INOXAN 583

Vitamin-Based Antioxidant
1. INTRODUCTION AND DESCRIPTION

In the quest to use antioxidant compounds occurring in nature or related compounds, extensive studies have been made with vitamins and derivatives such as ascorbyl palmitate, tocopherols, and ascorbic acid. Yet these vitamin antioxidants are considered as efficient and harmless for use in the food industry, especially for vegetable oils and animal fats. But their use in cosmetics has not been fully exploited, and therefore it is interesting to test their properties in cosmetic products. We have carried out several oxidation tests on shea butter, oxidizable oils such as hazelnut and wheatgerm oil, and cosmetic creams. The obtained results show that vitamin antioxidants are really effective, particularly when ascorbyl palmitate and dl-alpha-tocopherol are mixed together.

Thanks to these results, ENNAGRAM introduces INOXAN 583, an exclusive mix of ascorbyl palmitate and dl-alpha-tocopherol in glyceryl oleate, to be used readily as a vitamin antioxidant in oil-based cosmetics.

2. VITAMINS AS ANTIOXIDANT COMPOUNDS

Certain vitamins have antioxidant activity and were long ago shown to be effective. These are vitamin E (alpha-tocopherol), vitamin C (ascorbic acid), and vitamin C derivatives including ascorbyl palmitate (figure 1). Vitamin E and vitamin C are present in nature and in particular in the human body where they protect tissues especially from the effects of oxidation, which appear to be partially responsible for cell ageing and certain cancers. Alpha-tocopherol is able to insert into the cell membranes (figure 2) and to protect them from oxidation. Ascorbic acid remains outside the membranes. Some authors consider that it acts in vivo in synergy with alpha-tocopherol.
CHEMICAL STRUCTURE OF ANTIOXIDANT VITAMINS

(Figure 1)

dl-alpha-tocopherol:

[Chemical structure image]

ascorbic acid:

[Chemical structure image]

ascorbyl palmitate:

[Chemical structure image]
In contrast to alpha-tocopherol and most antioxidants, ascorbic acid and its derivative ascorbyl palmitate, are not phenolic antioxidants and their mechanism of action is different from that of the classical pathway. They have an ene-diol group which allows them to act directly and rapidly with oxygen from air, neutralising it. They can also irreversibly bind residual oxygen present in a medium, a process which authors refer to as « oxygen scavenging ». Classical phenolic antioxidants do not have this property. Furthermore, this ene-diol group is able to bind to metals dissolved in the cationic state, forming complexes. Metals such as iron and copper are very damaging catalysts of oxidation. These two complimentary properties (absorption of oxygen and metal complexing) are the basis of the synergy which is observed when ascorbic acid or one of its derivatives is added to classical antioxidants.

In view of their safety, they thus offer an attractive use in cosmetic practice. We have therefore performed some stabilisation studies using these antioxidants.
3. STABILITY STUDIES

Oil-soluble antioxidants, ascorbyl palmitate and dl-alpha-tocopherol, have been incorporated alone and associated (INOXAN 583) in shea butter, cosmetic oils, and cosmetic creams.

1/ SHEA BUTTER

10 g of shea butter were placed in glass cups with an internal diameter of 45 mm and heated in air in a Chopin cellular oven, thermostatically controlled to 80°C, which provides an even and identical temperature for each sample.

The peroxide indexes (P.I.) were measured after 20 hours and 50 hours in the oven. Figure 3 shows changes in the peroxide index and the very good behaviour of the antioxidant treated batches compared to the control batch.

Organoleptic studies have shown that when heated in the presence of the antioxidants, the shea butter did not change colour, whereas it became blue-green in colour in the control batch. In addition, only the batch without antioxidant released a rancid odour.

![Graph showing antioxidation test with shea butter at 80°C (Figure 3)]
2/ HAZELNUT OIL AND WHEAT GERM OIL

Alpha-tocopherol was not incorporated in tests, as this vitamin is present in the natural state in these vegetable oils, and it has been shown that when used at excessively high doses, alpha-tocopherol may become pro-oxidant (6). The stability of these oils was re-evaluated using two measurements methods: peroxide index and the Rancimat test.

The measurement of the P.I. was realised on different stabilised oils heated in cups, placed in a thermostatically controlled Chopin oven at 45°C. The P.I. were measured after 1, 3, and 21 days in the oven.

The values obtained are shown in figure 4 (hazelnut oil) and in figure 5 (wheat germ oil). The samples of hazelnut oil were far more stable than those of the wheat germ oil; the peroxide indexes found were approximately 90% lower. Both oils exhibited good stability in the presence of the antioxidants.

In order to confirm these results, the stability of samples was also evaluated using the Rancimat test. This test involves subjecting the fats to the effect of an air stream at a defined flow rate and given temperature under clearly determined conditions. The volatile acids which form during oxidation are trapped in the de-ionised water and detected by conductimetry. The longer the induction time, the more effective is the antioxidant incorporated into the fat.

The parameters used for this study were: temperature 100 or 120°C, air flow rate 20 l/s, test sample: 3 g.

Results show that the better stability of the hazelnut oil is confirmed, the induction times found being much more higher.

The association of ascorbyl palmitate and alpha-tocopherol produced the best results with the highest protection factors at 100 and 120°C.

The results of these two tests were consistent. They showed that incorporation of ascorbyl palmitate or the mixture ascorbyl palmitate and alpha-tocopherol protected the two oils satisfactorily.
At a dose of 500 ppm, ascorbyl palmitate gives good results but cannot be used as such in fluid oils as it is poorly solubilised. It has to be incorporated in the form of a mixture with specific glycerides (such as glyceryl oleate). A ready to use formula such as INOXAN 583 is therefore more effective.

![Graph showing antioxidant test results for hazelnut oil at 45°C.](image)

### TABLE 1

**EFFECTS OF SEVERAL ANTIOXIDANTS ON STABILITY OF HAZELNUT OIL**

(RANCIMAT TEST)

<table>
<thead>
<tr>
<th>Antioxidant (ppm)</th>
<th>Test at 100°C</th>
<th>Test at 120°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Induction time</td>
<td>Induction time</td>
</tr>
<tr>
<td></td>
<td>Protection factor</td>
<td>Protection factor</td>
</tr>
<tr>
<td>control (no antioxidant)</td>
<td>23h 15</td>
<td>5h 20</td>
</tr>
<tr>
<td>250 ppm ascorbyl palmitate</td>
<td>44h 55</td>
<td>9h 35</td>
</tr>
<tr>
<td>500 ppm ascorbyl palmitate</td>
<td>52h 55</td>
<td>11h 35</td>
</tr>
<tr>
<td>2000 ppm INOXAN 583</td>
<td>64h 00</td>
<td>15h 15</td>
</tr>
</tbody>
</table>
TABLE 2
EFFECTS OF SEVERAL ANTIOXIDANTS ON STABILITY OF WHEAT GERM OIL
(RANCIMAT TEST)

<table>
<thead>
<tr>
<th>Antioxidant (ppm)</th>
<th>Test at 100°C</th>
<th>Test at 120°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Induction time</td>
<td>Protection factor</td>
</tr>
<tr>
<td>control (no antioxidant)</td>
<td>6h 15</td>
<td>-</td>
</tr>
<tr>
<td>250 ppm ascorbyl palmitate</td>
<td>9h 40</td>
<td>1.5</td>
</tr>
<tr>
<td>500 ppm ascorbyl palmitate</td>
<td>13h 10</td>
<td>2.1</td>
</tr>
<tr>
<td>2000 ppm INOXAN 583</td>
<td>15h 15</td>
<td>2.4</td>
</tr>
</tbody>
</table>
3/ COSMETIC CREAM WITH VITAMIN A

Vitamin A is easily oxidised and for this reason was chosen as a marker in the oxidation test, particularly as it is often added to cosmetic creams as an active ingredient.

Figure 6 shows the influence of ascorbyl palmitate and alpha-tocopherol in the stability of vitamin A in a cosmetic cream.

This test confirms the effectiveness of INOXAN 583.

**CONCLUSION**

These tests demonstrate that INOXAN 583 uses the synergistic activity of ascorbyl palmitate and alpha-tocopherol to delay oxidation and rancid changes in fats used in cosmetic formulations.
8. PRODUCT SPECIFICATIONS

- **Appearance**: Paste
- **Colour**: Yellow to pale brown
- **Odour**: slight, characteristic of fat
- **dl-alpha-tocopherol content**: 99.0 - 128.0 mg /g
- **Ascorbyl palmitate content**: 99.0 - 128.0 mg /g
- **Total germs**: < 100 CFU/g
- **Yeast and mould**: < 100 CFU/g
- **Pathogens**: Absence

9. APPLICATIONS

**As an antioxidant in cosmetic products with high fat content**: creams, milks, emulsions, sunscreens, massage oils, lip balms, lipsticks, hair balms, etc...

**Use level**: 1000 to 3000 ppm (1 to 3 g /l).

**Method of incorporation:**
INOXAN 583 is soluble up to 2% in the fat phase preheated to 60°C.

10. TOXICITY

- **Oral toxicity**: Not considered as toxic
- **Skin irritation**: Not irritant
- **Skin sensitisation**: Not sensitising
11. PRODUCT IDENTIFICATION

INCI composition (EU):

12. STABILITY AND STORAGE

INOXAN 583 is packed with nitrogen atmosphere. It is stable for 18 months if kept in the original unopened container, at cool temperature (10-20°C), protected from light, heat, and humidity sources.
Once opened, use contents quickly, and store in the original tightly closed container at +4°C.
REFERENCES


