

# COLOCO<sup>®</sup> PRP

Procognitive | Neuroprotective | Immunomodulatory | Antioxidative

**Innovative**  
active ingredient







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# Geo-Poland's research and development

## We create innovative products to satisfy our customers' needs

Geo-Poland is a company with 30 years of experience within dairy industry. We develop, produce and distribute many different baby milk powder formulas. However, our research and development activity is not only focused on infant nutrition.

Geo-Poland has developed an innovative ingredient, COLOCO® prp, obtained from the bovine colostrum (first milk). Through series of scientific studies, we proved that COLOCO® prp exhibits positive influence on human cognitive functions and could help to prevent neurodegenerative diseases such as Alzheimer's disease (AD).

The production technology and application of the ingredient are subject to Geo-Poland's patents.





# Health benefits of COLOCO<sup>®</sup> prp

## What is colostrum?

Colostrum is the first milk produced by the mammary glands within 72 hours postpartum. Colostrum is a rich source of biologically active molecules such as growth factors and cytokines which are essential for its unique properties. It contains high levels of growth factors and immunomodulatory components, which are considered to play an important role in development of immune system in infants and protection of the newborn against a variety of microbial pathogens.

Bovine colostrum is widely used as a food supplement and it's well-known for its beneficial effects, in both animals and humans. Among the multiple natural fractions of colostrum, proline-rich polypeptides (PRPs) complex is considered to be one of the most valuable components, which is responsible for positive effects of colostrum. In different studies, it was shown that PRPs exhibit antioxidant, immunomodulatory, neuroprotective and procognitive properties.

## Facts about COLOCO<sup>®</sup> prp

COLOCO<sup>®</sup> prp is a complex of low molecular weight peptides ranging up to 10 kDa. It is isolated from bovine colostrum obtained up to 48 hours postpartum, using innovative technology that was patented by Geo-Poland (PL218693). COLOCO<sup>®</sup> prp contains PRPs and was proven to have a positive influence on human cognitive functions and neuroprotection. Moreover, COLOCO<sup>®</sup> prp is 100% natural, non-synthetic substance with no adverse effects which is safe and well tolerated. Therefore, COLOCO<sup>®</sup> prp can find variety of applications that are a subject of international patent application of Geo-Poland (PCT/PL2015/000180).





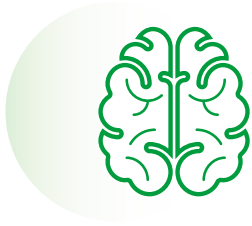
## Properties of COLOCO® prp

In recent years, Geo-Poland in collaboration with leading Polish scientific institutes, carried out research studies on composition and biological properties of COLOCO® prp.

COLOCO® prp has positive influence on function of numerous parts of human body.







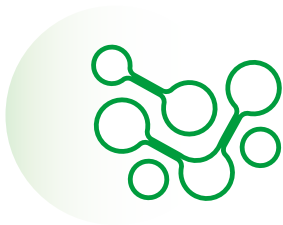
## Brain

Procognitive properties: affecting mind and behaviour (psychotropic activity) and **improving cognitive function**.



## Nervous system

Neuroprotective properties: **reducing amyloid beta (A $\beta$ ) aggregates**, which are characteristic for Alzheimer's disease (AD) pathology.



## Immune system

Immunomodulatory properties: modulating the immune system by **inducing production of both pro- and anti-inflammatory cytokines**, thereby playing role in maintenance of the immunological system homeostasis.



## Cardiovascular system

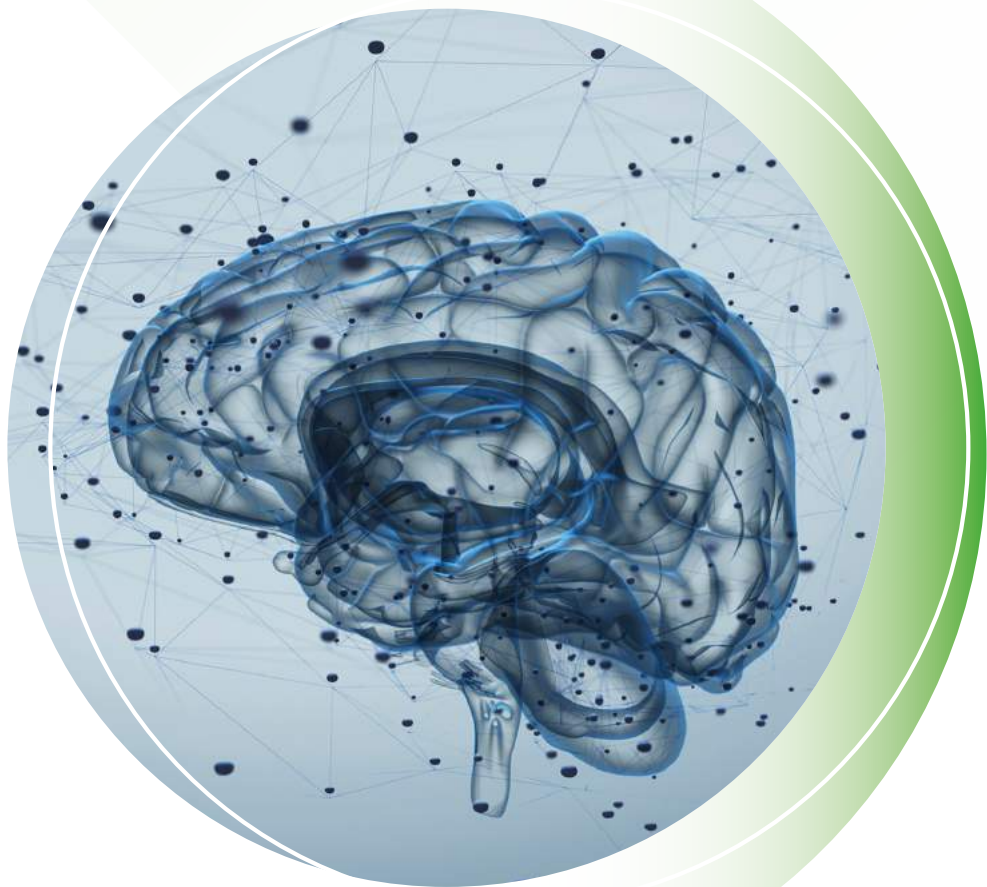
Antioxidant properties: inhibiting the nitric oxide (NO) production and therefore **protecting cells from oxidative stress and inflammation**.



# Improvement of cognitive skills

## Role of BDNF

Brain-derived neurotrophic factor (BDNF) is a specific protein found in human brain and periphery. BDNF plays a crucial role in differentiation and survival of neurons as well as long-term potentiation (LTP) and synaptic plasticity in the central nervous system (CNS). Synaptic plasticity is a biological process resulting in changes in synaptic strength that contribute to learning and memory. Therefore, BDNF is thought to be crucial for memory formation and cognitive functions.





## COLOCO® prp increases BDNF concentration in serum

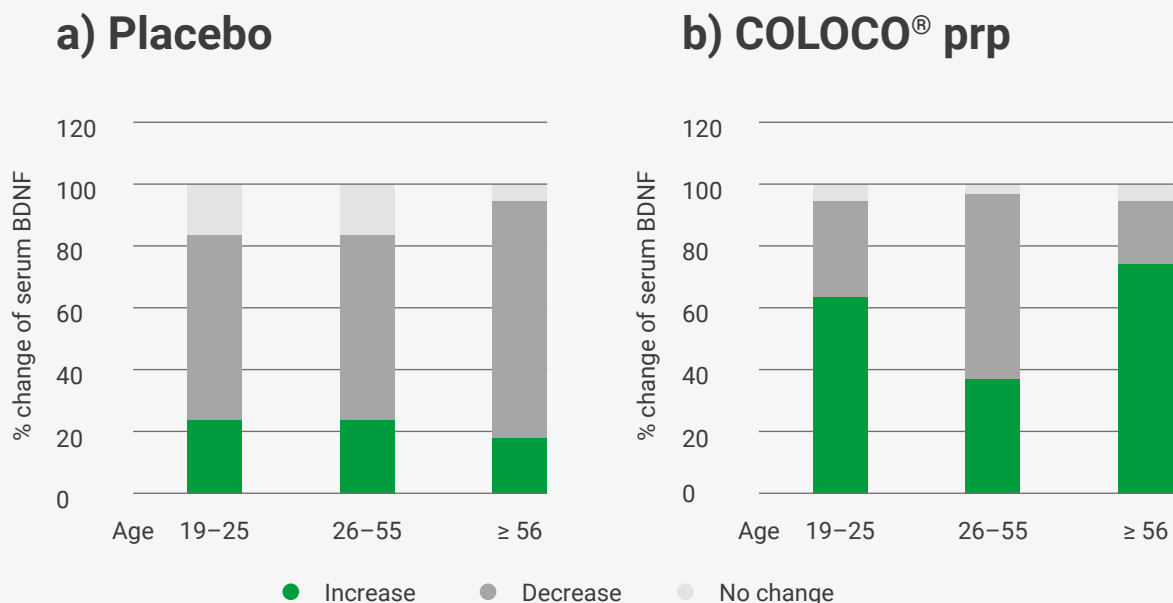
Geo-Poland conducted double-blind, placebo-controlled, randomized study on pro-cognitive effects of COLOCO® prp in three different targeted groups of healthy recipients.

BDNF level was measured in 137 healthy subjects (male and female) assigned to groups based on their age with enzyme-linked immunosorbent assay (ELISA). The participants were further divided into placebo and treatment groups.

**Figure 1** represents the study results as percentage of serum BDNF change in respective age groups (19-25, 25-55 and ≥55 years old). There is an increase in BDNF concentration in all age groups in participants treated with COLOCO® prp.

### Conclusion

COLOCO® prp increases BDNF level, being a valuable product for anyone who wants to **boost their cognitive skills**. Moreover, it helps to **prevent or attenuate the mild cognitive impairment (MCI) symptoms**.



**Figure 1.** Percentage change of serum BDNF level in three age groups (19-25, 26-55, ≥56 years old) with (a) Placebo and (b) COLOCO® prp treatment.



# Neuroprotection

## Alzheimer's disease

Alzheimer's disease (AD) is an irreversible and progressive neurodegenerative disease and the most common form of dementia. It might be caused by protein misfolding and aggregation of amyloid beta ( $A\beta$ ). AD is clinically characterized by memory and other cognitive abilities loss that eventually make it impossible to carry out even the simplest tasks. In most people with AD, first symptoms appear in their mid-60s. According to the "Alzheimer's Disease Facts and Figures" report prepared by the Alzheimer's Association® there are 5.7 mln Americans suffering from AD living in the United States in 2018 and it is predicted that this number will rise to 14 mln in 2050. Moreover, AD is 6th leading cause of death in the US. As of today, there is no cure for AD.

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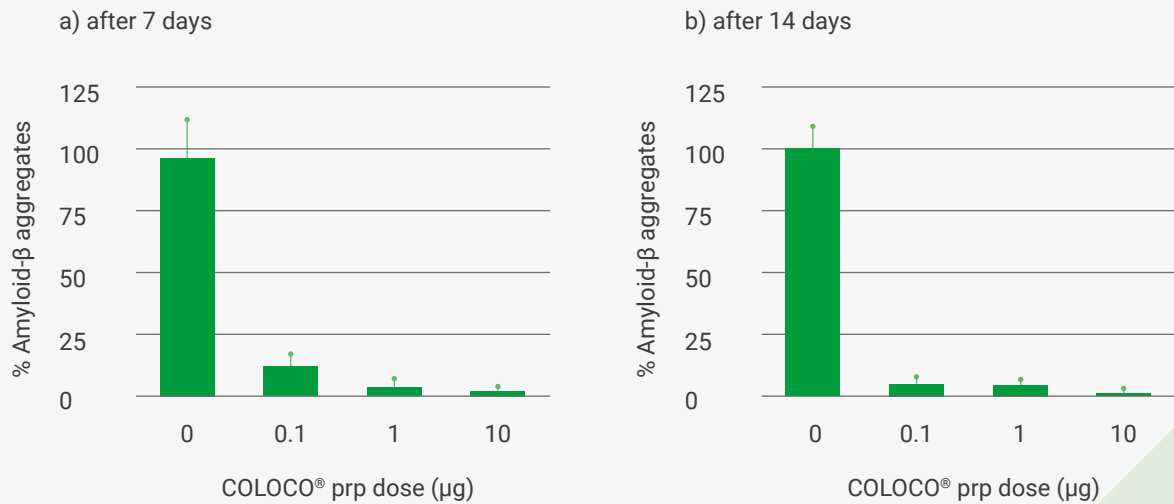
## COLOCO® prp inhibits and decreases amyloid beta aggregation

Geo-Poland in cooperation with Mossakowski Medical Research Centre Polish Academy of Sciences in Warsaw, conducted in vitro study to investigate the effect of COLOCO® prp on amyloid beta ( $A\beta$ ) aggregation.  $A\beta$  monomers were incubated with COLOCO® prp for 7 and 12 days. Under these conditions, COLOCO® prp prevented  $A\beta$  aggregation in a dose-dependent manner (**Figure 2**). Moreover, the concentration of preaggregated  $A\beta$  incubated in the presence of COLOCO® prp was significantly decreased after 5 days incubation period (**Figure 3**).



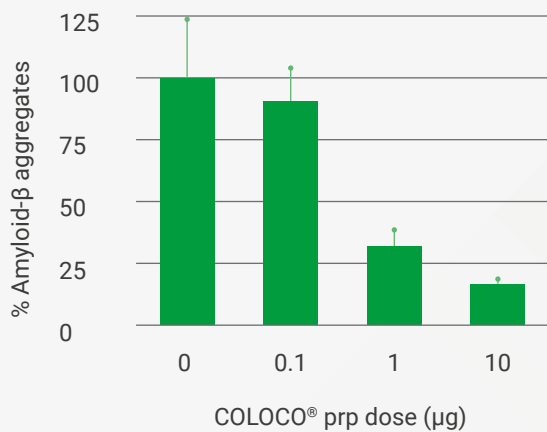


## Effect on A $\beta$ aggregates



**Figure 2.** Dose-dependent effect of COLOCO® prp on A $\beta$  monomers aggregation after (a) 7 days and (b) 14 days of incubation.

## Effect on preaggregated A $\beta$ fibrils



**Figure 3.** Dose-dependent effect of COLOCO® prp on preaggregated A $\beta$  fibrils after 5 days of incubation.

## Conclusion

COLOCO® prp inhibits aggregation as well as disrupts preaggregated amyloid beta (A $\beta$ ) fibrils and, therefore, can be applied in **preventive and supporting treatment of neurodegenerative diseases.**



# Immunomodulatory effect

## The importance of immune system

Immune system is extremely important for healthy life and it protects the human body from possibly harmful substances and pathogens such as bacteria, viruses, fungi and parasites. It is made up of complex network of cells, tissues and organs that work together to defend the body from infections. Lymphocytes, macrophages, white blood cells and cytokines are important for proper function of immune system.

## COLOCO® prp is immunologically active agent

PRPs' immunological function relates to their ability to modulate and stabilize many biological processes in the body, including immune cells stimulation and cytokine production.

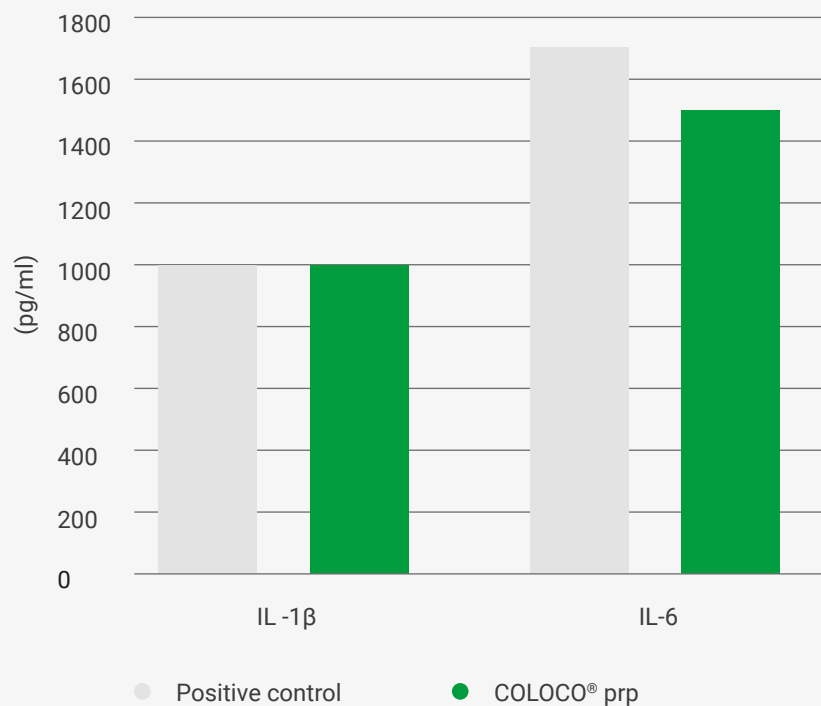
COLOCO® prp effect on pro-inflammatory cytokines: interleukin 1 beta (IL-1 $\beta$ ) and interleukin 6 (IL-6) production by peripheral blood mononuclear cells was examined in vitro with enzyme-linked immunosorbent assay (ELISA). The results were compared with positive control of phytohaemagglutinin/lipopolysaccharide (PHA/LPS). PHA and LPS are mitogens that trigger cell division (mitogenesis) and result in maximum concentration of interleukins.

**Figure 4** shows that COLOCO® prp induces secretion of IL-1 $\beta$  and IL-6.





## Effects of COLOCO® prp on cytokine production



**Figure 4.** The effect of COLOCO® prp on IL-1 $\beta$  and IL-6 production by peripheral blood mononuclear cells. The level of secreted IL-1 $\beta$  and IL-6 was determined by enzyme-linked immunosorbent assay (ELISA). PHA/LPS was used as a positive control. Results are a mean value from five independent assays.

## Conclusion

COLOCO® prp induces production of interleukins (IL-1 $\beta$  and IL-6), enhancing **health and proper functioning of the immune system.**



# Antioxidant properties

## Oxidative stress in neuropathological disorders

Oxidative stress is characterised by the imbalance between free radicals and antioxidants in the body. Free radicals, such as nitric oxide (NO) and reactive oxygen species (ROS), lead to oxidation reactions that can be harmful and cause damage to fatty tissue, DNA and proteins, driving the aging process and potentially the development of illness. Oxidative stress can be involved in development of many diseases, including diabetes, cancer, neurodegenerative diseases and cardiovascular diseases, such as coronary artery disease or atherosclerosis.

## COLOCO<sup>®</sup> prp as antioxidant

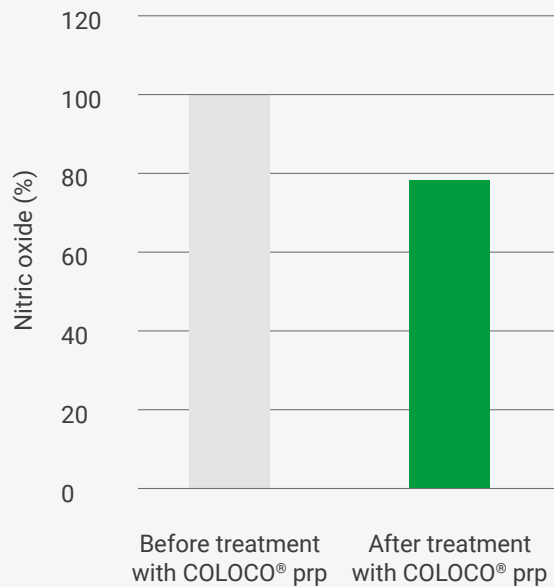
*In vitro* studies on peripheral blood mononuclear cells with COLOCO<sup>®</sup> prp proved its antioxidative properties. Nitric oxide (NO) production in cells was stimulated by lipopolysaccharide (LPS) mitogen. The level of NO before and after the treatment with COLOCO<sup>®</sup> prp was assayed using Griess reaction method. It was observed that COLOCO<sup>®</sup> prp inhibited production of NO by 21% (**Figure 5**).

Antioxidant capacity was further examined using Trolox equivalent antioxidant capacity (TEAC) method using ABTS radical cation. **Figure 6** shows the effect of COLOCO<sup>®</sup> prp and two reference products on ABTS radical cation concentration. Lower amount of ABTS free radical cation indicates higher antioxidant capacity.



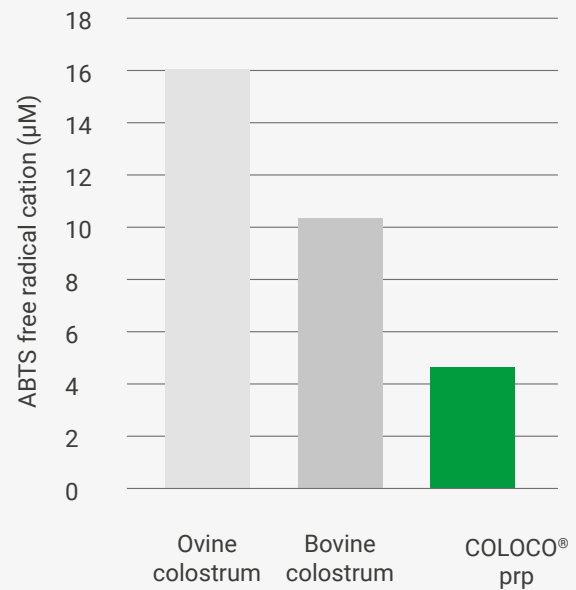


## Effect on production of nitric oxide free radical



**Figure 5.** The level of nitric oxide (NO) before and after treatment with COLOCO® prp. Decreased level of nitric oxide free radical indicates strong antioxidant properties.

## Antioxidant effect



**Figure 6.** Estimation of the antioxidant capacity of COLOCO® prp using Trolox equivalent antioxidant capacity (TEAC) method. Decreased level of ABTS free radical cation indicates strong antioxidant properties.

## Conclusion

COLOCO® prp acts as antioxidant agent and might **prevent cardiovascular diseases** as well as **slow down the aging processes**.



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# Notes

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