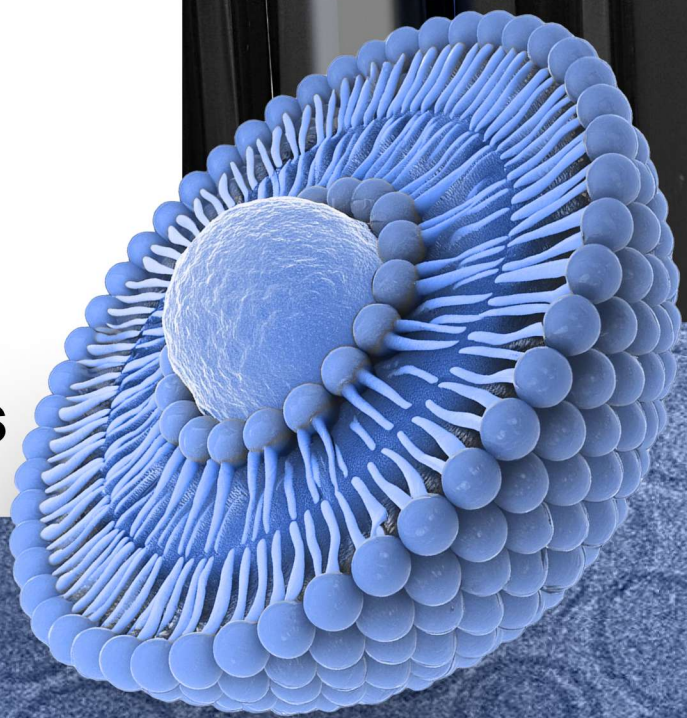
Brain market

Human Clinical Study on the Comparative Bioavailability of Various Vitamin C Supplementation Forms



Summary of the Study[1]

Abstract

The purpose of this study was to compare the bioavailability of liposomal and non liposomal vitamin C provided by competitors with supplement BrainMax Liquid Liposomal Vitamin C. Forty metabolically healthy volunteers were enrolled in the study.

Overall, **the** BrainMax Liquid Liposomal Vitamin C **had the highest bioavailability, up to 21 times more,** compared to other vitamin C supplementation forms tested.

KEYWORDS: Vitamin C, Liposomes, Bioavailability, Dietary Supplements, Biohacking.

Product Groups

LLA
Liquid Liposomal Vitamin C 1000 mg

Manufactured for Brainmarket

LLB
Liquid Liposomal Vitamin C 1000 mg

Manufactured by Competitor in the Netherlands

NL
Non-liposomal Vitamin C 1000 mg

Manufactured by Competitor in the Netherlands

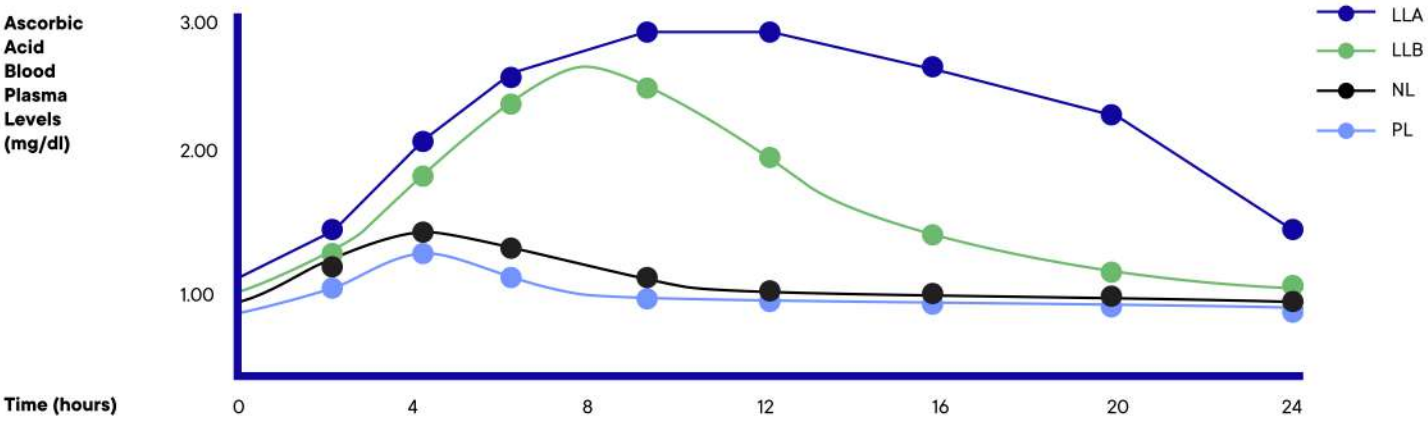
PL
Liposomal Vitamin C In Powder Form 1000 mg

Manufactured by Competitor in the Netherlands

Results

During the study, ascorbic acid (AA) blood plasma levels were measured over time after the intake of vitamin C 1000 mg in four supplementation forms, namely LLA, LLB, PL, and NL.

The results have shown that the BrainMax Liquid Liposomal Vitamin C (LLA) has **1.92 times** higher bioavailability than the competitor's liquid liposomal vitamin C (LLB), **21.6 times** higher bioavailability than the liposomal vitamin C in powder form (PL), and **12 times** higher bioavailability than the non-liposomal vitamin C (NL).



[1] See the full study from page 2.

Introduction

Ascorbic acid (AA), widely known as **vitamin C**, is a critical nutrient integral to several biological functions. These functions encapsulate supporting immune system efficacy, facilitating normal metabolic and psychological activities, protecting cellular structures from oxidative damage, and reducing exhaustion and fatigue.[1] Studies have shown that **the utilization of liposomes can substantially enhance the bioavailability** of numerous nutrients, including vitamin C.[2] The current study confirmed that the unique advanced liposomal technology LipoSone™, used in BrainMax, effectively enhances vitamin C bioavailability, outperforming other supplementation forms tested, such as non-liposomal vitamin C, liposomal vitamin C in powder form, and a competitor's liquid liposomal vitamin C.

Method

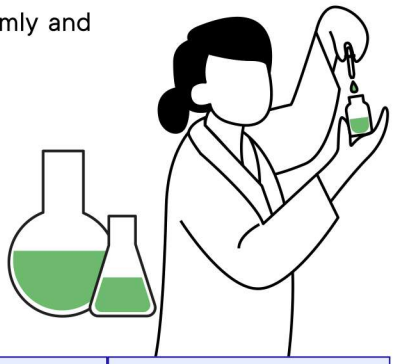
The current study was a randomized, controlled, four-group trial on the effect of vitamin C 1000 mg in four different formulations: BrainMax Liquid Liposomal Vitamin C, liquid liposomal vitamin C by competitor (LLB), liposomal vitamin C in powder form by competitor (PL), and a non-liposomal vitamin C by competitor (NL).

Participants

Forty (40) metabolically healthy volunteers were enrolled in the study. They were randomly and evenly assigned to one of the four supplementation groups.

Exclusion criteria for participants were:

- ✖ <20 and >50 years of age
- ✖ Any diagnosis of chronic condition(s)
- ✖ BMI outside of the normal category range (18.5–24.9kg/m2)
- ✖ Presence of acute illness
- ✖ Use of drugs or dietary supplements on a frequent and/ or mandatory basis



Measurements	LLA*	LLB*	PL*	NL*
Age (years)	26 ± 5	26 ± 5	27 ± 6	28 ± 7
Females (%)	50	40	60	40
BMI (kg/m2)	20 ± 2	21 ± 2	21 ± 1	20 ± 2
Systolic BP (mmHg)	120 ± 12	118 ± 13	117 ± 10	119 ± 13
Diastolic BP (mmHg)	78 ± 9	78 ± 8	80 ± 9	78 ± 7

Table 1. Participant Anthropometric Data

** Mean standard deviation n=10*

Active Substances & Supplementation Groups

a. Liquid liposomal product A (LLA): BrainMax Liquid Liposomal Vitamin C

b. Liquid liposomal product B (LLB): Competitor's AA 1000 mg in liposomal liquid form, manufactured in the Netherlands.

c. Powdered liposomal product (PL): Competitor's AA 1000 mg in powder form, manufactured in the Netherlands.

d. Non-liposomal product (NL): Competitor's AA 1000 mg in tablet form, manufactured in the UK.

Dosage and Blood Collection

Participants in the designated supplement groups, while in a fasted state, received a **1000 mg oral dose of vitamin C**. Blood samples were taken initially before the vitamin was consumed (baseline) and then at intervals of 2, 4, 6, 8, 10, 12, 16, 20, and 24 hours following the intake of the vitamin. These samples were promptly microcentrifuged, cooled to 2°C, and subjected to plasma ascorbic acid (AA) level quantification by High-Performance Liquid Chromatography (HPLC).

Data

All participants successfully completed the study. They were predominately in their late twenties, with an equal distribution of males and females. All were characterized by healthy Body Mass Index (BMI) and blood pressure levels, detailed by both systolic and diastolic measurements. Participant anthropometric data is provided in **Table 1**.

Each group's average blood plasma ascorbic acid (AA) levels over time are graphically represented in **Figure 1**. Pharmacokinetic parameters, such as the peak plasma concentration of ascorbic acid (C_{max}) and the time to reach this peak (T_{max}), are documented in **Table 2**.

The area under the concentration-time curve (AUC_{0-t}) was calculated from dosing to the last measurable concentration using the trapezoidal rule, indicating the total exposure to the active ingredient over time. The incremental area under the curve (iAUC) adjusts the AUC for baseline variations. The Oral Bioavailability Value (OBV) was determined by comparing the liposomal and non-liposomal $iAUC_{0-t}$ values.

Results

A temporal analysis of AA plasma levels reveals that:

After 2 hours, the **LLA** group displayed distinctly higher AA plasma concentrations and continued to exhibit elevated levels for the subsequent 24 hours when compared to other groups.

After 4 hours, both the **PL** and **NL** groups reached their peak AA plasma concentrations, which then returned to baseline levels over the next 8 hours.

After 8 hours, the **LLA** group attained its maximal AA plasma concentration, maintaining it for an additional 4 hours before gradually decreasing. In contrast, the **LLB** group peaked at 8 hours but then swiftly dropped back to baseline within the subsequent 14 hours.

After 24 hours, the AA plasma levels in the **LLA** group were akin to those observed at 2 hours post-supplementation, whereas the levels in all other groups were near baseline.

Considering the **iAUC** values, the outcomes suggest:

The liposomal group LLA has an OBV **1.9 times** greater than LLB group, **21.6 times** greater than PL group, and **12 times** greater than NL group.

LLA's bioavailability exceeds **PL** by **more than 20 times** due to the PL's loss of structural integrity and protective function in liposomes when dehydrated.

Measurements	LLA	LLB	PL	NL
C_{max} (mg/dL)	2,78	2,51	0,97	1,12
T_{max} (hours)	12	8	4	4
AUC_{0-t} (mg*hr/dL)*	51,86	34,51	15,19	17,61
$iAUC_{0-t}$ (mg*hr/dL)*	36,76	19,15	1,70	3,02
OBV		1,92	21,64	12,17

Table 2. Pharmacokinetic Parameters Data

** AUC_{0-t} and $iAUC_{0-t}$ calculated using trapezoidal rule*

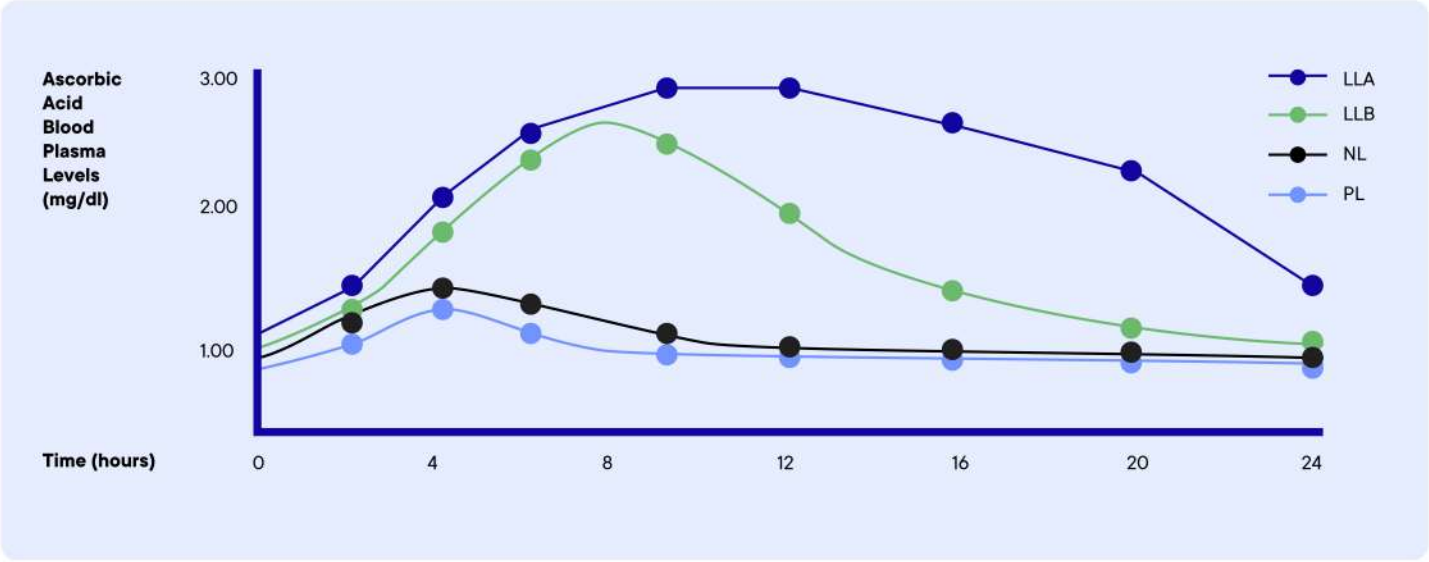


Figure 1. Ascorbic acid (AA) blood plasma levels measured over time after the intake of vitamin C 1000 mg in four supplementation forms, namely LLA BrainMax Liquid Liposomal Vitamin C, LLB liquid liposomal vitamin C manufactured by competitor, PL liposomal vitamin C in powder form manufactured by competitor, NL non-liposomal vitamin C manufactured by competitor.

Discussion and Conclusion

The study demonstrates that BrainMax Liquid Liposomal Vitamin C (LLA) exhibits the **highest bioavailability** among the tested groups. Specifically, LLA has **1.92 times** higher bioavailability than the competitor's liquid liposomal vitamin C (LLB), **21.6 times** higher bioavailability than competitor's liposomal vitamin C in powder form (PL), and **12 times** higher bioavailability than competitor's non-liposomal vitamin C (NL).

Additionally, LLA **maintained elevated plasma ascorbic acid (AA) levels** for the **entire 24-hour** duration of the study. In contrast, the LLB group showed significant increases for only 8 hours, while the PL and NL groups showed increases for just 4 hours.

These findings underscore the substantial impact of liquid liposomes on vitamin C bioavailability and highlight **the superior performance BrainMax liposomal formulations.** The observed differences between the two liquid liposomal vitamin C products may be attributed to variations in production methods and quality standards, which can significantly affect liposome properties such as stability, size, and encapsulation efficiency. These properties, in turn, influence the effectiveness of liposomes in delivering the active ingredient to the bloodstream. However, these specific factors were not measured in the present study.

Overall, the advanced liposomal technology LipoSone™,used in BrainMax supplements, is the most effective way to deliver vitamin C to the bloodstream while maintaining the highest blood plasma levels for up to 24 hours.

1. Vitamin C Fact Sheet for Health Professionals. National Institutes of Health ODS. https://ods.od.nih.gov/factsheets/VitaminC-HealthProfessional/. Published 2020.
2. Davis JL, Paris HL, Beals JW, et al. Liposomal-encapsulated Ascorbic Acid: Influence on Vitamin C Bioavailability and Capacity to Protect against Ischemia–Reperfusion Injury. Nutr Metab Insights. 2016: NMI.S39764. doi: 10.4137/nmi.s39764
Statistic tools used: two-way ANOVA. Statistical significance p=0.05. All analyses were conducted using the statistical software Jamovi 1.2.17, unless otherwise stated.

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