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Development and Applications of Nano emulsion in Food Technology

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***Abstract*— The importance of nanotechnology and uses in food industries has received great attention. Nano emulsions are finding application in diverse areas such as drug delivery, food, cosmetics, pharmaceuticals and material synthesis. In the food industry, nano emulsions are being explored to encapsulate, stabilize and deliver lipophilic constituents like flavors, omega-3 fatty acids, vitamins, preservatives and nutraceuticals. Nano emulsion production for encapsulation and delivery of functional compounds is one of the emerging fields which can be applied to food industry. High and low energy methods are used to prepare nano emulsions, with the help of high-pressure homogenizers, sonication, and some low-energy emulsification, as well as bubble bursting method used to prevent their degradation and improve their bioavailability. The application of nano based emulsion to food systems still poses challenges in terms of the production process, and the food systems to which they will be applied in terms of product safety. This review provides insight into nano emulsion composition, processing, properties, and potential applications for utilization within food industry.**

***KEYWORDS:* Nano emulsions, Encapsulation, Stabilization, Food Industry, Food Safety.**

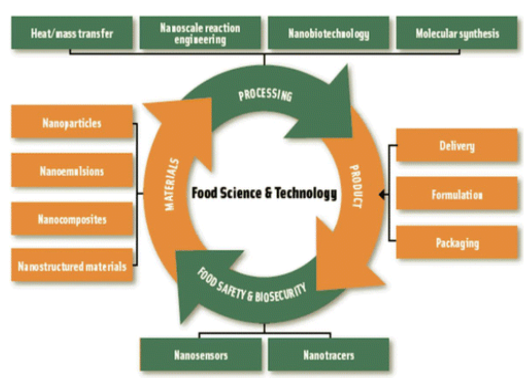
I. INTRODUCTION

Nanotechnology is the ability to measure, see, manipulate and manufacture things between 1 and 100 nanometers (A nanometer is one billionth of a meter). Their size allows them to exhibit novel and significantly improved physical, chemical, biological properties and processes because of their size. Nanotech can provide us with a never before known or understanding about materials and devices and will most likely have an impact on many fields. By using structures at the nanoscale as a tunable physical variable, it can greatly expand the range of performance of existing chemicals and materials. Alignment of linear molecules in an ordered array on a substrate surface (self-assembled monolayers) can function as a new generation of chemical and biological sensors. Switching devices and functional units at nanoscale can improve computer storage and operation capacity by a factor of a million [1-3]. Nano emulsions are one of the most interesting fields of application which consists of two immiscible liquids (usually oil and water), with one liquid being dispersed as very small spherical droplets in the other liquid. Usually, Nanoemulsions are thermodynamically unstable with particle diameter from 10 to 100 µm [4-6].
Nano emulsion to solve many problems facing humanity such as:

- Enzyme replacement therapy in the liver
- Vaccination
- Treatment of cancer
- Treatment of infection

Characteristics of Nano emulsion:

- ✓ Diameter varies from 10 to 100µm
- ✓ Thermodynamically unstable
- ✓ Clear Cloudy appearance
- ✓ Odour should be compatible with the product.
- ✓ Non Toxic
- ✓ High Surface area
- ✓ Optically Transparent



Materials in Nano emulsion Production:
Surfactants: Stabilization of emulsions is one of the important step in order to provide a good stability. The common way to stabilize is by surfactant adsorption at the

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interface. Different ways of promoting stability can be achieved by depending on the surfactant applied [7-8].

Solvents: Different types of solvents such as n-hexane, n-Decane, Acetone, etc are used for the Nano emulsion Production. There are some solvents which is not accepted by the consumers because certain solvents are not food gradable.

Functional Compounds: There are certain lipophilic functional compounds such as Lycopene, Curcumin, Lidocaine, etc. The lipophilic functional compounds that are needed to be incorporated in foods can be further divided into antioxidant, Phytosterols, Carotenoids and Fatty acids [9-10].

Factors to be Consider during the production of Nano emulsion:

1.Surfactant must be selected carefully

2.To stabilize the micro droplets concentration surfactants must be high.

3.To promote the formation of Nano emulsion factors must the surfactant must be flexible.

Production of Nano emulsions:

The Production of Nano emulsion can be done by different Methods, either by High energy or Low energy approaches. The high energy approaches use mechanical devices which leads to the formation of oil droplets. The low energy approaches depends on the spontaneous formation of oil droplets within mixed oil–water-emulsifier systems when the solution or environmental conditions are altered.

High-energy Approaches:

The Nano emulsion formation by the high energy methods is governed by the quality of energy and the selected compostion.High pressure homogenization, High speed device, Ultra sound are the mechanical processes which are divided into major groups classified based on the devices used for the production of Nano emulsion.

High-pressure homogenization—In high-pressure homogenization, the mixture is subject to have a very high pressures and it is pumped through a restrictive valve. The very high shear stress causes the formation of very fine emulsion droplets [11-12].

Ultrasound—When two immiscible liquids are subjected to high-frequency sound waves in the presence of a surfactant, emulsion droplets are formed by cavitation. This causes intense shock waves in the surrounding liquid and the formation of liquid jets at high speed is responsible for the formation of emulsion droplets. However, this technology has not yet been proved as efficient for industrial-scale applications [13-14]

High-speed devices—Rotor/Stator devices when compared with the other high energy approaches do not provide a good dispersion in terms of droplet sizes. With the energy provided mostly being dissipated, generating heat [15-16].

Low-Energy Approaches:

In the Low –Energy approaches there are certain methods such as Membrane emulsification, Solvent Displacement, Spontaneous emulsification, Emulsion inversion point, etc for the production of Nano emulsion products. In this Method, Nanoemulsions are obtained by phase transitions produced during the emulsification process at ant constant Temperature and by changing the composition or by vice versa [17-18].

Evaluation Parameters of Nano emulsion:

Dye test:

According to the colour of the dye dispersed Nano emulsion products can be revealed by microscopic examination. If dye is added in an o/w Nano emulsion the Nano emulsion takes up the colour uniformly. Conversely, If dye is added in an w/o Nano emulsion the emulsion is not uniformly coloured.

pH:

The Nano emulsion pH can be measured by pH meter.

Filter Paper Test:

When o/w Nano emulsion will spread out when it is dropped onto filter paper. But if an w/o Nano emulsion will not spread and they will migrate slowly.

Viscosity determination:

At different temperatures and different shear rates The viscosity of Nano emulsion is measured by using Brookfield-type rotary viscometer [19].

Droplet size analysis:

Droplet size analysis is measured by a diffusion method using a light-scattering, particle size-analyzer counter, etc . Droplet size analysis of Nano emulsion can also be performed by transmission electron microscopy (TEM) [20-22].

Zeta potential:

Zeta potential is measured by an instrument known as Zeta PALS. It is used to measure the charge on the surface of droplet in Nano emulsion [23].

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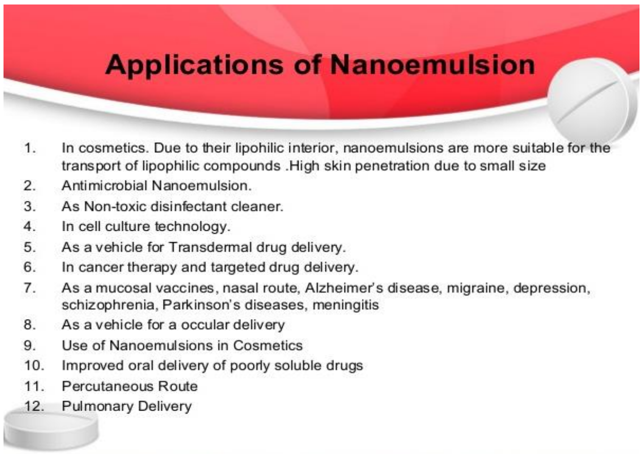

CONCLUSION:

Nano emulsions formulations offer several advantages for the delivery of drugs, biological, or diagnostic agents. It also offers one of the most promising systems to improve solubility, bioavailability and functionality of hydrophobic compounds. The application of Nano emulsions in food processing technology still poses challenges that need to be addressed both in terms of the production process; especially their cost but will require continued investments to fund the research and development to better understand the advantages and disadvantages of Nano emulsions offers.

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