Dietary Proteins and Fiber Beyond Nutrition

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Sources of bioactive proteins/ peptides

- Dairy Products
- Bovine Blood
- Meat
- Eggs
- Fish
- Wheat, Maize, Soy,Rice
- Sorgum
- Mushrooms

Modes of actions

- IGF
- Lactoferrins
- Immunoglobulins / immunomodulating
- Bioactive as part of a large protein molecule
- Anti Hypertensives- inhibiting ACE
- Anti lipidemic
- Osteoprotective
- Anti oxidant
- Anti microbial

Möller, N.P., Scholz-Ahrens, K.E., Roos, N. et al. Eur J Nutr (2008) 47: 171.

Bioavailability

- Released during natural digestion
- In vivo due to microbial enzymes
- Fermentation- enzymes from starter cultures
- Food processing
- Ripening
- Enzyme cleavage sites are different in different processes
- Bioactivity varies from Nil in Intestinal enzyme digestion to mild activity with bacterial enzyme digestion

Absorption

- Bi or Tripeptides directly pass through
- Larger molecules- through receptor binding and transcellular

Immune modulating Proteins

- Whole Casein, α, β, κ
- Whole Whey
- Lactoferrin, Lacto peroxidase

The
immunomodulatory action of
primary milk proteins
is well balanced and may get out of
control after
isolation or neutralisation of
certain components

. Cross ML, Gill HS (2000) Immunomodulatory properties of milk. Br J Nutr 84:S81–S89

The balancing act

- Lactoferrin- stimulates Phagocytic activity in granulocytes
- Glyco macropeptides from κ Casein has inhibitory properties on mouse splenocytes (Otani et al 1992)

- Lactoferrin binds Fe and deprives bacteria from growing
- Directly Microbicidal

Immunomodulatory proteins and peptides

Protein/peptide	Effect
Caseins (and digests)	T-lymphocyte proliferation
Whey	Lymphocyte blastogenesis
GMP	Splenocyte proliferation
YG/YGG	Lymphocyte proliferation
Milk Ig G	Antibody secretion
Lactoperoxidase	T-cell mitogenesis
Lactoferrin	Cytokine release

Möller, N.P., et al
2008

ACE inhibitory (anti hypertensive) actions of some peptides

- α β casein (Yamamoto, Maeno)
- Wheat germ(Matsui)
- Lactalbumin(Mullaly)
- Beef peptide (Okitsu)
- Sunflower (Megias)
- Whey

Osteoprotective Proteins

- Casein
- Casein Phosphopeptides
- Milk basic proteins
- Lactoferrin

Anti Lipemic Proteins

- Protamine
- Globin Digest
- Proteins from wheat
- Defatted Rice Bran
- Fish Protein Hydrolysate

Nutraceutical Bioactive peptides

- Through controlled tryptic digestion
- Synthesized from stable colostrum
- Milk from hyper immunized cattle
- If not properly characterized could cause undesirable effects like Allergies
- Marine Macroalgae a source of bioactive peptides
- Modern Biotechnology may help hyper express beneficial peptides

Dietary Fiber Constituents
Non Starch Poly & Oligosaccharides

Groups	Source
Cellulose	Veg, Brans
Hemi cellulose	β glucan,Arabinoxylans
	Galactomannan
Polyfructose	Inulin
Gum, Mucilages	Guar, Karaya,Psyllium
Pectins	Fruits, Veg,Legumes

Dietary Fiber Constituents 2 Carbohydrate Analogues

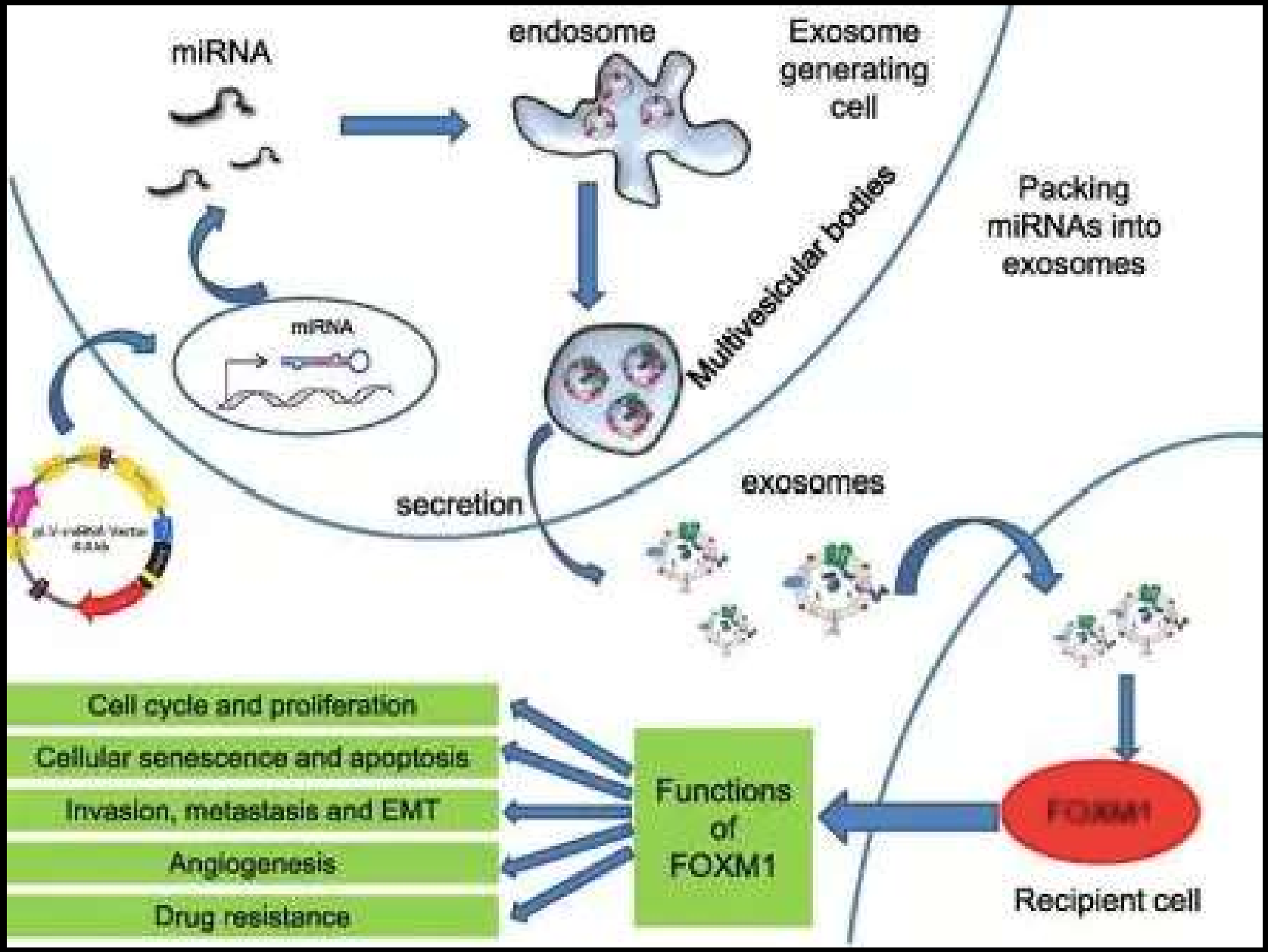
Groups	**Sources**
• Resistant Starch and Malto dextrins	• Maize,Peas, Potatoes
• Chemical Synthetics • Enzymatic Synthetics	• Polydextrose, Lactulose • FOS
• Lignins	Woody Plants
• Animal Origin- Chitin,Chitosan • Collagen, Chondroitin	Fungi,yeasts,Invertebrates

Tungland and Meyer. Comp Rev Food Sci Food safety 2002

Dietary Fiber- Physiological effects

- Satiety
- Hypolipidemic
- Hypocholesterolemic
- Hypocaloric- glucose tolerance
- Pre biotic- Generate SCFA and improve Gut Health
- Increased Water Holding- fecal bulking

Molecular Components in food as bioactive substances


miRNA
endosome
Exosome generating cell
Packing miRNAs into exosomes
Multivesicular bodies
miRNA
secretion
exosomes
Cell cycle and proliferation
Cellular senescence and apoptosis
Invasion, metastasis and EMT
Angiogenesis
Drug resistance
Functions of FOXM1
FOXM1
Recipient cell

Extracellular vesicles (EVs) in milk harbor a variety of compounds, including lipids, proteins, noncoding RNAs, and mRNAs.

Exosomes play essential roles in cell-to-cell communication.

Zempleni et al J Nutrition 2017

- Encapsulation in exosomes confers protection against enzymatic and nonenzymatic degradation of cargos and provides a pathway for cellular uptake of cargos by endocytosis of exosomes.

- Exosomes in bovine milk are transported by intestinal cells, vascular endothelial cells, and macrophages in human and rodent cell cultures, and bovine-milk exosomes are delivered to peripheral tissues in mice.

Evidence also suggests that cargos in bovine-milk exosomes, in particular RNAs, are delivered to circulating immune cells in humans.

Some microRNAs and mRNAs in bovine-milk exosomes may regulate the expression of human genes and be translated into protein, respectively.

- Low concentrations of dietary microRNAs may alter gene expression, such as the accumulation of exosomes in the immune cell microenvironment and the binding of microRNAs to Toll-like receptors.

- Phenotypes observed in infant-feeding studies include higher Mental Developmental Index, Psychomotor Development Index, and Preschool Language Scale-3 scores in breastfed infants than in those fed various formulas.

Cavalieri, D. et al. Plant microRNAs as novel immunomodulatory agents. Sci. Rep. 6, 25761; doi: 10.1038/srep25761 (2016).

Thank you