RESEARCH INSTRUMENTS FOR

Effects of Spray Drying Temperature on Dry Emulsion Properties and Aceclofenac Encapsulation Efficiency

Van Thu Nguyen [1*], *Duc Thinh Pham*[1]

[1]Institute of Pharmaceutical Education, Vietnam Military Medical University, Ha Dong district, Hanoi 12108, Vietnam.

[*]Corresponding authors. Email: thu_vmmu@hotmail.com ; Tel: +84-88-608-8388.

* Research instruments

The preparation process was carried out using temperature-controlled magnetic stirrers (IKA C-Mag HS 7 Control, IKA Vietnam Co., Ltd). Emulsification was performed with the T10 basic Ultra-Turrax (IKA Vietnam Co., Ltd). The emulsion was spray-dried using a YC-2000 spray dryer (Shanghai Yacheng Instrument & Equipment Co., Ltd., China). Particle size analysis of the dry emulsion samples was conducted using a Zetasizer Nano analyzer (SZ-100Z2, Horiba Ltd., Japan). The moisture content of the dry emulsion powder was measured with a rapid moisture analyzer (Hal Moisture Analyzer HC103, Mettler Toledo, China), and water activity was assessed at 25 °C using a water activity meter (HygroLab C1-SET-40, Rotronic, Switzerland). Differential scanning calorimetry (DSC) analysis was performed using a DSC-60 (Shimadzu, Japan). UV spectra were obtained using a spectrophotometer (UVD-2960, Labomed, USA), while Fourier-transform infrared (FTIR) analysis was conducted with an FTIR spectrometer (Cary 630 FTIR, Agilent, USA). Dissolution testing was carried out using USP apparatus 2 (paddle) on a DIS 600i Dissolution Apparatus (Copley Scientific Ltd., UK).

RESEARCH MATERIALS FOR

Effects of Spray Drying Temperature on Dry Emulsion Properties and Aceclofenac Encapsulation Efficiency

Van Thu Nguyen [1*], *Duc Thinh Pham*[1]

[1]Institute of Pharmaceutical Education, Vietnam Military Medical University, Ha Dong district, Hanoi 12108, Vietnam.

[*]Corresponding authors. Email: thu_vmmu@hotmail.com ; Tel: +84-88-608-8388.

Research Materials

Castor oil (*Ricinus communis*), olive oil (Olea europaea), sweet almond oil (*Prunus amygdalus*), and coconut oil (*Cocus nucifera*) were obtained from Natures Natural India Oils Pvt., Ltd., India. Cremophor RH40 was sourced from BASF SE (Ludwigshafen, Germany), while Tween 80, Span 80, and hydrochloric acid (37%) were supplied by Xilong Scientific Co., Ltd., China. Aerosil 200 was procured from Evonik Degussa (SEA) Pet. Ltd., Germany, and HPMC E6 and maltodextrin were purchased from Hopetop Pharmaceutical Company, China. All reagents were of analytical grade and used without further purification. The dialysis bags (Dialysis membrane, MWCO: 14000) were obtained from Biosharp, China.

RESEARCH RESULTS FOR

Effects of Spray Drying Temperature on Dry Emulsion Properties and Aceclofenac Entrapment efficiency

Van Thu Nguyen [1*], Duc Thinh Pham[1]

[1]Institute of Pharmaceutical Education, Vietnam Military Medical University, Ha Dong district, Hanoi 12108, Vietnam.

[*]Corresponding authors. Email: thu_vmmu@hotmail.com ; Tel: +84-88-608-8388.

List of Figures

List of Tables

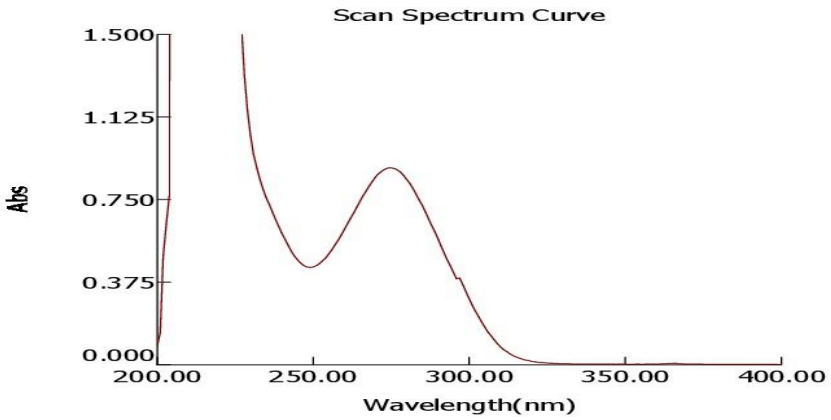


Figure S1. UV Spectral Scanning of aceclofenac at 10.0 µg/ml in phosphate buffer (pH 6.8)

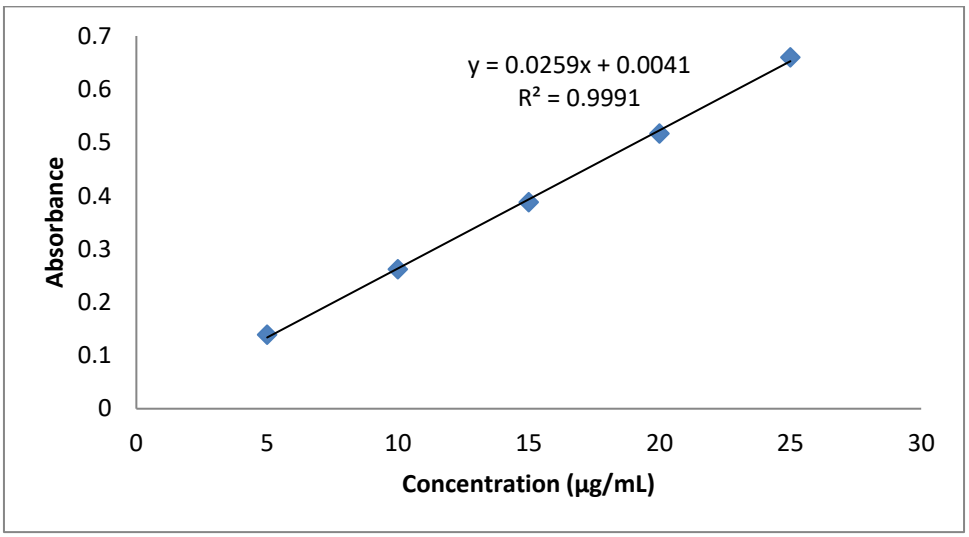
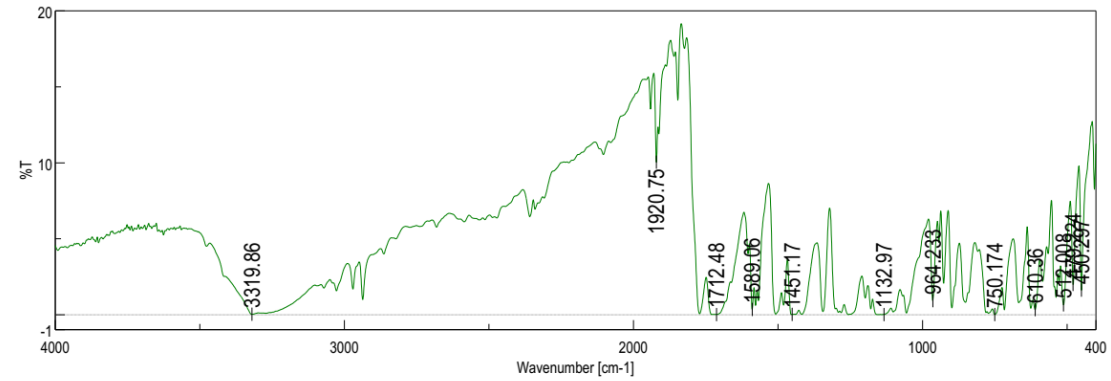


Figure S2. Depicting linearity chart of aceclofenac in phosphate buffer (pH 6.8)



[Comments]
Sample name
Comment
User
Division
Company HOC VIEN QUAN Y

[Detailed Information]
Creation date 5/23/2019 8:28 AM
Date modified 5/23/2019 8:29 AM

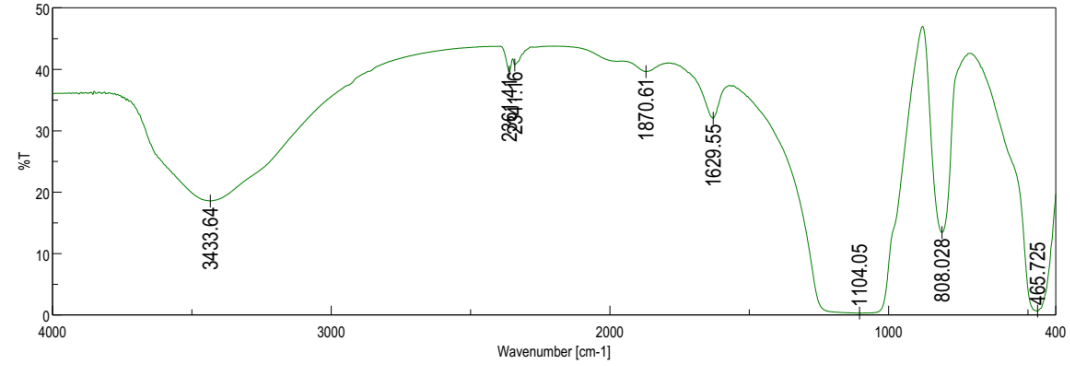
Data array type Linear data array
Horizontal axis Wavenumber [cm-1]
Vertical axis %T
Start 399.193 cm-1
End 4000.6 cm-1
Data interval 0.964233 cm-1
Data points 3736

[Measurement Information]
Model Name FT/IR-4700typeA
Serial Number D040661788

Measurement Date 5/23/2019 8:28 AM

Light Source Standard
Detector TGS
Accumulation 16
Resolution 4 cm-1
Zero Filling On
Apodization Cosine
Gain Auto (16)
Aperture Auto (7.1 mm)
Scanning Speed Auto (2 mm/sec)
Filter Auto (30000 Hz)

Fig. S3 - FTIR spectrum of aceclofenac.



[Comments]
Sample name
Comment
User
Division
Company HOC VIEN QUAN Y

[Detailed Information]
Creation date 5/23/2019 8:07 AM
Date modified 5/23/2019 8:09 AM

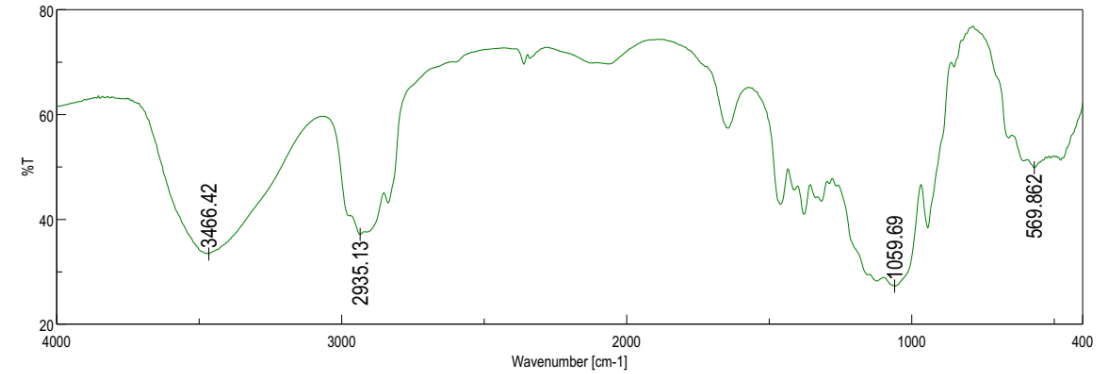
Data array type Linear data array
Horizontal axis Wavenumber [cm-1]
Vertical axis %T
Start 399.193 cm-1
End 4000.6 cm-1
Data interval 0.964233 cm-1
Data points 3736

[Measurement Information]
Model Name FT/IR-4700typeA
Serial Number D040661788

Measurement Date 5/23/2019 8:07 AM

Light Source Standard
Detector TGS
Accumulation 16
Resolution 4 cm-1
Zero Filling On
Apodization Cosine
Gain Auto (4)
Aperture Auto (7.1 mm)
Scanning Speed Auto (2 mm/sec)
Filter Auto (30000 Hz)

Fig. S4 - FTIR spectrum of aerosil 200



[Comments]
Sample name
Comment
User
Division
Company HOC VIEN QUAN Y

[Detailed Information]
Creation date 5/23/2019 8:01 AM
Date modified 5/23/2019 8:02 AM

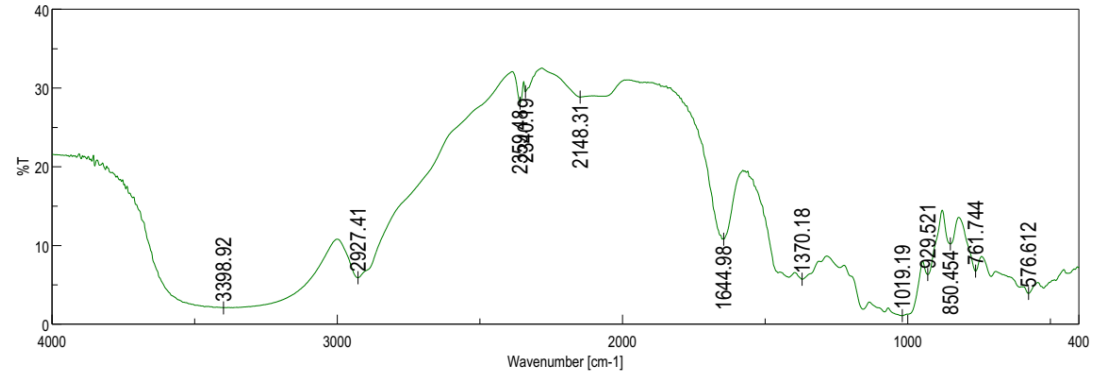
Data array type Linear data array
Horizontal axis Wavenumber [cm-1]
Vertical axis %T
Start 399.193 cm-1
End 4000.6 cm-1
Data interval 0.964233 cm-1
Data points 3736

[Measurement Information]
Model Name FT/IR-4700typeA
Serial Number D040661788

Measurement Date 5/23/2019 8:01 AM

Light Source Standard
Detector TGS
Accumulation 16
Resolution 4 cm-1
Zero Filling On
Apodization Cosine
Gain Auto (2)
Aperture Auto (7.1 mm)
Scanning Speed Auto (2 mm/sec)
Filter Auto (30000 Hz)

Fig. S5 - FTIR spectrum of HPMC E6



[Comments]
Sample name
Comment
User
Division
Company HOC VIEN QUAN Y

[Detailed Information]
Creation date 5/23/2019 8:13 AM
Date modified 5/23/2019 8:13 AM

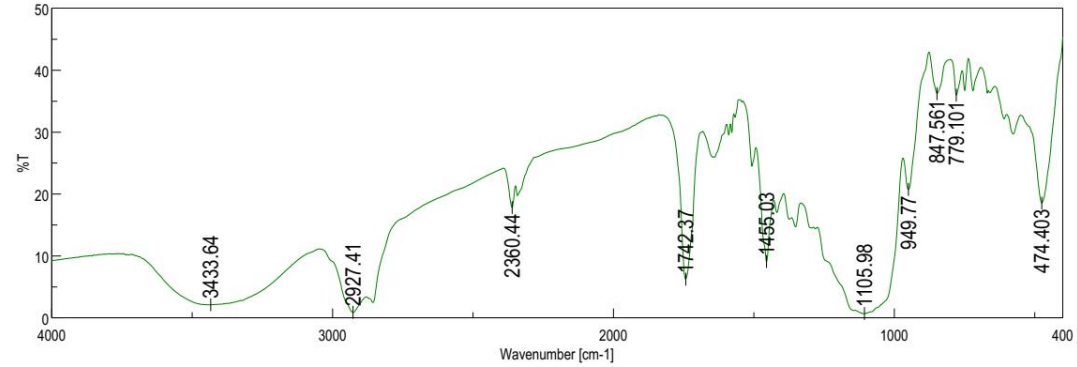
Data array type Linear data array
Horizontal axis Wavenumber [cm-1]
Vertical axis %T
Start 399.193 cm-1
End 4000.6 cm-1
Data interval 0.964233 cm-1
Data points 3736

[Measurement Information]
Model Name FT/IR-4700typeA
Serial Number D040661788

Measurement Date 5/23/2019 8:13 AM

Light Source Standard
Detector TGS
Accumulation 16
Resolution 4 cm-1
Zero Filling On
Apodization Cosine
Gain Auto (8)
Aperture Auto (7.1 mm)
Scanning Speed Auto (2 mm/sec)
Filter Auto (30000 Hz)

Fig. S6 - FTIR spectrum of Maltodextrin



[Comments]
Sample name
Comment
User
Division
Company HOC VIEN QUAN Y

[Detailed Information]
Creation date 5/23/2019 8:35 AM
Date modified 5/23/2019 8:36 AM

Data array type Linear data array
Horizontal axis Wavenumber [cm-1]
Vertical axis %T
Start 399.193 cm-1
End 4000.6 cm-1
Data interval 0.964233 cm-1
Data points 3736

[Measurement Information]
Model Name FT/IR-4700typeA
Serial Number D040661788

Measurement Date 5/23/2019 8:35 AM

Light Source Standard
Detector TGS
Accumulation 16
Resolution 4 cm-1
Zero Filling On
Apodization Cosine
Gain Auto (8)
Aperture Auto (7.1 mm)
Scanning Speed Auto (2 mm/sec)
Filter Auto (30000 Hz)

Fig. S7 - FTIR spectrum of F3 formulation

HORIBA Scientific

HORIBA SZ-100 for Windows [Z Type] Ver2.20

SZ-100

ACE 3d-1.nsz

Measurement Results

Date	: 03 June 2019 09:30:59
Measurement Type	: Particle Size
Sample Name	: ACE 3d
Scattering Angle	: 90
Temperature of the Holder	: 25.0 deg. C
Dispersion Medium Viscosity	: 0.895 mPa.s
Transmission Intensity before Meas.	: 19736
Distribution Form	: Broad
Distribution Form(Dispersity)	: Polydisperse
Representation of Result	: Scattering Light Intensity
Count Rate	: 1789 kCPS

Calculation Results

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	229.0 nm	396.1 nm	99.0 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	229.0 nm	396.1 nm	99.0 nm

Cumulant Operations

Z-Average	: 127.5 nm
PI	: 0.396

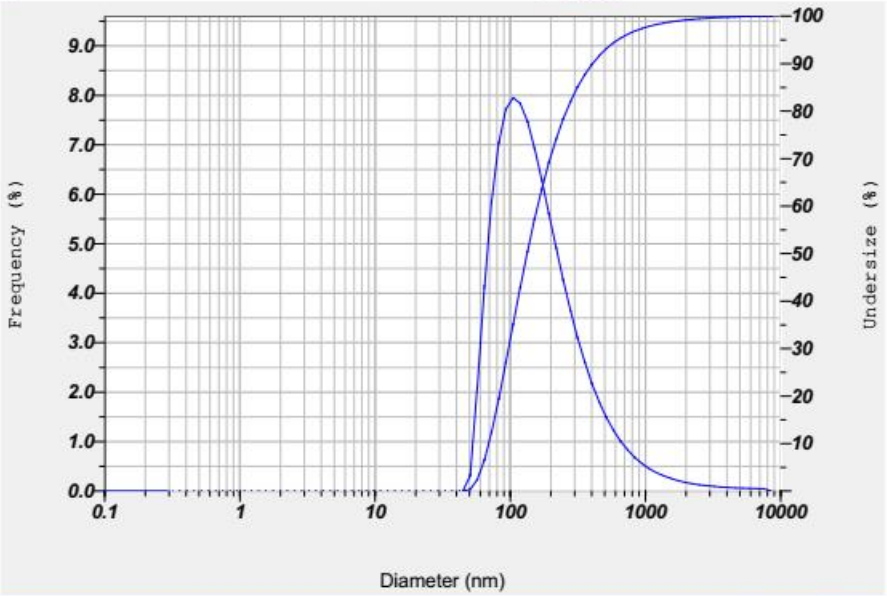


Fig. S8 - Z-average and polydispersity index of F1

HORIBA Scientific

HORIBA SZ-100 for Windows [Z Type] Ver2.20

SZ-100

ACE 12h-2.nsz

Measurement Results

Date	:	31 May 2019 09:11:14
Measurement Type	:	Particle Size
Sample Name	:	ACE 12h
Scattering Angle	:	90
Temperature of the Holder	:	25.0 deg. C
Dispersion Medium Viscosity	:	0.895 mPa.s
Transmission Intensity before Meas.	:	19942
Distribution Form	:	Broad
Distribution Form(Dispersity)	:	Polydisperse
Representation of Result	:	Scattering Light Intensity
Count Rate	:	1128 kCPS

Calculation Results

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	249.8 nm	522.8 nm	98.7 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	249.8 nm	522.8 nm	98.7 nm

Cumulant Operations

Z-Average	:	126.4 nm
PI	:	0.358

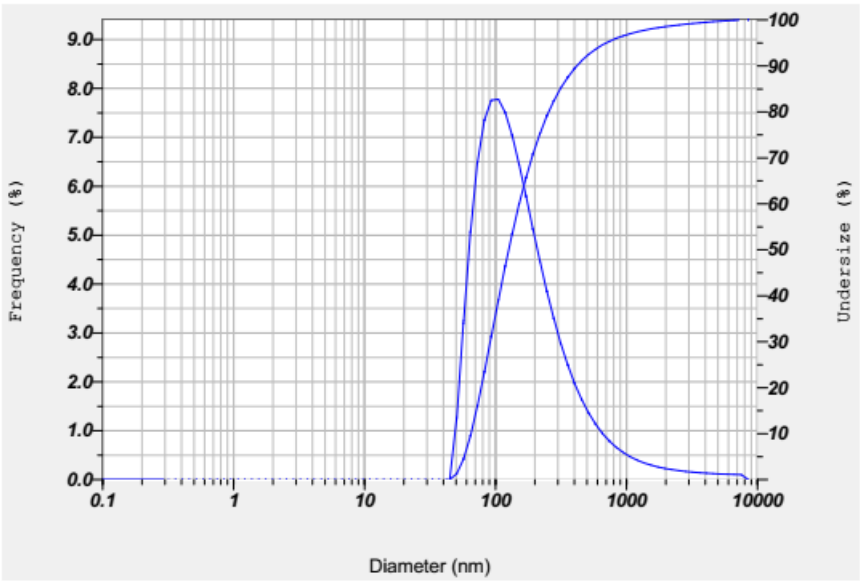


Fig. S9 - Z-average and polydispersity index of F2

HORIBA Scientific

HORIBA SZ-100 for Windows [Z Type] Ver2.20

SZ-100

ACE 45p-1.nsz

Measurement Results

Date	:	30 May 2019 15:33:35
Measurement Type	:	Particle Size
Sample Name	:	ACE 45p
Scattering Angle	:	90
Temperature of the Holder	:	24.9 deg. C
Dispersion Medium Viscosity	:	0.897 mPa.s
Transmission Intensity before Meas.	:	25034
Distribution Form	:	Broad
Distribution Form(Dispersity)	:	Polydisperse
Representation of Result	:	Scattering Light Intensity
Count Rate	:	2841 kCPS

Calculation Results

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	120.8 nm	67.0 nm	87.4 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	120.8 nm	67.0 nm	87.4 nm

Cumulant Operations

Z-Average	:	101.9 nm
PI	:	0.329

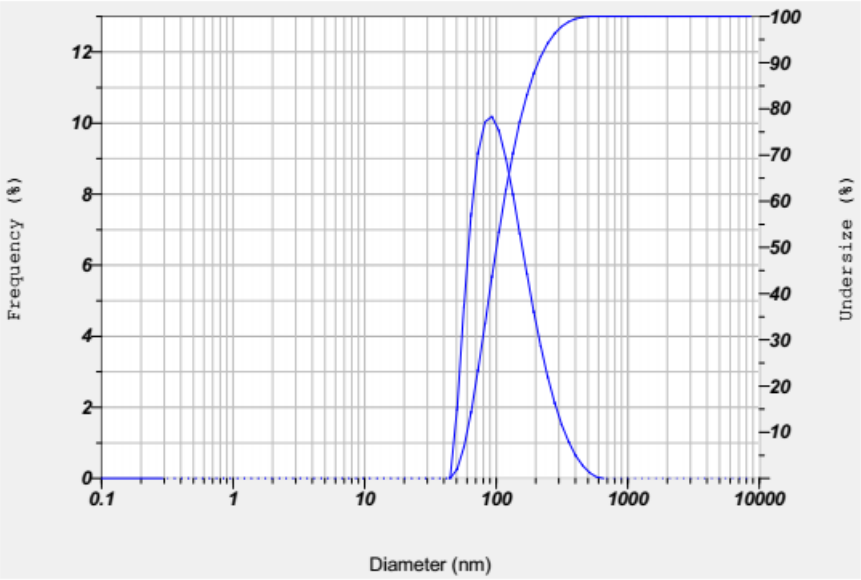


Fig. S10 - Z-average and polydispersity index of F3

HORIBA Scientific

HORIBA SZ-100 for Windows [Z Type] Ver2.20

SZ-100

201906041444001.nsz

Measurement Results

Date	:	04 June 2019 14:44:32
Measurement Type	:	Particle Size
Sample Name	:	ACE 7d
Scattering Angle	:	90
Temperature of the Holder	:	25.0 deg. C
Dispersion Medium Viscosity	:	0.894 mPa.s
Transmission Intensity before Meas.	:	17030
Distribution Form	:	Broad
Distribution Form(Dispersity)	:	Polydisperse
Representation of Result	:	Scattering Light Intensity
Count Rate	:	1355 kCPS

Calculation Results

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	251.4 nm	555.1 nm	99.2 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	251.4 nm	555.1 nm	99.2 nm

Cumulant Operations

Z-Average	:	139.0 nm
PI	:	0.303

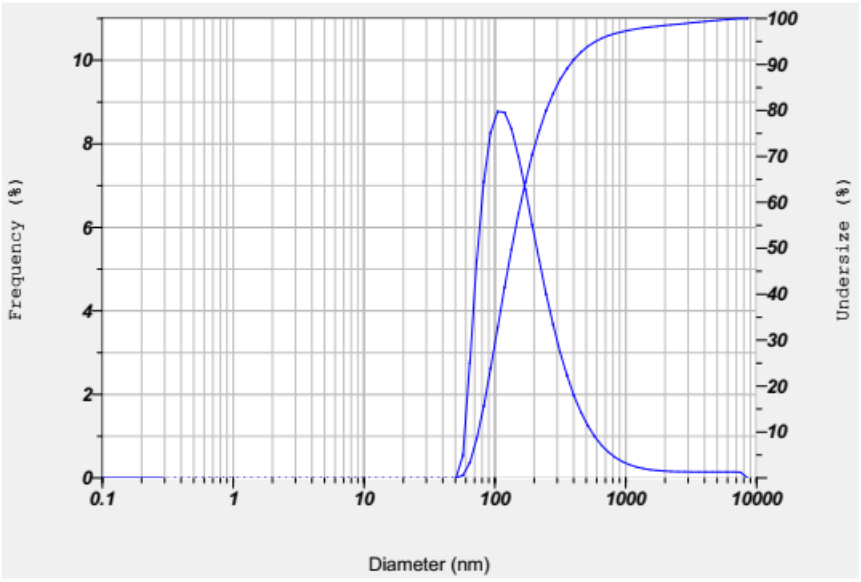


Fig. S11 - Z-average and polydispersity index of F4

Table S1- Depicting the linearity parameters of dihydromyricetin

Concentration (µg/mL)	Absorbance
5.0	0.139 ± 0.008
10.0	0.262 ± 0.004
15.0	0.388 ± 0.004
20.0	0.517 ± 0.003
25.0	0.660 ± 0.030

Table S2 - Solubility of aceclofenac in different oils and surfactants

Oils	Solubility (mg/g)	Surfactants	Solubility (mg/g)
Castor oil	57,78 ± 1,20	Cremophor RH40	322,36 ± 2,12
Olive oil	2,94 ± 1,09	Tween 80	314,66 ± 1,85
Sweet almond oil	10,37 ± 1,78	Span 80	34,5 ± 3,42
Coconut oil	8,2 ± 3,24		

Table S3 - The dissolution profiles of pure ACE and DE-ACE (F3)

No.	Time (min)	% Cumulative drug release	
		Pure ACE	DE-ACE
1	**5**	25	28
2	**10**	36	42
3	**15**	48	55
4	**20**	51	62
5	**30**	54	71
6	**40**	57	74
7	**50**	59	80
8	**60**	61	82