

NutraFine™ – Iron Fortification

Refined to Enrich

Höganäs 

Dedicated to global flour enrichment

We are what we eat!

Receiving all the micronutrients we need for a healthy diet is key to enjoying an active and productive life. The way we feel depends on our body and mind receiving regular inputs of vitamins and vital elements to fuel our activity levels even through the most hectic day. Most of us take it for granted that we will pick-up all we need to recharge our batteries through the food we eat.

One essential element none of us can do without is iron. Iron plays a vital role not only in the body's oxygen transport and delivery system, but also in the regulation of metabolism. Iron deficiency causes anemia, which can have widespread effects in terms of retarding growth, impairing IQ, tiredness and lowering our resistance to infection. ¹⁾

Iron Deficiency Anemia (IDA) affects more than 1, 5 billion people globally

The effects of IDA are not just a blight on the individual but, in parts of the world, are economically devastating for whole societies. The World Health Organization (WHO) estimates that two billion people or one-third of the world's population are anemic based on hemoglobin levels; 75% of these cases are due to iron deficiency. ²⁾

No other micronutrient deficiency is as widespread.

Iron enriches both the body and mind

Adding iron to flour is a simple, but highly effective way of eliminating anemia. Since bread is a staple food product in most countries it is an extremely efficient method of delivering the iron we all need. The positive impacts of iron enrichment are substantial for children, in particular, leading to fitter minds and bodies that can reach their full potential



"No other micronutrient deficiency is as widespread."

in adulthood. The risk to pregnant women dying or miscarrying is also greatly reduced and for the general adult population the capacity to work, without the tiredness associated with anemia, is greatly increased.

Purpose designed to eliminate IDA

Eliminating IDA is not just about adding iron to flour it is about adding the right type of iron in the correct doses. This requires the development of products particularly suited and adapted to the task. They must be easily absorbed by the body and have a neutral effect on the flour – in terms of storage, quality, color and taste. Höganäs is a world leader dedicated to the task of developing elementary iron product solutions to help eliminate IDA.



Enrichment technology and specialist knowledge

We have developed over the years a unique competence in iron fortification. Our 'enrichment technology' and specialist knowledge in the field enables us to produce purpose designed elemental iron products for all types of flour.

Iron fortification represents an important and growing part of our business activities. Our research and development capability is clearly focused on producing the very best iron powders for pre-mixers, millers and people now and in the future.

A pure and simple solution

The very best elemental iron enrichment solution should always be pure and simple. Pure in the sense those other trace elements are refined-out to the absolute minimum and certainly within regulatory requirements. And by simple we mean reduced to the smallest and simplest structure possible to facilitate easy absorption. Achieving these twin aims takes dedicated research and sophisticated technology. Our 'enrichment technology' allows us to guarantee you a pure and simple elemental iron.

1) Nutrition in Clinical Care, Sept/Oct 2002
2) WHO publications, Sept 2003

We specialise in iron fortification solutions

NutraFine™ Range

Designed for pre-mixing, milling and people

Selecting the best alternative

Our NutraFine™ range has been specifically developed to satisfy the needs and requirements of premixers, millers, bakers and, of course people. NutraFine™ balances all these needs in a unique way providing high quality and high bioavailability at the most competitive price. This makes iron enrichment affordable with no negative drawbacks relating to flour quality. It is a recipe designed to make everybody happy.

Elemental Iron Powder

NutraFine™ is an elemental iron powder range. Using our 'enrichment technology' we have been able to develop the range so that it is equal in bioavailability to electrolytic iron, but to a far more competitive price. The range has none of the side-effects associated with ferrous sulfate remaining pure and stable during mixing, milling and storing. NutraFine™ provides you with the consistency and quality you demand.

BIOAVAILABILITY: NutraFine™ has a high relative biological value (RBV) comparable to electrolytic irons.

CONSISTENCY: Each batch you receive is to the same level of quality, purity & consistency.

COLOR & TASTE: NutraFine™ products have no effect on the color or taste when mixed with flour.

FLOUR QUALITY & SENSORY CHANGES: NutraFine™ products are stable and less adversely affected by heat and humidity compared to other solutions. The quality of the flour is never affected by iron

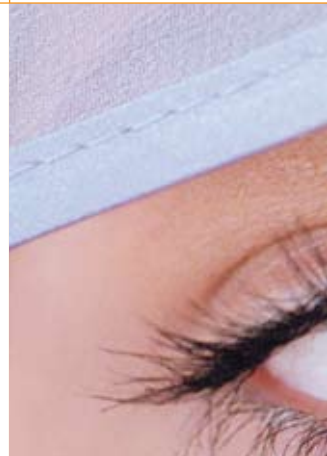
reacting with the natural fats in flour to cause rancidity as with ferrous sulfate (FeSO₄) solutions.

3)-4)

CONVENIENCE: NutraFine™ comes packaged in convenient sizes for storage and mixing with no hidden handling costs.

AFFORDABLE SOLUTIONS: NutraFine™ is offered to you at a significantly lower price than comparable electrolytic iron and ferrous sulfate products.

3) IFT Annual Meeting, Las Vegas, 2004
4) IFT Annual Meeting, Las Vegas, 2004





FLOUR FORTIFICATION SELECTION CRITERIA

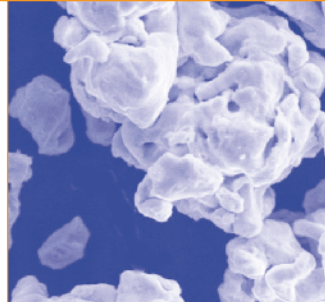
	RBV	Sensory Changes	Cost Efficiency	Convenience
NutraFine™ RS	+	+	++	+
Electrolytic	+(+)	+	-(+)	+
FeSO ₄	++	-	-	-



The consistency and quality you demand

NutraFine™ RS

The dawn of a new iron age



Fine particle size and shape

NutraFine™ RS represents a new generation product in food grade iron enrichment. Using the latest enrichment technology we have been able to refine iron powder to a morphology and surface shape that was not previously possible. This opens up exciting possibilities for further dramatic improvements in the future. Today we are confident that NutraFine™ RS represents the best all-round solution for flour enrichment and fortification.

Pure and safe

The importance of providing pure and safe products can never be taken for granted when dealing with the human food chain. Our scientists have developed NutraFine™ RS to reduce trace elements to the absolute minimum. In all the critical trace elements, such as for arsenic, lead and mercury, NutraFine™ RS is significantly lower than the Food Chemical Codex (FCC) recommendations for iron used in food fortification.



High bioavailability

The structure of NutraFine™ RS iron powder has been carefully sculpted to increase absorption and take-up by the body's metabolic system. In this sense less is more. The fineness and surface structure of NutraFine™ RS means you do not need to use as much powder in premixes to achieve the same beneficial effect as with reduced iron powders.

Most cost efficient solution

Our specialist technology and sophisticated manufacturing techniques allow us to produce a superior product at a significantly lower cost than any other competitive solution. NutraFine™ RS represents an affordable solution that makes it both attractive commercially and from the humanitarian perspective.

Pure and satisfying

NutraFine™ RS

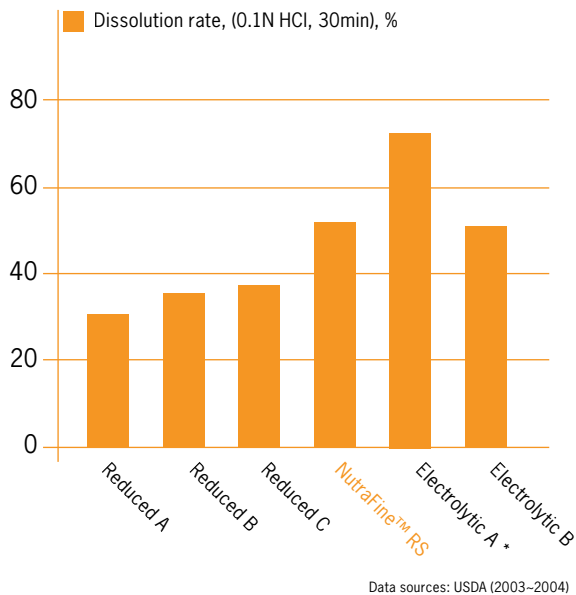
Performance and value

NutraFine™ RS – Purity & Chemistry

Elemental iron	Fe-total,%	Acid Insoluble,%	As,ppm	Pb,ppm	Hg,ppm
Reduced (FCC spec.)	>96	<1.25	<8.0	<10.0	<5.0
Conventional reduced	>97	<0.50	<8.0	<10.0	<5.0
Electrolytical (FCC spec.)	>97	<0.20	<3.0	<4.0	<2.0
NutraFine™ RS	>98	<0.50	<3.0	<4.0	<2.0

NutraFine™ RS performs significantly better in all parameters when compared to the Food Chemical Codex specifications. It has a purer chemistry that is better than or equal to the electrolytic iron specification.

NutraFine™ RS – Dissolution Rate



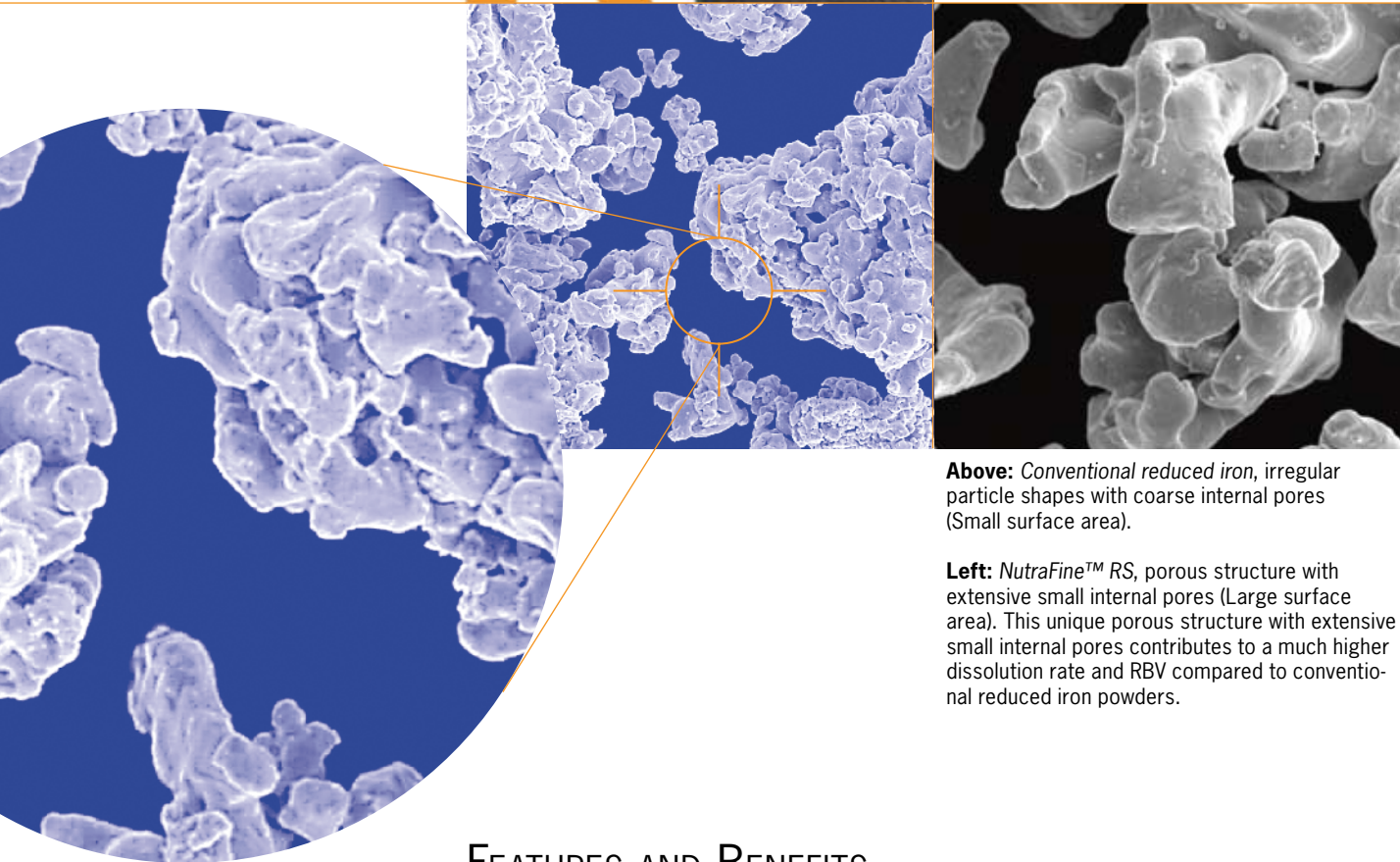
The design of NutraFine™ RS ensures that every particle has a high surface area. This property is one reason why the dissolution rate of NutraFine™ RS is significantly higher compared to reduced iron powders and comparable to electrolytic irons. Surface area, along with dissolution rate, is also highly predictive of RBV. ^{5)–6)}

5) USDA publications, 2003
6) USDA publications, 2004

*A 131 from North American Höganäs

RS

vs. conventional reduced iron



Above: Conventional reduced iron, irregular particle shapes with coarse internal pores (Small surface area).

Left: NutraFine™ RS, porous structure with extensive small internal pores (Large surface area). This unique porous structure with extensive small internal pores contributes to a much higher dissolution rate and RBV compared to conventional reduced iron powders.

FEATURES AND BENEFITS

- ✓ **Bioavailability** – High relative biological value that is compared to electrolytic iron
- ✓ **Cost efficiency** – Best price/consumption ratio
- ✓ **Consistency & Purity** – Purest reduced iron available with consistent quality
- ✓ **Sensory** – No adverse sensory changes
- ✓ **Convenience & Storage** – Designed for easy storage and usage

The best elemental iron available today

Global strength in iron fortification

Redefining the standards

Höganäs group is the largest iron powder producer in the world. Our specialist commitment to iron enrichment involves continuous research & development aimed at developing products with superior performance at an affordable price. The NutraFine™ range is a new generation of iron-enrichment products that are redefining the standards for global flour fortification.

A history in iron fortification

We have more than 50 years experience researching, producing and supplying food grade elemental iron powders. This unrivalled history gives us an accumulated knowledge and experience that you can rely upon wherever you are in the world. Today we are the only iron powder producer that can supply identical powder grades from different production facilities around the globe. Consistency of quality is a hallmark of our success.

Technology that counts

Our 'enrichment technology' and dedicated scientists have enabled us to push back the boundaries of what was previously possible. Smaller particle sizes and the unique surface structure of NutraFine™ powders have contributed to a significant improvement in the product quality benefits for premixers, millers and consumers. Our technology has also permitted us to produce the NutraFine™ range cost-efficiently allowing us to pass on the cost advantages throughout the supply chain. You can count on our technology for the most advanced products at the best prices.



The resources to deliver

Höganäs AB is a company that specializes in the development of iron fortification solutions. Our committed and substantial resources are continuously working towards the next generation of iron enrichment products. NutraFine™ represents the latest generation formed out of our long-term commitment to flour fortification. It also represents 'the dawn of a new iron age' in fortification with further major advances anticipated as we add to the range. We have the resources and technology to deliver our promises.

Global market support

With production facilities in Europe, Asia, North and South America and sales offices in all continents Höganäs has the global reach to be local and easily accessible. We provide continuous technical support of supplied iron-enrichment products, which guarantees you a fast response whenever and wherever you need us. Our committed support to iron-enrichment means you will always talk to people with the specialist expertise you require. It is an expertise and level of care that our customers have come to rely upon and value over the years.

Iron fortification and enrichment glossary

Absorption of iron: percentage of the iron in a iron or iron compound that is absorbed into the body through the duodenum

Atomized iron powder: iron powder produced by the dispersion of a molten iron by mechanical means such as a rapid moving gas or liquid stream. It consists of solid particles without internal porosity.

Bioavailability of iron: percentage of iron (fortificant) that would be absorbed by an iron deficient person under conditions that are ideal for promoting absorption.

Dissolution rate: percentage of iron or iron compounds dissolved in dilute acid such as HCl acid for a certain time. It can be used as an indicator how elemental iron or iron compounds are easily dissolved in gastric juice of stomach. The higher the dissolution rate the greater the probability that the iron will be absorbed by body.

Electrolytic iron: iron powder produced by electrolytic deposition based on a sulfate electrolyte with soluble anodes where iron is deposited on the cathodes

Elemental iron powder: a powder that only contains iron as a single chemical species with no other ingredients. Usually, it contains >96%Fe according to FCC

Enrichment: the process of adding micronutrients which are naturally present in the food to levels higher than naturally occurring.

FCC: the Food Chemical Codex (FCC) is a compendium of specifications defining quality (minimum criteria) for food grade chemicals approved by FDA (U.S. Food and Drug Administration). The criteria reflect 1) material evaluated toxicologically, 2) material in marketplace, 3) good manufacturing practices. FDA has a contract with Institute of Medicine, National Academy of Sciences (IOM/NAS) to develop the FCC. The FCC contains 900+ monographs and its fifth edition has been published in Fall 2003

Fortification: the process of adding micronutrients to food to levels that are much higher than naturally found in the food.

Hydrogen-reduced iron powder: iron powder produced, without melting, by hydrogen reduction of iron oxides. It consists of porous particles with extensive internal tiny pores and thus it has higher specific surface area than other reduced iron powders.

IDA: iron deficiency anemia, which impairs growth both mentally and physically, causes tiredness and lethargy and is life threatening in severe cases.

Iron compound powder: a powder that contains iron and other inorganic or organic chemical species. For example, ferrous sulfate (FeSO_4) usually contains <33%Fe and NaFeEDTA only contains ~13%Fe

Micronutrients: substances, such as vitamins or minerals, that are essential in minute amounts for the proper growth and metabolism of a living organism.

Reduced iron: iron powder produced, without melting, by the chemical reduction of iron oxides or other iron compounds. It consists of porous particles with internal porosity and it has higher specific surface area than atomized iron powder.

Relative biological value (RBV): Percentage of absorption from an elemental iron powder divided by absorption from ferrous sulfate (FeSO_4).

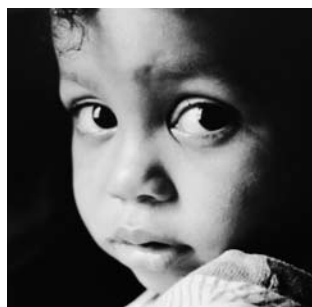
Sensory changes: are changes that adversely affect the flour or final product. These relate to quality changes in terms of visual appearance, smell, taste, and texture.

Stability: the degree to which flour deteriorates during production, storage, or processing after the addition of a premix.

Specific surface area: the external powder surface area per unit weight of powder. Usually it is measured by gas absorption (BET method).

References

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- 2) *Battling Iron Deficiency Anemia*. World Health Organization. Available at: <http://www.who.int/nut/ida.htm>. Sep. 2003
- 3) *Effect of fortifying flour with elemental iron, ferrous sulfate or sodium iron EDTA on the volume, color and crumb grain characteristics of bread*, 2004 Institute of Food Technologists (IFT) Annual Meeting, *Nutrition: General I*, 33H-14
- 4) *Studies on micronutrients stability and acceptability of Mexican tortillas fortified with different sources of iron*, 2004 Institute of Food Technologists (IFT) Annual Meeting, *Nutrition: General II*, 99E-11
- 5) USDA, *The American Society for Nutritional Sciences J. Nutr.* 133:3546-3552, November 2003
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Refined for you

Höganäs is represented in the majority of countries around the world. Please consult our website for further details.

www.hoganas.com

For more information about iron fortification and/or NutraFine™ please visit.

www.ironfortification.com

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