

# ***IONIPILEX***<sup>®</sup>

A clinically validated fulvic  
ionic mineral complex for:

cellular health and energy  
healthy blood glucose levels  
stronger hair, skin and nails



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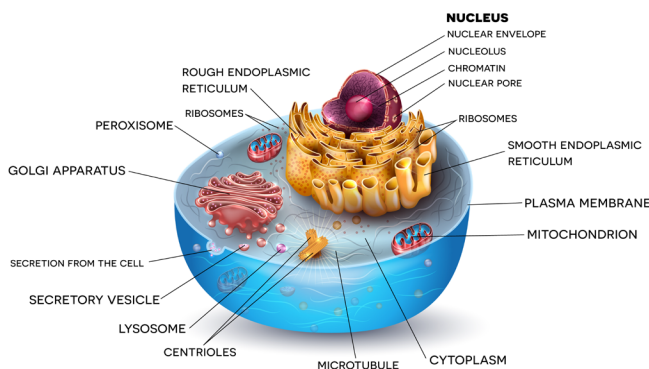
***40 years in business***

# Ioniplex® | a fulvic ionic mineral complex

## An Approach to Cellular Health and Energy

Ioniplex translocates rapidly through cellular membranes which makes it highly bioavailable<sup>1</sup>. Inside cells, it is capable of stimulating mitochondrial metabolism by up to 50%<sup>2</sup>. Thus, Ioniplex appears to protect and enhance cellular health in two distinct ways: by decreasing cellular damage from toxins and other contaminants, and by increasing the metabolic rate of mitochondria.

Fig. 1 | Anatomy of a Cell



## An Approach to Healthy Blood Glucose

Understanding blood glucose (sugar) begins with knowing how the body reacts to the types of food consumed. Blood sugar does not have to be elevated to diabetic levels in order to cause damage. Clinical studies reveal that even moderately increased blood glucose can lead to cellular damage, which is often irreversible<sup>3</sup>. Even in healthy individuals, blood glucose rises after consuming a meal, especially one that is heavy in

carbohydrates. These occurrences are known as post-prandial blood sugar spikes. Ioniplex helps reduce cellular damage caused by this excess glucose to better protect and enhance cells<sup>4</sup>.

## An Approach to Stronger Nails, Hair and Skin

The beauty and strength of nails, hair and skin depends on our bodies level of cellular health. Ioniplex has been shown to help the body generate Type I Collagen and rehydrate cells to create a more youthful appearance<sup>5</sup>. Ioniplex's ability to stimulate cells also promotes faster growth for hair and nails, while making them stronger<sup>6</sup>.

## About Ioniplex

Ioniplex is a proprietary fulvic ionic mineral complex, containing upwards of 65 major, minor and trace minerals, which are sourced from unique mineraloid veins located throughout North America.

Millions of years ago, these areas were lush with vegetation, that overtime, were compressed into the Earth, forming carbon-based compounds known as "humates" or "humic substances" that are rich in minerals and fulvic acid.

Mineral BioSciences® (MBS) carefully identifies, segregates and recovers this material and transports it to our state of the art facility in Goodyear, Arizona. Here it undergoes a patented extraction process<sup>7</sup> where the mineral rich fulvic material is extracted from the humic.

The resultant product is analytically tested for

quality assurance, then stored in bulk to eventually be bottled or dehydrated into a water-soluble powder, for use in a broad spectrum of health and personal care products.

## Ioniplex & Fulvic Acid

Ioniplex contains naturally occurring fulvic acid, the result is an ionic material full of electrolytes, macro and micro-nutrients for optimal health. Some of the benefits of fulvic acid are: enhanced nutrient absorption, improved immune support and performance as a chelation agent.

## Ioniplex & Bioavailability

bi • o • a • vail • a bil • i • ty  
 /, bīō, əvālə 'bilədē/  
 noun

the proportion of a substance that enters the circulation when introduced into the body and so is able to have an effect.

The effectiveness of any mineral supplement depends on its bioavailability. For example, Calcium is available in many forms (calcium citrate, calcium carbonate, oyster shell calcium etc.) each with varying levels of bioavailability, all of which deliver only fractions of the labeled ingredient to target organs. Ioniplex is classified as highly bioavailable, thus allowing it to penetrate through cellular membranes and deliver its full impact to metabolic sites within cells.

### Description of Test: Bioavailability<sup>1</sup>

Report 697-BIOAV

To study bioavailability, human cells were incubated with Ioniplex to measure:

**Binding:** The binding of Ioniplex to cells.

**Intracellular Delivery:** The delivery of Ioniplex within cells, using cell-permeant mineral binding dye (Mg-Green AM).

**Intracellular Detoxification:** The detoxification properties of Ioniplex within cells using cell-permeant mineral binding dye (Calcein AM). In the first experiment, cells were incubated with either 5% Ioniplex or double-distilled water for 45 minutes, followed by rinsing. Cells were observed with an epifluorescence microscope, in order to visualize and capture the intrinsic fluorescence of Ioniplex.

## Results

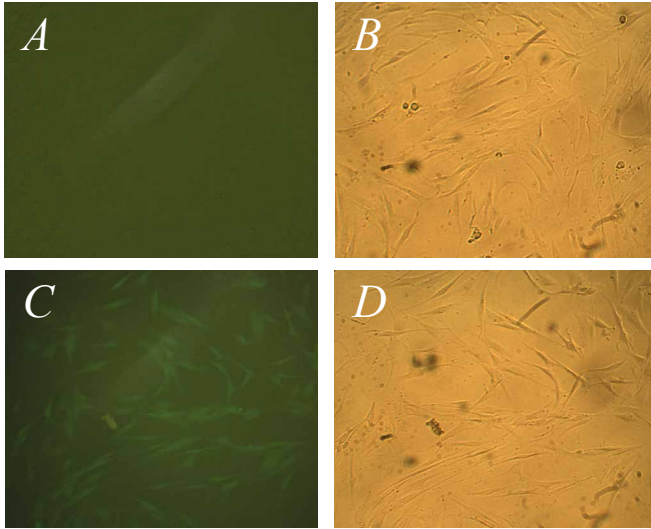
**Binding:** When cells were rinsed and subjected to fluorescence quantification, it was found that the signal in the Ioniplex treated cultures was over 10 times higher than the treated controls. Therefore, it can be concluded that Ioniplex associates with cells or cell membranes - a strong indication of its bioavailability.

**Intracellular Delivery:** The quantification of Mg-Green AM fluorescence, which is proportional to the concentration of intracellular magnesium, showed an overall increase in Ioniplex in treated cell populations.

**Intracellular Detoxification:** Microscopic observations of the Calcein AM-loaded cells revealed an increase of Calcein fluorescence in the Ioniplex-treated cells. Calcein AM fluorescence increases when the amount of pro-oxidant ions such as cobalt, nickel, iron, and copper decreases. Pro-oxidants induce oxidative stress, therefore, the intracellular increase of Calcein AM in Ioniplex treated cells demonstrates Ioniplex's detoxification / scavenging activity. Together, these results indicate that Ioniplex is a bioavailable vehicle capable of binding cells, delivering ionic mineral payloads inside cells, while detoxifying them by chelating pro-oxidative ions (Fig. 2).

Fig. 2 | Bioavailability Panels

Epifluorescent (left panels) and corresponding bright-field (right panels) images of Calcein AM-loaded control (A,B) and Ioniplex-treated (C,D) human cells. Note the appearance of fluorescent signal in Ioniplex-treated cells, suggestive of calcein de-quenching. Mag x40.



would increase metabolic activity in the mitochondria, more so than the standalone product, which acted as the control. To test this theory, cells were incubated either with only Ensure or with Ensure and Ioniplex.

## Results

Cells incubated with only Ensure (Fig 3 - Panel B) generated less metabolic activity than cells incubated with Ensure and Ioniplex (Fig. 3 - Panel D). Furthermore, when added, Ioniplex stimulated the expressions of genes that aid in muscle contraction and motility (measured by quantitative PCR).

## Ioniplex & Mitochondrial Health

mi • to • chon • dri • a  
/ ˌmɪdə ˈkændrēən/  
plural noun

Mitochondria are an integral part of a cell and are responsible for metabolizing, or breaking down, carbohydrates and fatty acids in order to generate energy.

Mitochondrial health and metabolism is essential for the healthy condition of the body, since mitochondrial metabolic activity and number decreases with age. Several in vivo studies have shown Ioniplex's ability to promote mitochondrial metabolism. These results are consistent with the notion of Ioniplex having beneficial activity towards maintaining mitochondrial health.

Finally, the gene expression profiling of Ioniplex treated cells revealed an overwhelming stimulation of genes involved in aerobic energy production.

### Description of Test: Mitochondrial Metabolism<sup>8</sup>

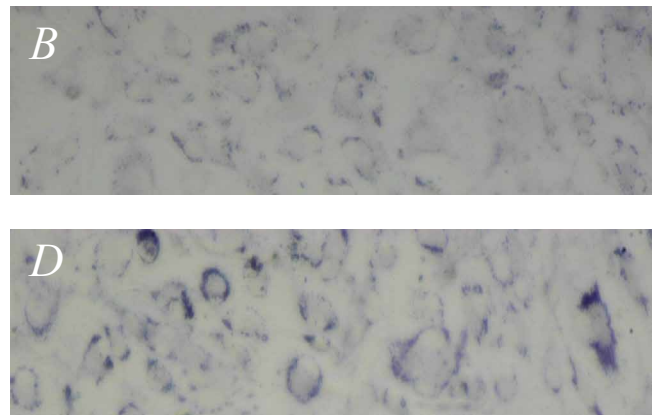
Report 466A

Ioniplex was added to the popular muscle enhancement product, Ensure<sup>®</sup> to determine if it

Fig. 3 | Mitochondrial Panels

Effect of Ensure (top panel) on metabolic activity in mitochondria of human skeletal muscle cells. Cells incubated with Ensure generated less metabolic activity than cells incubated with Ensure and 200 microg of Ioniplex (bottom panel).

Note panels B and D show bright field illumination. Magnification x40 with Nikon Eclipse TS100 inverted microscope.



### Description of Test: Mitochondrial Metabolism<sup>2</sup>

Report 439

An additional study utilized the colorimetric assay to determine the effects of Ioniplex on mitochondrial metabolism. This test compared the effects of different dosages of Ioniplex with

two leading energy drinks, No Fear<sup>®</sup> and Full Throttle<sup>®</sup>.

## Results

Among test materials, Ioniplex achieved the greatest stimulation, (over 50% at certain concentrations), and was above or on par with No Fear and Full Throttle.

Finally, in a cell-based DNA microarray study, where the expression of over 20,000 genes was measured in the absence or presence of Ioniplex, it was established that Ioniplex stimulates a whole array of genes involved in mitochondrial metabolism respiration and ATP production<sup>4,9</sup>.

Taken together, these results are consistent with the notion of Ioniplex having beneficial activity towards maintaining mitochondrial health.

## Ioniplex & Glycation Defense

gly • ca • tion  
/glai 'keɪʃən/  
noun

Glycation (sometimes called non-enzymatic glycation) is a chain of reactions that results in the cross-linkage of sugars with macromolecules, such as proteins and lipids. These cross-linked macromolecules are called Advanced Glycation End-products (AGEs).

In the human body, non-enzymatic glycation often results in alterations of the physiochemical properties of macromolecules, triggering undesirable processes, such as inflammation. In fact, AGEs are markers of physiopathologies such as diabetes and atherosclerosis, and are associated with the aging and photo-aging processes.

Ioniplex may increase metabolic activity by re-routing excess glucose (that would, otherwise, create Advanced Glycation End-products) out of the bloodstream into the cells. The direct result of that action is a decrease in the amount of

excess glucose available to mutate into AGEs, which consequently, leads to a decrease in glycation. To confirm, the following studies were conducted.

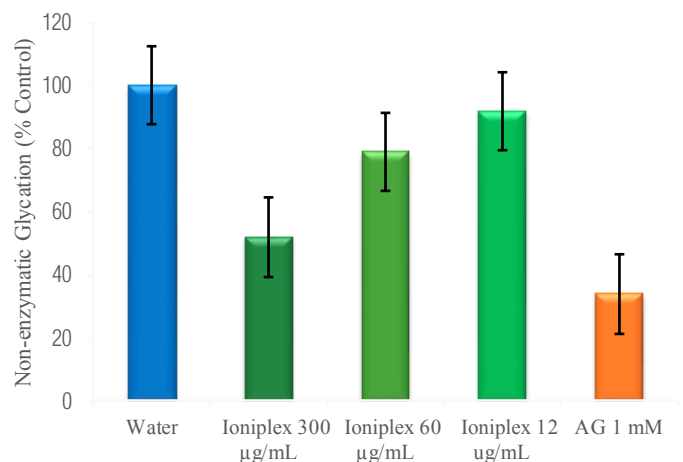
### Description of Test: AGE Inhibition<sup>10</sup> Report MX3

This test measured the inhibition of AGEs using Ioniplex at different doses in comparison to a negative control (water) and a positive control (aminoguanidine). Aminoguanidine is a medicinal inhibitor of non-enzymatic glycation.

## Results

Various batches of Ioniplex triggered up to a 50% decrease of AGEs, which directly correlates to a decrease in the levels of glycation within the body (Fig. 4). These results conclude that Ioniplex has the ability to inhibit AGEs in a dose-dependent manner comparable with aminoguanidine.

Fig. 4 | Inhibition of AGEs



### Description of Test: AGE Inhibition<sup>11</sup> Report AD070618

To validate the inhibition properties of Ioniplex, a second study was performed to determine if the results could be replicated.

A quantitative glycation assay based on the measure of Advanced Glycation End-products in proteins was performed. In this protocol, confluent cells are inactivated prior to the labeling experiment. In this model, glycation occurs in mature deposited collagen fibers.

## Results

Ioniplex was tested at different dosages against a control (water) and a reference (aminoguanidine). All dosages of Ioniplex showed a decrease in AGEs.

From these results, Ioniplex was patented as an anti-glycation agent to help prevent the occurrence of glycation within the body<sup>12</sup>.

## Ioniplex & Healthy Blood Glucose

blood • glu • cose  
/bləd/ /glōōkōs/  
noun

Blood sugar, or blood glucose, is the main sugar that the body makes from the food in a person's diet. Glucose is carried through the bloodstream to provide energy to all cells in the body. However, too much glucose in blood can cause serious health issues.

Another effect from the re-routing of excess glucose to the cells and away from the potential for glycation is less glucose present in the bloodstream. Mineral BioSciences is conducting wide ranging human studies to further confirm this process.

Preliminary data suggests Ioniplex positively affects glucose management. Previously an in vitro study was conducted with diabetic mice at the Molecular Medicine Research Institute.

### Description of Test: Anti-Diabetic Effects<sup>4</sup> Report 359

This project aimed to determine the effects of

Ioniplex in drinking water on genetically diabetic mice over a period of four weeks. There were two groups that received different dosages of Ioniplex as well as a control group. Water consumption, body weight, blood glucose, glycated hemoglobin and other body chemistry parameters were tested.

## Results

Water Consumption: Water consumption between groups was not significantly different.

Body Weight: All groups gained weight during the duration of the experiment. The group drinking 2% Ioniplex gained 6% less weight and the group drinking 10% Ioniplex gained 23% less weight than the control group.

Blood Glucose: All groups registered an increase in glucose levels in the blood, however this increase was reduced by approx. 60% in both groups drinking Ioniplex.

Glycated Hemoglobin (HbA1c): The Ioniplex groups registered a 3.5% decrease in the amount of glycated hemoglobin compared to the control.

Among blood chemistry parameters tested, alkaline phosphatase (AP) and albumin/globulin (A/G) ratio were significantly flexed towards non-diabetic levels.

Alkaline Phosphatase (AP): Decreased by approx. 15% by both Ioniplex treated groups. The decrease in AP may be associated with an improvement in diabetic condition, as increased AP has been long known to be a feature of diabetes mellitus<sup>13</sup>.

Albumin/Globulin (A/G): Increased in a dose dependent manner by 22% (2% Ioniplex) and 35% (10% Ioniplex). An increased ratio of A/G may indicate an attenuation of the prothrombotic environment, characteristic to the physiopathology of diabetes<sup>13</sup>.

All other parameters remained unchanged (with-

in 5% of the control), except blood urea nitrogen (BUN), which was moderately increased in the 2% Ioniplex-treated group, and whose significance is unclear, because it was not reproduced in the 10% Ioniplex-treated group.

Taken together, these results demonstrate that administration of Ioniplex in drinking water had multiple beneficial effects on the diabetic animals. These effects included significantly reduced growth of body weight and blood sugar, as well as improved alkaline phosphate and albumin/globulin levels.

### Description of Test: Glucose Management<sup>14,15</sup>

Report 697-DIAB / Report 809HbA1c

To determine if the results in the in vivo study conducted on diabetic mice could be replicated in an in vitro study. This test sought the effect of Ioniplex consumption on the blood glucose and glycated hemoglobin of an elderly diabetic patient medicated for hyperglycemia with Metformin.

Hyperglycemia (high blood glucose content) is a hallmark of Type 2 diabetes and a physiopathological effector in this disease. Metformin is one of the most common first-line medications prescribed for lowering hyperglycemia in diabetic patients.

### Results

Fasting Blood Glucose: Ioniplex was supplemented at 20 ml/day while maintaining the original Metformin dosage (1 gram/day) which resulted in rapid decrease of fasting blood sugar from an average of 112mg to 92mg.

While maintaining the Ioniplex, Metformin was decreased by 25%. This resulted in the fasting blood glucose sugar level to rise back to the starting average (112mg). However, this indicates that Ioniplex removed the need for 25% of the Metformin medication.

Further improvement of blood glucose levels were observed when the Ioniplex dosage was increased from 20 ml/day to 40 ml/day. This change allowed the Metformin dose to be decreased by another 25%. The result was a blood sugar drop from 112 mg to 105mg. This represents a decrease of about 7% in fasting blood glucose levels and a 50% reduction in medication.

Glycated Hemoglobin: In another clinical case study, HbA1c, also referred to as “glycated hemoglobin”, of the study subject was found to decrease proportionally to the length of the patients’ Ioniplex supplementation.

HbA1c levels were tested multiple times during this 17 week study, at every testing, glycated hemoglobin levels were reduced.

## Ioniplex & Hair, Nails & Skin

### Description of Test: Collagen Stimulation<sup>5</sup> Report 400

col • la • gen  
/käləjən  
noun

Collagen is the main structural protein found in skin and other connective tissue. Type I Collagen is the most abundant collagen found in the human body and supports skin, muscle, bone health, hair and nail growth and maintenance.

Collagen decreases during skin aging and new collagen formation is considered an important activity in wound healing and skin care. This study was meant to detect increases in soluble Type I Collagen in a human dermal fibroblast through Ioniplex application.

### Results

Ioniplex was repetitively shown to stimulate Type I Collagen in the fibroblast cells, some results reported as much as **quadruple collagen stimula-**

tion when compared to the control (water). As the level of stimulation depends on the cells used, the average stimulation observed was approximately 30%.

### Description of Test: Hair, Nails & Skin<sup>6</sup> Report 3411BK0609

To assess the effects of Ioniplex at different dosages on nail strength and growth, in addition to hair appearance, luster, thickness and skin condition. The study was conducted over six weeks in a randomized, double-blind, placebo controlled evaluation using three groups of healthy females with at least ten subjects in each group.

Two of the groups received Ioniplex “A” or Ioniplex “B” (Ioniplex at different dosages), and one group received water and flavoring as the Control.

Nail, hair and skin conditions were evaluated visually by an expert evaluator and subjectively by panelists. Nail growth was measured instrumentally using digital photography and subsequent image analysis.

### Results

Nail Growth: Percent change as a function of time was observed to be 142% (Ioniplex “A”), 141% (Ioniplex “B”) and 129% (Control)

Nail Strength: Ioniplex “A” affected significant increases in mean nail strength at week six relative to baseline values.

Hair Appearance and Luster: Ioniplex “A” and Ioniplex “B” affected significant increases in the overall appearance of hair. Ioniplex “B” also significantly changed hair luster.

Hair Thickness and Condition: Ioniplex “A” significantly improved hair thickness at week six and hair condition with 14% overall improvement.

Skin Texture: Ioniplex “A” showed improvement in

skin texture at week six compared to the baseline, with an overall improvement of 33%.

## Ioniplex & Prebiotics

pre • bi • ot • ic  
/prēbīātik/  
noun

Prebiotics are nondigestible food ingredients that promote the growth of beneficial microorganisms.

### Description of Test: Prebiotic for Skin<sup>16</sup> Report 912.2

The aim of this project was to investigate the potential of Ioniplex for use as a selective prebiotic for skin commensal bacteria.

Skin and digestive system are two organs in our body, which host a major population of commensal microorganisms. These microorganisms provide crucial support for vital functions of these organs, and their decline due to competition from infectious pathogens contribute to a diverse range of diseases. At the level of the skin, these can range from pruritic, inflammatory conditions such as dermatitis to psoriasis and serious skin infections, like cellulitis.

Ioniplex may be a potential prebiotic due to its track record of beneficial effects on the interaction between plants and their commensal microbiomes. Ioniplex is also a slow-release calcium reservoir, potentially capable of releasing enough calcium on skin to inhibit the growth of pathogenic bacteria such as *S. aureus*, while promoting the restoration of this ion’s natural gradient in the epidermis.

*S. aureus* and *S. epidermidis* were grown in bacterial medium, after reaching the plateau growth phase microorganisms were diluted 1/1000 in phosphate buffered saline solution (PBS).

Each bacterial strain was seeded either in PBS alone or in PBS supplemented with 0.1% Ioniplex



in K43 medium. After 24h bacterial metabolic activity proportional to bacteria numbers was then assessed. The absorbance of the blue color of formazan proportional to the metabolic activity of the microorganisms was quantified.

## Results

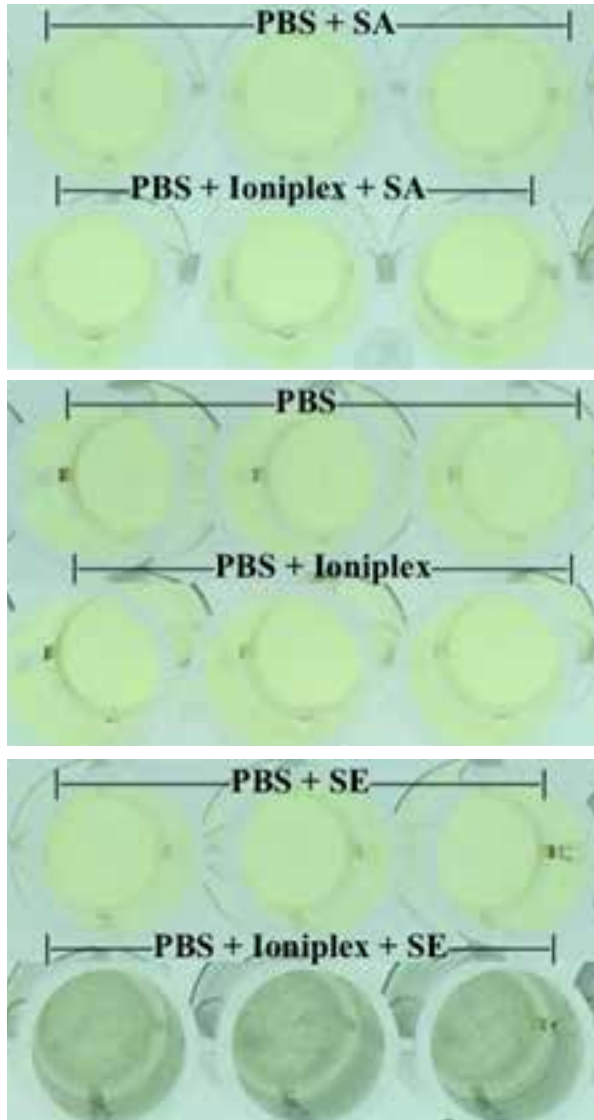


Fig. 5 | Prebiotic Panels

*S. epidermidis* and pathogenic *S. aureus* bacteria cultured in PBS.

Note darker color, indicative of viability for the commensal (SE) but not the pathogen (SA), when supplemented with Ioniplex.

Neither bacterium grows in PBS alone, providing the technical validation of the experiment.

Figure 5 shows that while the pathogenic bacterium *S. aureus* does not grow in 0.1% Ioniplex. In contrast, the commensal bacterium *S. epidermidis*, shows measurable growth in 0.1% Ioniplex.

None of the microorganisms tested grows in PBS alone, demonstrating the selective prebiotic effect of Ioniplex for the skin-friendly commensal but not pathogenic bacteria.

## Ioniplex & CBD

c • b • d  
/cbd/  
noun

Cannabidiol (CBD) is an active ingredient in cannabis derived from the hemp plant. It may help treat conditions like pain, insomnia, and anxiety.

## Description of Test: Epithelial Absorption Potential of Cannabidiol in the Presence or Absence of Ioniplex<sup>17</sup>

Report 1030PAMPA-HPLC

To assess the effects of Ioniplex as a carrier for Cannabidiol or CBD, researchers conducted a study on the absorption rate or bioavailability of CBD through a topically application. Its application through the skin is very popular due to its non-antioxidative, anti-inflammatory, neuroprotective and anti-anxiety properties. Penetration of the stratum corneum or outer layer of the skin (epidermis) was studied.

A Parallel Artificial Membrane Permeability Assay (PAMPA) membrane model showed a high degree of correlation with epithelial permeability. The PAMPA assay with pure CBD (99.9%) as a control was tested along with varied Ioniplex ratios (1:1 and 1:2 ratios of CBD to Ioniplex). The permeated CBD in the assay was analyzed using the Agilent HPLC series 1100. At the 1:2 ratio of CBD to Ioniplex, meaningful and effective CBD epithelial permeation could be detected (Fig 1) compared to CBD alone, wherein no permeation was detected. The permeated CBD assisted by

the Ioniplex was enough to elicit proximal bioactivity.

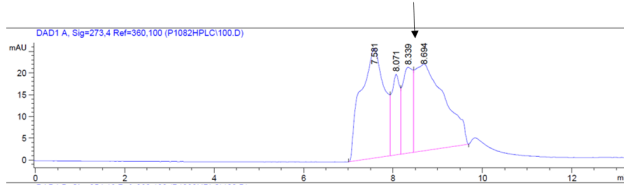


Fig 1| CBD detection in the PAMPA permeation assay using HPLC

Illustrated is the elution profile of CBD permeate as shown by the arrow (CBD peak) from CBD:Ioniplex (1:2) 5000ppm:10,000ppm treatment ratios. Agilent HPLC series 1100 (Agilent Technologies, Palo Alto, CA) station equipped with the Autosampler G1313A, Zorbax SB-C8 reverse phase column, diode array UV/Vis detector was used with Chemstation software and detection was at 273nm (A273nm).

## Conclusion

Several clinical studies have shown that Ioniplex is a safe, bioavailable mineral complex with specific properties in: mitochondrial metabolism, glycation defense, maintaining healthy blood and improving how we look and feel. This makes Ioniplex an attractive addition to dietary supplements, functional foods, and personal care products, especially those with a focus on cellular health and/or sugar related issues.

## References

All internal reports are available upon request.

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<sup>2</sup>Bojanowski, K. (2006). Report 439: Effects of Ioniplex, No Fear and Full Throttle on Mitochondrial Metabolism. Sunny BioDiscovery. Internal Report.

<sup>3</sup>Gilmore RM, Stead LG. The Role of Hyperglycemia in Acute Ischemic Stroke. *Neurocrit Care.* 2006;5 (2) :153-8.

<sup>4</sup>Deneau, J. et al. (2011, January). Anti-Diabetic Activity of a Mineraloid Isolate, invitro and in Genetically Diabetic Mice. *International Journal of Vitamin*

and Nutrition Research, 81(1).

<sup>5</sup>Bojanowski, K. (2010). Report 400: Effect of Ioniplex on Type 1 Collagen Levels. Sunny BioDiscovery. Internal Report.

<sup>6</sup>Boisits, E. (2009). Report 3411BK0609: A Six Week Study of Ioniplex on Nail Condition. International Research Services. Version 1.5.

<sup>7</sup>US Patent 9044417

<sup>8</sup>Bojanowski, K. (2011). Report 466A: Effect of Commercial Formulations with and without Ioniplex on Metabolic Activity. Sunny BioDiscovery. Internal Report.

<sup>9</sup>Bojanowski, K. (2008). Report 312A: Gene Expression in Cells Treated by Ioniplex. Sunny BioDiscovery. Internal Report.

<sup>10</sup>Bojanowski, K. (2007). Report MX3: Effect of Ioniplex on Advanced Glycation End-products. Sunny BioDiscovery. Internal Report.

<sup>11</sup>Juchaux, F. (2007). Report AD070618: Effects of Ioniplex on Non-Enzymatic Glycation. BIOalternatives. Internal Report.

<sup>12</sup>US Patent 8927031

<sup>13</sup>Goldberg, D.M., Martin, J.V., and Knight, A.H. (1977). Elevation of serum alkaline phosphatase activity and related enzymes in diabetes mellitus. *Clin. Biochem.* 10, 8.

<sup>14</sup>Bojanowski, K. (2015). Report 697-DIAB: Effect of Ioniplex on Glucose Levels in a Diabetic Patient. Sunny BioDiscovery. Internal Report.

<sup>15</sup>Bojanowski, K. (2016). Report 809HbA1c: Effect of Long Term Ioniplex Supplementation in a Diabetic Patient. Sunny BioDiscovery. Internal Report.

<sup>16</sup>Bojanowski, K. (2018). Report 912.2 Prebiotic: Ioniplex as a Selective Prebiotic for Skin Commensal Bacteria. Sunny BioDiscovery. Internal Report.

<sup>17</sup>Bojanowski, K. (2020). Report 1030PAMPA-HPLC Epithelial Absorption Potential of Cannabidiol in the Presence or Absence of Ioniplex, using the Millipore PAMPA Membrane Model. Internal Report.

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## About Mineral BioSciences

Mineral BioSciences, is a division of the Global Organics® Group, and is focused on human and animal wellness. For more than 20 years, we have been producing nutrient-rich mineral complexes for our domestic and international customers. Formulated using patented technology and refined state of the art, USDA certified facilities, our products are Generally Recognized as Safe (GRAS) Affirmed and Kosher Certified.

Subscribing to our corporate motto “Nature Knows Best”, and working in concert with our Integrated Life Science Research Center® (ILSRC), Mineral BioSciences continues to identify new and innovative applications of life enhancing mineral formulations for plants, animals and humans.

[www.mineralbiosciences.com](http://www.mineralbiosciences.com)  
[www.ioniplex.com](http://www.ioniplex.com)  
[www.protectcells.com](http://www.protectcells.com)

## Mineral List

Ioniplex has over 65 minerals in its formulation, including:

**Guaranteed Composition:** Fulvic Acid, Antimony, Sulfur, Barium, Boron, Calcium, Chromium, Cobalt, Iodine, Lanthanum, Magnesium, Manganese, Molybdenum, Neodymium, Phosphorus, Potassium, Rubidium, Selenium, Silicon, Silver, Sodium, Vanadium, Zinc, and Zirconium.

**Additional Composition:** Carbon (Total Organic), Iron, Copper, Germanium, Gold, Platinum, Sulfur, Fluoride, Niobium, Iridium, Strontium, Titanium, Palladium, Tungsten, Tin, Rhenium, Nickel, Lithium, Gallium, Yttrium, Bismuth, Hafnium, Cadmium, Thorium, Cerium, Tellurium, Beryllium, Samarium, Dysprosium, Erbium, Indium, Scandium, Ruthenium, Tantalum, Rhodium, Thulium, Thallium, Holmium, Ytterbium, Terbium, Lutetium, Gadolinium, Europium, and Praseodymium.

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