Components of Colostrum-LD® Powder and their Physiological Benefits

Understanding the benefits of bovine colostrum and what it does within the body involves looking at the individual components. Of the more than 280 identified individual components, no isolated component is as effective as the total. That being said, some of the most important components are the immunoglobulins and antibodies, in light of the enormous impact of gut-based pathogens and diarrhea on health around the world. The most serious and deadly gut-based infections we face today include: E Coli, Salmonella, Clostridium Difficile, Shigella, Campylobacter, Staphylococcus, Yersinia, Rotavirus, and Giardia. Antibodies against these pathogens and thousands others, including bacteria, viruses, protozoans and fungi, have been identified in bovine colostrum.

The means by which pasture-fed dairy cows express antibody-rich colostrum is their exposure from the soil-based and gut-based pathogens occurring naturally in the grasses they eat and from human contact. Cows produce antibodies to diseases that they do not contract, so they are considered universal donors. Not only does a cow’s colostrum contain antibodies she herself has produced, but also antibodies from her maternal lineage. She’s like a “walking pharmaceutical factory” and with her array of antibodies, humans can benefit by one of two ways. First, by drinking fresh, raw colostrum and milk on a daily basis, as once was done when every family had a cow or access to one. Second, by supplementing the diet with commercially processed, dried, pharmaceutical grade colostrum, such as Colostrum-LD®. Since the advent of pasteurization and homogenization, milk from the supermarket no longer contains the beneficial antibodies necessary to ward off pathogens of any type.

It’s well known that Leaky Gut Syndrome is a primary casual factor in the skyrocketing epidemic of chronic conditions and autoimmune diseases. Perhaps lesser known is that a hyper-permeable gut lining combined with an overgrowth of pathogenic bacteria is no match for conventional pharmaceutical treatment. The leaky gut allows the pathogens and their toxins to easily enter the bloodstream where they wreak havoc and frequently lead to the patient’s death. The growth factors in colostrum are essential to healing a leaky gut and preventing the crossover of pathogens, toxins, and undigested foods into the bloodstream. Colostrum does double duty in preserving the health of humans and of all other mammals. First, it maintains a strong intestinal lining which acts as a barrier to keep the intestinal flora in place. Second, the antibodies destroy illness-causing pathogens on contact and help keep a favorable balance of good to bad bacteria.

Colostrum is a viable solution to address the enormous and deadly toll taken by massive diarrhea and Leaky Gut Syndrome on people worldwide. Colostrum-LD® is laboratory-certified to contain the growth factors necessary to heal and prevent Laky Gut Syndrome, and standardized to contain the maximum quantity of colostrum’s major healing components. For additional information and to review clinical references, visit www.ColostrumTherapy.com
**Immunoglobulins** -- bind to disease-causing pathogens on the mucosal surfaces of the GI tract, thereby preventing them from colonizing and causing infection. This modulation by the immune system creates passive immunity for the patient.

- **IgA** (serum IgA) – similar to sIgA, but in monomeric form. Responsible for humoral immunity of mucosal surfaces.

- **sIgA** (secretory IgA) – dimer of serum IgA, secretory component protects it from enzymatic degradation, helps molecule pass through intestinal lining, prevents attachment of pathogens (viruses and bacteria) to mucosal surfaces; presence in colostrum is probably to prevent gastrointestinal infections.

- **IgD** – act as antigen receptors on the surfaces of B lymphocytes, highly antiviral.

- **IgE** – bind to receptors on mast cells and basophils, specialized cells that participate in allergic reactions. When an antigen such as pollen reacts with the IgE antibody, the mast cell or basophil releases histamine and other chemicals which produce the allergic reaction. Also attracts IgG, complement and phagocytic cells. Highly antiviral.

- **IgEb** (IgE binding factor) – acts to suppress action of IgE, may give anti-allergic role to colostrum.

- **IgG** – protect against circulating bacteria and viruses, neutralize bacterial toxins, trigger the complement system and bind to antigens, enhancing the effectiveness of phagocytic cells.

- **IgM** – first antibody produced in response to initial exposure to an antigen, involved in aggregating antigens and reactions involving complement.

**Antibodies to Major Deadly Gut-Based Pathogens:**

- **Clostridium Difficile** – bacteria causes infectious diarrhea and colitis; a major cause of death.

- **Campylobacter jejuni** – one of the most common bacterial causes of human gastroenteritis worldwide; commonly associated with poultry.

- **Eschericia coli** – various strains can cause common bacterial infections, such as food poisoning, traveler’s diarrhea, cholecystitis, bacteremia, cholangitis, urinary tract infections, meningitis and pneumonia; commonly associated with ingestion of human or animal feces. E. coli 0157:H7 is the enterohemorrhagic strain that can lead to kidney failure.
Salmonella enteritidis – the second most common (bacterial) gastrointestinal infection in the United States due to food poisoning. Salmonella typhimurium causes salmonellosis and enteric fevers (typhoid and paratyphoid).

Giardia – protozoan parasite in contaminated food, water, or soil; commonly associated with ingestion of human or animal feces.

Rotavirus – a major cause of fatal diarrhea among young children worldwide.

Shigella – the third most common (bacterial) gastrointestinal infection in the United States due to food poisoning.

Staphylococcus aureus – causes food poisoning, atopic dermatitis, and respiratory disease; more recently developed antibiotic-resistant form, Methicillin-resistant Staphylococcus aureus (MRSA).

Yersinia enterocolitica – bacterial gastrointestinal infection that causes bloody diarrhea and fever in humans (yersinosis); commonly associated with undercooked meat products.

Additional Antibodies & Action by Colostrum Components to Various Pathogens:

Adenovirus – responsible for 5-10% of upper respiratory infections in children as well as a variety of adult infections including respiratory disease, conjunctivitis, and gastroenteritis. Lactoferrin prevents infection when present prior to viral adsorption stage.

Alphavirus – cause of numerous diseases in humans, including arthritis, encephalitis, rashes and fever. Includes Sindbis virus and Semliki Forest virus. Lactoferrin interferes with the virus-receptor interaction, blocking entrance into cells.

Bacillus cereus – food poisoning; commonly associated with “fried rice syndrome”. Colostrum has antibodies against Bacillus cereus.

Candida albicans – opportunistic oral and genital fungal infection causing thrush and vaginal infections.

Dengue virus – causes a painful infectious fever in tropical countries. Colostrum has antibodies against Dengue virus.

Echovirus – mainly affecting children, this virus can cause an acute febrile illness and is the most common cause of aseptic meningitis. Lactoferrin blocks viral attachment to cell receptors.

Enterohemorrhagic Escherichia coli (EHEC) – the main cause of hemolytic-uremic syndrome, endemic to Argentina. Colostrum has antibodies against EHEC.
**Enterovirus 71** – one of major causative agents of hand, foot and mouth disease and serious neurological diseases. Lactoferrin inhibits this virus.

**Epstein-Barr** and **Human Herpes Virus-6** (Chronic Fatigue Syndrome) – PRPs given to chronic fatigue patients resulted in improvement in 60% of cases.

**Hantavirus** – causes potentially fatal diseases in humans, including hemorrhagic fever with renal syndrome and hantavirus pulmonary disease. Lactoferrin inhibits adsorption to target cells.

**Hepatitis C virus** – Lactoferrin prevents infection by binding to an envelope protein of the virus.

**Herpes viruses** – PRPs have proven very effective in the prevention of herpes virus infections.

**HIV-1** – HIV reverse transcriptase, protease and integrase, enzymes crucial to its life cycle, are inhibited by Lactoferrin.

**Human Papilloma virus** – implicated in cervical and other sexually-transmitted cancers. Lactoferrin blocks entry into target cells.

**Haemophilus influenzae** – causes brain and spinal cord meningitis.

**Helicobacter pylori** – leading cause of peptic ulcers. Colostrum has antibodies against H. pylori.

**Influenza** – colostrum in clinical trials proved three times more effective than vaccination in preventing influenza.

**Japanese encephalitis** – mosquito-borne virus is related to St. Louis virus that can cause encephalitis. Colostrum has antibodies against this virus.

**Klebsiella pneumoniae** – pneumonia, meningitis, liver abscesses, endophthalmitis.

**Listeria monocytogenes** – causes listeriosis (food poisoning) and meningitis in newborns (acquired transvaginally at birth). Colostrum has antibodies against listeria.

**Measles** – 8 of 9 patients suffering respiratory failure from severe measles recovered, and one patient with encephalitis was clear of symptoms within two weeks of the last dose.

**Polio virus** – cause of poliomyelitis. Immunoglobulins in colostrum show antipoliomyelitic activity. Lactoferrin prevents attachment to gastrointestinal wall.

**Proponiobacterium acnes** – causes acne. Colostrum has antibodies against this bacteria.
Respiratory syncytial virus – a major cause lower respiratory tract infections during infancy and childhood. Lactoferrin blocks virus entry into cells.

Shiga toxin-producing Escherichia coli – causes dysentery. Colostrum has antibodies to this form of E. coli.

St. Louis virus – mosquito-borne virus causes St. Louis encephalitis, which is related to Japanese encephalitis. Colostrum has antibodies against this virus.

Streptococcus pyogenes – causes strep throat and other strep diseases, septicemia. Colostrum has antibodies against this bacteria.

Streptococcus agalactiae – part of normal human flora, can cause septicemia and meningitis in newborns. Colostrum has antibodies against this bacteria.

Streptococcus pneumoniae – causes pneumonia, ear infections bacterial menigitis. Colostrum has antibodies against this bacteria.

Streptococcus mutans – tooth decay. Colostrum has antibodies against this bacteria.

Staphylococcus epidermidis - part of normal human skin flora; known to cause acne vulgaris and biofilms on plastic devices, such as surgical implants and catheters. Colostrum has antibodies against this bacteria.

Vibrio cholerae – bacteria that causes cholera. Cholera toxin B, which causes the disease, is bound by sialyllactose, which is found in colostrum and milk.

West Nile virus – mosquito-borne virus that can cause a fever or encephalitis or meningitis. Colostrum has antibodies against this virus.

Yellow fever virus – mosquito-borne virus that causes an acute viral hemorrhagic disease that can cause liver damage. Colostrum has antibodies against this virus.

Glycoproteins – proteins with sugars attached, inhibit pathogens by competing for binding sites on the intestinal wall, binding directly to pathogens, and by other means.

Transferrin family

Lactoferrin (Lactotransferrin) – an iron-binding protein with many functions: potent non-specific antimicrobial, including bacteria, viruses, fungi and protozoan parasites; essential growth factor for lymphocytes (immune system cells); stimulates activity of polymorphonuclear leukocytes (white blood cells); strongly augments natural killer cell and lymphokine-activated killer cell cytotoxic activity; powerful antioxidant and anti-inflammatory; stimulates production of IL-18; inhibits tryptase, an enzyme secreted by
mast cells and possible causative agent of asthma; prevents cancer in animal models; decreases severity and longitudinal prevalence of diarrhea in children; inhibits intestinal damage from Enteropathogenic Escherichia coli; and shows promise for osteoarthritis treatment. As a glycoprotein, lactoferrin competes with pathogens for binding sites on the intestinal wall or binds directly to pathogens.

**Transferrin** – an iron transporting protein similar in structure to lactoferrin.

**Protease inhibitors** – help colostrum components survive digestion by inhibiting digestive enzymes; enhance absorption of vital nutrients.

- **α2-macroglobulin** – inhibits thrombin and other proteases, anticoagulant
- **α2-antiplasmin** – thrombin inhibitor, anticoagulant
- **Antithrombin III** – inhibits thrombin, anticoagulant
- **C1-inhibitor** – inhibits C1 protease
- **Chymotrypsin inhibitor** – inhibits chymotrypsin, a type of protease
- **Elastase inhibitor** – inhibits elastase, another protease
- **Inter-α-trypsin inhibitor** – inhibits inter-α-trypsin, another protease
- **Trypsin inhibitor** (α1-antitrypsin) – inhibits trypsin, another protease

**Casein peptides**

- **κ-caseino glycomacropeptide** – a peptide from the casein fraction of milk which interferes with the binding of viruses and bacteria in the intestine, binds cholera and E. coli endotoxins, promotes the growth of helpful bacteria in the gut, helps modulate the immune system and helps prevent the formation of arterial thrombi (clots), a leading cause of heart attack and stroke.

- **κ-caseinoglycopeptide** – a peptide produced by digestion of kappa-casein, found in both bovine and human colostrum and milk, which is absorbed into the blood serum and which has antithrombic properties, preventing platelet aggregation.

**Hemopexin** – a transporter and binder of free heme molecules in body. Has antioxidant function by preventing participation of heme in oxygen radical reactions in tissues. Also plays a
key role in the homeostasis of nitric oxide. Known to suppress tumor growth. It may also have an anti-inflammatory effect by suppressing neutrophil accumulation and phagocytosis and by inhibiting the Mg++ dependent adhesion of polymorphonuclear leukocytes.

**Haptoglobin** – a protein binder of free hemoglobin. Binding of haptoglobin to free hemoglobin prevents hemoglobin-induced oxidative tissue damage, so haptoglobin effectively acts as an antioxidant. Increased levels in acute phase inflammation apparently act to selectively antagonize lipopolysaccharide (LPS) inflammatory effects by suppressing monocyte production of pro-inflammatory cytokines TNF-α, IL-10 and IL-12 while it does not inhibit anti-inflammatory cytokines IL-6, IL-8 and IL-1 receptor antagonist.

**Thrombospondin** – extracellular proteins involved in cell-to-cell and cell-to-matrix communication, including cell adhesion, platelet aggregation, cell proliferation and tissue repair. Potent inhibitor of angiogenesis and tumor growth. Also interact with coagulation and anticoagulant factors in blood.

**Milk globule membrane proteins**

**Mucin** (MUC-1) – major mucin glycoprotein expressed on surface of mammary epithelial cells; probably a lactation artifact.

**BAMP** (Bovine Associated Mucoprotein) – found only in milk and colostrum fat globule membranes, other secretory fluids and fetal serum, but not in adult serum.

**Lactadherin** – potent phospholipid-blocking anticoagulant, binds to rotavirus to help prevent viral diarrhea.

**Adipophilin** – necessary for lipid production and secretion into milk during lactation.

**Butyrophilin** – required for the regulated secretion of milk droplets. Also appears to be anti-inflammatory by suppressing inflammatory cytokines interferon-γ, IL-2, IL-12, GMCSF.

**CD36** (fatty acid translocase) – membrane protein expressed by mammary epithelial cells. Fatty acid transporter in milk production.

**α2-macroglobulin** -- the largest major nonimmunoglobulin protein in plasma; manufactured primarily in the liver; acts as an anticoagulant by inhibiting thrombin and other proteases.
**β2-microglobulin** (thymotaxin, lactollin) – light chain of histocompatibility class I antigen. Lactollin is the bovine form of human β2-microglobulin. Has structural homology with sections of both IgG light and heavy chains.

**Lipocalins** – a family of small, secreted proteins that transport steroids, bilins, retinols, and lipids.

- **β-lactoglobulin** – milk antigen, one of major causes of cow’s milk allergy, has antimicrobial effects, including antiviral activity.

- **Fatty acid binding protein** – binds long chain fatty acids to intestinal epithelial cells (enterocytes), plays a role in the regulation of macrophage inflammatory activity and cholesterol uptake.

**Clusterin** (Apolipoprotein J) – plays important role in cell-cell and cell-substratum interactions, also acts as an extracellular molecular “chaperone” that “steers” proteins into cells.

**Casein** – principal protein fraction of cow’s milk. Casein in colostrum is immune-related with antioxidant properties. It is not the same as caseins in milk which are for digestion and conversion to amino acids. Casein in colostrum does not produce an allergic reaction. Whole casein can be further separated into:

- α-casein
- β-casein
- κ-casein – inhibits attachment of *Streptococcus pneumoniae* and *Haemophilus influenzae* in gut.

**Orosomucoids** (α1-acid glycoprotein) - increased levels and altered forms of orosomucoids are associated with inflammation; anti-inflammatory mediator, particularly in the endothelium of capillaries, where it inhibits the effect of histamine on the capillary.

**Folate-binding protein** – protein in colostrum and milk that binds folate, allowing for slower absorption into body, which prevents loss of excess folate through urine.

**α-lactalbumin** – a modifier protein which modifies the action of galactosyl transferase to a lactose synthase. It binds divalent cations (such as Ca++ and Zn++) and may facilitate the absorption of essential minerals. Provides a well-balanced supply of amino acids to the
newborn. Most common protein in human milk (20-25% of total protein), but only 2-5% of total protein in bovine milk. Chemically related to lysozyme and has a weak lytic ability.

**Multimeric α-lactalbumin** (MAL) – a folded variety of α-lactalbumin which has the ability to kill transformed cells (i.e. cancer cells) by apoptosis (programmed cell death) by altering mitochondrial membrane permeability. Also has anti-infective ability.

**Prealbumin** -- a protein made primarily by the liver and is used as a building block to make other proteins.

**Albumin** – the main protein of human blood plasma and functions primarily to regulate the colloidal osmotic pressure of blood.

**Lysozyme** – a potent antimicrobial which often works in tandem with lactoferrin to kill bacteria and other microorganisms.

**Lactoperoxidase** – combines with thiocyanate and hydrogen peroxide to form a very potent antimicrobial agent. Secreted from mammary, salivary, and other mucosal glands.

**Proline-Rich Polypeptides** (PRPs / colostrinin) – these are short chain peptides (500-5000MW) with a high concentration of the amino acid Proline. They are also called: info-peptides, info-proteins, cytokine precursors, colostrinin and, or immune-modulators. PRPs support the regulation of the thymus, the gland responsible for the normal development of immunologic function in the body. PRPs are richly varied immune and inflammatory modulators and act as signaling molecules; induce white blood cell proliferation and the production of a number of cytokines. PRPs modulates the cytokine system by stimulating the production of a wide range of cytokines, including the pro-inflammatory cytokines tumor necrosis factor-alpha (TNF-α), which initiates the inflammatory cascade of cytokine production, and interferon-gamma (INF-γ), and the anti-inflammatory cytokines interleukins-6 and -10 (IL-6 and IL-10).

PRPs act against a wide variety of pathogens mainly by modulating the immune system to rally a defense against an infection, especially gut-based infections that cause massive diarrhea, as in HIV/AIDS patients. Help ease symptoms of Alzheimer’s and other cognitive/neurodegenerative disorders. The two primary and most important types of PRPs are PRP-2s (anti-microbial activity) and PRP-3s (anti-inflammatory activity). PRP-2s increase the immune system’s activity when it’s necessary to fight off an infection; block reproduction of pathogens; increase natural killer cell activity; and activate macrophages and T-cells. PRP-3s quell the immune system’s activity to prevent tissue damage once the infection has been defeated. PRP-3s also help relieve
allergy symptoms. The application of PRPs is immunotherapy, anti-viral, anti-allergy, anti-inflammatory, and restoration of normal cell function.

**Complement** (C3) – components of the innate immune system that act to amplify the response and activation of the cell-killing membrane attack complex that attacks pathogens.

**β-Defensin** – an antimicrobial peptide secreted by the skin and respiratory tract.

**Oligosaccharides** – provide protection from pathogens by competing for binding sites on intestinal lining. Also support growth of beneficial bacteria.

- **Fucose** – in breast milk, benefits the immune system.
- **Galactose** – keeps immune system healthy, helps in cell formation, assists in cellular communication.
- **Glucose** – the primary metabolic fuel for humans.
- **Mannose** – plays major role in cellular interactions, lowers blood glucose levels, has anti-inflammatory and anti-microbial effects.
- **N-acetyl-galactosamine** – plays a role in keeping cell communications clear and promptly delivered.
- **N-acetyl-glucosamine** – especially beneficial for joint health.
- **N-acetyl-neuraminic acid** – in human milk, impacts brain function and growth and boosts immune function.
- **Xylose** – has anti-bacterial and anti-fungal properties.

**Glycosaminoglycans** (mucopolysaccharides) -- large linear polysaccharides constructed of repeating disaccharide units with the primary configurations containing an amino sugar and an uronic acid. They are highly polar and attract water, which makes them useful to the body as a lubricant or as a shock absorber.

**Peptides**

- **Apelin** – found in bovine colostrum, is endogenous ligand of human orphan APJ receptor; stimulates proliferation of gastric cells; inhibits entry of HIV into the cells. Function in human colostrum is probably to modulate immune response in neonates.

**Angiotensin-I-converting enzyme (ACE) inhibitors and competitive substrates:**
**Enkephalins** – endorphin-like pentapeptides found throughout the body (endorphins are found in the brain only), natural painkillers, antidepressant, immune modulators

**Bradykinin** – vasodilatory peptide activated by ACE.

**Substance P** – potent vasodilator and secretagogue (an agent which promotes secretion), neurotransmitter belonging to neurokinin family, involved in depression and stress

**Casokins** (casein-derived ACE inhibitors):
- αs1-casein
- β-casein
- κ-casein

**Lactokins** (whey-derived ACE inhibitors):
- α-lactalbumin
- α-lactorphin
- β-lactoglobulin
- β-lactorphin
- β-lactosin
- β-lactotensin
- WE80BG

**Bovine serum albumin**

**Albutensin A** – ileum contracting and relaxing activity

**Immune peptides**

**Cathelicidin peptides** – part of the innate immune system, found to be highly effective against otherwise resistant bacteria found in cystic fibrosis, such as Pseudomonas aeruginosa, Burkholderia cepacia, Stentrophomonas maltophilia, Achromobacter xylosoxidans.

**Motilin** – peptide gastrointestinal hormone, controls pattern of smooth muscle contraction in upper GI tract, presence in human milk confirmed, but physiological significance unknown.
**Cytokines** – hormone-like, low molecular weight proteins which regulate the intensity and duration of the immune response and mediate cell-to-cell communication.

**Chemokines** – small, inducible, secreted, pro-inflammatory cytokines acting primarily as chemoattractants and activators of specific types of leukocytes.

- **CXCL 1-7** (CXC chemokine ligands)
- **CXCL 8** *(see IL-8)*

**Eotaxin** – chemoattractant for eosinophils

**GRO-alpha** (growth related protein alpha) – activates neutrophils, chemotactic for neutrophils, promotes angiogenesis and growth of certain tumors.

**Interferons** (IFNs) – signaling proteins produced and released by host cells in response to the presence of pathogens, such as viruses, bacteria, parasites, or tumor cells. An infected cell will release interferons, causing nearby cells to heighten their anti-pathogenic defenses. Interferons also activate natural killer cells and macrophages; increase host defenses by up-regulating antigen presentation by increasing the expression of major histocompatibility complex (MHC) antigens.

- **IP-10** (interferon-γ inducible protein) – in human milk, may contribute to the migration and activation of intestinal T lymphocytes to enhance mucosal immunity in neonates.

- **MCP-1** (monocyte chemotactic protein) – also chemotactic for T cells, induces chemotaxis and activation of monocytes.

- **MIG** (monokine induced by interferon-γ) – chemotactic for tumor infiltrating lymphocytes.

- **RANTES** (Regulated upon Activation, Normal T cell Expressed and Secreted) (also called SIS-delta) – chemotaxis of T cells, eosinophils and monocytes

**Lymphokines** -- a subset of cytokines that are produced by lymphocytes. They are protein mediators typically produced by T cells to direct the immune system response by signaling between its cells.

**Interleukins** -- a group of cytokines expressed by leukocytes.

- **IL-1β** – enhances proliferation of T helper cells and growth and differentiation of B cells, pro-inflammatory, fever inducing.

- **IL-2** – causes proliferation of T lymphocytes, NK cells and activated B lymphocytes.
IL-4 – causes differentiation of B lymphocytes and Th2 cells, increases IgG4 and IgE synthesis, anti-inflammatory.

IL-5 – activates B lymphocytes to produce IgA and causes eosinophils to differentiate.

IL-6 – activates T cells, increases synthesis and secretion of immunoglobulins by B lymphocytes.

IL-8 – in human milk, resistant to digestion, IL-8 receptors (CXCR1, CXCR2) are extensively expressed in fetal intestine, increases migration, proliferation and differentiation of both fetal and adult intestinal cells, promotes angiogenesis, protects cells from chemical injury, neutrophil chemoattractant.

IL-10 – inhibits interferon-gamma and IL-2 secretion by T lymphocytes, increases B cell and mast cell proliferation, anti-inflammatory.

IL-12 – induces interferon-gamma and IL-2 synthesis in T lymphocytes and natural killer (NK) cells, pro-inflammatory.

IL-13 – anti-inflammatory, growth factor for B cells, modulates B lymphocyte responses, increases IgM, IgE and IgG4 production.

IL-16 – chemotactant for CD4+T cells.

IL-18 – induces interferon-gamma production by T and NK cells.

Interferon-γ – highly immunoregulatory and pro-inflammatory, antiviral.

**Tumor necrosis factor-α family**

TNF- α – cytotoxic for many tumor cell types, increases fever and septic shock, main pro-inflammatory regulator.

TNF-α receptors – proteins which bind to TNF-α, inactivating it.

Osteopontin (bone sialoprotein, Eta-1 (early T-lymphocyte activation 1)) – secreted by epithelial cells, associated with bone mineralization.

Osteoprotegerin – inhibits osteoclast (“bone-eating”) differentiation, preventing bone destruction.
**Growth Factors** – growth factors play an important role in maintaining the body, including repair of leaky gut epithelia, bone remodeling and maintenance, fracture repair, wound healing, stimulating cellular migration and proliferation, increase in collagen production, growth of blood vessels into damaged areas, and many others.

**Colony-stimulating factor-1 (CSF-1)** – stimulate the production of mature blood cells and macrophages from stem cells.

**Epithelial/Epidermal growth factor (EGF)** – helps to promote wound healing by stimulating cell proliferation in wound.

**Betacellulin** – originally found in pancreas and thought to have a physiological role in the development of pancreatic islet cells (which produce insulin). Its function in the body and the reason for its presence in colostrum and milk is still unclear.

**Fibroblast growth factor (FGF)** – helps to promote wound healing by stimulating cell proliferation in the wound, helps maintain normal bone and repair fractures.

**Granulocyte colony-stimulating factor (G-CSF)** – increases growth, differentiation and activation of granulocytes (eosinophils, basophils, neutrophils). As it is not absorbed, it appears to act locally in the gut. Part of CSF family of growth factors.

**Insulin-like growth factor-1 (IGF-1)** – helps to promote wound healing by stimulating cell proliferation in the wound. Enhances bone healing in the elderly. Decreases in amounts in the body with age.

**Insulin-like growth factor-2 (IGF-2)** - promotes growth during gestation.

**IGFBP-3** (Insulin-like growth factor binding protein-3) – the major IGFBP in cows, binds both IGF and lactoferrin. With lactoferrin, can enter nucleus of cells and affects apoptotic (programmed cell death) signaling.

**Macrophage-activating factor (MAF)** – has high macrophage phagocytic activity; benefits serious infections, chronic fatigue syndrome, and symptoms of fatigue associated with chronic diseases.

**Macrophage-colony stimulating factor (M-CSF)** – increases growth, differentiation and activation of macrophages (phagocytic scavenger cells of blood and connective tissues). Part of CSF family of growth factors.

**Transforming growth factor-alpha (TGF-a)** - induces epithelial development, stimulates neural cell proliferation in adult injured brain,
**Transforming growth factor-beta1** (TGF-β1) – increases IgA production and activation of naïve T cells, decreases activation of monocytes and memory T cells, promotes fibroblast growth and wound healing. Vital factor in skeletal growth, bone mass maintenance and fracture healing.

**Transforming growth factor-beta2** (TGF-β2) - another isoform of TGF-β with similar activity.

**Platelet-derived growth factor** (PDGF) – plays a role in bone metabolism as a mitogen (cell division stimulant) for osteoblasts (bone forming cells). It also stimulates fibroblasts to divide.

**Vascular endothelial growth factor** (VEGF) – plays a role in healing of injuries, such as tendon and ligament injuries, by providing blood supply to damaged areas.

**Enzymes**

**Alkaline phosphatase** -- a hydrolase enzyme responsible for removing phosphate groups from many types of molecules, including nucleotides, proteins, and alkaloids.

**Amylase** -- an enzyme present in saliva that catalyzes the hydrolysis of starch into sugars.

**Carbonic anhydrase** – involved in the breakdown of sugars and fat for energy.

**Fructose-bisphosphate aldolase A** -- an enzyme that plays a key role in glycolysis and gluconeogenesis.

**Glycosyl transferases** – involved in the glycosylation of proteins in the milk fat globule membrane.

**β-galactoside α-2,6-sialyltransferase** -- transfers sialic acid from CMP-sialic acid to galactose-containing acceptor substrates.

**β-4-galactosyltransferase** -- catalyzes the production of lactose in the lactating mammary gland.

**Matrix metalloproteinases** – family of zinc-containing endopeptidases that play a key role in both physiological and pathological tissue remodeling.

MMP-2
TIMP-4
**Peroxidase** -- an enzyme that catalyzes the oxidation of various substances by peroxides.

**Superoxide dismutase** – an enzyme with powerful anti-inflammatory activity.

**Telomerase** – an enzyme that adds DNA sequence repeats to the end of DNA strands in chromosomes to prevent loss of important DNA sequences during replication. Length of telomere determines the number of times a cell can divide without error. Plays a significant role incolostrum’s anti-aging benefit.

**Thiamine pyrophosphatase** -- An enzyme that hydrolyzes thiamine pyrophosphate to thiamine monophosphate plus inorganic phosphate.

**UDP-N-acetylgalactosamine**: Polypeptide N-acetylgalactosaminyltransferase – a glycosyltransferase.

**Xanthine Oxidase** – important enzyme involved in the catabolism of purines in humans and other animals.

**Antioxidants**

**Glutathione (GSH) and precursors** – this peptide is a significant antioxidant, sometimes described as “the ultimate antioxidant”. It also has potent anti-viral and anti-bacterial properties. It helps protect the overall integrity of all cells and tissue against free radical and disease damage. Colostrum contains high quantities of both glutathione and its precursors.

**Uric Acid** -- plasma uric acid levels correlate with longevity in primates and other mammals and is presumably a function of urate’s antioxidant properties.

**Vitamins & Minerals** *(see below)*

**Hormones**

**Epo** (erythropoietin) – stimulates red blood cell production.

**Leptin** – secreted by fat tissue, acts to curb appetite and increase energy expenditure as body fat stores increase.

**Procalcitonin/Calcitonin** – produced by parathyroid, thyroid and thymus glands, increases deposition of calcium and phosphate in bone and lowers levels in blood.
**Relaxin** – peptide hormone which aids delivery, probably involved in nipple development in mother rather than having any function in newborn.

**Prolactin** – pituitary hormone which stimulates production of milk in mother, artifact from maternal blood serum

**Insulin** – from islets of Langerhans in pancreas, promotes glucose utilization, protein synthesis, fat storage.

**Gonadotropin-releasing hormone (GnRH) (gonadoliberin)** – hypothalamic hormone which stimulates the release of gonadotropin (hormone promoting gonadal growth and development), artifact from maternal blood serum.

**Luteinizing hormone-releasing hormone (LHRH) (luliberin)** – hypothalamic hormone which stimulates the release of luteinizing hormone (lutropin), artifact from maternal serum.

**Thyrotropin-releasing hormone (TRH) (thyroliberin)**—hypothalamic hormone which stimulates the release of thyrotropin, a hormone which stimulates the growth and development of the thyroid.

**Growth hormone** (somatotropin) – pituitary hormone which promotes body growth, fat mobilization and inhibition of glucose utilization.

**Somatostatin** (somatotropin-release inhibiting factor) – inhibits the release of somatotropin and the release of insulin and gastrin.

**Progesterone** – so-called pregnancy hormone which prepares the corpus luteum and placenta for pregnancy, artifact from maternal blood serum.

**Melatonin** – produced by pineal gland, involved in circadian rhythms.

**Nucleosides** – act as regulators in the body. Contribute to iron absorption in the gut and influence saturation and elongation rates in fatty acid synthesis.

- cytidine
- uridine
- guanosine

**Nucleotides** – important in intestinal integrity and immune function in infancy.
cytidine monophosphate (CMP)
uridine monophosphate (UMP)
adenosine monophosphate (AMP)
guanosine monophosphate (GMP)

**Nucleobases**

**Polyamines** – involved in cell growth and differentiation, important in intestinal maturation of the newborn.

- putrescine
- spermine
- spermidine

**Carotenoids** – antioxidant pigments in plants. People consuming diets rich in carotenoids from fruit and vegetables are healthier and have lower mortality than those who do not.

- alpha-carotene – Vitamin A activity (can be converted to Vitamin A)
- beta-carotene – Vitamin A activity
- lycopene – involved in the biosynthesis of beta-carotene
- beta-cryptoxanthin – Vitamin A activity

**Nutrients**

**Vitamin B1** (thiamin) – an essential nutrient required for the biosynthesis of the neurotransmitter acetylcholine and gamma-aminobutyric acid; thiamin deficiency causes non-descript symptoms such as irritability, confusion, malaise and weight loss; long-term deficiency may lead to optic neuropathy, beriberi, Korsakoff’s syndrome, and can be fatal if not treated.

**Vitamin B2** – an essential nutrient for energy metabolism and utilization of carbohydrates, proteins, fats, and ketone bodies; riboflavin deficiency is rare in developed countries, yet sub-clinical deficiency may present as skin conditions in/around the mouth, photophobia, and scrotal dermatitis; long-term deficiency in children results in reduced growth.

**Vitamin B6** – is a co-factor in amino acid metabolism and is necessary for conversion of glycogen into glucose; deficiency results in dermatologic and neurologic conditions and although rare, the elderly and alcoholics are susceptible.
Vitamin B12 – is essential to the formation of red blood cells, maintenance of the brain and nervous system, and metabolism of every cell in the body; mild deficiency can cause fatigue, poor memory and depression; long-term deficiency can cause irreversible damage to the brain and nervous system.

Vitamin E – is an antioxidant that halts the production of reactive oxygen species during fat oxidation; deficiency may cause retinopathy, peripheral neuropathy, myopathy, ataxia, and impaired immune response.

Vitamin A – is essential for growth and development, a healthy immune system and good vision; deficiency results in impaired vision, particularly night blindness, and more frequent ear infections, urinary tract infections, and Meningococcal disease.

Vitamin C – is an important co-factor in collagen synthesis and may function as an antioxidant; deficiency causes scurvy.

Vitamin D3 – is important for the intestinal absorption of calcium and phosphate which increases bone mineral density; deficiency causes osteomalacia in adults, or rickets in children.

Folic Acid (folate) – is essential for DNA synthesis and repair, cell growth and division, and the manufacture of healthy red blood cells; deficiency may result in embryonic neural tube defects; adults can experience a plethora of health problems including nerve damage, cognitive decline, depression, anemia, hyperhomocysteinemia, and possibly cancer.

Pantothenic Acid – an essential nutrient for the metabolism of carbohydrates, proteins, and fats; deficiency is exceedingly rare and typically observed in starvation cases.

Beta-carotene – is a precursor to Vitamin A whose absorption is restricted to the duodenum of the small intestine; absorption efficiency is between 9-22%.

Glycoconjugates
Glycogen
Retinoic Acid
Orotic Acid

Probiotics – necessary to maintain a healthy gut; help to re-colonize the gut after the pathogenic bacteria has been eliminated.
Lactobacillus acidophilus
Lactobacillus bifidus
Bifidobacterium spp.

**Minerals** — tend to have highest levels in early colostrum and taper off after that.

**Calcium** — an essential element in cellular physiology and the heart’s electrical conduction system; in conjunction with Vitamin D, is used in the mineralization of bone and teeth; long-term deficiency results in rickets and osteoporosis.

**Chromium** — food and water contains trace amounts of trivalent chromium, which is possibly required in trace amounts for sugar and lipid metabolism.

**Copper** — an essential trace element vital to health and necessary for the proper functioning of organs and metabolic processes.

**Iron** — essential to the formation of hemoglobin and myoglobin.

**Magnesium** — manipulates biological polyphosphate compounds such as ATP, DNA, and RNA, making magnesium ions essential to all living cells; hundreds of enzymes require magnesium ions to function.

**Phosphorus** — an essential component of DNA, RNA, ATP, and the phospholipids that form all cell membranes; deficiency (hypophosphatemia) causes muscle and neurological dysfunction and disruption of muscle and blood cells due to a lack of ATP.

**Potassium** — potassium ions are necessary for all living cells, and ion diffusion is an essential mechanism in nerve transmission; deficiency results in various cardiac dysfunctions.

**Selenium** — a component of the antioxidant enzymes glutathione peroxidase and thioredoxin reductase; necessary for the conversion of the thyroid hormone thyroxine (T4) into triiodothyronine, and although rare, a deficiency may cause symptoms of hypothyroidism.

**Sodium** — an essential element for all living cells and ion diffusion is an essential mechanism in nerve transmission.

**Sulfur** — an essential element for all living cells, and is necessary for metabolic reactions; is present in the vitamins biotin and thiamine; enzymes and antioxidants such as glutathione and thioredoxin; and in all proteins, as the amino acids cysteine and methionine.
**Zinc** – an essential trace element in RNA and DNA metabolism, signal transduction, gene expression, and apoptosis regulation.

**Amino Acids** – the building blocks of proteins. Colostrum contains nine essential amino acids and nine non-essential amino acids. While amino acid supplementation is popular, especially among athletes, most claims, such as muscle building, are unsubstantiated. In fact, excess amino acids can interfere with the action of prescription drugs or hormones (arginine, for example, can inhibit the action of pain killers and antibiotics) or worsen preexisting diseases (tyrosine, for example, can aggravate the symptoms of schizophrenia). Amino acid supplementation can be of benefit in cases of deficiencies where the deficiency resulted from weight loss diets, toxic environmental conditions, or unhealthy lifestyle behaviors; however isolated amino acid supplementation can be costly and unnecessary if taking 10 grams or more daily of Colostrum-LD®.

**Essential Amino Acids**

**Isoleucine** – branched chain amino acid used in body building. Hemodialysis patients often have low plasma levels of isoleucine and require supplementation.

**Leucine** – reduces protein breakdown and increases skeletal muscle protein synthesis. Required for healthy immune system. Used to treat hepatic encephalopathy.

**Histidine** – causes secretion and elimination of zinc to increase, suppresses food intake and fat accumulation in rats, essential to normal sexual functioning, may relieve symptoms of rheumatoid arthritis, used to make histamine. Controls diarrhea, increases calcium and zinc absorption. Scavenges reactive oxygen species and inhibits lipid peroxidation. Deficiencies in childhood can result in growth and mental retardation and impaired speech.

**Methionine** – can help in some cases of schizophrenia by lowering blood level of histamine. Deficiency can result in edema and susceptibility to infection, as well as cholesterol deposits, atherosclerosis and hair loss.

**Lysine** – required for growth, tissue repair and the production of antibodies, hormones and enzymes. Promotes concentration and proper use of fatty acids for energy.

**Threonine** – excessive threonine can cause formation of too much urea and consequent ammonia toxicity. Requires Vitamin B6, magnesium and niacin to be used properly in body. Both serine and glycine may be synthesized from it.
**Phenylalanine** – functions as a neurotransmitter

**Valine** – a branched chain amino acid that promotes mental vigor, muscle coordination and emotional calm. Helps prevent nervous and digestive disorders. Taken with leucine, decreases risk of side effects for muscle building.

**Tryptophan** – used by brain along with Vitamin B6, niacin and magnesium to produce serotonin, a neurotransmitter. Acts as an antidepressant reducing anxiety and tension.

**Non-essential Amino Acids**

**Arginine** – precursor of nitric oxide, reduces healing time of injuries (particularly bone), helps decrease blood pressure. Required for normal functioning of pituitary gland.

**Cystine** – readily converted to cysteine. When metabolized, yields sulfuric acid which is used to detox

**Glutamic Acid** – primarily used in brain. Converts ammonia in brain to glutamine.

**Alanine** – synthesized in muscle from branched chain amino acids. Helps regulate sugar levels in blood. Used by liver for gluconeogenesis. Deficiency may lead to muscle loss and poor glucose tolerance.

**Tyrosine** – neurotransmitter, stimulates and modifies brain activity. Supplementation can help control medication-resistant depression and anxiety.

**Glycine** – used in treatment of lower pituitary gland function and progressive muscular dystrophy. Also used to treat hypoglycemia. Stimulates release of glucagon, which mobilizes glycogen, which is then released into blood as glucose.

**Proline** – used for skin problems such as acne or ulcers, one of main components of collagen. Important for proper functioning of joints and tendons. Helps maintain cardiac muscle and helps with tissue repair and wound healing. May be useful in helping prevent atherosclerosis and other heart problems.

**Aspartic Acid** – helps get rid of harmful ammonia in body, which helps protect nervous system.

**Serine** – necessary for metabolism of fats. Precursor of tryptophan and serotonin. Plays major role in many biosynthetic pathways, including serine
proteases such as trypsin and chymotrypsin, digestive enzymes. Patients with Chronic Fatigue Syndrome often have low serine levels.

**Phospholipids** – a class of lipids that are a major component of all animal cell membranes. Naturally occurring in fresh, raw colostrum; when processed, the phospholipids are lost. When phospholipids are re-applied to Colostrum-LD®, cellular bio-availability is increased significantly.

**Phosphatidylserine** – plays a key role in cell cycle signaling, specifically in relationship to apoptosis; can cross the blood-brain barrier. Preliminary research shows that it reduces the risk of dementia and cognitive dysfunction in the elderly.

**Phosphatidylcholine** (lecithin) – also a major constituent of pulmonary surfactant. Plays a role in membrane-mediated cell signaling. Can be readily obtained from egg yolk, soybeans, and sunflowers.

**Phosphatidylinositol** – a minor component of the cell membranes; especially abundant in brain tissue, where it can amount to 10% of the phospholipids

**Phosphatidylethanolamine** – abundant in white matter of brain, nerves, neural tissue, and in spinal cord, where they make up 45% of all phospholipids.

**Sphingomyelin** – a type of sphingolipid found particularly in the membranous myelin sheath surrounding some nerve cell axons.

**Prosaposin (PSAP)** – a highly conserved glycoprotein which is a precursor for saposins A, B, C, and D. This protein is encoded by the PSAP gene; mutations in the gene have been associated with Gaucher disease, Tay-Sachs disease, and metachromatic leukodystrophy.

**Saposins A, B, C, D** – required for the hydrolysis of certain sphingolipids by specific lysosomal hydrolases.

**Tocopherols** – a class of organic chemical compounds (various methylated phenols), many of which have vitamin E activity.

**Fatty Acids**

**Linoleic acid** – a polyunsaturated omega-6 fatty acid essential to biosynthesis of arachidonic acid and some prostaglandins.
**Dihomo-γ-linolenic acid** (DGLA) – uncommon fatty acid, found only in trace amounts in animal products; Eicosanoid metabolites of DGLA have anti-inflammatory effects.

**Alpha-linoleic acid** – an essential omega-3 fatty acid which may have a slight preventative effect against cardiovascular diseases.

**Octadecatetraenoic acid** (α-parinaric acid) – a polyunsaturated fatty acid that is cytotoxic to some leukemia cells in cell culture; sensitizes the tumor cells to lipid peroxidation.

**Eicosatrienoic acid** (Mead acid) – an omega-9 polyunsaturated fatty acid found in large quantities in cartilage.

**Docosahexaenoic acid** – an omega-3 fatty acid that is a primary structural component of the human brain, cerebral cortex, skin, sperm, testicles and retina.

**Docosapentaenoic acid** (DPA) – an omega-3 fatty acid; human breast milk is high in DPA. Inhibits platelet thrombosis/aggregation; improves wound healing ability.

**Arachidonic acid** – a polyunsaturated omega-6 fatty acid and a precursor in the production of eicosanoids; necessary for the growth/repair of muscle tissue; aids in early neurological development; protects the brain from oxidative stress.

**Cholesterol** – a lipid molecule and an essential structural component of all animal cell membranes which is required to maintain membrane structural integrity and fluidity. Also acts as a precursor for the biosynthesis of steroid hormones, bile acids, and vitamin D.