Carbonyl

1. Clinical trials referenced for bioavailability and side effects

General
A lot of the supplement pages put it’s bioavailability at about 70% of sulfate but it’s not always easy to see where they get this figure from. *(Fidler 2003)* says that it is hard to label iron powders and therefore results need to be taken with caution. Also it is one that gets quite different results from rats, so need to ignore studies that are done on animals

- Most of the impurities are carbon, oxygen, and nitrogen.
- Ferronyl is a brand of carbonyl iron that is mentioned in a lot of the studies.
- Naturally slow release, so it doesn’t require coatings or additives

STUDIES SHOWING BIOAVAILABILITY LESS THAN SULFATE

*(Patil 2013)*
Study of 60 anemic pregnant women, given 100mg elemental iron of either ferrous fumarate, ferrous biglucinate or carbonyl iron. All supplements also had 1.5mg folic acid. No mention if taken with food. The usual tests were done for up to 3 months.

results
Hb increase was the same for all but Serum Ferritin was raised for fumarate.

![Fig 1 Rise in Serum Ferritin](image_url)

Side effects
Only gives this graph of individual effects, not a total.
Nausea and abdominal pain are often the main side effects. Interesting to see the difference in the Nausea results: fumarate - 50%, bisglycinate - 15%, carbonyl - 10%

My summary

In this study carbonyl was just as effective as fumarate in increasing Hb, but didn’t have as much of an increase in ferritin which is the main marker of iron levels. Side effects with carbonyl were better than fumarate and about the same as bisglycinate.

(Devasthali et al. 1991)

In this study of 50 anemic females, each given 100mg elemental iron in either carbonyl or sulfate. Taken before bed two hours after last meal. The usual tests were taken for 6 weeks.

results

Sulfate showed better serum iron results in first week, but by the end they were about the same. TIBC and Hb iron were similar for both. Serum ferritin results were better for sulfate by week 16.

'Using these approximations, the estimated overall bioavailability of carbonyl iron was about 70% that of ferrous sulfate.'

Side effects

Not any significant difference.

Gastrointestinal side effects

mild: carbonyl - 71%, sulfate - 80%
extreme: carbonyl - 13%, sulfate - 8%

My summary
Looks like carbonyl takes a bit longer to kick in, but in the end is pretty similar to sulfate. Not much difference with most the tests by the end except ferritin which is the most important test and what they based their 70% on. Would have been interesting to see the results over a longer period. No significant differences in side effects.

(Forbes et al. 1989)
A study of electrolytic iron vs sulfate showed it to have a RBV of 75%.

My summary
Probably not that useful a study as it isn’t carbonyl - carbonyl has been found to have a higher RBV than electrolytic iron.

(Hurrell 2002) study outlined in gluconate section
Bioavailability 5-20% of sulfate

My summary
Very low, but no information on the study so not really usable.

(Gordeuk et al. 1987)
75 women (51 completed the study) given either carbonyl, sulfate or a placebo. Given three times a day for a week after blood donation. All the usual markers taken after 56 days of treatment starting. Subjects had a range of different iron statuses, averaging a bit towards anemic. Iron doses weren’t equal. ie 600mg carbonyl, and 60mg sulfate.

results
Carbonyl had slightly better results than sulfate but they weren’t statistically significant except in the TIBC result which was statistically lower (which is better). Overall, their results at day 56 was about the same as day 0 (keep in mind that they gave blood at day 1). The placebo groups results were all lower.

side effects
No statistical difference between the side effects of carbonyl and sulfate.
carbonyl: mild 65%, severe 26%
sulfate: mild 50%, severe 25%
placebo: mild 22%, severe 13%

My Summary.
Hard to compare when the doses weren’t equal. Shows that carbonyl is slightly more effective than sulfate when given at higher doses (10x) but that this high dose doesn’t mean more side effects. Interesting to see the high amount of side effects from the placebo.

(Gordeuk et al. 1986)
Another one that isn’t that useful due to the high dose carbonyl with sulfate (30 times more carbonyl than sulfate). Gastrointestinal side effects were the same, but when cramping and diarrhea were included then significantly more side effects were with the carbonyl group.

STUDIES SHOWING BIOAVAILABILITY MORE THAN SULFATE

(Farias et al. 2009)
A study of 73, anemic Brazilian children given either carbonyl or sulfate. Range of ages, but all under 6. They were given 5mg iron per kg of their weight, per day. Given one hour before lunch.

results
After 30 days there wasn’t much difference, but after 90, ferritin levels were significantly better in the Carbonyl group. "After 90 days of treatment, the CI Group had significantly better results for hematocrit, MCV, MCH, iron binding capacity and ferritin concentration compared to the FS Group. The ferritin concentration was significantly higher in the CI Group at the end of the treatment (9.51 ng/mL to 26.16 ng/mL)"

side effects
"Adverse effects were absent in children of CI group, except for feces darkening. In FS group, 20% of children presented diarrhea, 36% experienced vomiting and/or spat out the medication, 6% experienced vomiting and diarrhea, and 38% did not present any adverse effect."

adverse side effects: carbonyl - 0%, sulfate - 62%

My Summary
Again carbonyl seems like it takes longer to kick in, but unlike the other studies it ended up being more effective than sulfate. Also it was better tolerated. Note that the sulfate was
given as drops which a lot of the kids didn’t like the taste of. Reasons for the carbonyl being more effective could be due to the smaller dose, or due to the difference in stomach acidity of kids compared to adults. Also maybe the sulfate causes more irritation which reduces its effectiveness over time as speculated in some other studies.

(Adsul et al. 2005)
A study of 60 Indian patients given either Modified Release (MR) carbonyl or fumarate. The usual markers were measured over 12 weeks.

results
"The estimated overall bioavailability of MR carbonyl iron was about 147% that of ferrous fumarate. Both the formulations were equally well-tolerated and adverse events were mainly gastrointestinal in nature. The prevalence of adverse events was slightly more in the ferrous fumarate group."

my summary
I have only read the abstract. I thought all carbonyl was naturally slow release so not sure what this MR carbonyl is. Quite a big RBV compared to fumarate. Not sure what it was taken with or if 45mg carbonyl is the same elemental iron as 300 fumarate. Not that useful.

OTHER
There are different types of elemental iron powders, carbonyl has been shown to be the most bioavailable (Swain & Hunt, 2003)

2. Info and sources regarding inhibitors and enhancers

(Hallberg, Brune, and Rossander 1986)
This study shows the effects on bioavailability when carbonyl is consumed with different wheat meals. Shows a large decrease but hard to see how this compares to sulfate with the same food. Ascorbic didn’t seem to have as much positive effect with the wheat.
"This relative bioavailability of carbonyl iron was unexpectedly low and varied from 20 to 5% when the iron fortified with wheat rolls were served with different meals."

(Hoppe, Hultén, and Hallberg 2006)
This study compared various iron powders against sulfate when taken with wheat rolls. Ferronyl (a carbonyl iron) came out with a relative bioavailability of 0.58 when compared to sulfate (also given with wheat). Used the Serum Iron increase method.

My summary
Seems to imply that carbonyl iron is more inhibited by wheat than sulfate. This could help explain some of the large variation between bioavailability.

(Fine 2000)
Fe$^0$ is converted to Fe$^{2+}$ by gastric acid before it can be absorbed. As a result, carbonyl iron is absorbed more slowly than ferrous sulfate.

(Devasthali et al. 1991)
The requirement for ionization and solubilization seems to account for the safety of carbonyl iron. After conversion to the ferrous form in the stomach, the fate of carbonyl iron is indistinguishable from that of iron ingested as ferrous sulfate. The mechanism of absorption of carbonyl iron appears to be dependent on solubilization by gastric acid.

"Dissolves in gastric secretion and is converted to hydrochloride salt prior to absorption in the stomach."
"Absorption rate is slow, which permits continued release of iron for 1 to 2 days."

3. References used in this section


