Ferrous fumarate

1. Clinical trials referenced for bioavailability and side effects

(Zariwala 2013) - study outlined in gluconate section
In vitro caco-2 method. RVB of 78% sulfate

(Brise and Hallberg 1962) - study outlined in gluconate section
They calculated fumarate to have a R VB of 101% when compared to sulfate with both in solution. Comparison wasn’t made in tablet.

(Harrington et al. 2011)
A study of 60 non-anemic woman, children and infants (20 of each), comparing ferrous fumarate and ferrous sulfate. Each given a small dose (4mg adults and 2.5mg children) of either sulfate of fumarate in a sweetened maize-milk drink. The iron was labeled and measured as a percent incorporation into Hb after 14 days (Hemoglobin incorporation method)

Results:

My summary
Ferrous fumarate was shown to have a bioavailability similar to sulfate in this study. They say that that this higher than expected result could be due to fumarate not up regulating as well as sulfate for people with low Iron. Most other studies where fumarate had a lower RBV has been in studies with anemic subjects. It kind of fits the data, as in this study although none were anemic, 39% of the women had iron deficiency, 6% of infants and 5% of children, and the women had a lower RBV compared to the children. Another possible reason they give for the higher RBV, is maybe sulfate is more sensitive to food inhibitors and enhancers than fumarate.
It’s interesting seeing the difference in overall absorption between the adults and the children. Again this could be due to the variance in iron status between the adults and children.

(Fidler 2003)

20 women, given either a meal with either sulfate or fumarate on alternate days. Meals contained 5mg of either iron and contained wheat and milk. The iron was labelled and measured as a percent incorporation into Hb after 14 days (Hemoglobin incorporation method). None of the women were anemic although some had low iron stores. They were divided into two studies, in one Na2EDTA was added at a molar ratio of 1:1 (26.7 mg Na2EDTA), and in study 2 ascorbic acid was added at a molar ratio of 4:1 (63 mg ascorbic acid).

Results

<table>
<thead>
<tr>
<th>Study No.</th>
<th>Plasma ferritin (µg/L)*</th>
<th>Test meal</th>
<th>Iron absorption %*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 1</td>
<td>16.9 (10.5, 27.1)</td>
<td>A</td>
<td>3.1b (1.3, 7.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>3.0b (1.6, 5.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>5.3b (3.2, 8.6)</td>
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<tr>
<td></td>
<td></td>
<td>D</td>
<td>3.3b (2.2, 5.0)</td>
</tr>
<tr>
<td>Study 2</td>
<td>14.9 (7.7, 29.0)</td>
<td>E</td>
<td>6.3b (3.1, 13.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>10.4b (4.0, 27.0)</td>
</tr>
</tbody>
</table>

† molar ratio iron/Na2EDTA 1:1; ‡ molar ratio ascorbic acid/iron 4:1; *geometric mean (-SD, +SD)

My summary

Showed that the adults absorbed iron from fumarate as well as from sulphate. Na2EDTA enhances sulphate but not fumarate. Ascorbic acid significantly enhances fumarate.

The good results for fumarate were probably assisted by the fairly small dose, so the gastric juices were able to dissolve the fumarate. Also by the fairly high ratio (4:1) of ascorbic acid.

(Hurrell 2002) - study outlined in gluconate

Don’t have much details about the study, but the bioavailability of fumarate was the same as sulfate.

SIDE EFFECT STUDIES:

(Cancelo-Hidalgo et al. 2013) - study outlined in gluconate section

Big dataset but no details like dosage, food or if double blind.

Overall AE’s (adverse events)

Ferrous sulfate with mucoproteose (SR) - 4.1%
Ferrous sulfate without mucoproteose 32.3% (11.21 relative to SR)
Ferrous fumarate - 43.4% (19.87 relative to SR)
My summary

Side effects were a little more than normal sulfate and a lot more than Slow Release sulfate.

(Patil 2013) - outlined in carbonyl section
The bioavailability part isn’t that useful for fumarate as it wasn’t against sulfate.
High nausea side effect though, at 50%, 3-5 times higher than carbonyl and bisglycinate.

(Melamed et al. 2007) - study outlined in bisglycinate section
unknown dose, take with caution

% with any side effects
Ferrous fumarate - 56%
Ferrous sulfate immediate release - 53%
Ferrous sulfate slow release - 43%

2. Info and sources regarding inhibitors and enhancers

It’s poorly water-soluble, and gastric acid is necessary to dissolve ferrous fumarate before absorption. Na2EDTA to have no effect, but ascorbic at a 4:1 ratio increased absorption by around 60%.

(Fidler 2003)
As mentioned above it showed Na2EDTA to have no effect, but ascorbic at a 4:1 ratio increased absorption by around 60%. Na2EDTA can be a reducing agent when it forms EDTA-iron complexes. This is probably why Na2EDTA doesn’t enhance absorption of fumarate as by the time the gastric acid has dissolved it and it’s ready for reduction, Na2EDTA has formed complexes with other minerals and trace elements.

(Davidsson et al. 2002)
Study of 33 non anemic girls aged 12-13. Three different studies with 3 different meals testing fumarate, ferrous sulfate, and the enhancing effect of Na2EDTA. Meals were a south american dish of tortilla and black bean, so high in phytate and low in ascorbic.

Results
Again showed that Na2EDTA doesn’t enhance fumarate. The meal inhibitors affected both. Although the comparison against fumarate and sulfate wasn’t directly made, they said "data indicate that fractional iron bioavailability from the test meal fortified with ferrous fumarate was similar to that from the meal fortified with ferrous sulfate"
3. References used in this section


