

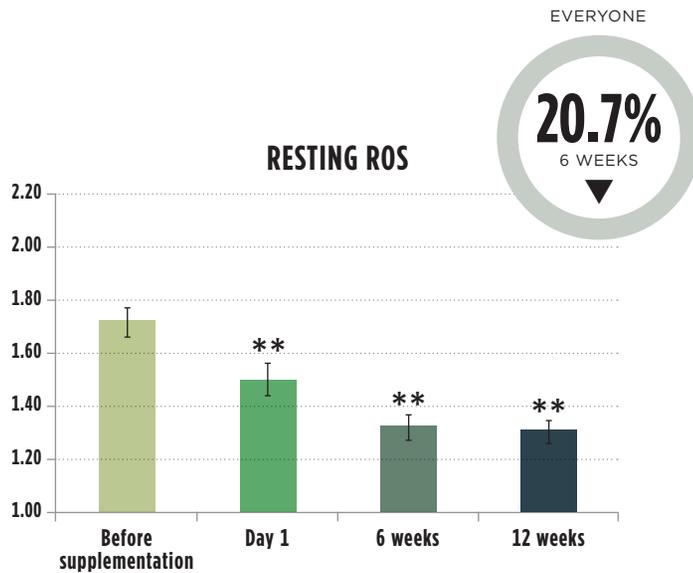
The Freiburg Study

Preliminary Findings

- **Free Radicals and Oxygen Metabolism**
- **Mitochondrial Free Radicals**
- **Inflammation** (hs-CRP)
- **Blood Lipids** (Cholesterol, Triglycerides)
- **Blood Pressure** (Systolic, Diastolic, Nitric Oxide)
- **Energy Utilization** (Heart Rate)
- **Sugar Metabolism** (Blood Glucose, HbA1c, HOMA)

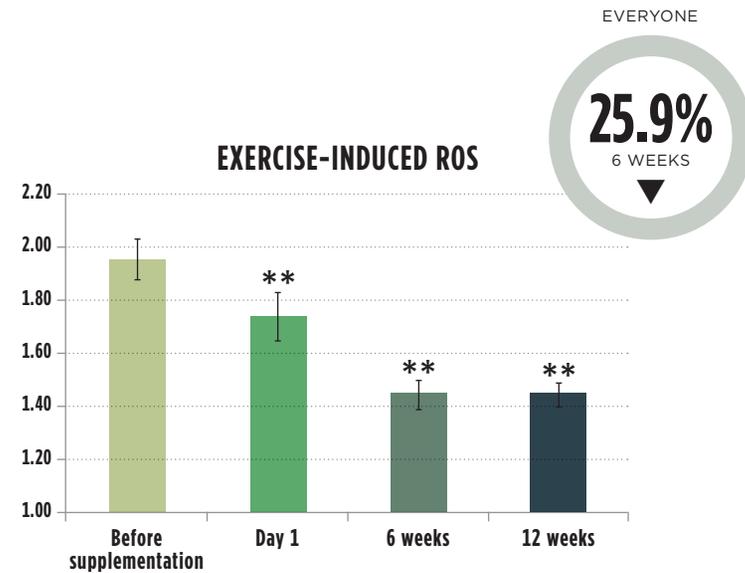
Free Radicals and Oxygen Metabolism: Resting vs. Exercise

In the study, free radicals were measured as Reactive Oxygen Species (ROS). After just one hour, study subjects recorded a 10% reduction in ROS during exercise. After six weeks of supplementation, the 48 subjects recorded an average of a 20.7% reduction in ROS while resting. This number dropped to an average 25.9% reduction in ROS during exercise.



	RESTING ROS 1 HOUR			
Resting	Control	Day 1	6 weeks	12 weeks
Average	1.71	1.51	1.35	1.33
t-test		< 0.001	< 0.001	< 0.001
% Change		-11.6%	-20.7%	-21.8%

Paired two samples for means

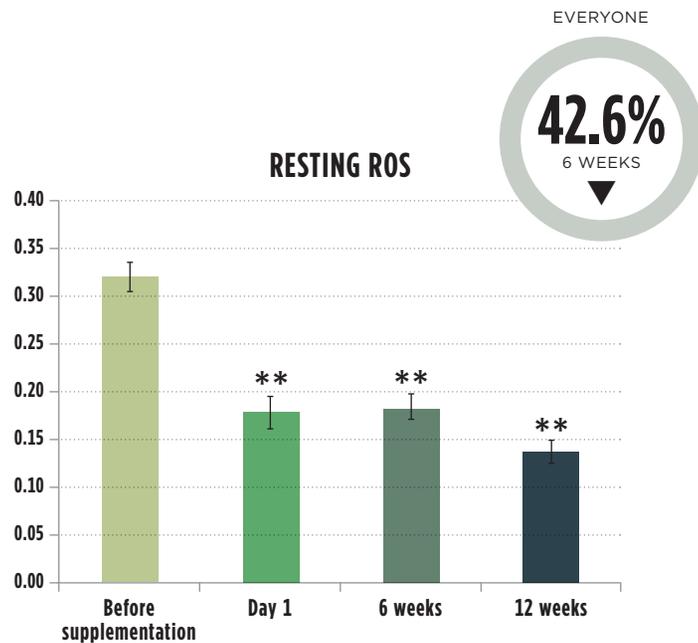


	ROS DURING EXERCISE 1 HOUR			
Exercise	Control	Day 1	6 weeks	12 weeks
Average	1.94	1.74	1.44	1.43
t-test		< 0.001	< 0.001	< 0.001
% Change		-10.2%	-25.9%	-26.3%

Paired two samples for means

Mitochondrial Free Radicals: Before and After Exercising

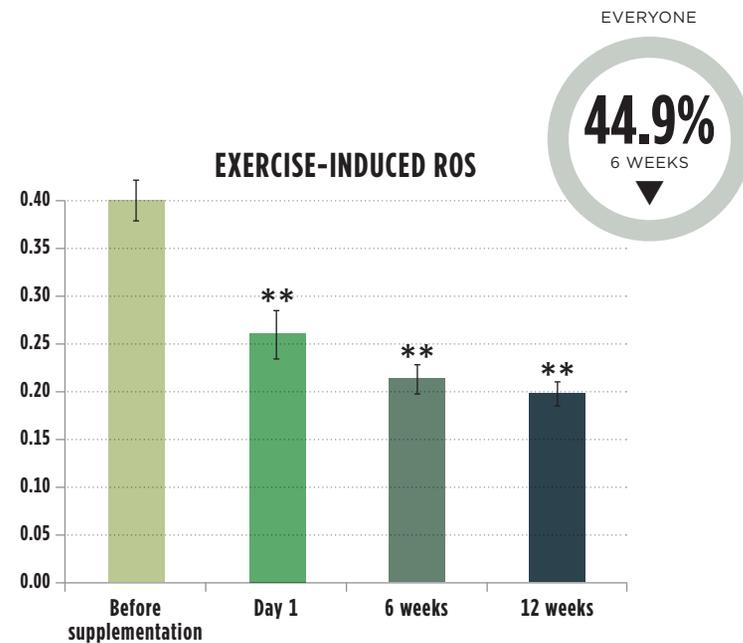
Mitochondria are the energy centers of the cell. Free radicals interfere with mitochondrial function. A reduction in free radicals in mitochondria increases the efficiency of energy production.



RESTING ROS 1 HOUR

Resting	Control	Day 1	6 weeks	12 weeks
Average	0.32	0.18	0.18	0.14
t-test		< 0.001	< 0.001	< 0.001
% Change		-45.2%	-42.6%	-55.9%

Paired two samples for means



ROS DURING EXERCISE 1 HOUR

Exercise	Control	Day 1	6 weeks	12 weeks
Average	0.40	0.26	0.22	0.20
t-test		< 0.001	< 0.001	< 0.001
% Change		-36.1%	-44.9%	-50.4%

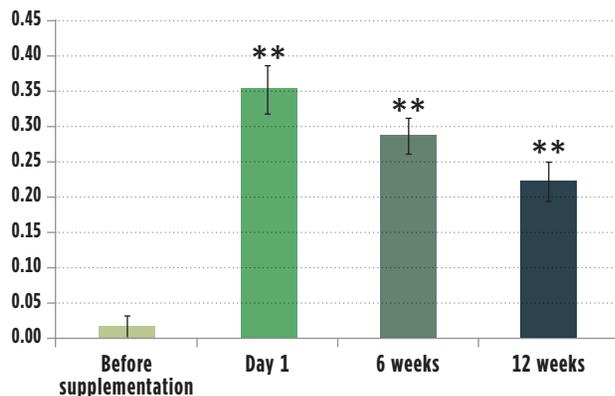
Paired two samples for means

Inflammation

A 35.8% improvement in inflammation resistance was recorded just one hour after taking the supplements for the very first time.



RESISTANCE TO INDUCED INFLAMMATION



RESISTANCE TO INDUCED INFLAMMATION

Resistance	Control	Day 1	6 weeks	12 weeks
Average	0.02	0.03	0.03	0.03
t-test		< 0.001	< 0.001	< 0.001
% Change		35.8%	28.7%	22.1%

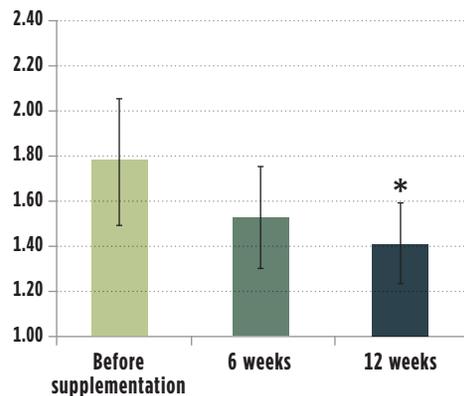
Paired two samples for means

Inflammation: hs-CRP

After 12 weeks of supplementation, the reduction in inflammation response was much greater. Subjects who had higher hs-CRP, but within normal range, recorded a significant 34.1% reduction in hs-CRP.



hs-CRP EVERYONE



hs-CRP

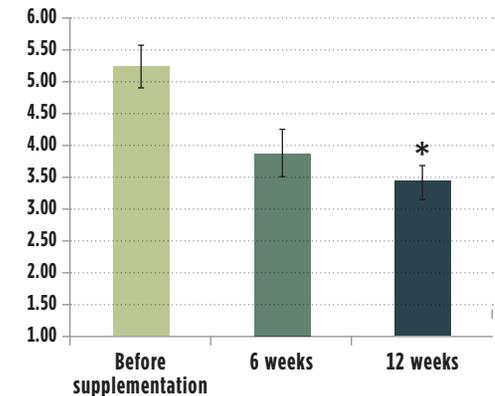
Everyone	Control	6 weeks	12 weeks
Average	1.79	1.53	1.41
t-test		ns	0.024
% Change		-14.6%	-21.3%

Paired two samples for means

HEALTHY BUT ELEVATED



hs-CRP HEALTHY BUT ELEVATED (>3.0)



hs-CRP

Elevated >3.0	Control	6 weeks	12 weeks
Average	5.25	3.82	3.46
t-test		ns	0.002
% Change		-27.2%	-34.1%

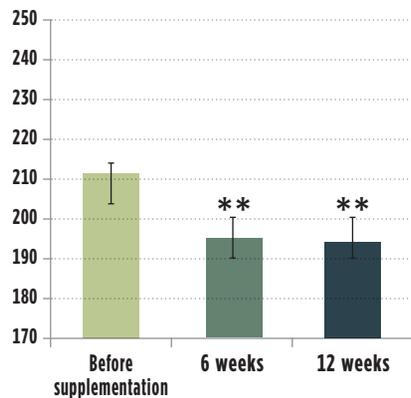
Paired two samples for means

Blood Lipids: Total Cholesterol

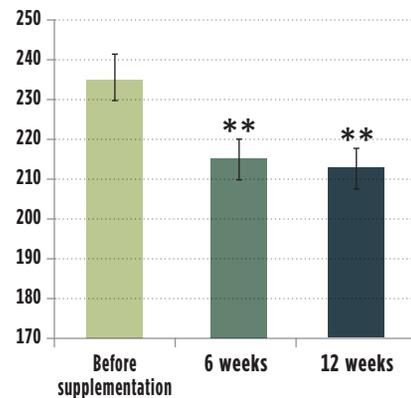
The 48 subjects recorded an average 7.5% reduction in total cholesterol in their blood, bringing the average down to within the ideal range. It's interesting to note that those subjects whose cholesterol levels were elevated recorded an even greater reduction of 8.5% in total cholesterol levels.



TOTAL CHOLESTEROL
EVERYONE



TOTAL CHOLESTEROL
HEALTHY BUT ELEVATED



TOTAL CHOLESTEROL

	Control	6 weeks	12 weeks
Average	211.3	195.5	195.3
t-test		< 0.001	< 0.001
% Change		-7.5%	-7.6%

Paired two samples for means

TOTAL CHOLESTEROL

	Control	6 weeks	12 weeks
Average	235.2	215.2	213.4
t-test		< 0.001	< 0.001
% Change		-8.5%	-9.3%

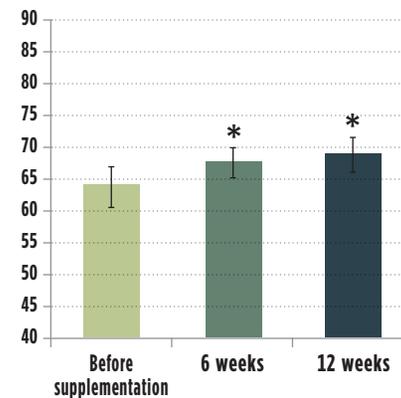
Paired two samples for means

Blood Lipids: HDL Cholesterol

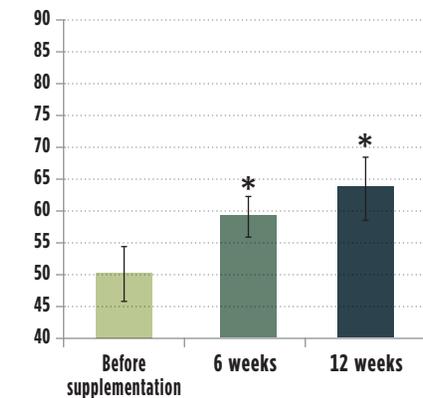
Study participants all showed an increase in HDL (or good cholesterol). Those who began the study with less than ideal HDL cholesterol levels recorded the biggest increase, with an average 18.3% rise in HDL.



HDL CHOLESTEROL
EVERYONE



HDL CHOLESTEROL
HEALTHY BUT LOW



HDL CHOLESTEROL

	Control	6 weeks	12 weeks
Average	63.1	67.6	68.8
t-test		0.0027	0.0026
% Change		7.1%	9.1%

Paired two samples for means

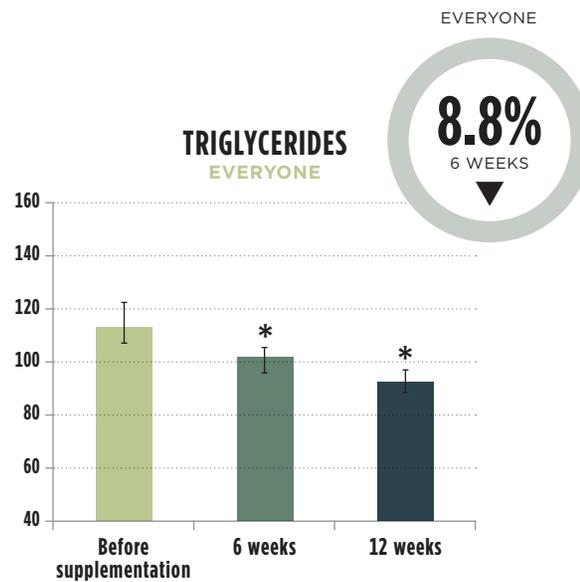
HDL CHOLESTEROL

	Control	6 weeks	12 weeks
Average	50.3	59.5	63.1
t-test		0.0027	0.0026
% Change		18.3%	25.6%

Paired two samples for means

Blood Lipids: Triglycerides

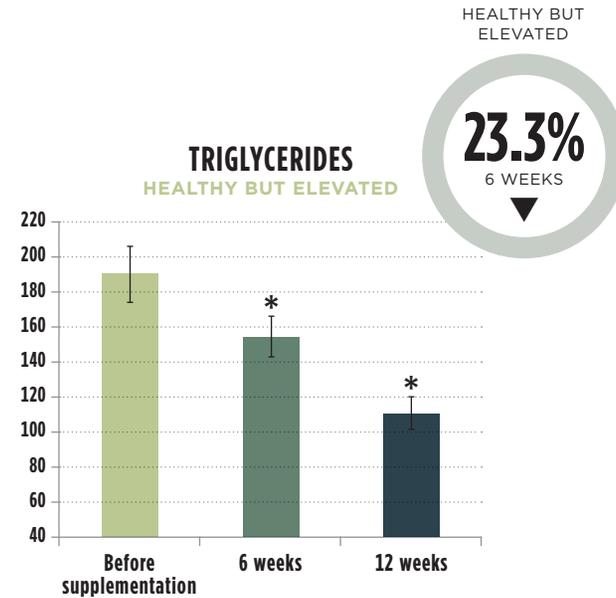
An average drop of 8.8% was recorded in triglyceride levels among the total population of 48 subjects after six weeks. But this drop was notably greater for people with healthy but slightly elevated triglycerides. This group recorded an average decrease in triglycerides of 23.3%.



TRIGLYCERIDES

Everyone	Control	6 weeks	12 weeks
Average	113.3	103.3	92.3
t-test		0.0266	0.0045
% Change		-8.8%	-18.5%

Paired two samples for means



TRIGLYCERIDES

Elevated	Control	6 weeks	12 weeks
Average	202.5	155.3	116.2
t-test		0.001	0.002
% Change		-23.3%	-42.6%

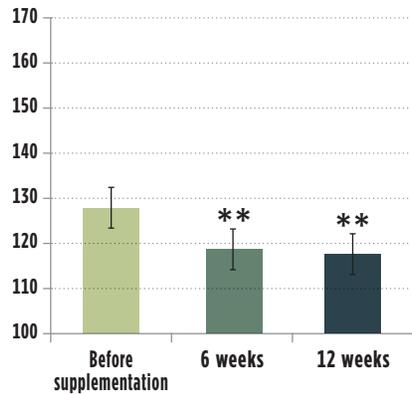
Paired two samples for means

Blood Lipids: LDL Cholesterol

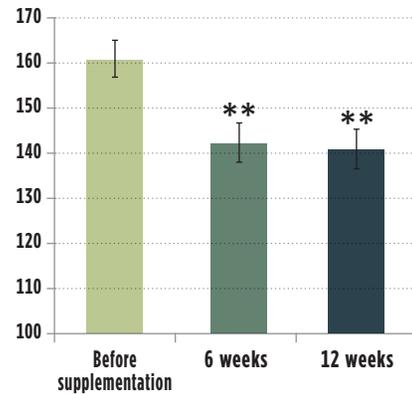
LDL (or bad cholesterol) dropped an average of 6.7% among the 48 subjects. In the elevated group, there was an average drop of 11.3% in LDL cholesterol levels.



LDL CHOLESTEROL
EVERYONE



LDL CHOLESTEROL
HEALTHY BUT ELEVATED



	Control	6 weeks	12 weeks
Average	128.2	119.6	117.8
t-test		< 0.001	< 0.001
% Change		-6.7%	-8.1%

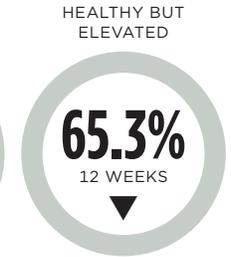
Paired two samples for means

	Control	6 weeks	12 weeks
Average	160.3	142.2	141.5
t-test		< 0.001	< 0.001
% Change		-11.3%	-11.8%

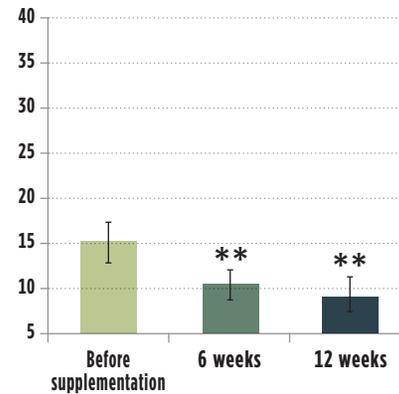
Paired two samples for means

Blood Lipids: VLDL Cholesterol

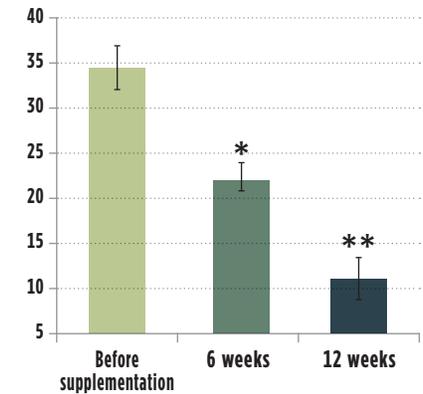
Very-low-density lipoprotein (VLDL) cholesterol was also measured in the Freiburg Study. VLDL contains the highest level of triglycerides, and high amounts in the blood can be an indicator of poor cardiovascular health. Participants in the study saw significant reductions in VLDL, especially over time.



VLDL CHOLESTEROL
EVERYONE



VLDL CHOLESTEROL
HEALTHY BUT ELEVATED



	Control	6 weeks	12 weeks
Average	15.1	10.9	8.8
t-test		< 0.001	< 0.001
% Change		-27.4%	-41.6%

Paired two samples for means

	Control	6 weeks	12 weeks
Average	34.1	22.4	11.9
t-test		0.005	< 0.001
% Change		-34.3%	-65.3%

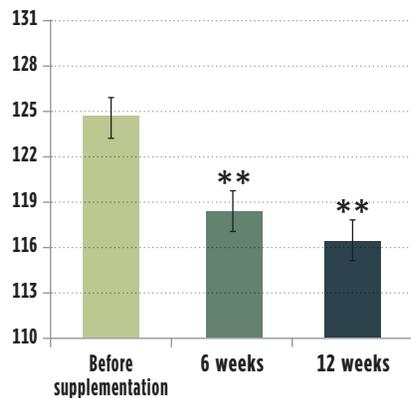
Paired two samples for means

Blood Pressure: Systolic

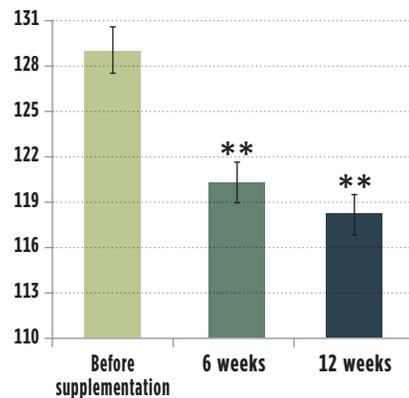
The 48 participants in the study recorded an average of a 5.2% reduction in systolic blood pressure after 6 weeks of continued supplementation. Even more importantly, those who began the study with normal but slightly elevated blood pressure recorded a 5.9% reduction.



SYSTOLIC BLOOD PRESSURE
EVERYONE



SYSTOLIC BLOOD PRESSURE
HEALTHY BUT ELEVATED



	Control	6 weeks	12 weeks
Average	124.5	118.0	116.6
t-test		< 0.001	< 0.001
% Change		-5.2%	-6.3%

Paired two samples for means

	Control	6 weeks	12 weeks
Average	129.3	121.6	118.8
t-test		< 0.001	< 0.001
% Change		-5.9%	-8.1%

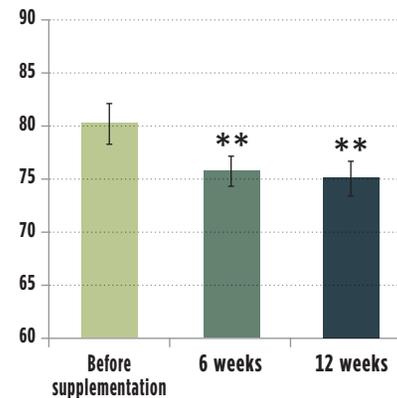
Paired two samples for means

Blood Pressure: Diastolic

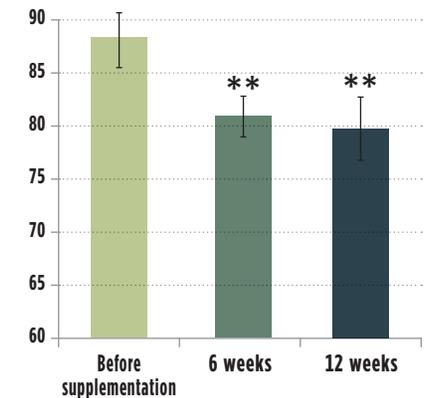
Study participants also saw a significant drop in diastolic blood pressure. The 48 participants saw an average 5.0% reduction in diastolic blood pressure after just 6 weeks, with an even greater 6.9% reduction in the same time period for those in the healthy but elevated group.



DIASTOLIC BLOOD PRESSURE
EVERYONE



DIASTOLIC BLOOD PRESSURE
HEALTHY BUT ELEVATED



	Control	6 weeks	12 weeks
Average	80.2	76.2	75.4
t-test		< 0.001	< 0.001
% Change		-5.0%	-6.0%

Paired two samples for means

	Control	6 weeks	12 weeks
Average	87.3	81.3	79.7
t-test		< 0.001	0.001
% Change		-6.9%	-8.6%

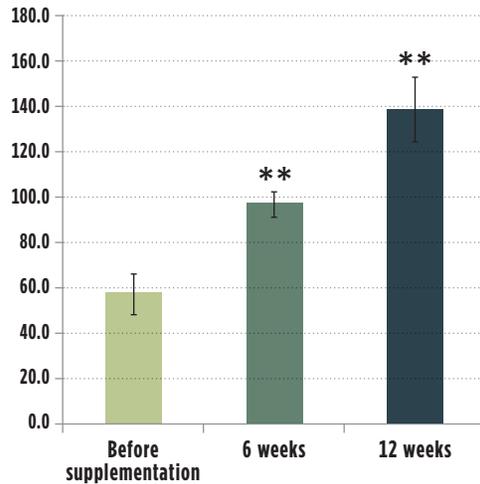
Paired two samples for means

Blood Pressure: Nitric Oxide

Nitric oxide is a metabolite responsible for relaxing vessel cells, which has an impact on blood pressure. Among the 48 participants, levels of nitric oxide in the blood more than doubled after 12 weeks of daily supplementation.



NITRIC OXIDE



NITRIC OXIDE

Everyone	Control	6 weeks	12 weeks
Average	59.1	98.3	139.0
SEM	6.6	6.6	12.7
t-test		< 0.001	< 0.001
% Change		66.4%	135.3%

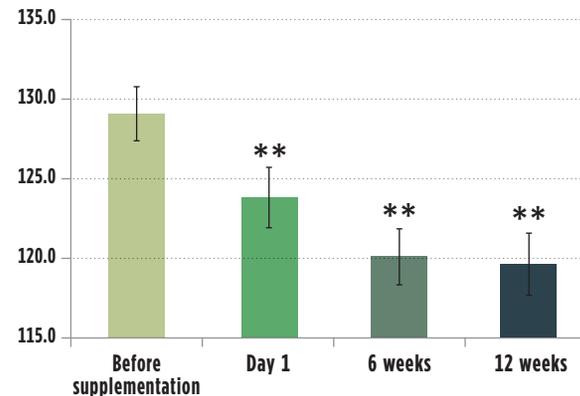
Paired two samples for means

Energy Utilization: Heart Rate

Just one hour after taking the supplements for the first time, an average reduction of heart rate by 5 beats per minute was recorded after the prescribed exercise. After 6 weeks of supplementation, the 48 subjects had an average heart rate of 8 fewer beats per minute. After 12 weeks of supplementation, they could do the same exercise with a pulse of 9 fewer beats per minute.



HEART RATE AFTER 1 HOUR



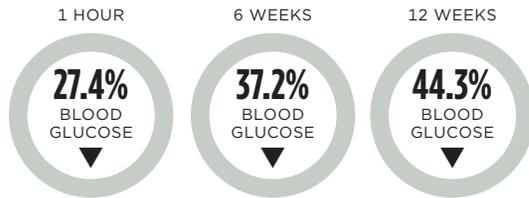
HEART RATE AFTER 1 HOUR

Everyone	Control	Day 1	6 weeks	12 weeks
Average	128.5	123.7	120.8	119.2
t-test		< 0.001	< 0.001	< 0.001
Beats/min		-4.8	-7.8	-9.4

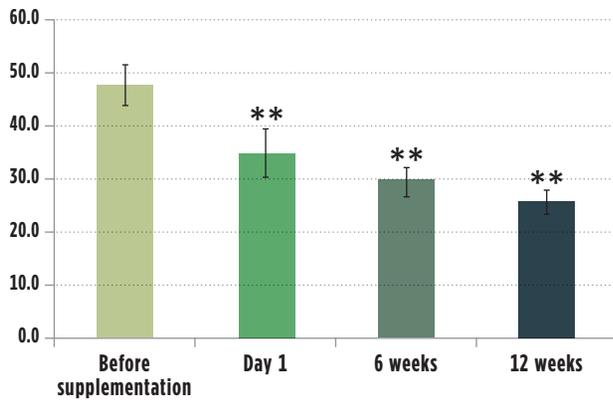
Paired two samples for means

Sugar Metabolism: Blood Glucose

In the first hour after supplementation, a significant 27.4% reduction in blood sugar spike was recorded after eating, with an increasingly greater reduction after several weeks of continual use of the supplements—37.2% after six weeks and 44.3% after 12 weeks.



POST-MEAL BLOOD SUGAR SPIKE IN 1 HOUR
EVERYONE AFTER TAKING SUPPLEMENT



POST-MEAL BLOOD SUGAR SPIKE

Exercise	Control	Day 1	6 weeks	12 weeks
Average	47.8	34.7	30.0	26.6
t-test		< 0.001	< 0.001	< 0.001
% Change		-27.4%	-37.2%	-44.3%

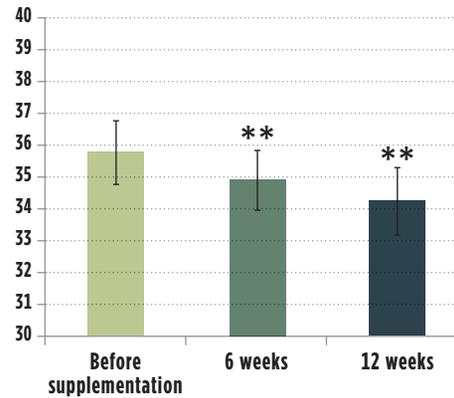
Paired two samples for means

Sugar Metabolism: HbA1c

HbA1c—which shows an overall picture of average blood sugar levels over a period of 90 days—also showed a significant reduction over the course of the study.



HbA1c
EVERYONE



HbA1c

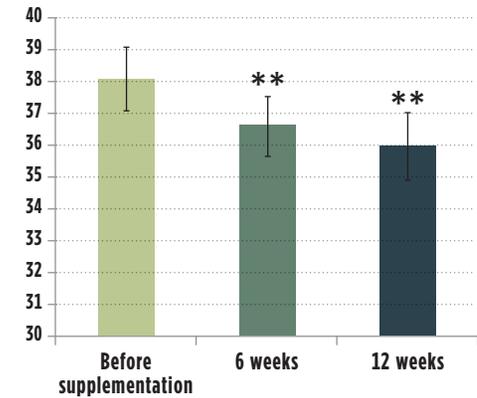
Everyone	Control	6 weeks	12 weeks
Average	35.8	34.9	34.3
t-test		< 0.001	< 0.001
% Change		-2.4%	-4.2%

Paired two samples for means

HEALTHY BUT ELEVATED



HbA1c
HEALTHY BUT ELEVATED



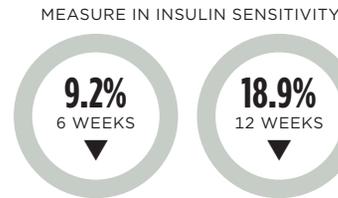
HbA1c

Elevated	Control	6 weeks	12 weeks
Average	38.0	36.7	36.0
t-test		< 0.001	< 0.001
% Change		-3.3%	-5.2%

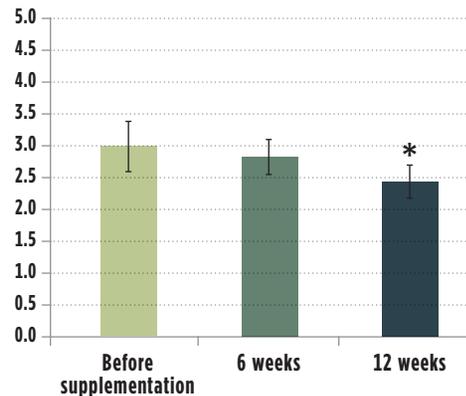
Paired two samples for means

Sugar Metabolism: HOMA

After 12 weeks, a significant 28.0% drop in the HOMA index—a measure of insulin sensitivity—was observed.

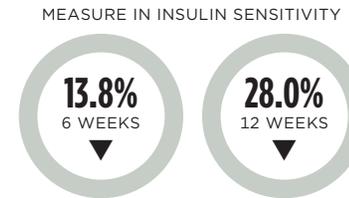


HOMA (INSULIN SENSITIVITY)
EVERYONE

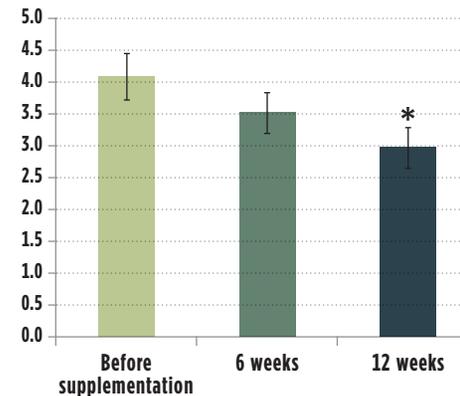


	HOMA		
	Control	6 weeks	12 weeks
Everyone			
Average	3.0	2.7	2.4
t-test		ns	0.02
% Change		-9.2%	-18.9%

Paired two samples for means



HOMA (INSULIN SENSITIVITY)
HEALTHY BUT ELEVATED



	HOMA		
	Control	6 weeks	12 weeks
Elevated			
Average	4.1	3.5	3.0
t-test		ns	0.01
% Change		-13.8%	-28.0%

Paired two samples for means