INTRODUCTION: Vitamin E remains the only major vitamin where the synthetic form differs significantly from the Natural form. As more is learned about the function of this vitamin the difference appears to have a greater effect on many biological functions.

STRUCTURE: Four forms of tocopherol substance that exhibit Vitamin E activity are present in nature. The forms have different biopotency.

### Vitamin E Activity of Natural Tocopherols

<table>
<thead>
<tr>
<th>COMPOUND</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>d-alpha-tocopherol</td>
<td>100%</td>
</tr>
<tr>
<td>d-beta-tocopherol</td>
<td>20-40%</td>
</tr>
<tr>
<td>d-gamma-tocopherol</td>
<td>5-20%</td>
</tr>
<tr>
<td>d-delta-tocopherol</td>
<td>1%</td>
</tr>
</tbody>
</table>

STUART

The Alpha form is traditionally supplemented in diets. Because of the activity associated with the Vitamin E, it is not naturally stable when added to diets. Therefore, an acetate molecule is added to the vitamin making it stable. This compound is commonly known as "Vitamin E-acetate".

The next and perhaps major question of structure has to do with the sterochemistry of the alpha form. Vitamin E contains three asymmetric carbons allowing for up to eight possible three dimensional structure to be formed. In nature, due to unique specificity, only one form, the RRR is produced. In the synthetic formulation, all eight forms are created diluting the natural form to only 12.5% of the vitamin added.

The model for Vitamin E potency utilizes the rat. In a recent study by Douglas, Pennino and Dierenfeld, they found that rat carcasses contain a higher level of Vitamin E/gram than mice of similar age and size. In certain classes, this level is over ten times higher. This may be some of the first evidence that rats may utilize Vitamin E more efficiently than other animals and may not be a good prediction of biological activity.

In traditional biochemical models, these other forms of Vitamin E may compete with the natural form causing reduction in activity.

Published relative values for various forms of Vitamin E indicate these differences.

### Relative Activity of Vitamin E Form
BIOLOGICAL FUNCTION: A 1990 review article by Burton and Traber concluded that Vitamin E(\textit{alpha}-tocopherol) is a superb antioxidant and appears to be the only major lipid-soluble antioxidant in mammalian membrane. This review also concluded that because of its slow turnover in neural and brain tissue, it is important in neurological function: though the mechanism of this action is not totally understood.

More recent work by various researchers have shown that the role of Vitamin E is important in various functions such as:

- The Immune System
- Disease Prevention
- Cataracts
- Cardiovascular Disease
- Aging
- Cancer

Vitamin E deficiency has been reported in various species. One classic reference is Liu et al where over 100 ruminants, primates and avian species were diagnosed with a Vitamin E deficiency, with many species resulting in death.

Today, numerous articles comparing the natural forms versus synthetic and the acetate versus alcohol have resulted in new findings. Studies at the University of Florida(Hidiroglou et al) and the University of Idaho in Dr. G.T. Schelling’s lab indicates that the standard values determine by the rat studies may not apply to ruminants.

They conclude natural Vitamin E may be between two and three times for available than the synthetic form. The University of Idaho data gives potential new values for Vitamin E.

Relative Value Of Vitamin E, Comparing Rat Values Versus Dairy Cow

<table>
<thead>
<tr>
<th>FORM</th>
<th>STANDARD VALUE (RAT)</th>
<th>NEW VALUE (CATTLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>dl-Acetate(synthetic)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>dl-Alcohol(synthetic)</td>
<td>1.10</td>
<td>1.76</td>
</tr>
<tr>
<td>d-Acetate(natural)</td>
<td>1.36</td>
<td>1.97</td>
</tr>
<tr>
<td>d-Alcohol(natural)</td>
<td>1.49</td>
<td>3.22</td>
</tr>
</tbody>
</table>
Further work with Vitamin E has clearly linked it to enhancing immune response in various animals including horses, fish, mice, cattle and humans. In a research summary published by VERIS they conclude, "the evidence seems clear that Vitamin E in intakes above minimal levels contributes to optimal functioning of immune responses and disease resistance in a number of test animals."

The most likely mechanism is the key role Vitamin E plays in destroying free radicals at the cellular membrane. With an enhanced immune system, the ability to flight infection both viral and bacterial is improved.

Another source of free radical production is during exercise. During exertion, the demand for oxygen is increased resulting in greater free radical production. In another research summary by VERIS they conclude that Vitamin E protected the body from the damage associated with strenuous exercise and that higher levels of Vitamin E may prove useful.

CONCLUSION: Though to date, no definitive studies have been conducted in llamas or alpacas, the evidence does appear that Vitamin E supplementation is critical and that the natural form should be the one of choice.

BIBLIOGRAPHY


