Research Article

Formulation Development and Evaluation of Kaolin – Curcumin Haemostatic Wound Healing Ointment

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Abstract

Background: Rapid control of bleeding and support of subsequent wound repair are important objectives in topical wound management. The supplied research draft describes a haemostatic wound-healing formulation combining kaolin, curcumin and a semisolid ointment base.
Objective: To develop and systematically evaluate a kaolin–curcumin ointment intended to provide haemostatic and wound-healing activity.
Materials and Method: Six prototype batches (F1–F6) were prepared by fusion using liquid paraffin, cetostearyl alcohol, hard paraffin and white soft paraffin, with graded kaolin and curcumin concentrations. The supplied study identifies F5 as the optimized batch, containing 5% liquid paraffin, 5% cetostearyl alcohol, 5% hard paraffin, 64% white soft paraffin, 20% kaolin and 1% curcumin. The research expands the evaluation framework to include appearance, homogeneity, pH, viscosity/rheology, spreadability, extrudability, washability, content uniformity.
Results and Discussion: The research reports that F5 was selected as the optimized formulation and that the formulated cream/ointment showed good spreadability, viscosity and with good potential to use.
Conclusion: F5 provides a potential formulation for wound healing and antimicrobial properties as compared with standard drug and there is future perspective of further detailed evaluation.

Keywords: Kaolin; curcumin; haemostatic ointment; wound healing; clotting; antimicrobial activity.

1. Introduction

Wound healing is a coordinated biological process involving haemostasis, inflammation, proliferation and tissue remodeling. An ideal topical wound-care system should help control bleeding while providing a protective microenvironment and supporting subsequent repair[1-4]. The invention describes a wound-healing system based on kaolin, curcumin and an ointment base, with kaolin intended to promote haemostasis and curcumin intended to contribute anti-inflammatory, antioxidant and antimicrobial effects. The source specifically describes kaolin as a haemostatic mineral that can activate the intrinsic coagulation pathway and curcumin as a polyphenolic wound-healing agent[5-9]. Kaolin has attracted interest in haemostatic materials because contact with blood can accelerate coagulation through surface-mediated activation of coagulation mechanisms[10-12]. Curcumin has been extensively investigated for topical wound care because of antioxidant, anti-inflammatory and antimicrobial activities; formulation is particularly important because curcumin has poor aqueous solubility and limited topical bioavailability[13-15]. Recent literature continues to investigate curcumin-containing topical systems for wound repair. The supplied draft reports six ointment batches prepared by fusion and identifies F5 as the optimized batch. The reported formulation process involved melting the base components at 70 °C, maintaining the melt for approximately 5 min, cooling with continuous stirring to 40 °C, and incorporating kaolin and curcumin by trituration to obtain 10 g of ointment[16].

2. Materials and Methods

2.1 Materials

Kaolin, curcumin, liquid paraffin, cetostearyl alcohol, hard paraffin and white soft paraffin were the principal formulation components were collected from SD fine Chemicals and Loba Chemicals.

2.2 Formulation design

Six batches (F1–F6) were prepared by varying the concentrations of liquid paraffin, cetostearyl alcohol, hard paraffin, white soft paraffin, kaolin and curcumin. The composition is presented in Table 1. F5 was designated the optimized batch in the supplied document[17-19] .

Table 1. Formulation design for optimized batch

Component (% w/w)	F1	F2	F3	F4	F5	F6
Liquid paraffin	10	5	10	5	5	5
Cetostearyl alcohol	5	10	5	10	5	5
Hard paraffin	5	5	6	5	5	5
White soft paraffin	74	70	69	64	64	59
Kaolin	5	9	5	15	20	25
Curcumin	1	1	5	1	1	1
Total	100	100	100	100	100	100

2.3 Preparation of ointment by fusion method

The ointment was prepared by the fusion method. The required quantities of liquid paraffin, cetostearyl alcohol, hard paraffin and white soft paraffin were weighed separately and transferred to a suitable melting vessel. The base components were heated to approximately 70 °C and maintained at that temperature with gentle stirring for about 5 min. The melt was then allowed to cool with continuous stirring to approximately 40 °C. Kaolin and curcumin were separately sieved and gradually incorporated into the cooled base by geometric dilution and trituration on an ointment slab using a spatula until a uniform, smooth preparation was obtained. The final mass was adjusted to 10 g where required[20-22].

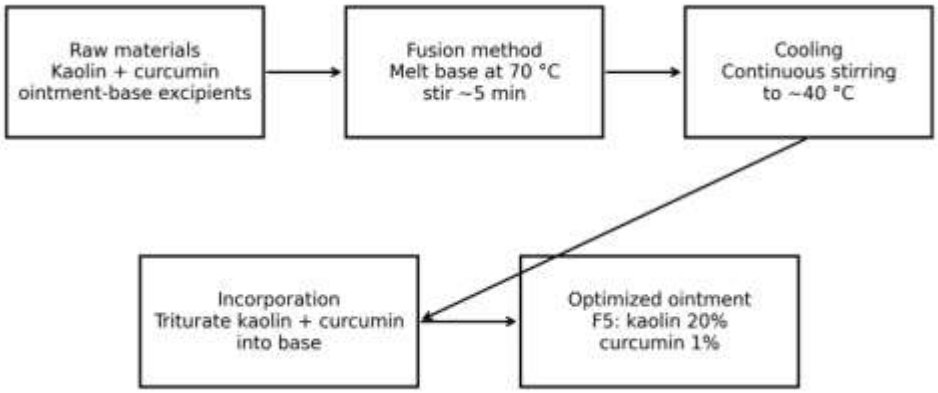


Figure 1. Schematic workflow for preparation of the haemostatic wound-healing ointment.

2.4 Preformulation and compatibility studies

Organoleptic examination; particle-size/sieve analysis of kaolin; FTIR spectroscopy of kaolin, curcumin, excipients and the physical mixture; DSC of curcumin, selected excipients and the physical mixture; and preliminary solubility/dispersibility assessment of curcumin in the selected base will be carried out. FTIR and DSC is interpreted against the actual spectra/thermograms generated in the laboratory [23-25].

2.5 Physicochemical evaluation of ointment

Table 2. Evaluation Parameters forPhysicochemical properties

Parameter	Suggested method	Report/acceptance approach
Appearance and colour	Visual inspection	Smooth, uniform; no phase separation/grittiness
Homogeneity	Microscopic/visual examination	Uniform dispersion; no lumps/coarse particles
pH	Suitable aqueous dispersion; calibrated pH meter	Mean ± SD; skin-compatible target justified by formulation

Viscosity/rheology	Brookfield or equivalent; report spindle/speed/temp.	Viscosity and flow curve
Spreadability	Glass-slide/weight or validated method	Validated unit and mean ± SD
Extrudability	Collapsible tube under defined load	Mass extruded/time or validated rating
Washability	Water-wash test	Qualitative/quantitative result
Consistency	Penetrometer or texture analyzer	Penetration/firmness
Stability	Defined long-term/accelerated conditions	Changes in appearance, assay, pH, rheology and release

2.6 Biological evaluation

The wound healing study to be carried out by using the methods of evaluation as described in table 3.

Table 3. Haemostatic/biological evaluation methods.

Assay	Proposed approach	Interpretation
Whole-blood clotting index	Expose defined blood volume to formulation and controls; quantify released haemoglobin after a defined period	Lower BCI/absorbance generally indicates greater clot formation
Clotting time	Measure time to a predefined clot endpoint	Report mean ± SD
PT/aPTT (optional)	Validated plasma coagulation assays with appropriate controls	Mechanistic exploration of coagulation pathways
Platelet interaction (optional)	Validated platelet assay	Exploratory mechanistic endpoint
Hemolysis	Formulation extract with erythrocytes; quantify released haemoglobin	Report % hemolysis

a) Antimicrobial evaluation

Antimicrobial activity is carried out against representative Gram-positive and Gram-negative organisms using a standardized agar diffusion, broth microdilution or validated equivalent method. Positive antibiotic control, vehicle control and formulation controls should be included. Results should be reported as inhibition-zone diameter or MIC/MBC as appropriate[26,27].

b) Skin irritation and preliminary safety

Topical tolerability should be evaluated using an ethically appropriate validated method.

Skin Irritation Test[28] (Patch Test)

Test: Apply small amount to skin (e.g., forearm)

Purpose: Check for redness, itching, or allergic reaction

Expected: No irritation

2.7 Stability study

The optimized formulation is evaluated under predefined long-term and accelerated conditions. At each interval, appearance, homogeneity, pH, viscosity/rheology, spreadability, and microbial quality is assessed[29,30].

Stability Test

Test: Store at different temperatures (e.g., room temp, 4°C, 40°C) over weeks

Purpose: Check for phase separation, color change, or pH change

Expected: Stable appearance and pH over time

3. Results and Discussion

3.1 Formulation development

Six batches were prepared according to the supplied formulation table. The research identifies F5 as the optimized batch.

Table 4. Developed optimized formulation

Optimized F5 component	% w/w	Quantity for 10 g
Liquid paraffin	5	0.50 g
Cetostearyl alcohol	5	0.50 g
Hard paraffin	5	0.50 g
White soft paraffin	64	6.40 g
Kaolin	20	2.00 g
Curcumin	1	0.10 g
Total	100	10.00 g

3.2 Physicochemical evaluation

The research states that the formulated ointment exhibited good spreadability and viscosity, were shown in table 5.

Table 5. Physicochemical evaluation results of designed formulations

Formulationcode	SurfacepH	Viscosity cps	Spreadability Gm.cm^2	Homogeneity
F1	5.46	4208	10.64	Poor
F2	5.44	4215	10.48	Poor
F3	5.62	4424	10.36	Poor
F4	5.80	4680	9.64	Good
F5	**6.48**	**5270**	**9.14**	**Excellent**
F6	6.42	5426	9.08	Good

Formulation code	Colour	Appearance	Feel on application	Skin Irritation	Stability
F1	Faint yellow	Translucent	LessSmooth	Observed	Not Stable
F2	Faint yellow	Translucent	Less Smooth	Less observed	Less Stable
F3	Faint yellow	Translucent	Less Smooth	Less observed	Less Stable
F4	Faint yellow	Translucent	Less Smooth	Not observed	Less Stable
F5	**Yellowish orange**	**Translucent**	**Smooth**	**Not observed**	**Stable**
F6	Yellow	Translucent	Smooth	Less observed	Less Stable

3.3 Biological evaluation

The antimicrobial activity of optimized formulation was carried out against the Gram positive and Gram-negative bacteria. The study was compared with Standard Ciprofloxacin, and results were shown in Table 6.

Table 6. Zone of inhibition diameters of optimized formulation

Sr. No.	Microbial strains	Zone of inhibition (mm)	
		F5 Formulation	Standard
1	*S.aureus*	13±0.57	18±0.74
2	*E.coli*	12±0.45	15±0.58
3	*B. subtilis*	10±0.29	14±0.64

4	*P. aeruginosa*	11±0.75	14±0.81

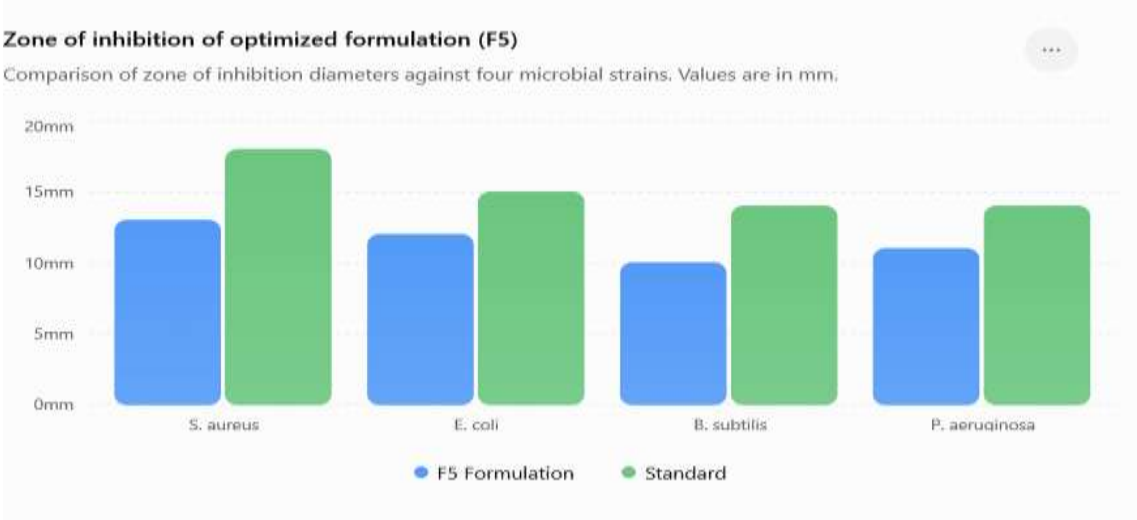


Figure 2. Graphical representation of zone of inhibition of optimized formulation F5

The formulation strategy combines a mineral haemostatic component with a bioactive polyphenol in a semisolid protective base. The research attributes rapid clotting to kaolin and anti-inflammatory from reported literature, antimicrobial and antioxidant effects to curcumin, while the base is intended to retain moisture and protect the wound. This is mechanistically attractive because haemostasis is the first stage of wound repair, whereas inflammatory control and tissue regeneration become important during subsequent stages.
The F5 composition provides 20% kaolin and 1% curcumin in a paraffin-based ointment. A robust follow-up study should compare all batches quantitatively for viscosity, spreadability, content uniformity, and define optimization criteria before selecting the final batch.

4. Conclusion

A kaolin–curcumin haemostatic wound-healing ointment was developed using a fusion-based semisolid manufacturing approach. The supplied formulation study prepared six batches and identified F5 as the optimized composition, consisting of 5% liquid paraffin, 5% cetostearyl alcohol, 5% hard paraffin, 64% white soft paraffin, 20% kaolin and 1% curcumin. The formulation provides a rational platform for combined haemostatic and wound-supportive topical therapy.

Conflict of interest

There is no any conflict of interest.

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