WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 9, 1574-1591. Research Article ISSN 2277–7105

EVALUATION OF WOUND HEALING ACTIVITY OF *SOODAN* (CAMPHOR) POWDER AND OINTMENT IN WISTAR ALBINO RATS

Vijayarajah Thanushiyan*[1] and Dr. Bamini Mithurendran[2]

Siddha Medical Graduate, Faculty of Siddha Medicine, Trincomalee Campus, Eastern University, Sri Lanka.

Senior Lecturer Gr II, Faculty of Siddha Medicine, Trincomalee Campus, Eastern University, Sri Lanka.

Article Received on
20 March 2024,

Revised on 10 April 2024,
Accepted on 30 April 2024

DOI: 10.20959/wjpr20249-32146

***Corresponding Author**
Vijayarajah Thanushiyan
Siddha Medical Graduate, Faculty of Siddha Medicine, Trincomalee Campus, Eastern University, Sri Lanka.

2. ABSTRACT

Background: One of the most important biological processes in tissue regeneration and repair is wound healing. Numerous topical drugs are used to promote wound healing. In any case, the emergence of bacterial resistance and expensive calls into question their effectiveness. The purpose of this study was to assess the healing effectiveness of purified *soodan* powder and ointment applied to excised wounds in Wistar albino rats. ***Methods*:** Healthy albino rats weighing between 150 and 200 grams were used in the study. Six rats each were placed in the following groups: Untreated group, Ointment base group, Neosporin powder group, 10% w/w Neosporin ointment group, purified *soodan* powder group, 10% w/w purified *soodan* ointment group. The rats' dorsolateral portion of the thorax was lacerated using a 120 mm^2 wound. Size of the wound was measured and bandaged every two days until the fourteenth day. The percentage change in the initial size of the wound over a range of days was used to compute the percentage of the wound contracting. ***Results:*** Significant difference in wound circumference between untreated and Neosporin powder group (p=0.029), untreated and purified *soodan* powder group (p= 0.044), untreated and 10% w/w Neosporin ointment group (p=0.000), untreated and 10% w/w purified *soodan* ointment group (p=0.003), untreated and emulsifying ointment base group (p=0.252) with the mean values of 3.500,3.333,7.667,4.333,2.500 respectively. ***Conclusion:*** It is concluded that 10% w/w

purified *soodan* ointment has a highly substantial wound healing impact in excised wounds, while purified *soodan* powder is moderately significant.

KEYWORDS: Camphor Ointment, Dosage, Pharmacological activity, Unit Healing Time, Wound Contraction Rate

3. INTRODUCTION

Traditional medicine is referred to as "The health practices, approaches, knowledge and beliefs incorporating plant, animal, and mineral-based medicines, spiritual therapies, manual techniques and exercises, applied individually or in combination to treat, diagnose and prevent illnesses or maintain well-being" by the World Health Organization.[1] The old Siddha Tamil literature provides a clear illustration of it, the medications can be taken more easily because they come in a variety of formulations and can be selected based on the ailment. Depending on the severity, siddha medication compositions comprise both internal and exterior uses.[2] *Soodan* was chosen because it promotes wound healing, as mentioned by the quotation that follows. The term "wound" appears in the following quotation as *punn*.

"*Kirumisala thodang kilaivalippu sanni porumu mantham angipatta* ***pun****nodu eru surangal vanthi pitham seethamuru vatham sevi muga noi kanthi karupporamendrat saatru*".[3]

In terms of morbidity and permanent impairment, wounds continue to be a major public health concern, particularly in developing nations.[4] Many synthetic pharmaceuticals have drawbacks such drug resistance and allergy, which forces researchers to look for substitute medications.[5] However, due to Sri Lanka's current economic situation, there are not enough medications available in our nation to successfully heal wounds and also some medicine available with high expensive. People in Sri Lanka are familiar with *soodan* (camphor) because it is used to make medications and to worship the Lord in Hindu temples. The benefits will be greater for regular people if the material is readily accessible. As a result, I discovered a Siddha text that discussed camphor's ability to cure wounds under the metals and minerals section of the Siddha Materia Medica. Before these could be recommended for the healing of wounds, however, scientific validation and safety evaluation of the minerals in traditional remedies were required.

The hypothesis under examination is whether *Soodan* (Camphor) Powder effectively promotes healing of excised wounds and if *Soodan* (Camphor) Ointment exhibits superior

wound healing properties compared to *Soodan* (Camphor) Powder. The overarching objective is to evaluate the wound healing capabilities of *Soodan* (Camphor) powder and ointment in Wistar albino rats. Specific aims include assessing the wound healing potential of purified *Soodan* (Camphor) Powder in comparison to a standard drug powder through macroscopic analysis, evaluating the wound healing effects of 10% w/w purified *Soodan* (Camphor) ointment in comparison to a standard drug ointment using macroscopic analysis, and comparing the wound healing efficacy of purified *Soodan* (Camphor) Powder versus 10% w/w purified *Soodan* (Camphor) ointment.

4. MATERIALS AND METHODS

4.1 Study design - Experimental Animal study

4.2 Study duration - 3 months

4.3 Sample size - 36 Wistar albino rats

n = 6

Control group I – 6 rats

Control group II – 6 rats

Standard group I – 6 rats

Standard group II – 6 rats

Test group I – 6 rats

Test group II – 6 rats

4.4 Materials

4.4.1 Selection of the material

Soodan, was selected through quotation of general character of the *Soodan* from the book, Gunapadam (Dhathu Jeeva Vaguppu).

4.4.2 Collection of the material

Soodan was collected from Badulla Ayurveda Osuhala, Trincomalee.

4.4.3 Authentication of material

Soodan and purified *Soodan* were authenticated by supervisor and Gunapadam division of Siddha medicine, TC, EUSL.

4.4.4 Purification of material

According to Gunapadam (Dhathu Jeeva Vaguppu) *Soodan* was soaked in flower juice of sengaluneer (Vernonia cinerea) for 01 Naazhikai (01 Naazhikai = 24 min), then dried in sun shade and packed.

4.4.5 Animal model

Either sex of thirty-six healthy Wistar albino rats weighing 100-200g were obtained from Medical Research Institute (MRI) animal house for experimental study.

4.4.5.1 Inclusion criteria

Well-being rats with the weight of 150 - 200 g

4.4.5.2 Exclusion criteria

Diseased rats

Rats weighed above 200 g or below 150 g.

4.5 Methods

4.5.1 Preparation of fine *Soodan* powder

After the collection, authentication and purification of *Soodan*, was made as powder by using mortar and pestle. The fine powder was stored in a clean air tight glass container and labelled.

4.5.2 Preparation of 10% Purified *Soodan* ointment

Emulsifying ointment base B.P. obtained from Bio Labs in Veyangoda.

5g of purified *soodan* powder and 45g of emulsifying ointment base were weighed by using electronic balance. Then placed the *soodan* powder on the center of ointment slab and emulsifying ointment base on the left side corner of ointment slab, after that half amount of ointment base was taken by using spatula then levigated with the *soodan* powder until the gritty particle completely dissolved. Then remaining ointment base was added and levigated well until particle completely dissolved. Finally, it was stored in a clean air tight glass container and labeled.[6]

4.5.3 Preparation of 10% Neosporin ointment

5g of Neosporin powder and 45g of emulsifying ointment base were weighed by using electronic balance. Then placed the Neosporin powder on the center of ointment slab and emulsifying ointment base on the left side corner of ointment slab, after that half amount of ointment base was taken by using spatula then levigated with the Neosporin powder until the

gritty particle completely dissolved. Then remaining ointment base was added and levigated well until particle completely dissolved. Finally, it was stored in a clean air tight glass container and labeled.[6]

4.5.4 Adaptation of animal

Either sex of thirty-six healthy Wistar albino rats were habitat in air-conditioned, well-ventilated room and fed with pellets thrice a day and watered per hour, cages of every group were cleaned once in three days.

4.5.5 Grouping of animals

Animals were divided into six groups, each group containing 6 rats.[7]

Group I A	Control 1	Considered as first control group and was left untreated
Group I B	Control 2	Considered as second control group and was treated with emulsifying ointment base.
Group II A	Standard 1	Considered as first standard group and was received Neosporin powder externally.
Group II B	Standard 2	Considered as second standard group and was received 10% W/W of Neosporin ointment externally.
Group III A	Test 1	Considered as first test group and was received Purified *soodan* powder externally.
Group III B	Test 2	Considered as second test group and was received 10% W/W of purified *soodan* ointment externally.

4.5.6 Excision wound model

The surgical interventions were carried out under the sterile conditions using 80mg/kg ketamine and 6mg/kg xylazine cocktail injected intraperitoneally. Hairs were removed from the dorsal thoracic region of the rats. A circular wound of approximately 120 mm2 was marked on the back of the rat by a standard ring. Full thickness of the marked skin was cut carefully. Then Animals were kept in separate cages.[8]

4.5.7 Treatment procedures and follow up

600mg of powders and 2mm thickness of ointments of test drug, standard drug and ointment base were topically applied once in two days starting from 1 hour later and till complete epithelization (14 days).[9]

4.5.8 Assessment

Data were collected once in 2 days from each group and recorded clearly. Every two days, the wound area was measured by applying a transparent piece of paper over the wound and outlining it; then, the area of this measurement was calculated using a graph sheet.[10]

Bates-Jensen Wound assessment Test

It is an objective measure used to assess wound status and track healing in control, standard and test groups.[11]

ITEM	ASSESSMENT
Size	ANOVA One Way Statistic Analysis

Wound contraction rate

Reduction in the wound area was expressed as percentage of the original wound size.[8]

% wound contraction on day X = [(area on day 0 − open area on day X)/area on day 0] × 100.

Unit Healing Time

Wound healing was assessed by Unit Healing Time. The Unit Healing Time means number of days required for healing of per sq. cm area of wound. Unit Healing Time will be calculated by the following formula:[12]

Unit Healing Time = Total number of Days Required for Healing / Initial Area of Wound (sq.cm)

4.5.9 Data processing and analysis

The data was entered, coded, and analyzed using statistical package for the social sciences (SPSS). Statistical analysis was done by Tukey's Honest Significant Difference (HSD) test and one-way analysis of variance (ANOVA) by using IBM, SPSS Version 20 for the circumference of wound and p value < 0.05 was considered statistically significant.[13]

5. RESULTS

A one-way ANOVA was performed to analyze the impact of purified *soodan* powder and ointment on wound curing ability were determined

Wound Circumference

Table 5.1 Wound Circumference Measurements in Day 00 and Day 14.

No of days	No of rats	Untreated group	Emulsifying ointment base group	Neosporin powder group	10% W/W Neosporin ointment group	Purified *soodan* powder group	10% W/W of purified *soodan* ointment group
Day 00	01	119 mm^2	120 mm^2	121 mm^2	120 mm^2	119 mm^2	122 mm^2
	02	118 mm^2	118 mm^2	120 mm^2	118 mm^2	120 mm^2	118 mm^2
	03	120 mm^2	120 mm^2	120 mm^2	120 mm^2	119 mm^2	120 mm^2
	04	118 mm^2	119 mm^2	119 mm^2	119 mm^2	120 mm^2	119 mm^2
	05	121 mm^2	118 mm^2	120 mm^2	120 mm^2	117 mm^2	121 mm^2
	06	118 mm^2	120 mm^2	117 mm^2	120 mm^2	119 mm^2	120 mm^2
Day 14	01	40 mm^2	22 mm^2	20 mm^2	6 mm^2	18 mm^2	3 mm^2
	02	39 mm^2	36 mm^2	24 mm^2	8 mm^2	20 mm^2	2 mm^2
	03	38 mm^2	30 mm^2	22 mm^2	10 mm^2	21 mm^2	1 mm^2
	04	27 mm^2	35 mm^2	26 mm^2	11 mm^2	19 mm^2	3 mm^2
	05	39 mm^2	29 mm^2	25 mm^2	12 mm^2	17 mm^2	1 mm^2
	06	35 mm^2	33 mm^2	24 mm^2	4 mm^2	23 mm^2	1 mm^2

Table 5.2: ANOVA One-way statistic for the circumference of the wound.

ANOVA					
		df	Mean Square	F	Sig.
Day 00	Between Groups	7	0.807	0.519	0.815
	Within Groups	40	1.554		
	Total	47			
Day 02	Between Groups	7	1.211	0.740	0.640
	Within Groups	40	1.637		
	Total	47			
Day 04	Between Groups	7	1.190	0.776	0.611
	Within Groups	40	1.533		
	Total	47			
Day 06	Between Groups	7	2.607	1.378	0.241
	Within Groups	40	1.892		
	Total	47			
Day 08	Between Groups	7	1.952	1.473	0.204
	Within Groups	40	1.325		
	Total	47			
Day 10	Between Groups	7	4.321	2.346	0.042
	Within Groups	40	1.842		
	Total	47			
Day 12	Between Groups	7	27.021	8.567	0.000
	Within Groups	40	3.154		
	Total	47			
Day 14	Between Groups	7	813.592	79.343	0.000
	Within Groups	40	10.254		
	Total	47			

Analyzed by: SPSS IBM 20 version One-way ANOVA (P < 0.05)

Table 5.3: Post Hoc Test ANOVA one-way statistic for the change of circumference of the wound between groups.

Multiple Comparisons							
Tukey HSD							
Dependent Variable	**(I) rats**	**(J) rats**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Day 12	Untreated	Emulsifying ointment base B.P.	2.500	1.025	0.252	-0.78	5.78
		Neosporin powder	3.500*	1.025	0.029	0.22	6.78
		10% W/W Neosporin ointment	7.667*	1.025	0.000	4.39	10.94
		Purified *soodan* powder	3.333*	1.025	0.044	0.06	6.61
		10% W/W of purified *soodan* ointment	4.333*	1.025	0.003	1.06	7.61
*. The mean difference is significant at the p < 0.05 level.							

Analyzed by: SPSS IBM 20 version Post Hoc Tukey (P< 0.05)

Wound Contraction Rate

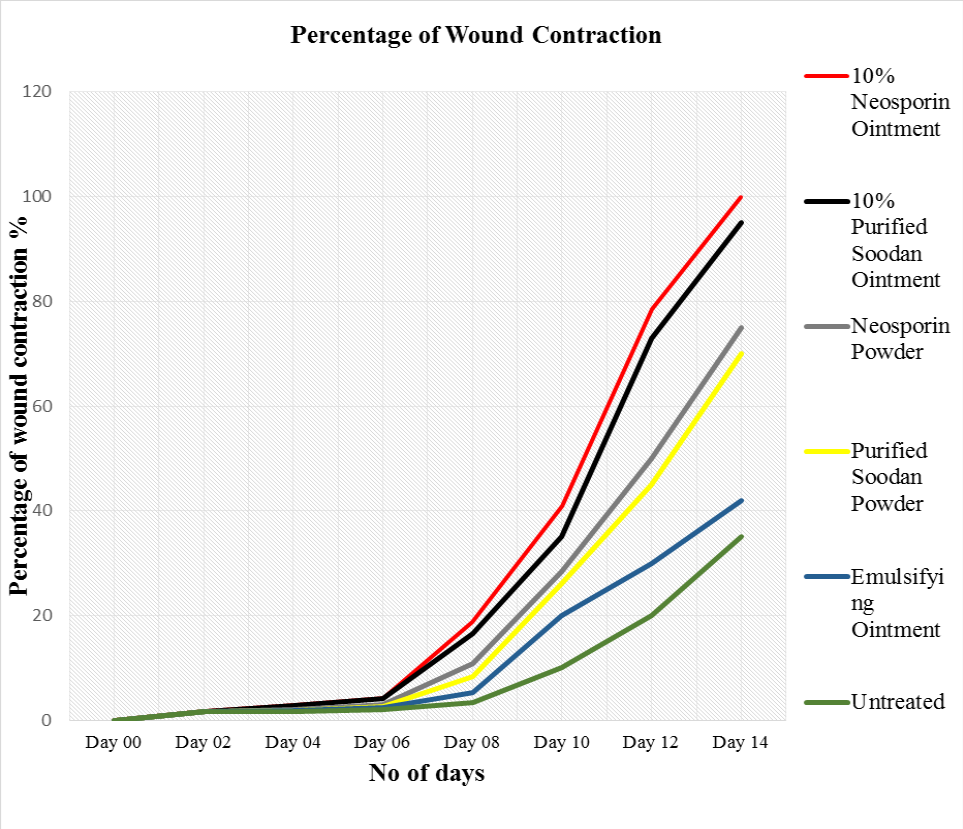


Chart 5.1 Comparison of the wound contraction rate within all six groups variations with days.

Unit Healing Time

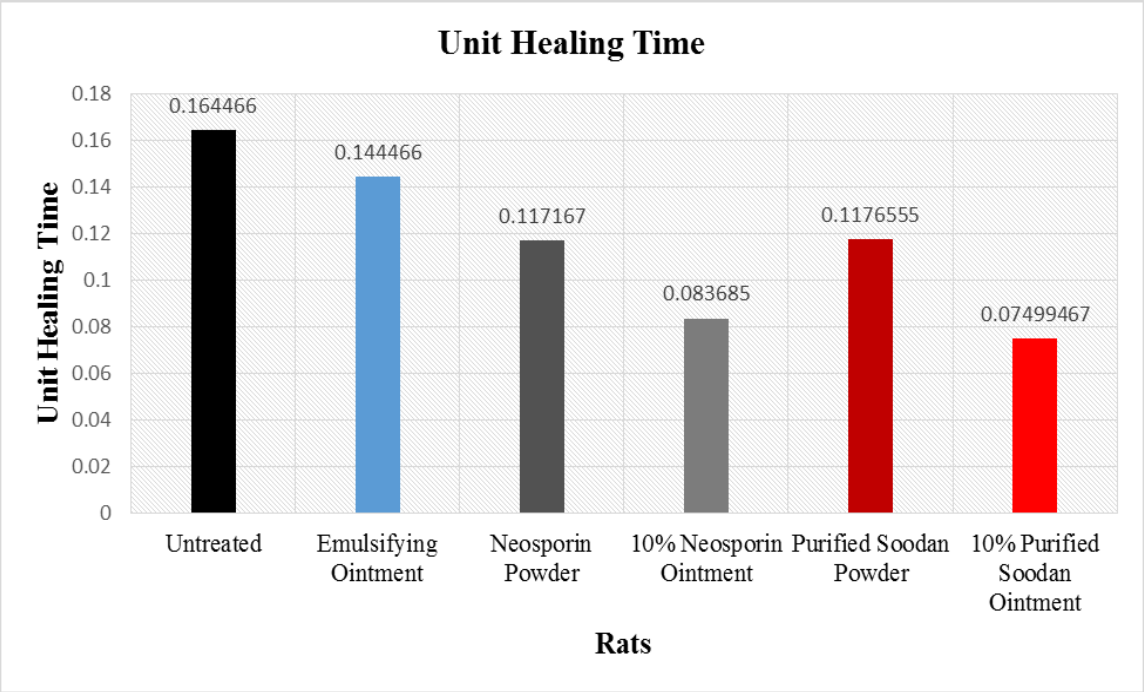


Chart 5.2 Unit healing time variation among the control, standard and test groups.

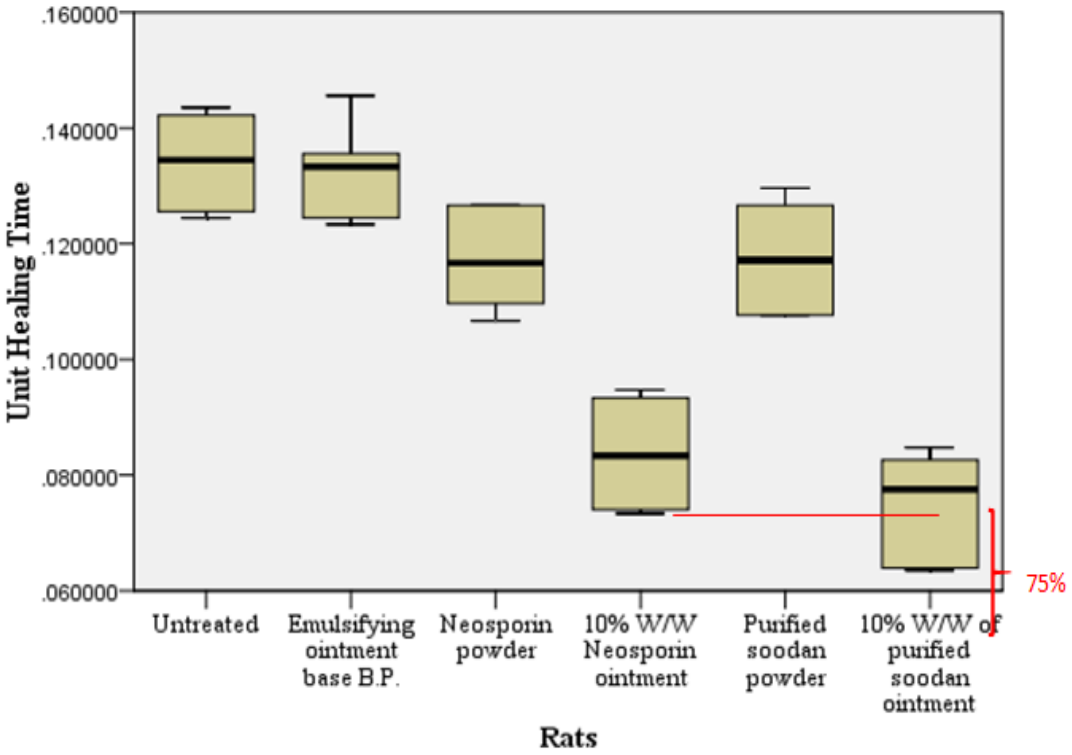


Chart 5.3 Box and Whisker Plot Diagram for Unit Healing Time variation among the control, standard and test groups.

Table 5.4: Independent t-Test (Group Statistics) analysis of UHT between purified *soodan* powder Vs 10% W/W of purified *Soodan* ointment.

Group Statistics					
	Rats	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Unit Healing Time	Purified *soodan* powder	6	0.11765550	0.009236715	0.003770873
	10% W/W of purified *soodan* ointment	6	0.07499467	0.009267976	0.003783635

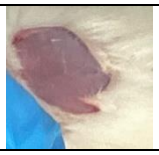
Analyzed by: SPSS IBM 20 version Independent t-Test

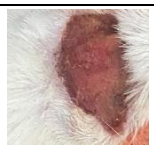
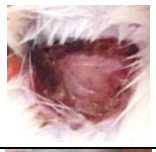
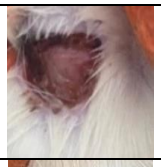
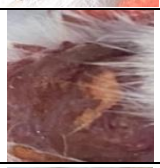
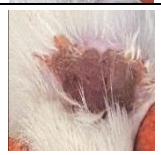
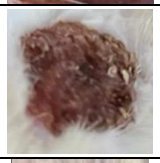
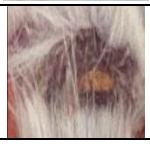
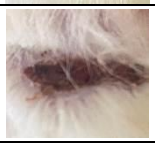
Table 5.5: Independent t-Test (Independent Samples Test) analysis of UHT between purified *soodan* Powder Vs 10% W/W of purified *soodan* ointment.

Independent Samples Test										
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Unit Healing Time	Equal variances assumed	0.034	0.858	7.986	10	0.001	0.042660833	0.005341852	0.030758446	0.054563221
	Equal variances not assumed			7.986	10.000	0.001	0.042660833	0.005341852	0.030758428	0.054563239

Analyzed by: SPSS IBM 20 version Independent t-Test

Table 5.6: Size of wound variation with days.

Day	**Untreated**	**Emulsifying Ointment**	**Purified *Soodan* Powder**	**Neosporin Powder**	**10% Purified *Soodan* Ointment**	**10% Neosporin Ointment**
Day 00						

Day 02						
Day 04						
Day 06						
Day 08						
Day 10						
Day 12						
Day 14						

6. DISCUSSION

A wound is any rupture in the skin, mucous membranes, or organ tissue's consistency. Wounds can be caused by mechanical, thermal, chemical, or radiogenic stress.[14] Since the amount of scar tissue that forms as a result of a wound will be higher, quick and complete wound healing is always necessary. Because of this, all medical personnel who treat wounds should aim to promote early wound healing.[15]

Reason to choose specific concentration of ointment

Particularly 10%W/W of Purified *Soodan* (Camphor) ointment was chosen because as per the research finding of Young-Jin and Heidi Pinkert[16], which shows camphor is FDA approved for external application in a concentration of 3% -11%. that means for external application of camphor concentration should not be more than 11%. If it is more than that which consider as an over dosage of camphor; causes seizure, confusion, restlessness, nausea and vomiting.

Comparison of test and standard drug toxicity

If it is an unbroke skin; test or standard drugs which not go into the systemic circulation, but here when we consider about the wound usually it is a broken skin; due to that there are many chances for systemic absorption, so we have to consider about the lethal doses of *soodan* (camphor) and also Neosporin powder. According to the research of Zuccarini, which mentioned that the synthetic form caused various toxic and behavioral symptoms, such as body jerks and slumped posture, myoclonic manifestations followed by quiescence, while the natural form was non-toxic at an oral dose of 100 mg/Kg body weight and no signs of toxicity were observed up to 2000 mg/kg body wt. In male Wistar albino rats, meanwhile doses up to 1000 mg/Kg body weight to rats and up to 681 mg/Kg body weight to rabbits showed no teratogenic effects.[6] But in Neosporin; as per the global drug survey version 11; which mentioned that the subcutaneous LD_{50} is 200 mg/kg in rat and 190 mg/kg in mouse.[17] Value is significantly lower than the *soodan* (camphor) powder, However, systemic absorption of Neosporin powder causes allergic hypersensitivity to neomycin, anaphylactic reactions, give rise to a theoretical risk of fetal toxicity, intensify and prolong the respiratory depression, irreversible ototoxicity, nephrotoxic potential and neurotoxic potential, so this statement is the best prove for human safety of *soodan* (camphor) rather than the Neosporin powder.

Discussion about results and data

According to table 5.2, One-way ANOVA (α=0.05) reveals that, there are no significant differences between the treatments at day first (p=0.815, df= 07, f=0.519), whereas at day 10 there is a significant difference between the treatment groups (p=0.042, df= 07, f=2.346). The significant value of the day 14 is 0.000. which means circumference of wounds from 10^{th} to 14^{th} days showed that the significant differences statistically between the all six groups.

Table 5.3 which shows that Post Hoc Tukey Test (α=0.05) reveals that on 1^{st} day, there was a statistical difference in wound circumference between untreated and Neosporin powder group (p=0.997), untreated and purified *soodan* powder group (p= 1.000), untreated and 10% Neosporin ointment group (p=0.997), untreated and 10% purified *soodan* ointment group (p=0.857), untreated and emulsifying ointment base group (p=1.000). On 12th day, there was a significant difference in wound circumference between untreated and Neosporin powder group (p=0.029), untreated and purified *soodan* powder group (p= 0.044), untreated and 10% Neosporin ointment group (p=0.000), untreated and 10% purified *soodan* ointment group

(p=0.003), untreated and emulsifying ointment base group (p=0.252) with the mean values of 3.500, 3.333, 7.667, 4.333, 2.500 respectively. These all values are compared with untreated groups, which means after 12th day compare to untreated group, 10% w/w Neosporin ointment group showed maximum effect in the closure of wound, then 10% w/w of purified *soodan* ointment group, Neosporin powder group and purified *soodan* powder group showed effective wound closure respectively. At last emulsifying ointment base group shows significant value of 0.252, which is much higher than the p value of 0.05 where the null hypothesis of there is no significant differences between the mean values of the untreated group, is accepted.

Chart 5.1 shows the wound contraction rate in all control, standard and test groups. According to that wound contraction rate were increased along with days in all six groups and 10% Neosporin ointment and 10% purified *soodan* ointment both shows higher contraction rate rather than other groups, likewise Neosporin and *soodan* powders have almost similar contraction rates rather than the untreated group and emulsifying ointment groups.

Chart 5.2 shows the unit healing time variation among the control, standard and test groups, according to these among the all groups, unit healing time is the lowest in 10% Purified *soodan* ointment. Chart 5.3 indicates the Box and whisker plot diagram reveals that 75% of samples of 10% purified *soodan* ointment shows unit healing time which was lower than the mean value of 10% Neosporin ointment. Which means 10% Purified *soodan* ointment heal the wound within a short period rather than other groups.

Analysis the efficacy of purified *soodan* powder with neosporin powder

As suggested above, *Soodan* (camphor) powder is extremely safe to use in wounds based on the lethal dose 50 and toxicity of *Soodan* (camphor) powder and Neosporin powder.

As per the results of circumference of wound, wound contraction rate and unit healing time shows; when compare to untreated wounds; effect of wound healing activity of purified *soodan* powder almost similar to Neosporin powder.

The mechanism of action in Neosporin powder; Polymyxin B is one of ingredients and which cause damage to the bacterial cytoplasmic membrane, and Neomycin is an aminoglycoside antibiotic which acts by binding to a specific protein on the 30S subunit of the microbial

ribosome, leading to false production of mRNA cause the damage in bacteria. Also, Bacitracin is a mixture of polypeptides which inhibits growth of bacteria primarily by preventing the formation of peptidoglycan chains needed for cell wall synthesis and by altering membrane permeability.[17]

According to this statement we have to think all three chemical compounds of Neosporin powder (Polymyxin B, Neomycin and Bacitracin) combined together and shows the effective results in wound healing based on their bactericidal activity. But purified *soodan* (camphor) powder individually shows the similar effect of these combined three chemical compounds which are in Neosporin powder, so we can assume that purified *soodan* (camphor) has a potent bactericidal activity, The Siddha text book of Gunapadam (*Dhathu Jeeva Vaguppu*), however, already stated that "*Soodan* has an antiseptic activity." There is still more microbiological study to be done in order to support this claim scientifically.

Addition to that *Soodan* contained approximately 74% D-camphor, and less than 5% of borneol, 1,8-cineole, α-terpineol.[18] So 1,8-cineole has potent anti-inflammatory properties, borneol is a potent anti-oxidant and α-terpineol has antibacterial properties. Anti-microbial (antibacterial and antifungal), antioxidant and anti-inflammatory; these are the main pharmacological actions involving in treatment of wounds. chemical constituents and their pharmacological actions suggest that *soodan* can cure the wound effectively.

Purified *Soodan* (camphor) Powder is effective than Neosporin Powder in on basis of both safety and successful wound healing.

Analysis the efficacy of 10% purified *soodan* ointment with 10% neosporin ointment

Ointments are more occlusive, which allows for better penetration of medication through the skin and higher potency.[19] Particularly 10% concentration of purified *soodan* ointment was selected.[16] Same concentration (10%) of neosporin ointment was prepared, because pharmaceutically prepared 10% neosporin ointment, which contain the hydrocortisone additionally, which also involve the wound healing process in the standard drug. To evaluate the efficacy of ointment of test drug, same concentration of standard drug needed, due to concentration and avoid the content of hydrocortisone; 10% neosporin ointment was prepared according to standard procedures.

According to above results, 10% neosporin ointment and 10% purified *soodan* ointment shows a very effective wound healing effect rather than neosporin powder and purified *soodan* powder as well as in untreated groups. 10% neosporin ointment and 10% purified *soodan* ointment shows almost similar effects.

When we used emulsifying ointment only, it shows significant value of 0.252, which is much higher than the p value of 0.05, it means no significant different between the untreated group and emulsifying ointment base group, because emulsifying ointment base has not any active ingredient for the wound healing but it may produce a protective layer above the wound and which control the invasion of micro-organisms. Due to that which show little effect than the untreated group.

Therefore, we are able to conclude that neosporin and purified *soodan* ointments exhibit very excellent wound healing activity. Ointment base, however not causes wound healing; rather, it improves the medication's penetration through the skin and serves as a barrier to protect wounds from the outside environment.

Compare the purified *soodan* powder vs 10% purified *soodan* ointment

According to tables 5.4 and 5.5, Means value of unit healing time of purified *soodan* powder is 0.1176 and 10% Purified *soodan* ointment is 0.0749. So mean unit healing time of 10% purified *soodan* ointment lower than mean value of purified *soodan* power and significant (2 tailed) in between two groups was 0.001, which is much lower than the p value of 0.05, so both groups have significant differences of mean value. Therefore, 10% purified *soodan* ointment is more efficient in treating wounds quickly than purified *soodan* powder.

According to that; 10% purified *soodan* ointment has a greater effect on wound healing than *soodan* powder. It May be due to high evaporation rate of *Soodan* (camphor). The evaporation rates of *Soodan*(camphor) were 0.085 ± 0.003 mg h^{-1} cm^{-2} so it can sublime at the room temperature.[20] *Soodan* ointments exhibit more effective outcomes than *soodan* powder when applied to wounds. The *soodan* may be sublime at room temperature but may not evaporate when mixed with an ointment base. However, 10% *soodan* ointment was taken into consideration; the *soodan* density is higher in the 10% ointment as a result of the high amounts of active components in camphor, which has the greatest impact on wound healing.

7. CONCLUSION

Purified *soodan* powder shows a very effective wound healing activity almost similar to neosporin powder. 10% w/w purified *soodan* ointment exhibit more significant outcomes than purified *soodan* powder when applied to wounds, because the *soodan* may be sublime at room temperature but may not evaporate when mixed with an ointment base and which improves the medication's penetration through the skin and serves as a barrier to protect wounds from the outside environment and high amounts of active components of *soodan* present in the 10% w/w Purified *soodan* ointment. So, it is concluded; comparatively 10% w/w purified *soodan* ointment has a greater effect on wound healing than purified *soodan* powder on excised wound.

8. ACKNOWLEDGEMENT

I do hereby have responsibility of expressing my sincere gratitude to all people who were being part of this dissertation study. My sincere gratitude to Dr. (Mrs).B.Mithurendran, Senior Lecturer, Faculty of Siddha medicine, Trincomalee campus, Supervisor of the study for providing the permission and guidance to conduct the study. I shall ever remember very kind guidance of her with her valuable time. My sincere gratitude to Research laboratory in charge for granting space to conduct my study and support for the research works. My sincere thanks to all the people who support to conduct the dissertation study.

Funding and Support - Self-funding.

9. List of abbreviations

- CAGR- Compound Annual Growth Rate
- PGDF- Platelet Derived Growth Factors
- TGF’s- Transforming Growth Factors
- TNF- Tumor Necrosis Factors
- MRI- Medical Research Institute
- BJWAT- Bates Jensen Wound Assessment Tool
- SPSS- Statistical Package for Social Sciences
- UHT – Unit Healing Time

Table 5.6: Size of wound variation with day.

Chart 5.1	Comparison of the wound contraction rate within all six groups variations with days
Chart 5.2	Unit healing time variation among the control, standard and test groups
Chart 5.3	Box and whisker plot diagram for unit healing time variation among the control, standard and test groups

10. References

1. **World Health Organization**. (2008) 'Traditional medicine Fact sheet', Available at: https://www.who.int/health-topics/traditional-complementary-and-integrative-medicine [Accessed on 21 August 2023].
2. **Amini, M. et al**. 'Effect of Plantago major on Burn Wound Healing in Rat', *Journal of Applied Animal Research*, 2010; 37(1): 53-56. doi: 10.1080/09712119.2010.9707093.
3. **Dr.R. Thiyagarajan, L.I.M**. *Gunapadam (dhathu jeeva vaguppu)*. Chennai: Sri Venkateshwara Enterprises, 2009; 402-404.
4. **Vajiravelu, S. *et al***. 'Overview of Wound Healing Siddha Medicines', *Open access Journal of Complementary and Alternative Medice*, 2019; 92-94. doi: 10.32474/OAJCAM.2019.01.000124.
5. **Chambliss, L.R**. 'Alternative and Complementary Medicine: An Overview', *Clincal Obstetrics Gynaecology*, 2001; 44(4): 640–52.
6. **Zuccarini, P**. 'Camphor: risks and benefits of a widely used natural product', *Journal of Applied Sciences and Environmental Management*, 2009; 13(2).
7. **Linjawi, S.A**. 'Effect of camphor on uterus histology of pregnant rats', *Journal of King Abdulaziz University-Medical Sciences*, 2009; 16(2): 77-90.
8. **Agarwal, P.K. et al**. 'Evaluation of wound healing activity of extracts of plantain banana (Musa sapientum var. paradisiaca) in rats', *Indian Journal of Experimental Biology*, 2009; 47(1): 32-40.
9. **Barnes, Joanne**. Pharmacovigilance of Herbal Medicines. Drug safety: an international journal of medical toxicology and drug experience, 2003; 26: 829-51. 10.2165/00002018-200326120-00001.
10. **Werner, S. et al**. 'Induction of keratinocyte growth factor expression is reduced and delayed during wound healing in the genetically diabetic mouse', *The Journal of investigative dermatology*, 1994; 103(4): 469-473. doi:10.1111/1523-1747.ep12395564.

11. **Bates-Jensen, et al**. 'Bates-Jensen Wound Assessment Tool Pictorial Guide Validation Project', *Journal of Wound, Ostomy and Continence Nursing*, 2010; 37(3): 253-259. DOI: 10.1097/WON.0b013e3181d73aab.
12. **Bronaugh, R.L., Congdon, E.R, and Stewart, R.F.** 'Methods for in vitro percutaneous absorption studies. II Animal models for human skin', Toxicology and Applied Pharmacology, 1982; 62(3): 481. doi: 10.1016/0041-008x(82)90149-1.
13. **Masuram, S. et al**. 'the druggable genome: Evaluation of drug targets in clinical trials suggests major shifts in molecular class and indication', *Annual review of pharmacology and toxicology*, 2014; 54: 9-26. Doi: 10.1146/annurev-pharmtox-011613-135943.
14. **Angela M. and Kujath, Peter**. 'Wounds - from physiology to wound dressing', *Deutsches Arzteblatt international*, 2008; 105(13): 239-48. doi:10.3238/arztebl.2008.0239.
15. **Coombes, Lusby, P.E., AL. and Wilkinson, JM**. 'Bactericidal activity of different honeys against pathogenic bacteria', *Archives of medical research*, 2005; *36(*5): 464–467. doi: https://doi.org/10.1016/j.arcmed.2005.03.038
16. **Heidi P and Young-Jin, S**. *Haddad and Winchester's Clinical Management of Poisoning and Drug Overdose* .4th Edn. Saunders publications, 2007.
17. **Neomycin-polymyxin B- bacitracin global datasheet**. Global Drug Survey Version 11 dated 26 March 2020.
18. **Guo, S. et al**. 'The chemical composition of essential oils from *Cinnamomum camphora* and their insecticidal activity against the stored product pests', *International Journal of Molecular Sciences*, 2016; 17: 1836. doi: https://doi.org /10.3390/ijms17111836.
19. **Robinson, R.C.V**. 'Comparative Study of Ointment Bases', *AMA Archives of Dermatology*, 1955; 72(1): 54–58. doi:10.1001/archderm.1955.03730310056010.
20. **Phaechamud, T and Tuntarawongsa, S**. 'Menthol, Borneol, Camphor and WS-3 Eutectic Mixture', *Advanced Material Research*, 2012; *506*: 355–358. Doi: 10.4028 /www. scientific.net/amr.506.355.