Palm oil-based nanoemulsion as drug carrier for pharmaceutical injections

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Abstract: A prototype palm oil-based nanoemulsion (NEMS™ MCT/LCT) has been successfully produced using a modified emulsion processing procedure and nanotechnology. NEMS™ MCT/LCT is a combination of medium chain and long chain triglycerides (MCT and LCT respectively). Characterization studies showed that palm oil has similar fatty acid contents (examples are linoleic, linolenic, and oleic acids) as found in the commercially available intravenous emulsions made from soybean and olive oil.

Physicochemical studies on NEMS™ MCT/LCT showed that its globule size distribution is in the range of 200–400 nm which is within the standard limits for an intravenous lipid emulsion (globule size < 500 nm). Comparison studies on the rheological properties of NEMS™ MCT/LCT showed similar flow characteristics as compared to other commercially available intravenous lipid emulsions. NEMS™ MCT/LCT retained its physicochemical stability profiles even after accelerated stability tests which included heat sterilisation (autoclave), and centrifugation tests. Pharmacological tests on animals (i.e. New Zealand white rabbits) did not show any signs of toxicity.

Studies on the use of NEMS™ MCT/LCT as a carrier for an anaesthetic agent (propofol) were conducted. Anaesthetic effects (i.e. sleep induction and recovery) of Propofol 1 % and 2 % in NEMS™ MCT/LCT injections in male Sprague-Dawley rats were investigated. A commercially available propofol in soybean injection was used as the positive control. All of these injections induced sleep in rats in less than one minute. Full recovery from sleep in these animals were similar i.e. 15.99 ± 0.34 minutes for the commercial product as compared to 15.93 ± 0.52 and 15.91 ± 0.32 minutes for propofol 1 % and 2 % in NEMS™ MCT/LCT respectively.

A stable intravenous lipid emulsion from superolein palm oil was developed by optimizing the preparation parameters, namely homogenization pressure, homogenization cycles and lecithin as an emulsifier, using response surface methodology. The emulsion was prepared using superolein palm oil and MCT oil (1:1), stabilized with egg lecithin and homogenized using high speed and high pressure homogenizers. The emulsion prepared using optimized parameters of 800 psi, 7 cycles and 1.2 g lecithin, produced a milky emulsion with droplet size of 253.63 ± 3.98 nm, polydispersity index of 0.047 ± 0.041, Zeta potential of -35.9 ± 2.26 mV, viscosity of 1.74 ± 0.04 cP, $PFAT_5$ of 0.00 % and pH of 7.84 ± 0.05. It was physically stable for 6 months in 4 ^{o}C, 25 ^{o}C and 40 ^{o}C storage temperatures. These results are encouraging and show the potential of utilising palm oil as a drug carrier system for sterile pharmaceutical products. Clinical use of NEMS™ MCT/LCT will hence diversify, enrich and lead the oil palm industry into the high-end pharmaceutical industry.

Keywords: Palm oil-based nanoemulsion, super olein palm oil, intravenous emulsions, drug carrier system, propofol.

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