It can be concluded that curcuminoids treatment improved all biochemical parameters of oxidative stress and antioxidants. 

**Improve red cell survival**

Eight children aged 8-18 years, with transfusion independent \(\beta\)-thalassemia/HbE disease were treated with oral curcuminoids 100 mg daily in two divided doses for 14 weeks. Red cell survival, erythrocyte lipid peroxidation level, and a quality-of-life (QOL) questionnaire were assessed before treatment and between week 12 and 16 of treatment. It was found that treatment with curcuminoids reduced the overall oxidative stress as measured by MDA level from 2546 ± 1214 nmol/g Hb to 1938 ± 783 nmol/g Hb at week 12. The half-life of red cells in patients was significantly increased, from 13.84 ± 7 days to 23.16 ± 4.4 days after 12 weeks of curcuminoids therapy. The improvement was most significant in 5 of 8 thalassemic children with shortened red cell survival (half-life 11-18 days) while no significant changes were observed in three milder cases. The overall QOL score improved after curcuminoids therapy in 4 of the 5 children who had increased red cell survival. 

**Remove non-transferrin bound iron (NTBI) from thalassemic plasma**

Plasma from \(\beta\)-thalassemia patients was used for in vitro study. With equivalent concentration at 100 \(\mu\)M NTBI, NTBI was removed by curcuminoids in a time-dependent manner as iron chelators, deferiprone (DFP) and desferrioxamine (DFO) (Fig. 1). The rate of NTBI removal by curcuminoids plus 100 \(\mu\)M DFP was slightly increased when compared to 100 \(\mu\)M DFP alone (control) (Fig. 2).

**Antioxidant as adjunctive therapy for thalassemia patients**

Curcuminoids 250 mg/day for 3 months. Blood samples were taken 2 times before treatment at 2 week interval as baseline control and after receiving curcuminoids capsule for 1, 2 and 3 months. The patients then stopped taking curcuminoids and blood was analyzed after curcuminoids withdrawal for 1, 2 and 3 months. Blood samples were evaluated for complete blood count (CBC), reticulocyte count and parameters for oxidative stress, MDA, antioxidative enzymes: superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px), and reduced glutathione (GSH). The results are shown in Table 1.

<table>
<thead>
<tr>
<th>Subject/Treatment</th>
<th>Control</th>
<th>1 month</th>
<th>2 months</th>
<th>3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDA ((\mu)M)</td>
<td>180</td>
<td>135</td>
<td>120</td>
<td>105</td>
</tr>
<tr>
<td>SOD (IU/ml)</td>
<td>300</td>
<td>350</td>
<td>380</td>
<td>400</td>
</tr>
<tr>
<td>GSH-Px (IU/ml)</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>GSH ((\mu)M)</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
</tr>
</tbody>
</table>

**About Curcuminoids**

Turmeric (Curcuma longa Linn) has been used traditionally for centuries in Asia for medicinal, culinary, and other purposes. Curcuminoids are orange-yellow substances, phenolic compounds extracted from rhizome of turmeric which consists of 3 major constituents curcumin, demethoxycurcumin, and bisdemethoxycurcumin. A large number of in vitro and in vivo studies in both animals and human have indicated that curcuminoids have strong antioxidant, anti-carcinogenic, anti-inflammatory, anti-angiogenic, anti-microbial and other activities. The Government Pharmaceutical Organization (GPO) by its Research and Development Institute has developed extraction process of curcuminoids from approved sources of turmeric. Our Governmental extracts have undergone chronic toxicity study in rats to ensure for its safety.

**Curcuminoids as Adjunctive Therapy for Thalassemia Patients**

- \(\beta\)-Thalassemia is a group of genetic disorders of hemoglobin synthesis. The disease is common in Mediterranean countries, the Middle East, the Indian subcontinent, South East Asia, Asia parts of Russia, and the northern-third of China. The ineffective erythropoiesis in \(\beta\)-Thalassemia is due to defective hemoglobin synthesis, leading to severe anemia, increased erythrocyte turnover and excessive iron absorption. Excess of iron causes deleterious oxidative reactions in red blood cell (RBC) membrane, therefore enhancing oxidative stress as indicated by increased susceptibility to lipid peroxidation, malonyldialdehyde (MDA). One way to protect these red blood cells from being damaged by free radicals in Thalassemia patients is by taking a safe and effective natural antioxidant. Due to strong anti-oxidative effect of curcuminoids, clinical studies and in vitro studies have been conducted to prove its efficacy in treatment of thalassemia patients as follows:

- **Improve biochemical parameters of oxidative stress and antioxidant**: Twenty-one \(\beta\)-thalassemia/HbE patients with 4 splenectomized cases, age ranged from 11-46 years old and hemoglobin level between 5.1-9.7 g/dl were treated with curcuminoids 100 mg/day for 3 months. Blood samples were taken 2 times before treatment at 2 week interval as baseline control and after receiving curcuminoids capsule for 1, 2 and 3 months. The patients then stopped taking curcuminoids and blood was analyzed after curcuminoids withdrawal for 1, 2 and 3 months. Blood samples were evaluated for complete blood count (CBC), reticulocyte count and parameters for oxidative stress, MDA, antioxidative enzymes: superoxide dismutase (SOD) and glutathione peroxidase (GSHPx), and reduced glutathione (GSH). The results are shown in Table 1.

**Table 1**: Evaluation of blood samples taken from \(\beta\)-thalassemia/HbE patients after curcuminoids treatment and withdrawal periods, respectively.

- **DOSAGE**: 60 capsules: Adults - 2 capsules daily; Children - as directed by the physician.
- **STORAGE**: Store below 25°C; SHELF LIFE: 2 years.
- **ABOUT CURCUMINOIDS**: Each capsule contains turmeric extract equivalent to curcuminoids 250 mg.
- **INDICATION**: Antioxidant
- **PRECAUTIONS**: Avoid using in pregnancy or nursing women and in biliary obstruction patients.
- **COMPOSITION**: Extracted from approved sources of turmeric (Curcuma Linn.)
- **USEFUL AS**: Excellent anti-oxidative performances; Effective natural antioxidant; Due to strong anti-oxidative effect of curcuminoids, curcuminoids improve red cell survival in patients with \(\beta\)-thalassemia/HbE.
- **PROVED FOR**: Safety in bile duct obstruction patients; Efficacy in at least 25 patients of both \(\beta\)-thalassemia/HbE and \(\beta\)-thalassemia/HbE patients with 6 splenectomized cases, age ranged from 11-46 years old and hemoglobin level between 5.1-9.7 g/dl were treated with curcuminoids 100 mg/day for 3 months. Blood samples were taken 2 times before treatment at 2 week intervals as baseline control and after receiving curcuminoids capsule for 1, 2 and 3 months. The patients then stopped taking curcuminoids and blood was analyzed after curcuminoids withdrawal for 1, 2 and 3 months. Blood samples were evaluated for complete blood count (CBC), reticulocyte count and parameters for oxidative stress, MDA, antioxidative enzymes: superoxide dismutase (SOD) and glutathione peroxidase (GSHPx), and reduced glutathione (GSH). The results are shown in Table 1.