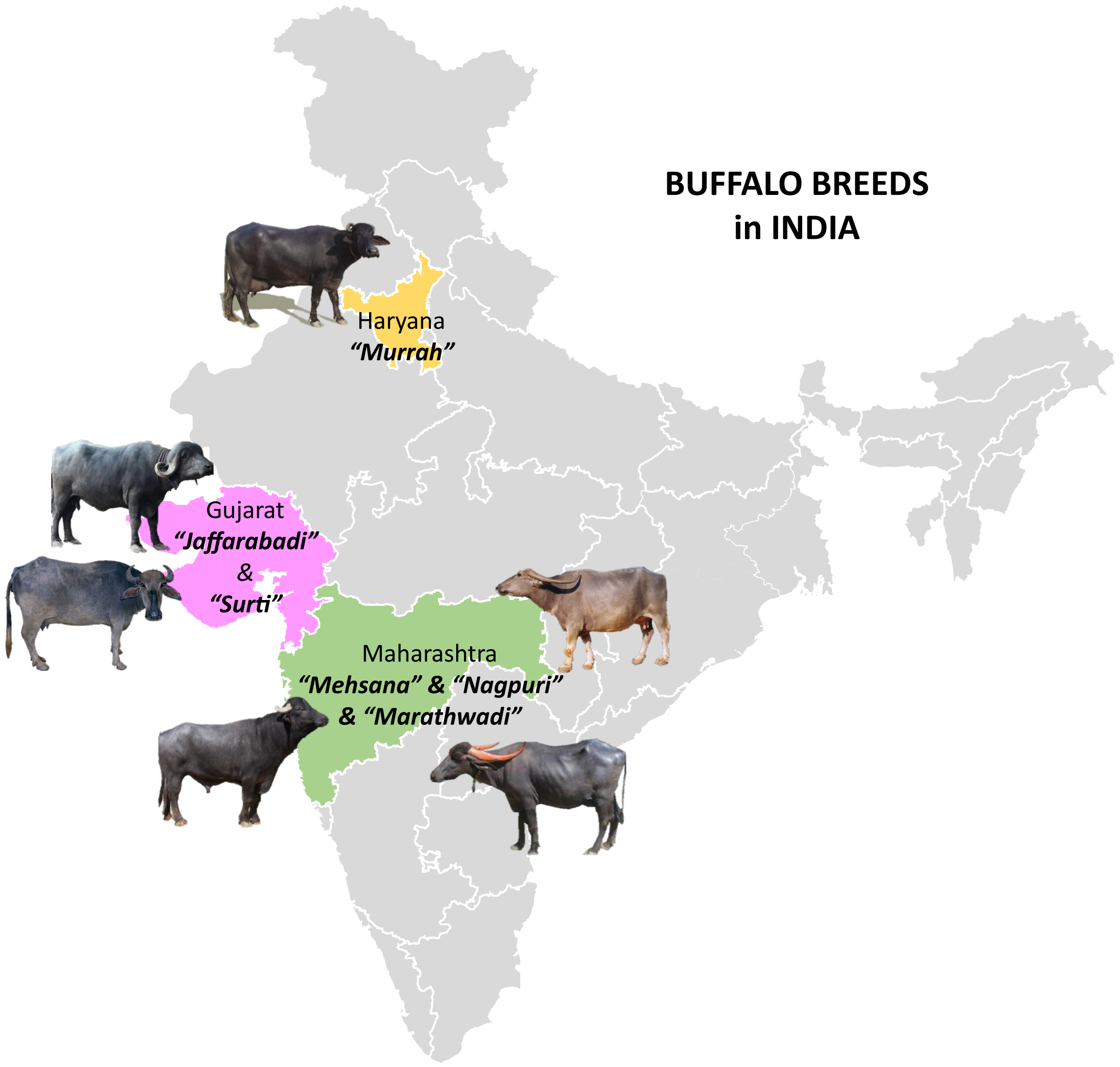
Buffalo Milk: An Essential Natural Adjuvant

Average Lactation Yield Per Animal (kg) 2023

Breed	Yield in Kg
Murrah	1752
Jaffarbadi	2239
Surti	1300
Mehsana	1988
Nagpuri/ Pandharpuri	1790
Marathwadi	1120

Density of milk: 1.03 g/mL

BUFFALO BREEDS in INDIA



Source: Discover Food

Comparison of Cow and Buffalo Milk

1 kg of **Cheese** = 8 kg of Cow Milk 5 kg of Buffalo Milk 1

kg of **Butter** = 14 kg of Cow Milk 10 kg of Buffalo Milk

MILK PROPERTIES	COW	BUFFALO
Fat	3-4%	6-8%
Protein	3-4%	4-5%
Shelf Life	6 days	7-10 days
PH	Low	High
Production	15-20 litres/ day	7-11 litres/ day
Lactose	4.7%	4.86%
Minerals (Daily Value)	29% of Phosphorous 21% of Calcium 6% of Magnesium 12% of Vitamin A	41% of Phosphorous 32% of Calcium 19% of Magnesium 14% of Vitamin A

Source: Discover Food

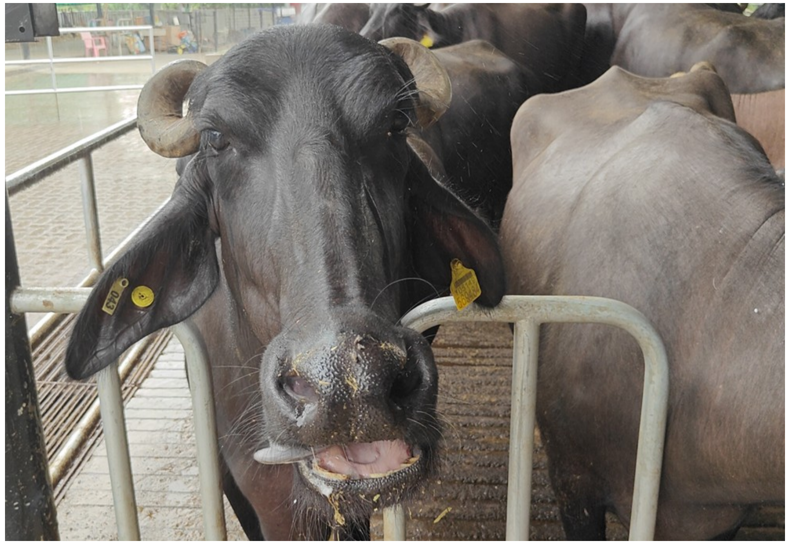
Superiority of Buffalo Milk

PROPERTIES

- Rich composition
- More protein and fat content
- High in vitamin B12 (Decreased risk of heart disease, stroke and other cardiovascular conditions)
- Exceptionally smooth, thicker consistency and white due to lack of carotene
- High richness makes it very ideal for processing- cost effective
- Fatter globule size
- Higher nutritious grade
- Resilient whey proteins
- Lactose in raw buffalo milk is 4.86%
- Great source: Ca, Mg, P, Zn and Vitamins A, B, D, E and K
- Therapeutic benefits and acts as an adjuvant
- 30% more total solids than cow milk
- Greater viscosity and antioxidant capacity than cow milk

Source: Discover Food, IDA

Traditional Buffalo Farming



Buffalo Farms: Challenges

- *2-200 Buffalo herd size -* Tied up Buffalo
- Hand Milking - Labour Intensive
- Buffalo Temperament
- Poor Animal Comfort & Hygiene
- Frequent Breeding Failure
- Reducing availability of Skilled Labour / Milker
- Different udder shapes – Different teat size
- Special physiology of Milk Ejection – Stimulation/ Calf

Conical shaped

Cylindrical shaped

Bottle shaped

Evolution of Organized Buffalo Farms in India

Adoption of Milking Solution for Different segment of Farms

Buffalo Bucket Milking Machine

Pipeline Milking System - Speedline

Fully Automatic Buffalo Milking Parlour

Buffalo Farm: New Generation Adopting Technology

NOBLE DAIRY FARM

- Traditional third generation farmer with 2000 + Buffaloes at Mumbai
- New generation in family decided for Green field farm for **800 Buffaloes**
- Location: Ghoti, Igatpuri, Nasik (Maharashtra)
- Complete mechanized Commercial Buffalo Dairy Farm
- Data collection and analysis automated with Delpro system from Delaval

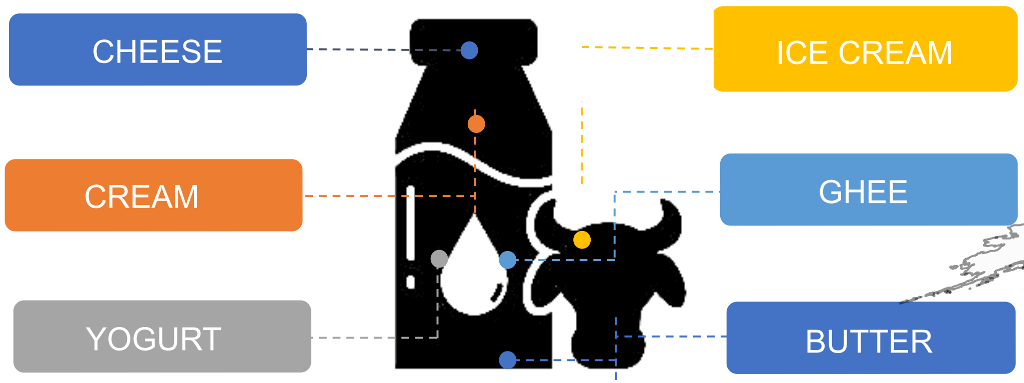
Loose Housing Shed for comfort

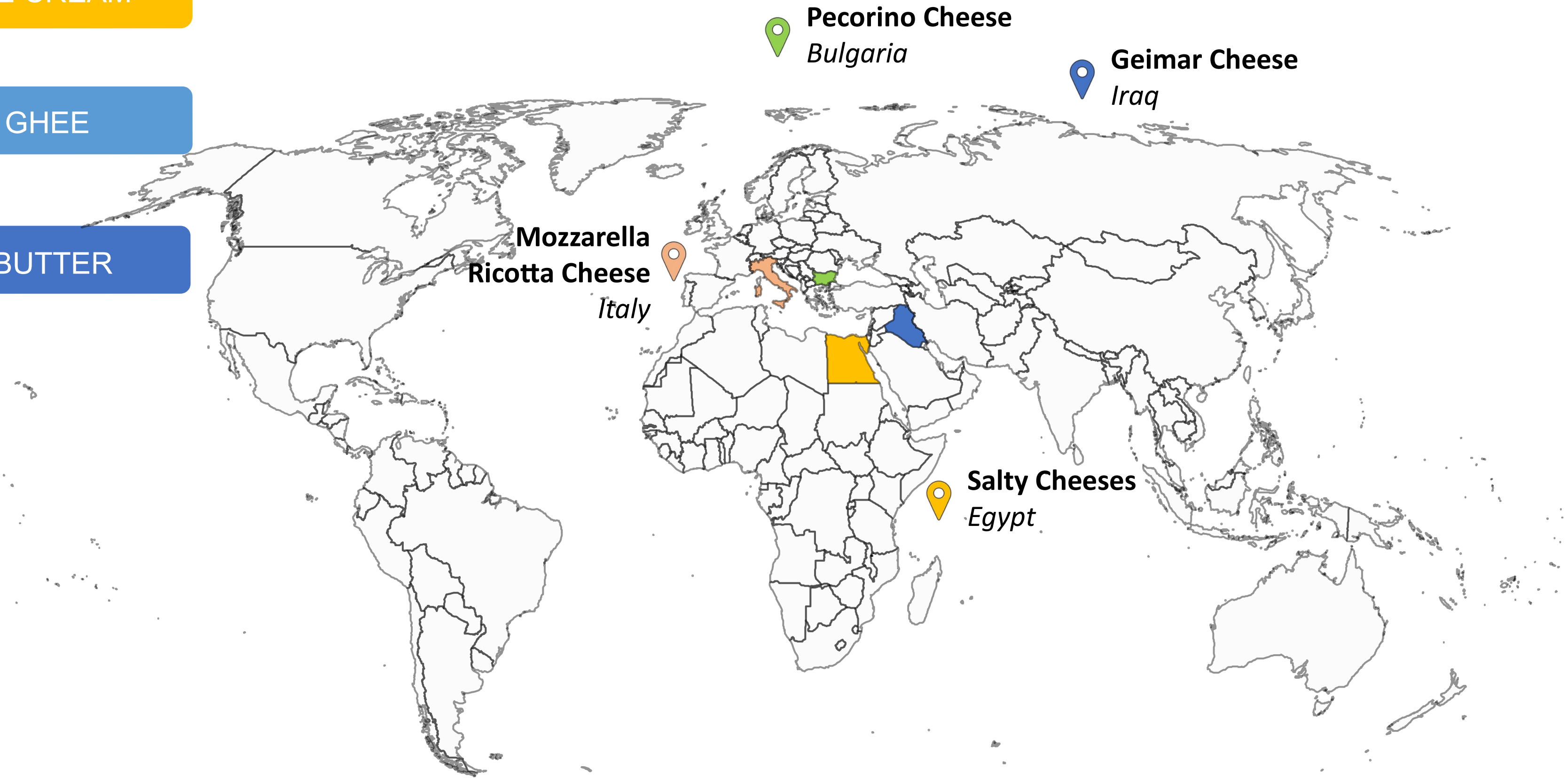
DeLaval Herring Bone 2*24 Parlour

Cow Shower to address body heat and cleaning

Spacious Alley for TMR Feeding

Buffalo Milk & Products





Variations in Milk is influenced by

- ✔ Age
- ✔ Breed
- ✔ Season
- ✔ Nursing stage

Curd tension of buffalo milk is higher

Butter from buffalo milk is tougher due to more fatty acids

Source: Discover Food

Indian Buffalo Milk & Products

CURD

MILK

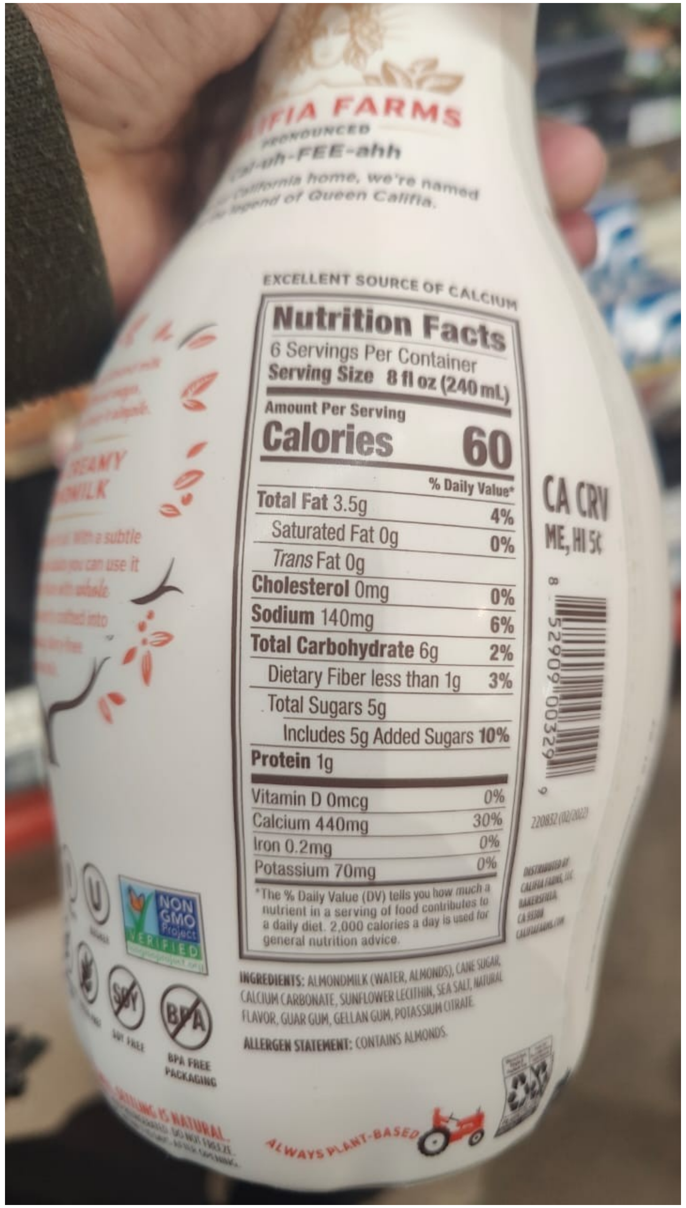
Indian Buffalo Milk & Products

GHEE

CHEESE

Plant Milk & Products

LIES OF PLANT BASED



Growth in Buffalo Milk Production & Consumption

GEOGRAPHIC REGION

- Some northern states prefer buffalo milk over cow milk
- Often used in traditional Indian cuisine and sweets
- Commands a premium price of ₵84/ ltr vis-à-vis cow milk at ₵67/ ltr

DAIRY INDUSTRY

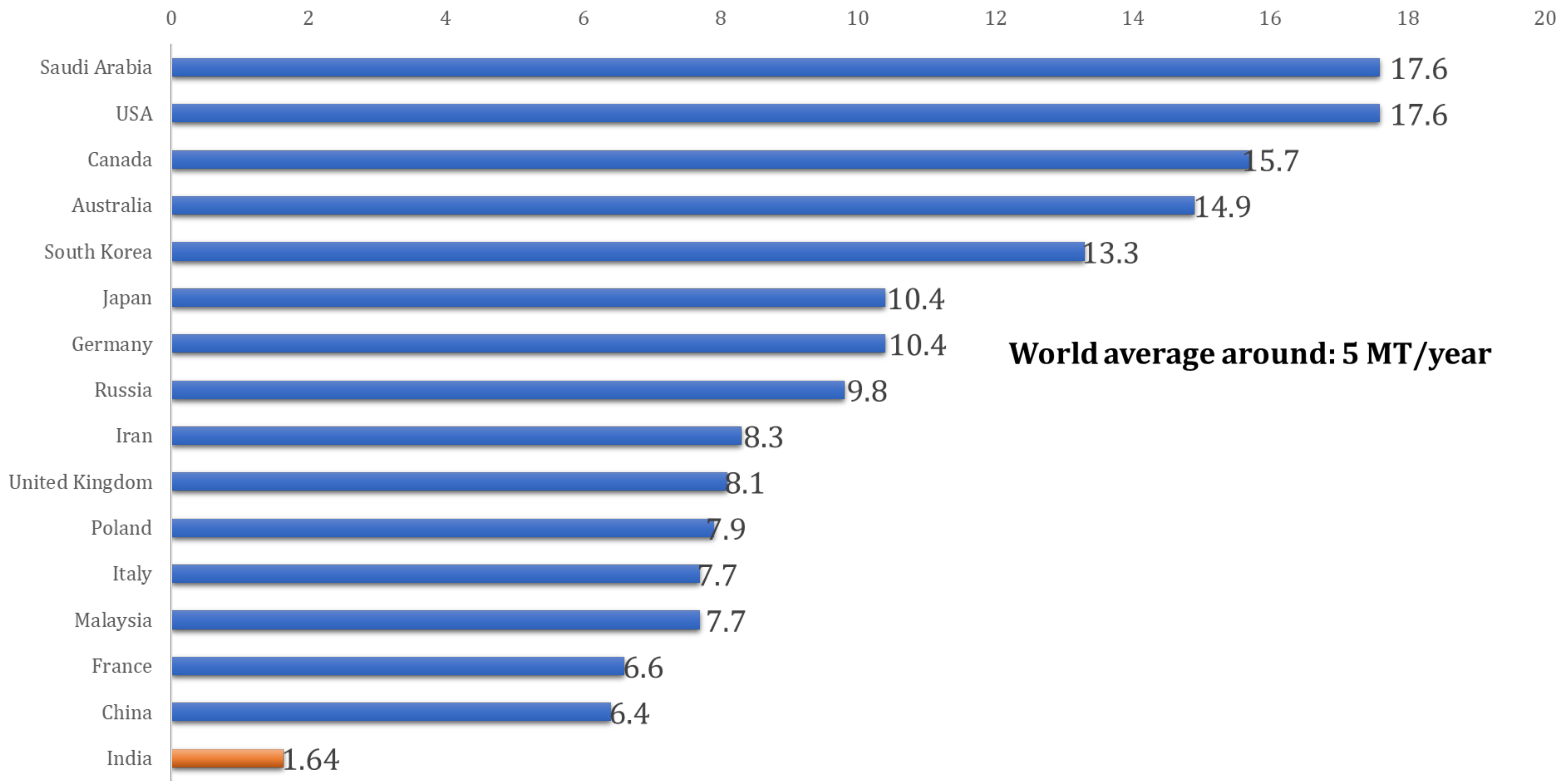
- Heavy dependence on buffalo milk for various dairy products
- Cheese, yogurt, butter, ghee, condensed milk, ice cream

ECONOMIC IMPORTANCE

- Provides livelihood opportunities for almost 80 million households in India

Sustainability

Per capita emission (MT/year)



Indian Dairy Industry: Small Holder System (Economical Aspect)

>

Value: USD 110 Billion
25% of Indian agriculture
231 MMT/year, CAGR: 4.5% of India & < 2% of world

Number of families depends on dairy ~ 80 million.

Symbiotic relationship between rural producers & urban consumers

75 – 80% consumer money goes back to milk producers. Twice than developed nations.

Dairy plants capacity: 120 million liter/day, Cattle feed plants: 80,000 MT/day and Semen station capacity: 90 million/year

1 million retailers selling milk and milk products

Indian Dairy Industry: Small Holder System (Environmental Aspect)

Largest producer of rice & fruits and second largest producer of wheat, sugarcane, groundnut, vegetables, fruit and cotton

Grains and pulses: Major source of nutrients

1.35 billion population. Milk and milk products are the major source of protein and minerals.

Largest producer of roughages.

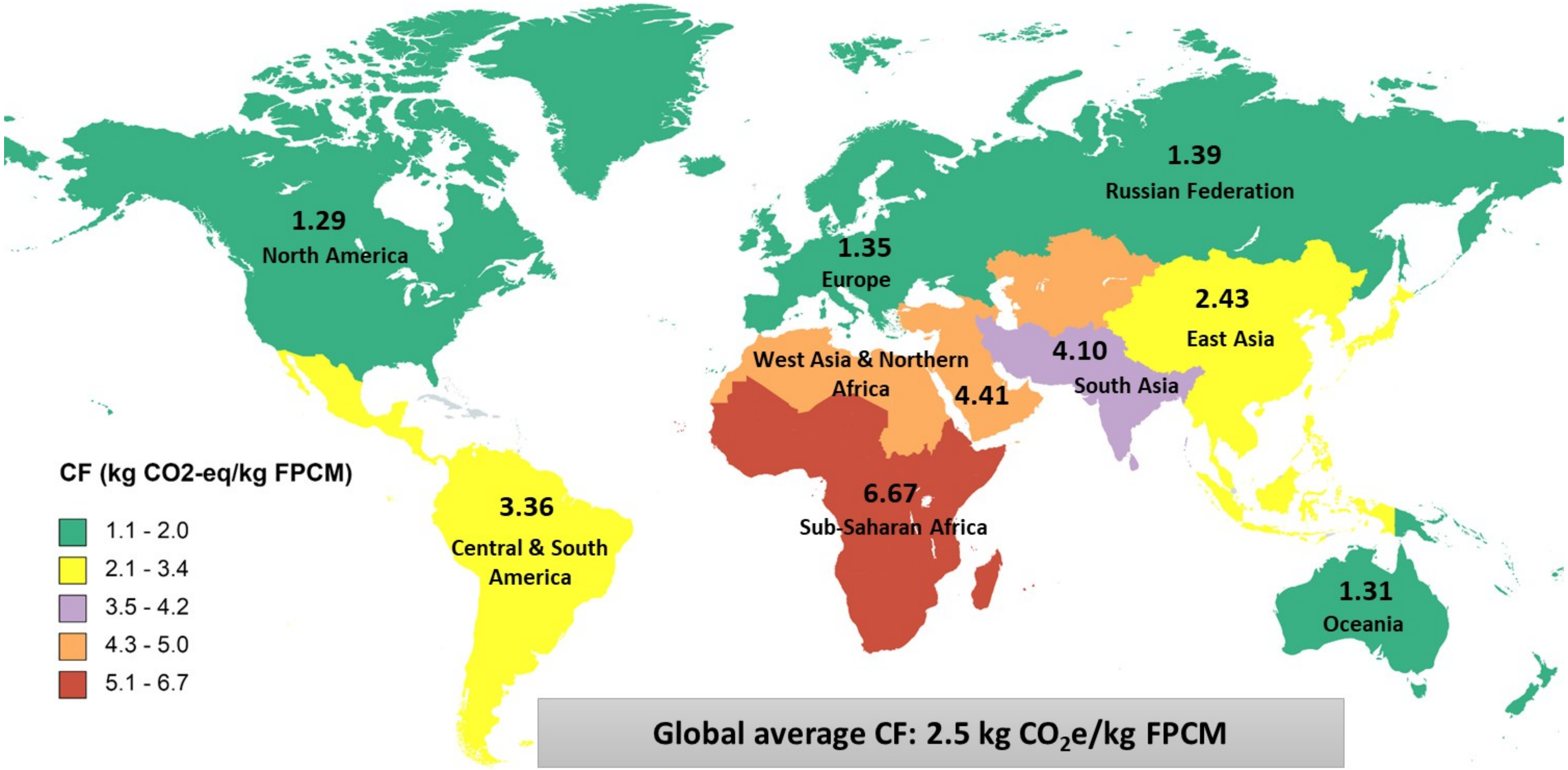
75% of bovine diet is not consumed by humans.

Self consumption by producer and excess milk selling within village

Indian Dairy Industry: Small Holder System (Environmental Aspect)

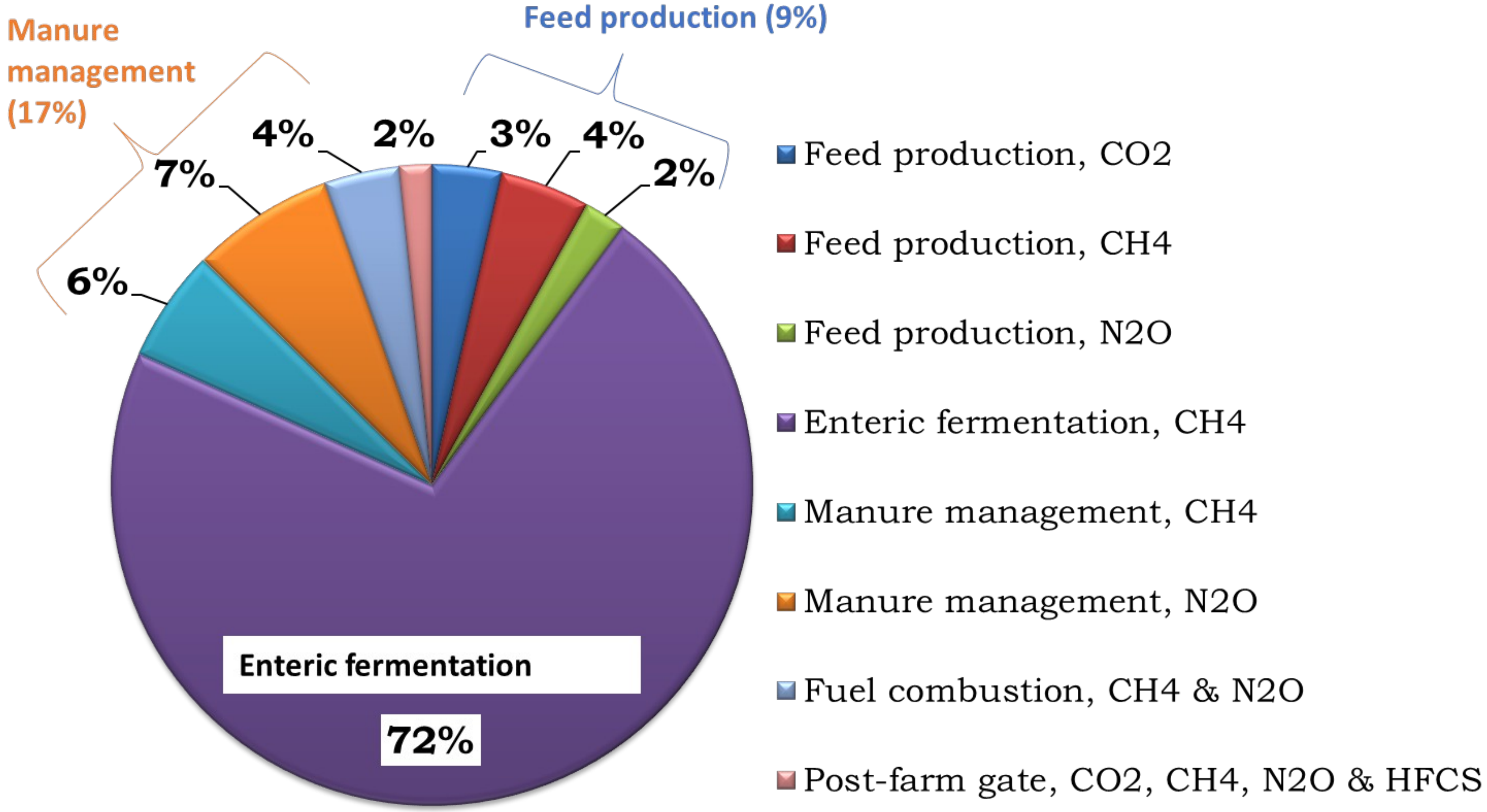
Flexi Dome Gobar Gas Plant Installation at Farmers Doorstep

Carbon Footprint (CF) of Milk by Region



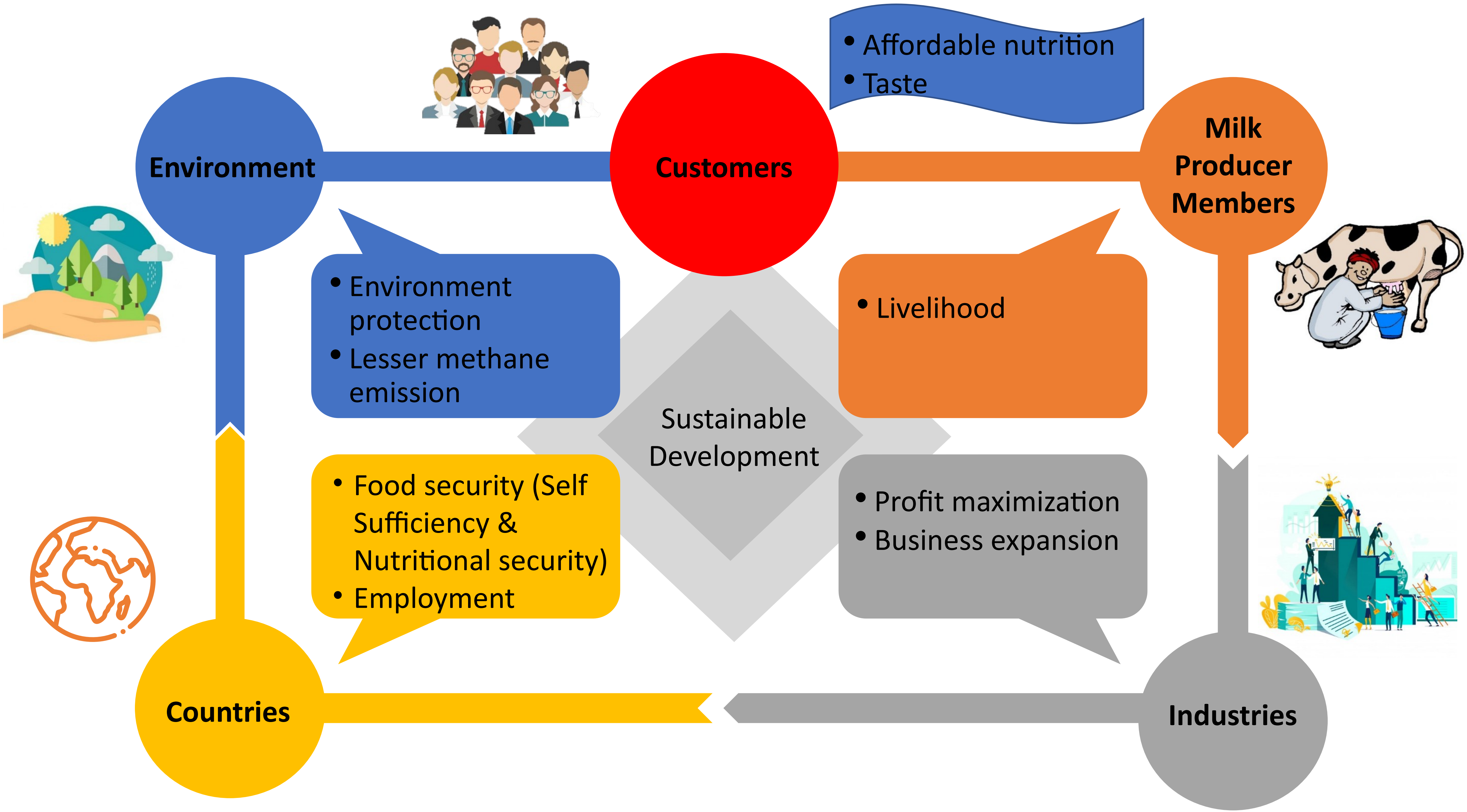
Source: FAO & GDP

GHG Emissions by the Indian Dairy Sector



GHG Hotspots

- **Enteric Methane (72%)**
- **Manure Management (17%)**


Environment
Customers
Milk Producer Members
Countries
Industries
• Affordable nutrition
• Taste
• Environment protection
• Lesser methane emission
• Livelihood
Sustainable Development
• Food security (Self Sufficiency & Nutritional security)
• Employment
• Profit maximization
• Business expansion

Sustainability Starts When Stomach Is Full

Emission for Livelihood vs Emission for luxury

Challenges to Dairy Industry

- Milk Production
- Animal productivity and Breeding
- Animal health and prevention
- Animal feeding
- Policy level
- Adulteration
- Analogue products
- Free Trade Agreement (FTA)
- Price Volatility
- Next Gen: Not ready to work in dairying
- Shortage of professionals
- A1 versus A2
- Cow versus Buffalo Milk
- Leadership

And Finally….

"We have traversed a path few have dared to.

We are continuing on a path still fewer have the courage to follow.

We must pursue the path that even fewer can dream to pursue.

Yet, we must, because we hold in trust the aims and aspirations of millions of our countrymen."

- Dr V. Kurien

THANK YOU

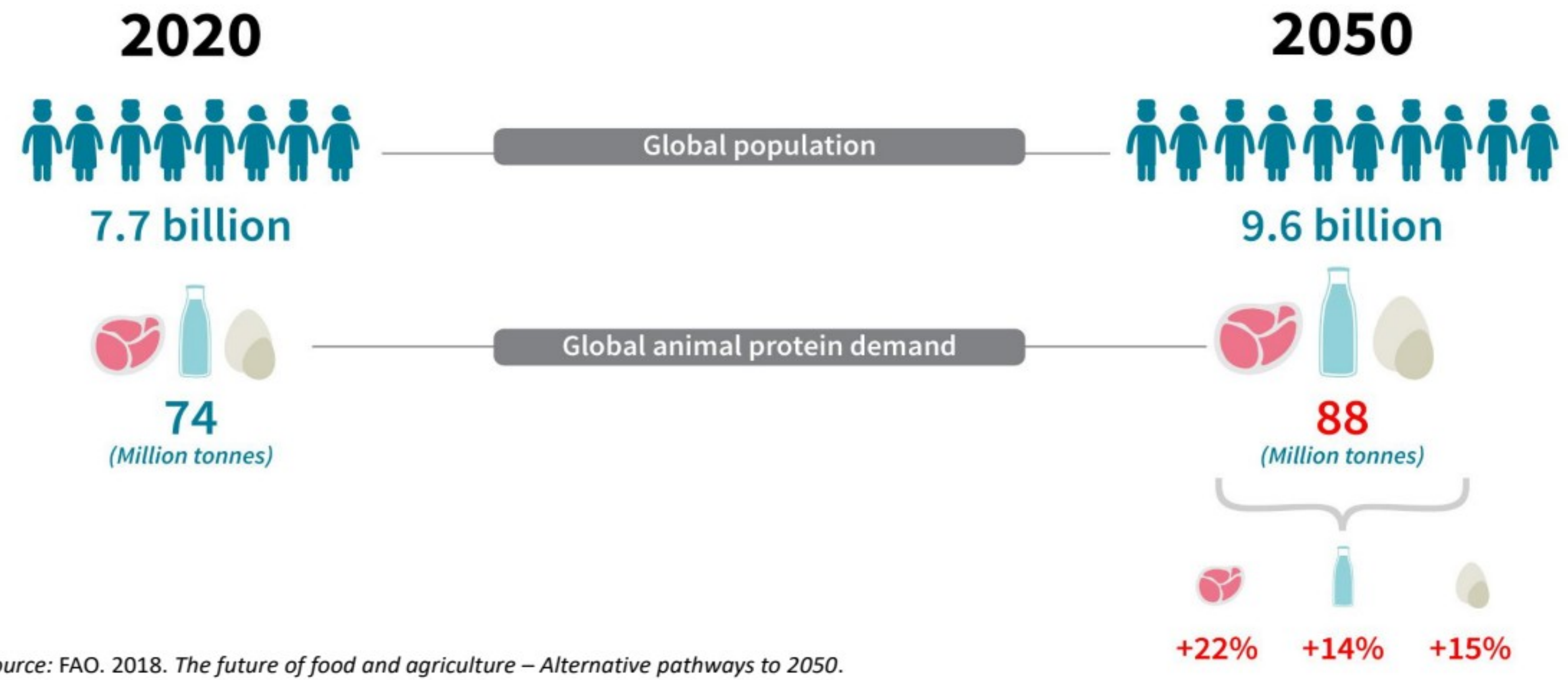
CONSORZIO DI MOZZARELLA DI BUFALA CAMPANA

25 Settembre 2024

PIERCRISTIANO BRAZZALE, FIL-IDF PRESIDENT

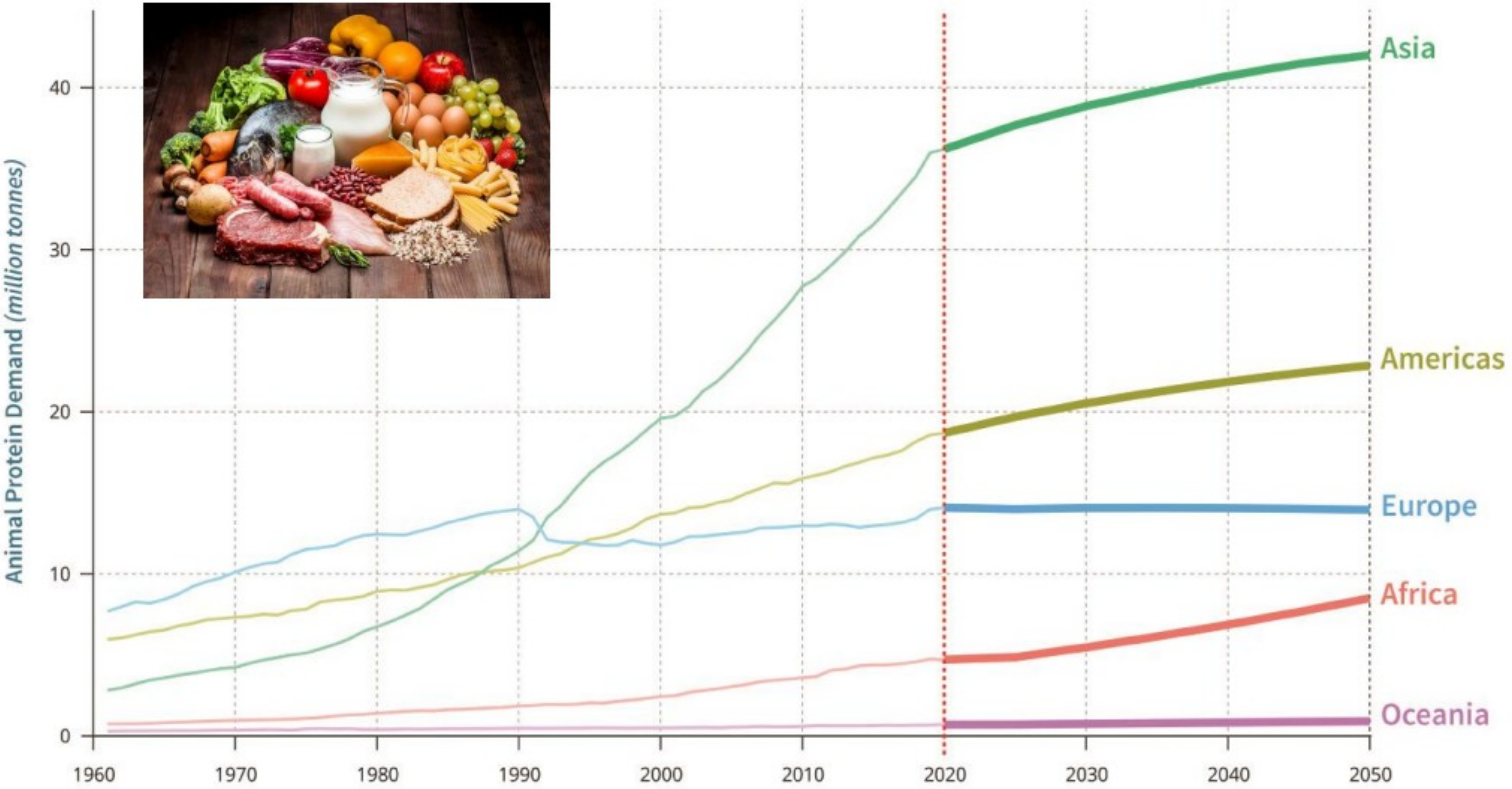
How to feed people in this planet?

Population growth and global demands of animal-source foods



Source: FAO. 2018. *The future of food and agriculture – Alternative pathways to 2050.*

Demands of animal-source foods by Region



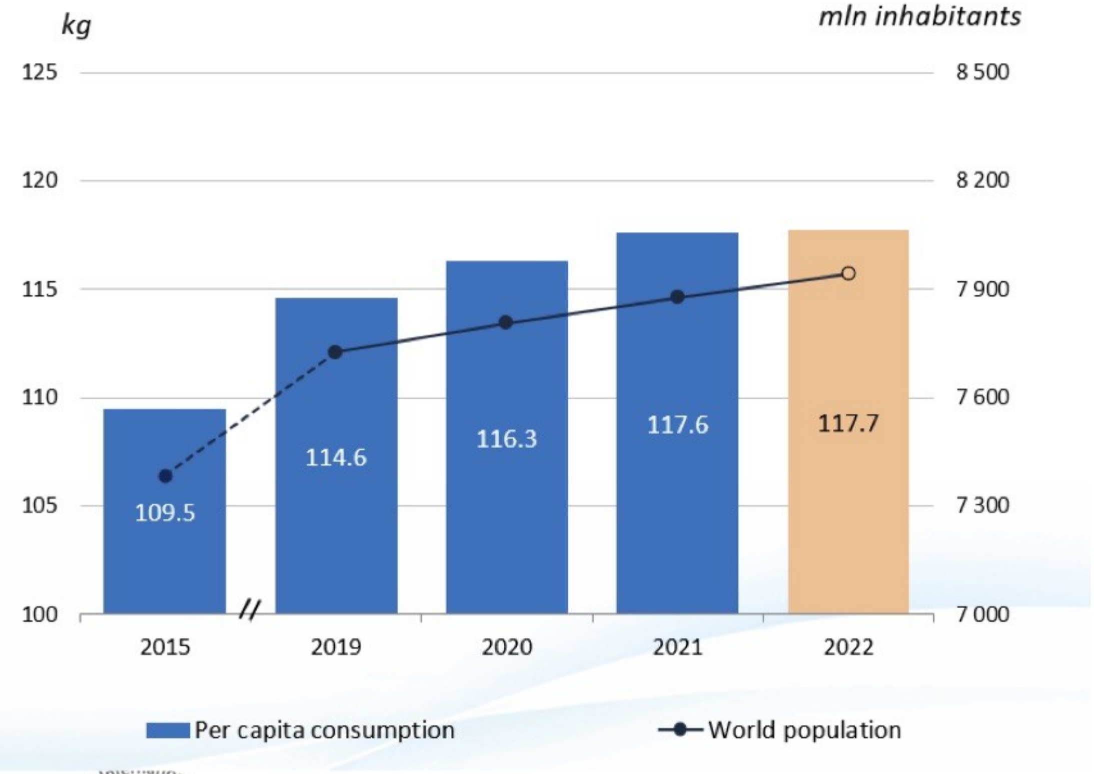
Projected increase in demand for animal protein by 2050:

+ 20%

compared to 2020

DEMAND

World: per capita consumption and population



Global dairy supply and demand outlook

Updated 2023

Source: Rabobank, 2023

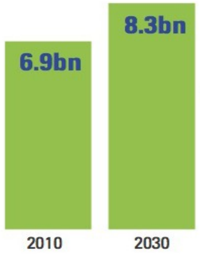
Global megatrend #8
Resource stress

The combined pressures of population growth, economic growth and climate change will place increased stress on essential natural resources including water, food, arable land and energy. These issues will place sustainable resource management at the center of government agendas.

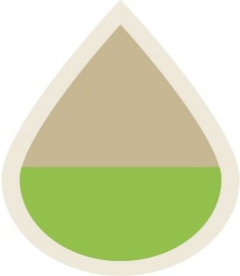
By 2030, significant changes in global production and consumption, along with the cumulative effects of climate change, are expected to create further stress on already limited global resources. Stress on the supply of these resources directly impacts the ability of governments to deliver on their core policy pillars of economic prosperity, security, social cohesion and environmental sustainability.

The evidence of change

The population is growing and so is the middle class:



50% INCREASE in food production will likely be necessary to feed this more demanding population.[120]



40% Estimated global gap between water supply and demand by 2030.[121]

The International Energy Agency projects an approximate **40%** increase in global energy demand by 2030.[122]

DRIVEN BY

Economic growth

Population growth

Technological advancements

> If nothing is done we will run out of water faster than we will run out of oil.[123]
>
> **Peter Brabeck-Letmathe, Chairman of the Board, Nestlé**

About **1 billion** more people will live in areas of water stress by 2030 in a business-as-usual scenario.[124]

= 200 million

Both growing demands and unstable production patterns due to climate change will cause global food prices to double between 2010 and 2030.[125]

The consequences of resource stress

Food and agricultural pressures

Increased water demand

Energy demand on the rise

Competition for metals and minerals

Increased risk of resource nationalism

Agri-food systems

uses 70% of fresh water

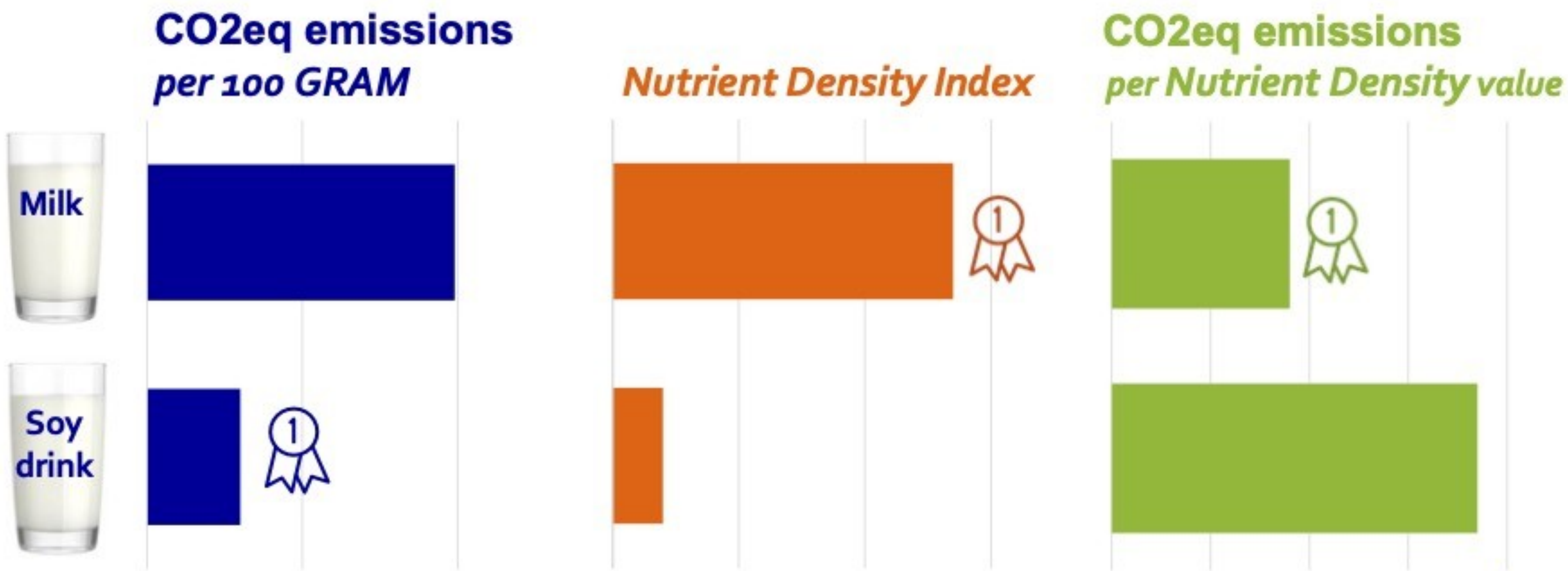
generates 24% of GHGs

uses 33% of land area

uses 30% of global energy

… But feed 100% of us

Metrics Matter



Source: Rabobank
Source: Smedman et al, 2010

Value of terrestrial animal source food in human health

Nutrients found concentrated and bioavailable in terrestrial animal source food play important roles in human health

MACRONUTRIENTS

High-quality proteins

- Increase muscle mass
- Prevent loss of muscle mass

Long-fatty acids and ratios of essential fatty acids

- Cognition
- Neurodevelopment
- Anti-inflammatory processes

MICRONUTRIENTS

Zinc

- Vital functions in growth, development and immunity

Vitamin B12

- Neurodevelopment
- Cell formation

Choline

- Growth
- Brain function
- Gene interactions

Calcium

- Bone health

Iron

- Prevents iron deficiency anaemia

Selenium

- Anti-inflammatory
- Genome-level processes

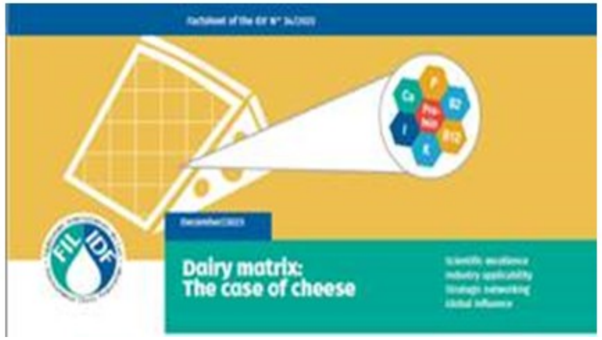
IDF Dairy Matrix - the Factsheets Series pubblished on November 2023

The (2023) series of IDF factsheets consists of 4 factsheets: general, milk, yogurt, cheese.

Factsheet of the IDF N° 27/2023: Dairy matrix: Understanding its impact on the health effects of dairy foods

Factsheet of the IDF N° 33/2023: Dairy matrix: The case of milk

Factsheet of the IDF N° 34/2023: Dairy Matrix: The case of cheese



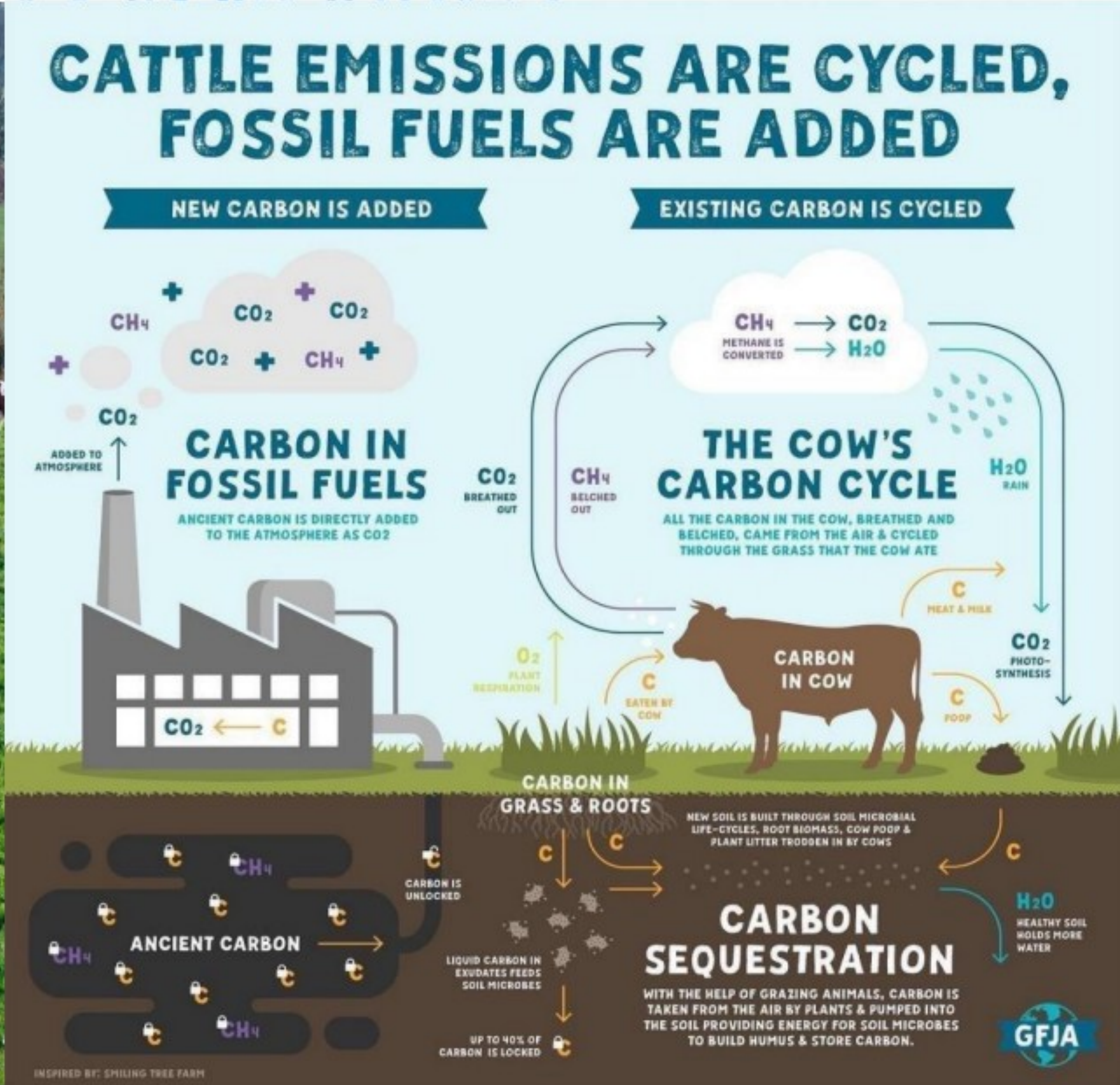
Factsheet of the IDF N° 35/2023: Dairy matrix: The case of yoghurt

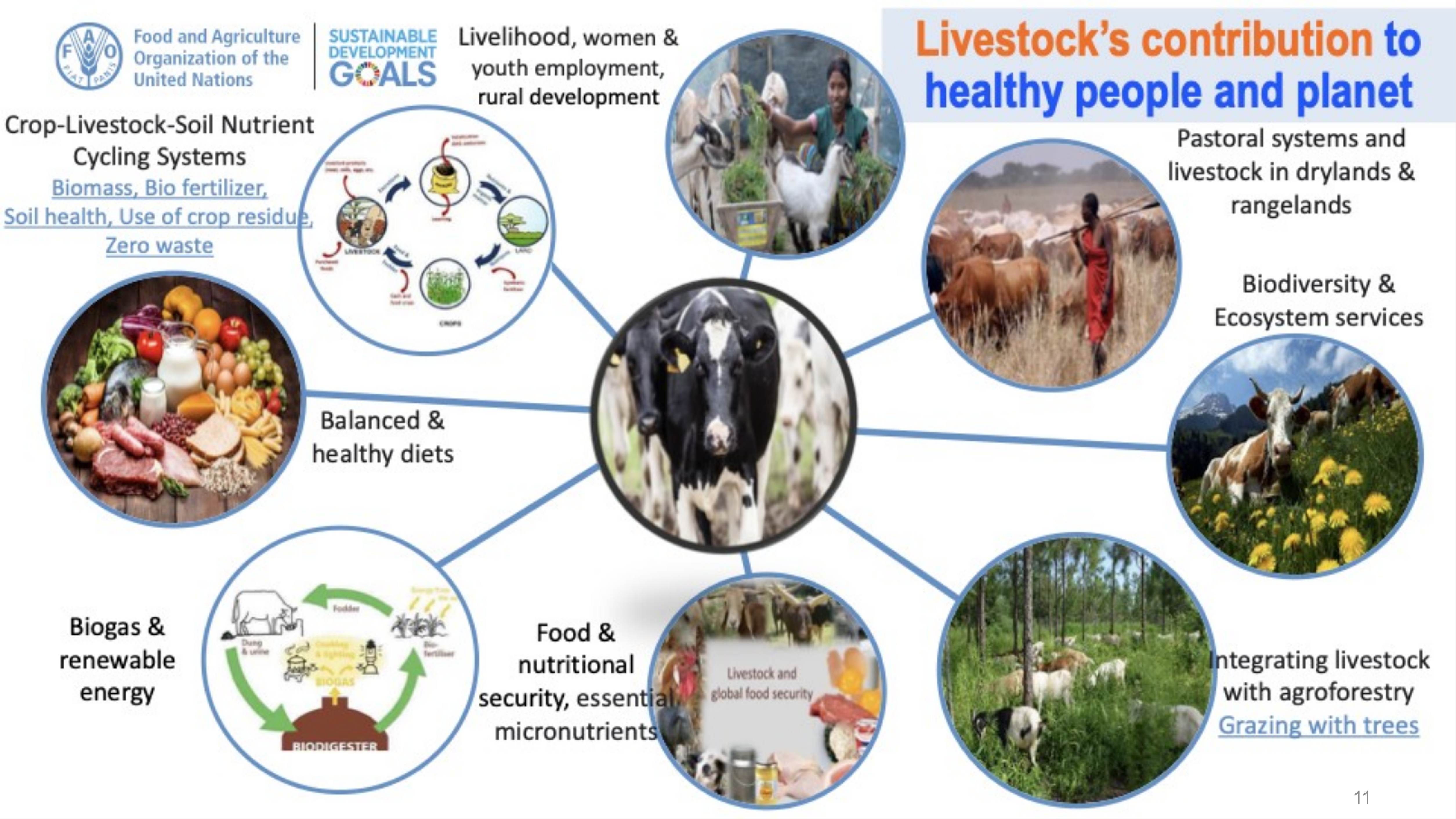
The factsheets report the synthesis of the most recent scientific evidence on the dairy matrix.

Fundamental concept: “the combination effect”: the action of a single nutrient is probably also dependent on the others and on how they are “combined” in the food itself.

Food and Agriculture Organization of the United Nations | SUSTAINABLE DEVELOPMENT GOALS

Net zero means we are not adding new emissions to the atmosphere.
Emissions will continue, but will be balanced by absorbing and cyclying.




Food and Agriculture Organization of the United Nations
SUSTAINABLE DEVELOPMENT GOALS
Livestock's contribution to healthy people and planet
Livelihood, women & youth employment, rural development
Crop-Livestock-Soil Nutrient Cycling Systems
Biomass, Bio fertilizer, Soil health, Use of crop residue, Zero waste
Pastoral systems and livestock in drylands & rangelands
Biodiversity & Ecosystem services
Balanced & healthy diets
Biogas & renewable energy
Fodder
Dung & urine
Bio-fertiliser
BIOGAS
BIODIGESTER
Food & nutritional security, essential micronutrients
Livestock and global food security
Integrating livestock with agroforestry
Grazing with trees
11

IDF WDS DAEJEON 2018
Milk is Perfection
Milk is critical and essential for international efforts to combat poverty and hunger.
3 GOOD HEALTH AND WELL-BEING
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
8 DECENT WORK AND ECONOMIC GROWTH
13 CLIMATE ACTION
FIL IDF
KOREA
THE GLOBAL GOALS
For Sustainable Development
IDF WDS DAEJEON 2018
Dairy for the Next Generation!

IDF position to CL 2022/06/OCS - CCEXEC
Request for Information on New Food Sources and production systems; Need for Codex guidance and attention to inform the CCEXEC sub-committee on working on this topic
(5 April '22)

The International Dairy Federation (IDF) is grateful for the opportunity to provide a response to the Request for Information on New Food Sources and production systems; Need for Codex guidance and attention to inform the CCEXEC sub-committee on working on this topic.

In the context of this work on new food sources and production systems, we consider it essential to focus on and ground the work within the mandate of Codex of protecting public health via food safety and quality and ensuring fair practices in food trade. These new food technologies may raise significant challenges in terms of food safety, labelling, fair trade practices, and could have unknown impacts on human health over time. Currently, there is still the need to understand and learn about the impact of these "new foods" and innovative technologies at the different levels. Any work within Codex should be aligned with its mandate and its procedure manual[1].

In addition, Codex must carefully avoid conflicts with any existing Codex Standards, Guidelines, or Codes of Practice when initiating new work. We would, therefore, specifically note the relevancy of the Codex General Standard for the Use of Dairy Terms (GSUDT) (CXS 206-1999) to many issues associated with some of the new food sources identified in the CL. Established in 1999, the GSUDT provides guidance on the correct use of terms which are universally identified with dairy products. The GSUDT defines milk as "the normal mammary secretion of milking animals obtained from one or more milkings without either addition to it or extraction from it, intended for consumption as liquid milk or further processing." If new work is initiated on these new food sources, this definition and other core principles of CXS 206-1999 must be considered and not undermined.

Consistent with the Codex General Standard for the Labelling of Prepackaged Foods, a core principle of the GSUDT is that foods shall be described and presented in a manner that ensures consumers are not misled or confused[2]. Labelling of dairy products or nondairy products using dairy terms shall not be false, misleading, deceptive, or create an erroneous impression regarding its character in any respect, including being suggestive of any other product with which the food might be confused.

[1] Codex procedure manual. Twenty-seventh edition. 2019. Criteria for the establishment of work priorities p43
[2] IDF Bulletin 507/2020 – The Codex General Standard for the Use of Dairy Terms. Its nature, intent and implications (accessed on 22 March '22 Bulletin-of-the-IDF-507_2020_The-Codex-General-Standard-for-the-Use-of-Dairy-Terms.CAT_-snusw3.pdf (fil-idf.org))

CODEX ALIMENTARIUS COMMISSION

E

Food and Agriculture Organization of the United Nations

World Health Organization

Viale delle Terme di Caracalla, 00153 Rome, Italy - Tel: (+39) 06 57051 - E-mail: codex@fao.org - www.codexalimentarius.org

Agenda Item 4 **CX/EXEC 22/83/4**
October 2022

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

EXECUTIVE COMMITTEE OF THE CODEX ALIMENTARIUS COMMISSION

Eighty-third Session

14 - 18 November 2022

CCEXEC SUB-COMMITTEE ON NEW FOOD SOURCES AND PRODUCTION SYSTEMS – REPORT

(Prepared by the Chairperson of the sub-committee)

Introduction

1. Since FAO and WHO first introduced new food sources and production systems (NFPS) as an issue that needed attention, Codex has held discussions and collected information on several occasions. Discussions began at 81st session of the Executive Committee of the Codex Alimentarius Commission (CCEXEC81), which established a CCEXEC sub-committee to consider this issue further[1]. CAC44 subsequently considered the issue, supported the need for Codex to be prepared to address cross-cutting, overarching and emerging issues, and requested the Codex Secretariat to issue a Circular Letter[2] (CL) to collect information from Members and observers on ongoing developments related to NFPS. The CCEXEC sub-committee supported the development of the CL and in addition a letter was sent to all Codex Members and observers inviting informal conversations with the Chairperson and Vice-Chairpersons of the Commission to share views on this issue. A detailed overview of this first phase of the work was presented to CCEXEC82as an interim report of the sub-committee[3].

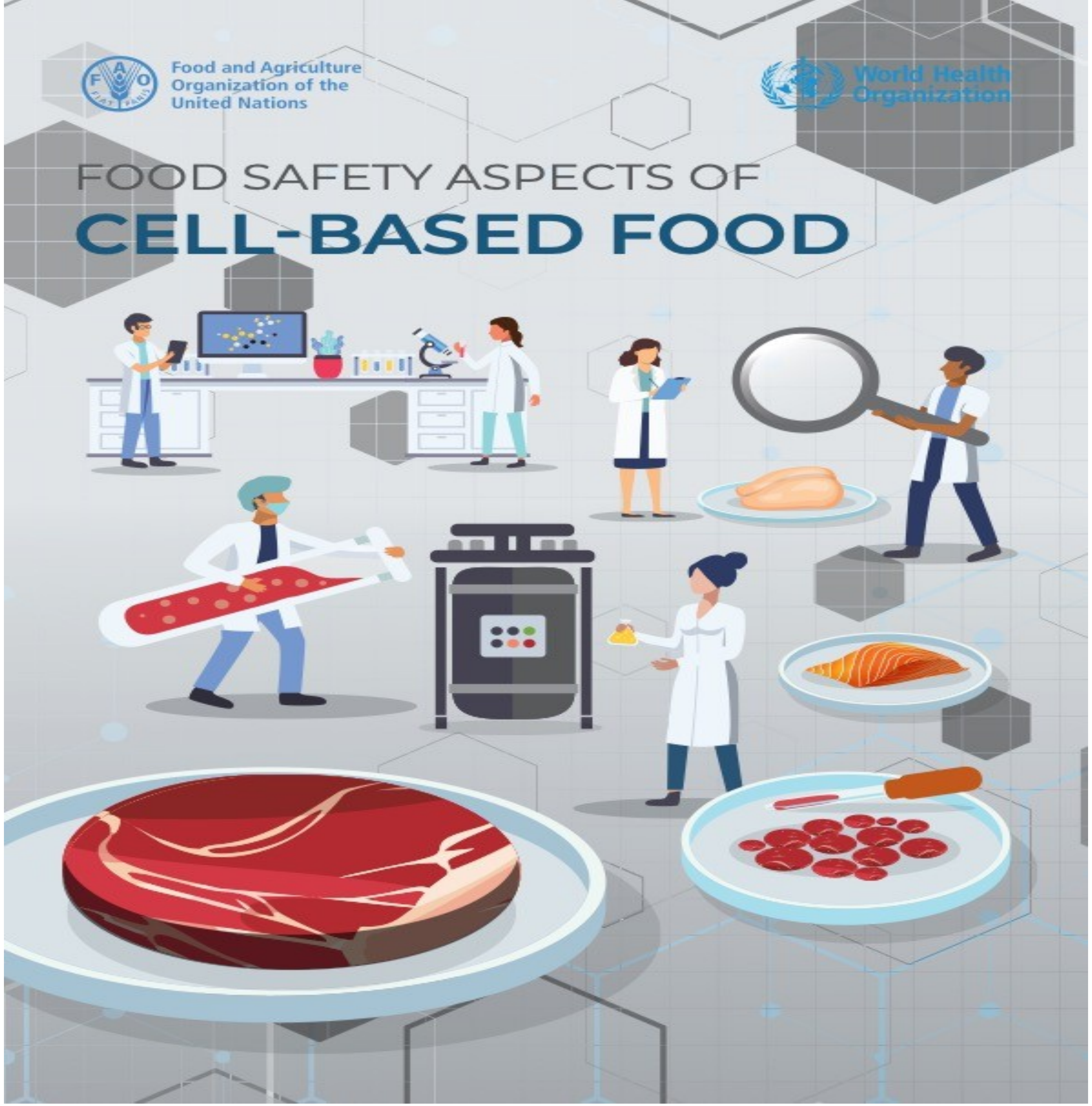
Overview of discussions at CCEXEC82 and ongoing work of the sub-committee[4]

2. CCEXEC82 considered the interim report of the sub-committee and underlined the complexity of this area. CCEXEC Members expressed different views about the pathway forward, including the need for sufficient time to consider the issues, and the need for specific expertise, or other working mechanisms to engage with the wider Codex membership (e.g. the establishment of an electronic working group (EWG) of the Commission). CCEXEC82 recognised that this ongoing CCEXEC work on NFPS did not preclude Codex committees from undertaking new work on such emerging issues falling within their respective mandates, using existing Codex working mechanisms. In noting the interim report of the sub-committee, the comments put forth during the debate and the extensive amount of data received in response to the CL, CCEXEC82 agreed that the subcommittee should continue its stepwise consideration of the issues, informed by an analysis of the information collected through the CL, CRDs and report of CCEXEC82.

3. With the support of FAO, a summary of the replies to the CLs was subsequently commissioned and is included as Appendix 2 to this report. This was considered further by an informal virtual meeting of the sub-committee.

4. Based on the summary of the replies from the CL, which allowed for a better understanding of the breadth of information about NFPS that was collected through the CL and the informal discussions, a virtual meeting of the sub-committee considered the potential way forward. Members recognized that NFPS presented both a

[1] REP21/EXEC 22/82/4, para 110
[2] The CL received replies from 25 Members and 10 Observers. Informal conversations were held with the six Regional Coordinators, CCAFRICA (Uganda), CCASIA (China), CCEURO (Kazakhstan), CCLAC (Ecuador), CCNASWP (Fiji) and CCNE (Saudi Arabia) and with the European Union, FAO, the Good Food Institute (GFI), International Dairy Federation (IDF), Germany and the United States of America
[3] CX/EXEC 22/82/4
[4] REP22/EXEC1, paragraphs 70-85



FIL IDF
Fédération Internationale du Lait
International Dairy Federation

Environmental impacts of cultured meat: A cradle-to-gate life cycle assessment

Derrick Risner[1], Yoonbin Kim[1], Cuong Nguyen[2], Justin B. Siegel [3,4,5,6], Edward S. Spang[1,6]

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[2] Division of Agriculture and Natural Resources, University of California, Holtville, CA 92250, USA

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*Correspondence: esspang@ucdavis.edu; Tel.: +1-530-754-544

Abstract

Interest in animal cell-based meat (ACBM) or cultured meat as a viable environmentally conscious replacement for livestock production has been increasing, however a life cycle assessment for the current production methods of ACBM has not been conducted. Currently, ACBM products are being produced at a small scale and at an economic loss, however ACBM companies are intending to industrialize and scale-up production. This study assesses the potential environmental impact of near term ACBM production. Updated findings from recent technoeconomic assessments (TEAs) of ACBM and a life cycle assessment of Essential 8™ were utilized to perform a life cycle assessment of near-term ACBM production. A scenario analysis was conducted utilizing the metabolic requirements examined in the TEAs of ACBM and a purification factor from the Essential 8™ life cycle assessment was utilized to account fo growth medium component processing. The results indicate that the environmental impact of near-term ACBM production is likely to be orders of magnitude higher than median beef production if a highly refined growth medium is utilized for ACBM production.

Introduction

Livestock production is an integral component of the global food system, providing staple proteins (milk, eggs, and meat) consumed worldwide, contributing to crop productivity via utilization of manure as fertilizer, and providing critical nutrition and income to underprivilege households in low to middle income countries (Gilbert et al., 2018; Robinson et al., 2011). Global meat production has increased from 70.57 million tonnes in 1961 to 337.18 million tonnes in 2020, though the consumption of different meat sources is highly regionalized (FOA, 2022; Ritchie et al., 2019). In 2020, beef and buffalo meat accounted for ~22% of global meat production, and poultry and pork accounted for ~39% and ~32% of worldwide meat productio respectively (FOA, 2022; Ritchie et al., 2019).

Cell-based meat could emit 25 times more than retail beef, study

Beef Central, 15/05/2023

RESEARCHERS from a renowned university in the United States say traditional meat production is likely to have less of an environmental footprint than producing meat in a lab.

The group from University of California Davis recently did life-cycle assessments on lab-grown meat and compared it to the warming potential of conventional meat. It has released the findings of the report, with the peer-review still to come.

Lab-grown meat, or animal cell-based meat, has been tipped as a more environmentally friendly alternative way of producing protein. But previous Beef Central articles have raised doubts about its viability.

The results have shown that its environmental impact could be four-to-25 times greater than retail beef. The study focused on energy used to grow the animal cells and says it was likely to show the minimal impact of lab-grown meat.

"We also acknowledge that our analysis may be viewed as minimum environmental impacts due to several factors including incomplete datasets," the study says.

"The exclusion of energy and materials required to scale the ACBM industry and exclusion of the energy and materials needed to scale industries which would support ACBM production."

Measuring a burgeoning industry

One of the main limiting factors to the study was the small-scale nature of the cell-based meat industry. The study was based on impact of a scaled-up cell-based meat industry.

"Currently, ACBM products are being produced at a small scale and at an economic loss, however ACBM companies are intending to industrialise and scale-up production," it says.

CARBON FOOTPRINTING | Open Access | Published: 26 August 2022

Comparison of carbon footprint and water scarcity footprint of milk protein produced by cellular agriculture and the dairy industry

Katri Behm, Marja Nappa, Nina Aro, Alan Welman, Stewart Ledgard, Marjut Suomalainen & Jeremy Hill

The International Journal of Life Cycle Assessment **27**, 1017–1034 (2022) | Cite this article

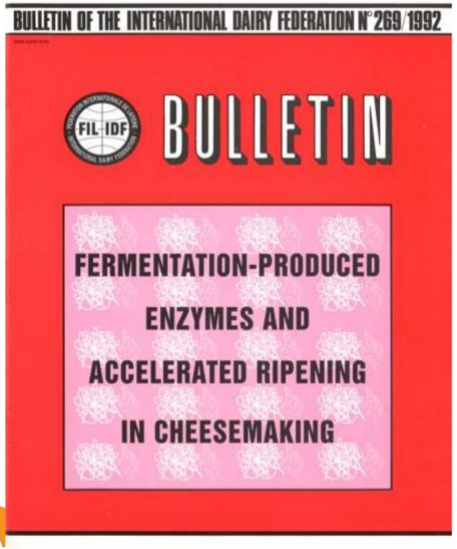
Abstract

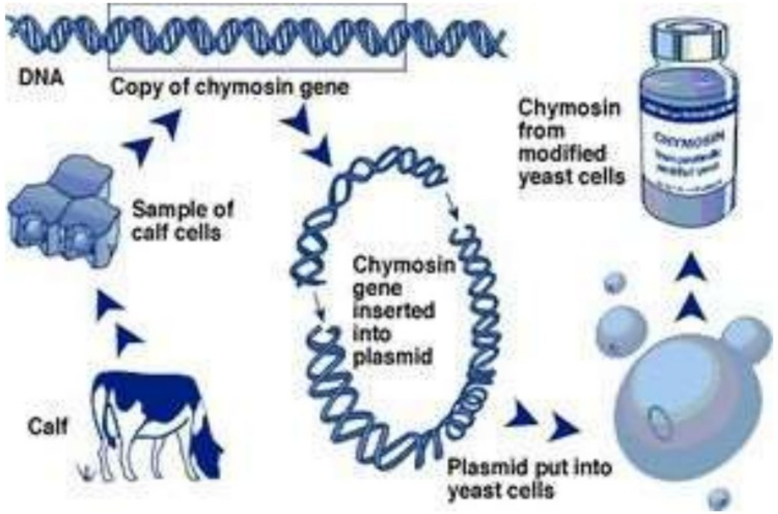
Purpose

This paper studies the carbon footprint and water scarcity footprint (WSF) of a milk protein, beta-lactoglobulin, produced by cellular agriculture and compares this to extracted dairy protein from milk. The calculations of the microbially produced proteins were based on a model of a hypothetical industrial-scale facility. The purpose of the study is to examine the role relative to dairy of microbially produced milk proteins in meeting future demand for more sustainably produced protein of high nutritional quality.

Methods

Is Precision Fermentation New to the Dairy Industry? No!





https://microbewiki.kenyon.edu/index.php/Microbial_production_of_recombinant_chymosin

Scientific Status of Cell-based Processes to Make Milk Proteins

- Lack of peer reviewed studies on the structural, functional and allergenicity of any proposed Startup's recombinant milk protein (some studies on recombinant β-lactoglobulin produced by academic researchers, could be different folding, altered binding sites, other modifications, etc)
- No published studies on the properties of any proposed Startup's recombinant caseins or casein micelles
- Lack of published studies on the carbon footprint of these non-cow milk proteins (just websites and marketing info)

Questions

- *Can precision fermentation replicate the full structure and functionality of caseins/micelles (including the ability to make cheese using the traditional clotting approach, etc)?*

No? The formation of casein micelles requires two key modifications of the primary casein protein sequence which is done by **enzymes** in the mammary cells
- **Phosphorylation** (adding phosphate), allows the caseins to bind calcium
- **Glycosylation** (adding sugars) stabilizes the micelles

The industrial bacteria/yeast do not have these specific enzymes and cannot recreate the environmental conditions, (pH, salt, temperature) needed to carefully bioassemble these various components. Bacteria/yeast could be engineered to do these modification but where/how to do the bioassembly?

Micelles produced by cows are made up of **4 different types of caseins**, each would need to be generated separately and then carefully mixed with various salts!!

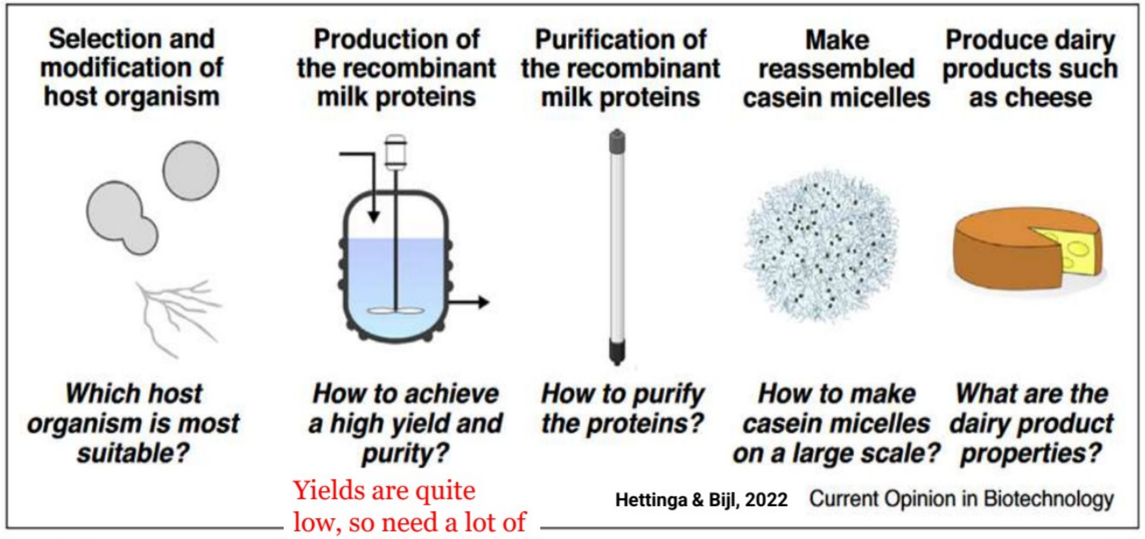
Questions

- *Can milk be recreated without the cow (in the lab, by plants)?*

Not by precision fermentation or transgenic plants (possibly by mammary cell-lines but that's not scalable for now, very expensive)
- **Too complex**, thousands of molecules, highly diverse,
- **Designed for nutrition** and health, not just a few basic components.
- **Requires bioassembly** into complex structures (casein micelles, fat globules) is critical for the functionality and nutritional aspects.

Startups will make a simple mixture of a couple of components and declare they have "replicated" milk!! Success!!

Some challenges for producing casein micelles by a precision approach, need to include how to do the post-translational modification?



Yields are quite low, so need a lot of concentration steps

Challenges

- Scalability (available fermentation capacity)
- Low yields (both precision fermentation and plant approaches)
- Cost
- Still a milk allergen
- Beyond the marketing hype of startups, the real LCA comparison to dairy components?
  - Environmental impact of a "milk" protein produced by precision fermentation **had a similar footprint** to proteins derived from the cow (Behm et al. 2022, Int. J. of Lifecycle Assessment, 27:1017)
- Sterility (for cell-cultured products)
- Consumer acceptance
- Regulatory acceptance

Opportunities for Precision Fermentation in the Dairy Industry?

- *Focus on high value components*
  - e.g., rennet is the most expensive ingredient in cheese
- *Focus on components present at low concentrations in milk*
  - precision fermentation can make more of it cost effectively
- *Focus on simple proteins*
  - where post-translation modification or further bio-assembly is not required
- *Examples:* lactoferrin, lactoperoxidase, immunoglobulins, oligosaccharides, etc
- Use of lactose-rich dairy feedstocks (e.g., permeate, acid whey) for the fermentation process improves the sustainability of dairy processing [*under one roof!]*

Conclusions

- Simple proteins or enzymes can be successfully made using the precision fermentation approach, e.g., rennet and β-LG
- Complex proteins, like casein, require critical post-translational modifications, unclear how these modifications can be done outside the mammary cells? Or if modified by a m/o then it's a GMO
- Unclear how bio-assembly of complex proteins structures like casein micelles can be done without the post-translation modification
- What is the functionality of these non-cow derived casein proteins? [*better than plant proteins but not identical to cow-derived*]
- Suggest precision fermentation focus should be on high-value proteins present in milk at low concentrations (e.g., lactoferrin)

Antibiotic resistance in potential probiotic and pro-technological lactic acid bacteria isolated from buffalo milk

R.L. Ambrosio[1], M. Di Paolo[1], V. Vuoso[1], F. Troise[1], A. Anastasio[1]

[1]*University of Napoli Federico II - Department of Veterinary Medicine and Animal Production, Italy*

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella & Milk Products

24/25 Sept. 2024

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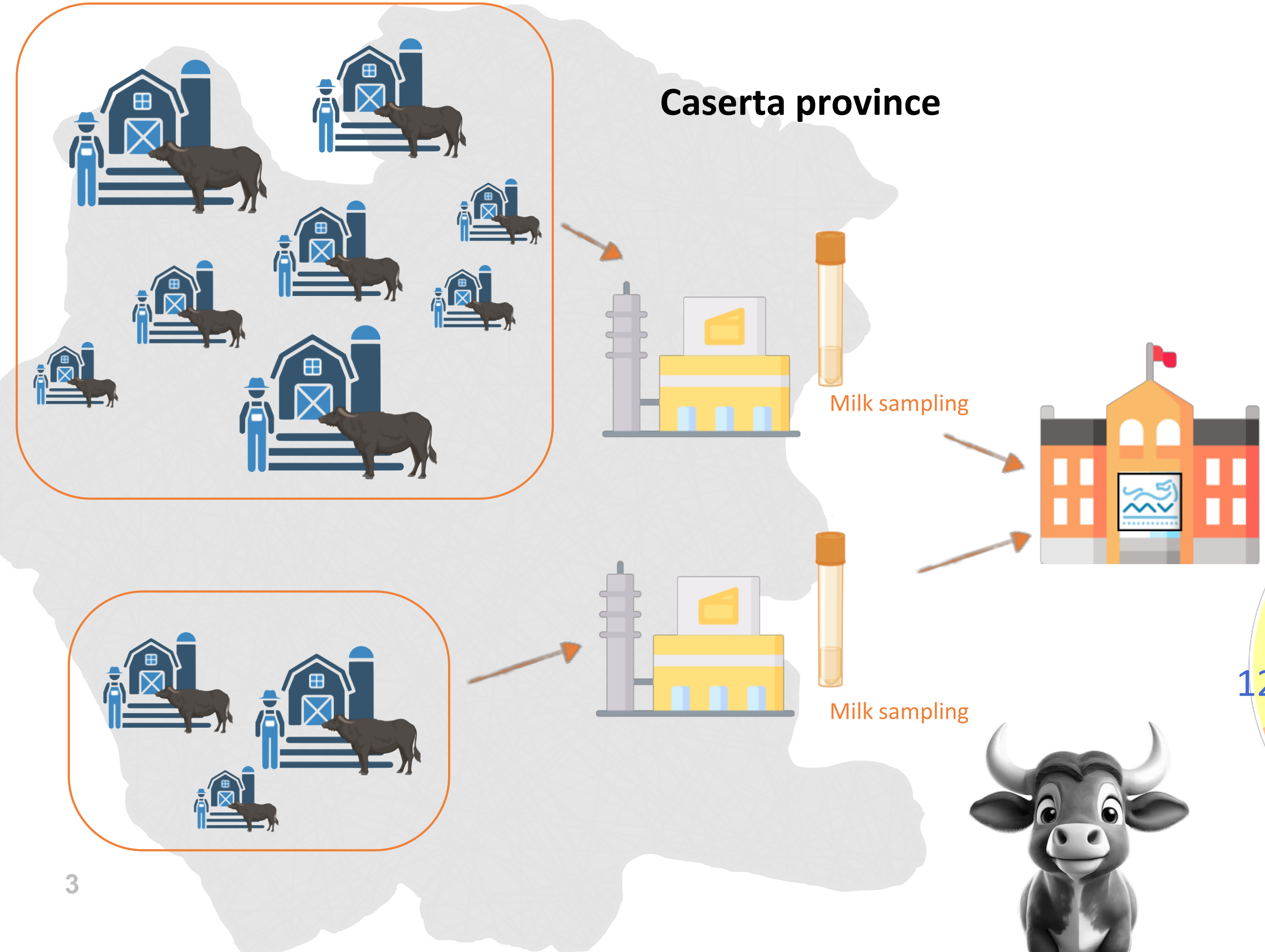
Context & AIM

Lactic acid bacteria (LAB) are safely used as probiotics and normally used technologically in dairy production. However, these bacteria could spread antibiotic resistance genes.

In this context, this study aimed to contribute to expanding knowledge on probiotic and pro-technological bacteria of buffalo milk.

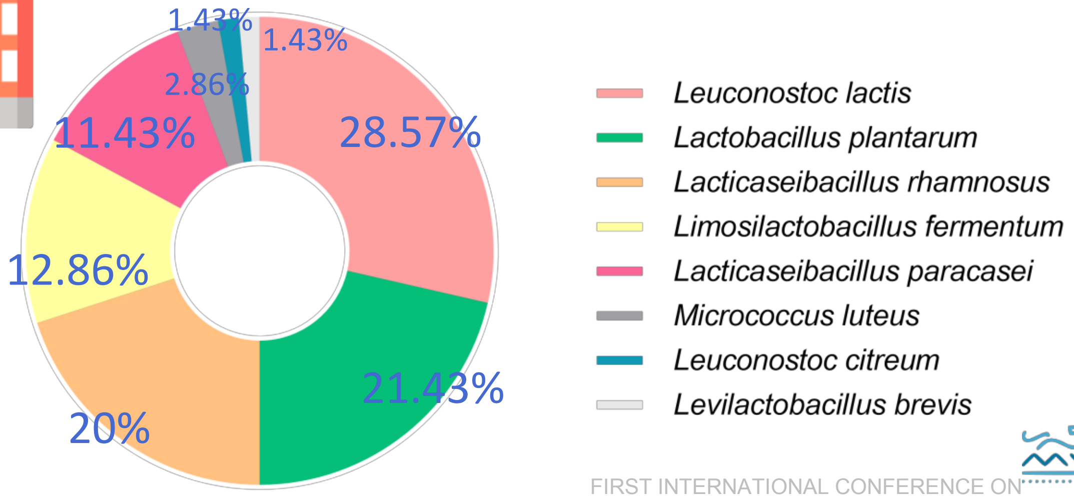
M&M and Results



The research on mesophilic aerobic Lactobacilli was conducted according to the ISO 15214:1998 method

Characteristic colonies were identified by MALDI-TOF/MS

70 strains selected

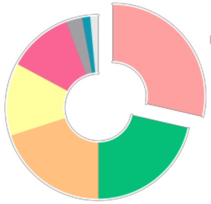


M&M and Results

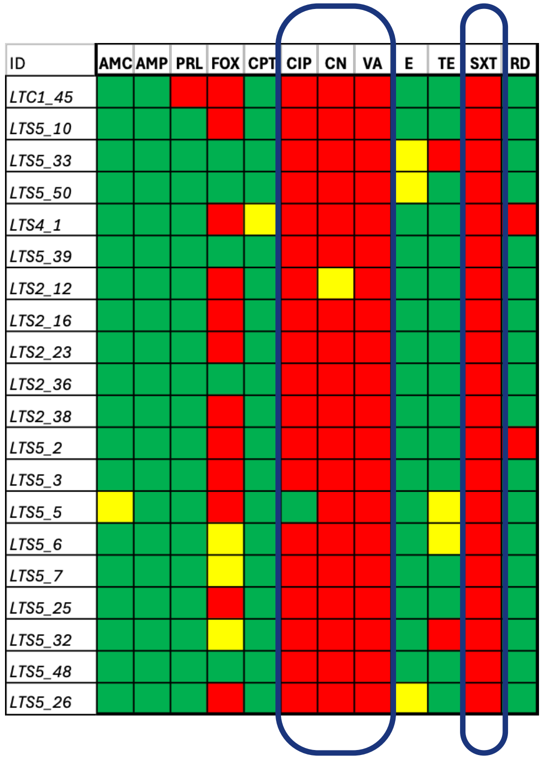
code	antibiotics	disk content
	penicillins	
AMC	Amoxicillin - clavulanic acid	20 - 10 µg
AMP	Ampicillin	2 µg
PRL	Piperacillin	30 µg
	cephalosporins	
FOX	Cefoxitin	30 µg
CPT	Ceftaroline	30 µg
	fluoroquinolones	
CIP	Ciprofloxacin	5 µg
	aminoglycosides	
CN	Gentamicin	10 µg
	glycopeptides	
VA	Vancomycin	30 µg
	macrolides	
E	Erythromycin	15 µg
	tetracyclines	
TE	Tetracycline	30 µg
	miscellaneous agents	
SXT	Trimethoprim-sulfamethoxazole	1.25-23.75 µg
RD	Rifampicin	5 µg

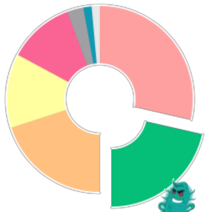
Disc diffusion method	Zone diameter (mm)
Susceptible	>20
Intermediate	15–19
Resistant	≤14

doi: 10.5650/jos.ess22052d
doi : 10.1111/jfs.12211
doi : 10.1007/s13205-017-0682-0

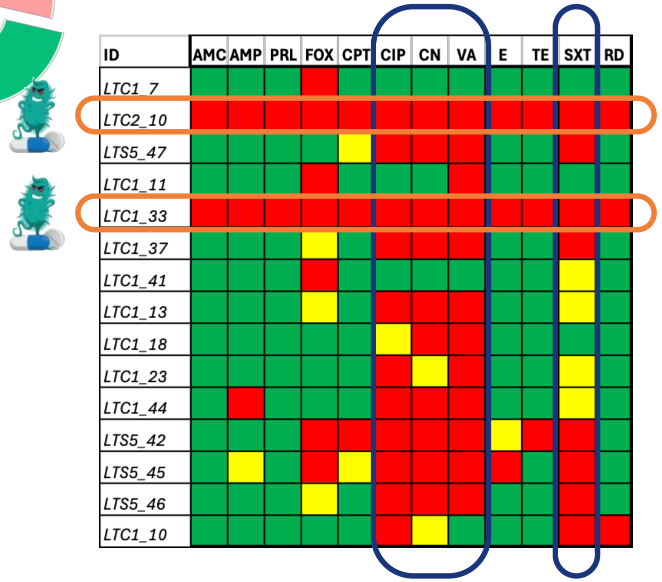


Leuconostoc lactis

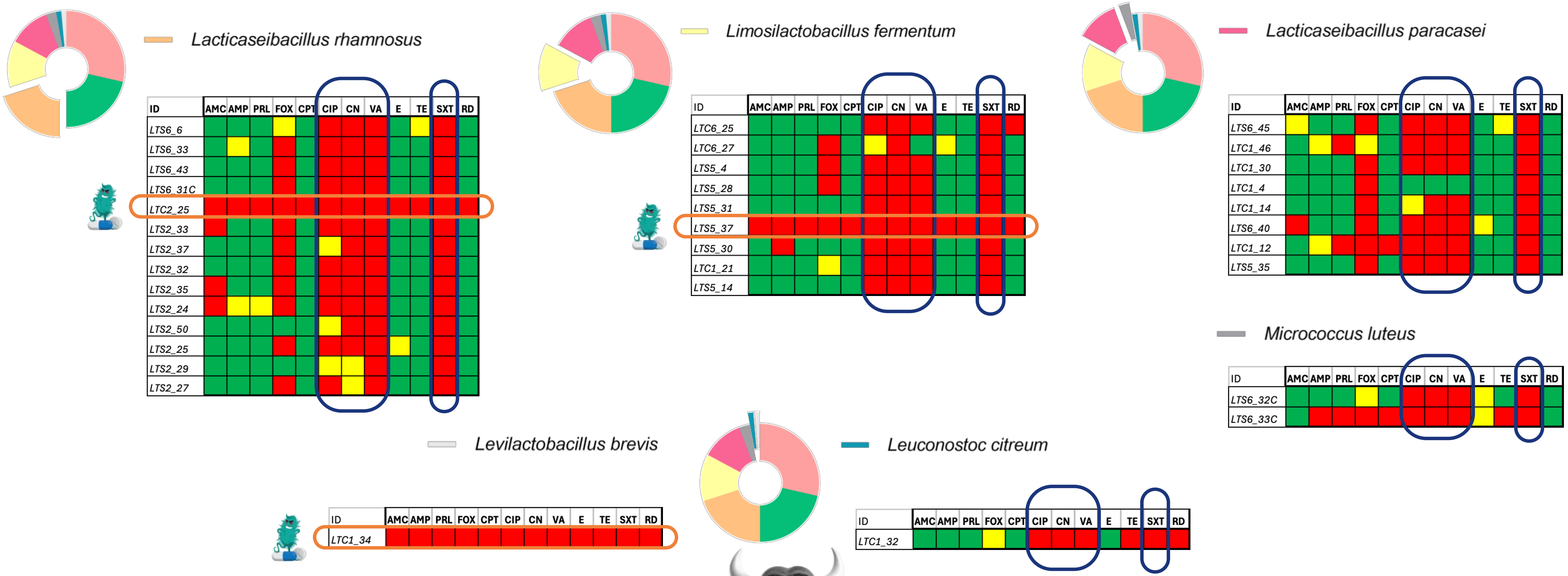




Lactobacillus plantarum



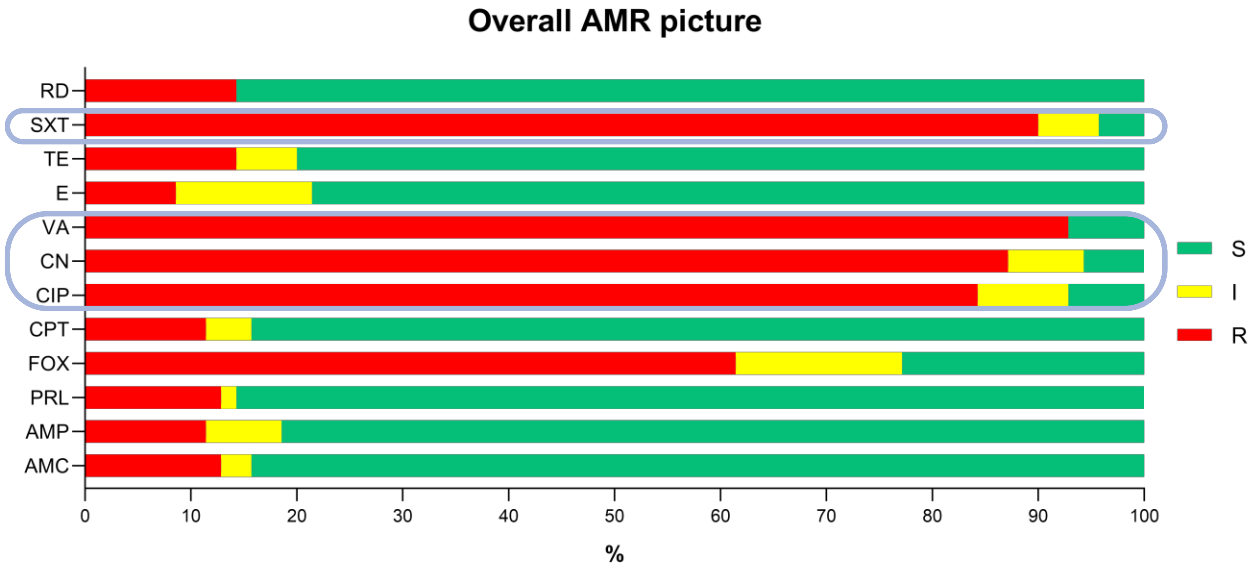
Results



All strains were resistant to at least two antibiotics, and 7.14% of them were resistant to all tested antibiotics

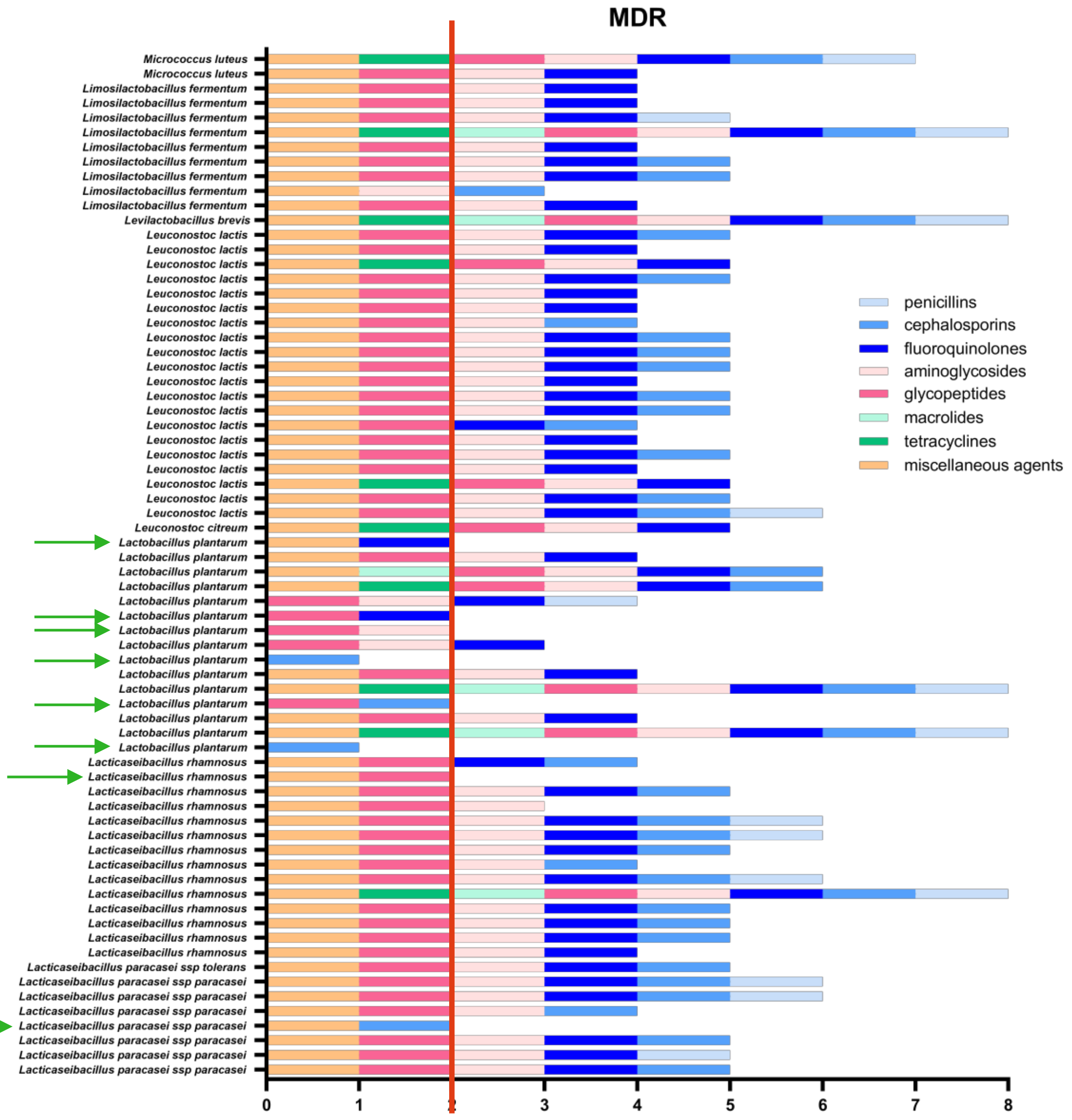
Results & Discussion

Percentage of **resistance (R)**, **intermediate sensitivity (I)** and **sensitivity (S)** of the strains with respect to the tested antibiotic



The highest resistances were found for **vancomycin (92.86%)**, **trimethoprim-sulfamethoxazole (90%)**, **gentamicin (87.14%)** and **ciprofloxacin (84.29%)**

Resistances in relation to the pharmacological classes to which the tested antibiotics belong



88.57% of strains were multi-resistant

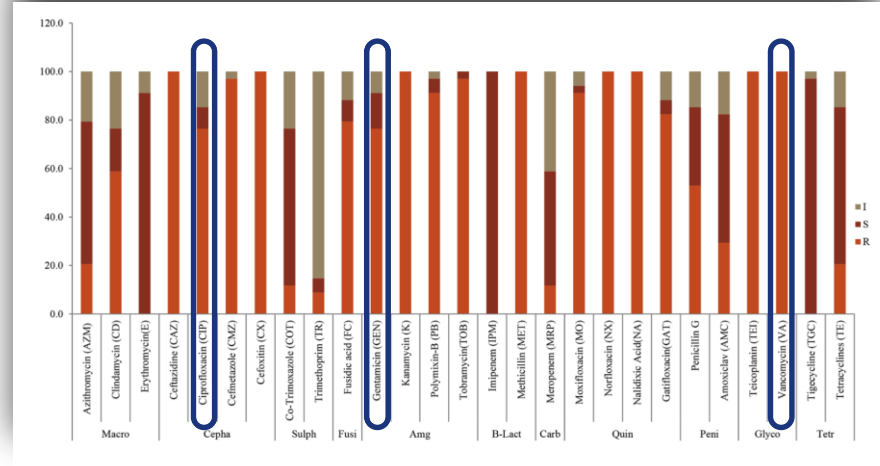
Discussion

Duche et al. BMC Microbiology (2023) 23:142
https://doi.org/10.1186/s12866-023-02883-0

BMC Microbiology

RESEARCH Open Access

Antibiotic resistance in potential probiotic lactic acid bacteria of fermented foods and human origin from Nigeria



https://doi.org/10.3389/fmicb.2013.00103

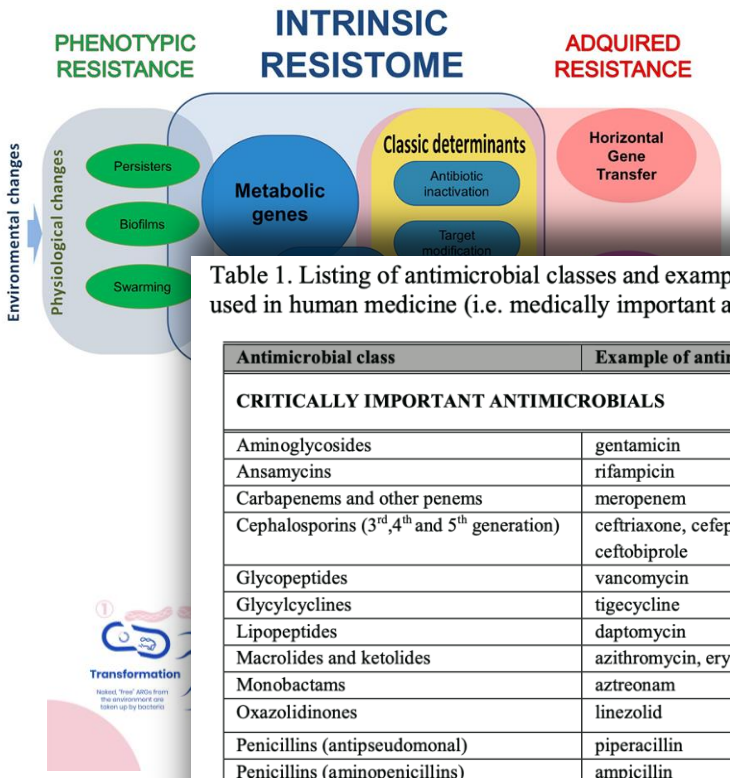
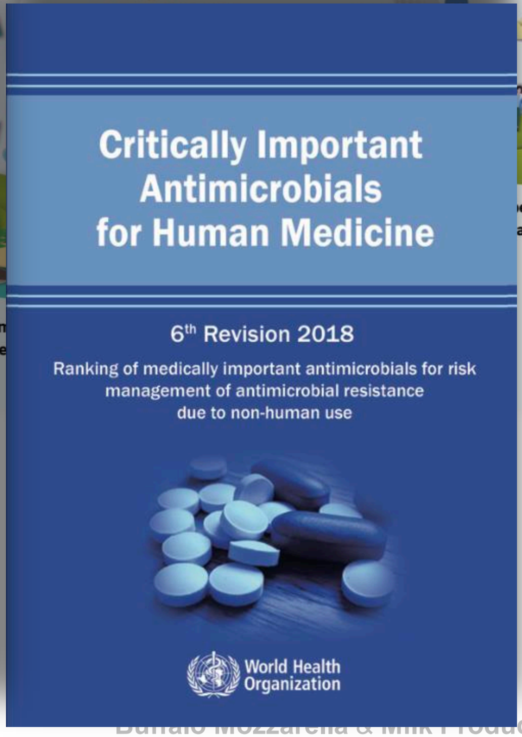
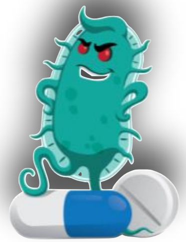
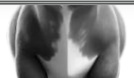


Table 1. Listing of antimicrobial classes and example antimicrobial agents used in human medicine (i.e. medically important antimicrobials)

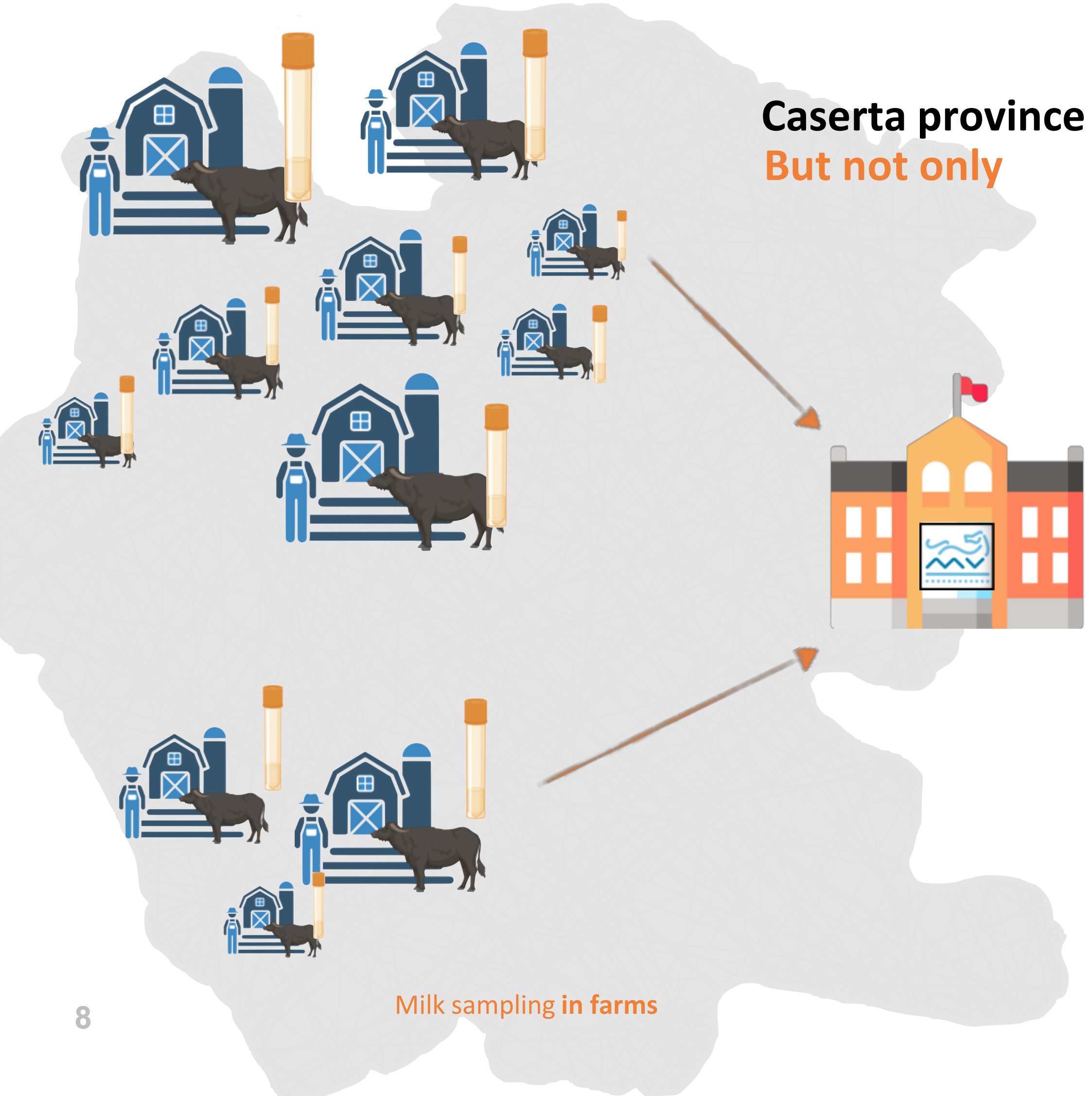
Antimicrobial class	Example of antimicrobials(s)
CRITICALLY IMPORTANT ANTIMICROBIALS	
Aminoglycosides	gentamicin
Ansamycins	rifampicin
Carbapenems and other penems	meropenem
Cephalosporins (3rd,4th and 5th generation)	ceftriaxone, cefepime, ceftaroline, ceftobiprole
Glycopeptides	vancomycin
Glycylcyclines	tigecycline
Lipopeptides	daptomycin
Macrolides and ketolides	azithromycin, erythromycin, telithromycin
Monobactams	aztreonam
Oxazolidinones	linezolid
Penicillins (antipseudomonal)	piperacillin
Penicillins (aminopenicillins)	ampicillin
Penicillins (aminopenicillin with beta-lactamase inhibitors)	amoxicillin-clavulanic-acid
Phosphonic acid derivatives	fosfomycin
Polymyxins	colistin
Quinolones	ciprofloxacin
Drugs used solely to treat tuberculosis or other mycobacterial diseases	isoniazid



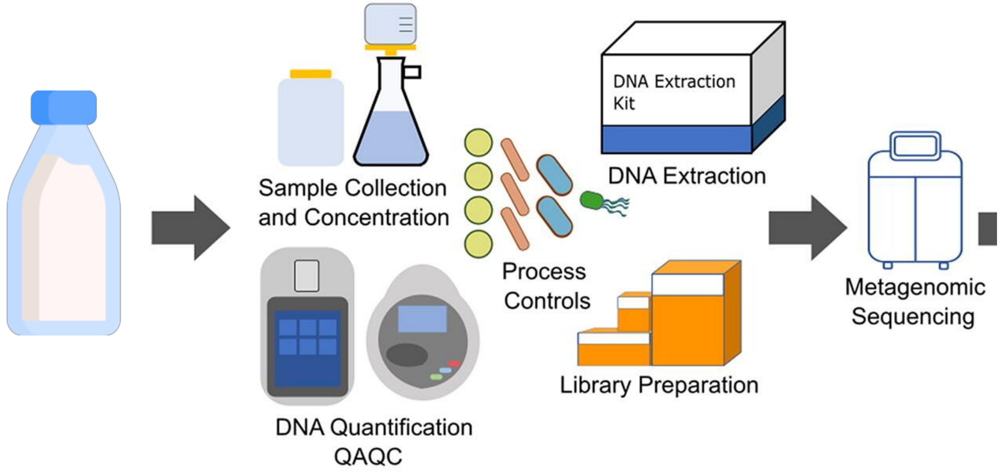




New ideas, future prospects and Conclusions



ARGs analysis



The awareness that LAB can present AMR genes transferable to other microorganisms, including pathogenic ones, must move the scientific/managerial communities towards monitoring plans that better allow the surveillance and containment of the spread of AMR.

Grazie per l'attenzione!

Rosa Luisa Ambrosio

DVM, Ph.D., Post Doc fellow

rosaluisa.ambrosio@unina.it

Differential SCC and MPO evaluation as buffaloes milk indicators of udder status under heat stress

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella & Milk Products

24/25 Sept. 2024

M. G. Ciliberti, A. Santillo, M. Caroprese, R. Marino, A. Sevi, M. di Corcia, M. Albenzio

Department of Agriculture, Food, Natural Resources, and Engineering (DAFNE), University of Foggia,71122, Foggia, Italy

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CONSORZIO DI TUTELA

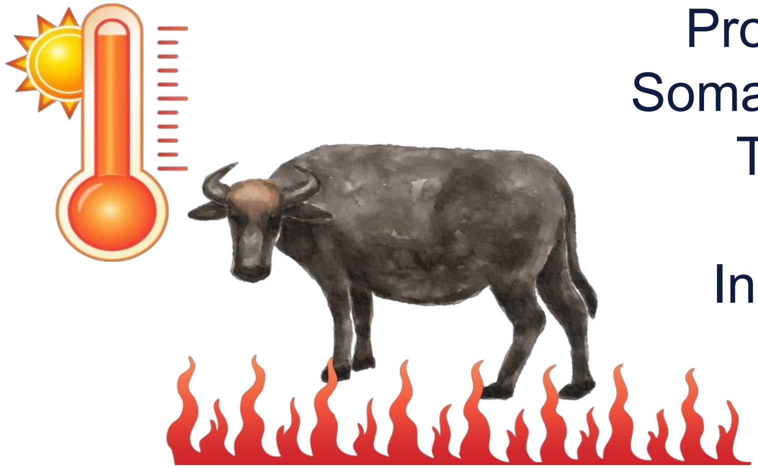
FEDERICO II

Dipartimento Medicina Veterinaria Produzioni Animali

DIPARTIMENTO DI AGRARIA

Context

When addressing GW and livestock species, heat stress is the most important outcome that negatively impacts animals' health, welfare, and productive performance (Bernabucci, 2019).



Prolactin
Somatotropin
TSH
LH
Insulin

Milk yield and composition
Growth
Disease resistance
Reproduction efficiency

This study aimed at the evaluation of the differential milk somatic cell count (DSCC), and the surface expression of myeloperoxidase (MPO) and its activity in somatic cell (SC).

Methods

From:

SPRING

To:

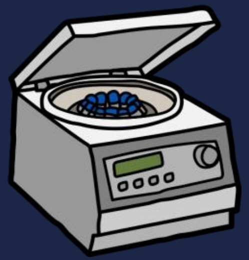
SUMMER

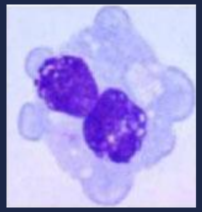
3 THI classes

THI < 72 (no HS)

THI>72<76 (moderate HS)

and THI > 76 (severe HS)





Macrophages

PNMs

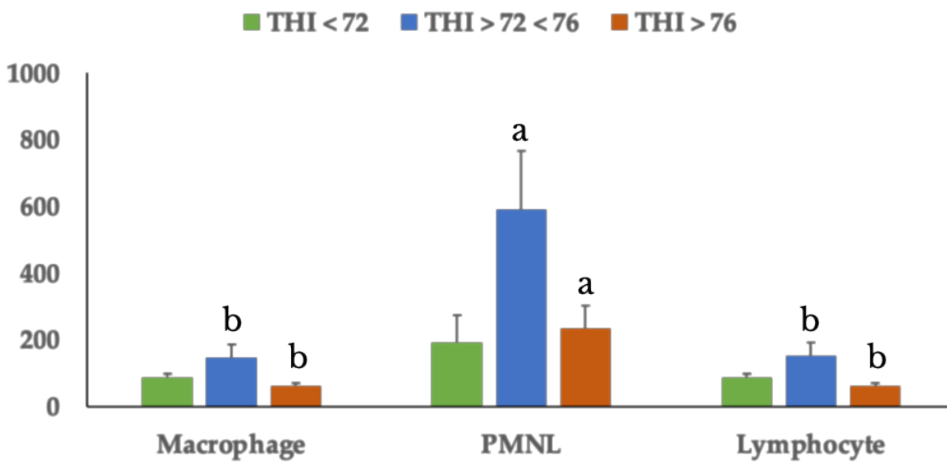
Lymphocytes

Abs panel cross-reactivity with buffalo

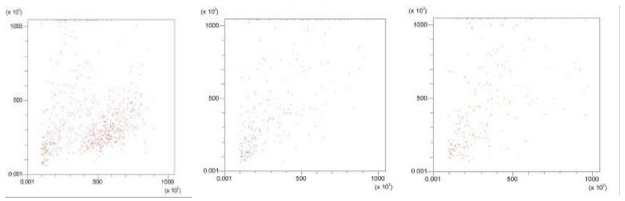
MPO surface expression
MPO activity by ELISA

Results

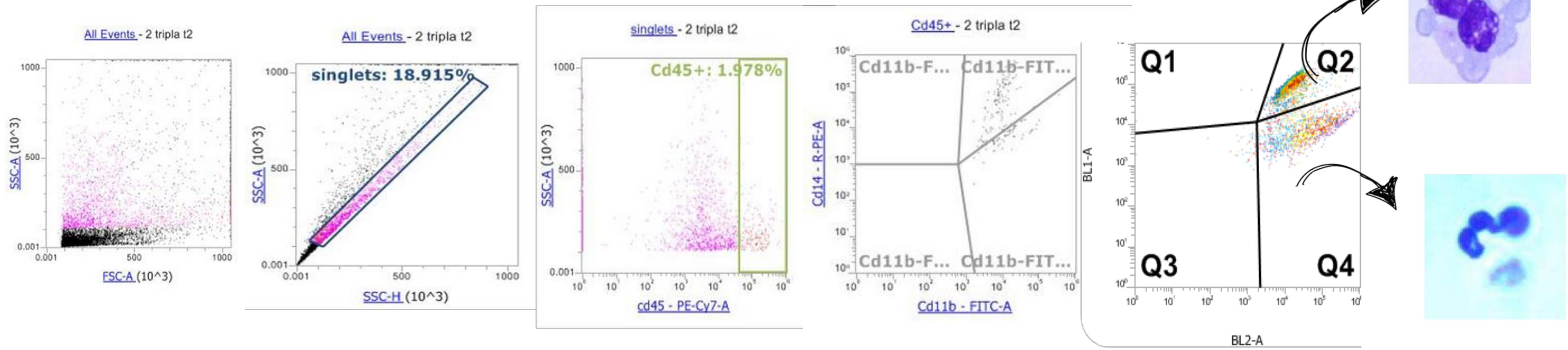
Morphological dot plot of positive somatic cell to MPO-FITC antibody



SSC-A versus FSC-A



	THI<72	THI>72<76	THI>76	P-value
MPO activity, U/mL	209.97 a	209.21 a	156.74 b	0.06
MPO surface expression, % on gated cells	2.30 a	1.43 b	1.16 b	0.024



Grazie per l’attenzione!

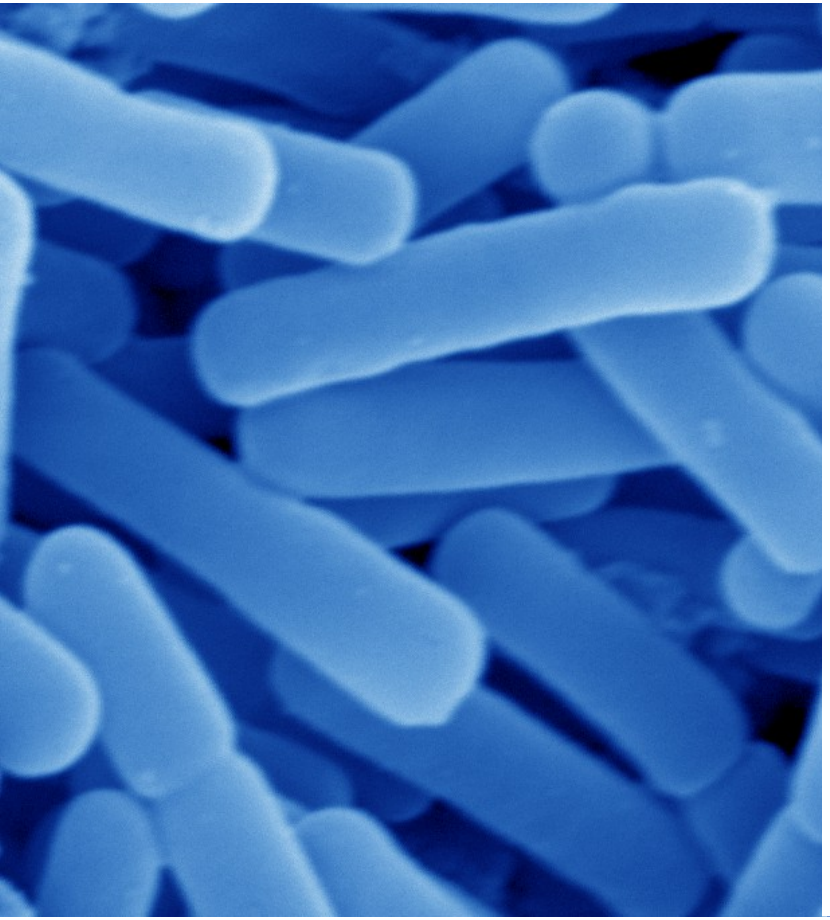
Maria Giovanna Ciliberti

maria.ciliberti@unifg.it

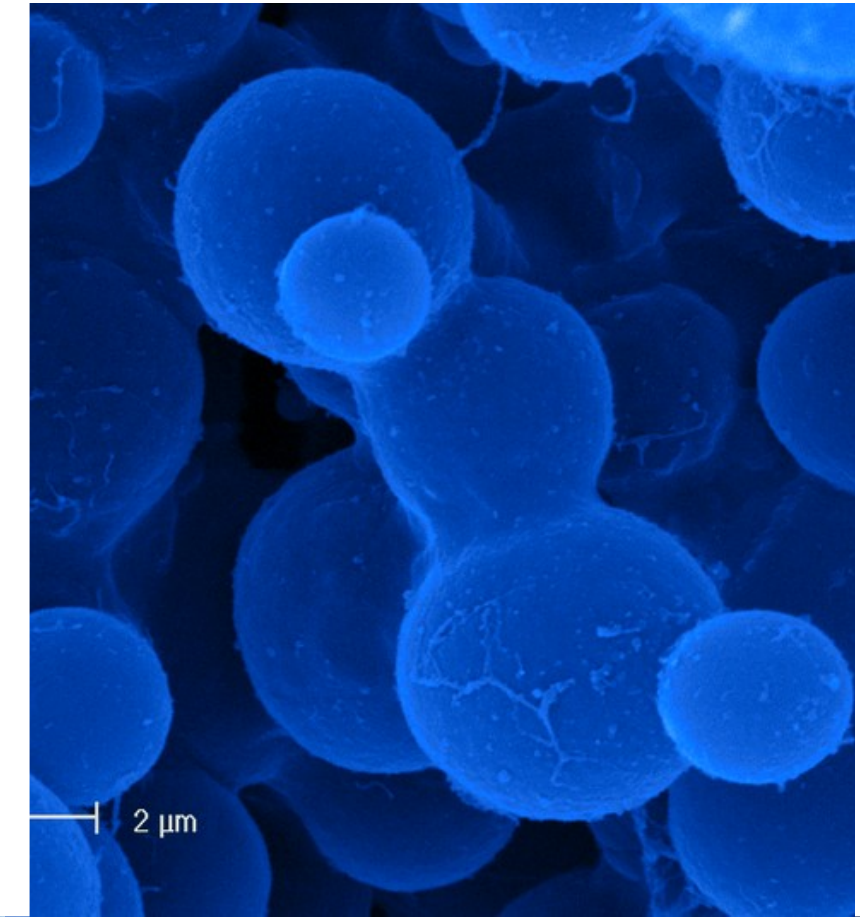
To be or not to be safe and sustainable? Comparing different scenario in lab-grown food and dairy trades

Pier Sandro Cocconcelli
Università Cattolica del Sacro Cuore
Piacenza-Cremona
piercocconcelli@unicattit

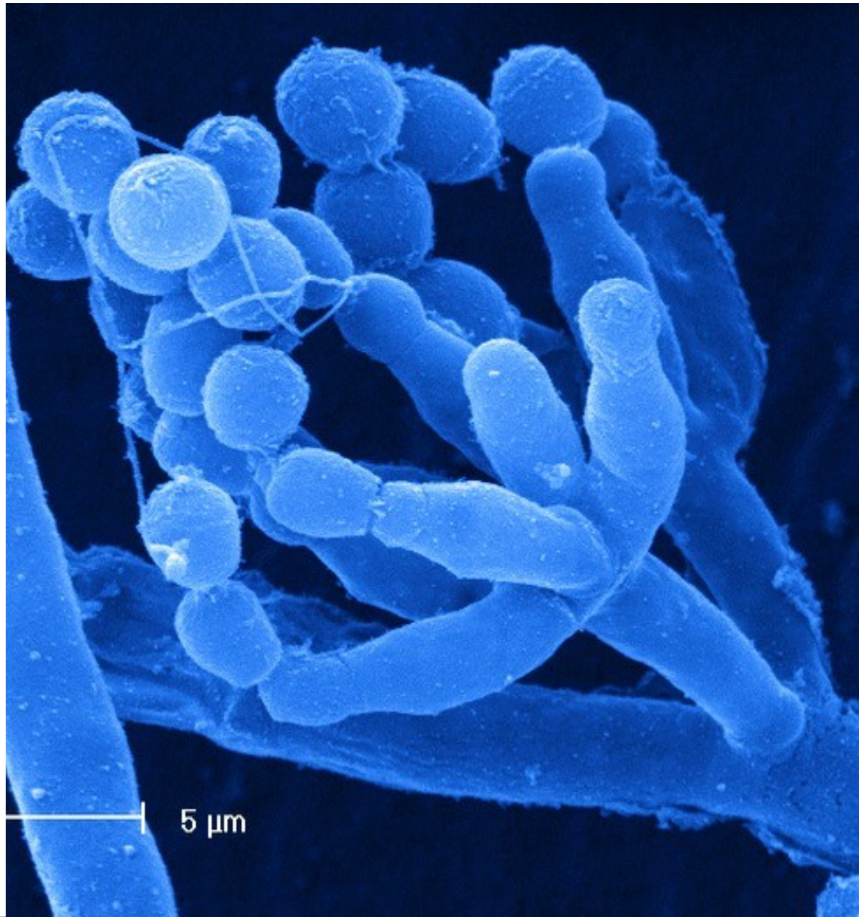
Cell Factories for protein production



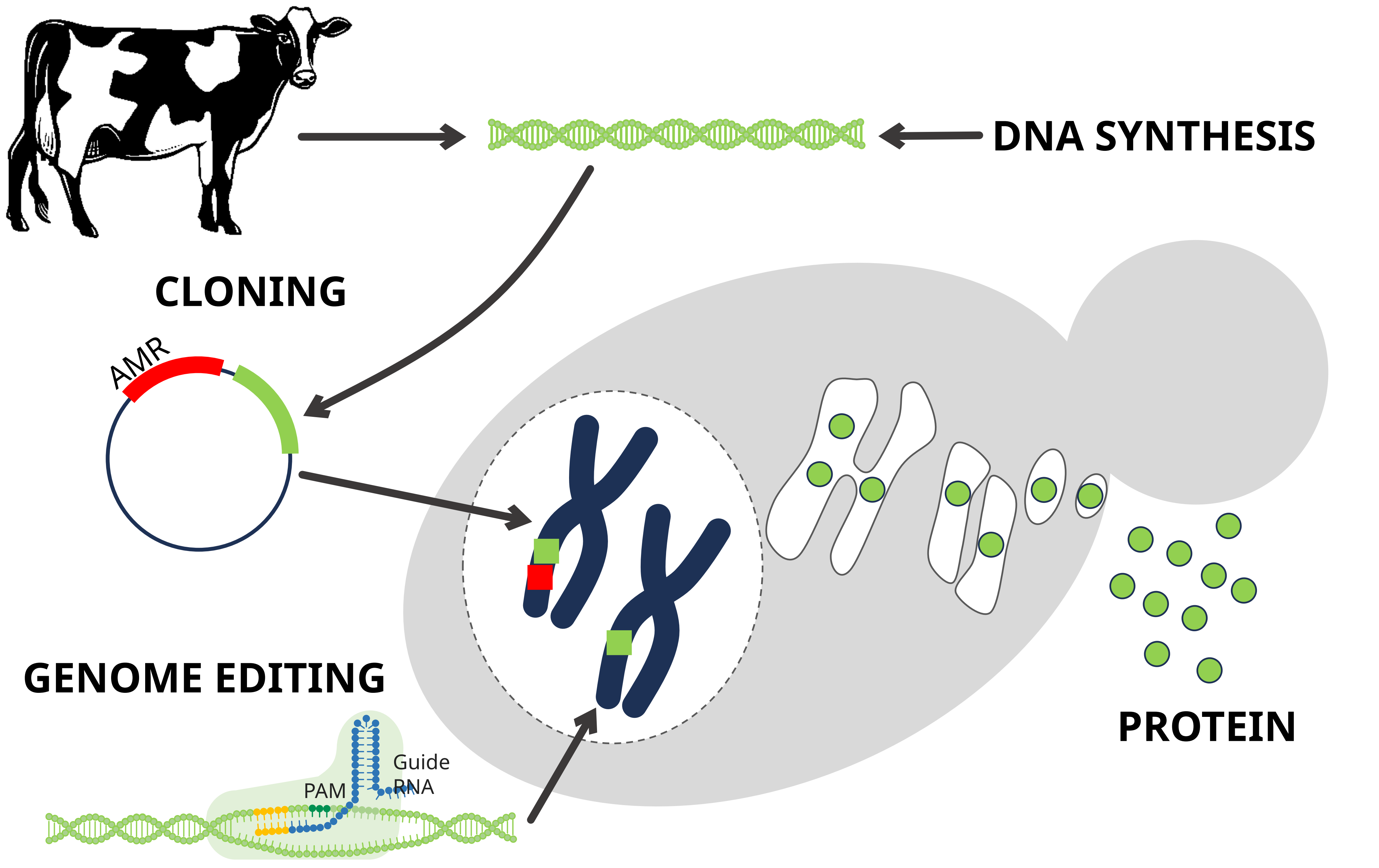
BACTERIA



YEASTS

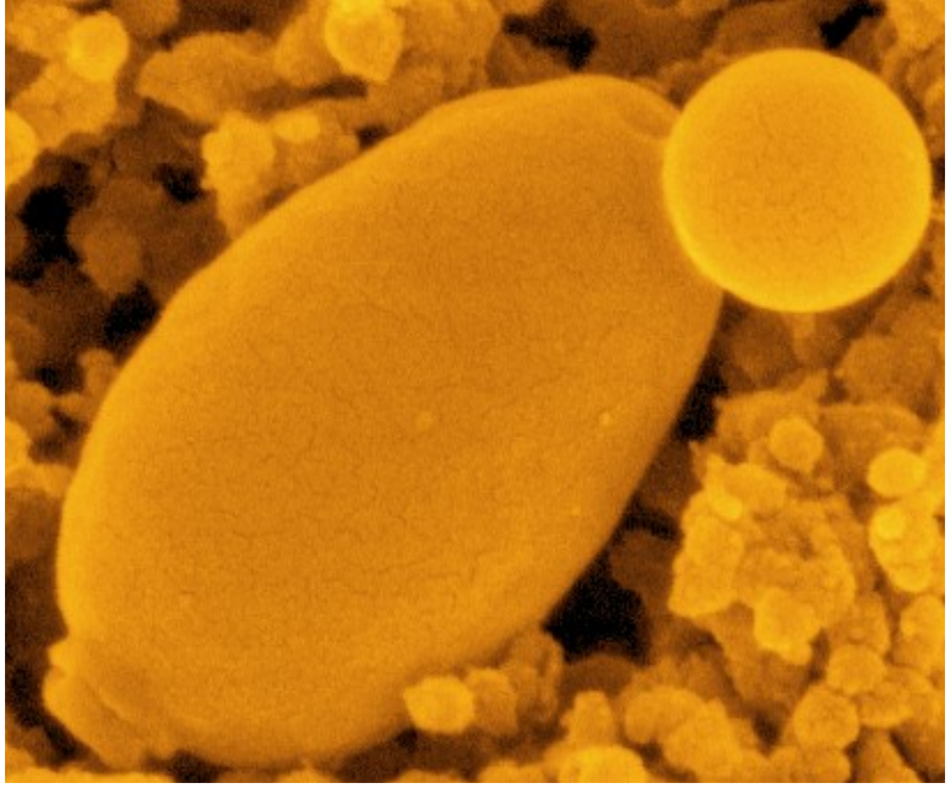


FUNGI



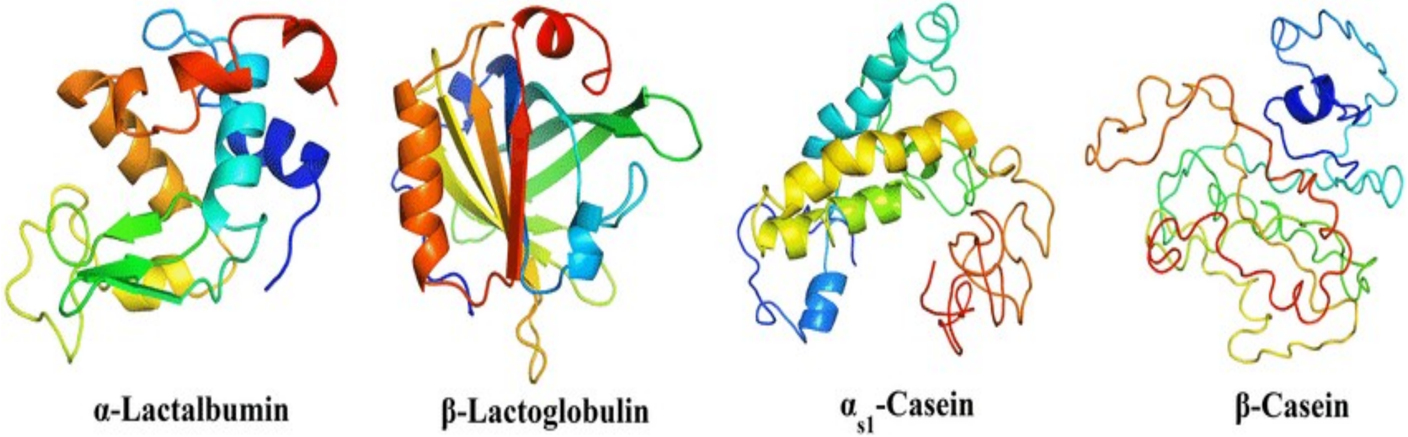
DNA SYNTHESIS
CLONING
AMR
GENOME EDITING
PAM
Guide RNA
PROTEIN

ENZYMES ← → FOOD



CHYMOSIN

LACTOFERRIN



Milk Components

Proteins

Casein Proteins (80% of total milk protein)

αS1-casein (Alpha S1-casein): 32-35% of total milk proteins
αS2-casein (Alpha S2-casein): 8-10%
β-casein (Beta-casein): 25-28%
κ-casein (Kappa-casein): 8-10%

Whey Proteins (20% of total milk protein)

β-lactoglobulin (Beta-lactoglobulin): 50% of whey proteins
α-lactalbumin (Alpha-lactalbumin): 20-25%
Immunoglobulins (IgG, IgA, IgM): 10-15%
Bovine Serum Albumin (BSA): 5-10%
Lactoferrin: < 1%
Lysozyme: Trace amounts

Free Amino Acids

Glutamic acid
Leucine
Lysine
Aspartic acid
Arginine
Isoleucine
Proline
Valine
Phenylalanine
Histidine
Methionine
Tryptophan

Triglycerides:

component, 98% of total milk fat
Phospholipids: ~1%, essential for cell membrane
Cholesterol: ~0.3%
Fatty Acids: Includes both saturated (65-70%) ar
unsaturated fatty acids (30-35%)

Saturated:
- Palmitic acid,
- Myristic acid
- Stearic acid

Unsaturated:
- Oleic acid,
- Linoleic acid
- α-linolenic acid

Short-chain fatty acids:
- Butyric acid
- Caproic acid
- Caprylic acid

Minerals

Calcium (Ca):
Phosphorus (P):
Magnesium (Mg):
Potassium (K)
Sodium (Na):
Chloride (Cl):
Trace minerals:
Zinc (Zn), Copper (Cu),
Iron (Fe) Iodine (I)
Selenium (Se)

Vitamins

Vitamin B1 (Thiamine)
Vitamin B2 (Riboflavin)
Vitamin B3 (Niacin)
Vitamin B5 (Pantothenic acid)
Vitamin B6 (Pyridoxine)
Vitamin B7 (Biotin)
Vitamin B9 (Folate)
Vitamin B12 (Cobalamin)
Vitamin C (Ascorbic acid)
Vitamin A (Retinol)
Vitamin D
Vitamin E
Vitamin K

Enzymes

Lactoperoxidase
Xanthine oxidase
Lipase
Alkaline phosphatase
Catalase

Milk Components

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Minerals

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Phosphorus (P):

Magnesium (Mg):

Potassium (K)

Sodium (Na):

Chloride (Cl):

Trace minerals:

Zinc (Zn), Copper (Cu),

Iron (Fe) Iodine (I)

Selenium (Se)

Vitamins

Vitamin B1 (Thiamine)

Vitamin B2 (Riboflavin)

Vitamin B3 (Niacin)

Vitamin B5 (Pantothenic acid)

Vitamin B6 (Pyridoxine)

Vitamin B7 (Biotin)

Vitamin B9 (Folate)

Vitamin B12 (Cobalamin)

Vitamin C (Ascorbic acid)

Vitamin A (Retinol)

Vitamin D

Vitamin E

Vitamin K

Free Amino Acids

Glutamic acid

Leucine

Lysine

Aspartic acid

Arginine

Isoleucine

Proline

Valine

Phenylalanine

Histidine

Methionine

Tryptophan

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Lactoperoxidase

Xanthine oxidase

Lipase

Alkaline phosphatase

Catalase

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component, 98% of total milk fat

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Short-chain fatty acids:

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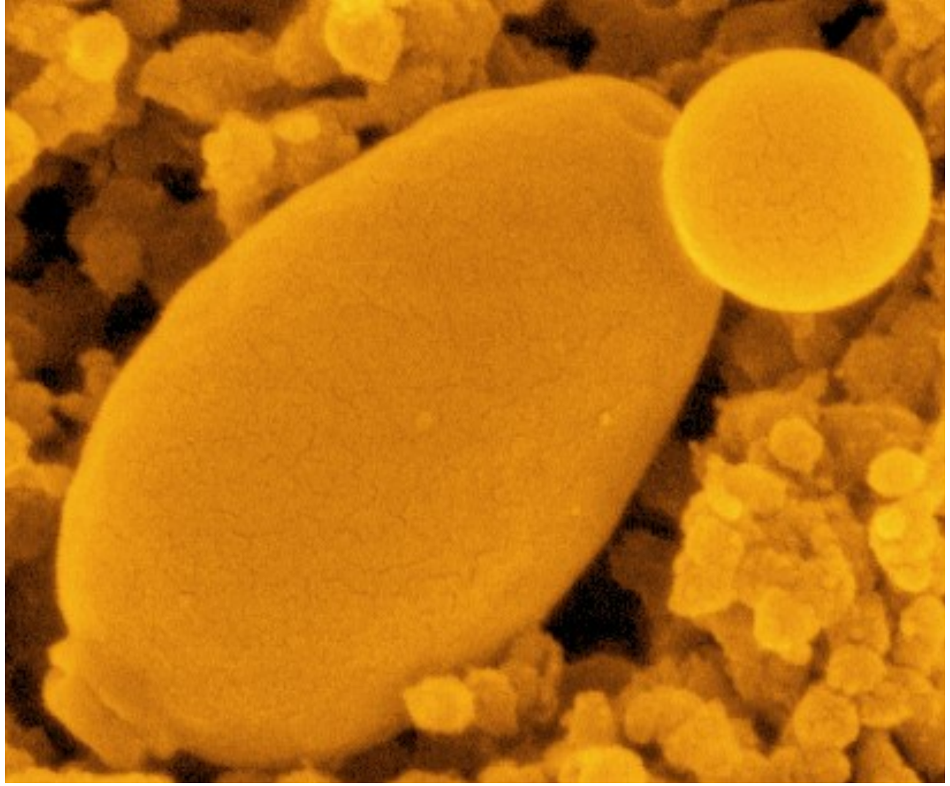
- Caprylic acid



SAFETY

SUSTAINABILITY

Risk Assessment of microorganisms and their products non-GM – GM – NGT (genome editing)

UNIVERSITÀ CATTOLICA del Sacro Cuore

2005

The EFSA Journal (2005) 223, 1-12

Opinion of the Scientific Panel on Additives and Products or Substances used in Animal Feed on the updating of the criteria used in the assessment of bacteria for resistance to antibiotics of human or veterinary importance

(Question N° EFSA-Q-2004-079)

Adopted on 25 May 2005

2008

efsa European Food Safety Authority — *The EFSA Journal* (2008) 923, 1-48

SCIENTIFIC OPINION

The maintenance of the list of QPS microorganisms intentionally added to food or feed[1]

Scientific Opinion of the Panel on Biological Hazards

(Question No EFSA-Q-2008-006)

Adopted on 10 December 2008

2018

GUIDANCE — EFSA Journal

ADOPTED: 21 February 2018

doi: 10.2903/j.efsa.2018.5206

Guidance on the characterisation of microorganisms used as feed additives or as production organisms

2021

STATEMENT — EFSA Journal

ADOPTED: 8 December 2021

doi: 10.2903/j.efsa.2022.7045

Update of the list of QPS-recommended biological agents intentionally added to food or feed as notified to EFSA 15: suitability of taxonomic units notified to EFSA until September 2021

STATEMENT — EFSA Journal

ADOPTED: 2 March 2021

doi: 10.2903/j.efsa.2021.6506

EFSA statement on the requirements for whole genome sequence analysis of microorganisms intentionally used in the food chain

European Food Safety Authority (EFSA)

2022

SCIENTIFIC OPINION — EFSA Journal

ADOPTED: 5 July 2022

doi: 10.2903/j.efsa.2022.7479

Evaluation of existing guidelines for their adequacy for the food and feed risk assessment of microorganisms obtained through synthetic biology

2024

Risk Assessment of NGT

2024

New Microbial Guidance Biomasses ERA

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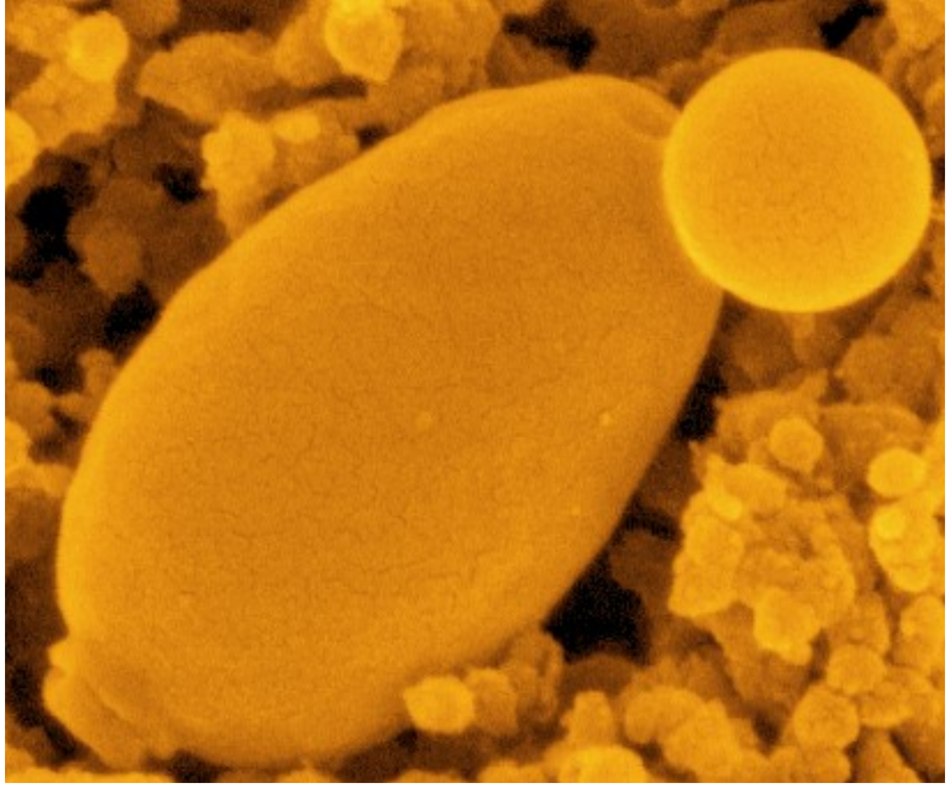
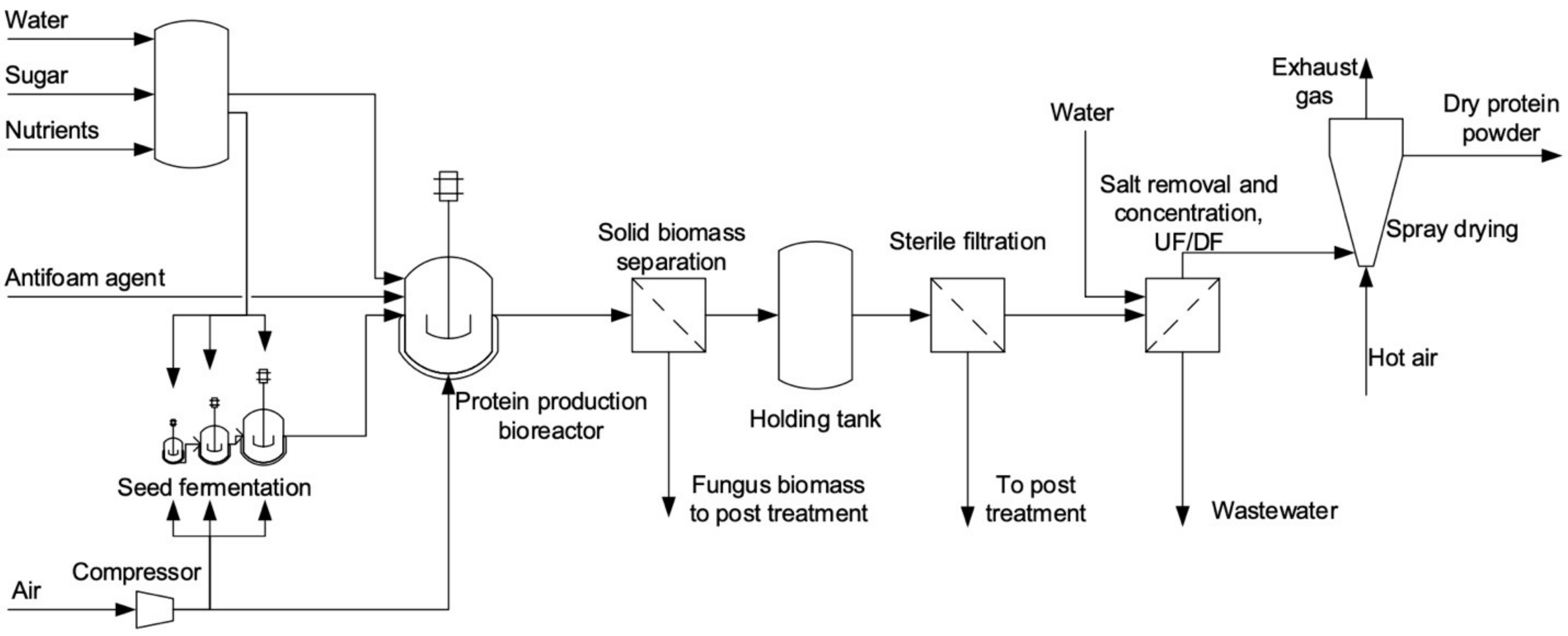
SAFETY



Food Enzymes
Processing Aids
Food/Feed additives
Novel Foods

- Whole genome Sequence and GMM assessment of the strains
- Presence of Antimicrobial Resistance Gene(s)
- Toxicology
- Manufacturing process
- Presence/Absence of viable cells and DNA of the production host



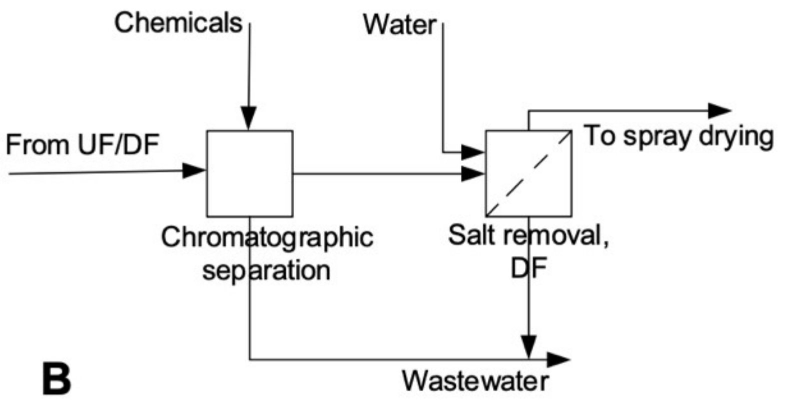


Fig. 1 Schematic process flow diagram: **A** main process; **B** additional steps for product purification (scenario 4)

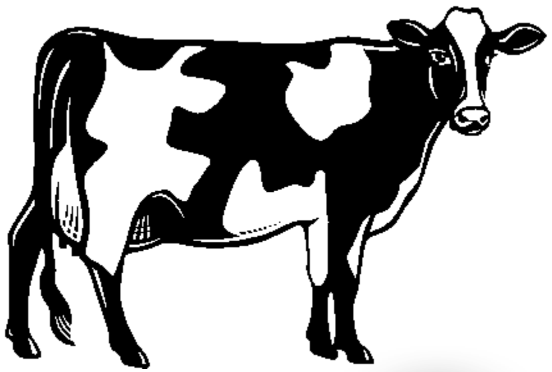
The International Journal of Life Cycle Assessment (2022) 27:1017–1034
https://doi.org/10.1007/s11367-022-02087-0

CARBON FOOTPRINTING

Comparison of carbon footprint and water scarcity footprint of milk protein produced by cellular agriculture and the dairy industry

Katri Behm[1] · Marja Nappa[1] · Nina Aro[1] · Alan Welman[2] · Stewart Ledgard[3] · Marjut Suomalainen[1] · Jeremy Hill[2,4]

SUSTAINABILITY - efficiency - LCA



volume	protein yield/d	protein kg/d	hard cheese
45 L	3.3%	1.44	4.5
1000 L	0.13%	1.33	?

Breeding techniques and nutritional quality of milk productions

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella
& Milk Products

24/25 Sept. 2024

Dr. Angela Salzano

Dipartimento di Medicina Veterinaria e Produzioni Animali
Università degli Studi di Napoli – Federico II

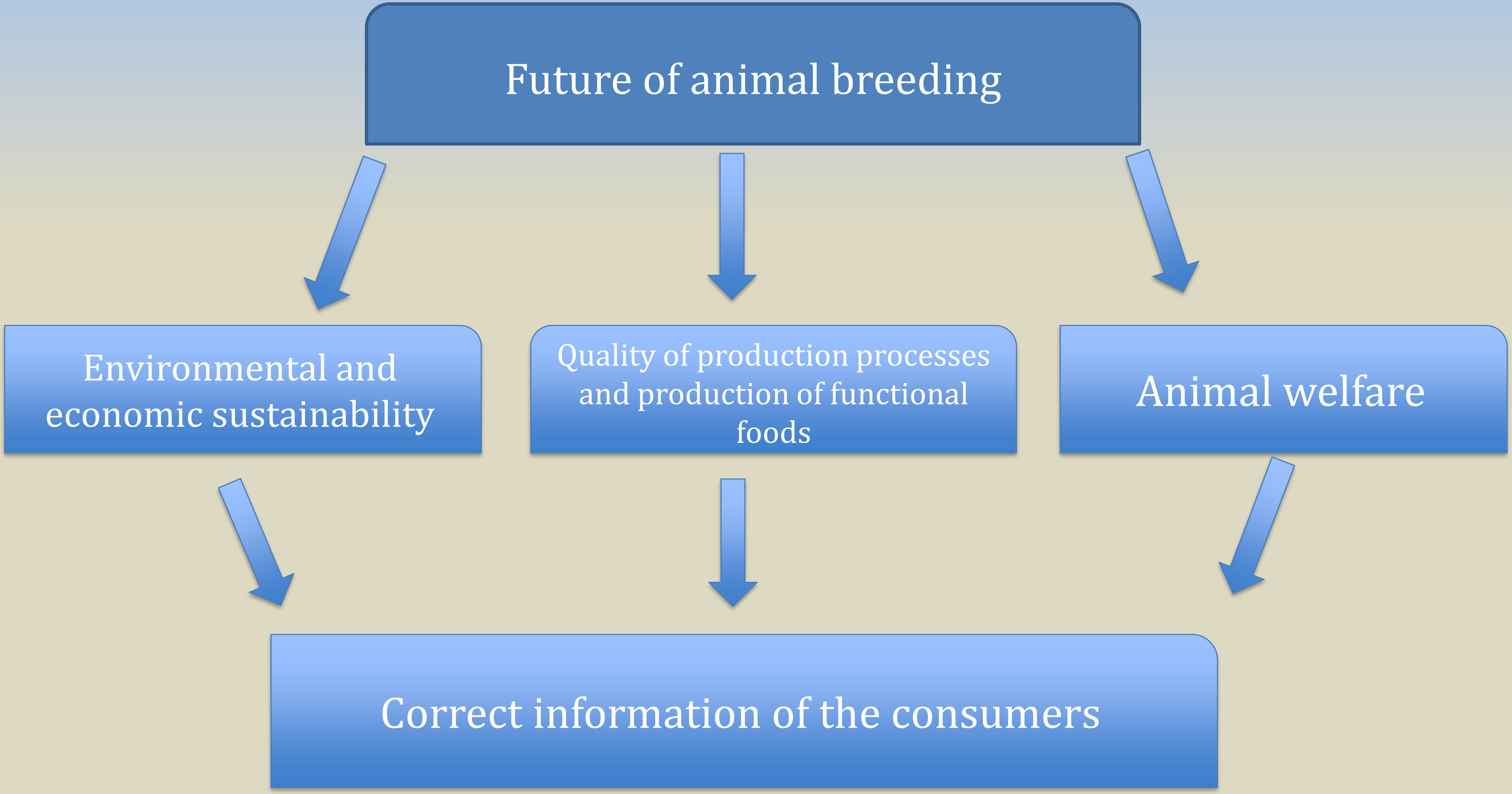
Powered by
CONSORZIO DI TUTELA
Università degli Studi di Napoli Federico II
Dipartimento Medicina Veterinaria Produzioni Animali
Dipartimento di Agraria

Problems related to animal-derived products

- "Intensification" of livestock systems
- Excessive exploitation of farm animals
- Increased exploitation of environmental resources
- Excessive use of antibiotics and synthetic products (residues)
- Use of GMOs

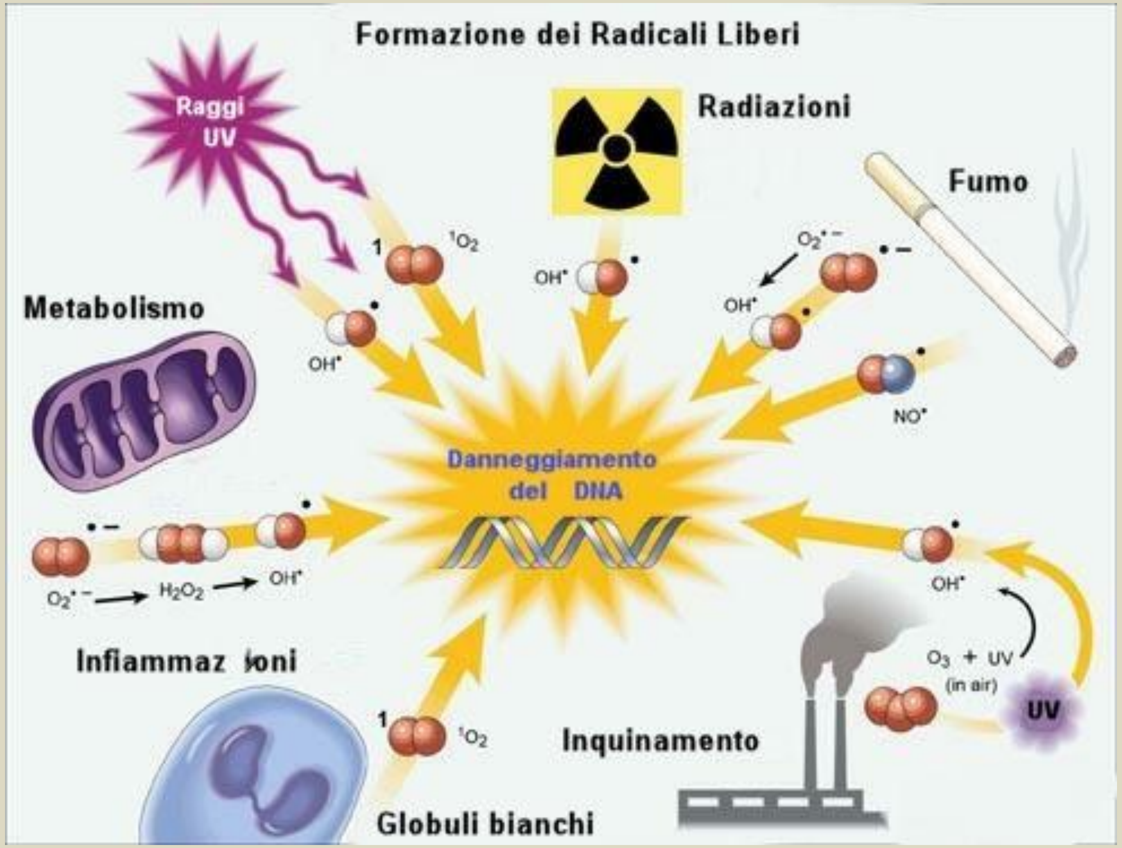
↓

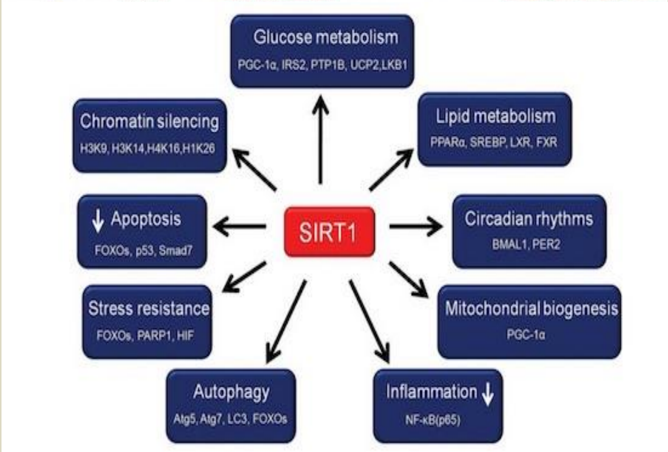
Lack of trust in animal-derived products


Future of animal breeding
Environmental and economic sustainability
Quality of production processes and production of functional foods
Animal welfare
Correct information of the consumers

Functional properties of buffalo products

SIRT foods: foods for longevity





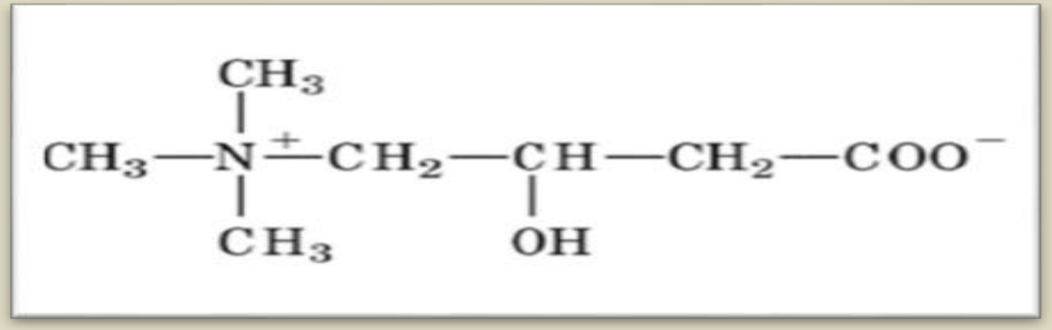
ACTIVITY OF MILK BIOPEPTIDES

- *Opioid-like and anti-opioid activity* → *Caseomorphins – Lactorphines;*
  → Casoxin;
- *Antimicrobial activity* → *Lactoferrin;*
- *Antihypertensive activity* → *Casochinine – Lactochinine;*
- *Antithrombotic activity* → *Caseoplateline;*
- *Fixing activity of minerals* → *Phosphopeptides*

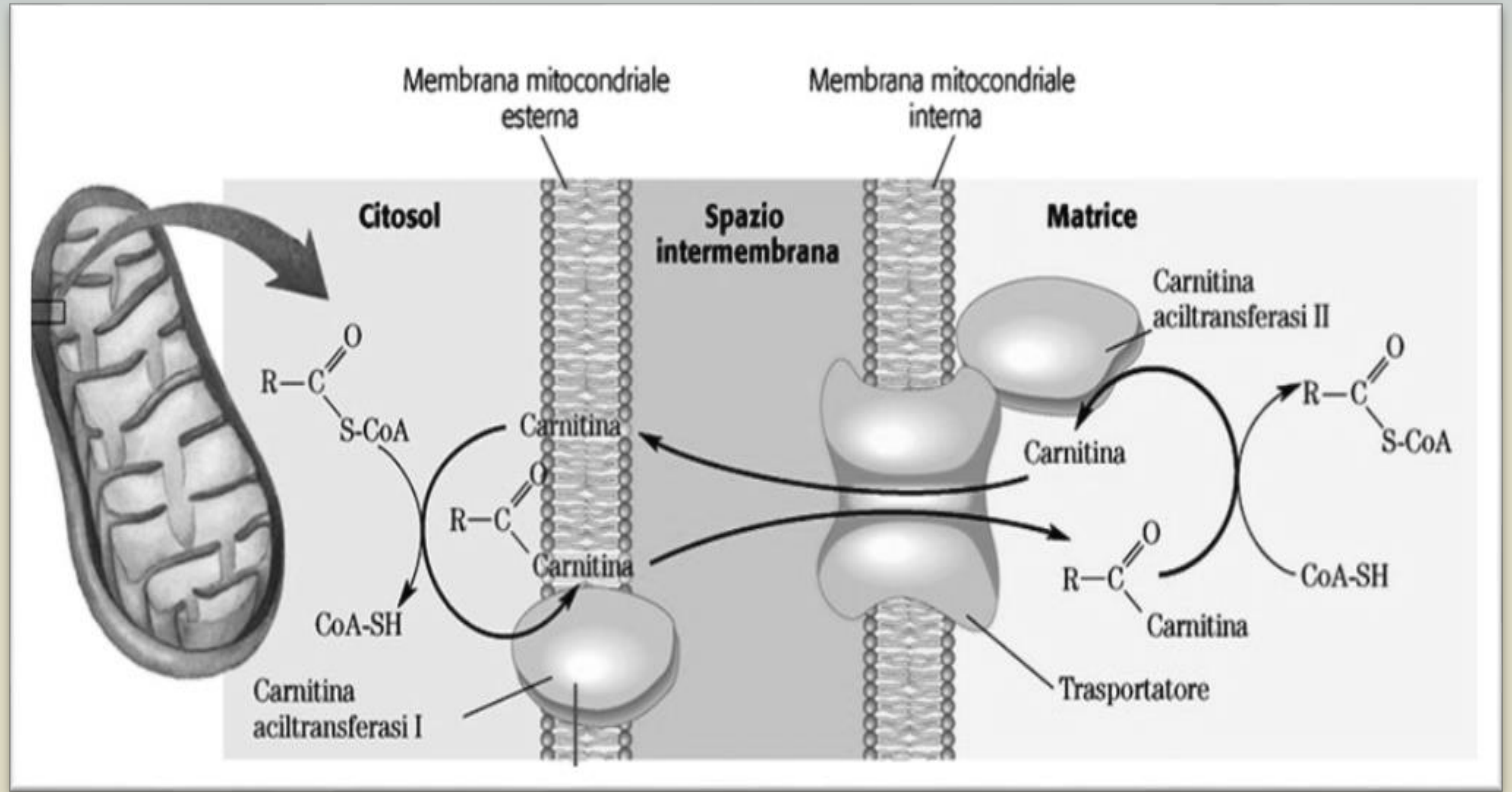
MILK AND NUTRITIONAL PROPERTIES: CARNITINE

Milk and dairy products, together with fish and meat, are the main source of **carnitine**.

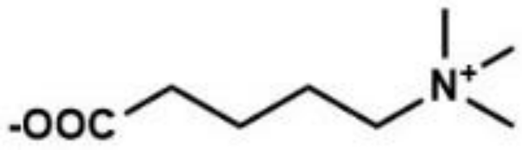
Chemically, carnitine belongs to the methylamine family and, despite being structurally similar to an amino acid, it does not form proteins, and is more similar to acetylcholine. It is a short-chain carboxylic acid and amino acid.



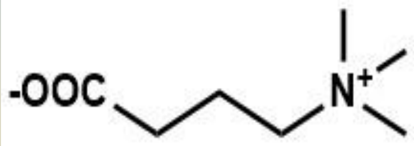
CARNITINE MEDIATED THE TRANSPORT OF FATTY ACIDS INTO THE MITOCHONDRIA



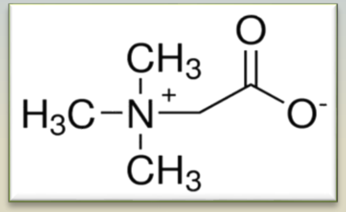
Bio-molecules of buffalo milk



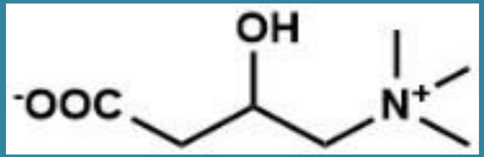
δ-Valerobetaine
Antioxidant and
Anti-inflammatory action



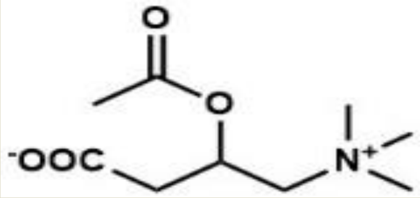
γ-Butirrobetaine



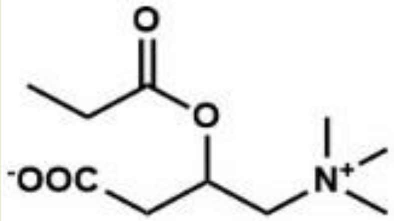
Glicine betaine
Hepatoprotective
Anticirrhotic
Antioxidant
Antiatherosclerotic
action



Carnitine



Acetilcarnitine
Powerful anti-aging antioxidant
Neuroprotector (Alzheimer's)



Propionilcarnitine
Anti-ischaemic properties
Protection from ischemia-reperfusion injury
Improve endothelial function

δ-Valerobetaine in different milk sources

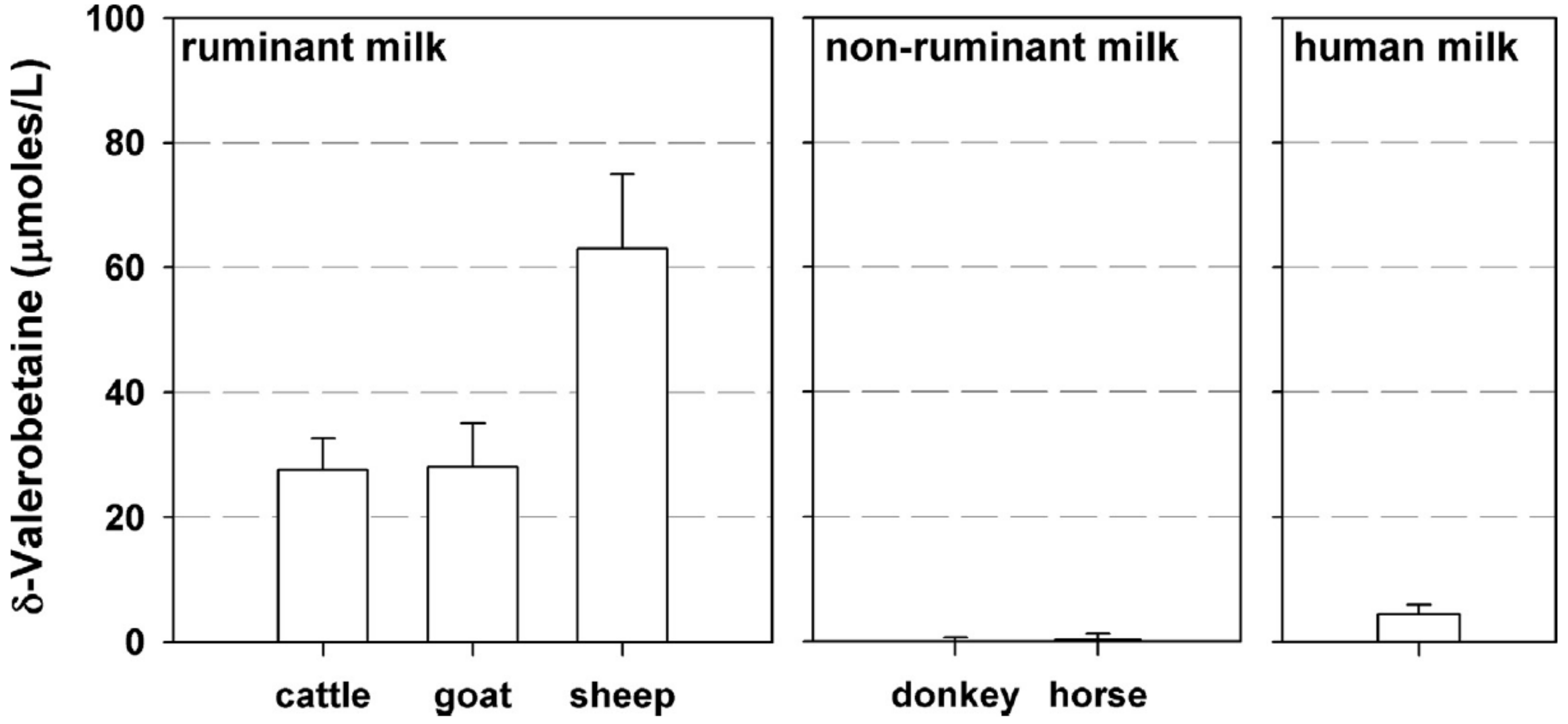
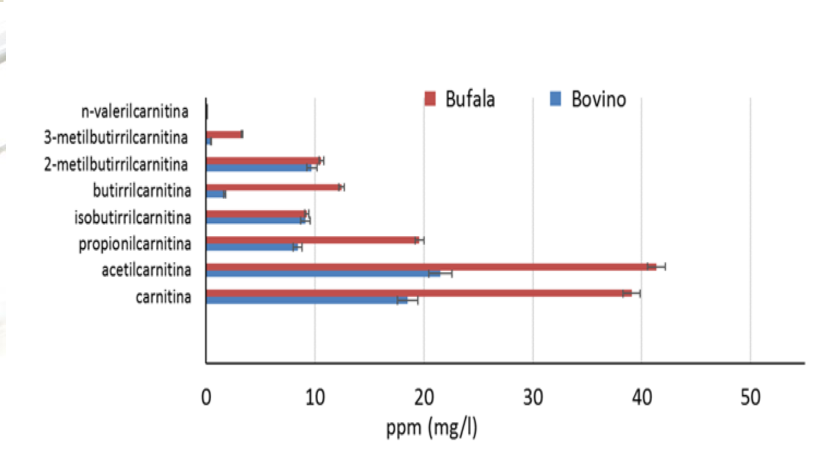
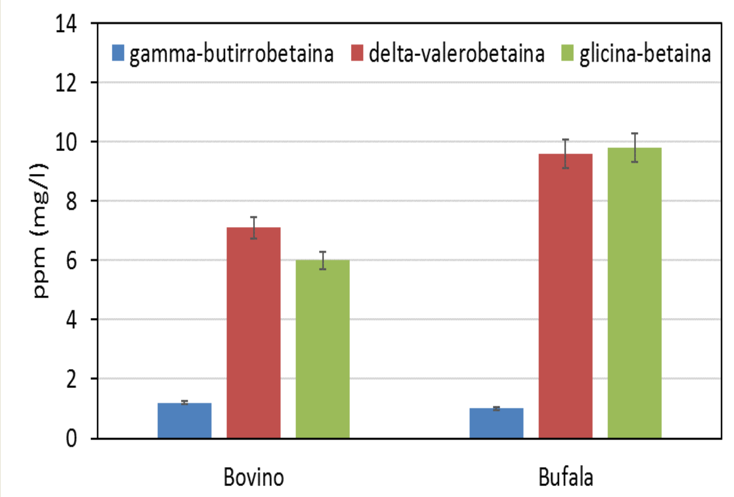


Fig. 3. Distribution of δ-valerobetaine content in ruminant and non-ruminant milk.

Biomolecules of buffalo milk

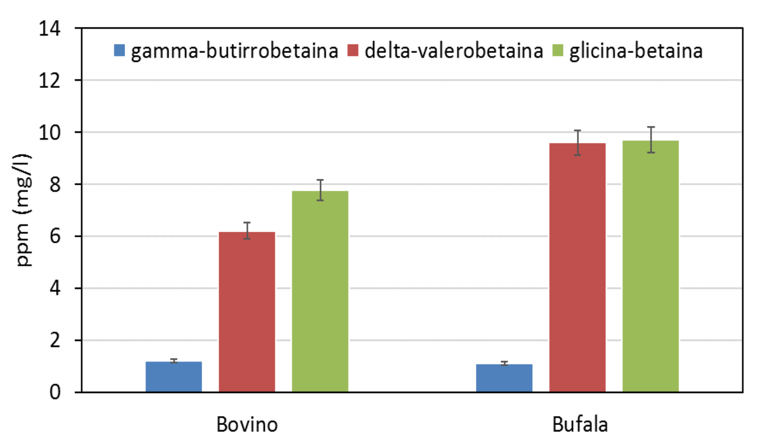
Buffalo milk is rich in carnitine, acetyl carnitine, propionyl carnitine, d-valerobetaine and glycine-betaine compared to bovine milk

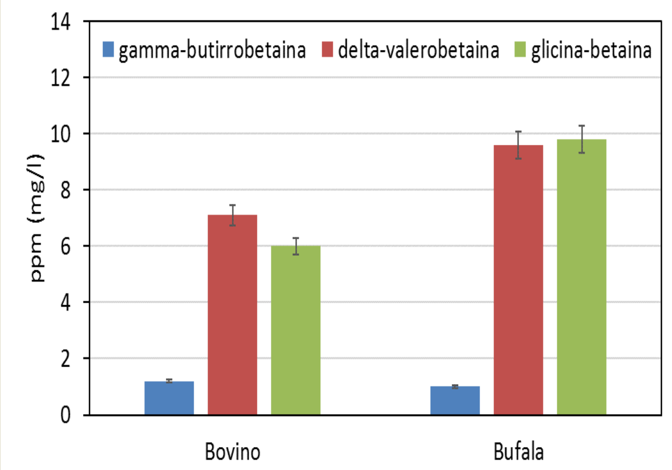




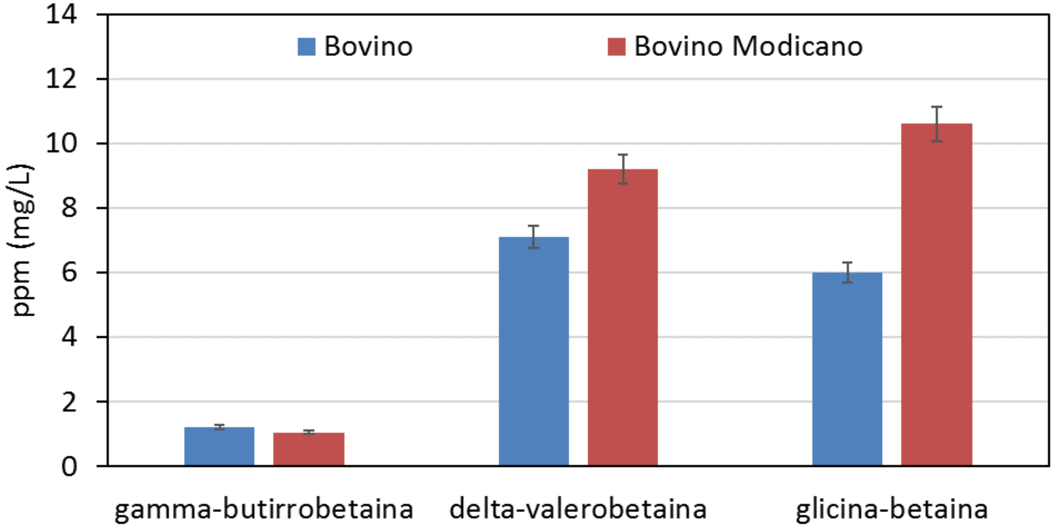
Biomolecules of buffalo milk

...as well as yogurt and whey...

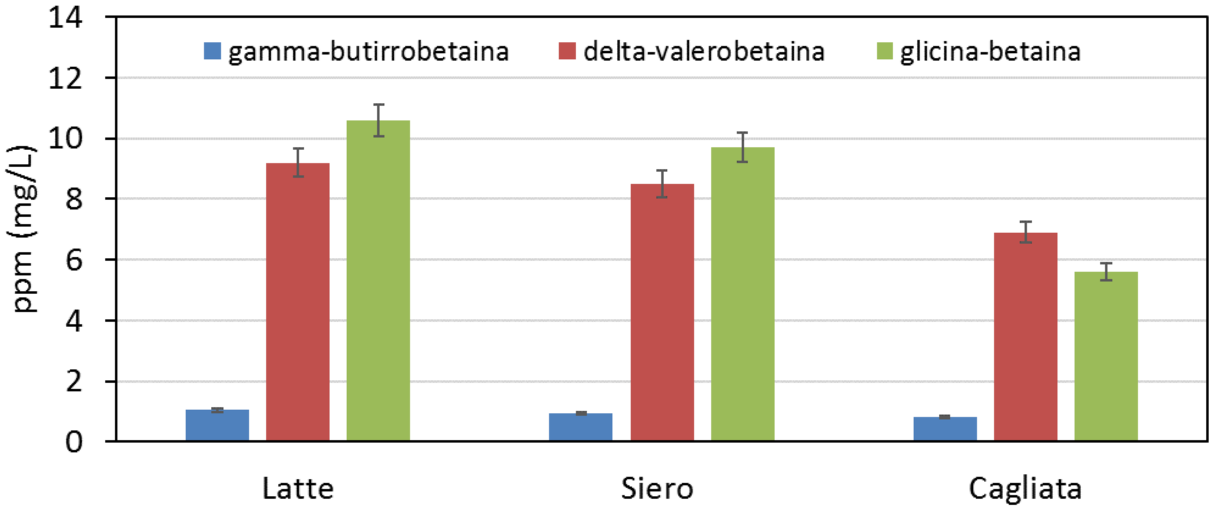




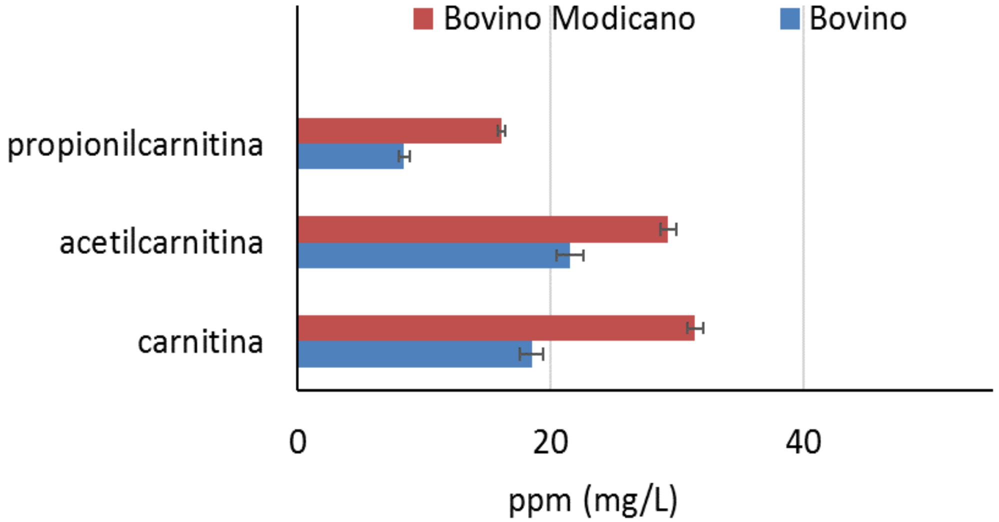
Betaine levels in Holstein (blue) and Modicana (red) milk



Betaine levels in Modicana milk and dairy products



Carnitine and acil-carnitine levels in Holstein (blue) and Modicana (red) milk



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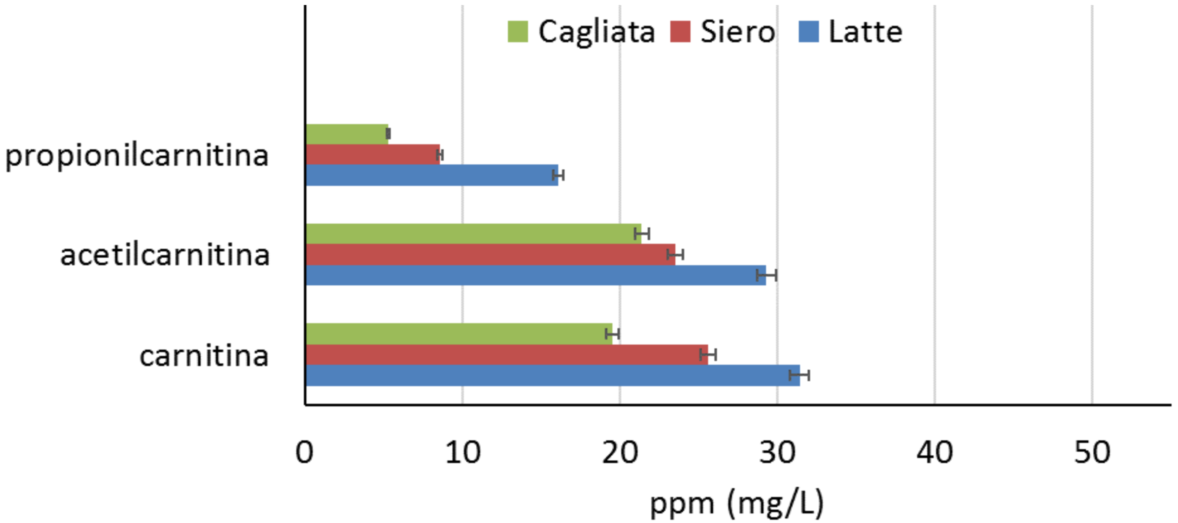


Use of breeding techniques

Availability of space

A greater availability of per capita space increases the nutraceutical power of milk (Salzano et al., 2019)

Feeding regimen

Using green forage, especially alfalfa, in the diet increases the health-promoting power of the milk (Salzano et al., 2021)

Biomolecules of buffalo milk

		Biomolecules[1] expressed in mg/l							
Product	Group[2]	Car	C_2Car	C_3Car	IC_4Car	nC_4car	γ-BB	δ-VB	glyBet
Milk	S15	56,7±1,1^{A}	51,9±0,3^{A}	34,8±1,0^{A}	10,9±0,6	14,2±1,2	6,6±0,2	24,2±0,5^{A}	23,1±2,0^{A}
	S10	39,8±0,7^{B}	39,7±0,7^{B}	21,0±0,9^{B}	11,3±0,9	12,6±0,9	6,1±0,2	16,7±0,5^{B}	13,5±1,6^{B}
Whey	S15	40,9±0,8^{A}	41,1±1,7^{A}	26,9±0,8^{A}	10,4±1,2	14,3±1,2	6,0±0,4	22,0±0,9^{A}	10,7±0,4^{A}
	S10	31,7±0,7^{B}	28,7±2,6^{B}	17,6±1,2^{B}	11,3±1,3	13,6±1,3	5.9±0,3	15,5±0,7^{B}	7,9±0,5^{B}
Mozzarella	S15	27,0±0,7	12,2±1,0	6,0±0,3	2,4±0,2	2,6±0,1	2,3±0,2	6,1±0,1	4.3±0.5
	S10	28,3±1,3	12,0±1,0	6,3±0,3	2,1±0,2	2,5±0,2	2,6±0,3	5,9±0,1	3,8±0,4
Ricotta	S15	44,2±2,2	39,3±1,4	22,5±0,9	9,8±0,7	11,1±0,5	6,5±0,3	15,7±0,3	14,9±0,8
	S10	41,4±0,9	36,8±0,8	23,9±0,7	10,7±0,5	11,7±0,7	6,1±0,2	16,0±0,4	15,6±0,7

[1]Car = l-carnitine; C2Car = acetilcarnitine; C3Car = propionilcarnitine; δ-VB = δ-valerobetaine; γ-BB = γ-butirrobetaine; iC4Car = isobutirrilcarnitine; nC4Car = butirrilcarnitine; glyBet = glicine betaine.

[2]S15= pro capita space of 15m^2 S10= pro capita space of 10m^2

[A, B,] Values whitin columns with different quotes differ; P <0.01

Influence of animal welfare (space availability: 10 vs. 15 m^2)

Biomolecules of buffalo milk

		Biomolecules[1] expressed in mg/l							
Product	Group[2]	Car	C_2Car	C_3Car	IC_4Car	nC_4car	δ-VB	γ-BB	glyBet
Milk	dry	31.5±0.8[a]	39.1±1.3[a]	13.5±1.3[a]			18.3±0.4[a]	4.8±0.3	7.01±1.7
	green	41.6±0.5[b]	49.7±0.8[b]	20.5±1.7[b]			21.8±0.4[b]	3.3±1.1	7.11±0.7
Yogurt	dry	35.7±1.7	24.8±5.2	25.5±5.6	10.9±0.5	11.6±0.8	17.2±0.5	5.6±0.2	5.2±0.5
	green	31.1±3.6	20.6±2.0	23.0±1.6	8.6±1.2	8.4±0.6	14.0±3.0	3.4±0.6	4.9±0.2
Mozzarella	dry	15.1±1.2	8.8±0.3	1.4±0.1	0.6±0.1	0.4±0.1	1.6±0.3	6.3±0.1	2.0±0.2
	green	13.6±0.1	7.3±1.2	1.1±0.2	0.6±0.1	0.4±0.1	1.4±0.2	5.0±0.8	2.0±0.7
Ricotta	dry	23.8±0.3	15.9±0.4	7.2±1.1	3.3±0.1	2.2±0.2	1.2±0.2	13.2±0.8	6.6±0.7
	green	21.1±0.5	13.8±0.6	5.9±1.0	3.0±0.5	1.9±0.3	1.4±0.4	11.0±2.3	14.9±1.3
Whey	dry	39.2±0.1	24.1±2.5	27.1±2.5	11.4±0.5	15.8±0.5	2.2±0.3	23.3±0.8	9.3±0.3
	green	31.2±0.5	24.4±2.5	25.1±0.9	10.6±0.0	14.7±0.5	2.7±0.3	20.9±0.5	8.5±0.7

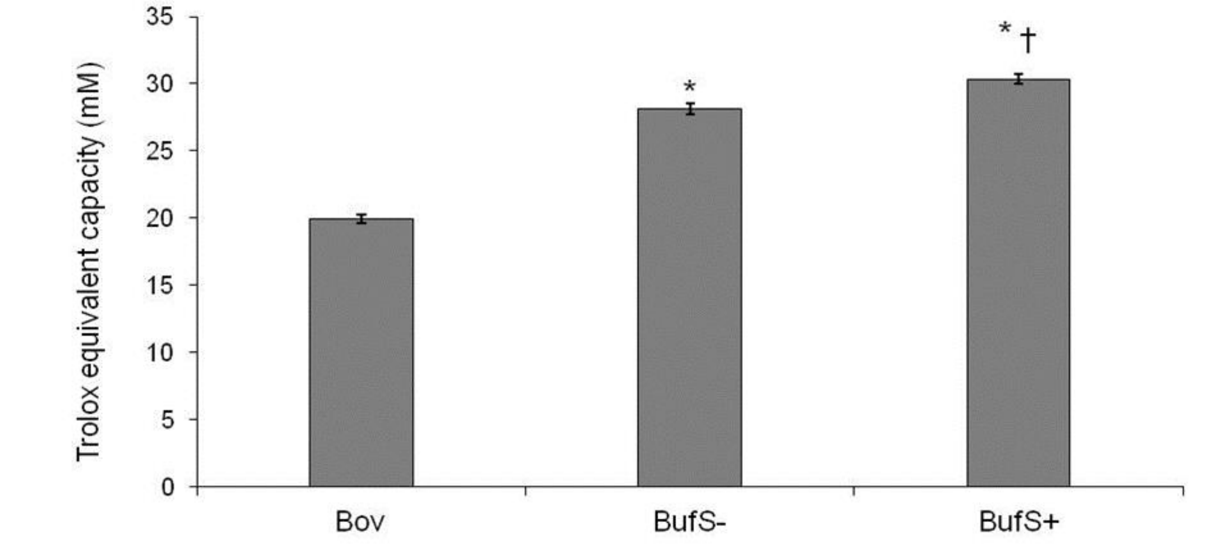
[1]Car = l-carnitine; C2Car = acetilcarnitine; C3Car = propionilcarnitine; δ-VB = δ-valerobetaine; γ-BB = γ-butirrobetaine; iC4Car = isobutirrilcarnitine; nC4Car = butirrilcarnitine; glyBet = glicine betaine.

[a, b,] Values whitin columns with different quotes differ; P <0.05

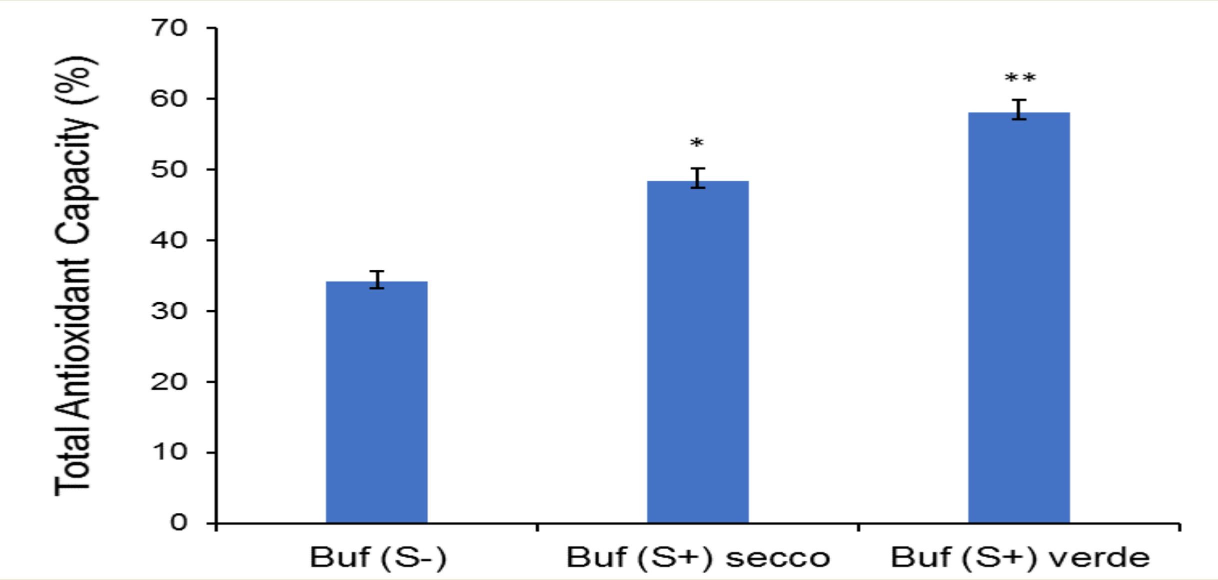
Influence of feeding regimen (green vs. dry forage)

Bio-molecules of buffalo milk

Antioxidant power of buffalo milk: influence of breeding techniques and animal welfare (space availability: 10 vs. 15 m2)



Bio-molecules of buffalo milk: antioxidant activity and dietary pattern (green vs dry forage)



What happens inside the rumen?

The study was carried out over 60 days by using Italian Mediterranean dairy buffaloes (n=16; 8 per group). Animals were randomly assigned to two homogeneous groups (Control and Treated) according to parity, age, days in milk and average milk production.

Control buffaloes received a total mixed ration (TMR) whilst treated buffaloes received TMR + green forage which comprised ryegrass (30% of the diet).

The two diets were created isonitrogenous and isoenergetic and differed only in the inclusion of ryegrass in treated animals.

At the end of the trial, samples of rumen and rumen liquid were collected for molecular studies.

Item	Control buffaloes	Treated buffaloes
Component	**Amount (kg of feed)**	
Ryegrass	-	25
Corn silage	18	13
Alfalfa hay	5	1
Soybean meal (48%)	1.6	-
Concentrate	4.4	4
Corn meal	1	1.8
Hydrogenated fats	0.3	0.3
Calcium Carbonate	0.1	-
Salt 1:3	0.1	0.1
Vitamins	0.1	-
Composition (% on dry matter intake)		
Dry matter	16.5	16.6
CP	14.7	14.7
Fat	6.0	7.0
NDF	36.8	36.8
ADF	21.2	19.5
NSC	33.8	34.7
Starch	18.8	18.8
Ash	8.8	6.8
Calcium	0.9	1
Phosphorus	0.4	0.4
MFU	0.93	0.93

Table. Feed and chemical composition of the buffalo diets without (Control) or with (Treated) 30% green ryegrass. NDF, neutral detergent fiber; ADF, acid detergent fiber; NSC, non-structural carbohydrates; MFU, milk forage units.

Green feed increases rumen bacterial diversity in dairy buffaloes

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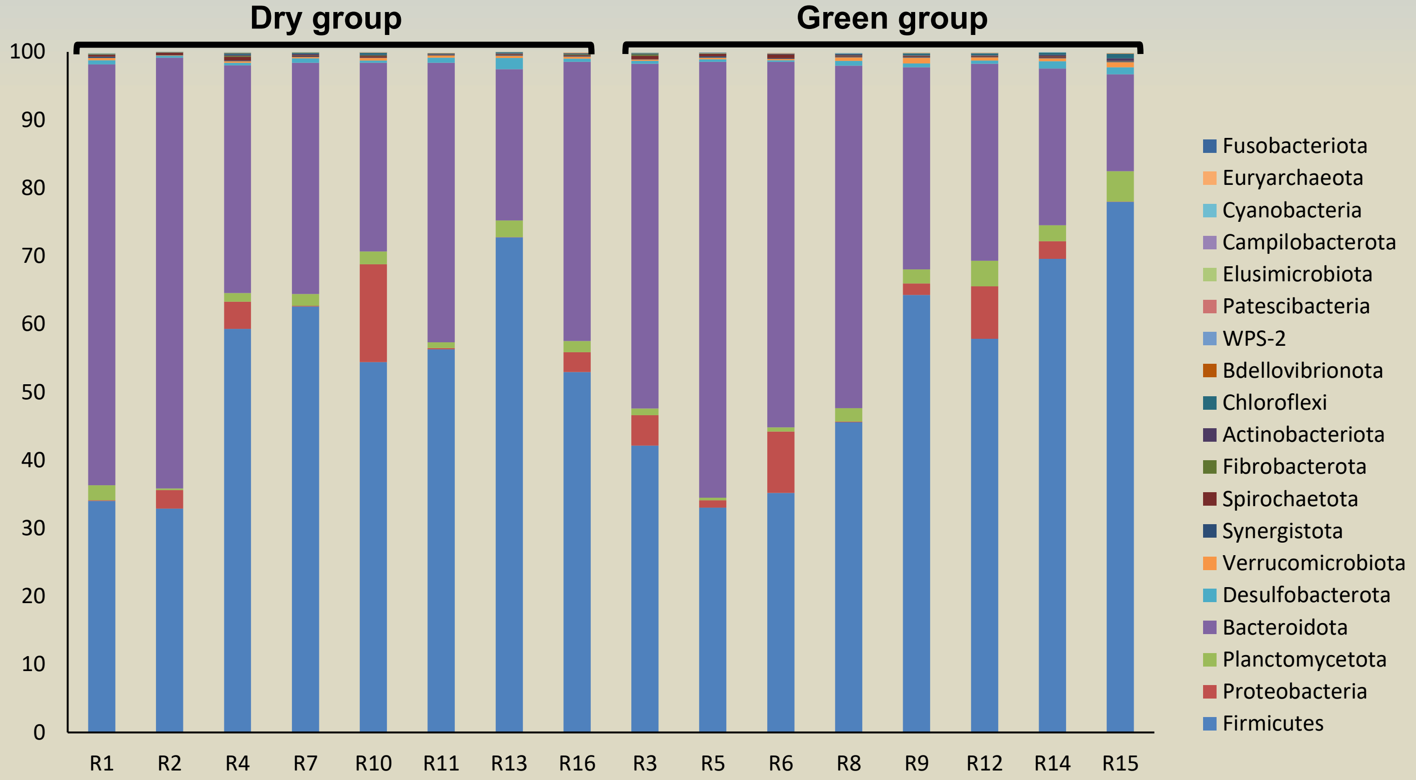


Green diet regimen slightly affects the microbial compostion of the rumen of water buffaloes. Rumens of animals fed green diet have an increased microbial biodiversity, mainly due to low (below 1%) represented bacterial genera. The metagenomic analysis indicated an increased number of metabolic functions associated to the rumen microbiota of the animals fed Green diet and different Carbohydrate-active enzymes that support the synthesis of functional biomolecules in milk.

Salzano et al., 2024 under review

Transcriptomic profiles of buffaloes ruminal wall fed green forage

Green feed diet in ruminants exerts a beneficial effect on rumen metabolism and enhances the content of milk nutraceutical quality. We performed RNA-sequencing in the rumen of buffaloes fed green feed (treated) or TMR (control), and identified differentially expressed genes.

Green feed modulates biological processes relevant for the rumen physiology and, then, health and well-being of buffaloes, such as lipid and protein metabolism, response to the oxidative stress, immune response, and muscle structure and function.

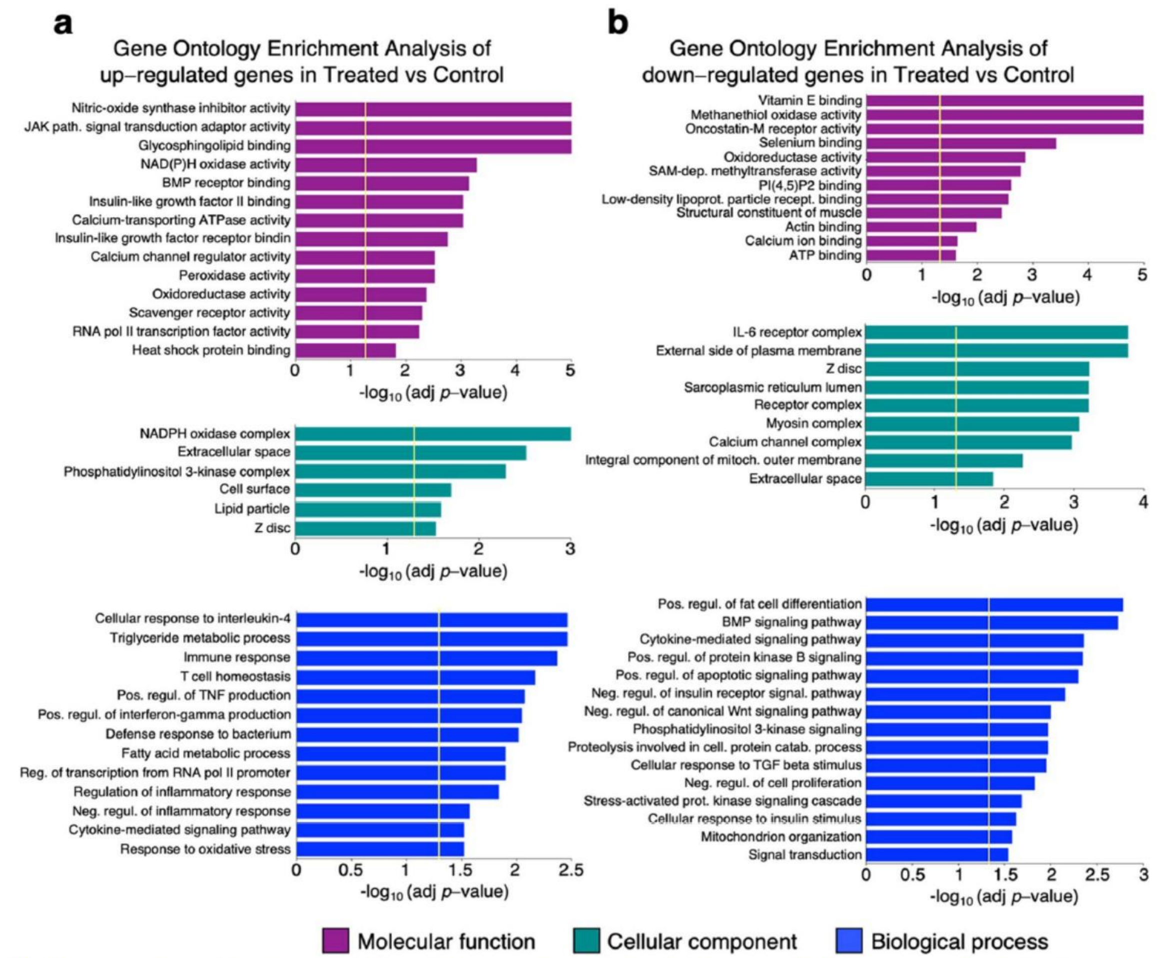


Fig. 4 Gene ontology enrichment analysis of differentially expressed genes. Selected GO-terms, enriched in genes up-regulated (**a**) and down-regulated (**b**) in rumen of buffaloes fed a TMR + green feed (Treated) in comparison with those fed the TMR diet (Control), are shown. GO terms were classified as molecular function (purple bars), cellular component (green bars) and biological process (blue bars). Bar graphs indicate the statistical significance of the enrichment, as $-\log_{10}$ (adj *p*-value). Vertical yellow bars indicate the cut-off level for significance ($p < 0.05$, adjusted by Benjamini-Hochberg correction)

Salzano et al., 2023 BMC Genomics

GENES RELATED TO FACTORS INVOLVED IN THE REGULATION OF BIOLOGICAL PROCESSES

ENERGY, AMINO ACID, AND LIPID METABOLISM

↑ ARFGEF3: Codes for the BIG3 protein, which participates in the regulation of systemic glucose homeostasis, through the regulation of insulin and glucagon secretion.

↑ HSD17B13: Associated with an increase in lipogenesis.

↓ CDO1 and SELENBP1: Related to the metabolism of cysteine/methionine, serine, and lysine.

CELLULAR RESPONSE TO STRESS

↑ VNN1: Codes for the pantetheinase enzyme, involved in the production of pantothenic acid (vitamin B5) and coenzyme A (CoA).

IMMUNE SYSTEM AND INFLAMMATION

↑ TRIM14: Codes for a protein belonging to the TRIM family, also known to promote the body's defense against viral infections.

↑ IGFBP6: Involved in the immune response.

GENES RELATED TO FACTORS INVOLVED IN THE FUNCTIONALITY OF THE RUMEN

ORGANIZATION OF THE EXTRACELLULAR MATRIX

↑ LAMA1 and COL4A6: Main constituents of the extracellular matrix.

↓ COL1A1 and UGDH: Main constituents of the extracellular matrix.

MUSCLE STRUCTURE/FUNCTION

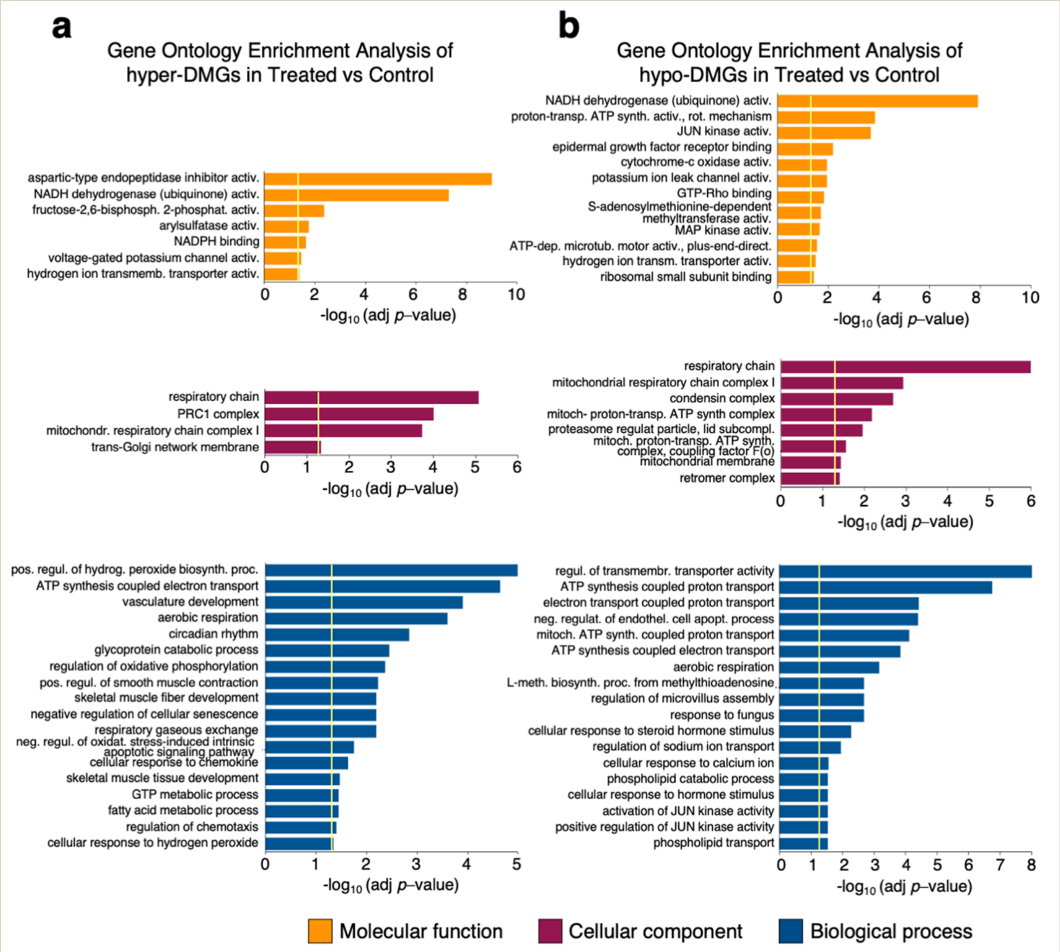
↑ KCNK10, CACNG4 and ATP2B4: Codes for factors that modulate Ca2+ homeostasis.

Green forage impacts on the DNA methylation in the ruminal wall of IMB

The aim of this study was to identify genomic regions differentially methylated in the ruminal wall of IMB fed green forage compared to a standard TMR diet, through the RRBS technique.

We highlighted 4648 genes associated with differentially methylated regions, the majority of which (82.4%) were protein-coding genes. Gene Ontology found categories related to response to oxidative stress, circadian rhythms, fungal infections and inflammation, rumen functionality, energy, lipid, and amino acid metabolism.

The integration of differential expression data with methylation data allowed to identify a discrete number of genes for which their expression varies as a function of DNA methylation.



Gene ontology enrichment analysis of genes associated with DMRs. Selected GO-terms, enriched in genes associated with hyper-DMRs (a) and hypo-DMRs (b) in the ruminal wall of BMI fed green forage in comparison with animals fed standard diet, are shown.

Fioriniello et al., 2024 under review

Buffalo milk and rumen fluid metabolome are significantly affected by green feed

The study of milk metabolomic profile revealed a compositional differences between buffaloes fed TMR only (DD group) or green feed (ZG group).

As resulted from the multi- and univariate analysis of the LC–MS dataset, DD and ZG groups cluster separately from each other when comparing samples collected at the same time point, differing in the abundance of specific metabolites (Table 2).

In rumen fluid, among the molecules differentially accumulated, four have been putatively identified (Table 5). All these compounds are down regulated in control vs green feeding.

Milk

Compound	Monoisotopic mass (Da)	Regulation DD vs ZG					
		June	July	August	LnFC (June)	LnFC (July)	LnFC (August)
γ-Butyrobetaine	145.1098	Down	Down	Down	− 18.1088	− 7.8222	− 16.2603
δ-Valerobetaine	159.1254	n.d.	Down	Down	n.d.	− 2.98936	− 14.3323
L-Carnitine	161.1048	n.d.	Down	Down	n.d.	− 3.20882	− 14.6969
Acetylcarnitine	203.1163	Up	Down	Down	21.28232	− 2.96594	− 14.6381
Propionylcarnitine	217.1312	n.d.	Down	Down	n.d.	− 14.4192	− 10.7945
Butyrylcarnitine	231.1485	Up	Down	Up	22.13542	− 2.93003	7.460587
2-Methylbutyrylcarnitine	245.1644	Up	Down	Up	19.65461	− 3.0367	5.092634
Glycerophosphocholine	257.1036	Down	Down	n.d.	− 12.3487	− 3.10791	n.d.
2-Hexenoylcarnitine	257.1664	Up	n.d.	n.d.	15.89597	n.d.	n.d.
Hexanoylcarnitine	259.1796	Down	n.d.	n.d.	− 15.6068	n.d.	n.d.

Table 2. Metabolites obtained from LC–MS data (positive mode), that are differentially accumulated in milk samples from buffaloes of DD Group (fed a total mixed ratio (TMR)) and ZG Group (fed TMR + 30% of green forage) analyzed for 3 months (June, July and August). Identifications were performed by comparing results with known compounds present in freely available electronic databases. Milk Composition Database (MCDB) and Bovine Metabolome Database (BMDB) were used for the identification. Up, up regulated; Down, down regulated; n.d., compounds not detected after statistical analysis. LnFC, Natural logarithm of Fold Change.

Rumen fluid

Compound	Monoisotopic mass (Da)	Regulation DD vs ZG	LnFC (DD vs. ZG)
3-(2-hydroxyphenyl)-propanoate	165.0338	Down	− 19.4548
Indole-3-acrylic acid	187.0635	Down	− 4.18757
Oleamide	281.2724	Down	− 3.20791
20-Carboxy-leukotriene B4	366.2024	Down	− 6.38134

Table 5. Metabolites obtained from LC–MS data (positive mode), that are differentially accumulated in ruminal fluid samples from buffaloes of DD Group (fed a total mixed ratio (TMR)) and ZG Group (fed TMR + 30% of green forage). Identifications were performed by comparing results with known compounds present in a freely available electronic database. Bovine Metabolome Database (BMDB) was used for the identification. Up, up regulated; Down, down regulated. LnFC, Natural logarithm of Fold Change.

Neglia et al., 2023 Scientific Reports

Former food products (FFPs) and biomolecules in milk

Our hypothesis was to test if FFPs could be used as an alternative to green forages to improve rumen metabolism and ensures higher levels of carnitine precursors during all year round. The inclusion of FFPs containing 87% biscuit meal in the diets of dairy buffaloes reached similar values to green feed for δ-valerobetaine and acetyl-L-carnitine while the antioxidant activity in milk and plasma is still higher in green feed compared to FFPs.

TABLE 7 Functional biomolecules content in milk (mg/L)

Group	Green	FFPs
γ-butyrobetaine	6.24 ± 0.10^{A}	5.87 ± 0.10^{B}
δ-valerobetaine	17.4 ± 0.14	17.2 ± 0.21
glycine betaine	15.5 ± 0.14^{A}	15.0 ± 0.12^{B}
L-carnitine	39.6 ± 0.36^{A}	37.3 ± 0.17^{B}
acetyl-L-carnitine	45.4 ± 0.59	43.8 ± 0.71
propionyl-L-carnitine	25.0 ± 0.36^{A}	22.3 ± 0.32^{B}

Note: Different letters along the row indicate statistically significant differences (^{A,B} $p<0.01$). Values are expressed as mean ± SEM. (standard error of the mean). Green is the group fed with fresh forage, FFPs is the group fed with Former Food Products (Top Star®).

TABLE 8 Total antioxidant activity (TAC) and Ferric Reducing Antioxidant Power (FRAP) in blood and milk

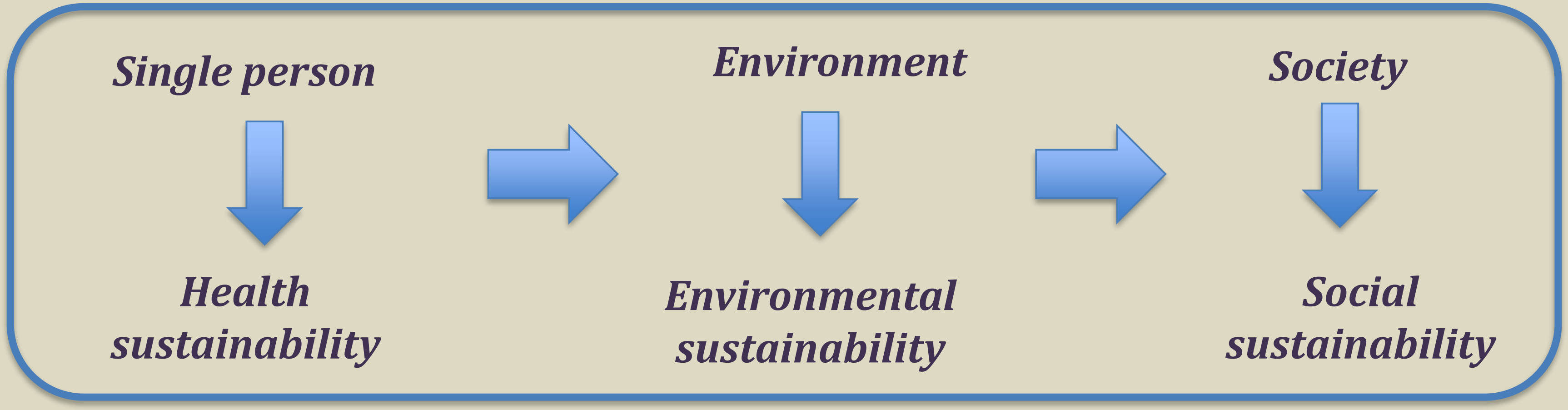
		Green	FFPs
TAC	*Milk*	276.51 ± 9.31^{b}	252.45 ± 7.66^{a}
FRAP	*Milk*	240.62 ± 6.00^{B}	213.86 ± 4.89^{A}
TAC	*Plasma*	77.52 ± 1.43^{B}	71.66 ± 1.74^{A}
FRAP	*Plasma*	58.53 ± 2.22^{b}	51.10 ± 1.89^{a}

Note: Different letters along the row indicate statistically significant differences (^{a,b} $p<0.05$, ^{A,B} $p<0.01$). Values are expressed as mean ± SEM. (standard error of mean).
Green is the group fed with fresh forage, FFPs is the group fed with Former Food Products (Top Star®).
Abbreviations: TAC, total antioxidant capacity, FRAP, ferric reducing antioxidant power assay.

Neglia et al., 2023 Journal of Animal Physiology and Animal Nutrition

Bio-molecules of buffalo products: quality nutrition

Offer the consumer food able to maintain health without negative effects on the environment



Thanks for the attention

BUFFALO MILK: A HEALTHY FOOD IN THE PREVENTION OF AGING DISEASES

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella & Milk Products
24/25 Sept. 2024

Maria Luisa Balestrieri

Università degli Studi della Campania Luigi Vanvitelli
Scuola di Medicina e Chirugia
Dipartimento di Medicina di Precisione

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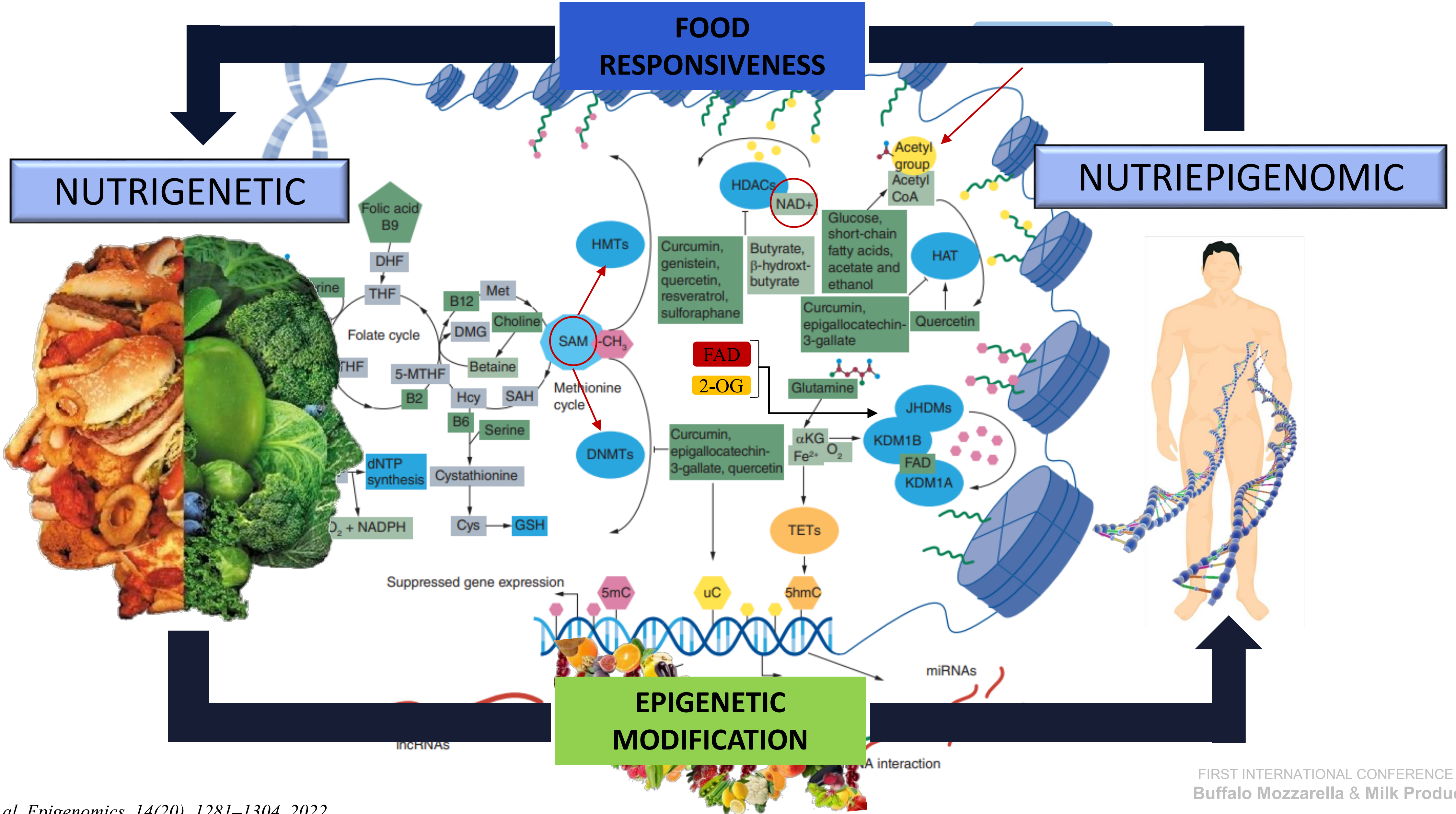
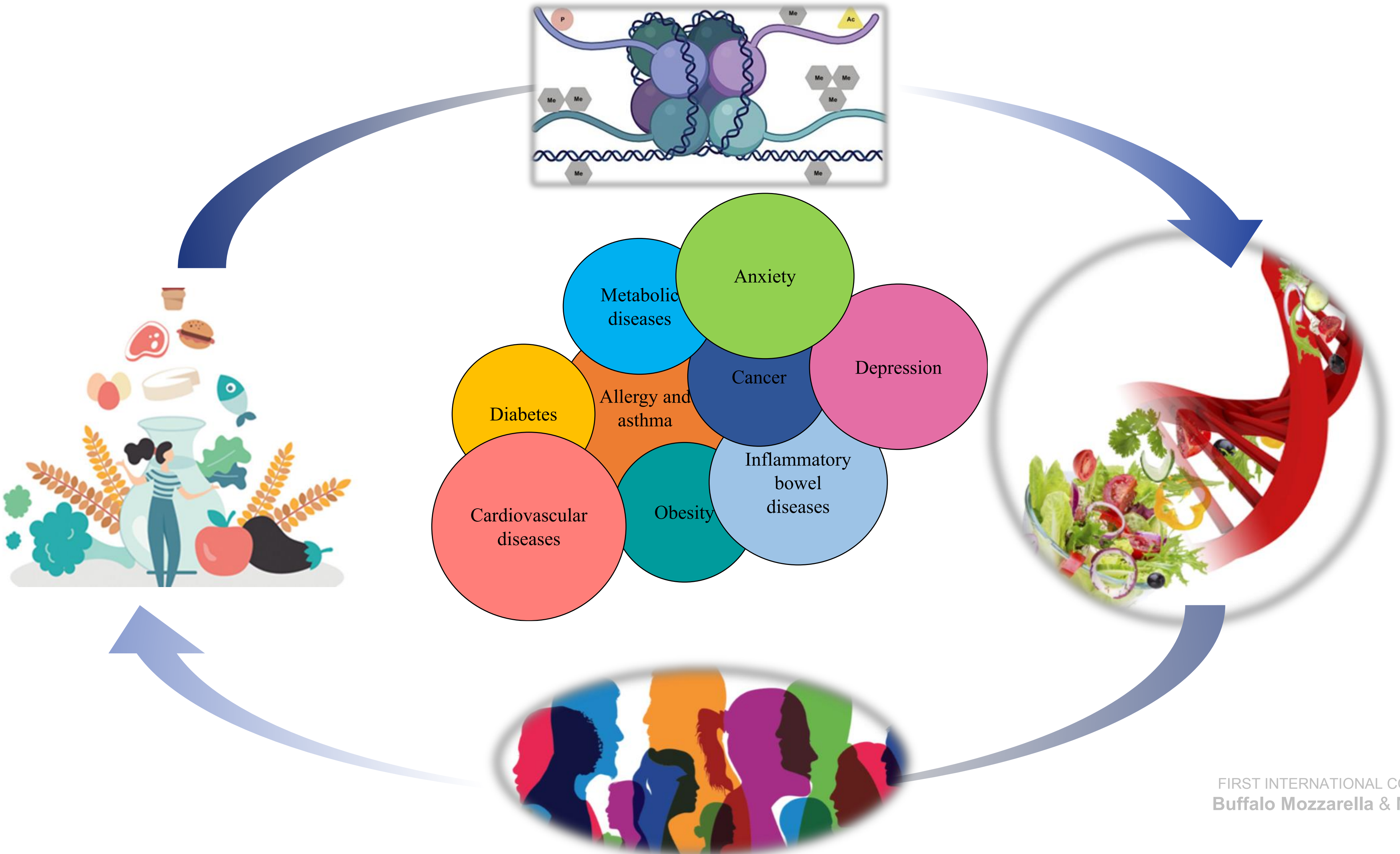
Interplay among nutrients, metabolites and epigenetic pathways

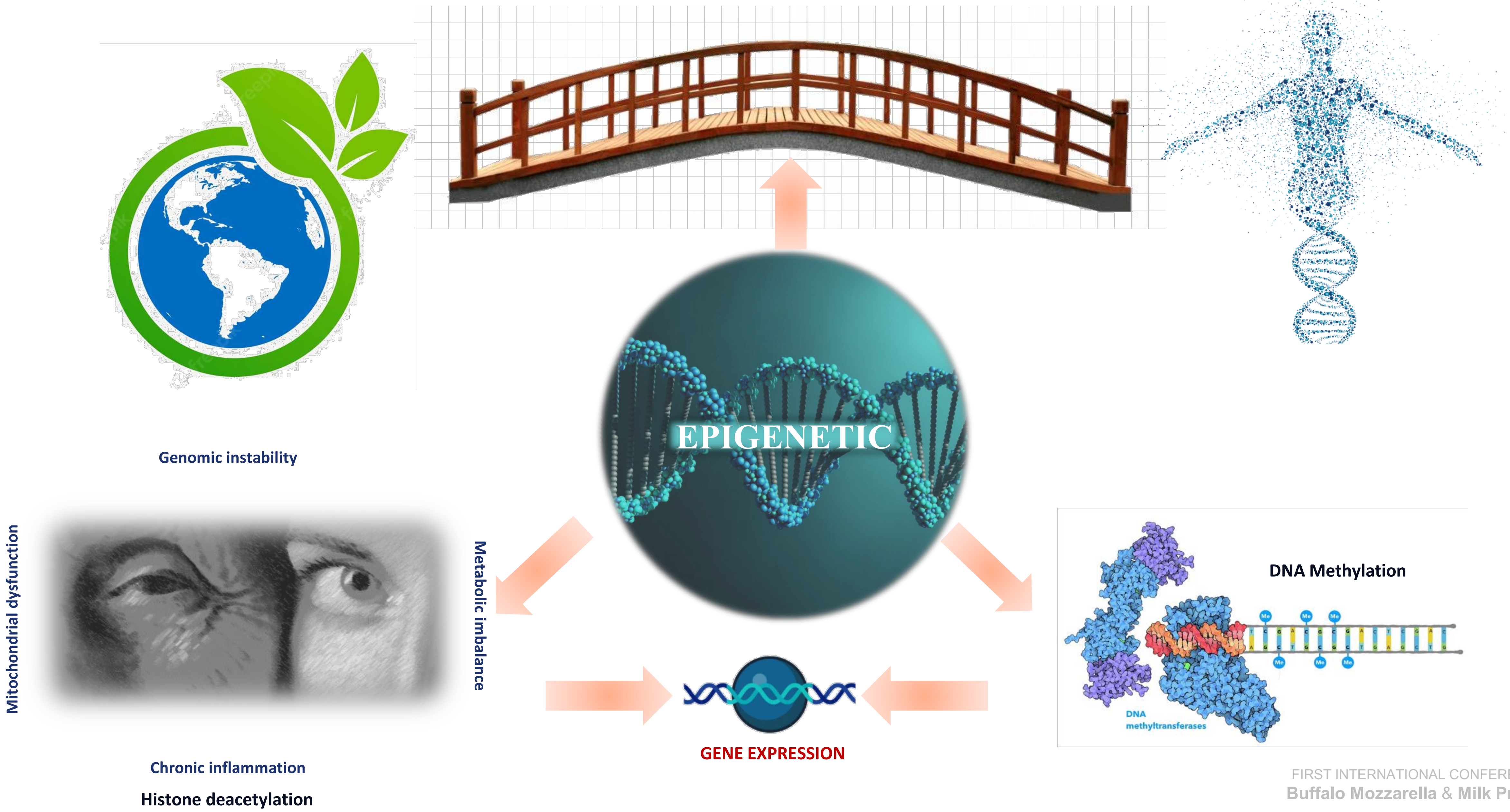


Coppedè F, et al. Epigenomics, 14(20), 1281–1304, 2022

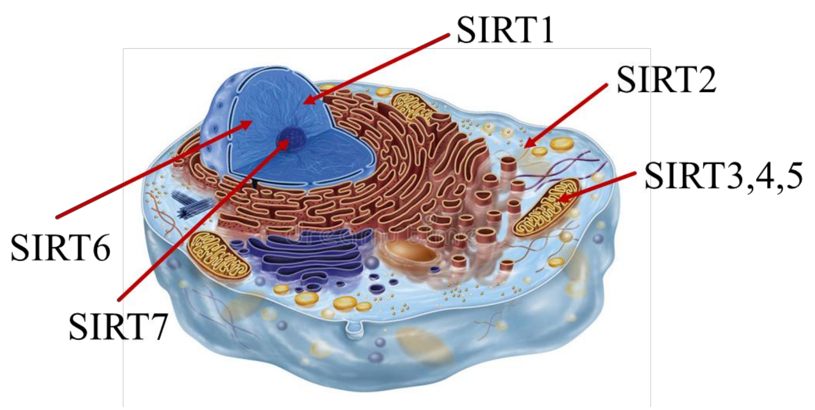
Nutritional factors influence the epigenome

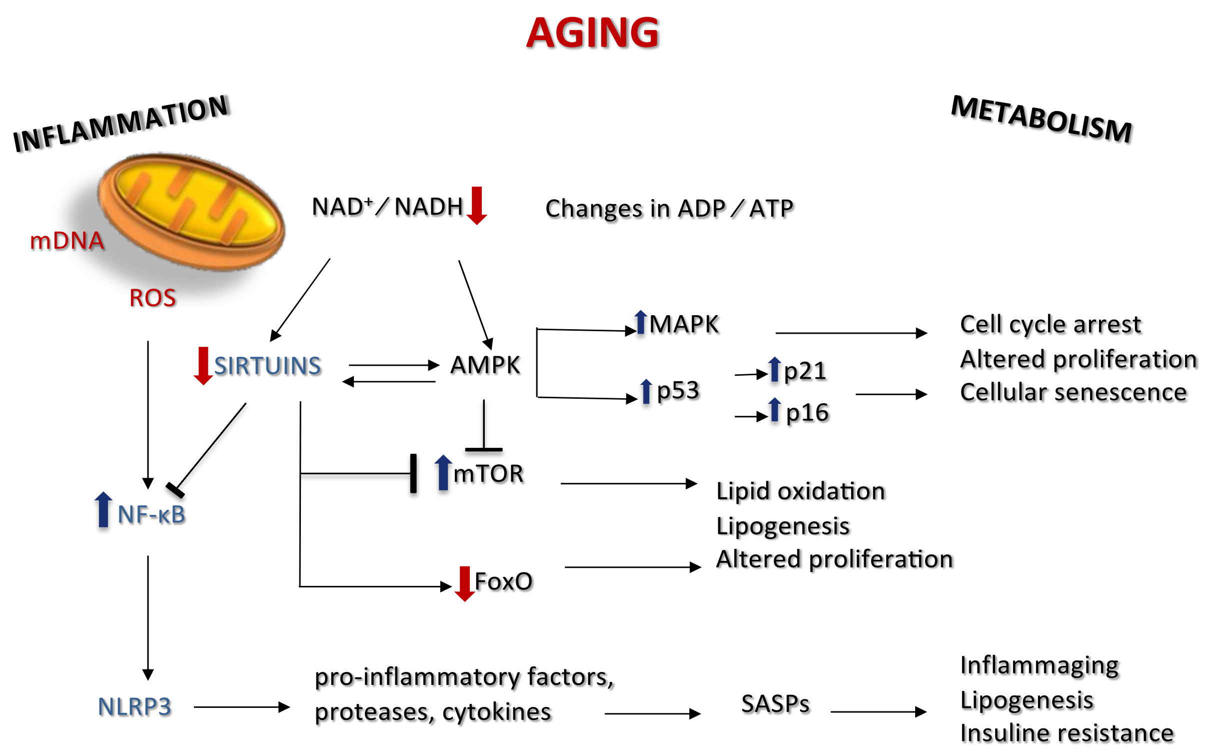


Epigenetic: the bridge between environment and genome



Sirtuin: the epigenetic stressor modulator





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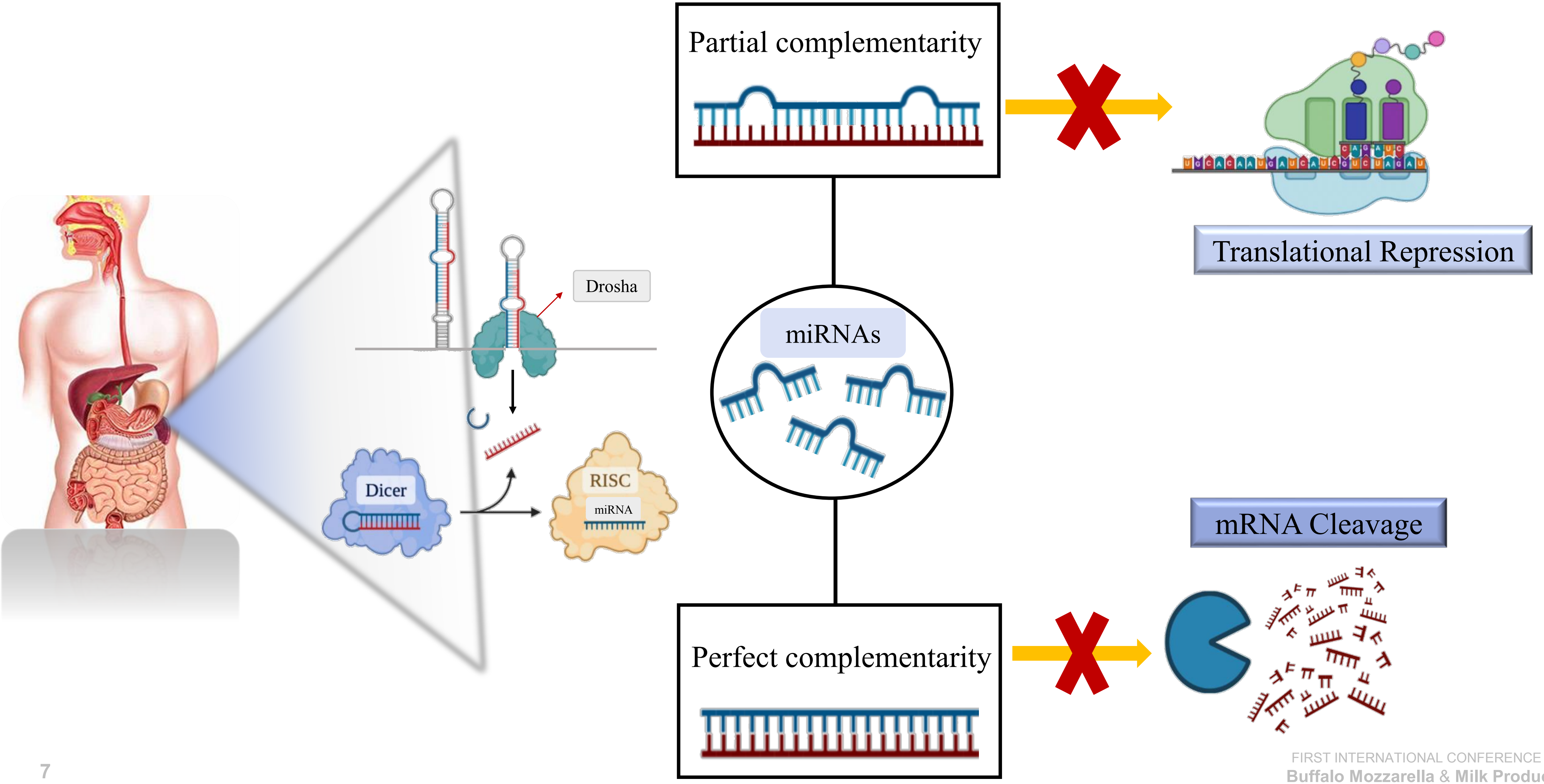
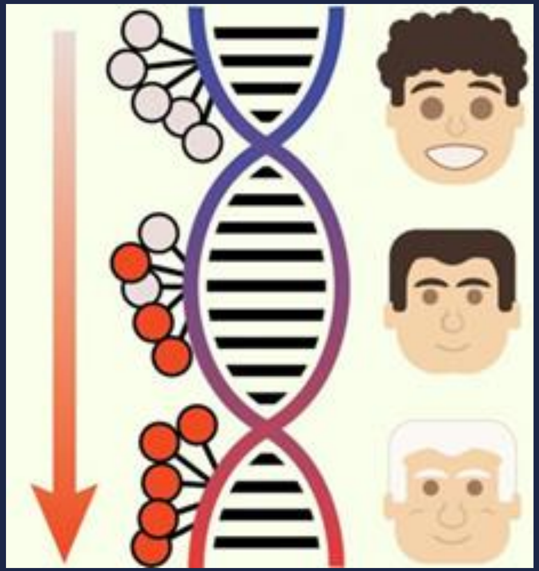
MicroRNAs in epigenetic regulation



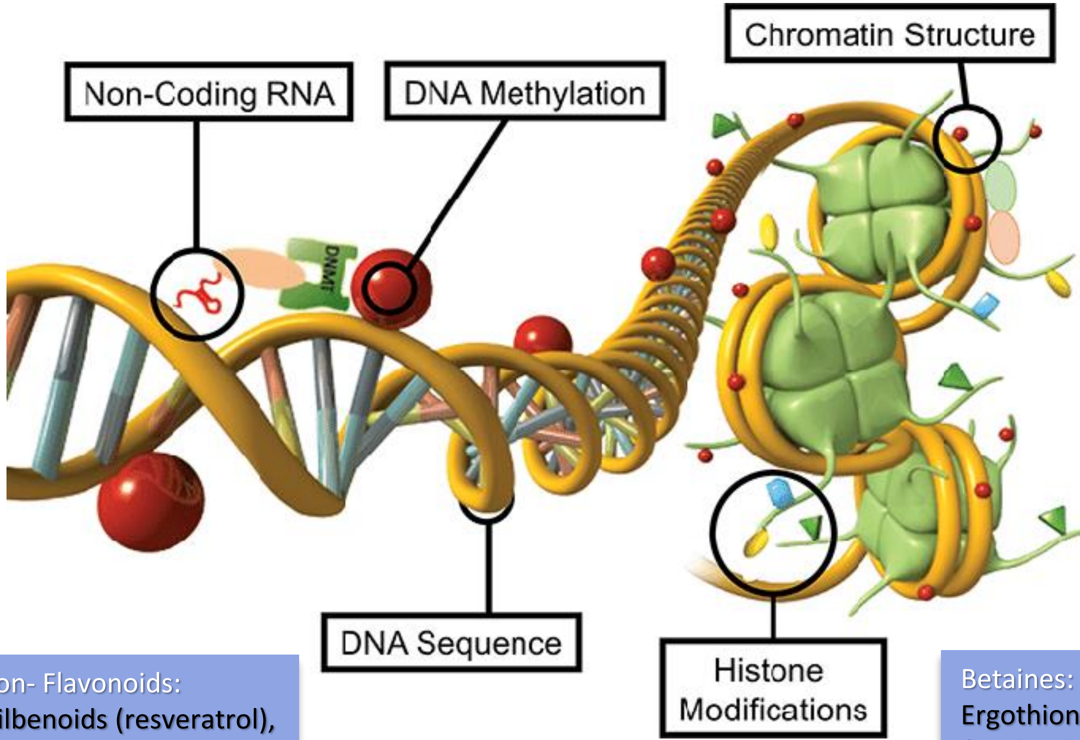
Molecular mechanism through which buffalo milk targets aging pathways



Dietary Epigenetic Modulators

Milk

Whey



Vitamin E, D, Omega 3

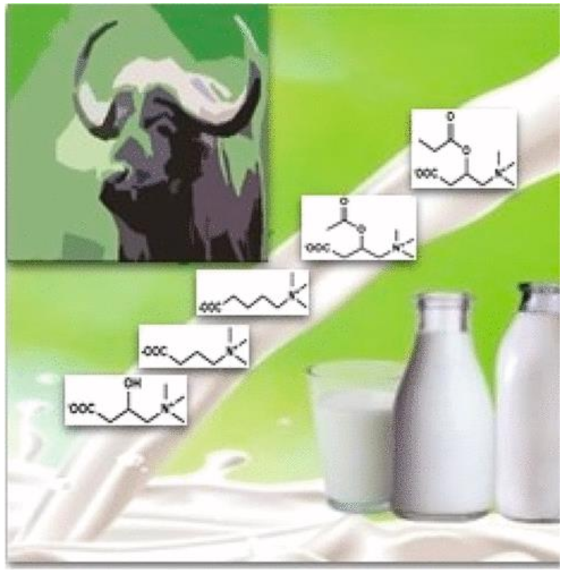
Flavonoids: flavonols, flavones, isoflavones, flavanones, flavanols, anthocyanidins

Hydroxycinnamic acids: curcumin

Non- Flavonoids: stilbenoids (resveratrol), Piceatannol, Trans-(−)-ε-Viniferin

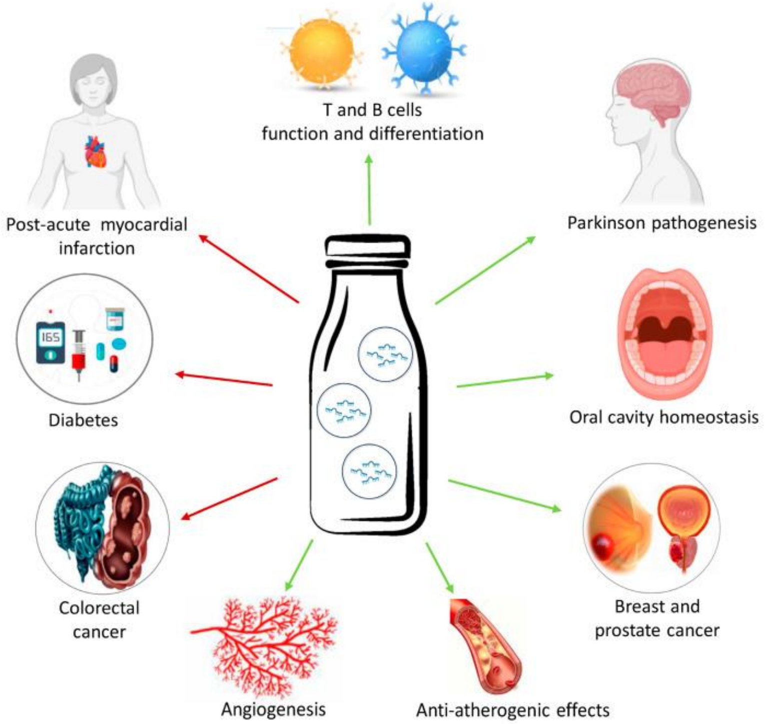
Betaines: Ergothioneine δ-Valerobetaine

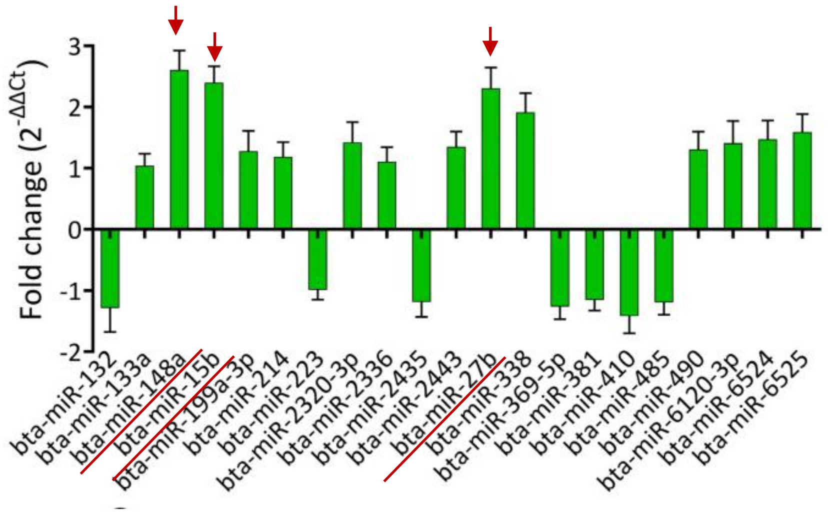
Epigenetic modulators of buffalo milk



Betaine and short chain acyl-carnitines

Servillo L, et al. JAFC, 1;66(30):8142-8149, 2018

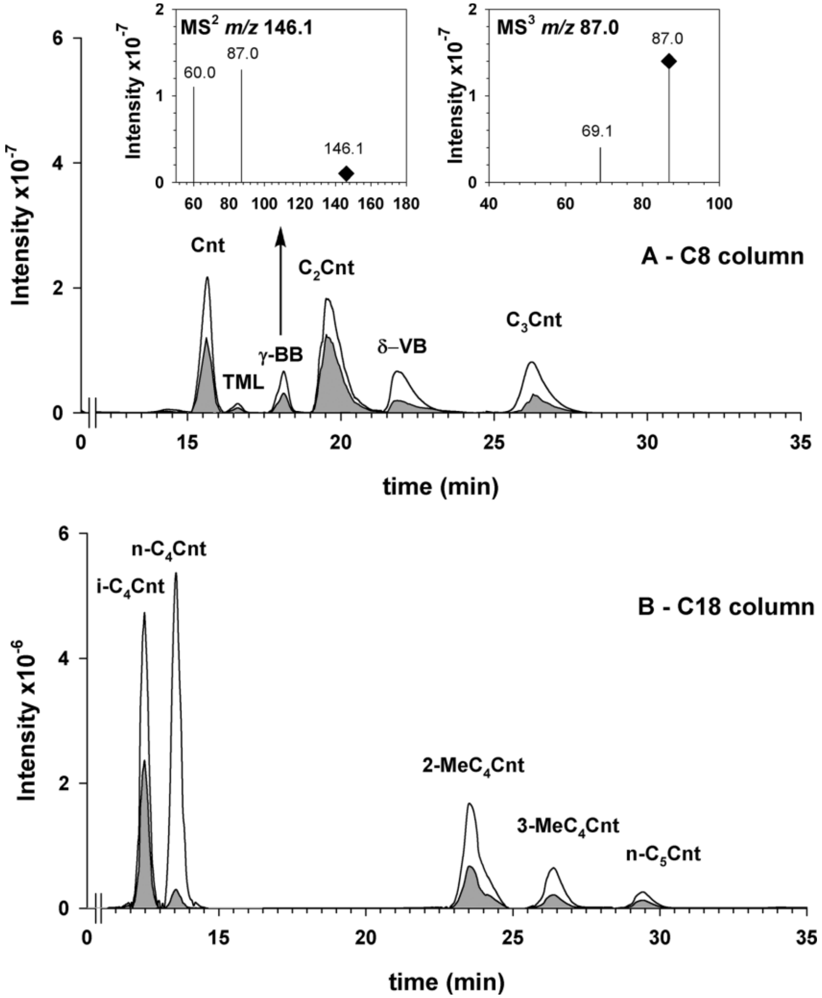


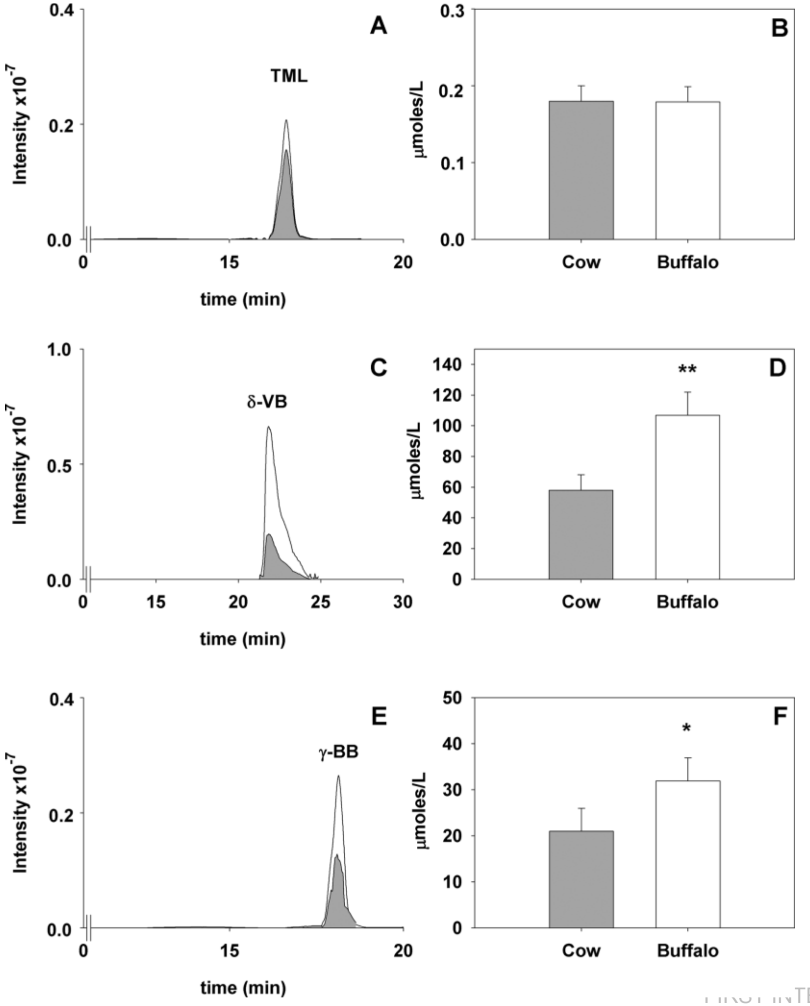


Exosome containing microRNA

Martino E, et al. Nutrients. 29;14(23):5081, 2022

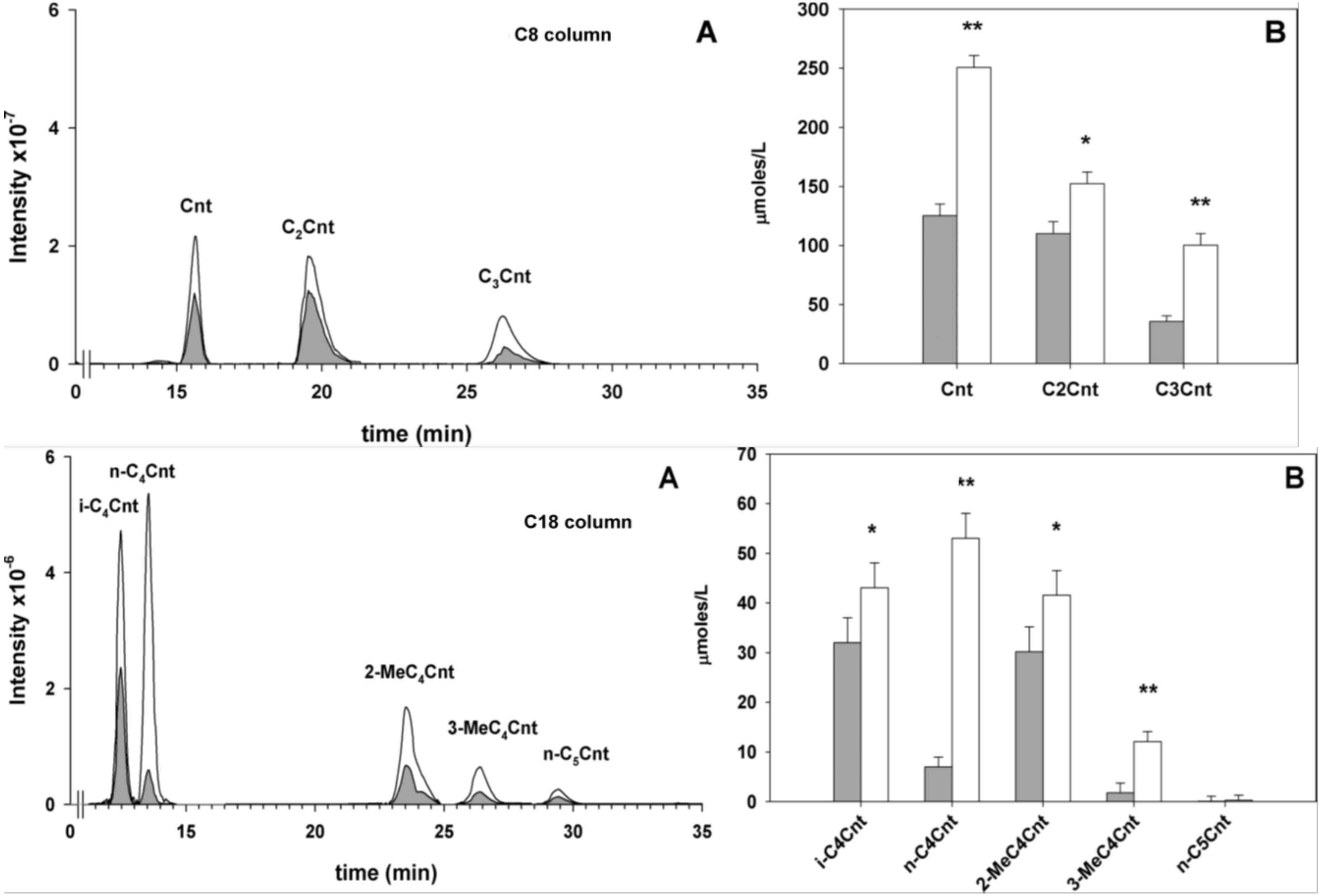
Betaine profile of buffalo milk





Servillo L, et al. J Agric Food Chem, Aug 1;66(30):8142-8149, 2018

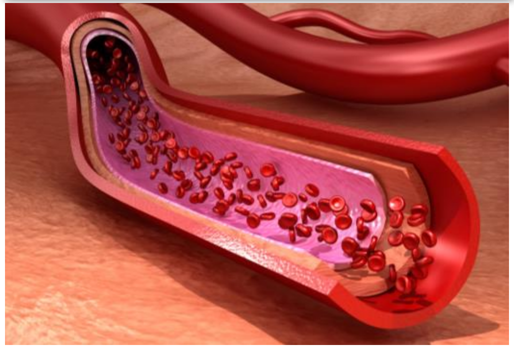
Carnitine and short-chain acyl carnitine profile of buffalo milk



Servillo L, et al.Agric Food Chem, 66:8142-8149, 2018

The experimental approach

Insuline resistance - Type 2 diabetes



In vitro models of human endothelial cells

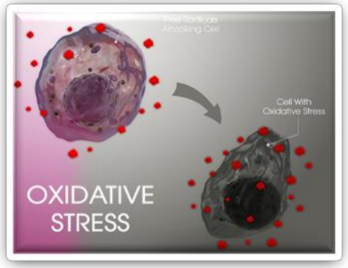
Oral Squamous Cell Carcinoma

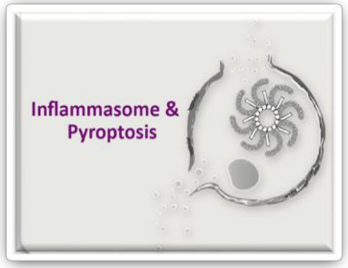
In vitro model of human oral squamous cell carcinoma

Colorectal cancer

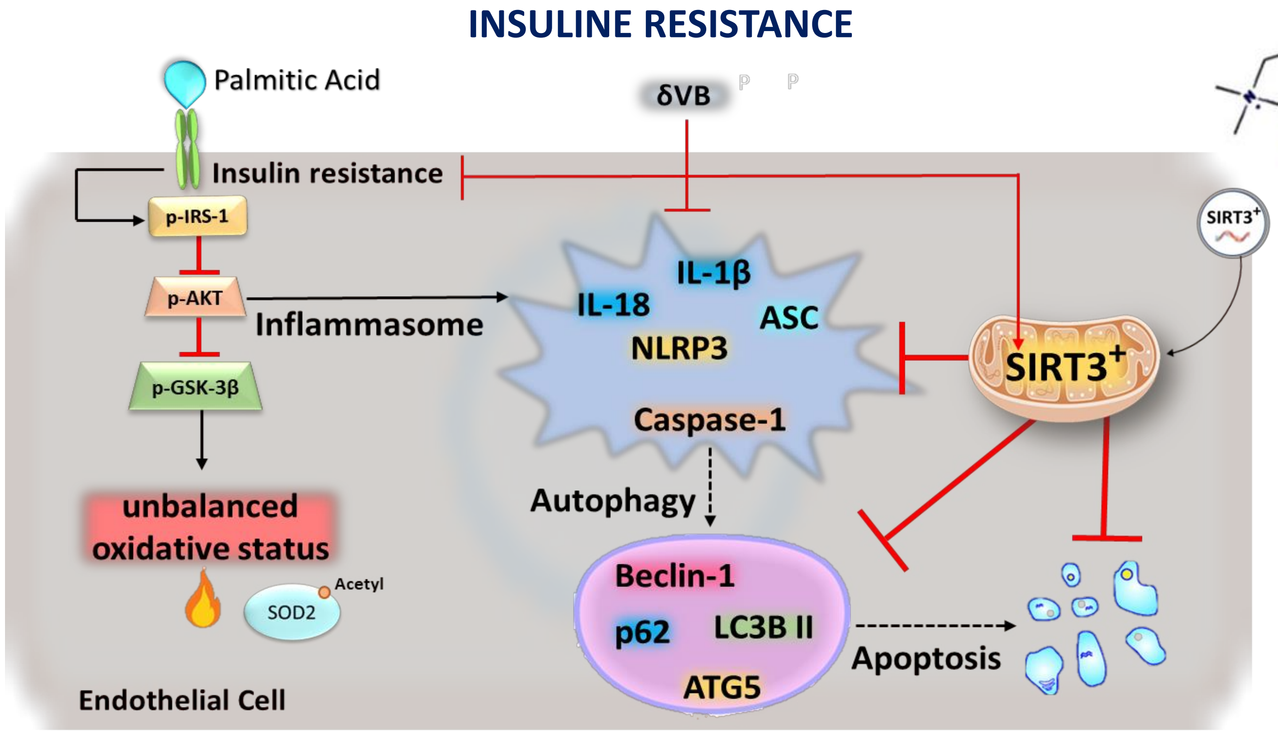
In vitro model of human colorectal cancer cells

Mouse model

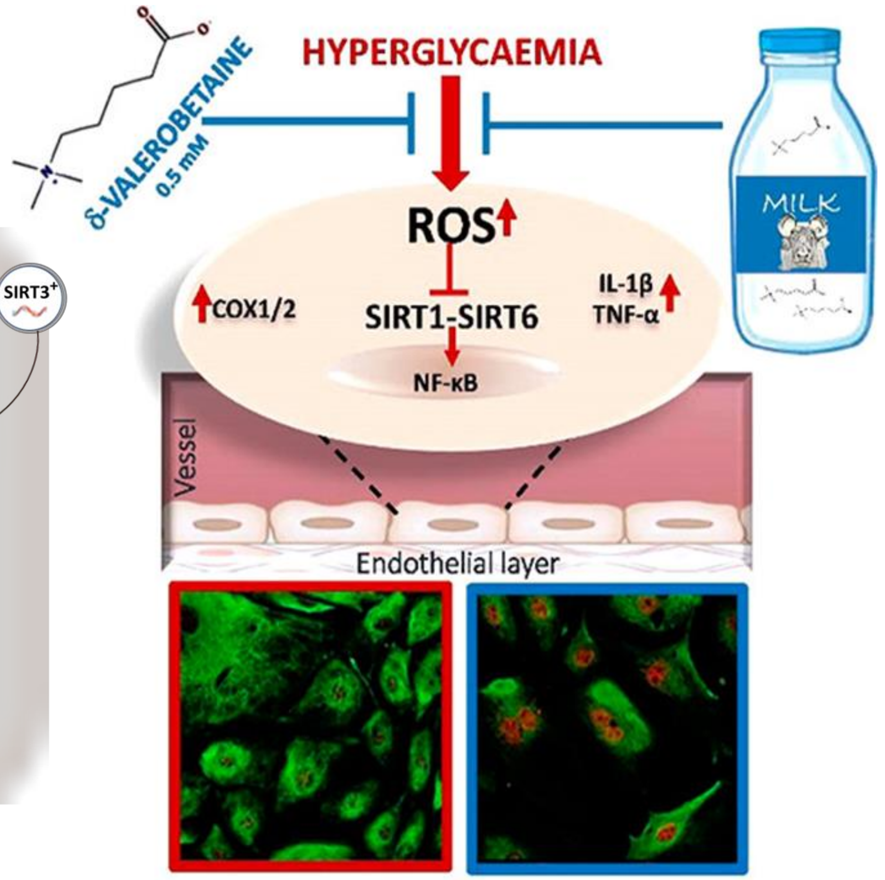




Epigenetic signature of buffalo milk-δ-valerobetaine in altered glucose homeostasis

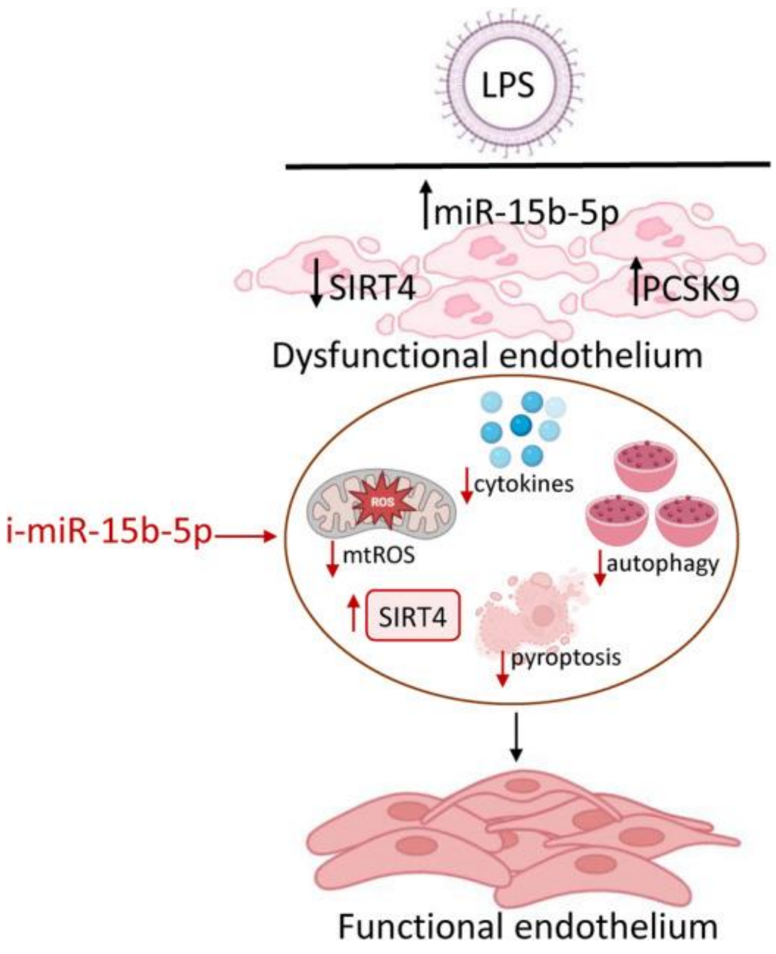


Martino E, et al. Antioxidants. 19;11(8):1611, 2022

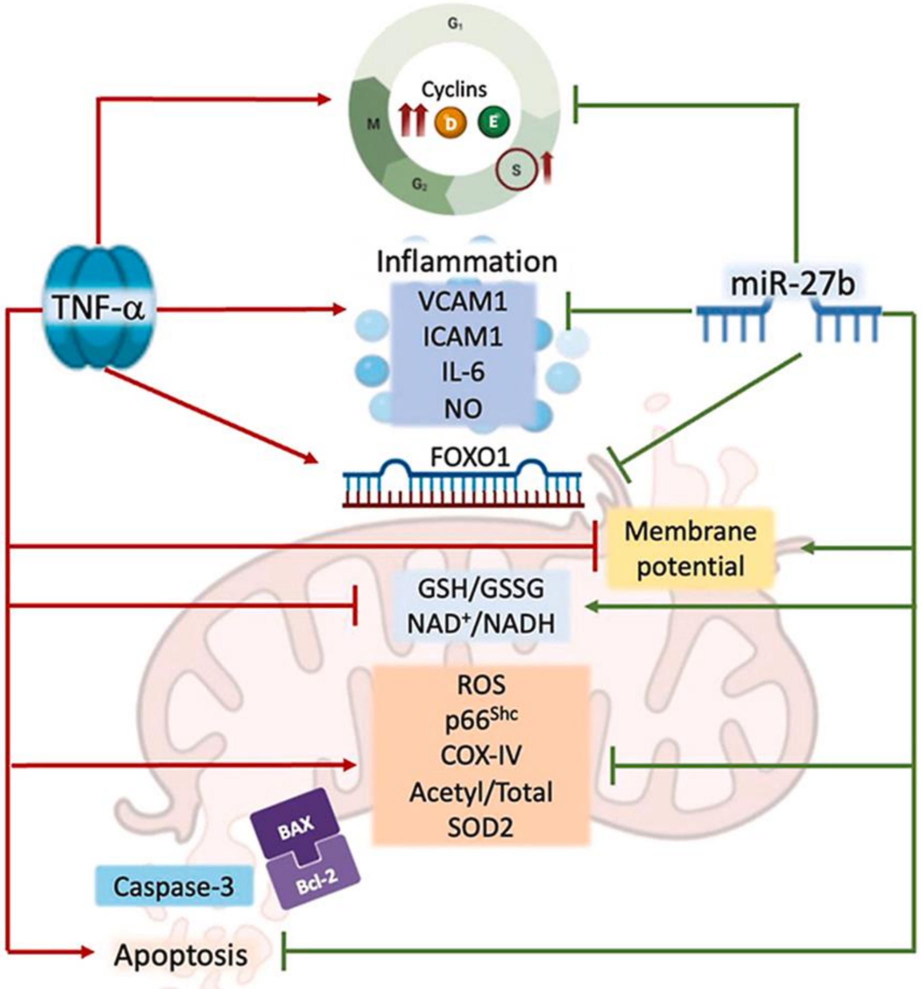


D'Onofrio N, et al. JAFC, 67(6), 1702–1710, 2019

Health effects of buffalo milk-derived microRNAs

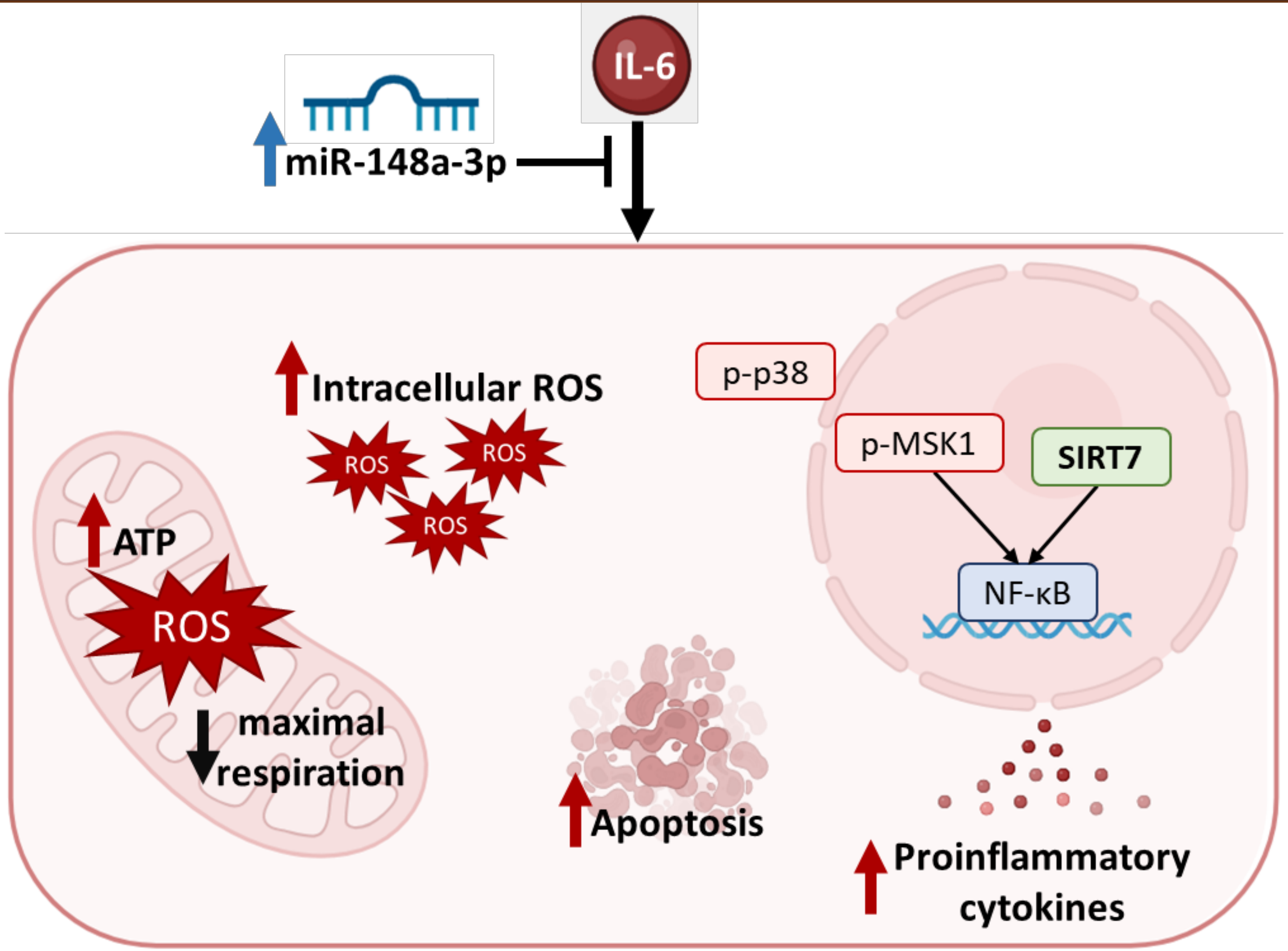


Martino E, et al. Cell & Mol Biol letters, 28(1), 66, 2023



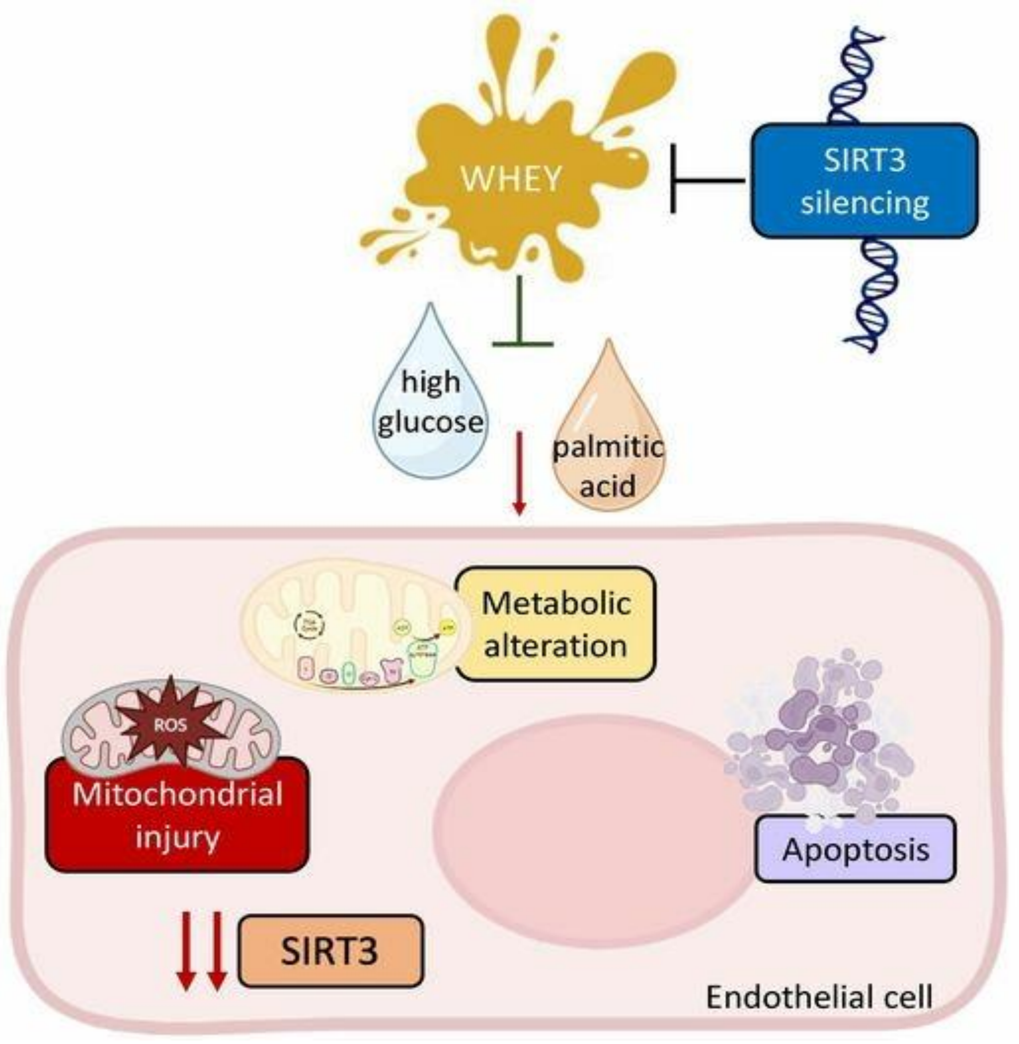
D'Onofrio N, et al . Redox Biol, 62, 102681, 2023

MiR-148a-3p/SIRT7 Axis Relieves Inflammatory-Induced Endothelial Dysfunction



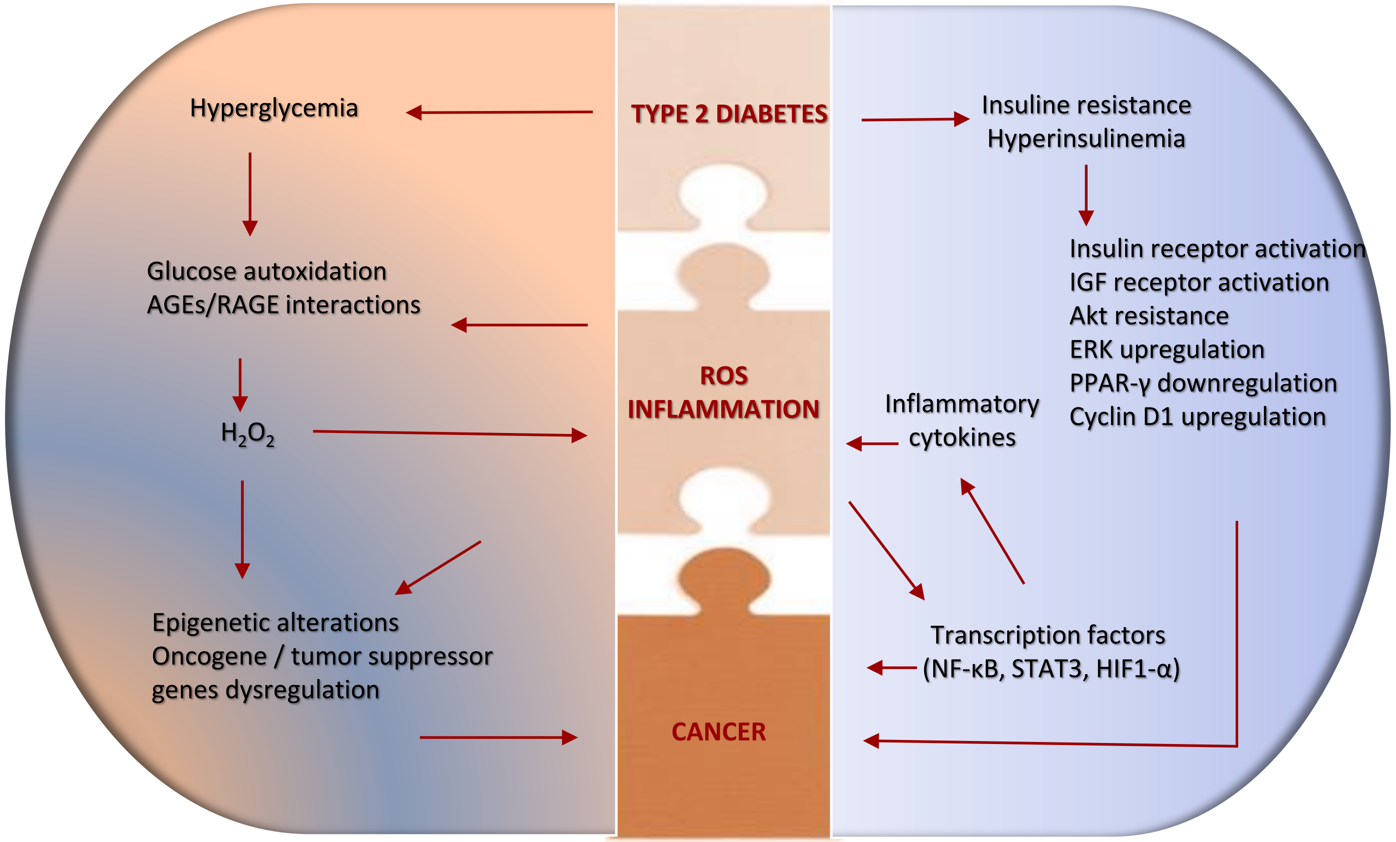
Anastasio C, et al. IJMS. 7;25(10):5087, 2024

The health benefits of whey in endothelial cells occur via SIRT3

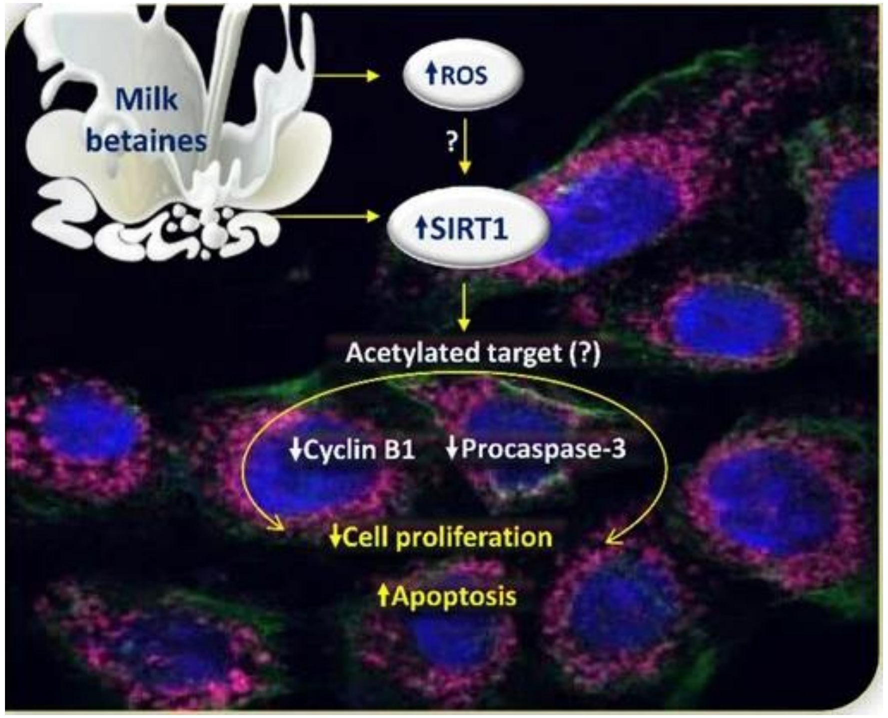


Martino E., et al. Antioxidants. 12(6), 1311, 2022

Pathways common to cancer and diabetes

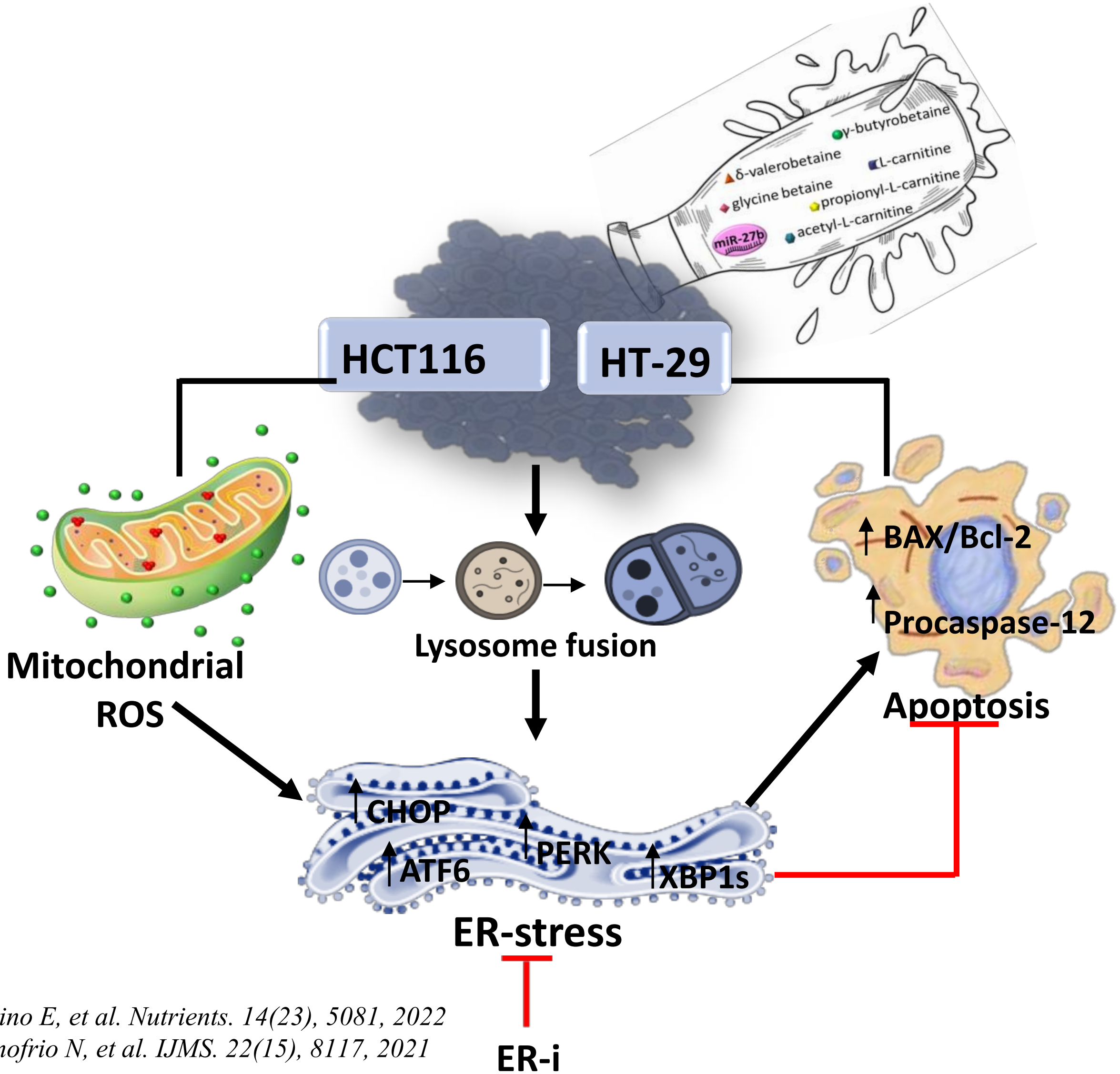


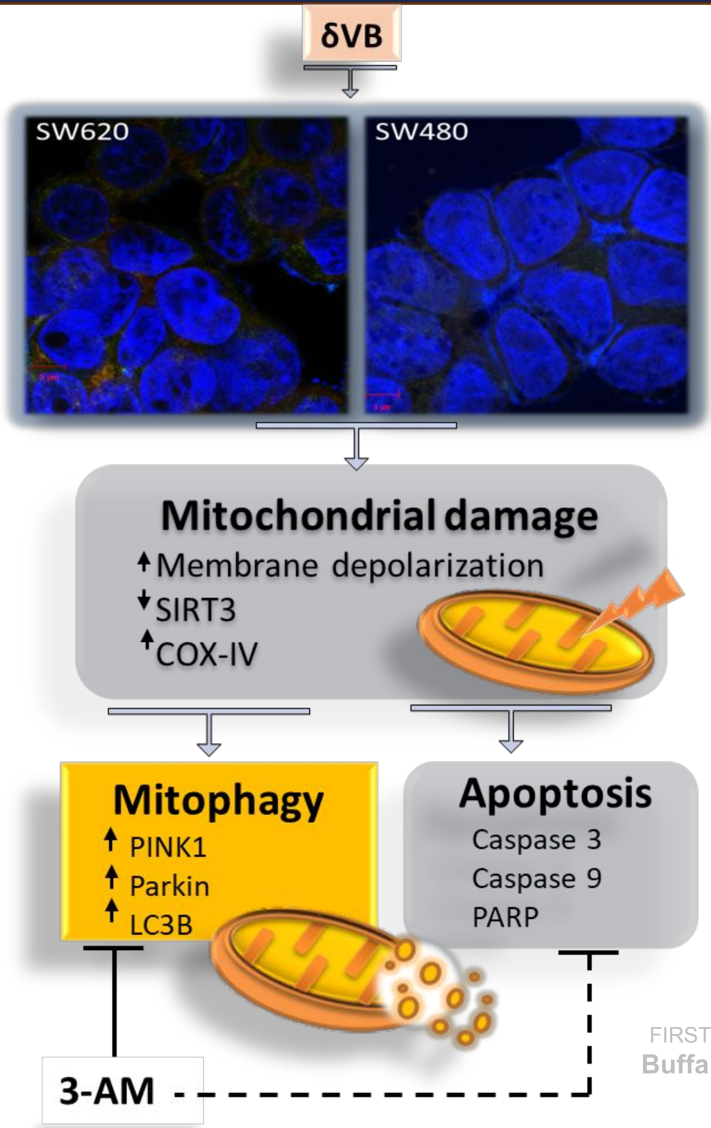
Synergistic Effect of Dietary Betaines in Human Oral Squamous Cell Carcinoma



D'Onofrio N et al. Cancers (Basel). 31;12(9):2468, 2020

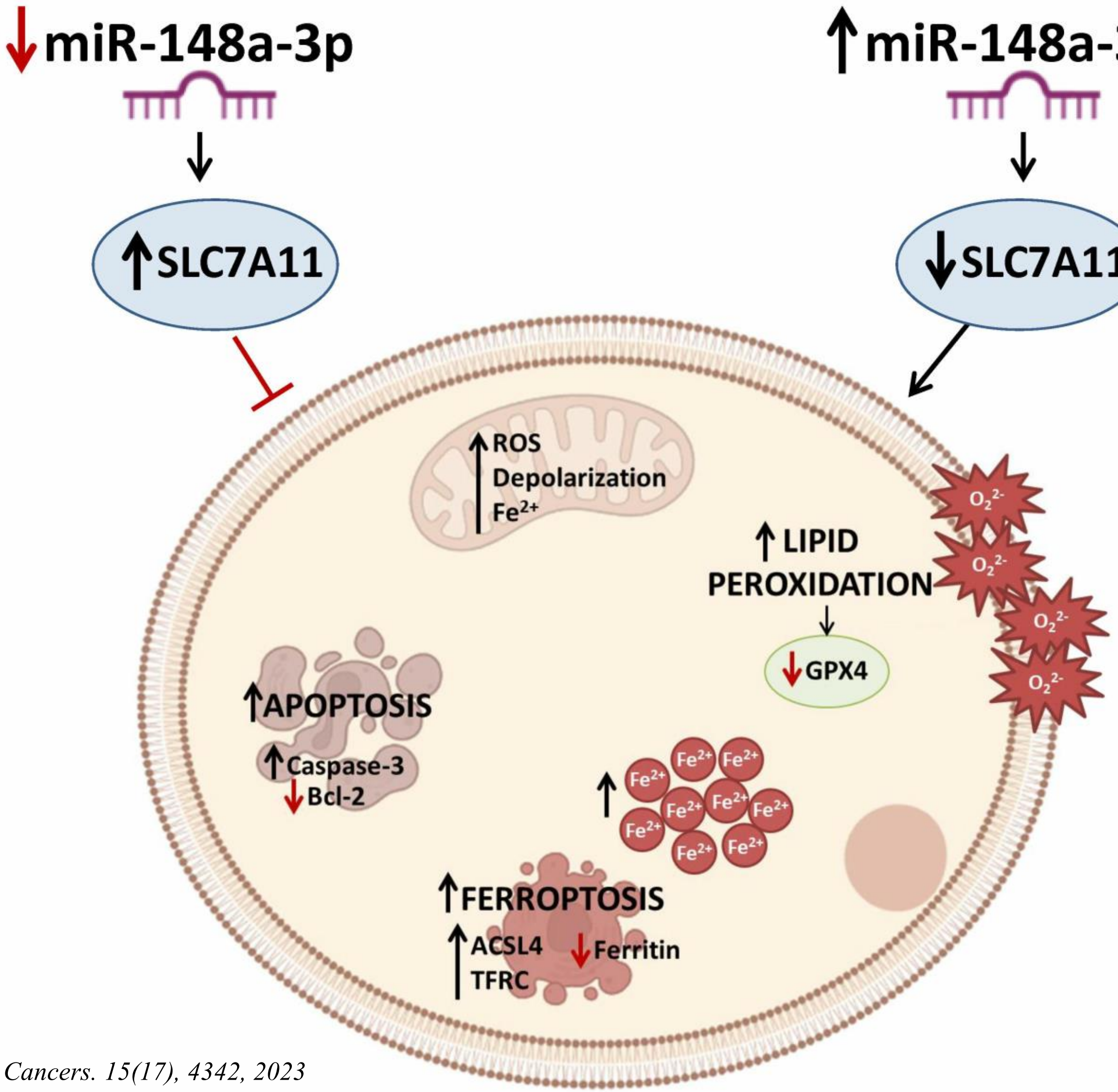
Epigenetic signature of buffalo milk in colorectal cancer





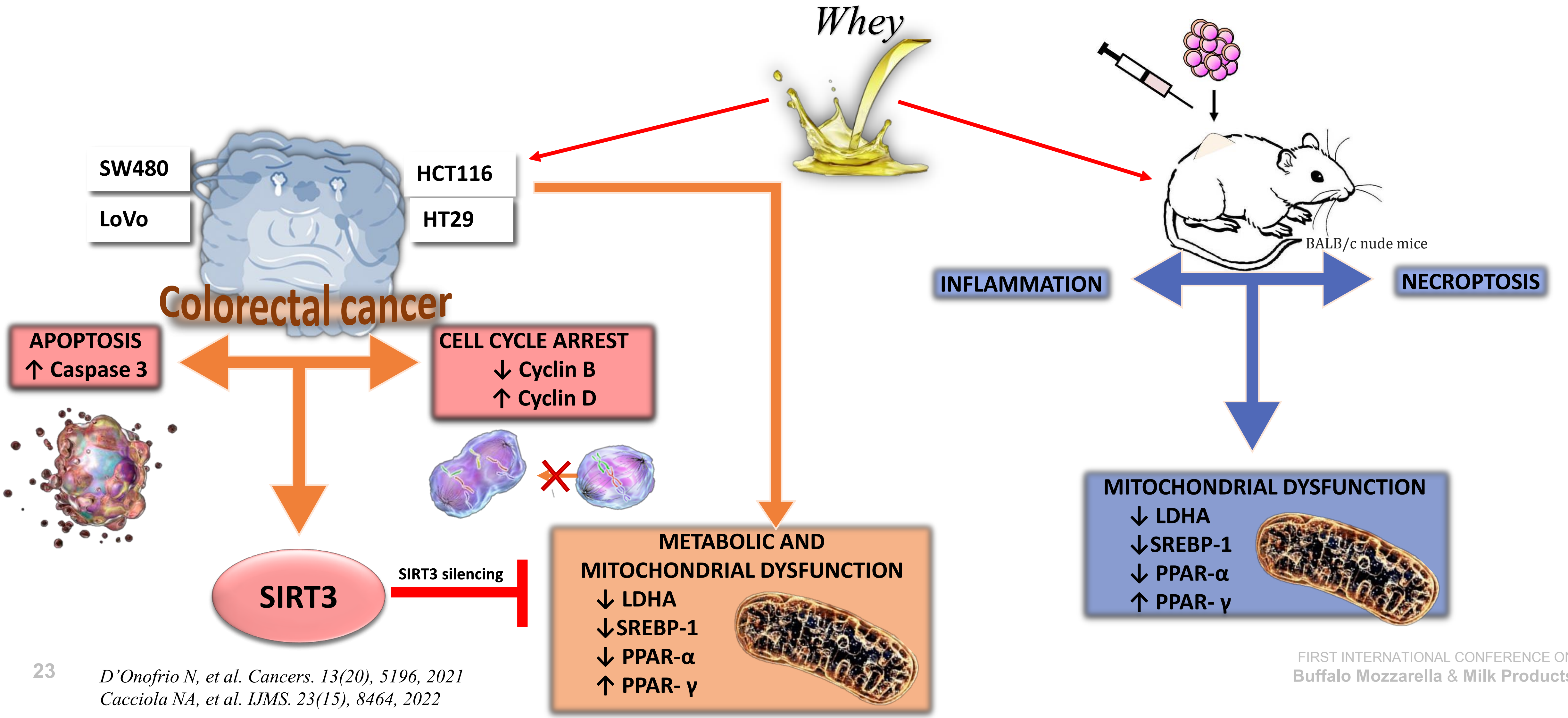
Martino E, et al. Nutrients. 14(23), 5081, 2022
D'Onofrio N, et al. IJMS. 22(15), 8117, 2021

MiR-148a-3p Promotes Colorectal Cancer Cell Ferroptosis by Targeting SLC7A11



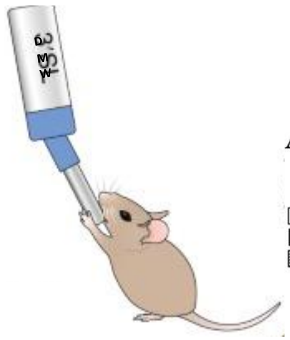
Martino E, et al, Cancers. 15(17), 4342, 2023

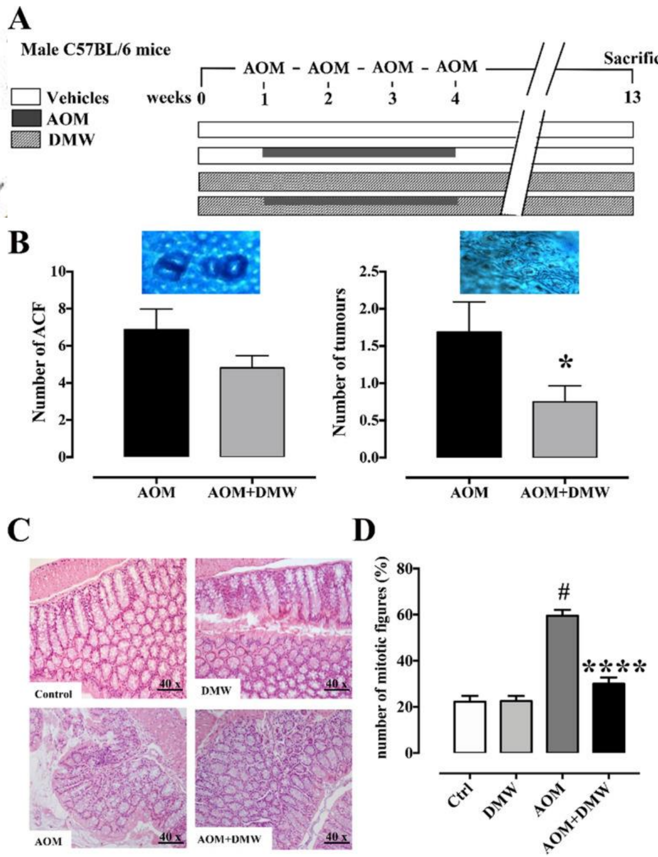
Chemopreventive effect of milk whey

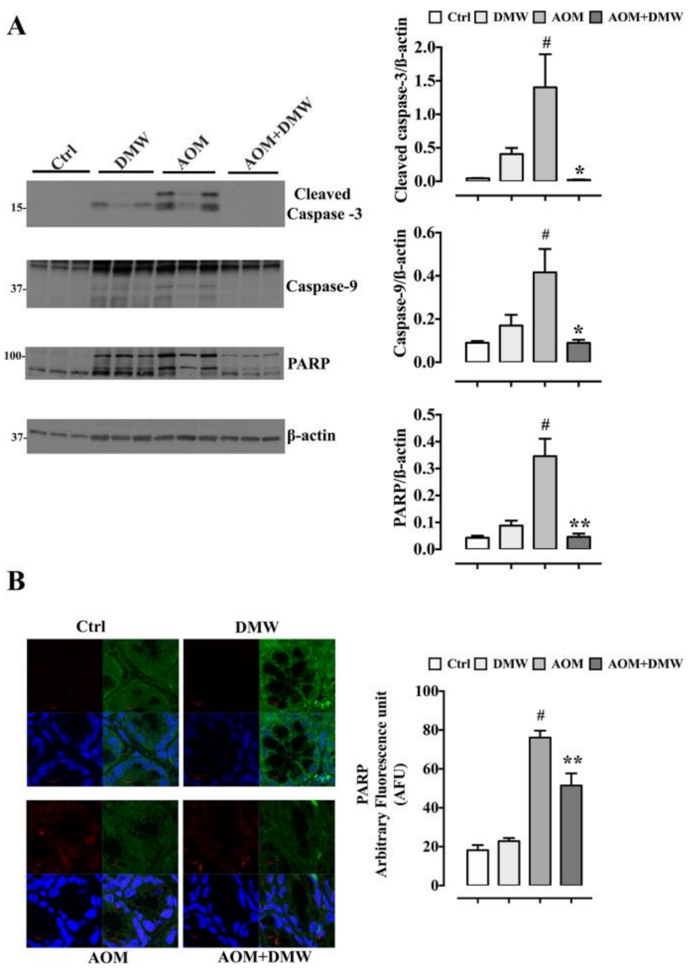


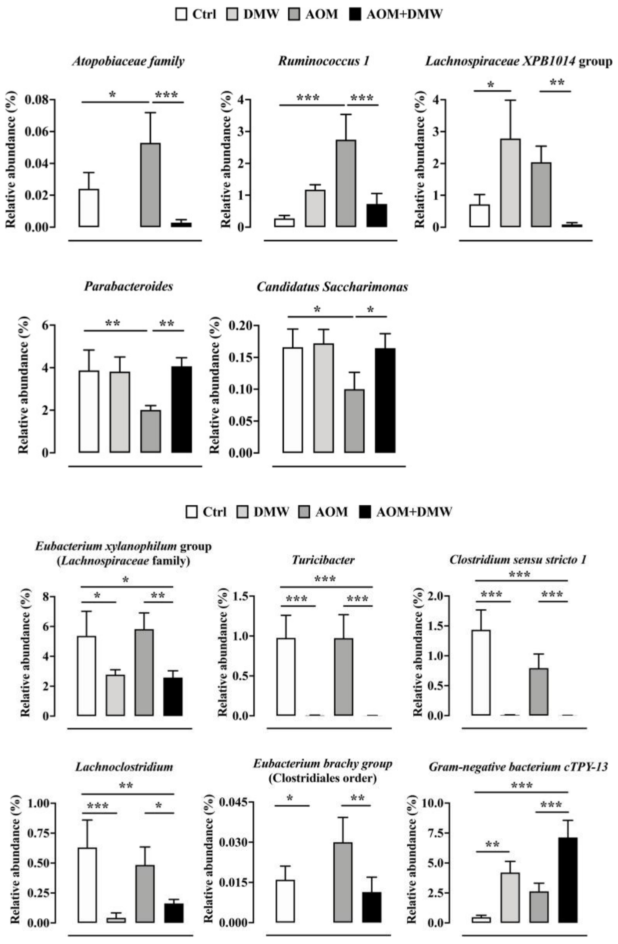
D'Onofrio N, et al. Cancers. 13(20), 5196, 2021
Cacciola NA, et al. IJMS. 23(15), 8464, 2022

Chemopreventive effect of milk whey



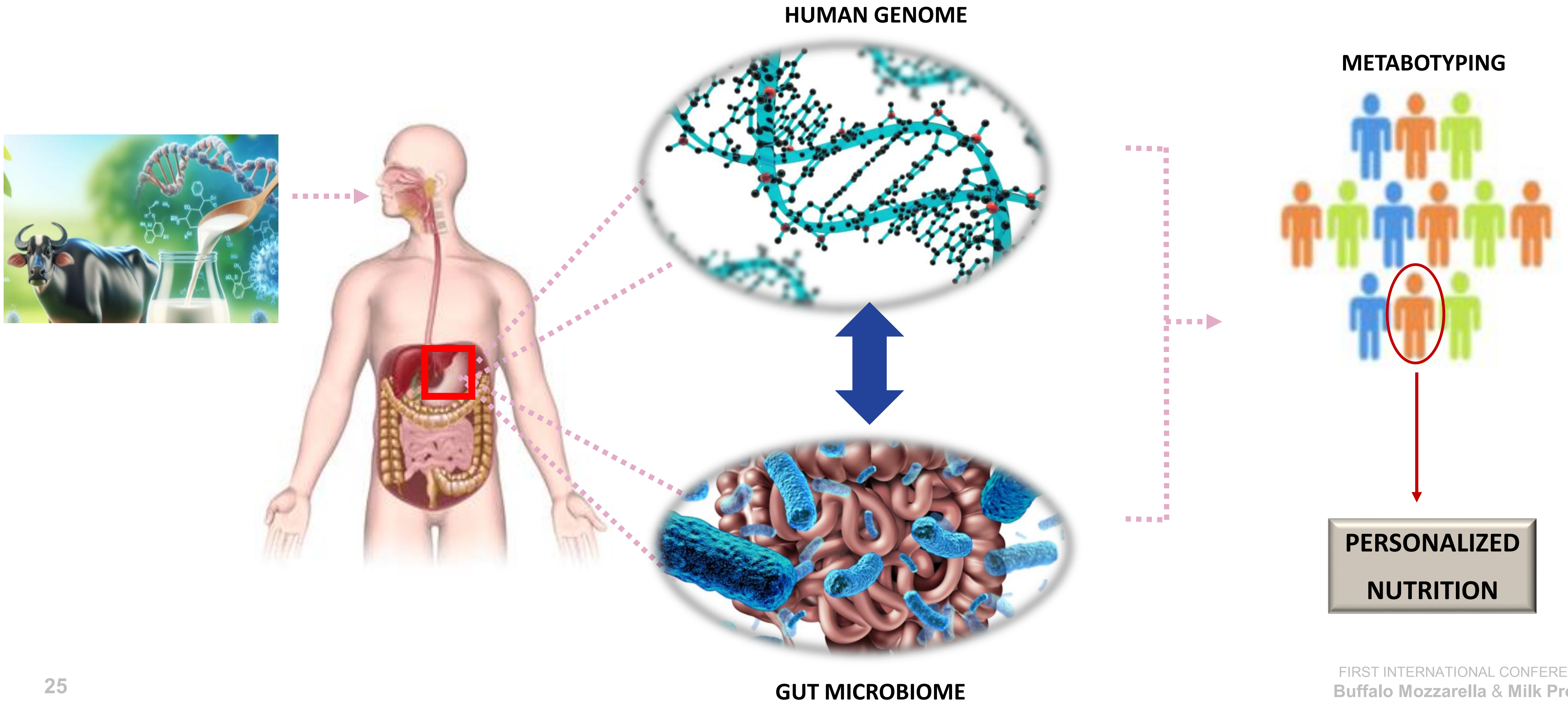






Cacciola NA, et al. Cell Commun Signal Sep 20;21(1):245,. 2023

Buffalo milk and whey: epigenetic modifiers for precision medicine



Grazie per l’attenzione!

Maria Luisa Balestrieri

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First International Conference on
Buffalo Mozzarella
& Milk Products
24-25 September 2024

Naples, Italy

BMMP2024

EXPLORING WINE AND CHEESE PAIRING

Angelita Gambuti

Department of Agricultural Sciences, Section of Vine and Wine Sciences, University of Napoli "Federico II",

Università degli Studi di Napoli Federico II

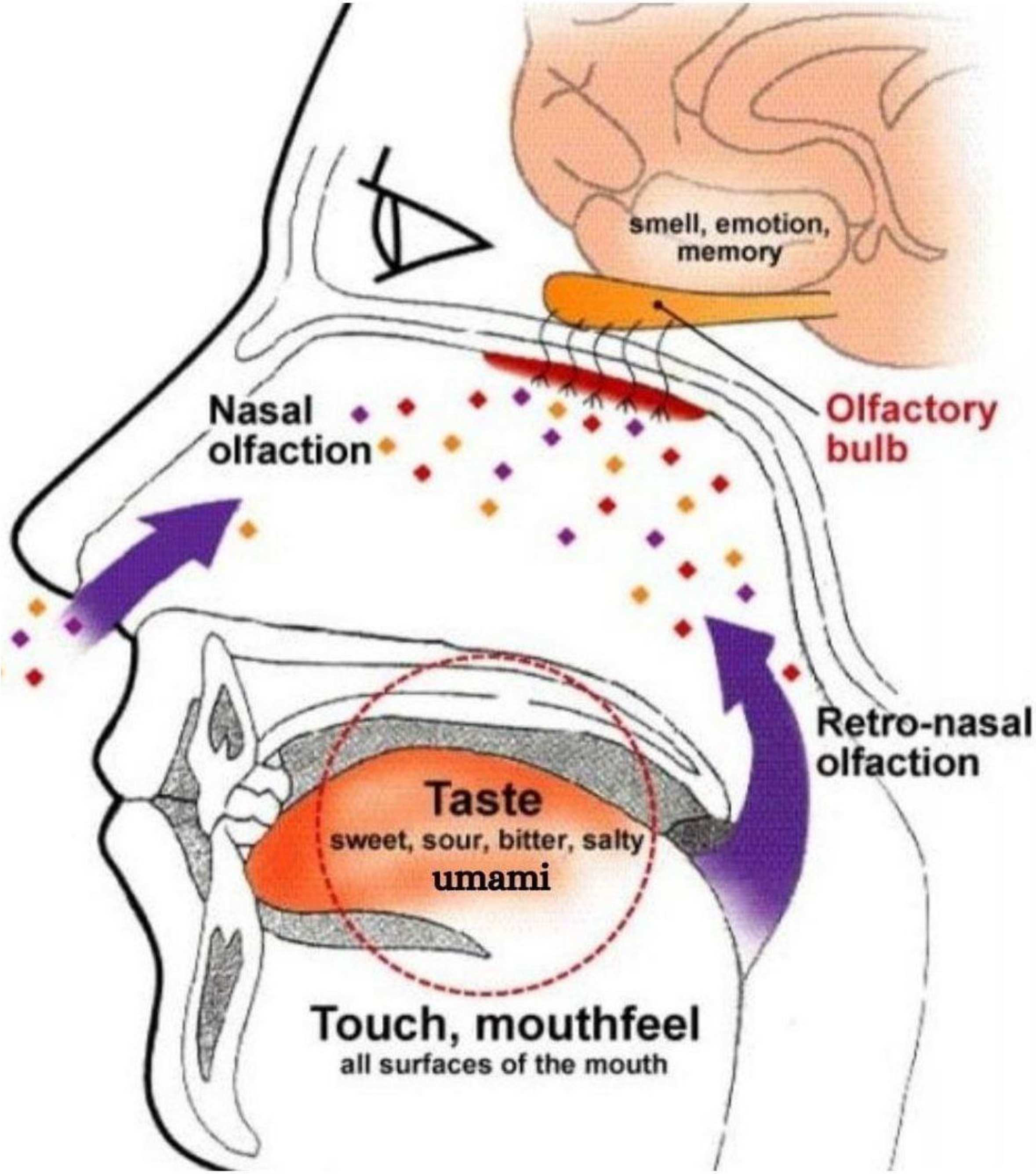
Which wines pair best with what cheeses?




Wine Racks America

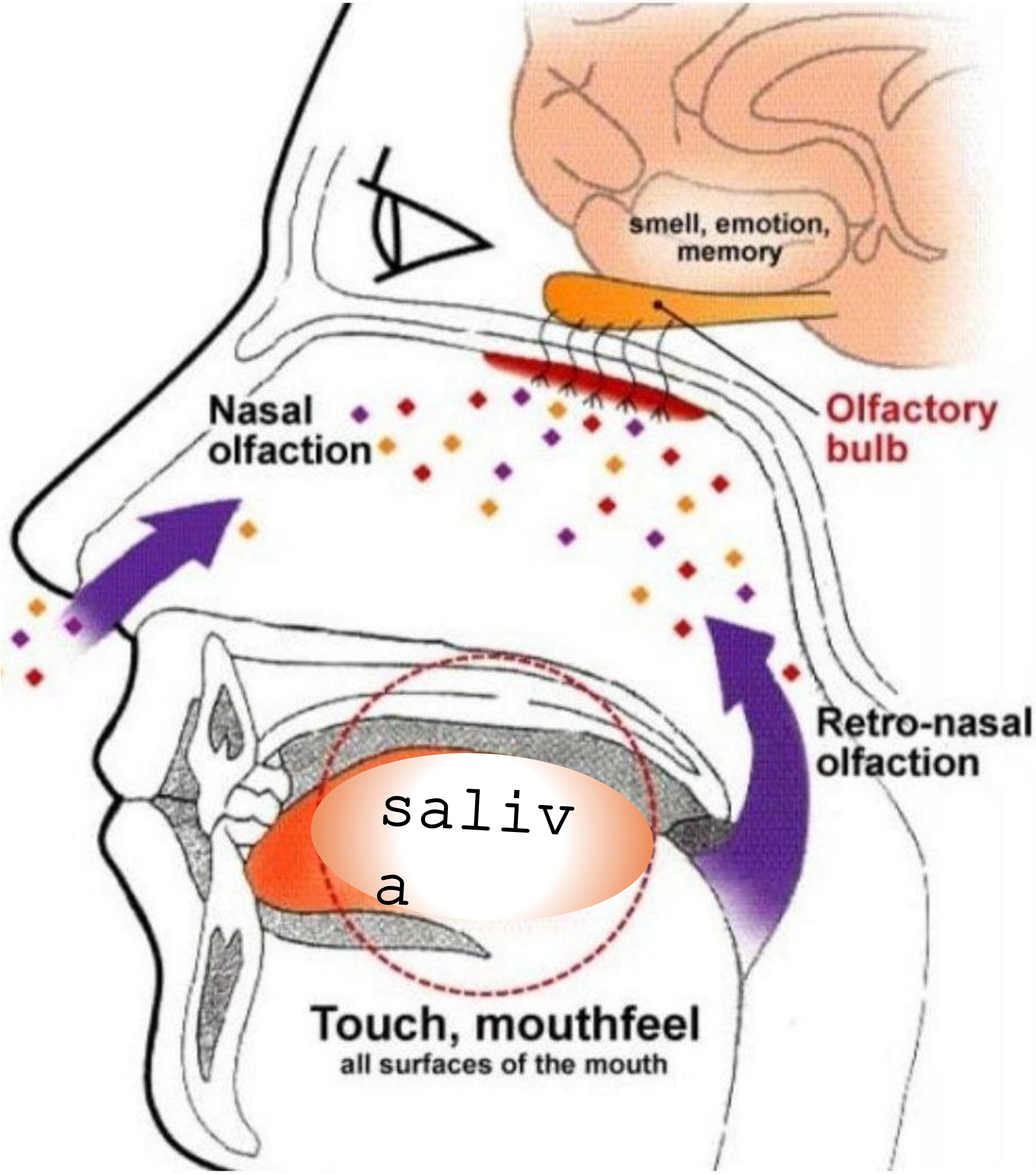
…….a question of interaction

NUTRITIONAL or
SENSORY
POINT OF VIEW?



Stimula:

- Odour active volatile compounds
- Tasty molecules
- «Touch molecules»



Stimula:

- Odour active volatile compounds
- Tasty molecules
- **Polyphenols, proteins, fats**

Mouthfeel active compounds

proteins, vitamin A, zinc, sodium, lactose, **fats,** phosphorus, calcium, volatile compounds

Mouthfeel active compounds

ethanol, sugars, **acids,** volatile compounds,

phenolic compounds

MOUTHFEEL SENSATION

A complex system:

cheese compounds (fats and proteins)
wine compounds (polyphenols and acids)
saliva

Food and beverages pairing by experts was described to depend on three perceptual principles: 1) rinsing for maintaining the qualities of each product;
2) **masking for suppressing off-flavor** in one product;
3) synergy for enhancing a positive attribute in a product.

Current Research in Food Science 9 (2024) 100792

Contents lists available at ScienceDirect

Current Research in Food Science

journal homepage: www.sciencedirect.com/journal/current-research-in-food-science

Exploring cheese and red wine pairing by an *in vitro* simulation of tasting

Alessandra Rinaldi [a,b,d], Giovanna Bifulco [c], Alessandra Luciano [a], Luigi Picariello [a], Luigi Moio [a], Raffaele Marrone [c], Giuseppe Campanile [c], Angelita Gambuti [a,*]

[a] Department of Agricultural Sciences, Section of Vine and Wine Sciences, University of Napoli Federico II, Viale Italia, Avellino 83100, Italy
[b] Better Sensing, TERINOV, Parque de Ciência e Tecnologia da Ilha Terceira, 9700-702, Terra Chã, Angra do Heroísmo, Azores, Portugal
[c] Department of Veterinary Medicine and Animal Production, University of Naples Federico II, 80137, Naples, Italy
[d] Fondazione Italiana per gli Studi sul Vino (FISSV) Avellino, Italy

Two pivotal factors may contribute to a positive evaluation of the cheese and red wine pairing:

suppression of **astringency** of red wine → By determining the precipitation of astringent tannins during tasting due to the cheese coating of mouth and saliva

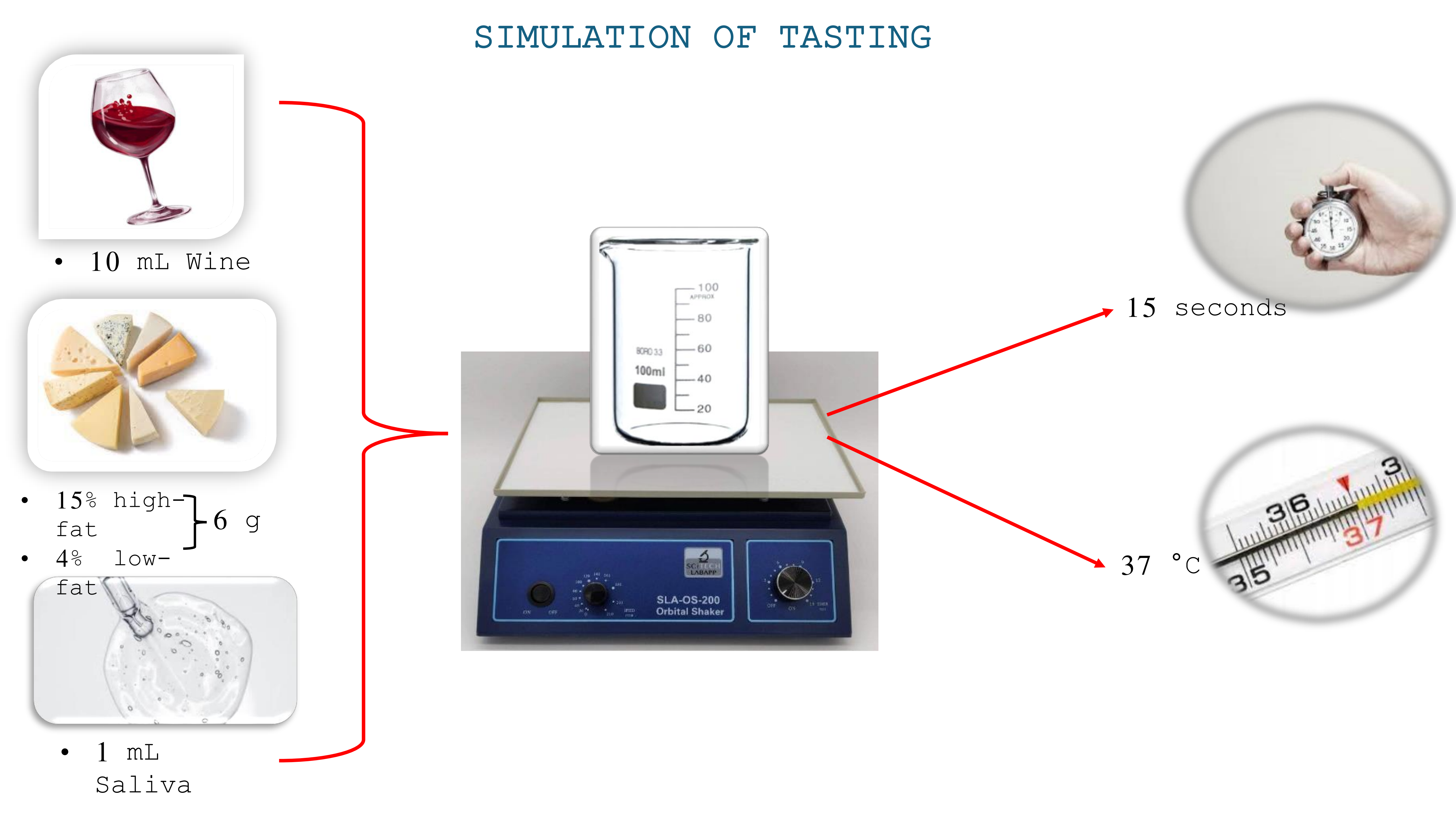
oral cleansing: effect of red wine in cleansing the oral cavity from **mouth-coating and lingering aftertaste** due to fat and proteins of cheese → By determining the decrease in residual proteins in mouth occurring during wine tasting

WINES

CHEESE

	% Fat
Primo sale cheese (P)	17
Semi-hard cheese (M)	50
Hard cheese (D)	45
Dry ricotta (R)	23

	Ethanol (%v/V)	Titratable acidity (g/L)	pH	Glucose + fructose (g/L)	Malic acid (g/L)	Lactic acid (g/L)	Free sulphur dioxide (mg/L)	Total sulphur dioxide (mg/L)
Wine 1	12.03 ±0.1	4.31±0.02	3.96±0.04	0.13±0.02	0.02±0.01	1.7±0.1	21.94±1.2	36.00±1.22
Wine 2	12.11 ±0.03	4.27±0.05	3.97±0.03	0.10±0.04	0.57±0.03	1.6±0.1	6.53±0.94	28.23±1.35


SIMULATION OF TASTING
• 10 mL Wine
• 15% high-fat
• 4% low-fat
6 g
• 1 mL Saliva
100ml
SLA-OS-200
Orbital Shaker
15 seconds
37 °C

Analytical tools: SPI and residual proteins

Available online at www.sciencedirect.com
SCIENCE DIRECT
Food Chemistry 97 (2006) 614–620
Food Chemistry
www.elsevier.com/locate/foodchem

Evaluation of aglianico grape skin and seed polyphenol astringency by SDS–PAGE electrophoresis of salivary proteins after the binding reaction

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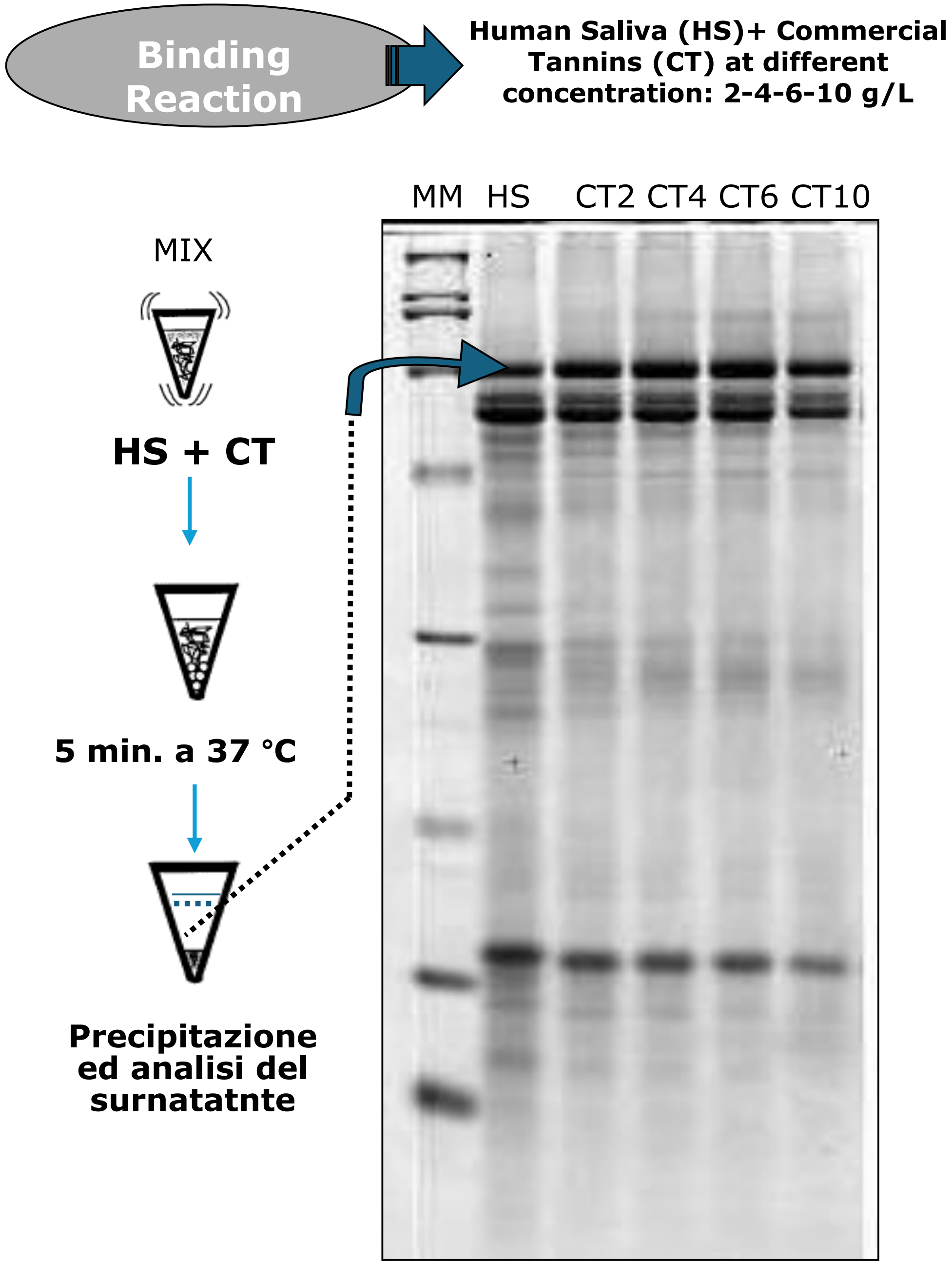
Received 28 February 2005; received in revised form 17 May 2005; accepted 17 May 2005

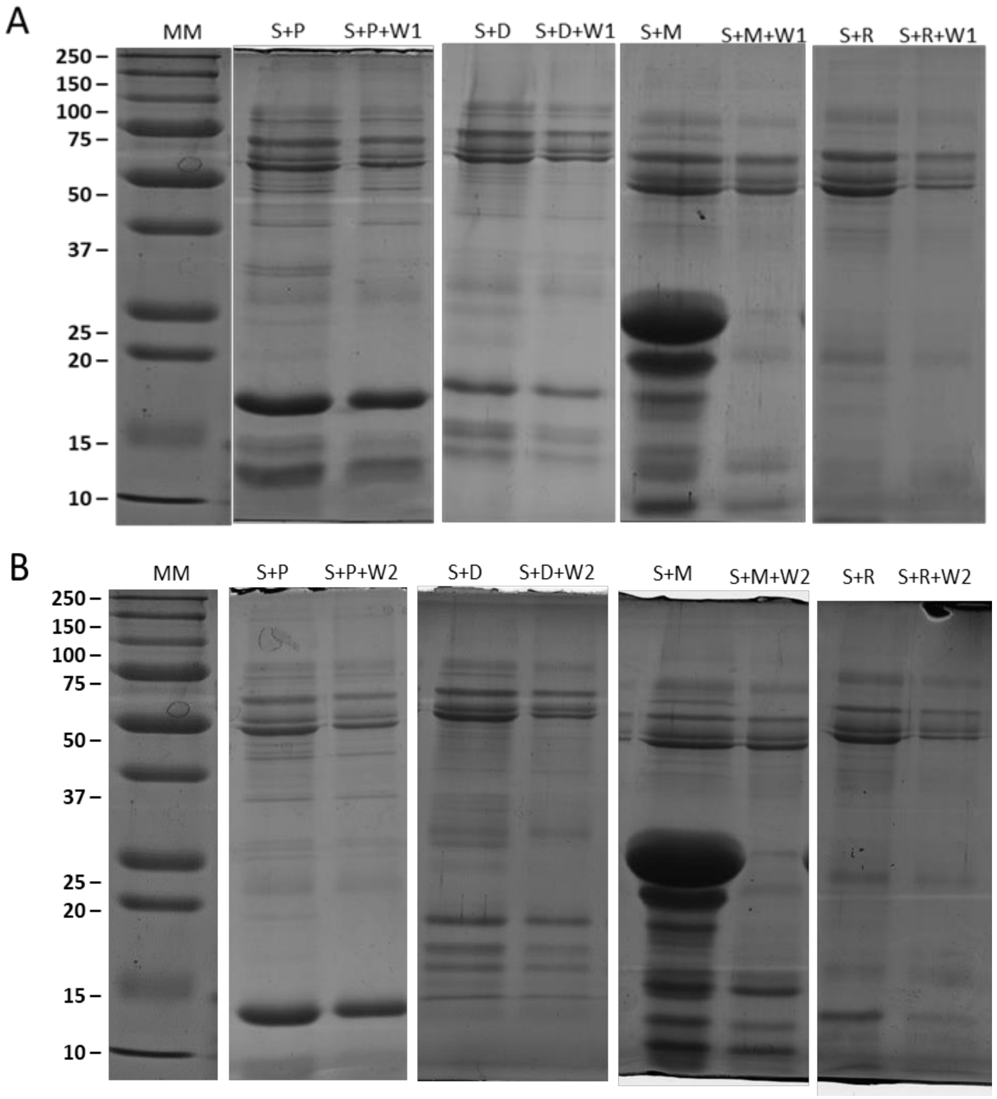
Current Research in Food Science
journal homepage: www.sciencedirect.com/journal/current-research-in-food-science

Multivariate prediction of Saliva Precipitation Index for relating selected chemical parameters of red wines to the sensory perception of astringency

Cristian Galaz Torres[a], Arianna Ricci[a], Giuseppina Paola Parpinello[a,*], Angelita Gambuti[b], Alessandra Rinaldi[b], Luigi Moio[b], Luca Rolle[c], Maria Alessandra Paissoni[c], Fulvio Mattivi[d], Daniele Perenzoni[d], Panagiotis Arapitsas[d,e], Matteo Marangon[f], Christine Mayr Marangon[f], Davide Slaghenaufi[g], Maurizio Ugliano[g], Andrea Versari[a]

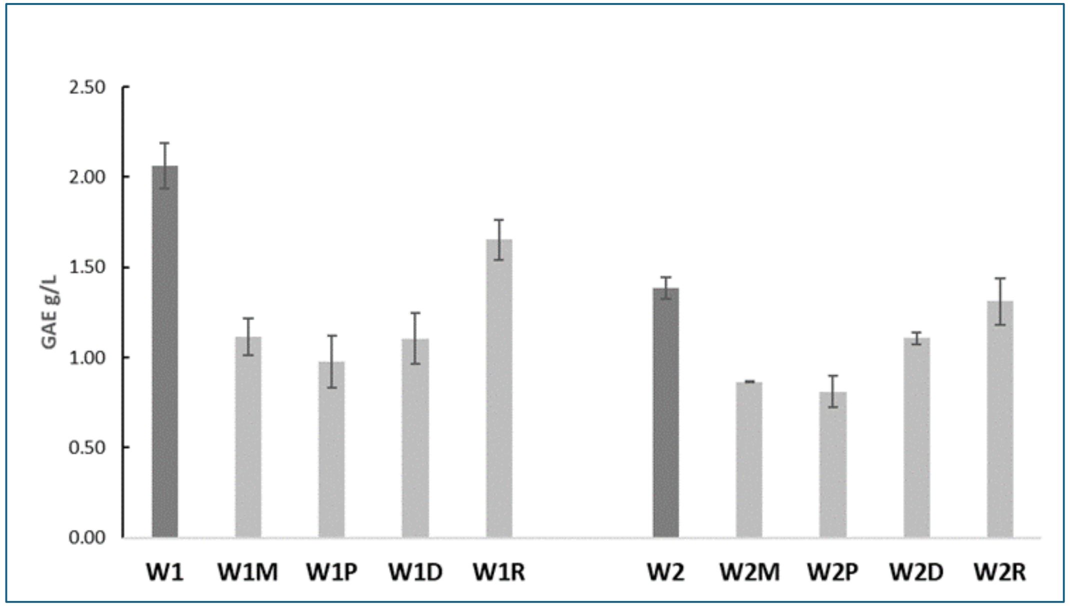


cleansing effect



The SDS-PAGE electrophoretic pattern of salivary proteins (S) interacting with cheeses (P, D, M, R), before (S+P, S+D, S+M, S+R) and after (S+P+W1, S+D+W1, S+M+W1, S+R+W1) the interaction with wine W1 (Figure 5A) and W2 (Figure 5B). MM: molecular marker (kDa).

SPI



The Saliva Precipitation Index (SPI) of wines before (W1 and W2) and after the interaction (W1M, W1P, W1D, W1R; W2M, W2P, W2D, W2R) with cheeses (M=semi-hard cheese; P= Primo sale cheese; D=Hard cheese; R=dry ricotta) expressed in g/L of gallic acid equivalent (GAE). Error bars represent standard deviation over three replications.

OP Optimal Pairing Index

In equation 1 (**Eq.1**), let:

OP be the optimal pairing score between cheese and wine.

$\Delta_{\text{cleansing effect}}$ be the **percentage decrease of total proteins (cheese and saliva) by wine**.

Δ_{SPI} be the **decrease of astringency by cheese**, measured by SPI.

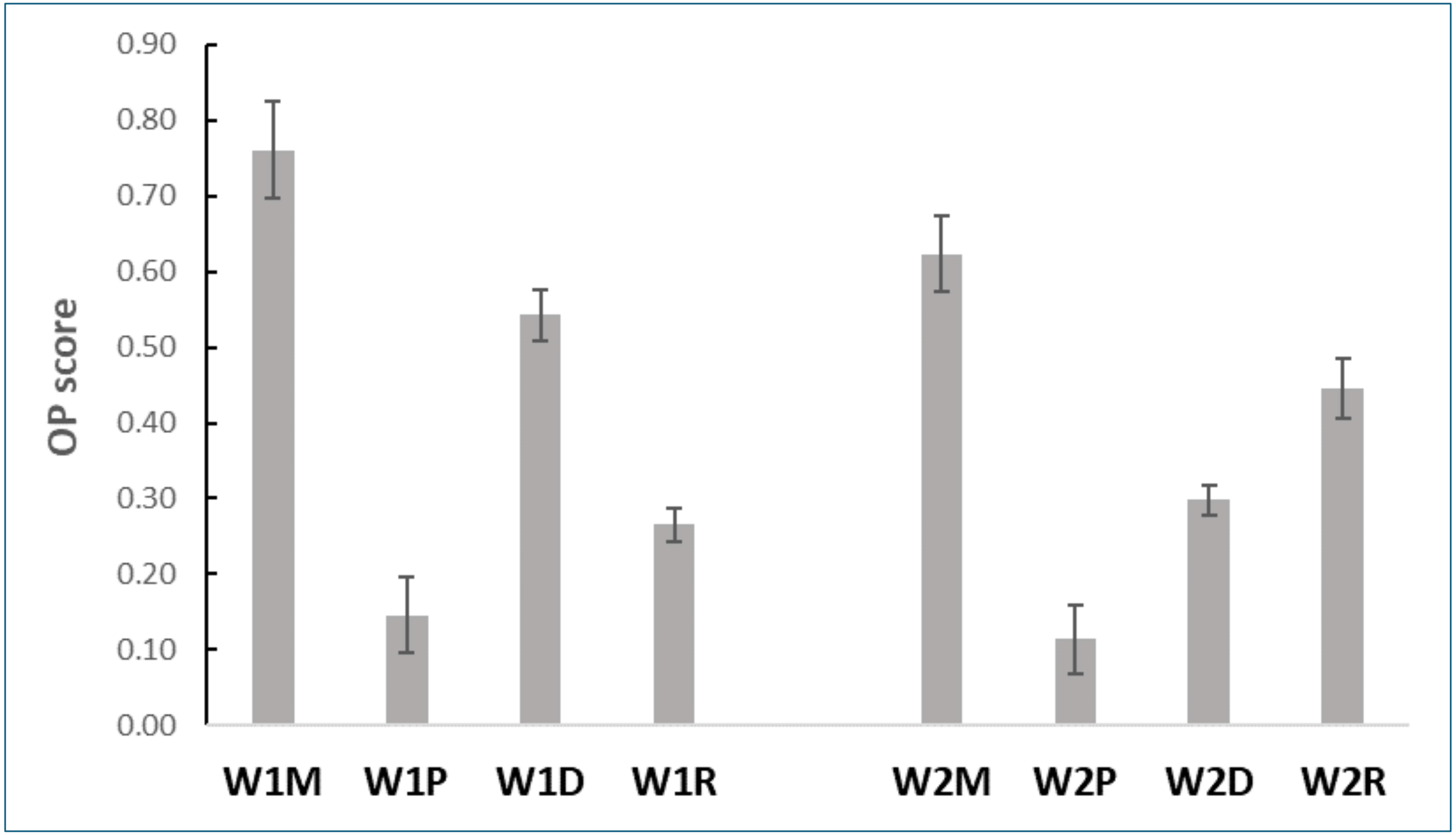
Residual fat be the content in fat (g) that would remain to coating mouth after eating a piece of cheese of 6 g (Repoux et al., 2012).

The OP is a function of these factors:

Eq.1: $$\mathbf{OP = [1 - (1 - \Delta_{\text{cleansing effect}}) \cdot (1 - \Delta_{SPI})] * \text{residual fat (g)}}$$

The **Eq.1** assumes that a higher percentage decrease in cheese protein by wine and a higher decrease in astringency (SPI) by cheese in presence of saliva contribute positively to the pairing score.

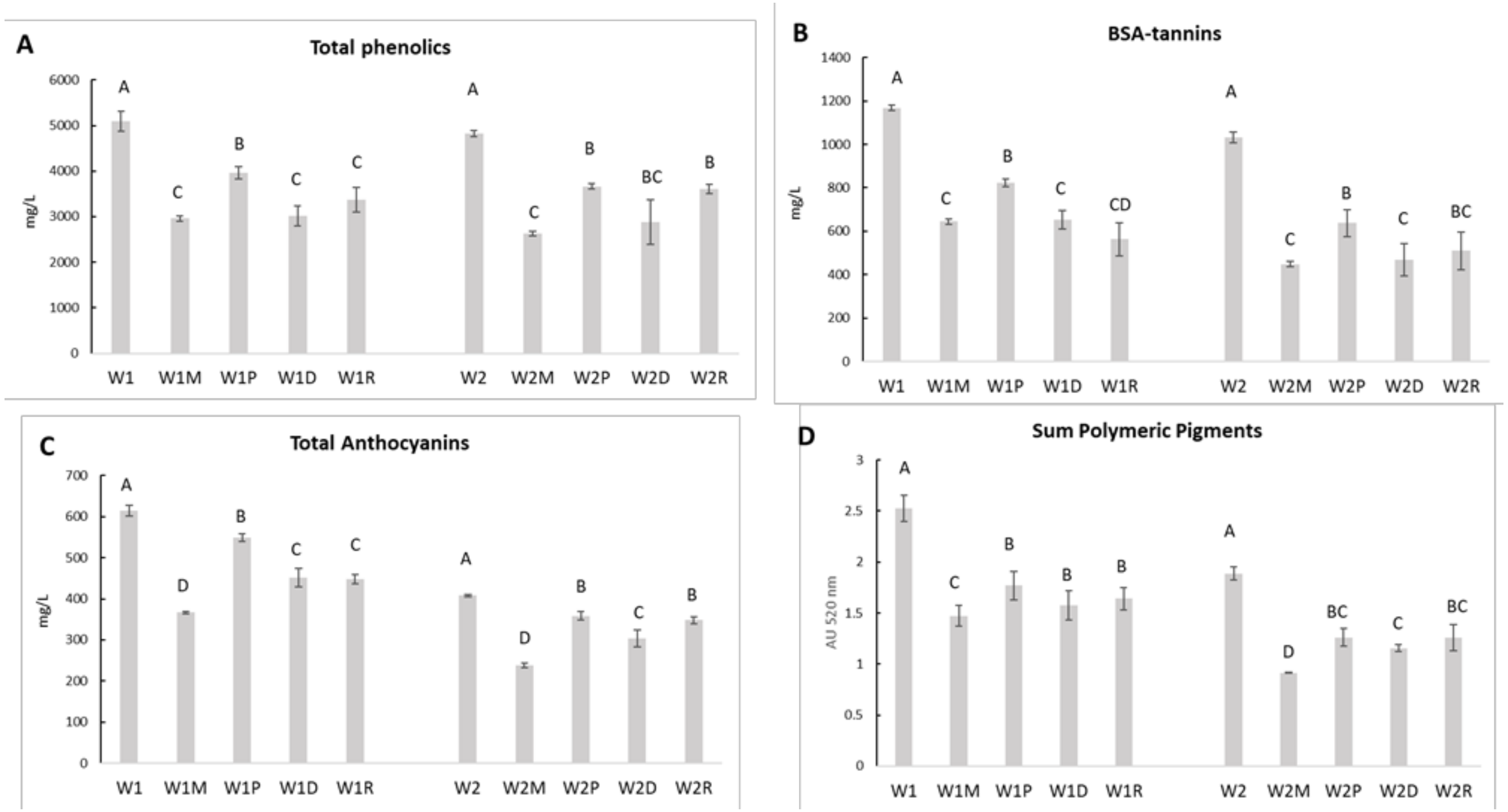
OP Optimal Pairing



Cheese wine optimal pairing (OP) between wines (W1 and W2) and cheeses (M=semi-hard cheese; P= Primo sale cheese; D=hard cheese; R=dry ricotta). Error bars represent standard deviation over three replications.

NUTRITIONAL
POINT OF VIEW?

Content of residual phenolic compounds in supernatant



Concentration of total phenolics (A), BSA-reactive tannins (B), total anthocyanins (C), and polymeric pigments (D) in wines before (W1 and W2), and after the interaction 1 with saliva and cheese (M=semi-hard cheese; P= Primo sale cheese; D=hard cheese; R=dry ricotta). Error bars represent standard deviation over three replications.

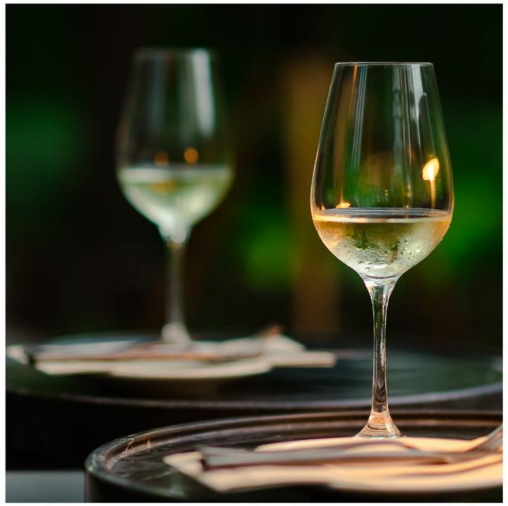
What is the effect on bioaccessibility and bioavailability?

CONCLUSION

The analysis of the proteins and phenolic compounds after the binding reactions represented only one side of the chemical interactions in food and wine pairing.

The study of the aroma and texture of both wine and cheese should also be considered from a sensory point of view.

Several variables affect the entity of the reciprocal interactions between polyphenols and other cheese compounds. Deeper in vitro and in vivo studies are urgently needed to understand all the variables that can influence the entity of these reciprocal interactions, from the **cheese matrices (i.e., types, structures, concentrations, hydrophilic/hydrophobic characteristics), to the environmental conditions (pH, temperature, processing methods), until to the physiological situations (bioavailability,**



Thank you for your kind attention !

ANY QUESTIONS?

Utilization of molasses-derived feeds in Italian Mediterranean buffaloes

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella & Milk Products

24/25 Sept. 2024

Alfio Calanni Macchio[1], Roberta Matera[1], Gabriele di Vuolo[2], Giuseppina Pedota[3], Valentina Longobardi[1], Federica Piscopo[1], Francesca Aragona[1], Gianluca Neglia[1]

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[2] Istituto Zooprofilattico Sperimentale del Mezzogiorno, Portici (NA), Italy
[3] Associazione Regionale Allevatori della Basilicata, Potenza, Italy

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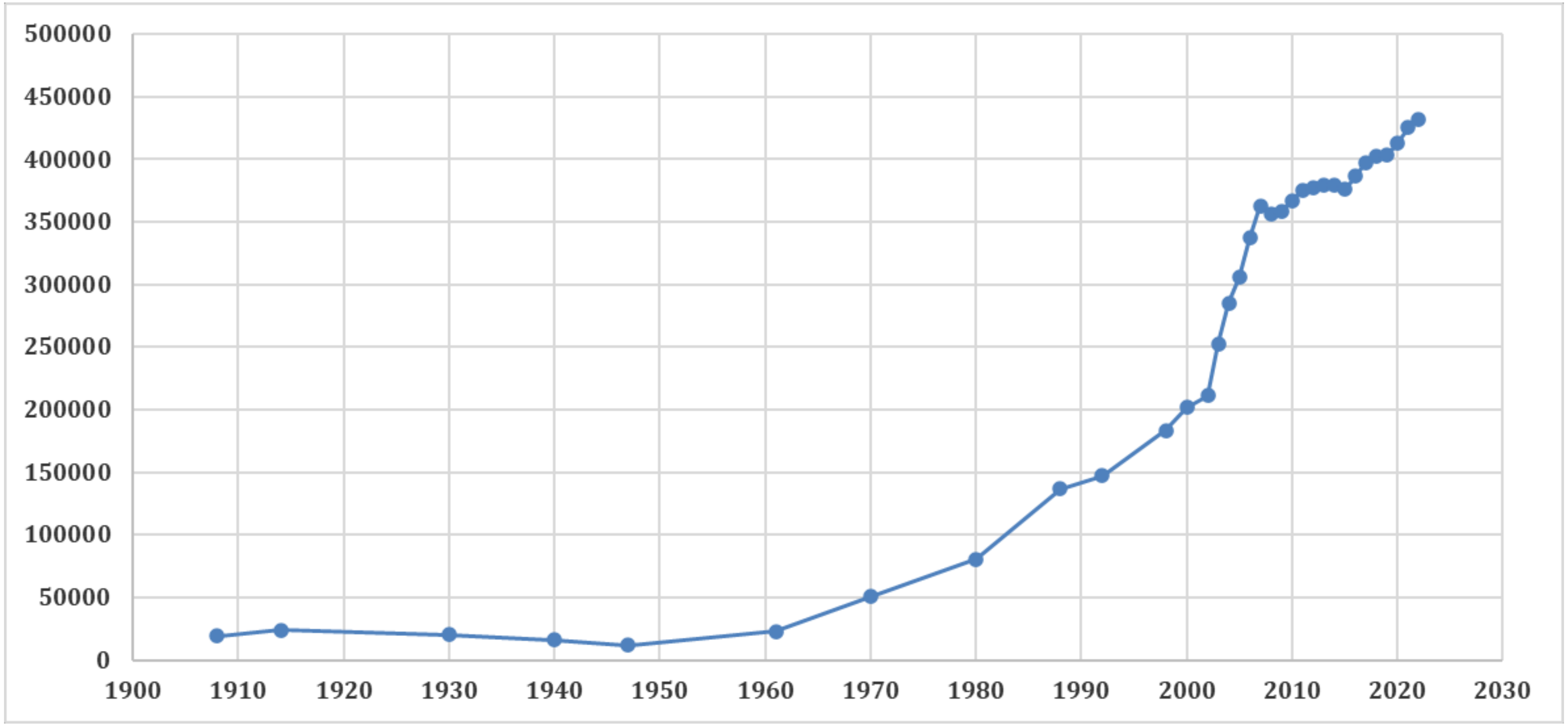
Università degli Studi di Napoli Federico II

Dipartimento Medicina Veterinaria Produzioni Animali

Dipartimento di Agraria

Background



Buffalo population in Italy has grown significantly - from just 12,500 animals in 1947 to nearly 432,000 in 2022 (National Zootechnical Database).

Materials and Methods

- 64 Italian Mediterranean buffaloes
- Cancello ed Arnone, Italy
- 134 days from February to June 2023

Two homogeneous groups (32 buffaloes each)	
Group C (control)	Group T (treatment)
Standard total mixed ration (TMR)	TMR + molasses-based liquid feed (SUGARPLUS®)

- Buffaloes’ milk production (daily)
- Milk samples (every 15 days) – fat, protein, casein levels
- Blood samples – metabolic profiles
- In vitro fermentation tests – impact of molasses on rumen efficiency

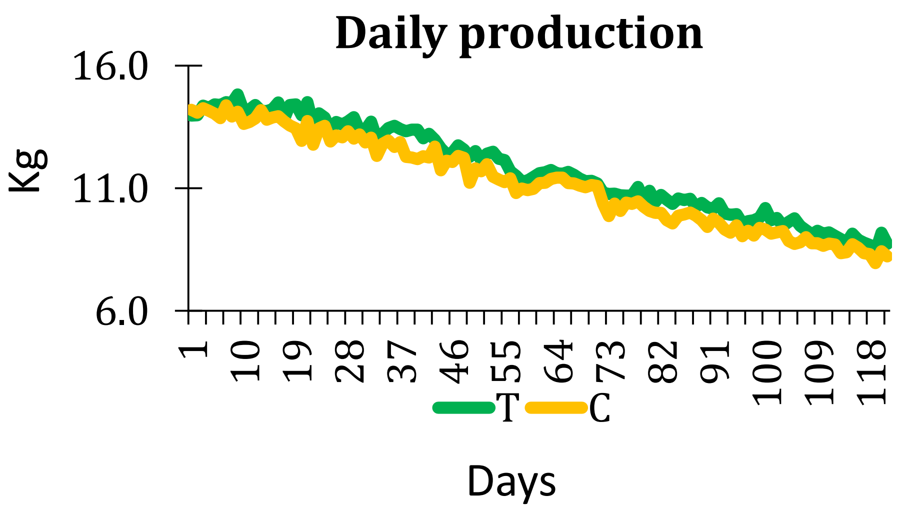
Diet and Production Efficiency

PRODUCT:
Mozzarella di Bufala Campana

Molasses-based liquid feeds:
ADVANTAGES

- Highly palatable
- Readily fermentable sugars, which increase feed intake
- Rumen efficiency
- Better digestion, nutrient absorption, and overall productivity

Experimental results



Buffaloes in the molasses-fed group produced more milk daily, averaging 12.2 kg per day, compared to 11.7 kg in the control group.

Caratteristiche qualitative del latte registrate nel corso dello studio.									
Gruppo	Grasso (%)	Proteine (%)	Lattosio (%)	Caseina (%)	SCC (n)	DSCC (%)	Urea (%)	Acetone (%)	BHB (%)
Controllo	8.34 ± 0.06^{A}	4.42±0.03	4.68±0.02	3.54±0.03	114.5±11.53	46.23±1.25	43.07 ± 0.83^{A}	0.32±0.02	0.22 ± 0.01^{A}
Trattato	8.59 ± 0.06^{B}	4.43±0.03	4.63±0.02	3.57±0.02	150.4±39.48	44.20±1.13	35.68 ± 0.71^{B}	0.36±0.03	0.28 ± 0.01^{B}

Valori con lettere differenti nella stessa colonna sono significativamente differenti (A,B, P<0,01)

Treated group's milk had a higher fat content—8.58% compared to 8.33% in the control group.

Resa alla caseificazione registrata durante la prova.								
Gruppo	pH inizio	pH aggiunta caglio	pH rottura cagliata	pH filatura	t inizio-caglio (min)	t caglio-rottura (min)	t rottura-filatura (min)	Mozzarella (kg)
Controllo	6,6975±0,0	6,635±0,0	6,4325±0,1	4,87±0,3	9,25±2,1	91,25±11,5	220,75±47	27,25±1,2
Trattato	6,7025±0,0	6,6225±0,0	6,4125±0,1	4,97±0,2	7,75±2,2	93,75±11,8	219±49	28,25±1,3

Cheese yield was higher in the treated group, increasing from 27.3% in the control group to 28.3%.

Experimental results

Impact on Milk Quality

Profilo acidico del latte registrato nel corso dello studio.

Gruppo	SCFA (mg/100 g)	MCFA (mg/100 g)	LCFA (mg/100 g)	MUFA (mg/100 ml)	PUFA (mg/100 ml)	UFA (mg/100 ml)	SFA (mg/100 ml)	TFA (mg/100 ml)
Controllo	768,9±53,13[c]	3135±77,99[a]	3242±79,59	2171±59,88	0,20±0,01	2076±54,58	5706±144,1[b]	0,14±0.01
Trattato	913,2±54,02[d]	3379±79,63[b]	3330±82.79	2226±61,04	0,21±0,01	2124±54,75	6140±150,4[a]	0.13±0.01

Valori con lettere differenti nella stessa colonna sono significativamente differenti (c,d, P<0,10; a,b, P<0,05; A,B, P<0,01)

Improvements in fat and protein content

Parametri di coagulazione registrati nel corso dello studio.

Gruppo	RCT (min)	K20 (min)	A30 (mm)
Controllo	12,0[a]	1,43	43,26[a]
Trattato	11,0[b]	0,98	48,63[b]

Valori con lettere differenti nella stessa colonna sono significativamente differenti (a,b, P<0,05)

Milk from the treated buffaloes had a shorter coagulation time and firmer curd

Risultati ottenuti in seguito al setacciamento delle feci nel corso dello studio.

Gruppo	Setaccio superiore (0,47 mm) (%)	Setaccio intermedio (0,32 mm) (%)	Setaccio inferiore (0,16 mm) (%)
	< 10%	< 20%	< 50%
Controllo	7,45[A]	11,5	20,28
Trattato	2,14[B]	11,8	21,27

Valori con lettere differenti nella stessa colonna sono significativamente differenti (A,B, P<0,01)

Milk from the treated group had higher levels of short-chain fatty acids (SCFAs) and medium-chain fatty acids (MCFAs)

Conclusions

Using molasses-based liquid feeds can improve both the quantity and quality of milk, boost milk yield, enhance milk's suitability for cheese-making, particularly for mozzarella production.

Sustainable and efficient way to improve production outcomes.

Grazie per l’attenzione!

Alfio Calanni Macchio

alfio.calannimacchio@unina.it

Effect of feeding and ripening system on nutritional and functional profile of buffalo cheeses

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella
& Milk Products

24/25 Sept. 2024

Marika Di Paolo[1], Nunzia D'Onofrio[2], Angela Salzano[1], Alfio Calanni Macchio[1], Alessandro Cuomo[3], Maria Luisa Balestrieri[2], Raffaele Marrone[1]

[1] *University of Napoli Federico II - Department of Veterinary Medicine and Animal Production, Italy;* [2] *University of Napoli Federico II - Department of Precision Medicine, University of Campania "Luigi Vanvitelli", Italy;* [3] *Arredo Inox S.r.l., Crotone, Italy.*

INTRODUCTION AND AIM

Unione Europea | FONDI STRUTTURALI EUROPEI | pon 2014-2020 | MIUR

PER LA SCUOLA - COMPETENZE E AMBIENTI PER L'APPRENDIMENTO (FSE-FESR)

CAPSULE - Ottimizzazione delle teCniche di Allevamento e dei Processi produttivi del Settore lattiero-caseario bUfalino e del vino per la produzione di aLimEnti funzionali

Ripened buffalo cheeses?

The chemical characteristics of buffalo milk **interfere and extend the ripening process of buffalo cheeses**

Accelerated Ripening

Biochemical changes that occur during ripening are relatively slow in buffalo milk cheeses (El Soda, 1993; Kanawjia and Singh, 1991). As a consequence, flavor development in buffalo milk Cheddar cheese is considerably slower than in regular Cheddar. Therefore, there is a need to accelerate ripening of cheeses made from buffalo milk. Several approaches, such as an elevated ripening temperature, stimulation of starter culture, use of an adjunct culture, addition of enzymes, and supplementation with goats' milk, among

SOURCE: Batool *et al.*, 2018

a **cost** for a company that wants to invest in buffalo ripened cheeses

The present study proposes to evaluate the effect of

provide solutions that enable the production of **nutritionally competitive and sustainable products**

Inclusion of green feed

Innovative Ripening System

MATERIALS AND METHODS

Animals, Diet , Cheese Making and Ripening process

Animals and Diet

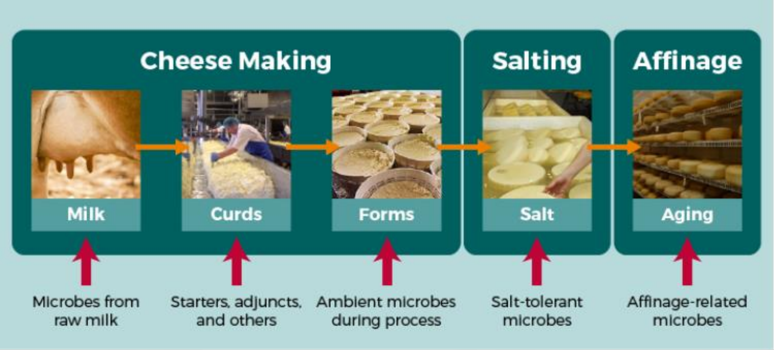
Feed (Kg)	Diet	
	CTL	FRS
Concentrate	5.50	2.50
Alfalfa	4.50	2.60
Straw	1.20	1.20
Silomais	23.00	18.00
Green ryegrass	-	25.00
Hydrogenated fats	-	0.30
Calcium carbonate	-	0.05
TOTAL	34.20	49.65

Table 1. Diets composition (kg) of buffaloes fed with (FRS) and without (CTR) green feed inclusion.

Buffalo were randomly divided in two group:

- Control group, **CTR**; *n* = 25
- Fresh group, **FRS**; *n* = 25

Cheese Making



Relative Humidity (RH%)

Temperature (°C)

Air Flow

pH

Ripening system

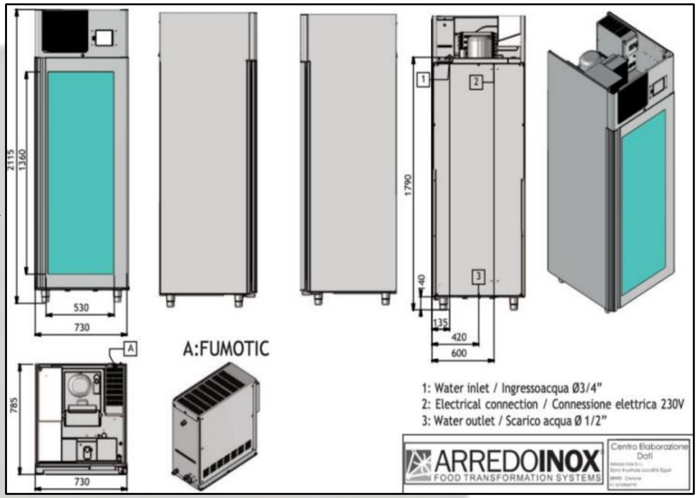
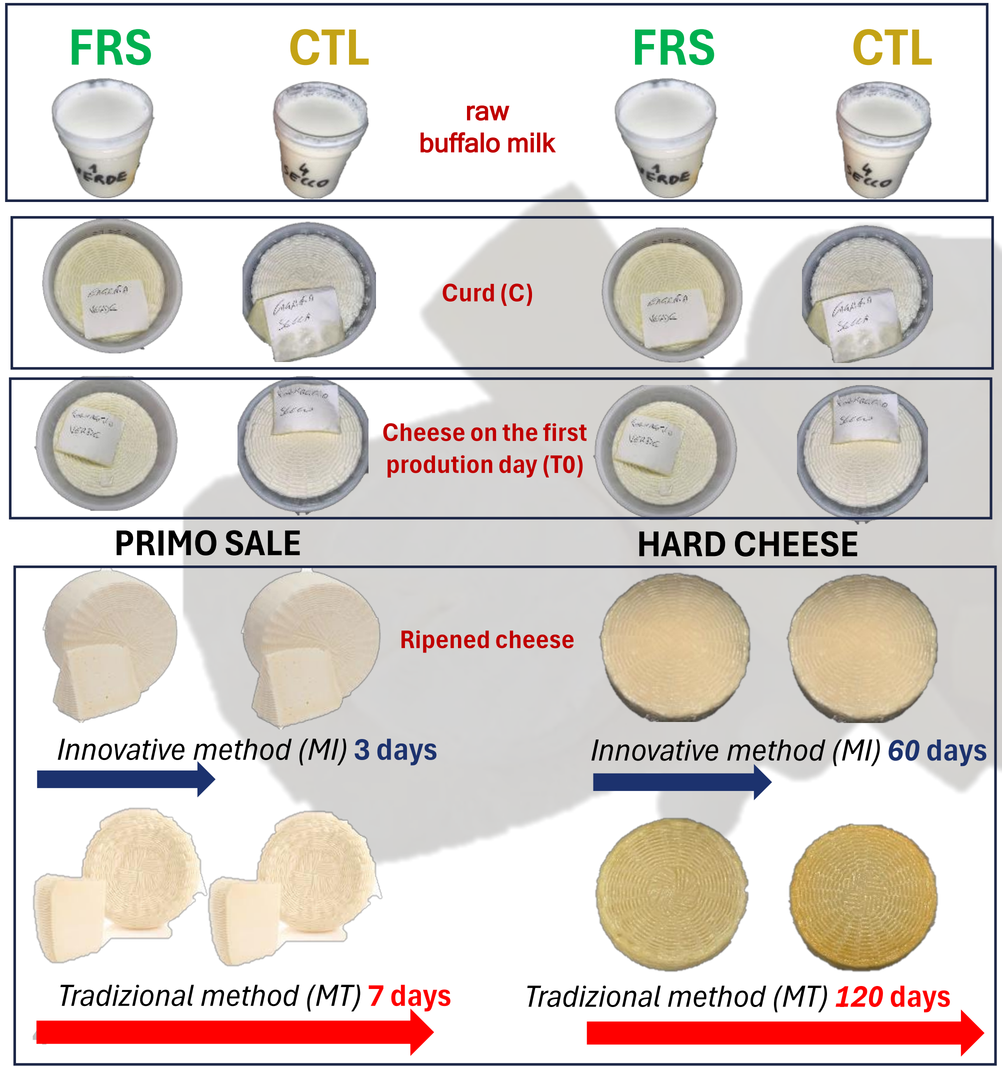


Figure 1. Industrial ripening plant (Stagionello ® European Patented Device and controlled pH – n. EP 2769276B1) to ripen cheeses.

The cheeses were ripened using a system called Stagionello®, equipped with an **internal control device** that allow the monitoring of the physical and chemical state of cheese during the ripening by continuously measuring of pH and climatic parameters.

MATERIALS AND METHODS

Sampling procedure



Climatic recipes

The cheeses obtained were ripened using two different methods: a **longer**, **traditional method** and a **shorter**, **experimental method.**

Cheese	Ripening time	Ripening steps	pH	Air temperature (°C)	RH (%)	Airflow
Hard cheese	**INNOVATIVE** 60 days	Stewing (1 h)	5.5	26	85	0
		Dripping (8 h)	4.8	24	80	1
		Drying 1 (24 h)	5.0	22	75	0
		Drying 2 (24 h)	5.0	21	76	0
		Drying 3 (24 h)	5.1	19	78	0
		Drying 4 (24 h)	5.1	17	80	0
		Pre- ripening 1 (48 h)	5.1	15	82	0
		Pre-ripening 2 (48 h)	5.2	14	82	0
		Pre- ripening 3 (48 h)	5.3	13	84	0
		Pre- ripening 4 (48 h)	5.4	12	85	0
		Ripening (48 days)	5.5	11	73	1
	TRADITIONAL 120 days		-	+14/15	90-96	-
Primo sale	**INNOVATIVE** 3 days	Ripening (72 days)	5.6	10	35	0
	TRADITIONAL 7 days		-	13	85	-

Table 2. Experimental ripening design for hard cheese and primo sale cheese.

For each interval, 2 samples were collected and classified based on the type of feed administered to the animals (CTL = without green feed; FRS = green feed).

MATERIALS AND METHODS

Analysis

The effects of the feeding and accelerated ripening were evaluated through **physicochemical analysis**, examination of **health-promoting biomolecules** and **antioxidant power.**

Study of the physical and chemical characteristics

- Chemical composition **(AOAC International, 2002)**
- Color (CIE L*a*b*) (**Serrapica *et al.*, 2020)**
- Texture profile Analysis – TPA (**Di Paolo *et al.*, 2023)**

Study of the lipolysis and oxidation indexes

- Free Fatty Acids - FFA **(Manzo *et al.*, 2019)**
- Thiobarbituric Acid - TBARs **(Ambrosio *et al.*, 2014)**
- Peroxide Value - PV **(De Luca *et al.*, 2019)**

Study of health-promoting biomolecules and antioxidant power

- **Health-promoting biomolecules:** γ-butyrobetaine, glycine betaine, δ-valerobetaine, l-carnitine, acetyl-l-carnitine and propionyl-l-carnitine (**Salzano *et al.*, 2021)**
- **Antioxidant power –** FRAP; Assay Kit (MBS169262) and total antioxidant capacity (TAC); Assay Kit (#K274-100) (**Salzano *et al.*, 2021)**

RESULTS AND DISCUSSION

Study of the chemical composition and the lipolysis and oxidation indexes

		Primo sale				Hard cheese			
		Semi-finished products		Ripened cheeses		Semi-finished products		Ripened cheeses	
Item		C	T0	MI	MT	C	T0	MI	MT
Fat,	CTL	17.56±0.65	18.22±1.23	16.85±0.81	16.56±1.77	23.35±1.07	34.52±1.24	33.58±1.25	44.43±0.81
%	FRS	21.66±0.38	19.23±1.61	13.06±0.41	15.98±0.35	24.83±1.18	33.95±0.80	44.86±2.40	45.61±0.87
Protein,	CTL	12.56±0.77	11.61±0.49	16.85±0.81	16.56±1.77	15.37±0.50	16.69±0.74	24.83±1.12	19.26±0.78
%	FRS	11.45±0.77	12.54±0.87	13.06±0.41	15.98±0.35	14.97±0.65	15.34±0.74	25.51±2.46	19.41±1.04
Moisture,	CTL	56.63±1.43	57.74±0.57	39.60±1.94	32.77±1.31	49.16±0.86	49.30±0.80	18.23±0.78	13.55±0.76
%	FRS	58.86±1.66	56.23±1.44	42.20±0.74	37.91±1.93	48.69±1.52	49.00±2.54	17.56±0.81	13.35±0.76
NaCl,	CTL	0.20±0.06	2.53±0.09	4.19±0.31	6.13±0.45	0.19±0.03	0.41±0.03	1.76±0.38	1.67±0.22
%	FRS	0.15±0.01	2.49±0.14	4.33±0.29	5.44±0.55	0.09±0.01	0.37±0.05	1.70±0.18	2.11±0.12

Table 3. Effects of feeding system and ripening time on **chemical composition** of primo sale cheeses and hard cheeses.

		Primo sale				Hard cheese			
		Semi-finished products		Ripened cheeses		Semi-finished products		Ripened cheeses	
Item		C	T0	MI	MT	C	T0	MI	MT
PV,	CTL	1.346	1.965	2.964	5.028	1.538	1.550	1.395	1.257
meqO2/kg	FRS	1.683	2.348	2.475*	4.582*	1.328	1.423	1.741	1.431
FFA,	CTL	0.047	0.037	0.065	0.052	0.148	0.112	0.693	0.946
%	FRS	0.056	0.037	0.047	0.054	0.076	0.114	0.630	1.080
TBARs,	CTL	0.028	0.012	0.064	0.025	0.054	0.076	0.061	0.538
mg/kg	FRS	0.012	0.125	0.055	0.010	0.086	0.132	0.129	0.429*

Table 4. Effects of feeding system and ripening time on the **lipolysis and oxidation indexes** of primo sale cheeses and hard cheeses.

Effect of feeding

The inclusion of green feed in the buffalo diet did **not significantly affect** the chemical composition of buffalo cheeses.

The **lowest peroxide values** were observed in **cheeses** of fresh group (FRS), pointed out the influence of the feeding system on the levels of antioxidant compounds during ripening.

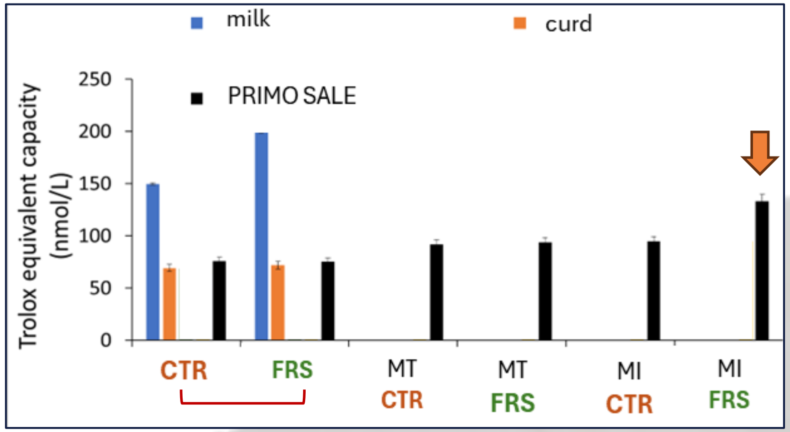
Effect of ripening method

The ripening method did **not significantly affect** the chemical composition of buffalo cheeses.

Lower levels of lipid oxidation in cheeses subjected to a **fast innovative ripening method (MI)**.

RESULTS AND DISCUSSION

Study of antioxidant power



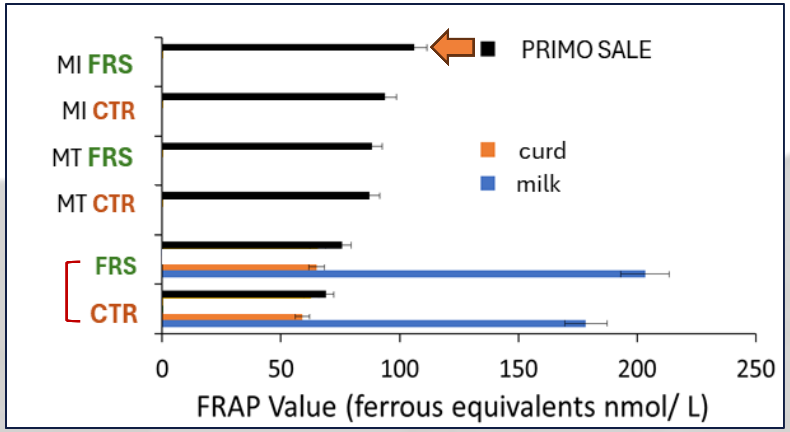
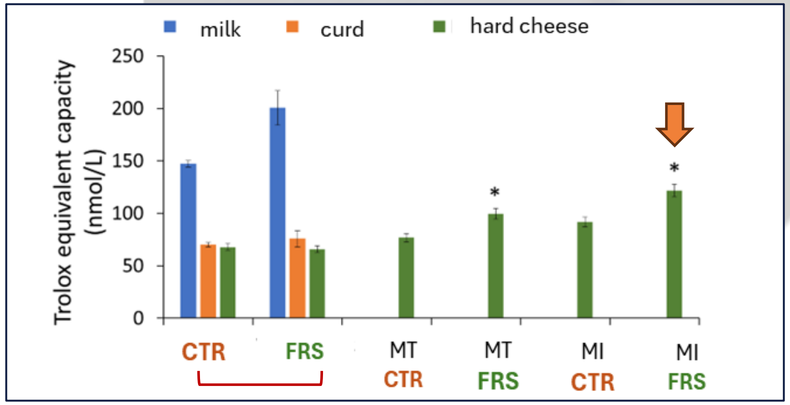


Figure 4. Antioxidant power of primo sale cheese during the ripening period.



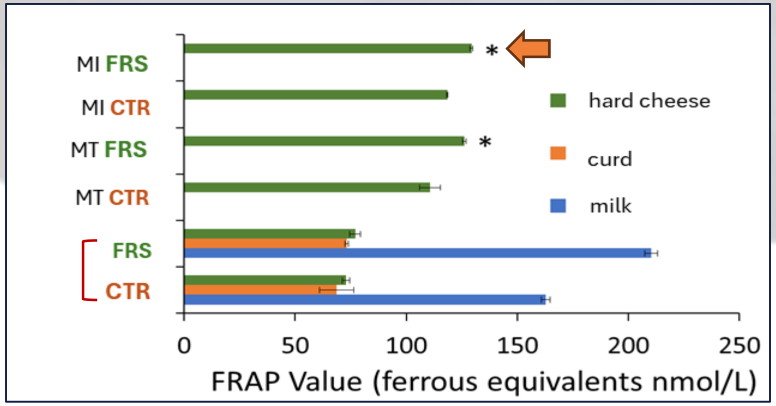


Figure 5. Antioxidant power of hard cheese during the ripening period. *=p<0.05 vs CTR group.

Effect of feeding

Higher antioxidant power was found in milk and cheese of fresh group (FRS) compared to the control group (CTR).

Leafy vegetables contain relatively **high amounts of Nε-trimethyl lysine (TML)**, which participates in l-carnitine and δ-valerobetaine biosynthesis, and has recognized antioxidant properties (**Salzano et al 2021**).

Effect of ripening method

The innovative ripening method (MI) **improved the antioxidant properties** of both buffalo cheeses.

RESULTS AND DISCUSSION

Study of health-promoting biomolecules

		Primo sale					Hard cheese				
ppm		milk	C	T0	MI	MT	milk	C	T0	MI	MT
γ-butirrobetaina	CTL	5.09±0.15	2.12±0.05	5.76±0.35	6.84±0.02	6.16±0.29	4.74±0.44	2.38±0.38	2.81±0.15	3.02±0.06	3.09±0.14
	FRS	5.96±0.5*	2.54±0.03	6.41±0.18	7.14±0.10*	6.42±0.07	5.00±0.51*	2.73±0.09	3.82±0.17*	4.03±0.06	3.87±0.61
δ-valerobetaina	CTL	17.57±0.46	6.25±0.07	14.56±0.47	15.15±0.04	14.97±0.24	18.58±0.22	6.11±0.47	6.04±0.03	6.08±0.10	5.98±0.19
	FRS	26.22±0.62**	6.43±0.19	16.29±0.42	16.85±0.14*	15.36±0.17	27.10±1.24**	7.05±0.46*	6.77±0.32*	7.03±.04*	6.95±0.39
glicinabetaina	CTL	16.87±0.11	4.19±0.3	14.23±0.05	14.47±0.07	14.16±0.07	16.57±0.88	3.90±0.09	4.93±0.13	5.05±0.06	5.01±0.09
	FRS	18.53±1.75*	5.11±0.06	14.88±0.22	15.61±0.24*	14.96±0.13	18.60±0.30*	4.95±0.12*	5.09±0.20	5.35±0.17	5.12±0.11
carnitina	CTL	38.45±1.73	21.99±2.30	30.10±1.64	37.69±0.55	34.62±0.26	39.8±0.86	23.54±0.35	30.37±0.44	30.58±0.60	29.96±0.21
	FRS	45.26±1.75**	25.50±1.10	30.15±0.47	33.2±0.7*	29.99±0.71	44.3±1.91*	24.25±0.39	32.04±0.80	32.32±0.70*	31.96±0.09
acetilcarnitina	CTL	40.20±0.6	11.62±1.78	23.02±0.08	23.99±0.40	23.370.50	40.38±0.70	12.12±0.40	13.76±0.15	14.15±0.04	19.96±0.08
	FRS	49.94±0.96**	13.55±0.98*	22.62±0.47	24.75±0.16*	22.26±0.31	49.08±0.56**	13.37±0.60	14.79±0.93*	15.2±0.12*	14.91±0.09
propionilcarnitina	CTL	16.72±1.52	5.54±0.12	20.54±0.41	21.63±0.21	20.49±0.29	16.80±1.61	5.44±0.17	5.93±0.13	6.06±0.04	5.98±0.07
	FRS	27.01±1.88**	6.02±0.18	23.27±0.24	23.61±0.29	23.71±0.50	28.83±0.95**	6.26±0.25*	6.21±0.04*	6.35±0.16	6.19±0.11

Table 5. Effects of feeding system and ripening time on **health-promoting biomolecules** of primo sale cheeses and hard cheeses.

Effect of ripening method

The innovative method, compared to the traditional one, did not negatively affect the content of betaine and carnitine but **positively contributed to their accumulation** in the cheeses.

Effect of feeding

Higher concentration of the health-promoting biomolecules in milk and cheeses of fresh group (FRS) compared to those fed without green feed (CTR).

The **greater δ-valerobetaine** content of milk in buffaloes that received green feed provides one explanation for the greater total antioxidant capacity compared with buffaloes of the CTR group (**D'Onofrio et al., 2019**).

CONCLUSION

foods MDPI

Article

Role of Feeding and Novel Ripening System to Enhance the Quality and Production Sustainability of Curd Buffalo Cheeses

Marika Di Paolo [1], Valeria Vuoso [1], Rosa Luisa Ambrosio [1,*], Anna Balestrieri [2], Giovanna Bifulco [1], Aniello Anastasio [1] and Raffaele Marrone [1]

Inclusion of green feed

the role of a diet with **green forage on buffalo productions**

Innovative Ripening System

the **importance of choice suitable climatic parameters**

Therefore, **accelerated ripening methods** and **functional diets** could be candidates as promising systems for the valorization of buffalo cheeses in the dairy industry.

Grazie per l’attenzione!

Marika Di Paolo

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Effect of dietary administration of green forage on carbohydrate-active enzymes (CAZymes) and milk quality in Italian Mediterranean buffaloes

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella & Milk Products

24/25 Sept. 2024

Roberta Matera[1], Angela Salzano[1], Anella Saggese[2], Elisa Martino[3], Martina Cascone[2], Matteo Selci[2], Gianmaria Pacelli[1], Giovanna Bifulco[1], Giuseppe Campanile[1]

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Buffalo Farming

Buffaloes are a major global livestock of economic and social importance in both developing and developed economies

Functional products

"Diet is the "medicine" we take daily to improve our health!!!"

In recent years, consumer attention has focused on functional foods of animal origin, especially if produced with respect for the environment and animal welfare.

Green feed increases antioxidant and antineoplastic activity of buffalo milk: A globally significant livestock

Angela Salzano[a], Gianluca Neglia[a], Nunzia D'Onofrio[b,*], Maria Luisa Balestrieri[b], Antonio Limone[c], Alessio Cotticelli[a], Raffaele Marrone[a], Aniello Anastasio[a], Michael J. D'Occhio[d], Giuseppe Campanile[a]

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Buffalo milk and rumen fluid metabolome are significantly affected by green feed

G. Neglia[1], A. Cotticelli[1], A. Vassetti[2], R. Matera[1], A. Staropoli[2,3], F. Vinale[1,2], A. Salzano[1] & G. Campanile[1]

Salzano *et al. BMC Genomics* (2023) 24:133
https://doi.org/10.1186/s12864-023-09215-6

BMC Genomics

RESEARCH Open Access

Check for updates

Transcriptomic profiles of the ruminal wall in Italian Mediterranean dairy buffaloes fed green forage

Angela Salzano[1†], Salvatore Fioriniello[2†], Nunzia D'Onofrio[3], Maria Luisa Balestrieri[3], Riccardo Aiese Cigliano[4], Gianluca Neglia[1], Floriana Della Ragione[2,5*] and Giuseppe Campanile[1]

The ruminal microbiota produces carbohydrate-active enzymes (**CAZymes**) which include lignocellulolytic enzymes that fundamentally determine the degradation and debranching of plant polysaccharides.

Glycoside hydrolases
(GH, hydrolyze and/or rearrange glycosidic bonds)

Glycosyl transferases
(GT, form glycosidic bonds)

Polysaccharide lyases
(PL, non-hydrolytic cleavage of glycosidic bonds)

Carbohydrate esterases
(CE, hydrolyze carbohydrate esters)

Auxiliary activities
(AA, redox enzymes that act in conjunction with CAZymes)

AIM

To determine the effect of including green forage (GF) in the diet of Italian Mediterranean buffaloes (IMB) on the CAZymes profile, functional biomolecules and total antioxidant activity in milk.

Animals and Diets

Commercial buffalo farm located in Southern Italy

60 days

16 Italian Mediterranean buffaloes

Two diets iso-nitrogenous and iso-energetic

Two homogeneous groups by live weight, parity (ODP), days in milk (DIM), production (MY)

Gruppo C – TMR standard

Gruppo T – TMR + Green forage

Item	TMR	TMR + green feed
Component (kg of feed)	*Amount*	
Ryegrass	-	24
Corn silage	22	17
Alfalfa hay	4	2.5
Soybeanmeal (48)	0.6	-
Concentrate	3.8	2.4
Wheat straw	1	1.1
Hydrogenated fats	0.3	0.3
Calcium Carbonate	0.1	0.2
Salt 1:3	0.2	0.2
Vitamins	0.1	-
Composition (dry matter intake)		
Dry matter	16.0	16.1
CP	14.5	14.4
Fat	4.8	5.0
NDF	38.0	38.5
ADF	24.0	23.4
NSC	34.0	33.1
Starch	21.0	15.5
Ash	8.1	9.0
Calcium	0.9	1
Phosphorus	0.4	0.4
MFU	0.93	0.91

Experimental Design

Creation of groups

Bulk milk and rumen fluid

0

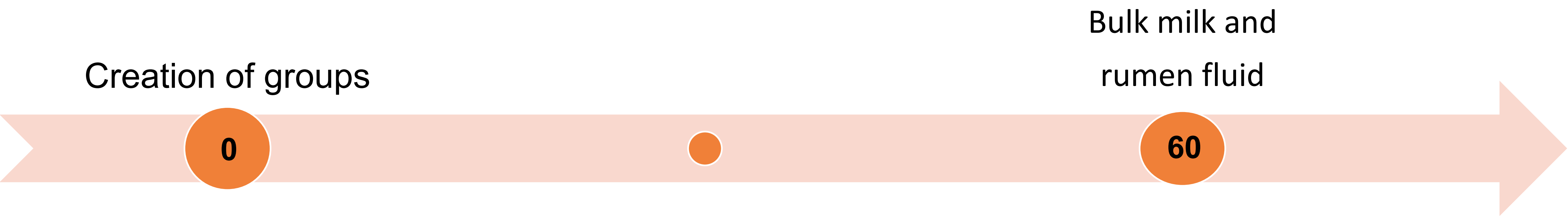
60

Bulk milk analysis

Functional molecules (*Servillo et al., 2018*)

FRAP and TAC

Experimental Design



Rumen fluid →

Microbiomes were investigated through metagenomic analysis and CAZymes were identified using the HMMER 3.0 package with the dbCAN CAZyme database.

Results

	TMR	TMR + green feed
L-carnitine	30.4±0.7 ^{A}	41.0±0.6 ^{B}
acetyl-L-carnitine	38.6±0.5 ^{A}	48.4±0.6 ^{B}
propionyl-L-carnitine	15.7±1.0 ^{A}	22.1±0.5^{B}
γ-butyrobetaine	4.4±0.3	3.8±0.2
δ-valerobetaine	19.1±0.6 ^{A}	23.4±0.6 ^{B}
glycine betaine	7.3±0.1	7.4±0.3
TAC	220.3±5.5^{A}	249.5±7.7^{B}
FRAP	194.3±4.2^{A}	225.8±4.8^{B}

Results

GT	Genus
GT4	Selenomonas, Prevotella, Oscillospiraceae
GT14	Prevotella
GT20	Prevotella
GT26	Selenomonas, Prevotella, Oscillospiraceae
GT30	Selenomonas, uncultured Prevotella
GT39	Oscillospiraceae
GT56	-

Group T had a greater ($p<0.01$) abundance of CAZymes of the **GT** class (GT4, GT14, GT20, GT26, GT39) and **AA** class (AA1, AA3, AA6)

Conclusions

The inclusion of green feed in the diet of dairy buffaloes favors ruminal microbiota that produce **CAZymes** that support the synthesis of amino acids and *functional biomolecules*.

The findings provide incentive to further refine feeding strategies that meet consumer preference for food products sourced from animals fed natural diets.

The approach adopted in the present study for buffaloes should also be applicable to dairy cattle.

Grazie per l'attenzione!

R. Matera

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- PSR REGIONE CAMPANIA 2014-2020 measure 16.1.2. Project" **STRABUF**: Strategie per il miglioramento della redditività dell'allevamento bufalino (Strategies for improving the profitability of buffalo breeding)". CUP: B68H19005200009.

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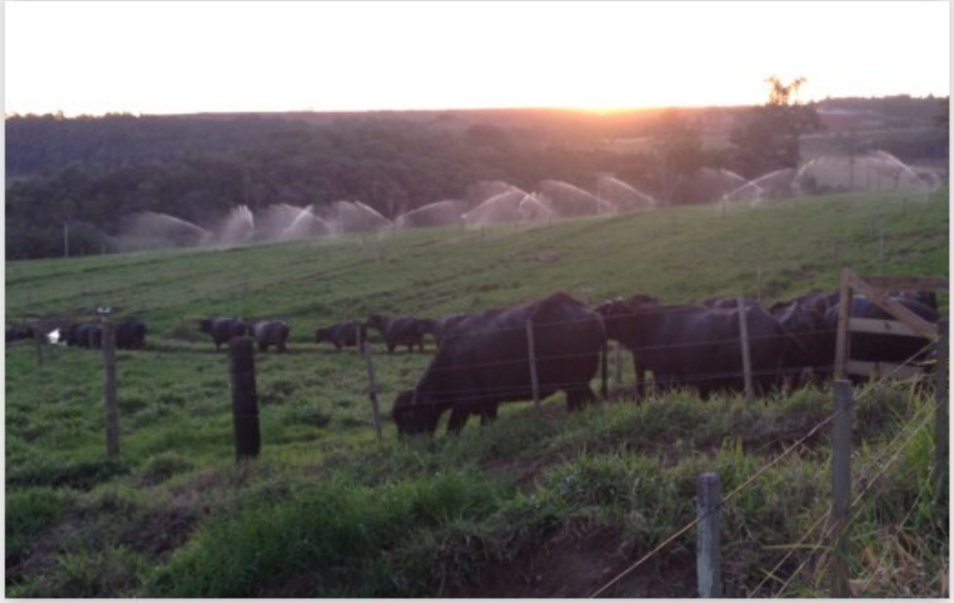
Milk and dairy buffalo supply chain in the Americas

Otavio Bernardes

Pastures: the most common model of exploitation in tropical and equatorial areas of Latin America

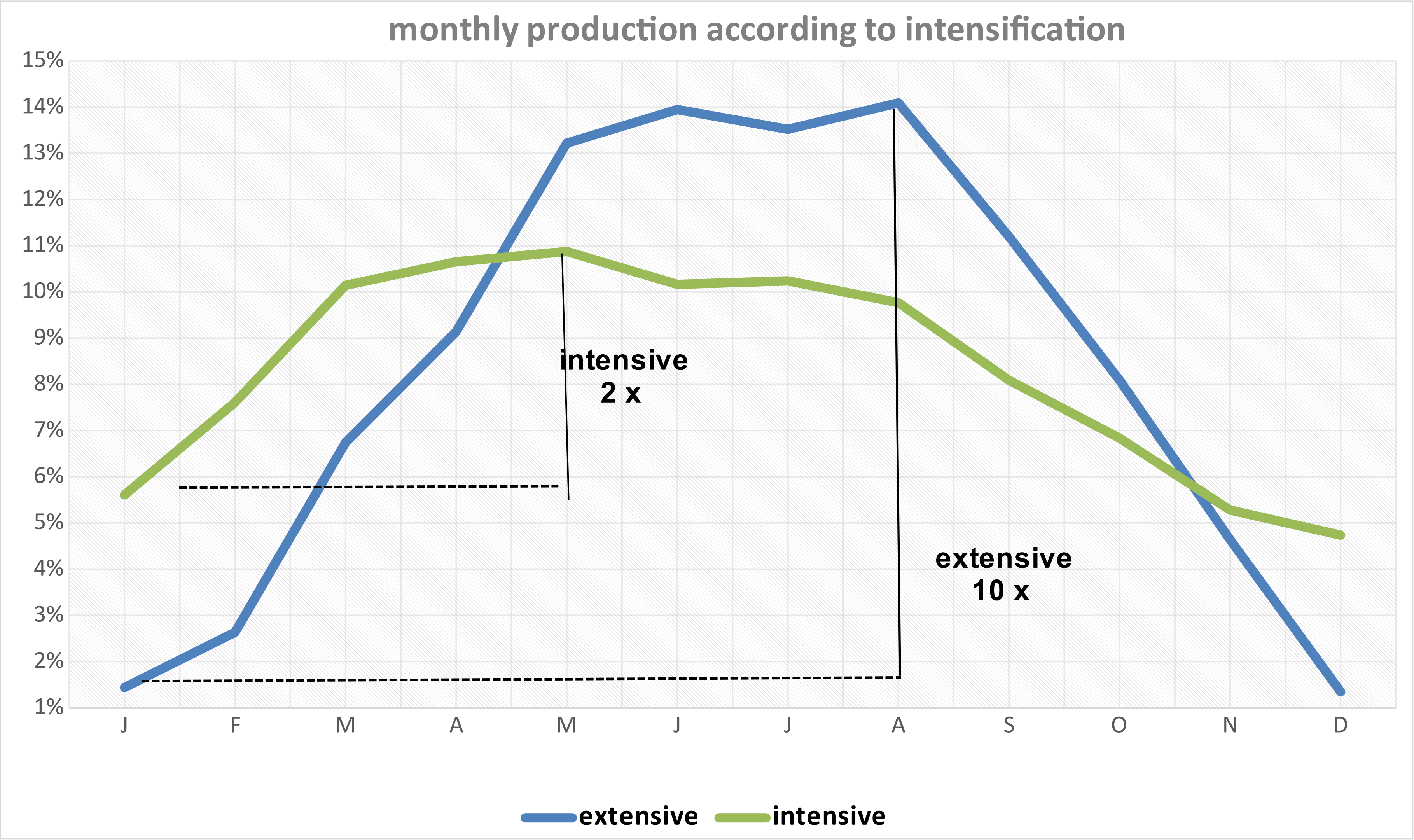
	supplementation and irrigation	without supplements
Kg of milk/animal/year	**3.552 kg**	**1.460 kg**
Kg of milk/ ha /year	**11.668 kg**	**1.168 kg**

Fat (%):	6,6 - 7,5 %
Protein (%):	4,1 a 4,3 %
Lactose(%):	4,4 a 5,5 %

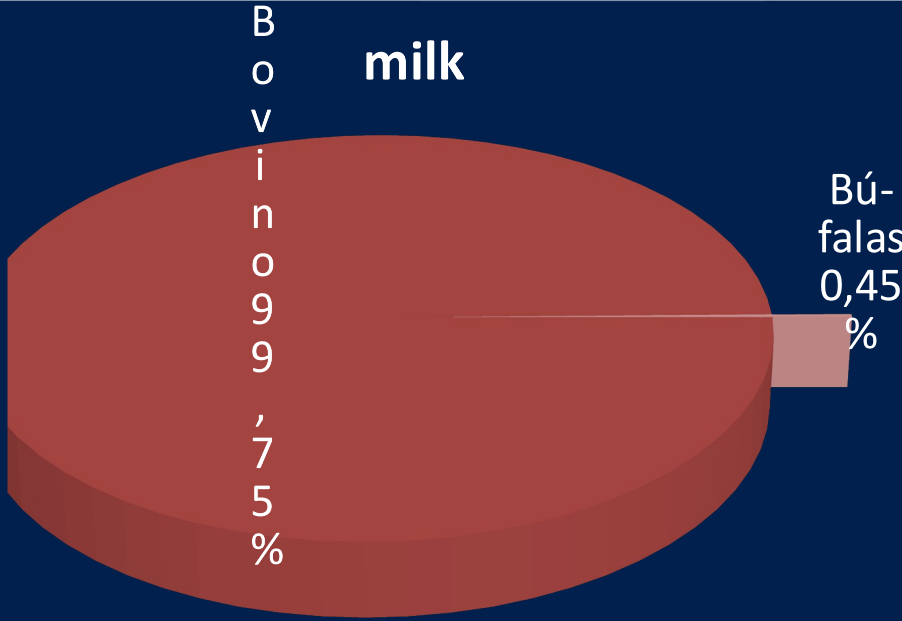
Industrial yield: 16-18 %

Tabela 6 - Teores de gordura, proteína e nitrogênio uréico no leite de búfalas ao longo da lactação

Variáveis	Faz.	Colheitas								
		Abril	maio	junho	julho	agosto	setembro	outubro	novembro	Média
		%								
Gordura										
	1	5,8±0,38^{1c}	6,7±0,34^{b}	7,7±0,64^{a}	7,5±0,34^{ab}	7,6±0,34^{a}	7,5±0,34^{ab}	8,4±0,34^{a}	8,6±0,68^{a}	7,5±0,16
	2	5,4±0,34^{b}	7,4±0,34^{a}	7,3±0,34^{a}	7,4±0,34^{a}	7,3±0,53^{a}	7,6±0,34^{a}	7,6±0,34^{a}	7,7±0,48^{a}	7,2±0,15
	3	5,9±0,40^{c}	6,6±0,34^{abc}	6,8±0,34^{abc}	6,5±0,34^{bc}	6,6±0,37^{abc}	7,4±0,39^{ab}	7,6±0,40^{a}	7,1±0,56^{abc}	6,8±0,16
	4	6,4±0,37^{b}	6,3±0,36^{b}	6,3±0,34^{b}	6,1±0,34^{b}	6,1±0,34^{b}	6,3±0,34^{b}	7,0±0,55^{ab}	8,3±0,56^{a}	6,6±0,17
	5	5,7±0,34^{b}	6,5±034^{a}	7,3±0,34^{a}	6,9±0,36^{a}	6,7±0,34^{a}	6,4±0,34^{ab}	7,0±0,34^{a}	6,4±0,48^{ab}	6,6±0,15
Proteína										
	1	4,2±0,13^{b}	4,1±0,12^{c}	4,1±0,12^{c}	4,0±0,12^{c}	4,0±0,12^{c}	4,4±0,12^{b}	4,5±0,12^{a}	4,5±0,24^{a}	4,2±0,06
	2	4,3±0,12^{b}	4,1±0,12^{c}	4,1±0,12^{c}	4,2±0,12^{c}	4,2±0,14^{c}	4,3±0,12^{b}	4,8±0,12^{a}	4,6±0,17^{a}	4,3±0,06
	3	4,0±0,14^{b}	4,0±0,12^{c}	4,0±0,12^{c}	3,9±0,12^{c}	4,1±0,13^{c}	4,4±0,14^{b}	4,7±0,14^{a}	4,6±0,19^{a}	4,2±0,06
	4	4,3±0,13^{b}	3,8±0,13^{c}	3,9±0,12^{c}	3,9±0,12^{c}	3,7±0,12^{c}	3,9±0,12^{b}	4,3±0,19^{a}	4,9±0,20^{a}	4,1±0,06
	5	4,5±0,12^{b}	4,1±0,12^{c}	4,1±0,12^{c}	3,8±0,13^{c}	4,0±0,12^{c}	4,0±0,12^{b}	4,2±0,12^{a}	4,5±0,17^{a}	4,2±0,06

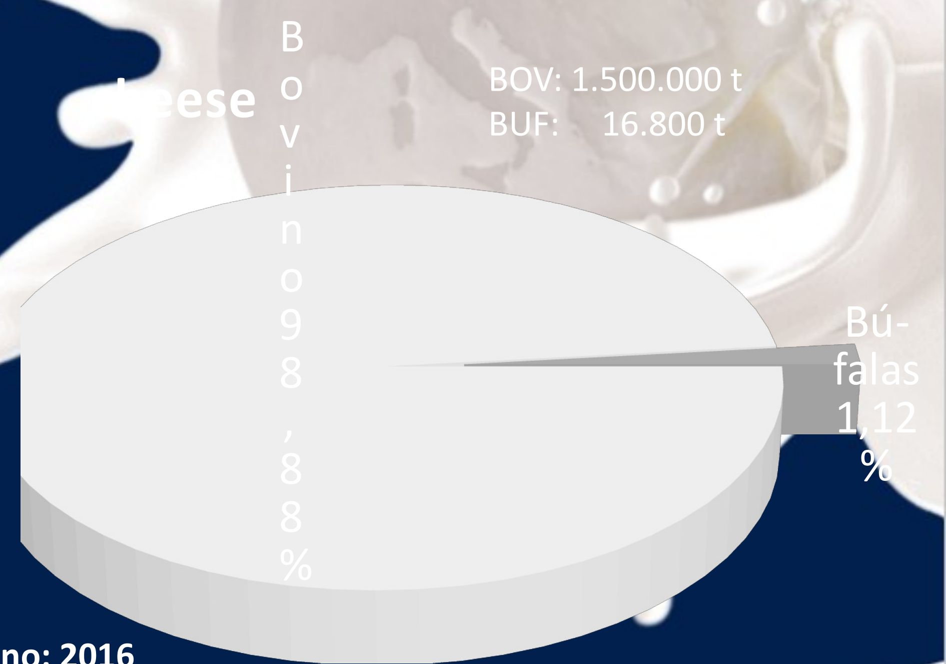


Paineiras da Ingai



BOV: 35.400 milhões litros
BUF: 160 milhões litros

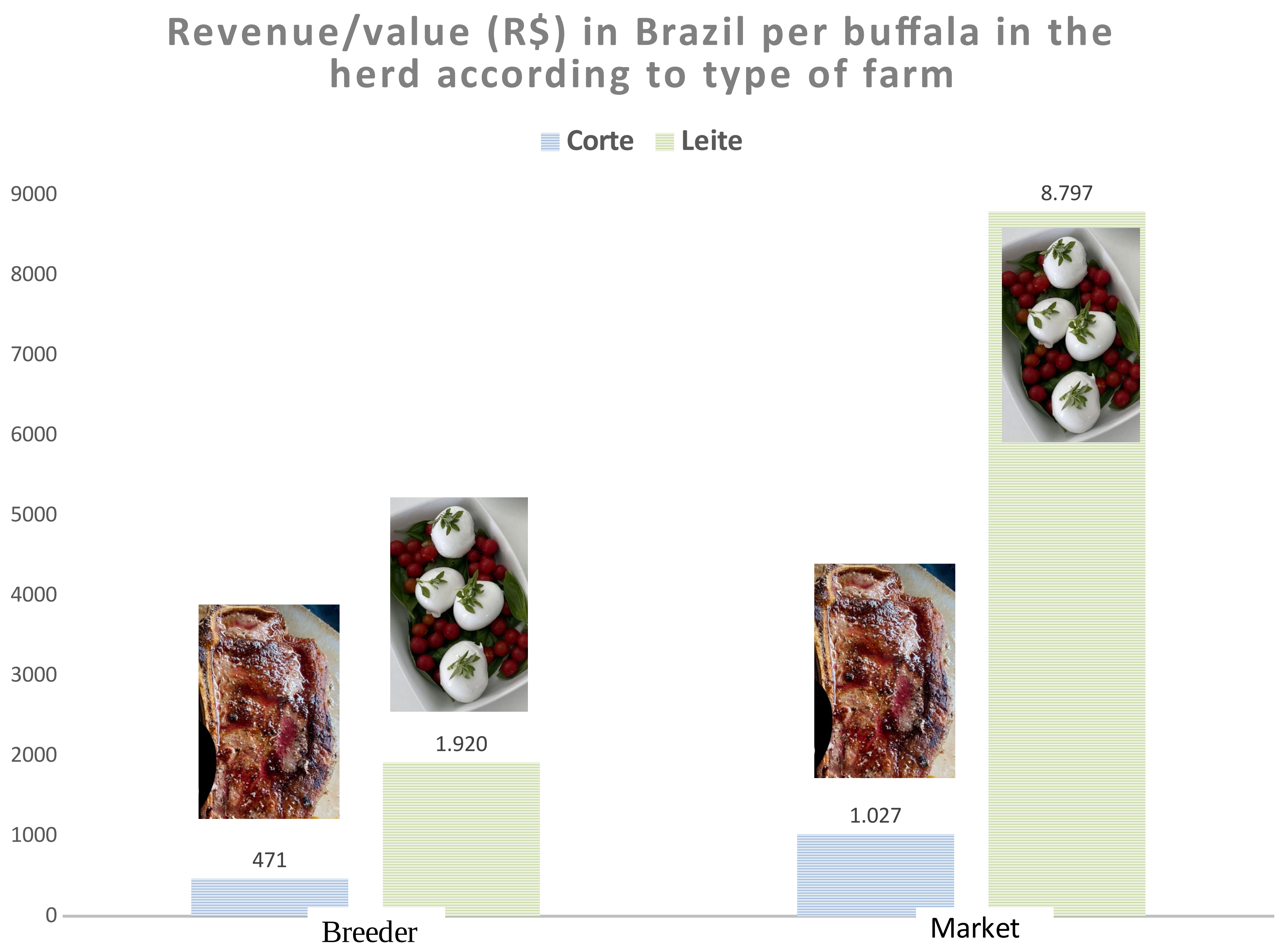
Brazil



Ano: 2016

Colombia 64 milhões de litros

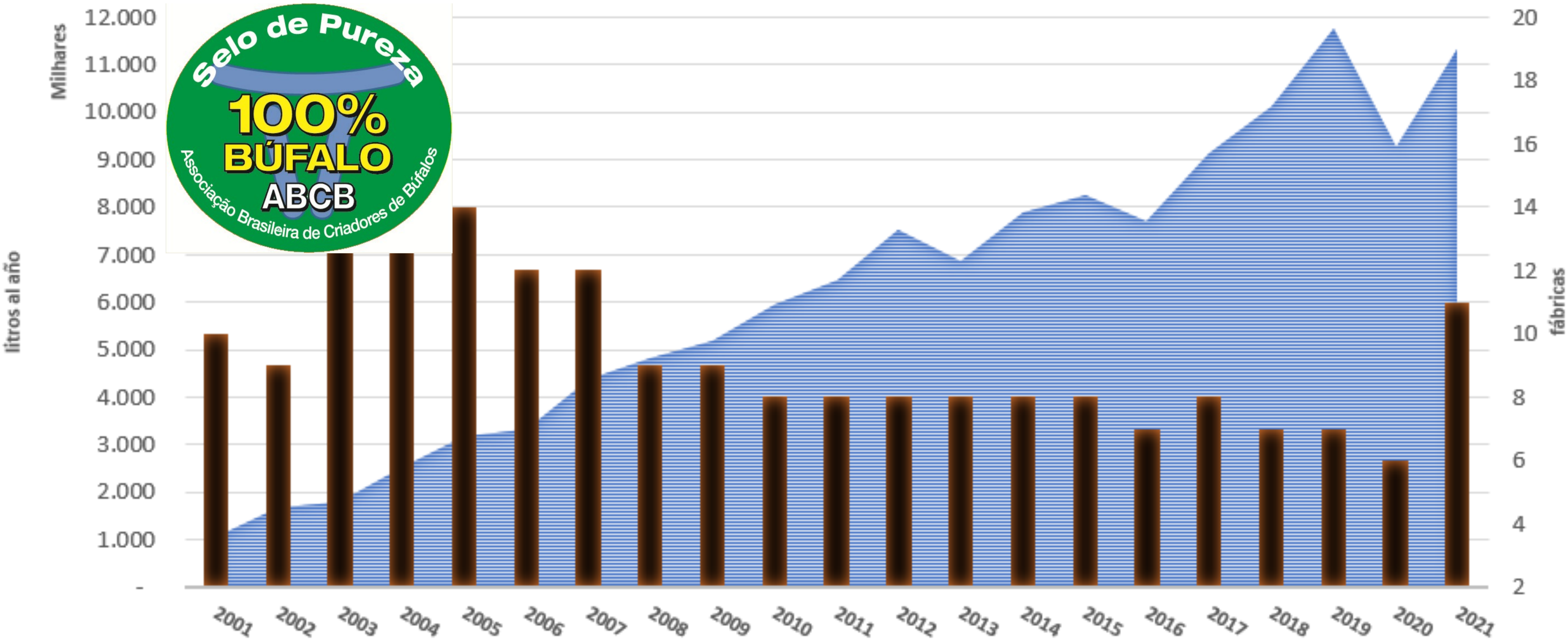
Venezuela 40% processed milk



Revenue/value (R$) in Brazil per buffala in the herd according to type of farm
Corte
Leite
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
471
1.920
1.027
8.797
Breeder
Market

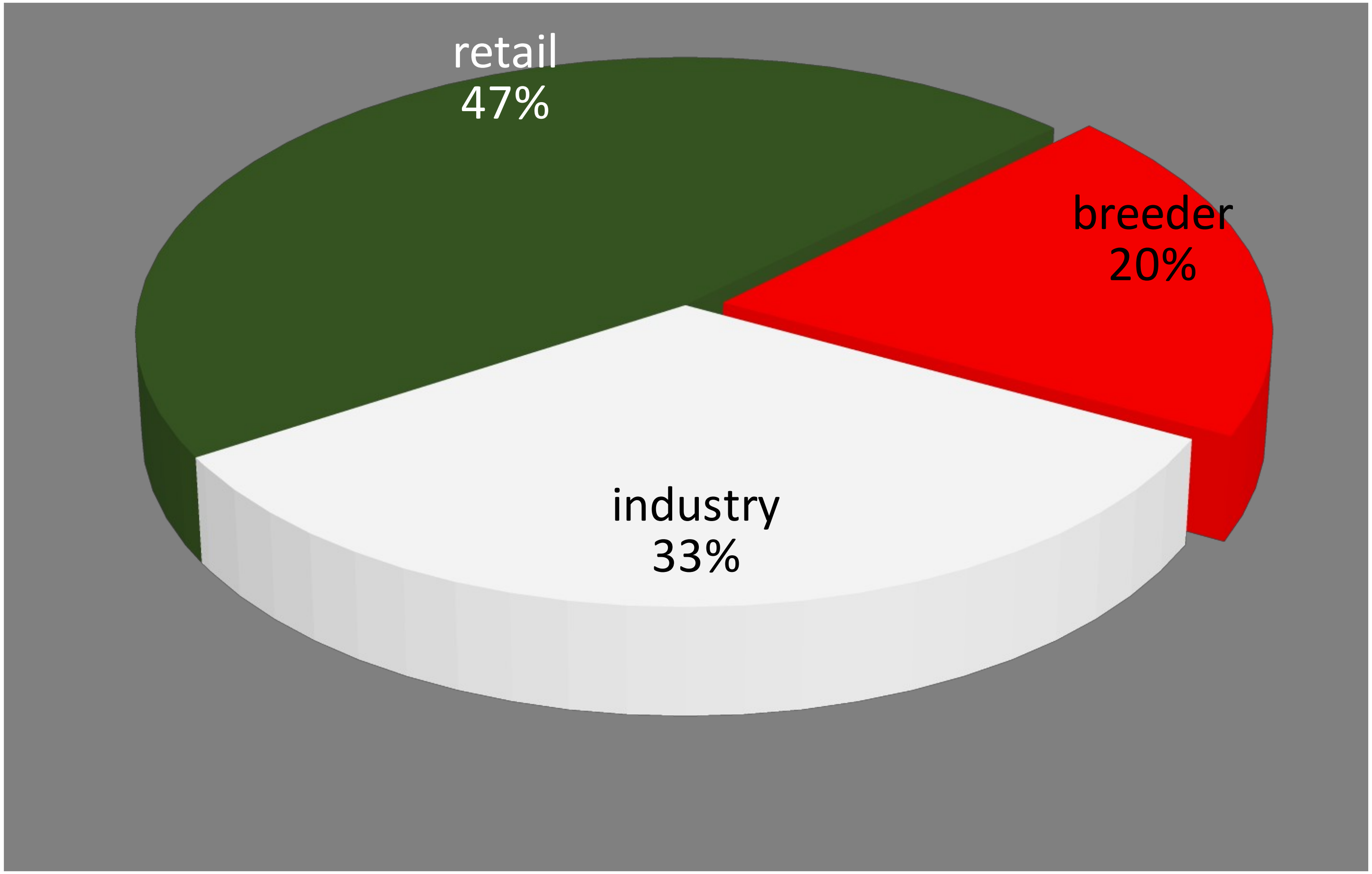
ASSOCIAÇÃO BRASILEIRA DE CRIADORES DE BÚFALOS

milk and dairy factories



The milk processed under the program maintains an average annual growth of 12.7% between 2001 and 2021, higher than that of bovine milk (4,5%)

Added value per liter in the buffalo milk mozzarella "chain"



milk price (breeder): € 0,60 – 0,70 / litro
wholesale value: € 10 – 12 / kg bocconcini
Retail price: € 18 – 20 / kg

Traditional cheeses made with buffalo milk

Suero costeño

Queso campesino

Queso llanero venezuelano

Queso de Mano

Queso Criollo

Queso maduro

Requeijão cremoso de búfala

Manteiga de leite de búfala

Doce de leite de búfala

Coalhada de búfala

Requeijão marajoara

Queijo coalho de búfala


Laticínios
Bom Destino
QUEIJO TIPO
PROVOLONE
de Búfala
DEVE SER PESADO EM PRESENÇA
DO CONSUMIDOR.
Indústria Brasileira
FRESCO
DEFUMADO


PARMESÃO DE BÚFALA
PEDRA DA MINA
Peça com 5kg
CONCURSO INTERNACIONAL DO QUEIJO
EXPOQUEIJO
BRASIL 2021 · ARAXÁ INTERNATIONAL CHEESE AWARDS
Vencedor Medalha de Ouro | Gold Medal
PEDRA DA MINA
PÉROLA DA SERRA
QUEIJOS PREMIADOS
100% Leite de Búfala

Consumers attribute value to dairys produced with buffalo milk

Frete grátis | Fique de Olho | Marcas Exclusivas | Nossas Lojas | Novidades | Cursos | Eventos

Zona Sul
Cariocas de Coração

queijos-frescos

Peça Novamente

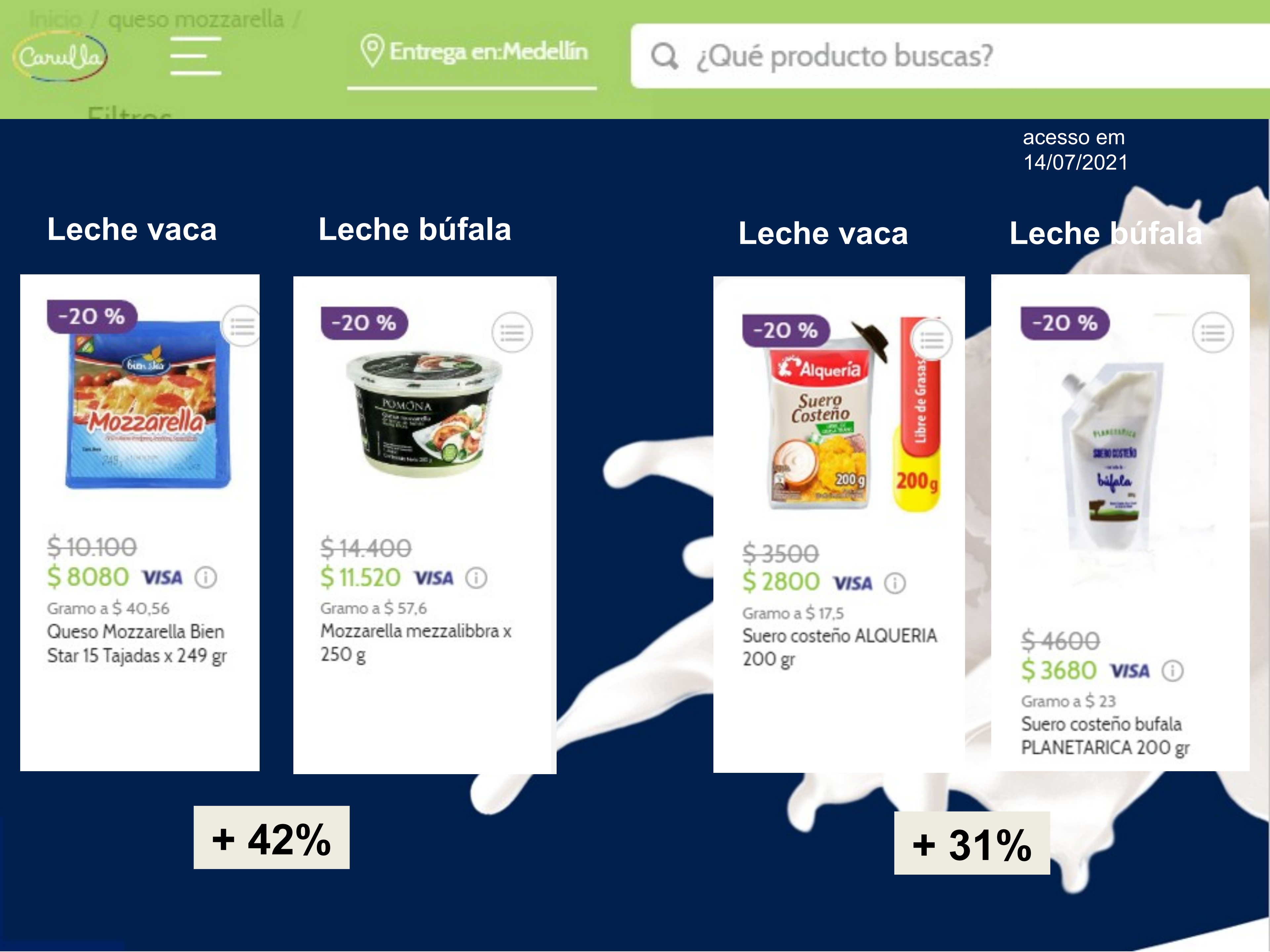
17/09/24

Queijo Minas Frescal De Búfala Bom Destino 500g

R$41,45
R$82,90/Kg

Queijo Minas Frescal Vitalatte Pote 420g

R$23,05
R$54,90/Kg


Inicio / queso mozzarella /
Carulla
Entrega en:Medellín
¿Qué producto buscas?
Filtros
acesso em
14/07/2021
Leche vaca
Leche búfala
Leche vaca
Leche búfala
-20 %
$ 10.100
$ 8080 VISA
Gramo a $ 40,56
Queso Mozzarella Bien Star 15 Tajadas x 249 gr
-20 %
$ 14.400
$ 11.520 VISA
Gramo a $ 57,6
Mozzarella mezzalibbra x 250 g
-20 %
$ 3500
$ 2800 VISA
Gramo a $ 17,5
Suero costeño ALQUERIA 200 gr
-20 %
$ 4600
$ 3680 VISA
Gramo a $ 23
Suero costeño bufala PLANETARICA 200 gr
+ 42%
+ 31%

Frete grátis | Fique de Olho | Marcas Exclusivas | Nossas Lojas | Novidades | Cursos | Eventos

Zona Sul
Cariocas de Coração

queijos-frescos

Peça Novamente

17/09/24

Muçarela De Búfala Vitalatte Média 250g

BÚFALA

~~R$35,90~~
R$31,90

Queijo Mozzarelline Vitalatte Pequena Pote 250g

VACA

R$26,90

Queijo Muçarela De Búfala Bom Destino Bola Média Pote 250g

BÚFALA

R$34,90

Argentina

21/05/24

VACA

MOZZARELLA BOCCONCINO

$16,852.00

1000 gr. | 200 gr. | 500 gr.

BÚFALA

Mozzarella

$6.614,00 ARS **$ 44.093** / 1000 g

Presentación

Mozzarella - Pulpeta x 150 g

Institucional | Nossas Lojas | Tabloide de Ofertas | Atendimento Delivery

Entrar | Criar uma conta | Delivery Hirota Online Nazaré

HIROTA FOOD SUPERMERCADOS

Buscar um ou mais produtos (ex.: arroz; feijão...)

17/09/24

Requeijão Levitare 200g

-

Por apenas
R$ 16,98 un.

Requeijão Tirolez Cremoso 200g

-

Por apenas
R$ 9,48 un.

alternative products are beginning to be made with buffalo milk

Leite e creme de leite pasteurizados de búfala (A2A2)

Embalagem para consumo (sem refrigeração)

Embalado à vacuo

Yema Queijo Mozzarella
Bocconcino

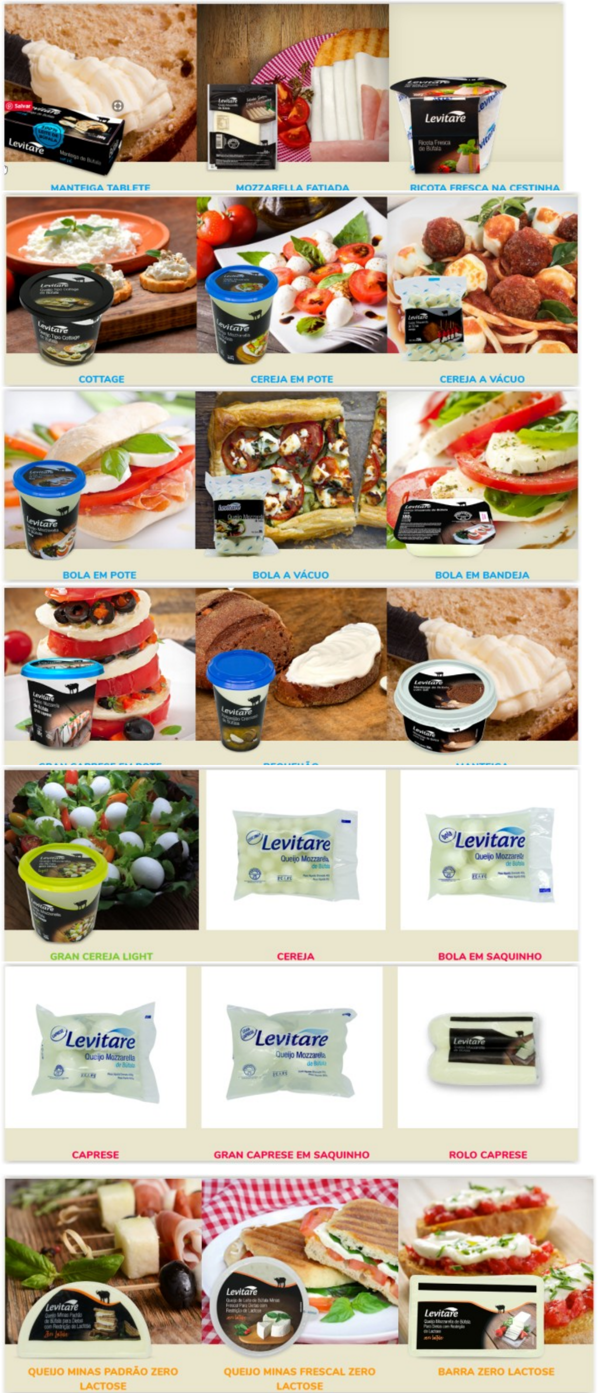
Mixed products (bovine and buffalo)

Produtos orgânicos certificados

Queijos orgânicos de leite de búfala

Manufacturers process multiple types of derivatives seeking to reach a greater number of consumers and increase the sales ticket.

Maior diversidade aumento do "cupom"



Maior diversidade aumento do "cupom"

Mozzarella Manta | Mozzarella Barra | Mozzarella Dibufalo | Bocconcine Alla Panna

Provolone Fresco

Inclusion of bovine line to expand portfolio and overcome seasonality

Queijo Minas Frescal | Burrata | Ricota | Queijo Coalho Dibufalo

Queijo Minas Frescal Light | Queijo Minas Frescal | Cottage | Queijo de Coalho Light

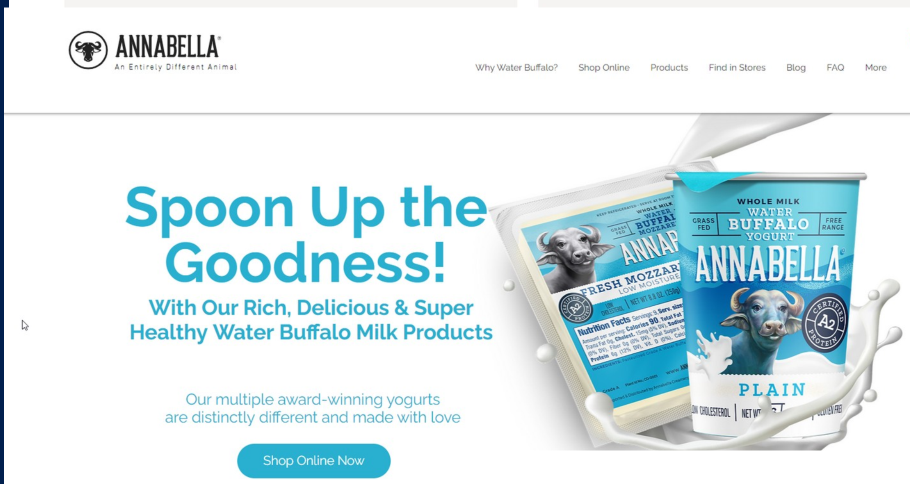
Queijo de Coalho | Ricota

Canada

WHOLESALE
MEDIA INQUIRIES
NATURAL PASTURES
cheese company
HOME
OUR STORY
BLOG
OUR CHEESES
RECIPES & PAIRINGS
WHERE TO FIND US
CONTACT US
JOIN OUR TEAM!
Our Cheeses
Soft Cheeses
Fresh Cheeses
Semi-Soft, Semi-Firm & Firm Cheese
Water Buffalo Cheese
Cheese made with water buffalo milk is graceful, porcelain white freshness. Water buffalo milk is
thicker, richer and nutritionally superior to cow's mi
is sourced from Island farms where the gentle water
Surprise your palate with a simple but profound taste by
brie with our tender, moist Mozzarella di Bufala, Buffalo
Or, for a truly exotic indulgence, add our handcrafted Bu
Mozzarella di Bufala
Authentic Italian mozzarella made with 100% free range water buffalo milk from Vancouver Island. Pure white, firm on the outside and moist creaminess on the inside. Delivers a simple yet profound taste that unfolds in layers of flavour and texture.
2007 British Empire Cheese Competition, Third Place, Pasta Filata Type
Buffalo Brie
An exotic twist on our world champion Comox Brie, our new Buffalo Brie is the very essence of traditional and inspired cheesemaking. Rich water buffalo milk from the Island transforms this cheese's texture and allows your taste buds to explore new pathways.
NATURAL PASTURES
cheese company
Courtenay, Vancouver Island
British Columbia, Canada

USA


AMBROSI
Store Locator
Shop
Our Brands


ANNABELLA
An Entirely Different Animal
Why Water Buffalo?
Shop Online
Products
Find in Stores
Blog
FAQ
More
Spoon Up the Goodness!
With Our Rich, Delicious & Super Healthy Water Buffalo Milk Products
Our multiple award-winning yogurts are distinctly different and made with love
Shop Online Now
WHOLE MILK WATER BUFFALO YOGURT
GRASS FED
FREE RANGE
ANNABELLA
PLAIN
FRESH MOZZARELLA
LOW MOISTURE


Fading D Farm
Water Buffalo
Gourmet Cheeses
Artisanal ~ Farmstead
Ricotta di Bufala
Keep Refrigerated ~ Lot #
Fading D Farm
Water Buffalo Milk
Pet Food
Fading D Farm
Classic Size
Mozzarella di Bufala
100% BUFFALO MILK


NEW
LACTOSE FREE · GMO FREE · GLUTEN FREE
FREE RANGE GRASS FED
būf
CREAMERY
mozzarella di bufala
WATER BUFFALO MOZZARELLA
NET WT. 10 OZ (280G)


Miami
CHEESE SHOP
Shop
Events
Catering
About
Login
Mozzarella Di Buffala PDO (Italy)
$7.99
Only 1 available
Mozzarella di Bufala Campana PDO (buffalo mozzarella) is a traditional soft cheese, with a white porcelain colour. Original and guaranteed products are packaged with the label "Mozzarella di Bufala Campana", brand mark of its Consortium.
Type of Milk: Italian Mediterranean Buffalo. Production Area: Mozzarella di Bufala Campana PDO is mainly produced in the Campania region, in the provinces of Caserta, Salerno and in several municipalities in the

México


LENRUZ
ASADERO
ASADERO
DE BÚFALA CON CHILE DE ARBOL
BURRATA
QUESO FRESCO DE BÚFALA
MOZZARELLA
QUESO MOZZARELLA FRESCO DE BÚFALA
PROVOLONE


100% Natural
Leche
De Búfala
QUESO ASADERO
Enchilado
AGROECOLÓGICO
QUESO MOZARELLA
Madurado
QUESO ASADERO
Con Finas Hierbas
QUESO MOZARELLA
Fresco
AGROECOLÓGICO
SAVANA
Productos a base de Búfalos
¡Garantía de lo Natural!


Quesos de Leche de Búfala
Queso Tipo Provolone Ahumado
$ 210
Queso Tipo Manchego Ahumado
$ 210
Queso Tipo Manchego Natural
$ 210

Guatemala


GHEE Mantequilla de Bufala

Bufala Mozzarella en salmuera

Burrata de Búfala

Costa Rica


HECHO EN
COSTA RICA
Bocatto
DI SOLE
MOZZARELLA DE BÚFALA
100% LECHE
DE BÚFALA
BURRATA
OVALINE
CILIEGINE
BOCCONCINI


QUESO ARTESANAL
100% Leche de Búfala
BLACK GOLD BUFFALO REPUBLIC
Buffalo Republic CR
176 curtidas • 187 seguidores


Rica Cheese Factory
Mozzarella
Seguir
CR Cheese Factory
@CRCheeseFactory


Buffalo Republic
Queso fresco
Yogurt natural
Yogurt griego
Acompaña las mañanas...

Cuba

Queso de Búfala

República Dominicana

Aperturan en Punta Cana primera quesería que fabrica quesos con leche 100% italiana

Equador


LÁCTEOS - BÚFALO - NATURAL
OLSEN
Producto Gourmet
@lacteosolsen
Manjar de leche
de Búfala
Telf: 0998521959


LA VICTORIA
100%
LECHE DE BÚFALA
GRIEGO
YOGURT
entero natural
100% LECHE DE
BÚFALA
440gr
TORIA

Peru


Queso maduro
Poder
de leche de Búfala
ALTO EN GRASAS SATURADAS
EVITAR SU CONSUMO EXCESIVO
www.granjaporcon.org.pe
Conservar en lugar fresco y seco
"Se forma el queso al cuajarse la leche"
Job 10:10
LOTE:
F.P.
F.V.
Ingredientes: Leche de búfala pasteurizada, cuajo, cultivos, sal, lácticos, cloruro de calcio SIN 509.
"De Jehová es la tierra y su plenitud" Salmo 24:1
Producto Peruano
Cajamarca - Perú
RUC: 20113873141
Reg. Sanitario:
Granja Porcón
CAJAMARCA - PERÚ

Bolívia


QUESOS BAYRO
Quesos BAYRO
1,1 mil curtidas • 1,2 mil seguidores


Queso Criollo
100% LECHE DE BÚFALA


Degustación de
Quesos "Bayro"
L'art du Fromage
28/09/2017
Biota!
Quesos Bayro
QUESOS BAYRO

Paraguai


PRODUCTO DE BÚFALA 100% ORGÁNICO • PRODUCTO DE BÚFALA 100% ORGÁNICO •
PASTEURIZADO
Queso fresco de búfala
estancia
Santa Florencia
CAAZAPÁ, PARAGUAY

Equador


LÁCTEOS - BÚFALO - NATURAL
OLSEN
Producto
Gourmet
@lacteosolsen
Manjar
de leche
de Búfala
Telf: 0998521959


LA VICTORIA
100%
LECHE DE BÚFALA
GRIEGO
YOGURT
entero
natural
100% LECHE DE
BÚFALA
440gr
TORIA

Chile


MOZZARELLA DI BUFALA ★ HECHO A MANO
BUFALINA FRESCA
★ CON LECHE DE BUFALAS CHILENAS ★
PREMIUM

Argentina

LÁCTEOS
LA DELFINA
100% BÚFALA

Colômbia


Queso
Mozzarella
COLBÚFALA
MOZZARELLA DE BÚFALA


PlanetaRica
Queso costeño de búfala :)
400 g
13 porciones aprox.
EXCESO EN SODIO


Bufalera Gibraltar
MOZARELLA
Jalapeño
ARTESANAL


Elaborado por LacBúfala - Lácteos de Búfala - Bufalera Villaluz - Vereda Rancheria - Turbo, Antioquia
Más proteínas,
Más vitaminas,
Más minerales
LAC BÚFALA
QUESO DE BÚFALA
• Queso fresco tipo Campesino •
Ideal para asar,
Peso Neto 400 gr
QUESO FRESCO
TIPO CAMPESINO


DIBUFALA
MOZZARELLA
BURRATA

Venezuela


Bufalinda
Mozzarella
Bufalinda
Mozzarella de Búfala
Bufalinda Es Sabor!... y Salud
100% Leche de Búfala


Bufilat
BURRATA
220 grs


La Guanota


Imperial
QUESO DE BÚFALA
Imperial
QUESO AMARILLO
De Búfala Tipo Legrhand
Imperial
QUESO LEGRHAND
De Búfala Sin Colorante
Imperial
QUESO MOZZARELLA

Selo de pureza

Otavio Bernardes

Buffalo mozzarella cheese's: the contribution of the CREA cheesemaker school

S. Claps[1], M.A. D'Oronzio[2]

CREA[1] Council for Agricultural Research and Economics)- Research Centre for Animal Production and Aquaculture), Italy

CREA[2] Council for Agricultural Research and Economics)- Research Centre of Policy and Bioeconomy, Italy

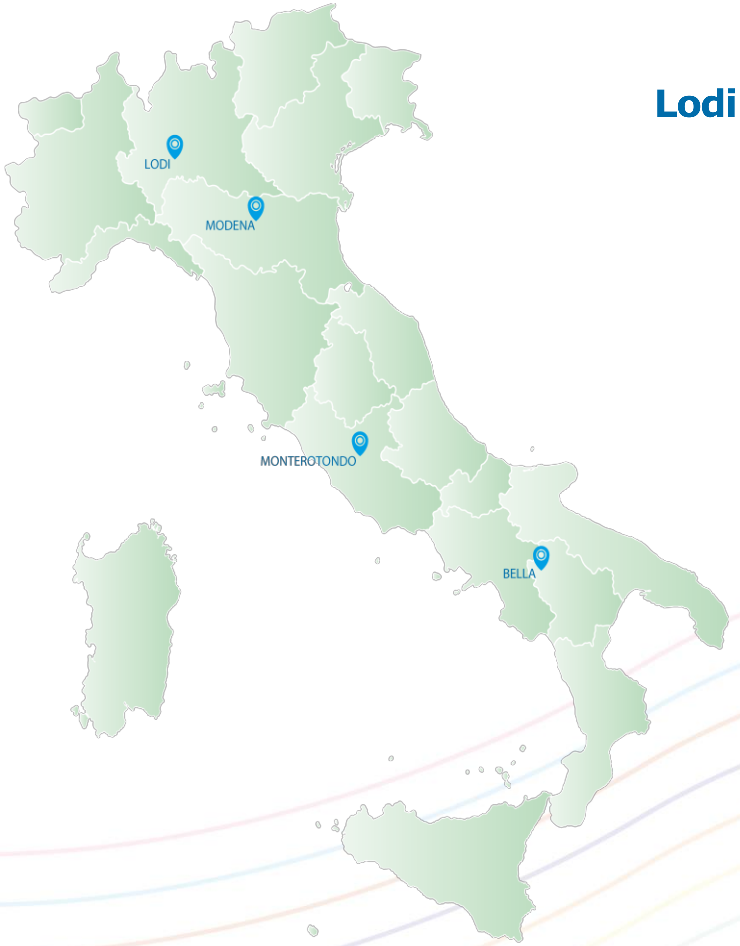
CREA – Council for Agricultural Research and Economics

The Center deals with animal husbandry and aquaculture, carrying out genetic improvement programs and developing innovations in the field of products of animal origin and the control of their sophistication, as well as systems and technologies for the optimization of farms. The center carries out conservation activities of zootechnical biodiversity, as well as genetic improvement of forage and protein species for zootechnical nutrition.

Research Center for Animal Production and Aquaculture (CREA- ZA)

Structures:
Monterotondo (RM), **Lodi**, Modena, Bella Muro (PZ)
Director: Salvatore CLAPS salvatore.claps@crea.gov.it https://www.researchgate.ne

Research unit of CREA-ZA:



Lodi: Viale Piacenza, 29 e Via Antonio Lombardo, 11

Monterotondo (RM): Via Salaria, 31

Bella Muro (PZ): S.S. 7 Via Appia

Modena: Via Beccastecca, 345
San Cesario sul Panaro

crea
Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

CREA – Council for Agricultural Research and Economics

CREA cheesemaker school

Bella Muro (PZ): S.S. 7 Via Appia

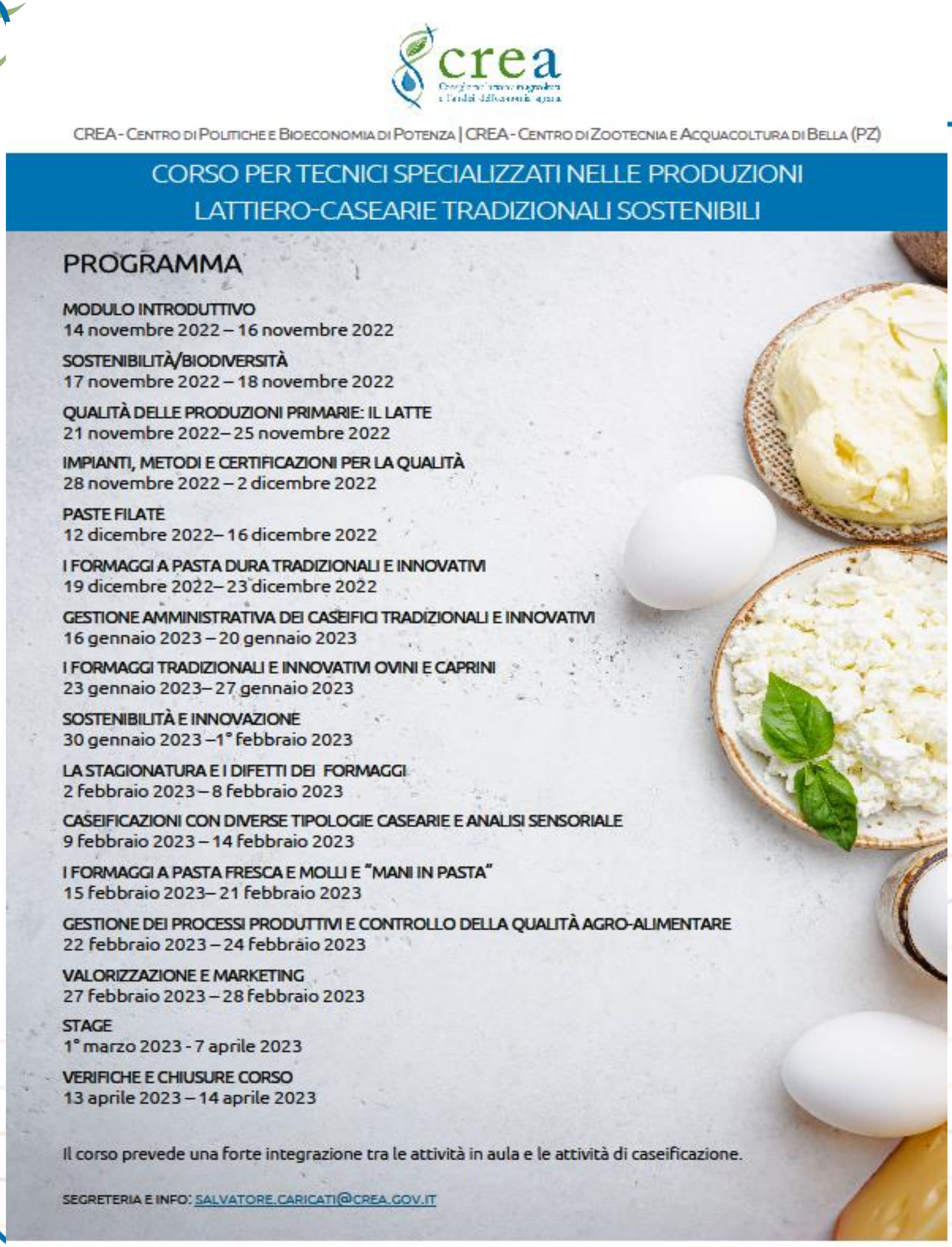
CREA School was set up, at the Bella (PZ) site of CREA research Centre for Animal Production and Aquaculture, in collaboration with Research Centre of Policy and Bioeconomy Basilicata (CREA-PB)

Target - To train young people in the dairy sector

Specialised profiles capable of preserving the typicality of traditional cheeses and innovation

This cheesemaker's school develops joint actions with public and private objects for the development of the dairy sector and the Italian inner areas

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella
& Milk Products
24/25 Sept. 2024



CREA - Centro di Politiche e Bioeconomia di Potenza | CREA - Centro di Zootecnia e Acquacoltura di Bella (PZ)

CORSO PER TECNICI SPECIALIZZATI NELLE PRODUZIONI LATTIERO-CASEARIE TRADIZIONALI SOSTENIBILI

PROGRAMMA

MODULO INTRODUTTIVO
14 novembre 2022 – 16 novembre 2022

SOSTENIBILITÀ/BIODIVERSITÀ
17 novembre 2022 – 18 novembre 2022

QUALITÀ DELLE PRODUZIONI PRIMARIE: IL LATTE
21 novembre 2022 – 25 novembre 2022

IMPIANTI, METODI E CERTIFICAZIONI PER LA QUALITÀ
28 novembre 2022 – 2 dicembre 2022

PASTE FILATE
12 dicembre 2022 – 16 dicembre 2022

I FORMAGGI A PASTA DURA TRADIZIONALI E INNOVATIVI
19 dicembre 2022 – 23 dicembre 2022

GESTIONE AMMINISTRATIVA DEI CASEIFICI TRADIZIONALI E INNOVATIVI
16 gennaio 2023 – 20 gennaio 2023

I FORMAGGI TRADIZIONALI E INNOVATIVI OVINI E CAPRINI
23 gennaio 2023 – 27 gennaio 2023

SOSTENIBILITÀ E INNOVAZIONE
30 gennaio 2023 – 1° febbraio 2023

LA STAGIONATURA E I DIFETTI DEI FORMAGGI
2 febbraio 2023 – 8 febbraio 2023

CASEIFICAZIONI CON DIVERSE TIPOLOGIE CASEARIE E ANALISI SENSORIALE
9 febbraio 2023 – 14 febbraio 2023

I FORMAGGI A PASTA FRESCA E MOLLI E "MANI IN PASTA"
15 febbraio 2023 – 21 febbraio 2023

GESTIONE DEI PROCESSI PRODUTTIVI E CONTROLLO DELLA QUALITÀ AGRO-ALIMENTARE
22 febbraio 2023 – 24 febbraio 2023

VALORIZZAZIONE E MARKETING
27 febbraio 2023 – 28 febbraio 2023

STAGE
1° marzo 2023 - 7 aprile 2023

VERIFICHE E CHIUSURE CORSO
13 aprile 2023 – 14 aprile 2023

Il corso prevede una forte integrazione tra le attività in aula e le attività di caseificazione.

SEGRETERIA E INFO: SALVATORE.CARICATI@CREA.GOV.IT

Technician of traditional sustainable dairy production

This course aimed at young people under 40 years of age with a technical or professional diploma or with skills acquired in the dairy sector. This is a 540-hour course, including 240 hours of internship in affiliated companies, to acquire multiple skills in different subject areas: sustainability and biodiversity, quality of primary productions, plants, methods and certifications for quality, administrative management of traditional and innovative dairies, pasta filata, fresh and soft cheeses, hard cheeses, sheep and goat cheeses, cheese-making with different types of cheese with sensory analysis

crea
Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

CONCLUSIONS

Training is one of the fundamental factors in meeting the challenges of competitiveness and innovation by guaranteeing the quality of our Italian excellence

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella
& Milk Products
24/25 Sept. 2024

Thank you for your attention !

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella & Milk Products
24/25 Sept. 2024

EVALUTATION OF THE NON-COMPLIANCES IN BUFFALO MILK AND BUFFALO DAIRY PRODUCTS IN THE PROVINCE OF CASERTA

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella
& Milk Products

24/25 Sept. 2024

M.F. Peruzy[1], G. Smaldone[2], N. Gammarano[2], R. Taglialatela[2], N. Murru[1]

[1] *Department of Veterinary Medicine and Animal Production, University of Naples "Federico II",80137 Naples, Italy;*

[2] *Prevention Department ASL Caserta, UOC Food Hygiene of A.O.. Via Feudo di San Martino 10, 81100 Caserta (CE)*

Powered by

The Buffalo (*Bubalus bubalis*)

Milk and Dairy Products

The Buffalo (*Bubalus bubalis*)

Official controls

The activity is carried out through official control over the entire milk production chain, from the farm to the final consumer, and is implemented across all stages: raw material production, thermal treatment, processing, storage, and distribution.

Why?

- ❖ check the health of animals,
- ❖ monitoring the cleanliness and hygiene of the milking process,
- ❖ Test the milk and dairy products for contaminants or diseases.

Aim

Aim

Analysis of the prevalence of non-compliance observed in buffalo milk and buffalo dairy products in the province of Caserta during the years 2022 and 2023.

Materials and Methods

Materials and Methods

Results

Results

n. 1330 samples (2022= 829, 2023= 501)

837 Milk samples and 483 Dairy products
(35 Food matrices)

813 livestock companies

276 approved companies

240 registered companies

Results

Chemicals

ADDITIVES	Polyphosphates	2
ALLERGENS	Lactose	2
CONTAMINANTS	Arsenic	1
	Dioxin	3
	Dioxin And Pcb Dioxin Like	13
	Phytosanitary	11
	Polycyclic Aromatic Hydrocarbons (Pah)	1
	Pcb Dioxin Like	4
	Pcb-Ndl	8
CHEMICAL ELEMENTS	Nickel	1
INHIBITING	Inhibiting	5
HEAVY METALS	Lead	15
	Cadmium	2
	Mercury	1
MYCOTOXINS	Aflatoxin M1	48
	Aflatoxin B1	2
FOOD QUALITY	Caseinate And Cow's Milk Revelation	114
	Species Identification	2
	Species Proteins	2
	Lactose Quantification	4
	Cow Milk Research	1
	Cow's Milk Whey Protein	6
DRUG RESIDUES	Polypeptide Antibiotics	1
	Avermectin	4
	Avermectins/Milbemicins	1
	Benzimidazoles	9
	Caf	1
	Quinolonics	10
	Chloramphenicol	10
	Macrolides	4
	Penicillins	13
	Sulphamides	8
	Tetracyclines	12

Bacteriological

BACTERIA	*B. Cereus*	3
	Sulfite-Reducing Bacteria	1
	Brucella Spp.	557
	Brucella Abortus	44
	Mesophilic Bacteria	87
	Clostridium Perfrigens	1
	Coliforms	1
	Enterobatteriacee	24
	Staphylococcal Enterotoxin	74
	Escherichia Coli O157:H7	3
	Detection Of *Escherichia Coli*	14
	Verocitotoxic *Escherichia Coli*	15
	Listeria Spp	5
	Listeria Monocytogenes	101
	Enumeration Of *Escherichia Coli*	11
	Enumeration Of *Pseudomonas*	4
	Enumeration Of *Stafiloccoccus Aureus*	4
	Enumeration OF Coagulase-Positive Staphylococci	29
	Salmonella Spp	37
	Salmonella Thyphimurium	2
	Staphylococci	2
	Streptococci	11

Gene Sequencing	1
Radionuclides	2
Mould And Yeast	11

Results

8.38 %, (n= 71/847)

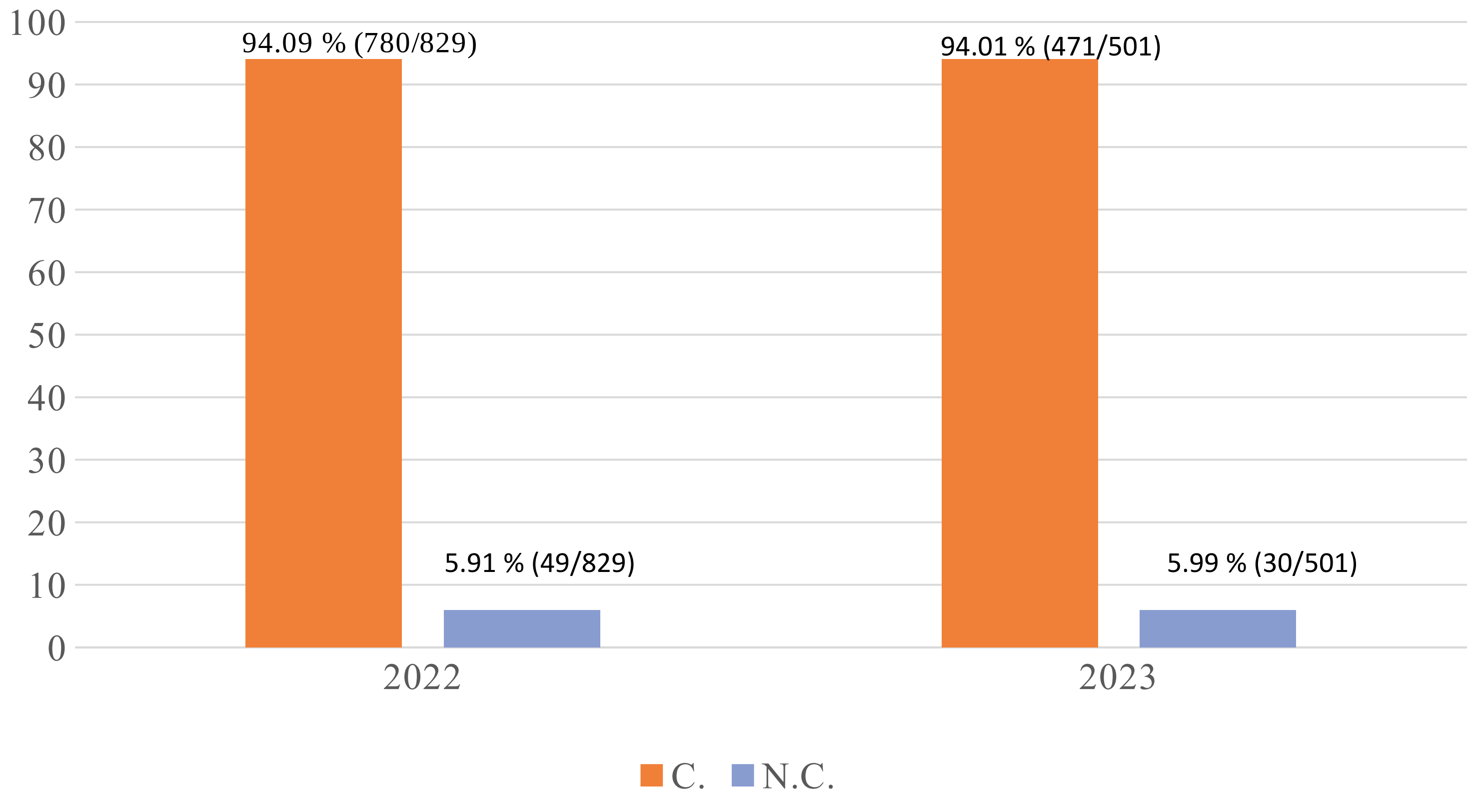
2.59 %, (n = 7/270)

Caseinate and Cow's Milk Revelation

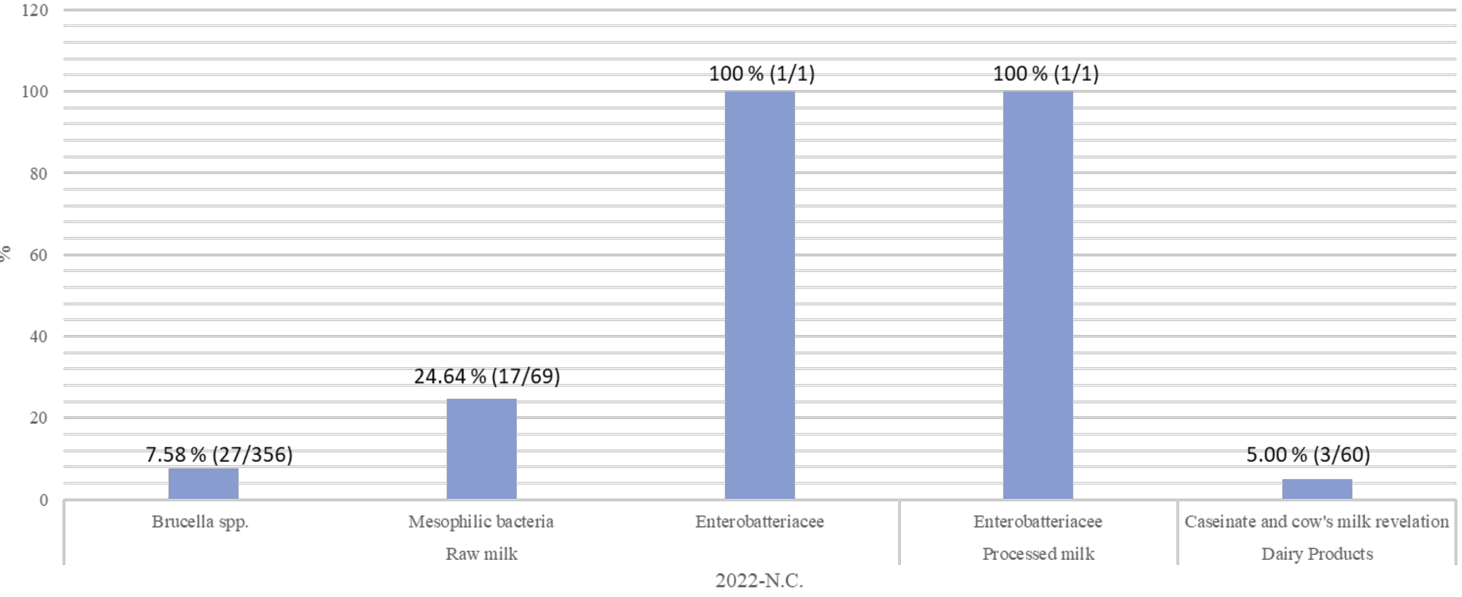
3.85 %, (n = 1/26)

Enterobacteriaceae

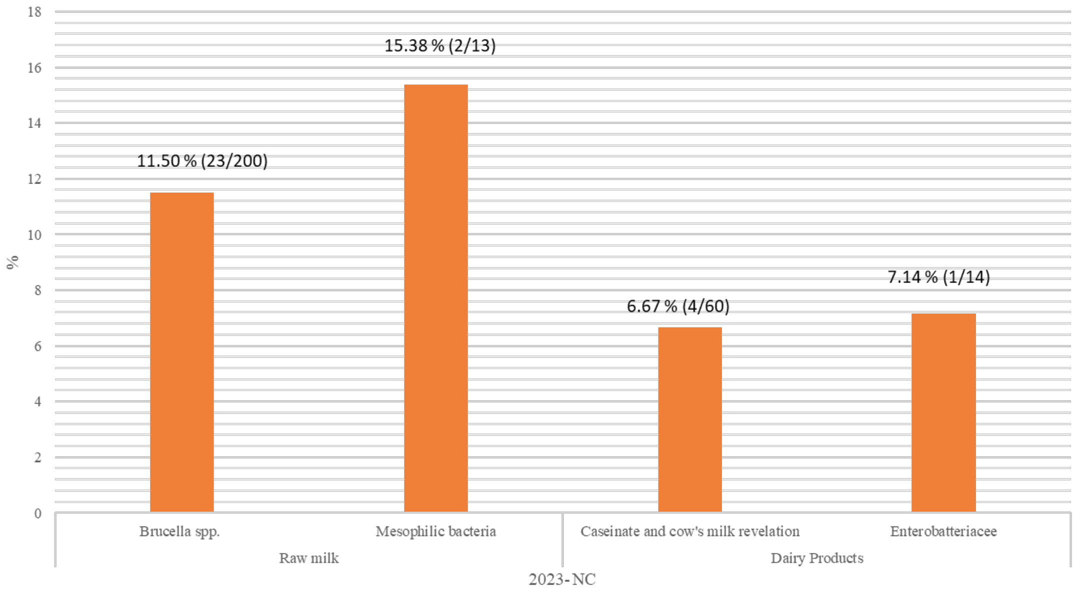
Results


100
90
80
70
60
50
40
30
20
10
0
94.09 % (780/829)
94.01 % (471/501)
5.91 % (49/829)
5.99 % (30/501)
2022
2023
C.
N.C.

Results



120
100
80
60
40
20
0
%
100 % (1/1)
100 % (1/1)
24.64 % (17/69)
7.58 % (27/356)
5.00 % (3/60)
Brucella spp.
Mesophilic bacteria
Enterobatteriacee
Enterobatteriacee
Caseinate and cow's milk revelation
Raw milk
Processed milk
Dairy Products
2022-N.C.



18
16
14
12
10
8
6
4
2
0
%
15.38 % (2/13)
11.50 % (23/200)
7.14 % (1/14)
6.67 % (4/60)
Brucella spp.
Mesophilic bacteria
Caseinate and cow's milk revelation
Enterobatteriacee
Raw milk
Dairy Products
2023-NC

Discussions

Discussions

23.17 % of samples exceed the limit for mesophilic bacteria in milk

02004R0853 — EN — 01.01.2021 — 020.001 — 1

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►B ►C1 REGULATION (EC) No 853/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 29 April 2004

laying down specific hygiene rules for food of animal origin ◄

(OJ L 139, 30.4.2004, p. 55)

3. (a) Food business operators must initiate procedures to ensure that raw milk meets the following criteria:

(i) for raw cows' milk:

Plate count at 30 °C (per ml)	≤ 100 000 (*)
Somatic cell count (per ml)	≤ 400 000 (**)

(*) Rolling geometric average over a two-month period, with at least two samples per month.

(**) Rolling geometric average over a three-month period, with at least one sample per month, unless the competent authority specifies another methodology to take account of seasonal variations in production levels.

(ii) for raw milk from other species:

Plate count at 30 °C (per ml)	≤ 1 500 000 (*)

(*) Rolling geometric average over a two-month period, with at least two samples per month.

(b) However, if raw milk from species other than cows is intended for the manufacture of products made with raw milk by a process that does not involve any heat treatment, food business operators must take steps to ensure that the raw milk used meets the following criterion:

Plate count at 30 °C (per ml)	≤ 500 000 (*)

(*) Rolling geometric average over a two-month period, with at least two samples per month.

Discussions

9 % of samples were positive to the milk-ELISA test

- milk-ELISA test is a screening test
- No information on the outcome of the serological tests.

5.83 % of samples were positive to caseinate and cow's milk revelation

The addition of cow milk is the most common fraud in the production of Mozzarella di Bufala Campana PDO (buffalo mozzarella)

Conclusions

Discussions

A low number of non-compliances was detected; however, while the results are encouraging, further and continued monitoring would be necessary to ensure long-term safety of buffalo dairy products

Grazie per l’attenzione!

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Index of freshness: a tool to assess the quality of the Buffalo Mozzarella cheese production

B. la Gatta, **M. Rutigliano**, F. Dilucia, M.T Liberatore, A. Di Luccia

Department of Sciences of Agriculture, Food, Natural Resources, and Engineering (DAFNE), University of Foggia, Via Napoli, 25, 71122, Foggia, Italy

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Freshness of Buffalo Mozzarella Cheese (BMC)

Freshness is a complex attribute to define, since it is the expression of technological, chemical and sensory elements and it is one of the attributes expected by the consumers.

Spherical shape, white porcelain colour, smooth, bright and humid surface and pleasant, slightly sour flavour

The use of fresh milk and the preservation of technological properties (i.e., texture and aroma)

The use of milk within 60 hours from milking, allow to expect very specific characteristics of the raw material

Regulation (EC) no. 1107/1996

Plasmin Activity

- Lys^{28}-Lys^{29}
- Lys^{68}-Ser^{69}
- Lys^{105}-His^{106}
- Lys^{107}-Glu^{108}

The occurrence of primary proteolysis

Index of Freshness

Chemical assessment

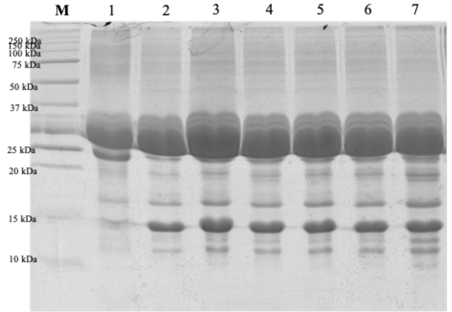
The study of primary proteolysis on β-CN, with the formation of γ-CN fragments, through an electrophoretic approach was applied as method to assess the freshness of PDO Buffalo Mozzarella cheese.

$$\Phi = \frac{\beta - \mathrm{CN}}{\beta - \mathrm{CN} + \gamma 1 + (\gamma 2 + \gamma 3) + \gamma 4} \mathrm{x}\ 100$$

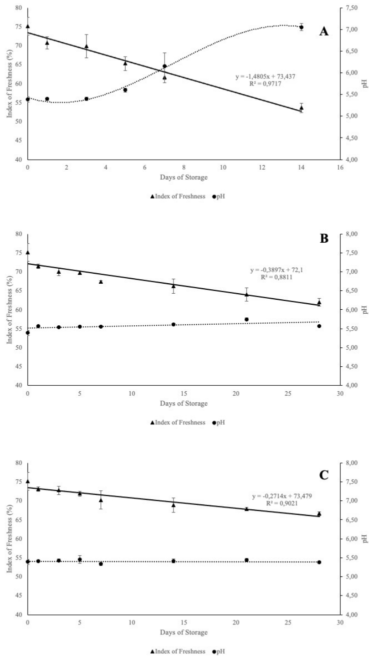
Trace quantiity of the electrophoretic bands, obtained by the image analysis

- 145 buffalo mozzarella cheese samples were purchased from the market evaluating their Φ and comparing it with the values obtained from a **“Control Line”** obtained from buffalo PDO samples testing three temperatures of storage for different times.

Outcomes of the investigation



SDS-PAGE of control line samples. Electrophoretic profiles of the samples stored at room temperature.



Trends of the index of freshness and pH of control line samples.

- **At room temperature**: freshness ranged from 75.10% to 69.84 % (3 days). Then, freshness decreased with a concomitant increase of pH (pH 5.40) up to the 54.64 % with the loss of the structure (pH 7.05);

- **At 4°C**: from 75.10% up to 69.75 % (5 days).

- **At -20°C:** freshness could be considered prolonged until 14 days (from 75.10% up to 68.84 %).

Index of freshness of the samples from the Market

Batch 1		Batch 2				Batch 3	
Samples	*Φ (%)*	*Samples*	*Φ (%)*	*Samples*	*Φ (%)*	*Samples*	*Φ (%)*
1	66,03	**1(53)**	56,88	**53(105)**	72,5	**1(127)**	68,02
2	70,39	**2(54)**	54,53	**54(106)**	70,13	**2(128)**	66,16
3	74,00	**3(55)**	59,7	**55(107)**	63,92	**3(129)**	66,63
4	72,62	**4(56)**	50,7	**56(108)**	68,14	**4(130)**	64,03
5	71,09	**5(57)**	58,86	**57(109)**	76,07	**5(131)**	60,55
6	72,31	**6(58)**	62,24	**58(110)**	57,33	**6(132)**	60,37
7	74,67	**7(59)**	67,57	**59(111)**	79,17	**7(133)**	59,73
8	70,51	**8(60)**	59,42	**60(112)**	67,19	**8(134)**	62,13
9	74,32	**9(61)**	60,92	**61(113)**	74,06	**9(135)**	63,04
10	71,1	**10(62)**	65,54	**62(114)**	75,48	**10(136)**	63,67
11	70,77	**11(63)**	59,5	**63(115)**	74,02	**11(137)**	65,19
12	75,56	**12(64)**	64,65	**64(116)**	71,91	**12(138)**	61,38
13	74,67	**13(65)**	58,91	**65(117)**	79,59	**13(139)**	62,89
14	56,1	**14(66)**	64,3	**66(118)**	76,07	**14(140)**	67,43
15	59,74	**15(67)**	63,65	**67(119)**	75,68	**15(141)**	65,43
16	65,1	**16(68)**	63,66	**68(120)**	79,04	**16(142)**	63,77
17	71,76	**17(69)**	53,76	**69(121)**	62,73	**17(143)**	64,89
18	62,1	**18(70)**	58,3	**70(122)**	70,59	**18(144)**	62,09
19	75,51	**19(71)**	66,69	**71(123)**	66,22	**19(145)**	62,59
20	67,34	**20(72)**	67,89	**72(124)**	78,52		
21	67,22	**21(73)**	64,24	**73(125)**	74,06		
22	65,99	**22(74)**	62,25	**74(126)**	74,34		
23	68,25	**23(75)**	61,06				
24	71,82	**24(76)**	66,78				
25	64,75	**25(77)**	65,78				
26	54,00	**26(78)**	59,2				
27	64,23	**27(79)**	59,03				
28	68,98	**28(80)**	74,69				
29	60,36	**29(81)**	69,41				
30	66,31	**30(82)**	66,6				
31	70,98	**31(83)**	70,67				
32	60,07	**32(84)**	59,05				
33	64,39	**33(85)**	73,4				
34	63,02	**34(86)**	67,96				
35	61,31	**35(87)**	72,92				
36	61,7	**36(88)**	75,32				
37	65,38	**37(89)**	72,81				
38	51,48	**38(90)**	70,79				
39	65,61	**39(91)**	74,91				
40	59,37	**40(92)**	69,52				
41	64,43	**41(93)**	69,48				
42	65,49	**42(94)**	72,49				
43	60,23	**43(95)**	69,21				
44	63,65	**44(96)**	70,96				
45	62,36	**45(97)**	73,2				
46	67,82	**46(98)**	71,74				
47	60,32	**47(99)**	73,28				
48	62,61	**48(100)**	72,86				
49	63,81	**49(101)**	73,22				
50	66,74	**50(102)**	70,51				
51	61,44	**51(103)**	73,87				
52	56,55	**52(104)**	79,11				

The values of the index of freshness ranged from a maximum of 79.59% to a minimum of 50.7%. Overall, 34.5% of the samples had an index of freshness > 70.00% and 65.5% had an index of freshness < 70.00%, but from these latest, only 21 samples (15%) had an index of freshness <60%.

A value higher than 70% is maintained up to 3 days at RT, 5 days at 4°C and about 10 days at 20°C. Comparing results of the samples from the market with those of the "Control Line" samples, the data of the index of freshness of the unknown samples were consistent with them, considering that the manufacturing and the quality of the raw matter can influence the rate of proteolysis and, consequently, the index.

Our results allowed to verify the feasibility of the ***Index of freshness*** as a helpful tool to assess the quality of the Buffalo mozzarella samples. Therefore, the Index of freshness can be considered an important contribution to the enhancement of an excellence of the *Made in Italy* production.

Results from Rutigliano et al., (2022).

Grazie per l’attenzione!

Mariacinzia Rutigliano

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Dairy under attack?
Let's safeguard the essentials at EU level!

Alexander Anton

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- Association of national dairy industry associations of **20 EU Member States**, the **UK** and **Georgia**
- **Cooperative** and **private** milk processors
- More than **90%** of the milk volumes processed in the EU

Squadra lactosferica: EDA team in Brussels

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"The role of the European Dairy Association in ensuring that the voice of your stakeholders is heard in Europe is key. I look forward to continuing our close cooperation to ensure that dairy has a promising future in Europe."
Ursula von der Leyen
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MEP **Christophe Hansen** (EPP, LUX)

Nominated
EU Commissioner for Agriculture & Food
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High Level Mission of EU Commissioner Janusz Wojciechowski to China 2018

Dairy Flash

Connect to the world of dairy_

Mozzarella at the EDA offices!

This week, EDA was surprised with a truly wonderful gift - none other than the exquisite fine cheese **Mozzarella di Bufala Campana** from the Consorzio in Caserta. The Mozzarella di Bufala Campana, is a Protected Designation of Origin (PDO), meaning that it has the strongest link to the place where it's made - the Campania region of Italy - and stands as a testament to the rich heritage and unparalleled craftsmanship of the region – get inspired: https://www.mozzarelladop.it/territory

*Mille grazie, dott **Pier Maria Saccani**, merci beaucoup, cher Pier Maria!*

Welcome to our new trainees:

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I love all varieties of cheese but my favourite one is for sure Stracciatella di bufala

Florian Spiegelhalter

Trade and Economics Trainee

That is like asking who your favourite child is but let's go with Mozzarella di bufala, PDO from Campania!!

Marcella Rosato

Food, Environment and Health Trainee

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  - Prioritizing Trade Policy
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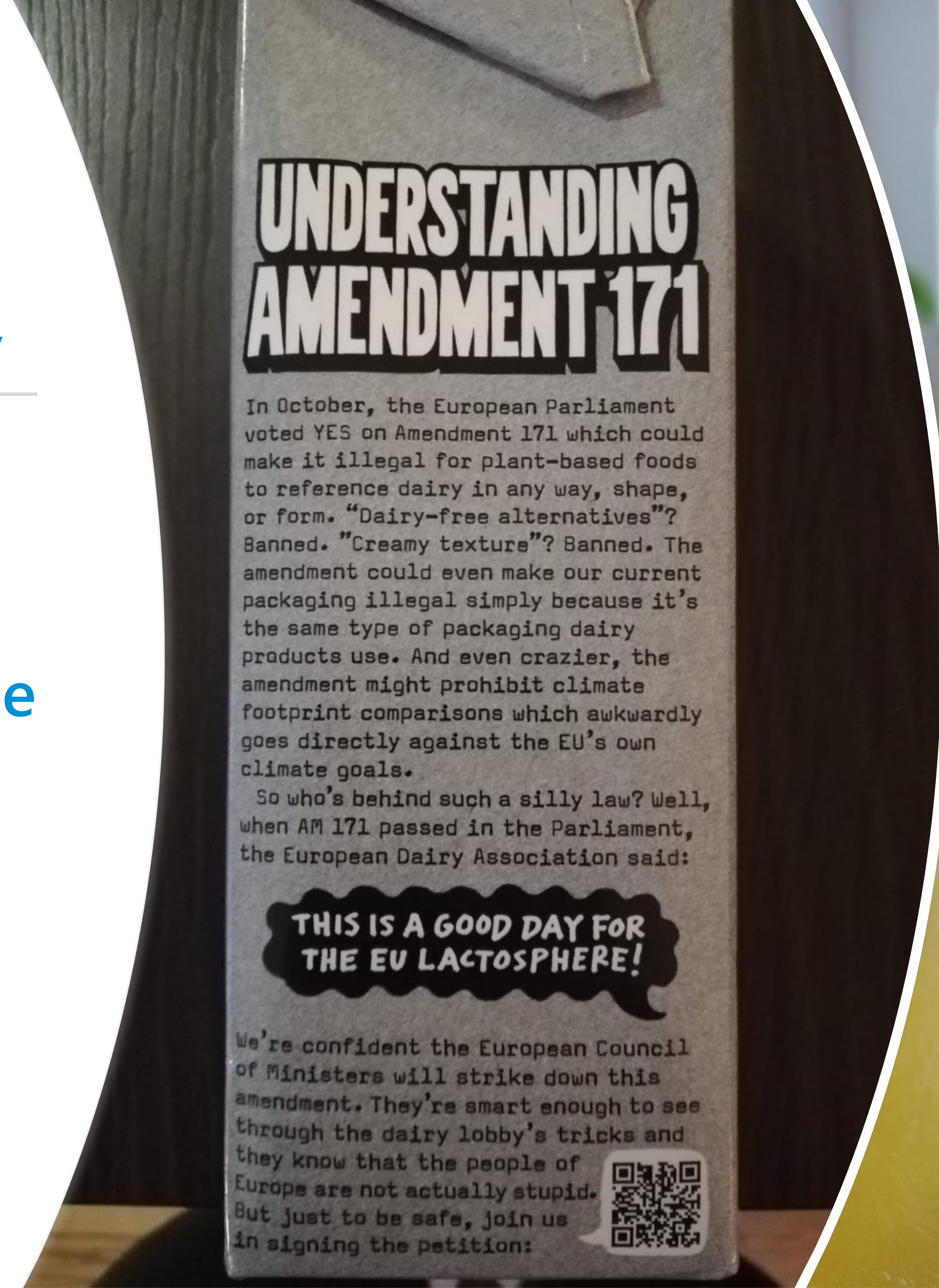
Promotion Policy

School Milk Scheme



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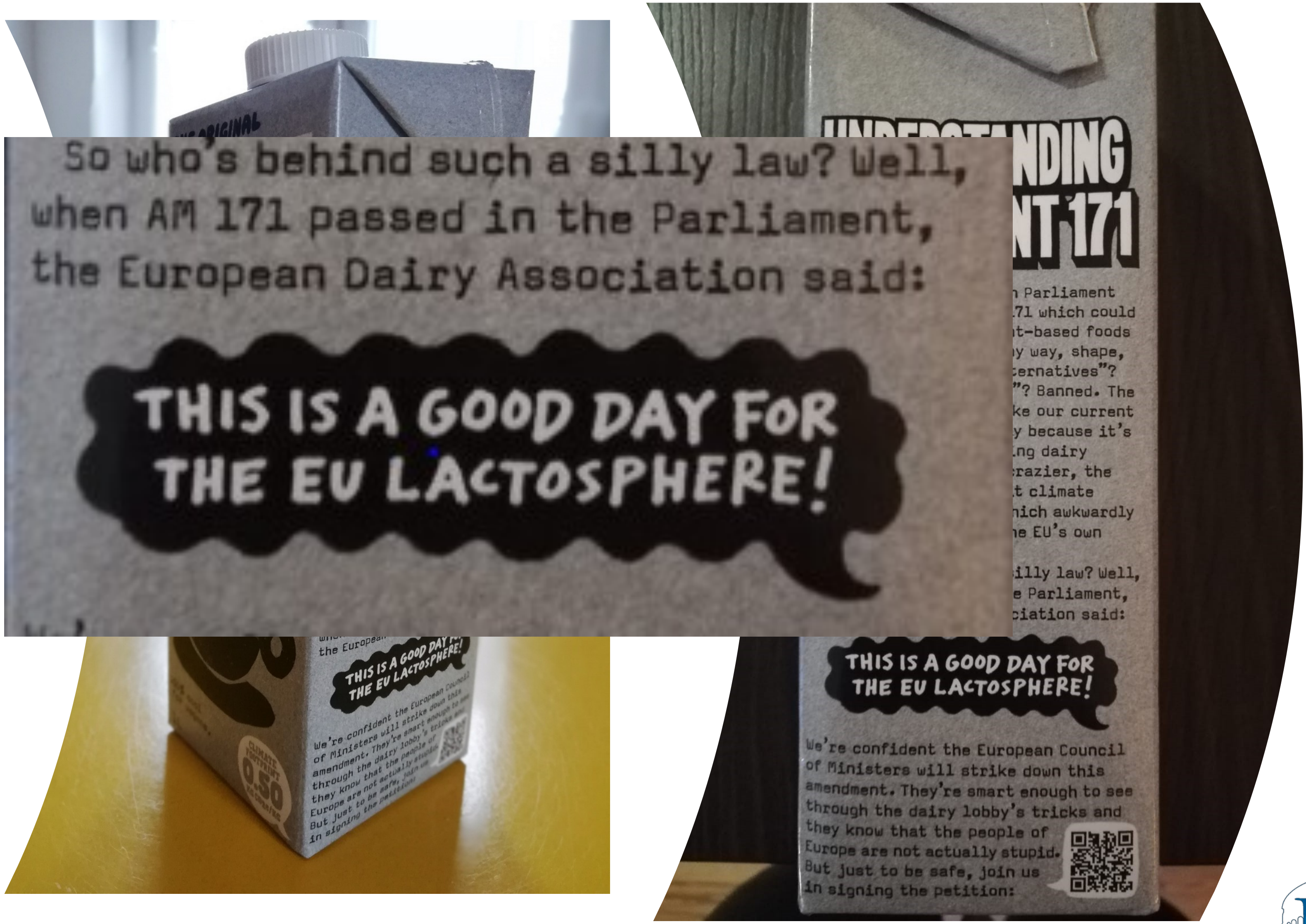

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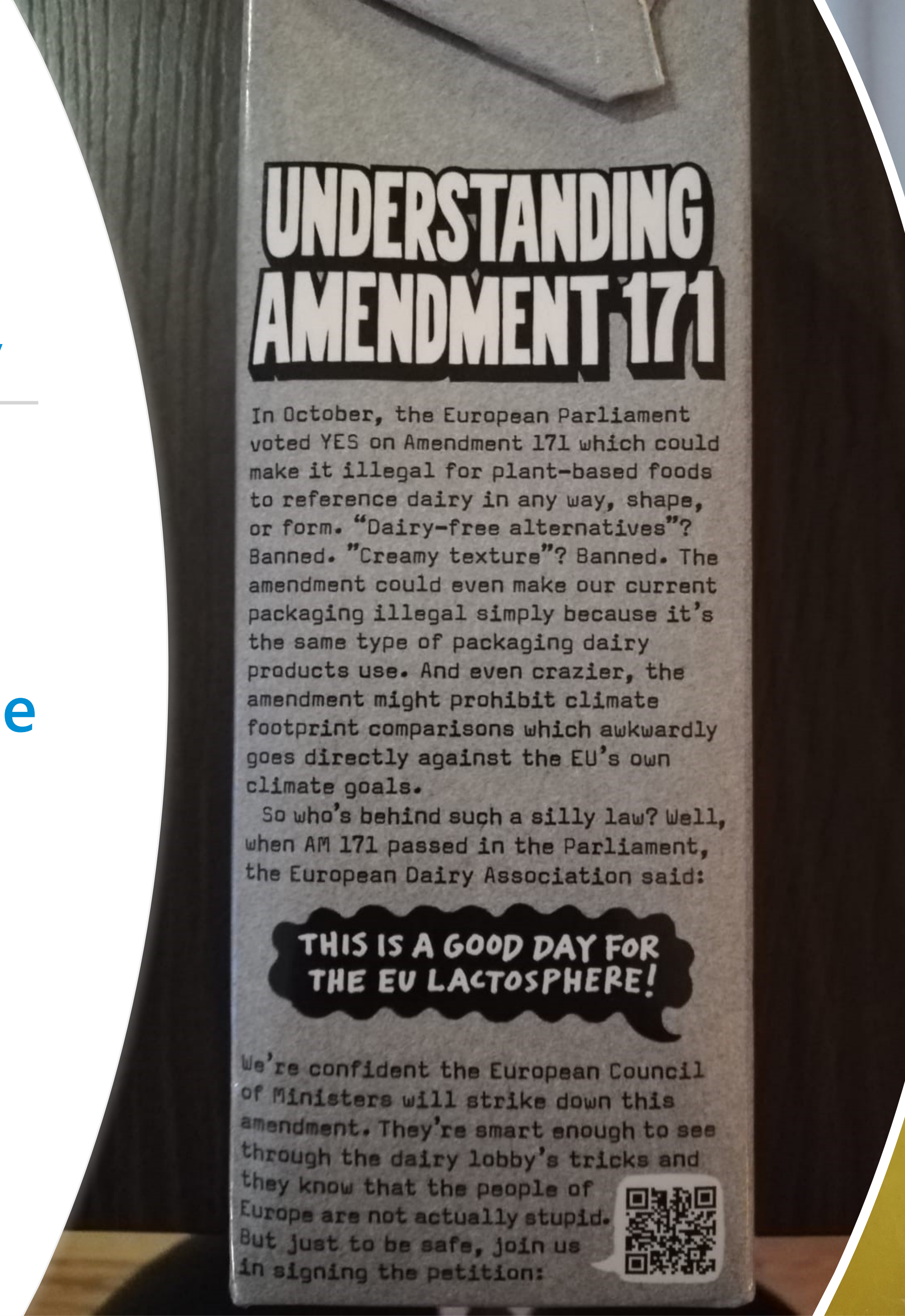

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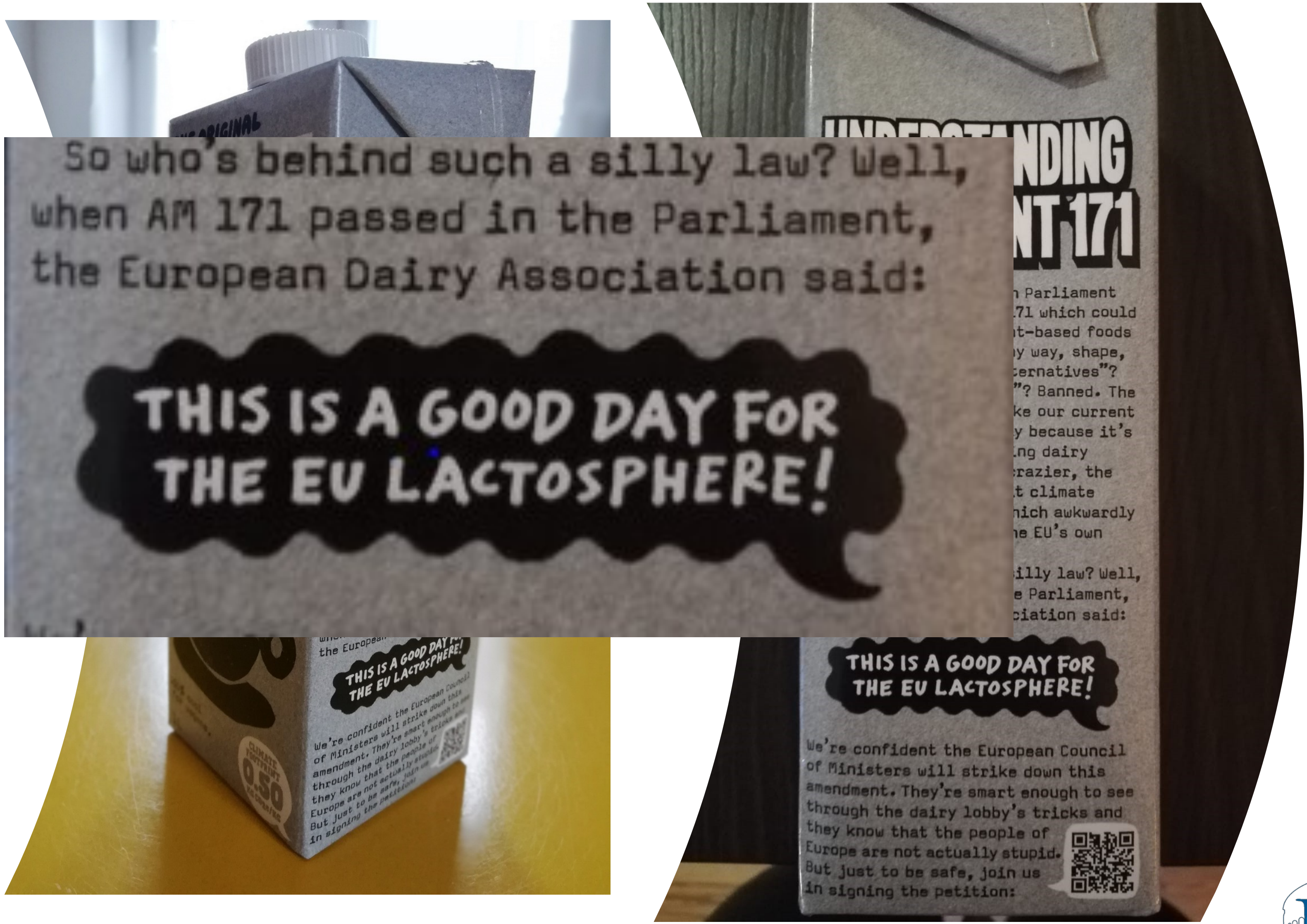

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Origin Control and Quality Assessment in the Dairy Supply Chain through the Bludev® System

Biondi L., Gallo A., Garofalo F., Anzalone A., Montone AMI., Nappa M., De Carlo E., Sansone G., Cascone D., Ciardella G.

FIRST INTERNATIONAL CONFERENCE ON
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Mozzarella di Bufala Campana
Università degli Studi di Napoli Federico II
Dipartimento Medicina Veterinaria Produzioni Animali
Dipartimento di Agraria

COLLABORATION IZSM- FARZATI

To combat fraud and ensure the authenticity of the DOP (Protected Designation of Origin) mozzarella product within the dairy supply chains, while safeguarding the final consumer, a collaboration between the Istituto Zooprofilattico Sperimentale del Mezzogiorno (IZSM-Portici) and Farzati S.p.A. was established in 2023.

Farzati S.p.A., founded in 2014, is dedicated to the research and development of products aimed at improving individual quality of life. The company enables the implementation of non-invasive and non-destructive analytical techniques to ensure the quality and authenticity of food matrices

INNOVATION

The innovation of the BluDev® technology system lies in creating a BIOLOGICAL DIGITAL FOOTPRINT (BFP Bio-FingerPrint) for each batch of actual finished product, with the information obtained being stored in a virtual laboratory to create a digital twin, capable of tracing origin and quality throughout all stages of the production process.

The acquisition of information regarding the analyzed matrices is based on spectroscopy.

Artificial Intelligence, combined with predictive models, transforms the input data into unique digital objects, generating a DIGITAL BIO FINGER PRINT.

All supported by safety systems to protect the data harvested

AIM

The aim of the following study is to develop an algorithm to discriminate between mozzarella produced with 100% buffalo milk and mozzarella produced with a mixed milk (buffalo and cow's milk).

MATERIALS AND METHODS

The analyses were carried out using two portable devices of the BluDev® system used in the laboratories of the Istituto Zooprofilattico Sperimentale del Mezzogiorno (IZSM) in Portici on known frozen mozzarella samp

Specifically the analysis involved thawing the

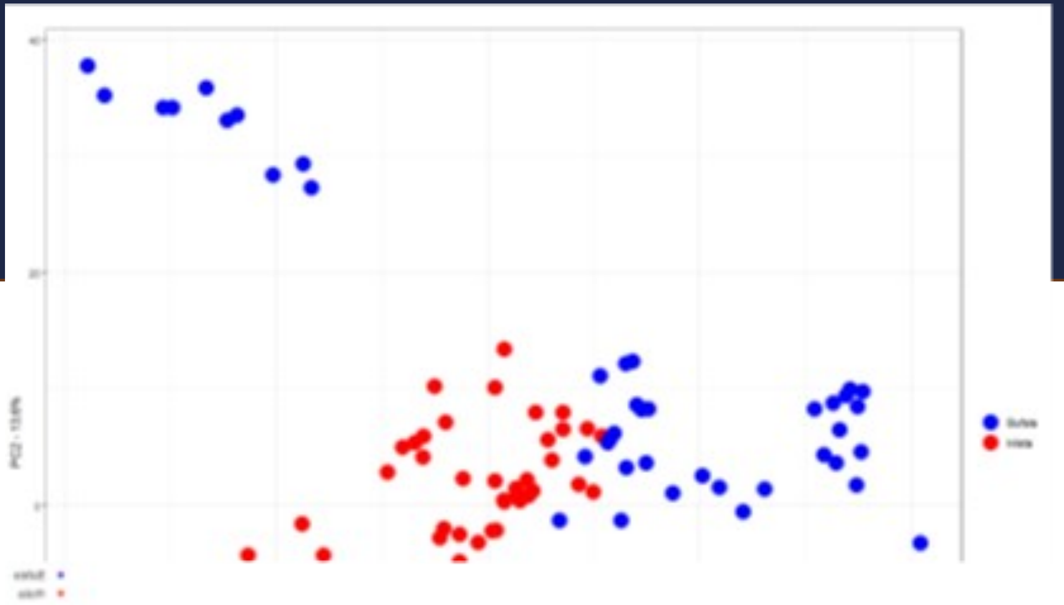
sample, taking a portion

and scanning that portion.

BluDev Pro®

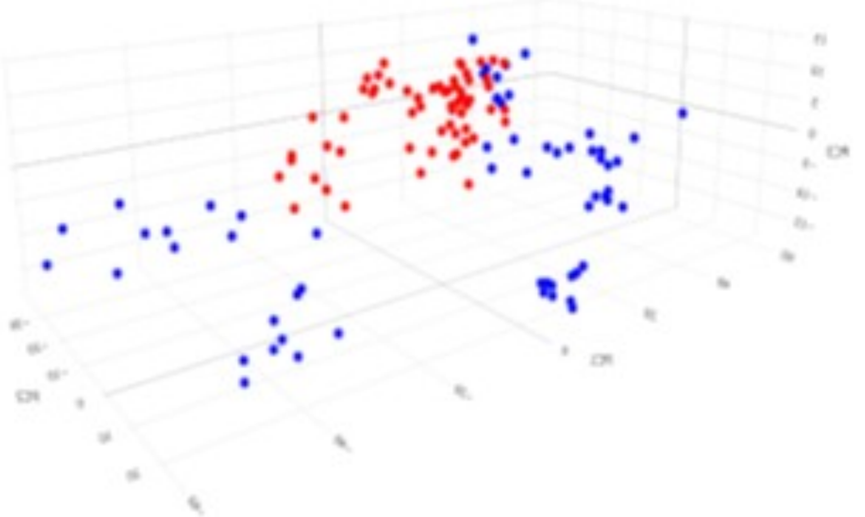
For the first BluDev Pro® device, a total of 12 aliquots from 12 samples (121 scans) were selected, with each sample being scanned at least 10 times. In the initial phase, a Principal Component Analysis (PCA) was performed for preliminary data exploration and to check for potential clustering

PRELIMINARY RESULTS



The following images display the results of this exploratory in both a 2-dimensional and a 3-dimensional charts.

It is possible to observe a random distribution of buffalo mozzarella (indicated in blue) compared to mixed mozzarella (indicated in red). There does not appear to be a clear separation between the two clusters. Although this is a relatively common situation, it does not preclude further analysis and model development based on the available data. This is only a preliminary study



RESULTS BluDev Pro®

	Buffalo mozzarella scans (n. of samples)	Mixed mozzarella scans (n. of samples)	Total scans (n. of samples)
TRAIN (80%)	51 (5)	50 (5)	101 (10)
TEST (20%)	10 (1)	10 (1)	20 (2)
TOTAL	61 (6)	60 (6)	121 (12)

Before creating an actual model, all the scans were divided into two separate groups "Train" and "Test": the two groups represent 80% and 20% respectively. In order to have a dataset for training the model (Train) and another statistically significant dataset for its validation (Test). Thus, the larger group will contain samples not present in the smaller group, and vice versa. This approach ensures that the model is validated using data that were previously unknown and separate from the initial dataset

RESULTS BluDev Pro®

The model correctly classified both scans of mozzarella produced with 100% buffalo milk (10 out of 10) and scans of mozzarella produced with mixed milk (10 out of 10).

In total, the model accurately classified 20 out of 20 scans (100%).

RESULTS BluDev Hand®

The same type of analysis, including modeling, was conducted by a second portable device, BluDev Hand®. In this case, 12 aliquots from 12 samples (121 scans) were also used. The following figures display the results of the PCA analysis in both 2-dimensional and 3-dimensional formats, the detailed composition of the Train and Test datasets, and the confusion matrix related to the model validation.

	Buffalo mozzarella scans (n. of samples)	Mixed mozzarella scans (n. of sample)	Total scans (n. of samples)
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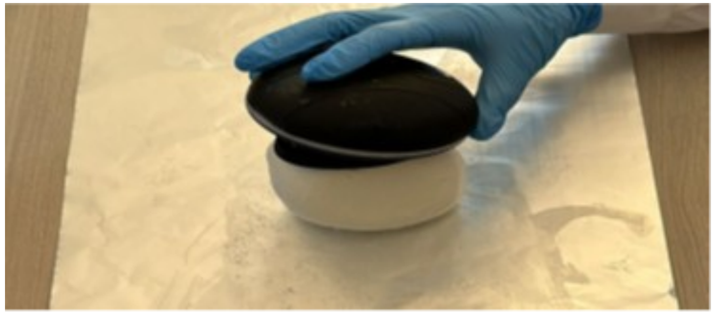
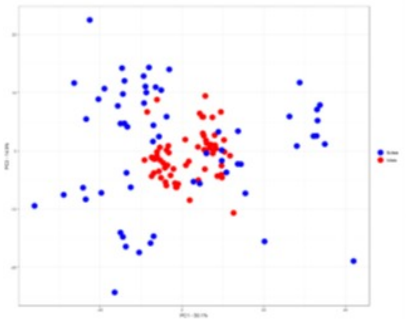
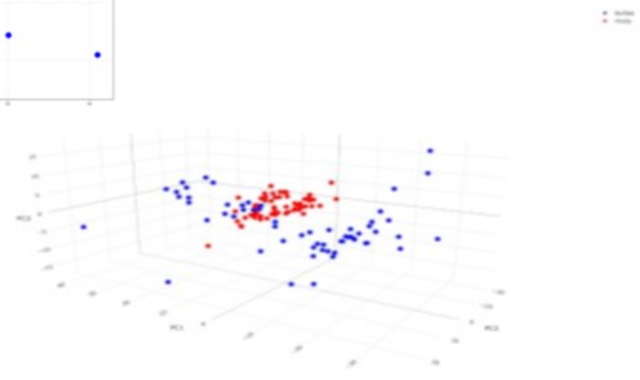


BluDev Hand®





RESULTS BluDev Hand®

- The results obtained are similar to the previous ones. In this case as well, the model correctly classified both scans of mozzarella produced with 100% buffalo milk (10 out of 10) and scans of mozzarella produced with mixed milk (10 out of 10). In total, the model accurately classified 20 out of 20 scans (100%).

CONCLUSION

We can conclude that this developed model suggests promising prospects for further improvement in near future: increasing the number of samples will improve the confidence of the method in order to discriminate between buffalo and mixed mozzarella.

We could imagine a *virtual* laboratory, performing a simple scan to screen mozzarella, identifying suspicious samples to be analysed to detect fraud.

THANK YOU FOR YOUR ATTENTION

Loredana Biondi

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24/25 Sept. 2024

Development of a healthy dairy custard based on buffalo milk and natural thickeners

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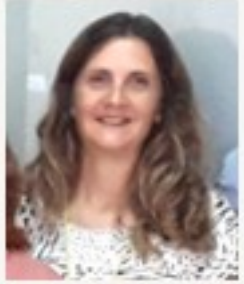


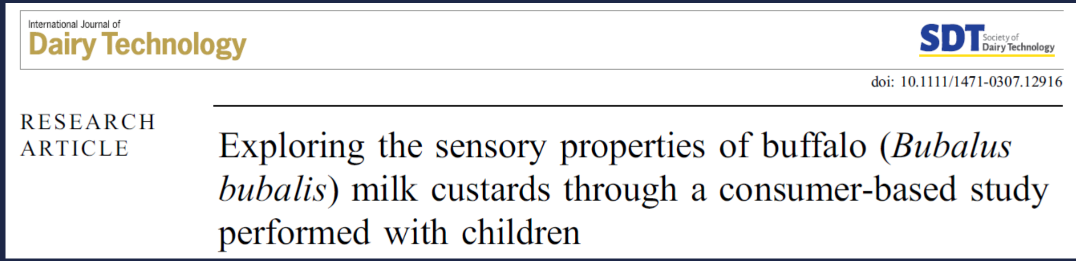
Dra. María Florencia Mazzobre
FCEyN - UBA

Objective

- The main objective of this work was to advance in the development of a healthy buffalo milk-based food product as an innovative alternative to traditional buffalo cheeses.

We proposed the manufacture of a vanilla custard-type dessert intended for child nutrition.

In a previous work...

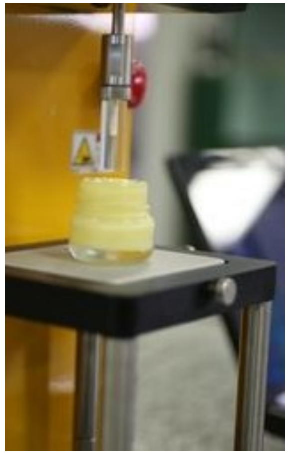

International Journal of
Dairy Technology
SDT Society of Dairy Technology
doi: 10.1111/1471-0307.12916
RESEARCH ARTICLE
Exploring the sensory properties of buffalo (*Bubalus bubalis*) milk custards through a consumer-based study performed with children

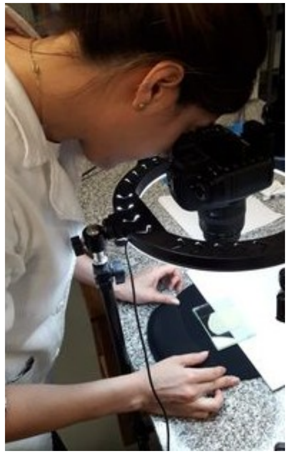
- We tested three formulations varying the amount of cornstarch, sucrose, and food-grade flavor/colorant to get samples with distinctive textural, sweetness, and chromatic properties.
- A sensory evaluation performed with 100 children (8 to 12 age) allowed identify the most relevant attributes and get precise indications for reformulation and product optimization.
- Obtained product required attention because it was high in calories and non-stable for long period in cold-storage (1 week).

In this context...

- The total replacement of sucrose with a non-caloric natural sweetener (Stevia) was proposed. ➡ Calories reducing strategy.

- The mixture of native starches from potato, cassava and corn was assessed as a healthier texturizer or stabilizer alternative to the modified starches commonly used in the industry. ➡ Natural additives as clear-label foods approach.



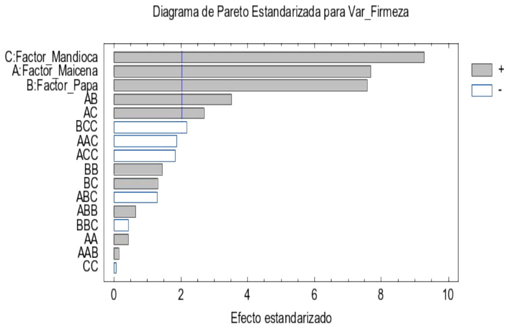


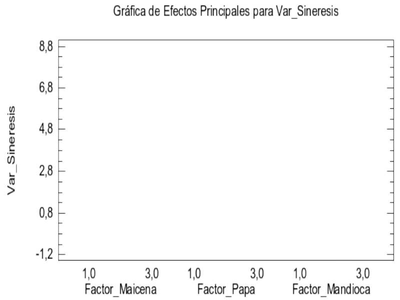
- The impact of formulation changes were assessed on textural and appearance properties by instrumental analysis.

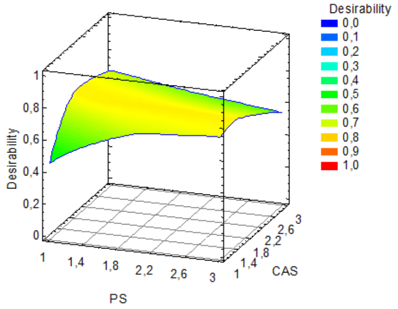
- Cold-storage physical stability (water holding capacity and syneresis) was also monitored.

Outstanding results...

- Potato, cassava and corn starches and their interactions exerted a significant positive effect on the firmness of custards as assessed through Texture profile analysis (TPA).
- Color parameters (L*, a* and b*) and opacity did not show statistical differences.
- Cold-storage stability measured in terms of water holding capacity (accelerated water leakage) and syneresis (spontaneous water leakage) was mainly affected by cassava starch and starch mixtures.
- It is was possible to obtain an optimum that conserve the most preferred texture of custard, minimizing the time-depending changes over cold-storage.







CONCLUSIONS

Obtained results encourage the use of non-caloric sweetener and the mixture of native starches for making healthy and commercially attractive dairy desserts.

Manufacture of buffalo custards constitutes a promising alternative for using of buffalo milk in less explored dairy products.

LET'S START WORKING TOGETHER

Caracas 13 th World Buffalo Congress 22-24 November 2023

Gracias por su atención!

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Istituto Zooprofilattico Sperimentale del Lazio e della Toscana *M. Aleandri*

A tailored-made model to predict the behaviour of *Listeria monocytogenes*

R. Condoleo, M.C. Campagna, M.L. De Marchis, T. Zottola, M.F. Iulietto

Istituto Zooprofilattico Sperimentale del Lazio e della Toscana M. Aleandri (IZSLT)

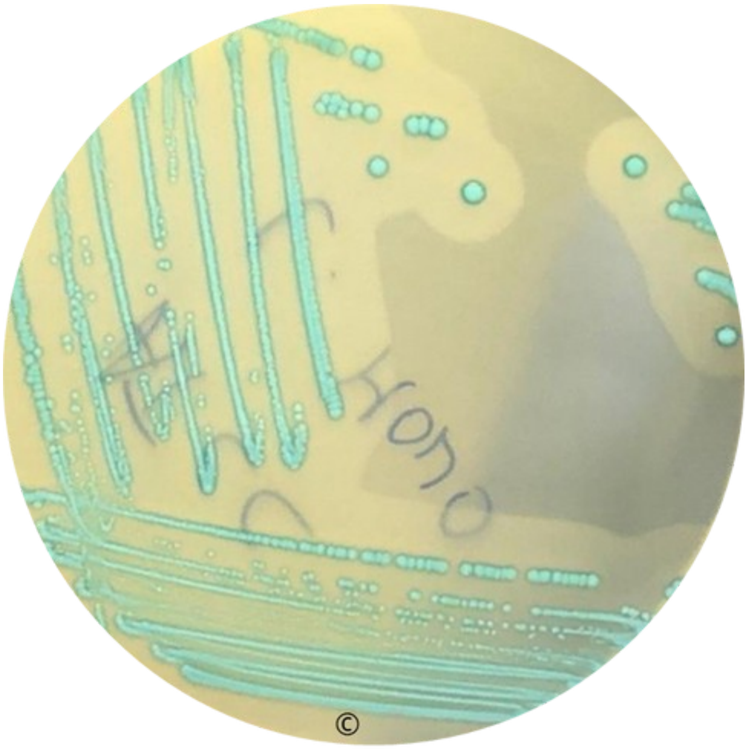
Naples, 24/09/24

Roberto Condoleo – IZSLT
Epidemiology Unit

The villain

Name: *Listeria monocytogenes*

Type: *Batterio Gram+*



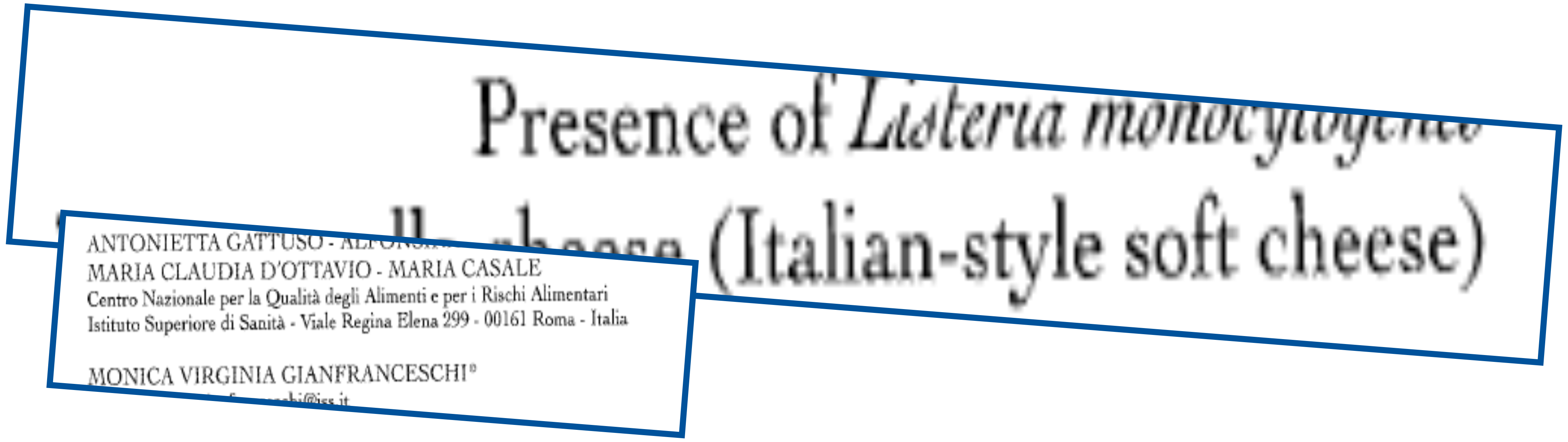
© MCampagna

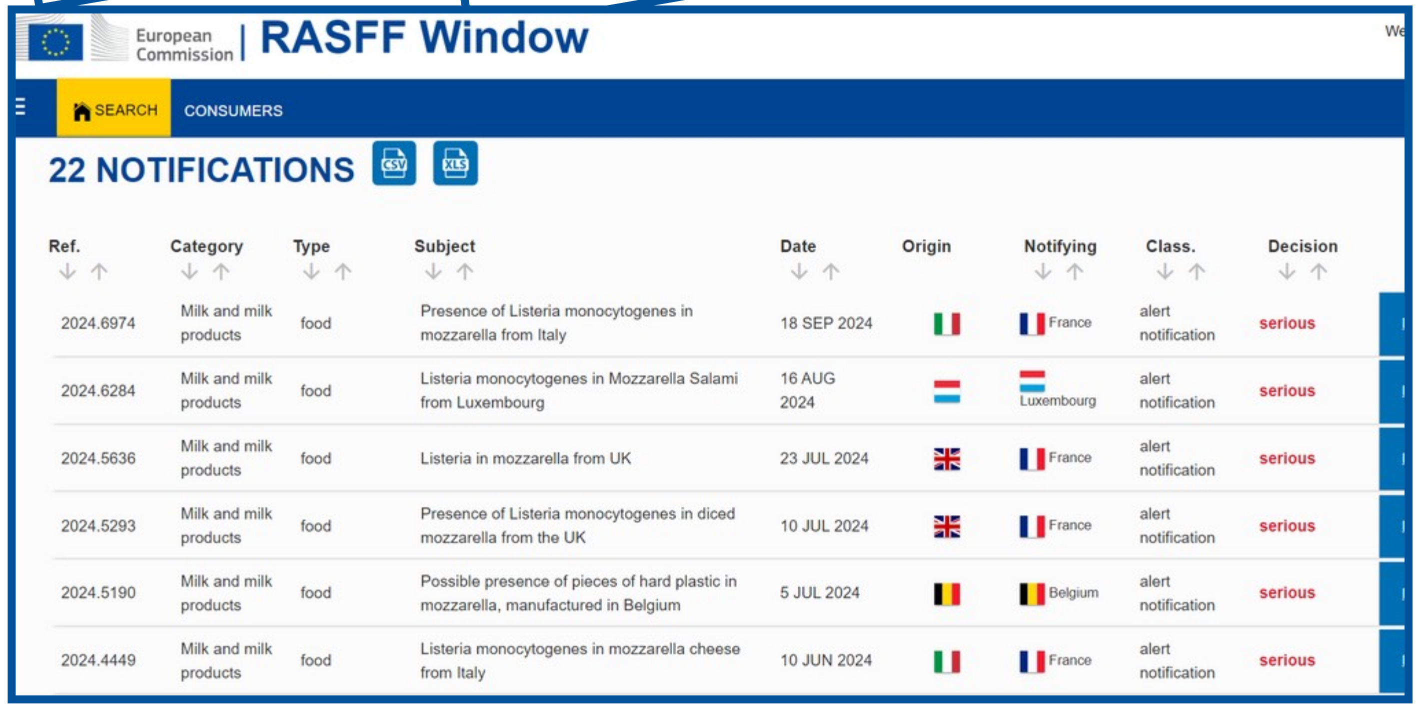
Seen last time: intestine, soil, farm, mastitic milk, dairy, any type of surface, kitchen… basically everywhere

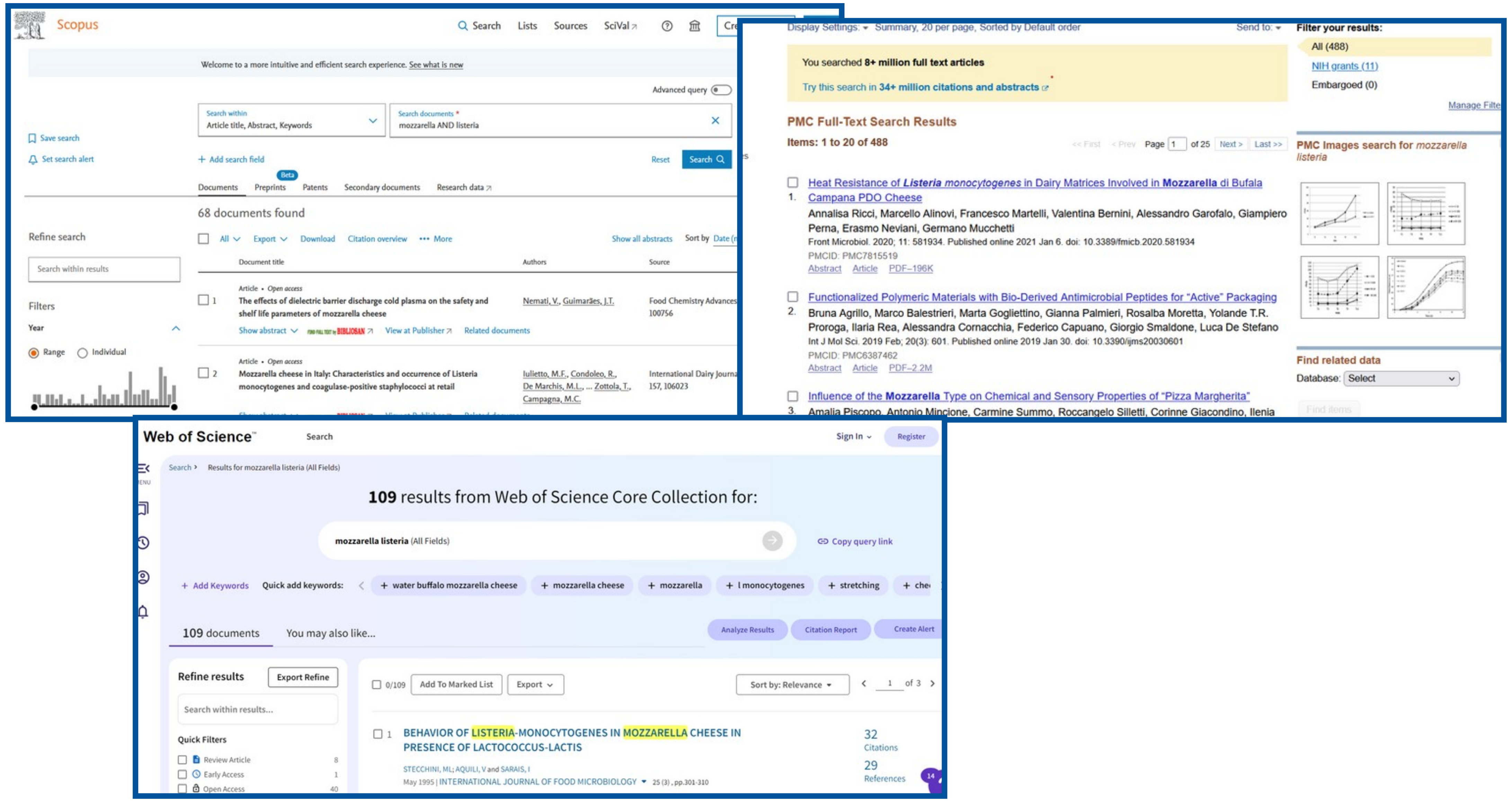
It loves 1) high pH foods 2) cold places 3) doing things slowly

It hates: 1) heat 2) good microorganisms

Particular signs: very evil with children, old people, pregnant women and sick people





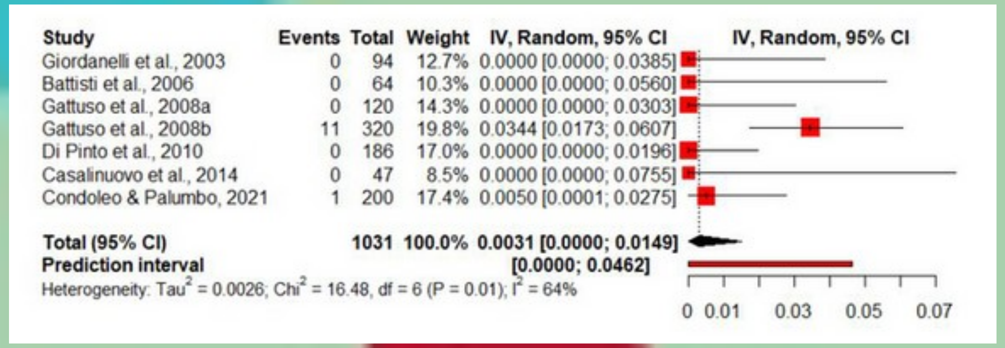


No listeriosis cases associated to mozzarella consumption so far

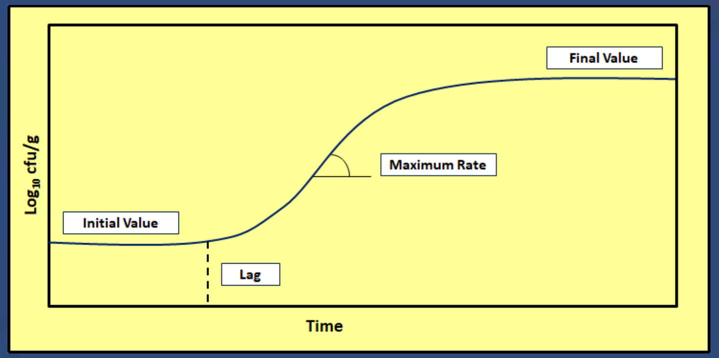
Istituto Zooprofilattico Spe
del Lazio e della Toscana M

Occurrence *L. monocytogenes* in mozzarella

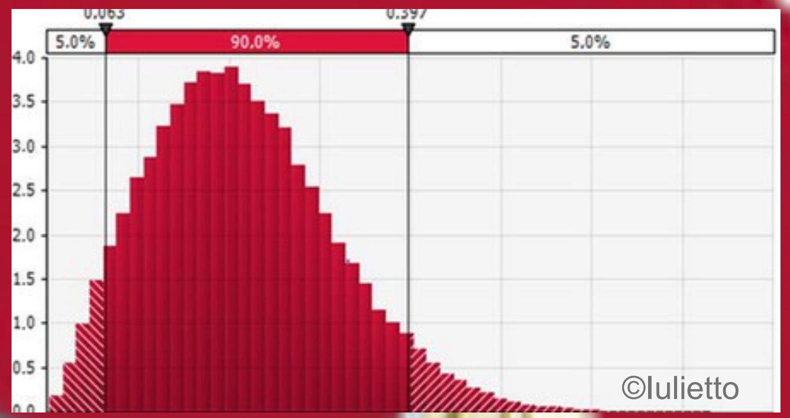
Systematic review and meta-analysis



Predictive microbiology model

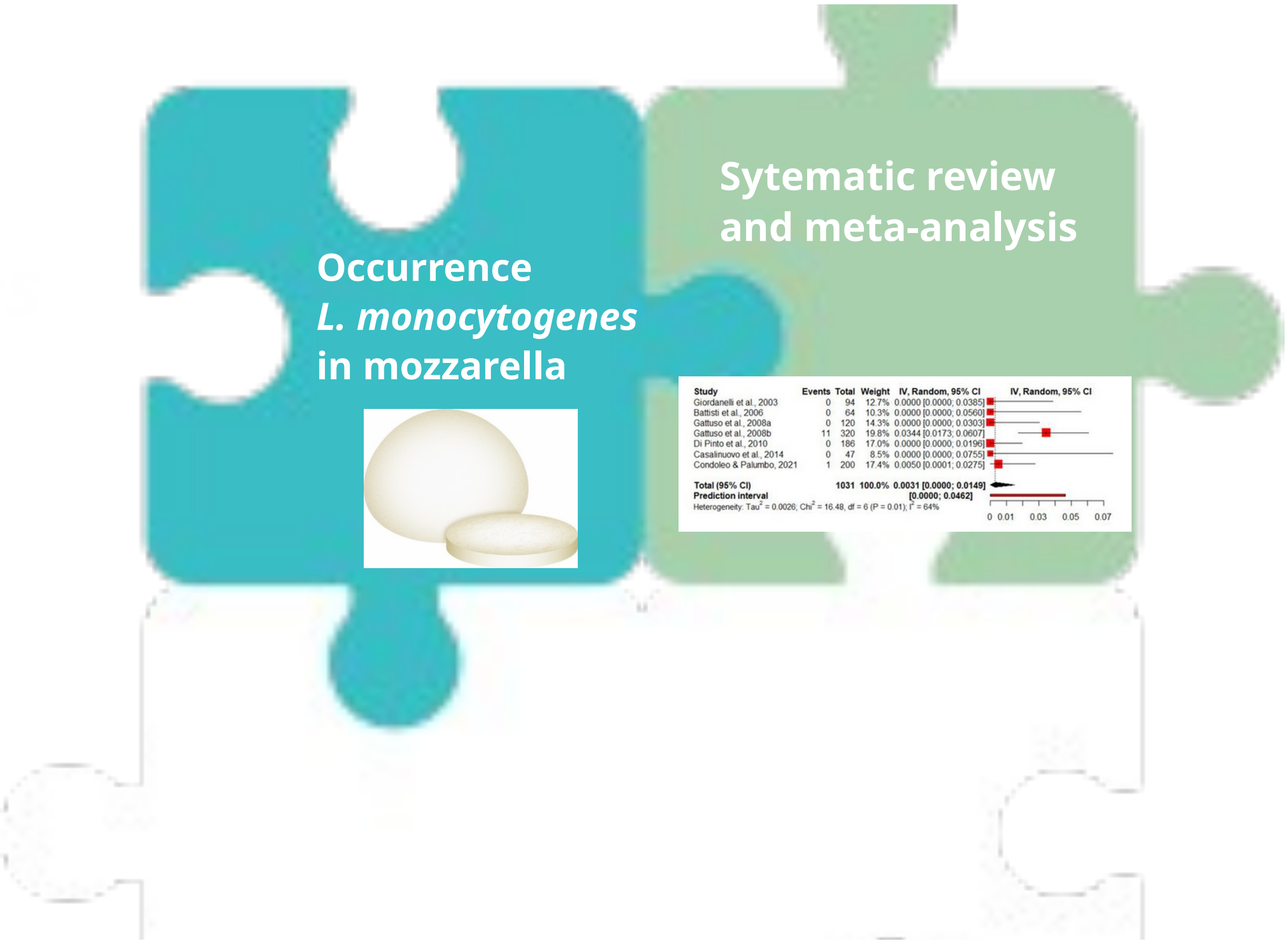


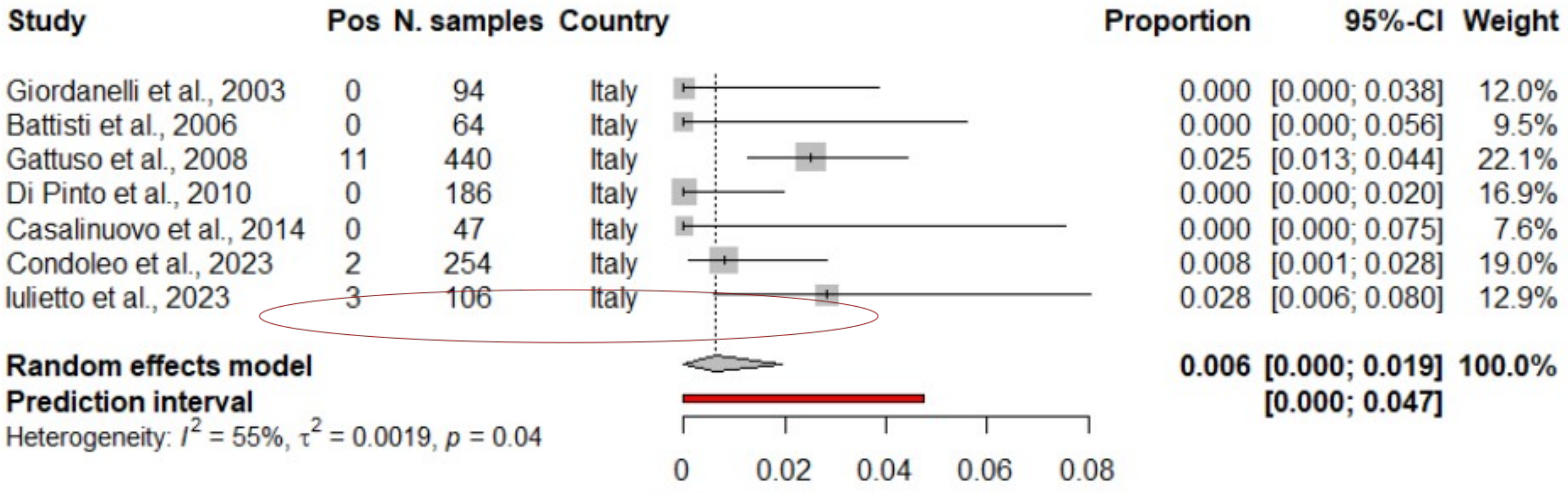
Risk assessment of listeriosis by mozzarella consumption

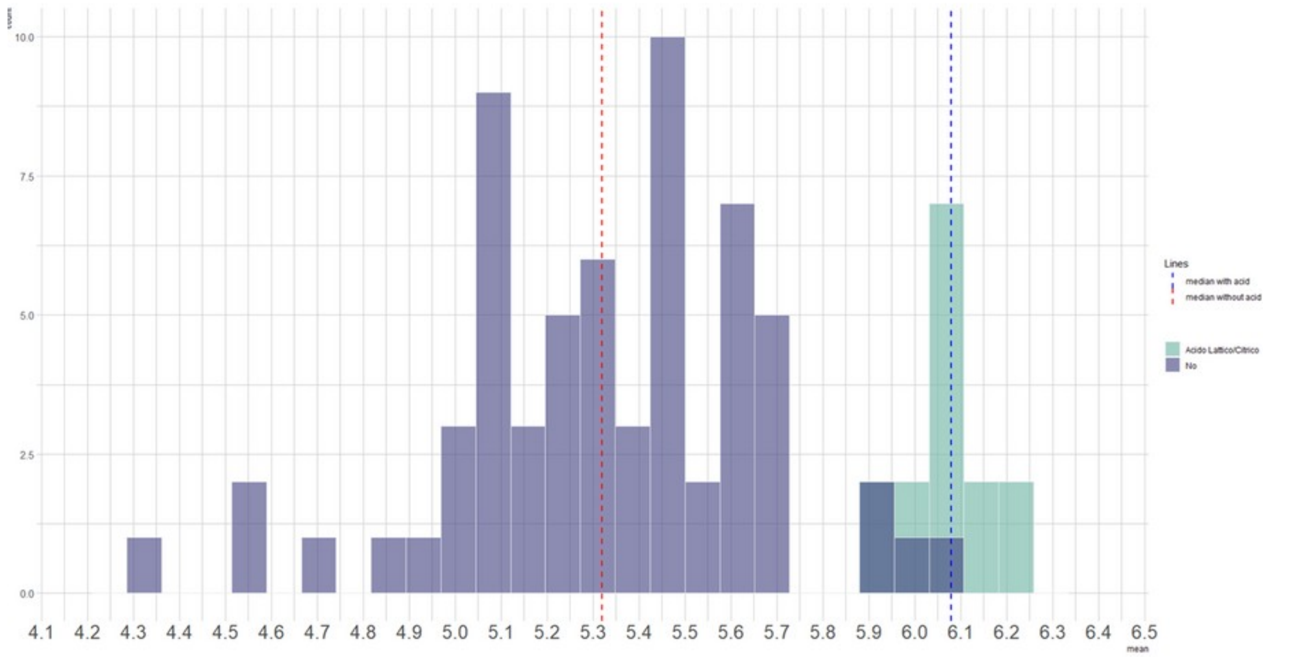


3 out of 106 batches were contaminated with *L. monocytogenes.* Occurence was 2.8% (IC 95% 0.6-8%)

Low concentration *L. monocytogenes* nei prodotti contaminati (< 10 CFU/g)







pH

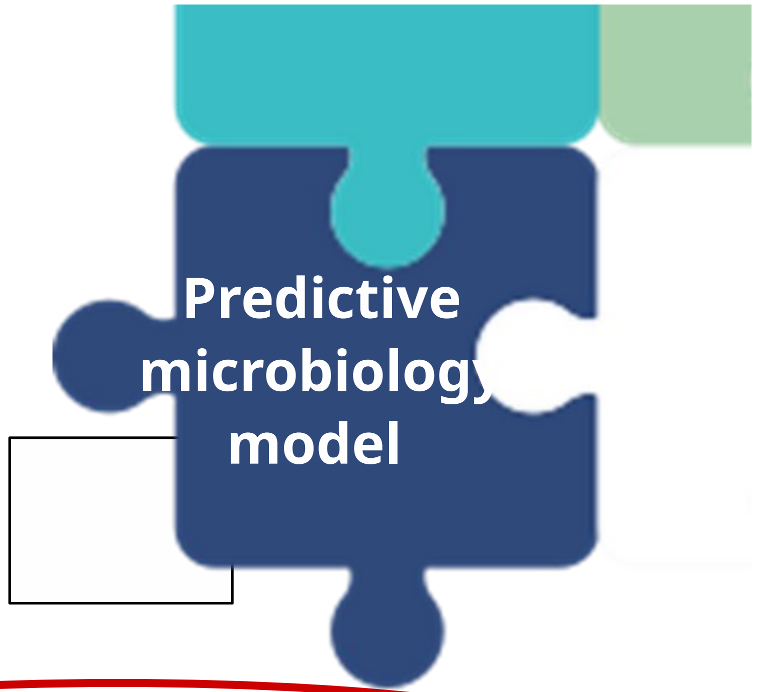
Mozzarella cheese in Italy: Characteristics and occurrence of *Listeria monocytogenes* and coagulase-positive staphylococci at retail

Maria Francesca Iulietto *, Roberto Condoleo, Maria Laura De Marchis, Tatiana Bogdanova, Valeria Russini, Sonia Amiti, Roberta Zanarella, Tiziana Zottola, Maria Concetta Campagna

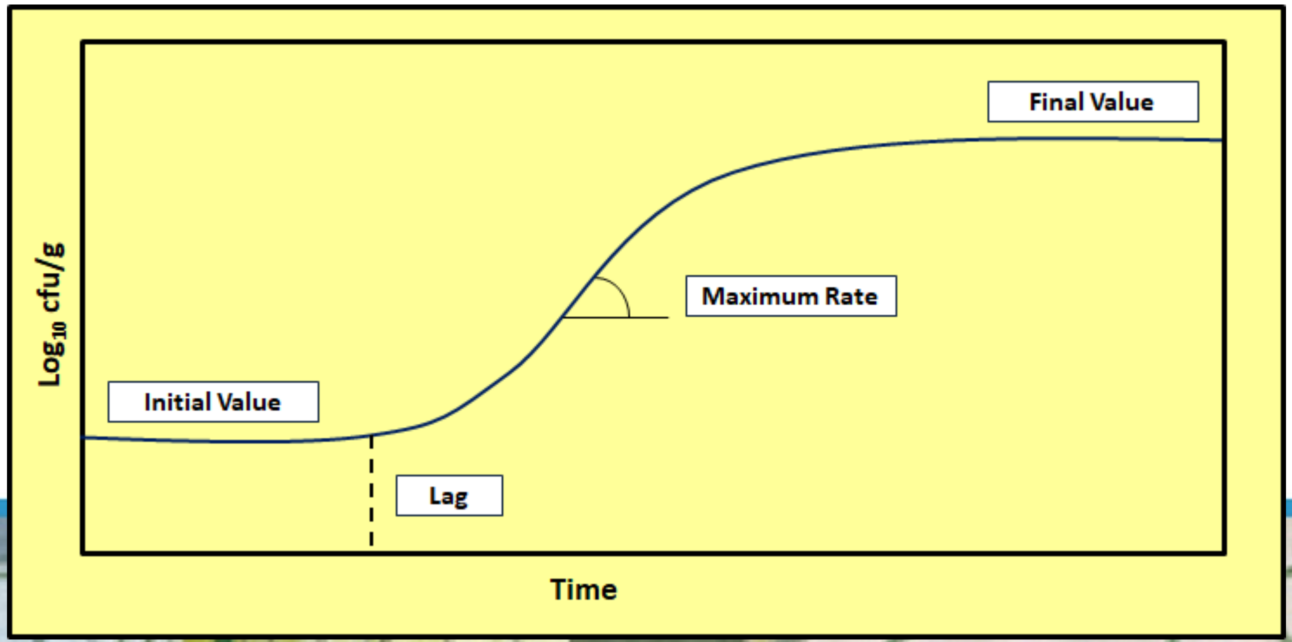
Istituto Zooprofilattico Sperimentale Lazio e Toscana M. Aleandri, Rome, Italy

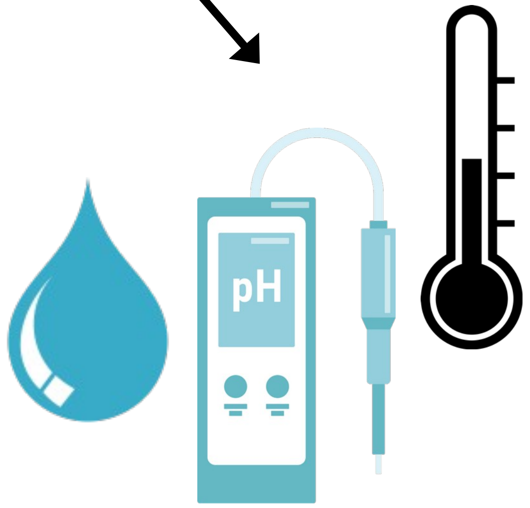
International Dairy Journal 157 (2024) 106023

Predictive Microbiology in few words…



A detailed knowledge of microbial behaviour in certain conditions described in a mathematical model that allows objective assessment of the food safety of the processing, retail and storage phases along the food chain without the need of microbiological tests





Reference	Year	Temperature °C	Max rate (Log CFU/day)
Murru et al (2018)	2018	4	0.028
Murru et al (2018)	2018	20	0.271
Murru et al (2018)	2018	30	0.211
Murru et al (2018)	2018	4	0.066
Murru et al (2018)	2018	20	0.206
Murru et al (2018)	2018	30	0.136
Kapetanakou et al. (2017)	2017	7	0.213
Kapetanakou et al. (2017)	2017	7	0.211
Kapetanakou et al. (2017)	2017	7	0.114
Kapetanakou et al. (2017)	2017	7	0.083
Nava et al. (2016)	2016	12	0.020
Nava et al. (2016)	2016	12	-0.003
Nava et al. (2016)	2016	12	0.104
Nava et al. (2016)	2016	12	0.027
Han et al (2014)	2014	10	0.247
Serraino et al (2012)	2012	5	-0.014
Serraino et al (2012)	2012	10	-0.140
Serraino et al (2012)	2012	15	-0.151
Serraino et al (2012)	2012	20	-0.132
Finazzi et al. (2011)	2011	5	-0.039
Finazzi et al. (2011)	2011	10	0.079
Finazzi et al. (2011)	2011	20	0.244
Finazzi et al. (2011)	2011	5	0.093

Potential growth of *Listeria monocytogenes* (*Log CFU/g/day*) in mozzarella cheese as affected by microbiological and chemical-physical environment.

Primary model fitting: takes into account only the time (experimental factors are not considered)

Reference	Year	Temperature °C	ph	Max rate at 8 °C
Murru et al (2018)	2018	4	5.40	0.08
Murru et al (2018)	2018	20	5.39	0.05
Murru et al (2018)	2018	30	5.37	0.02
Murru et al (2018)	2018	4	5.40	0.19
Murru et al (2018)	2018	20	5.39	0.04
Murru et al (2018)	2018	30	5.37	0.01
Kapetanakou et al. (2017)	2017	7	6.23	0.26
Kapetanakou et al. (2017)	2017	7	6.19	0.26
Kapetanakou et al. (2017)	2017	7	6.19	0.14
Kapetanakou et al. (2017)	2017	7	6.14	0.10
Nava et al. (2016)	2016	12	5.38	0.01
Nava et al. (2016)	2016	12	5.38	0.00
Nava et al. (2016)	2016	12	5.38	0.05
Nava et al. (2016)	2016	12	5.38	0.01
Han et al (2014)	2014	10	5.80	0.17
Serraino et al (2012)	2012	5	4.96	-0.03
Serraino et al (2012)	2012	10	4.95	-0.10
Serraino et al (2012)	2012	15	4.89	-0.05
Serraino et al (2012)	2012	20	4.66	-0.03
Finazzi et al. (2011)	2011	5	4.79	-0.08
Finazzi et al. (2011)	2011	10	5.13	0.05
Finazzi et al. (2011)	2011	20	4.66	0.05
Finazzi et al. (2011)	2011	5	4.63	0.20
Tirloni et al (2019)	2019	4	6.51	0.89
Tirloni et al (2019)	2019	4	6.51	0.57
Tirloni et al (2019)	2019	9	6.51	0.61
Tirloni et al (2019)	2019	9	6.51	0.65
Tirloni et al (2019)	2019	15	6.51	0.43
Tirloni et al (2019)	2019	15	6.51	0.51
Rivas et al (2022)	2022	10	5.36	0.01

Square-root model modified from McMeekin (1992)

$$\mu_{ref} = \mu_{obs} * \frac{(T_{ref}-T_{min})^2}{(T_{obs}-T_{min})^2} * \frac{pH_{ref}-pH_{min}}{pH_{obs}-pH_{min}}$$

Modello gamma-concept modified from Zwietering et al., (1992)

$$\tau(T) = \left(\frac{T-T_{min}}{T_{opt}-T_{min}}\right)^2$$

$$\mu_{max}(T, pH) = \mu_{opt}\tau(T)\rho(pH)$$

$$\rho(pH) = \left(\frac{pH-pH_{min}}{pH_{opt}-pH_{min}}\right)$$

Modello cardinale from Rosso et al., (1995)

$$\mu_{opt} = \frac{\mu_{max}}{\gamma(T).\gamma(pH).\gamma(aw).\gamma(AH).\gamma(int)} \quad (6)$$

$$\gamma(T) = \begin{cases} 0 & ,T \le T_{min} \\ \dfrac{(T-T_{max})(T-T_{min})^2}{(T_{opt}-T_{min})[(T_{opt}-T_{min})(T-T_{opt})-(T_{opt}-T_{max})(T_{opt}+T_{min}-2.T)]} & ,T_{min} < T < T_{max} \\ 0 & ,T \ge T_{max} \end{cases}$$

$$\rho(pH) = \frac{(pH-pH_{min})(pH-pH_{max})}{(pH-pH_{min})(pH-pH_{max})-(pH-pH_{opt})^2}$$

Performance of three models have been assessed estimating the growth of *L. monocytogenes* at the different experimental conditions of the selected curves and then evaluating the distribution of the residues with the following indexes:

- RMSE (Root Mean Squared Error)
- MRE (Mean Relative Error)
- R2 (Coefficient of determination)

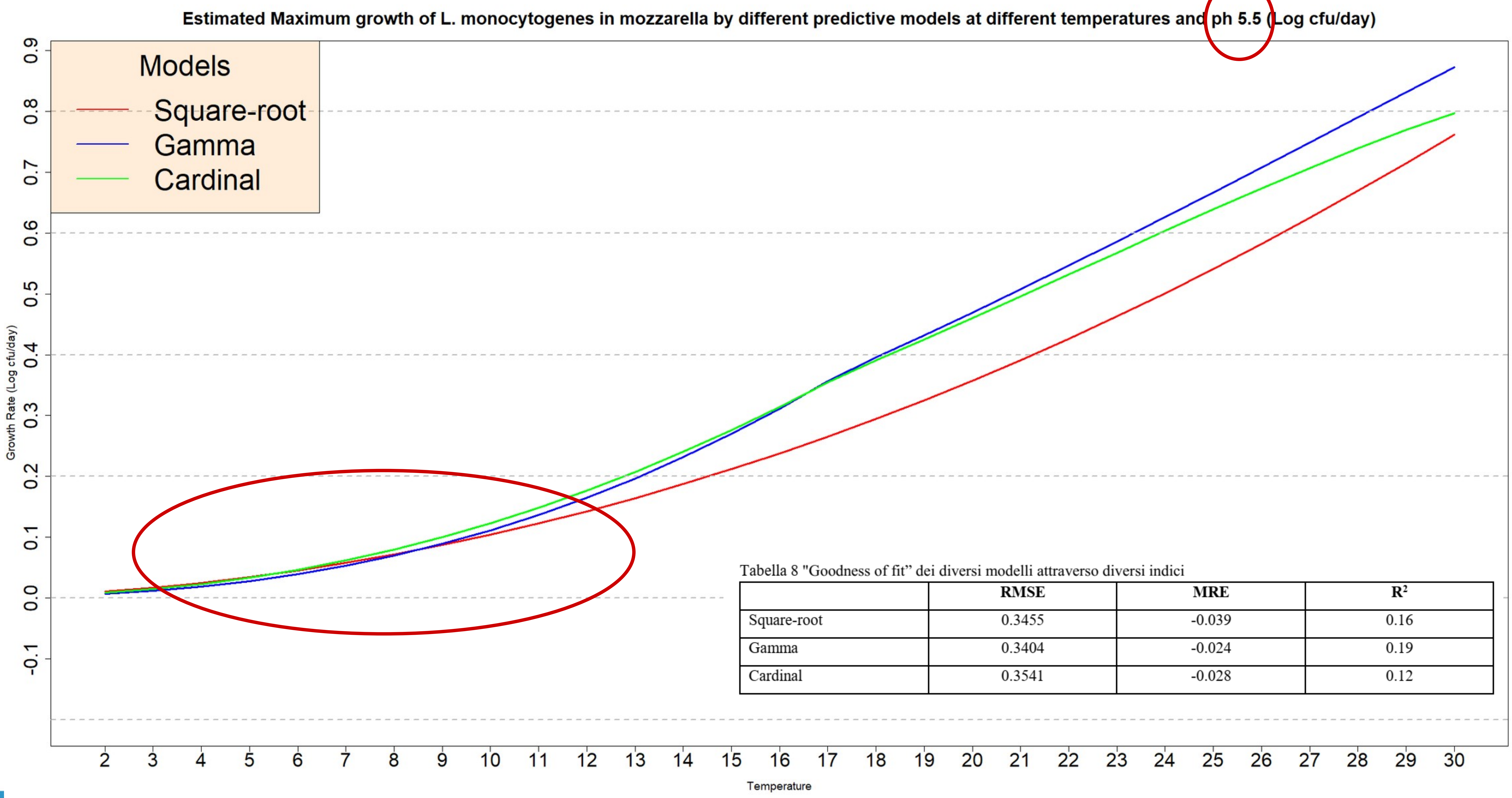
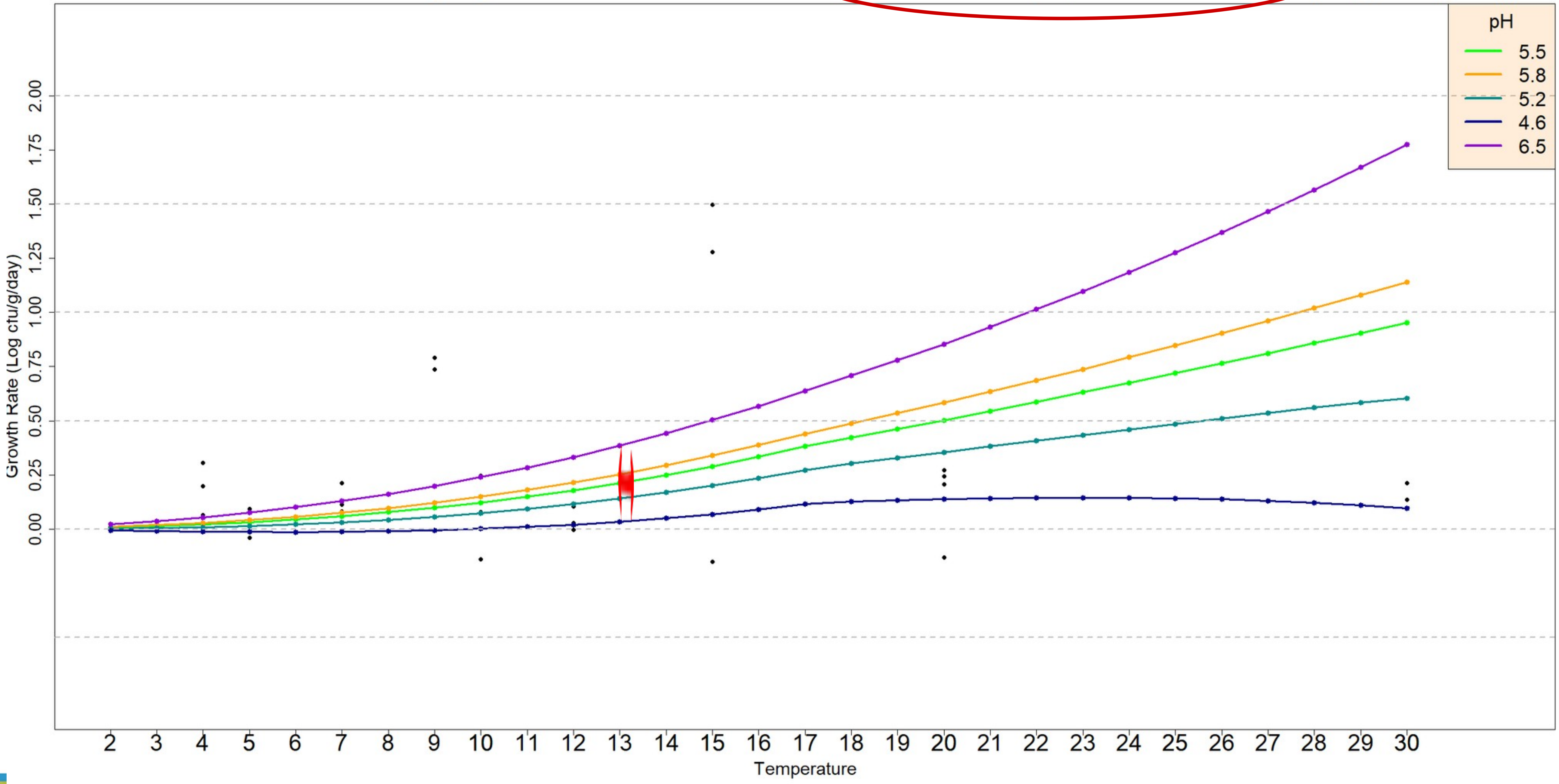
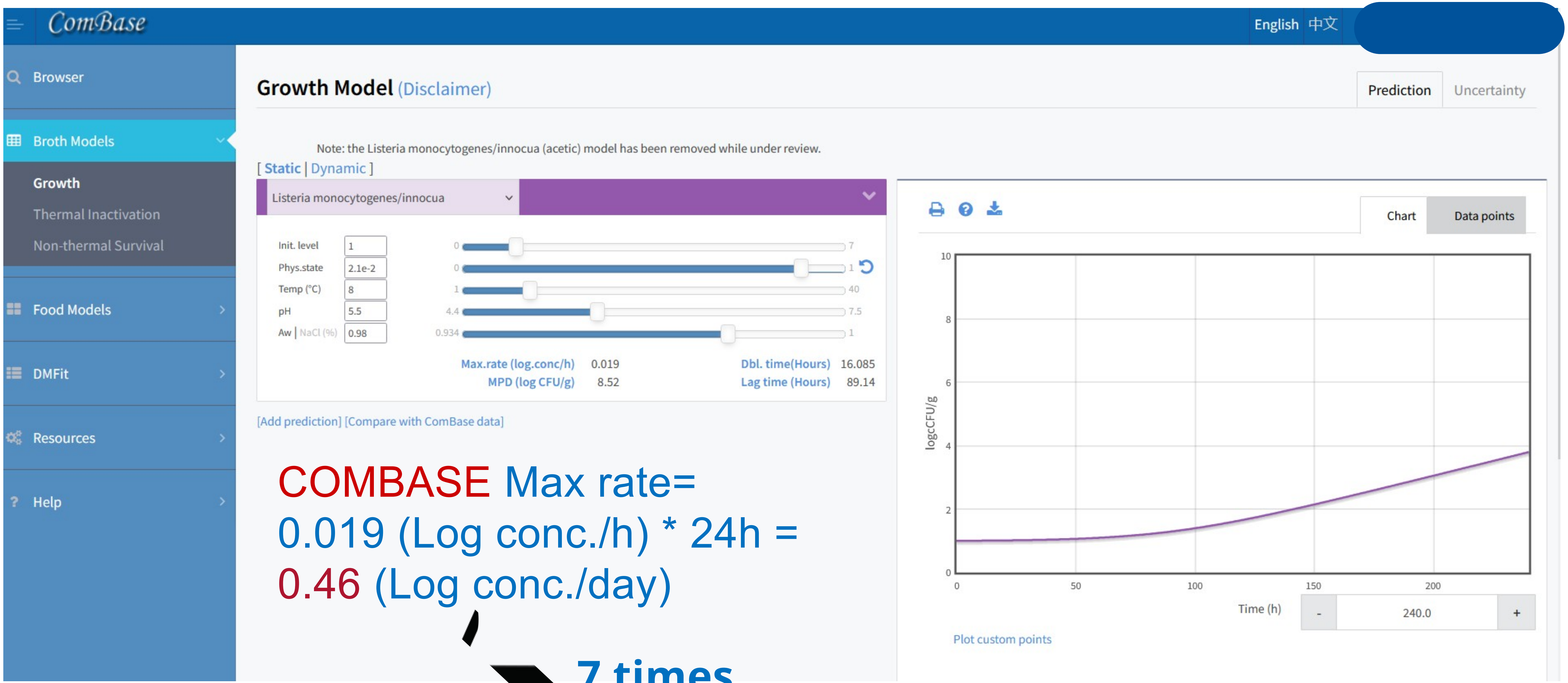


Tabella 8 "Goodness of fit" dei diversi modelli attraverso diversi indici

	RMSE	**MRE**	**R^2**
Square-root	0.3455	-0.039	0.16
Gamma	0.3404	-0.024	0.19
Cardinal	0.3541	-0.028	0.12

Growth rate of L. monocytogenes on the basis of the gamma-concept predictive model (Log cfu/g/day)





COMBASE Max rate=
0.019 (Log conc./h) * 24h =
0.46 (Log conc./day)

7 times difference!

Taylor-made model = 0.07 (Log conc./day)

Take-home messages

The model is more robust than those developed using lab media and can support FBO to predict the concentration *L. monocytogenes* during the shelf life at certain conditions

pH of the product is an important factor to limit the growth of the microrganism

The model should be improved in term of accuracy with new experimental data

THANK YOU FOR YOU ATTENTION…

My thanks to Dr. Maria Francesca Iulietto and the rest of the research group!

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Effect of aging on probiotic bacteria in semi-hard buffalo cheese

FIRST INTERNATIONAL CONFERENCE ON
Buffalo Mozzarella & Milk Products

24/25 Sept. 2024

Valeria Vuoso
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Department of Veterinary Medicine and Animal Production, Italy

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Introduction

Cheese refinement relies on complex processes, with bacteria playing a key role in developing flavor and texture. These microorganisms can originate from milk, the environment, or starter cultures, but production methods often impact which bacteria dominate.

Aim of the study

The aim of the study was to compare the effect of the traditional refinement method (**Trad; 98 days**) with the rapid method (**Fast; 42 days**) on probiotic bacteria in semi-hard raw milk buffalo cheese.

Materials and methods

Raw buffalo milk at 31.5 °C
↓
Heating at 40 °C (5 min)
↓
Adding commercial starter mix (CO.02)
↓
Adding kid lipase after 2 minutes
↓
Adding kid rennet paste after 60 min
↓
Manual curd breaking after 60 min
↓
Whey curd extraction
↓
Pressing curd into cylindrical forms
↓
Steam cooking (30 min)
↓
Pre-ripening at 4° C (48 h)
↓
Salting in brine (20%) for 1 h

Raw buffalo milk

Curd

Cheese on the first production day (t0)

Semi-hard cheese

42 days

Ripened cheese *RAPID METHOD*

98 days

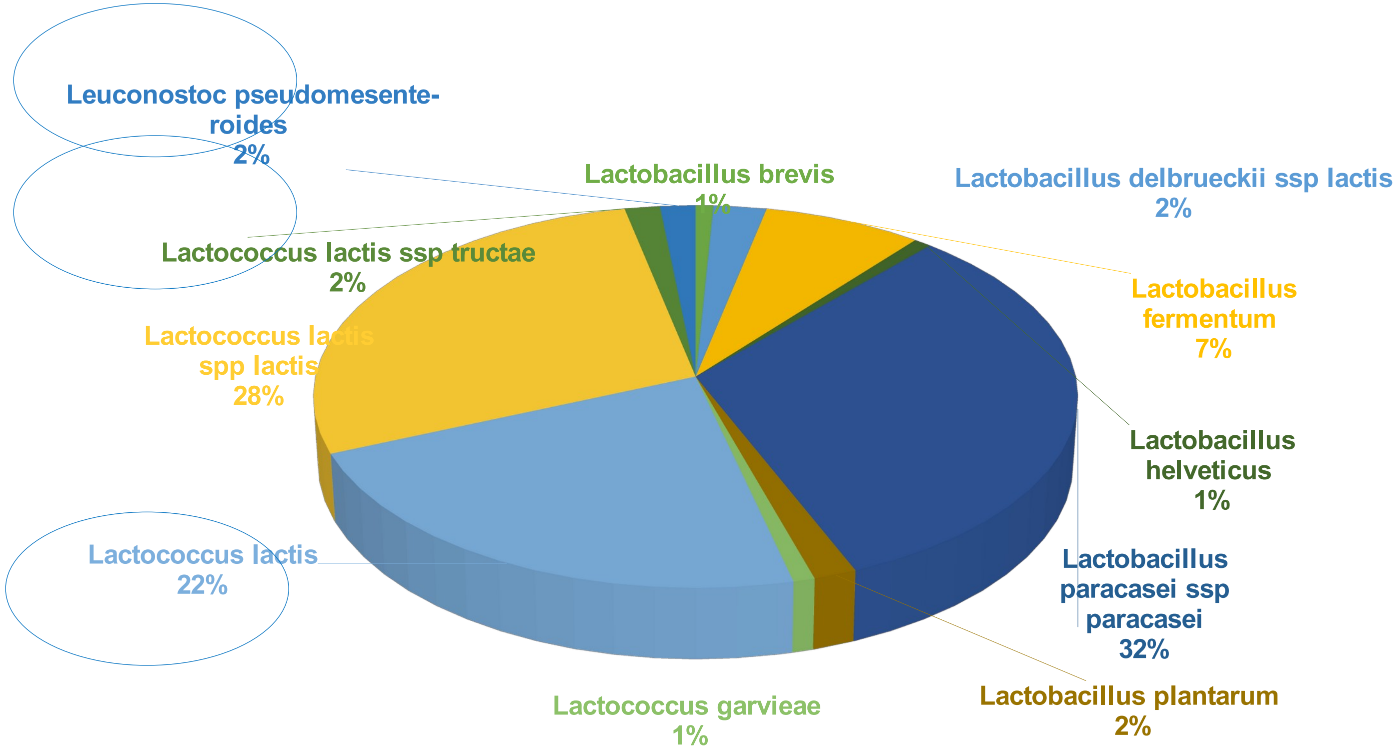
Ripened cheese *TRADITIONAL METHOD*

The chamber is capable of automatically regulating the climatic parameters, preserving the quality and characteristics of the cheeses..

Industrial maturation chamber

Results and discussion

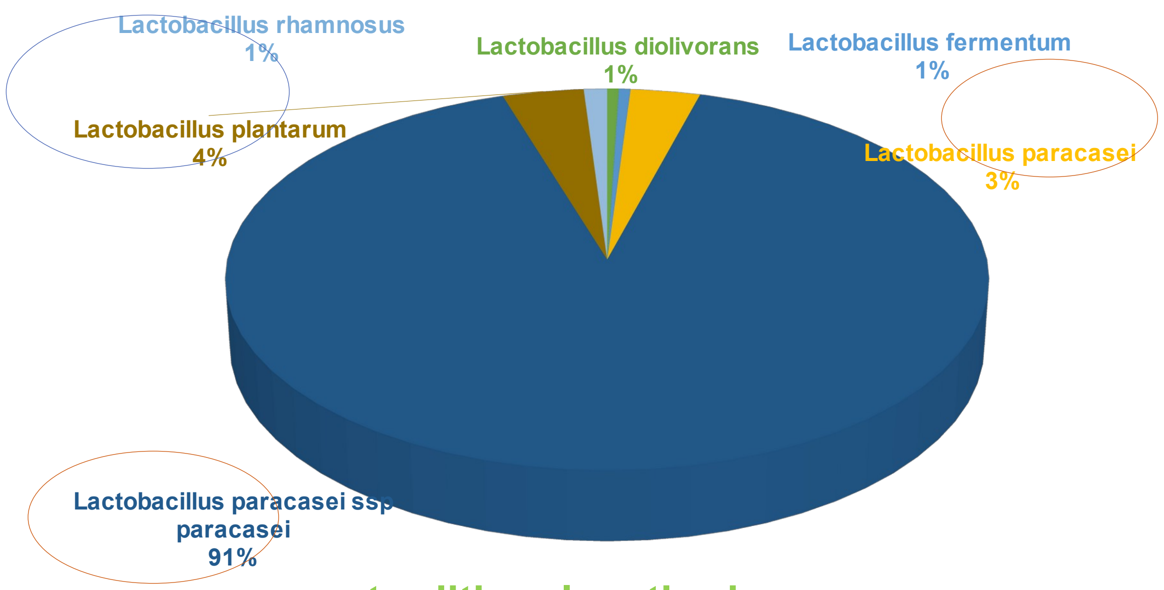
semi-hard cheese after 24h from production



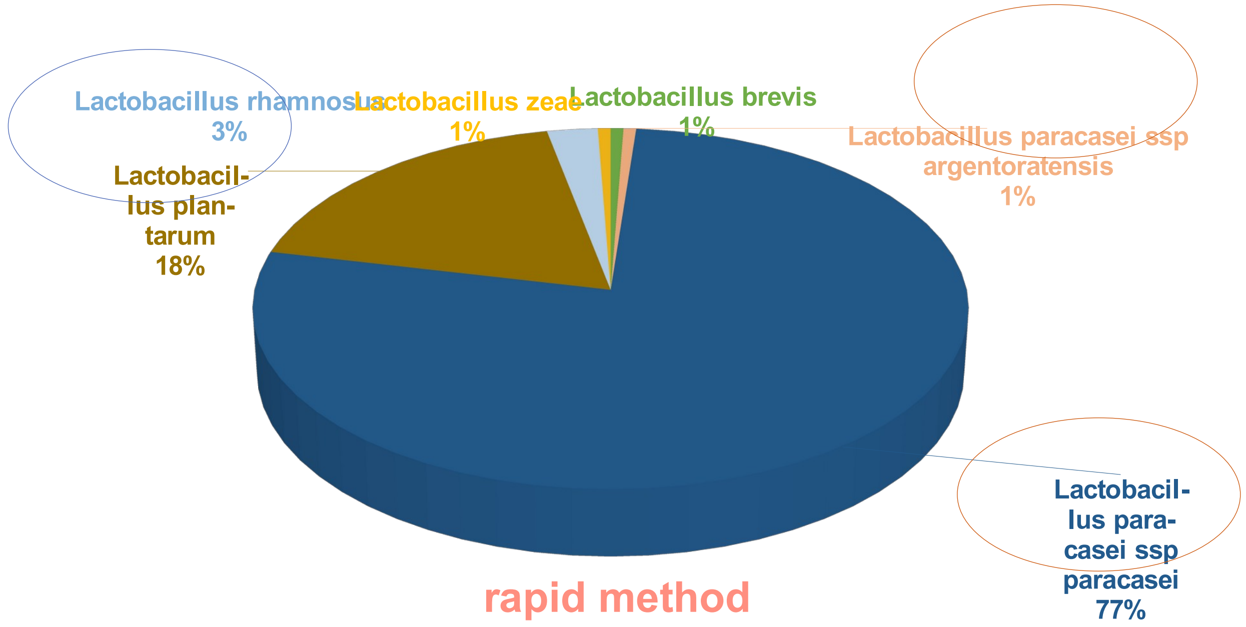
The **MALDI-TOF/MS** identification of the predominant bacterial populations isolated from pre-aged cheeses (after 24 hours from cheese production) indicates the presence of *heterofermentative bacilli.*

Lactococcus lactis **was the dominant species (52%).**

Results and discussion



traditional method



rapid method

After the ripening periods, indigenous lactic acid bacteria decreased in both experimental setups, allowing other microbial populations to prosper:

- the cocci were replaced by bacilli with ***Lactobacillus paracasei*** dominance **(trad 94%; fast 78%);**

- interesting was the isolation of ***Lactobacillus plantarum***, which exhibited a higher prevalence in the rapid method (**18%**) compared to the traditional one **(4%**).

Conclusions

Certain strains of ***Lactobacillus plantarum*** are recognized for their capacity to produce natural antimicrobial compounds, such as bacteriocins, which can inhibit undesired bacteria sharing the same ecological niche.

The rapid refinement method not only shortened production times but also facilitated the selection of a diverse bacterial flora, promoting the prevalence of selected strains into the starter during the process.

Grazie per l'attenzione!

Valeria Vuoso, PhD Student

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