



Antimicrobial Lubricating Powder for Bed Sores

Matoshri Institute of Pharmacy, Dhanore, Yeola

Authors- Om Sanjay Nagare, Savita Dattu Daunde, Baleshwari Chandrakant Jagtap, Prof.Pallavi Shivaji Ghule

Introduction:

Bedsore are injuries that develop due to extended pressure on your skin. Individuals who remain immobile for extended durations, like those confined to bed or reliant on a wheelchair, face the highest risk for bedsore. These sore lesions, or pressure sores, can become extensive and result in infections. In certain cases, pressure ulcers can be fatal.[1] Bedsore continue to be a significant health issue, impacting around 3 million adults. Pressure ulcers are commonly referred to as bedsore and decubitus ulcers. In 1993, there were reports of pressure ulcers in 280,000 hospital admissions, and 11 years later, the count rose to 455,000. The HCUP report revealed that between 1993 and 2003, there was a 63 percent rise in pressure ulcers, while the overall number of hospitalizations during these years grew by just 11 percent. Pressure ulcers are expensive, averaging \$37,800 per hospital stay.[2] They mainly arise from pressure and shear, are progressive, and are most commonly seen in individuals who are bedridden, chair-bound, or immobile. They frequently occur in individuals who have undergone prolonged hospitalization, typically for an unrelated issue, leading to increased overall duration and expenses associated with hospitalization that negatively impact the quality of life for patients. [3]

Non-Surgical Treatments:

You or a caretaker might have the capability to manage stages 1 or 2 pressure sores. For stage 3 or 4 bedsore, you may also consult a wound specialist. Depending on the seriousness of the pressure ulcer, it might require weeks or months for the sore to recover.

To manage a pressure injury, you or your medical professional might:

- Cleanse or irrigate the wound using soap and water or saline (a sterile saltwater solution).
- Cover the injury with specialized medical bandages intended to aid in the healing process. These consist of water-based gels (hydrogels), hydrocolloids, alginates (derived from seaweed), and foam bandages. [4]

For extensive, serious pressure ulcers, your healthcare professional will extract necrotic tissue in a procedure known as debridement. Your physician excises the necrotic tissue with a scalpel. Alternatively, they might use ointments that assist your body in breaking down the dead tissue. Your provider might initially numb the region with a local anaesthetic since the surrounding tissue remains sensitive, even if the tissue itself is dead.

Powdered substances:

Pharmaceutical powders are a solid form of medication where one or more drugs are distributed in a finely divided state, either with or without excipients. They can be found in either crystalline or amorphous states. [5]

Surgical Treatments:

Pressure sores that are classified as stage 3 or 4, which are deep or impact a significant skin area, might necessitate surgical intervention.

A skin graft might be necessary to seal the wound and encourage healing.

Medications for Pressure Ulcers:

- Antimicrobials
- Anti-inflammatory drugs that are not steroids (NSAIDs)
- Analgesics [6]

Dusting powder:

A powder applied to the skin or wounds primarily to reduce irritation or absorb moisture is known as Dusting powder. Dusting powders are typically combinations of two or more finely powdered substances, designed for external use on the skin (such as wounds, burns, or surgical incisions). Dusting powders are utilized to avert and address minor skin infections resulting from small cuts, scrapes, or burns. Certain skin infections can also be addressed with dusting powders, including athlete's foot, jock itch, and ringworm. It additionally alleviates burning, itching, skin cracking, and discomfort resulting from these infections.

Categories of dusting powder:

1) Medical dusting powder

Medical powders are utilized for surface skin issues. They need to be devoid of pathogens. Certain mineral components might harbour spores of tetanus, gas gangrene, etc., thus requiring proper sterilization. They are not intended for open wounds or regions of damaged skin, as indicated on the label as well.

2) Surgical dusting powder

Surgical dusting powders are applied in body cavities and significant wounds, on burns, and on the umbilical cords of newborns too. They consist of sterile powders.

Official standards for powders:

Sr. No	Grades of powder	Sieve all through which particles must pass	Normal mesh aperture size	Sieve through which 40% of particle size	Nominal mesh aperture size
1	coarse powder	10	1.7 mm	44	355 µm

2	moderately coarse powder	22	710 µm	60	250 µm
3	moderately fine powder	44	355 µm	85	180 µm
4	fine powder	85	180 µm	-	-
5	very fine powder	120	125 µm	-	-

Table No. 1 Official standards for powders [6,7]

Materials and Method:

Materials:

Sr. No	Ingredients	Category
1	Neem powder	Antimicrobial agent
2	Turmeric powder	Anti-inflammatory agent
3	Zinc Stearate	Lubricant
4	Starch	Powder base
5	Talc	Thickening agent

Table No.2 Ingredients Table

Ingredients:

A) Neem



Fig.3. Neem powder

Synonyms: Nim, Nimba, Limba, Margosa

Biological source: Obtained from fresh leaves of the plant known as *Azadirachta Indica*.

Family: Meliaceae

Chemical Constituents: Nimbidin, nimbin, azadirachtin, meliantriol, salanin, maegolone margolonone.

Uses of neem:

- 1) Treats Acne
- 2) Nourishes Skin
- 3) Treats Fungal Infections
- 4) Useful in Detoxification
- 5) Increases Immunity. [8,10,11]

B) Turmeric



Fig.4.Turmeric powder

Synonyms: Indian saffron, Haldi, Haridra

Biological Source: Obtained from dried rhizomes of *curcuma longa linn*

Family: Zingiberaceae

Chemical constituents: curcumin, curcuminoids, resin, starch grain, eugenol, azulene, decamphene, caprylic acid, cincol, turmerone.

Uses:

- Anti-Allergy
- Anti-fungal
- Anti-inflammatory
- Anti-viral
- Heals Wounds Fast
- Improve Digestion. [8,12]

• **Preformulation study:**

Sr No.	Parameters	Starch	Talc	Zinc stearate	Neem powder	Turmeric powder
1	Colour	White	White	White	pastel green	yellow or reddish yellow
2	Odour	odourless	odourless	characteristic	characteristic	aromatic
3	Taste	tasteless	Tasteless	tasteless	Bitter	bitter , pungent
4	Appearance	White powder	Fine White powder	White powder	green powder	yellow or reddish yellow powder
5	Solubility	Insoluble in cold water & alcohol	insoluble in water & alcohol	Insoluble in water & alcohol	soluble in water & alcohol	soluble in water & alcohol

Table No.3 Preformulation Study

Formula Development:

Method: For Preparation of Trial Batches.

Procedure:

- 1) Weigh the required quantity of purified talc and Zinc stearate.
- 2) Mix zinc stearate with starch and incorporate purified talc.
- 3) Then added the Neem powder and Turmeric powder mixed properly.
- 4) pass the mixed powder through a sieve no.120 to remove gritty particles.
- 5) After sieving whole of the powder must be again slightly mixed.
- 6) Pack the powder to protect it from air, moisture and contamination.

Sr. No	Ingredients	F1	F2	F3	F4
1	Starch	2.5	2.5	2.5	2.5
2	Talc	3.5	3.5	3.5	3.5
3	Zinc stearate	3	3	3	3
4	Neem	0.4	0.6	0.7	0.5
5	Turmeric	0.6	0.4	0.3	0.5
Total	---	10	10	10	10

Table No.4 Formula Development ^[13]

Fig.9. Trial Batches

Preparation Method:



Fig 8. Trituration process

Evaluation Parameters

1. **Physical characteristics-** The physical characteristics of the powder was evaluated. The colour of powder was greenish white or yellowish white with characteristics odour and smooth appearance.

2. **PH. of the formulation-** There is a high level of agreement that topical products should be acidified and possess pH in the range of 4 to 6.



Fig.10 ph. Apparatus Observation Table

Batch No	F1	F2	F3	F4
pH	5.4	5.6	5.5	5.9

Table No. 5 pH of formulation

3. **Abrasiveness-** The powder was found for absence of grittiness. It is a property which is very important as the areas where we are going to apply the powder is sensitive and proper lubrication is required so the powder should show less abrasive characteristics.

4. **Bulk density-** Bulk density is the weight of a volume unit of powder and is usually expressed in g/cm³, kg/m³, or g/100 ml. Bulk density is usually determined by measuring the volume of 100 g of powder in a 250 ml graduated cylinder after exposure to compaction by standardized tapping.

Observation Table:

Batch No	F1	F2	F3	F4
Bulk density	0.45g/cm ³	0.45g/cm ³	0.44g/cm ³	0.50g/cm ³

Table No.6 Bulk density

5. **Tapped density-** The tapped density is an increased bulk density attained after mechanically tapping a container containing the powder sample. The tapped density is obtained by mechanically tapping a graduated measuring cylinder or vessel containing the powder sample.

Observation Table:

Batch No	F1	F2	F3	F4
Tapped Density	0.55g/cm ³	0.52g/cm ³	0.52g/cm ³	0.60g/cm ³

Table No.7 Tapped density

5. **Angle of repose:** When a powder is allowed to fall on a flat surface from a funnel positioned at a certain height, the funnel is gradually moved upward in order to maintain a fixed height between the powder tip and the bottom of the funnel. The angle produced by the surface of powder.

Observation Table:

Batch No	F1	F2	F3	F4
Angle of repose	29 ⁰	30 ⁰	32 ⁰	33 ⁰

Table No: 9 Angle of repose of formulation

6. **Carr's index and Hausner's Ratio-** The Carr's Compressibility Index and Hausner Ratio are two measures which can be used to predict the propensity of a given powder sample to be compressed, and which are understood to reflect the importance of interparticulate interactions.

Observation Table:

Batch No	F1	F2	F3	F4
Hausner ratio	1.17	1.15	1.18	1.20
Carr's index	14	13	15	16

Table No: 11 Hausner ratio & Carr's Index of formulations

7. **Moisture content-** Moisture content is, simply, how much water is in a product. It influences the physical properties of a substance, including weight, density, viscosity, conductivity, and others. It is generally determined by weight loss upon drying.

Observation table

Batch No	F1	F2	F3	F4
% moisture content	1.01%	1.20%	1.17%	1.15%

Table No. 16 Moisture content [14, 15]

8. **Antimicrobial activity -** Microbe like E. Coil and Pseudomonas spp are associated with pressure ulcer. Turmeric and neem in formulation prevent the microbe to grow for some time.[16,17]

Observation table:

Parameters	F1	F2	F3	F4
Colour	yellowish white	Greenish white	Greenish white	yellowish white
Odour	characteristic	characteristic	characteristic	characteristic
Appearance	Smooth	Smooth	Smooth	Smooth
PH	5.4	5.6	5.5	5.9

Particle size	125 µm	125 µm	125 µm	125 µm
Abrasiveness	No grittiness	No grittiness	No grittiness	No grittiness
Bulk density	0.47g/cm ³	0.45 g/cm ³	0.44 g/cm ³	0.50 g/cm ³
Tap density	0.55 g/cm ³	0.52 g/cm ³	0.52 g/cm ³	0.60 g/cm ³
Angle of repose	29 ⁰	30 ⁰	32 ⁰	33 ⁰
Carr's Index	14%	13%	15%	16%
Hausner ratio	1.17	1.15	1.18	1.20
Moisture content	1.01%w/w	1.20%w/w	1.17%w/w	1.15%w/w

Table No .17 Evaluation Parameters

The standard dusting powder contains starch and talc as powder base. To increase the lubrication of powder zinc stearate is added. Turmeric and neem are added for antimicrobial and anti-inflammatory activity respectively. Microbe like E. Coil and Pseudomonas spp are associated with pressure ulcer. Turmeric and neem in formulation prevent the microbe to grow for some time.

After performing the evaluation parameter of the powder, the second number batch F2 Shows good results therefore this batch used to formulation development.

Formula:**Formula for 10gm of powder:**

Sr. No	Ingredients	Quantity
1	Neem	0.6gm
2	Turmeric	0.4gm
3	Zinc Stearate	3gm
4	Starch	2.5gm
5	Talc	3.5gm
Total	---	10gm

Table No 18. A**Formula for 50 gm of Powder:**

Sr. No	Ingredients	Quantity
1	Neem	3gm
2	Turmeric	2gm
3	Zinc Stearate	15gm
4	Starch	12.5gm
5	Talc	17.5gm
Total	---	50gm

Table No 18. B

Formulation pictures



Fig. No 19 Formulation picture

Results and discussion:

The Antimicrobial lubricating powder for bed sores is formulated and evaluated successfully.

Sr. No	Properties	Result	Inference
1	Physical Characteristics	The colour of powder was greenish white with characteristics odour and smooth appearance	Powder follows standard dusting powder characteristics
2	pH of formulation	5.6	The pH was found to be acidic. normal range of pH is 4 to 6.5
3	Abrasiveness	The powder was found for absence of grittiness	Abrasiveness is as per dusting powder
4	Bulk density	0.45 g/cm ³	Normal range of bulk density of dusting powder is 0.2 to 0.6g/cm ³
5	Tapped density	0.52 g/cm ³	Normal range of Tapped density of dusting powder is 0.2 to 0.6g/cm ³
6	Angle of repose	30 ⁰	Flowability of powder was found to be Excellent
7	Carr's index	13%	Carr's index was found to be Good
8	Hausner ratio	1.15	Hausner ratio was found to be Good.
9	Moisture content	1.20%	Standard moisture content range is 0.30% – 4.0%w/w. Calculated moisture content is as per standard moisture content

Table No. 19 Result and discussion

- 1) **Physical characteristics-** The physical characteristics of the powder was evaluated. The colour of powder was greenish white with characteristics odour and smooth appearance.
- 2) **PH of the formulation-** The pH of lubricating dusting powder was determined by digital pH meter. 1gm of powder was dissolved in 100 ml of distilled water and the pH was measured. The pH was found to be acidic.
- 3) **Particle size-** The particle size of the powder was found in the range was found to be 0.125 mm [125 microns].
- 4) **Abrasiveness-** The powder was found for absence of grittiness.
- 5) **Bulk density-**The bulk density of the powder was found to be 0.45 g/cm³.
- 6) **Tap density** - The Tap density of the powder was found to be. 0.52 g/cm³.
- 7) **Angle of repose** – The Angle of repose of the powder was found to be 30°.
- 8) **Carr's index-** The Carr's index of the powder was found to be 13%.
- 9) **Hausner index-** The Hausner ratio of the powder was found to be 1.15.

Moisture content- The Moisture content was found to be 1.20%w/w.

Summary & Conclusion:

Summary:

Bed sores develop when a patient remains inactive for an extended duration. Moreover, we also performed a market survey, which revealed that there is no particular product available for treating bed sores. The products currently offered in the market include gels, creams, pastes, ethanol wipes, and more. The available options tend to be costly, hard to find, or not convenient to use. Our goal was to enhance patient adherence for individuals using a new herbal powder formula. All other products on the market function by establishing a barrier between the skin and the surroundings, thereby aiding skin recovery. Our formulation stands out because it enhances lubrication and eliminates the causing microbes. Therefore, our formulation will be unique.

Conclusion:

Following our evaluation studies, we concluded that our product exhibits antimicrobial properties against the microbes responsible for bed sores. Since we utilize herbal components, our product is both safe and economical. Since we have changed the method of application, our formulation is now in spray form. It is easier for bedridden patients to utilize it.

The formulation no. F2 Antimicrobial lubricating dusting powder met all powder properties and displayed satisfactory outcomes. Based on the study provided, it can be concluded that all four dusting powder formulations were effective and exhibited all the necessary properties. Formulation F2 showed acceptable results, and Batch no second F2 was utilized for formulation development.

Future Scope:

The potential of antimicrobial lubricating powder continues to grow daily due to its natural components, absence of side effects on the body, ease of application, and cost-effectiveness.

References:

- 1) <https://www.mayoclinic.org/diseases-conditions/bed-sores/symptoms-causes/syc20355893>
- 2) Russo, C.A. and Elix Hauser, A., 2006. Hospitalizations related to pressure sores, 2003, Healthcare Cost and Utilization Project. Rockville, MD: Agency for Healthcare Research and Quality; April 2006.
- 3) Bhattacharya, S. and Mishra, R.K., 2015. Pressure ulcers: current understanding and newer modalities of treatment. *Indian Journal of plastic surgery*, 48(01), pp.004-016.
- 4) <https://my.clevelandclinic.org/health/diseases/17823-bedsore-pressure-injuries>
- 5) <https://www.healthline.com/health/gastric-and-duodenal-ulcers#symptoms>
- 6) A textbook of pharmaceutics -1, Author –R.M. Mehta, edition- 6, Vallabh Prakashan, 2019
- 7) Aulton's Pharmaceutics E-Book. (2021). Netherlands: Elsevier Health Sciences.
- 8) A textbook of pharmacognosy, c.k. kokate, Nirali Prakashan
- 9) <https://pubchem.ncbi.nlm.nih.gov/compound/ZINC-stearate>
- 10) Raja Ratna Reddy, Y., Krishna Kumari, C., Lokanatha, O., Mamatha, S. and Damodar Reddy, C., 2020. Antimicrobial activity of Azadirachta Indica (neem) leaf, bark and seed extracts.
- 11) <https://www.ndtv.com/health/neem-benefits-from-acne-free-skin-to-better-hairgrowth-know-all-the-beauty-benefits-of-these-leaves-2474423>
- 12) Verma, R.K., Kumari, P., Maurya, R.K., Kumar, V., Verma, R.B. and Singh, R.K., 2018. Medicinal properties of turmeric (*Curcuma longa* L.): A review. *Int. J. Chem. Stud*, 6(4), pp.1354-1357.
- 13) S, P, Karande. Y, U, Rahangdale. H, S, Kanhere., S, K, Rathod. S, Y, Dhabale. (2020). Formulation of antimicrobial polyherbal dusting powder and its evaluation. *International Journal for Pharmaceutical Research Scholars*, 9(1); 01-08.
- 14) A textbook of pharmaceutics -1, Author –R.M. Mehta, edition- 6, Vallabh Prakashan, 2019.
- 15) Textbook of pharmaceutics –I as per PCI Regulations by A.A. Hajare and Dr.D.A. Bhagwat Page no. 6.1-6.14
- 16) Raja Ratna Reddy, Y., Krishna Kumari, C., Lokanatha, O., Mamatha, S. and Damodar Reddy, C., 2020. Antimicrobial activity of Azadirachta Indica (neem) leaf, bark and seed extracts.
- 17) Nasri, H., Sahinfard, N., Rafieian, M., Rafieian, S., Shirzad, M. and Rafieian-Kopaei, M., 2014. Turmeric: A spice with multifunctional medicinal properties. *Journal of HerbMed Pharmacology*, 3(1), pp.5-8.