Casein micelles fortified with iron

Identification

Key words
Fortification, iron, targeted delivery, casein, micelle, CO2 acidification, carbonation, milk, dairy

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Completed by
INRA - IATE

How does it work?

Primary objective
Iron fortification of milk, thanks to encapsulation within casein micelles

Working principle
Caseins are one of the most important proteins of milk. Their native tri-dimensional form (III and IV structures) is a kind of more or less spheric "cage", with a space inside it. This space is usually occupied by calcium.

The technology consists in acidifying milk with CO2 (this operation is called carbonation), which causes a change in the III and IV structures of caseins. The micelle then “opens up”, allowing access to its inside. There, iron can be inserted alongside or instead of calcium. Then occurs the de-acidification (through degassing); the micelle “closes up”, locking the iron inside.

Images

Additional effects
When done with particular parameters, carbonation technology followed by degassing can lead to rennet clotting of Ultrahigh Temperature treated milk. This technology may also have an effect on the product shelf-life. More generally, the reversible acidification of milk modifies temporarily the functionality of casein micelles. This can lead to several applications (to be studied).

Important process parameters
Temperature, acidification speed, pH, holding time

Important product parameters

What can it be used for?

Products
Milk

Operations
Structure forming, fortification of common ingredients with molecules of interest

Solutions for short comings
Developing milk with the same properties as maternal milk, ways of added value milk products, targeted delivery of molecules of interest via encapsulation inside the micelle: legislation and analysis
**What can it NOT be used for?**

**Products**
This technology is available only on liquid or pumped products of low viscosity i.e. milk, soft drink containing casein micelles (micelles are mandatory for encapsulating molecules of interest)...

**Operations**
This technology must be applied at low temperature to optimize CO2 solubility.

**Other limitations**
Fat compounds could give some adverse reactions.

**Risks or hazards**
Working with moderated pressure (5 to 30 bars) and CO2 toxicity

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**Implementation**

**Maturity**
The technique has been demonstrated on lab-scale (see publications)

**Modularity**
This technology can be inserted in an existing production line using specific equipments as pump, CO2 injection system, pH and pressure monitoring

**Consumer aspects**
Such iron fortification is likely to be more easily assimilated by the consumer and it does not need any additional ingredient.
CO2 technology is already used for sparkling soft drink. As regard to processed milk, sparkling milks can be found in the market with good consumer acceptance.

**Legal aspects**
The technology is protected by an international patent (see references)

**Environmental aspects**
Use of CO2 gas

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**Facilities that might be interesting for you**

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**Further Information**

**Institutes**
INRA - IATE, UMII - ATA

**Companies**
Unilever
References

Patent:

Publications:
Raouche S., Dobenesque M., Bot A., Cuq J-L., Marchesseau S. 2009. Casein micelles as vehicle for iron fortification of foods. European Food Research and Technology, 229, 929-935

Source: