

Research Initiative: Bio-based Content Calculation of the Eniva VIBE Nutraceutical Through Radiocarbon Dating (2005)

To Whom It May Concern:

The Eniva Corporation and Eniva Research Group take great pride and care in the formulation and manufacturing of its wellness products. We are dedicated to producing products that are safe, quality driven, effective, and innovative. To accomplish this, we subject our products and the product development process to serious review and rigorous testing.

This letter explains the results and rationale behind the bio-based content calculation, as evidenced through radiocarbon dating of the Eniva VIBE product. With the development of the nutritional products industry, more and more companies are claiming "plant based" ingredients and products, but provide very little documentation to verify the authenticity of this claim.

To address this issue, the Eniva Research Group chose to radiocarbon date the Eniva VIBE product to determine its BIO-BASED and FOSSIL components.

The basis of radiocarbon dating has at its core the fact that Carbon-14 (C14) originates in the upper atmosphere of the earth. It is constantly being created and starts to decay as soon as it is formed. This constant cycle leaves the amount of C14 in the air relatively constant. It then reacts with oxygen in the air to form carbon dioxide (CO2). This carbon dioxide rapidly mixes throughout the atmosphere, where at ground level it is consumed by plants during photosynthesis. This process is constantly ongoing, such that at any point in time, the amount of C14 in living plants is the same as the amount of C14 in the air around them.

Living plants are an active component of the overall food chain. Animals eat plants, animals eat animals, and humans eat plants and animals. Therefore all living plants, animals and human beings have the same amount of C14 in their bodies at the same time. Their bodies are said to be in "equilibrium" with C14 in the air. Although the C14 is radioactively decaying away in the body, it is constantly being replaced by new photosynthesis or the ingestion of food, leaving the amount relatively constant. Only when an organism dies does the replacement process of C14 cease. Since C14 is radioactive, it is this level that is then used to calculate age, based on C14 content.

(Research Initiative: Bio-based Content Calculation of the Eniva VIBE Nutraceutical Through Radiocarbon Dating; p. 2)

In radiodating, two terms are critical:

1. <u>BIO – BASED (per parameters of radiocarbon dating):</u> This term refers to materials that are derived in whole or part from biomass resources. In its simplest terms, this refers to substances that were once living material. Examples would be wood and crop residues and aquatic plants.

2. <u>FOSSIL – BASED</u> (per parameters of radiocarbon dating): A material that does not contain C14 or a significantly reduced amount when compared to a sample of the same time period. This indicates the fossil is either 50,000 years old or greater, or the material did not inherently contain C14. An example would be petroleum products or various types of minerals. Neither of these were ever living and do not contain C14.

As per the enclosed results, the Eniva Research Group chose to have the Eniva VIBE product radiodated by a leading radiocarbon dating laboratory. The Eniva VIBE product yielded the following:

- A Radiocarbon Date of 107.5 pmc, corresponding to current year.
- A Bio-based content of 87%.
- A Fossil based content of 13%.

Analyzing these results, one can confidently say that (at a minimum) 87% of the material present in the Eniva VIBE product came from material that was once living. Since the VIBE product does not contain animal products, it can then be further stated that:

AT A MINIMUM, 87% OF THE MATERIAL FOUND IN THE VIBE PRODUCT WAS AT ONE TIME LIVING PLANT MATERIAL (or derivatives there of).

The remaining 13% of the product is fossil based material. As the Eniva VIBE product does not use petroleum based products and has a high content of minerals, the fossil based portion can be accounted to by the presence of minerals.

The results of this study demonstrate the desire of the Eniva Research Group to communicate the content of the Eniva VIBE product.

Respectfully,

The Eniva Research Group

Explanation of Results

Biobased vs Petroleum-based organic content derived from radiocarbon dating analysis

The application of radiocarbon dating to derive a "biobased content" is built upon the same concepts as determining a radiocarbon age, but without use of the age equations. It is done by deriving a ratio of the amount of radiocarbon (14 C) in an unknown sample to that of a modern reference standard. The ratio is reported as a percentage with the units "pMC" (percent modern carbon). If the material being analyzed is a mixture of present day radiocarbon and fossil carbon (containing no radiocarbon), then the pMC value obtained correlates directly to the amount of biobased material present in the sample.

The modern reference standard used in radiocarbon dating is a NIST (National Institute of Standards and Technology) standard with a known radiocarbon content equivalent approximately to the year AD 1950. AD 1950 was chosen since it represented a time prior to thermo-nuclear weapons testing which introduced large amounts of excess radiocarbon into the atmosphere with each explosion (termed "bomb carbon"). This was a logical point in time to use as a reference for archaeologists and geologists. For an archaeologist or geologist using radiocarbon dates, AD 1950 equals "zero years old". It also represents 100 pMC.

"Bomb carbon" in the atmosphere reached almost twice normal levels in 1963 at the peak of testing and prior to the treaty halting the testing. Its distribution within the atmosphere has been approximated since its appearance, showing values which are greater than 100 pMC for plants and animals living since AD 1950. It's gradually decreased over time with today's value being near 107.5 pMC. This means that a fresh biobased material such as corn would give a radiocarbon signature near 107.5 pMC.

Combining fossil carbon with present day carbon into a material will result in a dilution of the present day pMC content. By presuming 107.5 pMC represents present day biobased materials and 0 pMC represents petroleum derivatives, the measured pMC value for that material will reflect the proportions of the two component types. A material derived 100% from present day soybeans would give a radiocarbon signature near 107.5 pMC. If that material was diluted with 50% petroleum derivatives, it would give a radiocarbon signature near 54 pMC.

A biobased content result is derived by assigning 100% equal to 107.5 pMC and 0% equal to 0 pMC. In this regard, a sample measuring 99 pMC will give an equivalent biobased content result of 93%. This value is referred to as the MEAN BIOBASED RESULT and assumes all the components within the analyzed material were either present day living or fossil in origin.

The accuracy of the MEAN BIOBASED RESULT can vary due to local variations in modern atmospheric radiocarbon content and uptake, the potential for the fossil component to have some amount of radiocarbon due to contamination (perhaps introduced during the manufacturing process), the possibility of materials which are several years old being used in the manufacturing process (having elevated bomb carbon contents) and the possibility of loss of a volatile fraction of one of the components during the manufacturing process. The combined uncertainty from the first three should be within only a few percent. However, they can be eliminated by measuring the raw biobased components and the raw fossil components prior to manufacturing followed by measuring the manufactured material itself. The loss of a component during manufacturing can be accurately assessed with knowledge of the manufactured product rather than the total biobased component "used" in the manufacturing of that product. Because of uncertainties in the MEAN BIOBASED RESULT, the most applicable result from radiocarbon dating analysis is a range (called the APPARENT BIOBASED CONTENT).

The results provided in this report involved materials provided without any source information. This situation is highly probable in a real life situation. The APPARENT BIOBASED CONTENT quoted in this report encompasses an absolute range of 6% (plus and minus 3% on either side of the MEAN BIOBASED RESULT) to account for variations in end-component radiocarbon signatures (a conservative approximation). It is presumed that all materials are present day or fossil in origin and that the desired result is the amount of biobased component "present" in the material, not the amount of biobased material "used" in the manufacturing process. The most conservative interpretation of the reported percentages is as maximum values.

Summary of Results

Biobased vs Petroleum-based organic content derived from radiocarbon dating analysis

Date Reported: June 9, 2005

Company: Eniva Corporation

Laboratory Number	Submitter Number	Material	ASTM Method (D6866- 04a)	Delta 13C	Mean Biobased Result*	Apparent Biobased Content*
BETA-205500	VIBE 20013905	FLUID	Method C	-23.3 o/oo	87%	84 - 90 %

* Biobased percentages were derived by presuming all the carbon components in the analyzed material were derived from plants or animals either respiring atmospheric carbon dioxide within the last few years of 2003 or were fossil in origin. An absolute uncertainty of +/- 3% is estimated for variation in both the modern and fossil endpoints to derive the APPARENT BIOBASED CONTENT. Mean Biobased Estimates greater than 100% and less than 103% are assigned a value of 100% for simplification. The most conservative interpretation of these results is that the Mean Biobased Estimate and Apparent Biobased Content represent maximum values. See the explanation page provided with this report for greater detail.

Laboratory Number:	BETA-205500
Submitter Number:	VIBE 20013905
Material:	FLUID
Mean Biobased Result	:* 87%
Apparent Biobased Content	.* 84-90 %

* Biobased percentages were derived by presuming all the carbon components in the analyzed material were derived from plants or animals either respiring atmospheric carbon dioxide within the last few years of 2003 or were fossil in origin. An absolute uncertainty of +/- 3% is estimated for variation in both the modern and fossil endpoints to derive the APPARENT BIOBASED CONTENT. Mean Biobased Estimates greater than 100% and less than 103% are assigned a value of 100% for simplification. The most conservative interpretation of these results is that the Mean Biobased Estimate and Apparent Biobased Content represent maximum values. See the explanation page provided with this report for greater detail.



Beta Analytic Radiocarbon Dating Laboratory