Scopus

Documents

Rus, S.M.[a] , Anika, Z.M.R.[b] , Sabere, A.S.M.[c] , Rushdi Abu Bakar, M.[d e] , Mohamed, F.[d] , Doolaanea, A.A.[f]

Black Seed Oil-Alginate Nanoemulsion Characteristics Utilising an Ultrasonicator at Pilot Plant Scale
(2024) *Sarhad Journal of Agriculture*, 40 (Special issue1), pp. 43-49.

DOI: 10.17582/journal.sja/2024/40/s1.43.49

[a] Pharmaceutical Technology Programme, Faculty of Pharmacy and Health Sciences, Universiti Kuala Lumpur, Royal College of Medicine Perak, Jalan Greentown, Ipoh, Perak30450, Malaysia
[b] Advanced Manufacturing and Materials Center (AMMC), Institute of Integrated Engineering, Universiti Tun Hussein Onn Malaysia, Parit Raja, Johor, Batu Pahat, 86400, Malaysia
[c] Department of Pharmaceutical Chemistry, Kulliyyah of Pharmacy, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, Pahang, Kuantan, 25200, Malaysia
[d] Department of Pharmaceutical Technology, Kulliyyah of Pharmacy, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, Pahang, Kuantan, 25200, Malaysia
[e] IKOP Pharma Sdn Bhd, Jalan Sultan Ahmad Shah, Pahang, Kuantan, 25200, Malaysia
[f] Sabrena Experience, 1500 Dragon Street, Suite 160, Dallas, TX 75207, United States

Abstract
Black seed oil (BSO) contains thymoquinone, an active ingredient that is well-known for its antioxidant property and used in food and traditional medicine. BSO is encapsulated in micrometre-sized alginate beads (AB), to increase its palatability. This encapsulation is established and produced on a small scale in the lab. To achieve the ideal BSO alginate nanoemulsion during large-scale manufacturing, it is vital to use suitable parameters where two parameters were manipulated: the flow rate of the pump and the percentage of the power (amplitude) of the ultrasonicator. The droplet size, PdI, and zeta potential of the nanoemulsion were investigated. The zeta potential values for BSO nanoemulsions ranging from -53.83 ± 1.50 to −63.50 ± 0.66 mV. All zeta values were below -30 mV, demonstrating that the nanoemulsions are stable emulsions. Each amplitude and flow rate produced BSO alginate nanoemulsion within the targeted droplet size, which is below 500 nm of the sonication process, except at flow rates 144, 216 and 288 mL min-1 at 30 % power of amplitude. The droplet size was found to be smaller at a lower flow rate. The smallest droplet size was achieved at 72 mL min-1 i.e., 346.57 nm to the power of 90% of ultrasonicator amplitude. For every flow rate of 70% and 90% power of sonication, the PdI of BSO alginate nanoemulsion was less than 0.700, The PdI ranges for these parameters are from 0.262 ± 0.005 to 0.627 ± 0.045. The higher the flow rate and the low percentage of ultrasonicator power, the larger the particle size of the BSO alginate nanoemulsion obtained. As the applied power of the amplitude increases from the optimal value (70%), the size of the emulsion particle decreases. It is discovered that the BSO alginate nanoemulsion particle size is influenced by the pump flow rate and ultrasonicator power.

Author Keywords
Alginate beads; Black seed oil; Nanoemulsion; Thymoquinone; Ultrasonicator

References

- Bhattacharjee, S.
  DLS and zeta potential. What they are and what they are not?
  (2016) *J. Contr. Release*, 235, pp. 337-351.
- Bing, C., Hong, Y., Hernandez, C., Rich, M., Cheng, B., Munaweera, I., Chopra, R.
  Characterization of different bubble formulations for blood-brain barrier opening using a focused ultrasound system with acoustic feedback control
  (2018) *Sci. Rep*, 8 (1), pp. 1-12.
- Branco, I.G., Sen, K., Rinaldi, C.
  Effect of sodium alginate and different types of oil on the physical properties of ultrasound-assisted nanoemulsions
  (2020) *Chem. Eng. Process*, 153, p. 107942.
- Carpenter, J., George, S., Saharan, V.K.
  A comparative study of batch and recirculating flow ultrasonication system for preparation of multilayer olive oil in water emulsion stabilized with whey protein

isolate and sodium alginate
(2018) *Chem. Eng. Process*, 125, pp. 139-149.

- Goindi, S., Kaur, A., Kaur, R., Kalra, A., Chauhan, P.
Nanoemulsions: an emerging technology in the food industry
(2016) *Emulsions*, pp. 651-688.
Academic Press

- Gupta, A., Narsimhan, V., Hatton, T.A., Doyle, P.S.
Kinetics of the change in droplet size during nanoemulsion formation
(2016) *Langmuir*, 32 (44), pp. 11551-11559.

- (2009) *ICH Q8(R2) pharmaceutical development*,

- Joseph, E., Singhvi, G.
Multifunctional nanocrystals for cancer therapy: A potential nanocarrier
(2019) *Nanomaterials for drug delivery and therapy*, pp. 91-116.
Elsevier

- Kashaninejad, M., Mohammad, S., Razavi, A.
Influence of thermosonication treatment on the average size of fat globules, emulsion stability, rheological properties and color of camel milk cream
(2020) *LWT*, 132, p. 109852.

- Mohd Rus, S., Mohamed, F., Abu Bakar, M.R., Doolaanea, A.A., Sabere, A.S.M.
Impacts of various mixing approaches towards black seed oil-alginate emulsion attributes
(2021) *Mater Express*, 11 (10), pp. 1746-1751.

- Montes de Oca-Ávalos, J.M., Candal, R.J., Herrera, M.L.
Nanoemulsions: Stability and physical properties
(2017) *Curr. Opin. Food Sci*, 16, pp. 1-6.

- Mudalige, T., Qu, H., Van Haute, D., Ansar, S.M., Paredes, A., Ingle, T.
Characterization of nanomaterials: Tools and challenges
(2019) *Nanomaterials for Food Application*, pp. 313-353.
Elsevier

- (2015) *Process validation (PV) overview on ASEAN guideline on PV requirements overview on ASEAN guideline on PV requirements*,
Petaling Jaya: National Pharmacy Regulatory Agency

- Sharma, S., Cheng, S.F., Bhattacharya, B., Chakkaravarthi, S.
Efficacy of free and encapsulated natural antioxidants in oxidative stability of edible oil: Special emphasis on nanoemulsion-based encapsulation
(2019) *Trends Food Sci. Technol*, 91, pp. 305-318.

- Silva, K.C.G., Sato, A.C.K.
Sonication technique to produce emulsions: The impact of ultrasonic power and gelatin concentration
(2018) *Ultrason Sonochem*, 52, pp. 286-293.

- Son, Y., No, Y., Kim, J.
Ultrasonics-sonochemistry geometric and operational optimization of 20-kHz probe-type sonoreactor for enhancing sonochemical activity
(2020) *Ultrason. Sonochem*, 65, p. 105065.
(January)

- Zuki, N.M., Ismail, N., Omar, F.M.
Evaluation of zeta potential and particle size measurements of multiple coagulants

in semiconductor wastewater
(2019) *AIP Conf. Proc. AIP Publ. LLC*, 2124 (1), p. 020036.

Correspondence Address
Rus S.M.; Pharmaceutical Technology Programme, , Perak, Jalan Greentown, Malaysia; email: shaiqah.rus@unikl.edu.my
Doolaanea A.A.; Pharmaceutical Technology Programme, Perak, Jalan Greentown, Malaysia; email: abdalmonemdoolaanea@yahoo.com
Rus S.M.Sabrena Experience, 1500 Dragon Street, Suite 160, United States
Doolaanea A.A.Sabrena Experience, 1500 Dragon Street, Suite 160, United States

Publisher: ResearchersLinks Ltd

ISSN: 10164383
Language of Original Document: English
Abbreviated Source Title: Sarhad J. Agri.
2-s2.0-85212789533
Document Type: Article
Publication Stage: Final
Source: Scopus