Ilkogretim Online - Elementary Education Online, 2021; Vol 20 (Issue 1): pp. 5476-5487
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2021.01.581

Spray Bandage Of Curcumin

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ABSTRACT:
To formulate Spray Bandage to get good protective and therapeutic activities for a longer duration of time and form film which act as a protective barrier for open wound or another tropical disease. It is easy to use and apply by spraying directly on the affected area**.** It forms film within a few seconds and has good patient compliance. Curcumin is useful in various activities such as anti-tumor, antioxidant, anti-arthritic, anti-amyloid, anti-inflammatory, bacterial infections, wound healing, and tissue repairing. Curcumin has low GI stability hence it is given through a topical drug delivery system for sustained release of the drug. In the formulation, HPMC is a polymer used along with eudragit RS 100, it does not affect the normal perspiration mechanism of the skin, therefore, it improves the hydration of the skin and helps in the penetration of the drug.

Keywords: Spray Bandage, Curcumin,

INTRODUCTION:

Spray bandage is a novel approach that can be used as an alternative to conventional topical and transdermal formulations. It is defined as a non-solid dosage form that produces a film in situ, i.e. after application on the skin or any other body surface. These systems contain the drug and film forming excipients in a vehicle which, upon contact with the skin, leaves behind a film of excipients along with the drug upon solvent evaporation. The formed film can either be a solid polymeric material that acts as a matrix for sustained release of drug to the skin of a residual liquid film that is rapidly absorbed in the stratum corneum.[1]
Various drug delivery systems are available for topical application of pharmaceutical formulation such as creams, lotions, gel, transdermal patches and sprays their use depends on drug pharmacokinetic profile, whether their drug release is immediate or sustained. The formulations available in the market has a certain drawback such as pain on applying, cross-contamination or skin irritation, etc.[2]
To overcome this drawback caused by conventional formulation spray bandage formulation was introduced, which reduced the pain caused due to applying, cross-contamination is prevented due to direct spraying on infected areas, and skin irritation is also decreased.[2]

Need for spray bandage formulation:[1]

1. The need for spray bandage formulation is important to overcome the disadvantages of available topical delivery.
2. The spray bandage posses' certain advantages such as compact package, ease of apply, ease to wash.
3. There is no cross contamination on applying to topical microbial infections, pain will reduce when it is applied on the burnt wounds.
4. In case of musculoskeletal disorder, it is easy way of spreading in large surface area along with gripping sensation.
5. According to industrial point of view using such delivery system will be economically feasible, it is easy to commercialize, and it is smart way to care wound for next generation.
6. As compared to other medicated semisolid such as lotions, gels which provide long term stability is also commercial use when compared with spray formulation.

Advantages:[2]

1. Spray bandage provides the topical application of pharmaceutical compounds without causing occlusion problems and skin irritations.
2. The inventive compositions remove the need for an adhesive patch, because it directly gets adhere to skin after solvent evaporation.
3. The invention further provides a topically applied composition that may remain as a breathable film on the skin for an extended period of time.

EXPERIMENTAL, RESULT AND DISCUSSION:

2. PREFORMULATION:

A. Authentication of drug:

1. UV spectrum of curcumin:
   The solution of curcumin in methanol was found to be maximum absorption (λ_{max}) at 425 nm after scanning in the range of 200-600 nm.

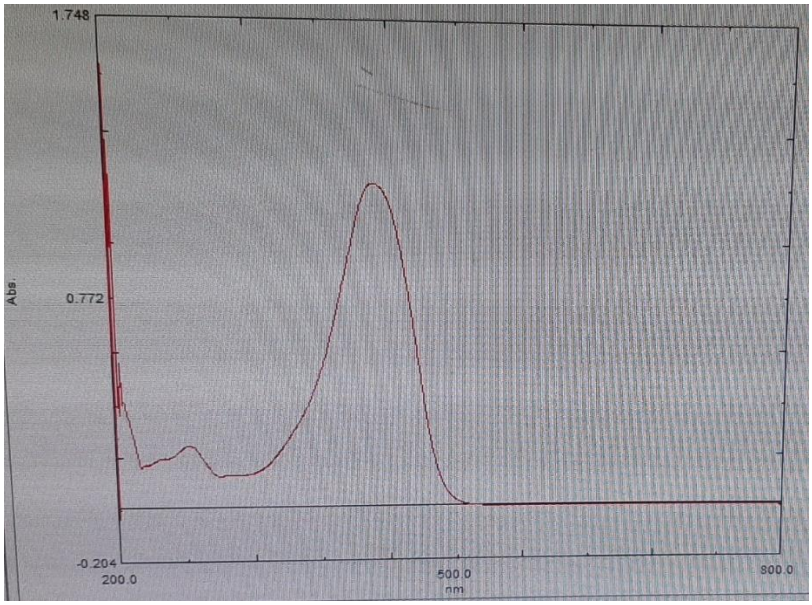

Fig 6: **U.V Spectrum of drug curcumin using methanol**

2. Solubility:
   Curcumin is less soluble in water, but it is soluble in organic solvent such as methanol, ethanol, acetone, dimethyl sulfoxide.

3. FTIR:13

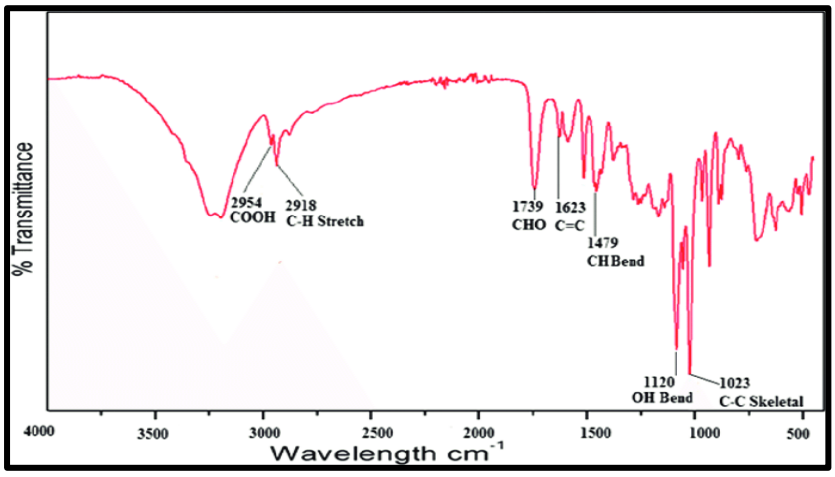

Fig 7: FTIR of Curcumin.

4. Melting point: The melting point of drug by capillary method found to be 181^{0}C, which was within the limits(180-183^{0}C) as per literature. This is confirmed the Purity of drug substance.[14]

B. Construction of calibration curve for Curcumin:

UV method: the calibration curve for curcumin was determined in methanol, Phosphate buffer PH 7.4.

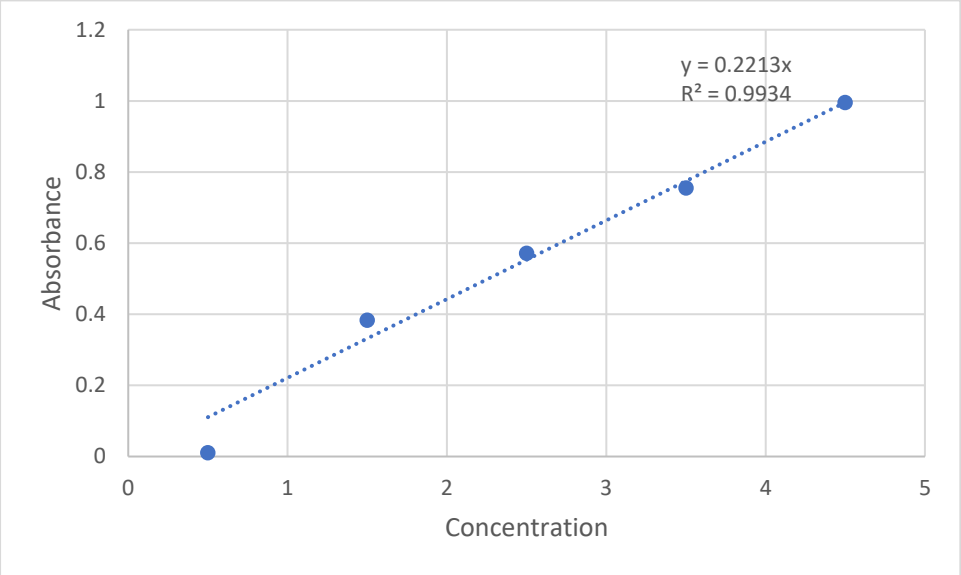

Fig 8: Calibration curve of curcumin in methanol

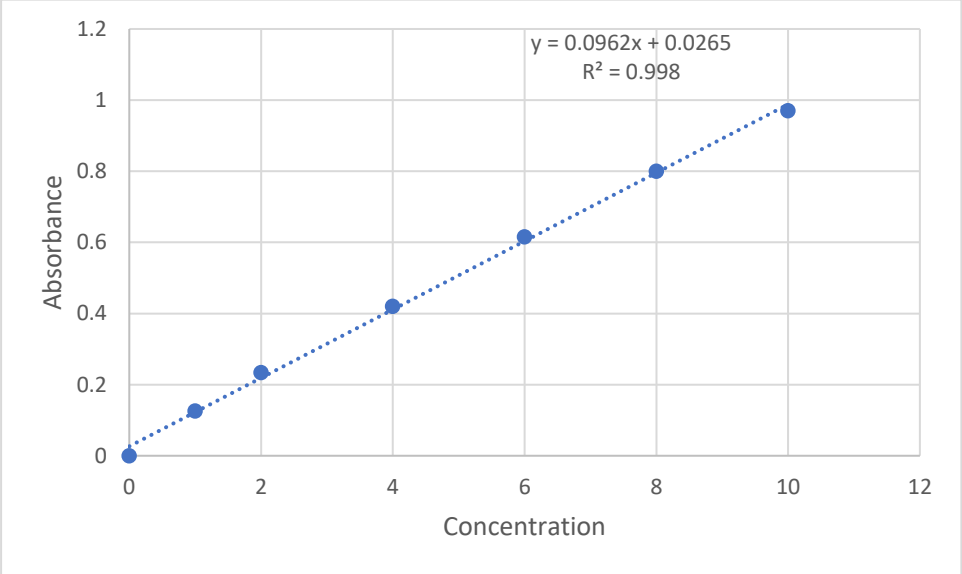

Fig 9: Calibration curve of curcumin in phosphate buffer pH 7.4

Medium	Slope	Coefficient of regression(R^2)
Methanol	0.2213	0.976
Phosphate buffer 7.4	0.0962	0.998

Table 1: Slope and the regression coefficients

C. **Drug- excipients compatibility studies using FTIR Spectroscopy:** The FTIR spectra of the pure drug and drug-excipients physical mixture indicated that characteristics bands of the drug were not altered, without any change in their position, indicating no chemical interactions between the drug and excipients used.

3. DESIGN OF FORMULATION:

Spray bandage of curcumin was prepared using different concentrations of polymers and further evaluated.

Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9
Drug	0.11gm	0.11gm	0.11gm	0.11gm	0.11gm	0.11gm	0.11gm	0.11gm	0.11gm
EudragitRS100	2.5gm	2.5gm	3.75gm	3.75gm	3.75gm	5gm	5gm	5gm	2.5gm
HPMC K4M	1gm	2.5gm	2.5gm	1.75gm	1gm	1gm	1.75gm	2.5gm	1.75gm
Vitamin E	0.25gm	0.25gm	0.25gm	0.25gm	0.25gm	0.25gm	0.25gm	0.25gm	0.25gm
Propylene glycol	1.5gm	1.5gm	1.5gm	1.5gm	1.5gm	1.5gm	1.5gm	1.5gm	1.5gm
Ethanol	20ml	20ml	20ml	20ml	20ml	20ml	20ml	20ml	20ml
Acetone	30ml	30ml	30ml	30ml	30ml	30ml	30ml	30ml	30ml

Table 2: Composition of various topical films of curcumin (f1 to f9).

4. EVALUATION PARAMETER OF SPRAY BANDAGE:

Physical evaluation:[15,16,17]

From the table given below, the evaluation parameters of all four batches are done. It was found that the f1 batch shows the desirable characteristics of than other three batches with good film-forming properties as compared to the other three and within the limits. So it was concluded, that the optimized batch was found to be an f1 formulation with most film-forming properties within the limits.

Formulation	Film formation	Drying time(sec)	stickiness	Spread ability test	Film flexibility	Drug content
F1	Uniform film	18.72	Good	18.5	Good	2.05mg/ml
F2	Uniform film	23.06	Good	18.5	Good	2.05mg/ml
F3	Sticky film	38.22	Poor	18.5	Fair	2.08mg/ml

F4	Sticky film	47.89	Poor	18.5	Fair	2.06mg/ml
F5	Sticky film	38.89	Poor	18.5	Fair	2.08mg/ml
F6	Uniform film	28.39	Fair	49.33	Good	2.05mg/ml
F7	Sticky film	34.89	Poor	49.33	Fair	2.05mg/ml
F8	Uniform film	22.72	Fair	49.33	Good	2.06mg/ml
F9	Uniform film	18.67	Good	18.5	Good	2.06mg/ml

Table 3: Evaluation parameters data of f1 to f9 batches.

Diffusion studies:[18,19]

Diffusion protocols:

1. Diffusion apparatus: Franz diffusion cell
2. Temperature: 37± 0.5^0C
3. Diffusion medium: Phosphate buffer 7.4.
4. Volume of Diffusion cell: 11ml
5. Volume of a sample removed: 5 ml
6. Sampling interval: 1,2,3,4,5,6,7,8 hrs.
7. Method of analysis: UV spectrophotometer at 425 nm for phosphate buffer 7.4

Time	F1	F2	F3	F4	F5	F6	F7	F8	F9
0	0	0	0	0	0	0	0	0	0
1	1.717	0.341	0.341	0.346	1.043	0.292	0.214	0.292	0.292
2	2.629	0.975	0.56	0.531	2.165	1.1707	0.4731	1.1707	0.341
3	5.136	1.975	0.824	0.809	2.985	1.902	0.8048	1.902	1.717
4	12.097	4.439	1.473	1.356	4.180	2.829	1.287	2.829	2.629
5	18	7.121	2.156	1.473	5.960	4.214	1.965	4.214	7.570
6	23.86	10.73	3.121	2.156	7.570	6.741	3.243	6.741	9.195
7	24.95	16.58	5.463	3.253	9.195	9.175	5.439	9.175	12.54
8	27.54	21.8	7.88	3.45	10.72	12.7	7.04	13.07	18.67

Table 4: In vitro diffusion studies of formulation f1 to f9

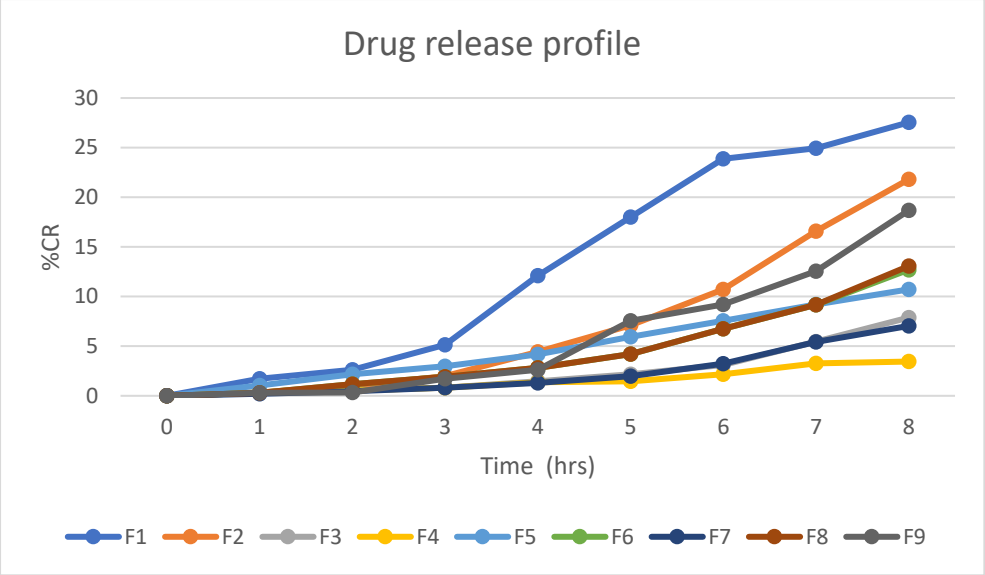

Fig 10: In vitro drug release profile of formulation f1 to f9

5. **RELEASE KINETICS OF OPTIMIZED BATCH(f1):**[20,21,22,23]
6.

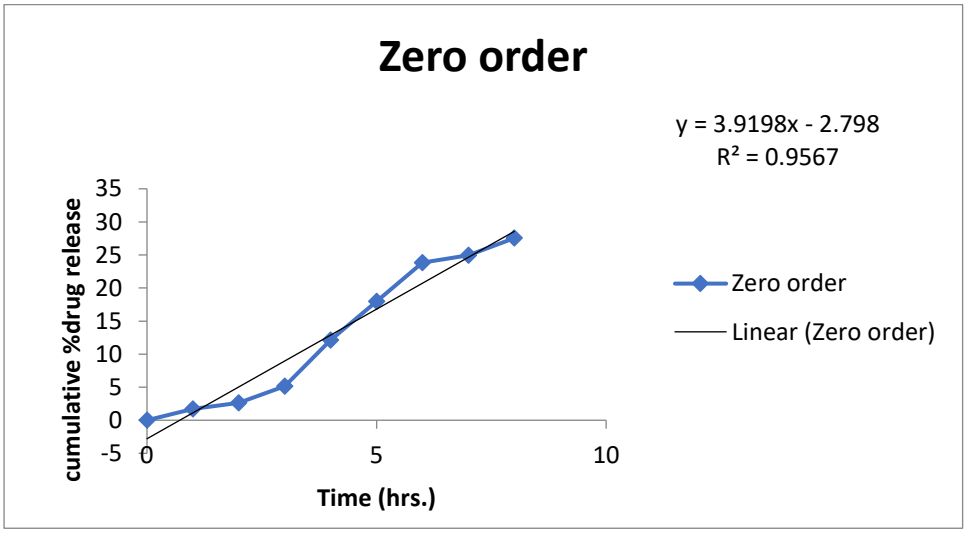

Fig 11: Zero order model of batch f1

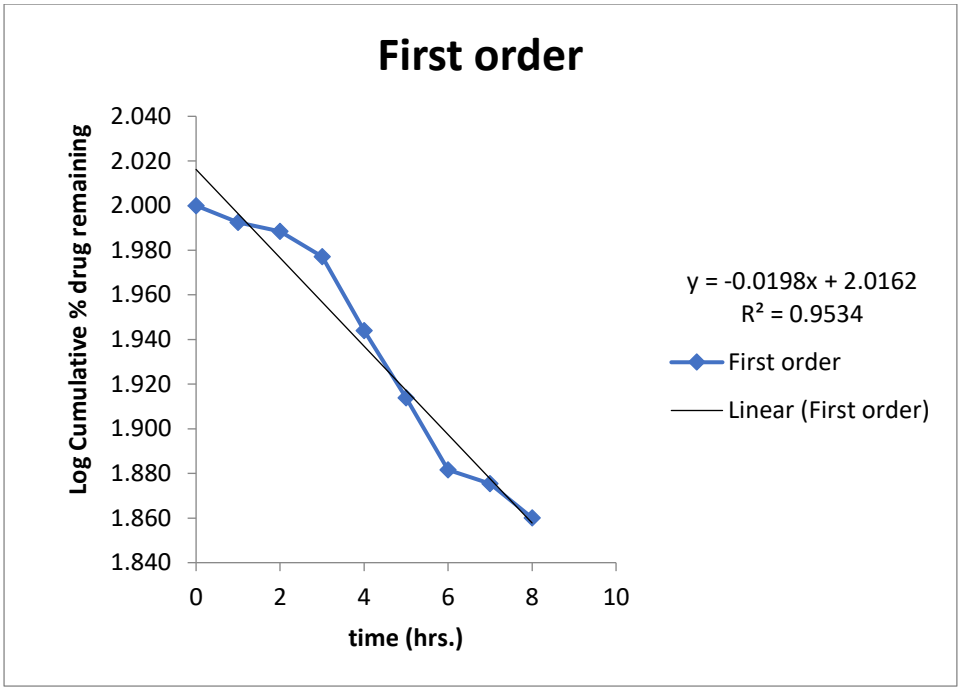

Fig 12: First order model of batch f1

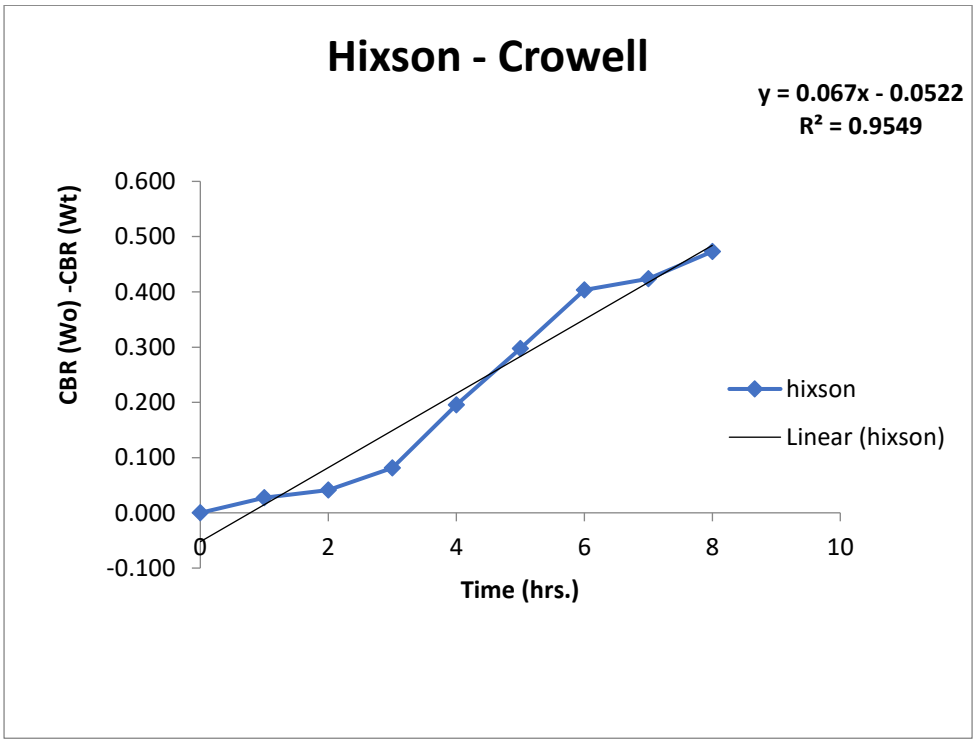

Fig 13: Hixon- Crowell model of batch f

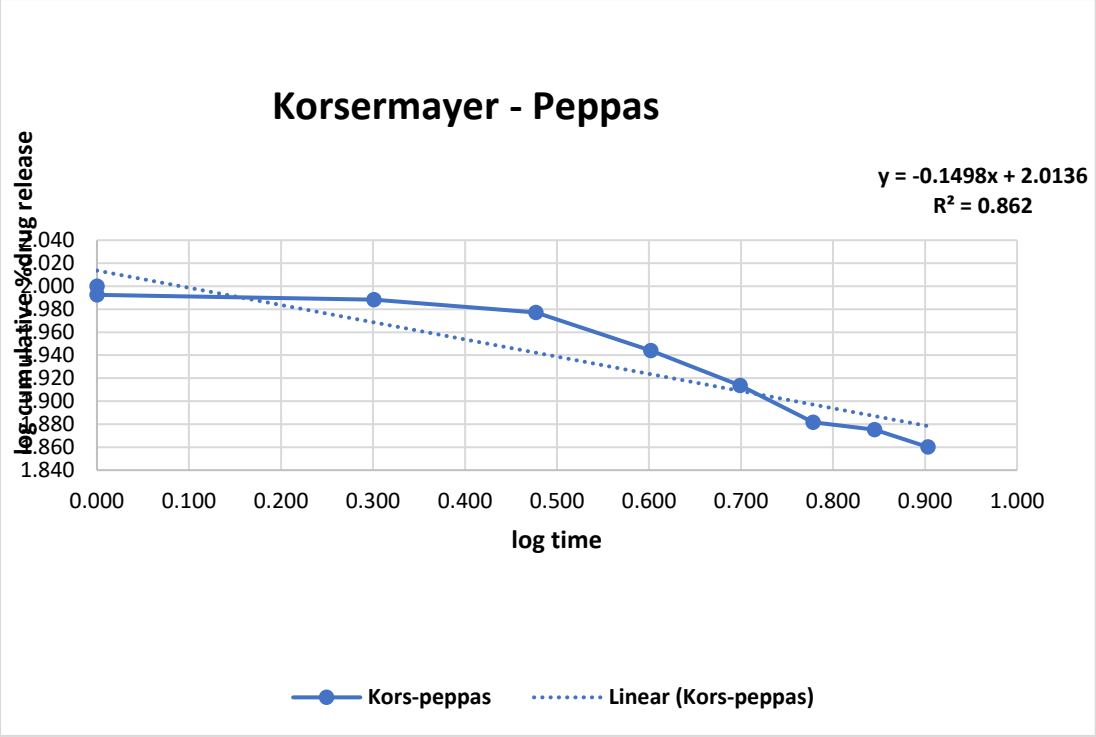

Fig 14: Korsermayer-peppas model of batch f1

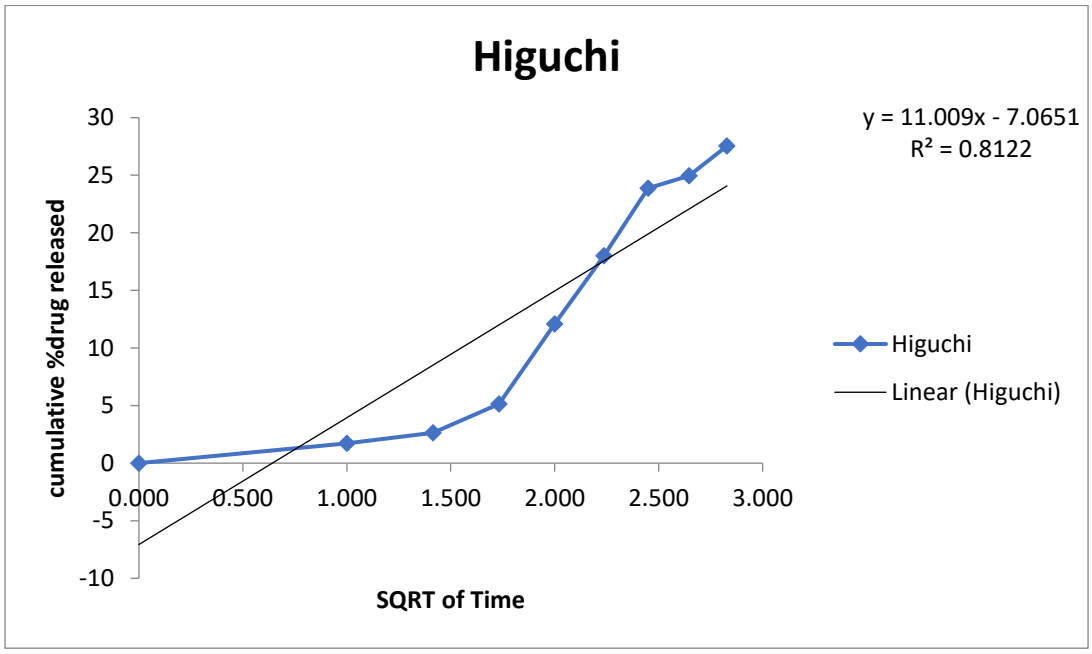

Fig 15: Higuchi model of batch f1

Release kinetic model	Regression coefficient (R^2)
Zero order	0.9567

First order	0.9534
Higuchi model	0.9545
Korsermayer-Peppas model	0.862
Hixson-Crowell model	0.8122

Table 5: Kinetic release data for formulation f1

7. Stability study of spray bandage:[24,25]

Evaluation parameter	1 month
Appearance	Yellow color
Film formation	Uniform film
Drying time	20 sec
Stickiness	Good
Spread ability test	27.95 g cm/sec
Flexibility	Good
% Drug release	23.36%

Table 6: stability studies of batch f1.

CONCLUSION:

The spray bandage of curcumin was effectively made for the treatment of topical bacterial infections and wound care.

The ethanol: acetone (30:20) as a solvent system and eudragit RS 100 as a film-forming polymer show desirable criteria of film formation and integrity of the skin.

Ayurvedic systems of medicine have described various methods and natural drugs. Since curcumin is obtained from a plant source by using it in such formulation it can be useful in topical care.

The curcumin has lower GI stability it undergoes rapid degradation, hence given through the topical drug delivery system shows the effective release of drug with low degradation.

The studies have brought about the polymer used in the formulation was compatible with the drug curcumin.

The prepared batches by using different concentrations of polymer and plasticizer show effective drug release and film-forming properties and form the result the desirable batch was concluded.

Spray bandage shows effective drug release in a controlled manner over a period of 8hrs.

The film formulation provided controlled release of drug and hence these systems can be used for the treatment of wounds, burns, inflammations, and tissue repairing.

Through these present experimentations, it has been found that the drugs of ayurvedic origin can be utilized better for enhanced efficacy for incorporation in modern drug delivery.

CONCLUSION:

5. A. Radhakrishnan, G. Kuppusamy, V.V.S.R. Karri, Spray bandage strategy in topical drug delivery, Journal of Drug Delivery Science and Technology (2017), doi: 10.1016/ j.jddst.2017.09.018.
6. Amar Lulla, Geena Malhotra, Preeti Raut US6962691B1 - Topical spray compositions - Google Patents https://patents.google.com/patent/US6962691B1/en.
7. Vogel, Pelletier; Curcumin-biological and medicinal properties. J. pharm 1818; 2, 50.
8. Chattopadhyay I, Biswas K, Bandyopadhyay U, Banerjee RK, 3Turmeric and curcumin: Biological actions medicinal applications. Curr. Sci. 2004; 87: 44-50
9. Liu Zhongfa, Ming Chiu, Jiang Wang, Wei Chen, Winston Yen, Patty Fan-Harvard, Lisa D. Yee, and Kenneth K. Chan; Enhancement of curcumin oral absorption and pharmacokinetics of curcuminoids and curcumin metabolites in mice cancer chemotherpharmacol 2012 March 69(3); 679-689.
10. Evionik
11. Handbook of pharmaceutical excipients. –5th ed. / edited by Raymond C. Rowe, Paul J. Sheskey, Siân C. Pg.no- 624.
12. Handbook of pharmaceutical excipients.–5th ed. / edited by Raymond C. Rowe, Paul J. Sheskey, Siân C. Pg.no: 8-9.
13. [cited 2011 august 06]. Available from: URL: http://en.wikipedia.org/wiki/ethanol.
14. 40. Ethanol, [cited 2011 august 06]. Available from: URL: http://msds.chem.ox.ac.uk/ET/ethyl_alcohol.html.
15. Ethanol, [cited 2011 august 06]. Available from: URL: http://www.ee.iitb.ac.in/~nanoe/msds/ethanol.pdf.
16. Vitamin E from drug bank- https://www.drugbank.ca/drugs/DB00163.

17. https://www.researchgate.net/publication/285609710_Thermal_behaviour_of_curcumin.
18. Beckett, A. H.; Stenlake, J. B. Practical Pharmaceutical Chemistry, CBS publishers, part two, 4th ed., 275 – 281.
19. Indre˙ S, Vitalis B. Effect of film-forming polymers on release of naftifine hydrochloride from nail lacquers. Int J PolymSci 2017;2017:7. https://doi.org/10.1155/2017/1476270.
20. Frederiksen K, Guy RH, Petersson K. Formulation considerations in the design of topical, polymeric filmforming systems for sustained drug delivery to the skin. Eur J Pharm Biopharm 2015;91:9–15.
21. Vij NN, Saudagar RB. Formulation, development and evaluation of film-forming gel for prolonged dermal delivery of terbinafine hydrochloride. Int J Pharm Sci Res 2014;5(9):537–554.
22. De A, Chakraborty S, Mukherjee A. Formulation & optimization of the transdermal film of 5-FU with in-vitro and ex-vivo study using ethyl cellulose and two grades of hydroxy propyl methyl cellulose. Pharm Sin 2013;4(4):103– 111.
23. Kashmira Kathe, Harsha Kathpalia, Film forming systems for topical and transdermal drug delivery,Asian Journal of Pharmaceutical Sciences (2017), doi: 10.1016/j.ajps.2017.07.004
24. Frisch, H. L. Sorption and transport in glassy polymers, Polym.Eng.Sci, 1980, vol 20, 2-13.
25. Park, G. S. Transport Principles—Solution, Diffusion and Permeation in Polymer Membranes. In: Bungay, P. M.; Lonsdale, H. K.; de Pinho, M. N. (eds) Synthetic Membranes: Science, Engineering and Applications. NATO ASI Series (Series C: Mathematical and Physical Sciences), Springer, Dordrecht, 1986, vol 181, 57-108.
26. LaoM, L. L.; Peppas, N. A.; Boey, F. Y.; Venkatraman, S. S. Modeling of drug release from bulk-degrading polymers, Int J Pharm., 2011, 418(1), 28-41.
27. Dash, S.; Murthy, P. N.; Nath, L.; Chaudhary, P. Kinetic modeling on drug release from controlled drug delivery systems, Acta Poloniae Pharmaceutica- Drug Research, 2010, 67(3), 217-223,
28. Cartensen, J. Drug Stability Principles and Practices, 2nd ed., New York, Marcel Dekker Inc., 1995, vol 68, 541 – 546.
29. "Stability Testing of New Drug Substances and Products", Eur Medicines Agency, 2003, 1-20.