Systematic review to evaluate the oxidative stability of omega-3 nanoemulsion systems

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Introduction

- Long chain omega-3 (ω -3) polyunsaturated fatty acids (LC ω 3PUFA) offer numerous health benefits throughout the lifecycle⁽¹⁾
- Low intakes of oily fish in a variety of populations has created a demand for food products enriched with LC ω 3PUFA
- Nanoemulsions, systems with extremely small droplet sizes have the potential to increase LC ω 3PUFA bioavailability⁽²⁾
- The use of nanoemulsion processing may cause problems with oxidative stability due to small lipid droplet sizes and large droplet surface areas⁽³⁾

Study aims

- The study aimed to systematically review published literature that focused on the oxidative stability of LC ω 3PUFA nanoemulsions suitable for integration into food vehicles.

Methods

- A systematic literature search was made in accordance with the PRISMA checklist
- Search engines PubMed, Science Direct, Google Scholar and SCOPUS were used to identify papers published between Jan 2007 and 2017
- Search terms included nanoemulsion (s), nanotechnology, emulsions, omega-3, ω -3, LC ω 3PUFA, DHA, EPA, ALA, fish/vegetable oils (e.g. salmon, tuna, carp or algae) or nut and seed oils (e.g. flaxseed, echium, walnut)
- Searches conducted and titles and abstracts were screened by two independent review authors

Results and Discussion

- The search criteria identified 1880 articles, which were reduced to 1403 upon screening
- Further reductions were achieved by applying the inclusion/exclusion criteria
- A total of 17 key studies that evaluated the oxidation stability of LC ω 3PUFA nanoemulsions were identified
- Researchers used a range of surfactants and antioxidants to create systems which were evaluated during 7 to 100 days of storage

Figure 1. Summary of systematic review selection process

- LC ω 3PUFA source oils included fish (n = 9), flaxseed (n = 2), algae (n = 3), krill (n = 2) and walnut (n = 1)
- Algal sources offer a sustainable equivalent to marine sources that is suitable for vegetarians
- Natural emulsifiers offered equivalent or increased oxidative stability compared to synthetic sources, which is useful as consumers are demanding more natural cleaner label products⁽⁴⁾
- Nanoemulsions processed and stored under optimal conditions have similar or improved oxidative stability in comparison to unprocessed/bulk oils
- Quillaja saponin is a promising natural emulsifier that offers equivalent/increased oxidative stability compared to other emulsifiers, particularly when additional antioxidants are used

Conclusions

The oxidative stability of nanoemulsions may remain similar or be improved in comparison to unprocessed/bulk oils when processed and stored under optimal conditions
Further studies to evaluate the oxidative stability of quillaja saponin nanoemulsions combined with algal sources of LC ω 3PUFA are warranted to enable the development of safe, clean label functional food products.

References

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