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## **ENCAPSULATION OF CLOVE OIL USING MICROCHANNEL EMULSIFICATION AND A HOMOGENIZATION METHOD**

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Clove oil is an essential oil extracted from clove, and it has been widely applied in pharmaceutical, fragrance, and flavor industry. The oil has several functionalities such as antioxidant agent, free-radicals scavenger, anti-microbial agent, etc. Clove oil is generally recognized as safe (GRAS) to be applied in foods with a considered safety limit (< 1500 ppm). Encapsulating clove oil in the form of oil-in-water (O/W) emulsion is a possibility to preserve the functionalities. The release of clove oil from the emulsion could also be controlled via its formulation to ensure its safety during application. Microchannel (MC) emulsification and homogenization method were used in this research to prepare clove oil-in-water emulsion. MC emulsification is a novel emulsification that requires low energy input and produces monodisperse emulsion droplets. Homogenization method involves high intensive energy to prepare the emulsion and usually results in polydisperse emulsion droplets. Clove oil emulsion droplets produced by MC emulsification were initially monodisperse with coefficient of variance of below 10%. However, the droplets shrunk immediately when surrounded by the continuous phase. This phenomenon took place because the nature of the clove oil that is slightly hydrophilic. Clove oil droplets tend to diffuse to the continuous phase regardless the surfactant applied, resulting in instable emulsion system over time. Instability was also observed when the emulsion was prepared by homogenization method. However, different instability phenomena involved, such as coalescence, Ostwald ripening, and sedimentation. Shrinkage of oil droplets was difficult to be determined with this method. In addition, the instability was contributed by the nature of clove oil that changes in color over time. Stable emulsion until 31 days was obtained when a high concentration (10% w/w) of whey protein isolate (WPI) as the surfactant was applied. However, high concentration of surfactant is hardly applied in food formulation. Instability of clove oil emulsion droplets with a low WPI concentration (2.5% w/w) prepared by homogenization method might be enhanced by increasing viscosity of the continuous phase. A mixture of sodium alginate and WPI with a ratio of at least 1:2 enhanced the stability of the emulsion for at least 10 days.