



# Colostrum Scientific Overview

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PanTheryx



# Introduction to Colostrum

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# More Than Just A Mother's Love...

## A Mother's Colostrum Prepares Her Baby For The World Around Her or Him

- Transfers immunity from mother to child
- Helps in the development of the immune and gut systems
- Strengthens the intestinal barrier to help keep pathogens out and improve digestion
- Supports healthy gut bacteria (probiotics) and reduces bad bacteria and viruses (pathogens)

The same holds true for all mammals, including dairy cows

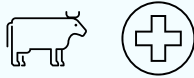


# Harnessing The Benefits of Colostrum for All Ages

**Colostrum from dairy cows enables us to harness the benefit of colostrum across the lifespan**



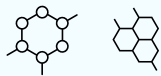
Completely natural product, produced by nature and meant to nurture



Calf receives all the colostrum it needs



Excess colostrum is collected and dried into a powder




Many bioactive components to provide an array of benefits



Supports immune and digestive health, sports nutrition and more

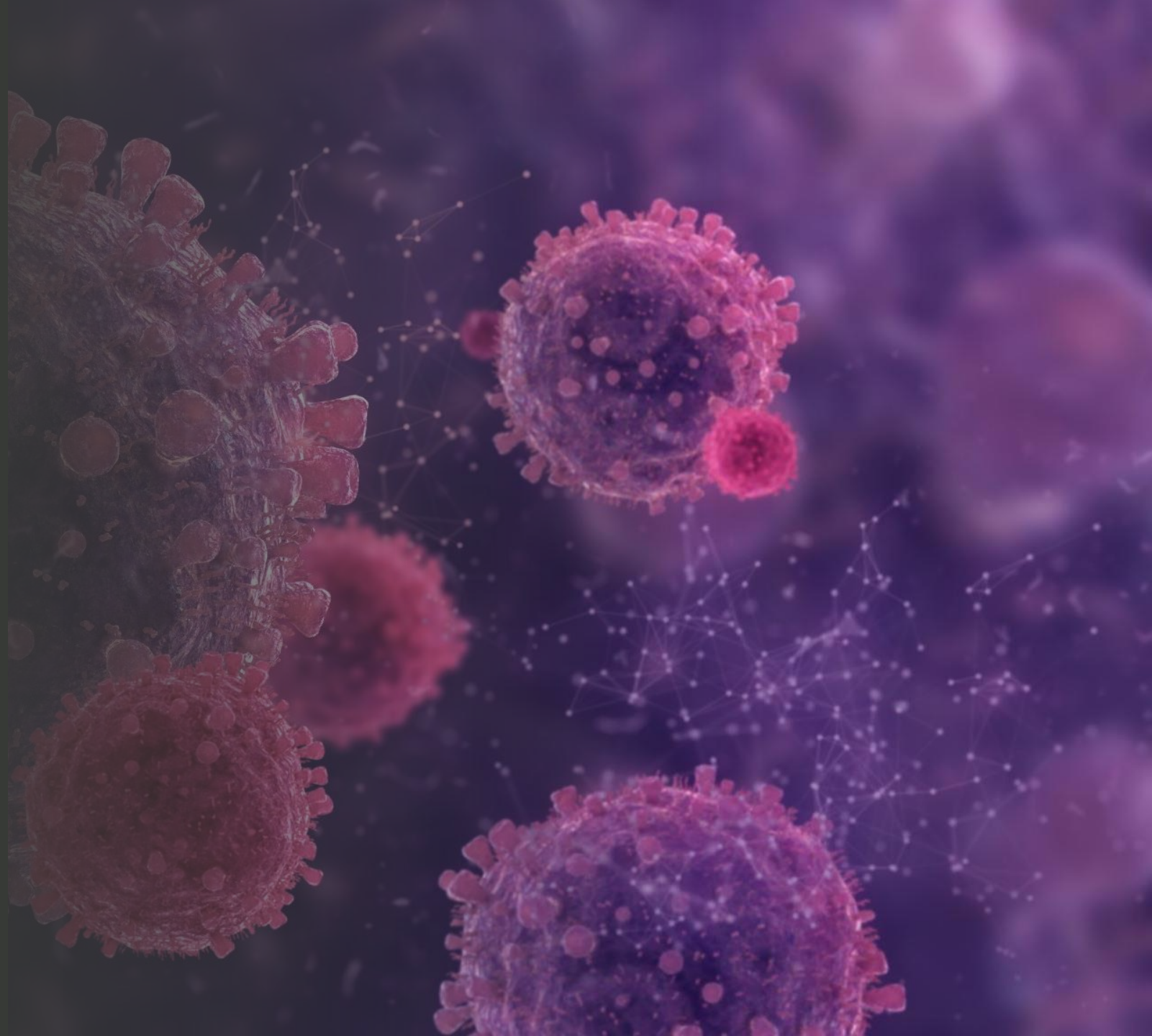




# Activity of Bioactive Components

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# Dairy Colostrum is a Powerhouse of Components

**Unlike traditional prebiotics and probiotics....**

**Dairy Colostrum contains over**

# 250

**Characterized  
Functional  
Beneficial  
Bioactive Components**

Including immunoglobulins, growth factors, oligosaccharides, immune factors, and more

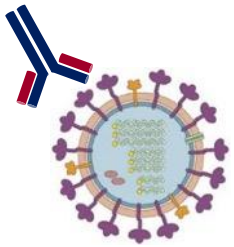




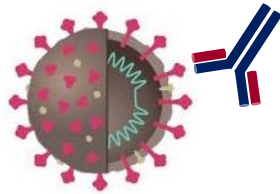
# Activity for Immunity

## Immunoglobulins

Bovine immunoglobulins have shown binding activity against a wide range of pathogens



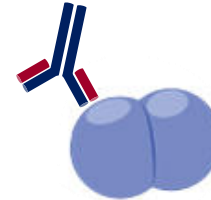
*Influenza*



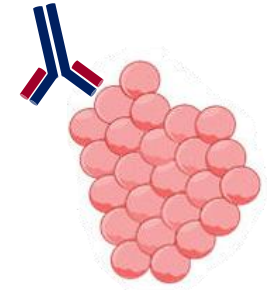
*Coronaviruses*



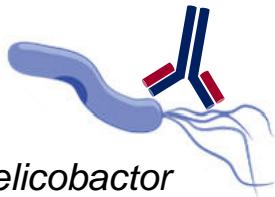
*Rotavirus*



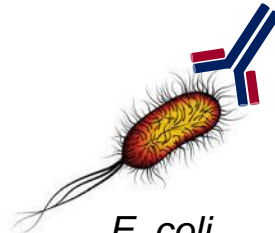
*Streptococcus pneumoniae*



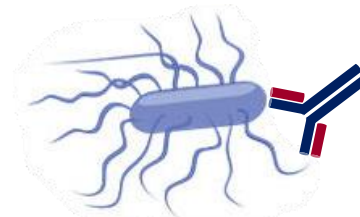
*Staphylococcus*



*Helicobacter pylori*



*E. coli*



*Salmonella*

And others including:  
*Candida albicans*, *Campylobacter*,  
*Cryptosporidium*, *Pseudomonas*,  
and *Enterobacter*

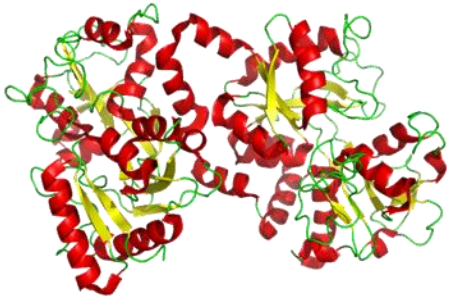




# Activity for Immunity

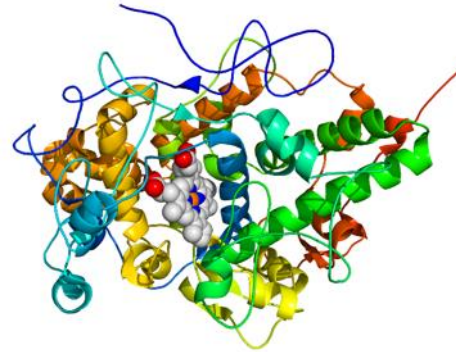
## Immune Factors

### Lactoferrin



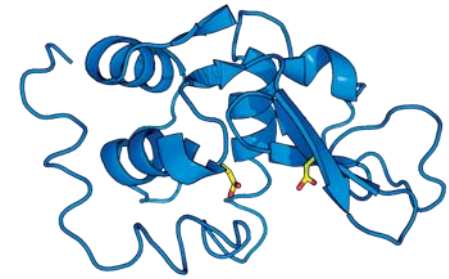
- Glycoprotein, antiviral and antibacterial
- Inhibits growth of E. coli, Salmonella, Listeria, Streptococcus, Giardia
- Blocks viruses from entering cells via binding cellular receptors or direct binding to viruses
- Antiviral against Rotavirus, RSV, herpes, Hepatitis B and C, HPV, HIV, and others

### Lactoperoxidase



- Enzyme with antibacterial functions
- Toxic to a wide array of bacteria via production of reactive oxygen species including hydrogen peroxide
- Inhibits bacterial metabolism

### Lysozyme



- Enzyme with antibacterial functions
- Utilizes bacterial cell wall as an enzymatic substrate causing bacterial cell lysis and death

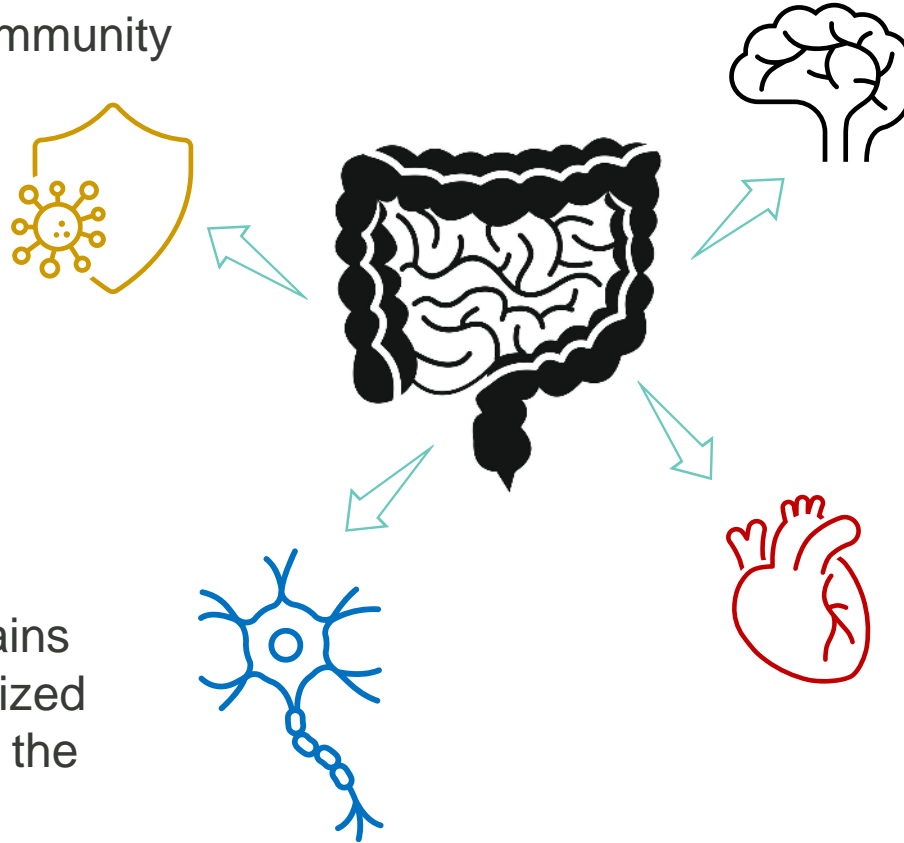




# The Health of Your Gut Impacts Your Entire Body

**Immune** – more than 70% of the immune system is in the gut which directly and indirectly impacts immunity outside the gut (whole body)

**Brain** – the gut communicates directly and indirectly with the brain and can affect brain inflammation, mood, and more



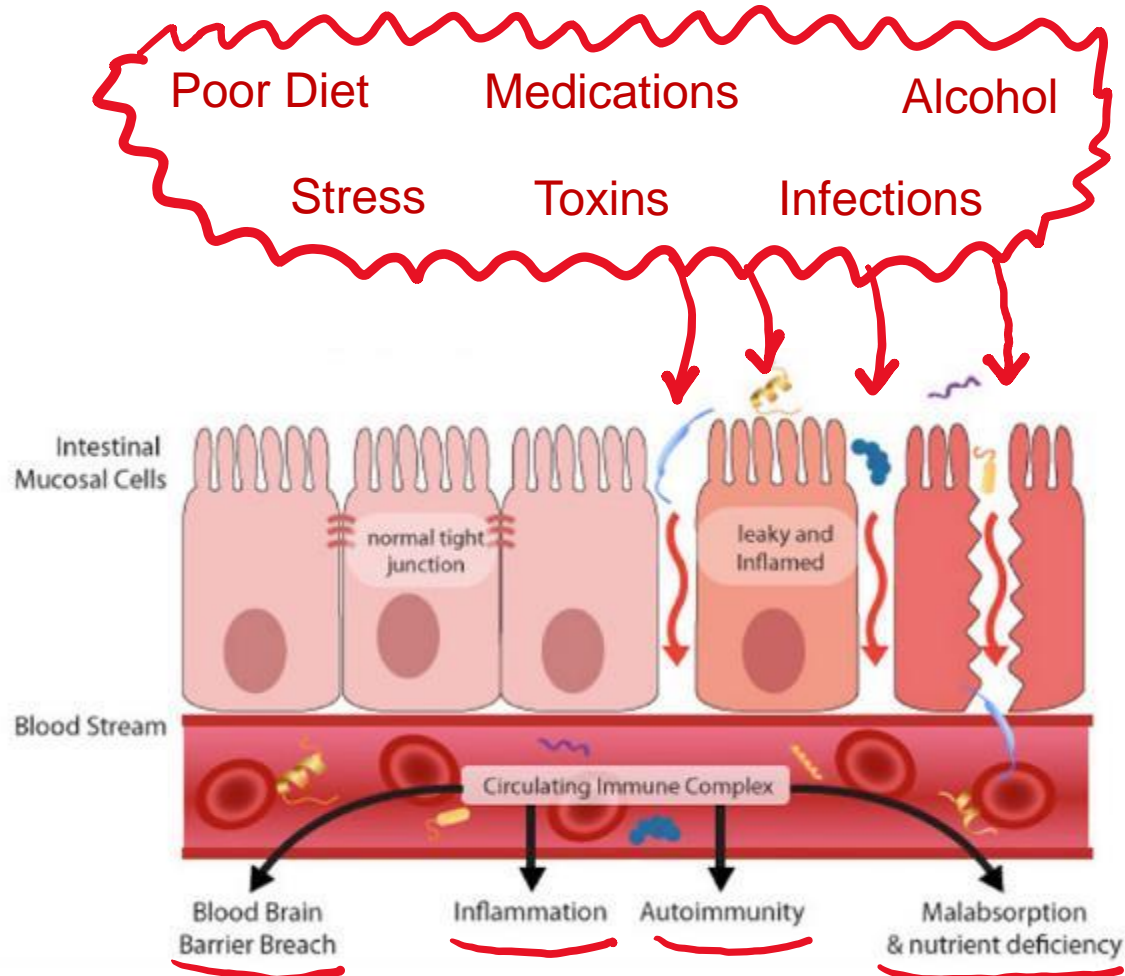
**Nervous system** – the gut contains 100-500 million neurons (specialized communication cells), more than the spinal cord, some call the gut a “**second brain**”

**Heart** – beneficial microbiota can affect things like good cholesterol (HDL) levels



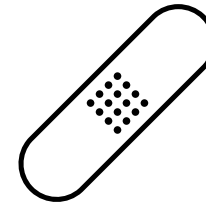
# Colostrum Growth Factors Can Help Heal The Gut

## A Permeable (Leaky) Gut is Caused By Many Factors



## Colostrum Contains Growth Factors

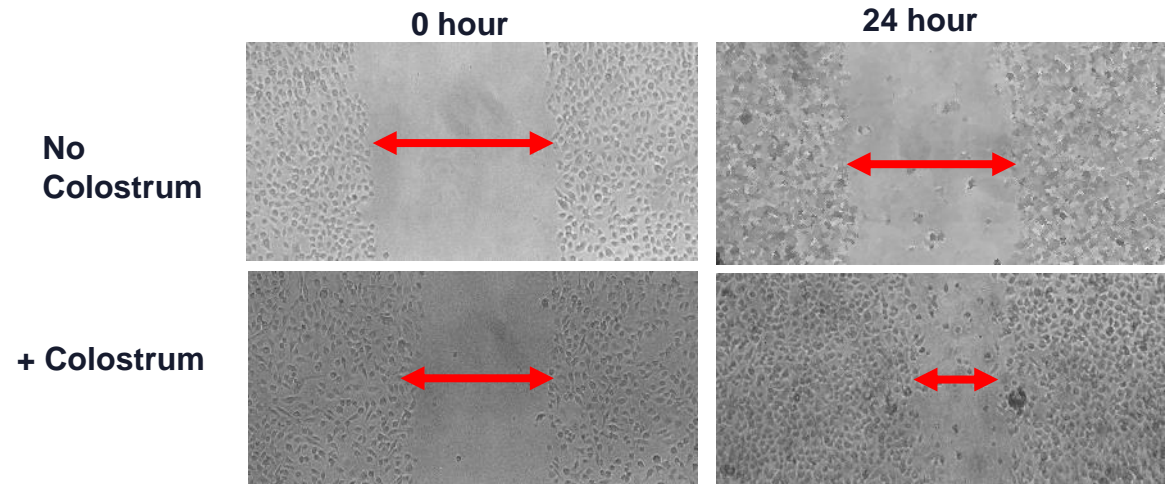
Can help protect and heal the intestinal barrier



**EGF** – Epidermal Growth Factor

**IGF** – Insulin-Like Growth Factor  
and more...

**Study:** Colostrum from dairy cows speeds up closure of a wound in an intestinal cell model



Playford and Weiser. Nutrients (2021).13(1):265



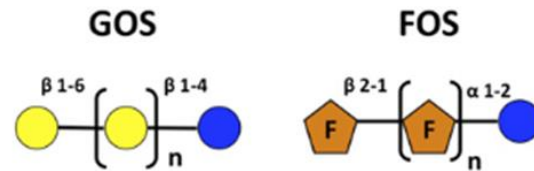
# Colostrum Oligosaccharides Can Act as Prebiotics

## Traditional Prebiotics

Simple structure, have health benefits, but can have side effects (discomfort)

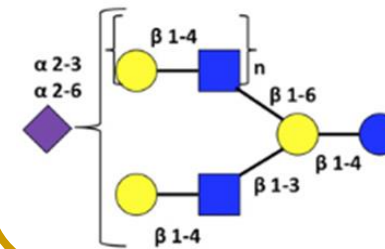
### Traditional Prebiotics

Galacto- and Fructo-oligosaccharides



### CCO

Cow Colostrum Oligosaccharides



### Cow Colostrum Oligosaccharides

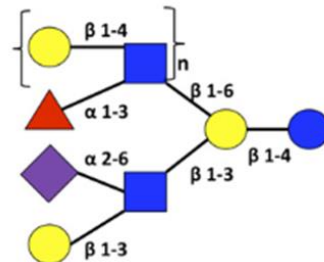
Complex oligosaccharides that have similarities to Human Milk Oligosaccharides (HMO)

### Human Milk Oligosaccharides

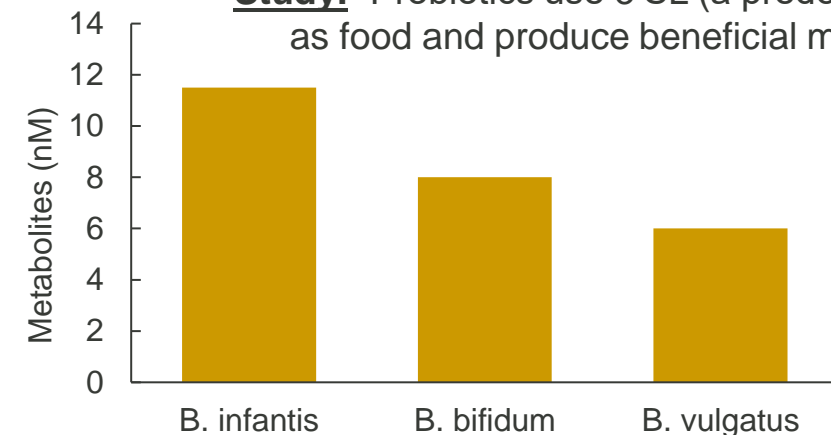
Complex structures that feed beneficial microbes in the infant gut (like *Bifidobacterium infantis*)

### HMO

Human Milk Oligosaccharides



**Study:** Probiotics use 3'SL (a predominant CCO) as food and produce beneficial metabolites



Moon, J. S., et al. J. Func. Foods 21 (2016): 497-506

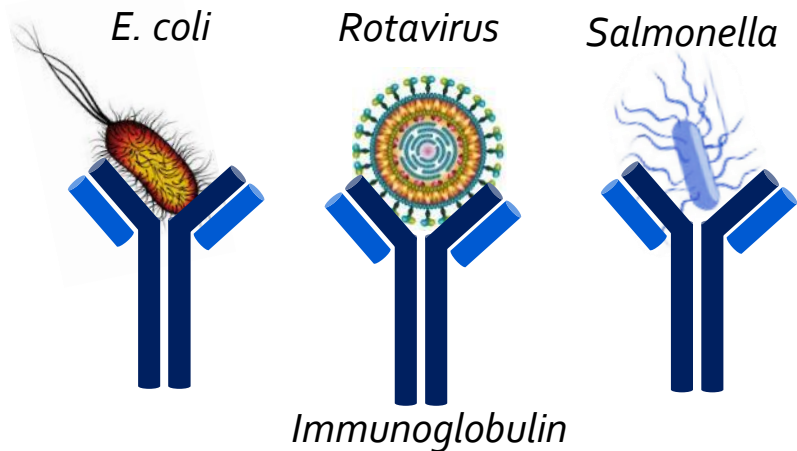




# Colostrum Immunoglobulins Improve Intestine Environment

## Colostrum Immunoglobulins

Can bind to pathogens in the intestine



Reducing likelihood of infection



Allowing probiotics to have more resources (food)

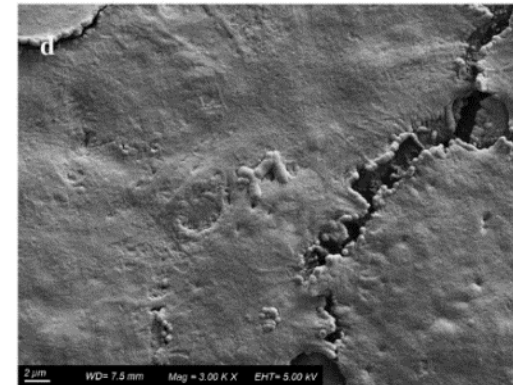


Helping to establish a good balance of bacteria

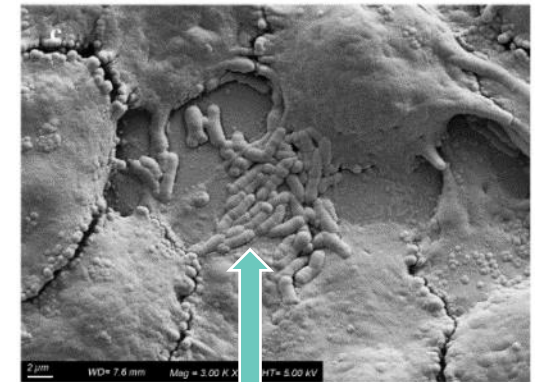
## Colostrum Immunoglobulins

Can help probiotics adhere to the intestinal wall

Control



+ Immunoglobulin



Probiotic attached  
to intestinal cells



They likely support more successful  
colonization of probiotics

Morrin ST, et al. *AMB Express*, 2020: 10(1), 1-10.



# Colostrum Can Support Probiotics

**Immunoglobulins  
Growth Factors**



Help create ideal  
intestinal environment

**Oligosaccharides  
Glycoproteins**

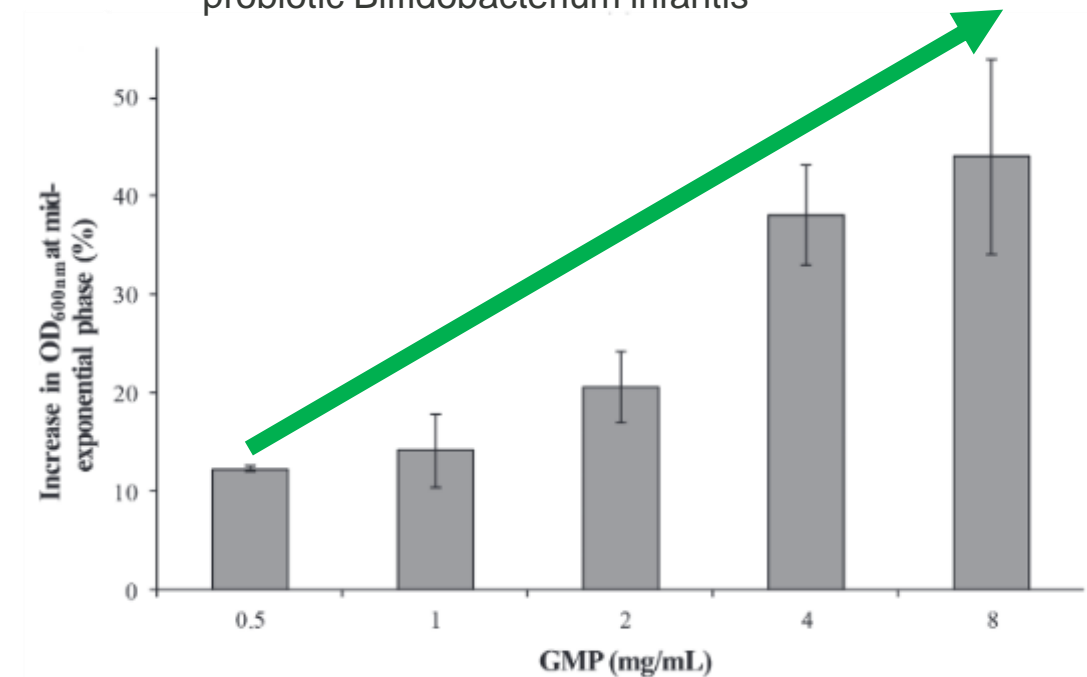


Help to feed and  
promote probiotic growth

**Study:** Colostrum from dairy cows increases the growth of many different types of probiotic strains

Strain	Col OD <sub>max</sub> <sup>†</sup>
<i>Pediococcus acidilactici</i> RBL39	↑
<i>Pediococcus acidilactici</i> R1001	↑
<i>Lactobacillus lactis</i> RBL22	↑
<i>Lactobacillus helveticus</i> R0052	↑
<i>Lactobacillus helveticus</i> R0389	↑
<i>Bacillus subtilis</i> R0179	NE
<i>Enterococcus faecium</i> R0026	↑
<i>Lactobacillus rhamnosus</i> R0011	↑
<i>Lactobacillus rhamnosus</i> GG	↑
<i>Lactobacillus rhamnosus</i> RW-9595M	↑
<i>Bifidobacterium lactis</i> BB12	↑
<i>Bifidobacterium longum</i> R0175	↑

**Study:** Colostrum glycoprotein (GMP) promotes the growth of probiotic *Bifidobacterium infantis*

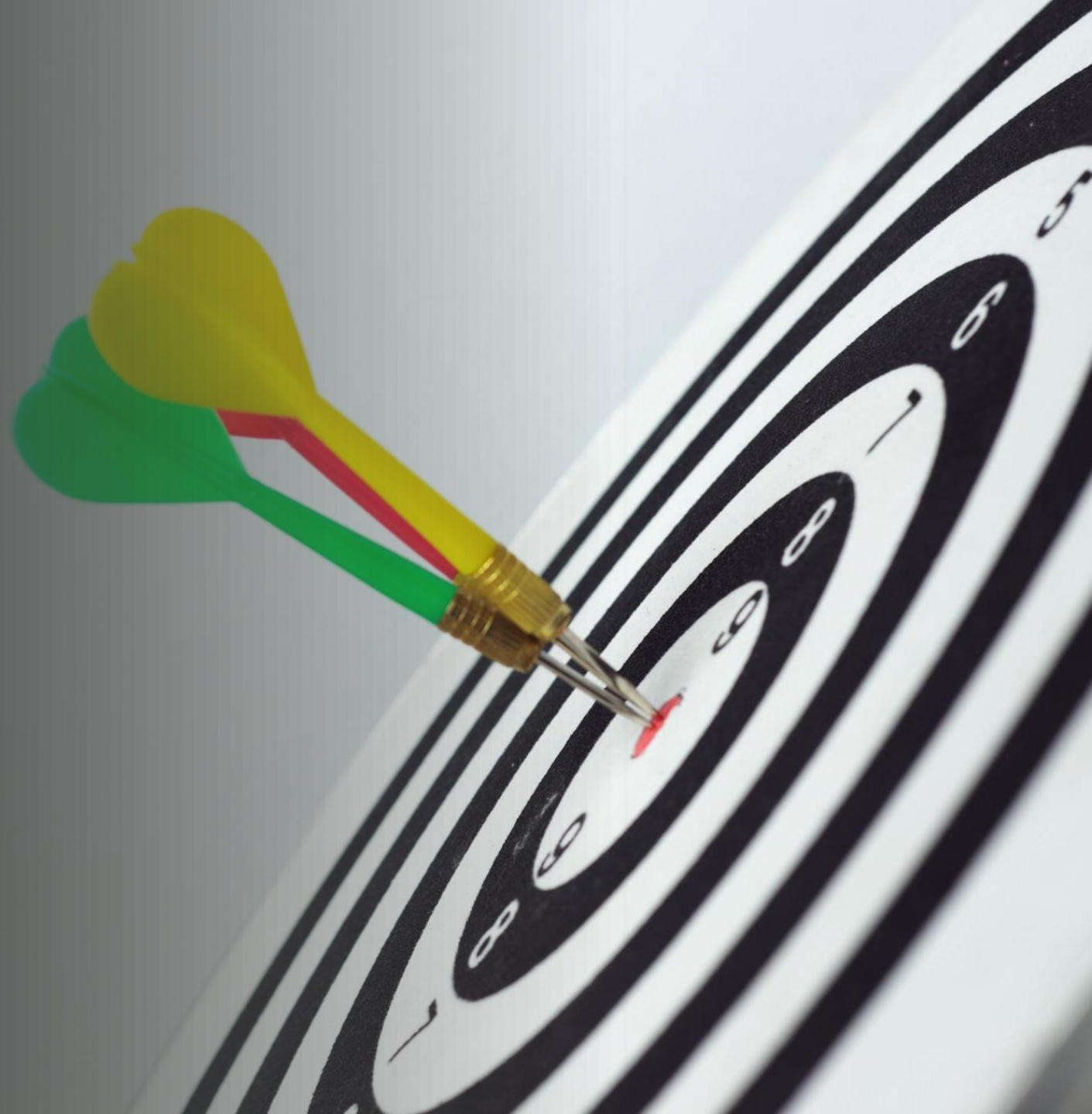


Champagne, C. P., et al. *Can. J. Microbiol.* 60.5 (2014): 287-295.

O'Riordan, Noelle, et al. *Journal of dairy science* 101.8 (2018): 6730-6741.

# Clinical Overview Summary

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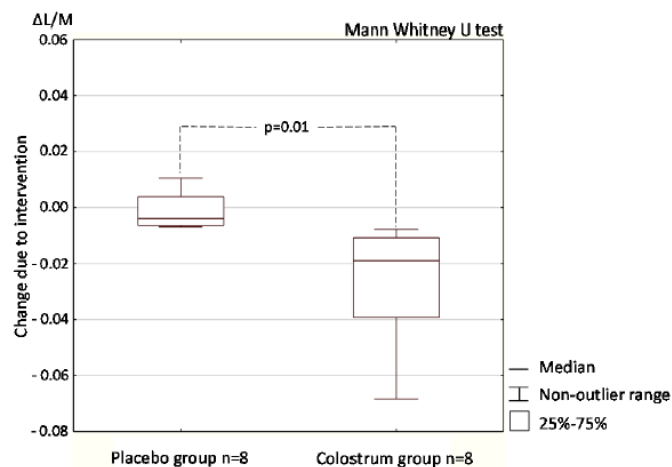




# Clinical Dose Examples

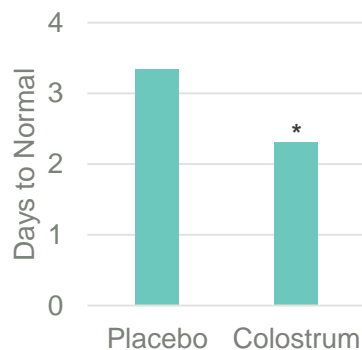
Health Benefit	Adults	Children
Digestive Health	1 g	750 mg
Immune Health	400 mg	500 mg
Development (growth)	N/A	560 mg
Sports performance	3.2 g	N/A

## Digestive Health



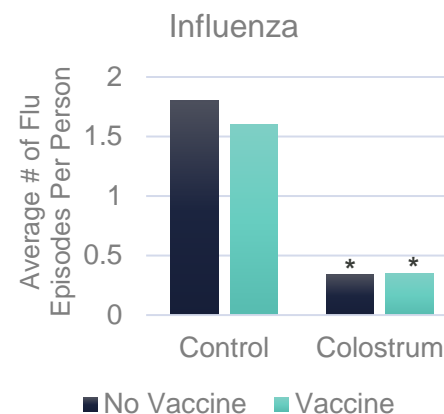
Halasa 2017: 1g/d BC for 20 days decreases intestinal permeability in adult athletes with an elevated baseline intestinal permeability

## Stool Frequency

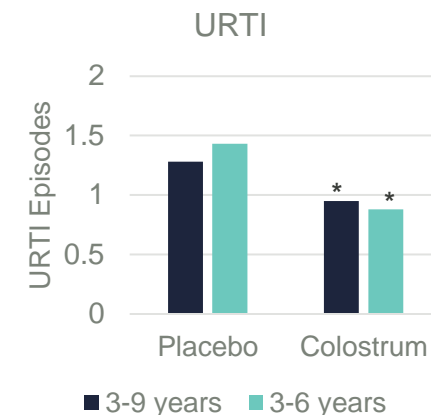


Suwarba 2006: 750mg/d BC for 1-week in toddlers with acute diarrhea decreased recovery time to normal stool frequency and consistency

## Immune Health

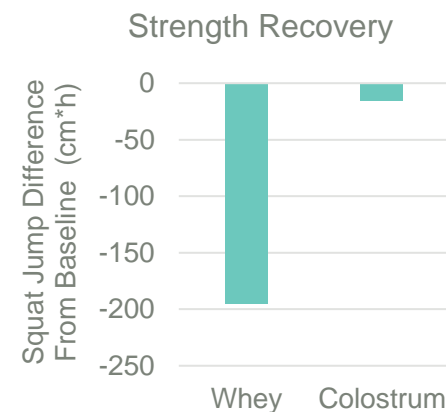


Cesarone 2007: 400mg/d BC in healthy adults decreases flu episodes and relative costs across a 2-month period



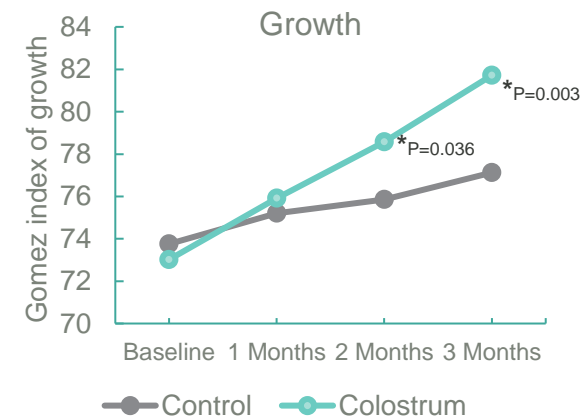
Uchida 2010: 500mg/d BC in healthy 3-9-year-olds decreases URTI episodes and URTI days across 8-week period

## Sports Performance



Kotsis 2018: 3.2g/d BC in adult soccer players for 8-weeks improved strength recovery immediately following intense physical challenge

## Development



Panahi 2010: 560mg/d BC (average) in 1-10-year-olds undersized for age increased growth rate across 3-month period



# Immune Health

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# Clinical Evidence: Immune Health



## Upper Respiratory Tract Infections (URTI)

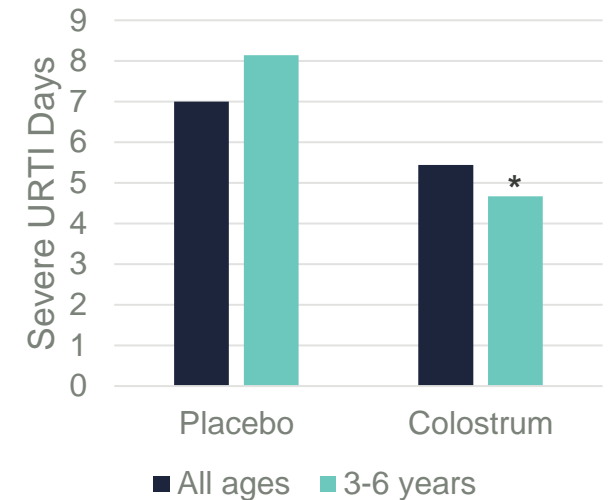
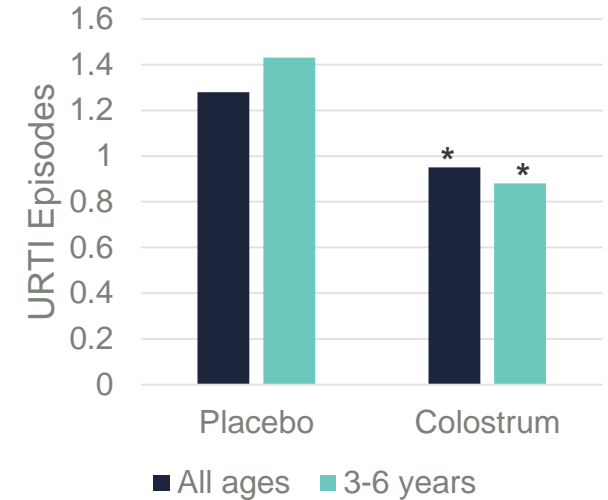
### Study

- **Children 3 year to 9 years old**
- 195 participants
- Normal healthy children
- Double-blind, placebo controlled randomized trial
- Milk powder placebo
- **Received 500 mg bovine colostrum per day for 8 weeks**

### Results

Compared to placebo controls:

- After 8 weeks consuming bovine colostrum
  - **Lower mean URTI episodes**
  - **Fewer days with severe URTI symptoms**





# Clinical Evidence: Immune Health



## Upper Respiratory Tract Infections (URTI) and Diarrhea

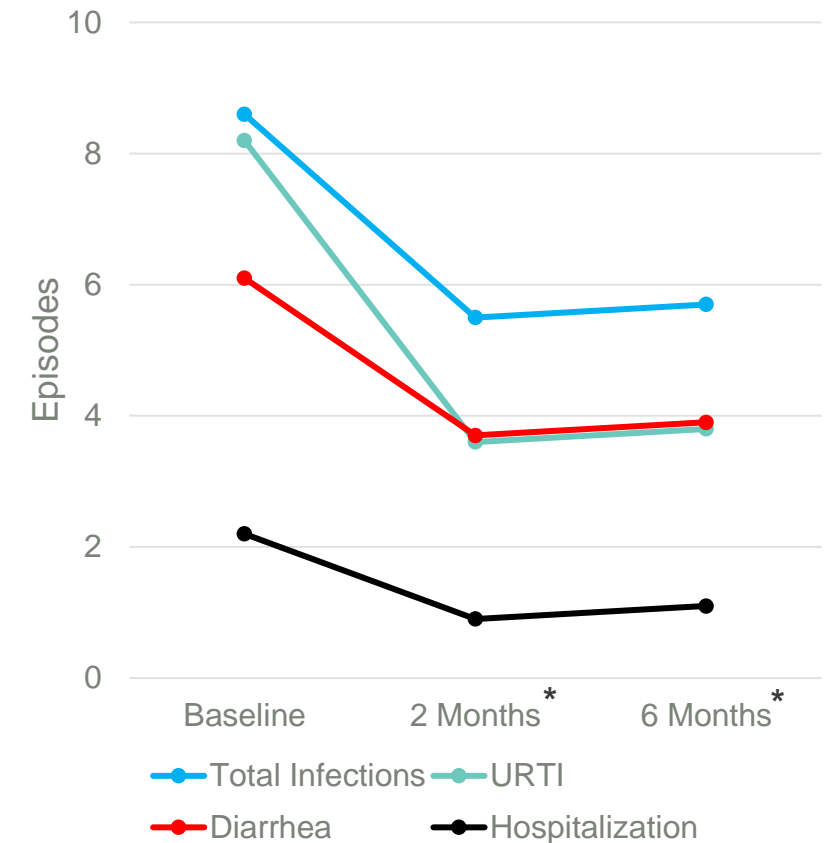
### Study

- **Children 1 year to 6 years old**
- 160 participants
- Had recurrent URTI and/or diarrhea
- Open label, multicenter
- **Received bovine colostrum 3g (<2 y) or 6g (>2 y) per day for 6 months**

### Results

Compared to intra-individual baseline:

- After 2 months consuming bovine colostrum
  - **Lower total infections**
  - **Lower URTI episodes**
  - **Lower diarrhea episodes**
  - **Less hospitalizations**
- After 6 months consuming bovine colostrum
  - **All measures still significantly lower No regression to baseline levels**



\* Significant difference  $P < 0.05$  vs baseline

# Clinical Evidence: Immune Health

## Upper Respiratory Tract Infections (URTI) and Diarrhea

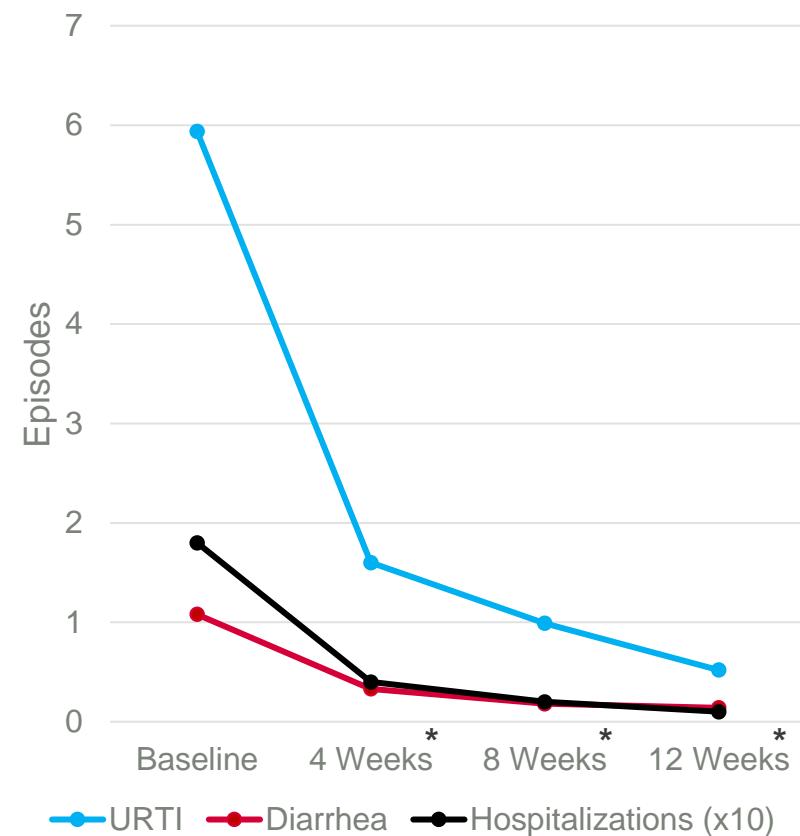
### Study

- **Children 1 year to 8 years old**
- 605 participants
- Had recurrent URTI and/or diarrhea
- Open label, multicenter
- **Received 3g bovine colostrum per day for 12 weeks**

### Results

Compared to intra-individual baseline:

- **Reduction in number of URTI episodes**
  - 73% by week 4
  - 83% by week 8
  - 92% by week 12
- **Reduction in number of diarrhea episodes**
  - 70% by week 4
  - 83% by week 8
  - 87% by week 12
- **Reduction in number of hospitalizations**
  - 76% by week 4
  - 89% by week 8
  - 92% by week 12



\* Significant difference  $P < 0.05$  vs baseline

Patel K et al (2006). *Indian Journal of Pediatrics*, 73(7): 585-591

# Clinical Evidence: Immune Health

## Influenza

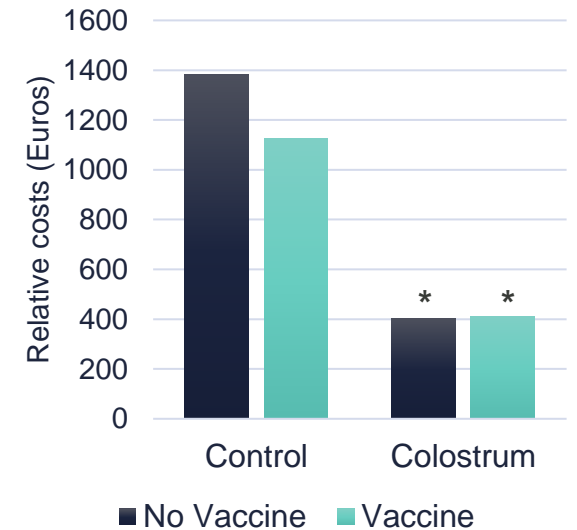
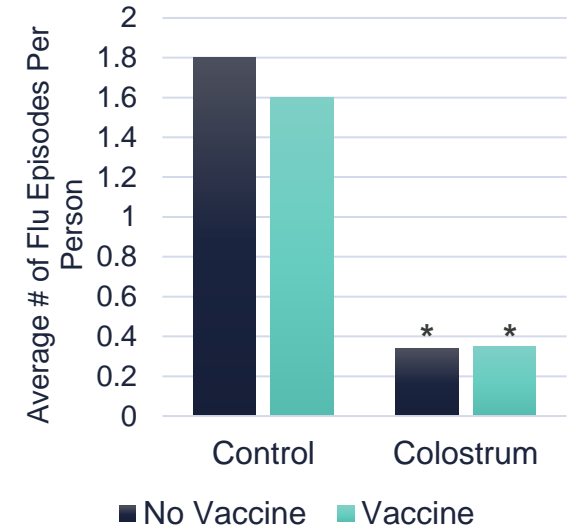
### Study

- **Adults 30 to 80 years old**
- 144 participants
- Normal healthy adults
- Participants placed into four groups:
  - no vaccine and no colostrum
  - no vaccine plus colostrum
  - vaccine but no colostrum
  - vaccine plus colostrum
- **The colostrum groups consumed 400mg of bovine colostrum per day for 2 months**

### Results

Compared to control group

- After 2 months consuming bovine colostrum
  - **Reduced number of flu episodes**
  - **Reduced relative costs**
- **Bovine colostrum was more effective than the influenza vaccine**



Cesarone et al (2007). *Clinical and Applied Thrombosis/Hemostasis*, 13(2): 130-136



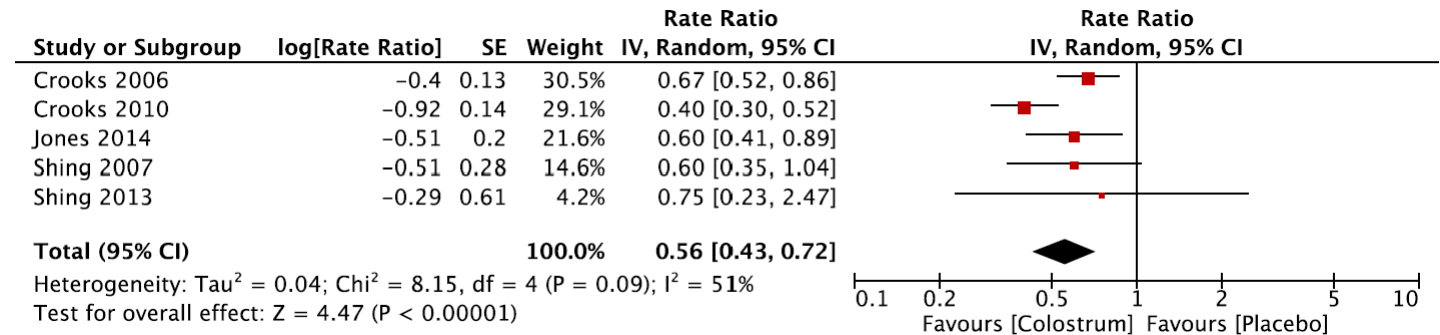


## Bovine colostrum supplementation and upper respiratory symptoms during exercise training: a systematic review and meta-analysis of randomised controlled trials

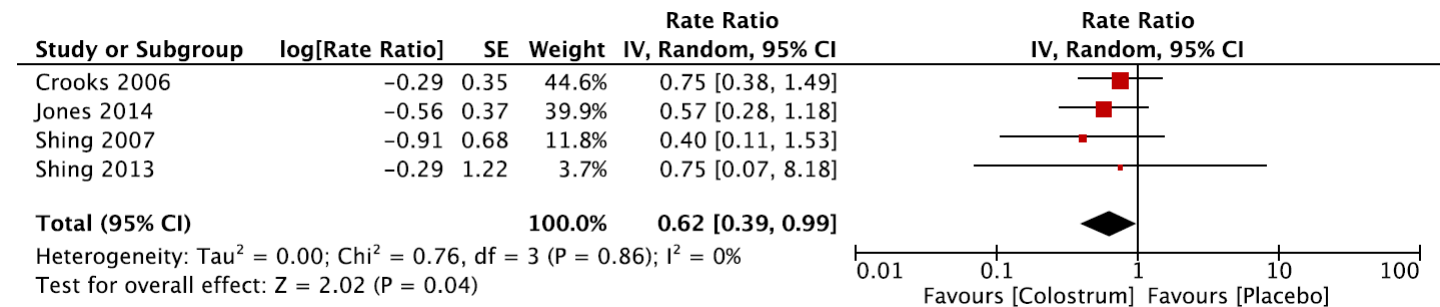
Arwel W. Jones<sup>1\*</sup>, Daniel S. March<sup>2</sup>, Ffion Curtis<sup>1</sup> and Christopher Bridle<sup>1</sup>

- Meta-analysis of studies with adult participants undergoing exercise training
- Strict inclusion requirements, only 5 out of 22 eligible studies made the cut
- Exercise training included running, swimming, cycling, and general cardiovascular and weight training
- Dosing ranged from 10-20 grams of bovine colostrum, and length ranged 8-12 weeks long
- **Pooled analyses revealed a significant decrease in days with URTI symptoms ( $P < 0.00001$ ) and number of URTI episodes ( $P < 0.05$ )**

### Days with Upper Respiratory Tract Infection



### Upper Respiratory Tract Infection Episodes



Jones et al. BMC Sports Science, Medicine and Rehabilitation (2016) 8:21



# Digestive and Gut Health

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# Clinical Evidence: Gut Health

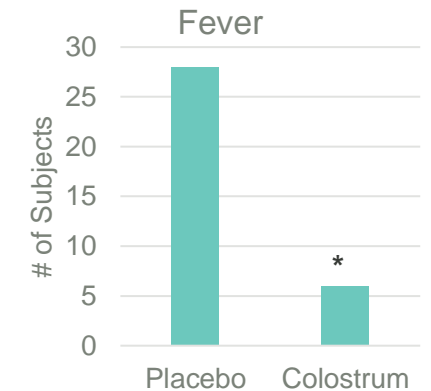
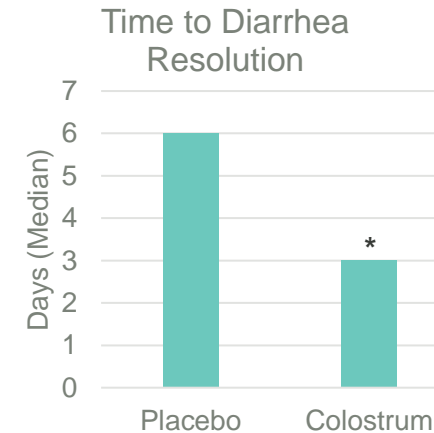
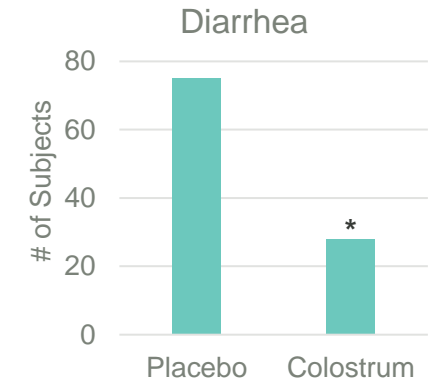
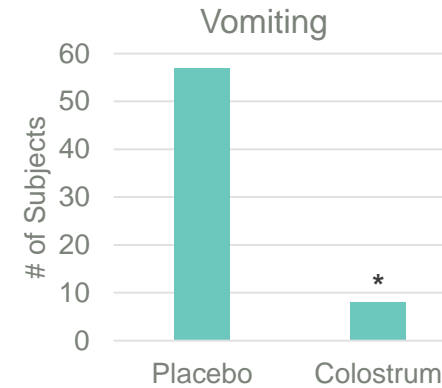
## Acute Diarrhea

### Study

- **Infants and toddlers age 6 to 24 months**
- 160 total subjects, 80 per group
- Double blind, randomized controlled trial
- Diagnosed with a case of acute diarrhea
- **All received 3g per day of bovine colostrum for 1 week**

### Results

- After 48 hours of bovine colostrum, **the number of individuals with vomiting, diarrhea, and/or fever were significantly lower** than the placebo group
- Over the 1-week trial, bovine colostrum **significantly reduced the time to disappearance of all symptoms**



Barakat et al (2020). Journal of Tropical Pediatrics, 66(1):46-55.



# Clinical Evidence: Gut Health

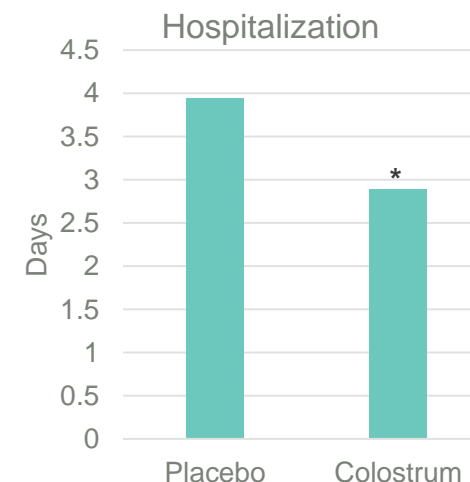
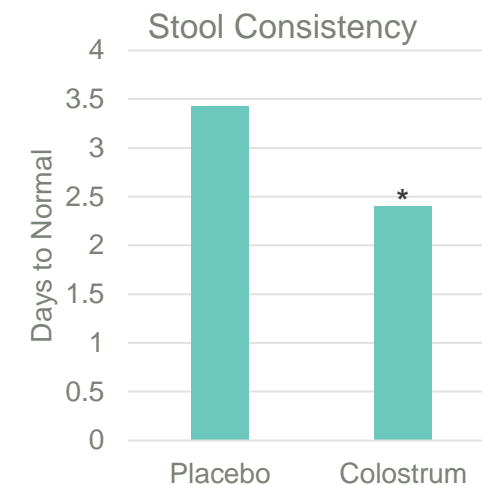
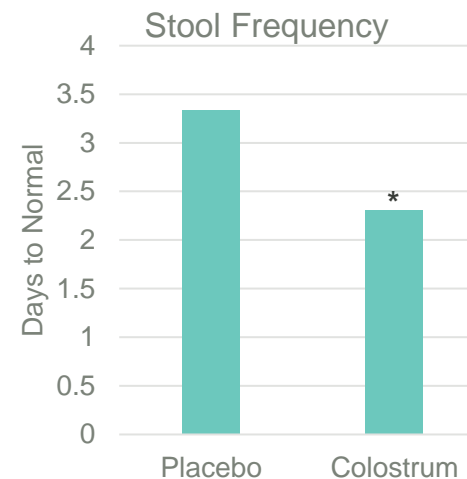
## Acute Diarrhea

### Study

- **Infants and toddlers age 6 to 24 months** (mean 10.9)
- 70 total subjects, 35 per group
- **Diagnosed with a case of acute mild-intermediate diarrhea**
- Double blind, randomized controlled trial
- **All received 750 mg per day of bovine colostrum for 1 week**

### Results

- Infants and toddlers on bovine colostrum **recovered significantly faster from acute diarrhea as measured by stool frequency and stool consistency** compared to the placebo group
- Consumption of bovine colostrum **significantly reduced the overall hospital stay length** compared to the placebo group



Suwarba et al (2006). Paediatrica Indonesiana, 46(5-6):127-133

\*P<0.001 vs placebo

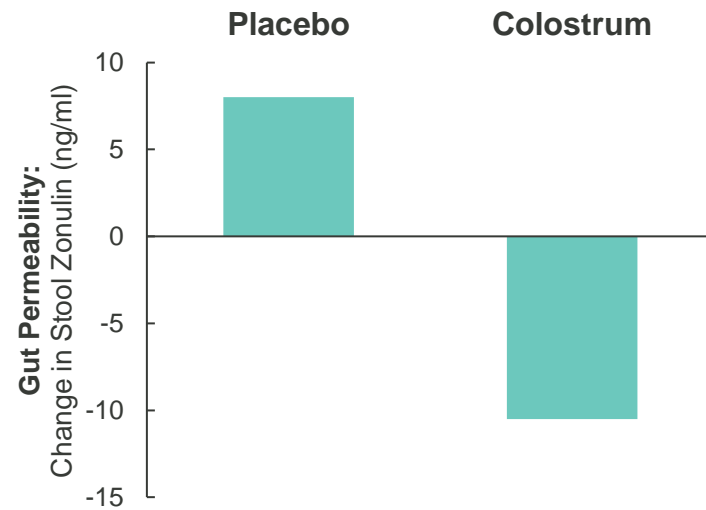




# Colostrum Gut Health Clinical Evidence Snapshot

## Clinical Study:

- Healthy adult athletes
- 1g/d Colostrum for 20 days
- Reduced intestinal permeability *reduced “leaky gut”*



Halasa et al (2017). *Nutrients*, 9(4):370

## Clinical Study:

- Healthy adult athletes
- 1g/d Colostrum for 20 days
- Reduced intestinal permeability only with first day milking  
*Resulted in reduced “leaky gut”*

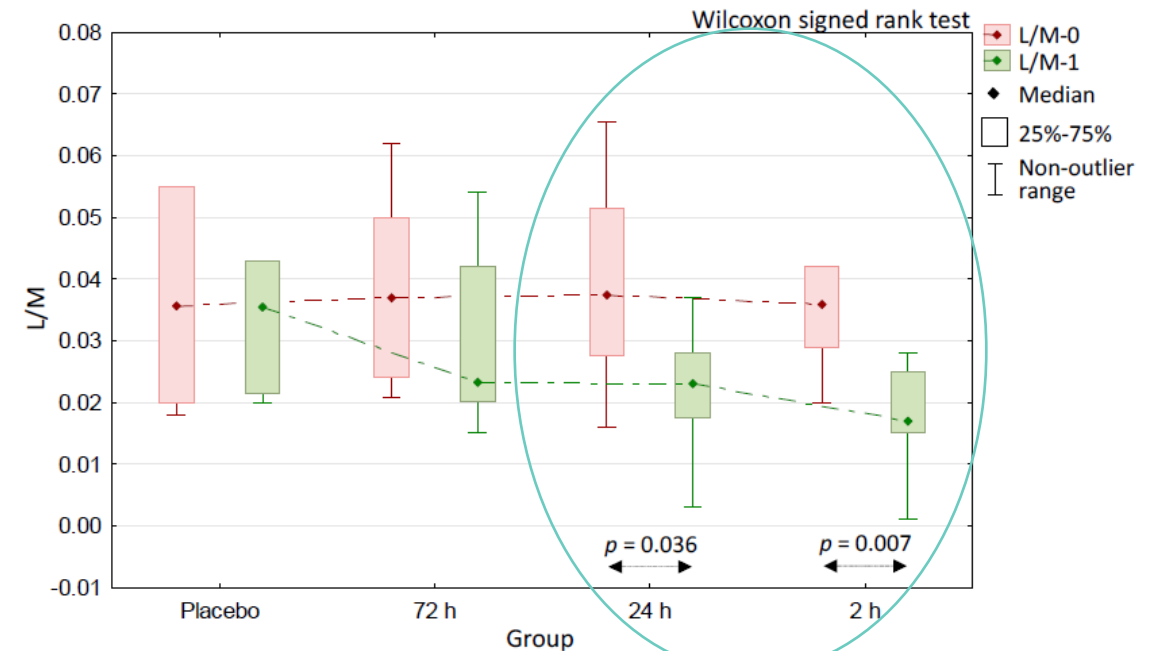


Figure 2. Comparison of lactulose/mannitol differential sugar absorption test results obtained before (L/M-0) and after (L/M-1) 20 days of supplementation with whey (placebo) and colostrum milked at 72 h, 24 h, and 2 h time points after delivery.

Halasa et al (2020). *Medicina*, 56, 495



# Developmental Growth

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# Clinical Evidence: Developmental Growth

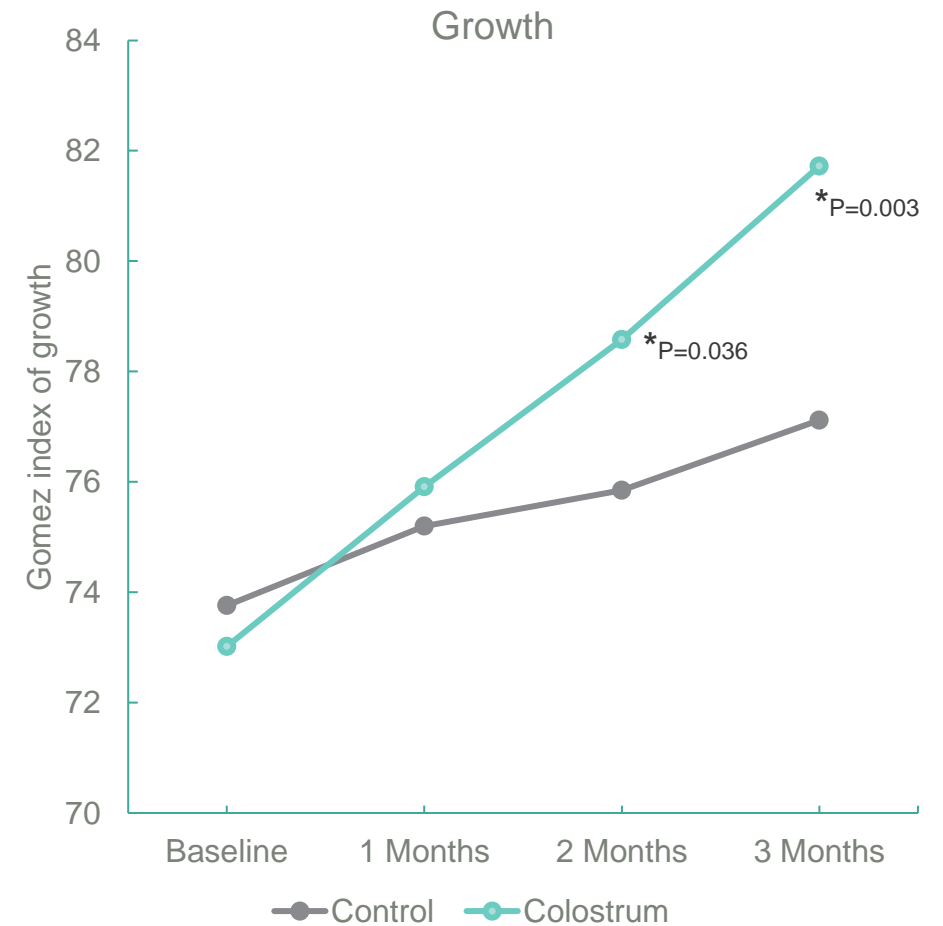
## Study

- **Children 1 year to 10 years old**
- 120 participants
- Mild or moderate unexplained failure to thrive
- 85-95% of 50th percentile for height
- 60-90% of 50th percentile for weight
- Participant blinded, randomized trial
- **Half received 40 mg bovine colostrum per kg body weight daily for 3 months**

## Results

Compared to control:

- After 2 months consuming bovine colostrum
  - **Faster growth rate**
- After 3 months consuming bovine colostrum
  - **Faster growth rate**





# Sports Performance

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# Clinical Evidence: Sports Performance

First Author	Year	Population	Sample Size	Intervention	Duration	Main Outcomes
Kotsis	2018	Soccer players (4-5 sessions per week + one match)	Total: 22 Control: 11 Colostrum: 11	Control: 3.2g of WPC <b>Tx: 3.2g BC</b> Specific training program plan 3-days pre- and 4-days post-LIST	6 weeks	<b>Squat jump height: BC &gt; CON</b> <b>Countermovement jump height: BC &gt; CON</b> <b>CRP: BC &lt; CON, IL-6: BC &gt; CON</b>
Antonio	2001	18-35 yo males and females Already on resistance training min 3x per week	Total: 20 Control: 11 Colostrum: 9	Control: 20g of WPC <b>Tx: 20g BC</b>	8 weeks	<b>Lean body mass: BC &gt; BC baseline (2.3%, 1.5kg)</b>
Buckley	2002	18-35 yo males Already participating in regular physical activity	Total: 30 Control: 13 Colostrum: 17	Control: 60g of WPC <b>Tx: 60g BC</b> 8 weeks of endurance running Nutrition plan	8 weeks	<b>Second bout running performance: BC &gt; CON (+0.3 mph)</b>
Buckley	2003	18-35 yo males Already doing regular physical activity	Total: 51 Control: 26 Colostrum: 25	Control: 60g of WPC <b>Tx: 60g BC</b> 8 weeks resistance and plyometric training	8 weeks	<b>Peak anaerobic cycling power: BC &gt; CON</b> <b>Max vertical jump: BC &gt; CON</b>
Duff	2014	Males (59.1 +/- 5.4y) and Females (59.0 +/- 6.7y)	Total: 40 Control: 21 Colostrum: 19	Control: 60g of WPC <b>Tx: 60g BC</b> 8 week resistance training program	8 weeks	<b>Leg press 1-RM strength: BC &gt; CON (21% vs 5% improvement)</b> <b>Bone resorption marker (N-telopeptides): BC &lt; CON</b>
Jones	2016	Meta-analysis and systematic review Clinical studies on athletes with UTRI endpoints	5 studies met inclusion criteria	<b>10g to 20g of BC</b>	8, 10, or 12 weeks	<b>URS days: BC &lt; CON</b> <b>URS episodes: BC &lt; CON</b>

# PANTHERYX

