Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 2, 2020, Pages. 1810 - 1818
Received 20 October 2020; Accepted 04 December 2020.

Formulation and Evaluation of Polyherbal Gel Containing Plant Extracts

Mahendra Pratap Singh [1]*, Shailesh Gupta[2] and Alok Pal Jain [1]
1. SRK University,NH-12 Hoshangabad Road, Misrod, Bhopal, M.P.,India
2. Millennium college of Pharmacy and Science , Bhopal, M.P.,India

Abstract

Solanum xanthocarpum, Trigonella foenum greacum and *Sesbania grandiflora* herbs are highly used by the rural and tribal people in curing various disorders. The aim of the current investigation is to formulation and evaluation of polyherbal gel. *S. xanthocarpum, Trigonella foenum greacum and Sesbania grandiflora* hydrogel were prepared, optimized and characterized for spreadibility, consistency Ph, viscosity ,stability and in-vitro release study. The

The result showed that Formulation FE_4 had good values of spreadability, viscosity, pH, drug content and during the accelerated stability studies the appearance was clear and no significant variation in spreadability, pH and drug content was observed. Hence Hydroalcohalic gel FH was formulated from hydrogel FE_4 formulation and its physiochemical study was found to be good. Percentage drug release of Hydroalcohalic gel FE_4 and FH formulation containing combination of plants extract *Trigonella foenum greacum* , *Sesbania grandiflora* and S. *xanthocarpum* extract was observed to be 24.24% and 28.37% (at 30 min.) and 56 .71 % & 62.21% (at 180 min.) respectively at 234 nm. While in 206 nm it was observed to be 29.13% and 31.41% (at 30 min.) and 61.51 % & 69.32% (at 180 min.) respectively

Keywords: *solanum xanthocarpum, Trigonella foenum greacum , Sesbania grandiflora* ,extract ,physiochemical study, gel,

Introduction

The use of medicinal plants as raw materials in the production of new drugs is ever increasing because of their potentials in combating the problem of drug resistance in micro-organisms. Demand for medicinal plants is increasing in both developing and developed countries. Research on medicinal plants is one of the leading areas of research globally.

Solanum xanthocarpum (Solanaceae) is an important medicinal herb in Ayurvedic medicine. Various studies indicated that S. *xanthocarpum* possesses antiasthmatic, hypoglycemic, hepatoprotective, antibacterial, analgesic and insect repellent properties. Although the results are very encouraging and indicated that some of the constituents of the plant like solasodine and diosgenin are important therapeutically, the herb should be studied more extensively to confirm these results and reveal other potential therapeutic effects. . In India it is largely found in UP, Punjab, Bihar, Bengal, Uttaranchal, & other north east states. It grows generally in March- April and produce fruits in May- June. It can grows on any type of soil but hot and dry region is more suitable Various traditional claims like immunomodulation, anti-inflammatory, antiallergic, antianaphylactic and antitumor effects of the plant are still remain to be validated scientifically while Alpinia officinarum belong to the ginger family and commonly used for its anti-inflammatory, antihyperlipidemic bioactivity, anticancer, dysmenorrhea, osteoblast, anti-influenza virus activity, antibiotic resistance, antimicrobial effect.[1-5]

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 2, 2020, Pages. 1810 - 1818
Received 20 October 2020; Accepted 04 December 2020.

Trigonella foenum-graecum L. (Fenugreek) commonly known as methi (in Hindi) has been used as a culinary spice, a flavoring agent and as a medicinal plant from ancient time

The seeds of fenugreek Fenugreek seeds are the most important and useful part of fenugreek plant. These seeds are golden-yellow in colour, small in size, hard and have four-faced stone like structure . Fenugreek seed is 3-6 mm long, 2-5 mm wide and 2 mm thick in geometry. Raw fenugreek seeds have maple flavour and bitter taste but by the process of roasting, their bitterness can be reduced and flavour can be enhanced. Fenugreek seeds are used as spices. The whole seed or its ground powder is used in pickles, vegetable dishes and spice powder. Dried seeds are used as condiments. Fenugreek seeds are gummy, fibrous, sticky and gummy in nature. Biologically, its seeds are endospermic in nature.[6-7]

Material & Methods

Collection of plant material

The seeds of *Trigonella foenum greacum and lavandula oil* were procured from local market while *Solanum xanthocarpum* plants, *Sesbania grandiflora* flowers and *Aloe vera* were collected from natural habitat and authenticated by Dr. S. N. Dwivedi, Prof. & Head, Department of Botany, Janata PG College, APS, University, Rewa, M.P.

Preparation of plant powder

The seeds of *Trigonella foenum greacum* were pulverized, sieved through 40 mesh to obtain a coarse powder. While whole plant (comprising of root, stem, leaves, flowers, and fruits) of *Solanum xanthocarpum* and *Sesbania grandiflora* flowers were dried under shade and then powdered with a mechanical grinder. The powder was passed through sieve No. 40 and stored in an airtight container for further use.

Preparation of extracts

About 250-250 gm of dried powder of *Trigonella foenum greacum* seed, and whole plant part of *Solanum xanthocarpum* and *Sesbania grandiflora* flowers were subjected to soxhlation separately . It was first defatted with petroleum ether then exhaustively extracted with ethanol solvent in a Soxhlet apparatus for 36 hours. The temperature was maintained at 40-50 degree centigrade. The solvents were removed by distillation under reduced pressure and the resulting semisolid mass was vacuum dried using rotary flash evaporator to obtain the extract.

To obtain Aloe vera extract, the mucilaginous jelly obtained from the centre (the parenchyma) of the plant leaf of Aloe vera, the thick succulent leaves of Aloe vera were collected, washed with water and a mild chlorine solution and were finally cut transversely into pieces. With a vegetable peeler, the thick epidermis was selectively removed and the inner gel-like pulp in the center of the leaf was separated with a spoon, minced, and homogenized in a mixer.[8-9]

Preparation of Hydrogel and Hydroalcohalic gel Containing Extract :

Preparation of Hydro Gel :

Different proportions of Carbopol 934 and Sodium CMC 3:0, 3:1, 2:1, 1:1, 0:3, 1:3 and 1:2 were dispersed in 50 ml of distilled water with continuous stirring. 5 ml of distilled water was taken and required quantity of methyl paraben and propyl paraben were dissolved by heating on water bath and cooled. Propylene glycol 5 % w/v was added and then mixed with first solution. Selected combinations of plant extracts (were dissolved in minimum quantity of ethanol and mixed to the polymer mixture. The volume was made up to 100 ml with distilled water. Finally all the ingredients

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 2, 2020, Pages. 1810 - 1818
Received 20 October 2020; Accepted 04 December 2020.

were then mixed properly with the Carbopol 934 gel with continuous stirring. Triethanolamine was added drop wise to the formulation for adjustment of required skin pH (6.8-7) and to obtain the gel of required consistency (Table:1). Turbidity and lumping occured in some batches of polymer based gel containing plant extracts. Hence, these batches were discarded and remaining batches (EF3, EF4 and EF5) were considered for further studies.

Preparation Hydroalcohalic gel

1:1 proportions of Carbopol 934 and Sodium CMC were dispersed in 50 ml of distilled water with continuous stirring. 5 ml of distilled water was taken and required quantity of methyl paraben and propyl paraben were dissolved by heating on water bath. The solution was cooled and then propylene glycol 5 % w/v was added and mixed with first solution. Selected combinations of plant extract were

Table 1: Formulations of polyherbal Gel containing plant extracts

Ingredient	FE_1	FE_2	FE_3	FE_4	FE_5	FE_6	FE_7	FH
Carbopol 934 (gm)	3	3	2	1	1	-	1	1
Sodium CMC (gm)	-	1	1	1	2	3	3	2
Seed extract of *Trigonella foenum greacum* (% w/w)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Solanum xanthocarpum (% w/w)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sesbania grandiflora (% w/w)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Lavandula oil	3 ml	3 ml	3 ml	3 ml	3 ml	3 ml	3 ml	3 ml
Aloe vera	5 ml	5ml	5ml	5ml	5ml	5ml	5ml	5ml
Propylene glycol 400 (5%)	5	5	5	5	5	5	5	5
Methyl Paraben (0.5%) (ml)	0.2ml	0.2 ml	0.2 ml	0.2 ml	0.2 ml	0.2 ml	0.2 ml	0.2 ml
Propyl Paraben (0.2%) (ml)	5 ml	5 ml	5 ml	5 ml	5 ml	5 ml	5 ml	5 ml
Triethanolamine (ml)	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.
Ethanol	-	-	-	-	-	-	-	30 ml
Distilled water (ml)	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml

Each formulation contains distilled water up to 100 ml .

$EF_{1,}$ to EF_7 = Hydrogel , FH = Hydroalcohalic gel

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 2, 2020, Pages. 1810 - 1818
Received 20 October 2020; Accepted 04 December 2020.

Characterization and Evaluation of Gel Formulation[13-19]:

All prepared formulations of gel were characterized for:

Physical Evaluation

Physical parameters such as color and appearance of the herbal gel were observed manually.

Measurement of pH

The pH of various gel formulations was determined by using digital pH meter. One gram of gel was dissolved in 100 ml distilled water and stored for two hours. The measurement of pH of each formulation was done in triplicate and average value was calculated.

Spreadibility

Spreadibility was determined by the apparatus which consists of a wooden block, provided with characteristics of gels. An excess of gel (about 2g) under study was placed on the ground slide. The gel was then sandwiched between this slide and another glass slide having the dimension of fixed ground slide and provided with the hook. A one kg weight was placed on the top of the two slides for 5 minutes to expel air and to provide a uniform film of the gel between the slides. Excess of the gel was scrapped of from the edges. The top plate was then subjected to pull of 80 gms weight with the help of string attached to the hook and the time (in seconds) required by the top slide to cover a distance of 7.5 cm was noted. A shorter interval indicates better spreadibility. Spreadibility was calculated using the formula given below:

$$S = M \times L / T$$

Where, S = Spreadibility, M = Weight in the pan (tied to the upper slide), L = Length moved by the glass slide and T = Time (in sec.) taken to separate the slide completely each other.

Consistency:

The measurement of consistency of the prepared gels was done by dropping a cone attached to a holding rod from a fix distance of 10cm in such way that it should fall on the centre of the glass cup filled with the gel. The penetration by the cone was measured from the surface of the gel to the tip of the cone inside the gel. The distance travelled by the cone was noted after 10sec.

Homogeneity

All the developed gels were tested for homogeneity by visual inspection after setting the gels in the container. They were observed for their appearance and presence of any aggregates.

Viscosity

Viscosity of gel was measured by using Brookfield viscometer with spindle No. 7 at 50 rpm at room temperature. The gels were rotated at 0.3, 0.6 and 1.5 rotations per minute. At each speed, the corresponding dial reading was noted. The viscosity of the gel was obtained by multiplication of the dial reading with factor given in the Brookefield Viscometer manual.

Drug content

1 g of the prepared gel was mixed with 100ml of suitable solvent. Aliquots of different concentration were prepared by suitable dilutions after filtering the stock solution and the drug content was determined measuring the absorbance at 234 nm for *Trigonella foenum greacum and* 206 nm for *S. Xanthocarpus* using UV/Vis spectrophotometer (Shimadzu UV 1700).

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 2, 2020, Pages. 1810 - 1818
Received 20 October 2020; Accepted 04 December 2020.

***In-vitro* drug release study of optimized formulation of gel containing Combination of plant extract [16, 17]:**

Franz diffusion cell (fabricated in our Lab.) with a diameter 3.7 cm was used in in-vitro release studies. A glass tube with both end open, 10 cm height and 3.7 cm outer diameter was used as a permeation cell. A one gram sample was accurately weighed and placed on a semipermeable cellophane membrane to occupy a circle of 3.7 cm diameter. The loaded membrane was stretched over the lower open end of a glass tube of 3.7 cm diameter and made water tight by rubber band. The tube (donor compartment) was immersed in a beaker containing 100 ml of phosphate buffer pH 6.8 (receptor compartment) .The cell was immersed to a depth of 1 cm below the surface of buffer. The system temperature was maintained at 37°±1° and speed was maintained at 30 rpm throughout the experiment by magnetic stirrer. Samples 3 ml were withdrawn at intervals of 15, 30, 45, 60, 90, 120 and 180 min, the volume of each sample was replaced by the same volume of fresh buffer to maintain constant volume. Samples were analyzed without dilution or filtration for herbal drug content spectrophotometrically at 234 nm and 206 nm.

Accelerated Stability Studies[19]

The optimized formulations were subjected to a stability testing for six months as per ICH norms at a temperature and RH of 40°C ± 2°C/75% RH ± 5% RH respectively. The selected formulations were analyzed for the change in appearance, spreadibility, pH and drug content.

Results and conclusion

Extraction

The dried powder of plant was extracted with solvents i.e., Ethanol solvent. The solvents were removed by distillation under reduced pressure and the resulting semisolid mass was vacuum dried using rotary flash evaporator to obtain the extract. The percentage yields of various extract was presented in Table 2.

Table 2: Extractive value of different extract

Sr. No.	Plant name	Extractive values (%w/w)
1.	*Trigonella foenum-graecum*	16.12
2.	*Solanum xanthocarpum*	12.27
3	*Sesbania grandiflora*	18.5

Evaluation of Gel Formulation:

The result showed that the developed herbal gel was brownish in color, translucent in appearance and showed good homogeneity with absence of lumps. Optimized Formulation Hydrogel FE_4 and hydroalcohalic Gel FH had good values of spreadability, viscosity, pH, drug content and during the accelerated stability studies the appearance was clear and no significant variation in spreadability, pH and drug content was observed. (Table.3)

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 2, 2020, Pages. 1810 - 1818
Received 20 October 2020; Accepted 04 December 2020.

Table 3: Physical evaluation of all formulations Spreadibility, Consistency ph viscosity and drug content

Batch	Appearance	Spreadibility (gm.cm/sec)	Consistency (60 mm)	Viscosity (cps)	Ph	Drug content (%)
FE_3	Homogeneous	24.81	8	16927	7.00	99.94
FE_4	Homogeneous	23.87	8	16996	7.00	99.97
FE_5	Homogeneous	24.31	8	16995	7.00	99.96
FH	Homogeneous	23.34	8	16935	7.00	99.97

***In-vitro* drug release study**

Percentage drug release of Hydroalcohalic gel FE_4 and FH formulation containing both plants *Trigonella foenum greacum* and S. *xanthocarpum* extract was observed to be 24.24% and 28.37% (at 30 min.) and 56.71 % & 62.21% (at 180 min.) respectively at 234 nm. While in 206 nm it was observed to be 29.13% and 31.41% (at 30 min.) and 61.51 % & 69.32% (at 180 min.) respectively. It was observed that addition of ethanol in formulation increase the release by increasing permeation properties of gel. The hydrolcohalic gel containing combination of extract formulation FH showed maximum drug release as compared to other formulation. (Table.4 and 5)

Table 4: % Drug Release of Formulation at 234 nm

Time Interval (Min)	% Drug Release of Formulation at 234 nm 234 nm	
	FE_4	**FH**
15	18.13	23.22
30	24.24	28.37
45	30.31	35.66
60	36.16	41.37
90	42.28	49.81
120	49.26	57.47
180	56.71	62.21

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 2, 2020, Pages. 1810 - 1818
Received 20 October 2020; Accepted 04 December 2020.

Table 5: % Drug Release of Formulation at 206 nm

Time Interval (Min)	% Drug Release of Formulation at 206 nm 234 nm	
	FE_4	FH
15	24.11	25.34
30	29.13	31.41
45	33.43	39.51
60	36.51	43.63
90	45.71	52.21
120	53.61	60.81
180	61.51	69.32

Fig 1: % Drug Release of Formulation at 234 nm

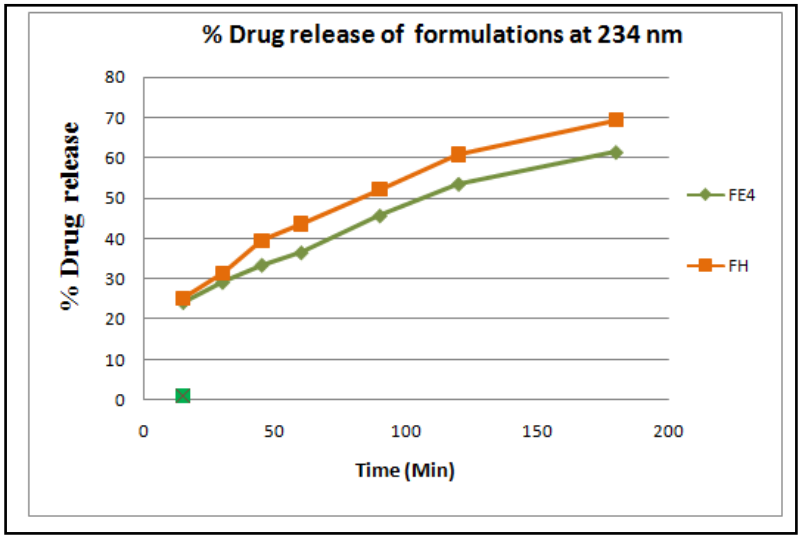
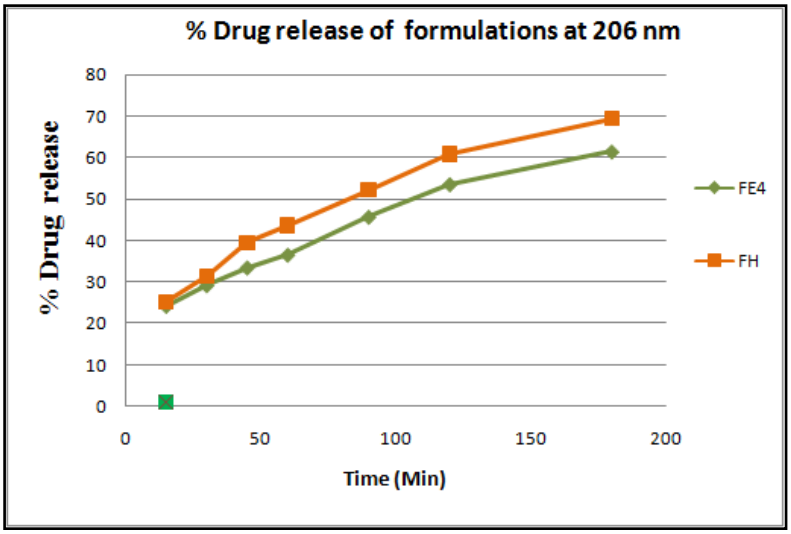


Fig 1: % Drug Release of Formulation at 206 nm



Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 2, 2020, Pages. 1810 - 1818
Received 20 October 2020; Accepted 04 December 2020.

Stability Study

The formulated gels were subjected to stability studies. No color fading was observed for all prepared gels. The pH of all formulations remained unchanged and was found to be within the range of 6.2-7.2. The viscosity and spreadability of all gels remained unaltered and found to be within the range. The drug content was found to be in the limit 90% -103% for all gel formulation. (Table.6)

Table 6: Accelerated Stability study of formulated gel

Batch	Color	Appearance	Spreadibility (gm.cm/sec)	Consistency (60 Sec)	Viscosity (cps)	Ph	Drug content (%)
F3	Brownish	Homogeneous	20.60	7	20230	6.82	99.76
F4	Brownish	Homogeneous	21.05	7	19570	6.93	99.83
F5	Brownish	Homogeneous	17.90	7	19010	6.91	99.55
FH	Brownish	Homogeneous	21.32	7	18179	6.92	99.90

Acknowledgement

The authors are highly thankful to Dr Alok Pal Jain, Principal of RKDF college of Pharmacy,Bhopal, M.P.-India for providing necessary facilities.

References

1. Khanna P and Nag TN (1972). Effect of Phenylalanine and Tyrosine on growth and alkaloid production in Datura metel L. tissue cultures. Indian J. Pharma. 34 (2): 42-44.
2. Keeler RF, Young S, Brown D (1976) Spina bifida, exencephaly, and cranial bleb produced in hamsters by the Solanum alkaloid solasodine. J. Res Commun Chem Pathol Pharmacol, 13 (4), 723-30.
3. Dixit VP and, Gupta RS (1982). Antispermatogenic/ antiandrogenic properties of solasodine obtained from Solanum xanthocarpum berries on the male genital tract of dog. A histopathological approach. J Int J Androl, 5(3), 295–307.
4. Manjunath BL & Shadaksharaswamy M. Reexamination of the alkaloids of the fruits of Solanum xanthocarpum, Journal of Mysore University, 1942;3B:117.
5. Mukherjee Pulak K. (2001).Quality Control Herbal Drug, Published by Business Horizon, Ist edition, 380.
6. Wijaya WH, Mun'im A, Djajadisastra J. Effectiveness test of fenugreek seed (*Trigonella foenum-graecum* L.) extract hair tonic in hair growth activity. Int J Curr Res 2013;5(11):3453–60.
7. Didarshetaban, M.B., Pour, S. and Reza, H., 2013.Fenugreek (Trigonellafoenum-graecum L.) as avaluable medicinal plant. Int. J. Adv. biol. biomed.Res., 1: 922-931.
8. Harbone J.B., Methods of Plant Analysis Chapter II In: Phytochemical methods: A guide to modern techniques of plant analysis Toppan Company Ltd, Japan., 1973, (1), 4 -5.
9. Mukherjee Pulak K. (2001).Quality Control Herbal Drug, Published by Business Horizon, Ist edition, 380.

10. A Gupta *et al.*, Formulation and evaluation of topical gel of diclofenac sodium using different polymers, Drug Invention Today 2010, 2(5),250-253
11. Das K, Dang R, Machale UM, Fatepuri S, Formulation and evaluation of herbal gel containing stevia leaves extract, The Pharma Review, 2010, 8(44), 112-118..
12. Prakash RP, Rao R. NG, Soujanya C, Formulation, evaluation and anti-inflammatory activity of topical etoricoxib gel, Asian J. pharmaceutical and clinical research, 2010, 3(2), 126-129.
13. A Gupta *et al.*, Formulation and evaluation of topical gel of diclofenac sodium using different polymers, Drug Invention Today 2010, 2(5),250-253.
14. Das K, Dang R, Machale UM, Fatepuri S, Formulation and evaluation of herbal gel containing stevia leaves extract, The Pharma Review, 2010, 8(44), 112-118.
15. Prakash RP, Rao R. NG, Soujanya C, Formulation, evaluation and anti-inflammatory activity of topical etoricoxib gel, Asian J. pharmaceutical and clinical research, 2010, 3(2), 126-129.
16. Das K, Dang R, Machale UM, Fatepuri S, Formulation and evaluation of herbal gel containing stevia leaves extract, The Pharma Review, 2010, 8(44), 112-118.
17. Kumar L, Verma R, In vitro evaluation of topical gel prepared using natural polymer, Int. J Drug Delivery, 2010, 2, 58-63.
18. Prakash RP, Rao R. NG, Soujanya C, Formulation, evaluation and anti-inflammatory activity of topical etoricoxib gel, Asian J. pharmaceutical and clinical research, 2010, 3(2), 126-129.
19. ICH Topic Q 1 A (R2) Stability Testing of new Drug Substances and Products, Note for guidance on stability testing: stability testing of new drug substances and products (CPMP/ICH/2736/99), European Medicines Agency, August, 2003.