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FORMULATION DEVELOPMENT OF MICRO AND NANOEMULSION OF FENUGREEK OIL

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Abstract:

Oil in water nano and microemulsions can be defined as emulsions containing oil droplets in the range of 50-100 nm in diameter and 5-50 nm respectively. There is a growing interest in the development of nano and microemulsions to encapsulate, protect, and deliver lipophilic compounds, such as nutraceuticals, drugs, flavours, antioxidants and antimicrobial agents, for their application in the food, pharmaceutical, agrochemical and other industries.

Formulation of a nano & microemulsion is achieved through low energy technique, using phase inversion technique and the droplet size depends on weight ratio between surfactant and oil. Different formulations of different proportions of surfactant tween 80 & fenugreek oil were prepared and added to it different amounts of water and the mixture was mixed using a vortex, for two minutes.

From the collected data it is clear that changing the proportion of water in the developed formulation while keeping the weight ratio between the surfactant and the oil constant, affected the droplet size, polydispersity index and zeta potential.

Key Words: *nanoemulsion, microemulsion, tween 80, fenugreek oil, polydispersity index, zeta potential*

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INTRODUCTION:

Oil in water nano and microemulsions can be defined as emulsions containing oil droplets in the range of 50-100 nm in diameter and 5-50 nm respectively [1]. There is a growing interest in the development of nano and microemulsions to encapsulate, protect, and deliver lipophilic compounds, such as nutraceuticals, drugs, flavours, antioxidants and antimicrobial agents, for their application in the food, pharmaceutical, agrochemical and other industries [2].

Colloidal delivery system based on microemulsion & nanoemulsions are increasingly being utilized in the food & Pharmaceutical industry to encapsulate & protect and deliver lipophilic bioactive components. The small size of the particles in these kind of delivery system [r < 100 nm] means they have a number of potential benefits for certain application: enhanced long term stability; high optical clarity; and, increased bioavailability. Currently there is a considerable confusion about the use of the terms microemulsion and nanoemulsion in the scientific literature. However, these are distinctly different types of colloidal dispersions. A microemulsion is thermodynamically stable, whereas a nanoemulsion is not. [3]

Colloidal dispersions generally consist of a suspension of small particles distributed within a liquid medium. They usually have better stability to particle aggregation and gravitational separation. Second, they contain particles that only scatter light waves weakly and so they are suitable for incorporation into products that need to be optically clear or only slightly turbid. Third, they can often be designed to have novel rheological properties high viscosity or gel like characteristics. Fourth they may be able to increase the bioavailability of certain types of bioactive lipophilic substances encapsulated within them. The most common types of colloidal dispersions that can be created from these components are microemulsions and nanoemulsions. There are many structural similarities between these two kinds of colloidal dispersions, but there are also some important differences . Nevertheless, there has been great confusion about the precise nature of these different systems, and there have been wide spread errors in the classification of colloidal dispersions reported in the scientific literature. For example, some researchers have clearly prepared microemulsions but referred to them as nano emulsions and vice versa. It is important to accurately specify the kind of colloidal dispersions

The droplet size distribution of an emulsion governs emulsion properties such as long term stability, texture and optical appearance. Consequently, means to control the droplet size during emulsification are of interest when well defined emulsion properties are needed [4]

The methods used in making emulsions can be divided into high energy and low energy methods. High energy methods use mechanical devices [high pressure, Homogenizers, micro fluidizers, ultrasonicator, etc.]. [5]. Emulsions with droplet sizes less than 100 nm is not readily achieved by high energy methods [6]. Microemulsions are produced through simply mixing oil, water and surfactant together by using low energy methods which do not require a high mechanical force and rely on the spontaneous formation of small droplets by changing the solution composition or environmental conditions [7] these include phase inversion methods, such as phase inversion temperature [PIT], phase inversion composition [PIC], and emulsion inversion point [EIP].

The formation of micro emulsions containing very fine droplet sizes is not readily achievable by using high energy emulsification methods that are conventionally used in preparation of emulsions [1] The preparation of microemulsions is generally carried out by using low energy methods and has some limitations with only certain type of emulsifiers [e.g. Non ionic surfactants at high concentrations and oils [e.g. non-triglyceride oils such as hydrocarbon based oils and mineral oils with very low viscosity].

Emulsification by phase inversion method makes use of two effects for the achievement of finely dispersed oil in water emulsions. The lamellar or minimal interfacial tension facilitates the droplet formation, explaining why the droplet size distribution only depends on the weight ratio between surfactant and oil rather than on the water concentration [4]

Fenugreek oil is obtained from the seed of fenugreek. These seeds are quite nutritious and have a plethora of health benefits. This oil is quite useful, even though it is not as popular as other oils. It is generally not cold pressed oil like most other seed oils. It is actually an essential oil obtained from the seeds. So it contains volatile organic compounds and is used in aromatherapy.

Fenugreek essential is obtained by steam distillation from the seeds of fenugreek [*trigonella foecum graecum*] the seeds are rhomboid shaped and are used in cooking and as a medicine. There are two varieties of fenugreek oil.

- Fenugreek seeds pressed oil- this oil contains healthy fatty acids
- Fenugreek seeds essential oil-it contains volatile compounds which have unique health benefits.

- Fenugreek infused oil – this prepared by infusing the seeds and other parts of fenugreek in base oil.

Fenugreek oil just like the seeds has tremendous healing properties, antiviral, anticancer, Antioxidant, hypoglycemic, phytoestrogen, circulant, anti inflammatory, expectorant , neuroprotective, immunomodulatory, Beta cell stimulant, Hypotensive, Antispasmodic, galactagogue

Diabetes

Fenugreek oil improves glucose intolerance and can lower blood glucose levels. It also stimulates the pancreas and reduces damage to beta cells [8] Fenugreek helps to restore normal kidney health. [9]

METHODOLOGY:

Formulation of a nano & microemulsion is achieved through low energy technique, using phase inversion technique and the droplet size depends on weight ratio between surfactant and oil. Different formulations of different proportions of surfactant tween 80 & fenugreek oil were prepared and added to it different amounts of water and the mixture was mixed using a vortex, for two minutes. The best weight ratio between surfactant and oil was identified on the basis of the droplet size, viscosity, transparency and poly dispersity index using Zetasizer ZS Malvern instruments Ltd.

Material:

Fenugreek oil [Cap Pharm], Tween 80 [Loba Chemie], distilled water.

Table1: weight ratio of fenugreek oil, tween 80 and water

Formula No.	Fenugreek oil [mg]	Tween 80 [mg]	Distilled water[mg]
F2	9	81	10
F3	8	72	20
F4	7	63	30
F5	6	54	40
F6	5	45	50
F7	4	36	60
F8	3	27	70
F9	2	18	80

RESULTS:

Table 2: droplet size, polydispersity index & Zeta potential

	Size [nm]	PDI*	Zeta± SD
F2	172.5	0.643	-8.05± 7.71
F3	41.24	0.460	-39.6±20.9
F4	62.21	0.257	-33.6±29.4
F5	292.8	0.539	5.19±3.87
F6	91.43	0.359	-36.0±10.6
F7	209.0	0.319	-16.5±12.7
F8	236.8	0.446	-31.7±8.78
F9	41.95	0.143	-16.6±10.3

*PDI= poly dispersity index

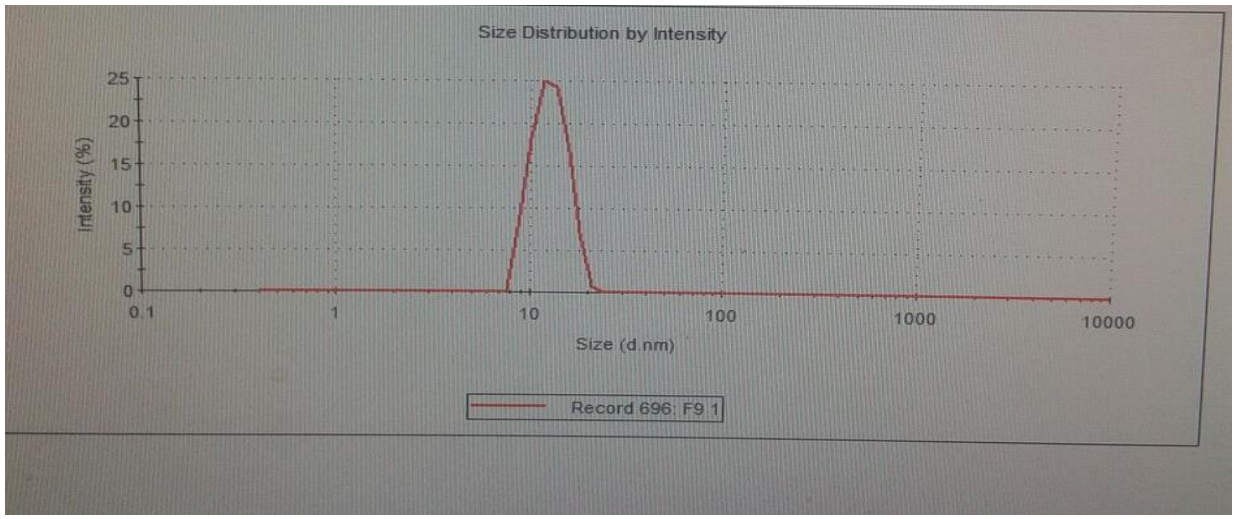

Fig. 1 Size Distribution

DISCUSSION:

From the collected data it is clear that changing the proportion of water in the developed formulation while keeping the weight ratio between the surfactant and the oil constant, affected the droplet size, polydispersity index and zeta potential.

Again from the above formulation it was seen that in keeping the weight ratio of surfactant: oil in the range of 9:1 most of the formulations have exhibited a droplet diameter in the range of less than 100 nm.

All developed formulations have exhibited a negative value of zeta potential which indicates a thermodynamic stability, i.e. they are of the micro emulsion type. Only the developed formula F5 have shown a positive zeta potential indicating a nano emulsion type

CONCLUSION:

For developing micro or nano-emulsion a critical weight ratio between the surfactant and oil should be attained.

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