

LUND UNIVERSITY

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Bioactive Proteins and Peptides in Milk

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BIOACTIVE PROTEINS - DEFINITION

- Food components that can affect biological processes or substrates and, hence, have an impact on body function or condition and ultimately health
 - A dietary component should impact a measurable biological effect at a physiologically realistic level
 - The bioactivity measured has to have the potential to affect health in a beneficial way, thus, excluding from this definition potentially damaging effects (such as toxicity, allergenicity and mutagenicity)

(Schrezenmeir *et al* 2000)



FUNCTIONS OF PROTEINS

- Bioactivity
 - Protective functions
 - Regulation of biological functions
- Nutritional value
 - Source of nitrogen for protein synthesis
 - Source of energy
- Technological value
 - Functional (physicochemical) properties
 - Sensory properties



BIOACTIVE PROTEINS IN MILK

- **Caseins**
 - α s1-casein
 - α s2-casein
 - β -casein
 - κ -casein
- **Whey proteins**
 - β -lactoglobulin
 - α -lactalbumin
 - BSA
 - Immunoglobulins
 - Lactoferrin
- **Minor proteins**
 - Growth factors and growth hormones (IGF-1, TGF- β 2, GH)
 - Milk basic protein and cytokines
- **MFGM proteins** (Butyrophilin, Xanthine dehydrogenase/oxidase, MUC1, PP3)
- **Enzymes** (Lactoperoxidase, glutathionperoxidase)



PROTEIN COMPOSITION

COMPONENT	COW MILK content (g/l)	COLOSTRUM content (g/l)
CASEINS	26	27
α s1-CN	10	10.3
α s2-CN	2.6	2.7
β -CN	9.3	9.5
κ -CN	3.3	3.4
WHEY PROTEINS	6.3	34
β -lactoglobulin	3.2	8.0
α -lactalbumin	1.2	3.0
Bovine serum albumin	0.4	1.3
Immunoglobulins	0.6-1.0	20-150
Lactoferrin	0.1	1.5
MFGM PROTEINS	0.4	0.4



LACTOFERRIN

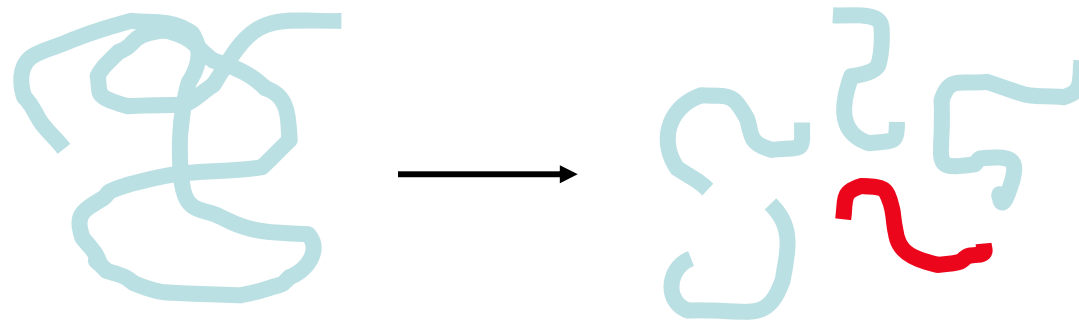
- Bioactive functions
 - Regulation of iron transport
 - Antimicrobial activity
 - Antiinflammatory and Immunomodulatory activity
 - Antioxidative effect
 - Antiinflammatory and Anticarcinogenic activity
 - Stimulation of cell proliferation



BIOACTIVE PEPTIDES - DEFINITION

- Biological active peptides or functional peptides are food derived peptides that in addition to their nutritional value exert a physiological effect in the body
 - Defined sequences of amino acids which are inactive within the original protein, but which display specific properties once they are released by enzymatic hydrolysis

(Vermeirssen *et al* 2004)



Inactive or less active form

Bioactive peptide



ORIGIN OF BIOACTIVE PEPTIDES

- In the cow
 - Natural occurring peptides
 - Proteolysis in the udder
- Dairy product processing
 - Enzymatic hydrolysis
 - Proteolytic action of microorganisms
- In human after ingestion
 - Digestion in the intestinal tract



LACTOFERRICIN

- LF f(17-42) from lactoferrin during the digestion in the gut by pepsin proteolysis
- Bioactive functions
 - Antimicrobial effects
 - Immunomodulatory effects
 - Antiviral effects
 - Anticarcinogenic activity



VARIATION IN PROTEIN COMPOSITION

- Genetic
- Physiological
 - Lactation stage
 - Udder health
- Environmental
 - Seasonal changes
- Processing
 - Heat treatment
 - Storage

COMMERCIAL PRODUCTS



Brand name	Type of product	Claimed functional bioactive peptides	Health/function claims	Manufacturers
Calpis	Sour milk	Val-Pro-Pro, Ile-Pro-Pro, derived from β -casein and κ -casein	Reduction of blood pressure	Calpis Co., Japan
Evolus	Calcium enriched fermented milk drink	Val-Pro-Pro, Ile-Pro-Pro, derived from β -casein and κ -casein	Reduction of blood pressure	Valio Oy, Finland
BioZate	Hydrolysed whey protein isolate	β -lactoglobulin fragments	Reduction of blood pressure	Davisco, USA
BioPURE-GMP	Whey protein isolate	κ -casein f(106–169) (Glycomacropeptide)	Prevention of dental caries, influence the clotting of blood, protection against viruses and bacteria	Davisco, USA
PRODIET F200/Lactium	Flavoured milk drink, confectionery, capsules	α_{s1} -casein f (91–100) (Tyr-Leu-Gly Tyr-Leu-Glu-Gln-Leu-Leu-Arg)	Reduction of stress effects	Ingredia, France
Festivo Cysteine Peptide	Fermented low-fat hard Ingredient/hydrolysate	α_{s1} -casein f (1–9), α_{s1} -casein Milk protein derived peptide	No health claim as yet Aids to raise energy level and sleep	MTT Agrifood Research DMV International, the Netherlands
C12	Ingredient/hydrolysate	Casein derived peptide	Reduction of blood pressure	DMV International, the Netherlands
Capolac	Ingredient	Caseinophosphopeptide	Helps mineral absorption	Arla Foods Ingredients, Sweden
PeptoPro	Ingredient/hydrolysate	Casein derived peptide	Improves athletic performance and muscle recovery	DSM Food Specialties, the Netherlands
Vivinal Alpha	Ingredient/hydrolysate	Whey derived peptide	Aids relaxation and sleep	Borculo Domo Ingredients (BDI), the Netherlands